# Control System Studio: BOY

Kay Kasemir

**ORNL/SNS** 

kasemirk@ornl.gov

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

Sept. 2014

ORNL is managed by UT-Battelle for the US Department of Energy



## **BOY – Best OPI, Yet**

#### **Operator Interface Editor**



#### Runtime





#### Example: ITER





#### **Examples: SNS**

(SNS) File Edit CSS Window Help				
	*5 🔍 🔍 100% 🖵 🗇 🗸	S <del>v</del>	FP 🔛 OF	PI Runtime
Test Bench 🛛 🖾 ReadBack Test				
Card A (0x0) Card B (0x080000)	ning Receiver 1	fest Bench		
Board ID SNS Timing Receiver VM	1E Board V232S	Board Rev - E	Base Address 0x0	
Firmware Version FW v 0.xxx Date 02 24 2	011	Board SN 0x0 G	eog Address 0x8	
Event # DelayTurns Delay 1/ 0-255 0-65535 Turn 0	64th Delay Time Pulse Width -63 us 0-262143	Pulse Width Enable Time us Output	Inverted 1 Shot Enable Manual Output 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	0000.000 0	0000.000		
CH5 0 0	0000.000 0	0000.000		
CH6 0 0	0000.000 0	0000.000		
CH7 0 0	0000.000 0	0000.000		
CH8 3 0 0	0000.000 0	0000.000		
ScratchPad ScratchPad 0xC8 0xCFA71	0xCFA6D Auto Test	Grouping Container Temp Limit Set 55.0		
ScratchPad 0xCC 0xCFA71	0xCFA6D	Temperature 25.38 C		
ScratchPad 0xD0 0xCFA71	0xCFA6D			
ScratchPad 0xD4 0xCFA71	0xCFA6D			
Write Data to Arbitrary Address	8 Data at Offset Address:			
Data to Write 0xCE263 0xC	FA6D	23:16 15:8	7:0	
□			ē	Not logged in



5

# 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 display limits set the knob's default range
- Indication of 'disconnected' state via a pink border
- ✓ Widget will be greyed-out if read-only





# **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

😭 🔛 OPI Runtime	
≝ first.opi 🛛	
2.939 a.u.	
·	
	IDGE

# 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





 $\triangleright$ 

#### **View Online Help**

#### Find

- CSS Core, Process Variables
- CSS Applications, Display, BOY, Widgets

Help	
css Welcome	
CSS About	
Help Contents	
Cheat Sheets	Shift+Alt+Q H
<u>K</u> ey Assist	Shift+Ctrl+L
<u>S</u> oftware Updates	•

Help - CSS (ITER) (on next.codac.iter.org)			
earch: Go <u>Scope</u> All topics			
Contents 👜 🚽 🚀 🕒 🗟	(우 수 🗄   송 에 🖮 🗖		
CODAC Core System	CSS Applications > Display > Best OPI Yet > Widgets		
	VV Graph		
RDB Table Editor	лі біаріі		
🗉 🚅 adl2Boy - Converter	A widget that is able to plot 1D or 2D date in an VV Graph. It has comprehensive drawing and exercising		
PV Table	A wuget that is able to plot 1D of 2D data in an AT Graph. It has comprehensive drawing and operating functionalities.		
🖻 💷 Best OPI Yet			
Introduction	Supports scalar PV, array or waveform PV.		
Install Examples	Line chart, scatter chart, bar chart, step chart, area chart		
Getting Started	Abundant interactive operating capabilities: Five Zoom Types, Panning, Auto Scale, Add/Remove		
OPI Editor Perspective	Annotations, Undo/Redo, Take snapshot.		
OPI Editor	Configure properties at Runtime, such as chaning trace color, line width and axis color etc,.		
OPI Runtime	• Multiple axes support		
🗉 🝱 Setting Preferences	Log scale, date time format axis support     Group legends by aves		
🖻 💷 Widgets	• Anotations could be free or snapped to a trace		
Widget Properties			
E PV Widgets			
E III Boolean Widgets	80 Multi-Axes Graph		
Ext Update			
Graled Widgets	40 (25.9), 61)		
XY Graph			
Intensity Graph			
Byte Monitor			
Action Button	-60		
🗎 Menu Button	-80		
Text Input	2011-05-02 2011-05-02 2011-05-02 2011-05-02 201		
Spinner	15:35:16 15:35:18 15:35:19 15:35:20 15:35:21		
Scrollbar	Time 0.1 +		
Thumb Wheel	Line Bar Area Primary X Axis (0)		
Check Box			
Choice Widgets	Operations		
Web Brower	-		
	The widget is equipped with a toolbar which allows you to:		
Color and Font	• Configure the properties of graph axes or traces		
PV Connectivity	Compute the properties of graph, axes of traces.     AddRemove Annotations - Anotations are moveable by dragging and dropping		
Action	Parform auto scaling.     Perform auto scaling.		
	• Zoom In/Out on nlotting area or axes in different ways		

#### **PV Names**

- ca://some\_pv\_name
   EPICS Channel Access PV
- some\_pv\_name
  - Typically same, since "ca://" is the default
- sim://sine
  - Simulated PV. Read online help for details
- loc://x(4)
  - Local PV. Read online help for details
- pva://x
  - EPICS V4 pvAccess



#### **Formula Support**

- ='some pv name' \* 2
  - Start with '='
  - Enclose PV names in <u>single</u> quotes
- =3.14
  - Formula with constant value (replaces previous 'const:\\3.14')
- ="I like CS-Studio"
  - Enclose strings in double quotes
- loc://x(4)
  - Local PV. Read online help for details

Check online help, see CSS/Debugging/Formula, note auto-completion hints. Beware: Don't use formulas for conversions that should happen on the IOC!

/ Probe Σ	3
PV Formula	: =sin
Value: [L	$\int_{0}^{f_{x}} \frac{\sin(x)}{\sin(x)} = \sin(x)$
New Value	e: fx sin( fx sinh(
	History (0 matching items)
R	Probe 怒 sin( <vnumber>arg)</vnumber>
PV	Formula: =sin(2*

# **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.

	Properties 🛛		( an	🍰 🗟 🖻 🎽	E
Pr	operty		Va	llue	
~	Basic				
	Name			LED	
	PV Name				
	Widget Typ	e		LED	
Þ	Behavior				
~	Border				
	Alarm Sens	itive	$\checkmark$	yes	
	Border Cold	or		IO Border	
	Border Style	e		None	
	Border Wid	th		1	
~	Display				
	3D Effect		$\checkmark$	yes	
	BackColor	Alarm Sensitive		no	
	Background	d Color		IO Background	
	Font			Default	
	ForeColor A	lam Sensitive		no	
	Foreground	Color		IO Foreground	
	Off Color			(0,100,0)	
	Off Label			OFF	
	On Color			(0,255,0)	
	On Label			ON	
	Show Boole	ean Label		no	
	Square LED	)		no	
	Tooltip			\$(pv_name) / \$(p	
~	Position				
	Height			34	
	Width			34	
	х			167	

OAK KIDGE

# **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





# **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





# **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>?



#### **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



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

#### **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

Try with OPI Examples: Open in tab, ... Window



OPIs in 'Tabs'

• \$ •



#### **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



#### 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

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



National Laboratory

# **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 within Linking.opi

ty Value th AmplifierDsp.opi s (Parent Macros) (PSH=RE-ICH1_CTR1=RE-ICH1_RS
th AmplifierDsp.opi s (Parent Macros) (PSH=RE-ICH1, CTRI =RE-ICH1-RS
s (Parent Macros) (PSH=RE-ICH1, CTRI =RE-ICH1-RS
- (
ie 🗌 no
iption

#### **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:

🚰 xxx.opi 🕱	- 6
Power Supply 1	Power Supply 2
Setpoint:	Setpoint:
Readback:	Readback:

- 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
- $\checkmark~$  PV can be 'monitored', showing brief spikes
- 26 Fewer display options

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

**CAK RIDGE** National Laboratory

#