Creating of HDF5 Files as Data Source for Analyses Using the Example of ALPS IIc and DOOCS Control System

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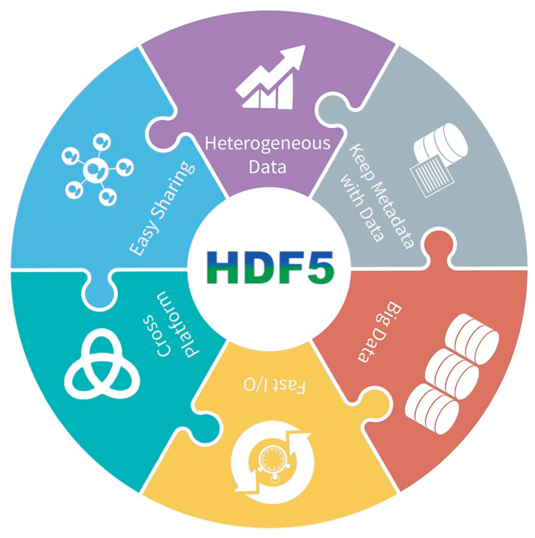
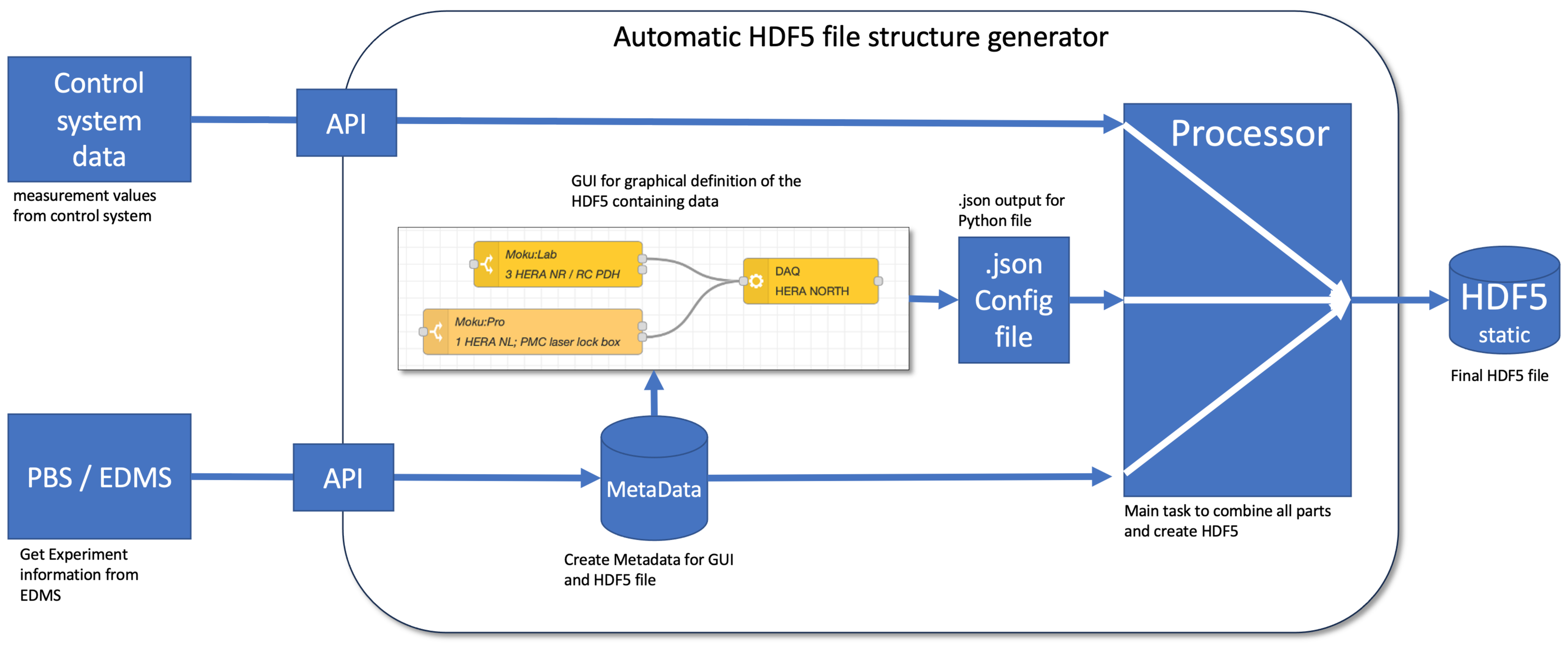
Abstact

A versatile and graphical HDF5 file generation project. In the realm of physical experiments, data is typically gathered through the utilization of measurement devices intricately integrated into control systems. These control systems employ diverse methods for archiving historical data. Nevertheless, users consistently grapple with a recur-ring challenge: how to access the data, decipher the intri-cacies of the control system's structure, and understand the formatting. The prevailing approach involves the crea-tion of scripts or programs tasked with extracting data from these control systems, and if necessary followed by the requisite data pre-processing for subsequent analysis. Typically, this pre-processing is carried out in formats known exclusively to the individual user. Moreover, the longevity of data utility often teeters on the brink when users depart or deviate from established conventions.

To address these challenges, we are actively developing software that serves a dual purpose: firstly, to provide an API for a control system (in this instance, DOOCS), and secondly, to transform the extracted data into a universally recognized format, such as HDF5, complete with all relevant metadata.

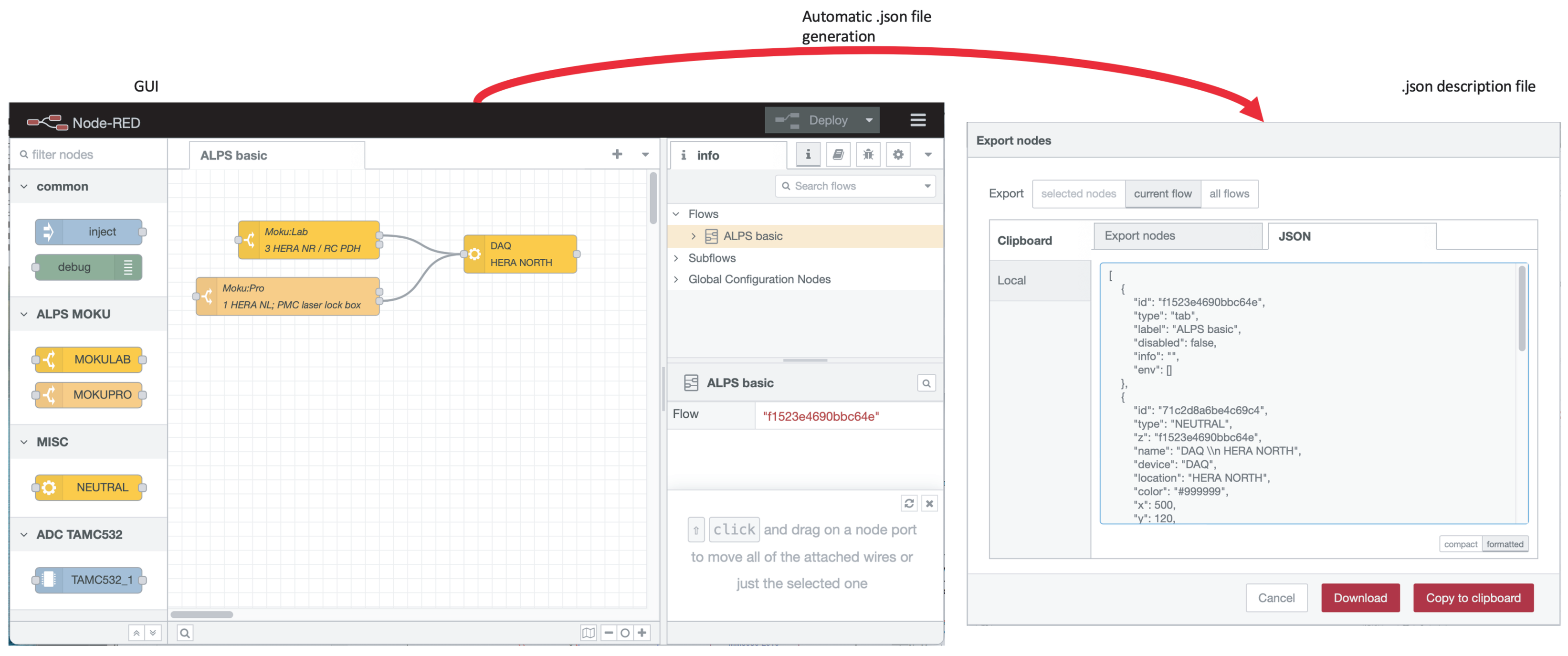


HDF5 Generator



The diagram provides a comprehensive overview of the HDF5 data generation process.
To the left, control system data is received and meticu-lously processed via an API. Metadata containing essen-tial information about the control system data and setup of the whole experiment for potential source reconstruc-tion, follows a parallel procedure. Additionally, certain metadata serves the crucial role of furnishing users with a tailored graphical interface, simplifying the process of data selection. These elements are seamlessly amalgamated by the processor and subsequently archived as an HDF5 file.

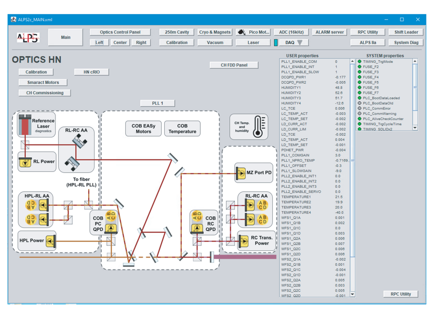
GUI Capabilities

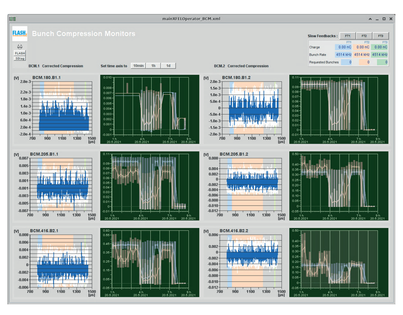


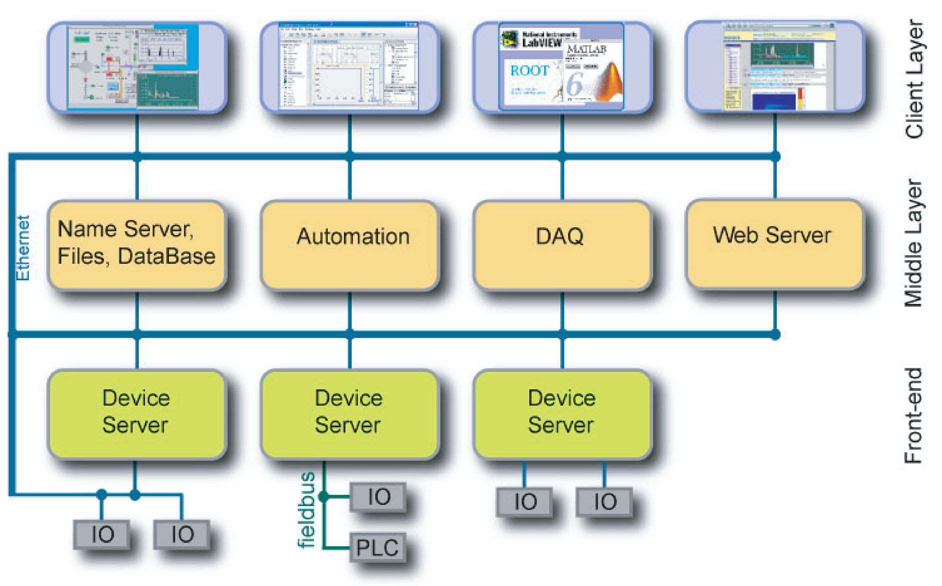
The graphical interface encompasses all experiment-related devices and channels, providing the user with the capability to choose which data to record in the HDF5 file. Each data value is supplemented with metadata, facilitating precise one-to-one associations. The graphical structure is documented and stored in a JSON file, ensuring a well-defined structure for ease of reading. As a proof of concept, we initially utilized Node-RED to conduct a feasibility analysis, with the final product slated to feature a distinct GUI.

Control system

DOOCS.





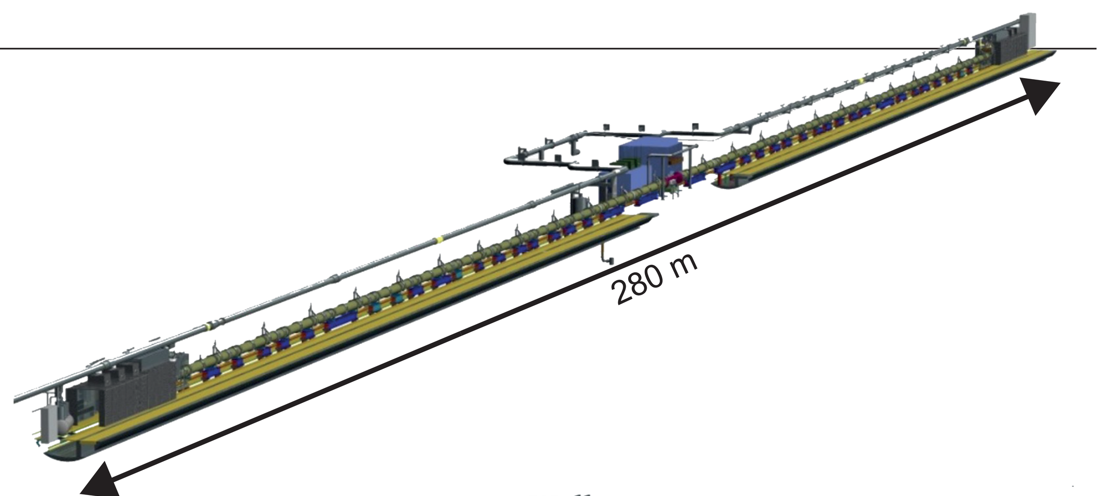


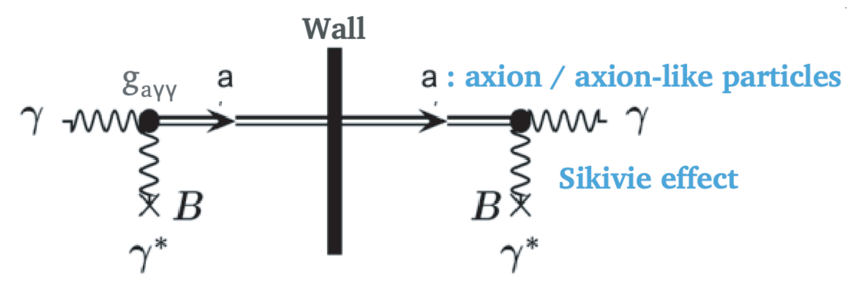
DOOCS, the Distributed Object Oriented Control System was designed for FLASH. Currently it is used also to control the European XFEL accelerator, PETRA IV and a bunch of smaller detectors like ALPS, BabyIAXO and MADMAX.

Recent developments for the client side applications are written in JAVA to allow them to be used on many computer platforms. This object oriented abstraction model helps for clean programming interfaces and in the overall system design including the hardware for a machine and is a significant step forward in the goal to improve software productivity and quality.

Detector

ALPS





The **ALPS (Any Light Particle Search)** experiment, which stretches a total length of 280 metres, is looking for a particularly light type of new elementary particle.
The international research team wants to search for new particles, the axion and axion-like particles, that can justify some anomalies observed in these latest years. To do so the experiment is using twenty-four recycled superconducting magnets from the HERA accelerator, an intense laser beam, precision interferometry and highly sensitive detectors. Such particles are believed to react only extremely weakly with known kinds of matter, which means they cannot be detected in experiments using accelerators. ALPS is therefore resorting to an entirely different principle to detect them: in a strong magnetic field, photons – i.e. particles of light – could be transformed into these mysterious elementary particles and back into light again.