



# The Data Acquisition system (DAQ) of the FLASH facility



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**Abstract**

Nowadays the photon science experiments and the machines providing these photon beams, produce enormous amounts of data. To capture the data from the photon science experiments and from the machine itself we developed a novel Data Acquisition (DAQ) system for the FLASH (Free electron LASer in Hamburg) facility [1].

Meanwhile the system is not only fully integrated into the DOOCS[2] control system, but is also the core for a number of essential machine related feedback loops and monitoring tasks.

A central DAQ server records and stores the data of more than 900 channels with 1MHz up to 2GHz sampling and several images from the photon science experiments with a typical frame rate of 5Hz.

On this server all data is synchronized on a bunch basis which makes this the perfect location to attach e.g. high level feedbacks and calculations.

**Introduction**

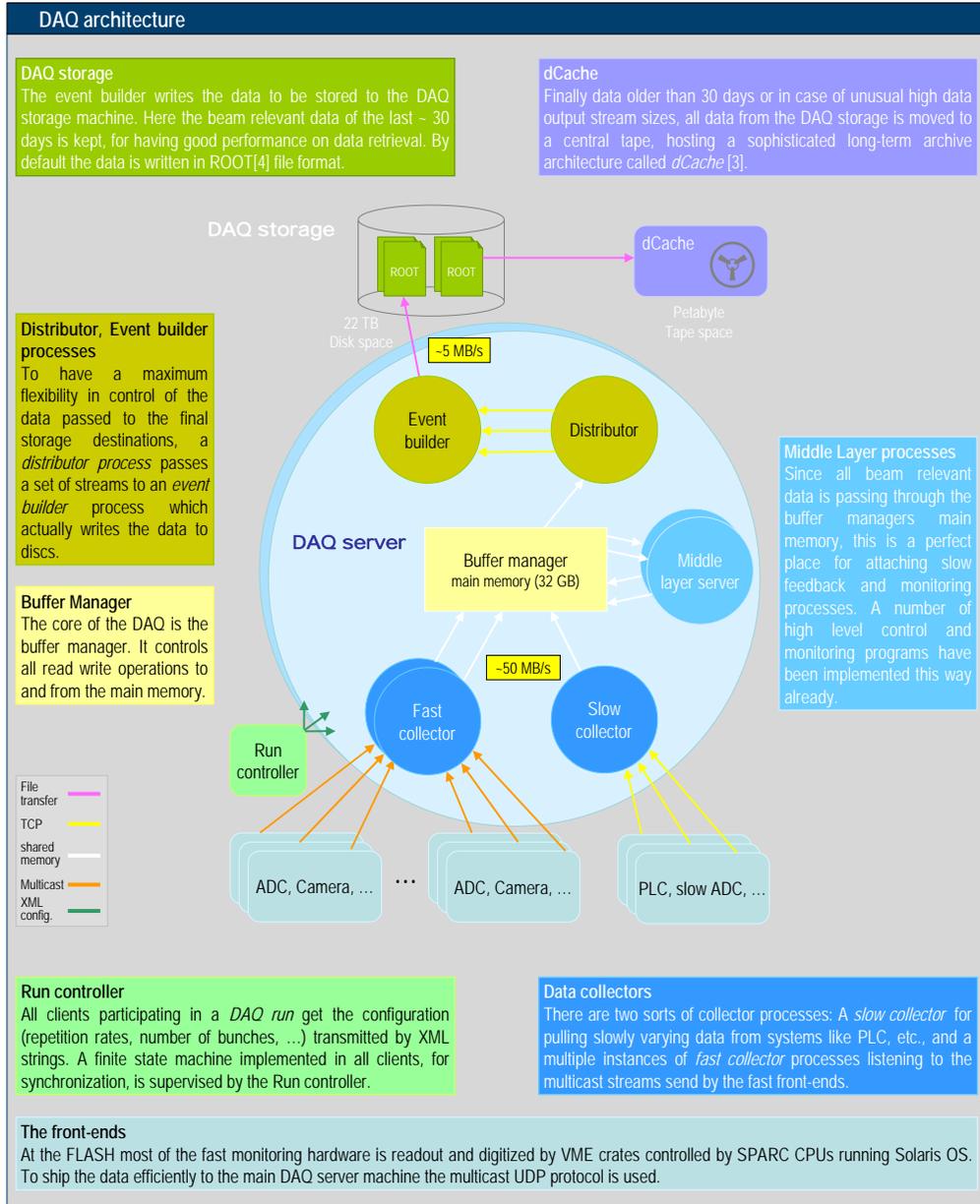
The FLASH is not only a permanent user facility providing laser like X-ray beams in a before unmatched wavelength regime, but also serves as a R&D study for exploring the superconducting cavity technologies to be used at future linear accelerators.

The requirements for both of these efforts demand a very high level of diagnostic and electronic instrumentation. To get a deep and clear understanding of the machine, we developed a data acquisition system capable to record all relevant data from about 900 ADC channels distributed over tenths of VME crates with the full machine repetition rate (5 Hz with up to 800 bunches per cycle).

**The data acquisition system**

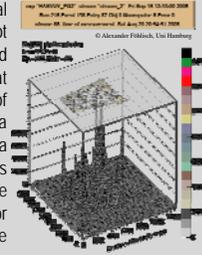
The core of the DAQ system is formed of a multiprocessor SUN Fire E2900 hosting 32 GB of memory (the DAQ server) and a SUN Fire X4500 providing 22 TB RAID file space (ZFS).

For the necessary network connections the existing infrastructure of the FLASH accelerator (1 Gigabit Ethernet) is used.

**Usage examples**

Different from the original expectations, it showed that not the machine physicists but instead the photon experiments done at FLASH are heavily making use of this possibility for mass data storage. Here the huge data volume produced by various camera systems needs to be stored and methods for comfortable data retrieval must be provided.



The middle layer servers unique position within the data flow triggered a number of developments for implementing monitoring and slow feedback applications. Some of them are already part of the standard machine operation. A API to easily attach C++ and MATLAB based applications has been developed for this purpose.



**Conclusions**

The DAQ system developed and now already running more than a year reliable at the FLASH facility, has extended the possibilities for understanding and controlling a complex linear accelerator like this.

The novel combination of High Energy Physics (HEP) techniques and an accelerator control system successfully shows that such an integrated framework can solve the requirements demanded by the high data rates and number of components.

The FLASH DAQ system was developed in a collaboration of three institutes: DESY Zeuthen, DESY Hamburg and LEPP Cornell University, Ithaca, NY, USA

**References**

- [1] <http://flash.desy.de>
- [2] <http://doocs.desy.de>
- [3] <http://dCache.desy.de>
- [4] For ROOT see: <http://root.cern.ch>