Upgrade of SACLA DAQ System Adapts to Multi-beamline Operation

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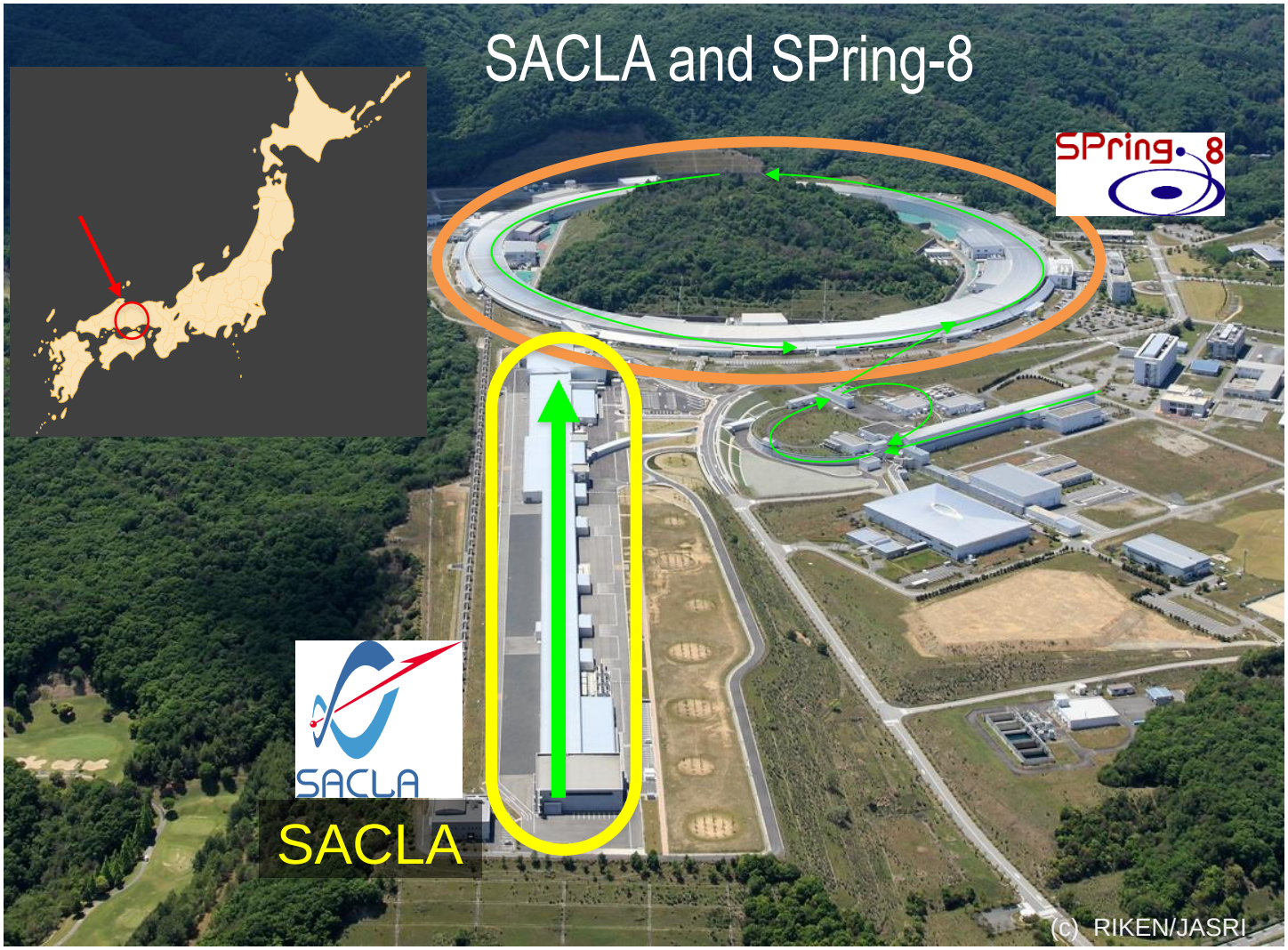
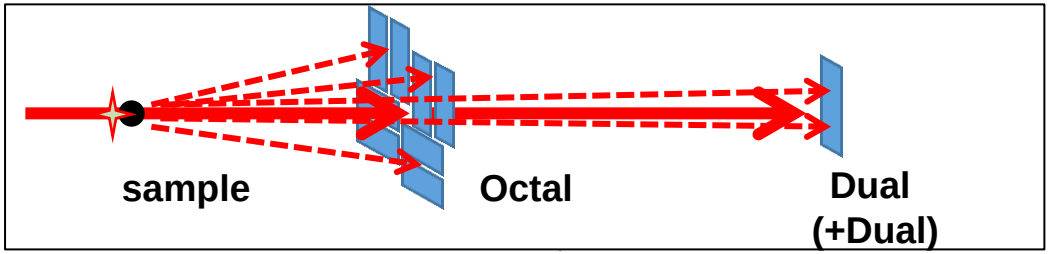


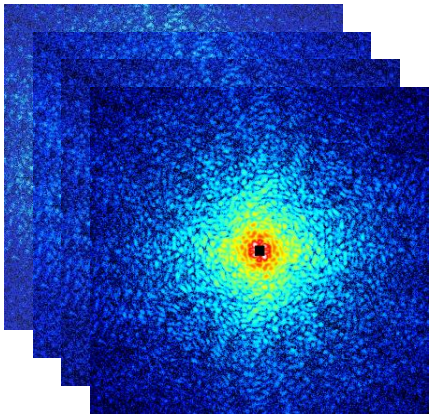
DAQ for user experiments

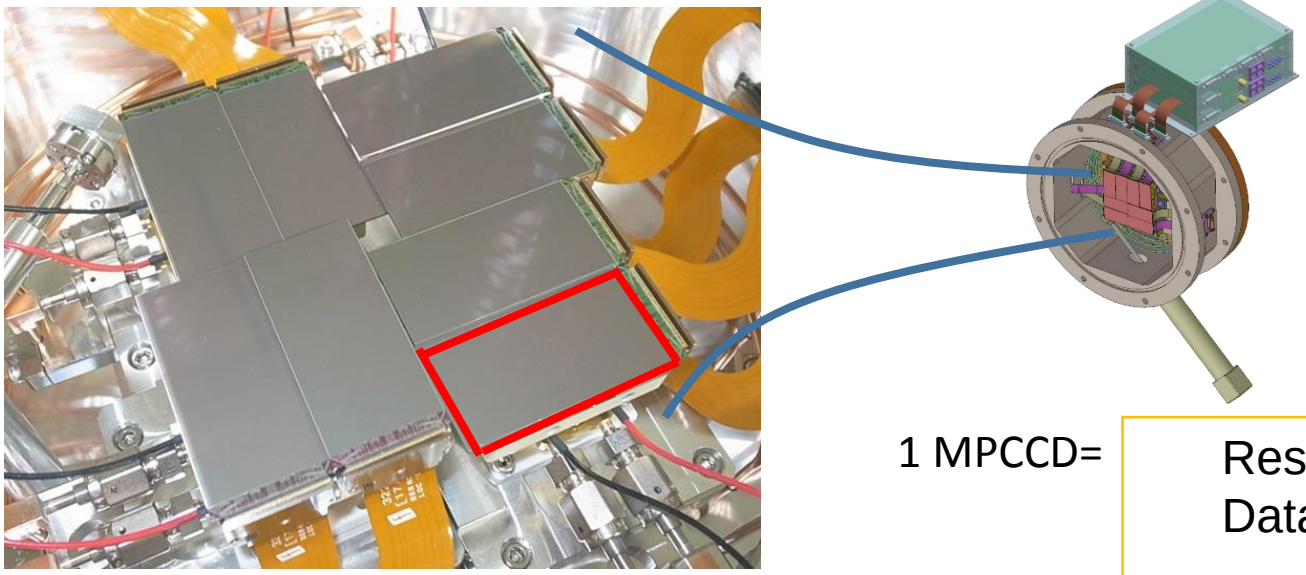
Outline

- DAQ overview
- DAQ upgrade
  - Reliability
  - Secure system
  - Throughput
  - Offline analysis power
- Items to be done
- Summary

Experiment with MPCCD Sensors







Octal MPCCD (Multiport CCD) Sensor

1 MPCCD=

Resolution : 1024x512 px
Data depth : 16 bit

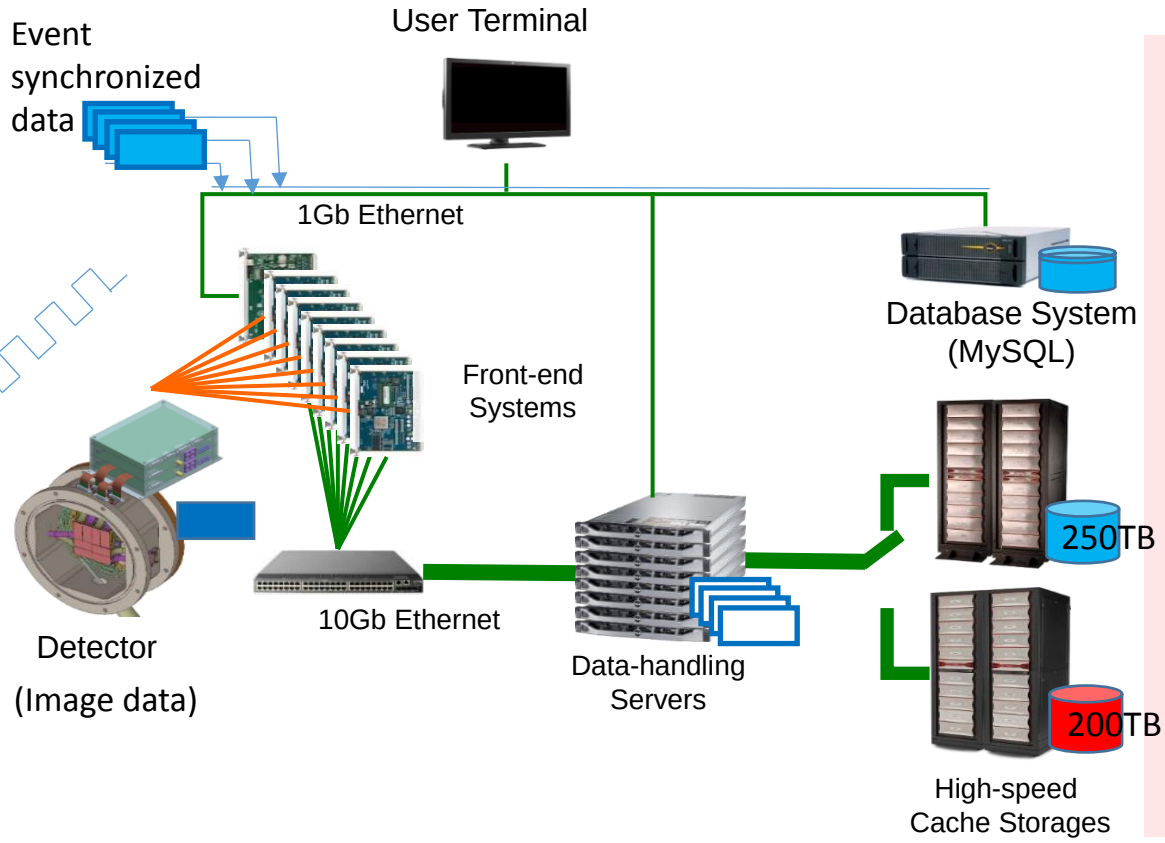
Single-sensor data rate is
0.5Gbps @ 60Hz (max)

DAQ Requirements

- 6Gbps data throughput
  (=MPCCD image sensor x 12 sensors x 60Hz)
- Shot by shot beam synchronization
  (The sample is likely destroyed by a single shot)
- Common analysis platform
  (Computing farm : Basic data processing tools)

→ Operating since 2012.

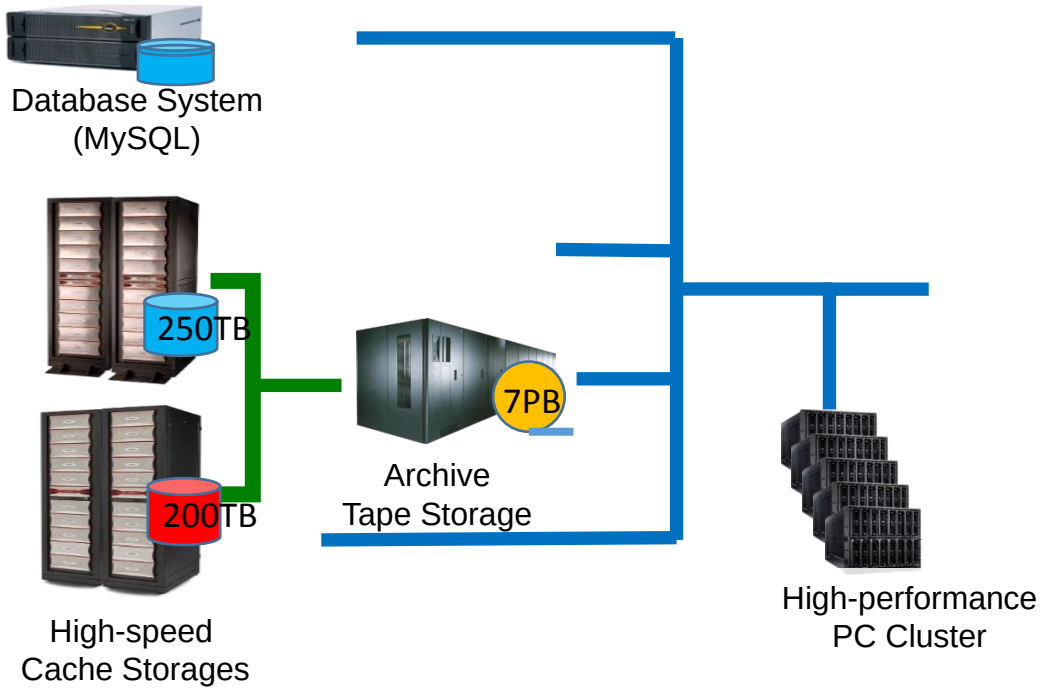
DAQ Overview



- Online
  - 10GbE for image data
  - 1GbE for other data and meta data
  - Detectors synchronized to accelerator cycle
  - Cache storage / Database
  - Data-handling servers

DAQ Overview

- Offline
  - Archive tape storage
  - PC cluster
  - Tool: Online format to HDF5 format

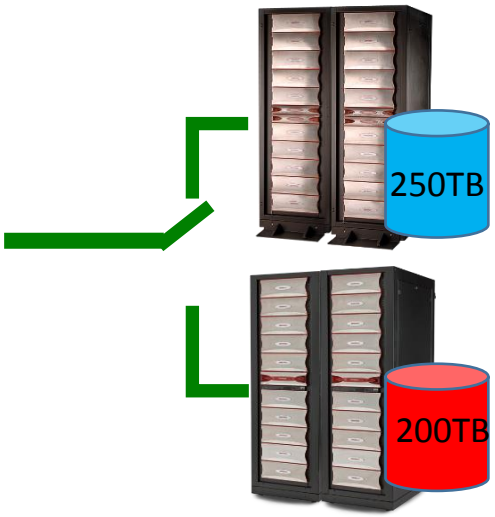


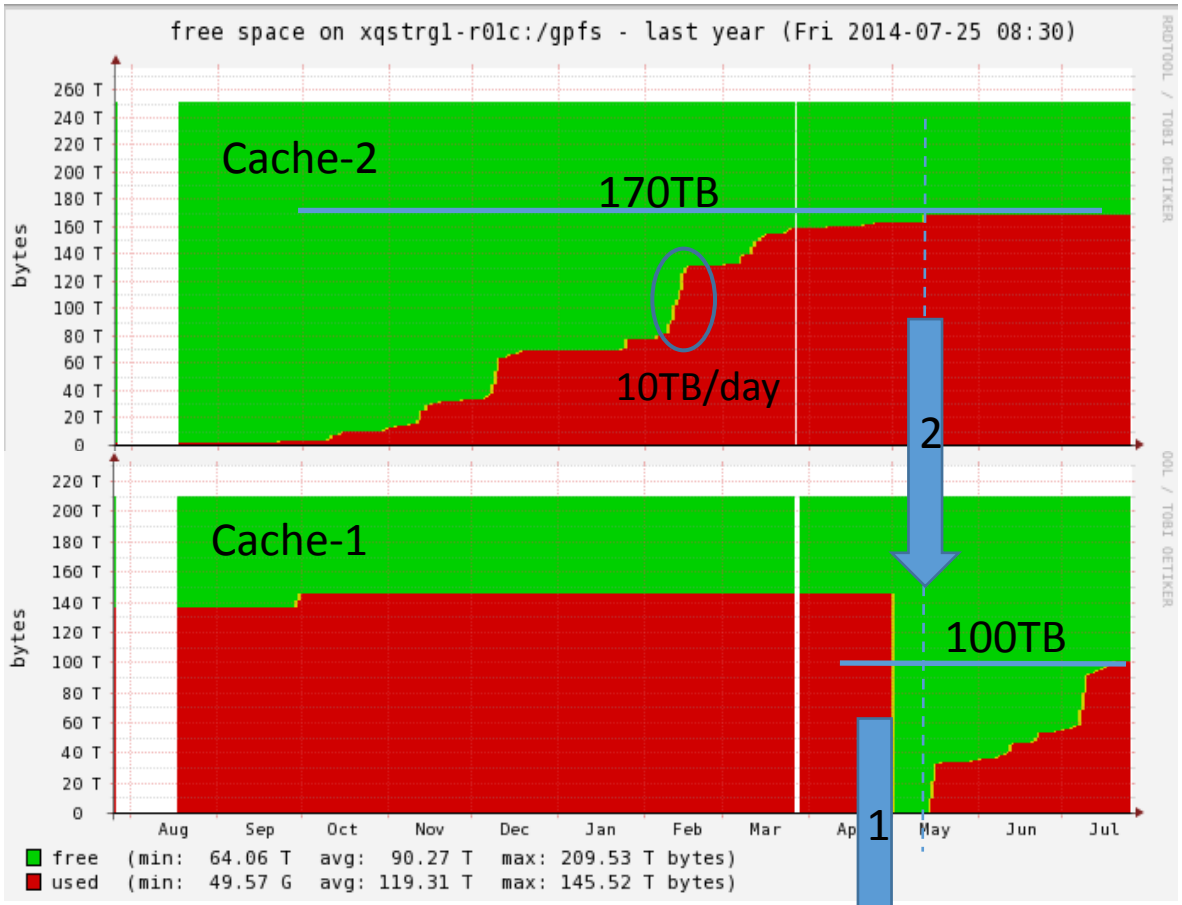
Data accumulation history

Aug. 2013 – Jul. 2014

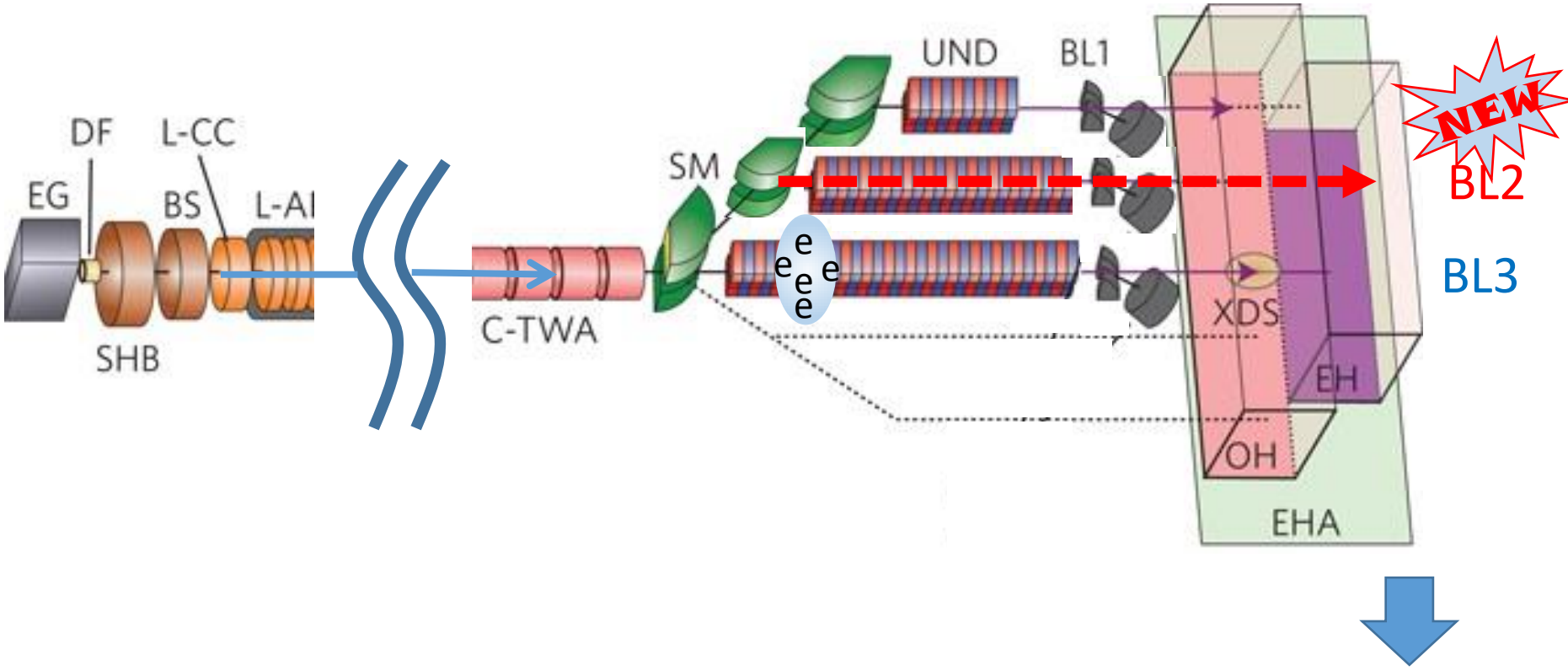
Various experiments → various slopes

Total ~300TB





Motivation for the DAQ upgrade +Beamline (BL2) in 2014



Upgrade for

Multi-beamline capability
More offline analysis power

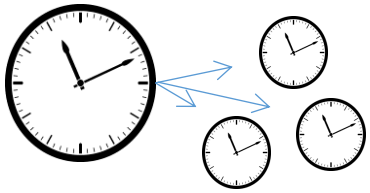
Upgrades : 4 items

Upgrade1 : Reliable Synchronization

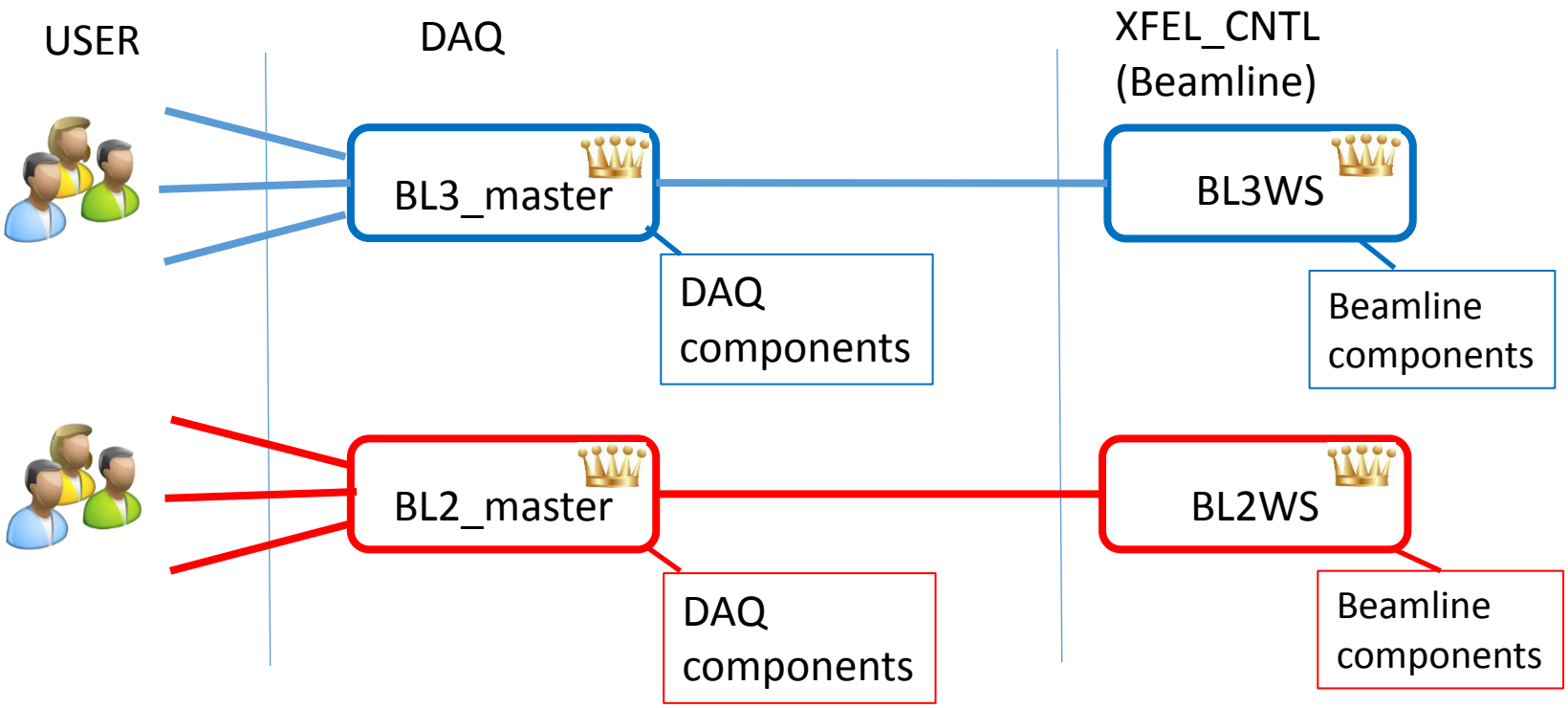
- Local counting system

Each subsystem has its own counter.
Once some misbehave (loss or overcount), it needs a manual reset .

- Tree structure system
  - Tag Data Master delivers the tag number and the timestamp to all subsystems.
- Installed and stably working since April.



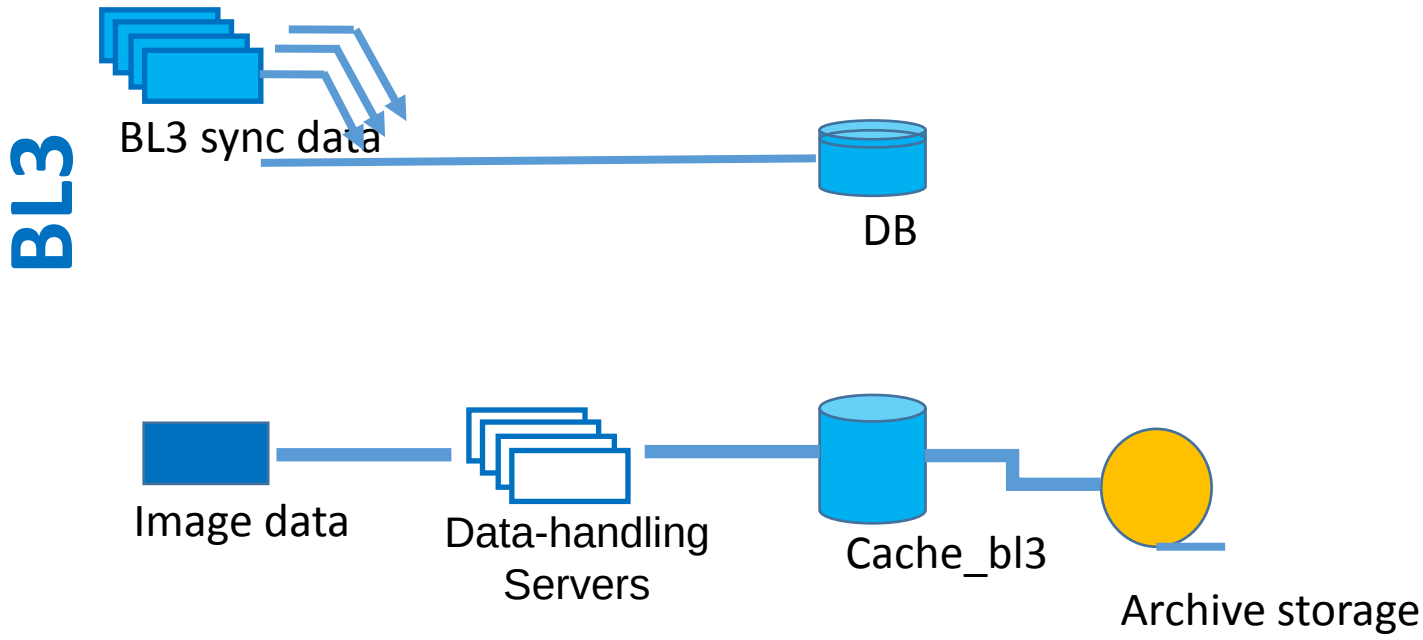
Upgrade2 : Secure Network



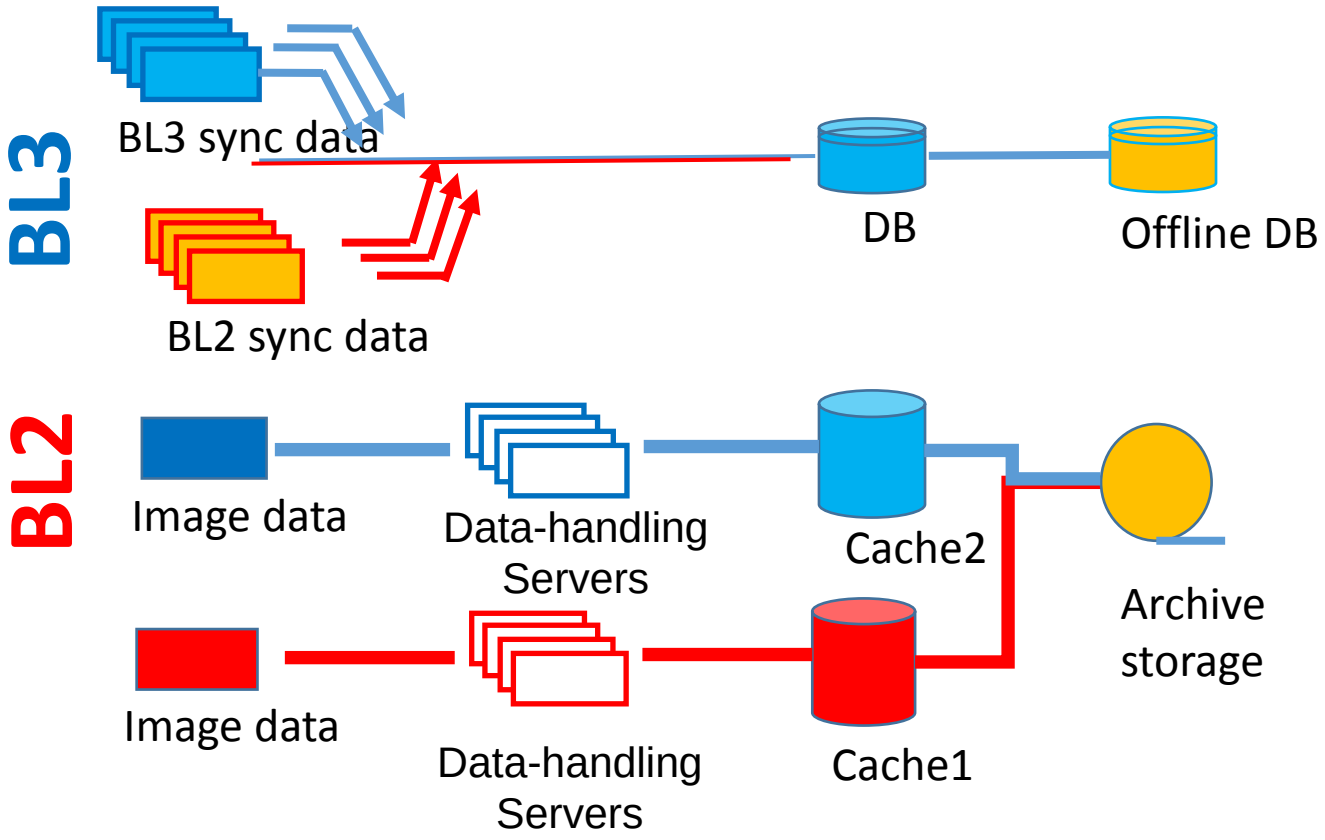
The separation between beamlines and access groups is secured by the VLAN settings.
The access control is centralized in the BL_master.

(The messaging is based on MADOCA II framework.)

Upgrade3 : Keeping full throughput

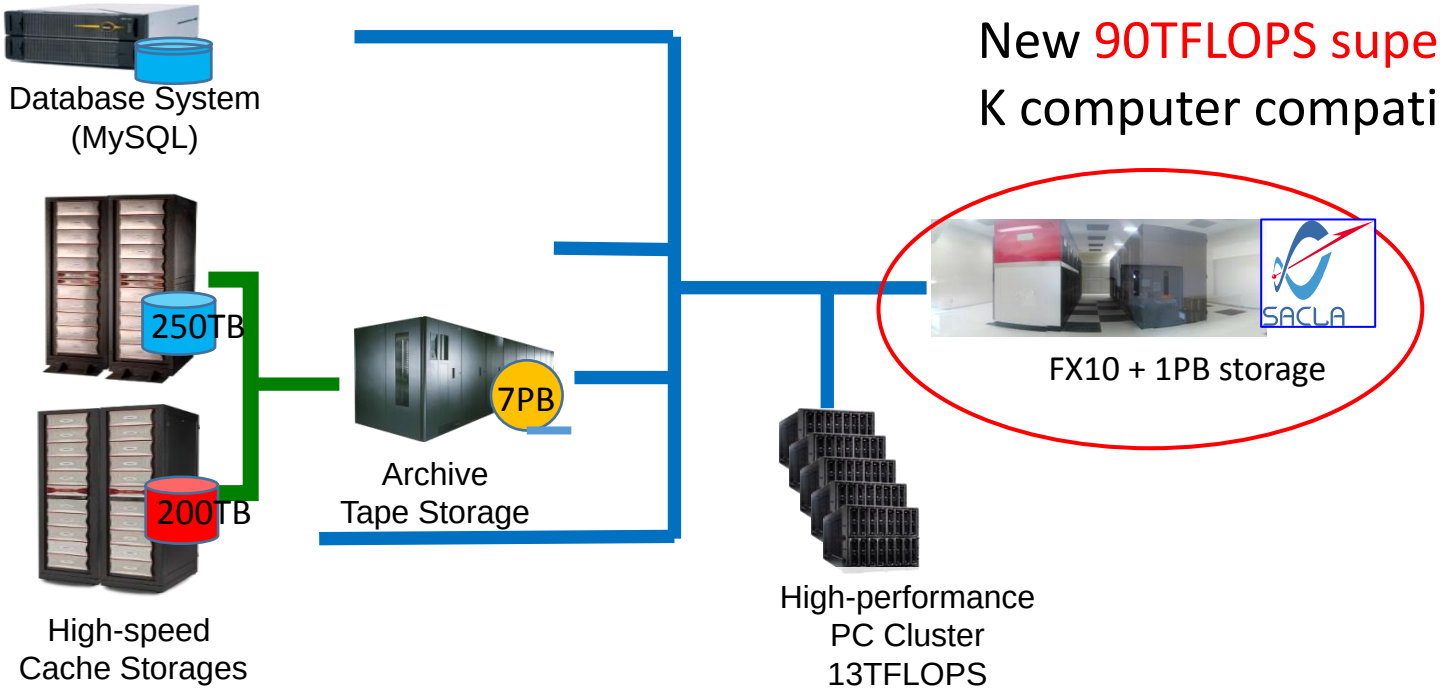


Upgrade3 : Keeping full throughput



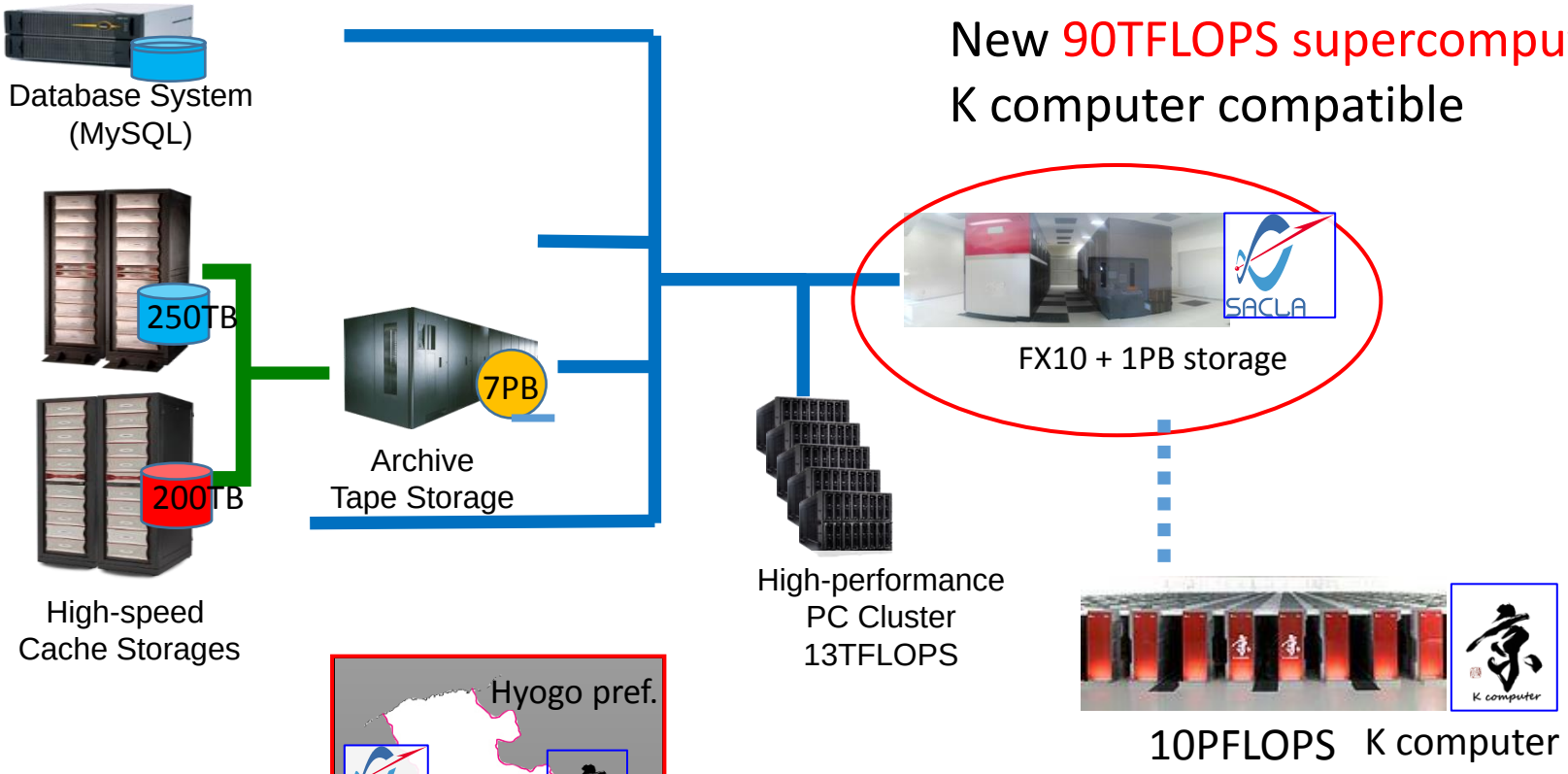
- Add network line for image data physically.
- Downstream (offline) is unchanged.

Upgrade4 : Additional offline analysis power



New 90TFLOPS supercomputer
K computer compatible

Upgrade4 : Additional offline analysis power



Recorded 6.4Gbps data transfer speed between SACLA and K-computer(Kobe)
→ Not a bottleneck for 1day/exp analsyis

More to come

- Switching beamlines with any intended (not fixed) pattern
  - Delivery of beamline information shot by shot
- Safe data transfer from Cache to Archive
  - Manual → Automation
- Industrial users
  - Data ownership management

- Next generation high resolution image sensor
  - An order more capability is required.
    → Next major upgrade.

Summary

- SACLA DAQ provides the common data stream for users. (online + offline)
- In 2014, several upgrades are made towards multi-beamline experiments.
  - Reliability:
    - Tree structure tag supply system
  - Secure system:
    - Access Control
  - Throughput:
    - Additional data line for image data
  - Offline analysis power:
    - 90TFLOPS supercomputer
- Some items already on the To-Do list

SACLA DAQ continues to evolve!