EPICS Automation

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Jan. 2019
Control System

.. should support **automated control**.

How can EPICS do this?
Monitoring, Supervisory Control

**IOC**

```plaintext
record(ai, “sensor”)
{
  field(DTYP, “SensorXYZ”)
  field(INP, “@bus1 signal2”)
  field(SCAN, “1 second”)
  ...
}

record(ao, “voltage”)
{
  field(DTYP, “PowerSupplyABC”)
  field(OUT, “@bus2 signal4”)
  field(SCAN, “Passive”)
  ...
}
```

**User Interface**

Channel Access
- ‘monitor’
- ‘put’
Automation via Records on IOC

Data flow driven, periodic, steady-state control:

1. Read inputs

2. Compute desired outputs
   a) calcout to write ao.VAL
   b) calc, then use DOL and OMSL=closed_loop in ao

3. Write outputs
Distribute Records onto different IOCs

Almost no additional work!

Anticipate network issues; see ‘MS’, ‘IVOA’
Automation via State Machine

```
record(ai, "sensor")
{
    field(DTYP, "SensorXYZ")
    field(INP, "@bus1 signal2")
    field(SCAN, "1 second")
    ...
}

record(ao, "voltage")
{
    field(DTYP, "PowerSupplyABC")
    field(OUT, "@bus2 signal4")
    field(SCAN, "Passive")
    ...
}
```

“Sequencer”, “State Notation Language”: Event driven, on-demand, stateful
Automation via Scripts

```python
#!/usr/bin/env python
from epics import caget, caput
import time
while True:
    sensor = caget("sensor")
    voltage = 5 if sensor < 10 else 0
    caput("voltage", voltage)
    time.sleep(1.0)
```

- Tempting, but
  - Error Handling?
  - caget? caput?
    - Monitor; Connect once, then re-use the connection (PyEpics actually does this)
  - Handle disconnects, re-connects

- Should have ‘console’, run under procServ
  - IOC has shell

- Long-term maintenance of “Fred’s script”? 
  - Calc record has CALC, SCAN, INPA, ..
Automation via User Interface?

Check allowed values?
- What if other CA client writes to PV?
  Use DRVH, DRVL, calc records, .. to perform check on IOC

Automation scripts?
- What if users open multiple user interfaces?
- What if GUI crashes (which is more likely than IOC)?

Keep user interface as just that!
Automation with EPICS

✓ Records
  • Steady-data, data flow driven operations
  • Continuous: Read input, compute, write output
  • Limited conditional processing: calcout.OOPT

✓ State Notation Language
  • On-demand, event driven
  • Stateful: In State X, if Y happens,..

? Scripts
  • Useful for “I need this just once, but I need it now”
  • Permanent “Python IOCs” require effort similar to IOCs

Automation via Operator Interface
  • UI should never do anything