NSLS-II Beamline Requirements

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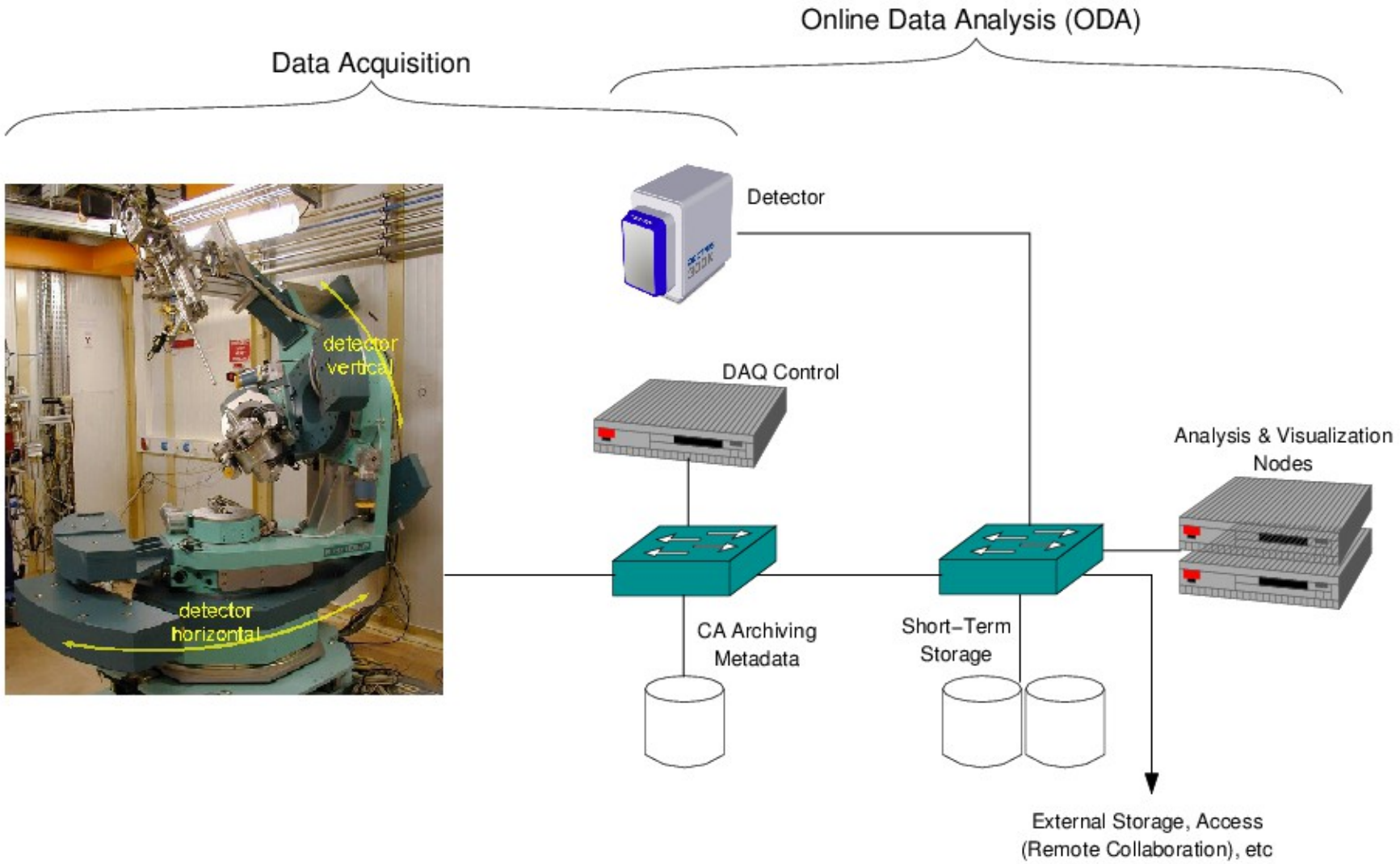
V4 Working Group Meeting
Brookhaven National Lab
10/18/12

Outline

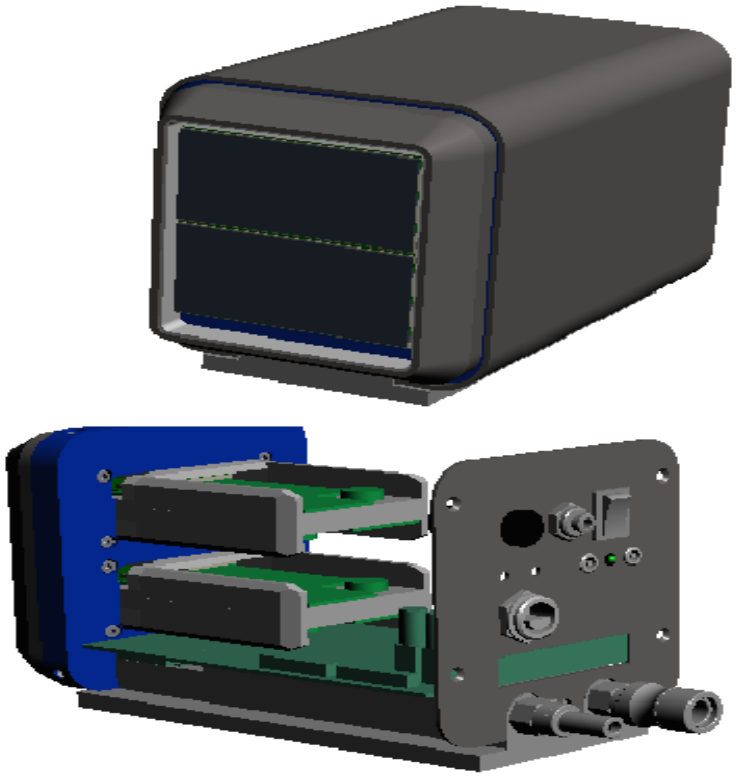
- The Problem(s)
- Approaches
  - Hardware
  - Software
- Time Line

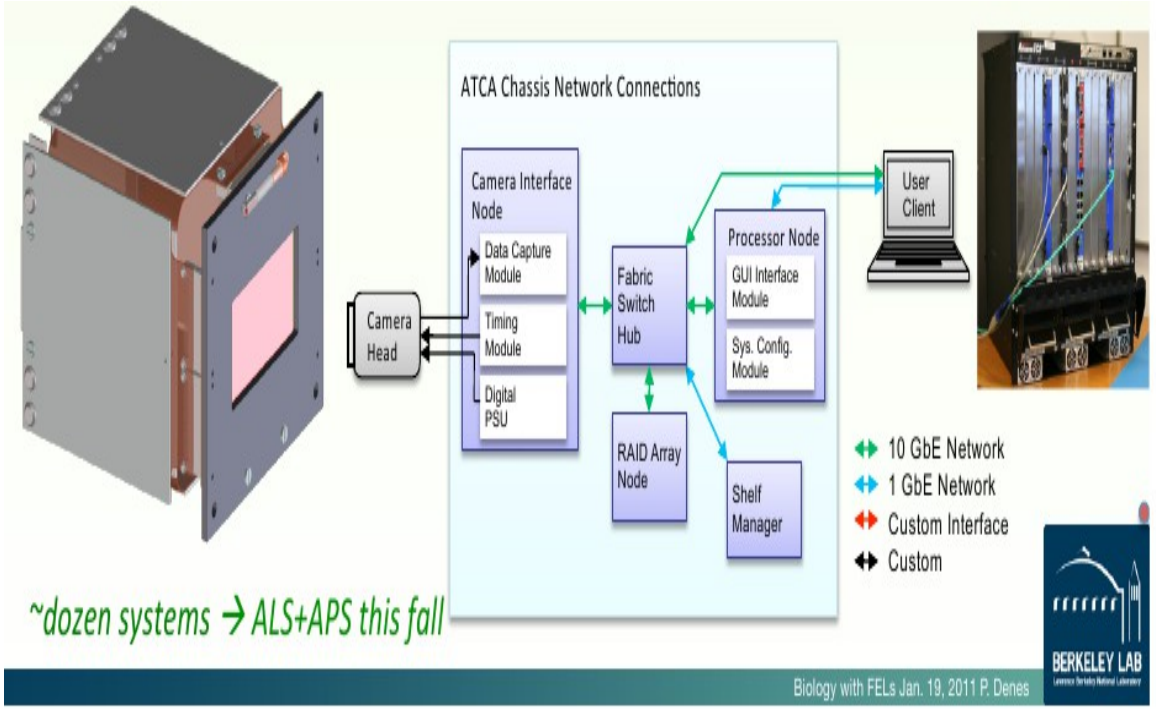
10,000 ft View



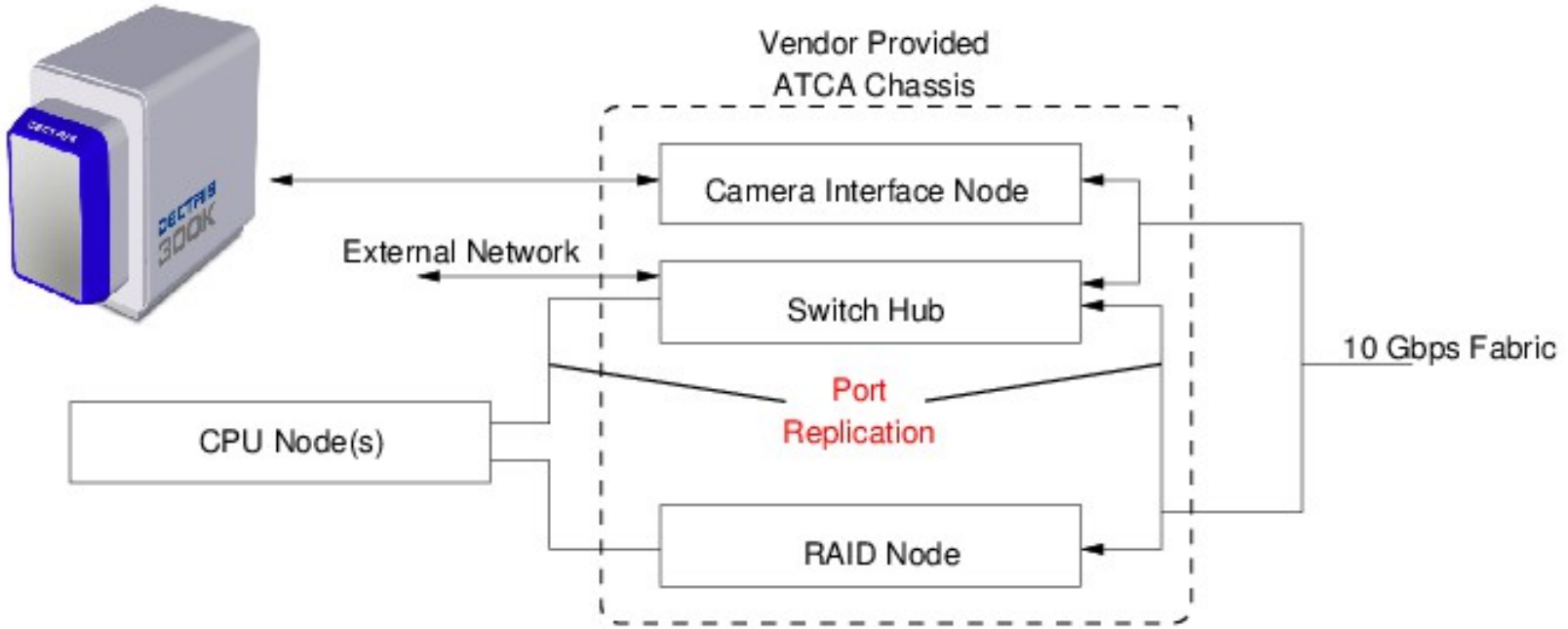
Zooming In: Next-Gen 2D Detectors

- Eiger (Dectris/PSI)
  - 1-4 Mpix @ 2-24 kHz
    - 47 Gbps @ 3 kHz (1Mpix)
- LBNL FastCCD
  - 2 Mpix @ 200 Fps
    - 6.4 Gbps



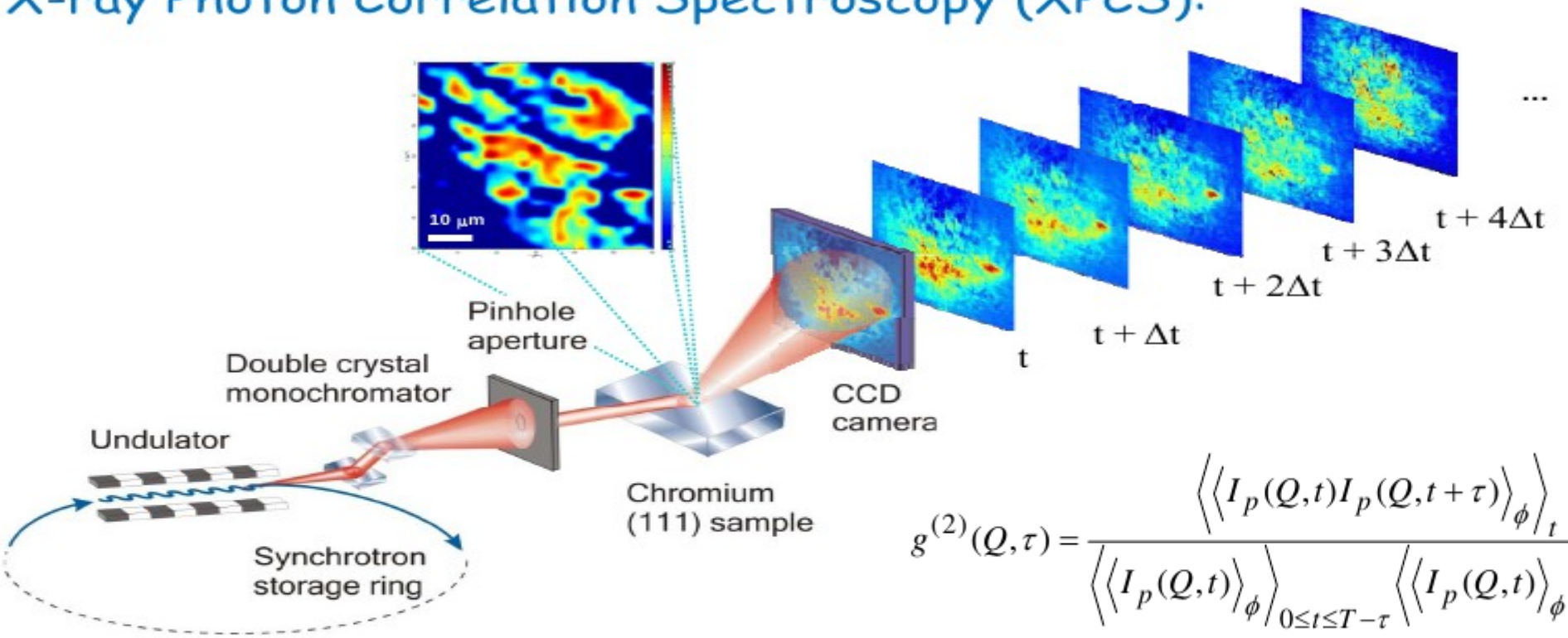


Example: CSX

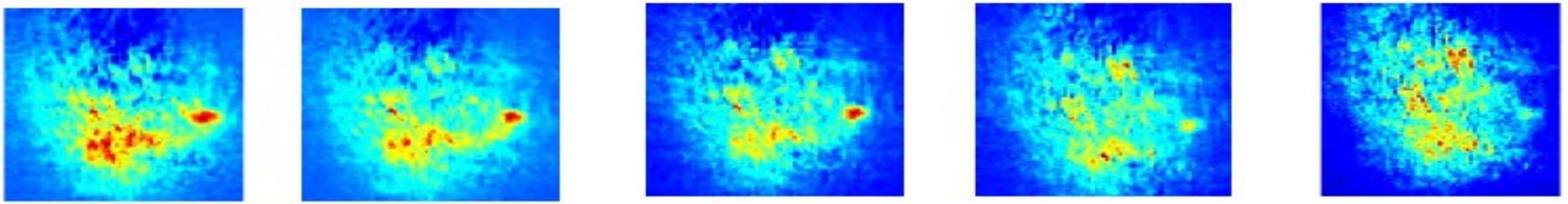

Vendor Provided
ATCA Chassis
Camera Interface Node
External Network
Switch Hub
10 Gbps Fabric
Port
Replication
CPU Node(s)
RAID Node

Data Analysis Example

X-ray Photon Correlation Spectroscopy (XPCS):



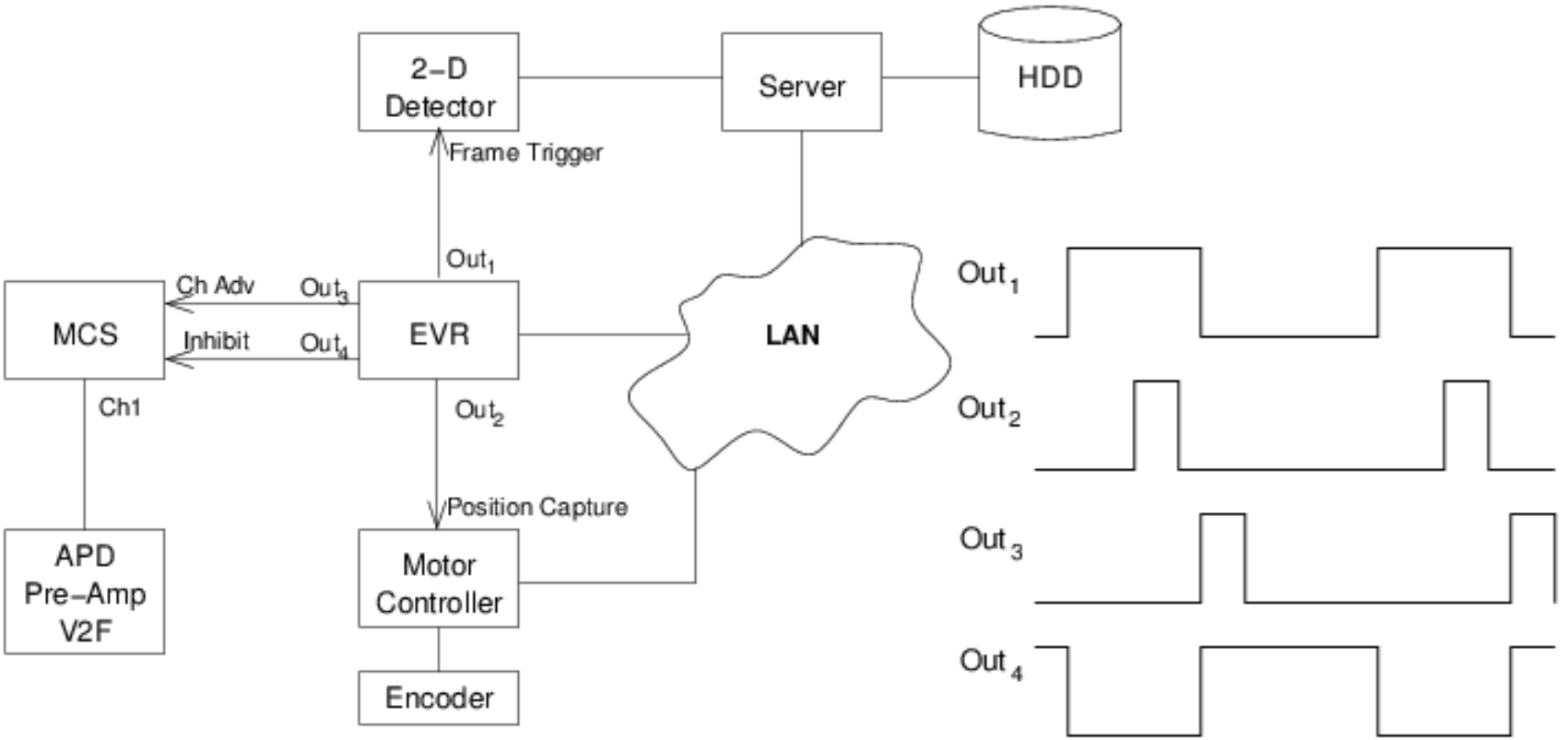
$$g^{(2)}(Q,\tau) = \frac{\left\langle \left\langle I_p(Q,t) I_p(Q,t+\tau) \right\rangle_\phi \right\rangle_t}{\left\langle \left\langle I_p(Q,t) \right\rangle_\phi \right\rangle_{0 \le t \le T-\tau} \left\langle \left\langle I_p(Q,t) \right\rangle_\phi \right\rangle_{\tau \le t \le T}}$$



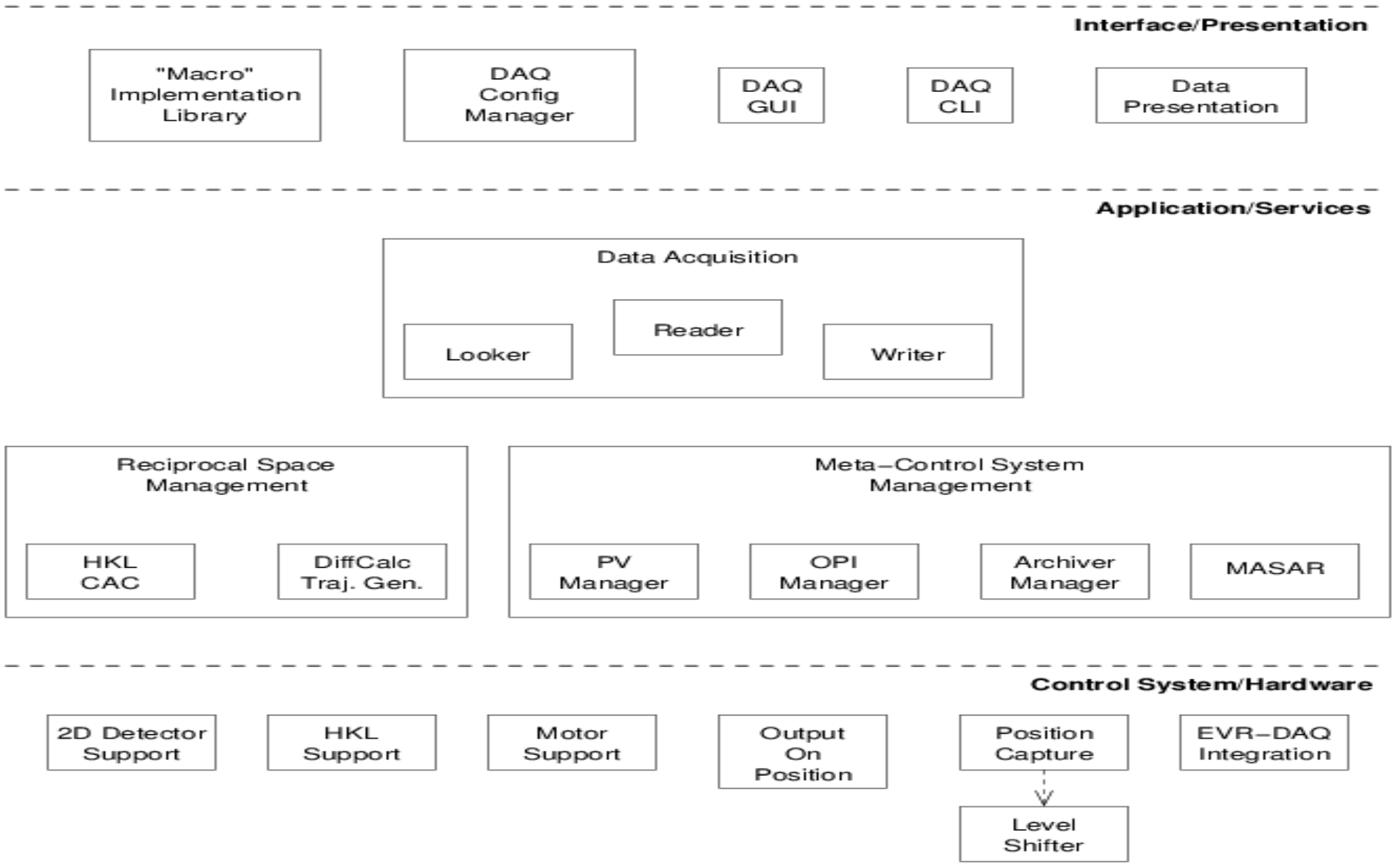
O. G. Shpyrko et al., *Nature* **447**, 68 (2007)

1000 ft View: Hardware Architecture

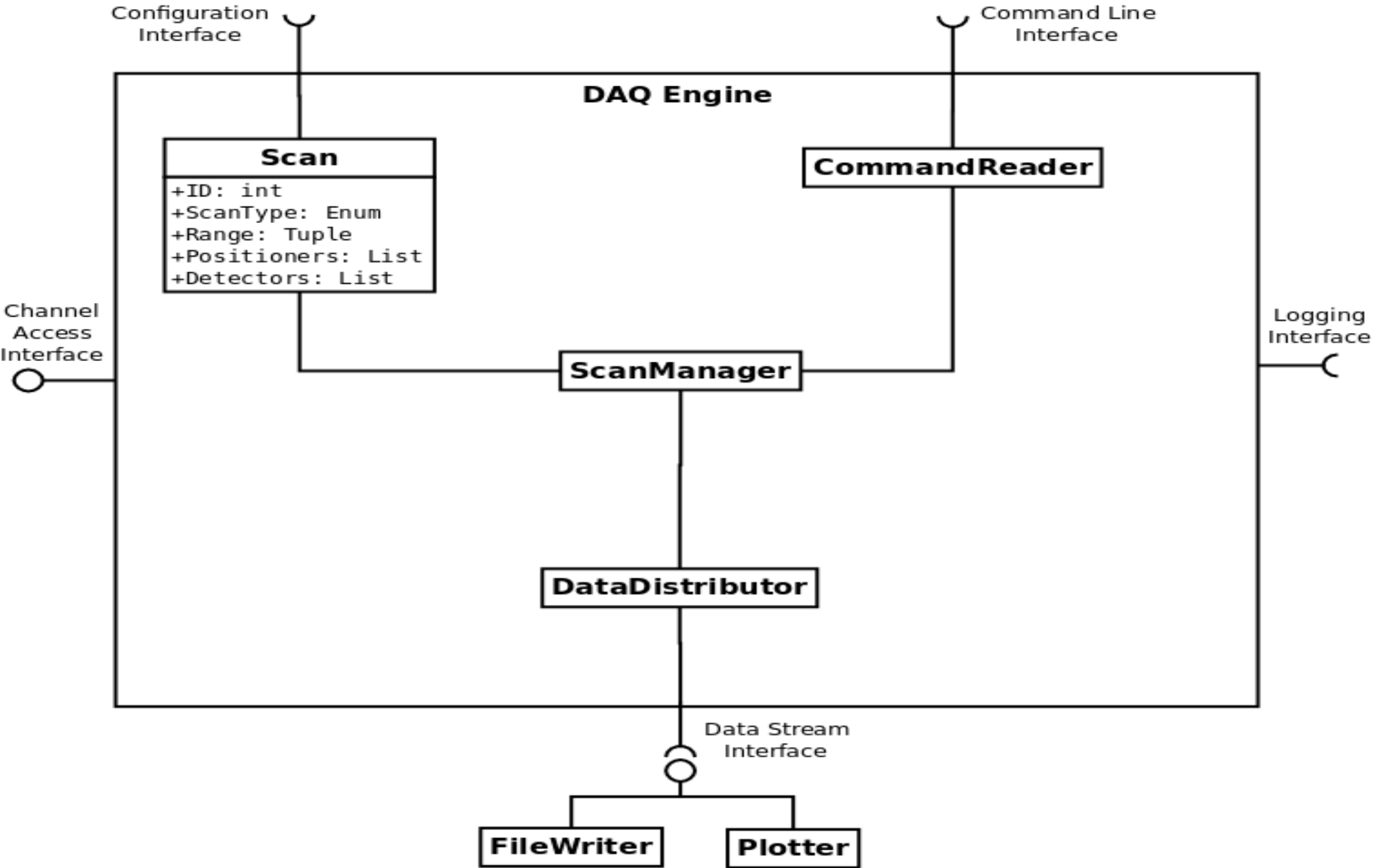
- Time-based data acquisition
  - EVR is the Master
  - Up to 1 kHz



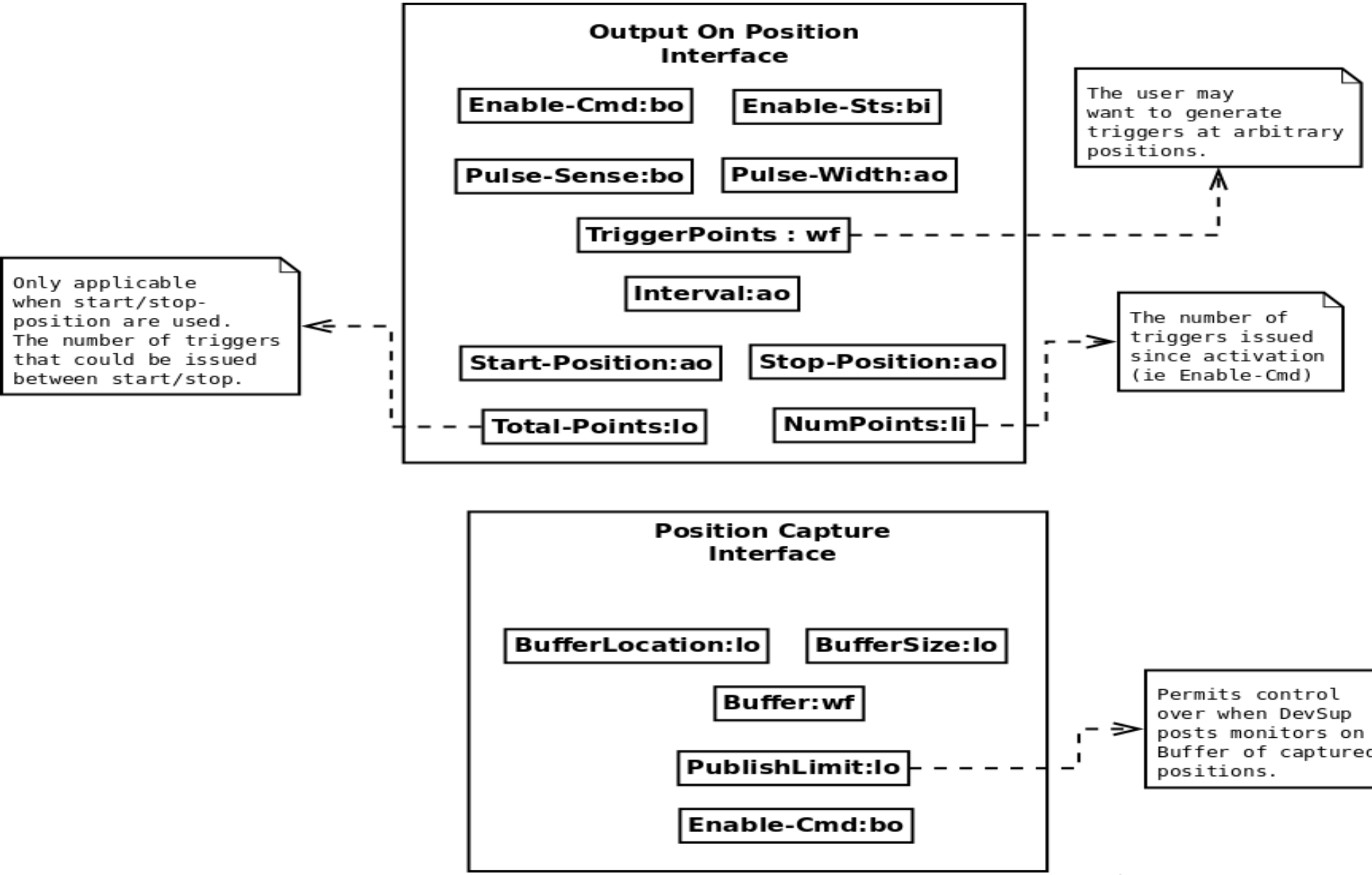
Software Components



Scanning Engine



Fly Scanning: EPICS



Scheduling

- Pkgs (optics) arriving – Apr-Nov 2013
  - All Control System/Hardware pieces by 6/1/13
  - Mtr Support to include ID-Mono coordination
    - SRX and CSX-B (then SST & BMM)
- Cold commissioning – Dec 2013
  - Meta-Control System Mgmt by 9/1/13
- Hot commissioning – after Jan 2014
  - HKL, DAQ, and basic “macros” by 9/1/13
  - Data presentation (basic!) by 9/1/13

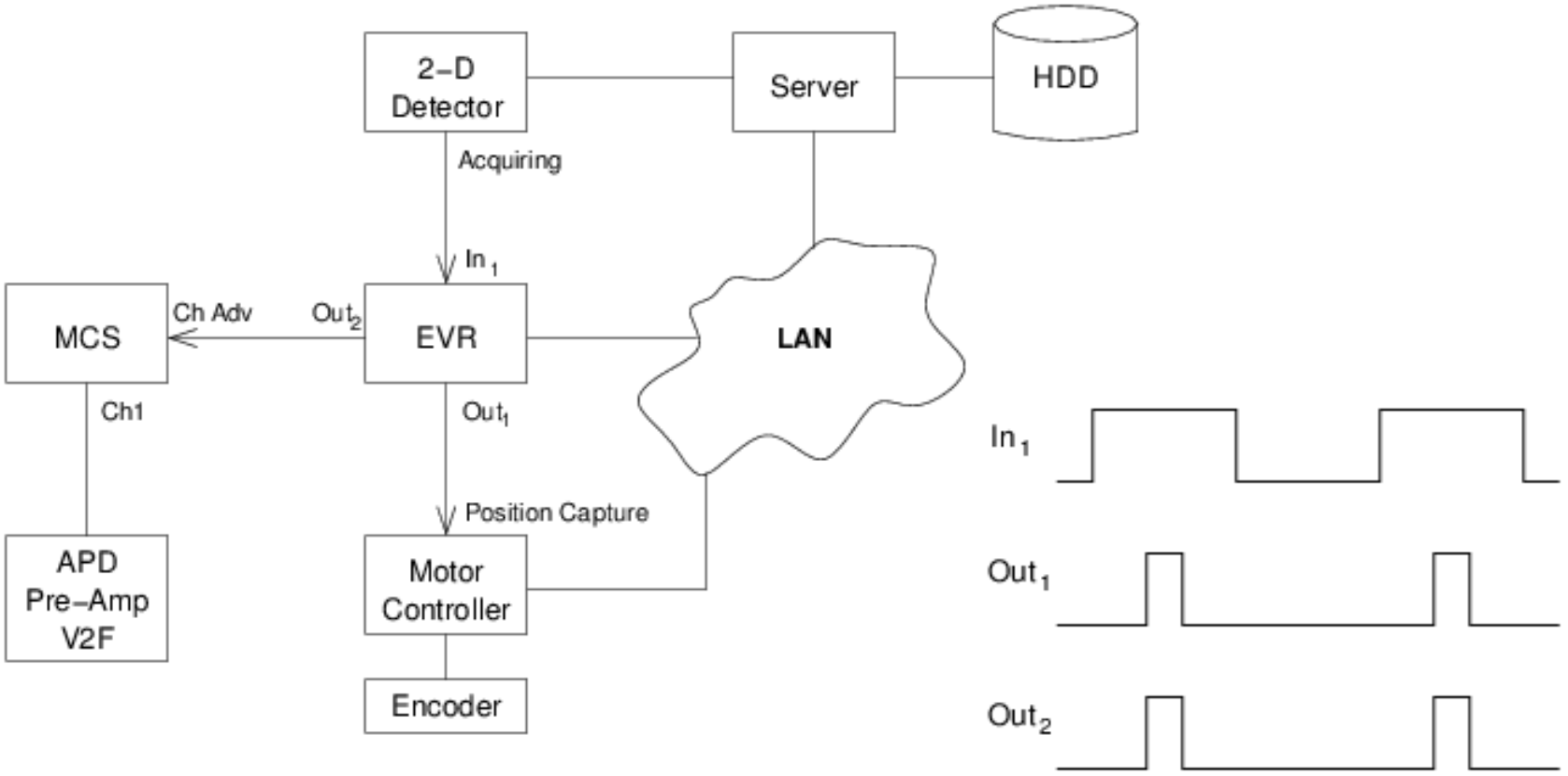
Summary

- New detectors pose a challenge
  - Demand for “instant feedback” even more so
- DAQ must become more broad
  - Greater degree of hardware participation
  - Software must permit interactive exploration
    - Applies to acquisition *and* analysis
- Collaborative efforts seem to be a **must have**

Feel free to throw stones... :-)

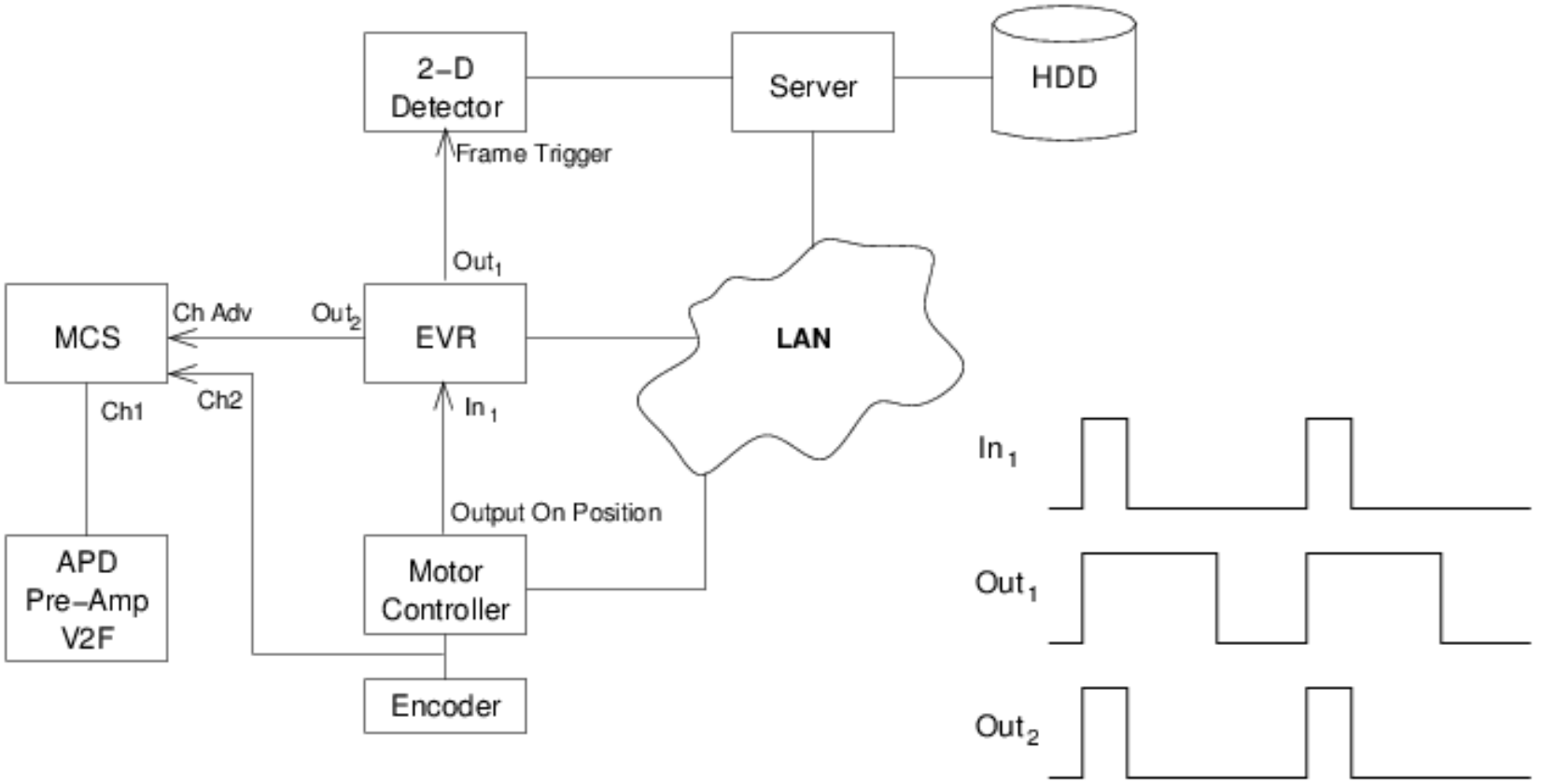
Hardware Architecture (1)

- Position Capture (0.1-0.5 kHz)
  - Detector is Master



Hardware Architecture (2)

- Output on Position (< 1kHz)
  - Motor Controller is the Master

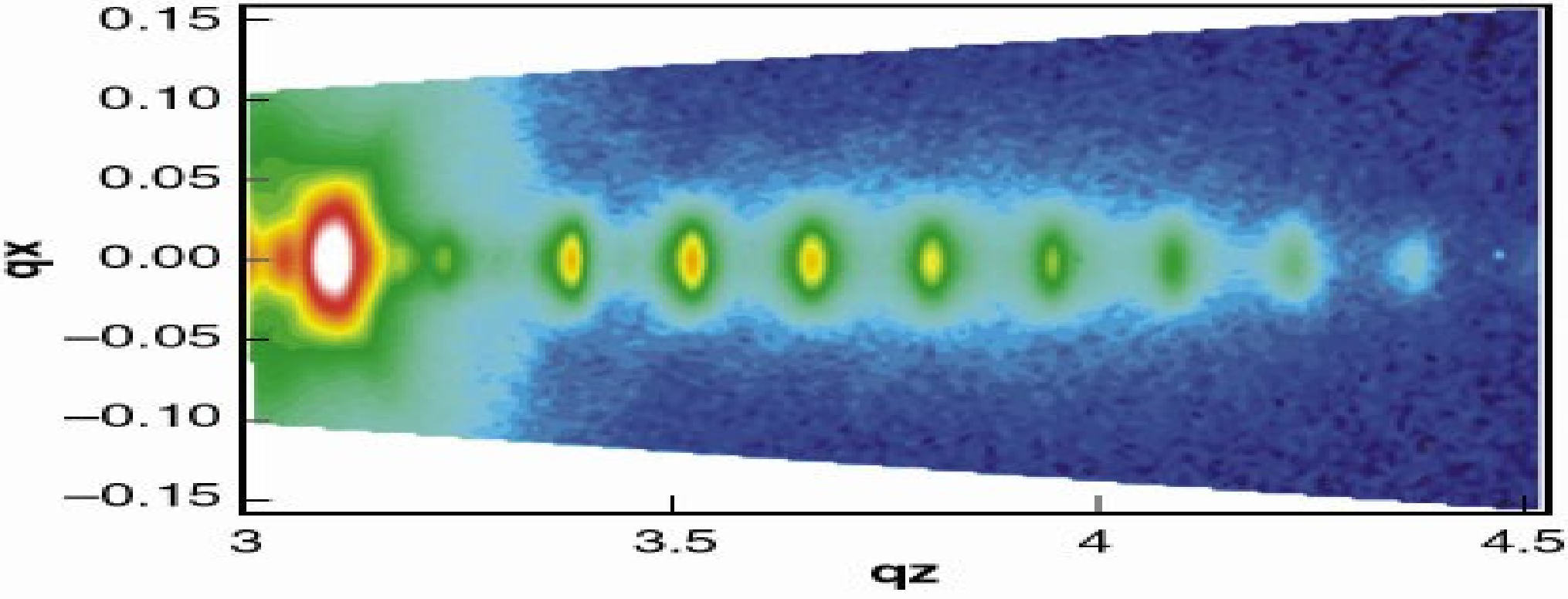


Reciprocal Space

- "*Q-space*" or "*k-space*"
- Crystallography defines reciprocal axes as [h k l]
  - Orientation of [h k l] maps to several physical axes:
    - Multiple diffractometer angles + detector position
- ***No existing representation in V3 EPICS***
  - Cannot archive, save/restore, alarm, etc

Reciprocal Space (2)

- Many scanning operations are defined in terms of Reciprocal Space operations
  - "*scan from [1 0 0] to [8 0 0] in 100 steps*"
  - "*scan circularly around the [0 0 2] vector*"



Hardware Filtering

- Proactive collaboration with detector vendors can produce powerful results