Eiger DAQ System at Diamond

High Data-Rate Macromolecular Crystallography (HDRMX) Meeting
7. November 2019
Diamond Light Source

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Odin DAQ & Control Software Framework

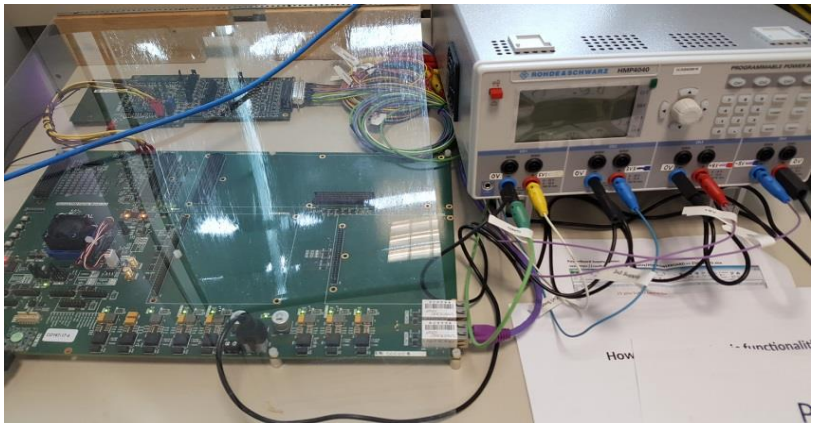
- Started developments around 2014
- Goal: scalable DAQ & Controls framework to support modular, high performance detector systems
  - Scalable but with a single point of control for integration
  - Control system agnostic to support collaborators
- Collaboration between STFC & Diamond
  - Open source on github
  - Developers: 10+ contributing, 5 core

Odin Supported Detectors

Excalibur

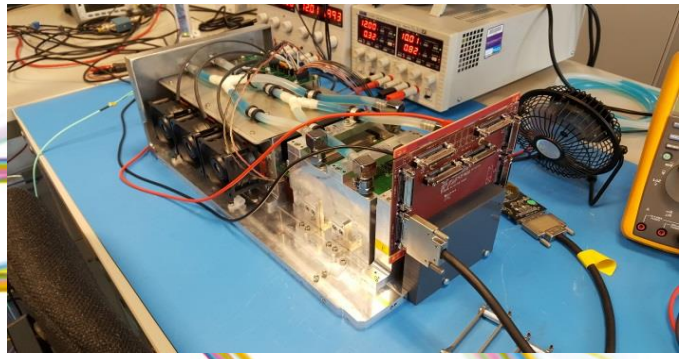
~1GB/s

- **Modular, Scalable Detector Systems**
- **High Data Rates**



Percival

~6GB/s



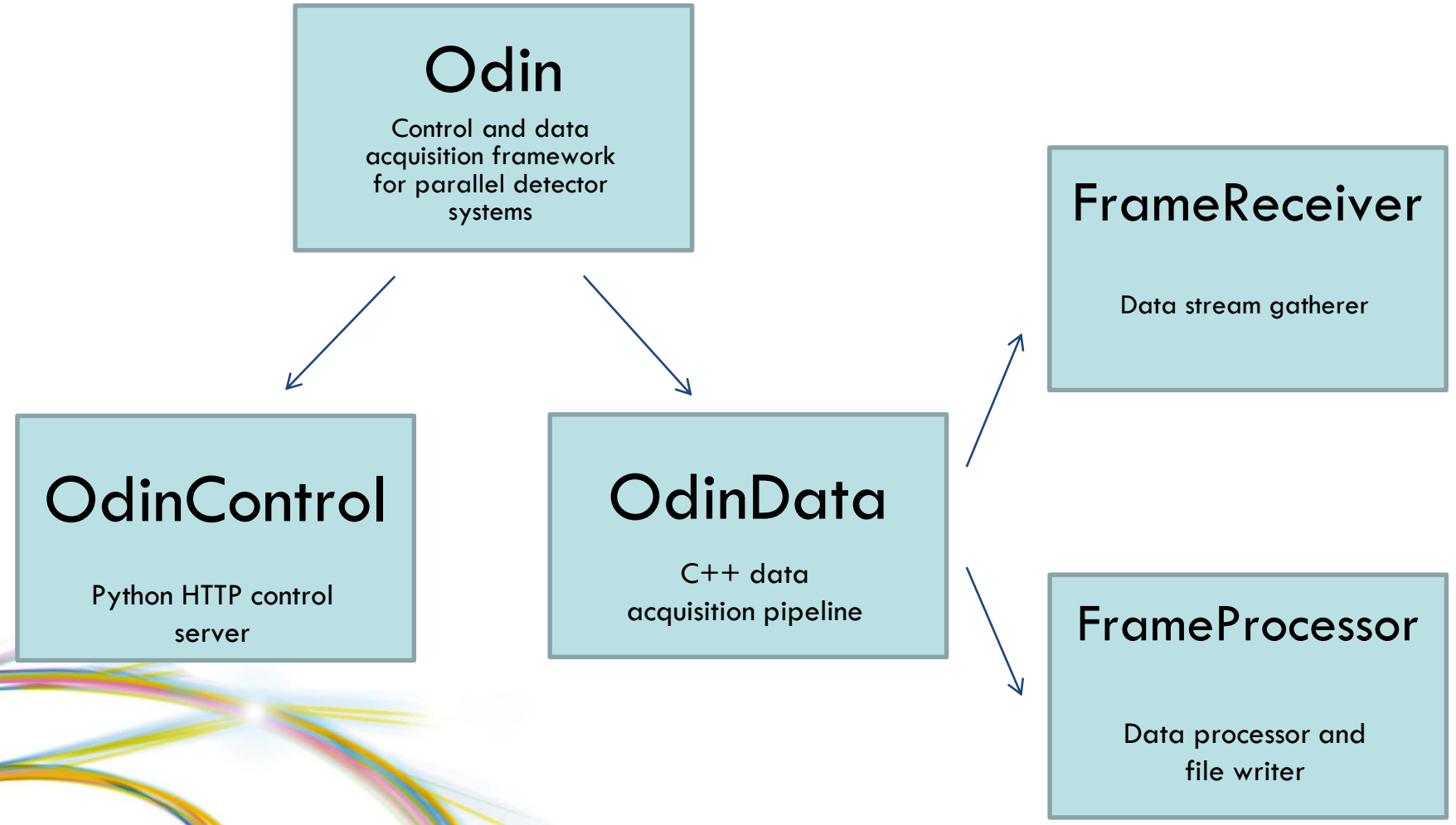
Tristan

>10GB/s

Eiger…

diamond

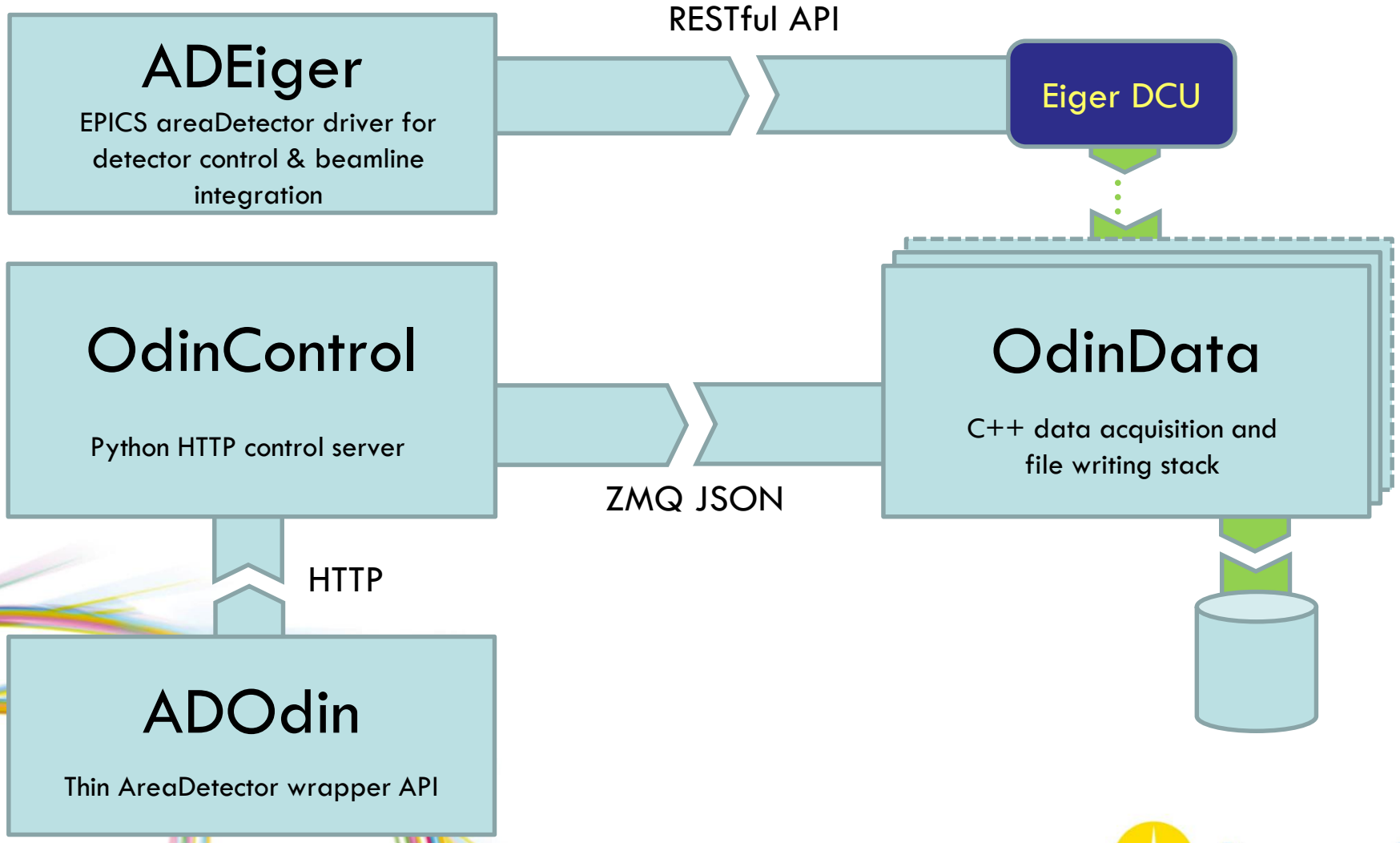
Odin DAQ & Control software



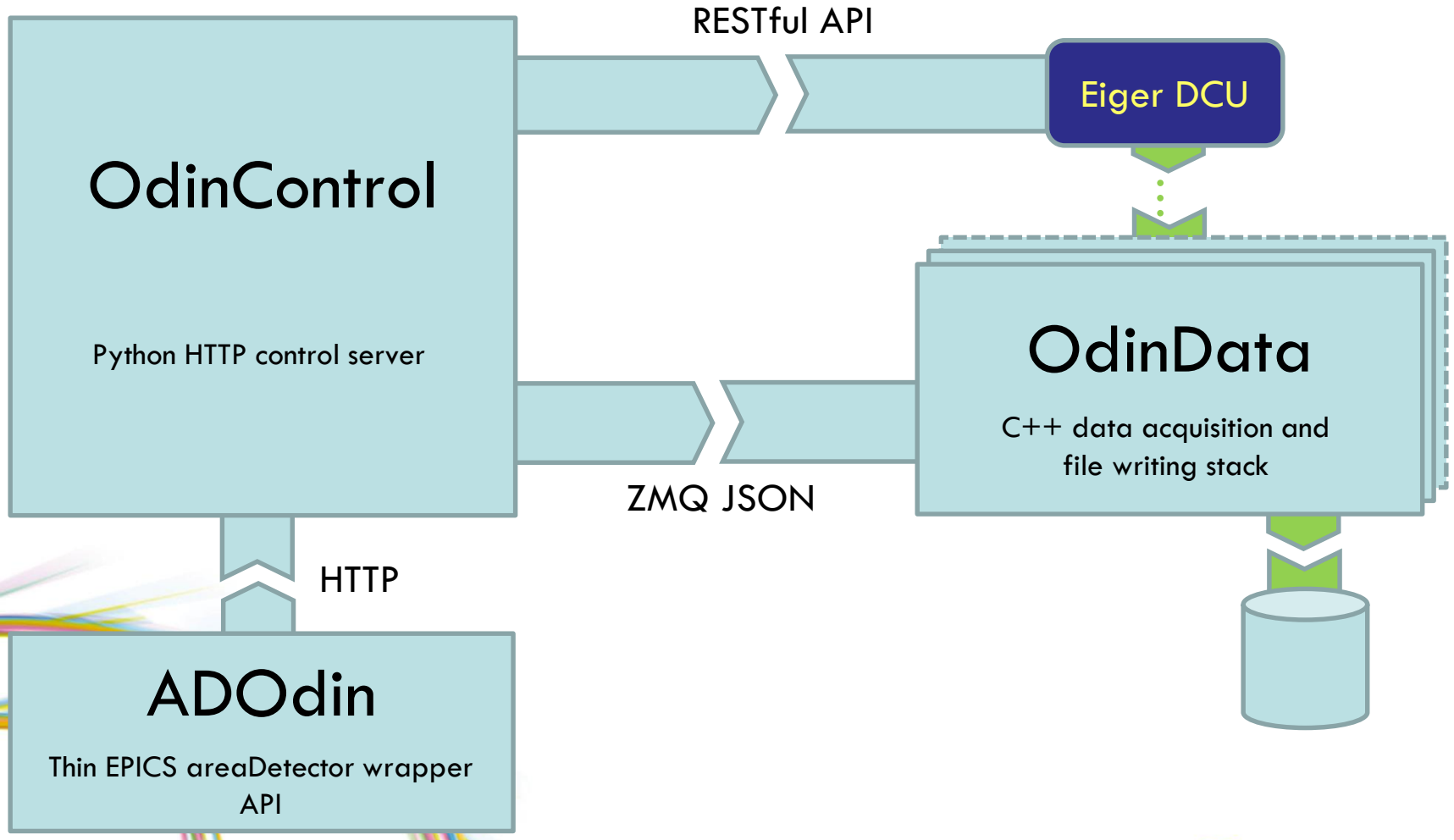
Odin for Eiger additions

- **EigerFan:**
  - **Service to “fan-out” the ZeroMQ stream of images from Eiger DCU in a deterministic guaranteed fashion**
  - **Publish output as ZeroMQ stream(s)**
- **MetaWriter:**
  - **Service to collect and store meta-data**
    - **From detector ZMQ stream**
    - **Diagnostics from Odin HDF5 file writer**

Odin & ADEiger

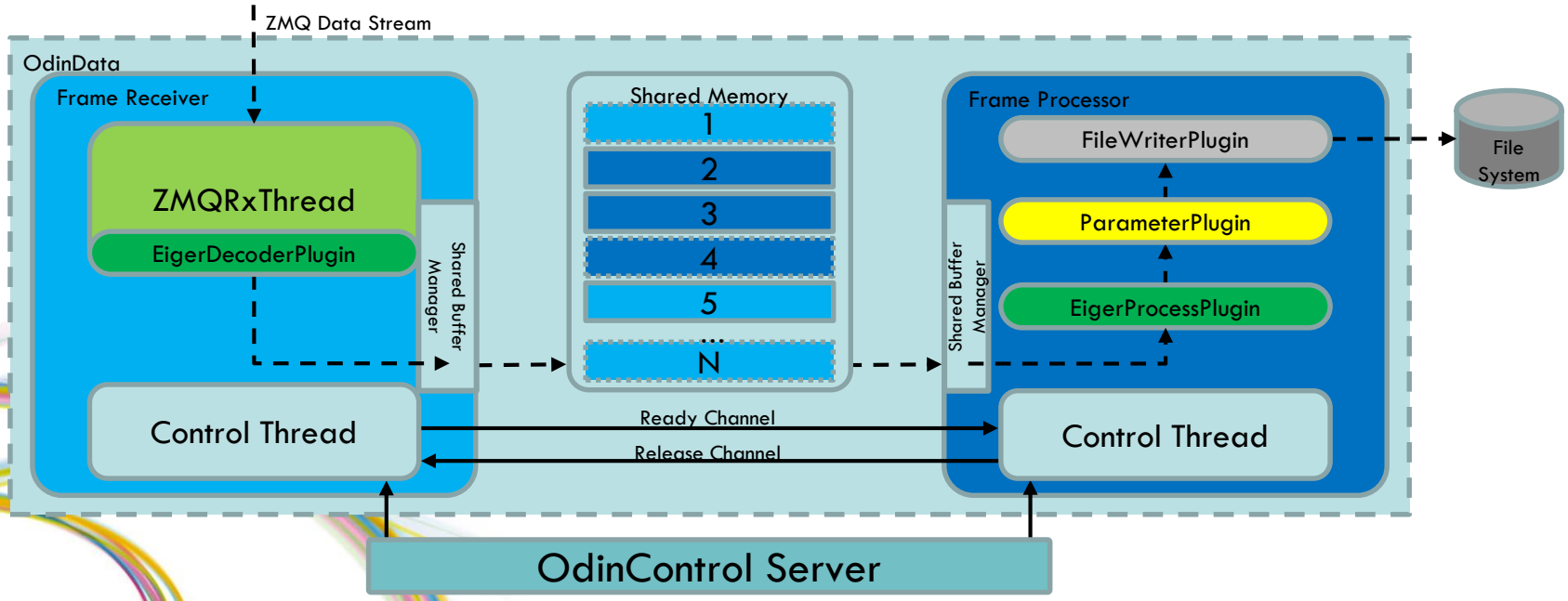


Odin & ADOdin


RESTful API
Eiger DCU
OdinControl
Python HTTP control server
OdinData
C++ data acquisition and file writing stack
ZMQ JSON
HTTP
ADOdin
Thin EPICS areaDetector wrapper API

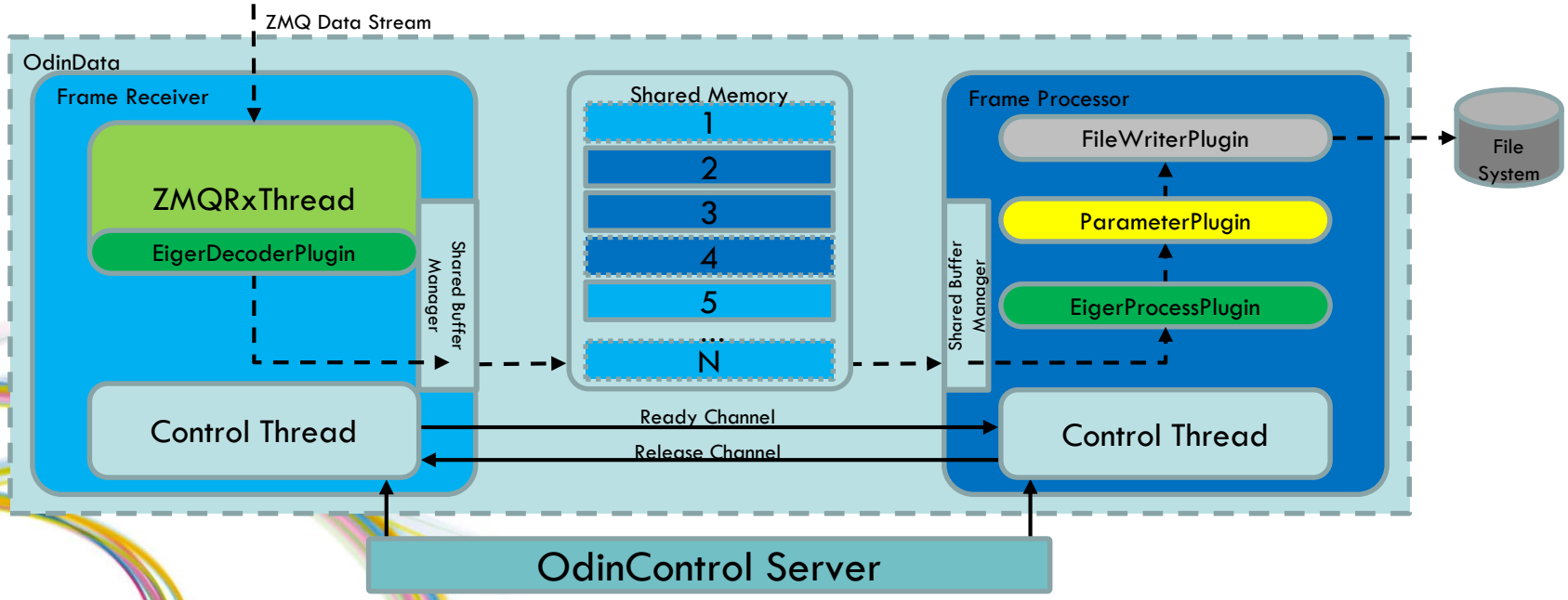
Odin Data

- FrameReceiver gathers data from ZeroMQ stream
- Parse ZMQ messages into buffers in shared memory
- Buffer ID passed to FrameProcessor, which wraps memory in Frame object

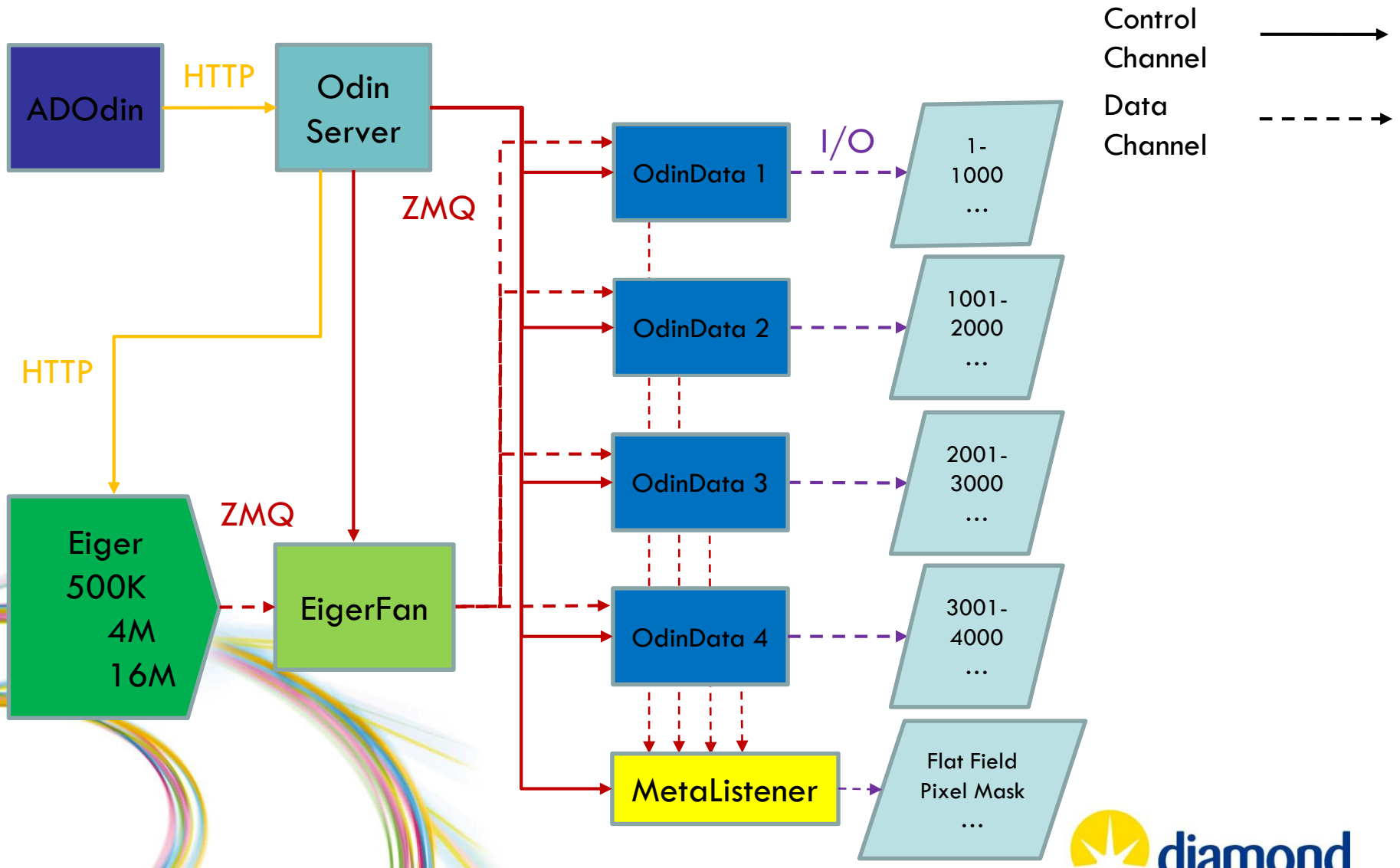


Odin Data

- Detector agnostic FileWriterPlugin writes pre-compressed data directly to HDF5 dataset using Direct Chunk Write
- Sets configured compression mode on dataset so it can be read
- Bypasses HDF5 processing pipeline by using “Direct Chunk Write”

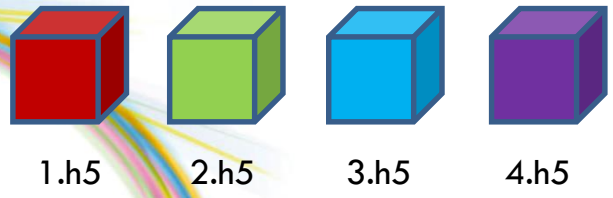


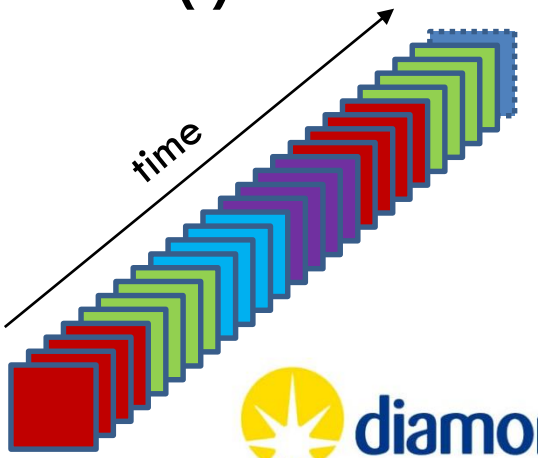
Deployment


ADOdin
HTTP
Odin Server
ZMQ
HTTP
Eiger 500K 4M 16M
ZMQ
EigerFan
OdinData 1
OdinData 2
OdinData 3
OdinData 4
MetaListener
I/O
1-1000 ...
1001-2000 ...
2001-3000 ...
3001-4000 ...
Flat Field Pixel Mask ...
Control Channel
Data Channel

Odin Data Features

- Minimal copying and processing
- Meta data published on ZMQ stream
- Robust to out of order / missing frames
- Scalable without overhauling system
- HDF5 file writer uses:
  - Direct Chunk Write (pre-compressed data)
  - Single Writer Multiple Reader (SWMR) – optional!
  - HDF5 library v1.10.x but can write v1.8 files(!)





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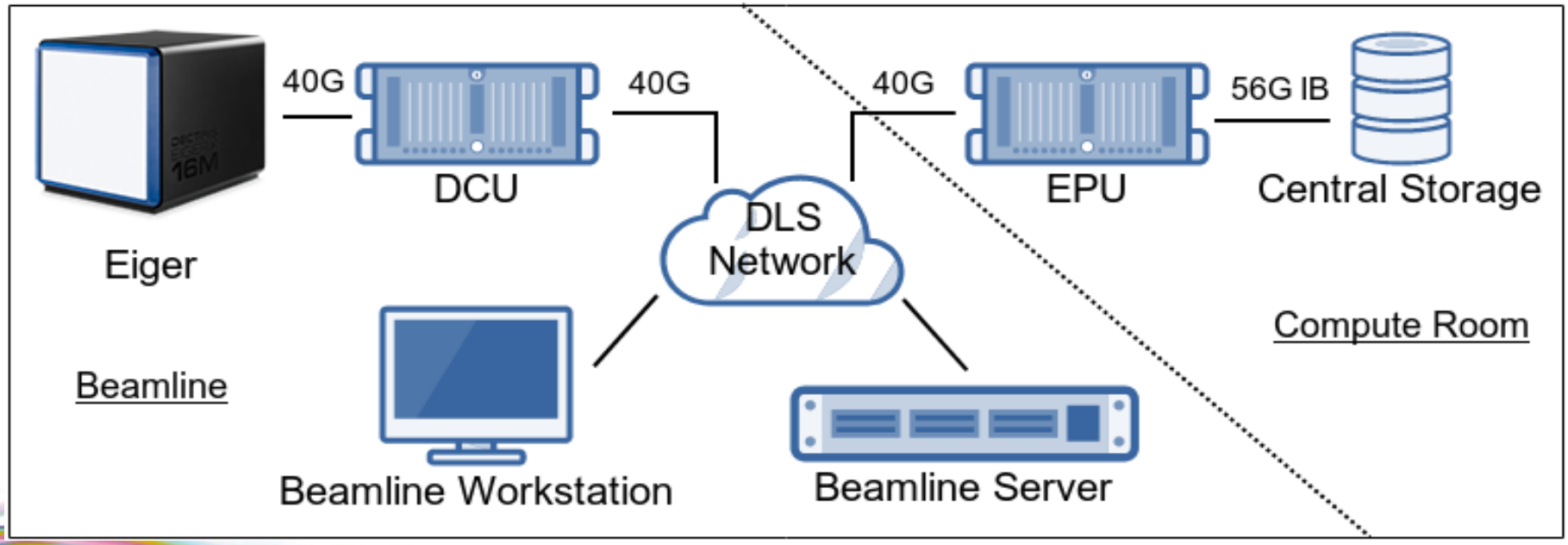
Odin Control Features

- **Generic HTTP server**
- **Adapters provide functionality for each device / application**
- **Server presents hierarchical tree of URIs to Adapter attributes and methods**
- **Control through simple webpages or client application**

IT Infrastructure



Current Developments

- **Publish data from Odin to low-latency buffer system**
  - **Using Kafka as fast buffer system**
  - **Avoid disk I/O for fast, on-the-fly processing**
- **Packaging for easy distribution to other sites**
  - **Including docs**

Thank You for listening

Acknowledgements

Gary Yendell (slides & figures), Matthew Taylor, Sky French, James O'Hea | DLS

Tim Nicholls, Adam Neaves | STFC

Alan Greer | OSL

References

https://github.com/dls-controls/eiger-detector

https://github.com/odin-detector

ICALEPCS2019 paper on Odin & Eiger at DLS

ICALEPCS2015 paper on developing hdf5 for synchrotrons