A new major release of ChimeraTK ApplicationCore and DeviceAccess.

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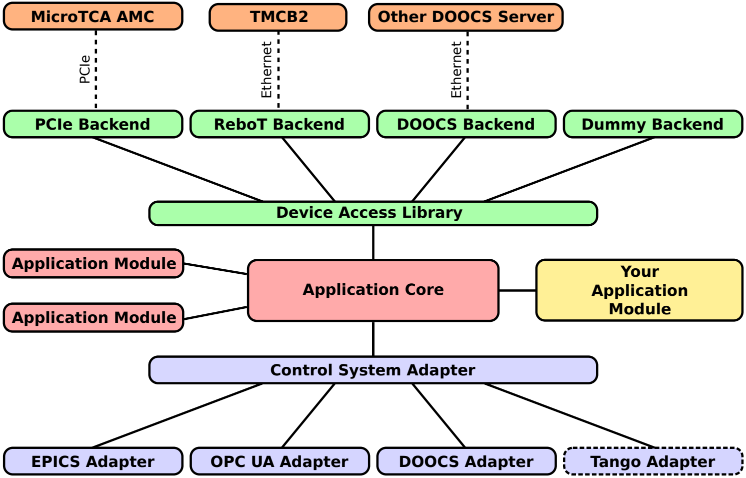
ChimeraTK Overview



DeviceAccess

- Abstract access to different hardware
- Extensible backend interface

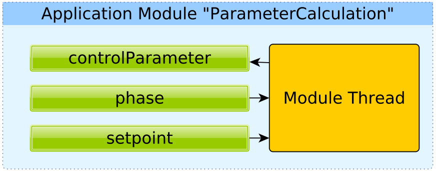
ApplicationCore

- ApplicationModules implement application logic
- Multi-threaded

ControlSystemAdapter

- Abstract interface to different control system middleware
- Integrate via configuration

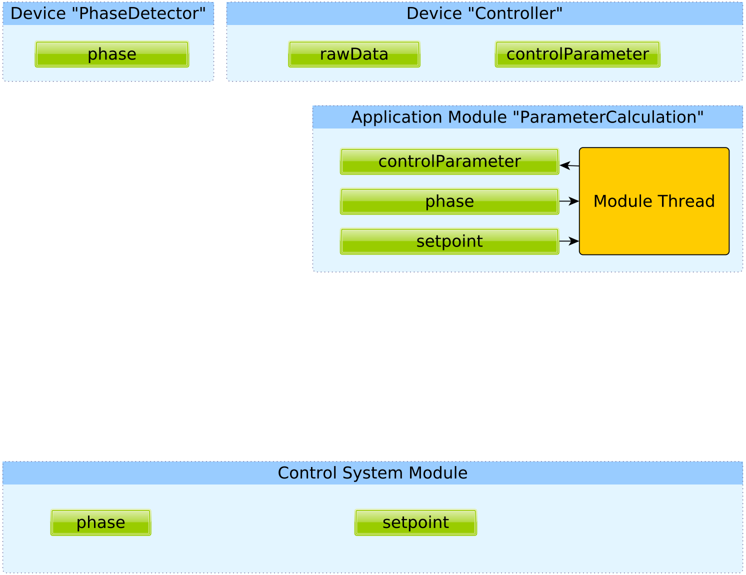
ApplicationCore



Modules

- Input/output variables
- Application Modules
  - One thread per module

ApplicationCore



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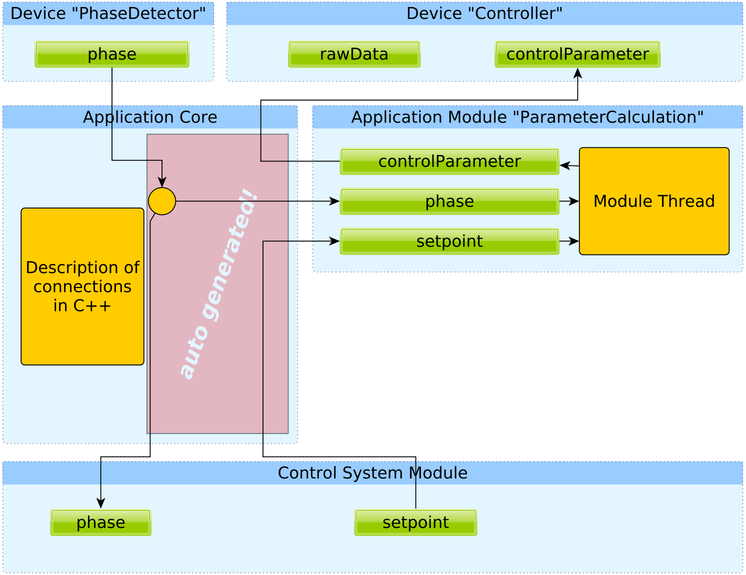
  - One thread per module
- Special modules
  - Device module
  - Control system module

ApplicationCore



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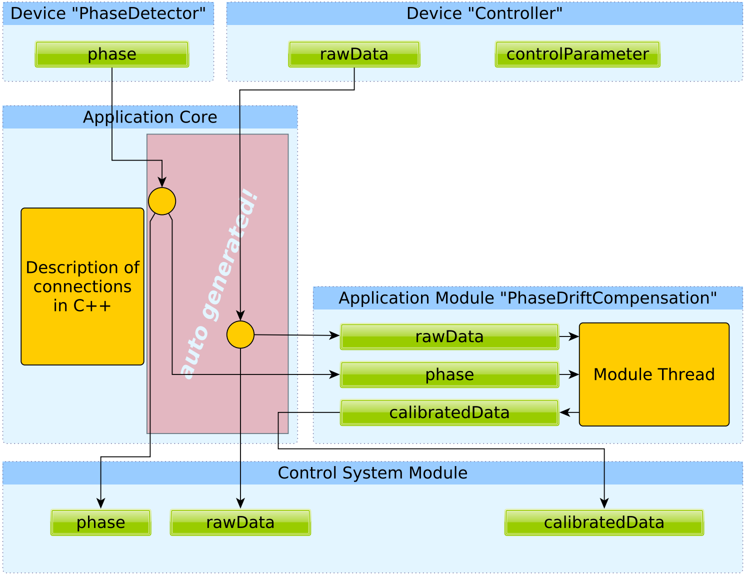
Connections

- Mostly auto-generated

High locality

- Algorithms don't need to know how variables are connected
- Perfect modularity, as modules are self-contained

ApplicationCore



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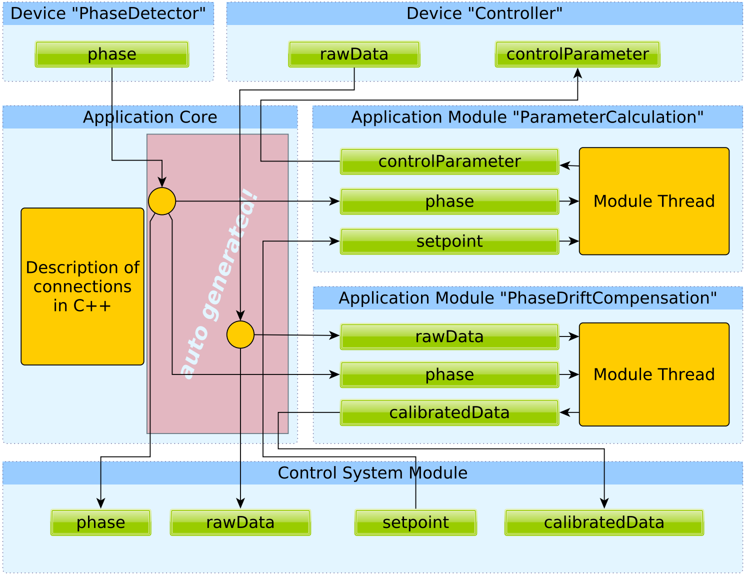

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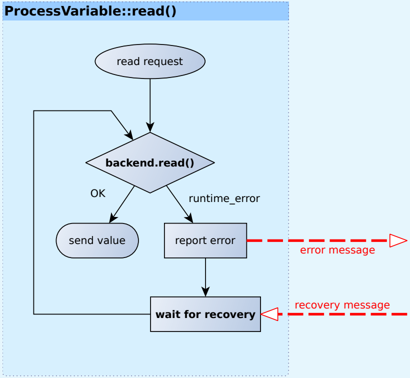
Device Error Handling

- Modules can just use the input and output process variables
- Frameworks takes care of device opening and error handling

Concept presented on MTCA workshop 2019



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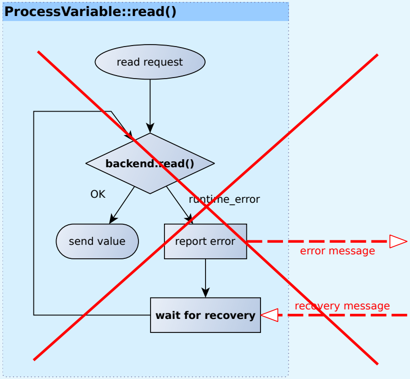


Problems with the proposed solution

- You don't see which PVs are stale in the application
- The `read()` blocks where it should not

⇒ Back to the drawing board

  - Write extensive detailed specification first
  - Match details in DeviceAccess, ApplicationCore and ControlSystemAdapter

Device Error Handling 2.0

Typical example: RF phase

- Basically constant at one operation point
- Slowly drifts with time

Assumption

- When it's not updating I can keep the system running with the old value for a while

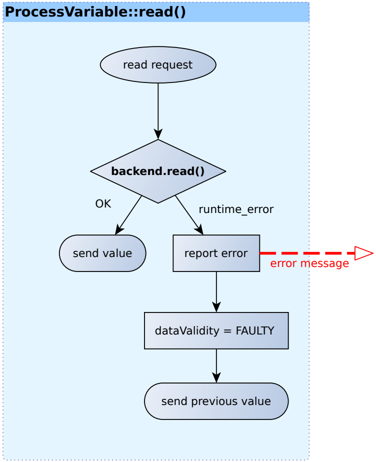
Requirements

- I want to know when it's not updating
- I want to keep the old value

Device Error Handling 2.0

New concept

- Send last good value with `DataValidity` set to `FAULTY`



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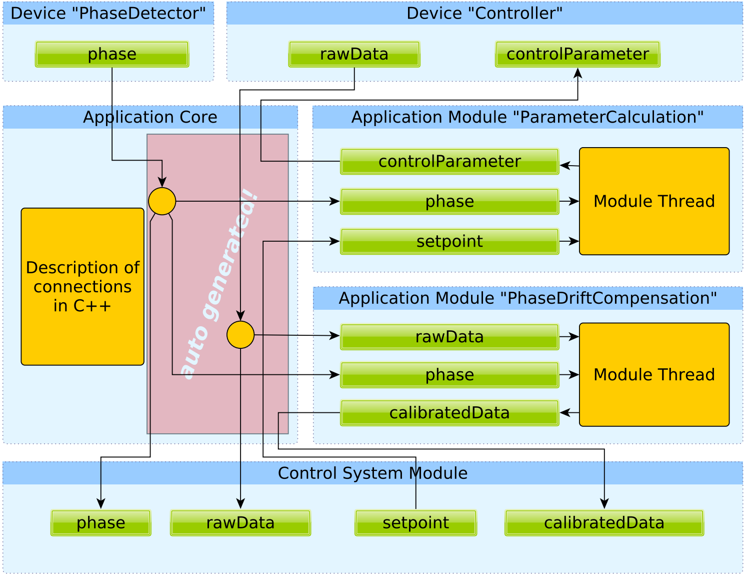
Propagation of the Data Validity Flag



Agenda

- data validity faulty
- data validity OK

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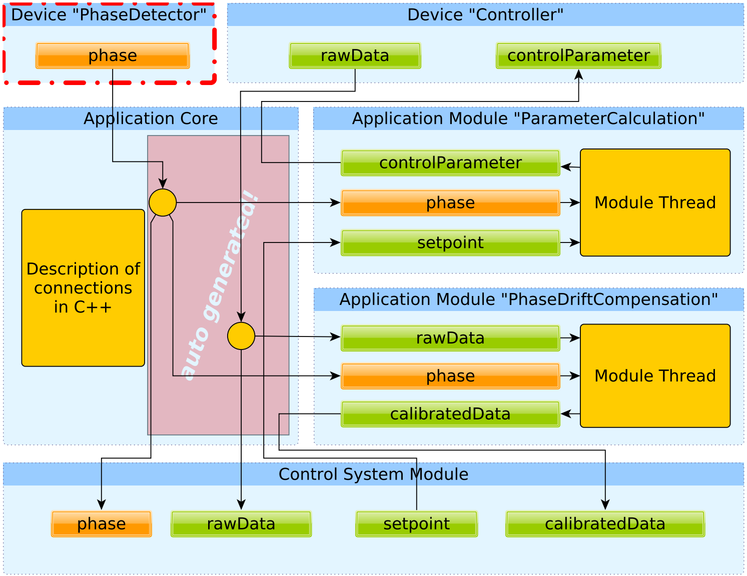

“PhaseDetector” has an error

- All outputs marked as faulty
- Framework tries to re-open

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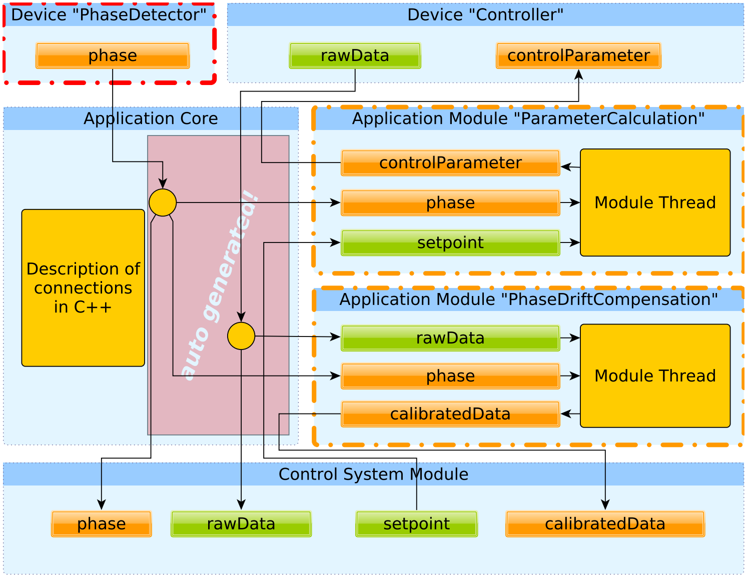

"PhaseDetector" has an error

- All outputs marked as faulty
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Application Modules

- Small with correlated inputs and outputs
- If one input is faulty, all outputs are faulty
- Module stays active

Device Modules

- Uncorrelated inputs and outputs
- `rawData` stays valid

Agenda

🟧 data validity faulty

🟩 data validity OK

Initial Values

Application start

- I don't know the current operation point
- The RF phase can be anything between -180° and +180°
- There is no previous good value

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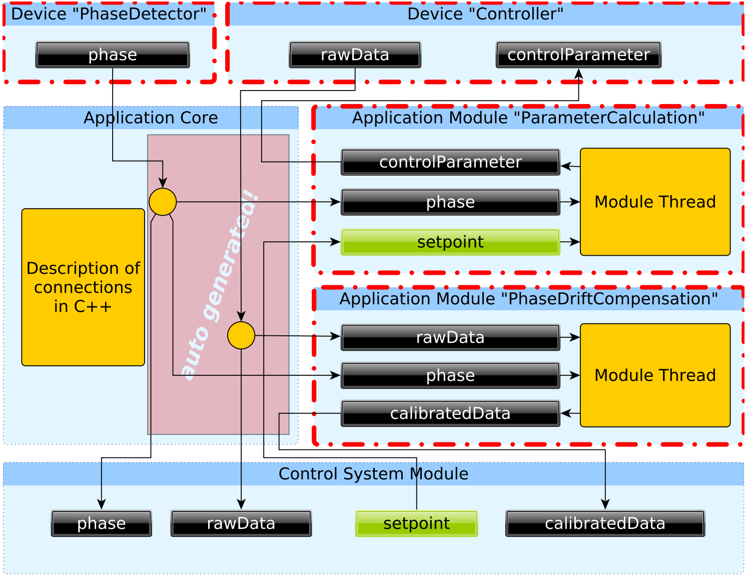
New concept: Initial values

- When constructed, process variables know they have not seen any data yet
- When reading, it blocks until the *initial value* has been received

Advantages

- Allows clean application start
- ApplicationModules only start when they have all the data
  - No special exception handling

Initial Value Propagation



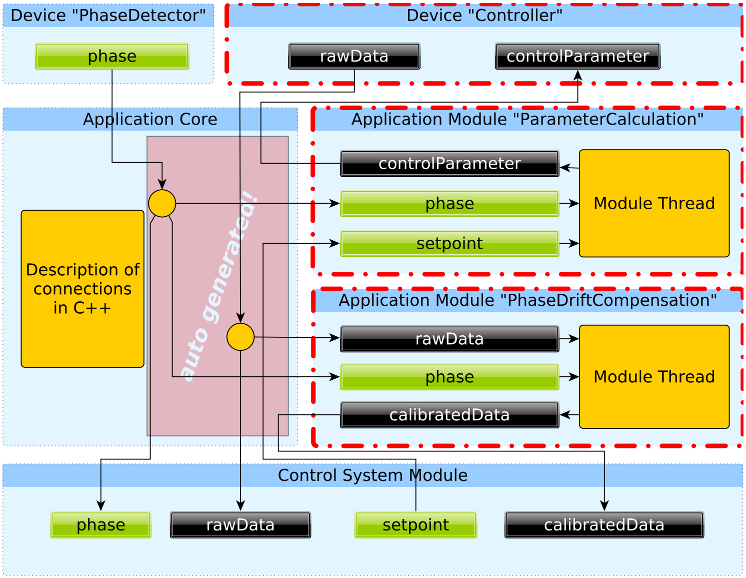
Application start

- Both devices still closed
- Application modules waiting for initial values
- Control system has initial values from persistency layer

Agenda

- no initial value
- data validity faulty
- data validity OK

Initial Value Propagation



Devices are opening

- “PhaseDetector” opens successfully
- “Controller” still waiting for initial values
- “ParameterCalculation” has all initial values
- “PhaseDriftCompensation” still waiting for `rawData`

Agenda

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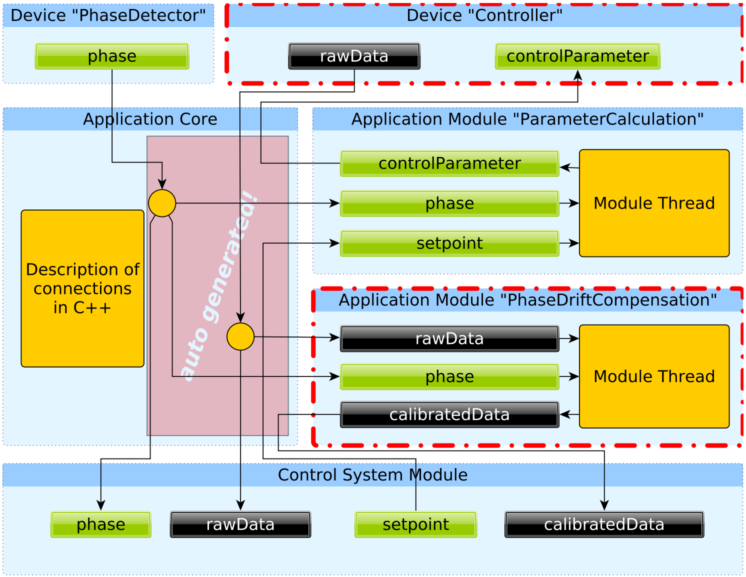
Initial Value Propagation



"ParameterCalculation" is starting

- sends `controlParameter` to "Controller"
- "PhaseDriftCompensation" still waiting for `rawData`

Agenda

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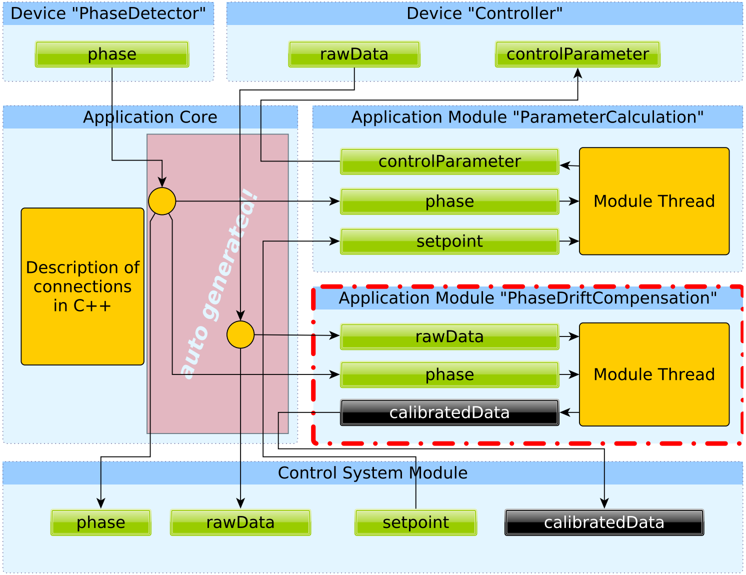
Initial Value Propagation



Device “Controller” is fully initialised

- Sends `rawData`
- “PhaseDriftCompensation” has all initial parameters

Agenda

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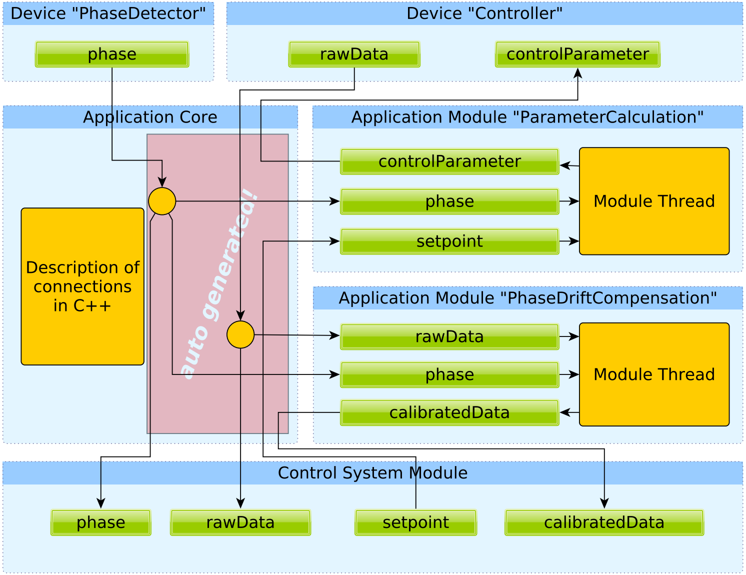
Initial Value Propagation



“PhaseDriftCompensation” is starting

- Sends `calibratedData`
- The application is up and running!

Agenda

- no initial value
- data validity faulty
- data validity OK

Summary

ChimeraTK

- Design modular, multi-threaded applications
- Talk to hardware
- Interface with the control system infrastructure

DeviceAccess 02.02 and ApplicationCore 02.00

- Consistent device exception handling
- Data validity propagation
- Initial value propagation

LLRF software at the European XFEL and FLASH are currently being updated!

Software Repositories

All software is published under the GNU GPL or the GNU LGPL.

- ChimeraTK source code: https://github.com/ChimeraTK
- Ubuntu 20.04 packages are available in the DESY DOOCS repository.

Documentation and Tutorials

- API documentation https://chimeratk.github.io/
- Tutorials on the MicroTCA Workshop 2019 Indico page
- e-mail support: chimeratk-support@desy.de

Backup

Backup

Push Type and Poll Type Variables

Push Type Variables

- Producer/device is actively sending the data
- `read()` is blocking until new data is received

Exception handling

- In case of an error, exactly one exception is send per variable (DeviceAccess layer)
- The exception is caught in ApplicationCore, and the last value is send with dataValidity=Faulty

⇒ `read()` returns once with dataValidity=Faulty

⇒ The next `read()` blocks until the next value after device recovery has been received

Poll Type Variables

- Passive producer
- `read()` is polling the latest value
- `read()` is not blocking

Exception handling

- The exception in the synchronous device access is caught in ApplicationCore
- Each `read()` returns immediately with the last value and dataValidity=Faulty until the device has recovered