

Integrating Control Applications Into Different Control Systems.

The MTCA4U Control System Adapter



Martin Killenberg

M. Hierholzer, C. Schmidt, *DESY, Hamburg, Germany*

S. Marsching, *aquenos GmbH, Baden-Baden, Germany*

A. Piotrowski, *FastLogic Sp. z o.o., Łódź, Poland*

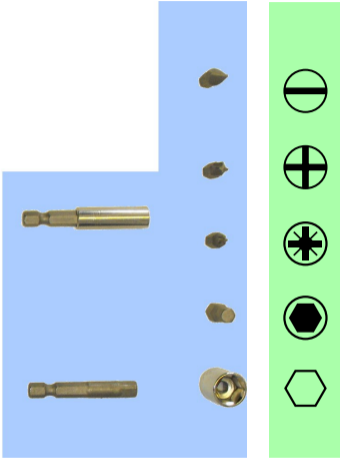
J. Wychowaniak, *Łódź University of Technology, Łódź, Poland*

24th November 2015

SRF Controls and CW Operation Mini-Workshop, Dresden-Rossendorf

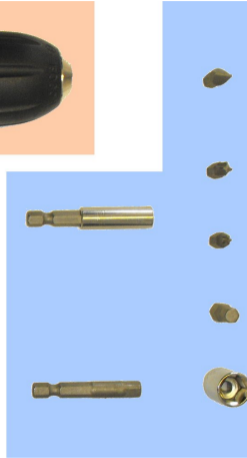


Sometimes You Need An Adapter





Device

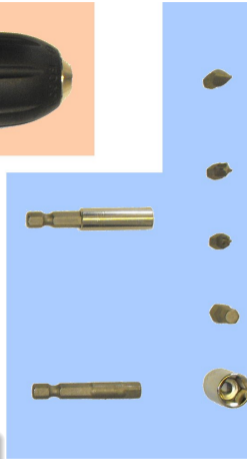


Adapter



Control System





Adapter



Control System

EXAMPLE: LLRF Server

- $O(400)$ process variables
- iterative learning algorithm
- feed forward table calculation

EXAMPLE: Target Control Systems

- DOOCS at FLASH, XFEL/DESY
- EPICS 3 at FLUTE/KIT
- WinCC/OPC-UA at ELBE/HZDR

Task

Complex control algorithms should be used with different control systems.

Task

Complex control algorithms should be used with different control systems.

Requirements For Abstraction

- Keep application code control system independent
- The algorithm must interact with the control system
- Use functionality provided by the control system
- Minimise device-dependent code on the control system side

Additional Requirements:

- Thread-safety
- Real-time capability
- Must not copy large data objects (arrays)

Task

Complex control algorithms should be used with different control systems.

Requirements For Abstraction

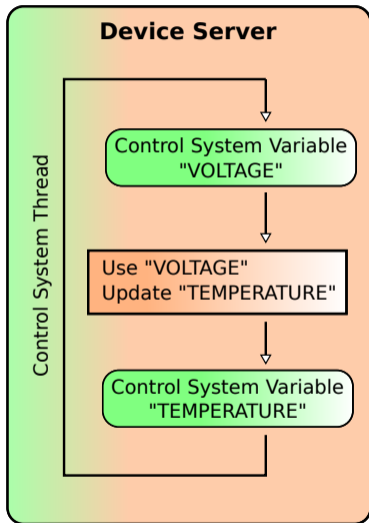
- Keep application code control system independent
- The algorithm must interact with the control system
- Use functionality provided by the control system
- Minimise device-dependent code on the control system side

Additional Requirements:

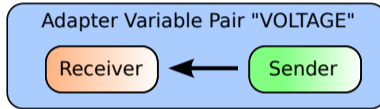
- Thread-safety
- Real-time capability
- Must not copy large data objects (arrays)

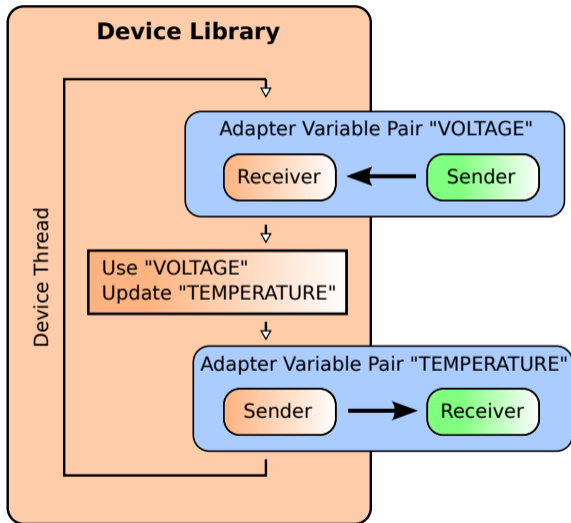
First Implementation

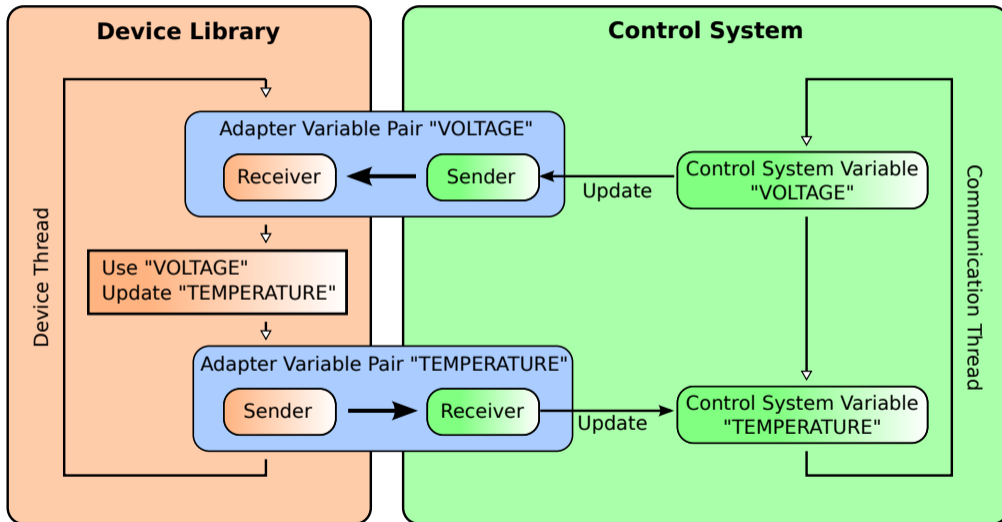
- Process variables to transfer data to/from the control system

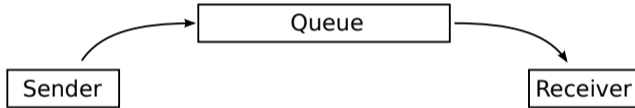


- Control system data types used inside the algorithm
- Control system variables can be locking/blocking
- Control system variables might not be thread safe
- Threading often handled by control system

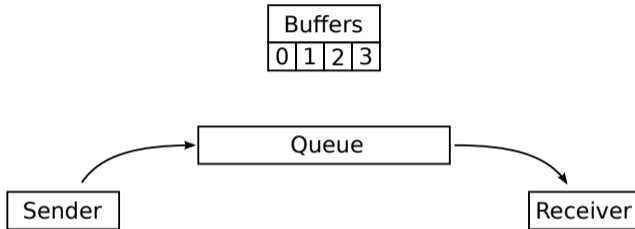




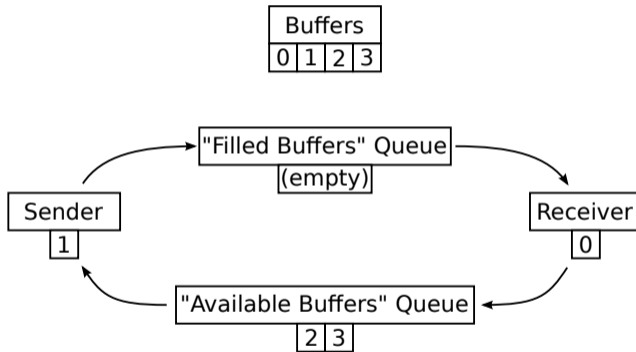




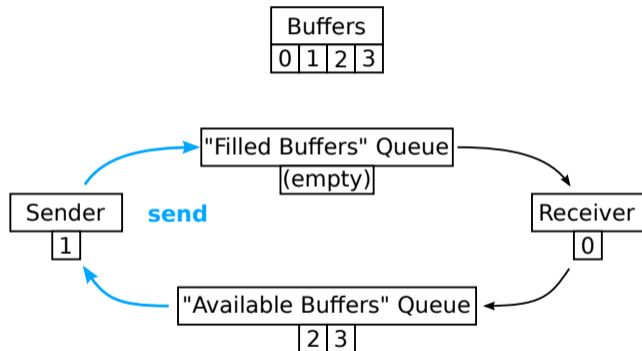
- Lock-free queue



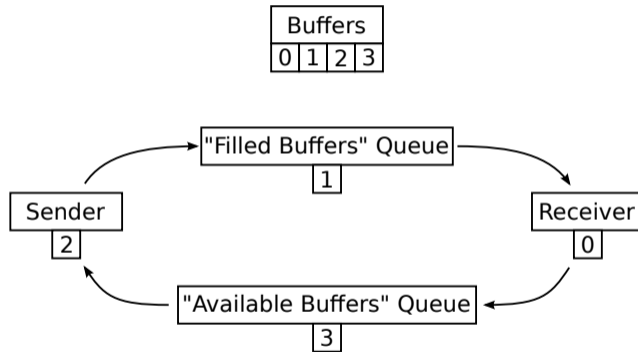
- Lock-free queue
- Pre-allocated buffers for arrays



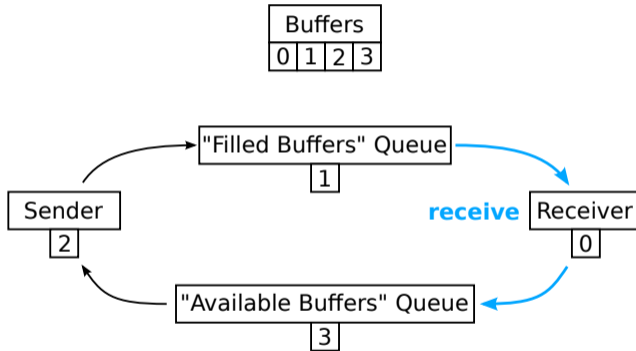
- Lock-free queues
- Pre-allocated buffers for arrays
- Copy references, not buffers



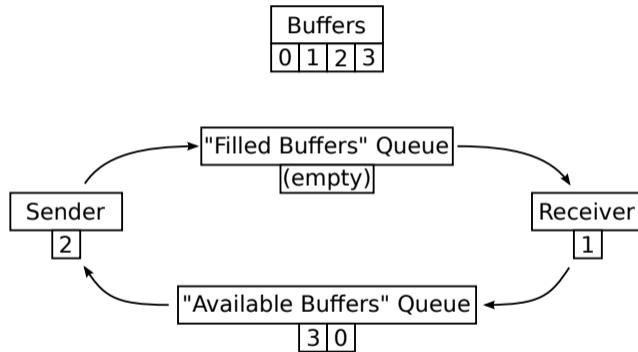
- Lock-free queues
- Pre-allocated buffers for arrays
- Copy references, not buffers



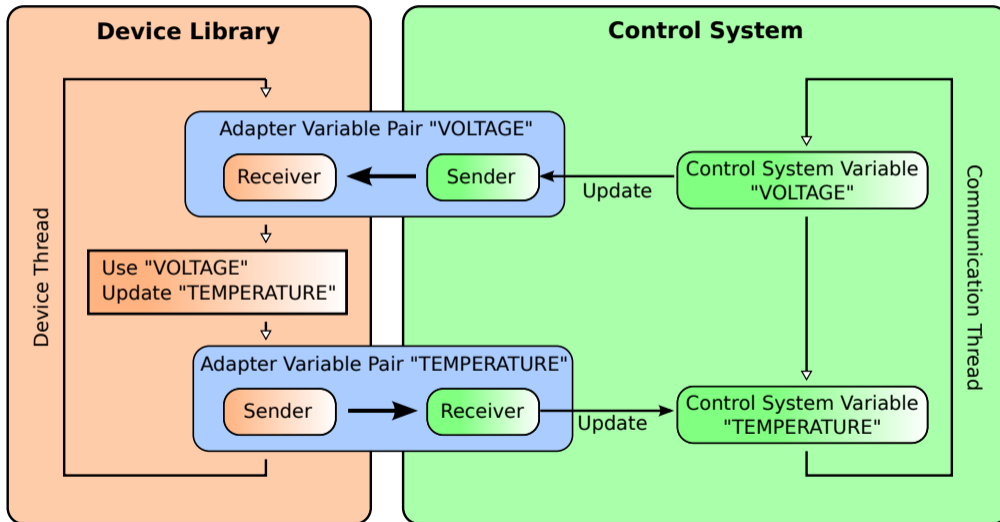
- Lock-free queues
- Pre-allocated buffers for arrays
- Copy references, not buffers

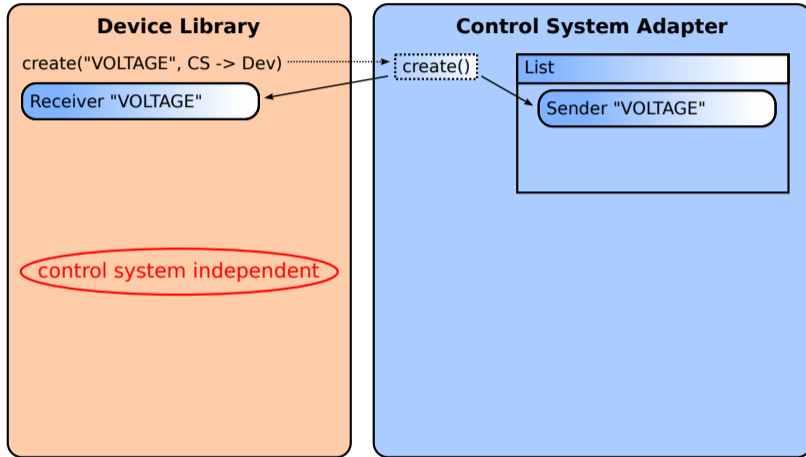


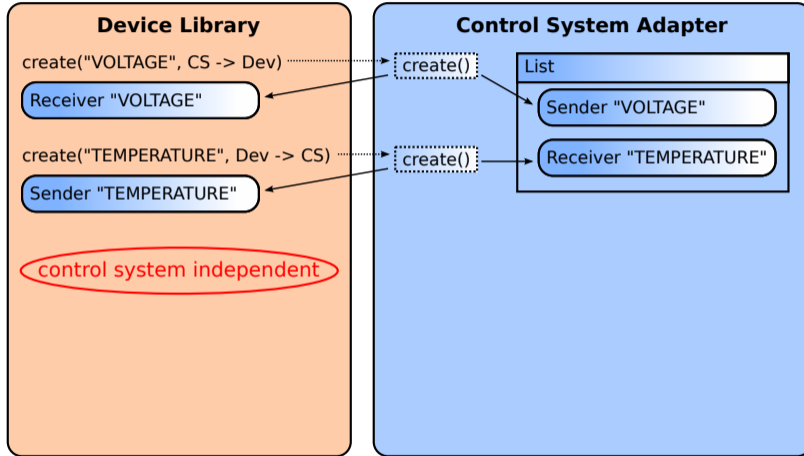
- Lock-free queues
- Pre-allocated buffers for arrays
- Copy references, not buffers

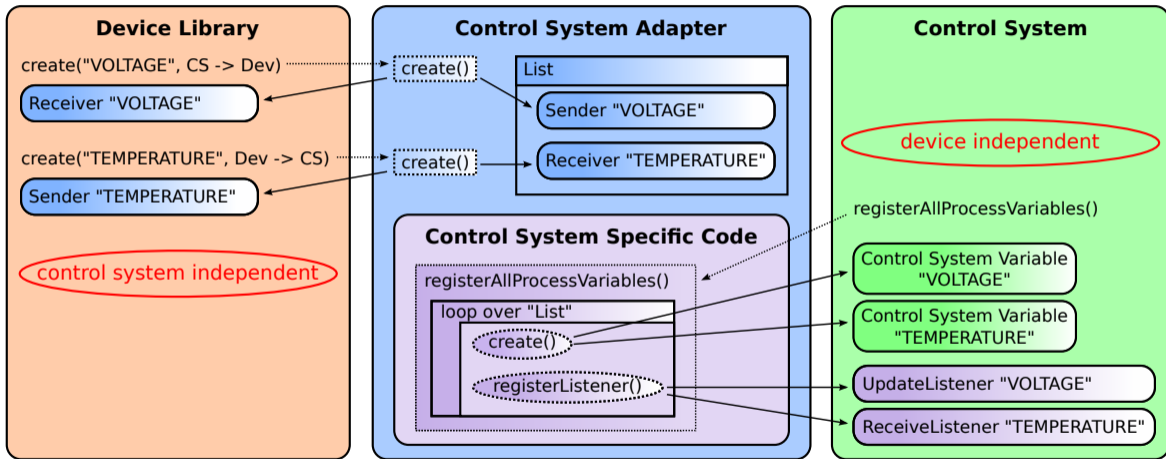


- Lock-free queues
- Pre-allocated buffers for arrays
- Copy references, not buffers









Adapter for process variables

- Generic part
- Control system specific part
 - Implementations for DOOCS and EPICS 3

Design Goals

- Control system independent process variables ✓
- Thread safety ✓
- Real time capability ✓
- Minimise copying ✓
- Minimise device-dependent code on control system side (✓)

Missing: Access to control system features

- Limits
- History
- Engineering units
- Handle alarms
- Synchronise with timing (currently done by DOOCS)
- ...

Missing: More sophisticated data objects

- Currently only scalars and arrays

Tasks for this workshop

1. Identify which features are needed/wanted for the LLRF server!
2. Discussion: How to implement it in the adapter and for various control systems?
Implementations are very different in the various control systems!

MTCA4U Control System Adapter

- Adapter to use device logic with different control systems
- Implementations for DOOCS and EPICS 3 exist
- Planned: support for OPC-UA
- How to use control system features through the adapter?

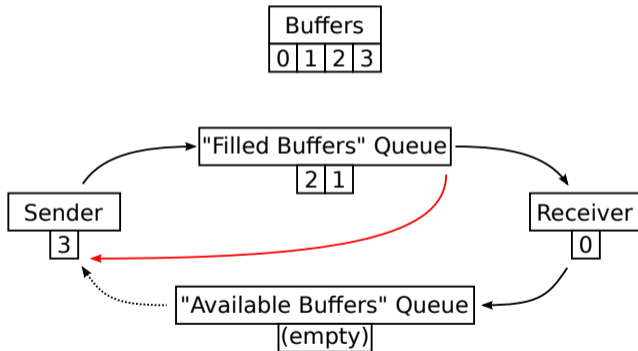
Software Repositories

All software is published under the GNU General Public License.

- MTCA4U Control System Adapter: <https://svnsrv.desy.de/public/mtca4u/ControlSystemTools/>
- EPICS 3 extension: <http://oss.aquenos.com/svnroot/epics-mtca4u/>
- DOOCS extension: https://svnsrv.desy.de/desy/mtca4u_applications/DOOCS_Adapter/

Backup

Update the queue if the receiver is slow/down



- No free buffers for the sender
- Overwrite the oldest buffer
- Pop the head of the "filled buffers" queue (buffer 1)
- Send the buffer which has just been filled (buffer 3)