Integrating Real-Time Control Applications Into Different Control Systems.

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Motivation
- Device servers for the radio frequency controls at particle accelerators shall be reused at different facilities
- All facilities are using different control system middleware (DOOCS, EPICS 3, WINCC + OPC-UA)

Problem
- Sophisticated algorithms with strong couplings to one particular middleware make the applications difficult to port
  - Middleware data structures used in the device logic
  - Middleware threads, locks and process flows

Approach
- Have an adapter layer which decouples the device logic from the middleware
- Device independent

Control System Adapter and Process Variables
- Device Thread
  - Only talks to device-side sender or receiver
  - No direct interaction with the middleware
- Middleware Thread
  - Only talks to the control-system-side sender or receiver
  - Synchronises adapter variables and control system variables

Registering Process Variables
- Keep the application code (device logic) independent from the middleware
- Minimise device-dependent code on the control system side

Implementation of Process Variables
- Lock free queues for thread safety and real-time capability
- Pre-allocated buffers for real-time capability
- Copy references, not buffers for efficiency

Requirements
- Task
  - Complex control algorithms should be used with different control systems

Requirements for Abstraction
- Keep application code middleware independent
- The algorithm must interact with the control system
- Minimise device-dependent code on the control system side

Additional Requirements
- Thread safety
- Real-time capability
- Do not copy large data objects
- Extensible to new middlewares

Device Access Library
- Register based hardware access
  - C++ library with
    - Language bindings to Matlab and Python
    - Graphical User Interface
  - More information: Poster Session 1, Poster 135

Virtual Lab
- Framework for software tests
  - Virtual time: Avoid race conditions in tests
  - Dummy device: Simulate hardware
  - State machine: Simulate firmware
  - More information: Poster Session 1, Poster 100

Control System Adapter
- This poster

ChimeraTK was formerly known as MTCA4U

Status
- Adapter for Process Variables
  - Generic part
    - Thread safe and real-time capable
  - Control system specific part
    - Implementations for DOOCS and EPICS 3 are working
    - OPC-UA adapter is currently being implemented

Next Steps
- Access to middleware features (range limits, engineering units, history)
- Name mapping for process variables (device → control system)

Availability
- All software is published under the GNU Lesser General Public License or the GNU General Public License.

Control System Adapter
https://github.com/ChimeraTK/ControlSystemAdapter

EPICS extension
http://oss.aquenos.com/smarttool/epics-mtca4u/

DOOCS extension
https://github.com/ChimeraTK/ControlSystemAdapter-DoocsAdapter

OPC-UA extension
https://github.com/ChimeraTK/ControlSystemAdapter-OPC-UA-Adapter

20th IEEE Real Time Conference
Padova, Italy, 2016

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