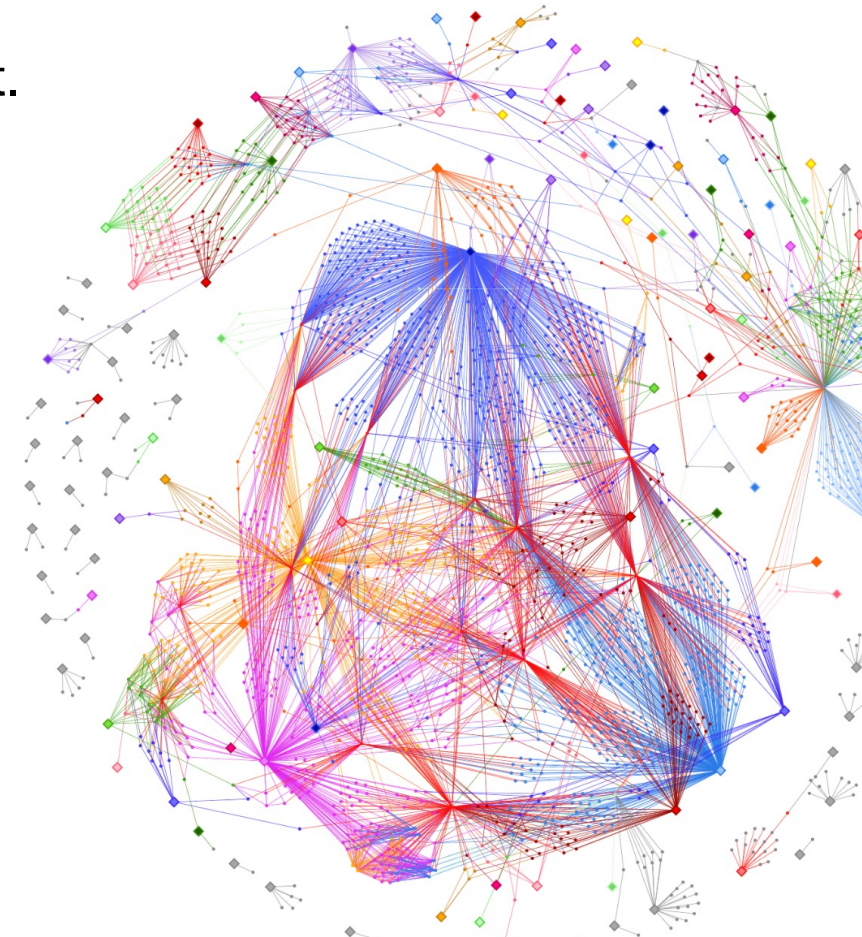
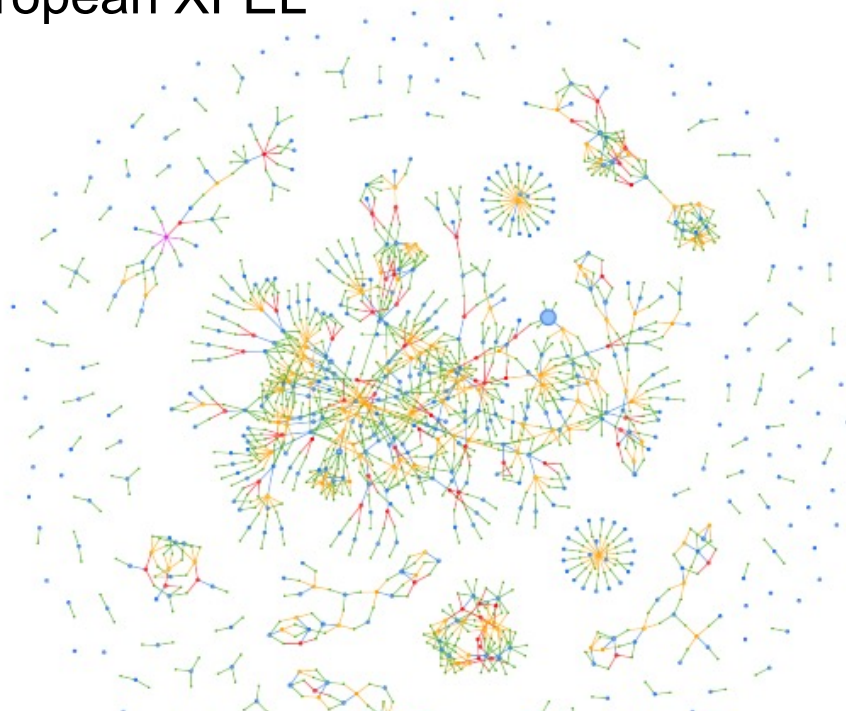
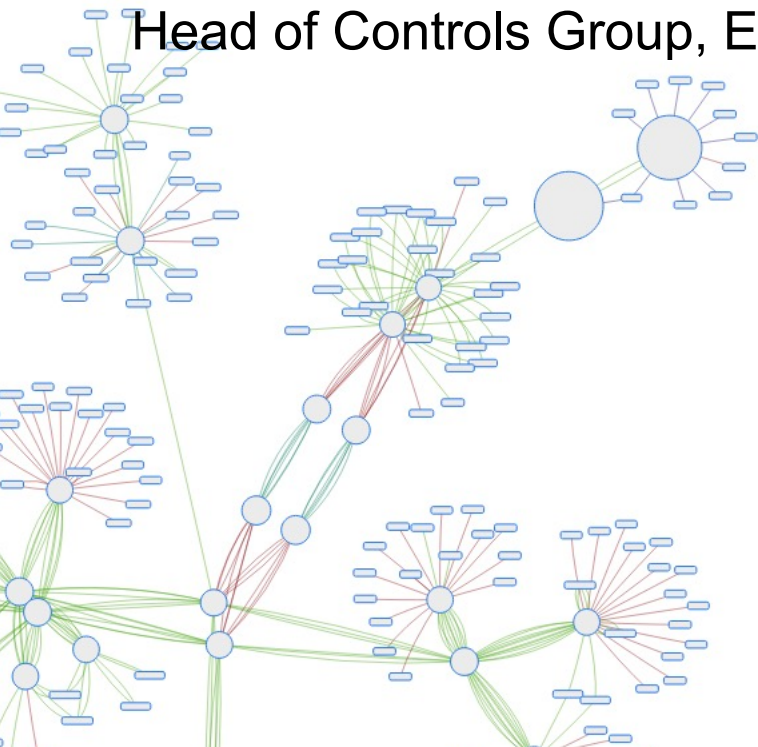


The European XFEL Data Stack



Steffen Hauf with contributions from across the EuXFEL Data Dept.

Head of Controls Group, European XFEL



Outline

- * The European XFEL – a data perspective
- * The EU.XFEL Data Operation Center
- * Experiences from running the Data Operation Center

The European XFEL – a Data Perspective

X-Ray Detectors at EU.XFEL Instruments

SASE I SASE II	Hard X-rays	Single Particles, Clusters and Biomolecules (SPB)	AGIPD	Gotthard V1/2	Jungfrau	
		Materials Imaging & Dynamics (MID)	AGIPD	Gotthard V1/2	ePix	Jungfrau
		Femtosecond X-ray Experiments (FXE)	LPD	Gotthard V1/2	Jungfrau	
		High Energy Density Matter (HED)	Jungfrau	Gotthard V1/2	ePix	Jungfrau
SASE III	Soft X-rays	Small Quantum Systems (SQS)	DSSC	pCCD	MCP	
		Spectroscopy and Coherent Scattering (SCS)	DSSC	Fast CCD		

100 MB/s - 10 GB/s
10 Hz burst

The European XFEL – a Data Perspective

Custom FPGA-based Data Producers at EU.XFEL



MicroTCA Crates
Large 12 slot 9U and small 6 slot 2U (including MCH, Power Supply and CPU)



X2Timer
XFEL Timing System module for synchronization (clocks and triggers) and pulse parameters from NAT



DAMC2
Required for Clock & Control system for fast 2D detectors, VETO System, Machine Protection System and photon beam loss monitors from DESY



SIS8300
Fast 125MSPS ADC with 10 channels and 16bit resolution for diagnostics and detectors from Struck Innovative Systems

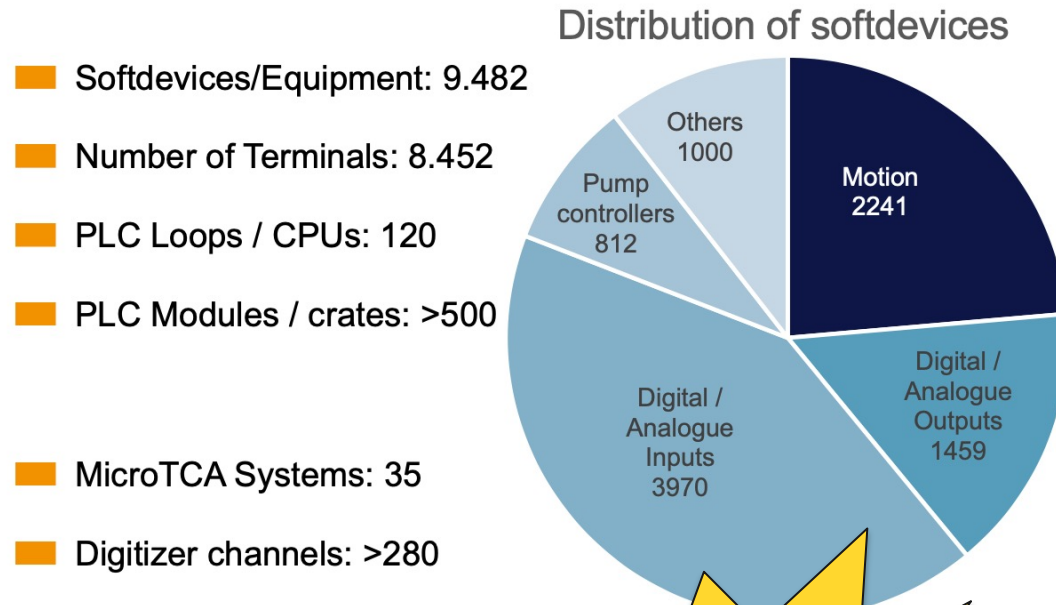


ADQ412/ADQ14/ADQ7
High-speed digitizers from 1.8GSPS to 10GSPS with 12 to 14 bit resolution from Teradyne SP Devices

**1 MB/s - 1 GB/s
10 Hz burst**

The European XFEL – a Data Perspective

PLC Systems at EU.XFEL

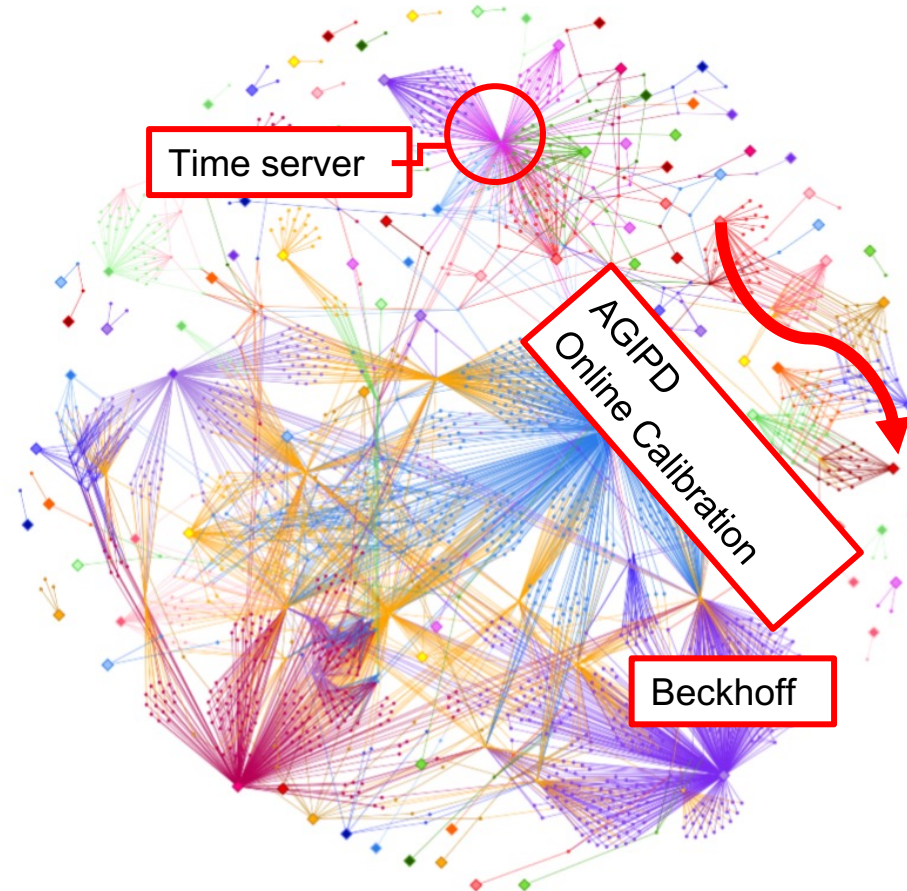


- Softdevices/Equipment: 9.482
- Number of Terminals: 8.452
- PLC Loops / CPUs: 120
- PLC Modules / crates: >500
- MicroTCA Systems: 35
- Digitizer channels: >280

**1 B/s - 1 MB/s
event driven**

The European XFEL – a Data Perspective

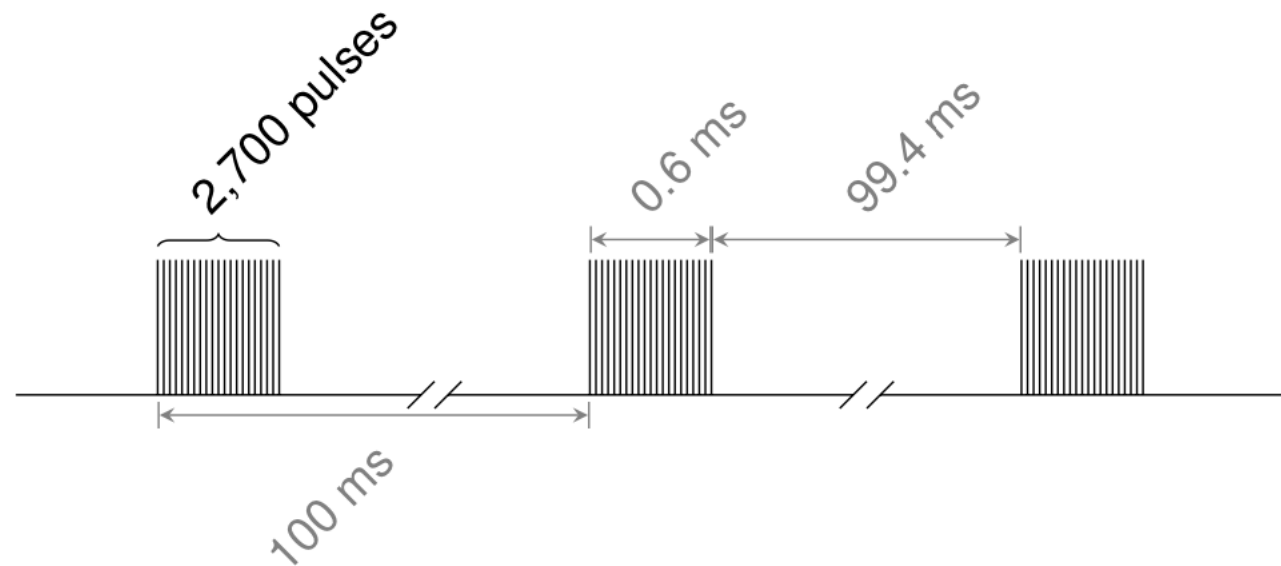
The Karabo Control System for the MID instrument



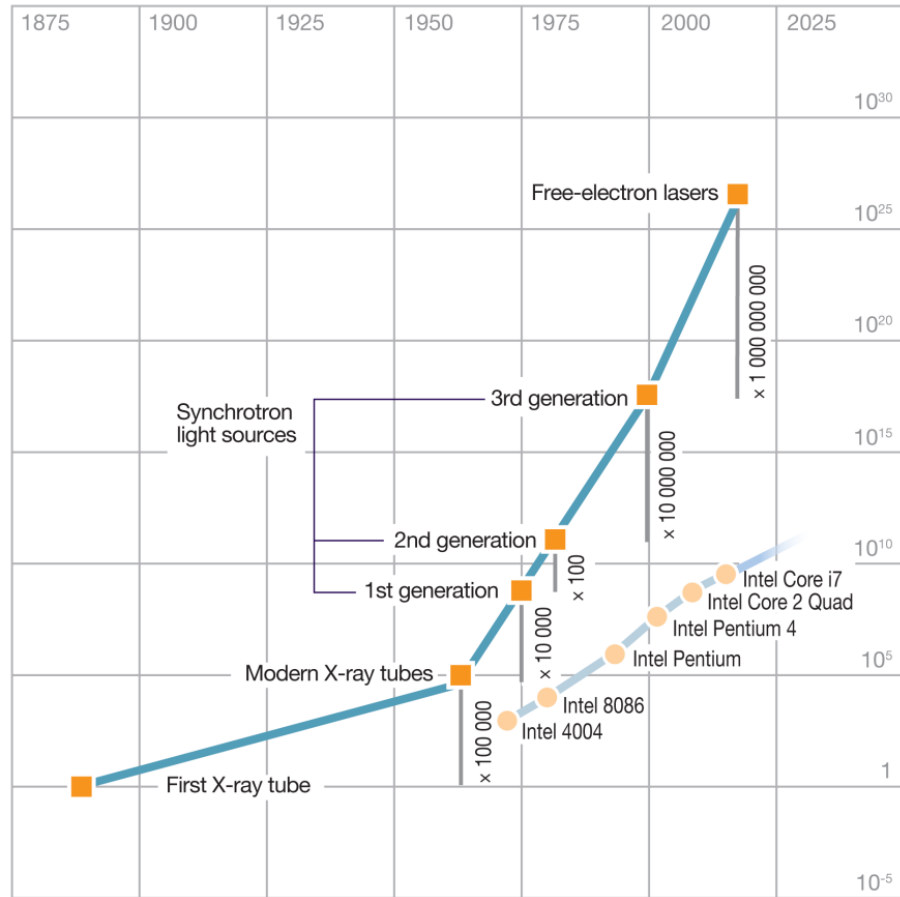
topic	# properties	# devices
LA1	26914.0	257.0
LA2	28103.0	250.0
LA3	32013.0	298.0
SA1	192656.0	1588.0
SA2	274426.0	2260.0
SA3	233216.0	1886.0
FXE	121905.0	905.0
HED	268688.0	1892.0
MID	258094.0	1789.0
SCS	205557.0	1444.0
SPB	267424.0	1872.0
SQS	306817.0	1954.0
Total	2215813.0	16395.0

European XFEL – Time Structure

- * 10 Hz base structure
- * Up to 4.5 MHz burst
- * Readout of pulse resolving detectors in the 99.4 ms gap
- * → Bursts of up 20 Gb/s data for MHz detectors
- * → 10 Hz or event driven updates for everything else



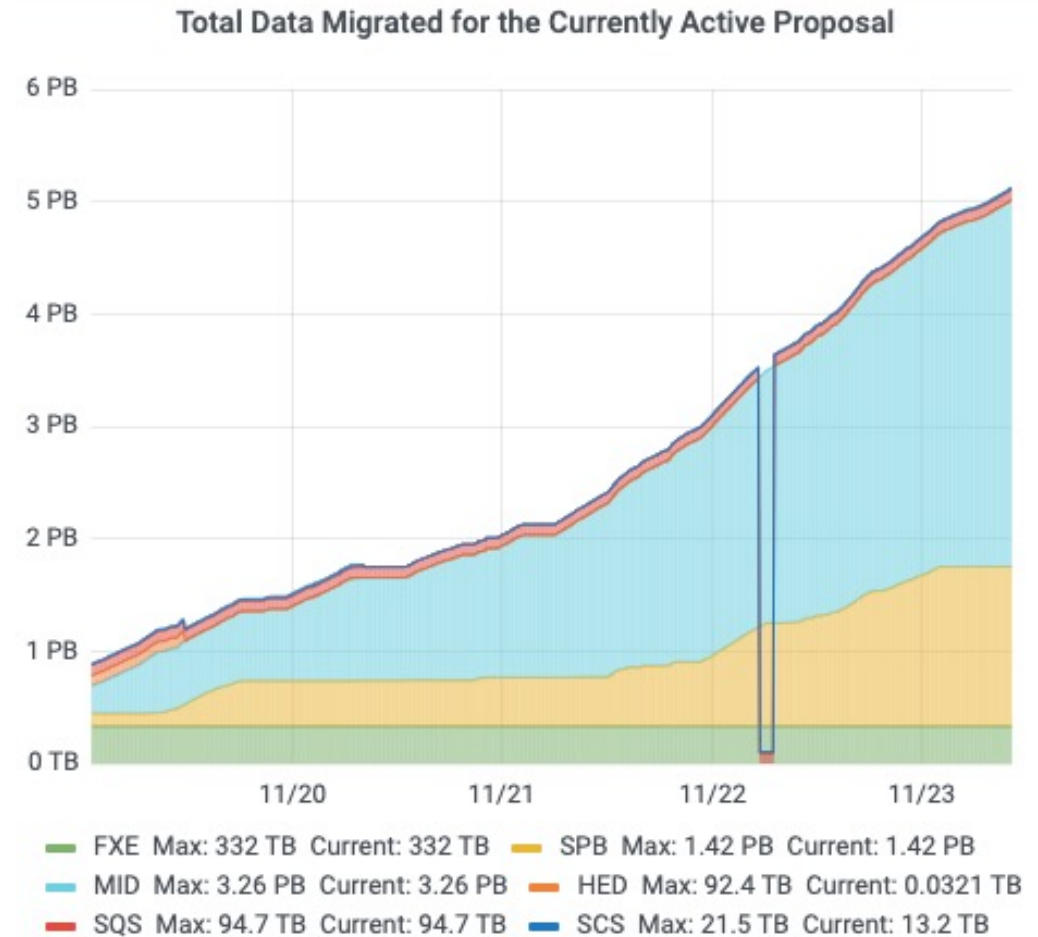
The European XFEL – a Data Perspective



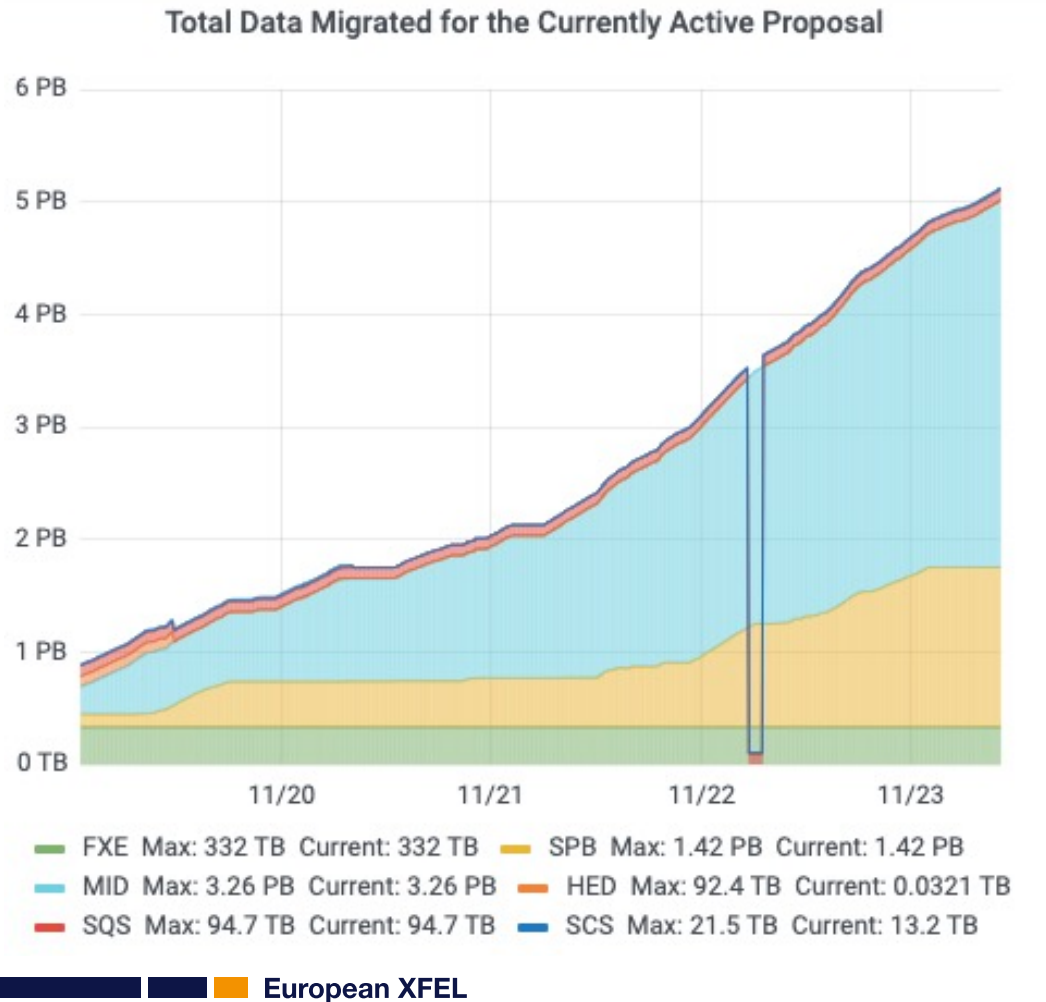
— Relative peak brilliance (first X-ray tube = 1)
 — Number of transistors in processors

European XFEL

Data Produced in CW46 2021 – All Data Systems Working



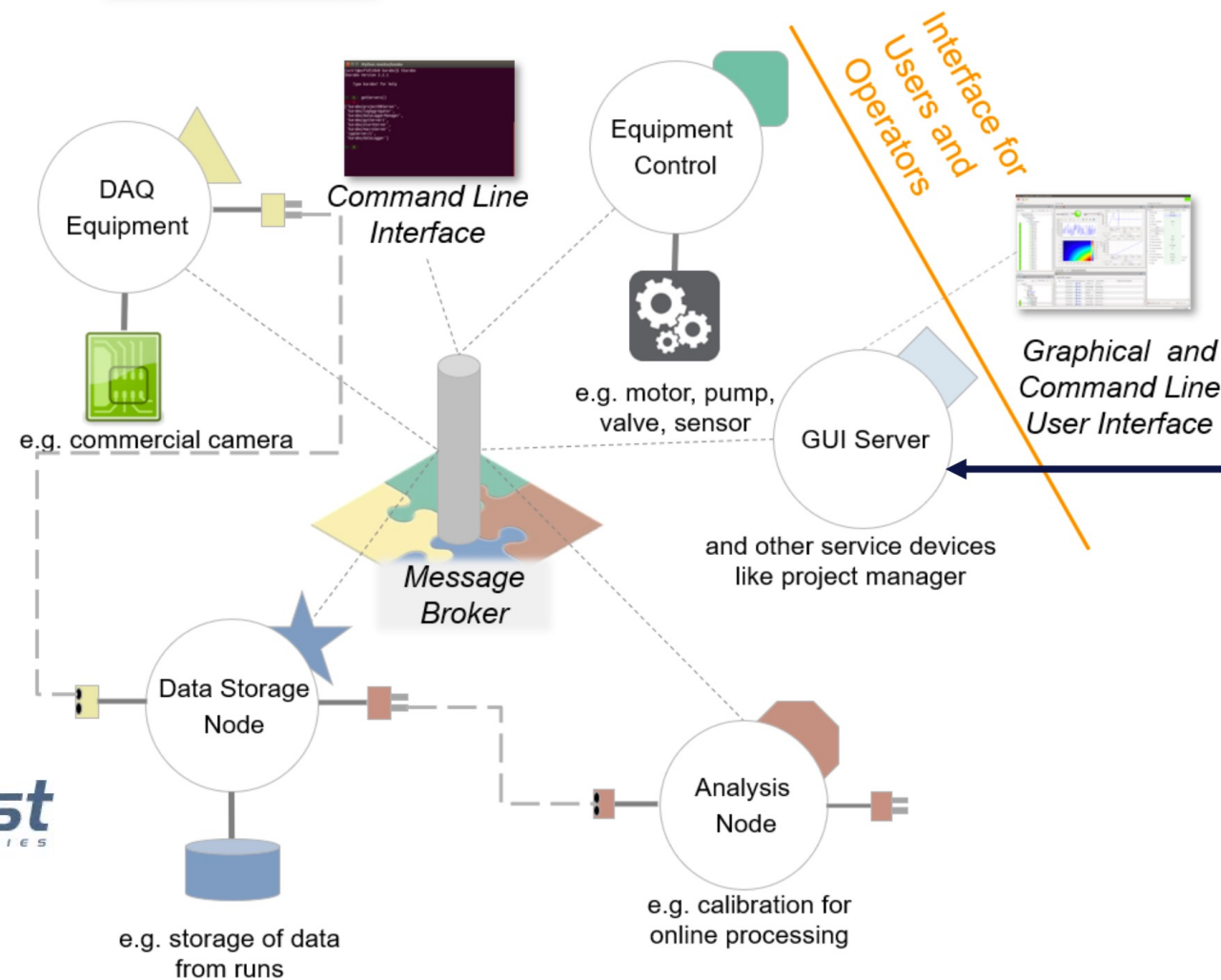
The European XFEL – a Data Perspective



If data services are working, facilities like EU.XFEL easily produce scientific data in the Peta-Byte range in a few days

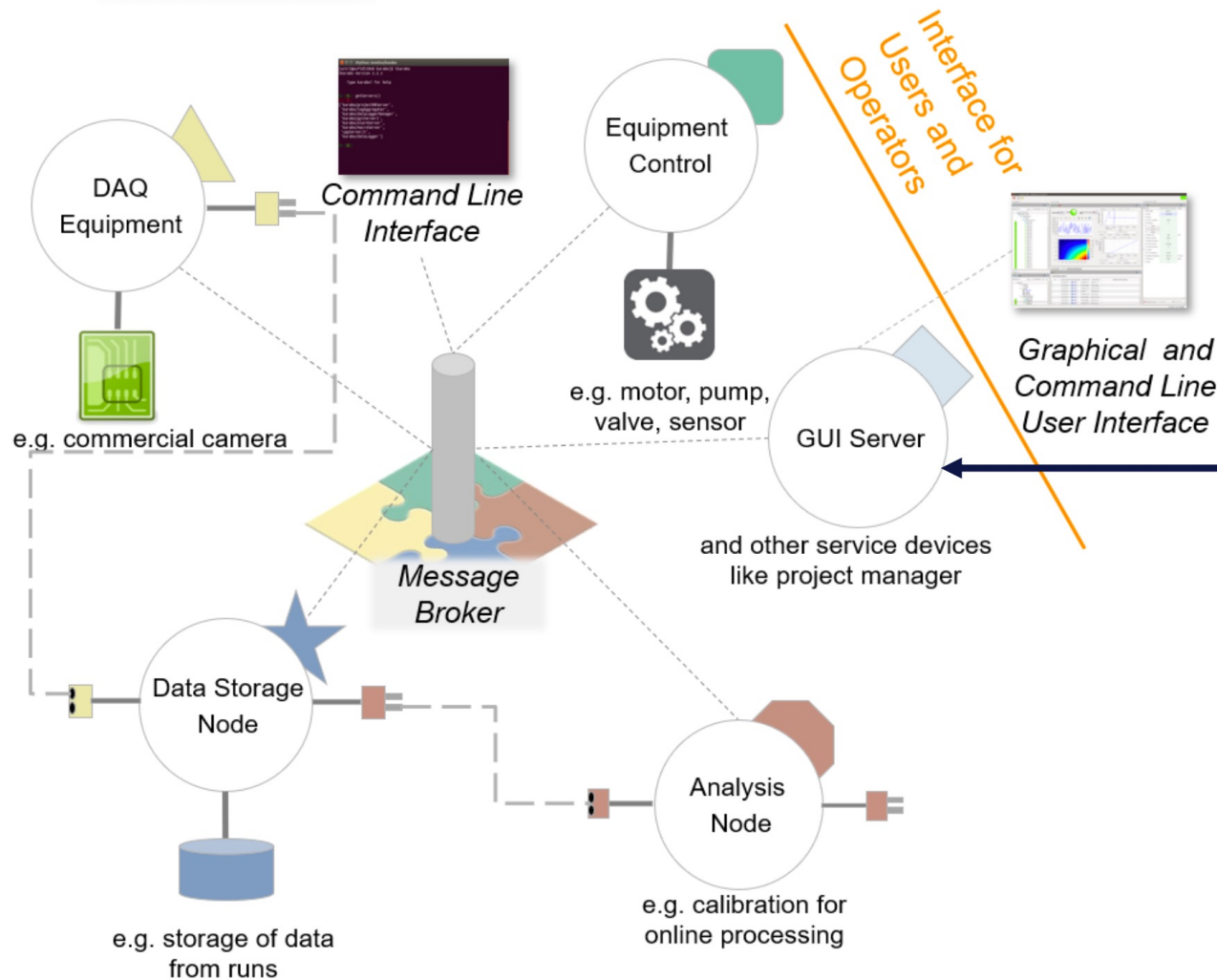
Karabo - Architecture

- * Central Message Broker (Control and slow data)
 - * Currently: OpenMQ
 - * Soon RabbitMQ.
- * Event driven:
 - * Data propagates through the system when values change – push not poll
- * Message driven:
 - * Signal – Slot paradigm
 - * Asynchronous core, synchronous convenience in middleware



Karabo - Architecture

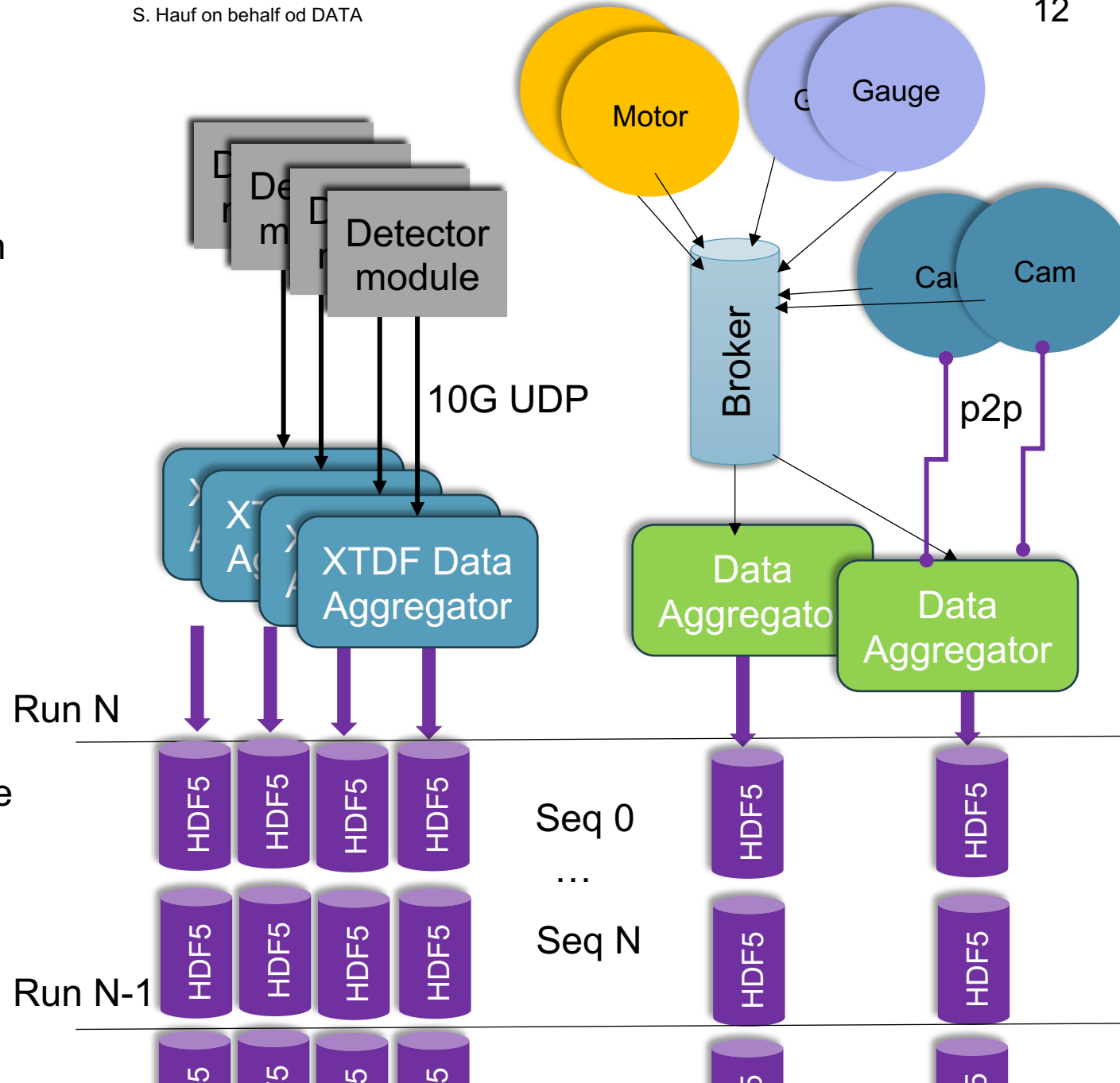
- * pipeline (p2p) connections (scientific/large) data
 - * Scatter/Gather/Copy/Distribute
 - * Block/Drop on congestion
 - * TCP
 - * Also GUI Server – GUI client
 - * Capable of saturating a 10G line
- * Dynamic, discoverable topology
 - * No central database instance
- * GUI Server:
 - * Gateway to the Control system



Centralized Data Acquisition

- * Central DAQ instance per instrument/installation
- * Distributed "Data Aggregators"
 - * 1 per MHz detector module (e.g. 16 total)
 - * ~5-10 for remaining data
 - ▶ Fast pipeline data: Imagers, digitizers
 - ▶ Slow broker data
- * Data acquisition is run-based. A run is a period of (semi-) static experimental conditions
 - * Importantly, data shapes* and Karabo device schema do not change

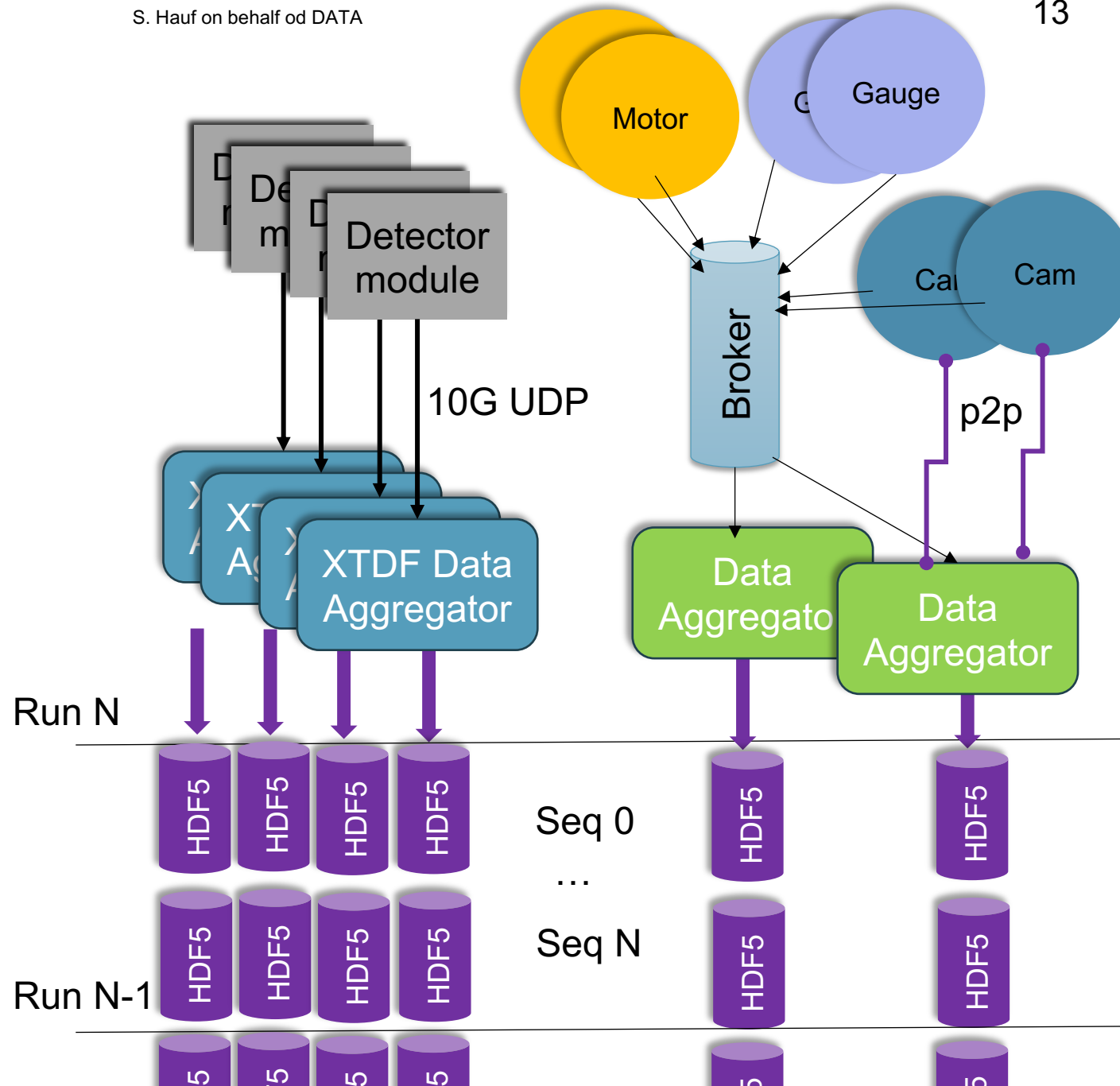
* Except along pulse axis



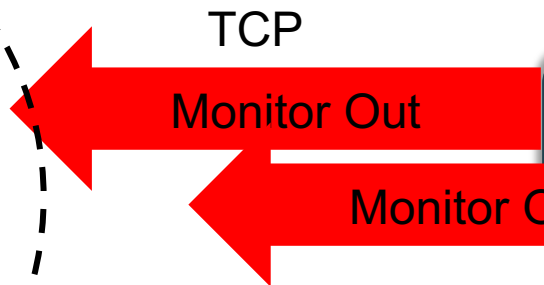
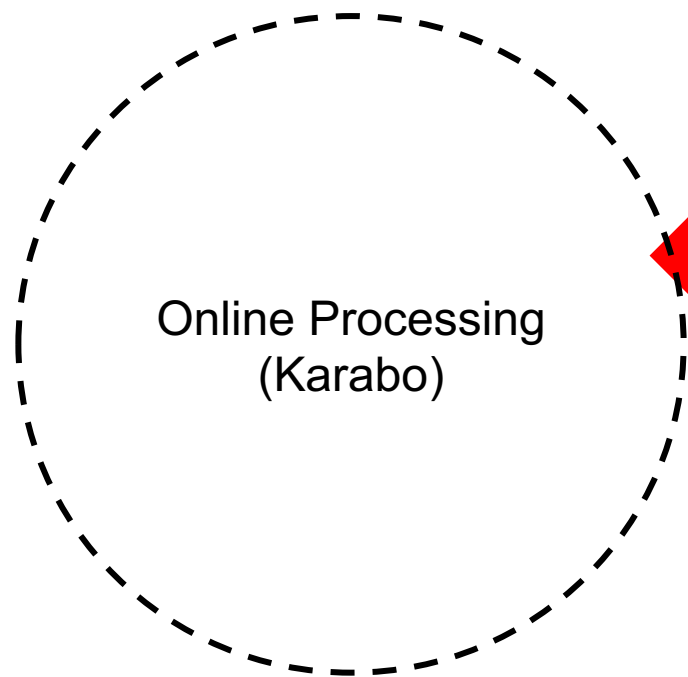
Centralized Data Acquisition

- * Implemented as Karabo Devices (C++)
- * Up to ~30 GB/s for a full installation
- * Single aggregator can handle a few 1000 slow control properties
- * Within one sequence file all sources are aligned by train id in the rows of the HDF5 tables
- * Current work: refactoring to facilitate integration of online data reduction using RDMA offloading of processing.

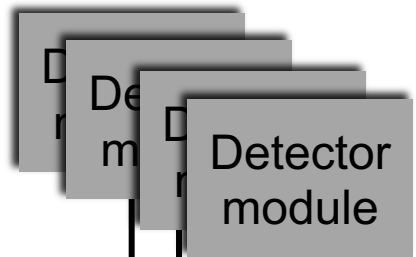
Contacts: Alessandro Silenzi/Dennis Goeries



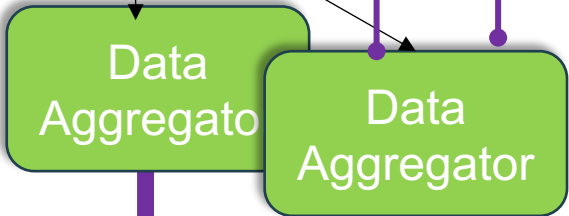
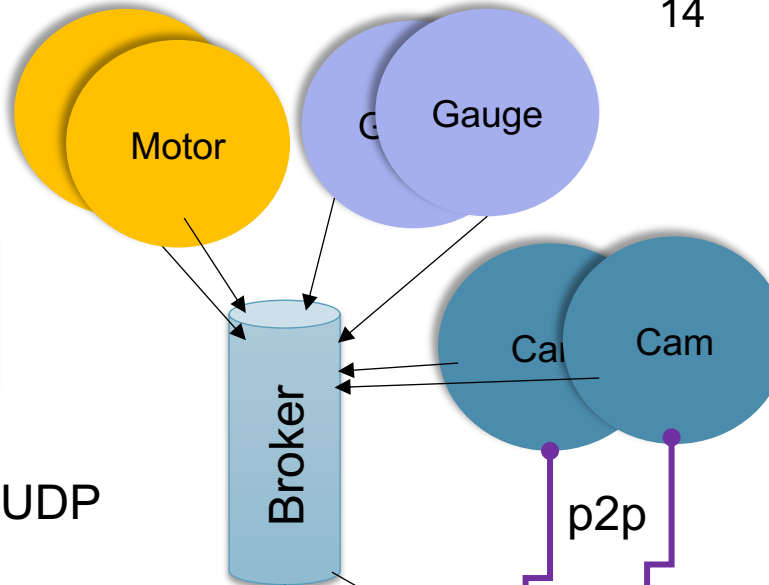
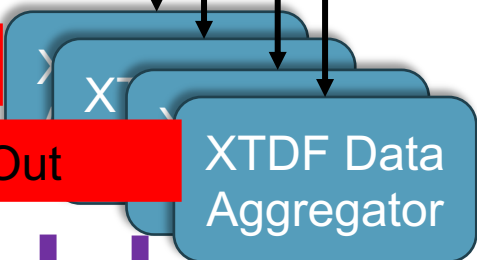
Centralized Data Acquisition



TCP



10G UDP



p2p

Run N



Seq 0

...

Seq N



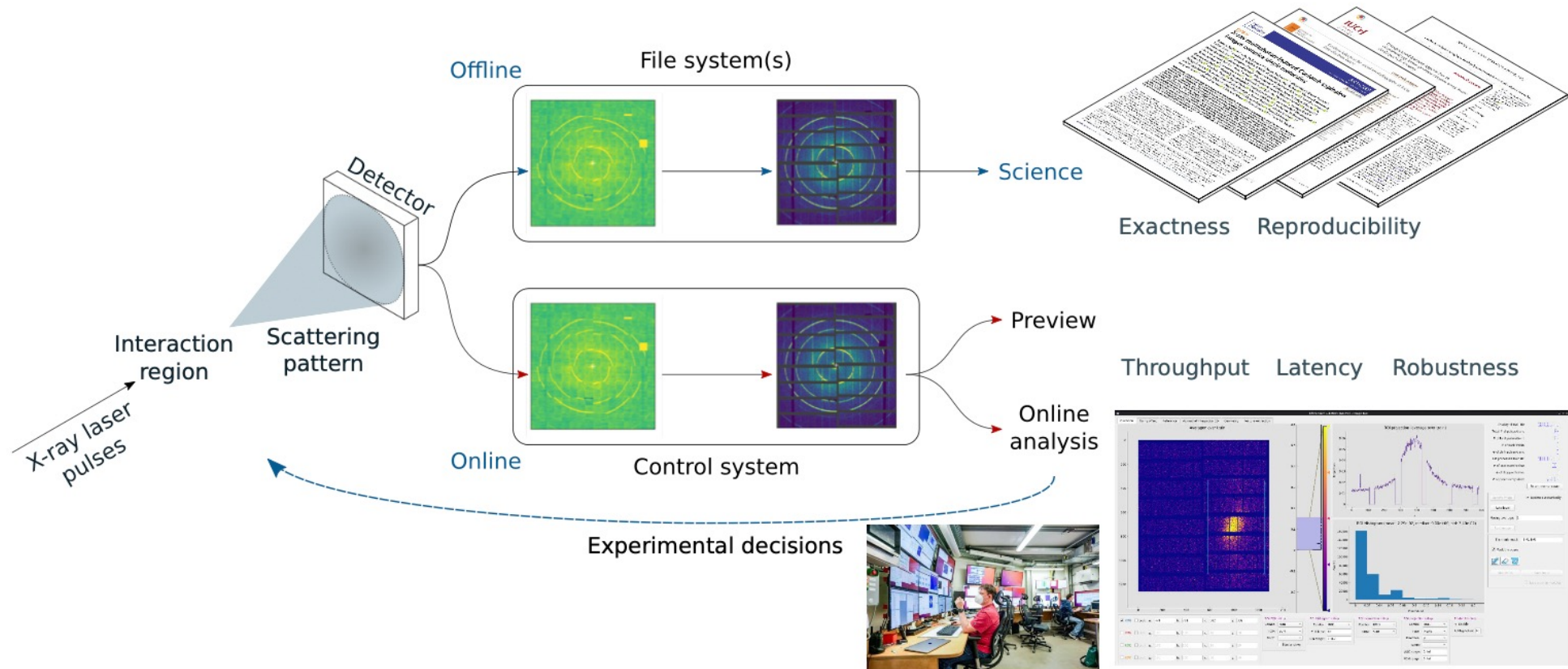
Run N-1



Contacts: Alessandro Silenzi/Dennis Goeries

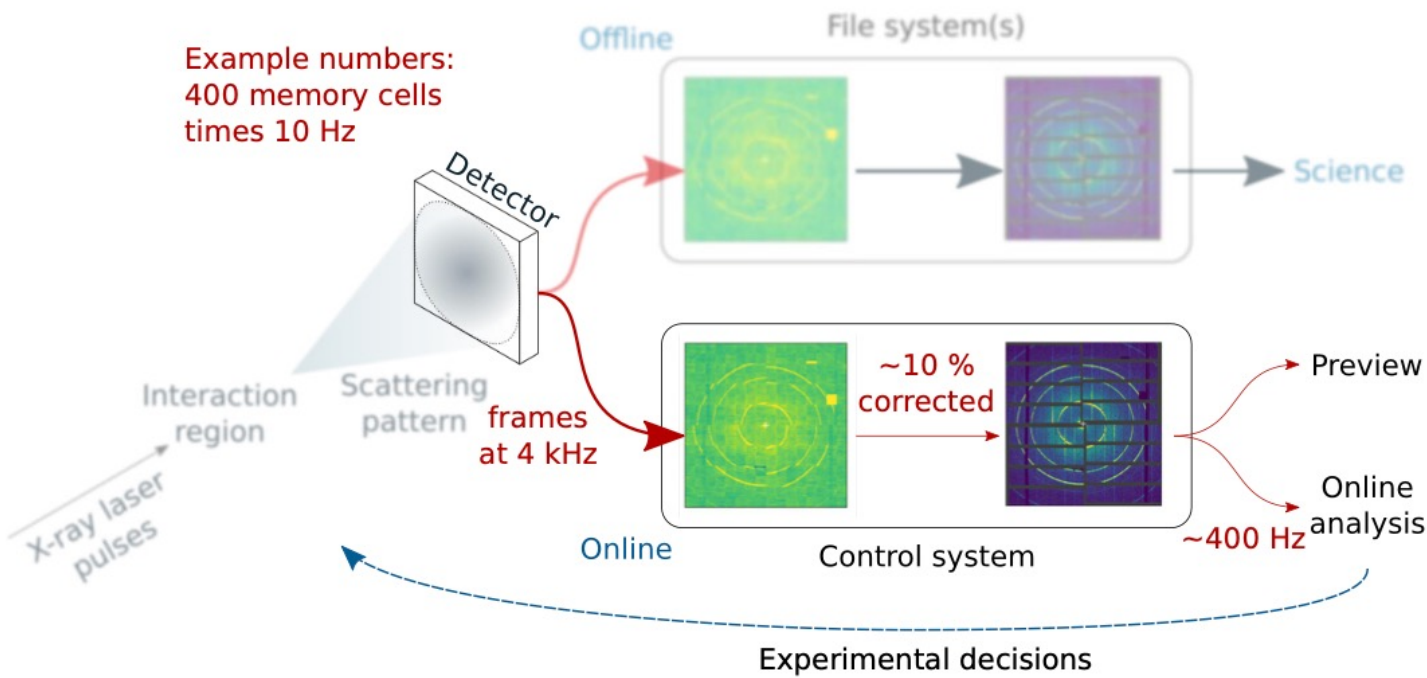
Importance of Facility-Side Processing: Calibration

Offline / online



Importance of Facility-Side Processing: Online Calibration

Bottleneck: initial calibration pipeline



Approximate bandwidth needed for image data + gain information only:

detector	cells	bandwidth	per module
JUNGFRAU 4M	16	16 Gbit/s	2 Gbit/s
DSSC 1M	400	67 Gbit/s	4.2 Gbit/s
LPD 1M	512	86 Gbit/s	5.4 Gbit/s
AGIPD 1M	352	118 Gbit/s	7.4 Gbit/s
DSSC 1M	800	134 Gbit/s	8.4 Gbit/s

Can correction be made to keep up?

Throughput
Latency
Robustness

Contact: David Hammer (Data Analysis)

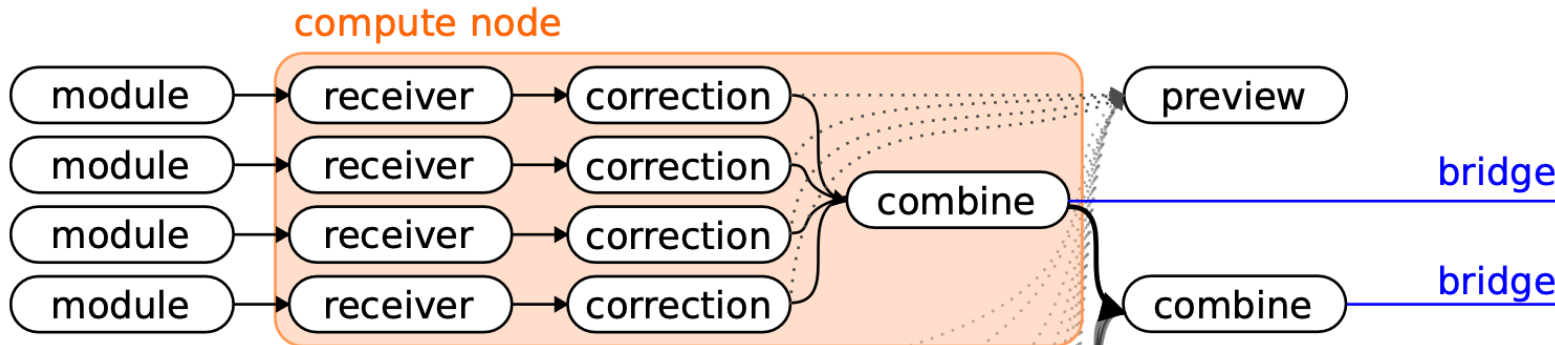
Importance of Facility-Side Processing: Online Calibration

- Sufficient I/O bandwidth to pass single module data into calibration host
- Once data is on the host, use shared memory and GPU memory to link different correction steps
- Sufficient I/O bandwidth to pass single module data from calibration host to online processing code.

Approximate bandwidth needed for image data + gain information only:

detector	cells	bandwidth	per module
JUNGFRAU 4M	16	16 Gbit/s	2 Gbit/s
DSSC 1M	400	67 Gbit/s	4.2 Gbit/s
LPD 1M	512	86 Gbit/s	5.4 Gbit/s
AGIPD 1M	352	118 Gbit/s	7.4 Gbit/s
DSSC 1M	800	134 Gbit/s	8.4 Gbit/s

Can correction be made to keep up?

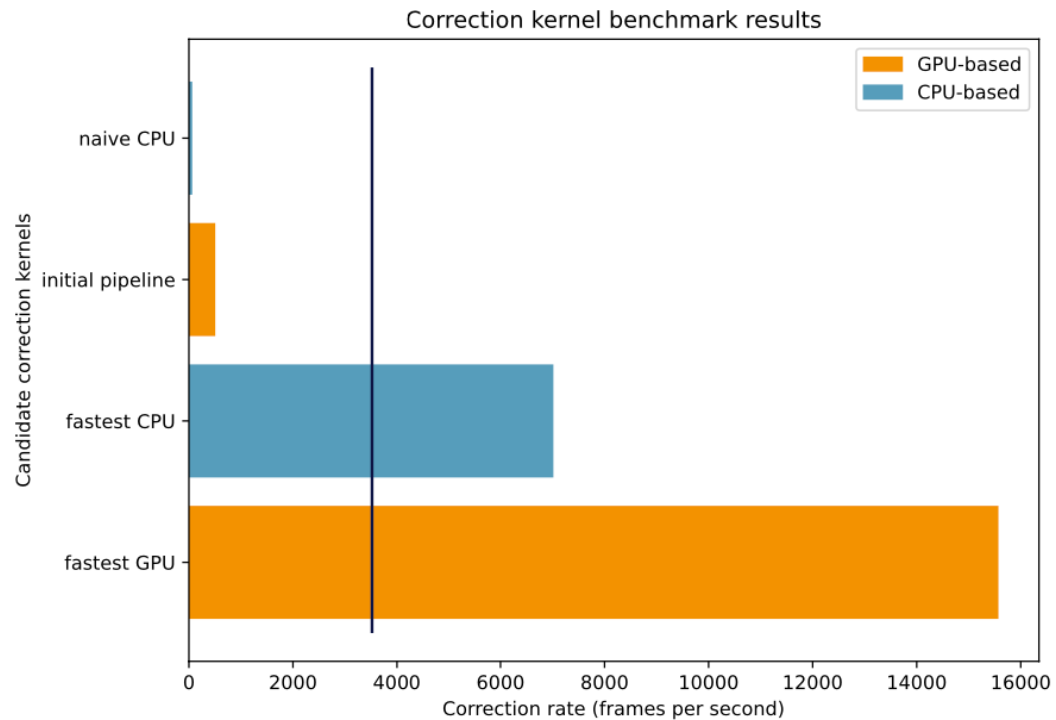


Importance of Facility-Side Processing: Online Calibration

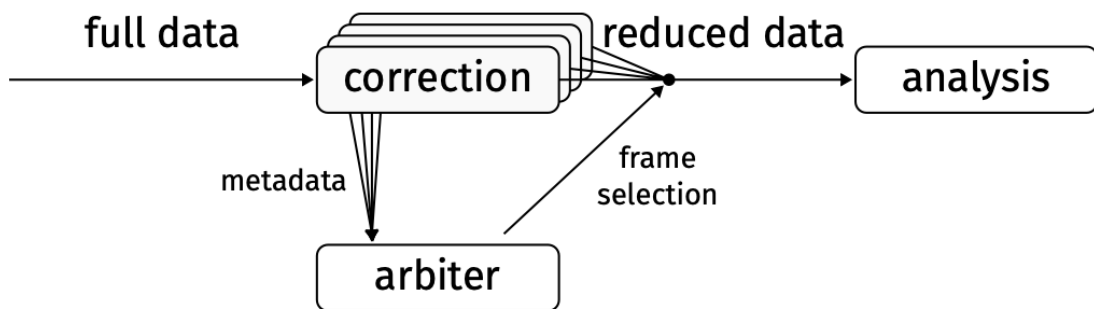
Benchmarks

Initial findings:

- Correction at full speed feasible
 - Test setting: AGIPD with 352 memory cells
- GPUs useful for big detectors
- Can even process more modules per node



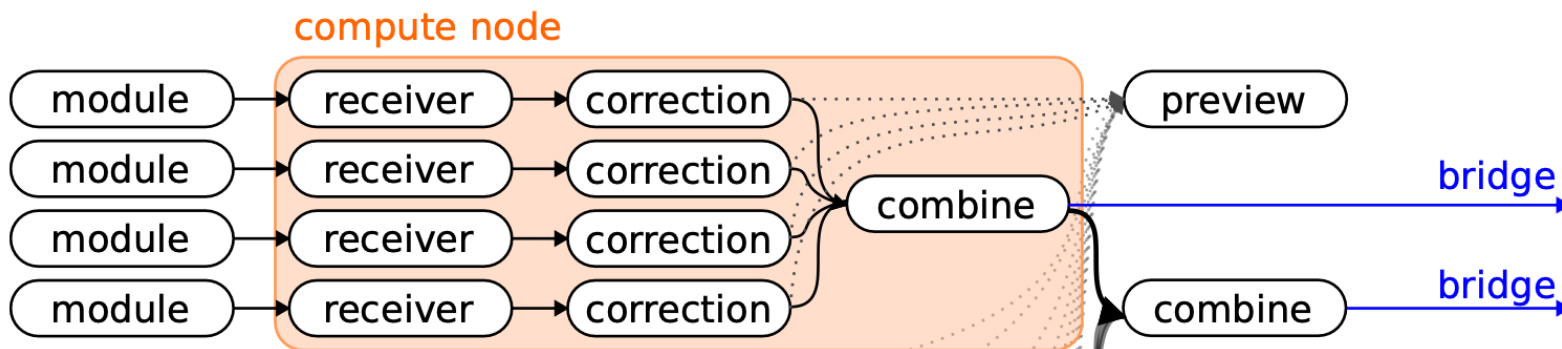
Importance of Facility-Side Processing: Online Calibration and Data Reduction



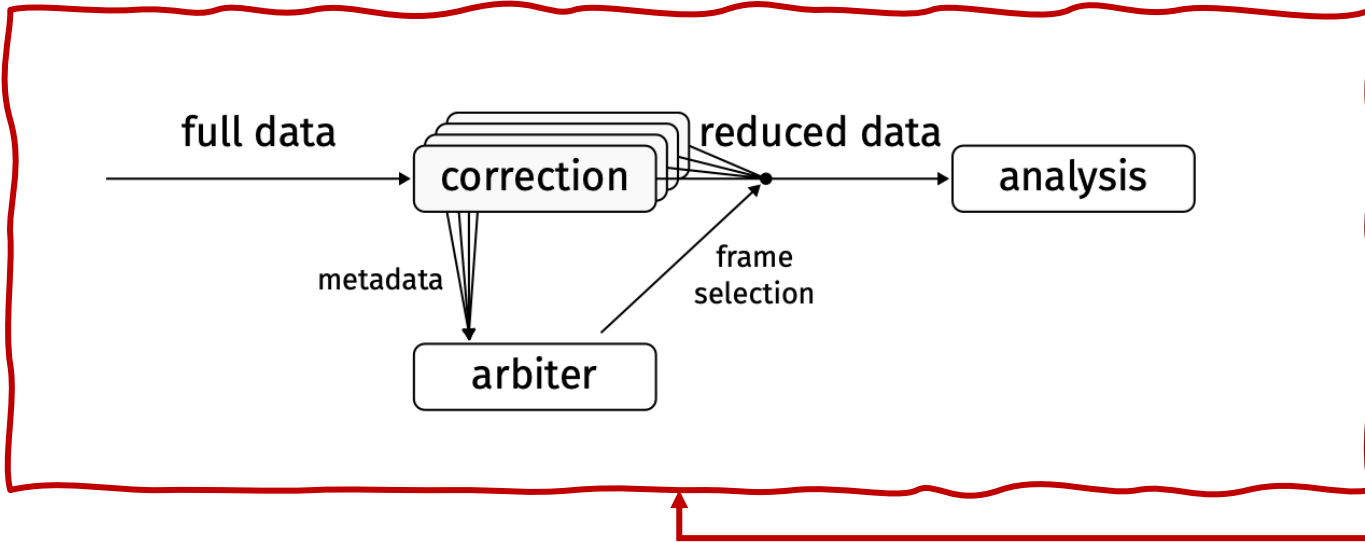
Approximate bandwidth needed for image data + gain information only:

detector	cells	bandwidth	per module
JUNGFRAU 4M	16	16 Gbit/s	2 Gbit/s
DSSC 1M	400	67 Gbit/s	4.2 Gbit/s
LPD 1M	512	86 Gbit/s	5.4 Gbit/s
AGIPD 1M	352	118 Gbit/s	7.4 Gbit/s
DSSC 1M	800	134 Gbit/s	8.4 Gbit/s

Can correction be made to keep up?



Importance of Facility-Side Processing: Online Calibration and Data Reduction



Approximate bandwidth needed for image data + gain information only:

detector	cells	bandwidth	per module
JUNGFRAU 4M	16	16 Gbit/s	2 Gbit/s
DSSC 1M	400	67 Gbit/s	4.2 Gbit/s
LPD 1M	512	86 Gbit/s	5.4 Gbit/s
AGIPD 1M	352	118 Gbit/s	7.4 Gbit/s
DSSC 1M	800	134 Gbit/s	8.4 Gbit/s

Can correction be made to keep up?

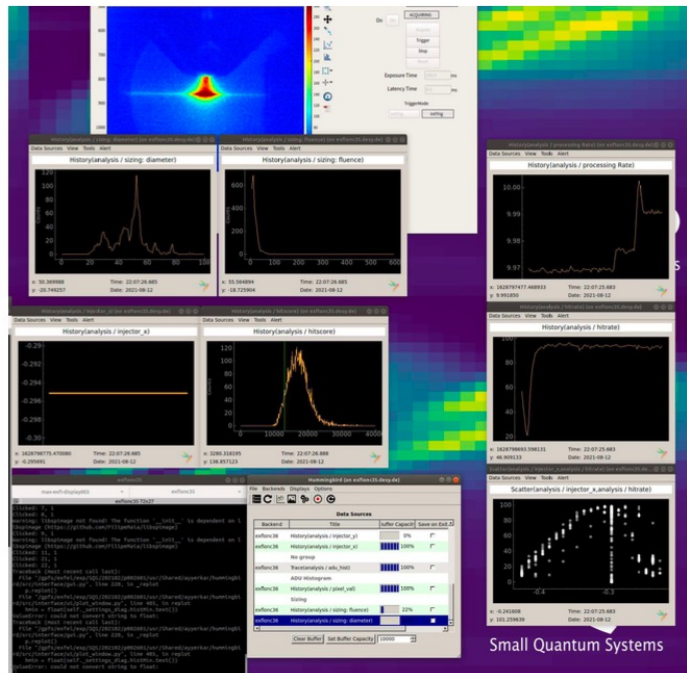
- Sufficient I/O bandwidth to pass single module data into calibration host
- However, data serialization to transfer via TCP takes too long to scale to all modules of a Mpixel detector
- Solution (work in progress): RDMA via Infiniband: 80Gbit/s on 100 Gbit/s link from Karabo device to Karabo device for ~100MB images stacks.



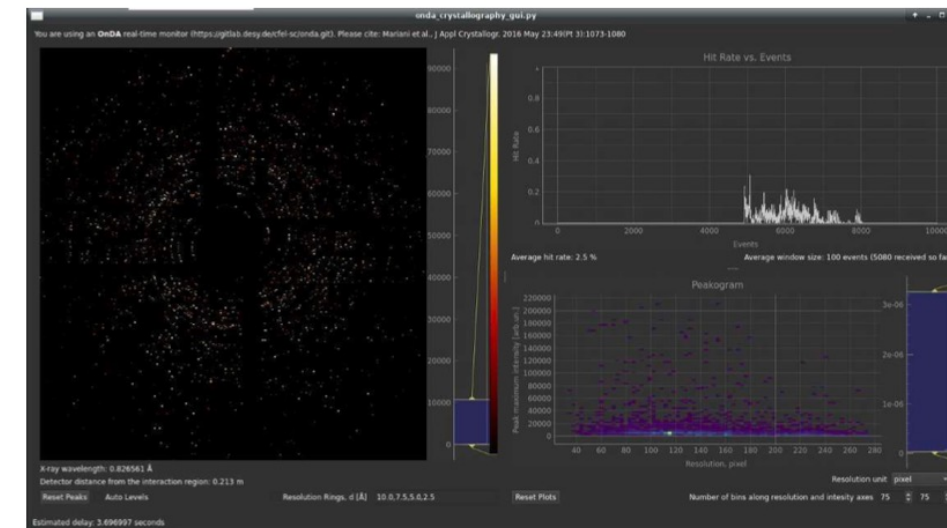
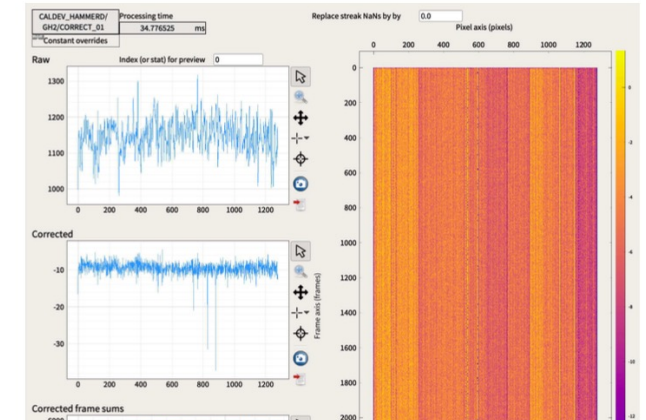
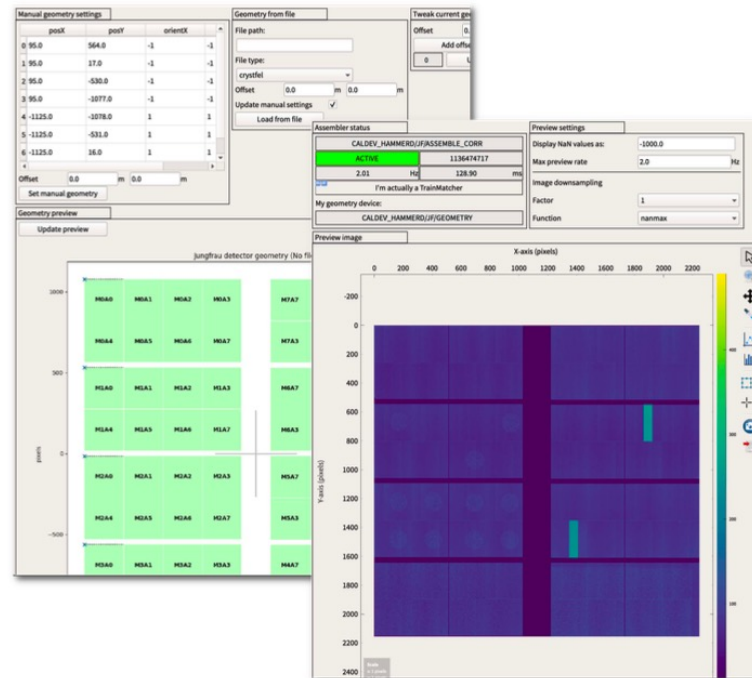
Importance of Facility-Side Processing: Online Processing Tools (Gallery)

Gotthard II: Commissioning GUI

DSSC: 4000 frames/s into Hummingbird



Jungfrau 4M: geometry assembly



Data Management Activities using myMdC

- Preparation for beamtime (storage folders, LDAP,...)
- Catalog and document the data generated
- Data migration services
- Keep track of data location
- Allow data publishing and export
- Manage permissions and accesses to the data in an uniform manner and guarantee that only authorized people have access to the data

Proposal no. 900054

myMdc Proposals' Beamline status workflow

Run Number (alias)	Run type	Sample Name	Start date	Run status	Data Assessment	Calibration
0082	Test DAQ	No Sample	2019-01-23 14:20:18 +0100	Closed	Unknown/Unclear	<input type="checkbox"/>
0081	Test DAQ	No Sample	2019-01-23 12:10:47 +0100	Closed	Run Quality -	(Re)calibra
0080	Test DAQ	No Sample	2019-01-23 03:13:08 +0100	Closed	Unknown/Unclear	<input type="checkbox"/>
0079	Test DAQ	No Sample	2019-01-22 14:29:27 +0100	Closed	Unknown/Unclear	<input type="checkbox"/>
0078	Test DAQ	No Sample	2019-01-22 14:16:09 +0100	Closed	Unknown/Unclear	<input type="checkbox"/>
0077	Test DAQ	No Sample	2019-01-22 14:07:09 +0100	Closed	Unknown/Unclear	<input type="checkbox"/>
0076	Test DAQ	No Sample	2019-01-22 13:44:21 +0100	Closed	Run Quality -	<input type="checkbox"/>

The workflow diagram shows a sequence of steps: S (Start) -> SDC -> DDC -> WDFC -> DDFC -> DRVA -> DRVC -> DRNC -> DRDC -> R -> A -> I -> F -> FB -> WCLD -> CLO. A legend on the right defines the steps: S: Run, WCL: Waiting LAMP Configuration, SDC: SDC Configuration Done, WDFC: Waiting DDFC Configuration, DDFC: DDFC Configuration Done, WDFC: Waiting DRVA Configuration, DRVA: DRVA Configuration Done, DRVA: DRVA Configuration Not Approvable, R: Ready, A: Active, I: Idle, F: Beamline Reversed, FB: Full Beamline Reversed, WCLD: Waiting EPFD Online Folder Removal, CLO: Closed, C: Cancelled, T: End.

■ Data Retention Policies control and execution

- Data Quality Assessment
- Data Calibration
- Data Archiving
- Data Cleanup

Contact: Luis Maia (ITDM)

Data Management and Data Migration

- Runs which are assessed as Good or Unclear are preserved long term and accessible from Maxwell cluster and by export services.

The screenshot displays the 'Runs' tab in a data management system. It features a navigation bar with tabs for 'General', 'Public Information', 'Runs', 'Logbook', 'Team', 'Repositories', 'Calibration Constants', 'Publication', and 'History'. The 'Runs' tab is active, showing a section for 'Proposal Runs' with a 'globus' icon and a refresh button. Below this, there are two informational messages: one about automatically assessing new runs as 'Good (migrate data to Maxwell)' and another about automatically starting run calibration after migration, with a note that calibration will not occur for 'Darks' or 'Test experiments' types.

A table lists several runs with columns for Run Number (alias), Run type, Sample Name, Techniques, Start date, Run status, Data Assessment, Calibration, Run Comment, and Edit. The runs shown are 0250, 0249, 0248, 0247, and 0246, all of type 'LCP SFX' and sample 'KR2'. Run 0250 is 'New (ongoing)', while the others are 'Closed'. Data Assessment for 0249-0246 is 'Good'. The 'Calibration' column shows 'Run in progress' for 0250 and various icons for the others.

Below the 'Proposal Runs' section, there is another table with columns for Run Number (alias), Run type, Sample Name, Techniques, Start date, Run status, Data Assessment, Calibration, Run Comment, and Edit. This table shows three 'Test DAQ' runs (0003, 0002, 0001) with 'No Sample' and 'Closed' status. The 'Data Assessment' column for these runs has a dropdown menu open, showing options: 'Run Quality', 'Good (migrate data to Maxwell)', 'Unclear (migrate data to Maxwell)', and 'Not interesting (data won't be migrated to Maxwell)'. The 'Calibration' column for these runs shows a square icon.

DOI workflow

- DOI automatically registered for proposal data after proposal reached status Finished and Reviewed

General Public Information Runs Logbook Team Repositories **Beta!** Calibration Constants Publication History

General

#id: 875
 DOI: 10.22003/XFEL.EU-DATA-003492-00 Internal Only: DOI not searchable in Metadata
 Proposal Number: 003492
 Name: p003492
 Title: Time-resolved structural studies of optogenetic tools at European XFEL (derived from 2805)
 URL: <https://in.xfel.eu/upex/proposal/3492/view>
 Abstract: Rhodopsins are the most universal biological light-energy transducers and abundant phototrophic mechanisms evolve



General Public Information Runs Logbook Team Repositories **Beta!** Calibration Constants Publication History

General

#id: 866
 DOI: 10.22003/XFEL.EU-DATA-003493-00 DOI Published
 Proposal Number: 003493
 Name: p003493
 Title: Dynamics in supercooled liquids using hard X-ray self-seeding (derived from 2843)
 URL: <https://in.xfel.eu/upex/proposal/3493/view>
 Abstract: One of the long-standing problems in condensed matter science is the origin of the glass transition, i.e. the observation



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The DOI® System

ISO 26324



Resolve a DOI Name

Type or paste a DOI name, e.g., 10.1000/xyz123, into the text box below. (Be sure to enter all of the characters before and after the slash. Do not include extra characters, or sentence punctuation marks.)

Clicking on a DOI link (try this one: <https://doi.org/10.1109/5.771073>) takes you to one or more current URLs or other services related to a single resource. If the URL s

[REGISTER](#) [LOGIN](#)



Proposal no. 002012

DOI: 10.22003/XFEL.EU-DATA-002012-00
 Proposal Number: 002012
 Name: p002012
 Title: Serial Femtosecond Crystallography at MHz repetition rates
 Abstract: This community proposal arising out of the SFX-SPB workshop held in December 2016 directly addresses the key issue of high throughput structure determination for maximising the science output from EuXFEL.
 We will
 (1) Establish sample delivery methods suitable for the MHz repetition rates;
 (2) Exploit these techniques to establish high throughput serial crystallography; and
 (3) Obtain the first new structure(s) of biological interest using the EuXFEL.
 Participation is open to anyone who wishes to contribute, results will be shared openly with the community.
 Beamtime 1: 2017-09-14 20:00:00 +0200 - 2017-09-19 08:00:00 +0200
 Beamtime 2: 2018-03-29 20:00:00 +0200 - 2018-04-02 08:00:00 +0200
 Instrument: SPB/SFX SASE1
 Instrument Cycle: 201701
 Principal Investigator: Henry Chapman
 Main Proposer: Anton Barty
 Local Contact: Richard Bean
 Release at: 2021-04-02 08:00:00 +0200
 open data?: No

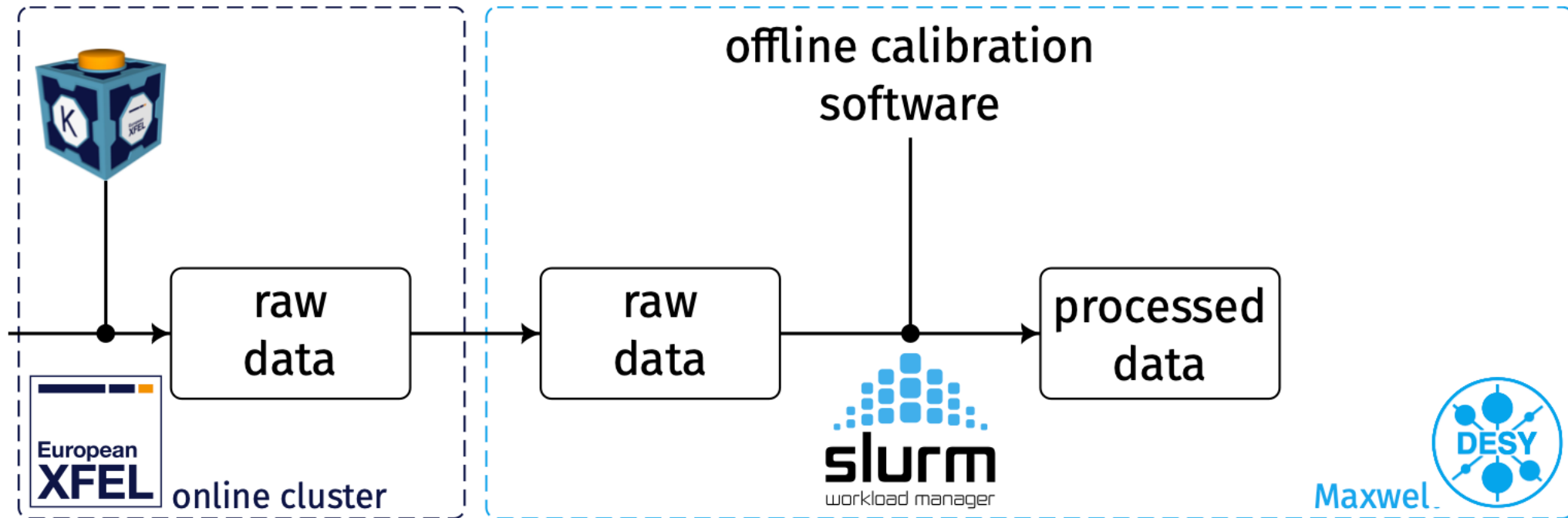
This proposal data is open

Would you like to get access to this proposal datasets?

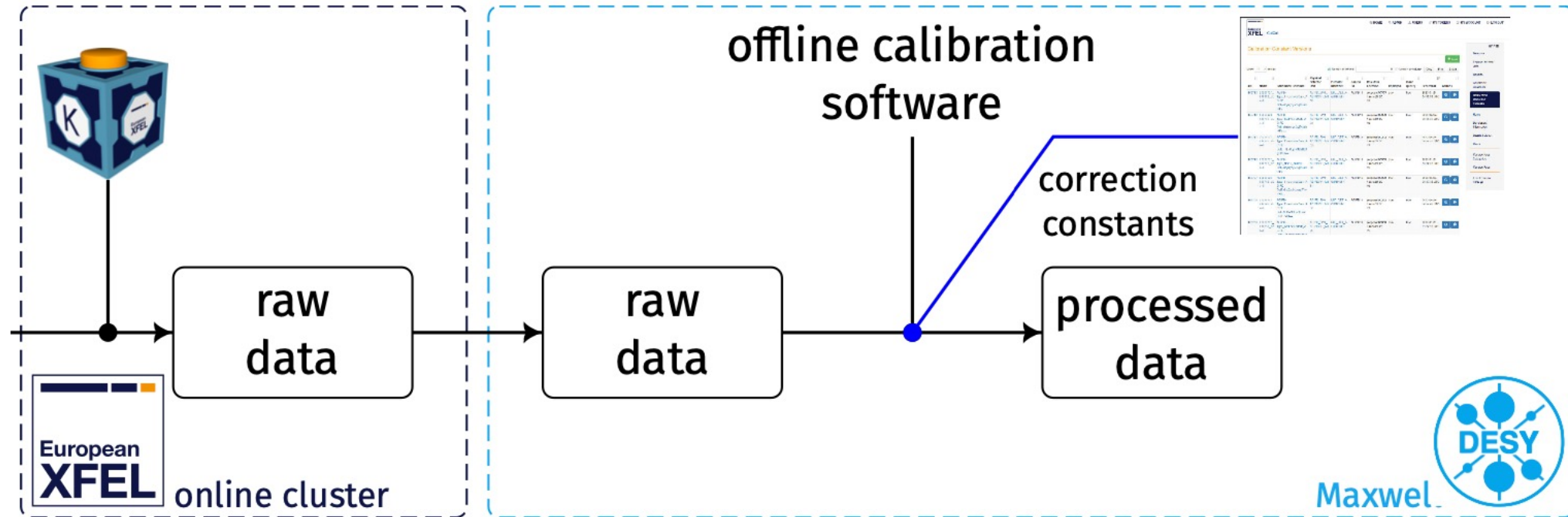
Please contact us through the open.data@xfel.eu email address.

Thank you for visiting!

Importance of Facility-Side Processing: Offline Calibration

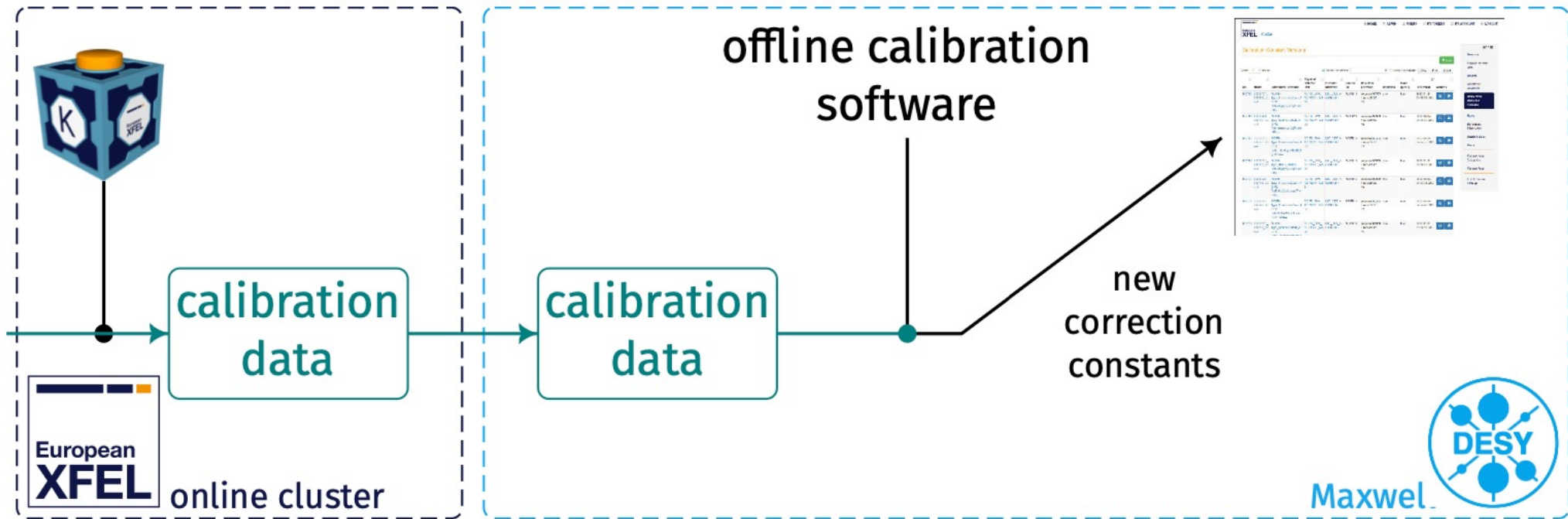


Importance of Facility-Side Processing: Offline Calibration



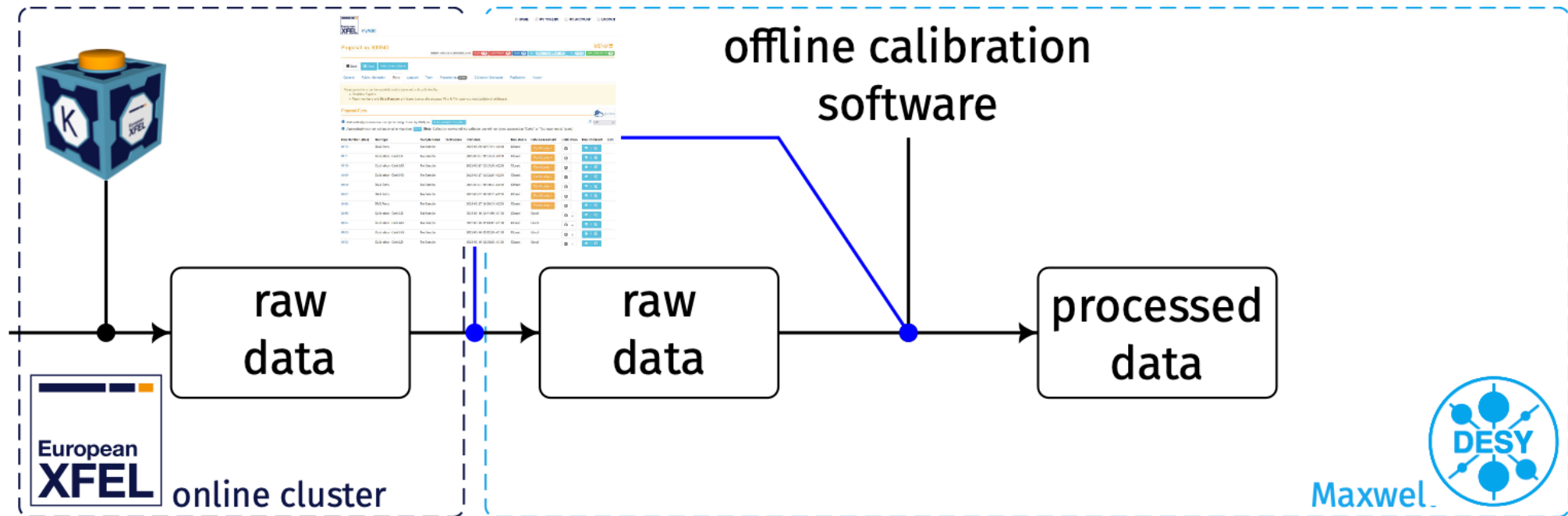
Automated processing: raw to processed data

Importance of Facility-Side Processing: Offline Calibration



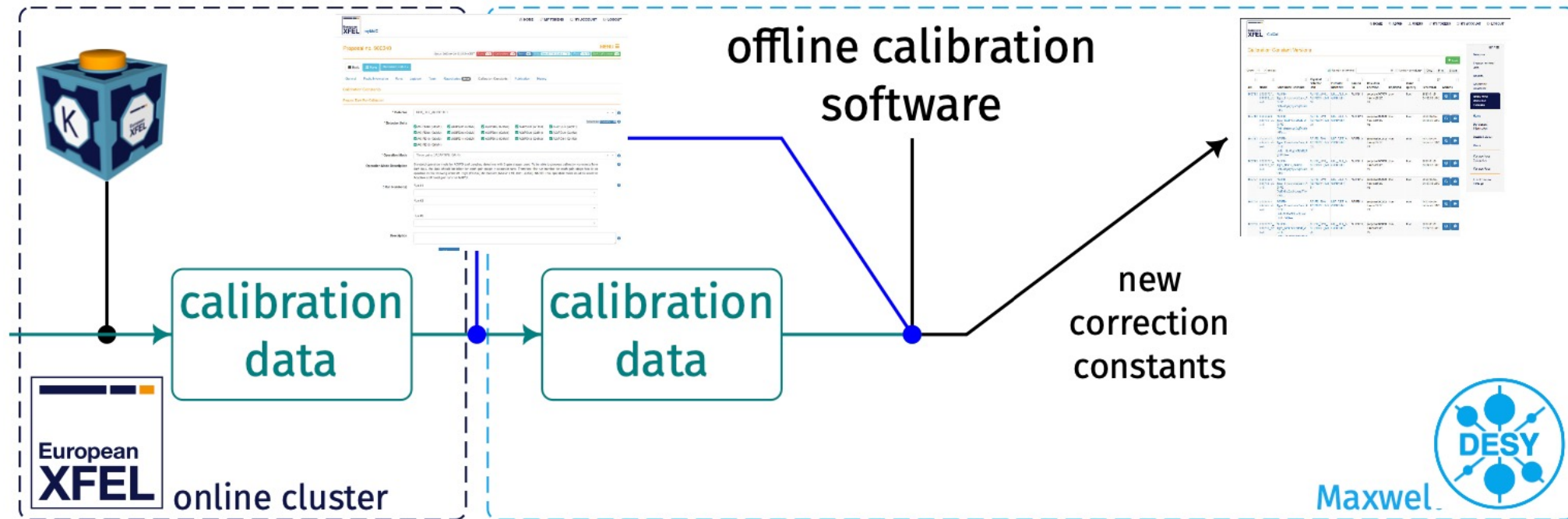
Automated processing: new correction constants

Importance of Facility-Side Processing: Offline Calibration



On-request processing: raw to processed data

Importance of Facility-Side Processing: Offline Calibration



On-request processing: new calibration constants

Importance of Facility-Side Processing: Offline Calibration - Tech Stack



```

AGIPD Offline Correction
Author: European XFEL Detector Group, Version: 2.0
Offline Calibration for the AGIPD Detector

In [ ]: in_folder = "/gpfs/xfel/exp/MID/202301/p003381/raw" # the folder to read data from, required
out_folder = "/gpfs/xfel/data/calibration/output/111700/p003381/0223" # the folder to output to, required
metadata_folder = "" # Directory containing calibration_metadata.pkl when run by xfel-calibrate
sequences = [1] # sequences to correct, set to -1 for all, same allowed
modules = [-1] # modules to correct, set to -1 for all, same allowed
tests_sbs = [-1] # tests to correct, set to -1 for all, same allowed
run = 223 # run to process, required

kazohe_id = "MID_DET_AGPIDM-1" # kazohe kazohe_id
kazohe_ids = [-1] # a list of data aggregator names, default [-1] for selecting all data aggregators
receive_template = "[COMP] # insert for receive device
path_template = "%s-%d-%d-%d-%d-%d" # the template to use to access data
instrument_source_template = "(%d?)(%d?)" # a path in the HDF5 file to images
index_source_template = "(%d?)(%d?)(%d?)" # a path in the HDF5 file to images
ctrl_source_template = "(%d?)(%d?)(%d?)" # a path to control information
kazohe_id_control = "MID_DET_AGPIDM-1" # kazohe_id for control device

slates_ff_from_files = "" # a path to locally stored slatesff and hadfieldslatesff constants, loaded in pre correction notebook

use_dif_creation_date = True # use the creation date of the input dif for database queries
cal_db_interface = "tcp://mysql101.001500045" # the database interface to use
cal_db_timeout = 30000 # in milliseconds
creation_date_offset = "00:00:00" # use an offset to creation date, e.g. to get different constants

mem_cells = 0 # number of memory cells used, set to 0 to automatically infer
bins_outstage = 0 # bins outstage, set to 0 to use second value in size data
acq_rate = 0 # the detector acquisition rate, use 0 to try to auto-determine
gain_setting = -1 # the gain setting, use -1 to use value stored in size data
gain_mode = -1 # gain mode (0: adaptive, 1: Fixed high-resolution, -1: read from CONTROL_data)
slates_energy = 0.0 # slates energy, set to 0 to use value stored in size data


Signal vs. Analogue Gain
In [ ]: hist, bins_x, bins_y = calgs.histogram2d(raw[0,...].flatten(), astype=np.float32,
                                             range=[4000, 8192], [4000, 8192])
du_2d_plot(hist, bins_x, bins_y, "Signal (ADU)", "Analogue gain (ADU)",
           range=[4000, 8192], [4000, 8192])

Signal vs. Digitized Gain
The following plot shows plots signal vs. digitized gain
In [ ]: hist, bins_x, bins_y = calgs.histogram2d(corrected.flatten(), astype=np.float32,
                                             gain.flatten(), astype=np.float32, bins=(100, 3),
                                             range=[-50, 8192], [0, 3])
du_2d_plot(hist, bins_x, bins_y, "Signal (ADU)", "Gain bit value")

Intensity per Pulse
In [ ]: pulse_range = np.min(pulseid[pulseid>0]), np.max(pulseid[pulseid>0])
# Modify pulse_range, if only one pulse is selected
if pulse_range[0] == pulse_range[1]:
    pulse_range = (0, pulse_range[1]+int(acq_rate))

mean_data = np.mean(mean_corrected, axis=(2, 3))
hist, bins_x, bins_y = calgs.histogram2d(mean_data.flatten(), astype=np.float32,
                                       pulseid.flatten(), astype=np.float32,
                                       bins=(100, int(pulse_range[1])),
                                       range=[-50, 1000], pulse_range)
du_2d_plot(hist, bins_x, bins_y, "Signal (ADU)", "Pulse ID")
du_2d_plot(hist, bins_x, bins_y, "Signal (ADU)", "Pulse ID")
  
```

AGIPD Offline Correction



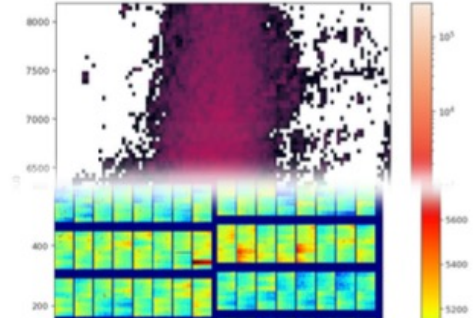
Data department
Based on data sample: /gpfs/xfel/exp/MID/202301/p003381/raw
Release : 3.10.0

CHAPTER ONE

INPUT OF THE CALIBRATION PIPELINE

in folder	"/gpfs/xfel/exp/MID/202301/p003381/raw"	the folder to read data from, required
out folder	"/gpfs/xfel/data/calibration/output/111700/p003381/0223"	the folder to output to, required
metadata folder	""	Directory containing calibration_metadata.pkl

6.3.1 Signal vs. Analogue Gain



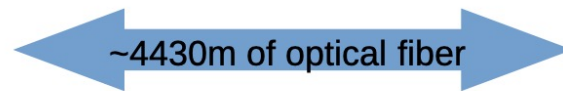
Fully reproducible

Infrastructure locations - overview



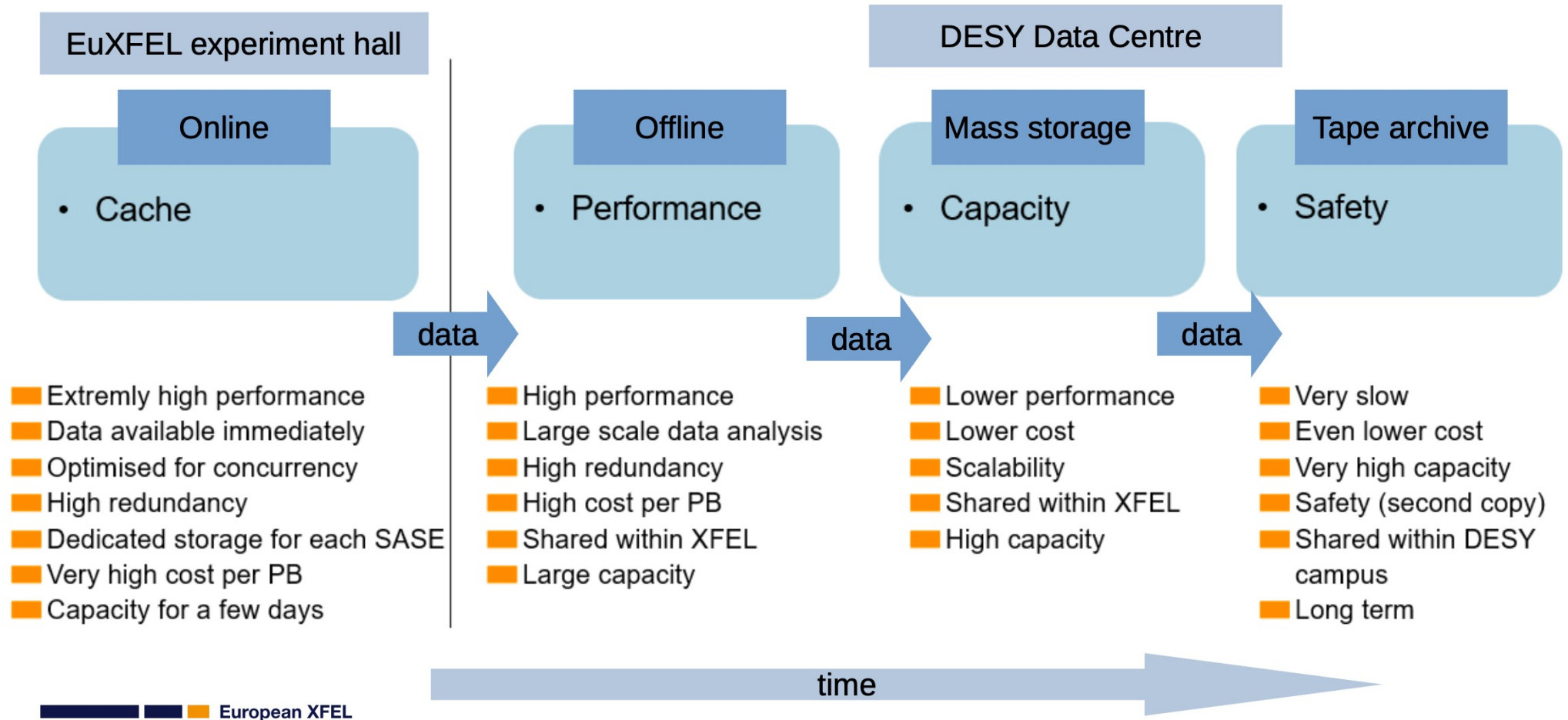
3 computer rooms (red) in the experiment hall at EuXFEL campus, Schenefeld

EuXFEL hardware in DESY Data Centre, Hamburg



Contact: Janusz Malka (ITDM)

European XFEL Storage Overview

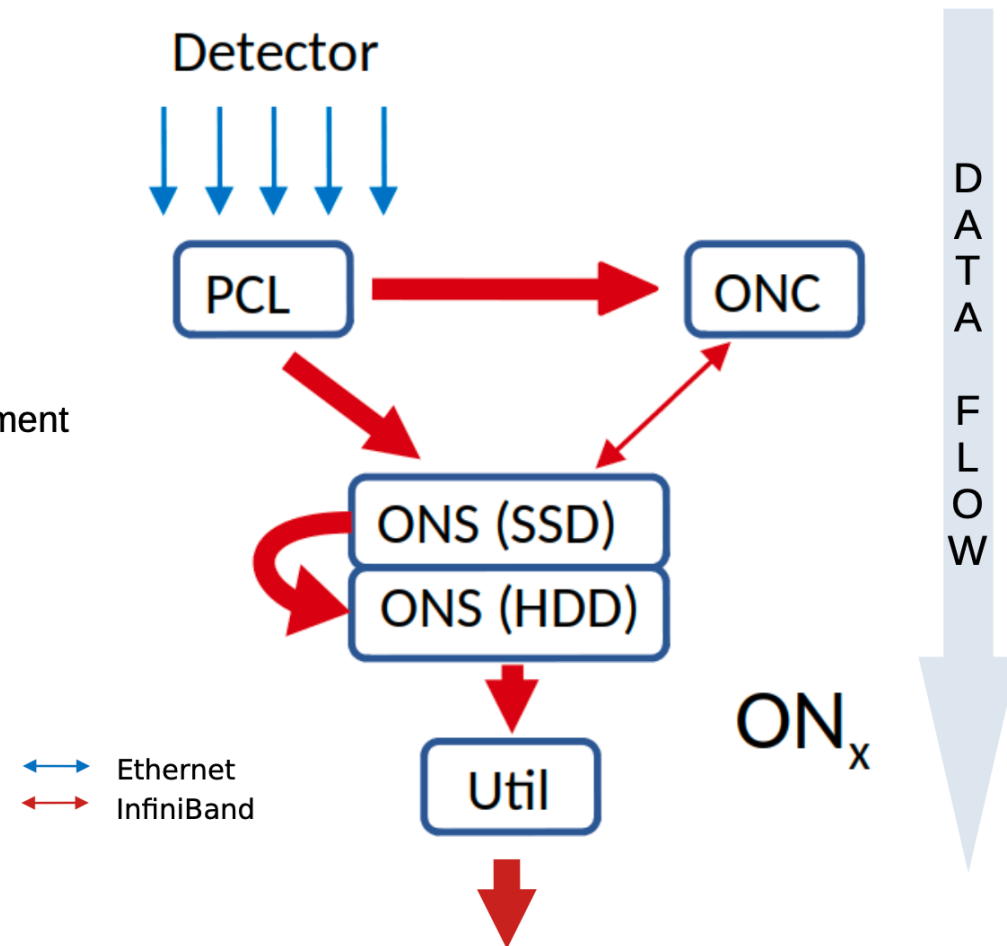


Online infrastructure (per SASE)

- PC-Layer (**DAQ** ~30nodes)
 - data aggregation from different sources
 - HDF5 file creation (up to 15GB/s)
 - data source for the on-line data analysis

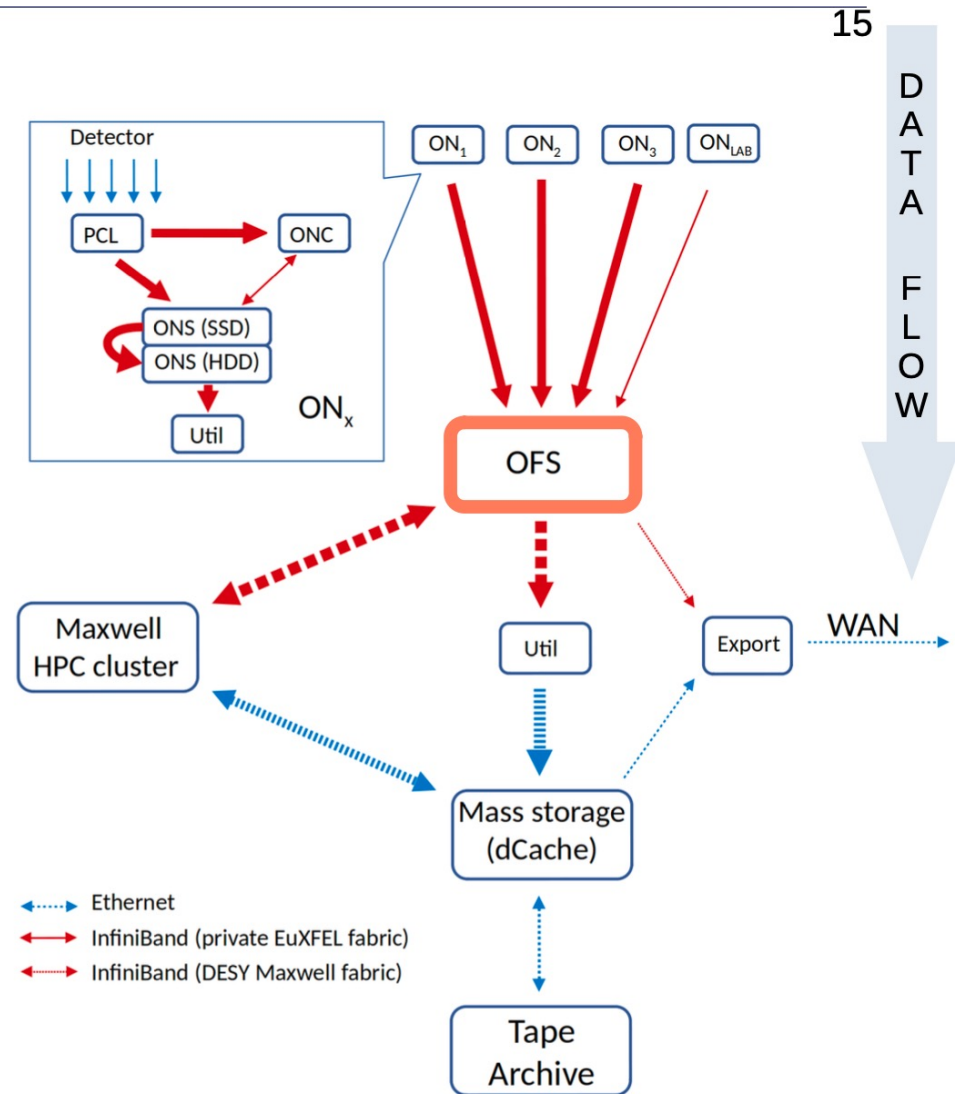
- ONC – Online Computing Cluster (**CPU, GPU** ~20nodes)
 - captures raw data stream from DAQ
 - initial online calibration of raw data
 - online data preview and analysis provide feedback to experiment
 - first data quality assessment
 - exclusive for experiment

- ONS – Online Storage Cluster
 - storage for the raw data from DAQ
 - two layers **400TB SSD/NVMe** and **2.5PB HDD**
 - source for raw data copy to the offline storage
 - based on IBM **Storage Scale System** (f.k.a GPFS)
 - write performance (**50-60GB/s write**)
 - 5 file systems



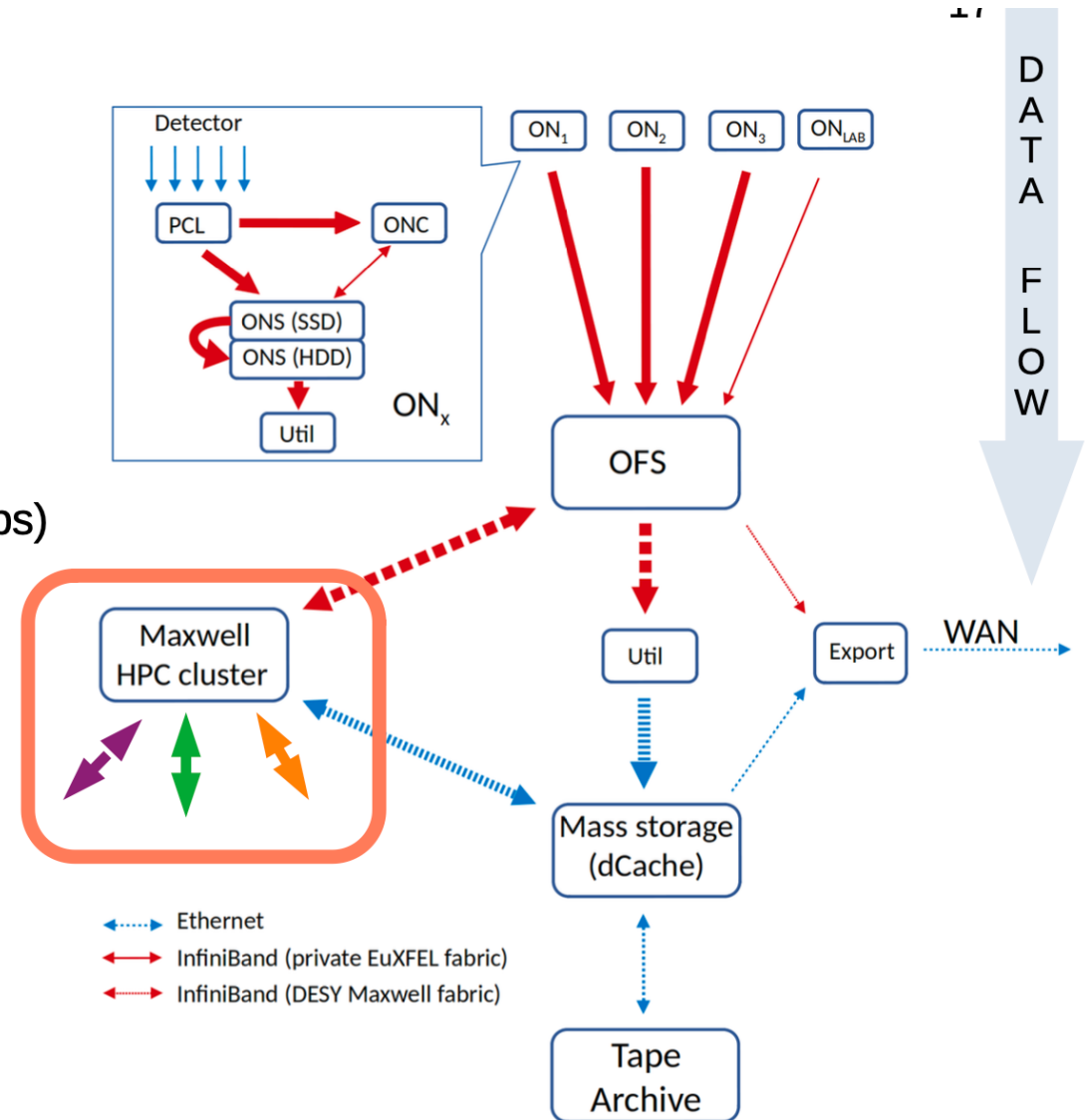
Offline infrastructure (common)

- High-performance storage - (Offline)
 - shared data storage for all SASEs
 - connects private EuXFEL IB and DESY Maxwell IB
 - data source for the offline data analysis
 - short term storage for raw data
 - storage for processed data and intermediate results
 - source for data transfer to the dCache system
 - based on **IBM Storage Scale System** (f.k.a GPFS)
 - size of **50PB** in 7 file systems
 - **175GB/s** observed read processes (during data taking)
- Maxwell – HPC computing cluster
- Mass storage
- Tape Archive
- Export services



Offline infrastructure (common)

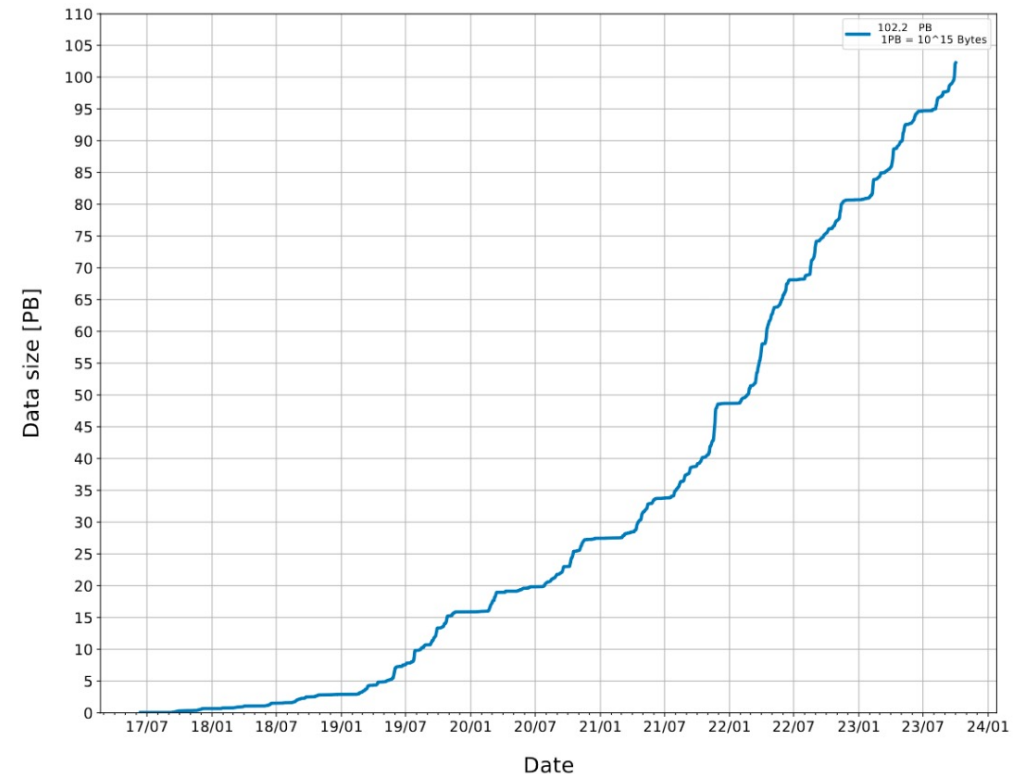
- High-performance storage - (Offline)
- Maxwell – HPC computing cluster
 - shared computing cluster among user communities
 - extremely heterogeneous in type and age
 - ~940nodes in total (4000TFlops)
 - 439 CPU, 30 GPU EuXFEL contribution (1200TFlops)
 - SLURM managed
 - post experiment data analysis and reprocessing
 - reservations for active experiments for data processing during experiment and analysis
- Mass storage
- Tape Archive
- Export services



Infrastructure Summary

- The infrastructure has capacity to accept and process up to 2PB of data per day (peak performance), which demonstrates the remarkable capabilities of all sub-services involved in this process.
 - 102PB of RAW data as of now
 - 50PB of processed data
- Simple approach of storing all generated data for long-term is not sustainable any longer
 - We are addressing the issue currently by modifying our scientific data policy, applying data reduction techniques and introducing data management plans
 - Looking for statistics driven data management within boundaries of data policies

Raw Data Generated at European XFEL Instruments



Summary

- * Infrastructure and Software go hand-in-hand to achieve peak storage of 2PB/day, and online streams of 4kHz mega pixel images.
- * Separation between online and offline data stream
 - * Online: in-memory, staged pipelines using Karabo and ZMQ (to user space). Python and C++
 - * Offline: HDF5 files with most computing done on Maxwell HPC. Mainly Python.
- * Data reduction will be the next challenge in terms of throughput (and is mandatory to address the storage challenge)
 - * Online data reduction exceeds current stream protocol bandwidth. RDMA is a promising evolution path currently being implemented.

Expert Contacts

- * Data Management via MyMDC: Luis Maia (luis.maia@xfel.eu)
- * Data Infrastructure: Janusz Malka (janusz.malka@xfel.eu)
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