The Layout Database

Experiences in Cryogenic Instrumentation and Control

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What is the Layout Database?

- Layout Database was developed in 2003 by AB-CO & TS-IC
  - **Plan** for the installation of components in the LHC
  - A **model of the system architecture** - Not asset management! [MTF]
  - **CERN-Wide** Oracle Database allows **centralised**, **integrated** information management
  - Public **web-interface** with navigation and search

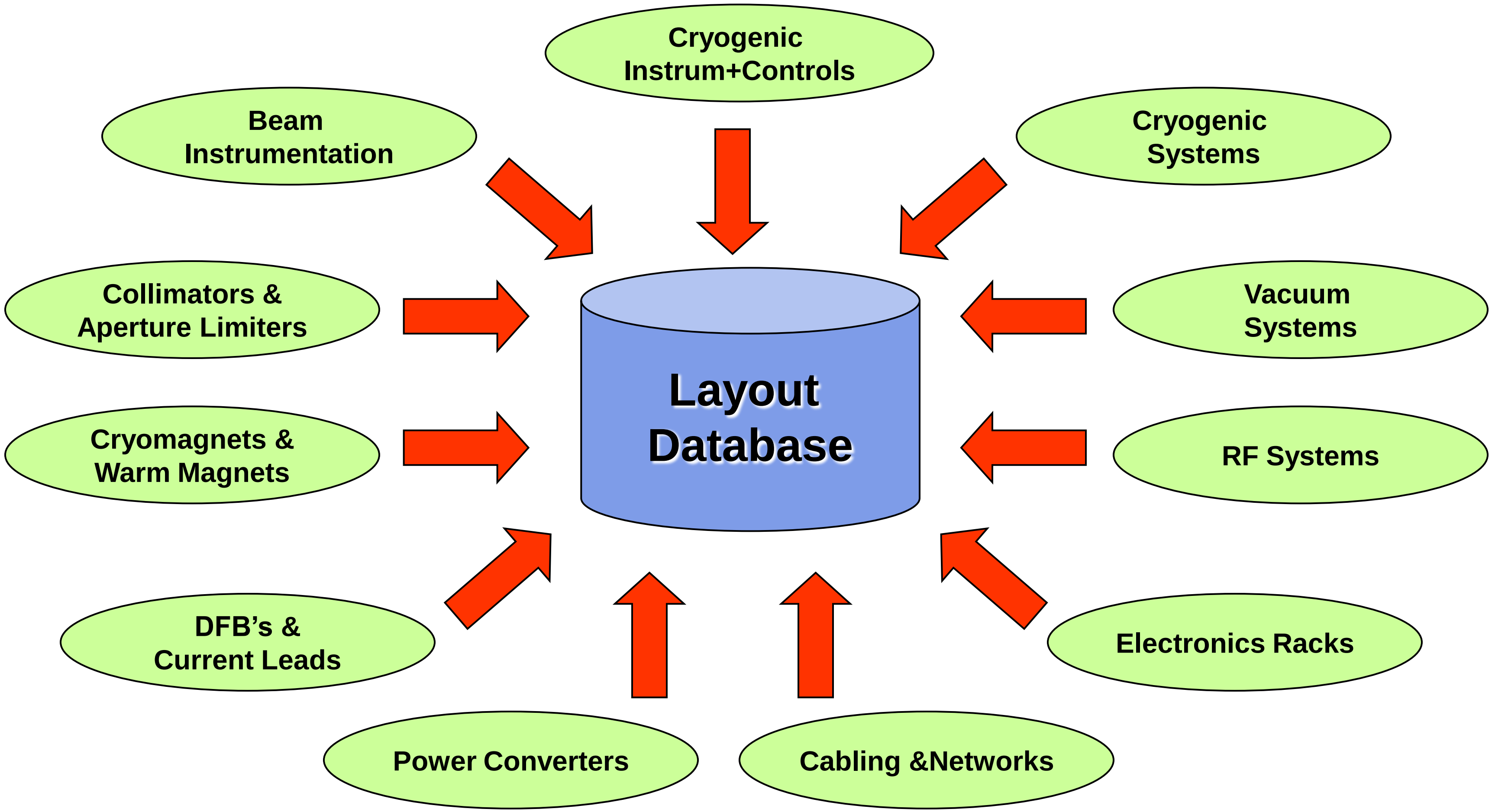
- Extension to non-LHC information began in 2007
  - **2007**: TI2, TI8, TT60, TT40, TT41 and F61
  - **2008**: SPS and PS rings
  - **2009**: PSB rings
  - **2010**: LT, LTB, BI and Linac4
  - **2011 and beyond:** Layout DB to describe the entire accelerator complex

    (implies a restructuring of the database and new user interfaces)

- Layout information is not static
  - Gradual completion with more data
  - Layout modifications at technical stops

What components are stored in the Layout DB?

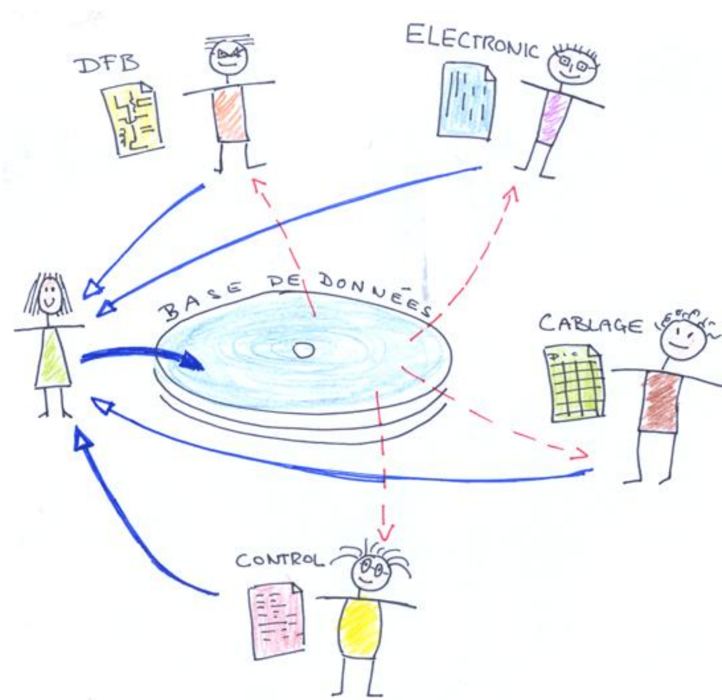
Many accelerator domains are described in the Layout database…



…but any domain can be accepted

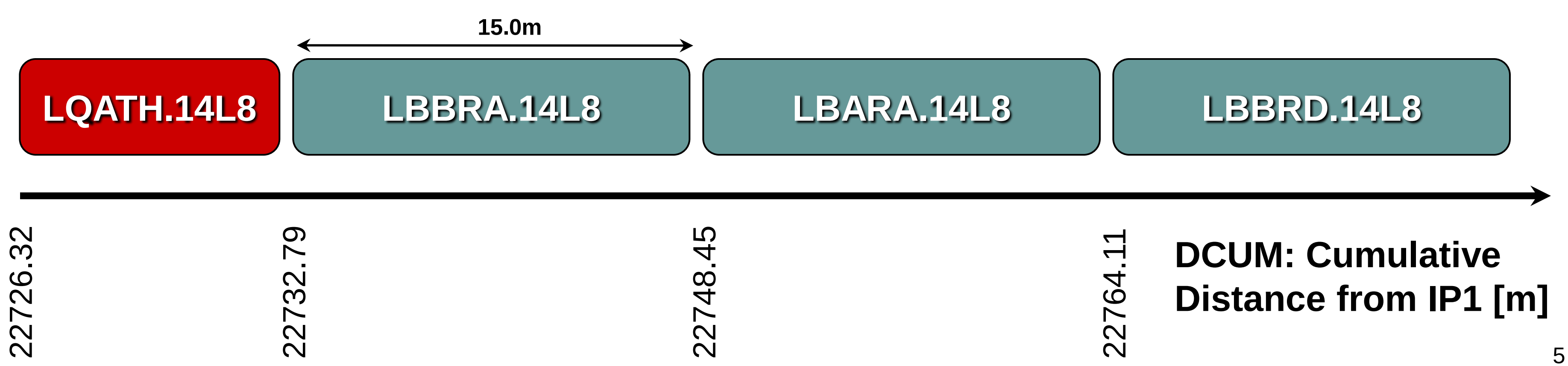
Why use the Layout Database for Cryo instrumentation and Controls?

- **Urgent need** to assemble and structure operational data in a database
  - Define configuration of front-end crates for manufacture
  - Produce the specifications for the UNICOS control system
- **Problem:**
  - Complex, inconsistent and incomplete data **dispersed across many sources**
    - Excel spreadsheets, plans and technical documentation
    - Stored on people's local hard disks!
    - Difficult to extract and share accurate information
- **Solution:**
  - Use the **Layout Database!**
    - A single, **reliable** source of information
    - **Accessible** to all team members
    - Cryogenic Instrumentation data **fully integrated** with data from other equipment groups
    - Pre-existing **CERN-wide** database & interface
    - No custom database development required



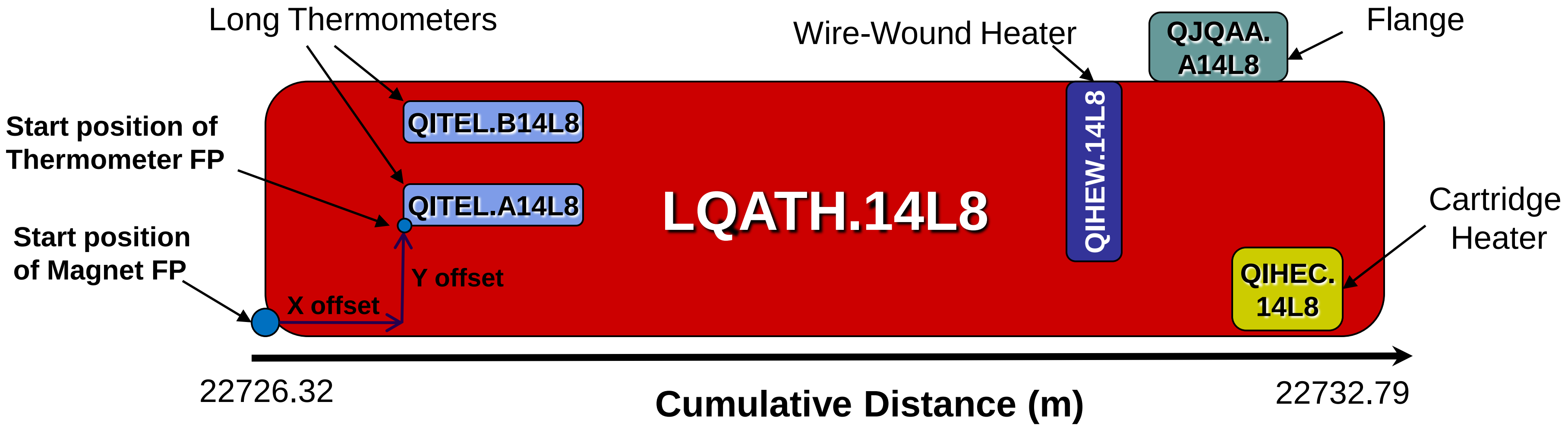
Representing components in Layout DB: Functional Position

- Every component in the Layout database is defined as a **Functional Position (FP)** which specifies the **size** and the **position** of the space that the component occupies in the accelerator.
- **Functional Positions** have the following characteristics:
  - A **Type Code**: A 5-letter code defined by the CERN naming conventions
  - A **Location**: Machine Half Cell, Period, Alcove, Building Number etc
  - A **Position:** within the location, or within the accelerator
  - **Dimensions**: can be very large (several metres) or very small (a few millimetres)
  - **Unique Name(s)** according to the QA plan of each machine + expert names



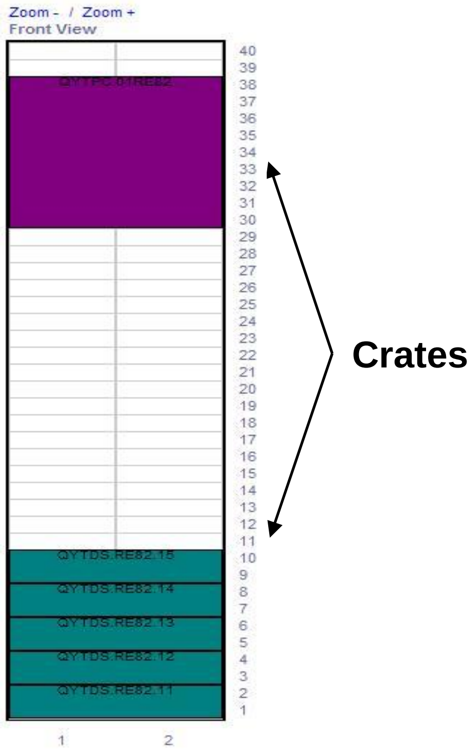
Representing components in Layout DB: Machine Hierarchies

- Most Functional Positions are defined as part of a **hierarchy**:
  - **Example**: An instrument FP is defined as the child of a magnet FP.
    - The position of the instrument is defined as an offset **with respect to** the start position of the magnet
    - The instrument **inherits the location** of the magnet
    - The **exact position** of the instrument in the accelerator is then **calculated**.
    - **If the position of the magnet changes, the position of the instrument is updated automatically.**

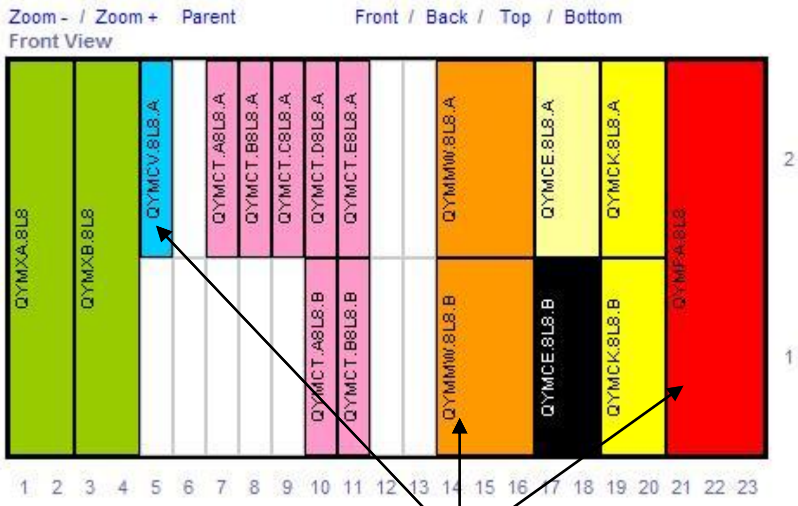


Representing components in Layout DB: Controls Hierarchies

- Control components are also defined in Functional Position hierarchies:
  - The crate FPs are defined and positioned within rack FPs
  - The electronic card FPs are defined as children of crate FPs



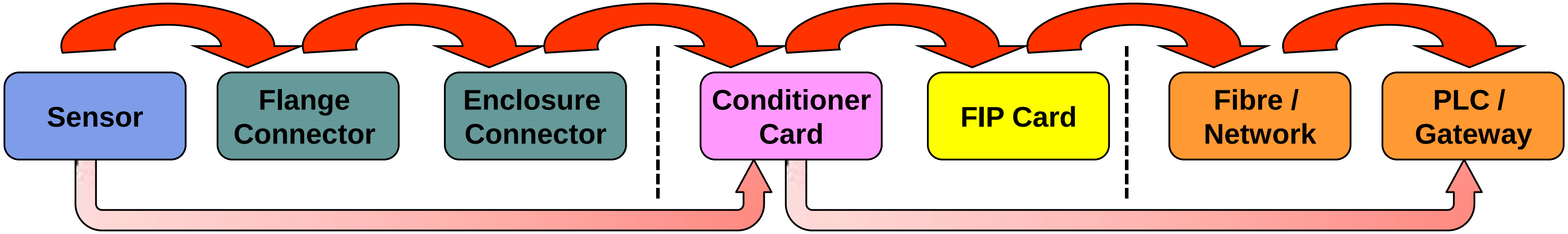
Crate: QYTCF.8L8.B



- Using the **Layout web interface** http://cern.ch/layout it is easy to **navigate** through the hierarchy

How to define relationships?

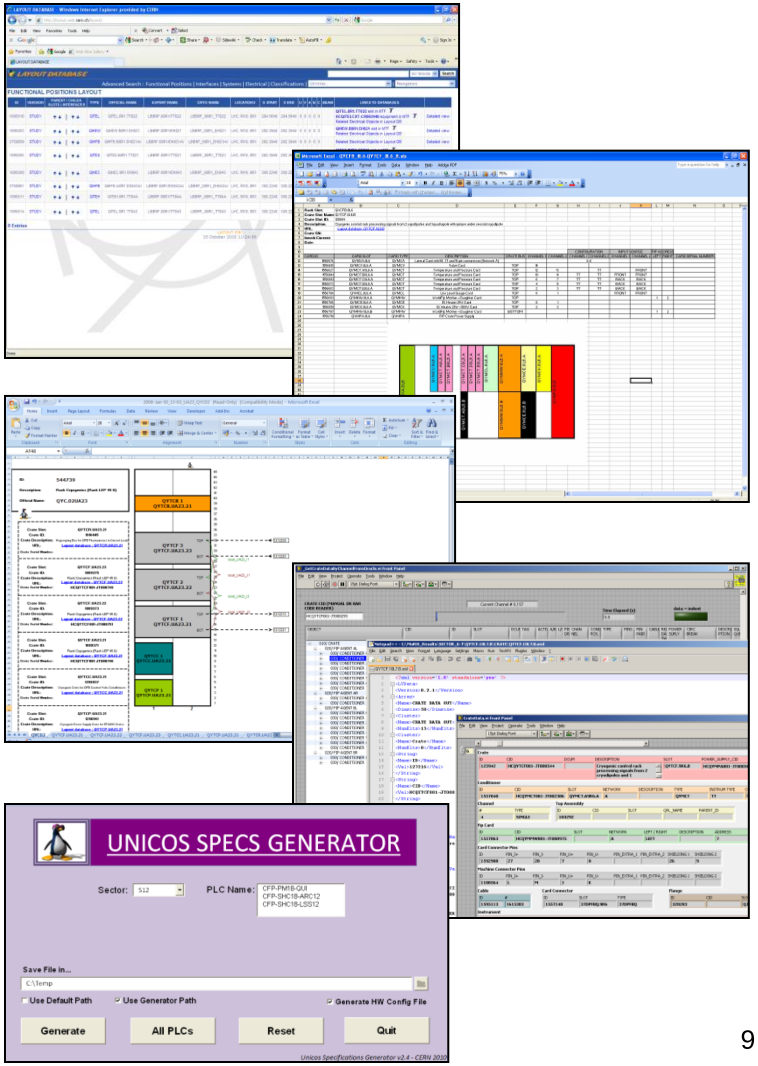
- Once all of the instrumentation and electronics slots are declared, they can be **connected** together to describe an **instrumentation channel**.
- **Connections** are logical relationships between two functional positions.
  - **Physical Approach (*Cabling*)**:
    - High level of detail, approaching physical installation
    - Connections may have additional properties such as cable numbers, types and pins
    - Cryogenics defined 25,000+ instrumentation channels with all intermediate components and connections fully described from Sensor to PLC.



  - **Conceptual Approach**:
    - Lower level of detail, more conceptual, defining only the minimum connections required to describe the system.
  - Each equipment owner must decide the level of detail that is required, based on the foreseen use of the information.

How can this information be used?

- The Layout Database **fully documents** the Cryogenic Instrumentation and Control system. By developing applications to extract and format the information we were able to:
  - Install and configure all equipment components *(Layout web interface)*
  - Manufacture and configure electronic control crates *(Crate Specification Generator)*
  - Install and configure all connections and debug cabling problems *(Cabling File Generator)*
  - Fully automate the electrical tests of all instrumentation channels *(Mobile Test Bench XML file generator)*
  - Produce control software specifications *(UNICOS Specs Generator)*
  - Achieve QA by using the database as the **only source** of information across all tasks.



Summary

- **Benefits**
  - **Integration** with other equipment group data
    - Easier maintenance (auto-update induced by other groups' actions)
    - Consolidated information describing the complete architecture of all accelerators
  - **Links** to other data repositories
    - Design information, drawings, pictures [EDMS]
    - Integration with physical equipment information [MTF]
    - Domain-specific databases [i.e. Cablotheque, Thermbase]
  - **Traceability** when used in association with MTF:
    - Can trace which equipment was installed in a Functional Position
  - **Identification** and **naming** in line with QAP
- **Costs**
  - Requires an investment of **time** and **effort**
    - Data is **already privately managed;** we are just moving towards **centralising** the information using **common** tools.
    - Effort is **different**, but **not** necessarily **increased**…
    - New **user-friendly** interfaces are under development – so that equipment groups are **responsible** for entering and managing their own data