

CPP/CXML - A HOST-BASED SEQUENCER FOR EPICS

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ISAC Control System Highlights

- ☐ Uses EPICS
- ☐ 4500 Devices
- ☐ 130 000 EPICS records
- ☐ Beam diagnostics: VME
- ☐ Beam optics: CANbus micros
- ☐ Vacuum, Ion sources, Cryo distribution: Modicon PLC
- ☐ Cryo Plant (Linde): Siemens PLC

HISTORY

cppe

- A host-based sequencer
- C program cppe: Command Procedure Processor for EPICS
- Processes a home-made procedural language
- Language pre-checks: won't execute unless all variables are defined and syntax is okay
- Procedural steps, including waits and conditions
- PVs for procedure locking, abort, and message reporting defined by engineer and explicitly handled in the procedure

cppe examples

- Synchronized ramping of target heaters
- Vacuum pumpdown
- Electrostatic dipole conditioning

Macros

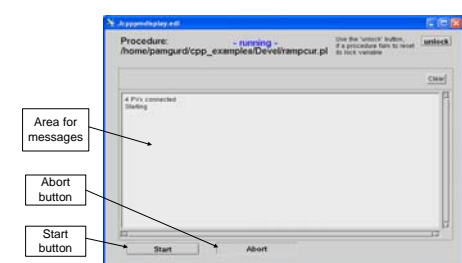
- Capture operator actions between start button-push and stop
- caPutLog -> file -> conversion to cppe procedure

CPP.PM

Why move to Perl?

- Perl more capable than cppe
- Perl already used extensively in ISAC system (get rid of the cppe language in required knowledge base)
- Rapid prototyping
- Impose standardization of environment
- Improve display of procedure and status

Generic CPP.pm Screen for Testing



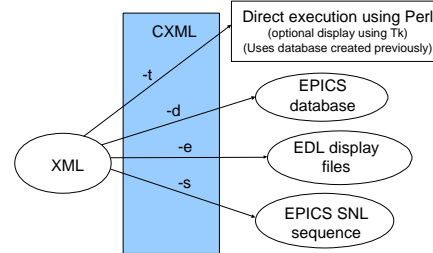
- Area for messages
- Abort button
- Start button

CXML

CXML – a handler for XML-defined state machines

- State Machine defined using XML
- Using XML definition for telephony: State Chart XML (SCXML): State Machine Notation for Control Abstraction (<http://www.w3.org/TR/scxml/>)
- Modified for control
- Automatically produces edl screens and database files to support the state machine
- Perl option uses the CPP.pm package, with Tk for optional display
- Or can automatically produce an EPICS SNL file to run on an IOC

CXML at Work

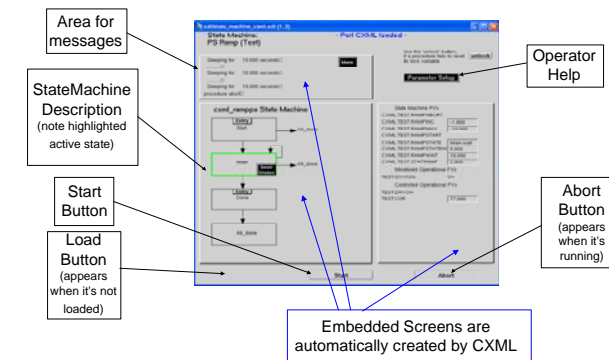


XML Fragment

```
<state id="Start">
  <entry id="Start.entry">
    <log expr="Entering voltage ramp" />
    <send target="par(PS):DRVON"
          targettype="epics-pv"
          data="1" />
    <send delay="2 s" />
  </entry>
  <transition cond="pv(par(PS):STATON) &lt; 0.5"
              target="All_done">
    <log expr="power supply did not turn on" />
    <send target="CXML:par(PS):RAMPSTAT"
          targettype="epics-pv"
          data="2" />
  </transition>
</state>
```

- Identify a state
- State entry (exit is similar)
- CA put (SNL pvPut)
- Condition including CA get (SNL monitor + event flag)
- Report a message

edl Screen for CXML Sequence

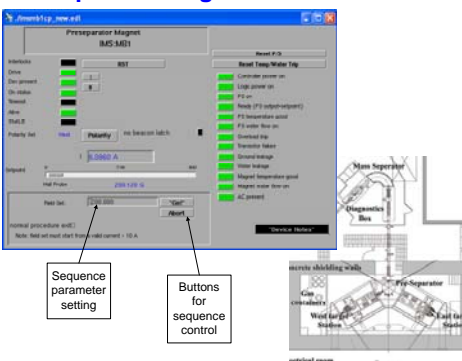


- Area for messages
- StateMachine Description (note highlighted active state)
- Start Button
- Load Button (appears when it's not loaded)
- Operator Help
- Abort Button (appears when it's running)
- Embedded Screens are automatically created by CXML

CPP.pm

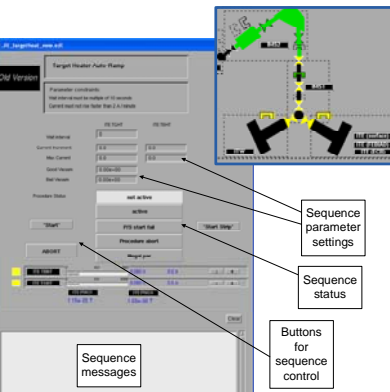
- A package of Perl routines (wrapper around CA.pm)
- API for procedural host-based sequences
- Features:
 - Handles PV connections
 - Provide routines to get data from PVs and send data to PVs
 - Provide delays and condition testing
 - Standard methods for abort, lock/ synchronizing/exclusion and reporting
 - Provide a way to register a cleanup procedure
 - Allow parameterized common routines

Preseparator Magnet



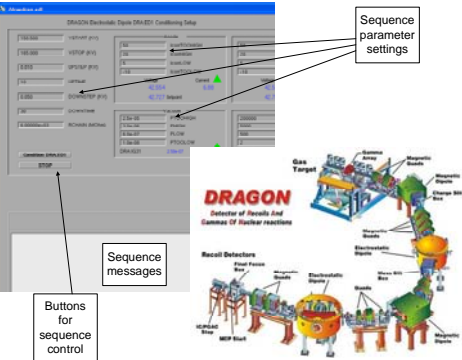
- Sequence parameter setting
- Buttons for sequence control

Target Auto-Ramp



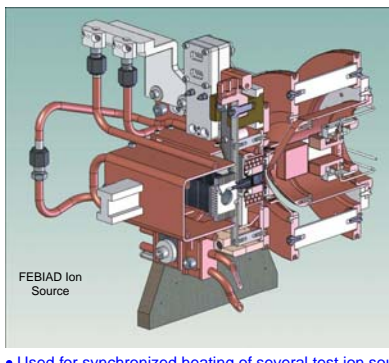
- Sequence messages
- Sequence parameter settings
- Sequence status
- Buttons for sequence control

DRAGON

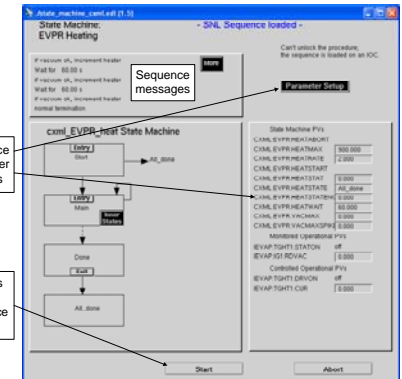


- Sequence messages
- Sequence parameter settings
- Buttons for sequence control

Test Ion Sources



- Used for synchronized heating of several test ion sources including the FEBIAD (Forced Electron Beam Ion Arc Discharge) source and the Laser Ion Source.
- Also used to ramp up Laser Ion Source currents.



- Sequence messages
- Sequence parameter settings
- Buttons for sequence control

Where we're going

- Replace cppe procedures
- Recreate the macro facility (works on captured caPutLog)
- Direct CPP.pm vs CXML?
 - More natural to convert an existing cppe procedure to Perl sequences with CPP.pm
 - Once other engineers are trained in the CXML approach, they may find that natural as well.
- A visual state machine editor

More Information

- About TRIUMF: <http://www.triumf.ca/about-triumf/triumf-faq/triumf-backgrounder>
- About ISAC: <http://www.triumf.ca/about-triumf/triumf-faq/isac-backgrounder>
- About the ISAC Control System: Status Update on the ISAC Control System, R. Keitel, D. Bishop, D. Dale, T. Howland, H. Hui, K. Langton, M. Leross, R. Nussbaumer, C. Payne, K. Palzer, J. Richards, W. Roberts, E. Tikhomolov, G. Waters, ICALEPCS07, Knoxville
- About CA.pm: <http://www.aps.anl.gov/epics/base/R3-14/11-docs/CA.html>
- About SCXML (State Machine Notation for Control Abstraction): <http://www.w3.org/TR/scxml/>
- About CPP.pm and CXML.pm: pamgurd@triumf.ca