

Automatic inventory and configuration management tools for the LHC power converter controls



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The Challenge



- As a group we are responsible for tens of thousands of pieces of equipment installed in ~1700 power converters around a very large (27 km) machine
- During the commissioning phase, there are many interventions to install and replace equipment
- Equipment must be tracked so we know its location and history
- Configurations and calibrations associated with equipment must be maintained in order to achieve required machine performance
- Interventions should take as little time as possible to optimise machine availability

Intervention Process



- A technician goes to the LHC tunnel and replaces a piece of equipment
- The tunnel is a remote location with limited computer access
- Through automation we can simplify the process and reduce the time needed for an intervention
- We ensure that equipment is correctly configured

Configurable Items



Magnet circuits



- Gains
- Limits
- Defaults

- Loop parameters
- Resistance
- Inductance
- Limits

Current transducers



- Calibrations
- Gains
- Temperature coefficients



Voltage sources

- Calibrations
- Gains
- Temperature coefficients



ADCs

Equipment



- Equipment is physical hardware that may be installed in the accelerator complex
- Current transducers (DCCTs), voltage source electronics and controls hardware are examples of equipment
- The location of equipment must be tracked
- Equipment may have configuration and calibration values associated with it

Systems



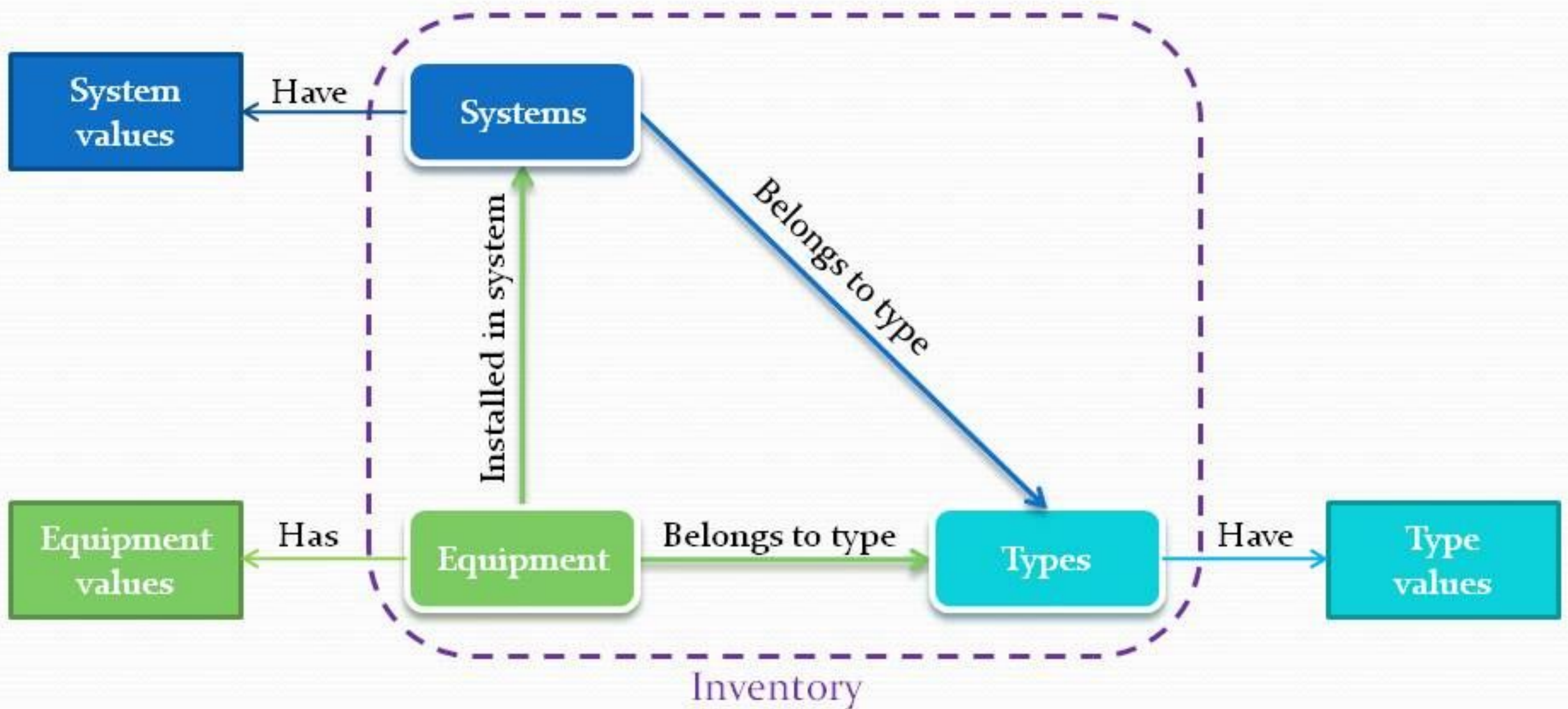
- A system is a virtual ‘slot’ in the accelerator into which several pieces equipment may be installed
- A named power converter position in the accelerator is an example of a system
- Does not refer to a particular piece of physical hardware
- A system may have associated configuration properties, typically relating to the circuit

Types



- Equipment and systems must belong to a defined type
- A type identifies the model of equipment or the specification of a system
- The type of a system dictates which types of equipment may be installed in it
- A type may have values associated with it
- The property values associated with a type are common to all equipment or systems that belong to the type

Inventory and Configuration Relationships



Equipment identification

- Each piece of equipment is tagged with a standard barcode that identifies its type and serial number and provides an LHC ID



- For power converter equipment we also attach a Dallas ID chip that can be read via the power converter controller and that is therefore remotely accessible

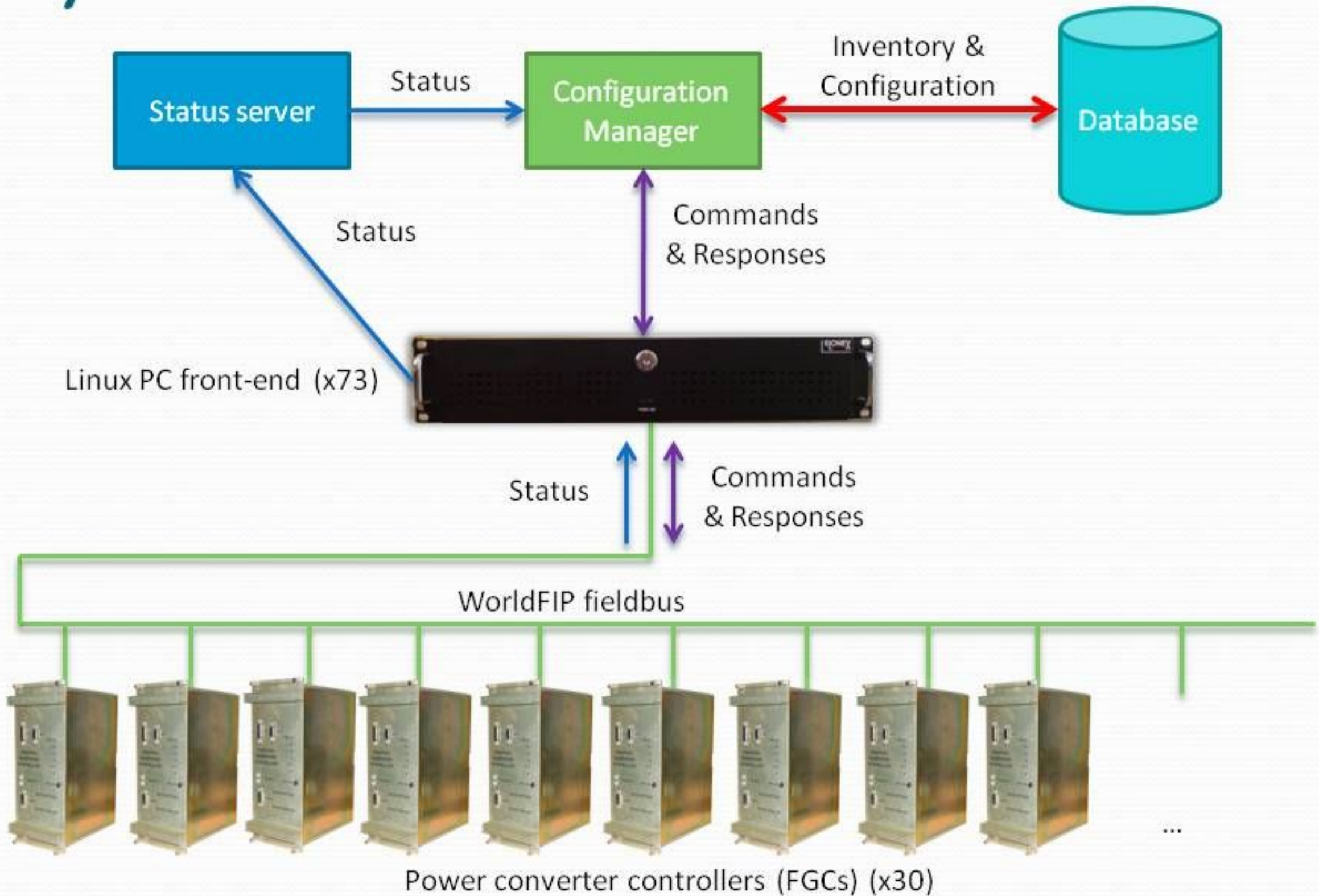


Function Generator/Controller

- Every power converter is controlled by an FGC
- Each FGC knows the mapping between all ID chips and LHC IDs
- The list of equipment installed in a power converter is therefore accessible through the control system
- Configuration takes the form of standard properties, accessible by any application through the control system



System Architecture



Modifying the Configuration



- Configuration can be updated through the control system by setting properties
- If a configuration is modified, the device is marked as being out of synchronisation with the database
- Once a modification has been tested, the user can either keep the change by triggering a synchronisation from the controller to the database, or revert it by synchronising in the other direction

Results



- Automated management of the inventory and related configuration has proven vital during LHC hardware commissioning
- Greatly simplifies the job of a technician when they install equipment
- Automatic inventory is used to perform an automatic configuration
- After new equipment is installed, the power converter controller is automatically loaded with the related configuration within a few seconds
- Some statistics:
 - 1975 power converter configurations managed
 - 49251 pieces of equipment
 - 342 types of equipment
 - 99642 property values
- The system is a success!



Thank you for listening.