OAK RIDGE National Laboratory

PV Access

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U.S. DEPARTMENT OF ENERGY

EPICS Network Protocols

Channel Access

- Since beginning of EPICS
- DBR_*: Number, enum, string, scalar or array, with time, alarm, limits
- Still fully supported with bug fixes

PV Access

- Started as "EPICS V4", since EPICS 7 (2017) in base
- PV Data: Arbitrary structures
- New features being added

First Glance

- softIocPVA instead of softIoc

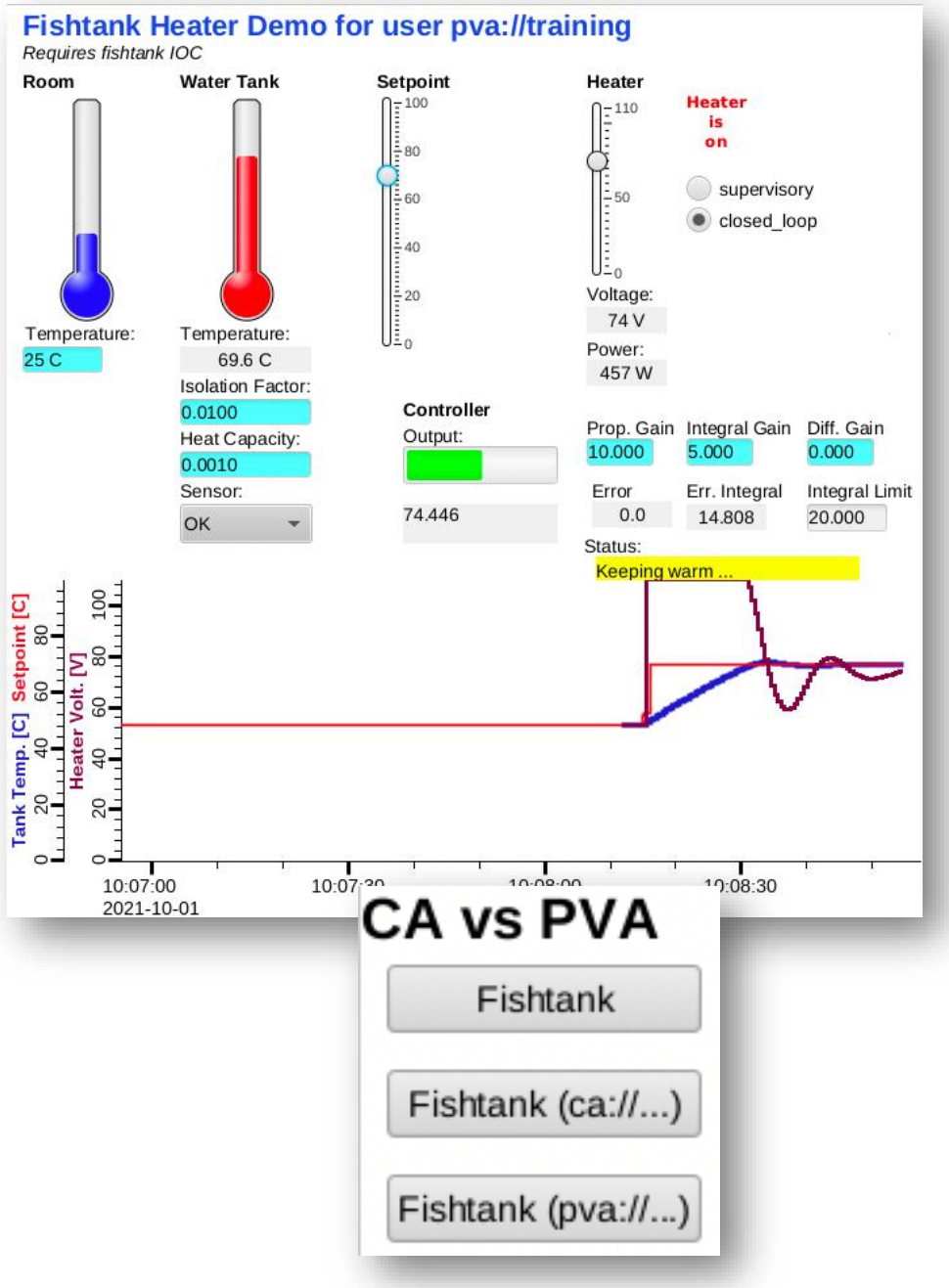
```
# We did this before:
cd /ics/examples/fishtank
cat st.cmd

# Compare, then run:
cd /ics/examples/15_pvaccess
cat st.cmd
./st.cmd
```

- pv... instead of ca...

```
camonitor epics-dev:setpoint epics-dev:tank
pvmonitor epics-dev:setpoint epics-dev:tank
pvput     epics-dev:setpoint 40
caput     epics-dev:setpoint 30
```

- CS-Studio:

```
css -resource /ics/examples/15_pvaccess/pva.bob
```



PV Access

Like Channel Access

- Name search via UDP
- Connection for data transfer via TCP
- EPICS_PVA_ADDR_LIST, EPICS_PVA_AUTO_ADDR_LIST

Get, put, monitor

- Plus an 'RPC' type operation

Arbitrary PV Data structures instead of DBR_.. types

Custom Data: Great, but then what?

Fred's structure:

double	value
short	status
short	severity
string	units
time	timeStamp
…	

Keith's structure:

short	level
double	data
string	type
time	stamp
…	

Jürgen's structure:

short	grad
double	wert
string	typ
long	zeit
…	

Jane's structure:

short	info
double	content
string	meta
long	ms
…	

- Which number to show on a user display?
- What units?
- Is this an alarm?
- Time stamp?

“Normative Types”

- Channel Access

```
struct  dbr_ctrl_double:
short    status
short    severity
short    precision
char     units[8]
… no timestamp …
double   value
```

```
struct  dbr_time_double:
short     status
short     severity
timestamp stamp
double    value
```

You get what you request
(network always transfers complete struct)

- PV Access

```
epics:nt/NTScalar:
double   value
int      alarm/status
int      alarm/severity
string   display/units
int      display/precision
time     timeStamp
…
```

You get what you request
(but network only transfers changes)

Channel Access vs. PV Access

Similar command line tools:

```
caget epics-dev:tank
```

```
pvget epics-dev:tank
```

```
camonitor epics-dev:tank
```

```
pvmonitor epics-dev:tank
```

```
cainfo epics-dev:tank
```

```
pvinfo epics-dev:tank
```

```
caget -d CTRL_DOUBLE epics-dev:tank
```

```
pvget -M raw epics-dev:tank
```

```
# Not supported
camonitor -d CTRL_DOUBLE epics-dev:tank
```

```
# Note first few updates!
pvmonitor -M raw epics-dev:tank
```

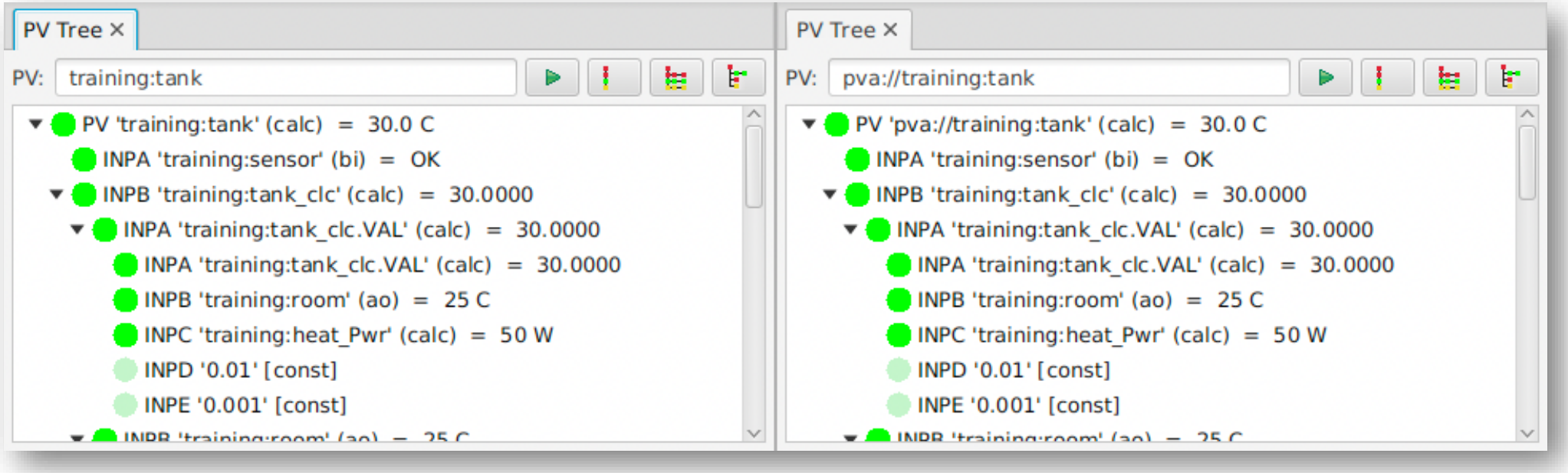
```
caget epics-dev:tank.SCAN
```

```
pvget epics-dev:tank.SCAN
```

… and `pvxget, pvxinfo, …`

CS-Studio

- Use pva://… prefix to select PV Access



- Use ca://… prefix to select Channel Access
- Set default in /ics/tools/css_training.ini

```
# Default PV type: ca or pva?
org.phoebus.pv/default=pva
```

So it's very similar, maybe more efficient…

What's really new?

How about those custom structures?

Images: Normative type NTNDArray

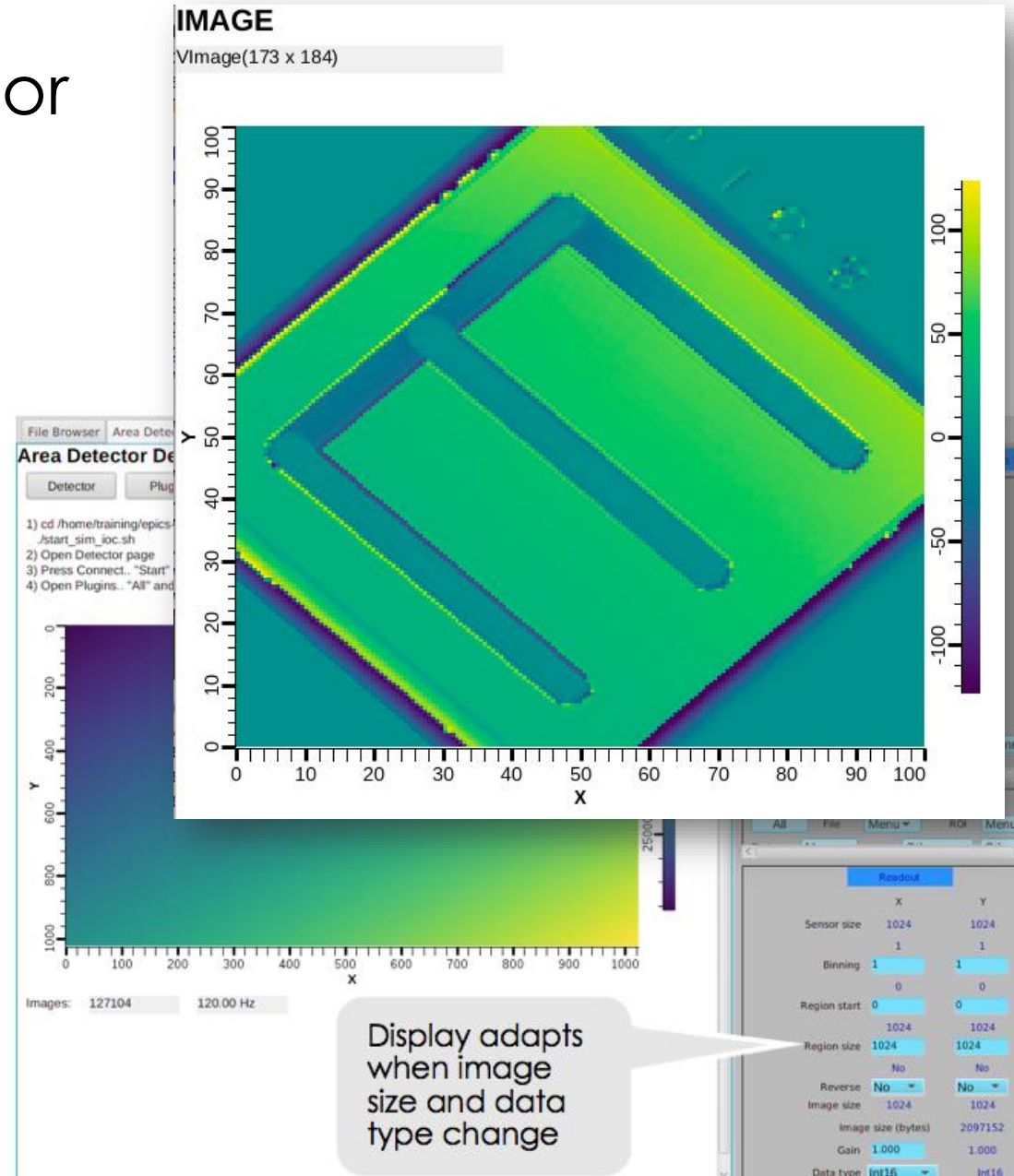
- See Area Detector (NDPluginPVA) or

```
cd /ics/examples/15_pv_access
./start_imagedemo
```

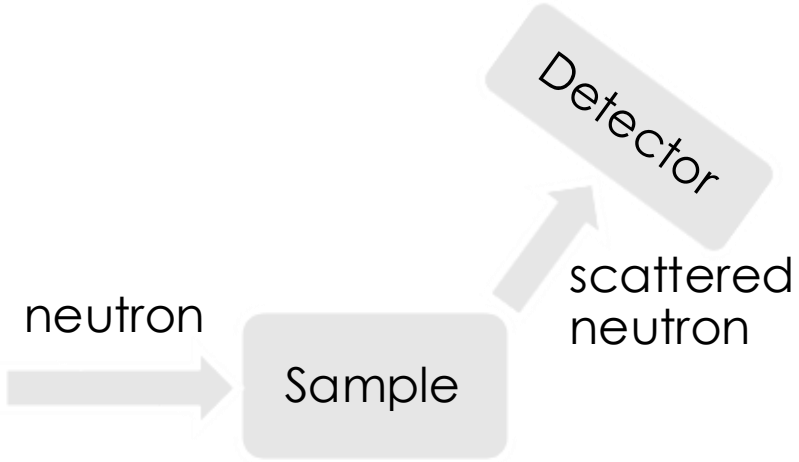
- Terminal

```
pvinfo IMAGE
```

- CS-Studio: Image widget
  - Only needs pva://IMAGE
  - See examples/15_pvaccess/PVA_IMAGE.bob

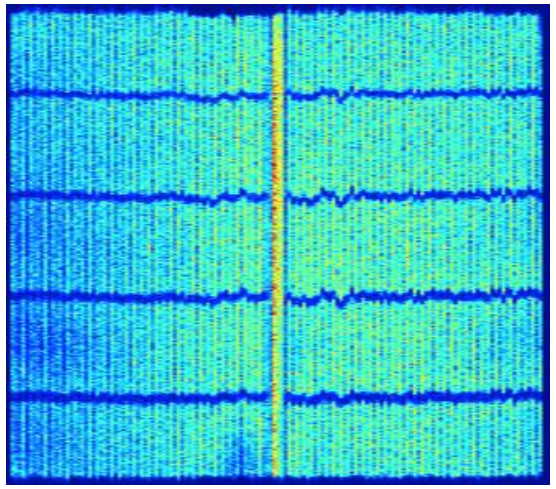


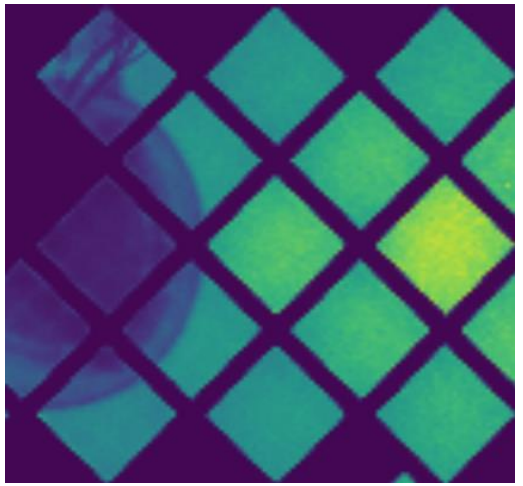
SNS Neutron Data



1) Where was the detector hit?

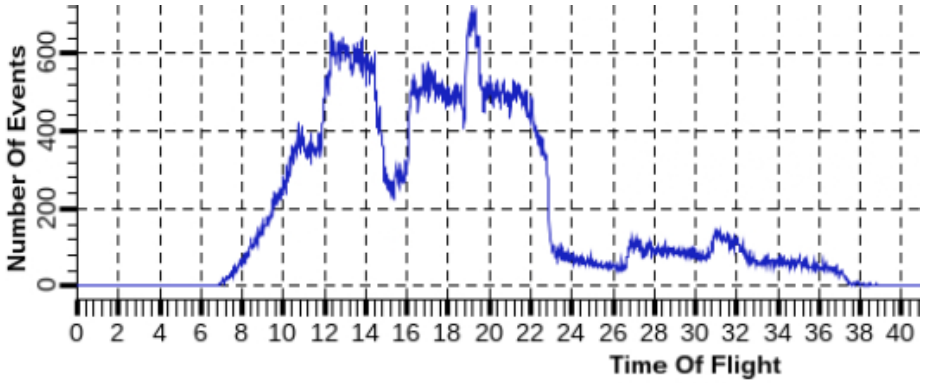
PID 135597,bank 2,wire/tube 58,loc_pid 86,TwoTheta
93.0845341874 degrees,Phi -8.70233063857





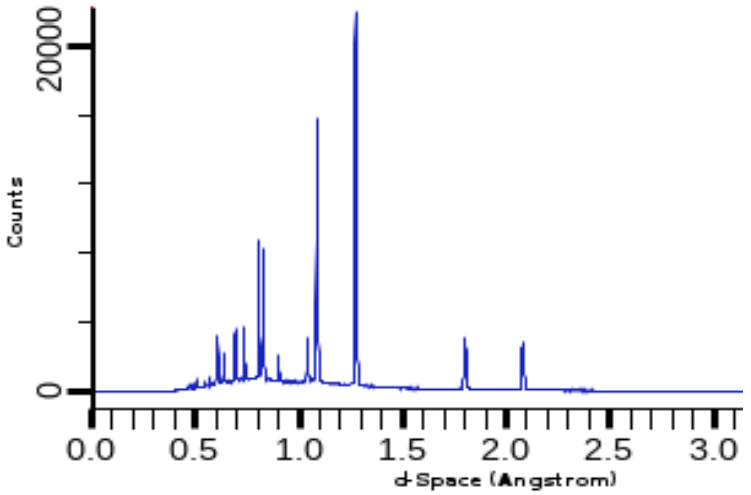
2) When was the detector hit?

.. relative to start of cycle: 60 Hz, 30 Hz, …
"Time of Flight" → Speed of neutron → Wavelength

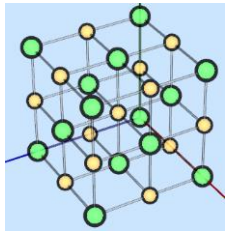


3) Where & wavelength?

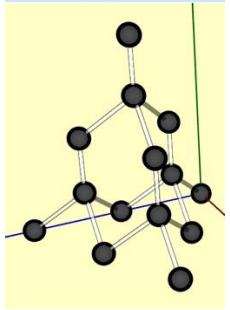
→ Distance of scattering centers



→ Model of sample structure

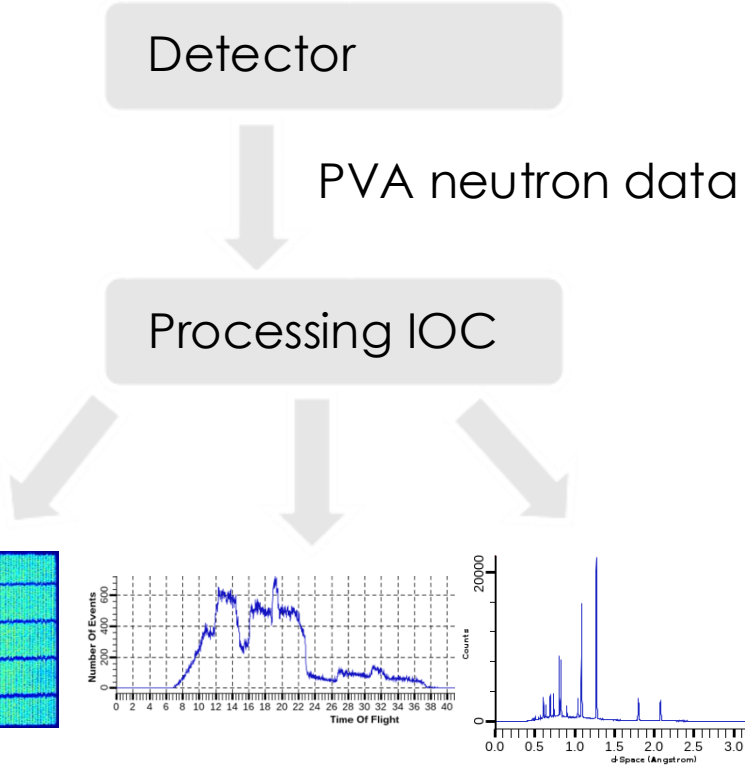


NaCl?



Diamond?

Custom PV Data



SNS Beam Lines started to use this in ~2014

```
cd /ics/examples/15_pvaccess
./start_neutrondemo

pvinfo neutrons
pvmonitor neutrons
```

Allows fetching just what's needed:

```
# For detector pixel display
pvget -r 'field(pixel)' neutrons
# For time of flight display
pvmonitor -r 'field(timeStamp, pixel)' neutrons


# For d-space displays
pvmonitor -r 'field(time_of_flight, pixel)' neutrons
```

Custom PV Data in CS-Studio

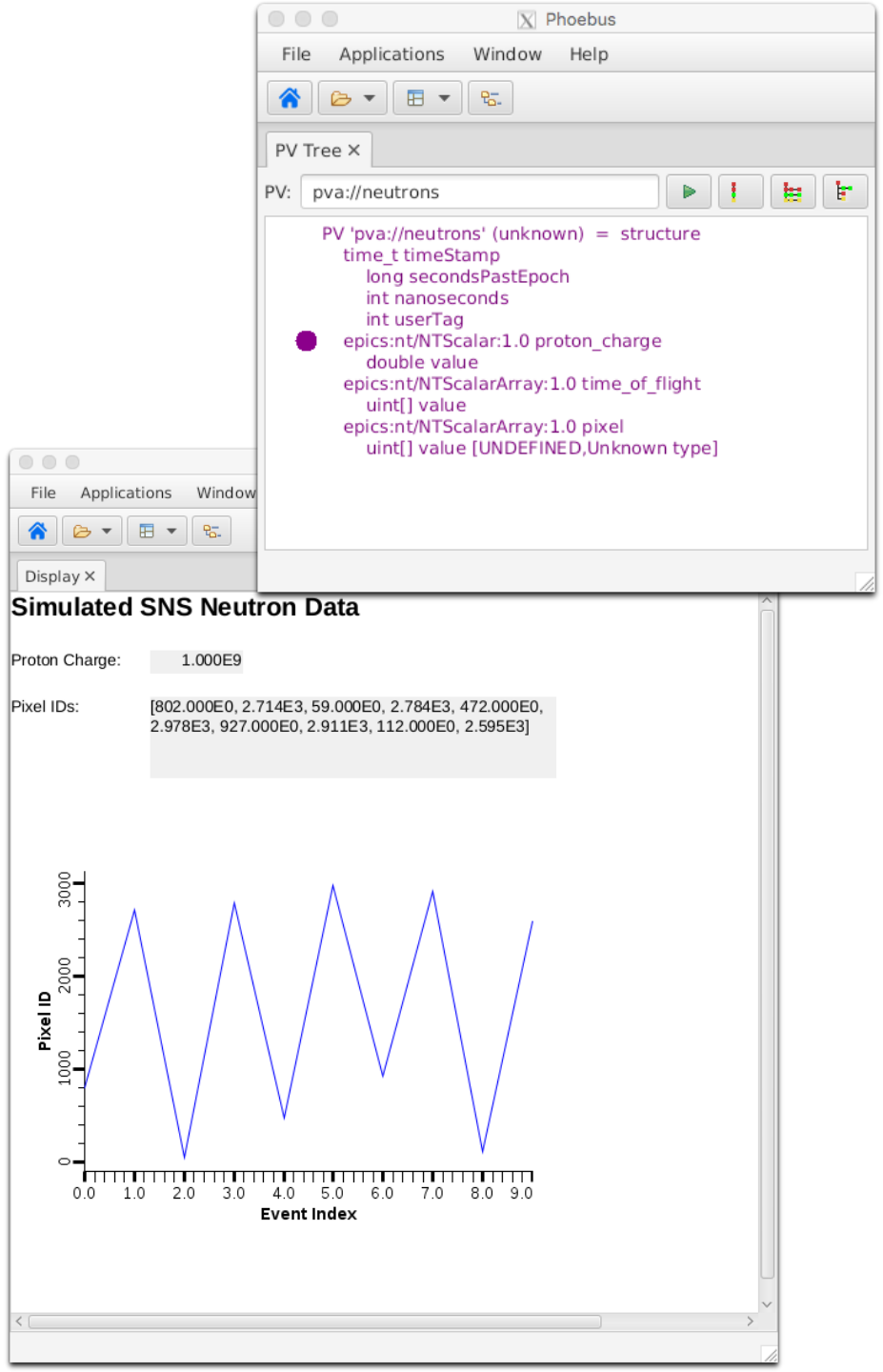
Cannot handle *arbitrary structure*

```
pva://neutrons
```

Can handle fields which are *scalar* or *array*

```
pva://neutrons/proton_charge
```

```
pva://neutrons/pixel
```



PV Access and Python

- Basic ‘get’, ‘put’, ‘monitor’
- PV Access server for normative types or custom data
  - See *.py examples under

    ```
    cd /ics/examples/15_pvaccess
    ```

Custom PV Data from IOC Records

`makeBaseApp.pl –t example` includes "group":

```
rm -rf /ics/examples/mine
mkdir -p /ics/examples/mine
cd /ics/examples/mine
makeBaseApp.pl -t example demo
makeBaseApp.pl -t example -i demo
# When prompted, use the previously created 'demo'
make
cd iocBoot/iocdemo
chmod +x st.cmd
./st.cmd
```

- Check demoApp/Db/circle.db
  - Calc records ..:circle:x & ..:circle:y compute (x, y) coordinate on circle
  - info() annotations create PV "epics-dev:circle" PV as struct `{ angle, x, y }`
- PVA "epics-dev:circle" updates atomically

`camonitor epics-dev:circle:x epics-dev:circle:y` receives separate x, y updates

`pvmonitor epics-dev:circle` will always see `sqrt(x^2+y^2)==1`

```
cd /ics/examples/15_pvaccess
python circle.py
```

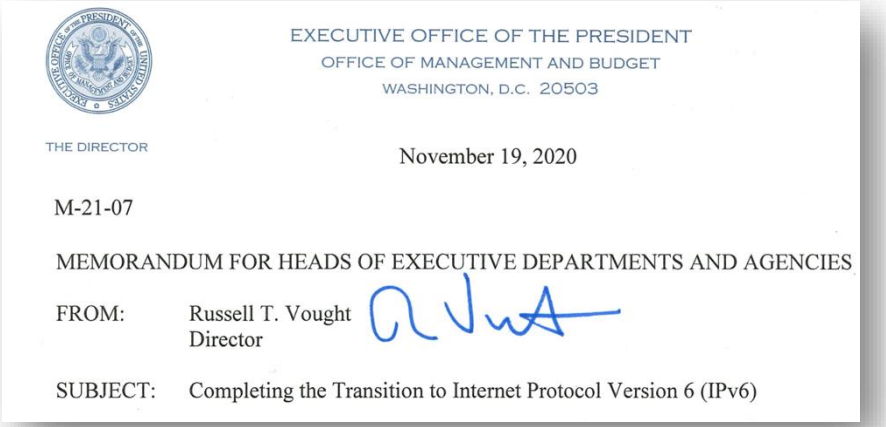
State of PV Access in June 2026

Done, operational

- PVA server for records in IOC
- CS-Studio client
- Area Detector images
- Custom data servers and clients
  - SNS: neutron data
  - APS: services
- Gateway

Ongoing

- How to best combine data from records into custom PVA data?
- Syntax for PVA links between IOC.
  Need global "use PVA" option
- Support for IPv6
  - Implemented,
    no operational experience
- Network Security
  - Can replace TCP with 'TLS'
  - Ongoing work related to certificate management



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

THE DIRECTOR

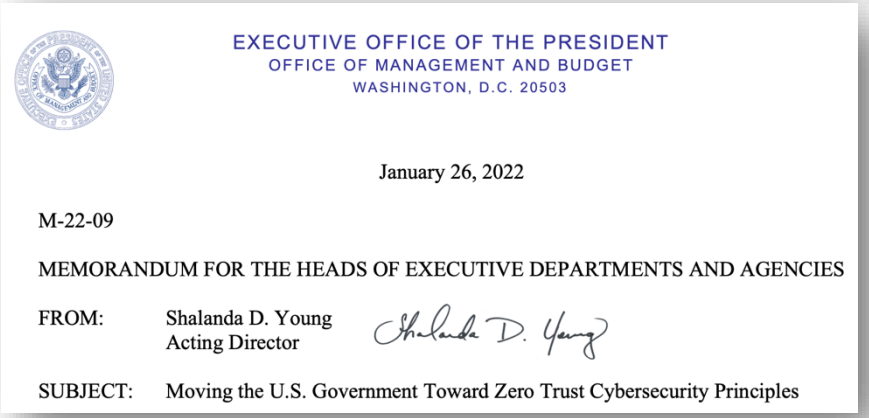
November 19, 2020

M-21-07

MEMORANDUM FOR HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: Russell T. Vought
Director

SUBJECT: Completing the Transition to Internet Protocol Version 6 (IPv6)



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

January 26, 2022

M-22-09

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

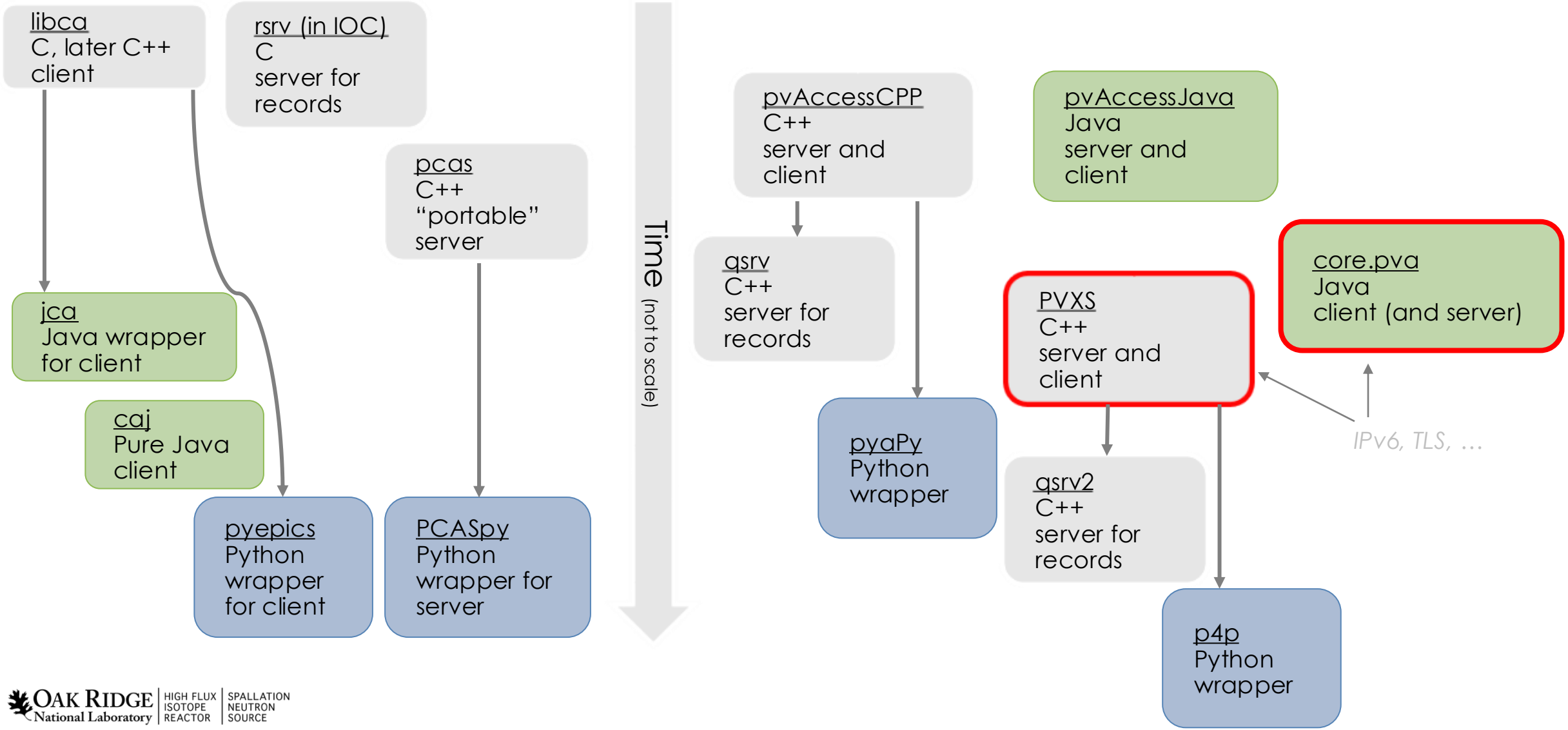
FROM: Shalanda D. Young
Acting Director

SUBJECT: Moving the U.S. Government Toward Zero Trust Cybersecurity Principles

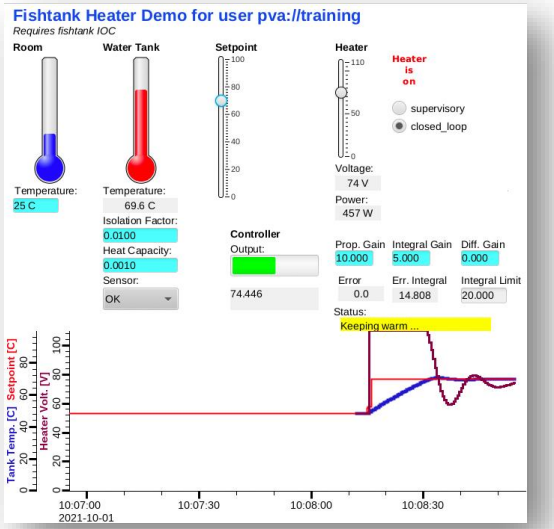
History

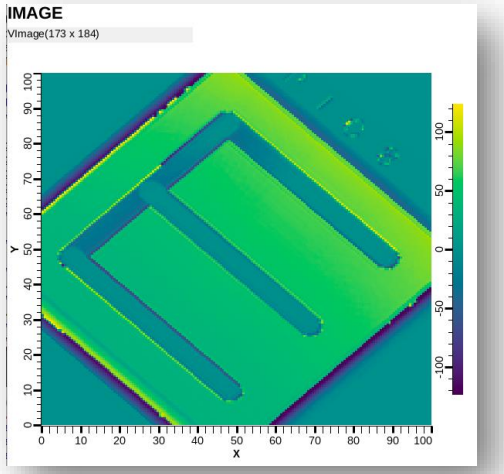
Channel Access

PV Access



Summary: PV Access is ..





- Update to Channel Access
  - Both can be used in parallel

- Similar, but supports custom data types
  - Won't replace IOC/records/normative types, but useful for special cases

```
PV 'pva://neutrons' (unknown) = structure
  time_t timeStamp
    long secondsPastEpoch
    int nanoseconds
    int userTag
  epics:nt/NTScalar:1.0 proton_charge
    double value
  epics:nt/NTScalarArray:1.0 time_of_flight
    uint[] value
  epics:nt/NTScalarArray:1.0 pixel
    uint[] value [UNDEFINED,Unknown type]
```

- Since EPICS 7 included in base IOC
  - Details of 'group', 'field(...)' access still evolving

IPv6 and network security will require PVA!