



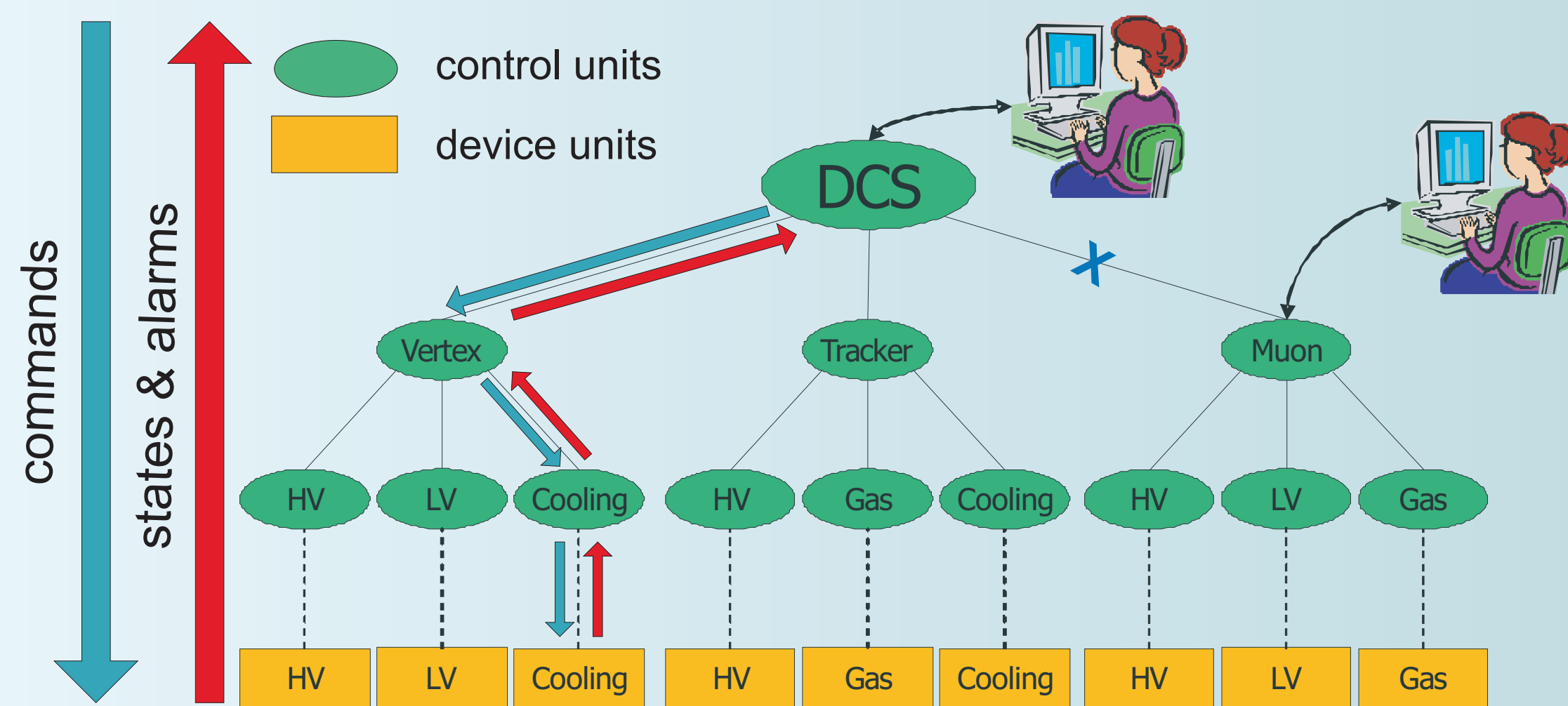
AUTOMATING THE CONFIGURATION OF THE CONTROL SYSTEMS OF THE LHC EXPERIMENTS

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The different modes of operation of the LHC experiments impose strong requirements on the flexibility and re-configurability of their control systems. Each control system is built from a range of hardware devices and of inter-cooperating software applications. These are based on the commercial package PVSS and are operated as a Finite State Machine(FSM). The setup of these devices and applications from a configuration database must be synchronized in order to allow for a coherent operation of the experiment.

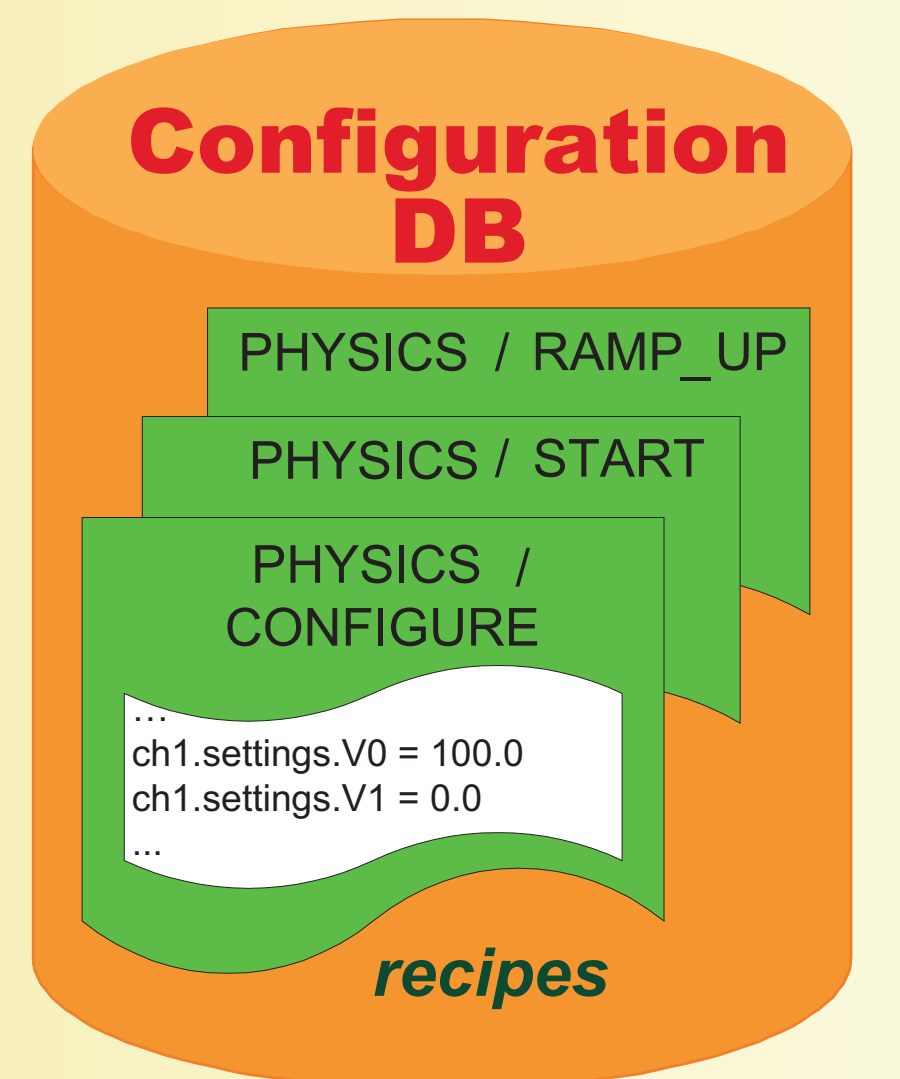
FSM

The FSM package allows to model the behaviour of the different parts of the control system by means of decision units characterized by a set of well-defined states and the possible transitions between them. The FSM units are arranged in a tree-like structure in order to represent the hierarchical organization of the experiments' control systems. Commands are propagated downwards in the hierarchy and their execution triggers state transitions in the FSM nodes. The tool permits the partitioning of the control tree into different control domains that can be operated independently.



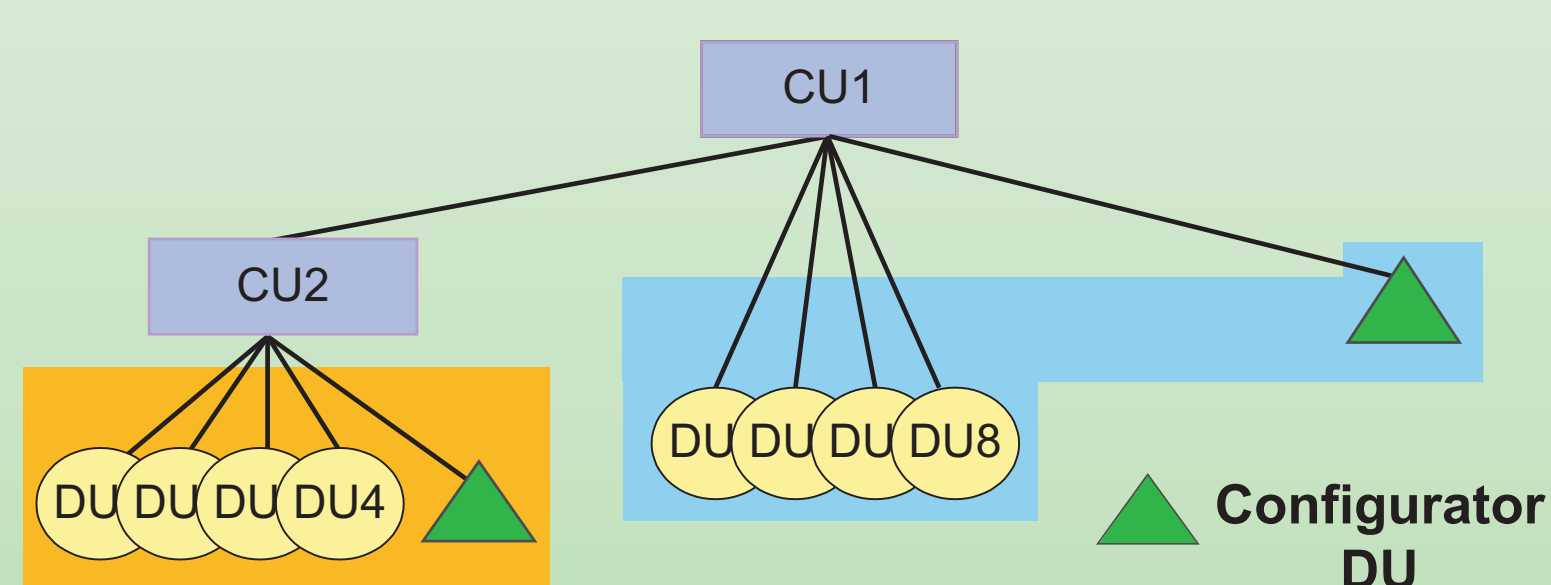
Configuration DB Tool

All configuration parameters of the devices in the control system are stored in the Configuration Database. The data directly related to run-time control is grouped in so-called *recipes*. A recipe is a collection of settings (values or/and alert parameters) corresponding to a number of data-points in PVSS, that is identified by a unique name. Applying a recipe to a control system may be seen as executing a complex command that involves setting a large number of related parameters and reconfiguring alert thresholds. The Configuration DB Tool allows to pre-load, on request, the recipe data from the database into a local storage in the PVSS application, called *recipe caches*. Once the recipe data is loaded into the PVSS application, these caches may be accessed directly regardless of the state of the database connection.

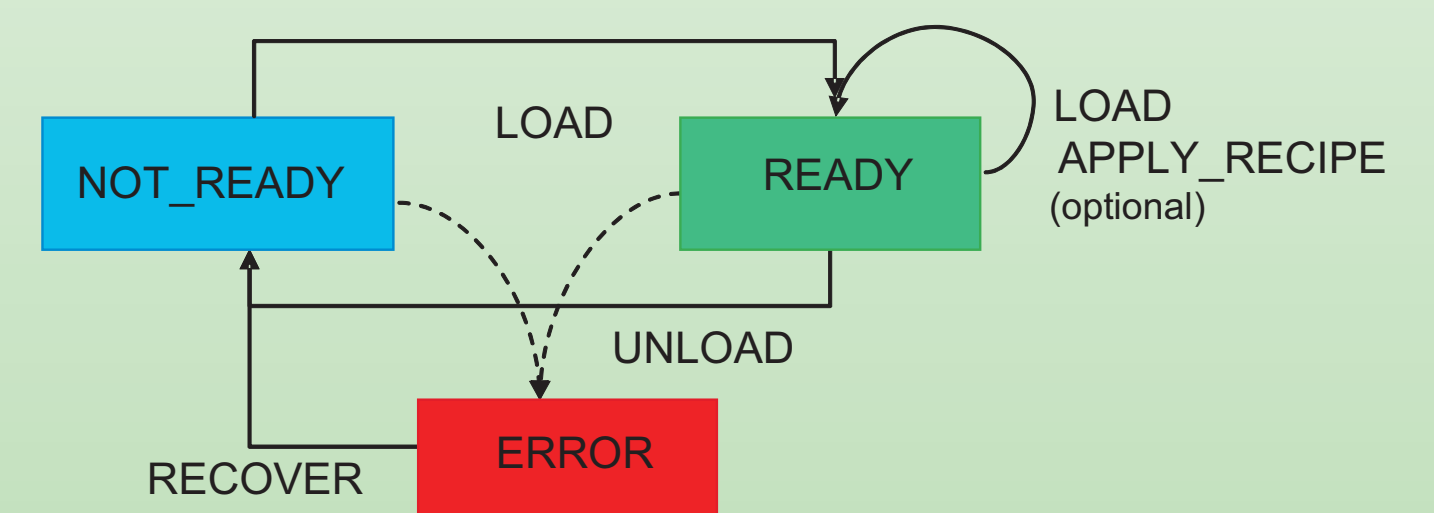


FSM-Configuration DB Tool

The FSM-Configuration DB Tool connects the control system FSM and the configuration database together to automate the handling of the configuration data required by the experiments at run-time.

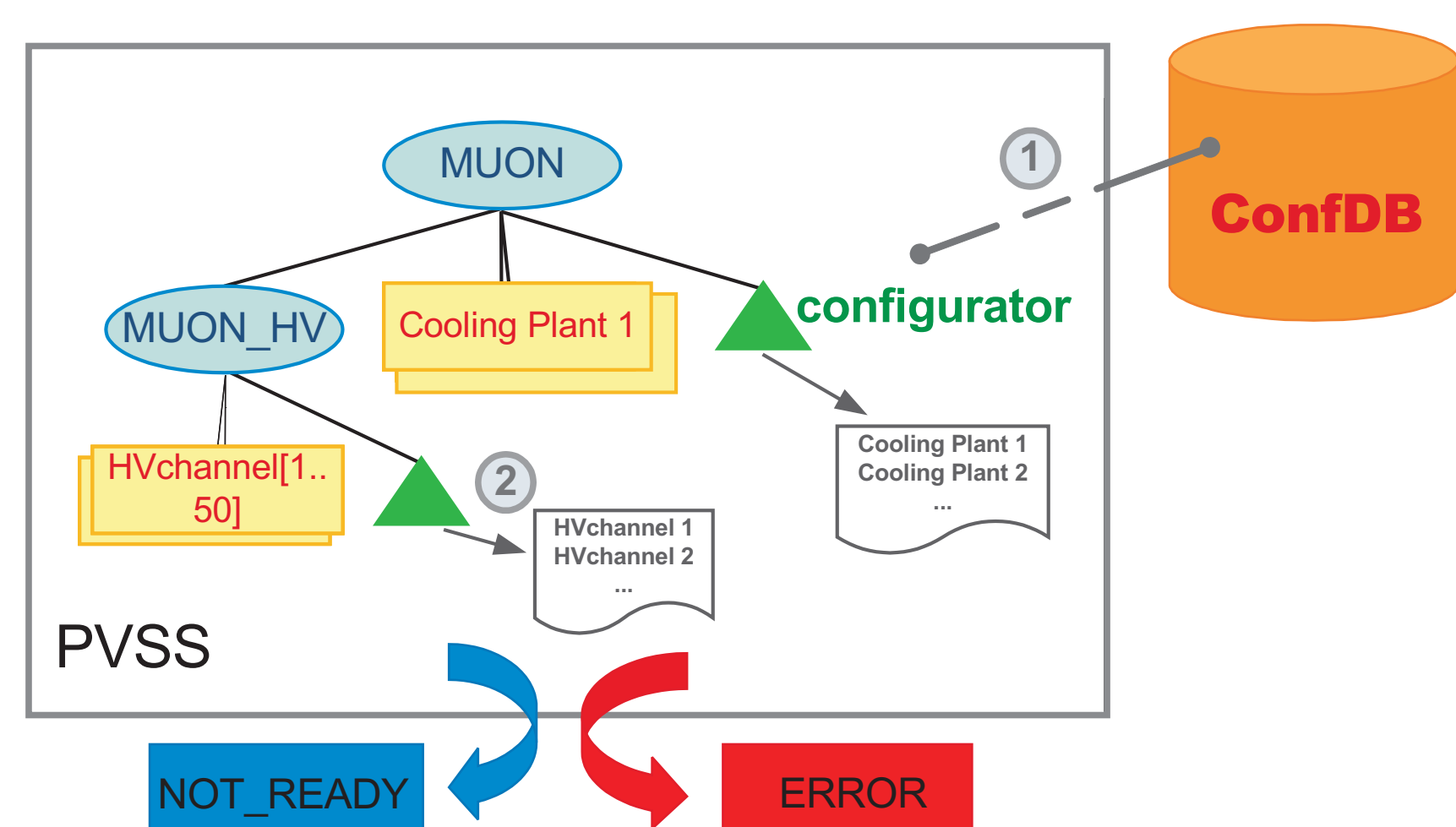


- The FSM-Configuration DB Tool integrates into the FSM tree specific devices units called **configurators**.
- The tool adds one configurator per FSM control domain to allow for partitioning.
- Each configurator only handles the information strictly required by the devices in its sub-tree.
- The figure on the right shows the state diagram of a configurator.



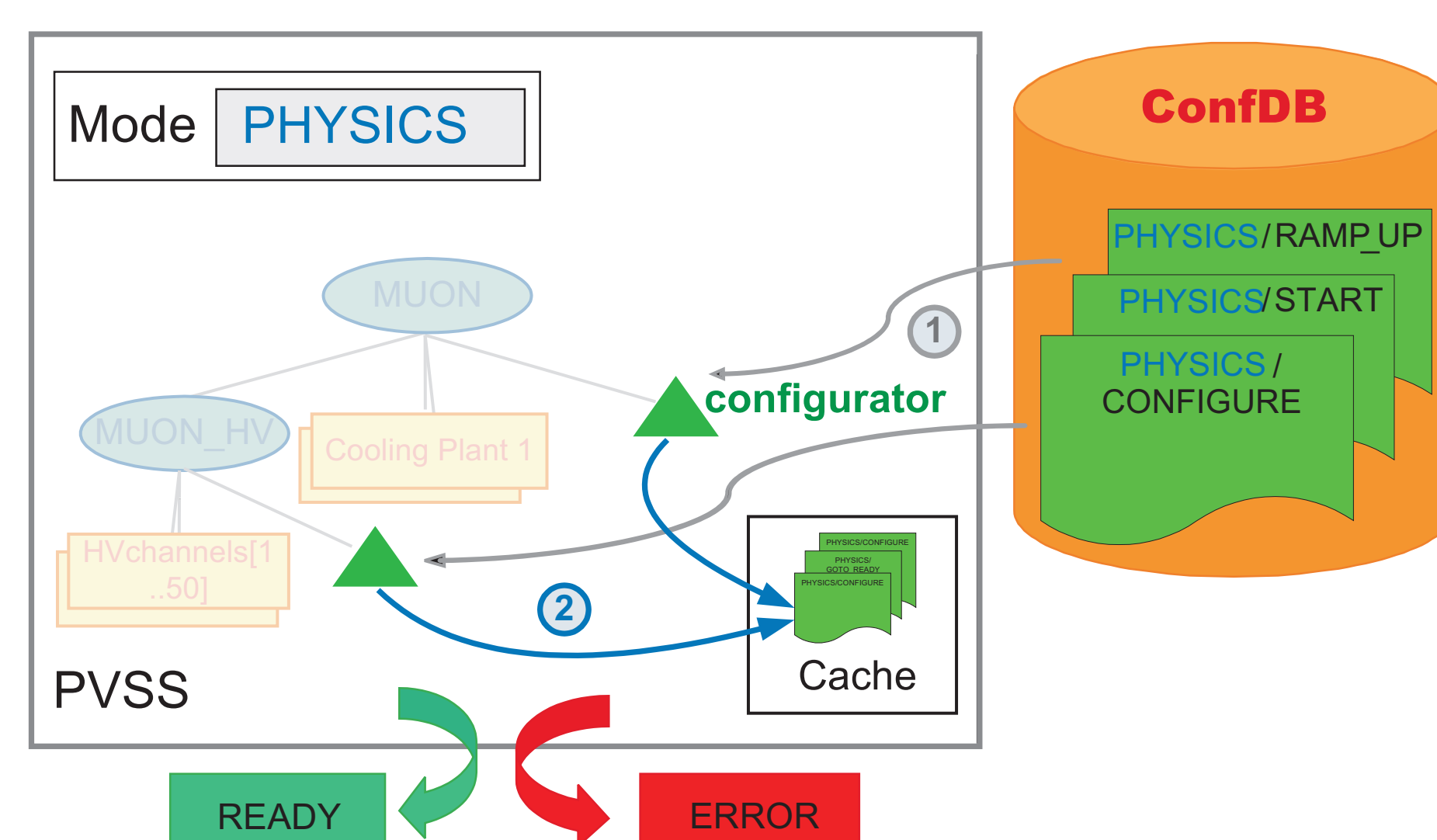
- Configurators make use of the functionality of the Configuration DB Tool to access the database and pre-load the configuration data into the recipe caches.
- Following a FSM command, these caches are accessed by the configurators to apply the recipes to the devices in the hierarchy tree.

Initialization



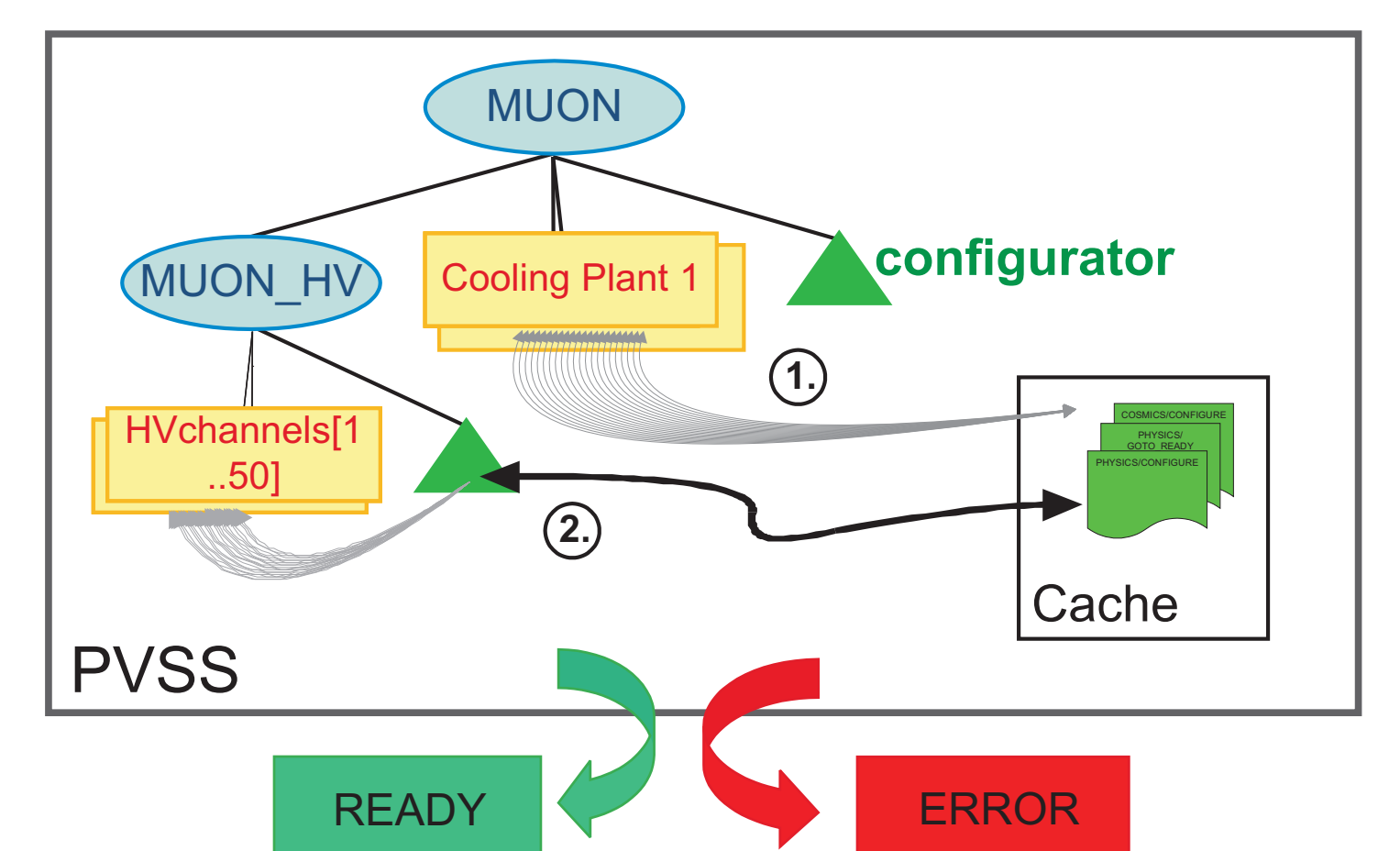
Upon start up of the FSM hierarchy, the configurator
 ① establishes connection with the Configuration Database.
 ② determines the list of devices and their FSM transitions.
 If these operations are successful, the state of the configurator is set to **NOT_READY**, otherwise to **ERROR**.

Loading recipes



Once the configurator is initialized, the operator defines the run mode to be performed, e.g. PHYSICS, COSMICS...
 ① The configurator accesses the database and loads all the recipes required by the devices in its sub-tree for the given run mode.
 ② Stores the loaded data into recipe caches.
 The state of the configurator is set to **READY** or in the event of a problem to **ERROR**.

Applying recipes



Data cached in PVSS can be applied directly by the devices or by the configurators using the **APPLY_RECIPE** command.

1. When each device applies a recipe to itself:
Maximizes flexibility
2. When the configurator applies the recipes to all active devices at once:
Optimizes speed

The FSM-Configuration DB Tool

- A flexible tool for all LHC experiments to automate the configuration of their control systems.
- A common solution that reduces the experiments' development and maintenance effort.
- Currently in an advanced stage of development and already being used by several detectors.