System Overview Tool
Joint COntrols Project (JCOP) Framework

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Introduction

Due to the unprecedented size and complexity of the LHC experiments, understanding the operational state of their control systems and diagnosing problems may be cumbersome.

The control system of each of the LHC experiments:

- Monitors and controls ~1 million I/O parameters.
- Comprises a large variety of applications based on the commercial package PVSS.
- Uses approximately 150 Linux and Microsoft Windows computers.
- Is geographically distributed.
- Models the hierarchical organization of the detectors.
- Uses a wide range of different technologies.

In contrast to previous experiments, no one person can be expected to have detailed knowledge of an entire experiment.

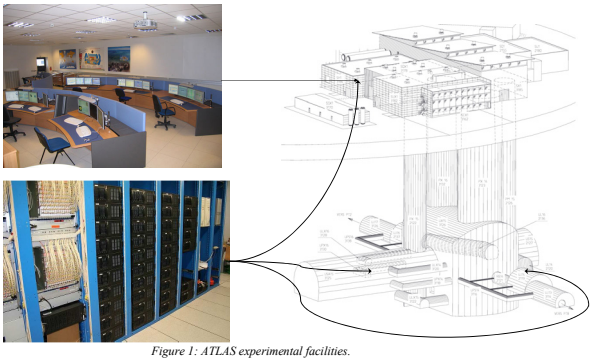


Figure 1: ATLAS experimental facilities.

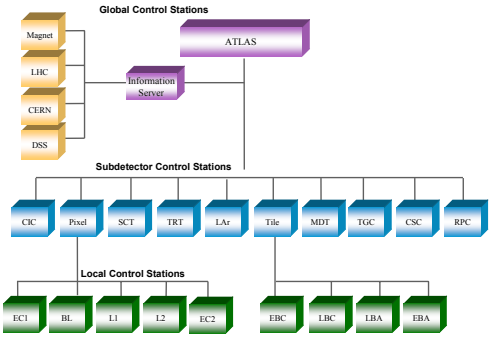


Figure 2: Hierarchy of the ATLAS detector control system with approximately 150 computers.

The JCOP System Overview Tool

Although the reliability of the control systems of the LHC experiments was a key issue during the design and implementation phases, a diversity of problems may still arise during operation as a consequence of abnormal situations like power cuts, damaged equipment, misbehavior of software processes. For these reasons, the JCOP System Overview Tool was developed as a centralized utility to monitor the overall integrity and performance of the control systems and to help experts diagnose problems.

The JCOP System Overview Tool:

- Consists of a central PVSS-based application and a set of distributed agents.
- Gathers, displays and archives information from the remote PVSS applications.
- Assumes an arrangement of the control system into layers (Figure below).
- Accesses the elements in these layers via parallel independent paths.
- Raises alerts in the event of problems.
- Organizes the information into different views.
- Allows for different filtering criteria to reduce the information shown.
- Makes correlations between the information shown in the different views.
- Enables corrective actions to be taken.
- Is configured from the System Configuration Database

Application

The integrity of the full distributed controls application including its relation to external services is monitored by accessing the internal database of each PVSS system. The information is made available via the PVSS messaging system.

- ***Possible Incidents***: connection/heartbeat lost, overflow in communication queues
- ***Monitored Items***: connection between PVSS systems, external systems (e.g. database servers, gas systems, power distribution)
- ***Appropriate Commands***: change settings, reset connections

PVSS Infrastructure

The PVSS processes (managers) are supervised by a dedicated agent (pmon), accessible via TCP and HTTP. This agent automatically respawns these processes in the event of failure.

- ***Possible Incidents***: stuck drivers, blocked database queries, software misconfiguration
- ***Monitored Items***: manager state and configuration
- ***Appropriate Commands***: start/stop or configure managers, set debug options

Operating System

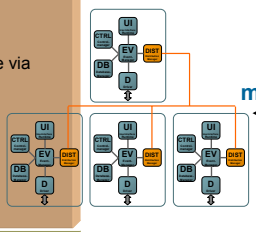
The control applications run on Windows and Linux computers. Custom agents access OS resources and some hardware parameters not available in the layer below. This information is published via the CERN Distributed Information Management (DIM) protocol.

- ***Possible Incidents***: high CPU load, out of memory, full disk
- ***Monitored Items*** : CPU, memory, network cards, TCP/IP stack, disks
- ***Appropriate Commands***: start/stop processes, shut down, restart

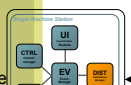
Hardware

The control systems run on standard industrial PCs with redundant power supplies and hard disks. The low level hardware control is implemented using the Intelligent Platform Management Interface (IPMI).

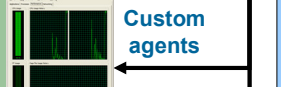
- ***Possible Incidents***: power cuts, overheating, broken fans
- ***Monitored Items***: power state, voltages, fans
- ***Appropriatte Commands***: switch on/off, reset



PVSS messages



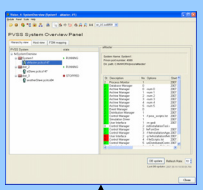
PVSS process monitor



Custom agents

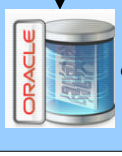
IPMI

System Overview



Functions

- Data organization in views
- Raise alarms
- Write archives
- On-screen filtering
- Issue commands



System Configuration Database

Conclusion

The JCOP Framework System Overview Tool provides centralized monitoring of the integrity of the components of the control systems and allows experts to track down effectively the cause of any problem. The adopted implementation model arranges the constituents of the control system into a set of layers and uses different paths to access them. This modular approach permits unambiguous isolation of the root of the problem. The System Overview Tool is in an early stage of development and its functionality is being extended based on the initial experience gathered by the experiments.