Experience on SP-AGPS interface using non-standard EPICS setup

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Source for Production of I on of Deuterium Extracted from Rf plasma (SPIDER) has started operating in 2018 as the first ITER component prototype.

SPIDER is devoted to test and develop the most critical component of the heating beam: the negative ion source of deuterium (D-) and hydrogen (H-). To this aim SPIDER will be equipped with state-of-the-art diagnostics system that will allow a detailed study of the generated beam and its thorough optimization.

https://www.igi.cnr.it/
SP AGPS : NBTF, Italy

APGS SPS Module Installation

RT Controller

HMI Cubicle
SP AGPS : NBTF, Italy

LabVIEW User Interface
SP AGPS : NBTF, Italy

BOY User Interface
Power Supplies with Similar Architecture

SPIDER Acceleration Grid Power Supply (96kV/75A – 7.2 MW)
- Currently in Operation at NBTF Facility
- Successfully, hydrogen Beam Extracted

DNB Acceleration Grid Power Supply (96kV/75A -7 MW)
- Currently in Operation at Indian Test Facility

Ion Cyclotron High Voltage Power Supply (14kV & 27kV)
- Currently in Operation at Indian Test Facility
- Thales/Europe RF Source Acceptance test
- CEC/USA RF source Acceptance Test
Why this Controller?

Requirements:
- Prime objective of HVPS Regulation
- Performance requirements
- COTS
- Reasonable length of Software Development Cycle
- Good Life Cycle for Hardware
- Technical Support Available

PXI Based Controller: Highly Modular
Controller Runs on Real time operating system: Performance
Developed in LabVIEW: Support and Development cycle
Adding Support for other Platform

Power supply with various specification for different application.

HVPS has users from various fields
  ◦ Windows
  ◦ Linux

Addressing User interface on Linux Platform
  ◦ Without changing current proven architecture
  ◦ Minimum changes
Interface Requirements

Local Operation
- User Interface based on LabVIEW

Remote operation
- EPICS based panel for operation commands
- LabVIEW based panel for maintenance
- Data transfer
- Synchronous Operation
Exposing System to public functionalities

LabVIEW Shared Variable Engine deployed on both sides of the system.

Simple TCP/IP Protocol to monitor slow data.
Exposing System to public functionalities

LabVIEW Shared Variable Engine deployed on the both side of the system
Simple TCP IP Protocol to monitor slow data

EPICS IOC Server utilises Channel Access protocol to transfer data
Tested data format

1. Unsigned integer 8, 16, 32bit
2. Signed integer 8, 16, 32 bit
3. Floating point 32bit
4. Array of all these format
5. string
Location of EPICS server

Remote HMI  LabVIEW HMI  EPICS HMI
           LabVIEW Engine
           RTC
           FPGA
           HVPS
           EPICS Server

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Location of EPICS server

Pros
- Totally Head Less, No dependency
- No need to provide user console, Saves costs.

Cons
- Supporting code at RTC, thus difficult to update without compromising performance
- On site Changes difficult so user inputs cannot be integrated at last stage
Location of EPICS server

**Pros:**
- Easy to modify and Update
- RTC code is undisturbed
- Late user inputs can be integrated
- Can be distributed independent Real time control
- Different functionality at different user interface can be supported

**Cons**
- Extra cost, More space
EPICS Interface implementation

AGPS RT Controller
  - Control
  - Monitoring
  - Faults

AGPS State Machine

EPICS Server

Translator IOC

PON

Command & Configuration

CODAS HMI

Alarm Handler

Archiving

Timing Network

Timing Hardware

PTP

NTP

FO Links

Network

Control

Monitoring

Faults

Faults

Timing

PTP

NTP

FO Links
Issues
Issue: Importing Variables

Is there any method to convert existing LabVIEW Variables in library to directly EPICS library variables?

No Export and Import, Manual Entry is the only Option
Issue: Crash

Stops responding randomly

All PVs disconnects

OPI Restart or Refresh needed

Sometimes required system Restart

Causing Events:

- Mostly happens, When any new variable is added. Need to restart CSS.
- Network Connectivity has to be stable. LAN and Wifi should not be ON together
- All PVs should be linked properly, failure to set one PV properly may disconnect whole OPI.
- Multiple libraries Running on LabVIEW
Issue: PV not updating

PV Assigned to CSS Mimic
Set automatically 0, no matter what PV value is.
Caput will change value on command line
Caget will display actual Value
CSS displays 0 always

Solution
○ Auto Range has to be removed

[codac-dev@localhost ~]$ caput
Hitesh:Ser_Lib:Amplitude 6
Old: Hitesh:Ser_Lib:Amplitude 5
New: Hitesh:Ser_Lib:Amplitude 6
Incompatibility
Issues : Alarms

Alarm severity

Case 1 (Required case) : Variable 2 (Configuration : Alarm On = "Low")
  ◦ Set "VAL" to "false"
  ◦ Alarm severity "SEVR" = NO_ALARM

So, No alarm is detected at archiving even if "STAT" says "STATE_ALARM"

Case 2 (Normal case): Variable 3 (Configuration : Alarm On = "High")
  ◦ Set "VAL" to "true"
  ◦ Alarm severity "SEVR" = MAJOR_ALARM

So, Alarm is detected perfectly at EPICS Archiving and Client side.
Issues: Alarms

OSV and ZSV
Issues: Alarms

Now Registered as Known Issue

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<th>Reported Version: 2016</th>
<th>Resolved Version: N/A</th>
<th>Added: 05/21/2018</th>
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<td>The alarm in EPICs Client for boolen when set to low doesn't work</td>
<td>When you set an alarm for a boolen in EPICs Client when the value becomes low, it doesn't work</td>
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<td>Workaround: N/A</td>
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Known Issues by Category

The following items are known issues in DSC2018 sorted by Category.

Compatibility

636042 — Library deploy fails in localization environment

Distributed System Manager

676093 — NI Distributed System Manager constrains the "Remove Process" confirmation dialog
Translator
IOC

- Incompatible Data types like MBBI, MBBO
- Inverted Alarms
- Other PV Fields
CA Lab?

Support
- Issues are very application specific
- Issues are environment specific
- As we are buying customer for National Instrument,
  - Remote Support with Mail
  - In-person Meetings
  - Video Conference Meetings (Team from Paris & China)
  - Live debugging
  - On Site Help

http://www-csr.bessy.de/control/SoftDist/CA_Lab/
Thanks

RFX CODAS Team
NI EPICS Team
CODAC Support

With your support,
EPICS interface was
successfully implemented
References

1. Integration of EPICS based monitoring for ion cyclotron high voltage power supply, Fusion Engineering and Design, Volume 123, November 2017, Pages 737-742


Thank you