Control System Studio Training - BOY

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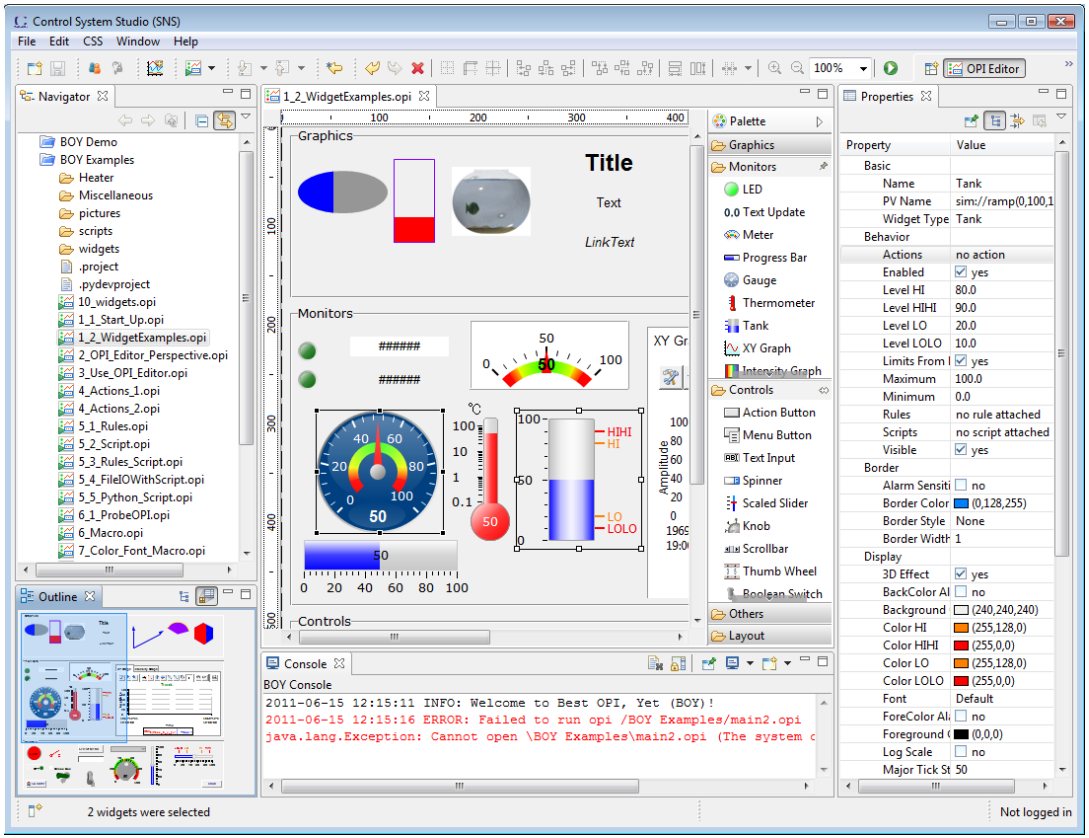
A lot of material from Nadine Utzel, ITER and BOY online help by Xihui Chen, SNS

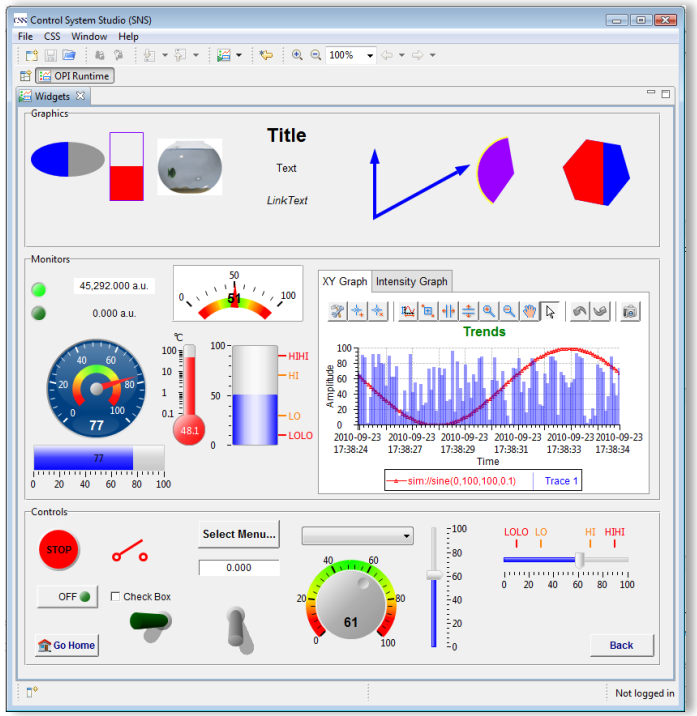
Oct. 2012 EPICS Meeting, PAL, Korea

BOY – Best OPI, Yet

Operator Interface Editor



Runtime



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

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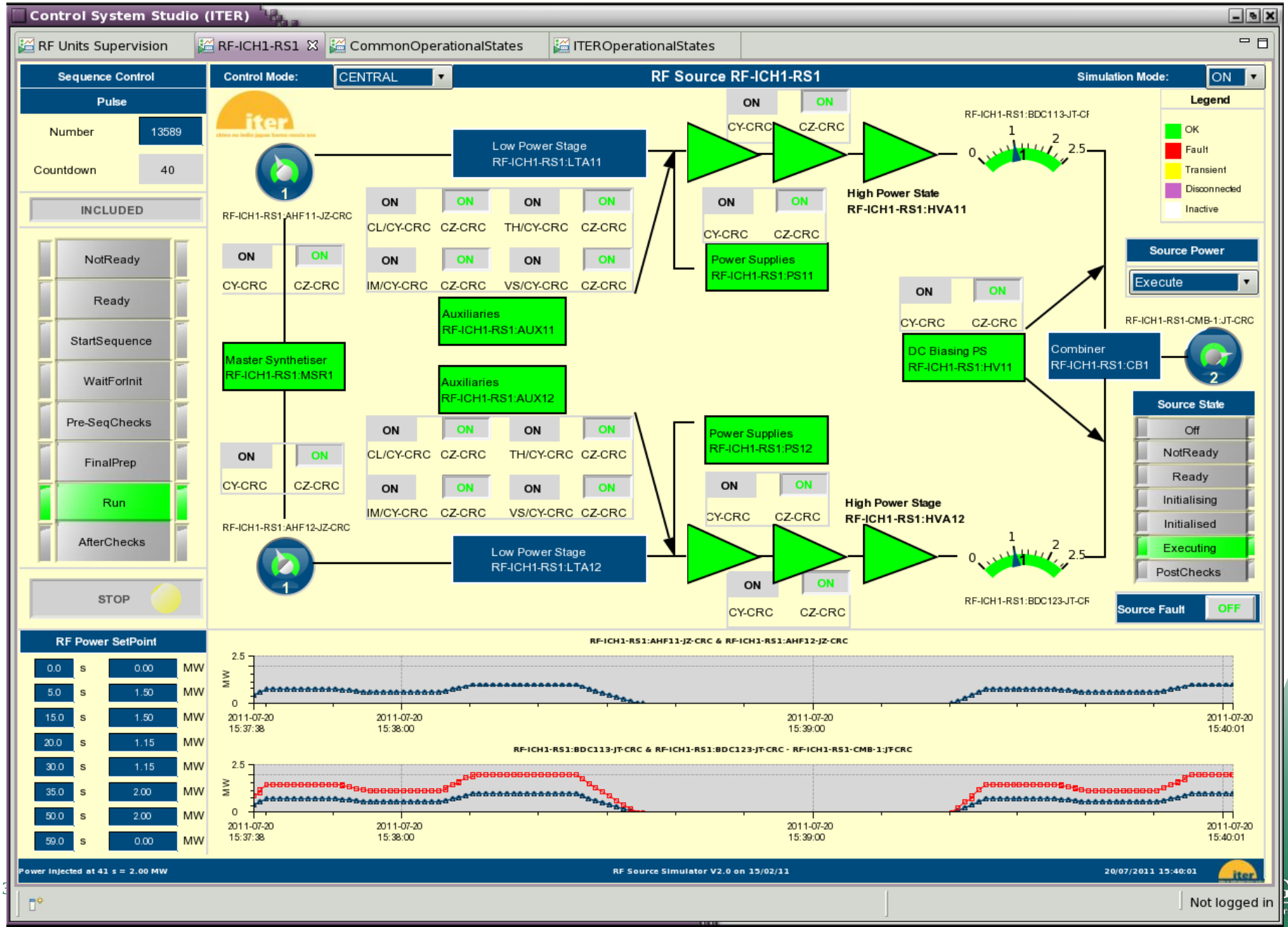
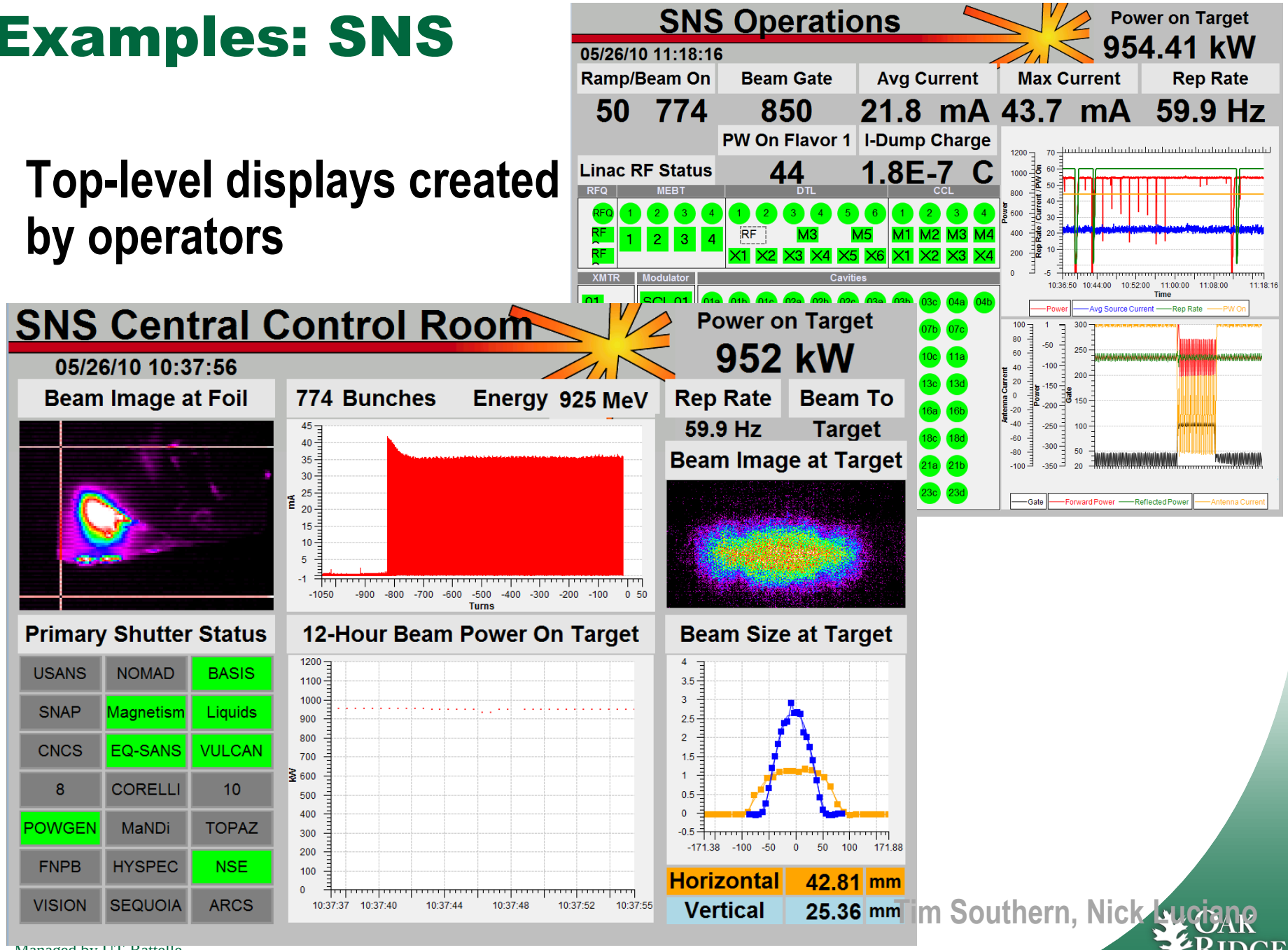
Example: ITER



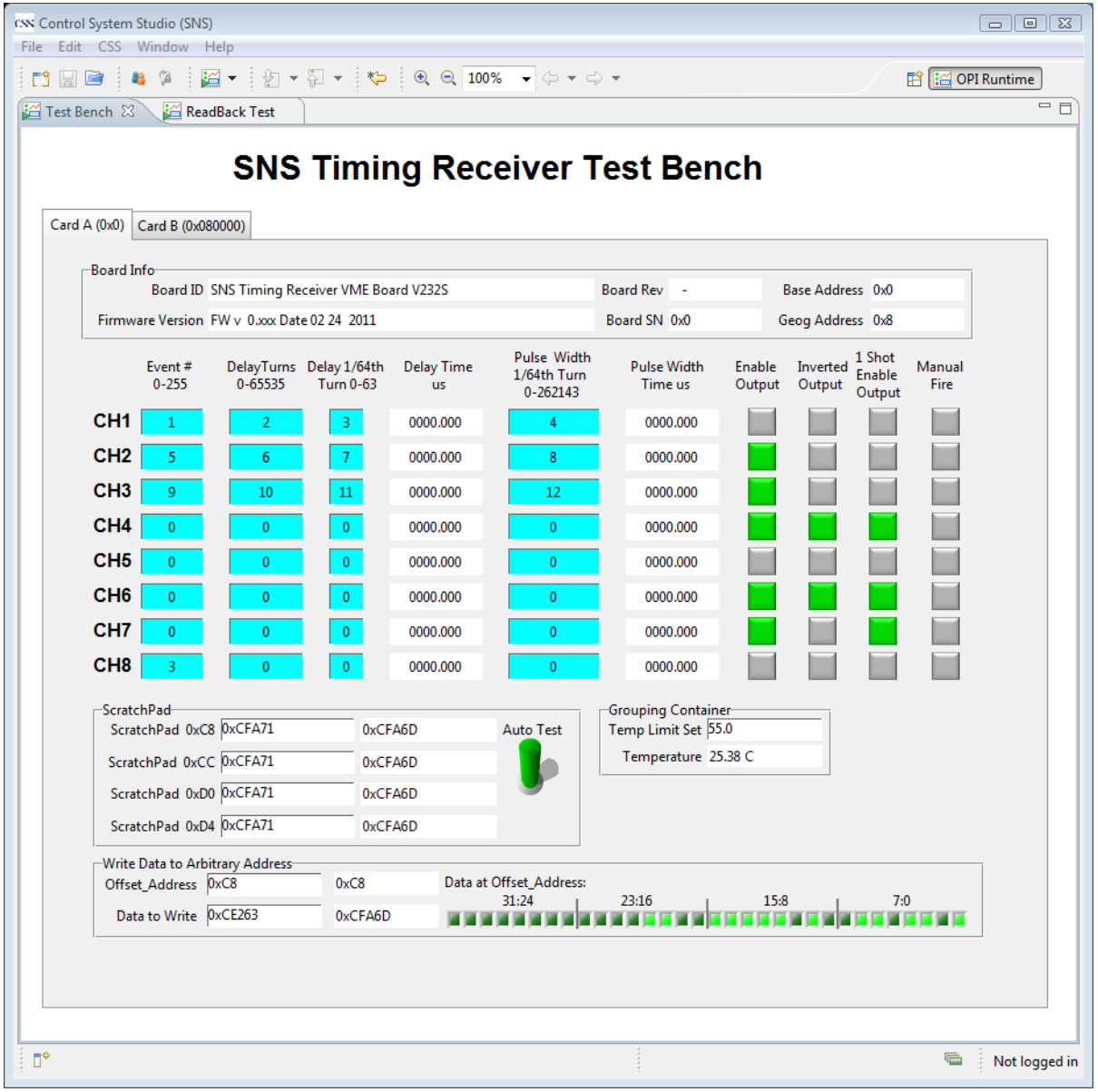
Examples: SNS

- Top-level displays created by operators

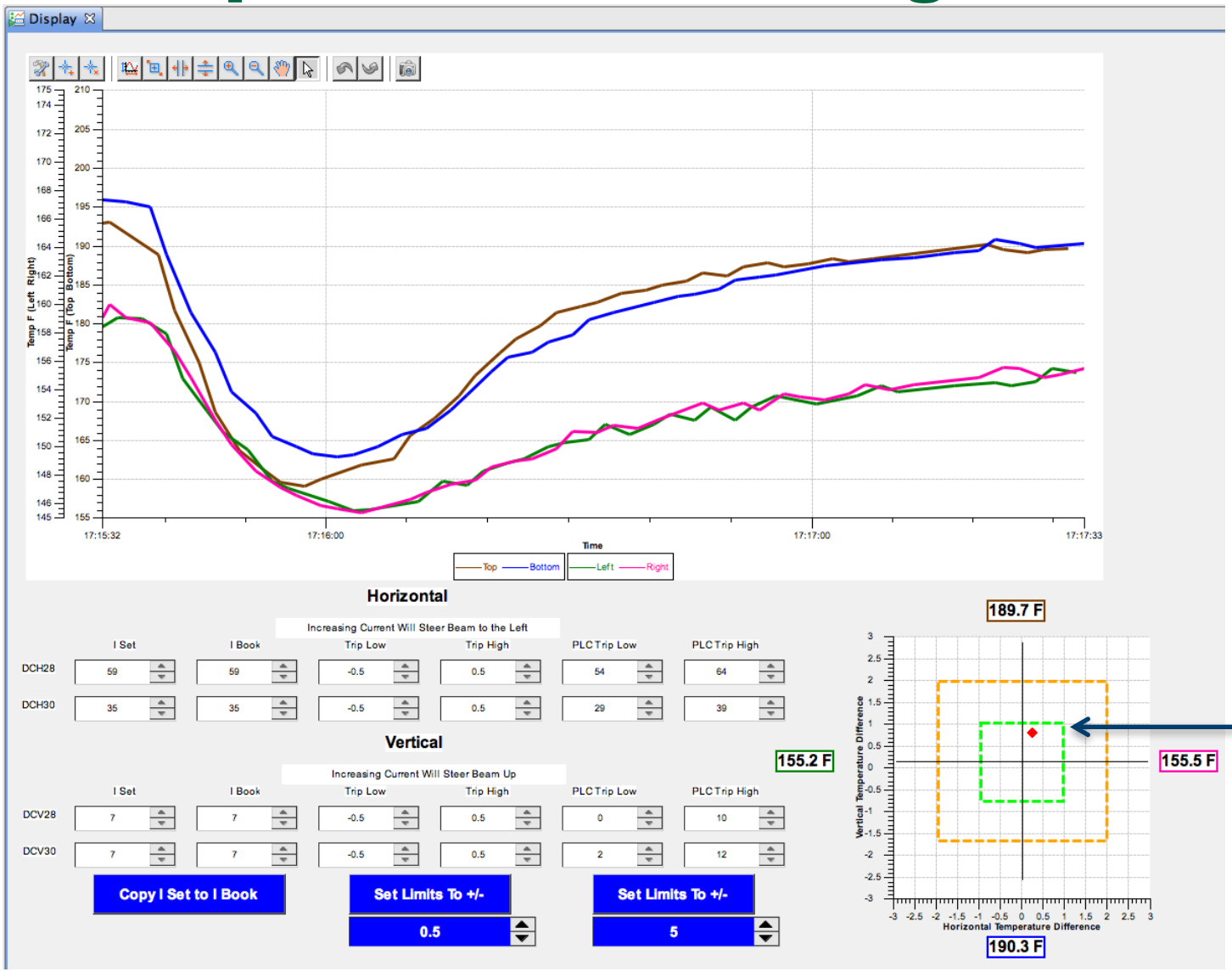


Tim Southern, Nick Luciano

Examples: SNS



Examples: SNS "Steering" Tool



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

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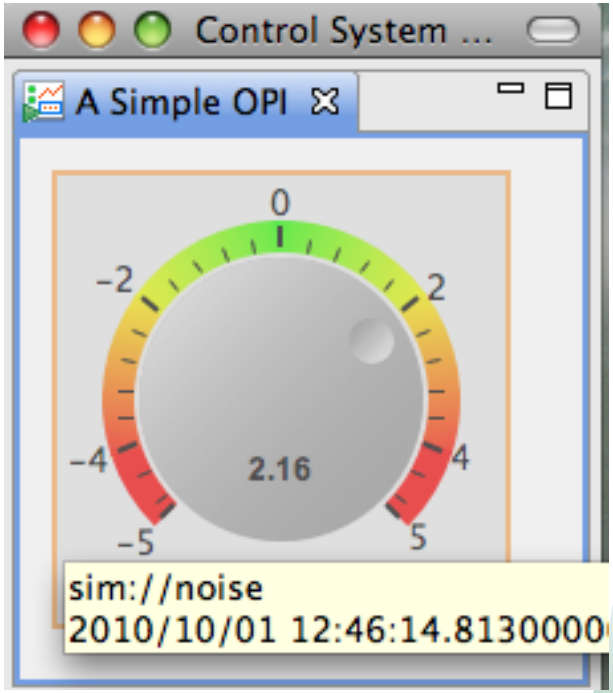
Main Idea: Simple Things are Easy

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

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

Controls

Palette

- Graphics
- Monitors
  - LED
  - 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

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

Console

BOY Console

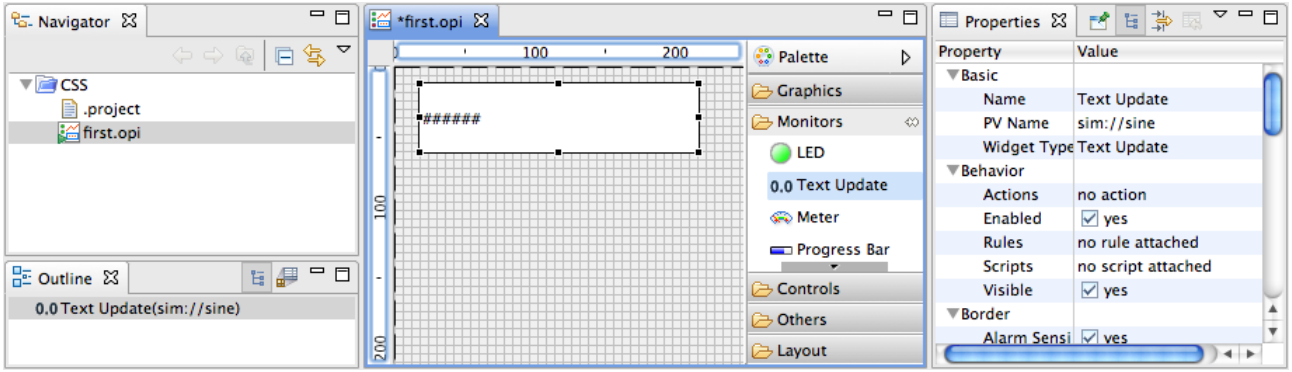
```
2011-06-15 12:15:11 INFO: Welcome to Best OPI, Yet (BOY)!
2011-06-15 12:15:16 ERROR: Failed to run opi /BOY Examples/main2.opi
java.lang.Exception: Cannot open \BOY Examples\main2.opi (The system c
```

2 widgets were selected

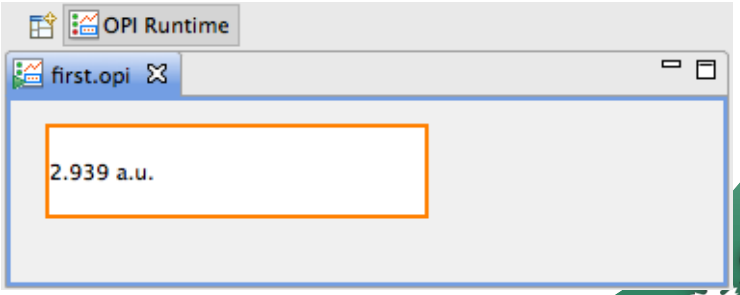
Not logged in

Exercise: First Display

- **Menu *CSS*,**
  - ***Display*, *OPI Editor Perspective***
  - ***Display*, Install *OPI Examples***
- **Navigator Context menu on CSS: *New*, *OPI File*, call it "first.opi"**
  - ***Or* Menu *File*, *New*, *BOY*, *OPI File***



- **Locate in Palette: *Monitors*, *Text Update***
  - **Drag' *Text Update* onto display grid**
  - **Move widget around, resize**
- **Locate *Properties* View**
  - **Enter *PV Name* "sim://sine"**
- **Press Run button in Toolbar**

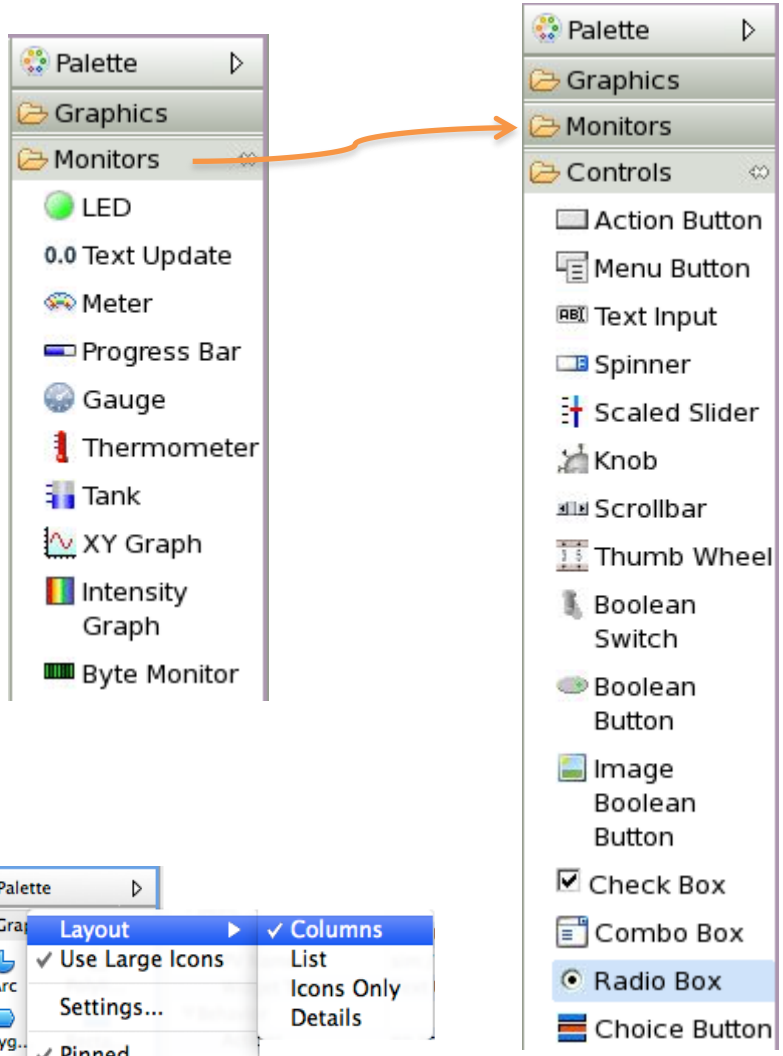


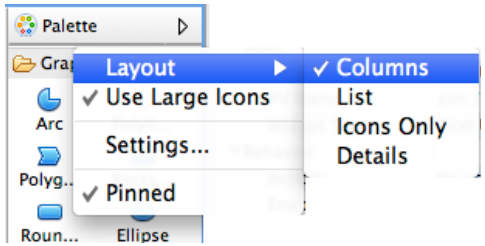
Widget Palette Hints

Many widgets, hard to see them all

- Scroll
- Click on section header

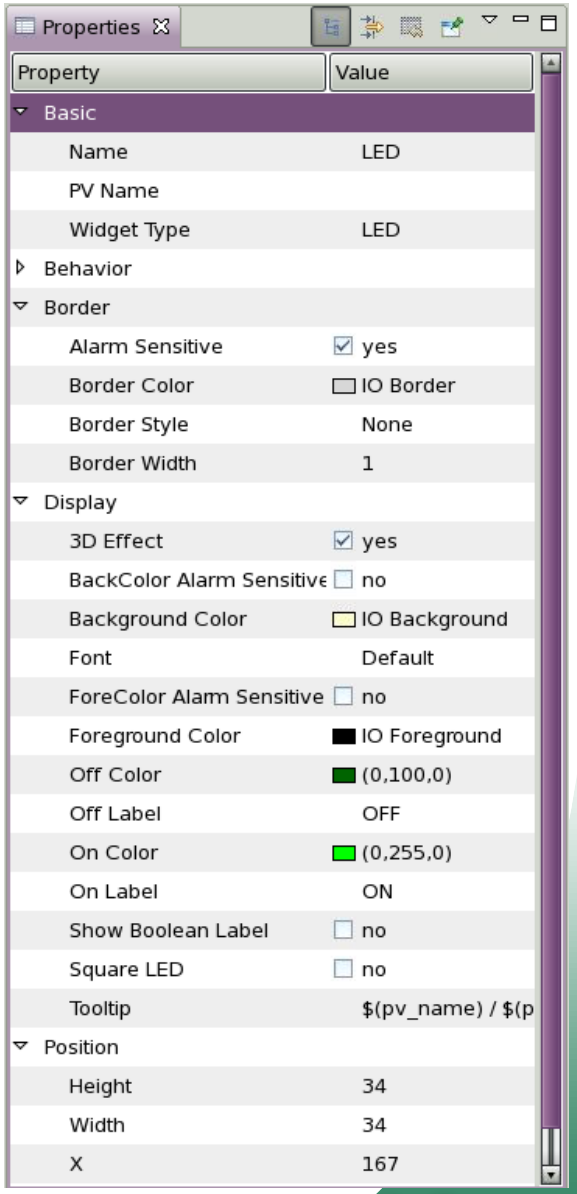
- Try the ‘pins’
- Header Context menu offers *Columns* mode to display Widgets as small icons in columns





Widget Properties

- **Widgets are configured by setting Properties in the *Properties* view**
- **Common Properties:**
  - **Name**
  - **Position***
  - **Background color**
  - **Border**
- **Widgets that read/write PVs:**
  - **Basic: PV Name**
  - **Border: Alarm Sensitive**
  - **Behavior: Limits from PV**



* **Position can also be modified by moving or resizing the widget in the editor, or via Toolbar buttons to align etc.**

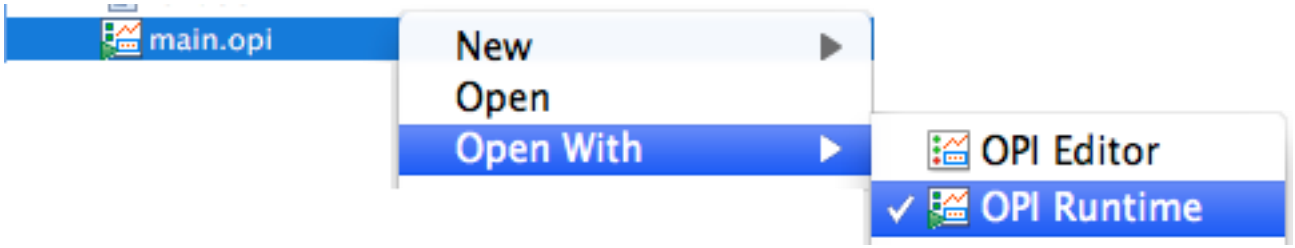
Exercise: Extend First Display

- **Locate in Palette: *Controls*, *Knob***
- **Drag *Knob* onto display**
- **Move *Knob* around, resize**
- **Locate Property *PV Name* for Knob**
- **Enter "sim://sine"**
- **Create another *Knob*:**
  - **PV Name = "loc://test",**
  - **"Increment" = 0.1**
  - **"Limits from PV" = no**
- **Run**

- **Note how the "sim://sine" Knob is really read-only, but you can change the "loc://test" PV via the Knob**

OPI Files: Run or Edit?

- **Default: Double-click on *.opi in Navigator opens in "OPI Runtime", i.e. executes the display**
- **Context menu allows to select**
  a) **Editor to edit?**
  b) **Runtime to execute?**



- **Once you select "Editor", that will become the double-click default**
  – **Select "Runtime" once to restore previous default**

Exercise: Edit vs. Runtime Mode

- **Close all CSS Editors (Menu *File*, *Close All*)**
- **In the Navigator, double-click on the first.opi that you created before**
  - **Does it open in the Editor or Runtime?**
- **In the Navigator, open the Context Menu on first.opi and select Open With, <u>OPI Editor</u>.**
  - **Close first.opi, now double-click the file in the Navigator. Does it open in the <u>Editor</u>?**
- **In the Navigator, open the Context Menu on first.opi and select Open With, <u>OPI Runtime</u>.**
  - **Close first.opi, now double-click the file in the Navigator. Does it open in the <u>Runtime</u>?**

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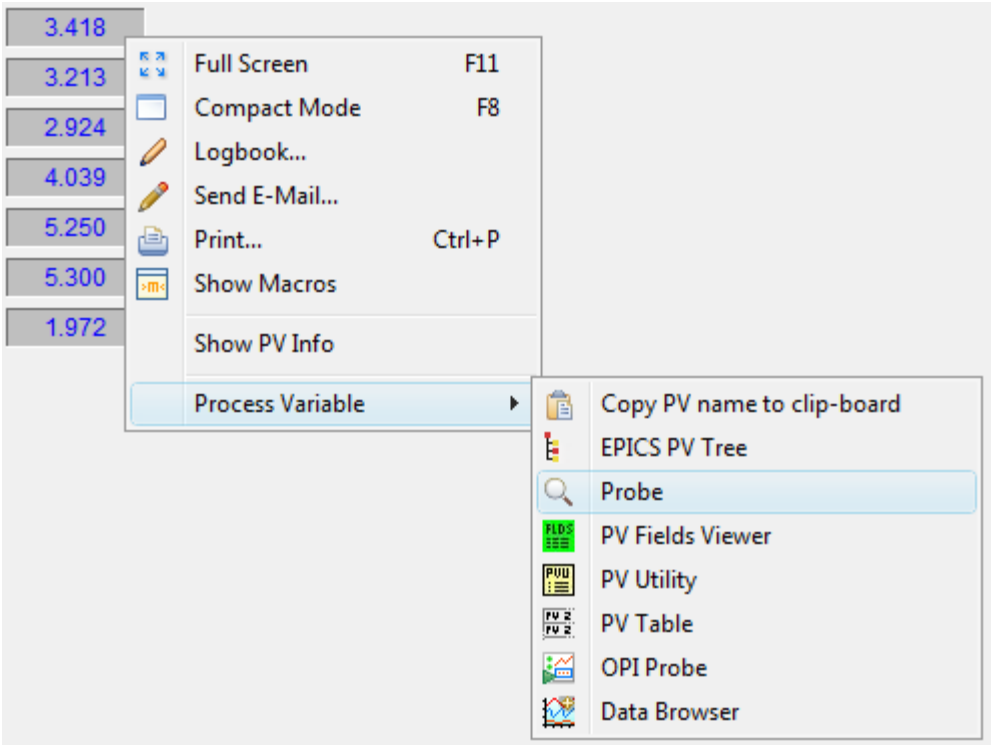
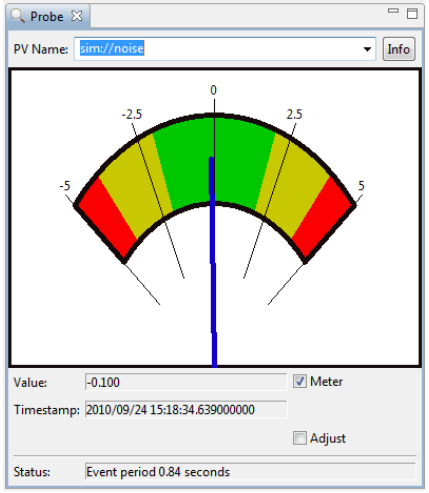
Exercise: Send PV to other CSS tools

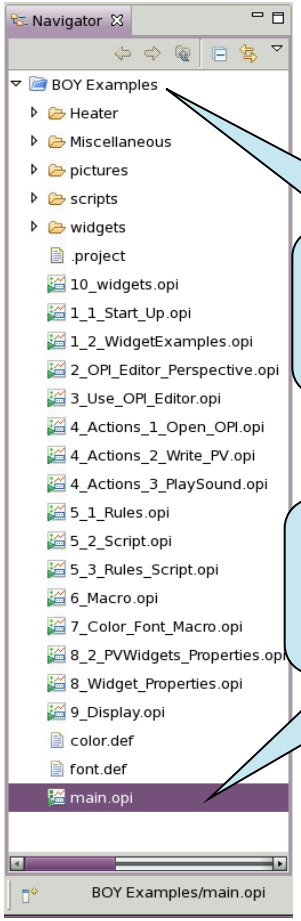
- Run the OPI that you created
- Use CSS Process Variable context menu on a widget that displays a PV to open Probe





Example Displays

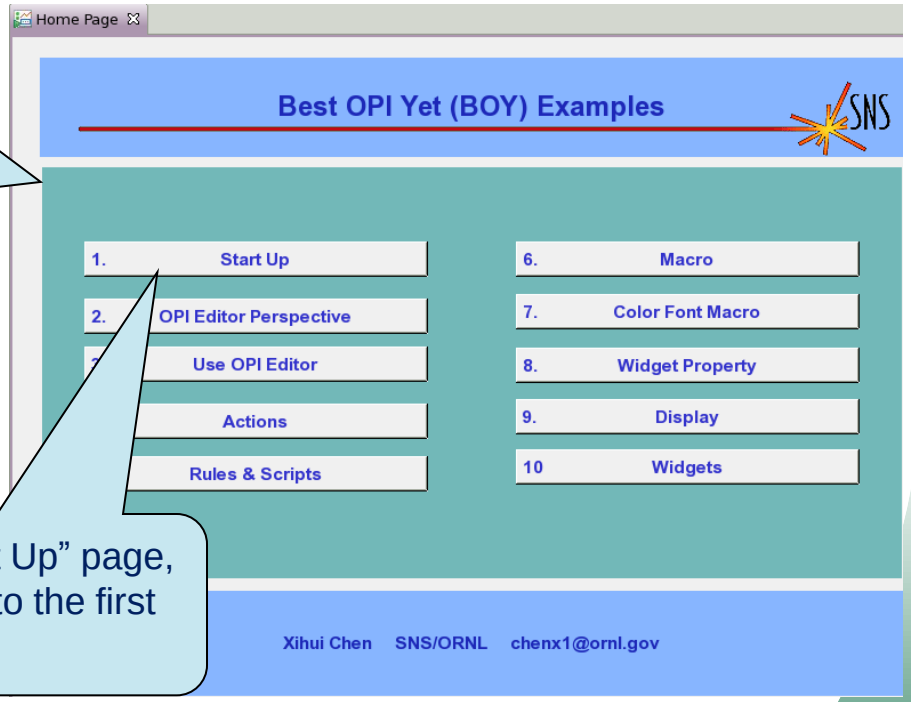
- **Installed via Menu *CSS*, *Display*, *Install OPI Examples***



Note new project named BOY Examples

Double-click on main.opi file to open

Explore the examples



Check the “Start Up” page, which is similar to the first two exercises

Remember: You can *Open With*, .. *Editor* to see implementation

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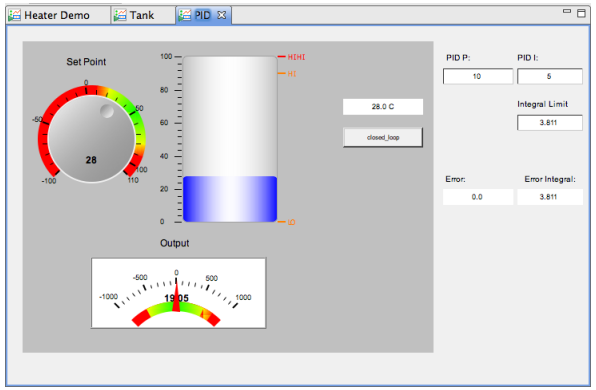
Exercise: Screen Navigation

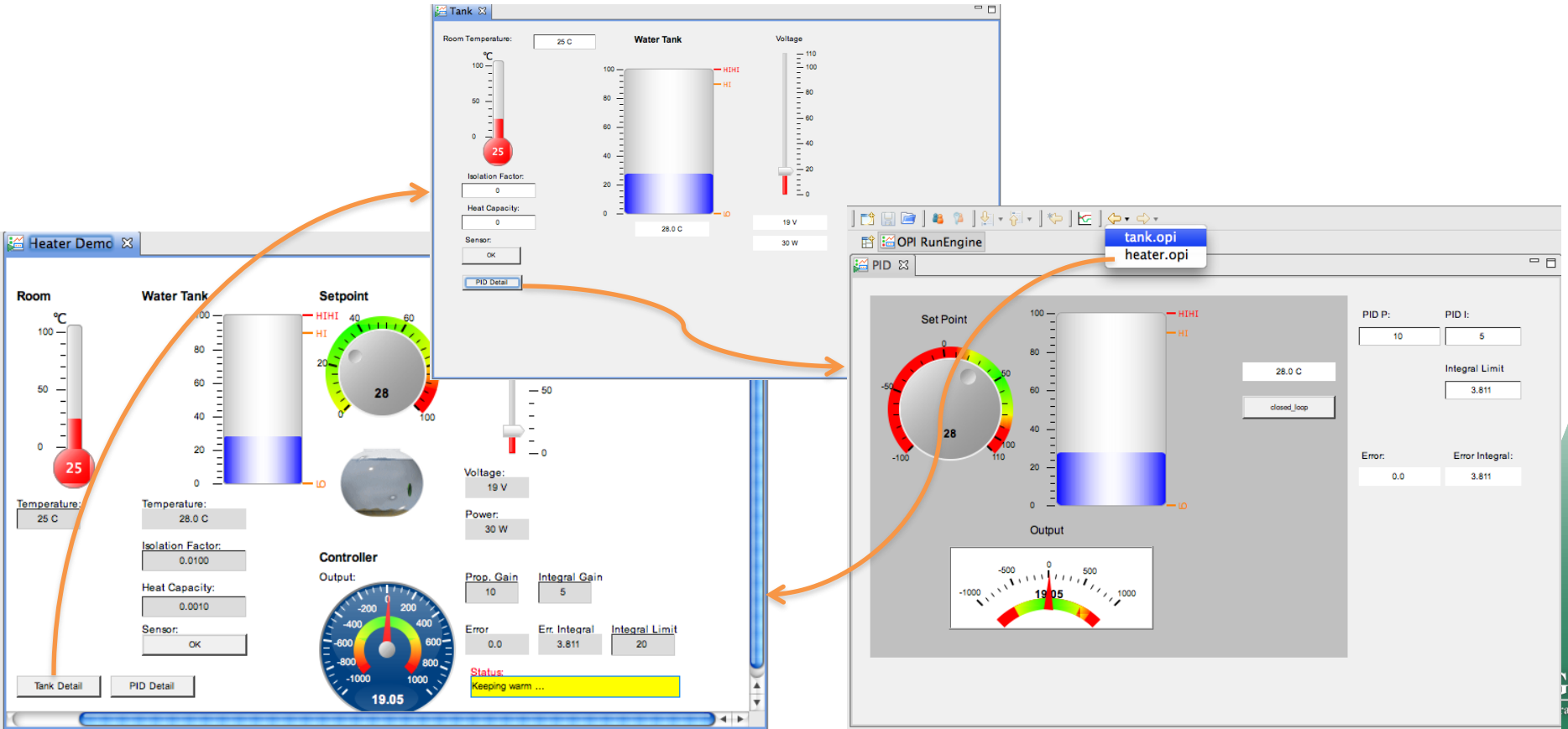
- Similar to hyperlinks in a Web Browser:
  - Default: Linked display replaces the current display.
  - Zoom in/out, go "back" via toolbar:

  - Use context menu to open in 'tabs' or new Window



OPIs in 'Tabs'

Try with OPI Examples: Open in tab, … Window



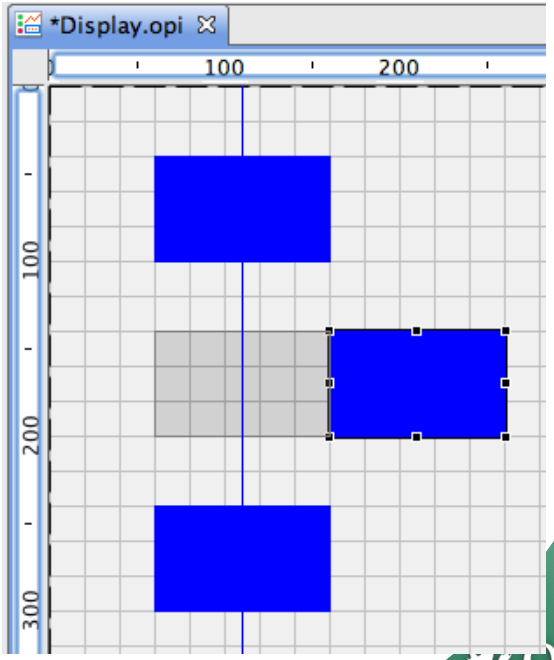
Exercise: Editing Features

Add, duplicate Widgets in various ways

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

•Arrange them on the display

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



Select multiple widgets to

- Edit common properties
- Adjust size or move around

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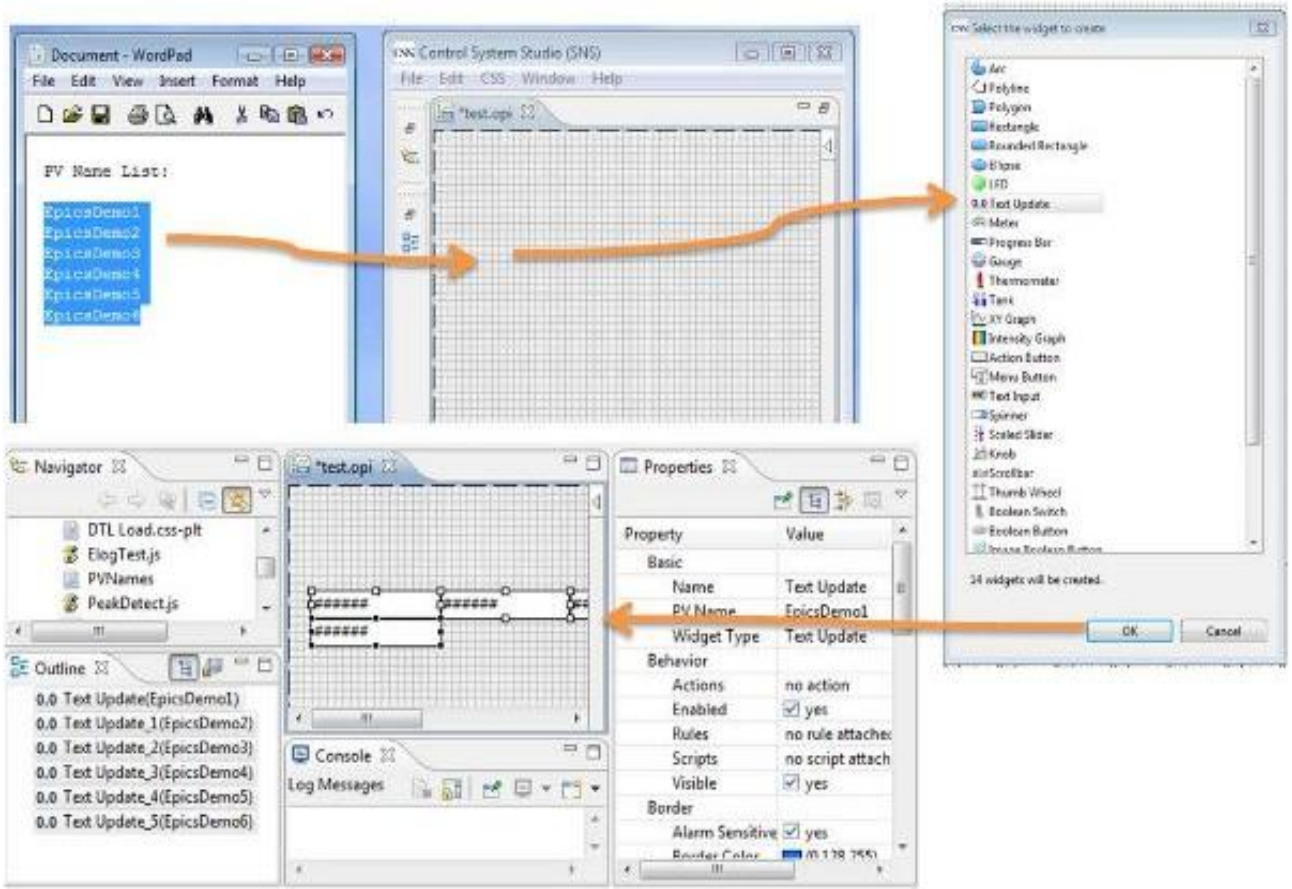
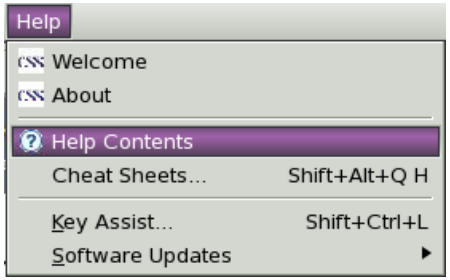
Hint: Drop PV Names

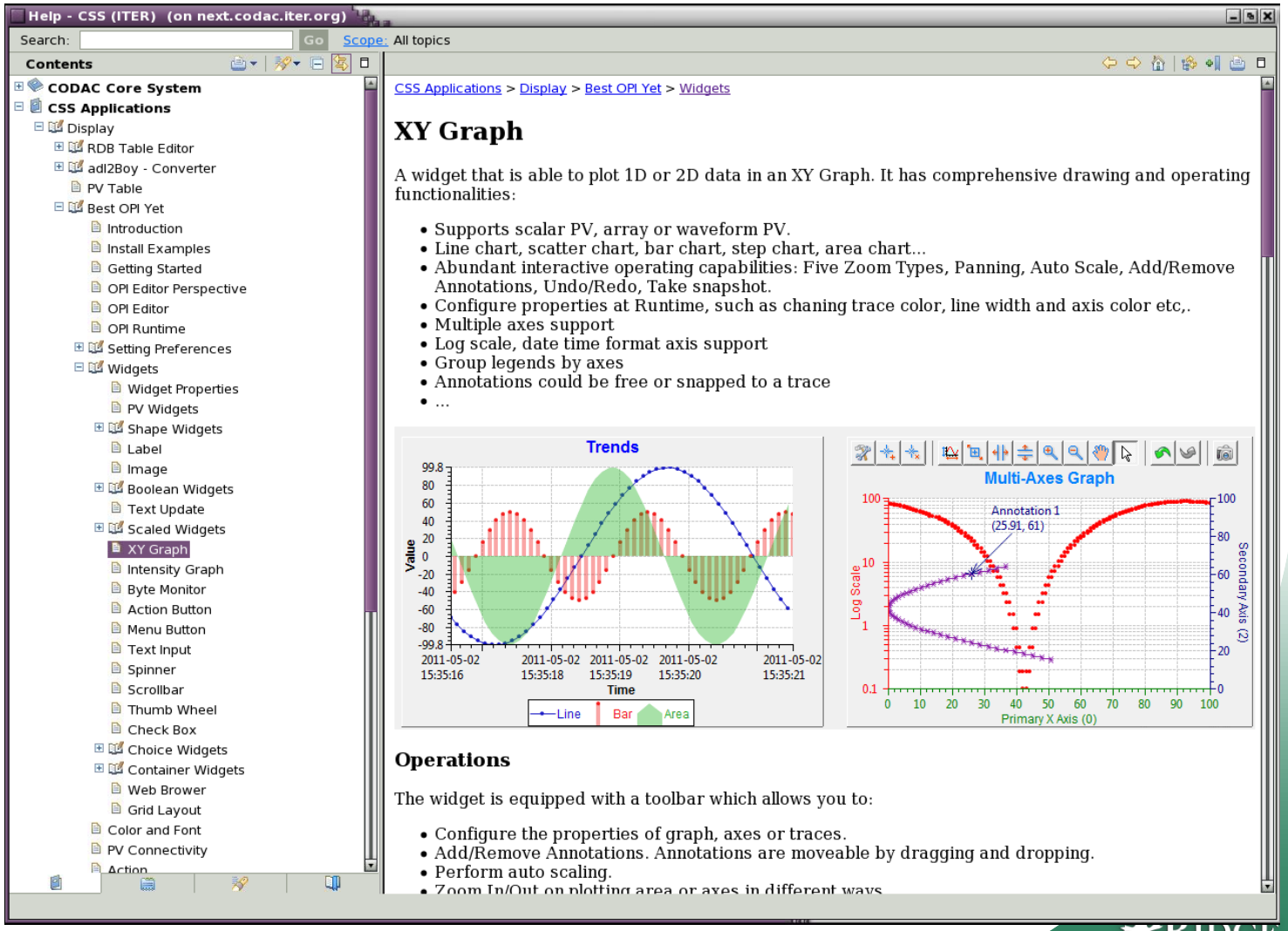
- **Assume you have some text document with a list of PVs**
- **How to quickly create a display with Text Update widgets for these PVs?**
  - **Just drag the names into the display**
  - **Will be prompted for the type of widget**



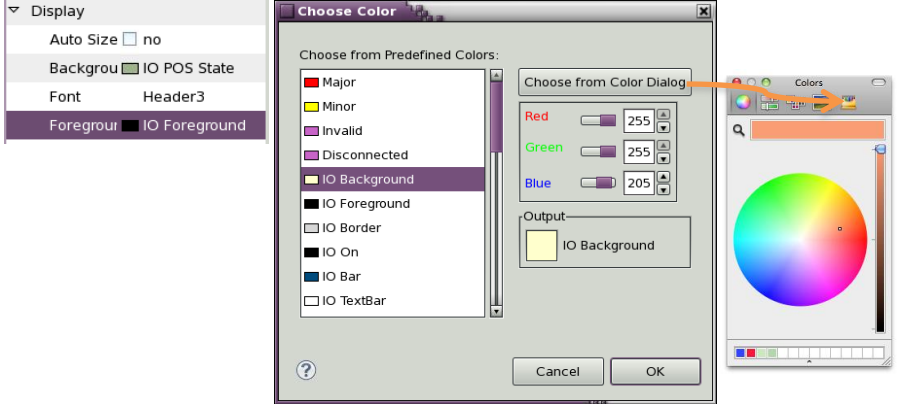
Exercise: View Online Help



- Find the "Widgets" section



Font and Color Names



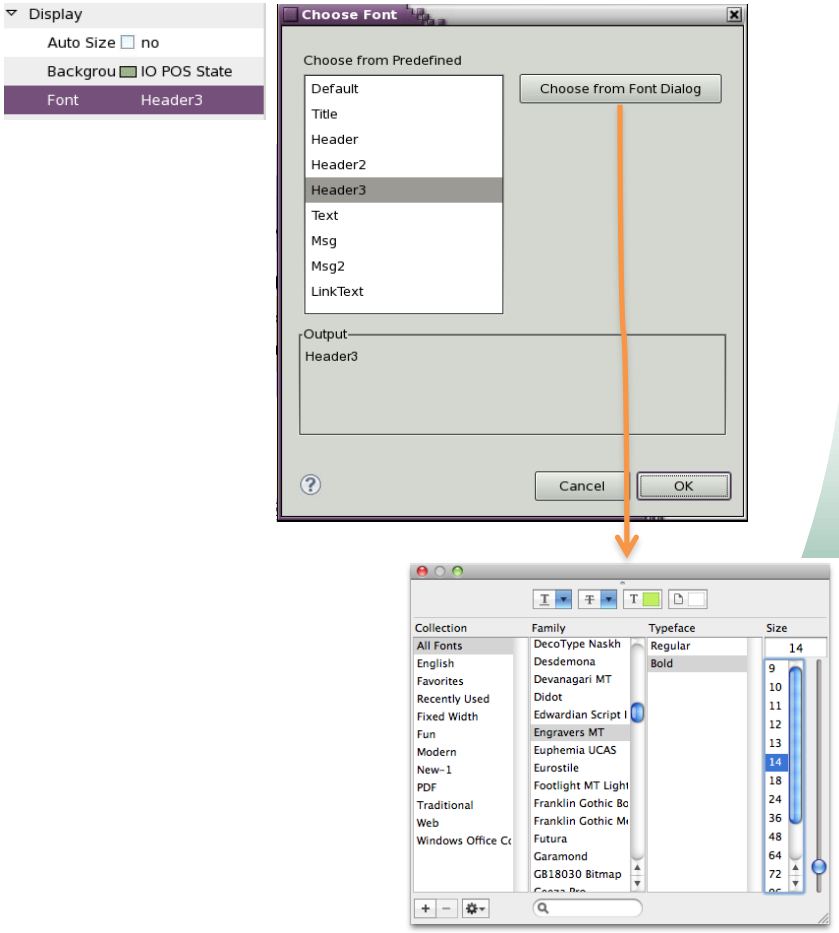
When configuring a color (foreground, background, border, …) or font (Text Update font, …), you have two options:

a) Pick any color or font

- RGB resp. Name, Typeface, Size

b) Pick a Predefined Color resp. Font

- Remember BOY Preferences, Color and Font file?

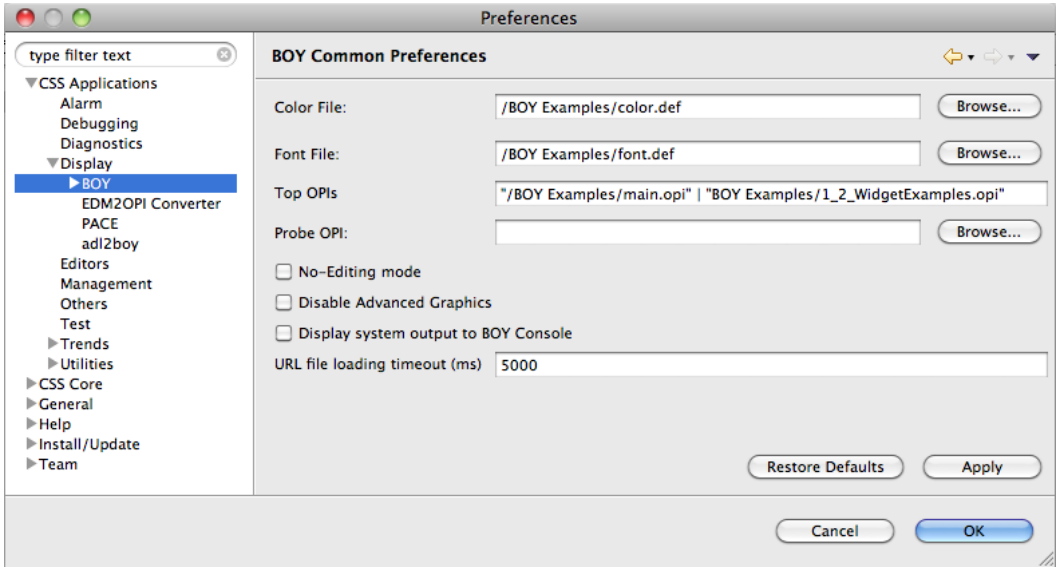


Exercise:
Explain why (b) is better.

Exercise: BOY Font, Color Preferences

Menu *CSS*, *Preferences*:

- Locate the BOY settings
- Assert that the
  Color File, *Font File*, *Top OPIs*
  settings use files from the BOY Examples that we just installed:



Exercise: Use Predefined Fonts

- Add a Label to your display
  - Set font to the predefined Title font
  - Set text to something like “This is the Title”
- Add another Label
  - Assert that it uses the “Default” font

Exercise: Schema File

- Create a new display file “schema.opi”
  - Add a Text Update
    - Background Color: Yellow
    - Foreground Color: Red
  - Save, close the schema.opi
- Menu CSS, Preferences, CSS Applications, Display, BOY, OPI Editor
  - Set the “Schema OPI” to the schema.opi that you just created
- Create a new OPI file
  - Add a Text Update widget
  - Notice its initial Background & Foreground color?

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Portable Usage of Fonts

Fonts differ between operating systems: "Times New" vs. "adobe-times-.." etc.

How can an OPI file "Look the same" on Windows, OS X, Linux?

1. **If possible, install the same fonts on all your computers**
   - **Microsoft "Office" fonts available on most Windows and Mac OS computers because they also run MS Office**
   - **MS Office fonts are also available for Linux! Google "free office fonts Linux"**
2. **BOY fonts.def file allows system-specific tweaks**

```
# Though using the same MS Office font
# on all operating systems, the sizes seem
# somewhat different.
# Fix that by using different sizes for
# each OS:
Default=Verdana-regular-10
Default(macosx_cocoa)=Verdana-regular-14
Default(linux_gtk)=Verdana-regular-10

# Same with "Header1": OS X needs bigger font
# for same on-screen pixel size
Header1=Verdana-bold-24
Header1(macosx_cocoa)=Verdana-bold-36
```


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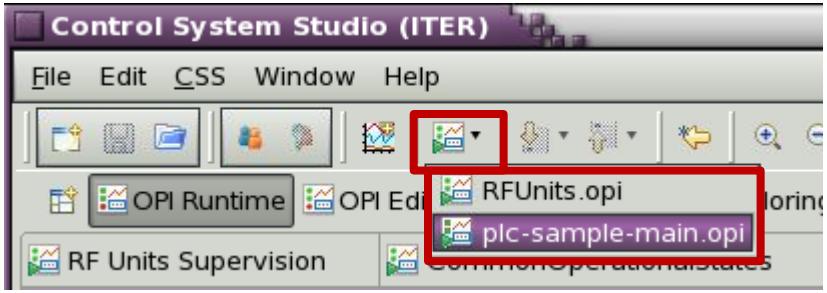
Preferences: Top OPIs, Sitewide settings

- **Top OPIs: Appear in Toolbar**



- **Path names for color & font files, "Top" OPIs, Schema can be web links**
  - **Instead of** `/BOY Examples/font.def` **use** http://some.server.org/path/font.def

Good for site-wide files like your top-level control system screen!

Suggestions for your site

- After gaining some experience with BOY, somebody with design talents defines which colors, fonts, … to use for displays at your site
- Pick fonts that look similar on all operating systems
- Create color.def, font.def, schema.opi
  - Place these on a web server
  - Configure CSS for your site to use the http://… paths to the *.def and schema.opi
- You can put your *.opi files into CVS
  - or subversion, Mercurial, GIT, …CSS can include support for these
- Each night, you can publish the current *.opi files from CVS on your web server
  - Point the "Topi OPIs" to http://web.server/opis/main.opi
  - End users can now easily run the "current" version from the Toolbar

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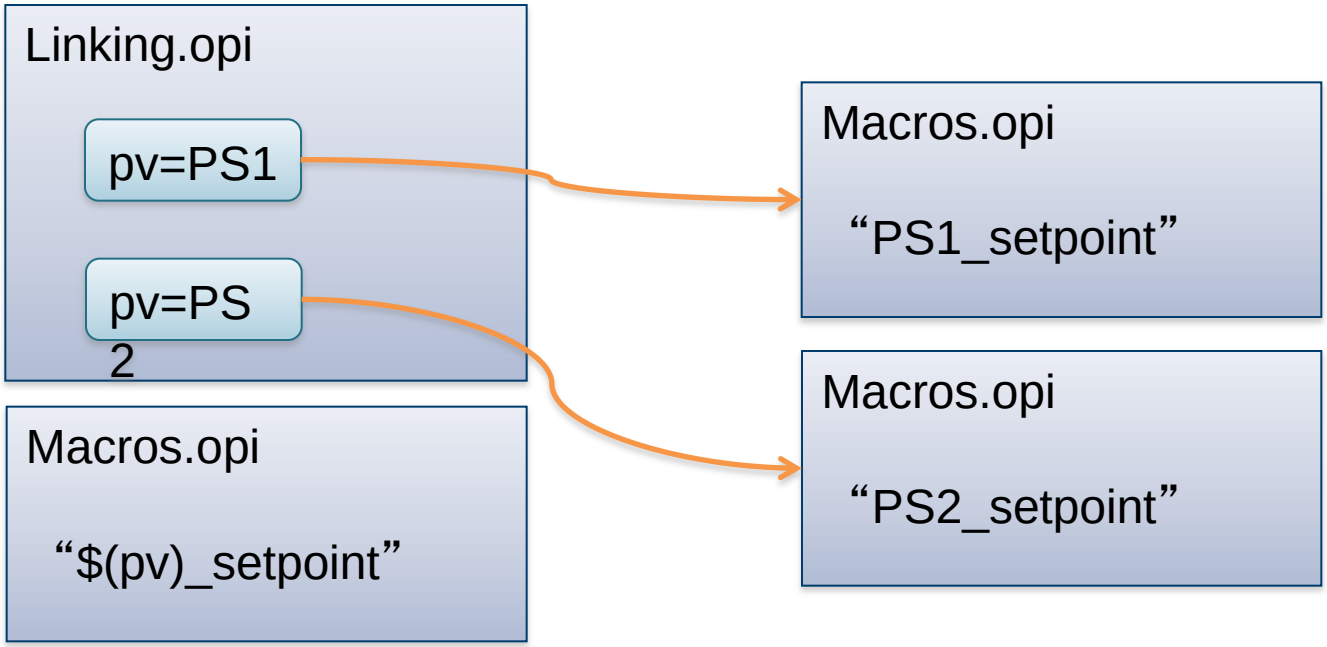
Macros

Usage: $(macro) or ${macro}

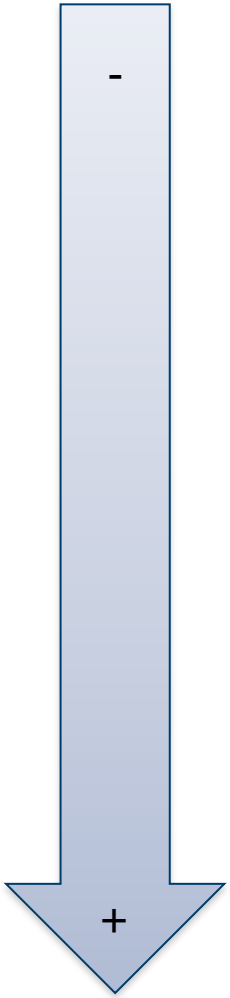
- **Wherever you enter a widget property**
- **Most often used for (partial) PV name:**
  - **$(pv)_setpoint**
  - **$(pv)_readback**

  Such a display can then be invoked with
  pv="PowerSupply1" or "PowerSupply2"



Macro Definition

- **Predefined Macros: Widget properties, see online help for name mapping**
  - **Property "X": Macro $(x)**
  - **Property "Name": Macro $(pv_name)**
  - **Automatic: Macro $(pv_value)**
    - **See default for the "Tool Tip" property**
- **User-defined:**
  1. **BOY Runtime Preference Setting (-pluginCustomization ….)**
  2. **User Preference settings (CSS, Pref…, ..App.., Display, BOY, OPI Runtime)**
  3. **Macro parameter of Action that opens the *.opi file**
  4. **Display *.opi file property "Macros"**
  5. **Grouping/Linking/Tabbed Container that wraps the widgets**

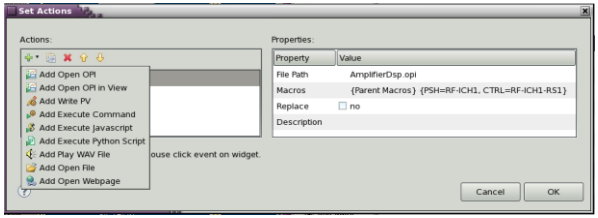


Priority

Example:
Macro parameter of *Action* will override *Preference* settings.

Exercise: Linking Displays with Macros

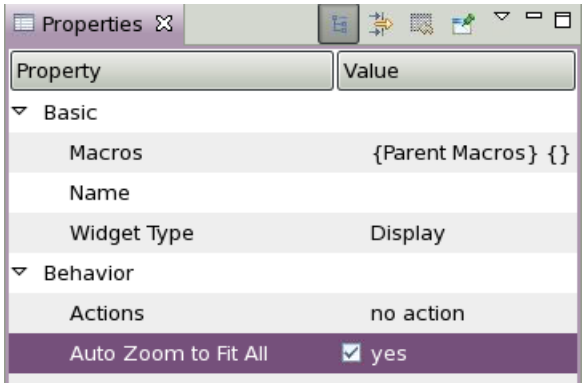
- Create display file “Macros.opi”
  - Label with Text “$(pv)”
  - Text Update with PV Name “$(pv)”
- Create display file “Linking.opi”
  - Action button with “Actions” to “Open OPI”
    - Use File Path for Macros.opi
    - Define Macros: pv= “sim://sine”
  - Add another action button (copy previous one)
    - Set macro to pv=“sim://ramp”



- Execute. Check that you can open the linked display
- Extra: Check OPI Examples, “4. Actions”
  - Can have more than one “Open OPI”
  - Any widget can have “Action”. Try Label.
  - Try Linking Container to display Macros.opi <u>within</u> Linking.opi

Miscellaneous

- Display has an “Auto Zoom” property
  - Size will adjust to fit window

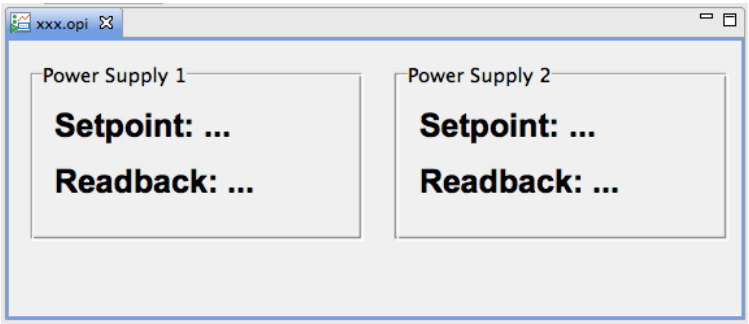


Exercise: Grouping Container

In EDM, MEDM, … we needed lines and rectangles to visually group related displays.

In BOY there is the Grouping Container

- **Create a display with Grouping Containers that look like this:**



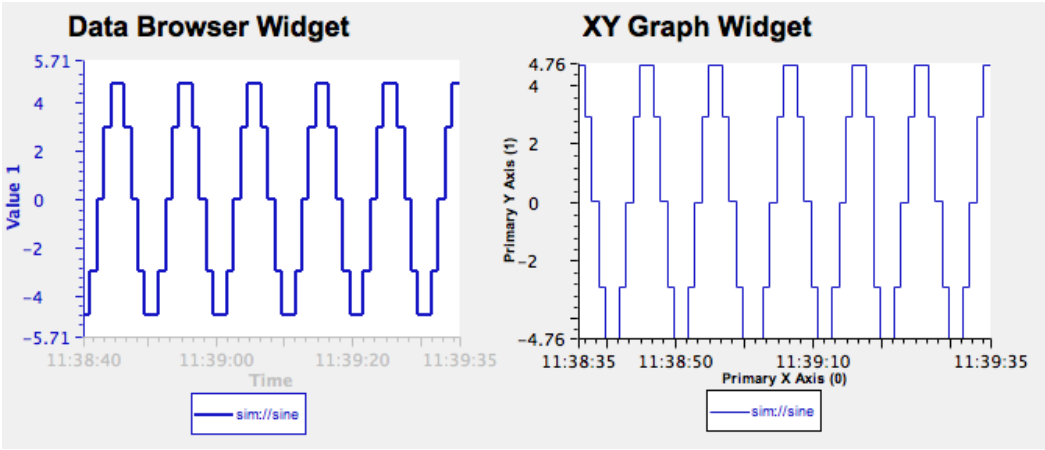
  - **Border Style=Group Box Style**
  - **Name = Power Supply 1, Power Supply 2**
  - **Add Labels "Setpoint:…", "Readback:…"**

- **Note how you can**
  - **Move the Grouping Container an all its content**
  - **Move Labels inside and out of the container**

Exercise: "Striptool" type Plots of PV over Time

Try both options

- Data Browser Widget
  - New Data Browser Plot, add PV
  - Set desired axis and time range
  - Save as *.plt
  - Add Data Browser Widget to BOY
  - Set its File Name to the *.plt
- XYGraph Widget
  - Behavior, Trigger PV: "sim://noise"
    - This PV updates once a second and will trigger plot updates
  - Primary X Axis(0), Time Format: "HH:MM:ss"
    - To get a "time" axis
  - Trace 0, Trace Type: Step Horizontally
  - Trace 0, Update Mode: Trigger
  - Trace 0, Y PV: Name of PV to plot



- ✓ Can also display archived data
- ✓ PV can be 'monitored', showing brief spikes
- ❑ Fewer display options

- ✓ Has many more display options
- ❑ Cannot show archived data
- ❑ PV scanned at update rate, can miss brief spikes

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Widgets and Properties Galore

- Compared to EDM, MEDM, … BOY tries to offer specialized widgets
  - Grouping Container instead of Lines
  - LED instead of Circle-with-color-rule
  - Image Button instead of Images with conditional visibility in front of invisible button
  - Tabbed Container instead of embedded window, many invisible buttons, conditionally visible graphics, local PVs to update the display inside the embedded window
- .. with many Properties
  - Alarm sensitive Border/Background/…
  - Precision, Limits, … from PV or direct entry
  - Actions

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Widgets and Properties Galore because..

Display file describes Meaning:

LED to display something, not Circle that happens to change color.

Group of related widgets, not rectangle that happens to surround something.

Border color to reflect alarm state, not arbitrary change in color.

Font name "Title", not "Arial-bold-12".

Displays with same Representation (Lines, circles with changing color, "Arial-bold-12") look the same as displays with Meaning (group, LED, Title).

But they are like compiled binaries without source code.

Less useful in the long run.

In the future, files with Meaning will be easier to translate for other, new tools than files with only Representation.

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Rules & Scripts: Disclaimer

… can change any property of any widget:

- Change text of label based on a PV
  - i.e. build your own Text Update
- Change color of an Ellipse based on PV
  - i.e. build your own LED

Based on last slide, that is a bad idea!

Still, there are places where rules and scripts can be very powerful.

A BOY display with Rules/Scripts can replace a custom Java/Python/C/C++ application!

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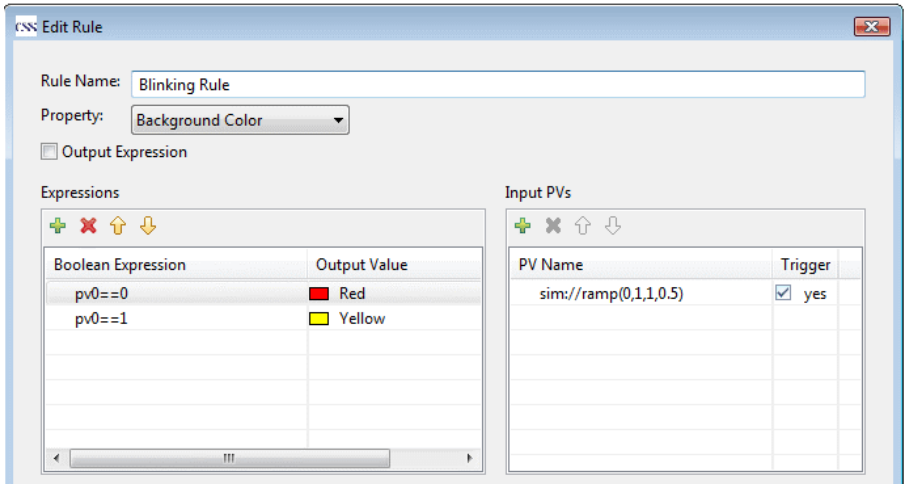
Rules, Scripts

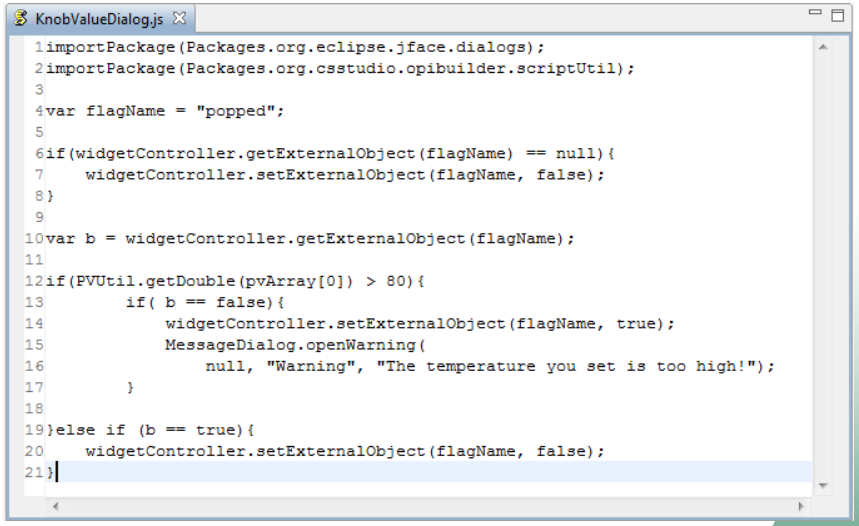
Rules create dynamic displays

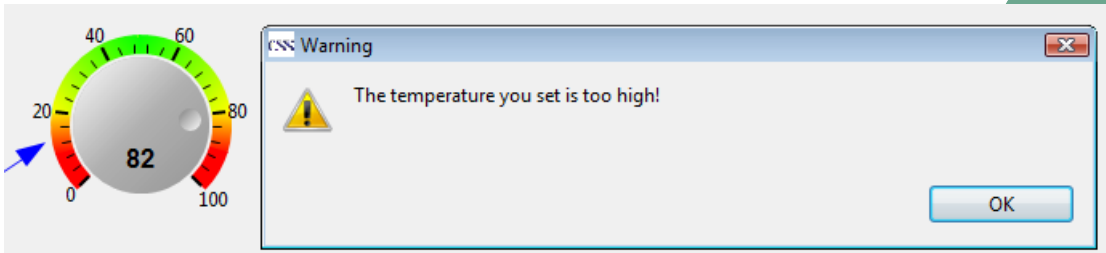
- Easy: PV → Widget Property



Scripts can to "anything"

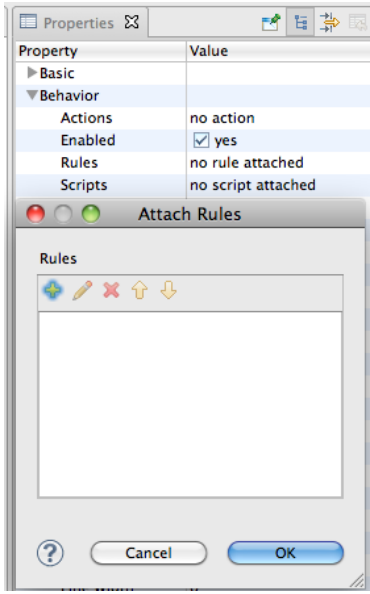
- Read PVs,
  change widget properties,
  open dialog, …
- JavaScript or Python (Jython)

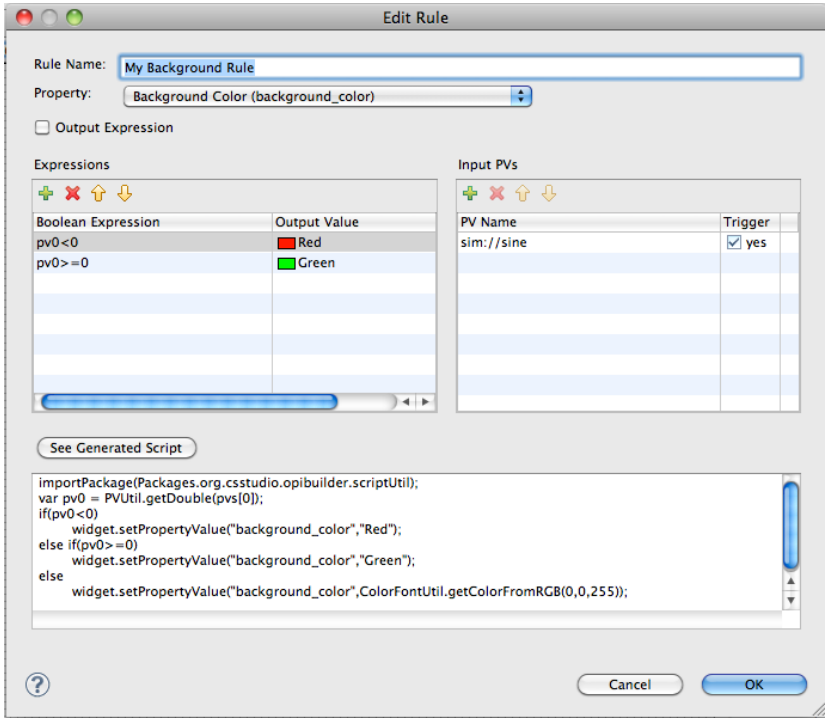




Exercise: Rule to change color of Ellipse

- Create *Ellipse* widget
- Locate its *Behavior*, *Rules* Property
- Click the "no rule attached" value to open the dialog to Attach (or edit) Rules
- Add a rule that changes the background color as shown between Red and Green, triggered by changes in the sim://sine PV
- Press "See Generated Script", compare with screenshot
- Maybe add another TextUpdate widget to display the same sim://sine PV
- Run the display





Rules vs. Scripts

Rules

- are simpler: One or more PVs change <u>one</u> property
- are closer to describing Meaning
- are internally converted to scripts, but what's saved in the *.opi file is the Meaning: Property to adjust, expressions for rule, input PVs
- should be preferred to scripts whenever possible

Scripts

- can be pretty much any Java Script of Jython code
- can affect multiple properties, widgets, even add and remove widgets
- should be used with care, because they can be hard to maintain in the long run
  - Use org.cstudio.opibuilder.scriptUtil (PVUtil, ColorFontUtil)
  - Add many source code comments

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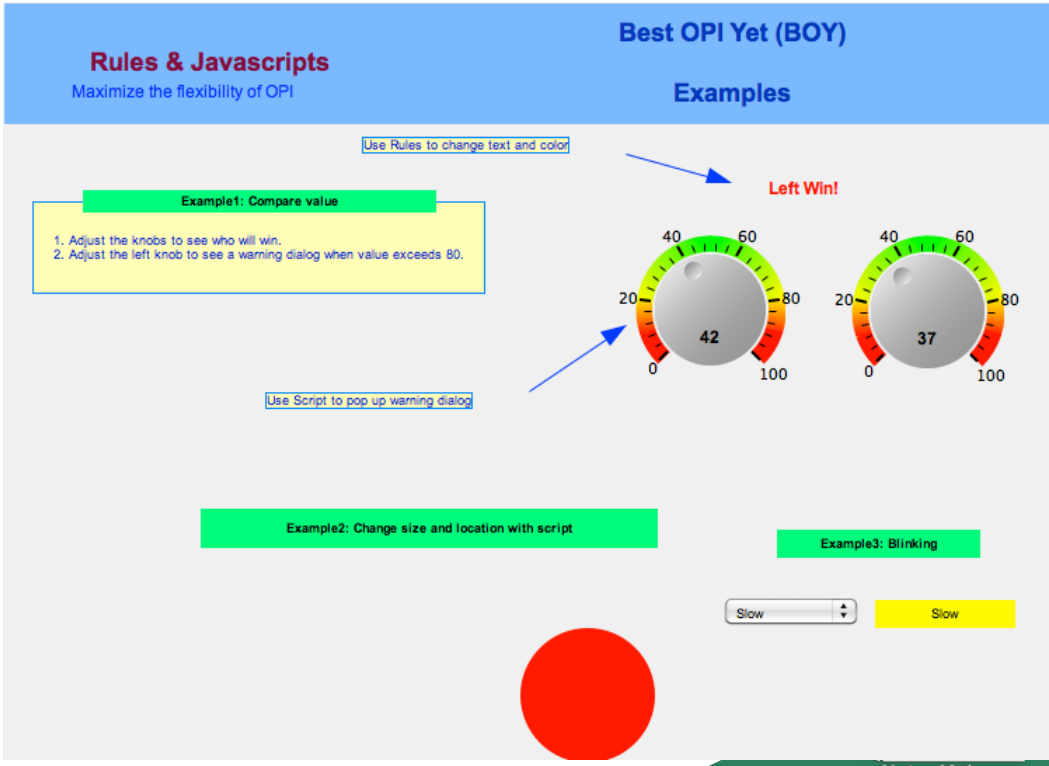
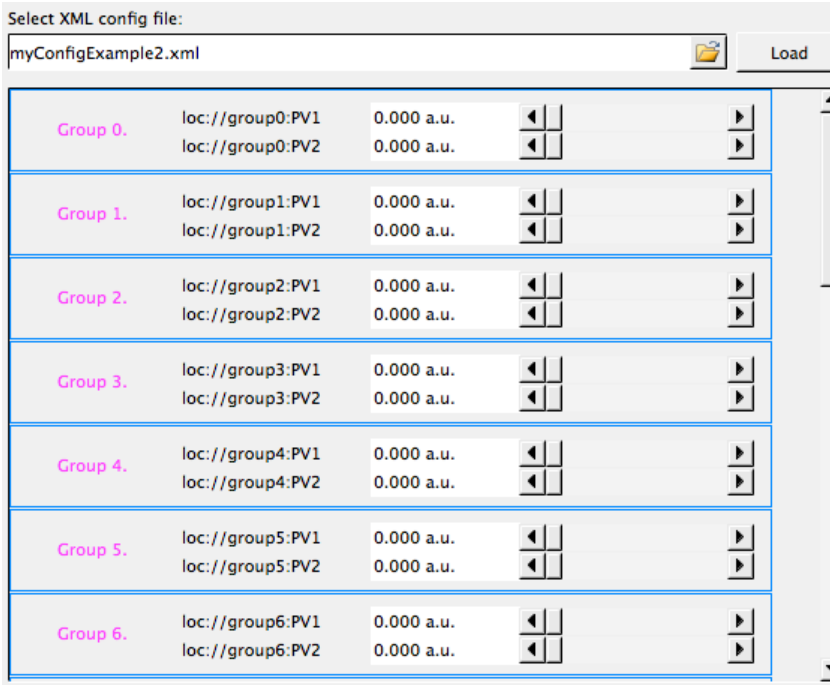
Exercise: Rules, Scripts in OPI Examples

- Open BOY Examples/5_3_Rules_Script.opi, first in Runtime, then in Edit mode
- Check the rules behind the "Left Win!" text above the two knobs
- Check the Script attached to the left Knob
- Check the Script attached to the moving circle
  - How does it change its color?



Exercise: Script-generated Displays

- **Open**
  BOY Examples/Miscellaneous/DynamicLoadWidgets/LoadWidgetsExample.opi
  in Runtime mode



- **Enter "myConfigExample.xml", press "Load".**
  Enter "myConfigExample2.xml", press "Load".
  - **Notice a difference?**

- **Open SubPanel.opi in Edit mode, change it slightly by setting the color of the "Group…" label to violet, save, then press "Load" on LoadWidgetsExample.opi**
  - **See how it's using the current version of SubPanel.opi?**

Investigate how this is done!

- **What PV is attached to the text field where you enter the *.xml file names?**
- **What PV is attached to the "Load" button?**
- **Note the script attached to the big Grouping Container that appears empty in edit mode, but is dynamically populated with copies of SubPanel.opi in runtime mode.**
- **Read that script together with myConfigExample.xml.**
  Writing such a script requires knowledge of the BOY widget model.
  You don't have to write such a script, but you should be able to understand what it does.

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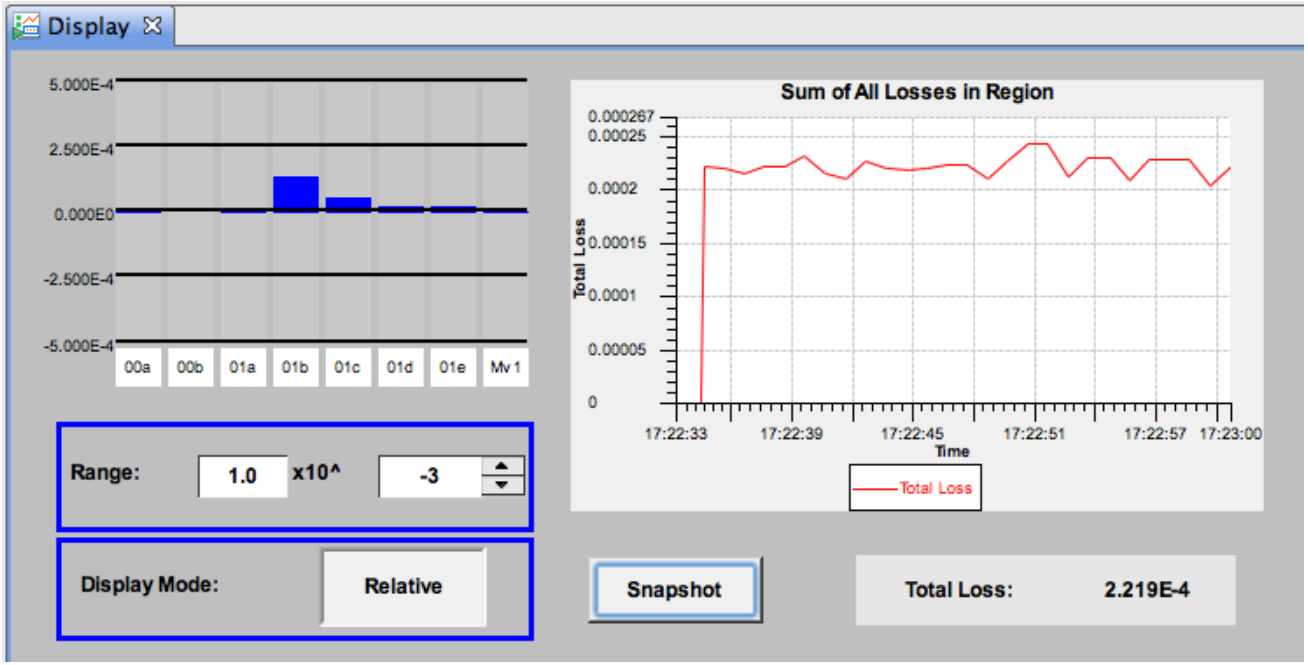
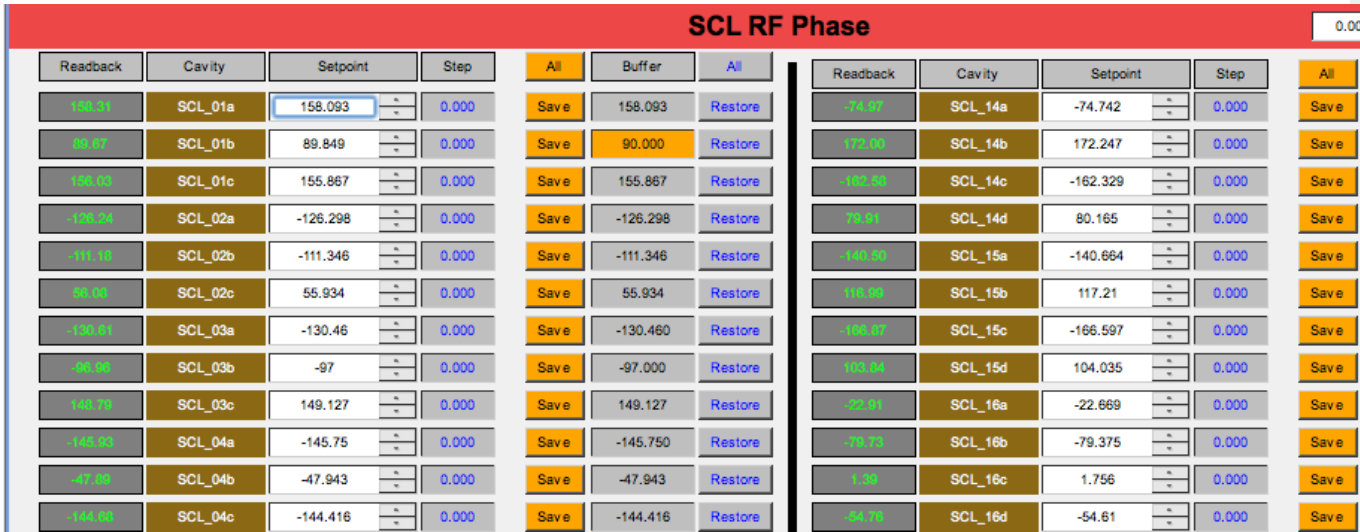
Scripts can replace custom Applications!



Display how beam loss is increased or reduced relative to a "snapshot"

Save, Adjust, maybe Restore settings

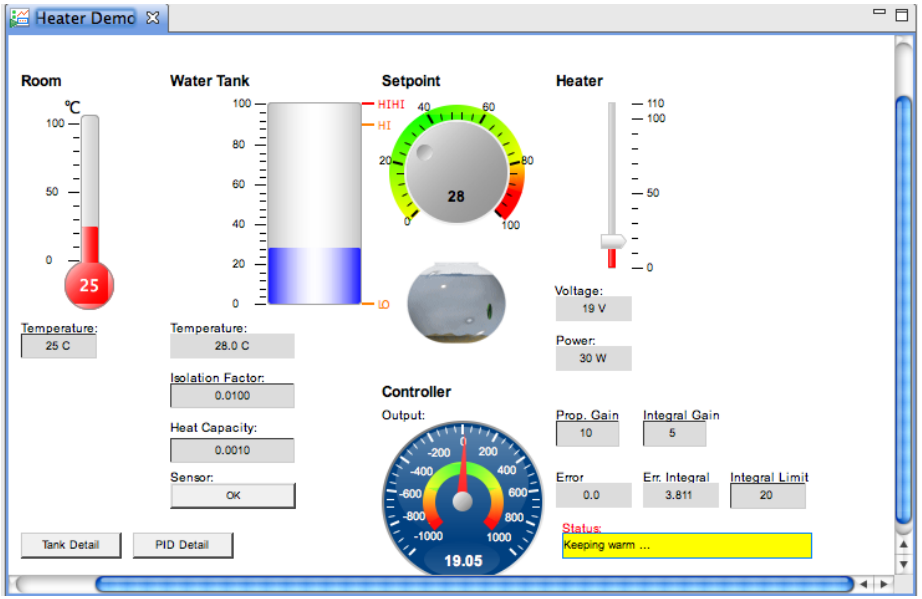


SNS operation group:
Tim Southern, Nick Luciano

Summary

There is a lot you *can* do in BOY

- Macros, Rules, Scripts, …



Remember the Main Idea:

Simply Things are Easy

1. Add widget
2. Enter PV Name
3. Run