

## CONTEXT

The Full Remote Alignment System (FRAS) is a three-dimensional, micrometric, position monitoring and alignment system, playing a key role in the HL-LHC project.

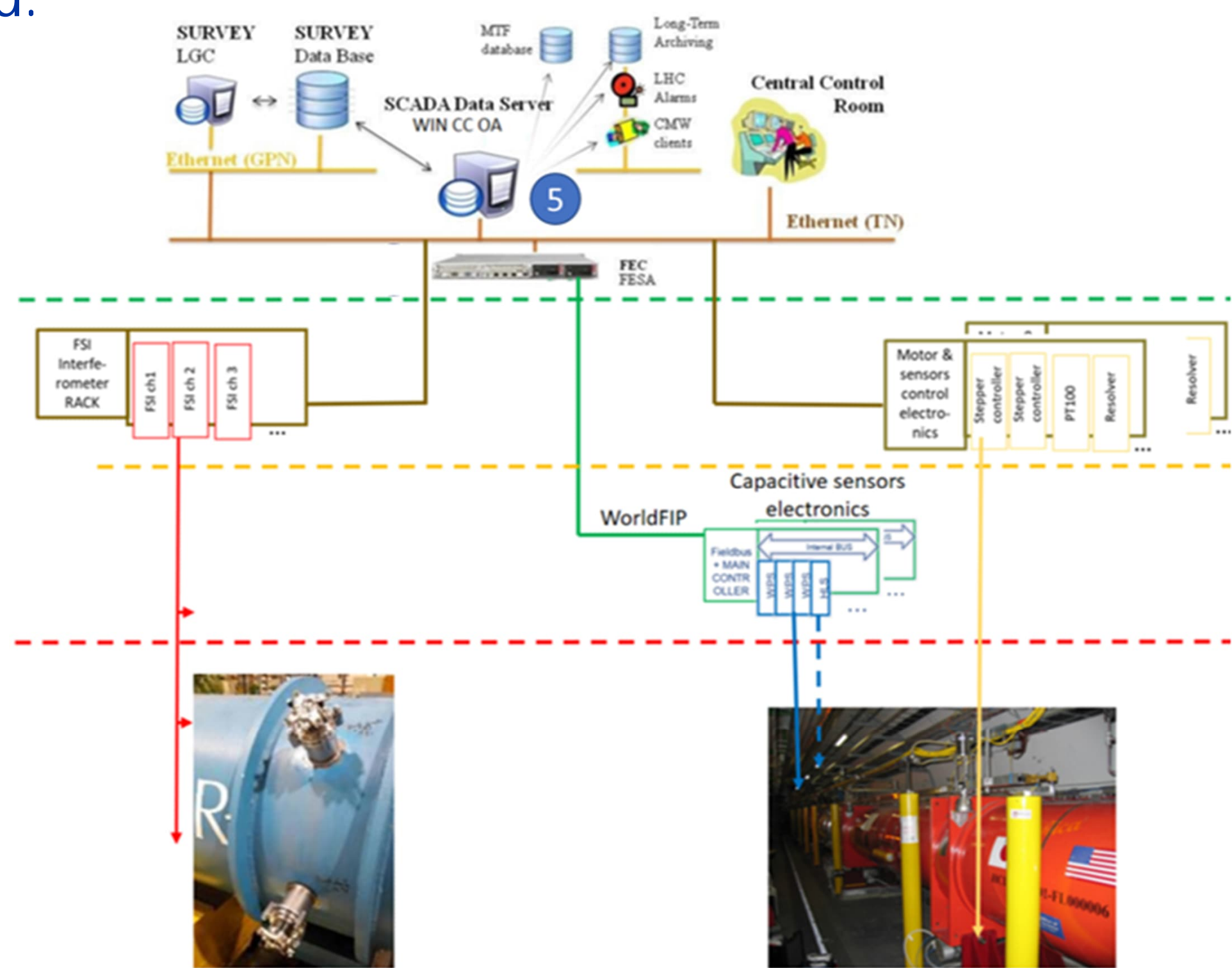
It is used to monitor and align 68 components, over 200 m of straight sections on each side of ATLAS and CMS experiment within the LHC tunnel.

All these sensors and actuators are defined by dozens of parameters each which are defined at different steps of their lifecycle.

The integration, storage and tracking of these parameters across multiple databases is one of the primary challenges and essential throughout the entire process.

## THE CHALLENGE

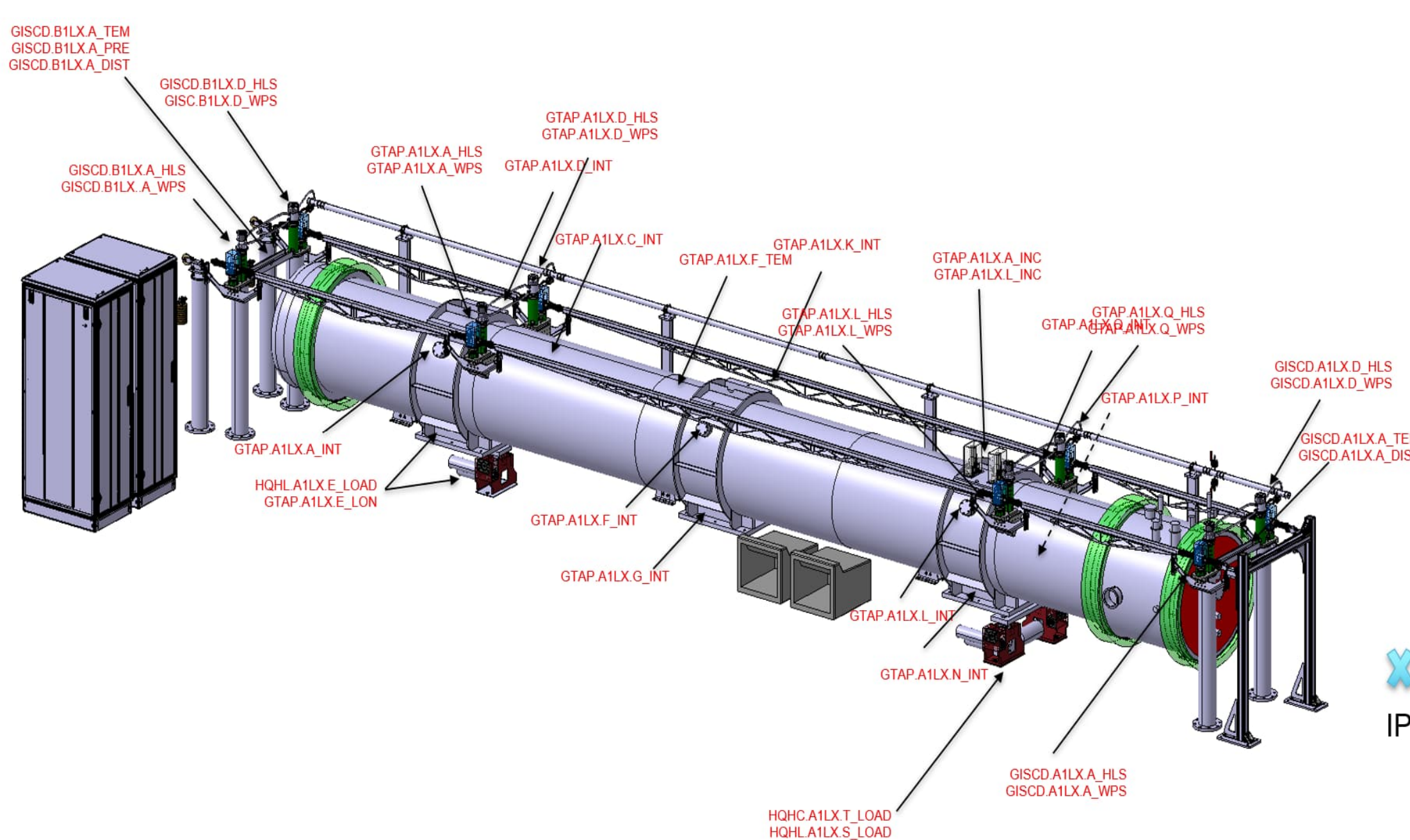
The system performs real-time 3D computations using data from seven different sensor systems, configured with 1,150 sensors, representing approximately 100,000 parameters. Results are computed and stored every second.



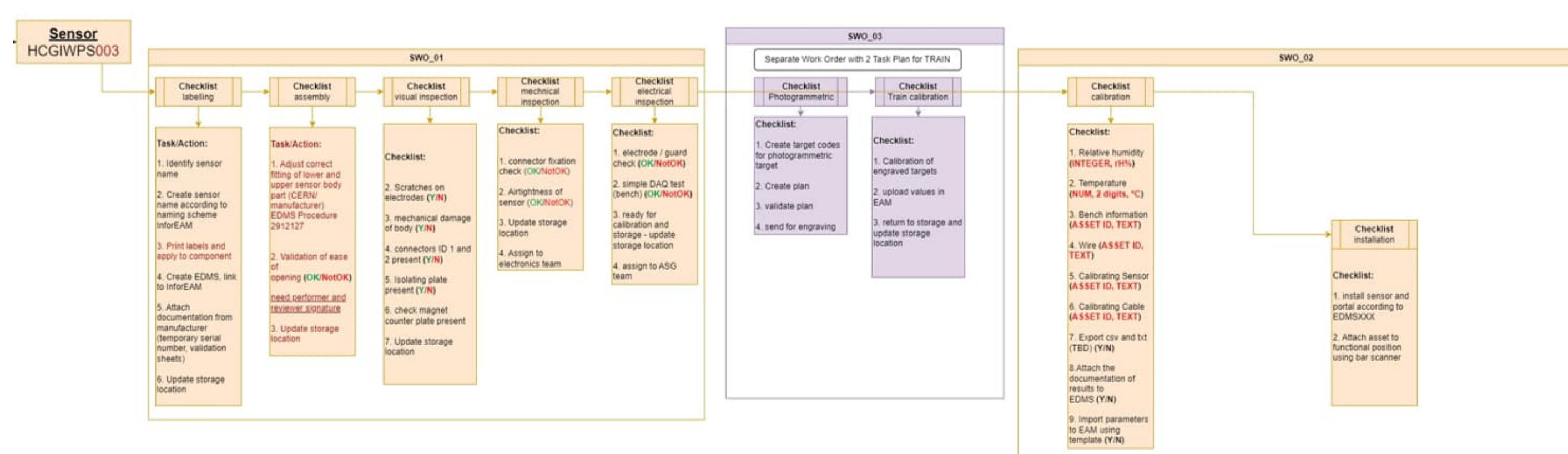
## NAMING

Unified CERN naming for automation:

- Asset and positions generation (EAM, LAYOUT database)
- Retrieval of assets parameters (LGC configuration)
- Variable creation and results export (LGC, NXCALS database)



## ASSET MANAGEMENT LIFECYCLE

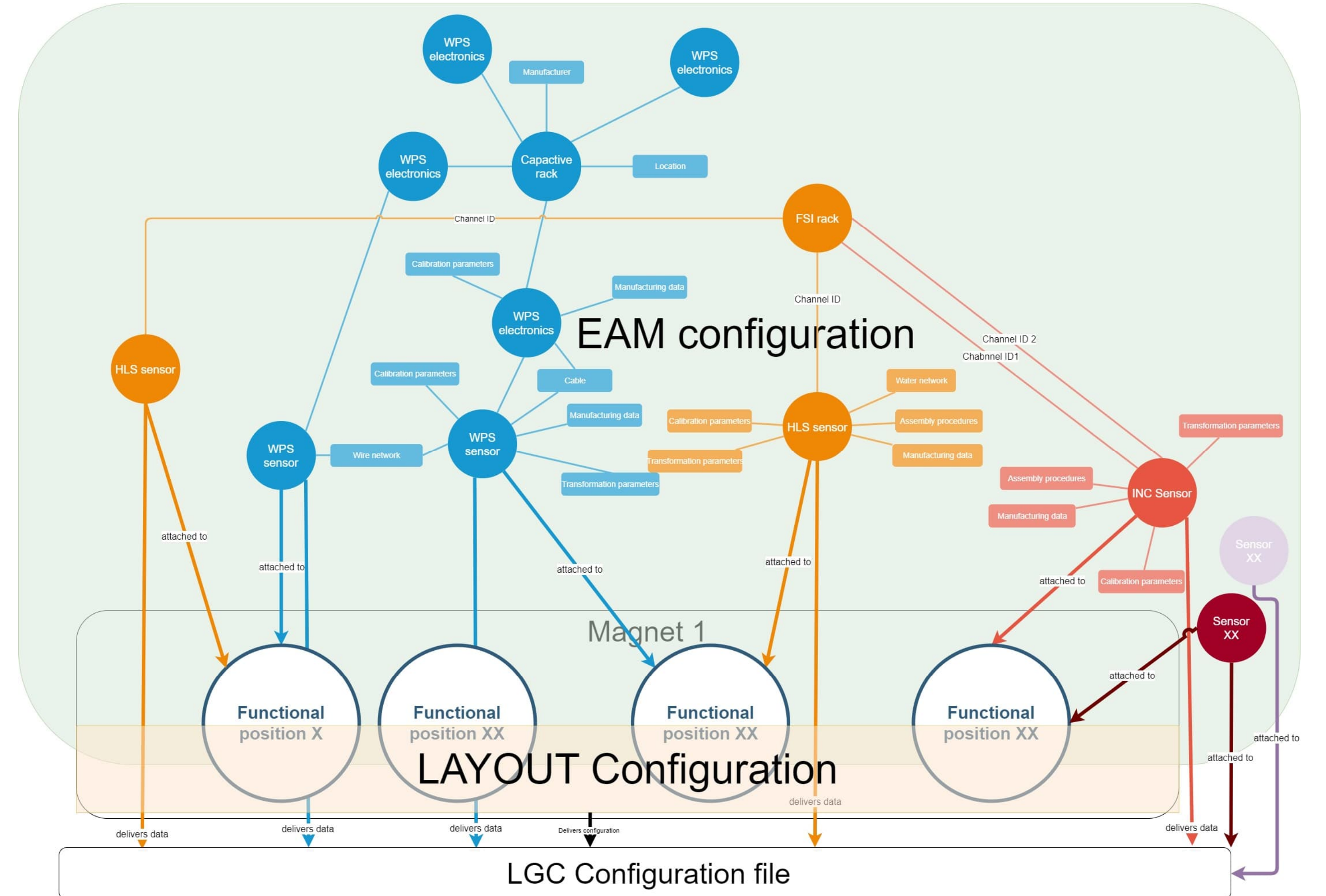


EAM is used from manufacturing to deinstallation workflow.

- Procedures to use
- Checklists
- Storage
- Calibration and geometrical data
- Link to documents stored in EDMS.

## THE CONFIGURATION

EAM and LAYOUT databases are used to structure, integrate, and organize asset data and positions in a hierarchical manner, ensuring consistent naming conventions and well-defined links. A script enables the automatic retrieval of configurations for LGC.

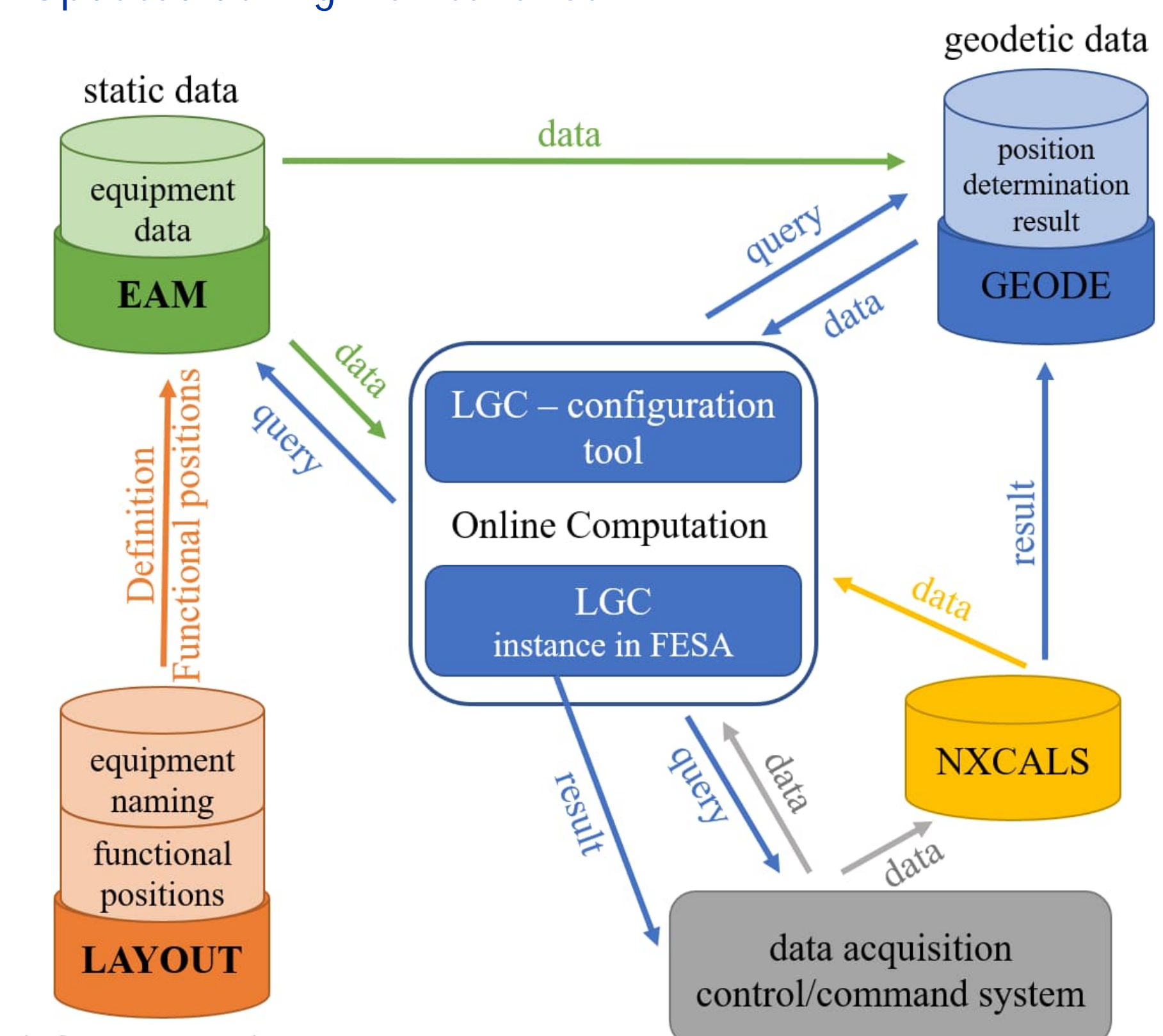


## THE INTERACTIONS

All databases and software are interconnected to deliver and store information. Results are used to perform remote alignment and stored in a long-term storage database.

Enterprise Asset Management (EAM)  
Asset life. Static data from calibrations and fiducialisation.  
Updated during maintenance.

SURVEY DB.  
Naming reference and storage for geodetic points and magnets assemblies



LAYOUT DB  
Reference for infrastructure layout, including functional positions.

Data acquisition - control/command system.  
Stores data, provides live data to, and manage results from LGC.

Logiciel Général de Compensation (LGC)  
CERN compensation software for 3D position network adjustment. Combines all measurements and parameters from the different databases.

NXCALS  
Storage for sensor measurement and computation results

## SUMMARY AND PERSPECTIVES

The FRAS quality assurance concept has been implemented and validated successfully on the Single Component Test installation.

Next steps includes the validation on the Inner Triplet String Test, composed of six magnets.

The FRAS and its quality assurance scheme will then be deployed on production through RAC3 and HL-LHC project.