A Scalable and Homogeneous Web-Based Solution for Presenting Control System Data

ICALEPCS 2013, San Francisco

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on behalf of PH-CMD CERN group
CMS Control System Architecture

WINCC OA
- USER INTERFACE
- CMS FRAMEWORK
- JCOP FSM
- JCOP FRAMEWORK
- DRIVER CLIENTS
- DRIVERS

MONITORING AND CONTROL

SUPERVISION

MIDDLEWARE

FRONT-END HARDWARE

FRONT-END
CMS Control System Architecture

WINCC OA

USER INTERFACE

MONITORING AND CONTROL

CMS FRAMEWORK

SUPERVISION

JCOP FSM

JCOP FRAMEWORK

MIDDLEWARE

DRIVER CLIENTS

FRONT-END

DRIVERS

FRONT-END HARDWARE

DCS enables safe and coherent operation of CMS
# CMS Control System Architecture

<table>
<thead>
<tr>
<th>WINCC OA</th>
<th>MONITORING AND CONTROL</th>
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<tr>
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| MIDDLEWARE | |
| DRIVER CLIENTS |

| FRONT-END |
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**DCS** enables safe and coherent operation of CMS

About **3M** parameters monitored and controlled
CMS Control System Architecture

WINCC OA

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About 3M parameters monitored and controlled

Hierarchical Control
CMS Control System Architecture

- **Front-End Hardware**
  - **Driver Clients**
  - **Jcop Framework**
  - **Cms Framework**
- **Middleware**
  - **Jcop Fsm**
- **Monitoring and Control**
  - **User Interface**
- **Supervision**

### Front-End

- **Drivers**
- **Driver Clients**
- **Cms Framework**
- **Jcop Framework**
- **Jcop Fsm**
- **User Interface**

### Dcs

DCS enables safe and coherent operation of CMS

### About 3M

About 3M parameters monitored and controlled

### Hierarchical Control

Visual representation of hierarchical control structure.
CMS Control System Architecture

**CMS Control System Architecture**

- **FRONT-END HARDWARE**
- **DRIVER CLIENTS**
- **CMS FRAMEWORK**
- **JCOP FSM**
- **JCOP FRAMEWORK**
- **FRONT-END**
- **MONITORING AND CONTROL**
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- **MIDDLEWARE**

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Hierarchical Control

**USER INTERFACE**

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**DRIVERS**

**WINCC OA**

**ABOUT 3M PARAMETERS** monitored and controlled

**Hierarchical Control**

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FRONT-END HARDWARE

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Hierarchical Control
Remote Access to DCS Data

Why we need it?

- Remote Monitoring of Detector Status at any level of detail
- Incident Analysis
  - Access to online and historical (archived) data
- Long-term Trend Analysis
  - Access to archived data
Remote Access to DCS Data

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Traditional WinCC OA Interface
Remote Access to DCS Data

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Remote Administration

- DCS Developers do not access SCADA projects in production directly
  - Simplified maintenance
  - Flexible configuration of DCS machines

- Web based applications used for
  - DCS Software Deployment
  - DCS Infrastructure Monitoring and Control

![Diagram of Web Component Handler and WinCC OA Servers with DCS Developer and Monitoring integrated]
Advantages of a Web Solution

Web Thin Client Architecture

- No specific software needed
  - Just a web browser

- Usable from mobile devices

- Scalable
  - Low Impact on SCADA System

- Simple Deployment

- Improves Expert On Call reaction time

- Large pool of freely available components to be reused for development
Our Approach

- **No automatic translation** of existing SCADA User Interfaces

- Development of a Web Framework for accessing DCS Data

- Standard Web Solutions
  - J2EE Portlets
  - EJB
  - Javascript
  - AJAX

- Integrated in an Enterprise Portal Environment

- Combine transparently data from various sources
  - Databases
  - Online Data
Strategy for Data Access

WEB CLIENTS

WEB SERVER

SCADA

FRONT-END

Web App
FSM Web App
DIM Client (EJB)
Plot Tool

FSM (DIM)
FSM (DIM)
FSM (DIM)

WinCC OA
WinCC OA

Condition DB
Strategy for Data Access

No Direct Connection from WinCC OA to Web Server

WEB

CLIENTS

WEB

SERVER

SCADA

FRONT-END
Strategy for Data Access

No Direct Connection from WinCC OA to Web Server

Historical Data accessed via Database
Strategy for Data Access

FSM (DIM) | FSM (DIM) | FSM (DIM)
---|---|---
WinCC OA | WinCC OA

No Direct Connection from WinCC OA to Web Server

Historical Data accessed via Database

Online Data accessed via DIM (one EJB client)
Strategy for Data Access

No Direct Connection from WinCC OA to Web Server

Historical Data accessed via Database

Online Data accessed via DIM (one EJB client)

Multiple accesses served by local cache
The last values of all archived parameters are stored in a separate table:

- Small table allows for faster queries
- Last values in the DB are equal to the current reading in SCADA (with the approximation of the archiving deadband)
- They can be used in the web display as “current value”
The last values of all archived parameters are stored in a separate table.

- Small table allows for faster queries
- Last values in the DB are equal to the current reading in SCADA (with the approximation of the archiving deadband)
- They can be used in the web display as "current value"
Example: Browsing the FSM Tree

- Interactive navigation in the FSM hierarchy from the web
  - Tree view
  - Web Interface looks like native SCADA interface
The radial graph gives a quick overview of the states of all the nodes in the selected sub-tree.
Plot for Devices in Subtree

Access to archived data

- Select the type of device and the parameter to plot
  - e.g. LV Current
Plot for Devices in Subtree

- Plot obtained with a few clicks
- Very useful for incident analysis
- Data from various sources (database, FSM) combined transparently
Custom Plots

Tracker CAEN Channel

Time Interval: Select From and To Date
From: 2012-12-01  To: 2012-12-05

Select Alias: TOB minus 1.1.2 HV1
Search pattern...: TOB
Selected: 2844 / 8734

Select Element: ACTUAL.IMON

Plot  Save result to the DB  Actions...
Custom Plots

Tracker CAEN Channel

Time Interval: Select From and To Date
- From: 2012-12-01
- To: 2012-12-05

Select Alias: TOB minus 1.1.2 HV1

Search pattern: TOB

Select Element: Actual IMON

Plot

Save result to the DB

Querying...
Custom Plots

Tracker CAEN Channel

TOB minus 1.1.1.2 HV1
Custom Plots

Tracker CAEN Channel

Predefined Templates allow non-experts to plot relevant parameters.
Custom Plots

Tracker CAEN Channel

Predefined Templates allow non experts to plot relevant parameters

Archived Data accessed from Database without impact on the SCADA System
Read-only access

- Web Access to DCS Data is mainly read-only
  - CMS Operational Rules require that commands can be given only through the standard SCADA interface (only by the Central Shifter when CMS is controlled centrally)

- Some exceptions:
  - VME Crates can be switched on and off from the web interface
  - Access Control to ensure that user has proper privileges
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Administrative Tools

Web-Based Deployment
Administerative Tools

Web-Based Deployment

**DEVELOPMENT ENVIRONMENT**

- Commit Code
- Upload Hardware Configuration

**WEB APPLICATION AND SERVICES**

- SVN Repository
- Import
- Web Component Handler
- Installation DB
- Set Active
- Configuration DB
- Monitoring
- Install Targeted Components
- Download Targeted Configurations
- WinCC OA projects

**PRODUCTION ENVIRONMENT**

- DCS Developers provide code and functionalities packaged in **components**

DCS Developers provide code and functionalities packaged in components.
**Administrative Tools**

**Web-Based Deployment**

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**DCS Expert**

**PRODUCTION ENVIRONMENT**

- Web Component Handler
- Web-Based Deployment
- DCS Developers provide code and functionalities packaged in **components**
- Hardware Configurations are stored in a dedicated DB

- Installation DB
- Configuration DB
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- Set Active

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- WinCC OA projects
DCS Developers provide code and functionalities packaged in components.

Hardware Configurations are stored in a dedicated DB.

DCS Expert

Commit Code

Code is imported from SVN and a new version of the component is released.

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WEB APPLICATION AND SERVICES

PRODUCTION ENVIRONMENT

Functional Component

Commit Code

SVN Repository

Code is imported from SVN and a new version of the component is released

The Installation Tool synchronizes with the DB and installs the new version

Web Component Handler

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WinCC OA projects

Install Targeted Components

DCS Expert

DCS Developers

DB

Commit Code

Code

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**Administrative Tools**

**Web-Based Deployment**

**DEVELOPMENT ENVIRONMENT**

- **DCS Developer**
  - Functional Component
  - Commit Code
  - Upload Hardware Configuration
  - Provide code and functionalities packaged in **components**

**WEB APPLICATION AND SERVICES**

- **SVN Repository**
- **Web Component Handler**
  - Import
  - Code is imported from SVN and a new version of the component is released

**INSTALLATION TOOL**

- **Web Component Handler**
  - Installation DB
  - Configuration DB

**MODULES**

- **Commit Code**
- **Upload Hardware Configuration**
- **Set Active**
- **Download Targeted Configurations**

**PRODUCTION ENVIRONMENT**

- **DCS Expert**
  - Monitoring
  - The status of the SCADA projects can be monitored from the web

**WINCC OA PROJECTS**

- **Install Targeted Components**
  - WinCC OA projects

**HARDWARE CONFIGURATIONS**

- Are stored in a dedicated DB

**DEVELOPMENT ENVIRONMENT**

**WEB APPLICATION AND SERVICES**

**PRODUCTION ENVIRONMENT**
SCADA Monitoring and Control

![SCADA Monitoring and Control Interface](image)
SCADA Monitoring and Control

SCADA projects can be monitored from the web.
SCADA Monitoring and Control

SCADA projects can be monitored from the web.

DCS Experts can start and stop SCADA processes.

<table>
<thead>
<tr>
<th>Manager</th>
<th>num</th>
<th>mode</th>
<th>status</th>
<th>arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Monitor</td>
<td>1</td>
<td>manual</td>
<td>running</td>
<td></td>
</tr>
<tr>
<td>Database Manager</td>
<td>0</td>
<td>always</td>
<td>running</td>
<td></td>
</tr>
<tr>
<td>Event Manager</td>
<td>0</td>
<td>always</td>
<td>running</td>
<td></td>
</tr>
<tr>
<td>Control Manager</td>
<td>1</td>
<td>always</td>
<td>running</td>
<td>-i pveas_scripts.bat</td>
</tr>
<tr>
<td>Simulation Driver</td>
<td>1</td>
<td>always</td>
<td>running</td>
<td></td>
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<tr>
<td>Distribution Manager</td>
<td>1</td>
<td>always</td>
<td>running</td>
<td></td>
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<tr>
<td>Redu Manager</td>
<td>1</td>
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<td>running</td>
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<td>Split Manager</td>
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<td>always</td>
<td>running</td>
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<td>running</td>
<td>fwFsmSrvr</td>
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<tr>
<td>Control Manager</td>
<td>1</td>
<td>manual</td>
<td>stopped</td>
<td>CMSfwLicenseCollector/CMSfwLicenseCollector.ctl</td>
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<tr>
<td>Control Manager</td>
<td>4</td>
<td>always</td>
<td>running</td>
<td>unDistributedControl.ctl</td>
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Enterprise Portal: Advantages

- Single Sign On
- Role-based Access Control
  - Integrated with CERN Credentials
  - Easy to restrict some pages or functionalities to groups of users
  - Exported to DCS to define control privileges
- Portlets deployed independently
- Consistent Look & Feel
- Structured Navigation
Enterprise Portal: Advantages

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Summary

- Web Interfaces used daily
  - 100s of CMS users access the portal for multiple purposes

- Number of users with access to DCS data has increased

- Usage of native WinCC OA interfaces in Terminal Server dropped
  - Limited to few cases when experts need to take very specific actions from remote

- Web Administration Tools are now an essential part of the deployment process and monitor tasks
  - Helped to achieve the flexible and maintainable architecture of the DCS
  - Now indispensable for CMS Operation