

Integrating Real-Time Control Applications Into Different Control Systems.



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Motivation

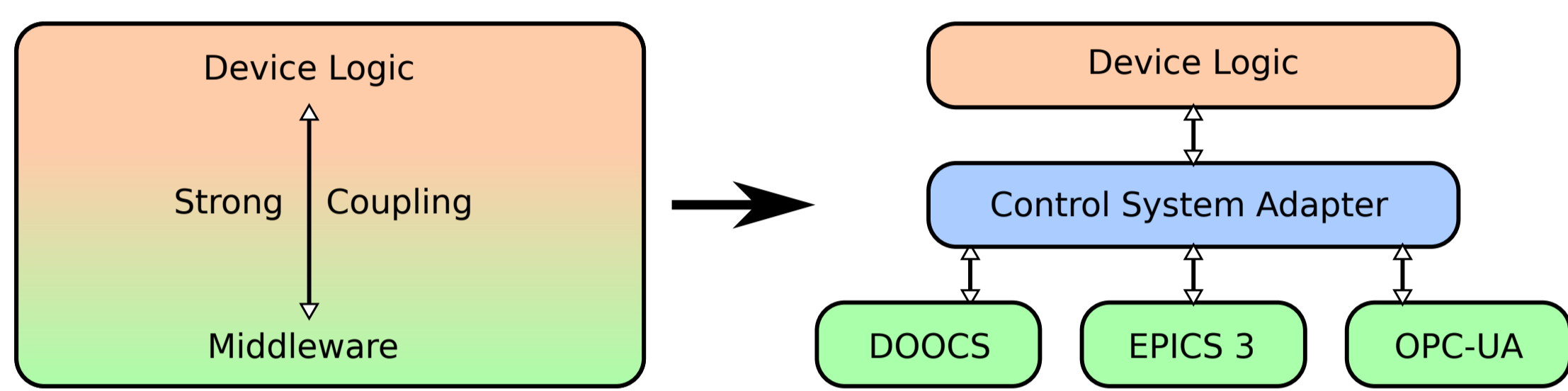
- > Device servers for the radio frequency controls at particle accelerators shall be used at different facilities
- > All facilities are using different control system middleware (DOOCS, EPICS 3, WINCC + OPC-UA)

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



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

The Chimera Tool Kit

Tool kit to facilitate the development of controls applications



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

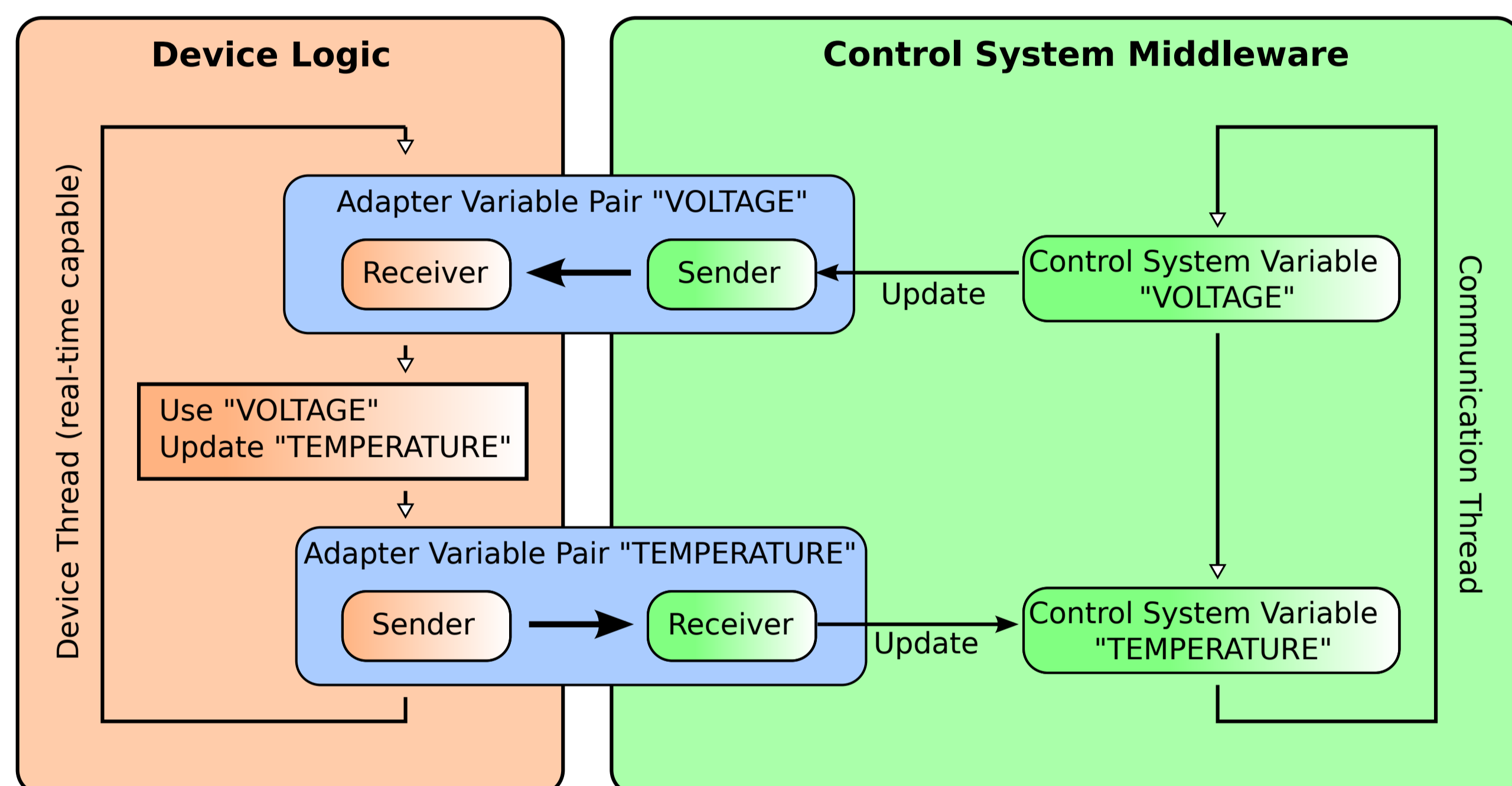
- > Framework for software tests
 - Virtual time: Avoid race conditions in tests
 - Dummy device: Simulate hardware
 - State machine: Simulate firmware
- > More information: Poster Session 1, Poster 100

Control System Adapter

- > This poster

ChimeraTK was formerly known as MTCA4U

Control System Adapter and Process Variables



Control System Adapter

- > Process variables are sender-receiver pairs

Device Thread

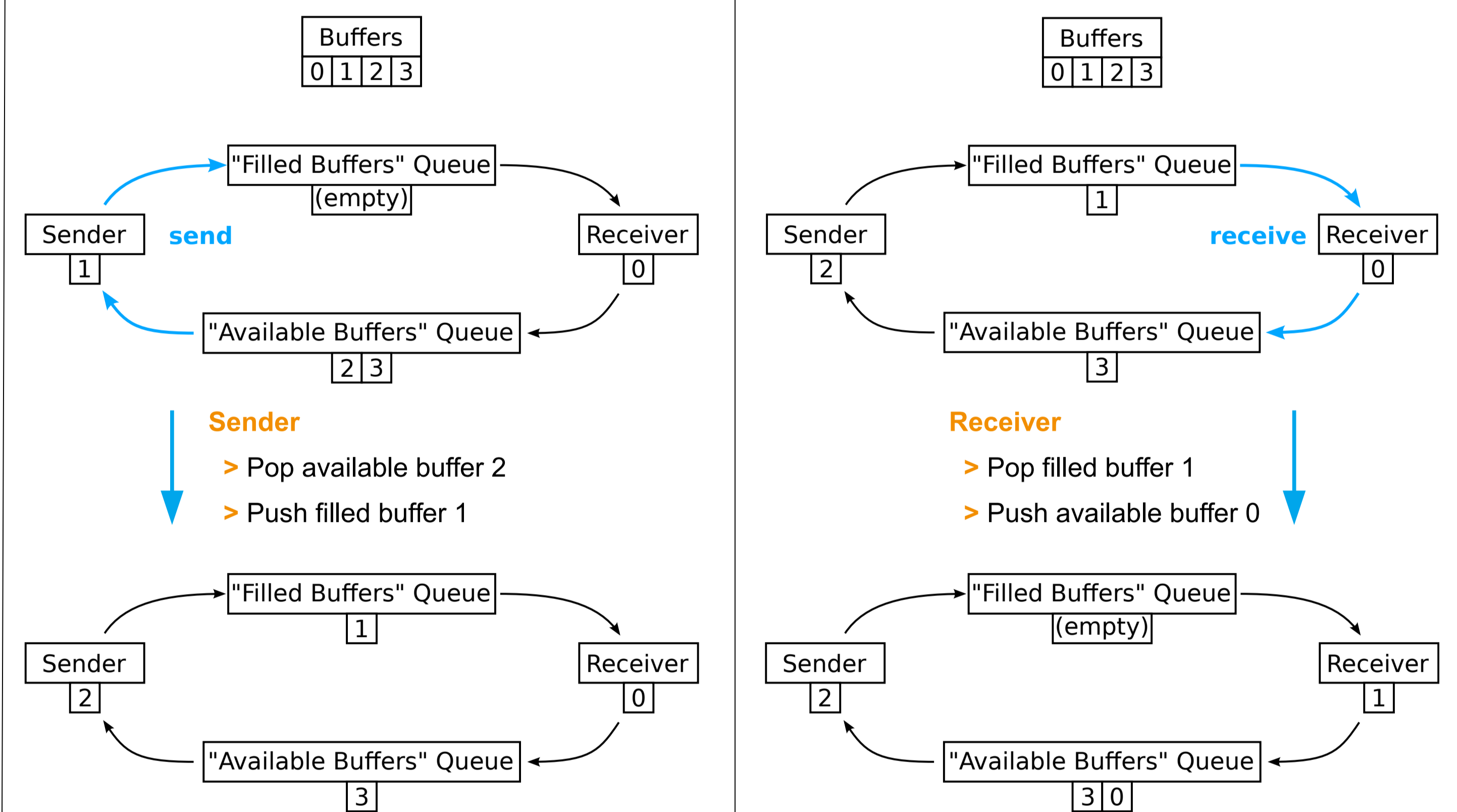
- > Only talks to device-side sender or receiver
- > No direct interaction with the middleware.

Middleware Thread

- > Only talks to the control-system-side sender or receiver
- > Synchronises adapter variables and control system variables

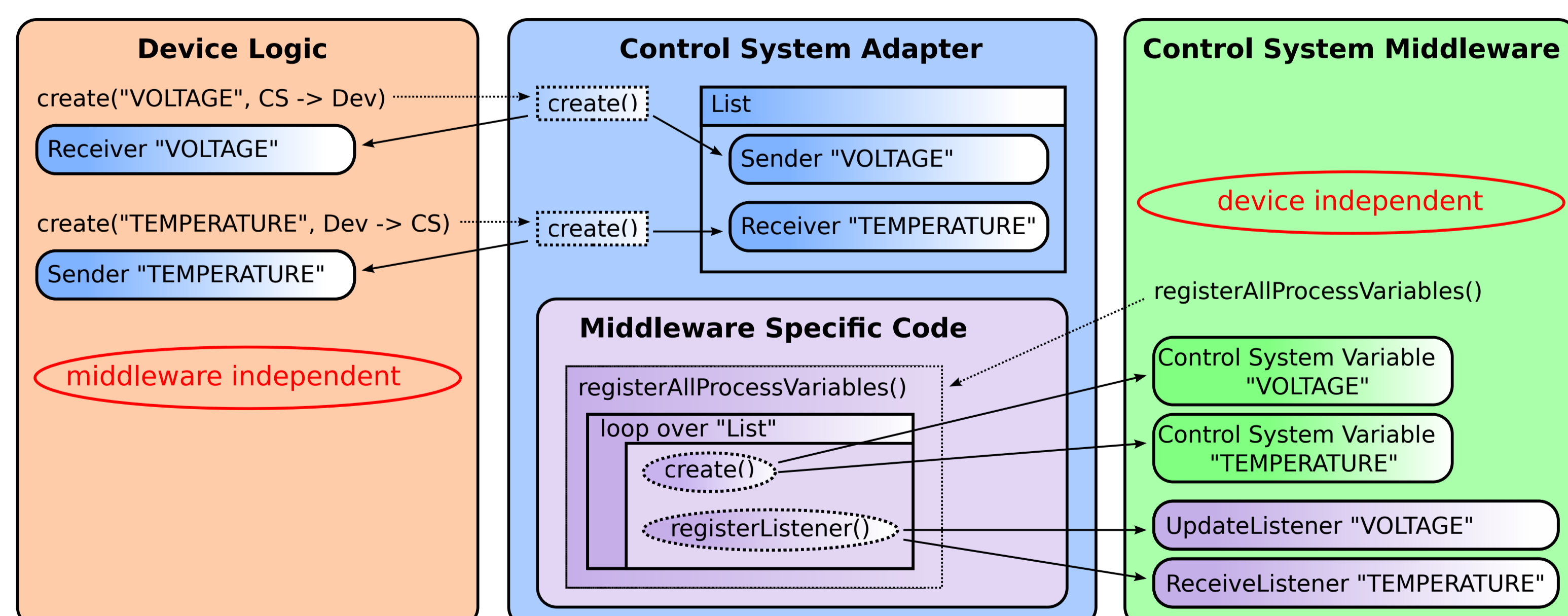
Implementation of Process Variables

- > Lock free queues for thread safety and real-time capability
- > Pre-allocated buffers for real-time capability
- > Copy references, not buffers for efficiency



Registering Process Variables

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



Device Logic

- > Registers process variables
- > Only talks to the adapter
- middleware independent

Adapter Layer

- > List of process variables
- > Middleware specific extension to create process variables

Control System Code

- > Instantiates all process variables with one command
- > Only talks to the adapter
- device independent

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/svnroot/epics-mtca4u/>

DOOCS extension

<https://github.com/ChimeraTK/ControlSystemAdapter-DoocsAdapter>

OPC-UA extension

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



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