On AWA Control and Data Acquisition System EPICS Upgrade

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Outline

• Overview of Argonne Wakefield Accelerator facility
• The current state of AWA control and data acquisition system
• AWA control and data acquisition system EPICS upgrade/transition plan
The Argonne Wakefield Accelerator (AWA) is a premier electron accelerator with the world’s highest bunch charge to carry out fundamental accelerator research with an emphasis on wakefield acceleration.
The Argonne Wakefield Accelerator (AWA) Facility

Double Emittance Exchange Beamline

~40 m

Drive beamline
8 – 70 MeV
0.001 – 100 nC (single bunch)
Bunch trains (up to 32 bunches with 600 nC total)

Witness beamline
4 – 15 MeV
0.001 – 20 nC
AWA Research Area of Focus

- Advanced Structure Development
- Beam Driven Radiation Source
- RF Breakdown Studies
- Collinear Wakefield Acceleration
- Dielectric and Metallic Two-Beam Acceleration
- Electron Sources Research
- Phase Space Manipulation
- Diagnostics
AWA Control and DA hardware topology

**Control room**
- Ctrl PC
- DAQ PC
- Quantum 9530 pulse generators
- Timing signals to laser, modulators, etc.
- Pulse and Delay Generators
- Laser power amplifier system

**Bunker roof**
- PXE boot Server for new Bira and Raspberry Pis
- Bira power supply systems with EMCOR

**Bunker**
- Analog cameras
- GigE cameras
- Digi connect TS16 port server

**AWA LAN**
- AWA Control
- DA hardware topology

**AWA GigE Camera LAN**
- Fiber
- Coax cables
- Control signals to modulator HV power supplies and filament heater power supplies; 10Hz line lock signal
- Control signals to power supplies; readback from power supplies; digital IO for air actuator control and stepper motor control signals
- Power supplies with analog interface
- Chillers for cavity temperature control
- SiS580 stepper driver controlling phase shifter and power splitter
- Ion Gauge Controller for vacuum monitoring & interlock

**LLRF Ctrl**
- LLRF boxes
- LLRF drive signals; RF signals from pickups
- USB6509 DIO for interlock ctrl & Mon.
- Digi connect 16 port server
- Raspberry pis serving different control and monitoring purpose

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AWA Control and Data Acquisition System

- Operating System: Windows 10
- IDE: Microsoft Visual Studio
- Language: C++
- GUI are programmed using Microsoft Foundation Classes
- Control hardware are mainly interfaced with PXI, USB and RS232
- Web based user interfaces are added in for recently added hardware
Motivations

• The current system is becoming an obstacle for collaborations and future facility growing.

• Upgrade into EPICS will make it easier for AWA to collaborate with other facilities as EPICS was created through collaborative contributions and is widely used among large facilities.

• Upgrade into EPICS will make it possible for AWA to avoid the potential interruptions from losing personnel.
Constrains to the Upgrade

• AWA can’t afford much down time for the upgrade. There are almost one new experiment every 3 weeks on average at AWA facility.

• AWA can’t afford to rebuilt the control and DA system with new hardware from scratch. It will not only require funding for purchasing hardware, but also down time to install and commission them.

• The upgrade shall not replace any control hardware unless there will be no down time of facility.
Plan for the Upgrade

• For phase 1 of the upgrade, we will focus on provide EPICS support on top of existing AWA control system. The goal is to allow both EPICS based control system and the existing control system to function simultaneously so that we can minimize the impact to the operation of AWA facility while operators can get themselves familiarized with the EPICS based control system.

• For phase 2 of the upgrade, we will be phasing out of the non-EPICS control system and transform AWA control and Data acquisition system into EPICS only control and DA system.
Thank You