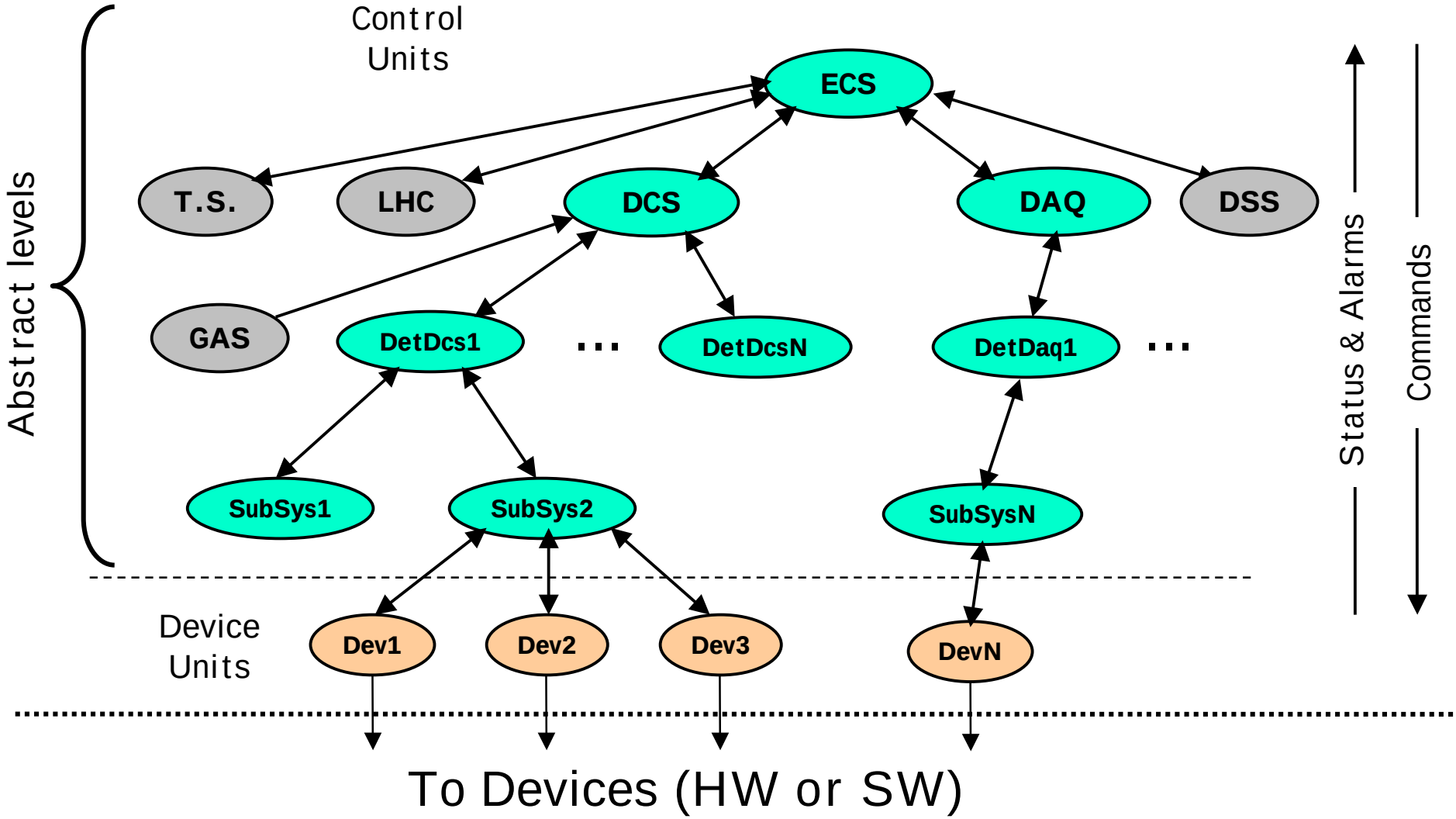
Demonstration:

Partitioning, Automation and Error Recovery in the Control System of an LHC Experiment

Clara Gaspar, September 2001

Generic SW Architecture



A Framework

- **An integrated collection of guidelines, tools and components**
- **Should be provided to sub-system developers in order to:**
  - Allow the development of each component coherently in view of its integration in the complete system.
  - For the two types of components:

Control Units

Device Units

SCADA based Framework

- **PVSSII has tools for:**
  - Device Description (Configuration Database):
  - Device Access (OPC, Profibus, drivers)
  - Alarm Handling (Generation, Filtering, Masking, etc)
  - Archiving, Logging, Trending
  - User Interface Builder
  - Alarm Display, Access Control, etc.
- **SMI++ provides:**
  - Abstract behaviour modeling (Finite State Machines)
  - Automation & Error Recovery (Expert System like)

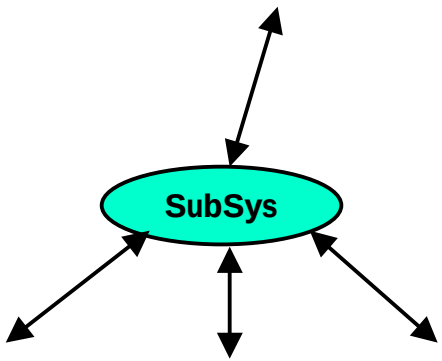
Control Units

Each CU is inherently able to:

- Configure, monitor and control its children
  - Sequence & Automate operations
  - Recover errors
- Handle Alarms
  - Filter and display alarms
- Partition
  - Exclude one or more of its children
- User Interfacing
  - Present information and receive commands

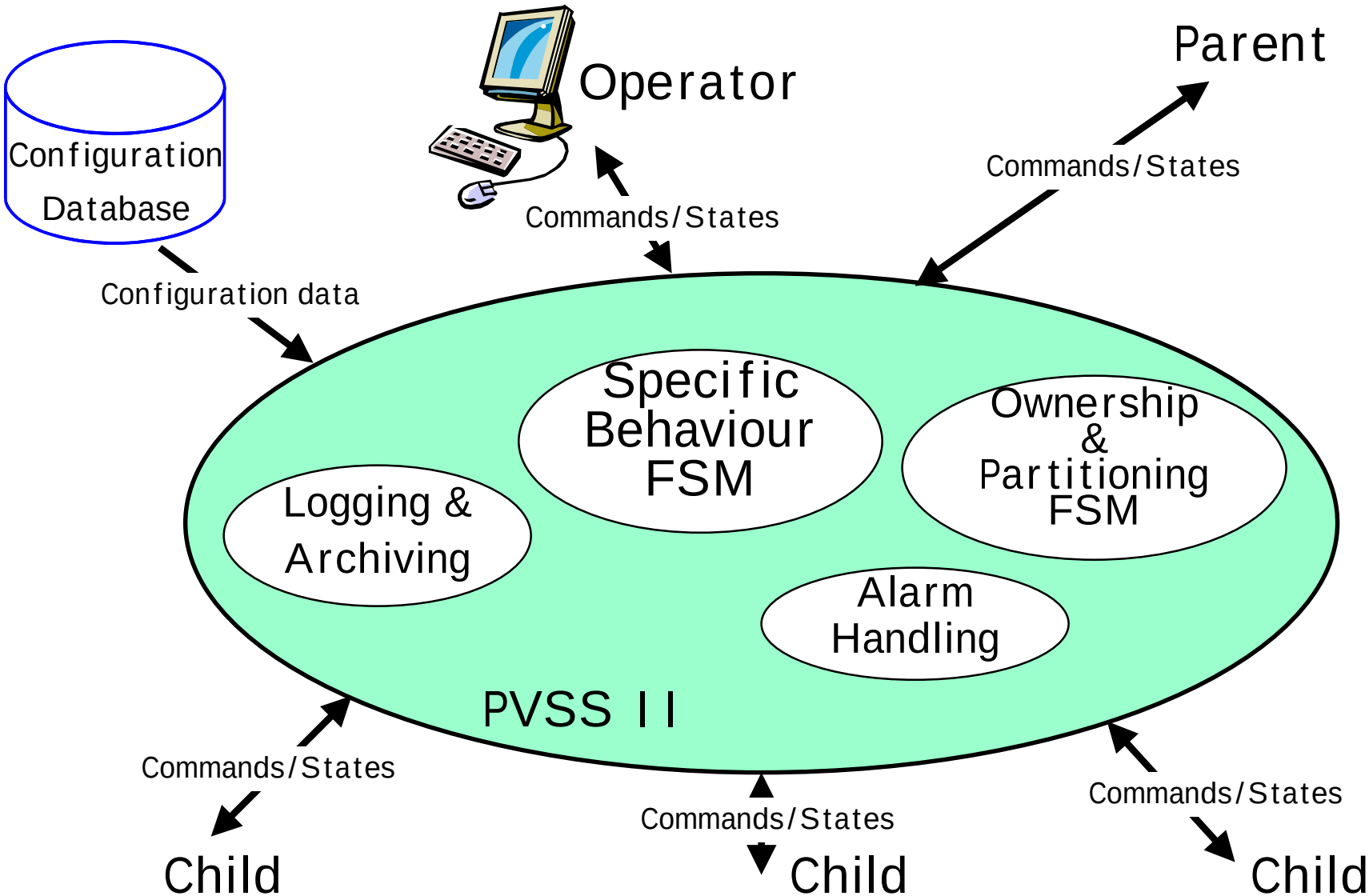
Control Units (cont.)

- **A combination of PVSS II & SMI++**



- Hierarchical Characteristics:
  - State/Commands
  - One Owner
  - Exclusive/Shared
  - Partitioning Mode
- Other Characteristics
  - Alarm Handling
  - Access Control
  - Archiving, etc.

Control Units (cont.)



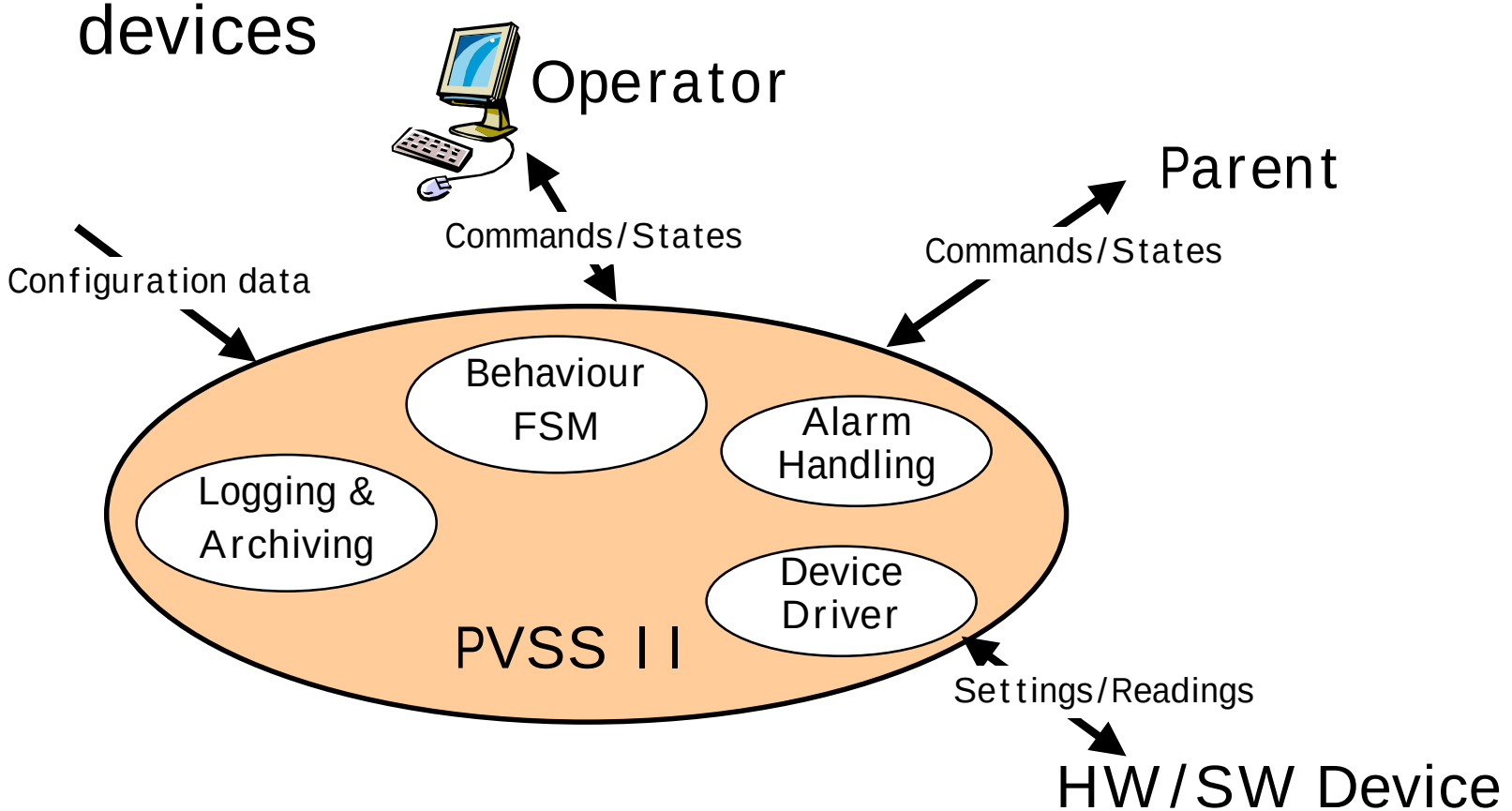
Device Units

DU **Device Units's specific tasks are:**

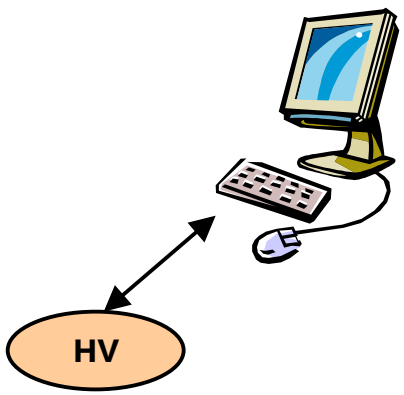
- Interface to the device it models
  - Implement Actions
  - Retrieve States
- Generate Alarms
- User Interfacing
  - Present specific information and receive commands

Device Units (cont.)

- **Device Units**
  - Provide the interface to the different devices

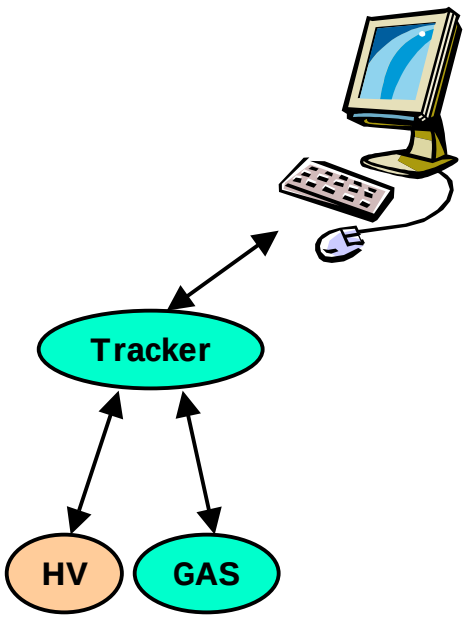


Demo – HV Sub System



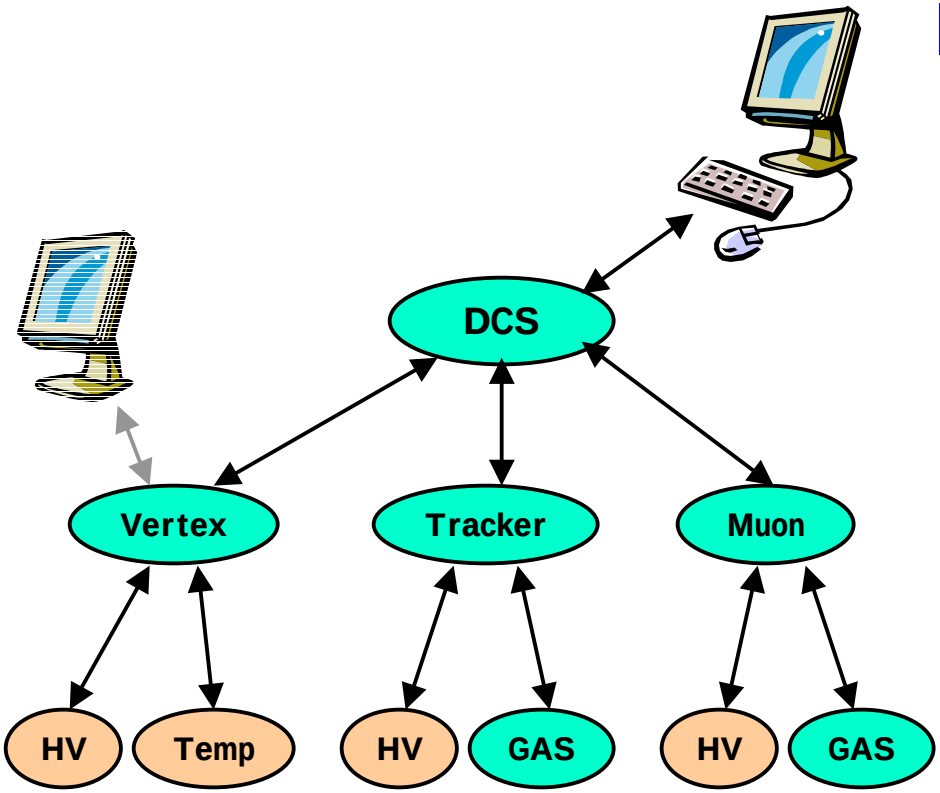
- **Sub Detector HV**
  - OFF when all channels OFF
    - SWITCH_ON
      -> HV ON
  - ON when all channels ON
    - SWITCH_OFF
      -> HV OFF
  - ERROR when at least one channel TRIPPED
    - RECOVER
      (-> CLEAR_TRIP)
      -> HV ON

Demo - Sub Detector DCS



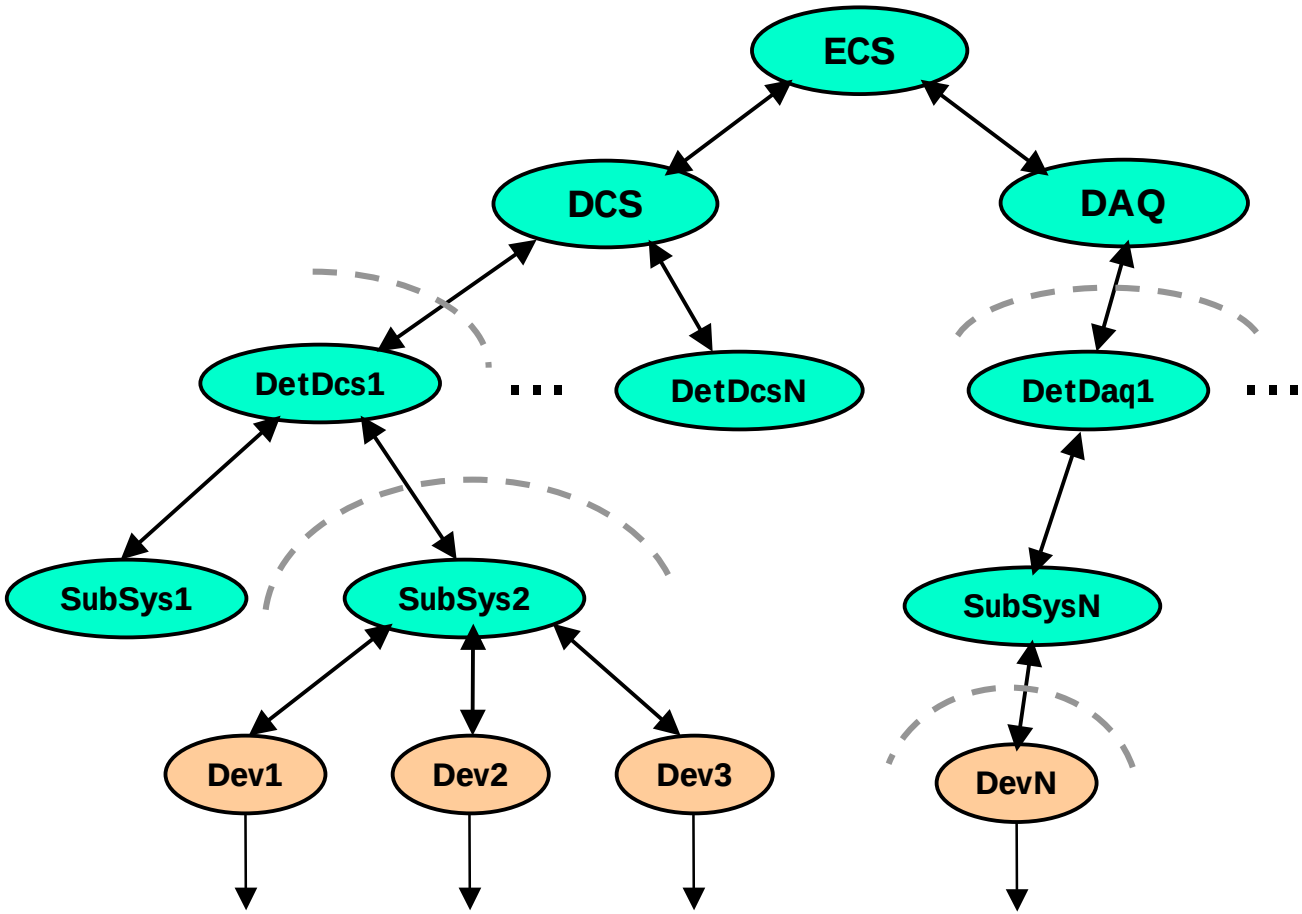
- **Sub Detector**
  - NOT_READY when at least one component NOT READY
    - GET_READY
      -> HV ON
  - READY when all Components OK
    - SET_NOT_READY
      -> HV OFF
  - ERROR when at least one component in ERROR
    - RECOVER
      (-> CLEAR_TRIP)
      -> HV ON

Demo - DCS



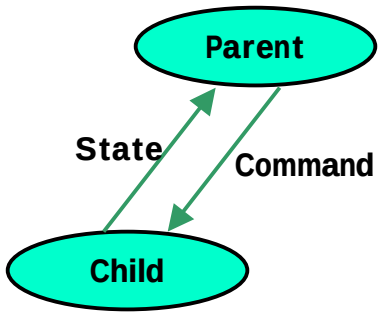
- **DCS**
  - NOT_READY when at least one detector NOT_READY
    - GET_READY -> all
  - READY when all detectors READY
    - SET_NOT_READY -> all
  - ERROR when at least one detector in ERROR
    - RECOVER -> all

Partitioning

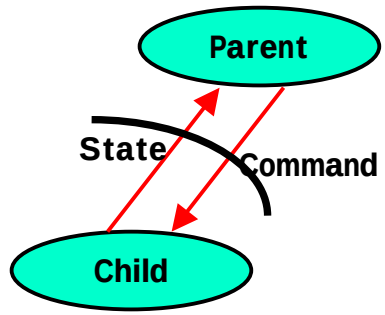


Partitioning Modes

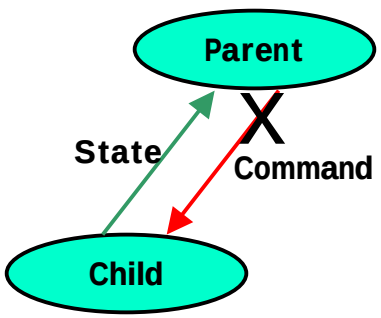
INCLUDED
Child Fully Controlled by Parent



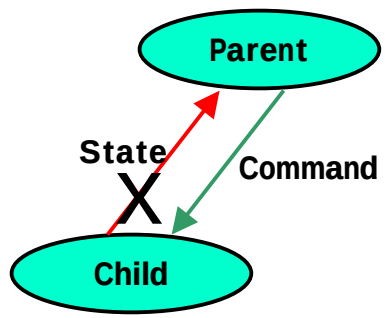
EXCLUDED
Child Not Controlled by Parent



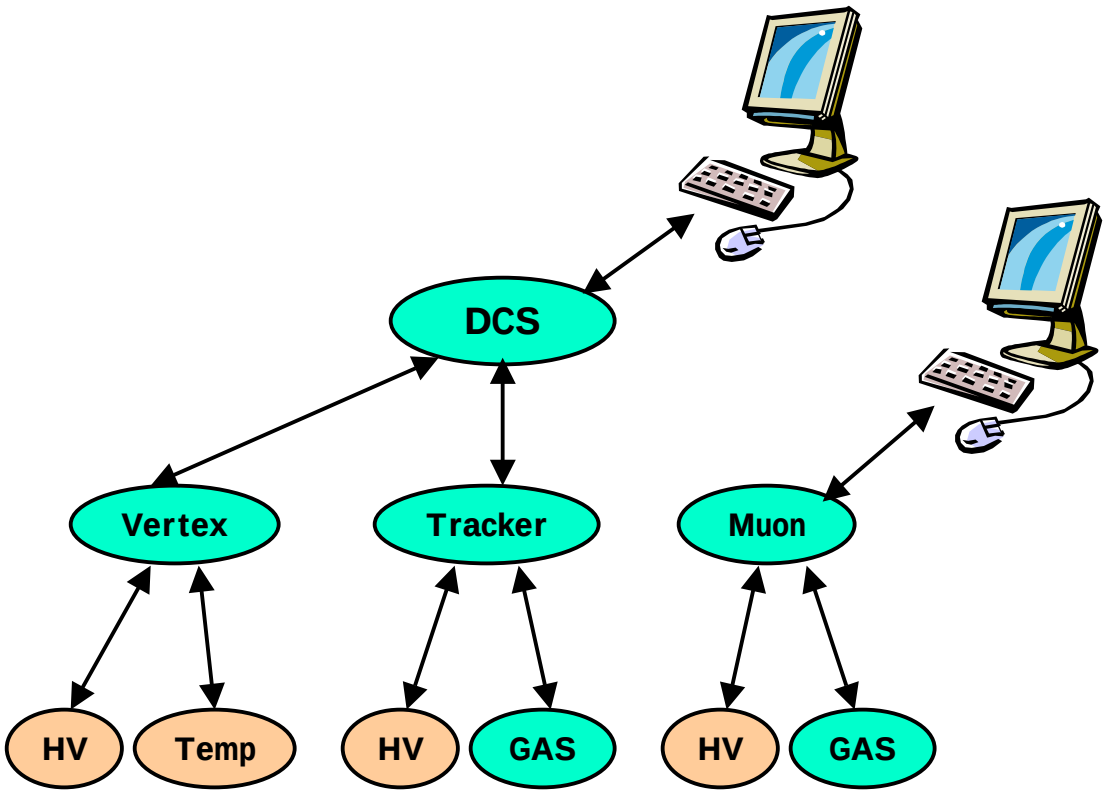
MANUAL
Parent does not send Commands



IGNORED
Parent Ignores State

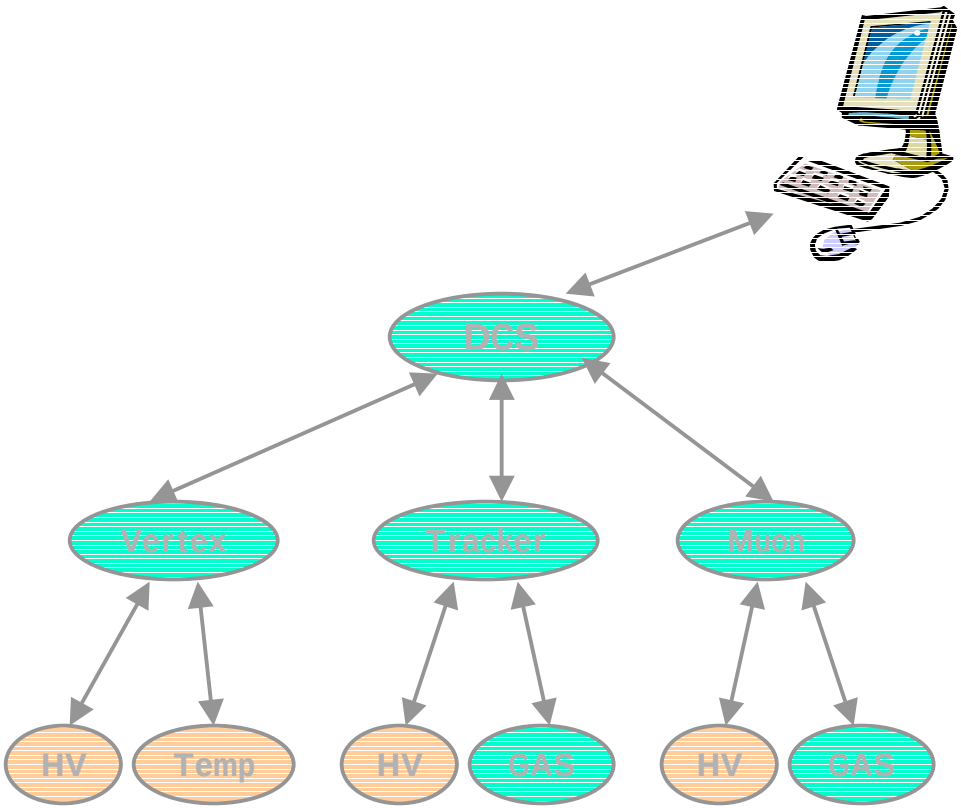


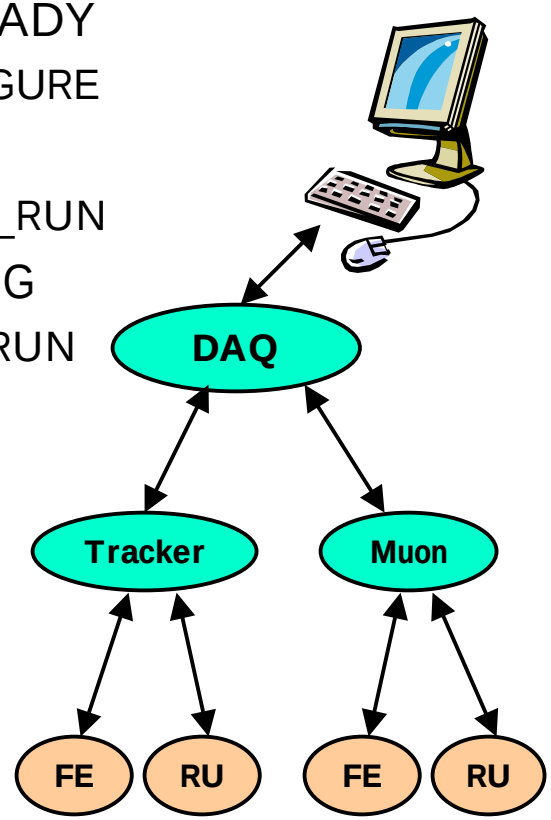
Demo - DCS / Partitioning



Demo - DAQ

- DAQ
  - NOT_READY
    - CONFIGURE
  - READY
    - START_RUN
  - RUNNING
    - STOP_RUN



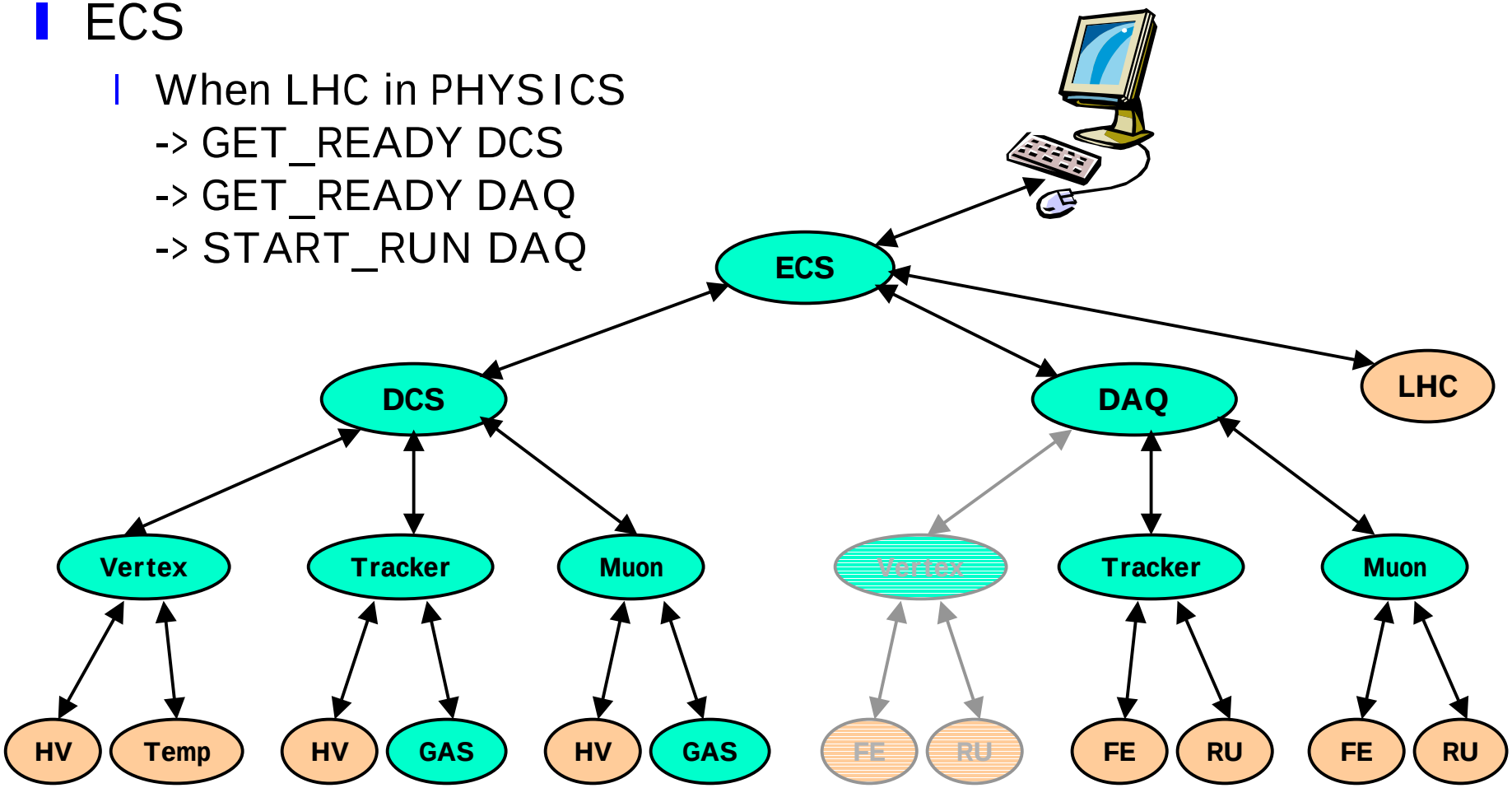


Run Control

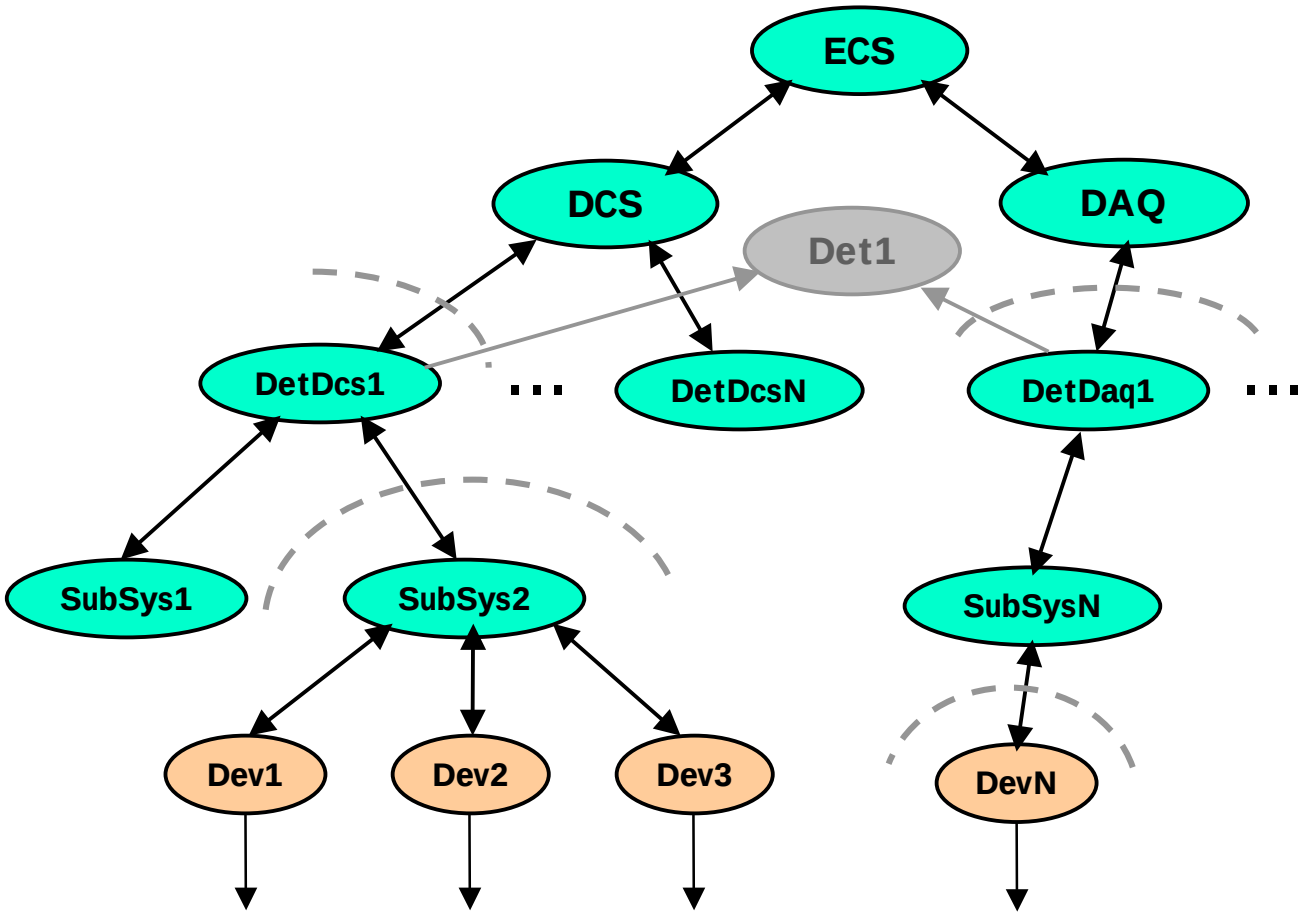
- **Each Control Unit (and its sub-tree)**
  - Can run in stand-alone
  - Can be controlled independently
    (by an authorized User Interface)
- **Run Control**
  - Is a particular instance of a user interface:
  - ➡ It is the interface to the Root of the tree
  - ➡ If the tree is partitioned there can be several Run Controls.

Demo - Run Control

- ECS
  - When LHC in PHYSICS
    -> GET_READY DCS
    -> GET_READY DAQ
    -> START_RUN DAQ

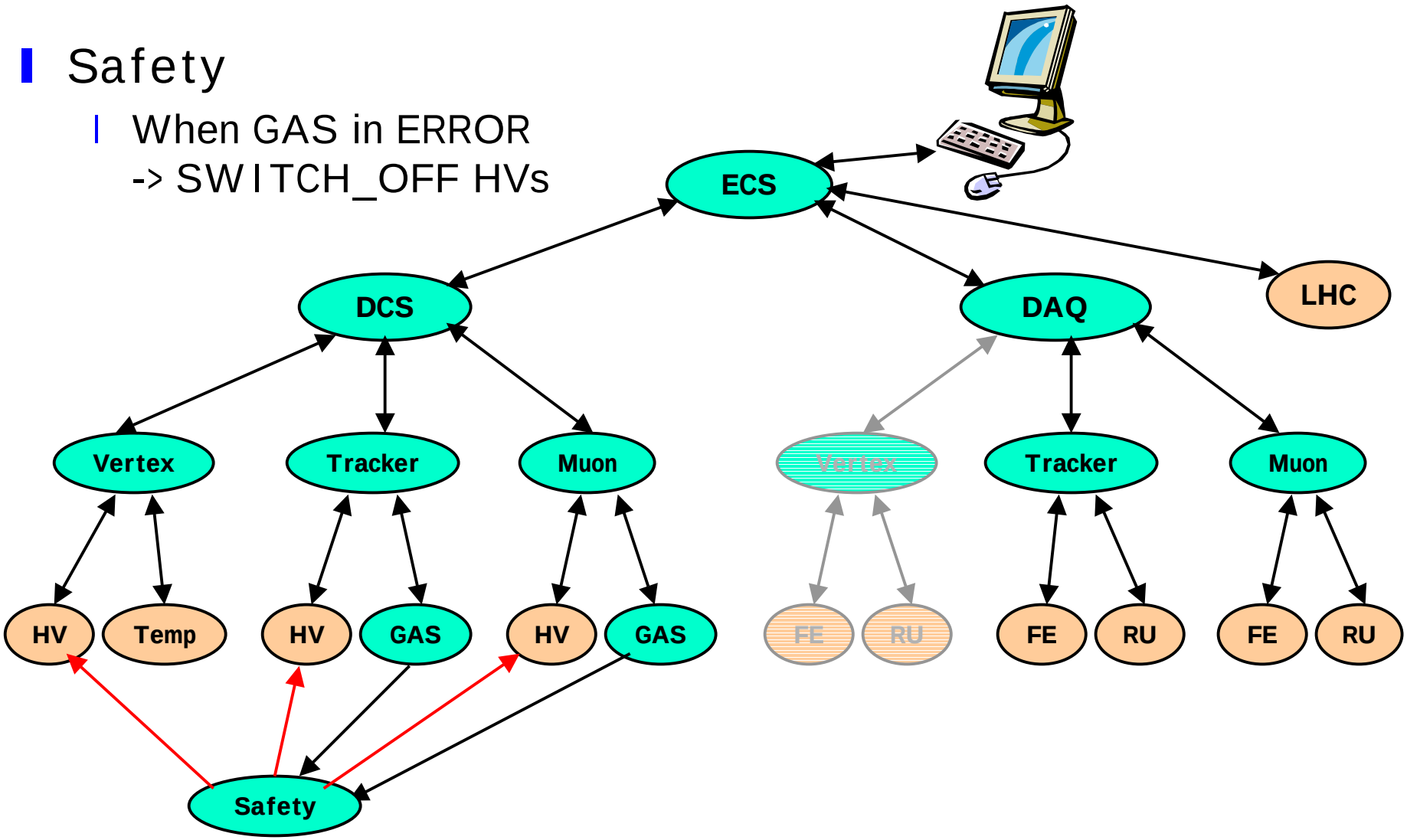


Demo - Sub Detector RC

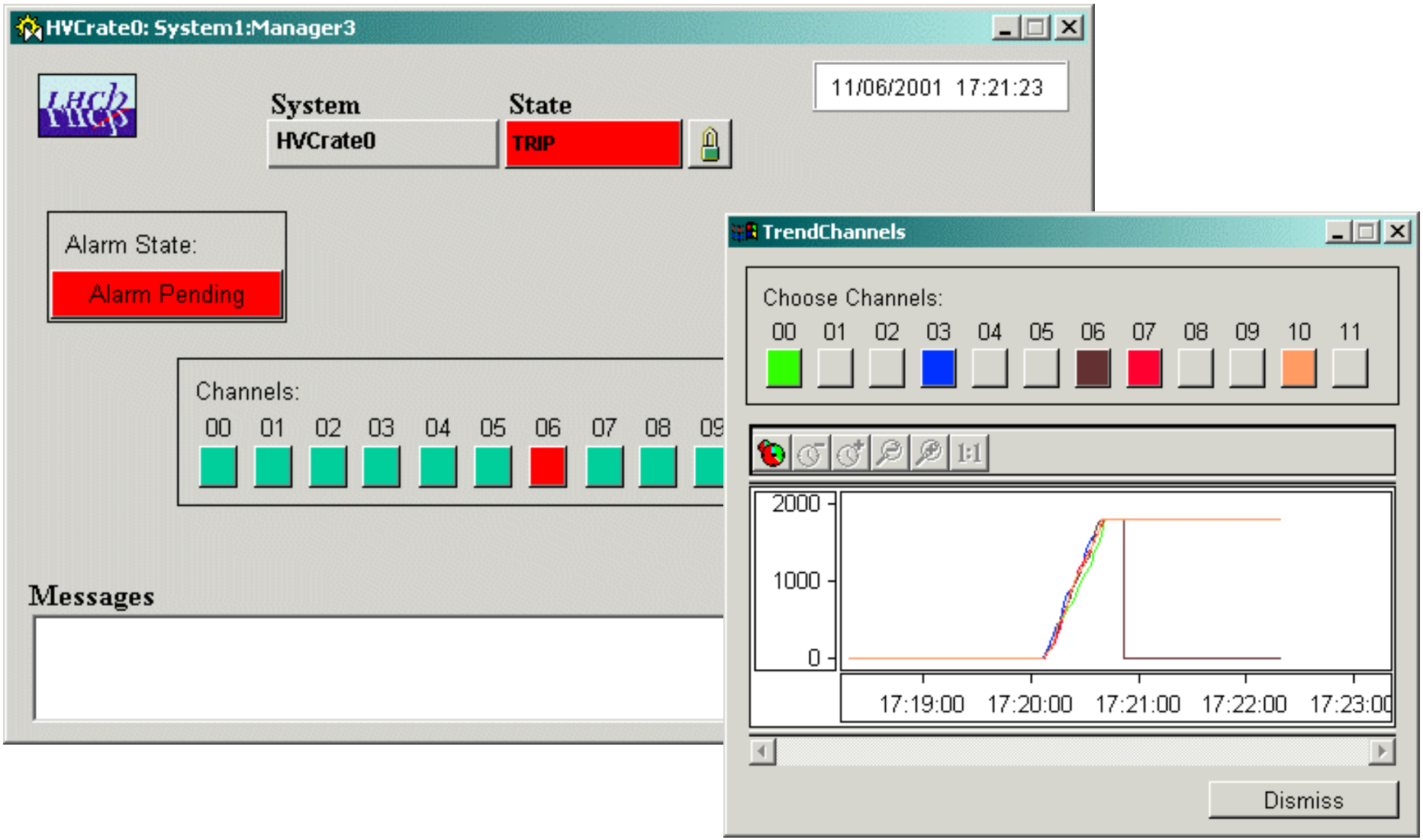


Demo - Safety

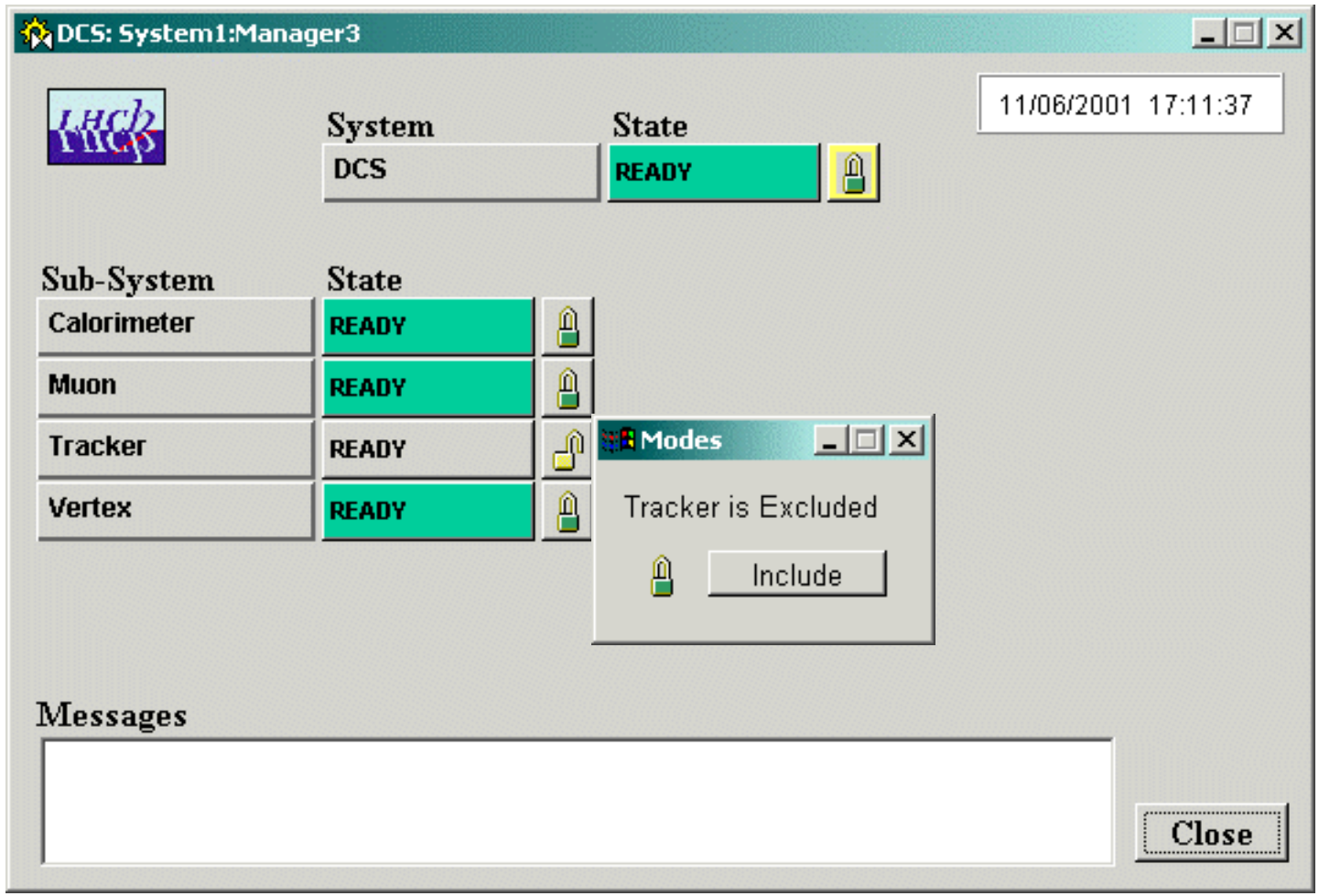
- Safety
  - When GAS in ERROR
    -> SWITCH_OFF HVs



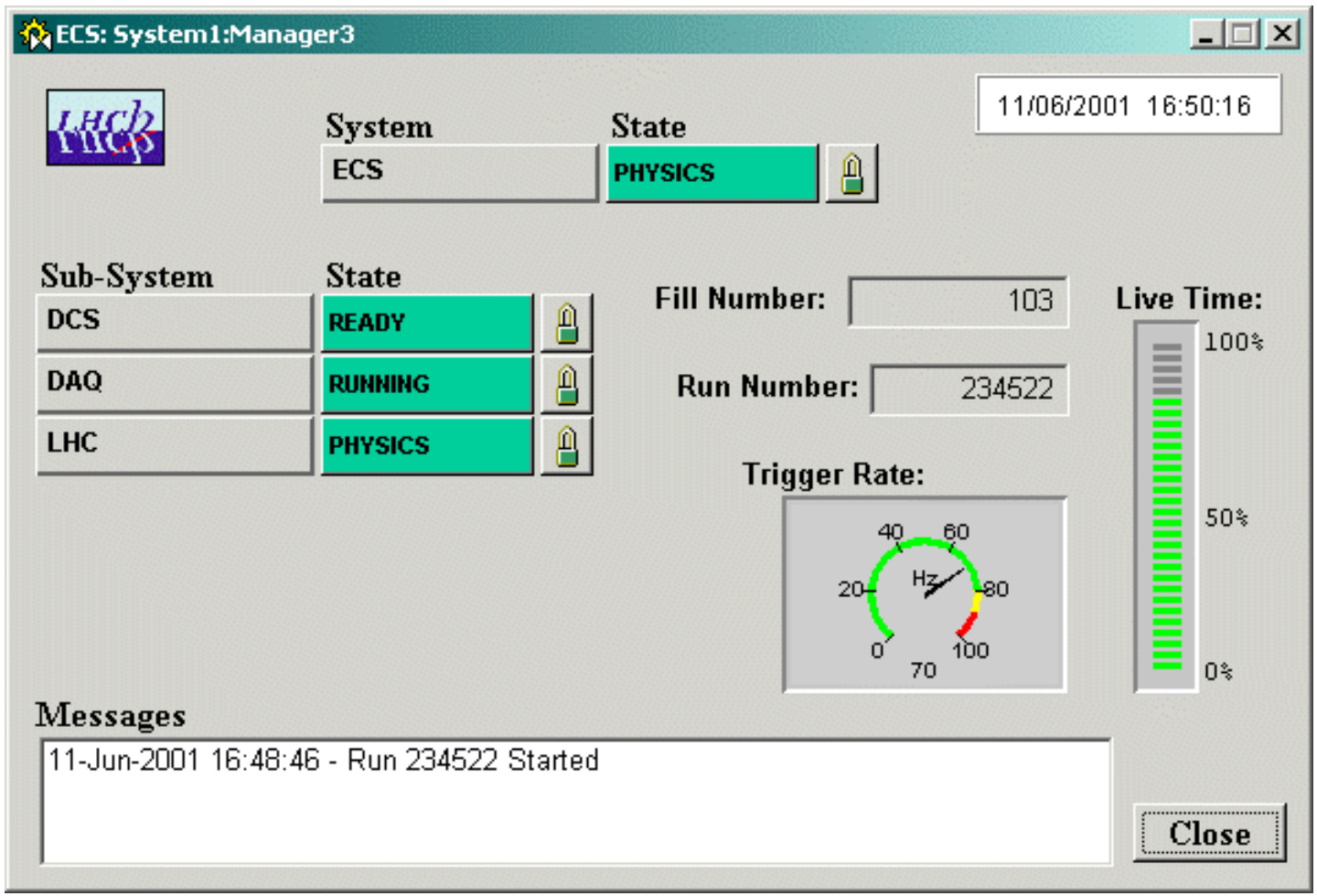
HV Device


HVCrate0: System1:Manager3
11/06/2001 17:21:23
System
HVCrate0
State
TRIP
Alarm State:
Alarm Pending
Channels:
00 01 02 03 04 05 06 07 08 09
Messages
TrendChannels
Choose Channels:
00 01 02 03 04 05 06 07 08 09 10 11
2000
1000
0
17:19:00 17:20:00 17:21:00 17:22:00 17:23:00
Dismiss

Partitioning Sub-Systems



Run Control


ECS: System1:Manager3
11/06/2001 16:50:16
System
ECS
State
PHYSICS
Sub-System
State
DCS
READY
DAQ
RUNNING
LHC
PHYSICS
Fill Number:
103
Run Number:
234522
Live Time:
100%
50%
0%
Trigger Rate:
0
20
40
60
80
100
Hz
70
Messages
11-Jun-2001 16:48:46 - Run 234522 Started
Close

Sub-detector Control