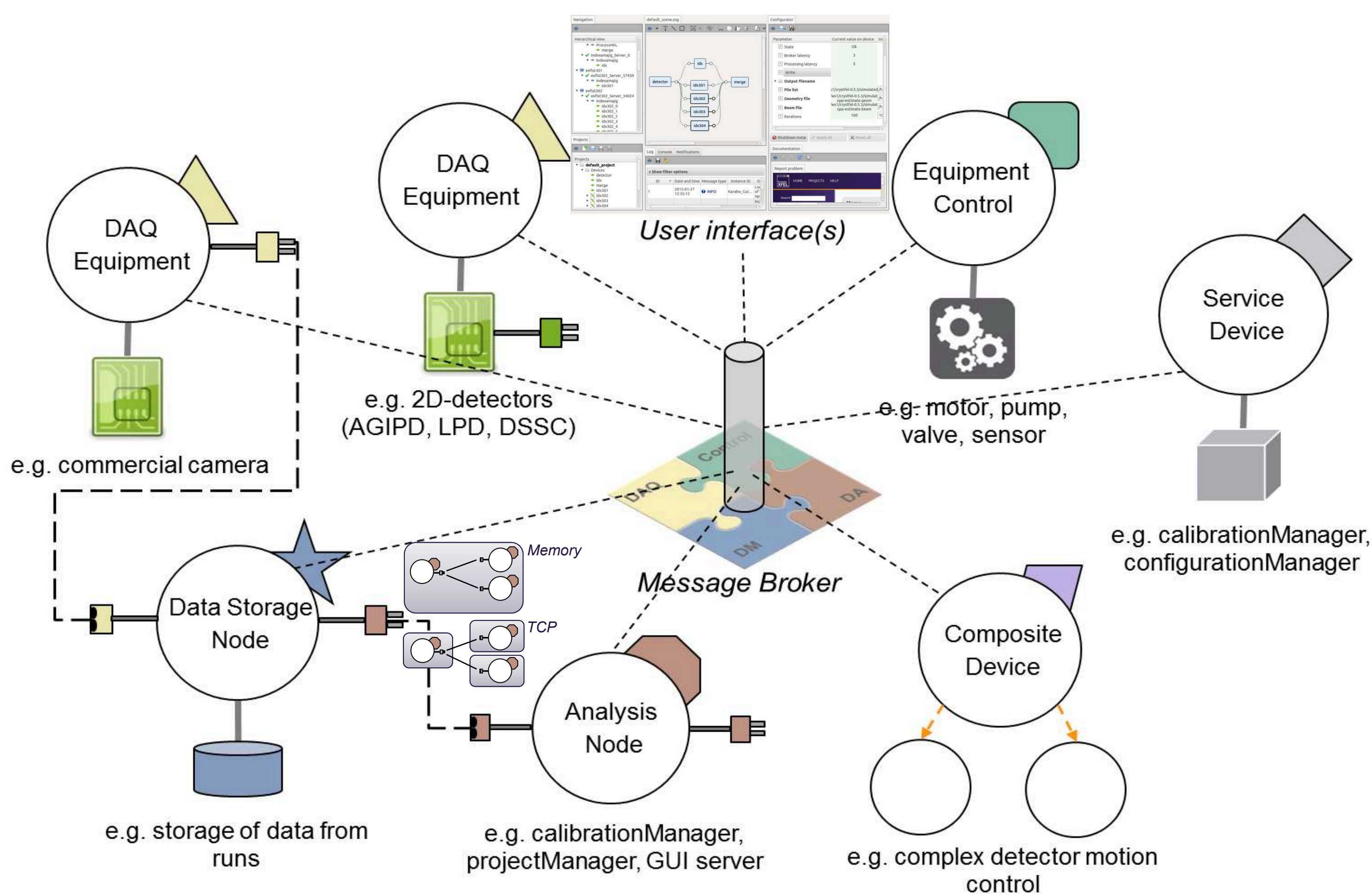


## Karabo, the Control and Analysis System for the European XFEL

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**ABSTRACT** The European XFEL is a 3.4 km long X-ray Free Electron Laser in its final construction and commissioning phase in Hamburg. It will produce spatially coherent X-rays in the energy range between 0.25 keV and 25 keV. The machine will deliver 10 trains/s, consisting of up to 2700 pulses/trains at 4.5MHz repetition rate. In 2015 a first electron beam was produced in the RF-photo-injector and the commissioning of consecutive sections are ongoing. A huge number and variety of devices for the accelerator, beamlines, experiments, cryogenic and facility systems needs to be controlled together. Data acquisition requires a precise timing and synchronisation system. Fast feedbacks from front-ends, the DAQs and online analysis system must be seamlessly integrated and provided for the accelerator and the initial 6 experimental stations. An overview of the XFEL control system, Karabo is presented.



### ■ FXE

Femtosecond X-ray Experiments

### ■ SPB/SFX

Single Particles, clusters, and Biomolecules

### ■ SCS

Spectroscopy & Coherent Scattering



### ■ SQS

Small Quantum Systems

### ■ HED

High Energy Density Science

### ■ MID

Materials Imaging and Dynamics

## KARABO 2.0

### ■ Low Level Control System (C++/Python)

Direct access to hw with unified *State*, *Alarm* and *Error* management  
Support for seamless hw *simulation* with physics engine  
Configuration database to manage hw settings

### ■ Middle Layer Devices (Python)

### ■ Macro Services (GUI + CLI)

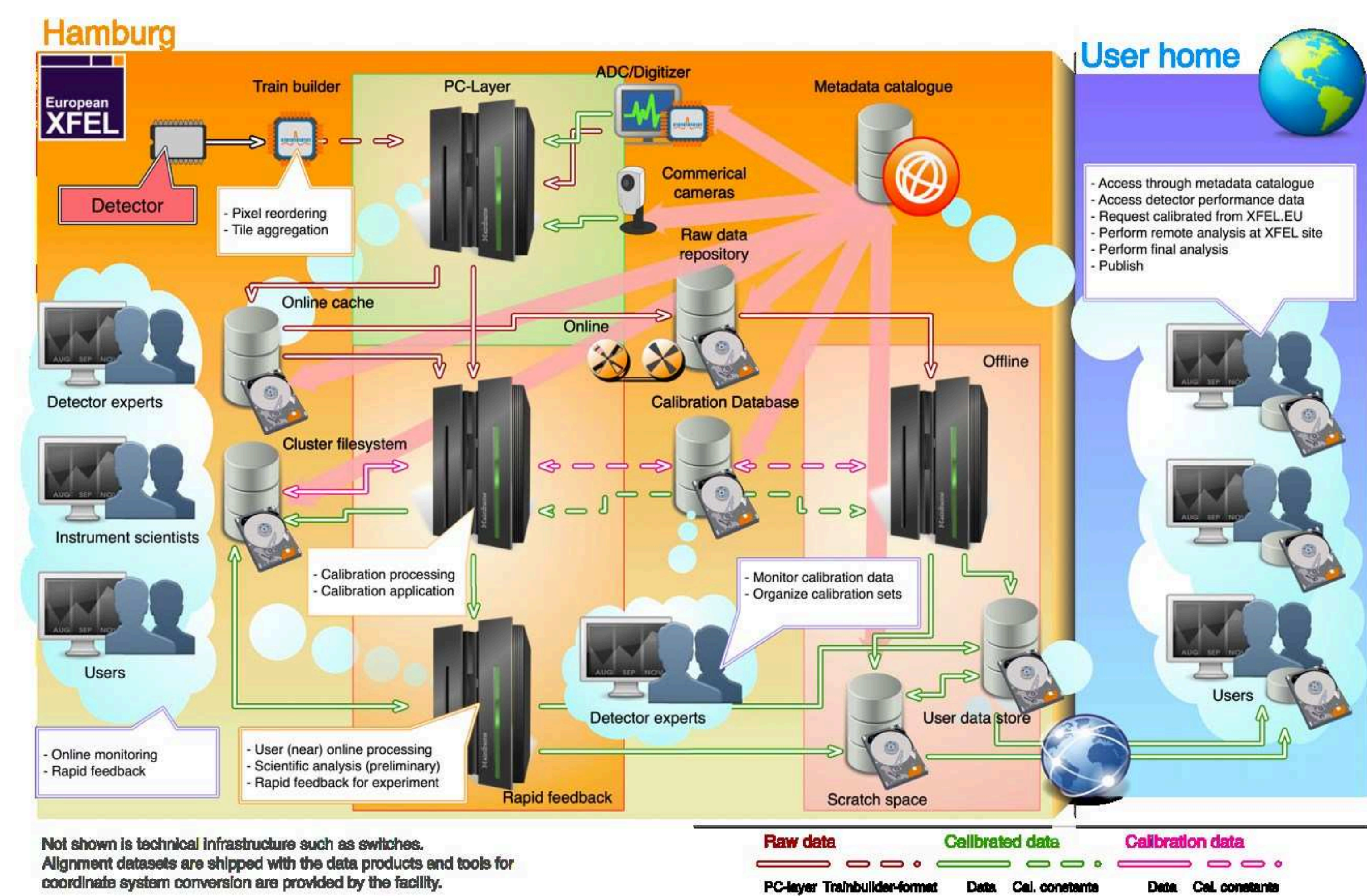
### ■ Data Analysis Pipeline

Full *workflow* engine with designer  
Optimised data throughput

### ■ GUI with Designer and Basic Widget Set

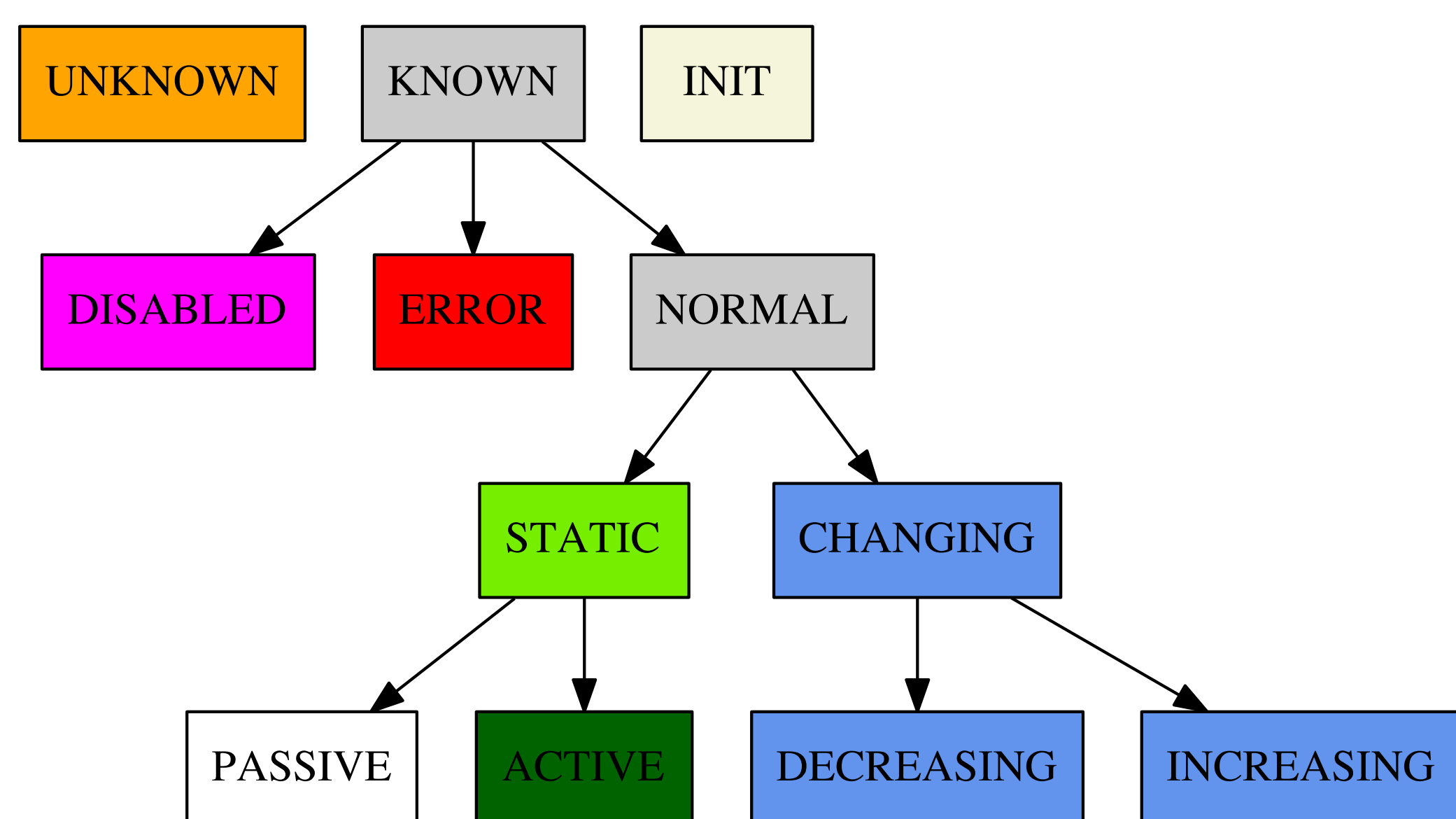
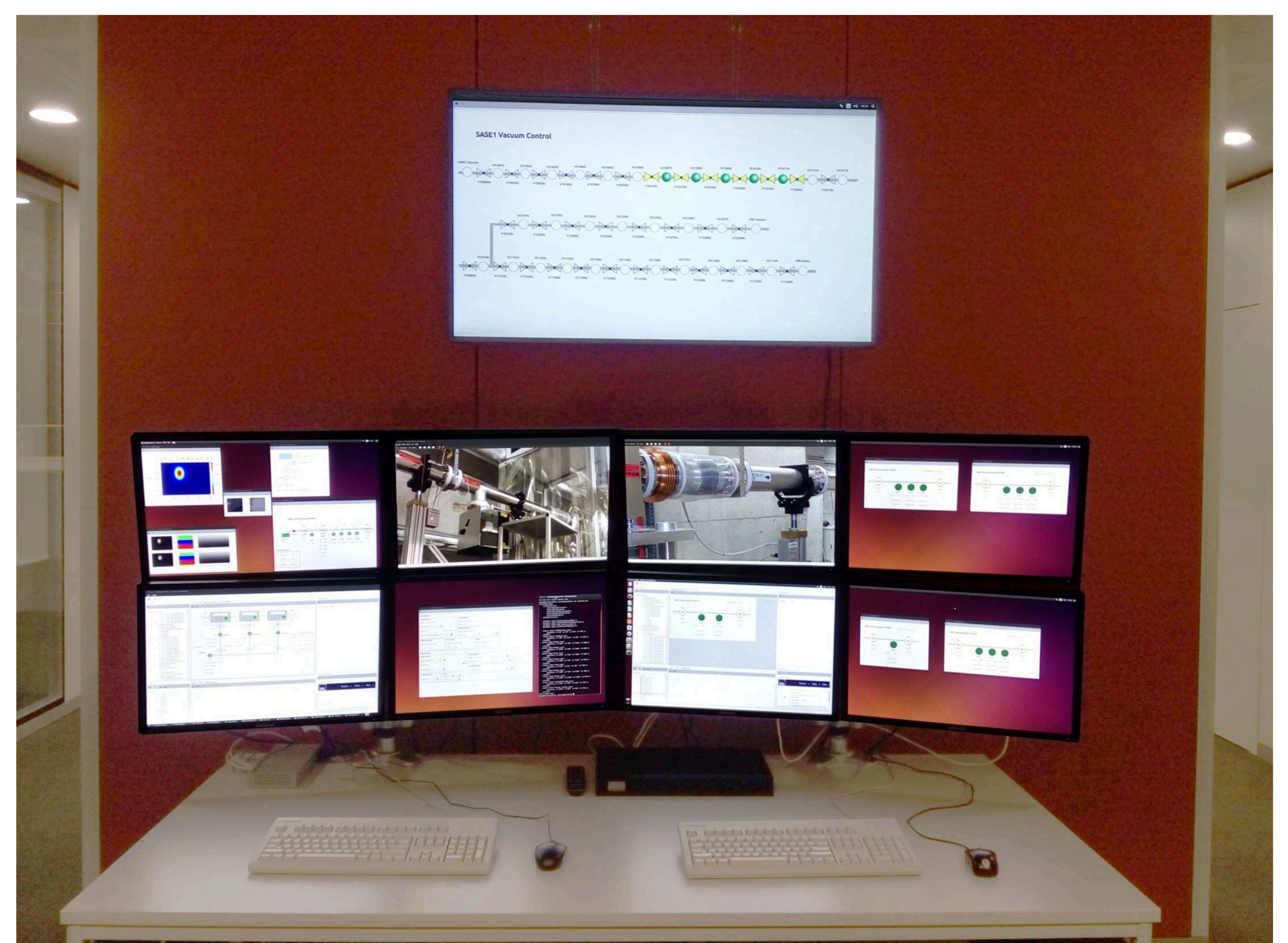
Device Browser and Configurator  
Configurable control and analysis screens

### ■ CLI with iPython Integration



Not shown is technical infrastructure such as switches. Alignment datasets are shipped with the data products and tools for coordinate system conversion are provided by the facility.

Raw data: PC-layer Trainbuilder-format  
Calibrated data: Data, Cal. constants  
Calibration data: Data, Cal. constants



Fixed set of states. All other states derive from these.

Control Room Mockup runs Karabo in simulated environment