Activities of the NTUA-CMS Group on the Central Detector Control System of the CMS Detector

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Outline

• Introduction to Control Systems
• CMS Detector Control System
• NTUA-CMS Activities
Compact Muon Solenoid

CMS Detector

- **Pixels Tracker**
  - ECAL
  - HCAL
  - Solenoid
  - Steel Yoke
  - Muons

- **Steel Return Yoke**
  - ~1300 tonnes

- **Superconducting Solenoid**
  - Niroxium-titanium coil
  - carrying ~18000 A

- **Silicon Tracker**
  - Pixels (100 x 150 um²)
  - ~1m² ~66M channels
  - Microstrips (80-180um)
  - ~200m² ~9.6M channels

- **Crystal Electromagnetic Calorimeter (ECAL)**
  - ~7k scintillating PWO crystals

- **Preshower**
  - Silicon strips
  - ~16m² ~137k channels

- **Forward Calorimeter**
  - Steel + quartz fibres
  - ~2k channels

- **Hadron Calorimeter (HCAL)**
  - Brass + plastic scintillator
  - ~7k channels

**Specifications**

- **Total weight**: 14000 tonnes
- **Overall diameter**: 15.0 m
- **Overall length**: 28.7 m
- **Magnetic field**: 3.8 T
Detector Control System

• Control the detector
• Monitor the conditions under which it operates
• Sophisticated and sensitive equipment (more than 6 million parameters)
• Take necessary actions
• Around 10% of the total readout channels
• Data used for data quality as well as reconstruction
Control Systems

• SCADA system (Supervisory Control And Data Acquisition)
  • Monitor and Control a remote process
  • Factories, airports, physics experiments
• Toolkits
  • Tools for developing the supervisory layer
• Ability to connect to hardware (communication layer, drivers)
Control Systems at CERN

Experiment’s Framework

- Distributed Systems
- Runtime Database
- OS Independent
- Native language, GEDI
- Embedded drivers

WinCC_OA
Runtime DB

- Current image of the control system.
- Store values and structures.
- Each element of the system is a data point (DP) of a certain data point type (DPT).
- A DPT is a structure used to model data such as devices (Object oriented way)
- A data point consists of Data point Elements (DPE) that can hold values
Finite State Machine

- Efficiency in detector operation.
- Division of system in nodes
- Set of states and Actions
- States from bottom up
- Commands from up to bottom
CMS Detector Control System (DCS)

- More than 35 individual systems
- Minimal systems modified by a bunch of JCOP-like CMS components
- Centralized
- Central DCS responsible for the maintenance of all the projects
DB editor navigator

- Administer all CMS systems
- Store the system information in a Database
- Completely reworked to fit CMS needs
- Merged with the CMS installation utilities
CMSfwInstallUtils

- CMS extension to the JCOP configuration DB tool, CMSfwInstallUtils.
- Quick and flexible way of selecting the datapoints.
- Save all information in a single click.
- Comparison mechanism between system and database
High Granularity CALorimeter (HGCAL)
HGCAL DCS

- Wrapped in a component
- FSM approach
- Oracle DB archiving
- Access Control
CMS LHC Communication
Conclusions

• Overview of the Detector Control System of CMS
• Involvement of NTUA-CMS group in DCS
• Improvement and maintenance of the system
• CMS upgrade
THANK YOU FOR YOUR ATTENTION!