Options for Interfacing EPICS to COTS Hardware Through LabVIEW

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Agenda

- Why use EPICS and LabVIEW?
- Benefits of COTS hardware
- Options for integrating EPICS and LabVIEW
- Summary

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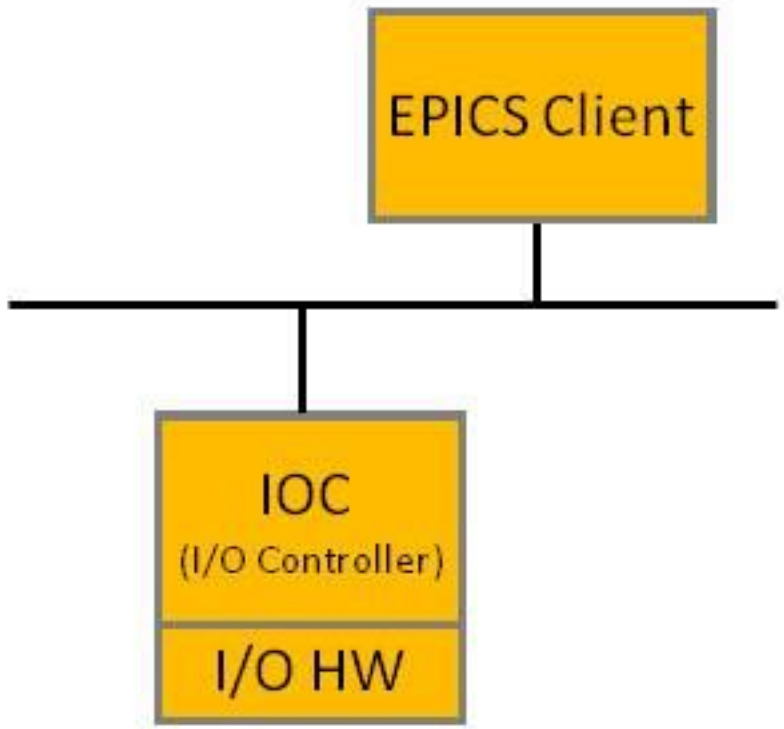
Why Use EPICS and LabVIEW ?



- LabVIEW as a Client
  - ✓ Presentation
  - ✓ Analysis
  - ✓ Control
- LabVIEW as a Server
  - ✓ **Interface to hardware**
  - ✓ Real-time control
  - ✓ Access to FPGA

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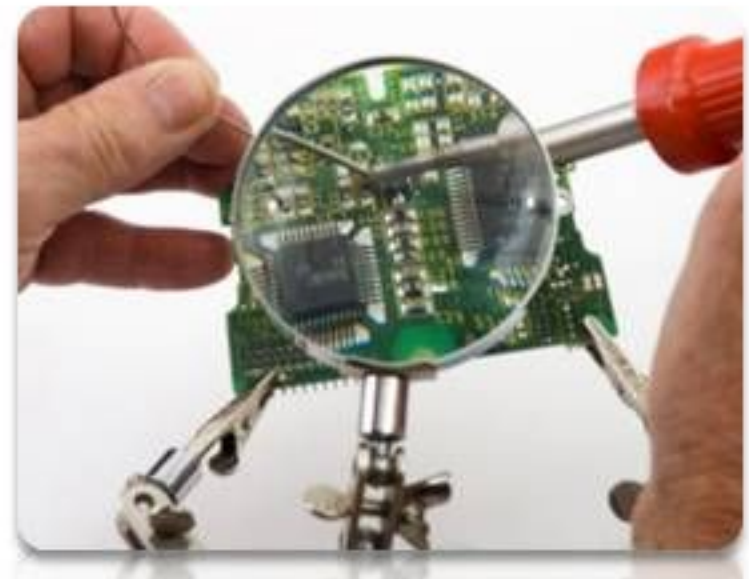
Benefits of COTS Hardware

- Benefits
  - Shorter development time
  - Vast selection of hardware
  - Lower cost
  - Easier maintenance
- Challenges
  - EPICS support availability
  - Possible need for custom driver



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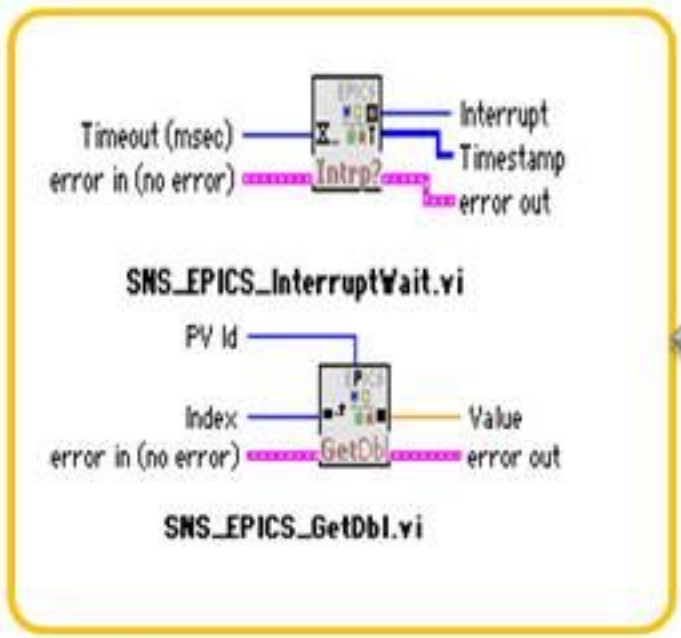
Integrating EPICS and LabVIEW

- Shared memory interface (SNS)
- Channel Access Server
  - Programmatic API (SNS)
  - Configuration-based server (NI)
- EPICS IOC on VxWorks (NI – Cosylab – LANL)

EPICS Shared Memory Interface



LabVIEW Application
(Wire scanner, BPM, etc)

ReadData()
WaitForInterrupt()
GetIndexByName()
WriteData()
SetInterrupt()
CreateDBEntry()

Shared Memory DLL

EPICS Channel Access
EPICS Database

EPICS IOC

Shared Memory IOC

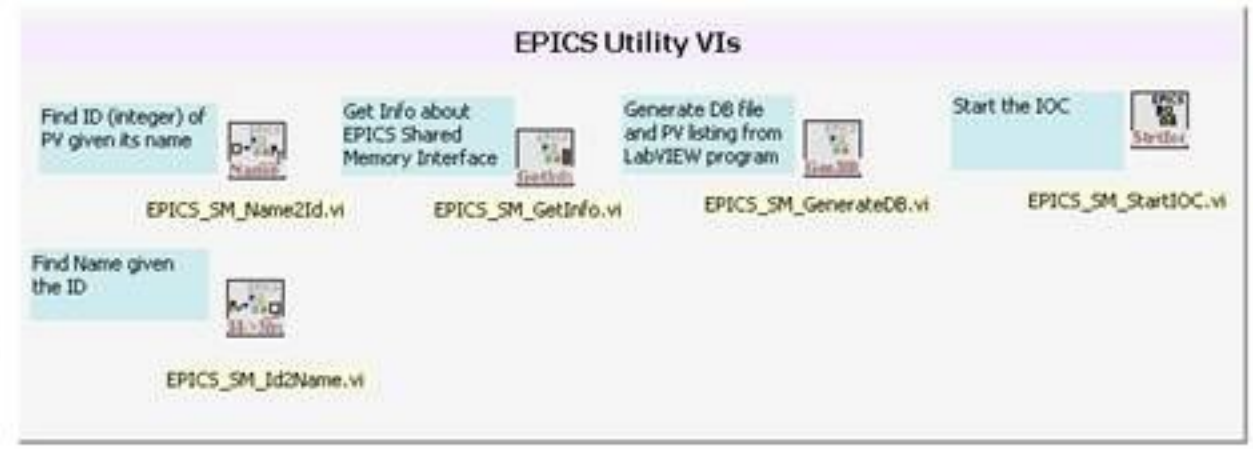
Integration with the control system

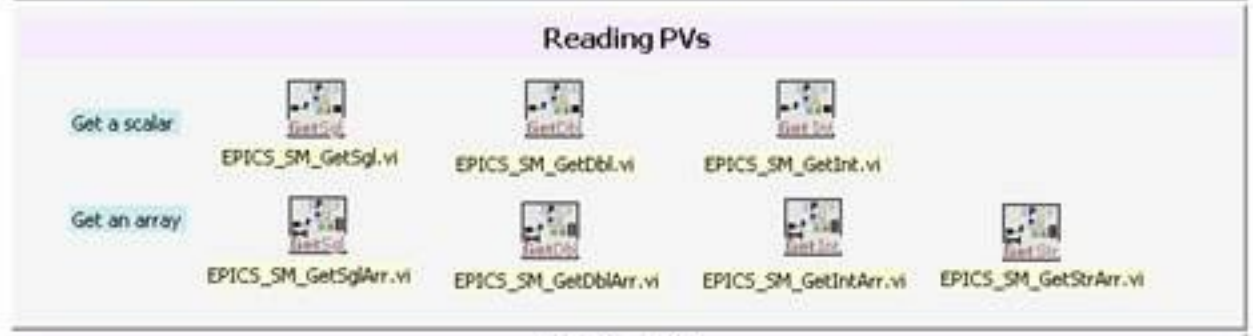
The Shared Memory IOC allows us:

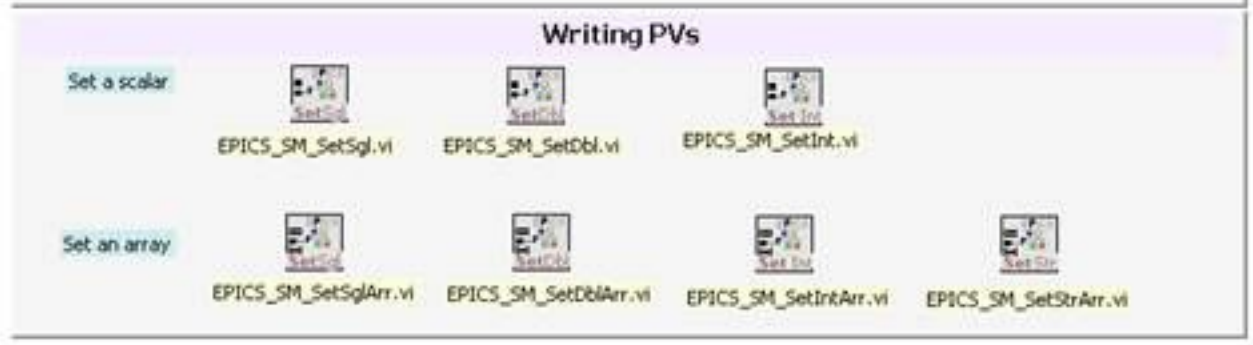
- Support additional processes
- Use records as placeholder of data but no function
- Not worry about buffering data
- Respond to events
- Be compatible with other IOCs

Functions:

- Create, find and destroy variables
- Read from and write to variables
- Set and receive events
- Retrieve information about variables
- Create IOC database







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Pros and Cons

Advantages

- You have full IOC and everything that comes with it (including record processing)
- All EPICS tools will work by default

Challenges

- Linux and RTOS support would require considerable efforts
- Need to support 2 infrastructures for EPICS IOC and for LabVIEW program deployment is complicated.

Example – SNS Facility

- Instrumentation
  - Measure beam parameters such as position, transverse profile, current, etc
- Off-line Data Analysis
  - Statistics, performance
- Testing Equipment
  - Calibration
  - Prototyping
  - Test electronics
- Simulation
  - Electron scanner
  - Ion profiles

When To Use LabVIEW Channel Access Server ?

- When using EPICS IOC only for Channel Access communication
  - Record processing can be done in LabVIEW
- To be compatible with all platforms LabVIEW runs on
  - Windows, Linux, Mac, VxWorks, Pharlap
- To connect to EPICS clients

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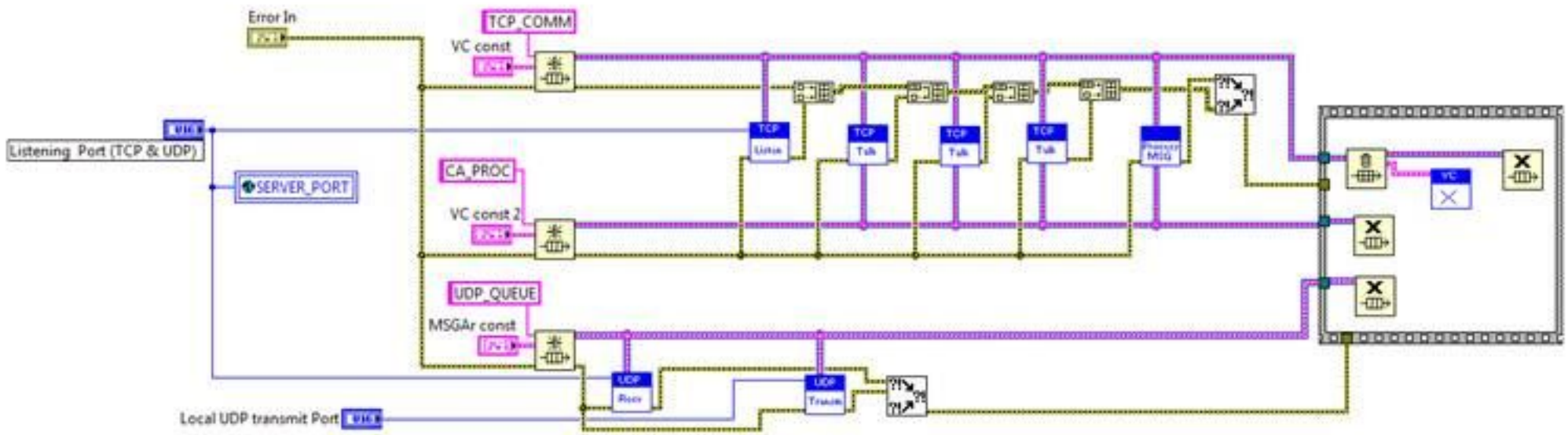
LabVIEW CA Server Structure



- Launch UDP listener (for search requests)
- Launch TCP listener (for new VC connections)
- Launch several “threads” for communication
- Launch one (or several) “threads” for message processing
- Three queues responsible for data transfer and data locking
- VC can be in either processing state or in communication state
- “Records” are guarded differently

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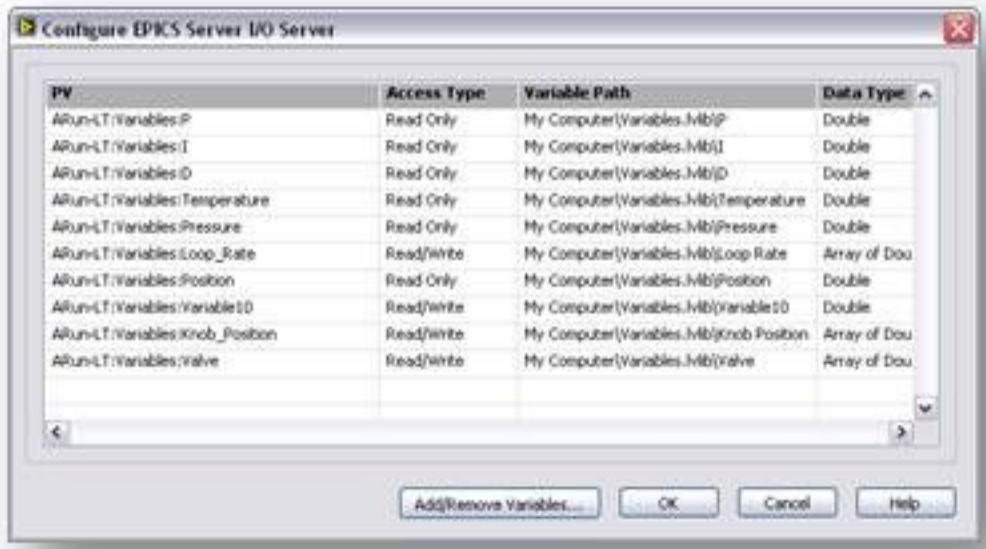
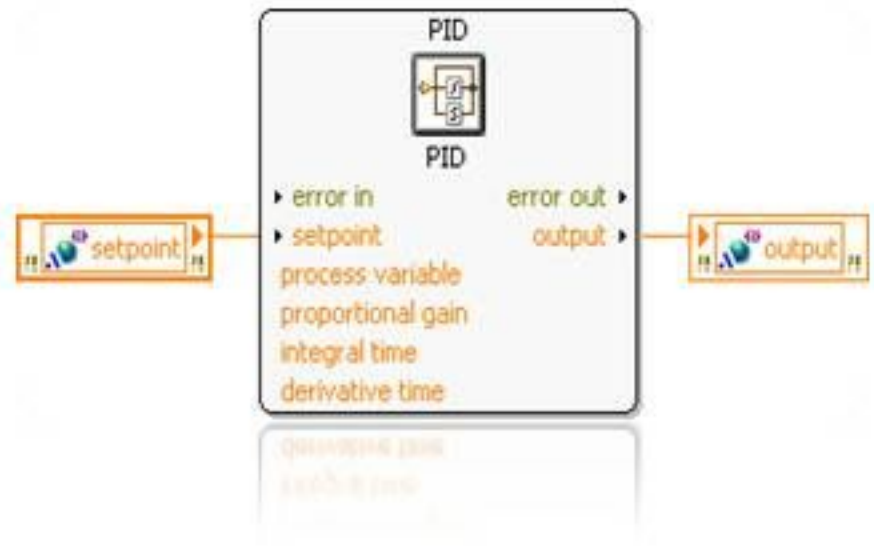
Configuration-Based CA Server in LabVIEW 2009





- Expose required data points as PVs using CA server
- Program required functionality using LabVIEW function blocks
- Ability to run on Windows and RTOS (VxWorks and Pharlap)

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Example – BiRa's Power Supply

- 16 channels of high precision bipolar DC power
- Mainly used for corrector magnets in particle accelerators
- Running LabVIEW EPICS CA Server on an embedded real-time controller

BiRa

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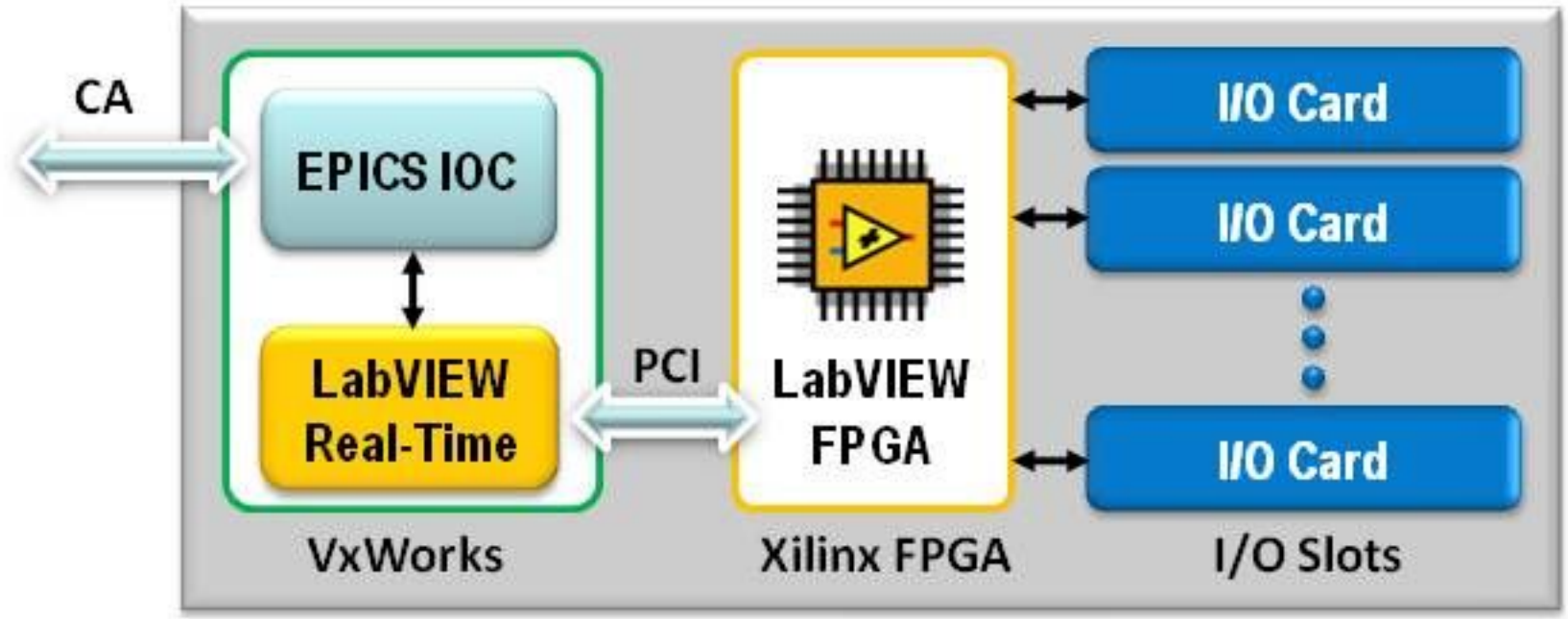
Embedding EPICS IOC on CompactRIO

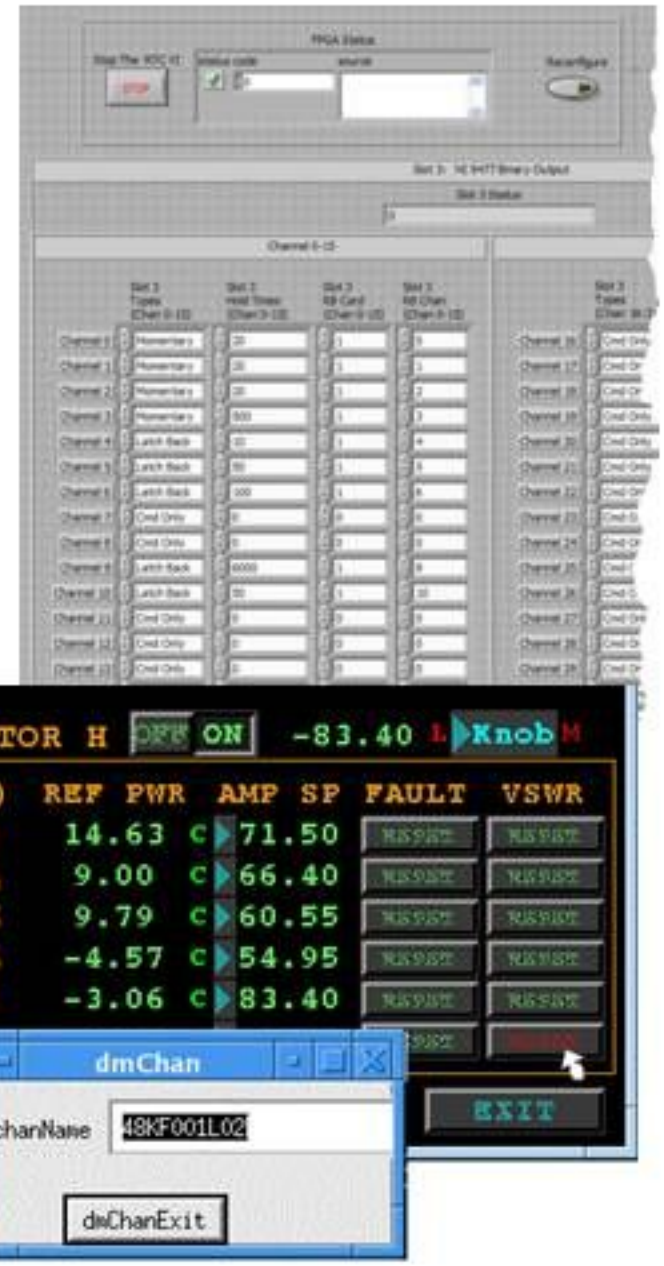


CompactRIO Architecture

- EPICS IOC and LabVIEW Real-Time running simultaneously
- Take advantage of FPGA platform with CompactRIO

Example – Los Alamos LANSCE-R

- Ongoing migration to a cRIO with embedded EPICS
  - 12 binary outputs
  - 36 binary inputs
  - 12 analog inputs
  - 5 stepper motor channels



- Full IOC functionality allows access to all record fields and EPICS utilities
- Maximum flexibility for partitioning the problem
  - LabVIEW for beam diagnostic
  - EPICS for industrial control

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Summary

- Many options for integrating LabVIEW and EPICS
- LabVIEW enables COTS hardware to be EPICS nodes

Thank You For Your Attention