The CMS Tracker Detector Control System

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On behalf of CMS Tracker Collaboration

Control system facts

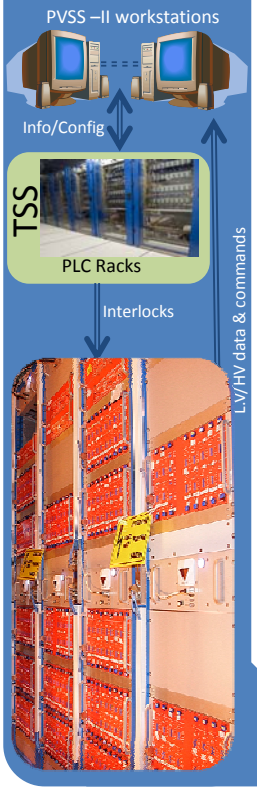
- ✓**3888** Low voltage channels
- ✓**3888** High voltage channels
- ✓**356** Control channels
- ✓**29** Power Racks
- ✓**1004** Environmental sensors
- ✓**4** Mainframes (SY1527)
- ✓**10** PLC Racks

The CMS Silicon Strip Tracker is by far the largest detector ever built in micro-strip technology, consisting of

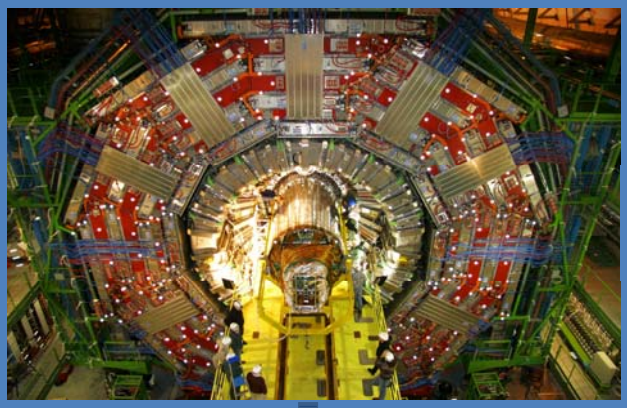
- ✓**15232 Silicon modules with a total of**
- ✓**9648128 readout channels read out via**
- ✓**75376 APV Front End chips**
- ✓**206 m² of overall surface area with some tens of microns track sensitive area**

The Detector Control and Safety System handles all these challenging figures with its distributed architecture provides safe and seamless control to the level of each individual channel

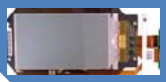
Hardware



The largest silicon Tracker is operational!



Tracker Endcap (TEC) | Tracker Outer Barrel (TOB) | Tracker Inner Barrel (TIB)



The building block of the CMS Tracker is a module; each module needs individual biasing voltage and individual settings for four to six readout chips (APVs) that accompany it

Software

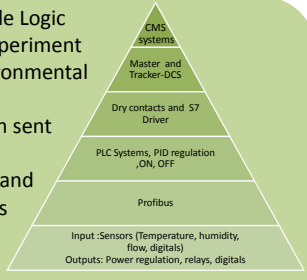
The DCS software is developed using PVSS SCADA system (developed by ETM, Austria), enhanced by the framework developed by the CERN/JCOP team that is tailored to the needs of the CERN scientific community

The complete hardware is represented in a hierarchy of Finite State Machines (FSMs), where commands propagate from top to bottom and information propagates from bottom to the top

Modules which share power and cooling services are grouped together and known as Power Groups (PGs), and Cooling Loops (CLs) respectively

Control is provided with the granularity corresponding to individual power group

- ➢The Tracker Safety System (TSS) is an independent system based on Siemens S7-300 Programmable Logic Controllers (PLCs), monitoring the environmental conditions, of the Tracker and, of the rest of the experiment
- ➢The PLCs have been programmed in a flexible way, so that they allow DCS to associate sets of environmental sensors with Interlock lines enabling power groups
- ➢DCS configures PLCs for interlock schemes, yet PLC performs a series of checks on the configuration sent by DCS, and only the configuration passing these safety checks and satisfying criteria is accepted
- ➢Six PLC systems monitor the six Tracker subdivisions, another PLC monitors general environmental and system parameters of the rest of the experiment, while two more, operating in closed feedback loops ensure the correct temperature for Tracker and its services.
- ➢All PLC systems are under the control of a redundant Master PLC system which deals with 'global' conditions such as main power failures, emergency shutdowns on PLC Failures etc.



- ➢ The FSM hierarchy of the CMS Tracker reflects the complete hardware, where Tracker is the top node, subdivided into TOB, TIB and TEC, the subsequent children are the CLs, that father the CGs and the lowest unit is the PG representing one power supply output
- ➢A 'software' switch-off mechanism has been built into DCS to allow for a graceful shutdown of power groups before the TSS intervention, by comparing the input values from the PLC sensors with thresholds stricter than those used by the PLC
- ➢The EINSTEIN wizard has been implemented to help non-specialist operators in identifying the causes of Interlock actions, and in attempting automated recovery