areaDetector CSS opi screens deployment at NSLS2 beamlines

AD Plugin: barcode reader

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BROOKHAVEN NATIONAL LABORATORY
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U.S. DEPARTMENT OF ENERGY | Office of Science

EPICS deployment

- Detectors
  - GigE, Pilatus, Eiger, PCO, Andor3, XMAP, PE, Merlin, Lambda, Zebra/PanDaBox -> Pizza/‘Tiger’ box
- Base: R3.14.12.6, 7.0.1.1;
- most are AD 1-9, new ADCore 3-2

areaDetector CSS screens

- NSLS2 has ‘100s of beamline AD devices
  - different AD ioc versions
- adl -> opi converter works well
- adl screens are flat – one folder (or set of folders)
- many screens with dependencies on
  - ADCore,
  - other modules (asyn, iocStats, …)

- **GOAL:** minimize CSS AD screen maintenance

NSLS2 beamline CSS opi

~24 branches/beamlines + accelerator

Folder		Comment
Flat	Common	Not every AD upgraded
Flat	Each beamline	75 -125 {beamlines x (5)AD versions}
Not flat	Each beamline	?
Not flat	Common	??

- Flat structure leads to many ‘identical’ screen folders – maintenance ‘nightmare’ **X**
- Not flat – how to use new capabilities of css

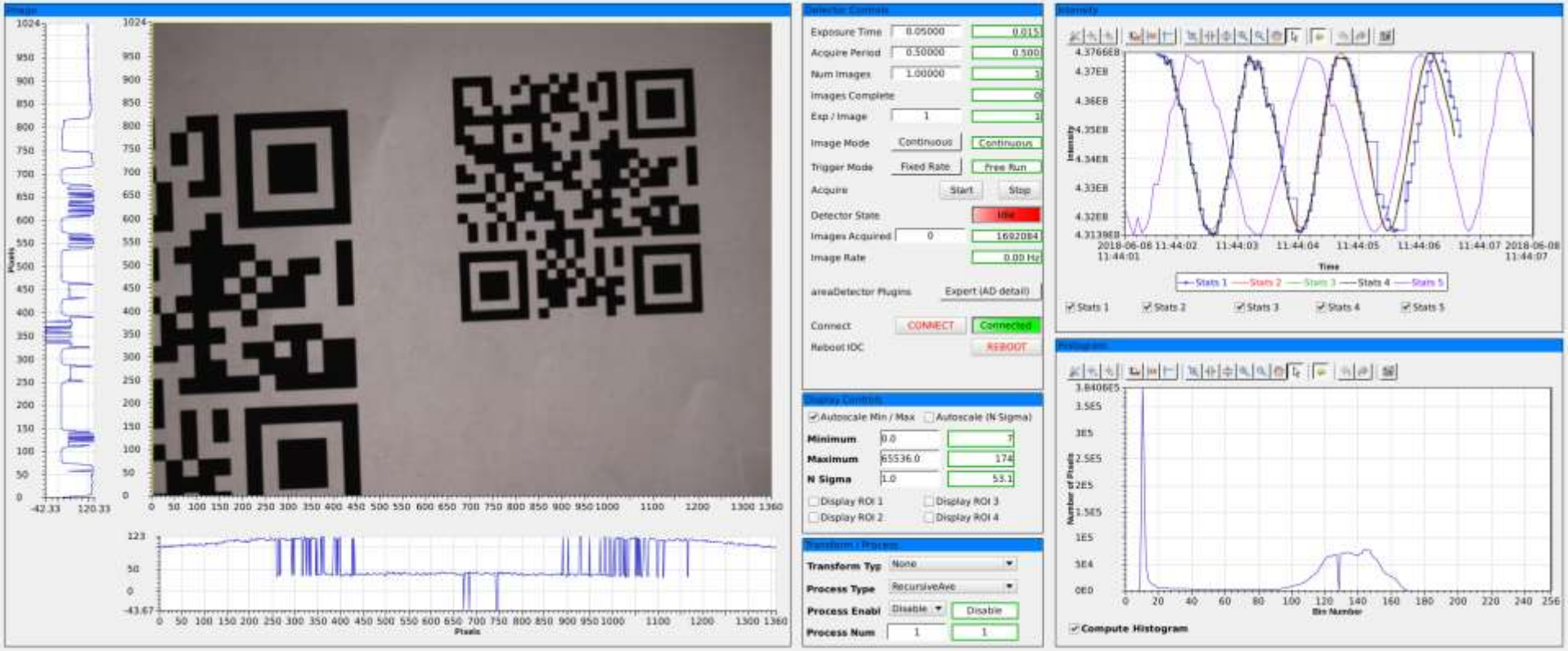
AD opi screen file structure

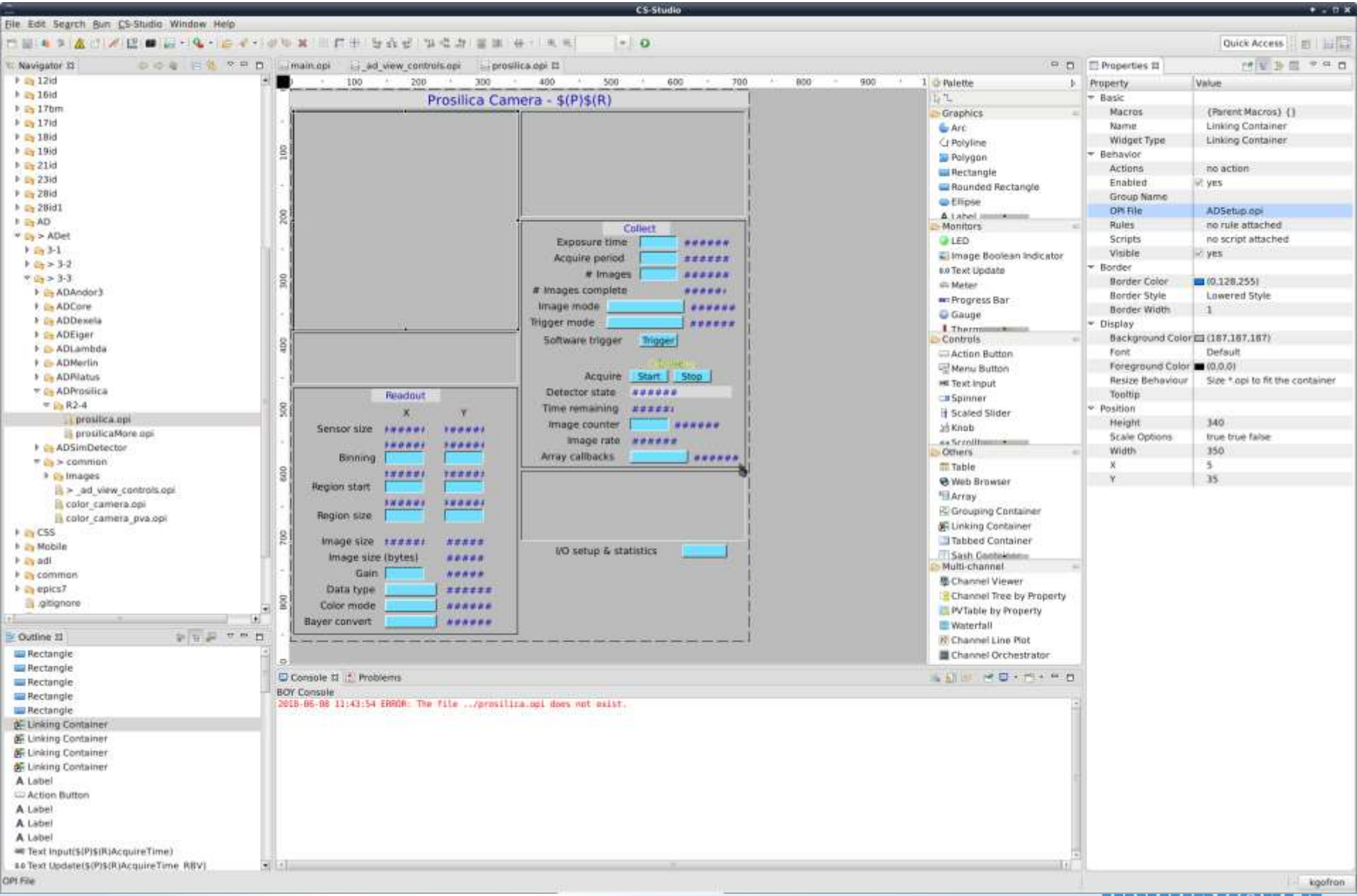
Flat

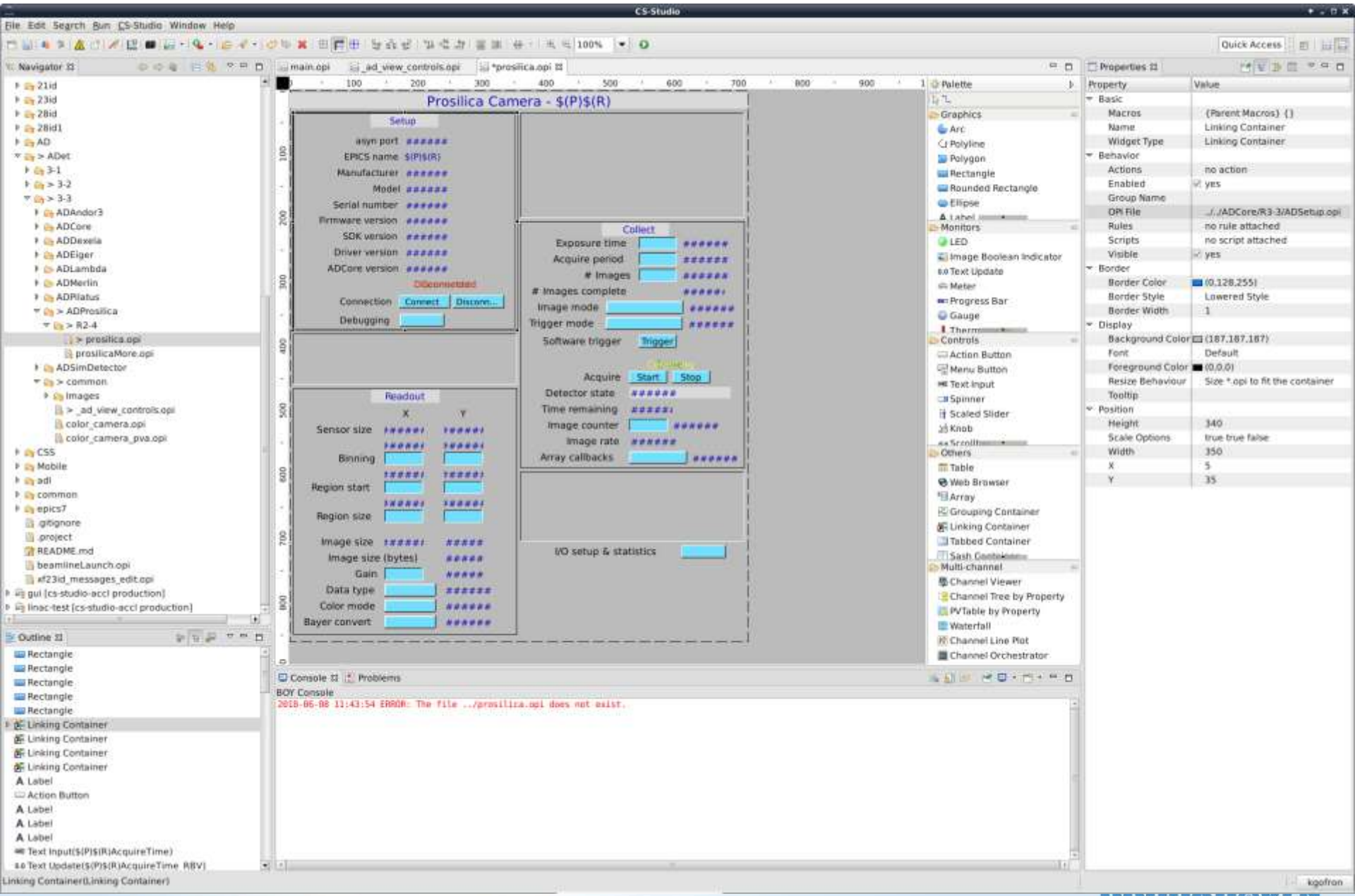
```
kgofron@xf10id-ws1:~/src/gitlab/cs-studio-xf/AD$ ls
ADAttrFile.opi              NDFileNexus.opi          NDTimeSeriesAll.opi
ADBase.opi                  NDFileNull.opi           NDTimeSeries.opi
ADBuffers.opi               ND_File.opi              ND_TimeSeriesPlot.opi
ADCollect.opi               NDFile.opi               ND_Transform.opi
ADDriverFile.opi            NDFileTIFF.opi           NDTransform.opi
ADEpicsShutter.opi          NDOverlay8.opi           ND_Transform_Single.opi
ADPlugins.opi               _ND_OverlayN_Line.opi    PerkinElmerCollect.opi
ADReadout.opi               ND_Overlay_N.opi         PerkinElmerCorrections.opi
adsc.opi                    NDOverlayN.opi           PerkinElmerInit.opi
ADSetup.opi                 ND_Overlay.opi           PerkinElmer.opi
ADShutter.opi               NDOverlay.opi            pilatusAncillary.opi
ADTop.opi                   ND_Overlay_Single.opi    pilatusDetector.opi
Andor.opi                   NDPlot.opi               pixiradLV.opi
BIS.opi                     NDPluginBase.opi         pixirad.opi
commonPlugins.opi           _ND_Plugin_Setup.opi     pointGreyFrameRate.opi
EPICS_ShutterControl.opi    ND_PluginTimeSeries.opi  pointGrey.opi
firewireFeatures.opi        ND_Process.opi           pointGreyPixelFormat.opi
firewire.opi                NDProcess.opi            pointGreyProperties.opi
firewireVideoFormats.opi    ND_Pva.opi               prosilicaMore.opi
mar345.opi                  NDROI4.opi               Prosilica_More.opi
marCCDAncillary.opi         _ND_ROIN_Line.opi        prosilica.opi
marCCD.opi                  ND_ROIN.opi              PSL.opi
ND_ColorConvert.opi         ND_ROI.opi               pvCam.opi
NDColorConvert.opi          NDROI.opi                RoperFile.opi
NDFFMPEG.opi                NDStats5.opi             Roper.opi
ND_FFTFreqSpectrumPlot.opi  _ND_StatsN_Line.opi      scan_more.opi
ND_FFT.opi                  ND_StatsN.opi            simDetector.opi
_NDFile_Control.opi         ND_Stats.opi             simDetectorSetup.opi
NDFileHDF5.opi              NDStats.opi              title.opi
NDFileJPEG.opi              ND_Stats_Plot.opi        URLDriver.opi
NDFileMagick.opi            ND_StdArray.opi          URLDriverSetup.opi
NDFileNetCDF.opi            NDStdArrays.opi
```

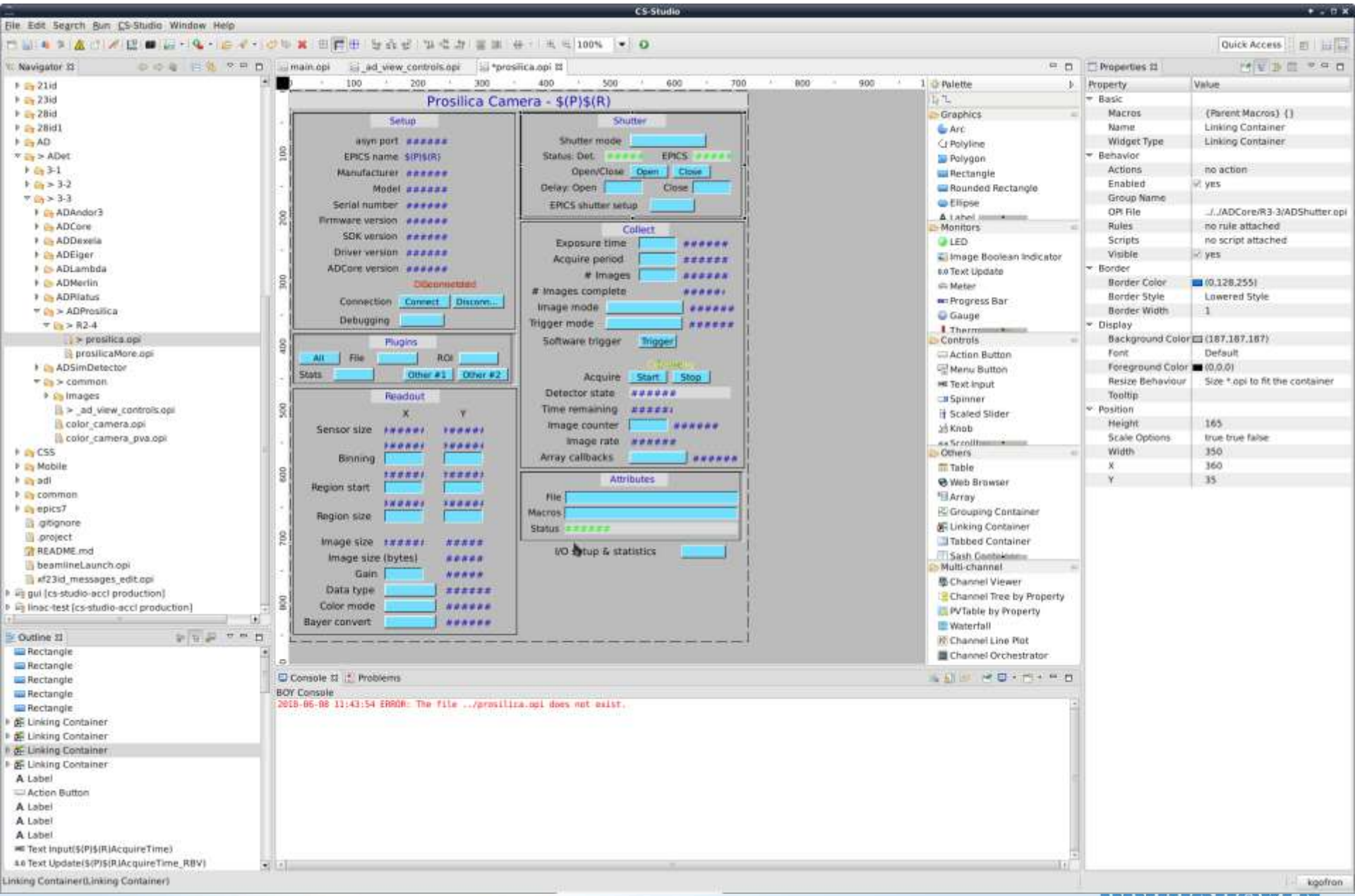
Folder

Prosilica main screen




CS-Studio
File Edit Search Run CS-Studio Window Help
Navigator
main.opi
_ad_view_controls.opi
prosilica.opi
Prosilica Camera - (P)(R)
Collect
Exposure time
Acquire period
Images
Images complete
Image mode
Trigger mode
Software trigger
Trigger
Acquire
Start
Stop
Detector state
Time remaining
Image counter
Image rate
Array callbacks
Readout
X
Y
Sensor size
Binning
Region start
Region size
Image size
Image size (bytes)
Gain
Data type
Color mode
Bayer convert
I/O setup & statistics
Palette
Graphics
Arc
Polyline
Polygon
Rectangle
Rounded Rectangle
Ellipse
Monitors
LED
Image Boolean Indicator
Text Update
Meter
Progress Bar
Gauge
Controls
Action Button
Menu Button
Text Input
Spinner
Scaled Slider
Knob
Others
Table
Web Browser
Array
Grouping Container
Linking Container
Tabbed Container
Multi-channel
Channel Viewer
Channel Tree by Property
PVTable by Property
Waterfall
Channel Line Plot
Channel Orchestrator
Properties
Property
Value
Basic
Macros
Name
Widget Type
Behavior
Actions
Enabled
Group Name
OPI File
Rules
Scripts
Visible
Border
Border Color
Border Style
Border Width
Display
Background Color
Font
Foreground Color
Resize Behaviour
Tooltip
Position
Height
Scale Options
Width
X
Y
Outline
Console
Problems
BOY Console
2018-06-08 11:43:54 ERROR: The file ../prosilica.opi does not exist.
OPI File

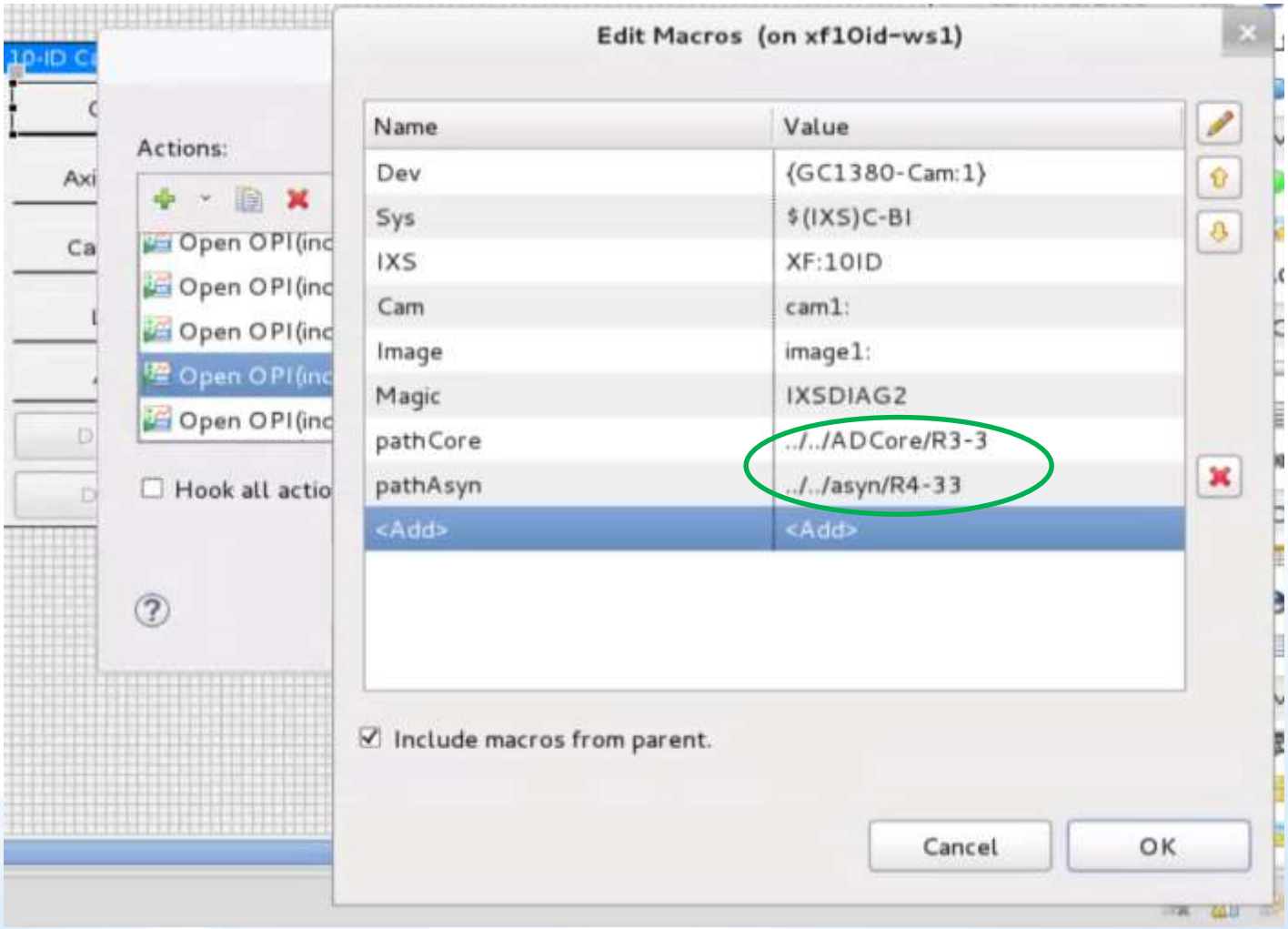

CS-Studio
File Edit Search Run CS-Studio Window Help
Navigator
Outline
main.opi
_ad_view_controls.opi
*prosilica.opi
Prosilica Camera - (P)(R)
Setup
asyn port
EPICS name (P)(R)
Manufacturer
Model
Serial number
Firmware version
SDK version
Driver version
ADCore version
Disconnected
Connection
Connect
Debugging
Collect
Exposure time
Acquire period
Images
Images complete
Image mode
Trigger mode
Software trigger
Trigger
Acquire
Start
Stop
Detector state
Time remaining
Image counter
Image rate
Array callbacks
Readout
X
Y
Sensor size
Binning
Region start
Region size
Image size
Image size (bytes)
Gain
Data type
Color mode
Bayer convert
I/O setup & statistics
Palette
Graphics
Monitors
Controls
Others
Multi-channel
Properties
Property
Value
Basic
Behavior
Display
Position
Console
Problems
BOY Console
2018-06-08 11:43:54 ERROR: The file ../prosilica.opi does not exist.
Linking Container(Linking Container)


CS-Studio
File Edit Search Run CS-Studio Window Help
Navigator
main.opi
_ad_view_controls.opi
*prosilica.opi
Prosilica Camera - (P)(R)
Setup
asyn port
EPICS name (P)(R)
Manufacturer
Model
Serial number
Firmware version
SDK version
Driver version
ADCore version
Disconnected
Connection
Connect
Debugging
Shutter
Shutter mode
Status: Det.
EPICS
Open/Close
Open
Close
Delay: Open
Close
EPICS shutter setup
Collect
Exposure time
Acquire period
Images
Images complete
Image mode
Trigger mode
Software trigger
Trigger
Acquire
Start
Stop
Detector state
Time remaining
Image counter
Image rate
Array callbacks
Plugins
All
File
ROI
Stats
Other #1
Other #2
Readout
X
Y
Sensor size
Binning
Region start
Region size
Image size
Image size (bytes)
Gain
Data type
Color mode
Bayer convert
Attributes
File
Macros
Status
I/O Setup & statistics
Palette
Graphics
Arc
Polyline
Polygon
Rectangle
Rounded Rectangle
Ellipse
Monitors
LED
Image Boolean Indicator
Text Update
Meter
Progress Bar
Gauge
Controls
Action Button
Menu Button
Text Input
Spinner
Scaled Slider
Knob
Others
Table
Web Browser
Array
Grouping Container
Linking Container
Tabbed Container
Multi-channel
Channel Viewer
Channel Tree by Property
PVTable by Property
Waterfall
Channel Line Plot
Channel Orchestrator
Properties
Property
Value
Basic
Macros
(Parent Macros) {}
Name
Linking Container
Widget Type
Linking Container
Behavior
Actions
no action
Enabled
yes
Group Name
OPI File
../../ADCore/R3-3/ADShutter.opi
Rules
no rule attached
Scripts
no script attached
Visible
yes
Border
Border Color
(0,128,255)
Border Style
Lowered Style
Border Width
1
Display
Background Color
(187,187,187)
Font
Default
Foreground Color
(0,0,0)
Resize Behaviour
Size *.opi to fit the container
Tooltip
Position
Height
165
Scale Options
true true false
Width
350
X
360
Y
35
Outline
Rectangle
Linking Container
Label
Action Button
Text Input((P)(R)AcquireTime)
Text Update((P)(R)AcquireTime_RBV)
Console
Problems
BOY Console
2018-06-08 11:43:54 ERROR: The file ../prosilica.opi does not exist.
Linking Container(Linking Container)
kgofron

Non flat opi folder structure

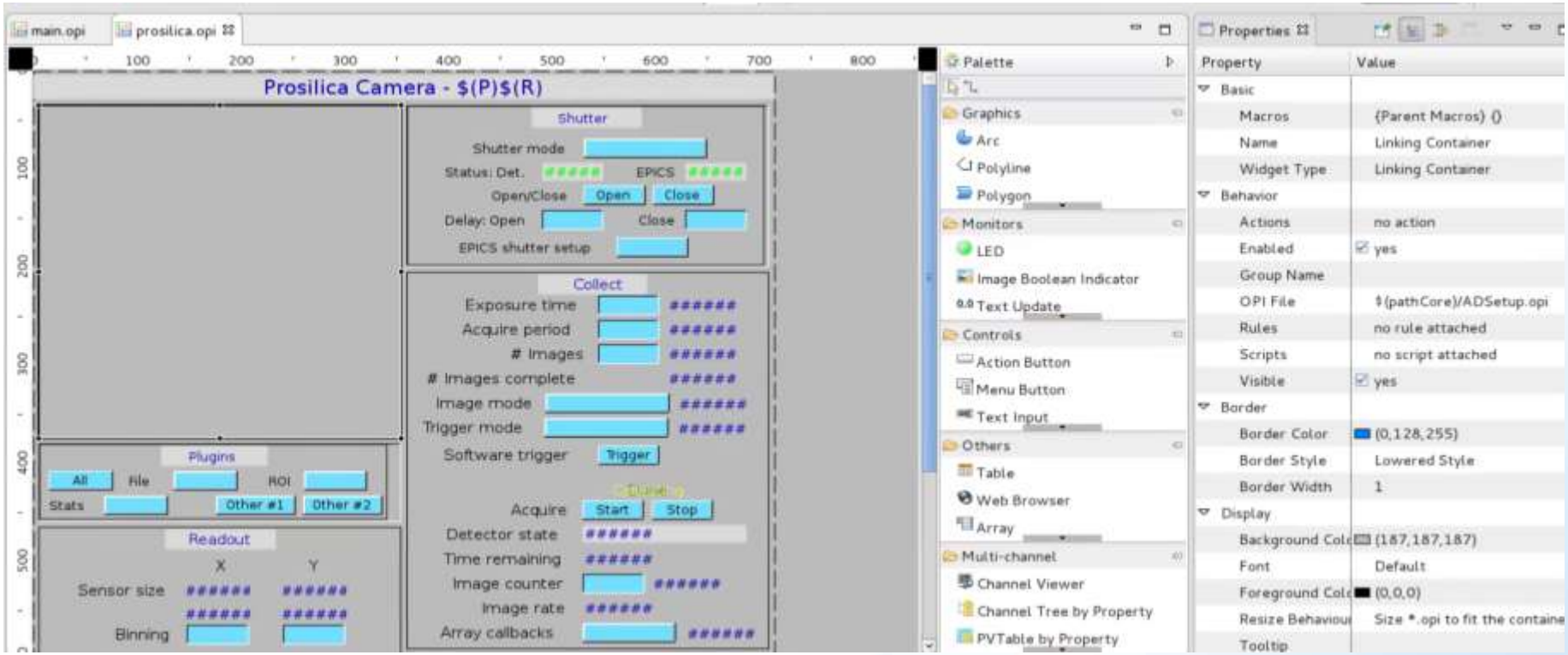
- Relative path resulted in one fixed configuration of areaDetector opi screens
  - No improvement over flat folder
    - {same number of multiple screen folders}

Run-time macro substitution

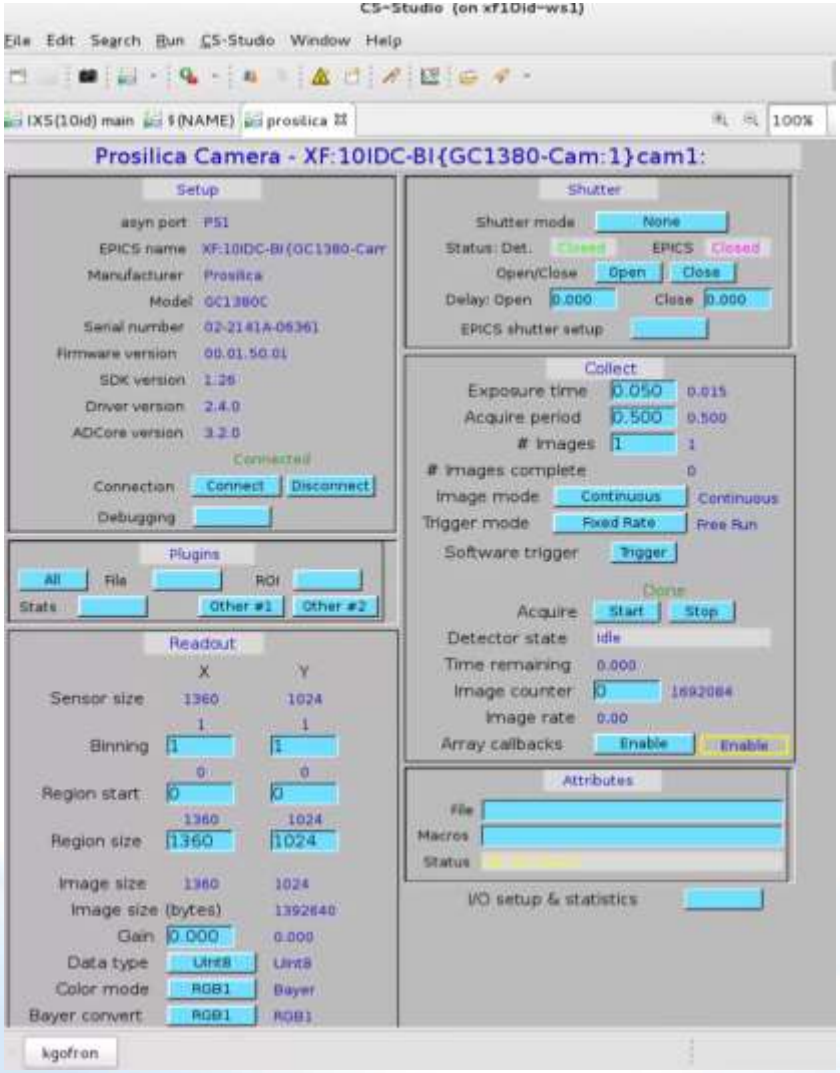


Relative Path

Prosilica run-time macro substitution



Prosilica runtime with pathCore



- Relative path
  - one copy of areaDetector opi screens
  - copy of folder still works (individual specific beamlines)
  - Easier maintenance than multiple copies of flat legacy medm screens

Macro substitution for modules

- Relative path to modules
  - **one** copy of areaDetector opi screens
  - Major improvement over multiple copies of flat folder opi
- Use Macro substitution for module Paths
  - Replace relative path to ADCore with CSS macro
  - Relative paths for other modules
  - pathCore, pathAsyn, pathIocStats,…
- Use script to insert path Macro in opi files
  - Generate any run-time combination of the ADCore, asyn, other modules from **one set of AD opi screens**

Relate to mdm, edm, caQtDM

- Medm
  - EPICS_DISPLAY_PATH {folder(s) where screens are}
  - Runtime
  - No need to change autoconverted screens
- Edm
  - Real time choice
  - Ioc and screens are co-located
- caQtDM
  - ??

areaDetector ioc

```
kaz@xf10id-is1:/epics/iocs/cam-GC1380$ ls -l
drwxrwxrwx 4 kaz kaz   4096 Oct  2  2017 as
-rw-r--r-- 1 kaz kaz     71 May  2 16:42 config
-rw-r--r-- 1 kaz kaz   1457 May  2 17:07 envPaths
-rwxr-xr-x 1 kaz kaz   4855 May  2 17:15 st.cmd
```

AD Plugin: Barcode reader

```
jwlodek@debian:~/Documents/barcodeproject$ ./check
Type : QR-Code
Data : xf10id -barcode test
```

```
/*
Function that does the barcode decoding. It is passed an image and a vector
that will store all of the codes found in the image. The image is converted to gray,
and a zbar scanner is initialized. The image is changed from an opencv to a Image object,
and then it is scanned by zbar. We then iterate over the discovered symbols in the image, and
create a instance of the struct. the struct is added to the vector, and the bars location
data and type are stored, and printed.
 */
static void decode_bar_code(Mat &im, vector<bar_QR_code> &codes_in_image){
  ImageScanner zbarScanner;
  zbarScanner.set_config(ZBAR_NONE, ZBAR_CFG_ENABLE,1);
  Mat imGray;
  cvtColor(im, imGray, CV_BGR2GRAY);
  Image image(im.cols, im.rows, "Y800", (uchar*) imGray.data, im.cols *im.rows);
  int n = zbarScanner.scan(image);

  for(Image::SymbolIterator symbol = image.symbol_begin(); symbol!=image.symbol_end();++symbol){
    bar_QR_code barQR;
    barQR.type = symbol->get_type_name();
    barQR.data = symbol->get_data();

    cout << "Type : " << barQR.type << endl;
    cout << "Data : " << barQR.data << endl;
    setStringParam(NDPluginBarBarcodeType, barQR.type);
    setStringParam(NDPluginBarBarcodeMessage, barQR.data);
    setIntegerParam(NDPluginBarBarcodeFound, 1);
    for(int i = 0; i< symbol->get_location_size(); i++){
      barQR.position.push_back(Point(symbol->get_location_x(i), symbol->get_location_y(i)));
    }
    codes_in_image.push_back(barQR);
  }
}
```

Enabling technology

Open source

- openCV
- zbar

Conclusions

- Use **one** set of areaDetector opi screens to support any version of the AD ioc.
  - Opi screen placed in common CSS area
  - pathMacro substitution to select releases of
    - ADCore,
    - asyn,
    - etc.
- ADPlugin for barcode scanning - work in progress.