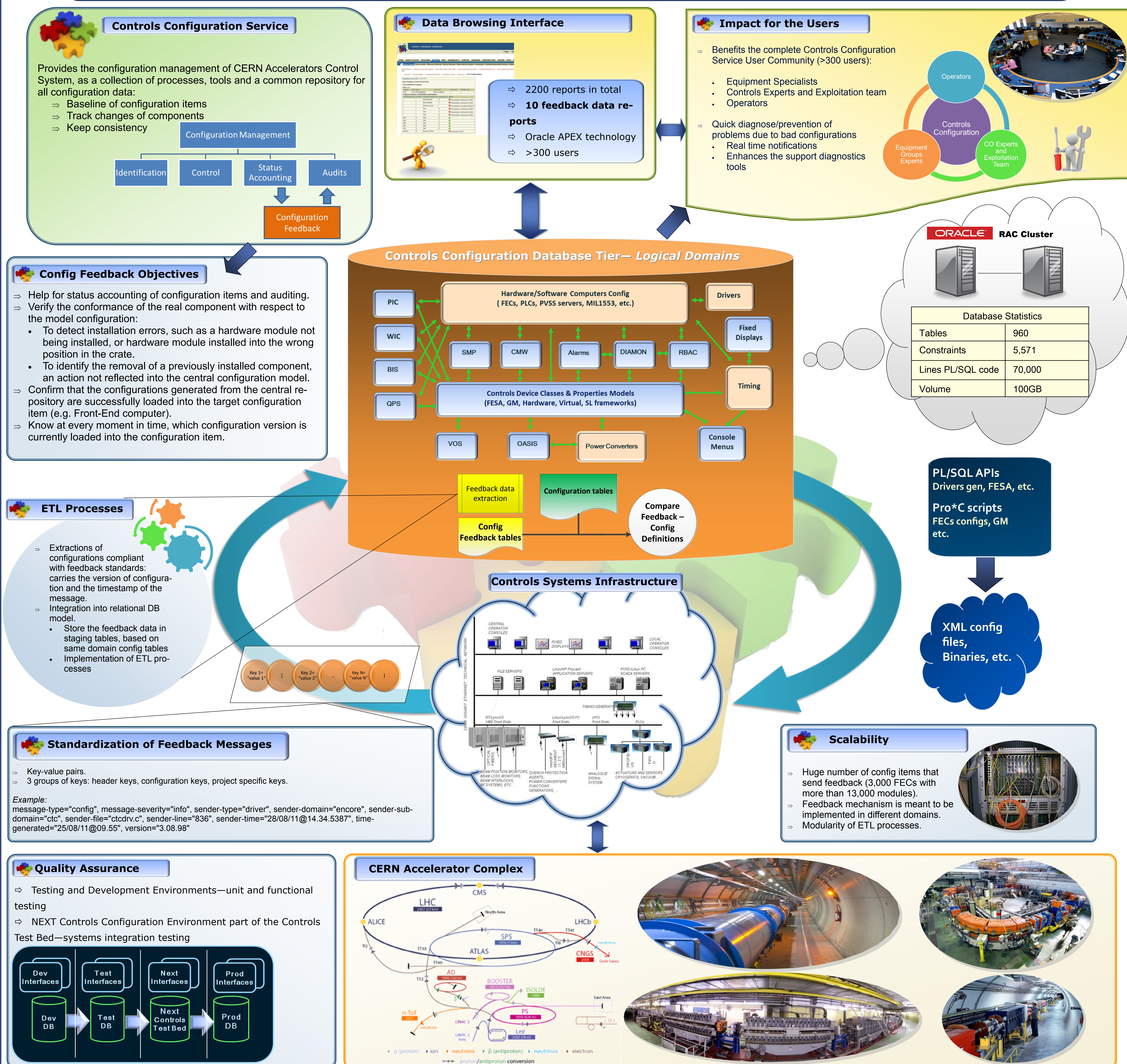# ICALEPCS'13

Advantages and Challenges to the Use of On-Line Feedback in CERN's Accelerators Controls Configuration Management

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Abstract

The Controls Configuration Service (CCS) provides the Configuration Management facilities for the Controls System for all CERN accelerators. It complies with Configuration Management standards, tracking the life of configuration items and their relationships by allowing identification and triggering change management processes. Data stored in the CCS is extracted and propagated to the controls hardware for remote configuration. The article will present the ability of the CCS to audit items and verify conformance to specification with the implementation of on-line feedback focusing on Front-End Computers (FEC) configurations. Long-standing problems existed in this area such as discrepancies between the actual state of the FEC and the configuration sent to it at reboot. This resulted in difficult-to-diagnose behaviour and disturbance for the Operations team. The article will discuss the solution architecture (tailored processes and tools), the development and implementation challenges, as well as the advantages of this approach and the benefits to the user groups – from equipment specialists and controls systems experts to the operators in the Accelerators Controls Centre.

Controls Configuration Service

Provides the configuration management of CERN Accelerators Control System, as a collection of processes, tools and a common repository for all configuration data:
⇒ Baseline of configuration items
⇒ Track changes of components
⇒ Keep consistency

Configuration Management
- Identification
- Control
- Status Accounting
- Audits
- Configuration Feedback

Data Browsing Interface

⇒ 2200 reports in total
⇒ **10 feedback data reports**
⇒ Oracle APEX technology
⇒ >300 users

Impact for the Users

⇒ Benefits the complete Controls Configuration Service User Community (>300 users):
  - Equipment Specialists
  - Controls Experts and Exploitation team
  - Operators
⇒ Quick diagnose/prevention of problems due to bad configurations
  - Real time notifications
  - Enhances the support diagnostics tools

Operators
Controls Configuration
Equipment Groups Experts
CO Experts and Exploitation Team

Config Feedback Objectives

⇒ Help for status accounting of configuration items and auditing.
⇒ Verify the conformance of the real component with respect to the model configuration:
  - To detect installation errors, such as a hardware module not being installed, or hardware module installed into the wrong position in the crate.
  - To identify the removal of a previously installed component, an action not reflected into the central configuration model.
⇒ Confirm that the configurations generated from the central repository are successfully loaded into the target configuration item (e.g. Front-End computer).
⇒ Know at every moment in time, which configuration version is currently loaded into the configuration item.

Controls Configuration Database Tier— *Logical Domains*

PIC
WIC
BIS
QPS

Hardware/Software Computers Config
(FECs, PLCs, PVSS servers, MIL1553, etc.)

Drivers
Fixed Displays
Timing
Console Menus

SMP | CMW | Alarms | DIAMON | RBAC

Controls Device Classes & Properties Models
(FESA, GM, Hardware, Virtual, SL frameworks)

VOS | OASIS | Power Converters

Feedback data extraction
Configuration tables
Config Feedback tables
Compare Feedback – Config Definitions

ORACLE RAC Cluster

Database Statistics	
Tables	960
Constraints	5,571
Lines PL/SQL code	70,000
Volume	100GB

PL/SQL APIs
Drivers gen, FESA, etc.

Pro*C scripts
FECs configs, GM etc.

XML config files, Binaries, etc.

ETL Processes

⇒ Extractions of configurations compliant with feedback standards: carries the version of configuration and the timestamp of the message.
⇒ Integration into relational DB model.
  - Store the feedback data in staging tables, based on same domain config tables
  - Implementation of ETL processes

Key 1= "value 1" | Key 2= "value 2" | ... | Key N= "value N"

Controls Systems Infrastructure

CENTRAL OPERATOR CONSOLES | FIXED DISPLAYS | LOCAL OPERATOR CONSOLES
FILE SERVERS | LinuxPC ProLiant APPLICATION SERVERS | PVSS-Linux PC SCADA SERVERS
TIMING GENERATOR
RTOSLynxOS VME Front Ends | LinuxLynxOS PC Front Ends | cPCI Front Ends | PLCs
BEAM POSITION MONITORS, BEAM LOSS MONITORS, RF SYSTEMS, ETC. | QUENCH PROTECTION AGENTS, POWER CONVERTERS FUNCTIONS GENERATORS | ANALOGUE SIGNAL SYSTEM | ACTUATORS AND SENSORS CRYOGENICS, VACUUM

Standardization of Feedback Messages

⇒ Key-value pairs.
⇒ 3 groups of keys: header keys, configuration keys, project specific keys.

Example:
message-type="config", message-severity="info", sender-type="driver", sender-domain="encore", sender-sub-domain="ctc", sender-file="ctcdrv.c", sender-line="836", sender-time="28/08/11@14.34.5387", time-generated="25/08/11@09.55", version="3.08.98"

Scalability

⇒ Huge number of config items that send feedback (3,000 FECs with more than 13,000 modules).
⇒ Feedback mechanism is meant to be implemented in different domains.
⇒ Modularity of ETL processes.

Quality Assurance

⇒ Testing and Development Environments—unit and functional testing
⇒ NEXT Controls Configuration Environment part of the Controls Test Bed—systems integration testing

Dev Interfaces → Test Interfaces → Next Interfaces → Prod Interfaces
Dev DB → Test DB → Next Controls Test Bed → Prod DB

CERN Accelerator Complex

Conclusion

The configuration feedback is an extremely important functionality provided by the Controls Configuration Service. It presents a solution to the years-old problems of discrepancies between the generated FECs configurations and the actually loaded ones, usually resulting in unexpected behaviour after a reboot (so called 'time-bombs').
By putting in place this specific status accounting of the configuration items and its usage for items auditing, the Controls Configuration Service answers to the latest standards in the area of Configuration Management. The feedback gives the possibility to automatically discover information about the configuration items and track changes as they happen. Different challenges were overcome in order to provide a scalable and user-friendly solution, which gives the users the possibility to quickly troubleshoot configuration problems or even to prevent them from happening thus improving the availability of the FECs and of the Controls System in general.

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