



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

ICALEPCS 2013, San Francisco

**Lorenzo Masetti**
**on behalf of PH-CMD CERN group**

# CMS Control System Architecture

WINCC OA

USER INTERFACE

MONITORING AND CONTROL

CMS FRAMEWORK

JCOP FSM

JCOP FRAMEWORK

SUPERVISION

OPC

Modbus

DRIVER CLIENTS

DRIVERS

MIDDLEWARE

FRONT-END HARDWARE

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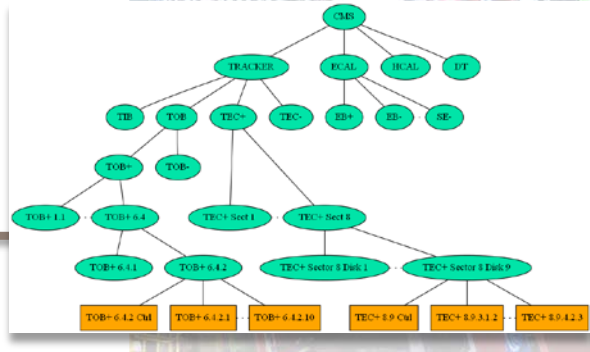

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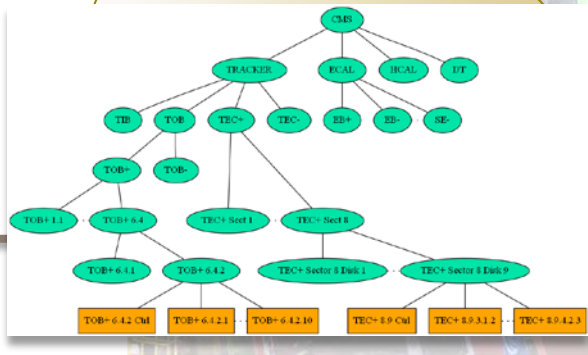

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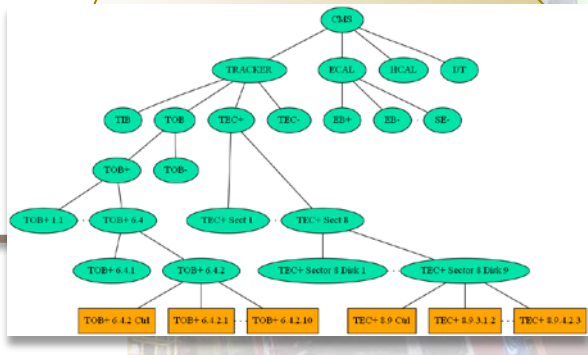

# Remote Access to DCS Data

## 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
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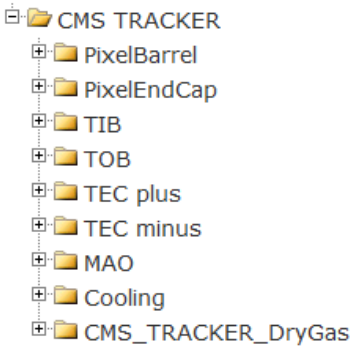


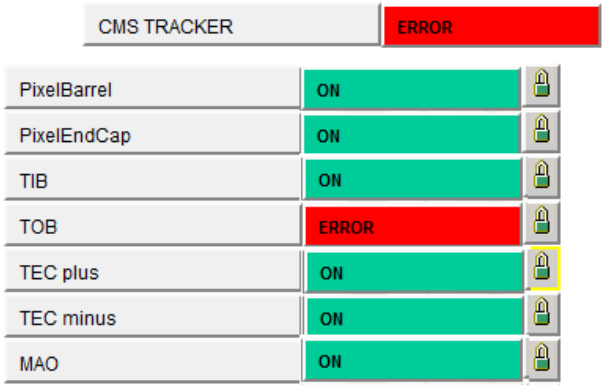

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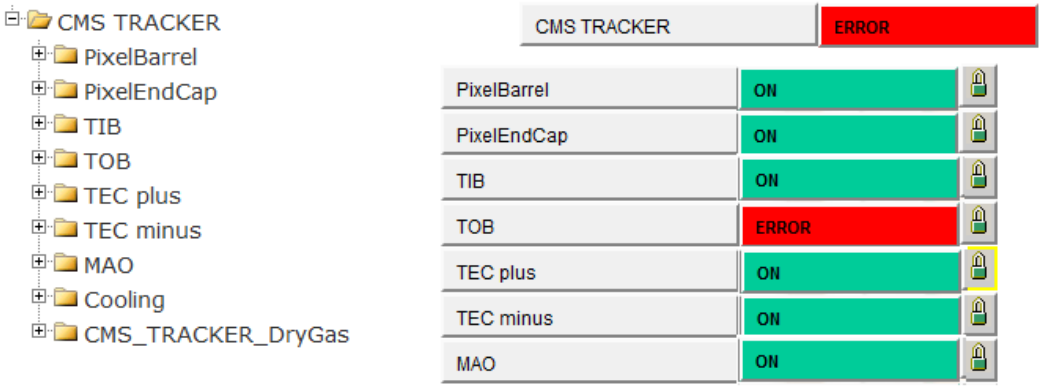


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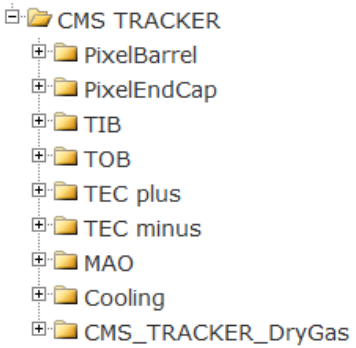


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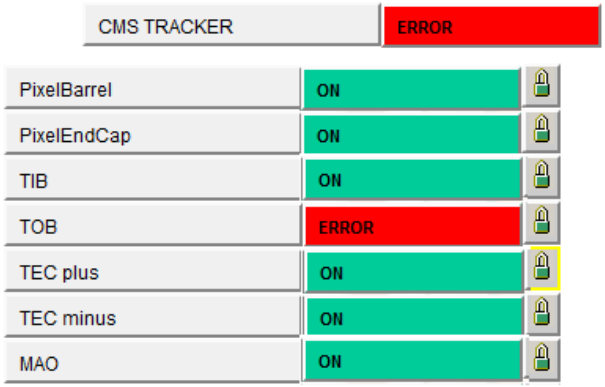


CMS Web Interface

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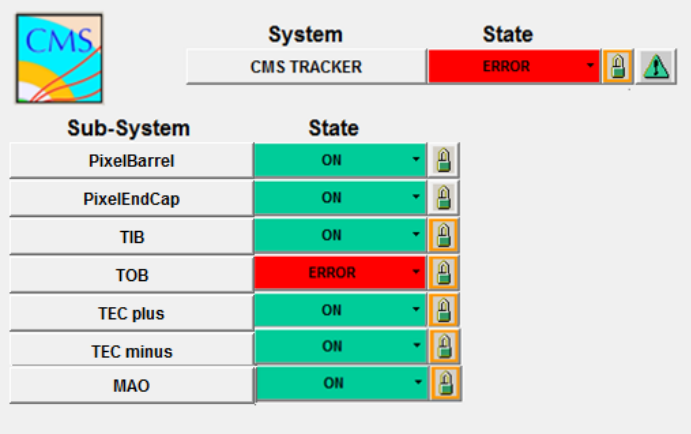


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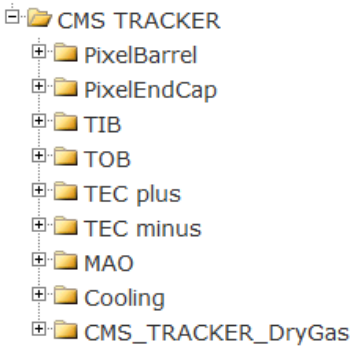
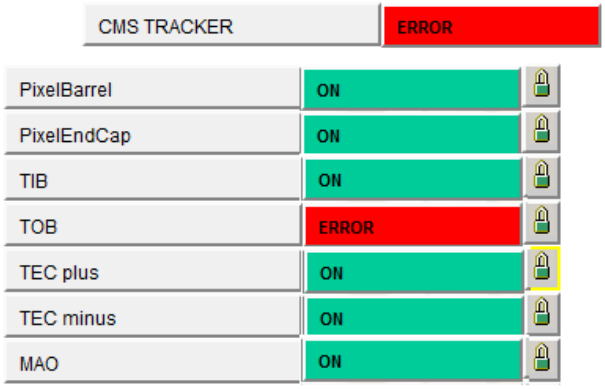
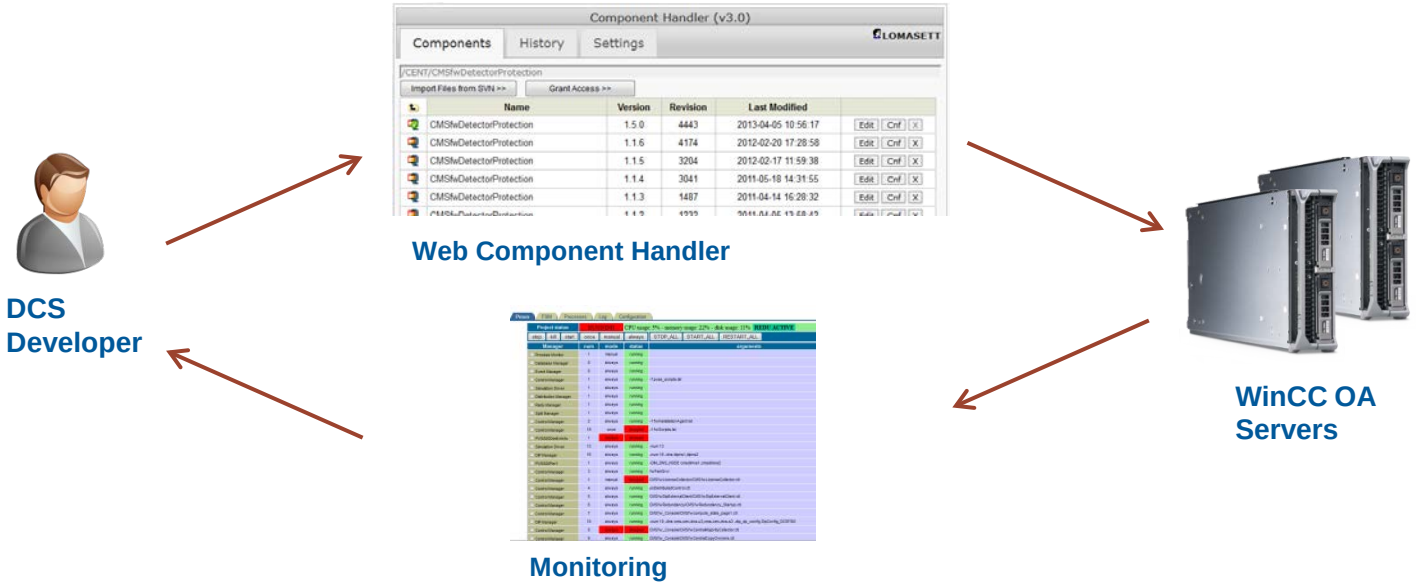



CMS Web Interface

# 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



# 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

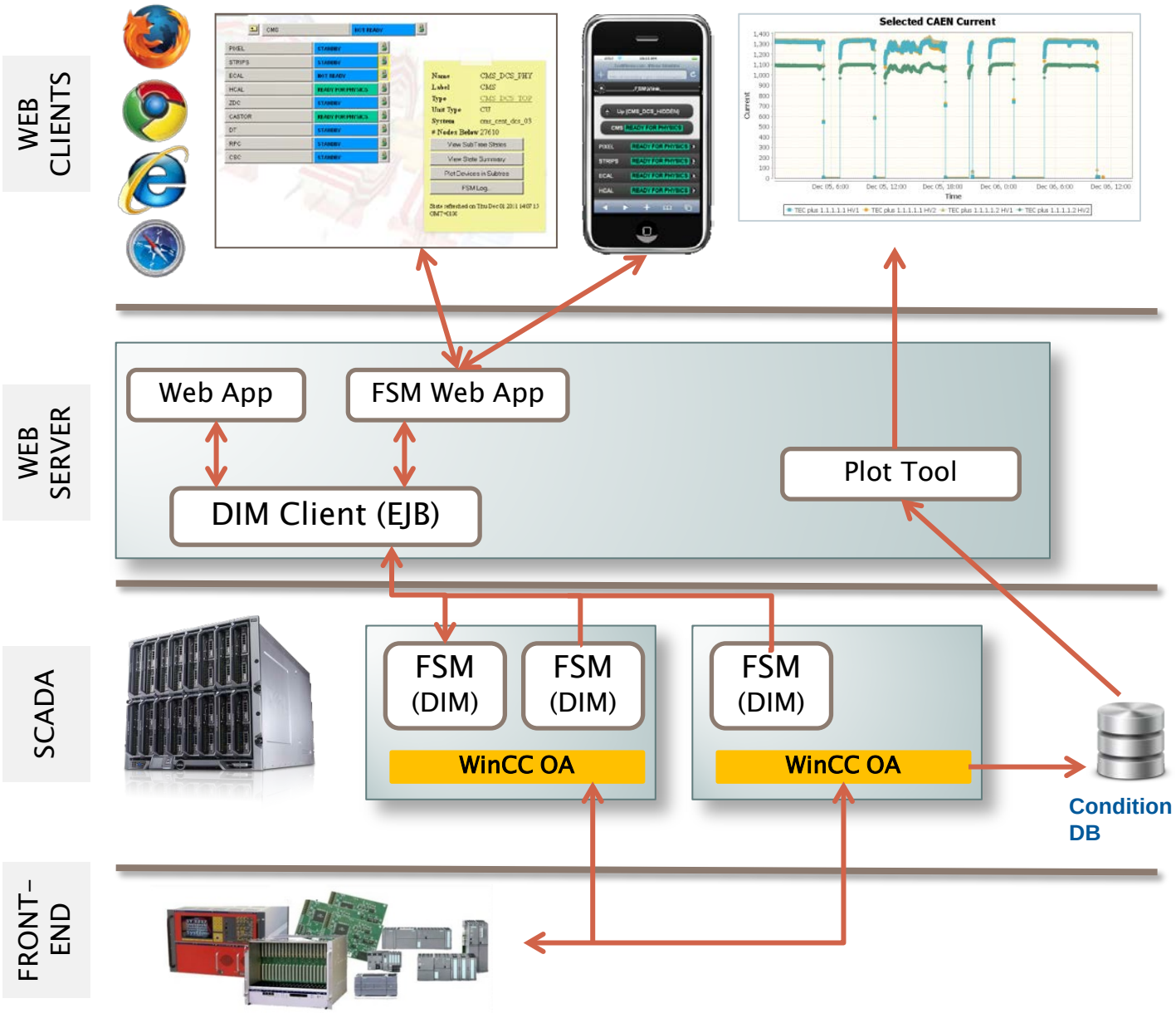
# Our Approach

- **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



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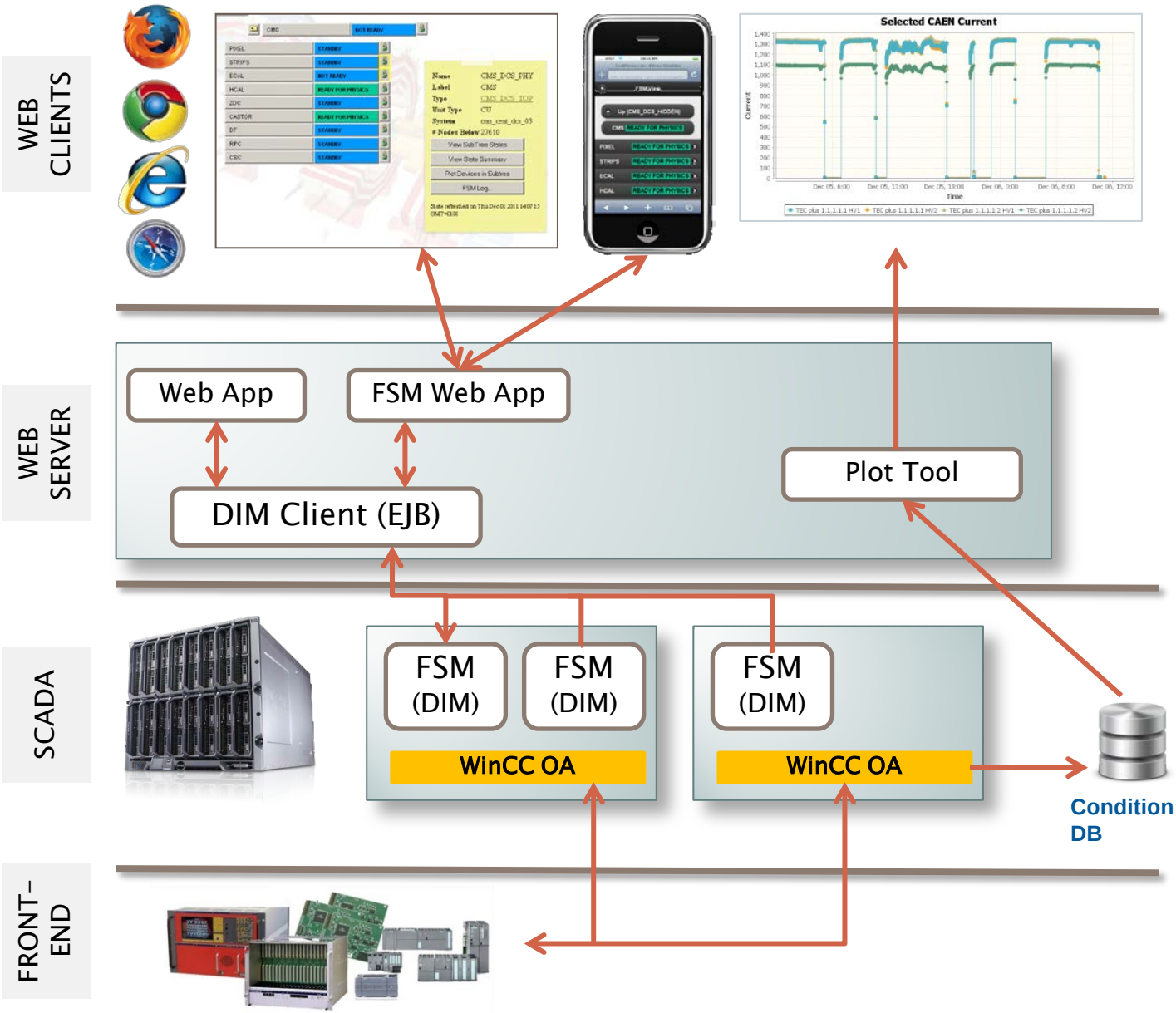


**No Direct Connection** from WinCC OA to Web Server

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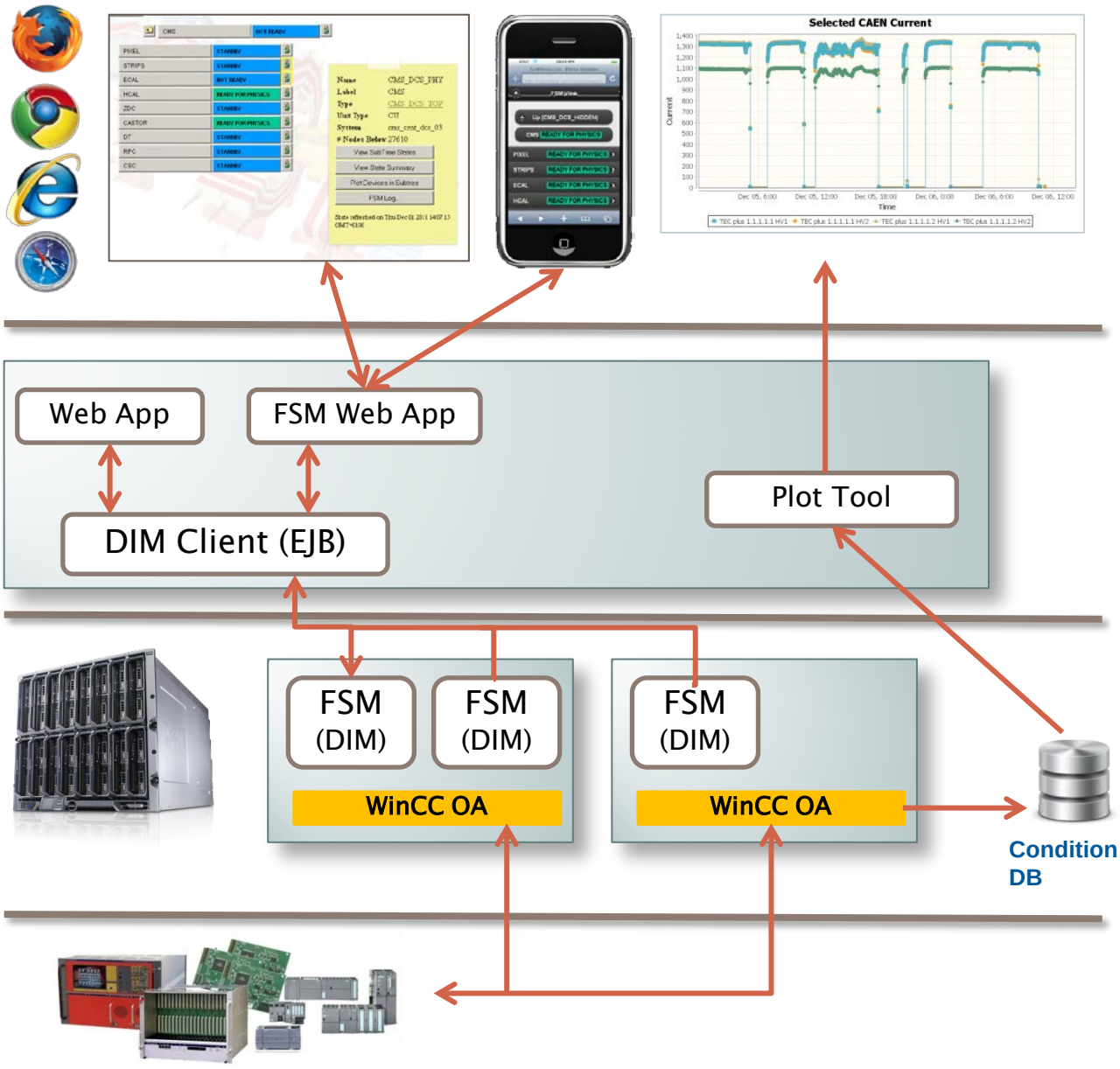


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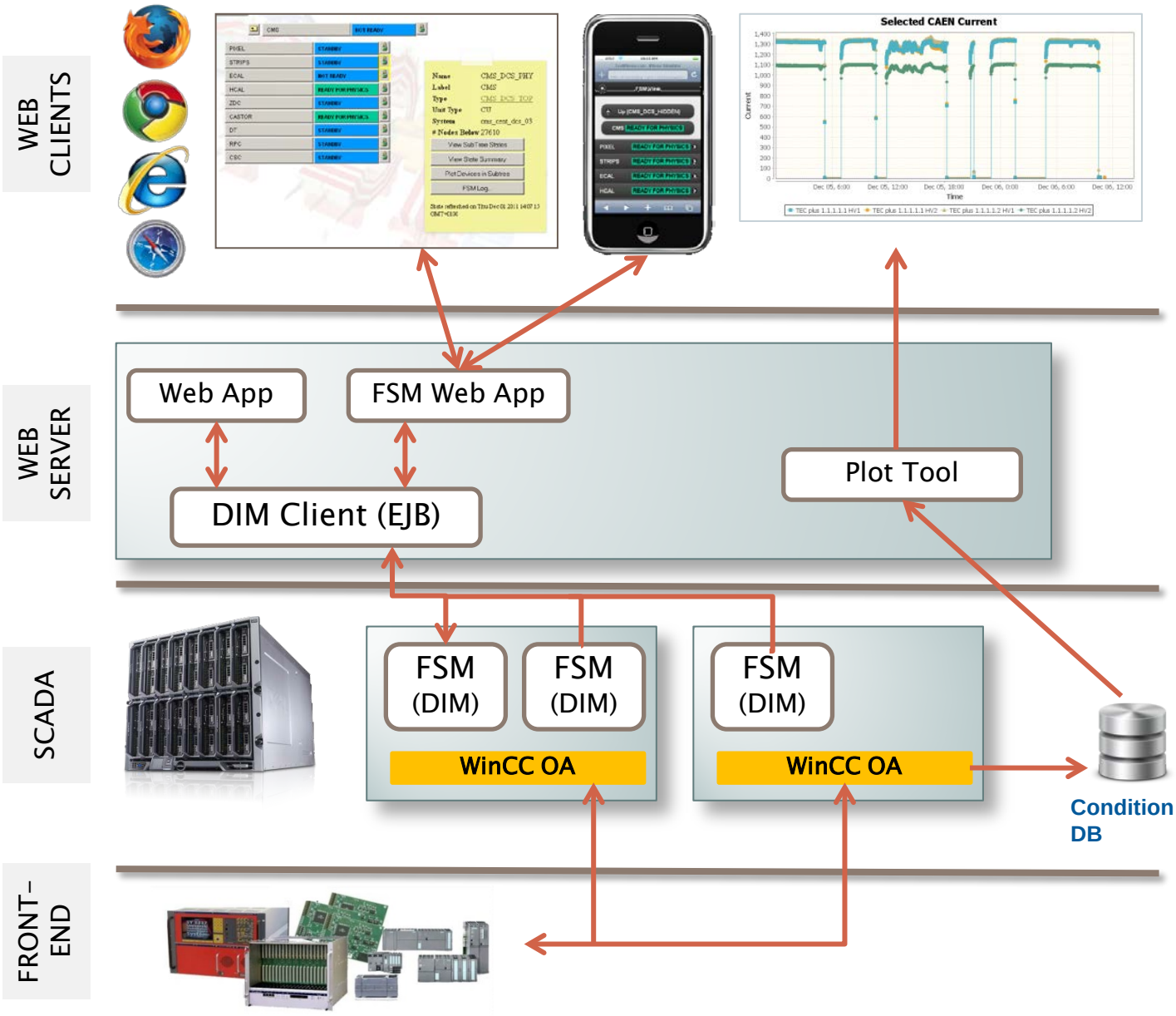


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**Online Data** accessed via DIM (one EJB client)

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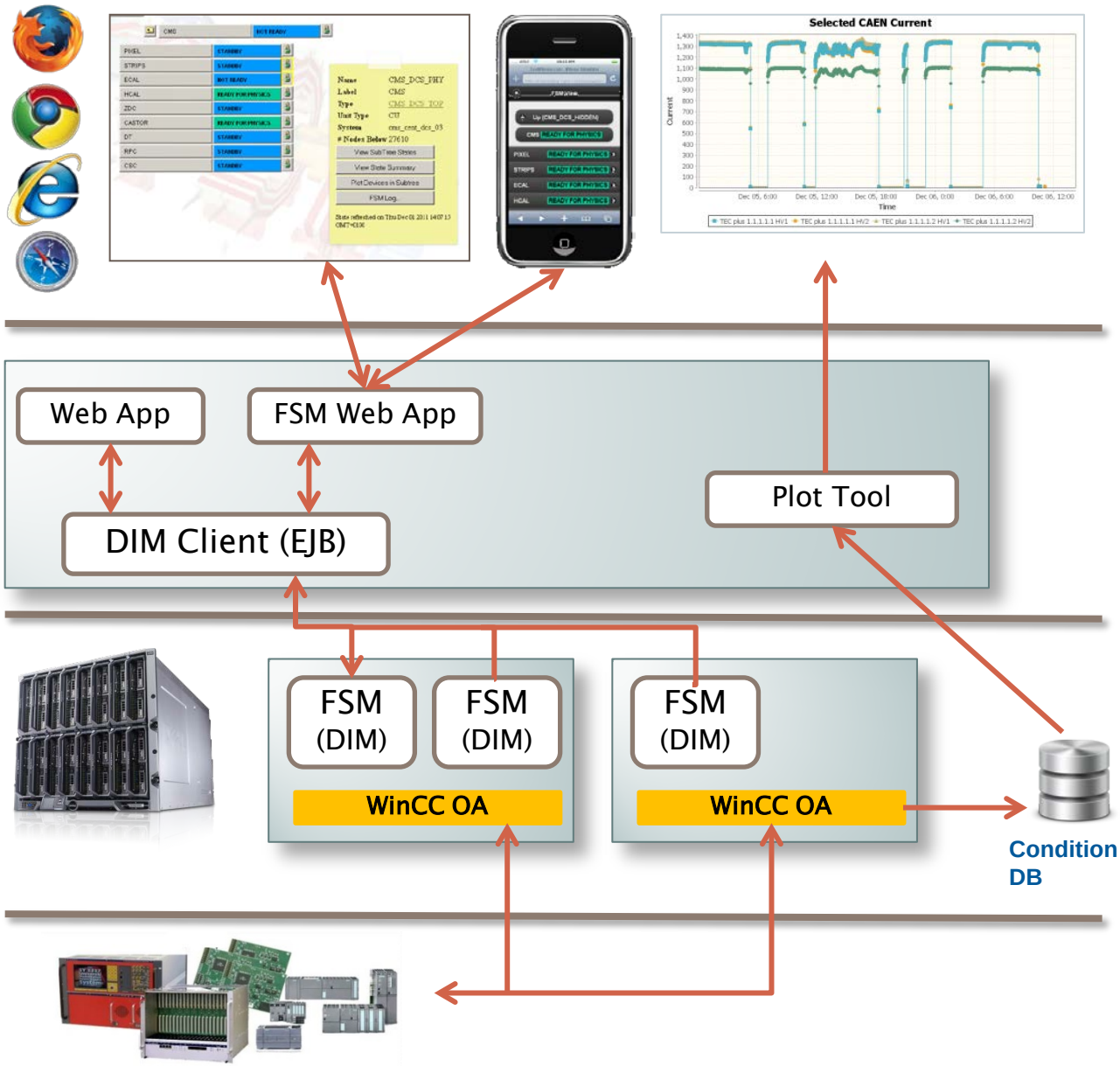


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Multiple accesses served by **local cache**

# Last values from Database

## Fast Display of Last Archived Values

- 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"

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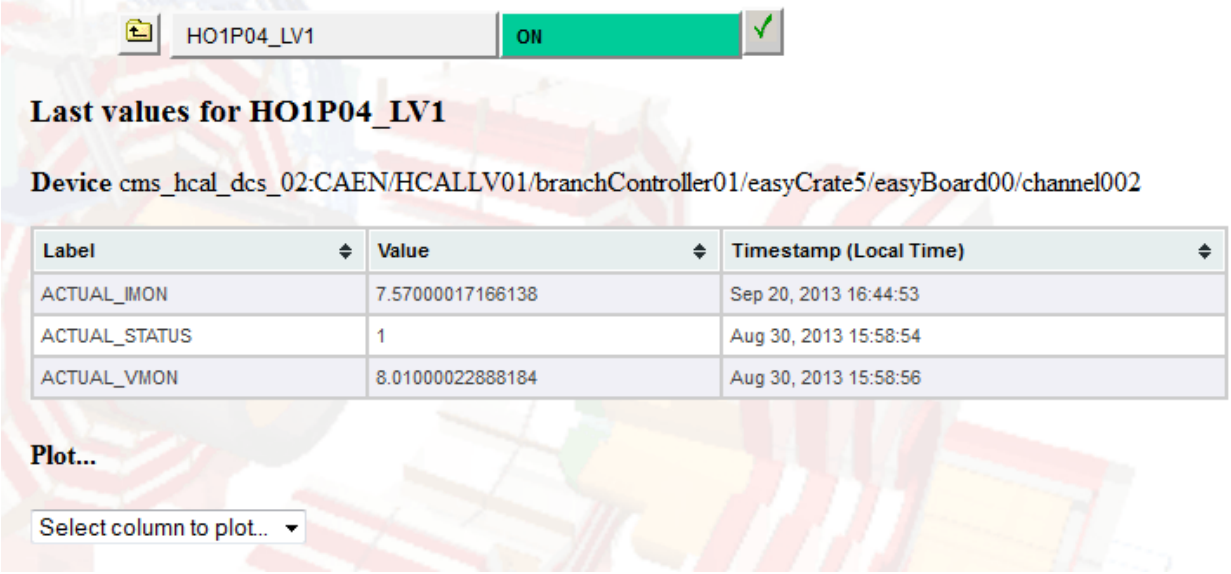
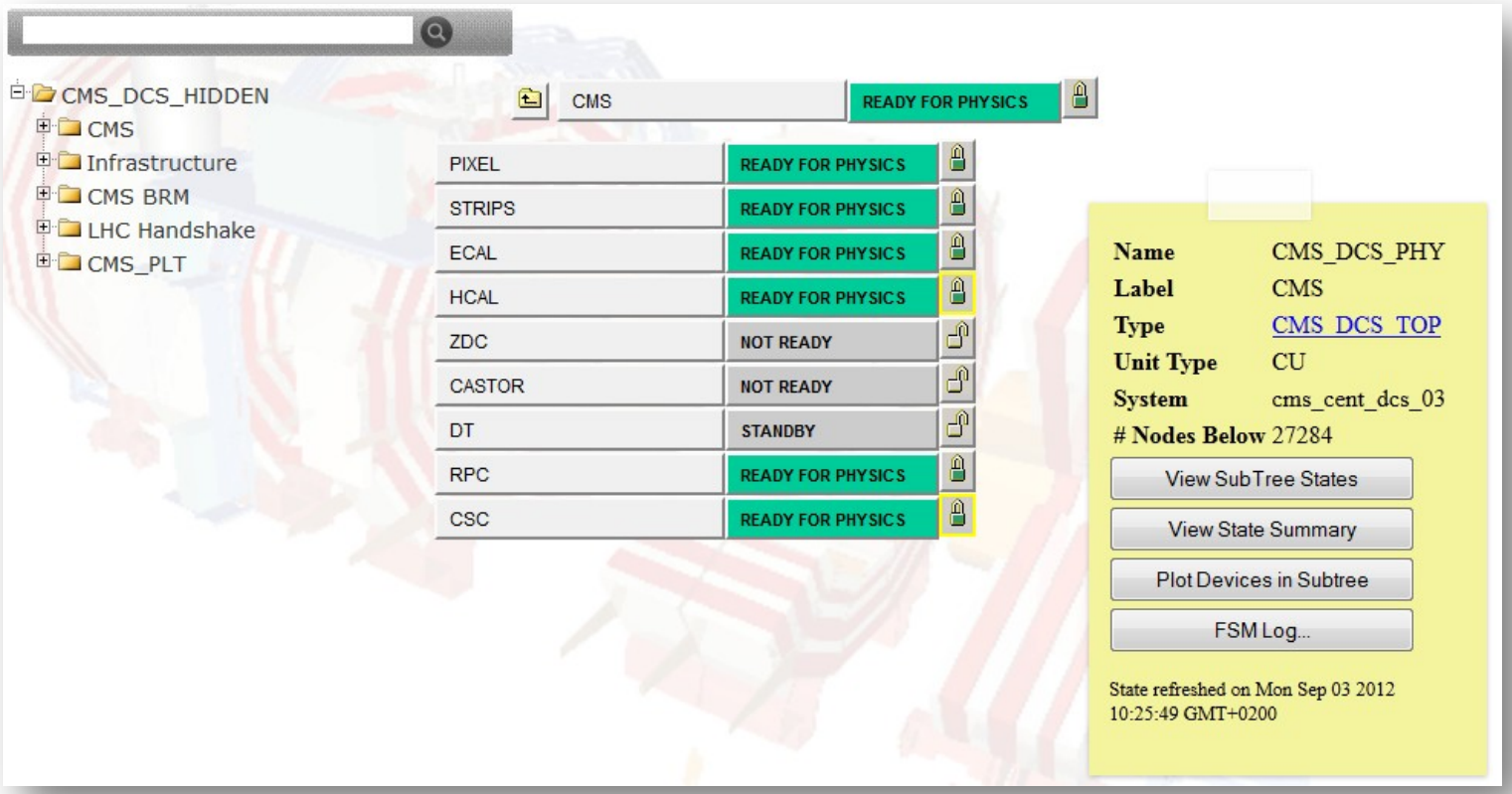


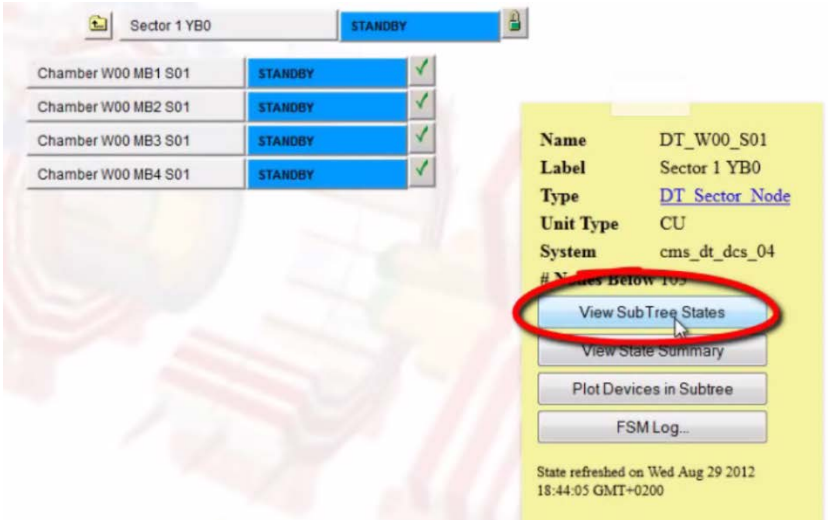
# Example: Browsing the FSM Tree

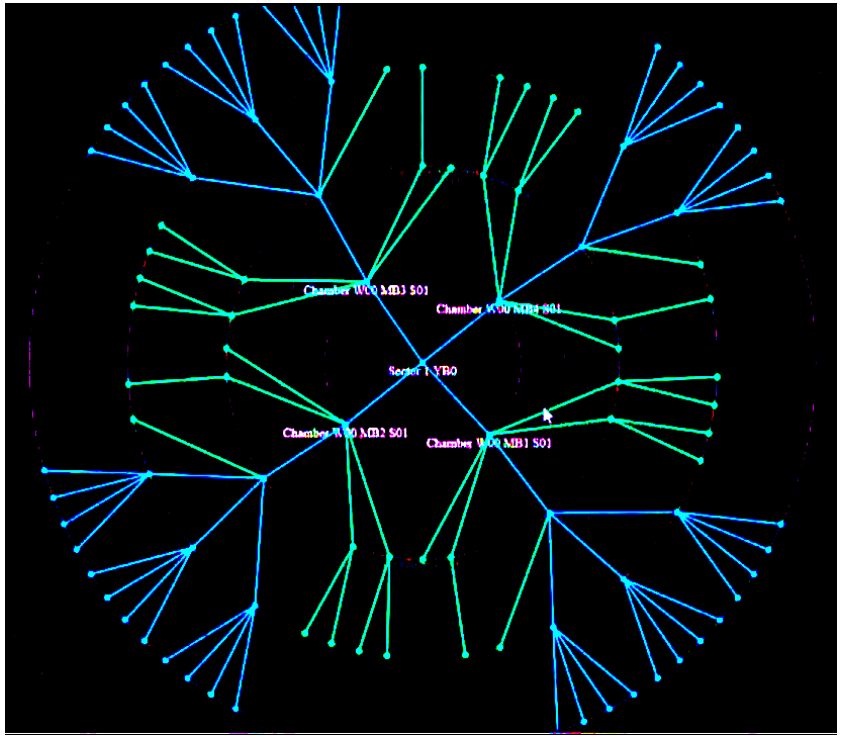



- Interactive navigation in the FSM hierarchy from the web
  - Tree view
  - Web Interface looks like native SCADA interface

# Radial Graph Visualization

## Using Javascript Visualization Library

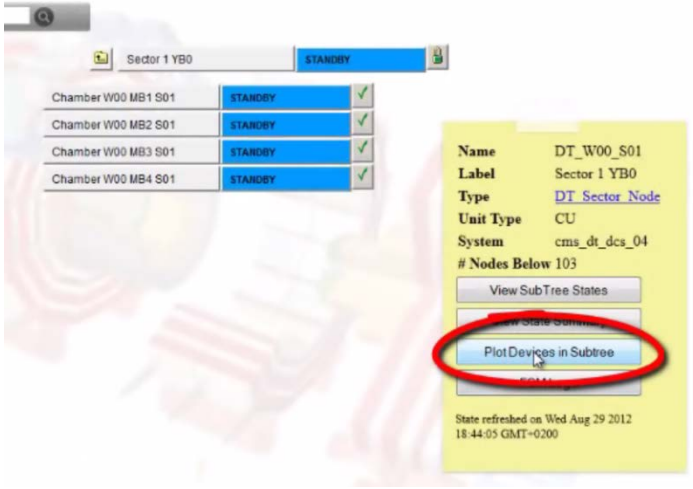


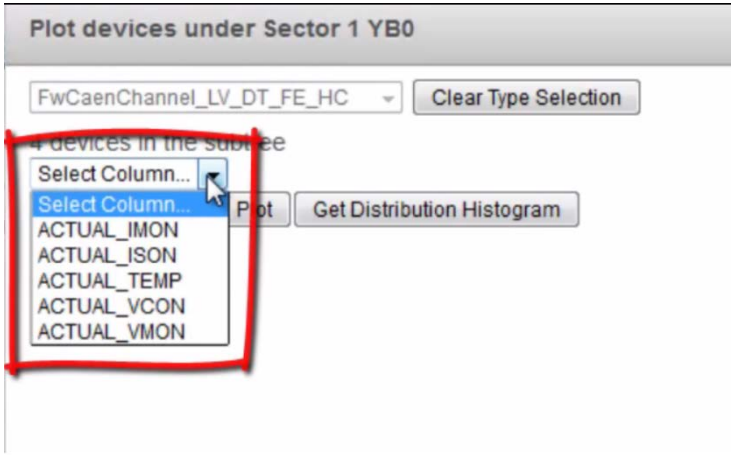



- The radial graph gives a quick overview of the states of all the nodes in the selected sub-tree.

# Plot for Devices in Subtree

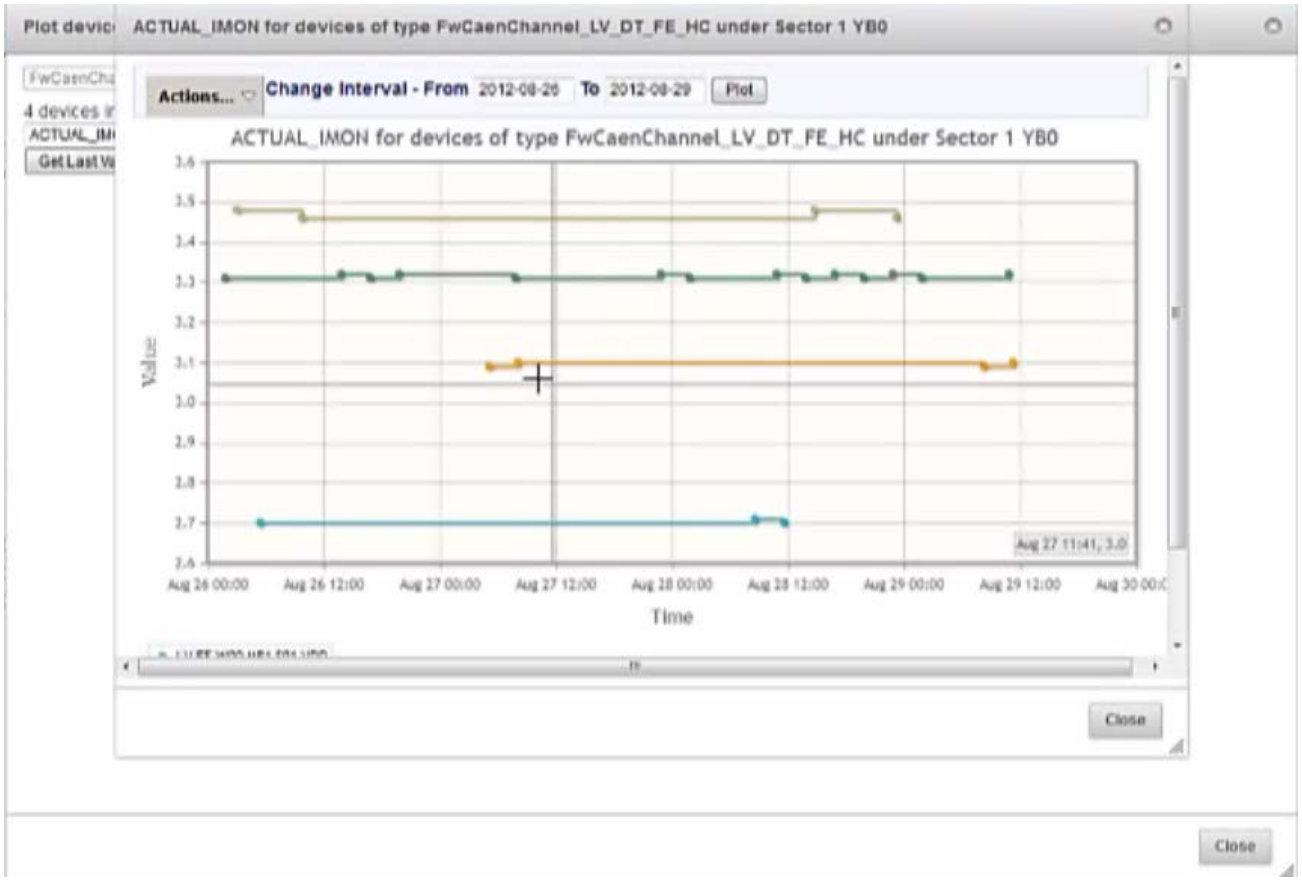
## Access to archived data



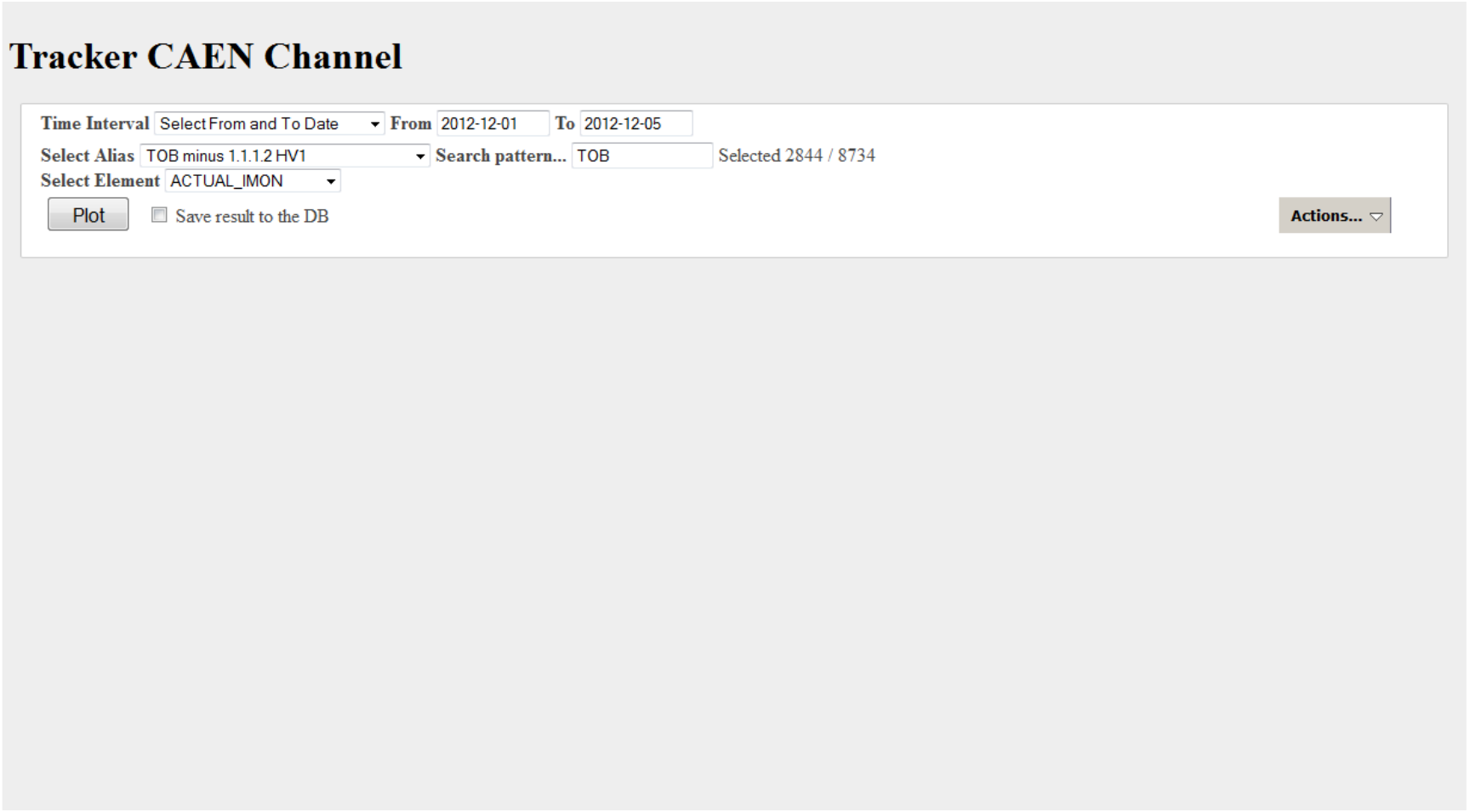

- Select the type of device and the parameter to plot
  - e.g. LV Current

# 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



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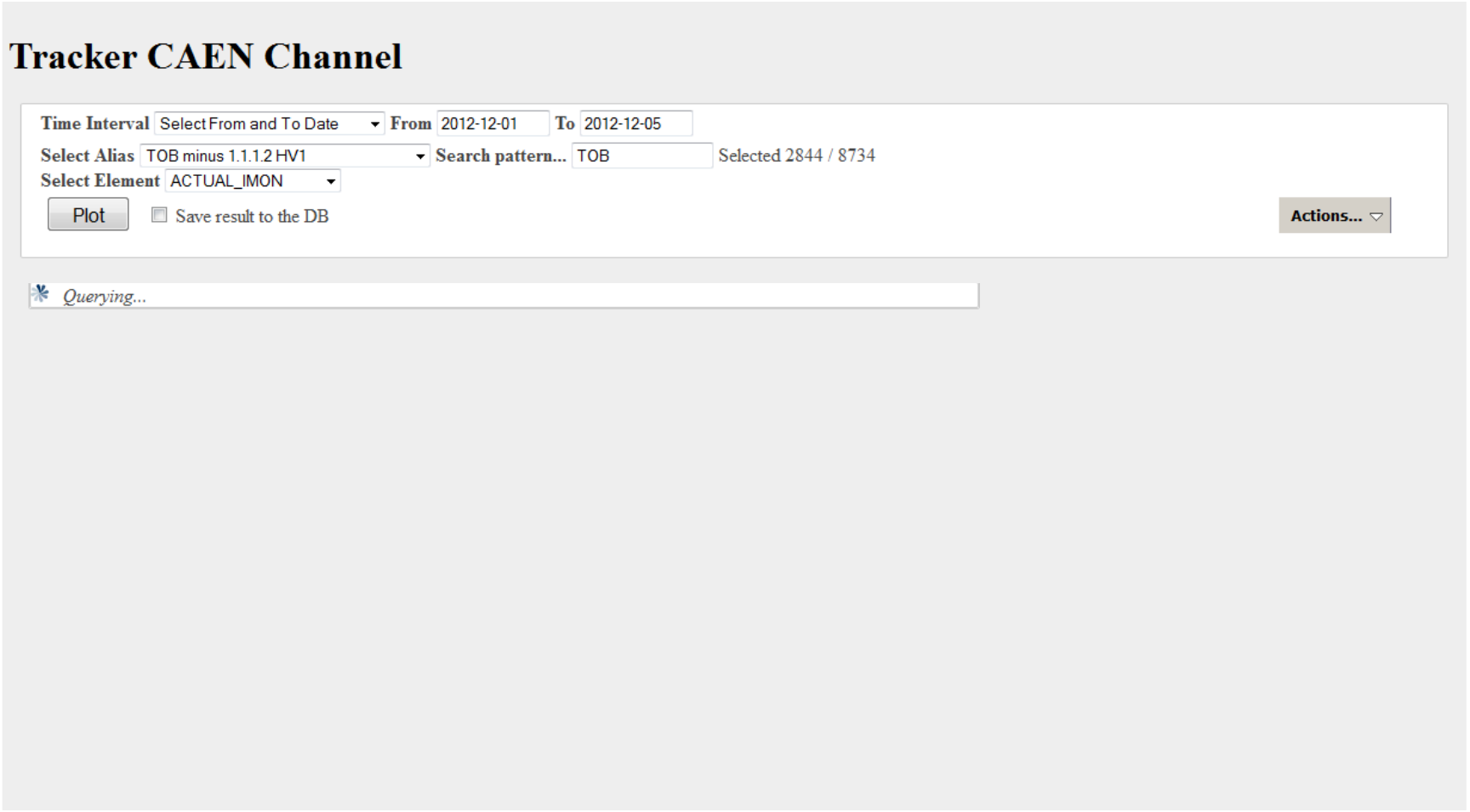


# Custom Plots

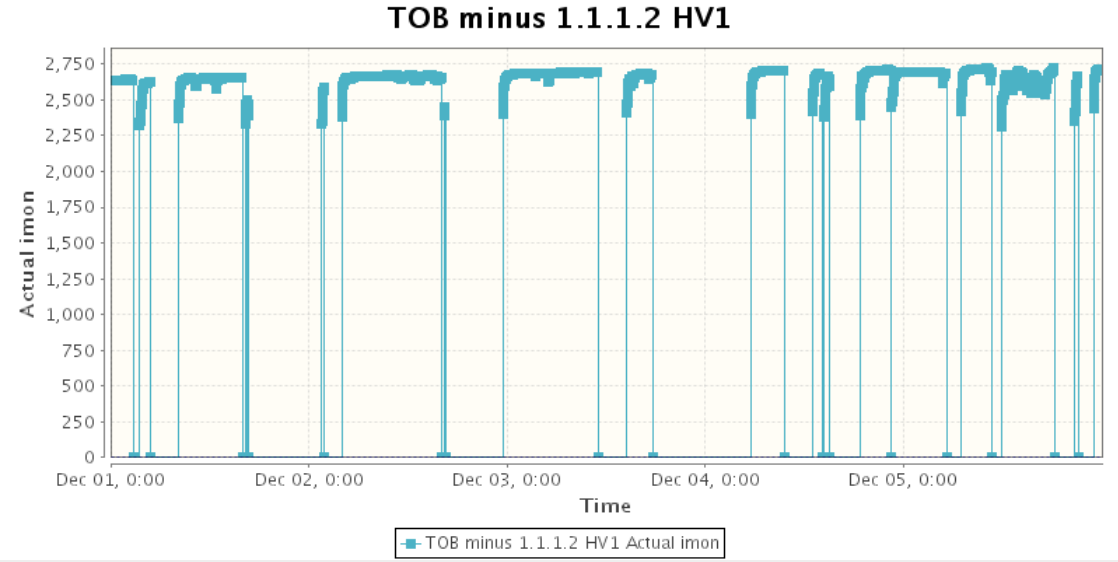
## Tracker CAEN Channel

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

Select Alias: TOB minus 1.1.1.2 HV1 | Search pattern...: TOB | Selected 2844 / 8734

Select Element: ACTUAL_IMON

Plot | Save result to the DB | Actions...



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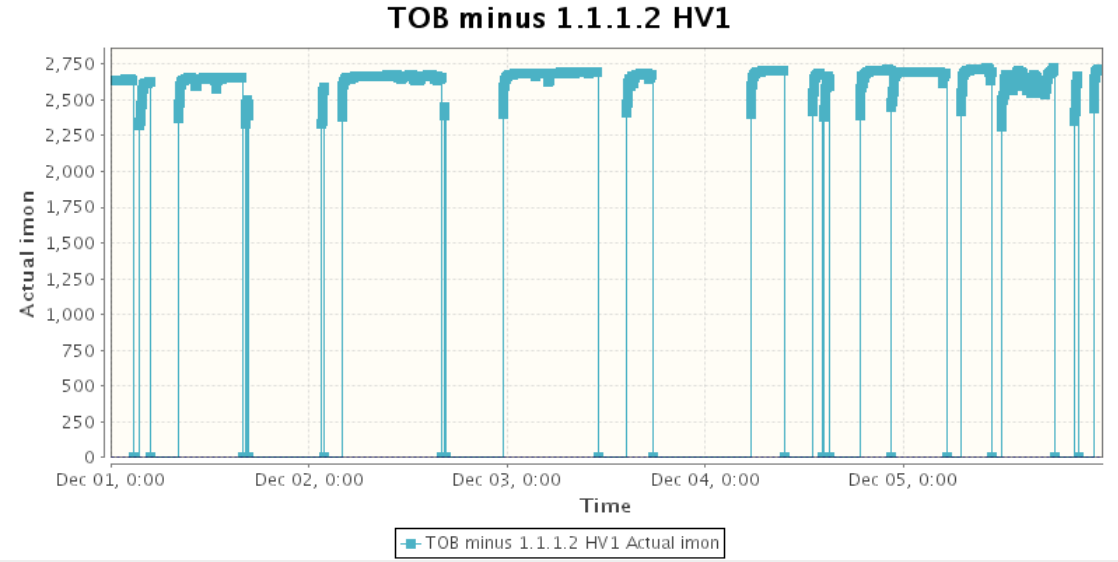


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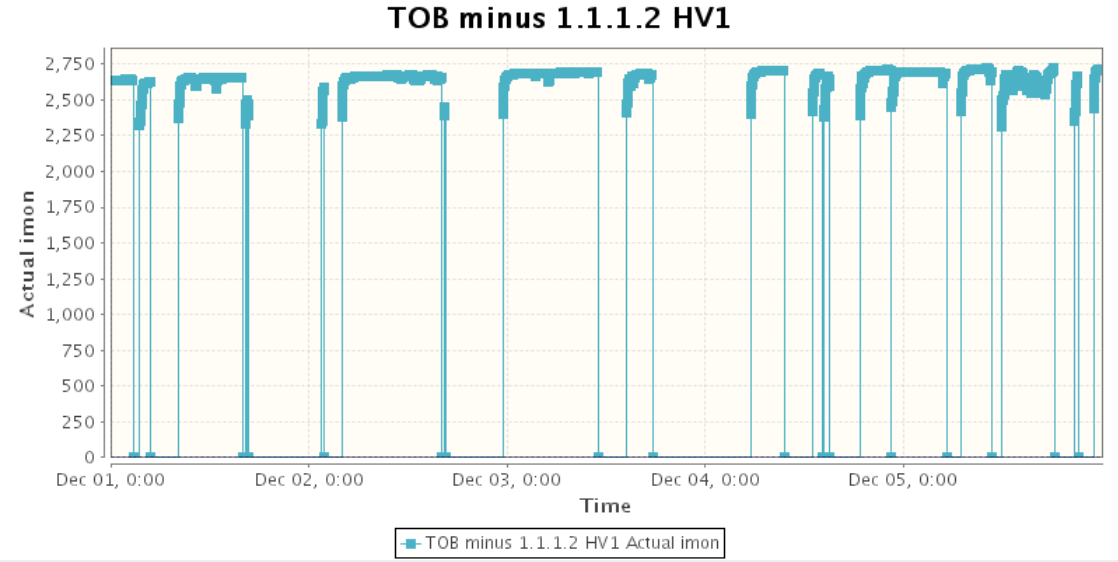


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**Archived Data** accessed from Database without impact on the SCADA System

# 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
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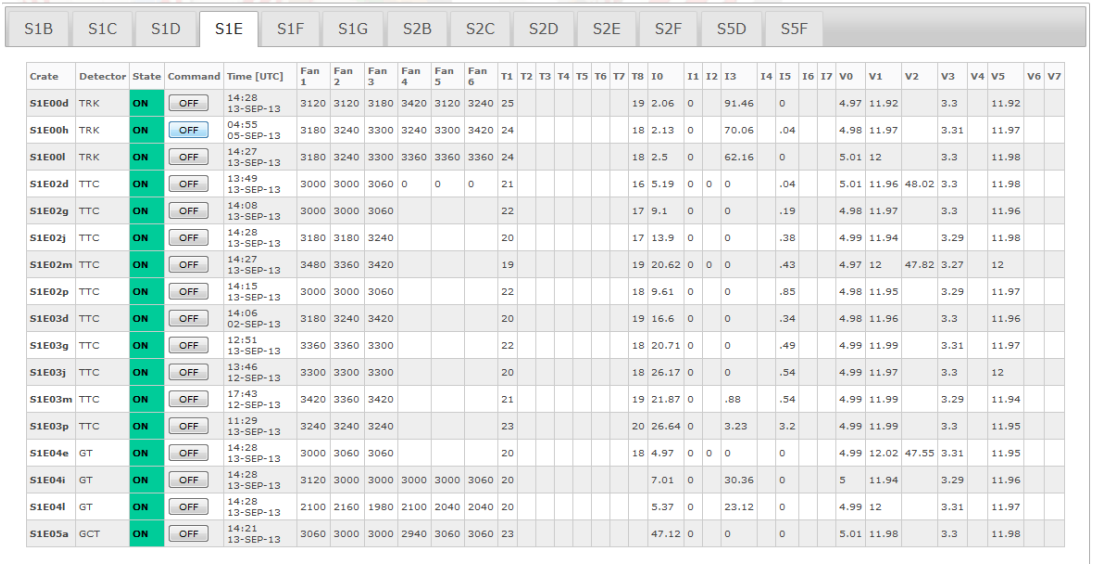
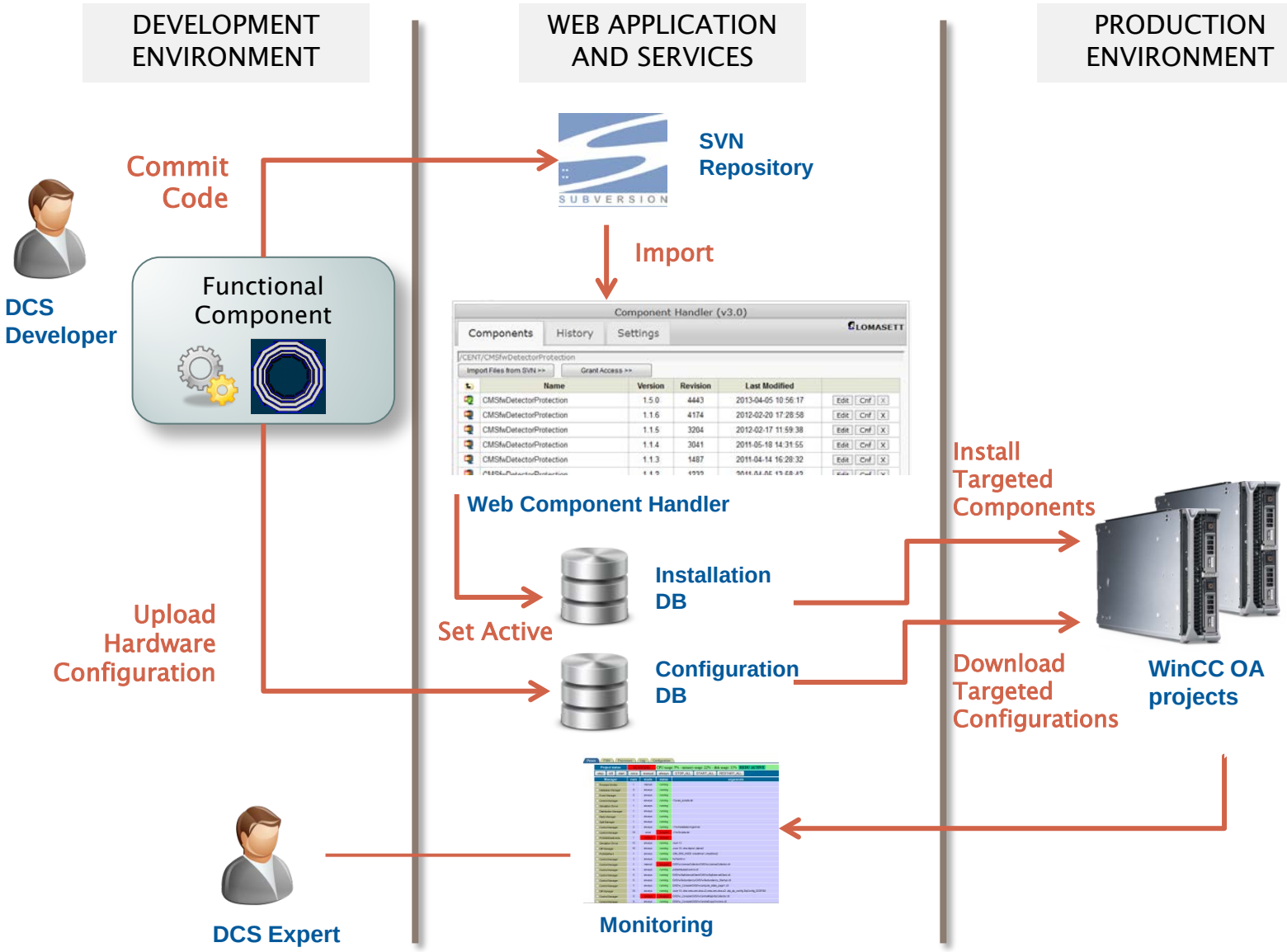



| Crate | Detector | State | Command | Time [UTC] | Fan 1 | Fan 2 | Fan 3 | Fan 4 | Fan 5 | Fan 6 | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | I0 | I1 | I2 | I3 | I4 | I5 | I6 | I7 | V0 | V1 | V2 | V3 | V4 | V5 | V6 | V7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S1E00d | TRK | ON | OFF | 14:28 13-SEP-13 | 3120 | 3120 | 3180 | 3420 | 3120 | 3240 | 25 | | | | | | | 19 | 2.06 | 0 | | 91.46 | | 0 | | | 4.97 | 11.92 | | 3.3 | | 11.92 | | |
| S1E00h | TRK | ON | OFF | 04:55 05-SEP-13 | 3180 | 3240 | 3300 | 3240 | 3300 | 3420 | 24 | | | | | | | 18 | 2.13 | 0 | | 70.06 | | .04 | | | 4.98 | 11.97 | | 3.31 | | 11.97 | | |
| S1E00l | TRK | ON | OFF | 14:27 13-SEP-13 | 3180 | 3240 | 3300 | 3360 | 3360 | 3360 | 24 | | | | | | | 18 | 2.5 | 0 | | 62.16 | | 0 | | | 5.01 | 12 | | 3.3 | | 11.98 | | |
| S1E02d | TTC | ON | OFF | 13:49 13-SEP-13 | 3000 | 3000 | 3060 | 0 | 0 | 0 | 21 | | | | | | | 16 | 5.19 | 0 | 0 | 0 | | .04 | | | 5.01 | 11.96 | 48.02 | 3.3 | | 11.98 | | |
| S1E02g | TTC | ON | OFF | 14:08 13-SEP-13 | 3000 | 3000 | 3060 | | | | 22 | | | | | | | 17 | 9.1 | 0 | | 0 | | .19 | | | 4.98 | 11.97 | | 3.3 | | 11.96 | | |
| S1E02j | TTC | ON | OFF | 14:28 13-SEP-13 | 3180 | 3180 | 3240 | | | | 20 | | | | | | | 17 | 13.9 | 0 | | 0 | | .38 | | | 4.99 | 11.94 | | 3.29 | | 11.98 | | |
| S1E02m | TTC | ON | OFF | 14:27 13-SEP-13 | 3480 | 3360 | 3420 | | | | 19 | | | | | | | 19 | 20.62 | 0 | 0 | 0 | | .43 | | | 4.97 | 12 | 47.82 | 3.27 | | 12 | | |
| S1E02p | TTC | ON | OFF | 14:15 13-SEP-13 | 3000 | 3000 | 3060 | | | | 22 | | | | | | | 18 | 9.61 | 0 | | 0 | | .85 | | | 4.98 | 11.95 | | 3.29 | | 11.97 | | |
| S1E03d | TTC | ON | OFF | 14:06 02-SEP-13 | 3180 | 3240 | 3420 | | | | 20 | | | | | | | 19 | 16.6 | 0 | | 0 | | .34 | | | 4.98 | 11.96 | | 3.3 | | 11.96 | | |
| S1E03g | TTC | ON | OFF | 12:51 13-SEP-13 | 3360 | 3360 | 3300 | | | | 22 | | | | | | | 18 | 20.71 | 0 | | 0 | | .49 | | | 4.99 | 11.99 | | 3.31 | | 11.97 | | |
| S1E03j | TTC | ON | OFF | 13:46 12-SEP-13 | 3300 | 3300 | 3300 | | | | 20 | | | | | | | 18 | 26.17 | 0 | | 0 | | .54 | | | 4.99 | 11.97 | | 3.3 | | 12 | | |
| S1E03m | TTC | ON | OFF | 17:43 12-SEP-13 | 3420 | 3360 | 3420 | | | | 21 | | | | | | | 19 | 21.87 | 0 | | .88 | | .54 | | | 4.99 | 11.99 | | 3.29 | | 11.94 | | |
| S1E03p | TTC | ON | OFF | 11:29 13-SEP-13 | 3240 | 3240 | 3240 | | | | 23 | | | | | | | 20 | 26.64 | 0 | | 3.23 | | 3.2 | | | 4.99 | 11.99 | | 3.3 | | 11.95 | | |
| S1E04e | GT | ON | OFF | 14:28 13-SEP-13 | 3000 | 3060 | 3060 | | | | 20 | | | | | | | 18 | 4.97 | 0 | 0 | 0 | | 0 | | | 4.99 | 12.02 | 47.55 | 3.31 | | 11.95 | | |
| S1E04i | GT | ON | OFF | 14:28 13-SEP-13 | 3120 | 3000 | 3000 | 3000 | 3000 | 3060 | 20 | | | | | | | | 7.01 | 0 | | 30.36 | | 0 | | | 5 | 11.94 | | 3.29 | | 11.96 | | |
| S1E04l | GT | ON | OFF | 14:28 13-SEP-13 | 2100 | 2160 | 1980 | 2100 | 2040 | 2040 | 20 | | | | | | | | 5.37 | 0 | | 23.12 | | 0 | | | 4.99 | 12 | | 3.31 | | 11.97 | | |
| S1E05a | GCT | ON | OFF | 14:21 13-SEP-13 | 3060 | 3000 | 3000 | 2940 | 3060 | 3060 | 23 | | | | | | | | 47.12 | 0 | | 0 | | 0 | | | 5.01 | 11.98 | | 3.3 | | 11.98 | | |

# Administrative Tools

## Web-Based Deployment



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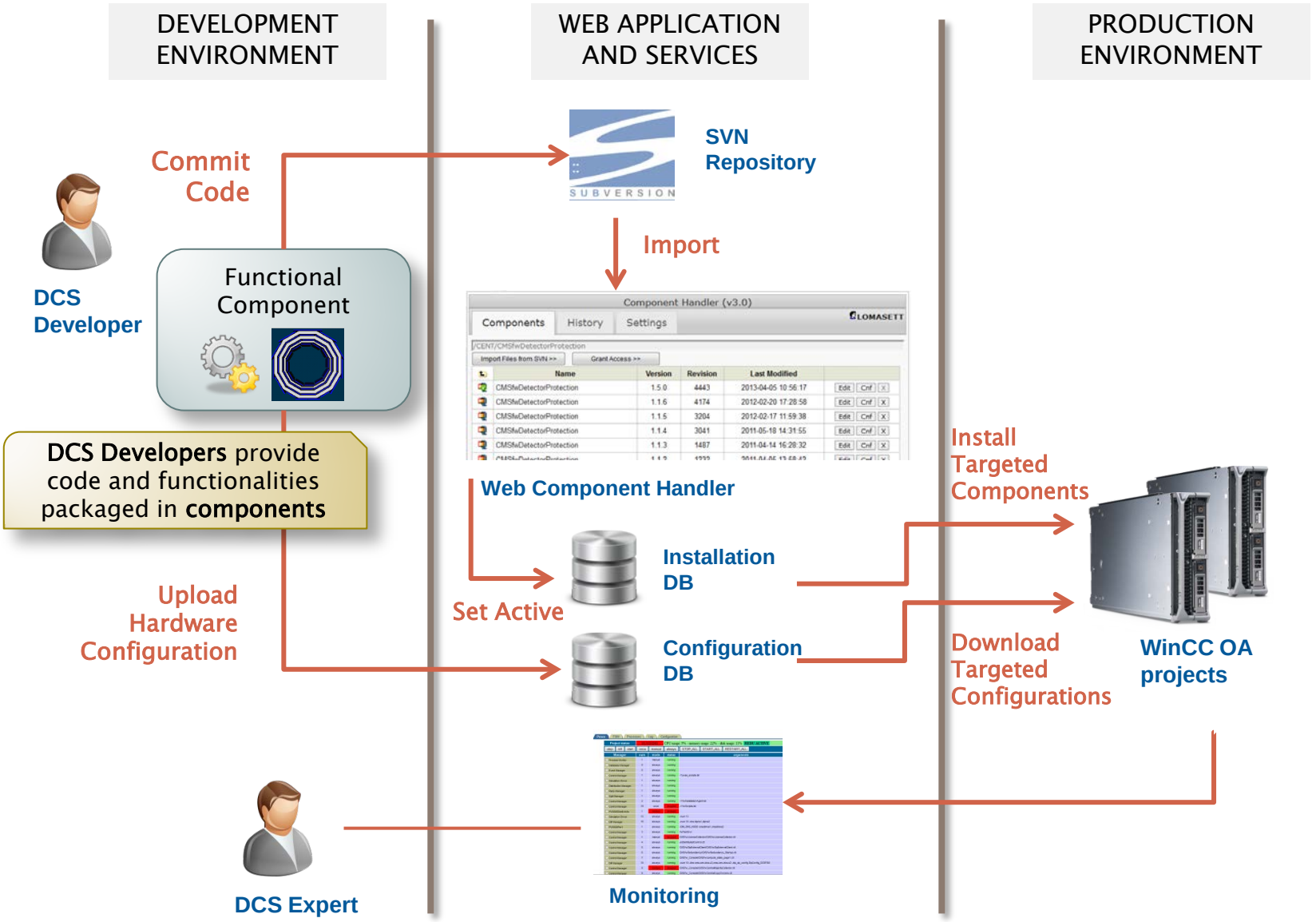

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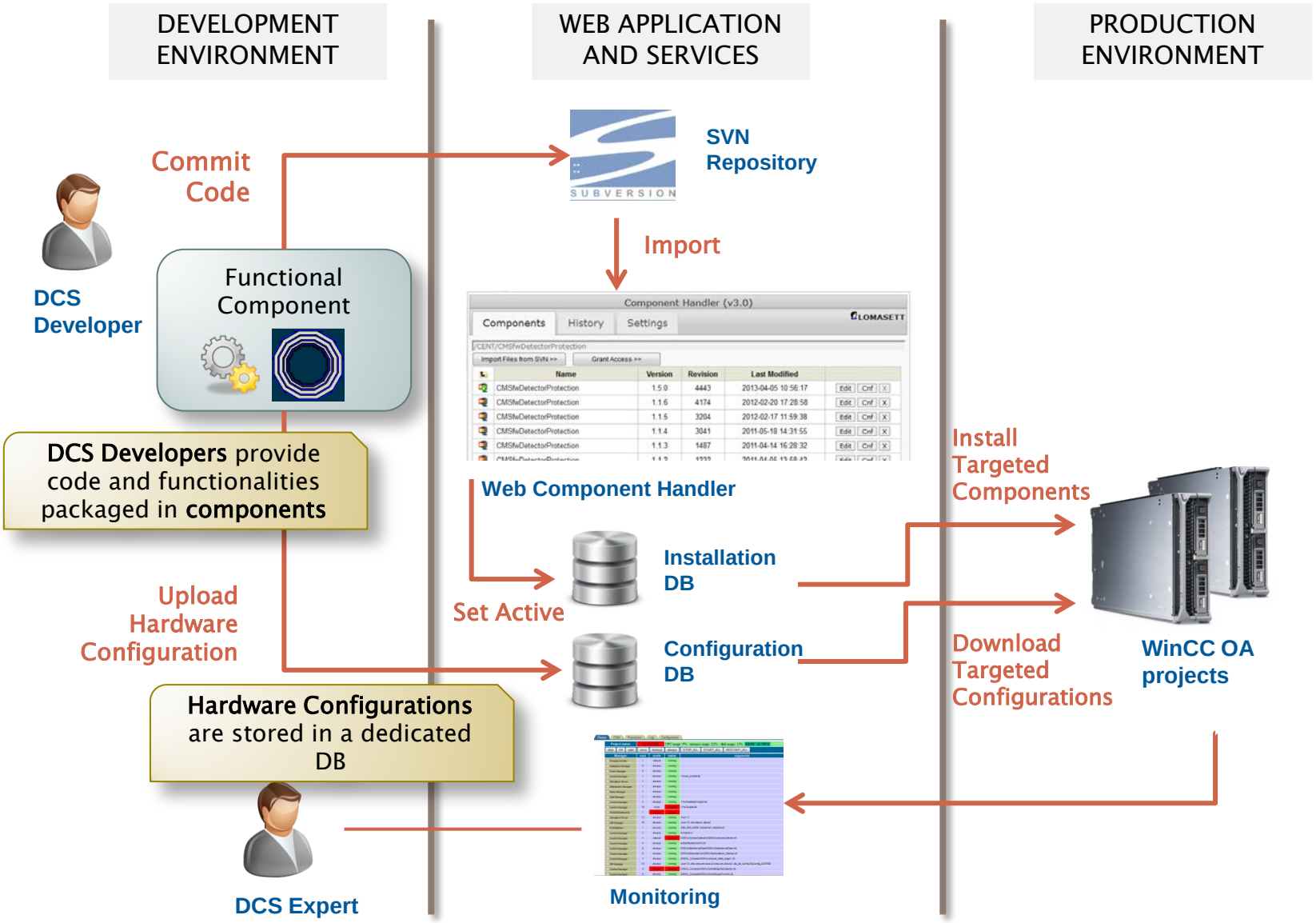

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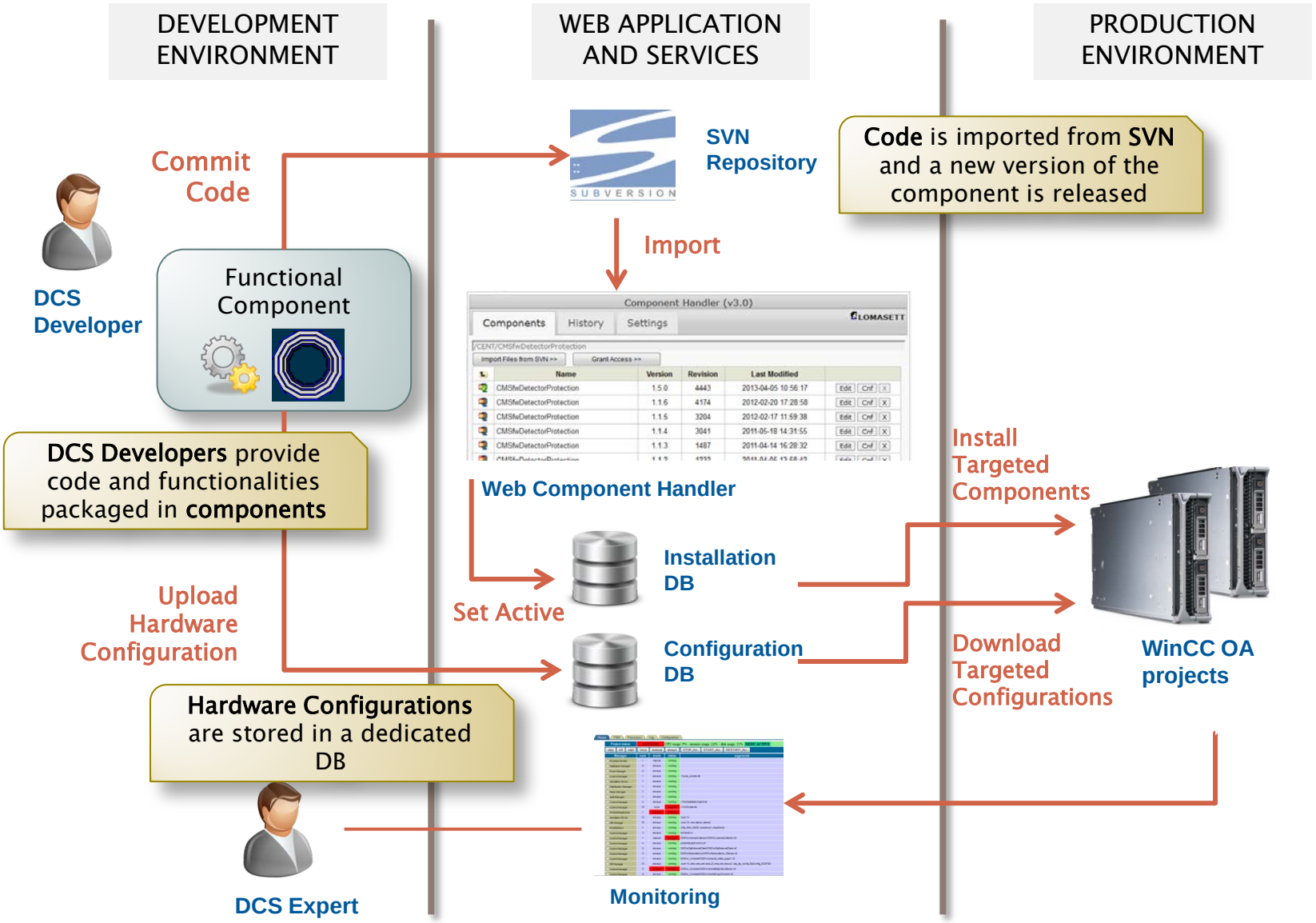

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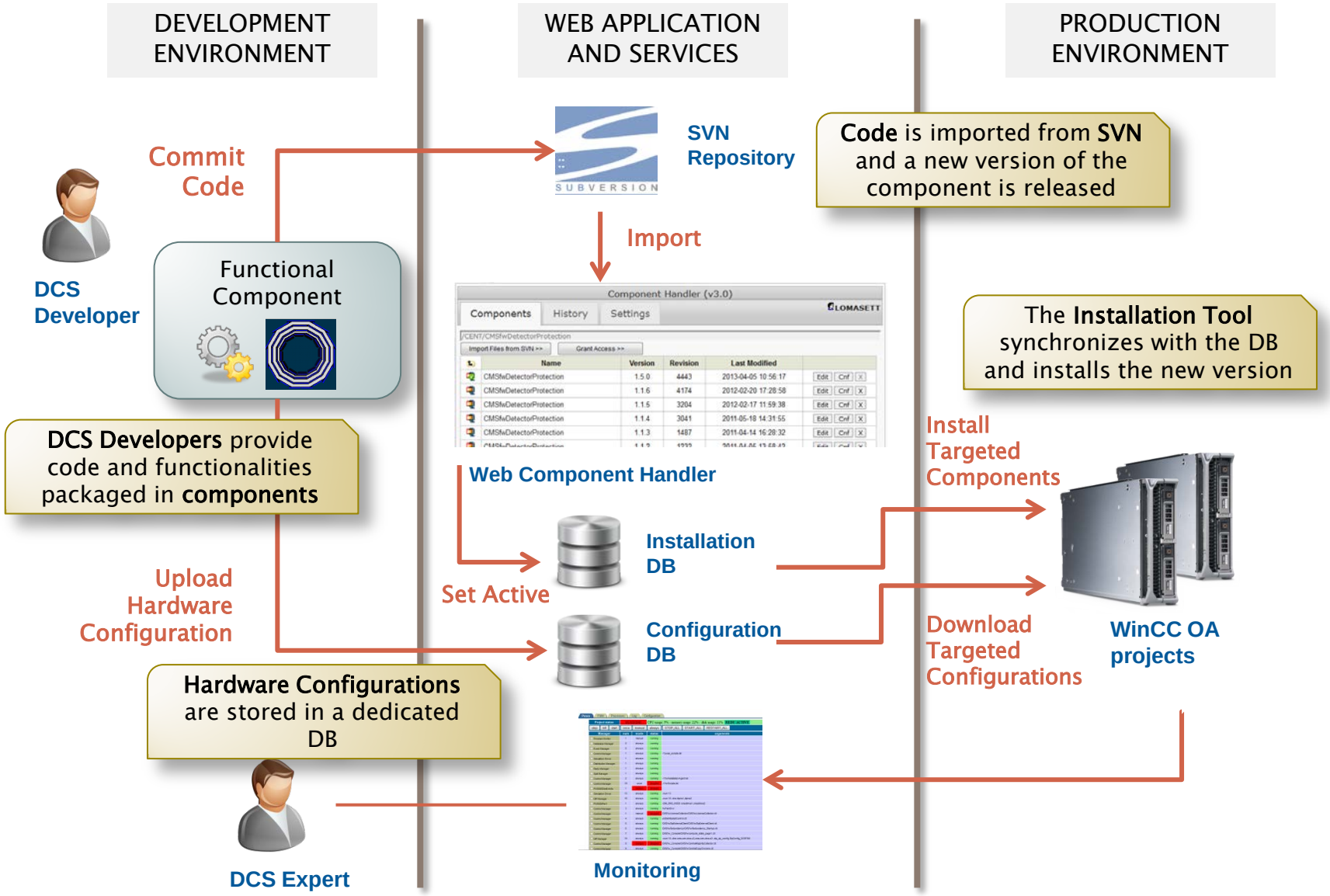

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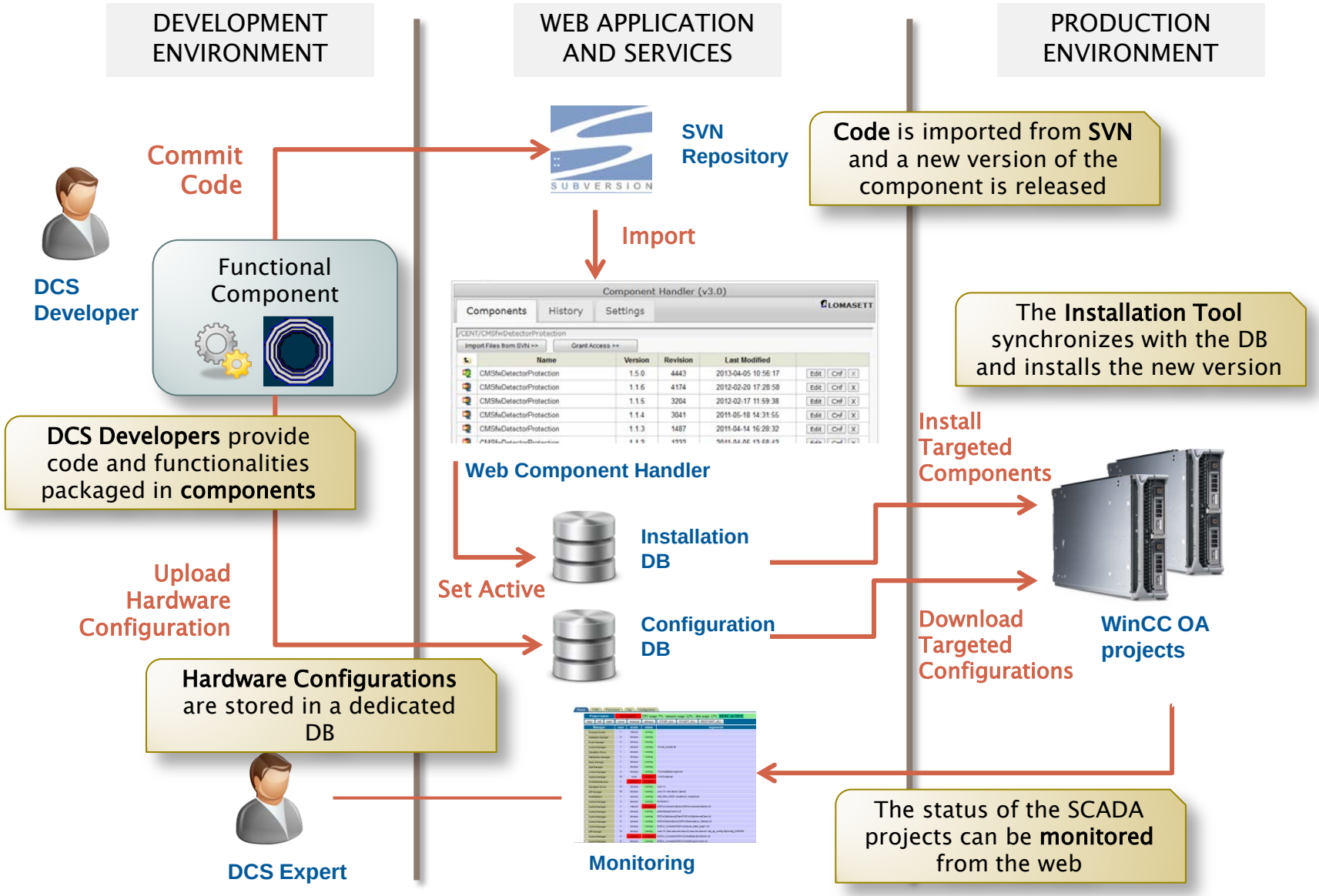
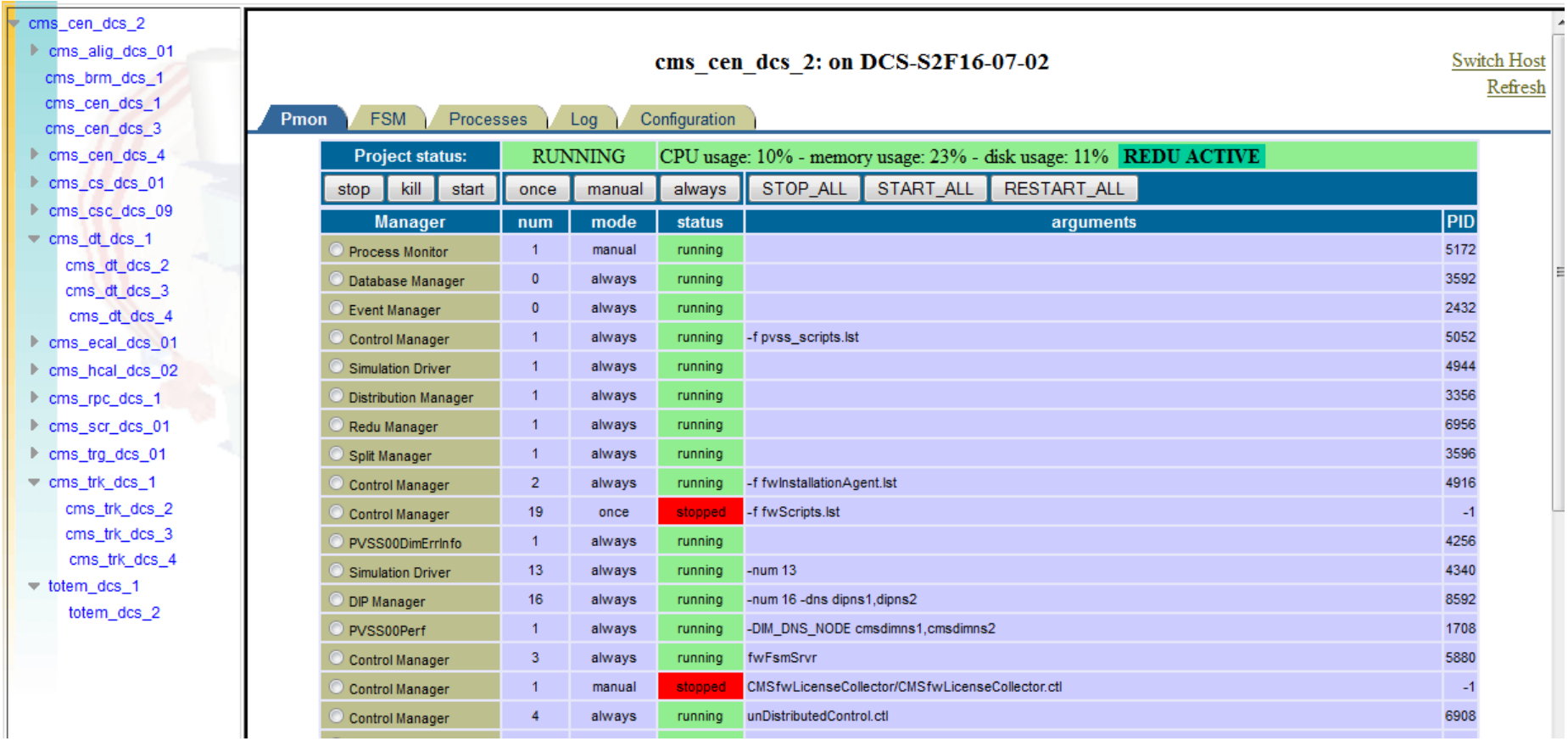


# SCADA Monitoring and Control



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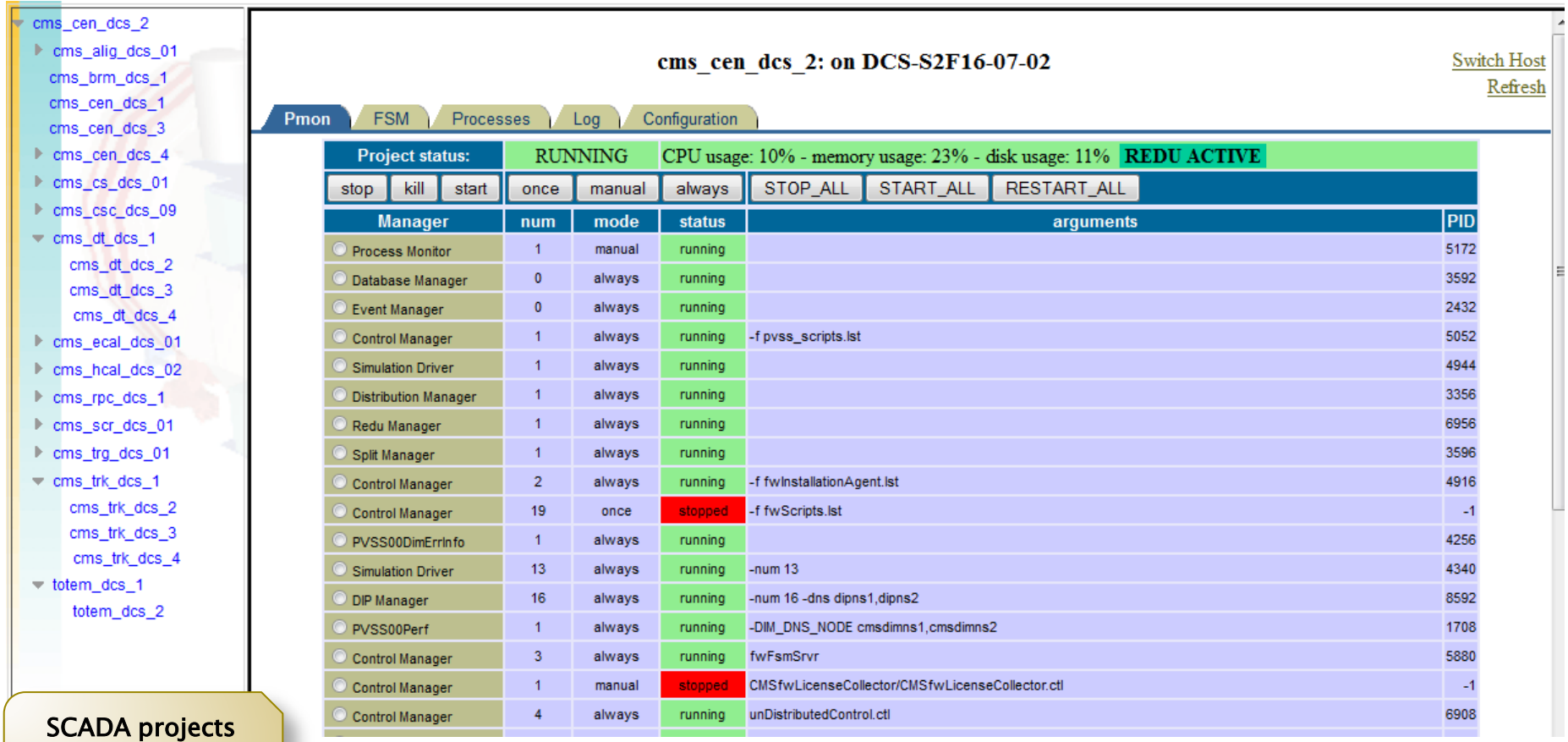


**SCADA projects** can be monitored from the web

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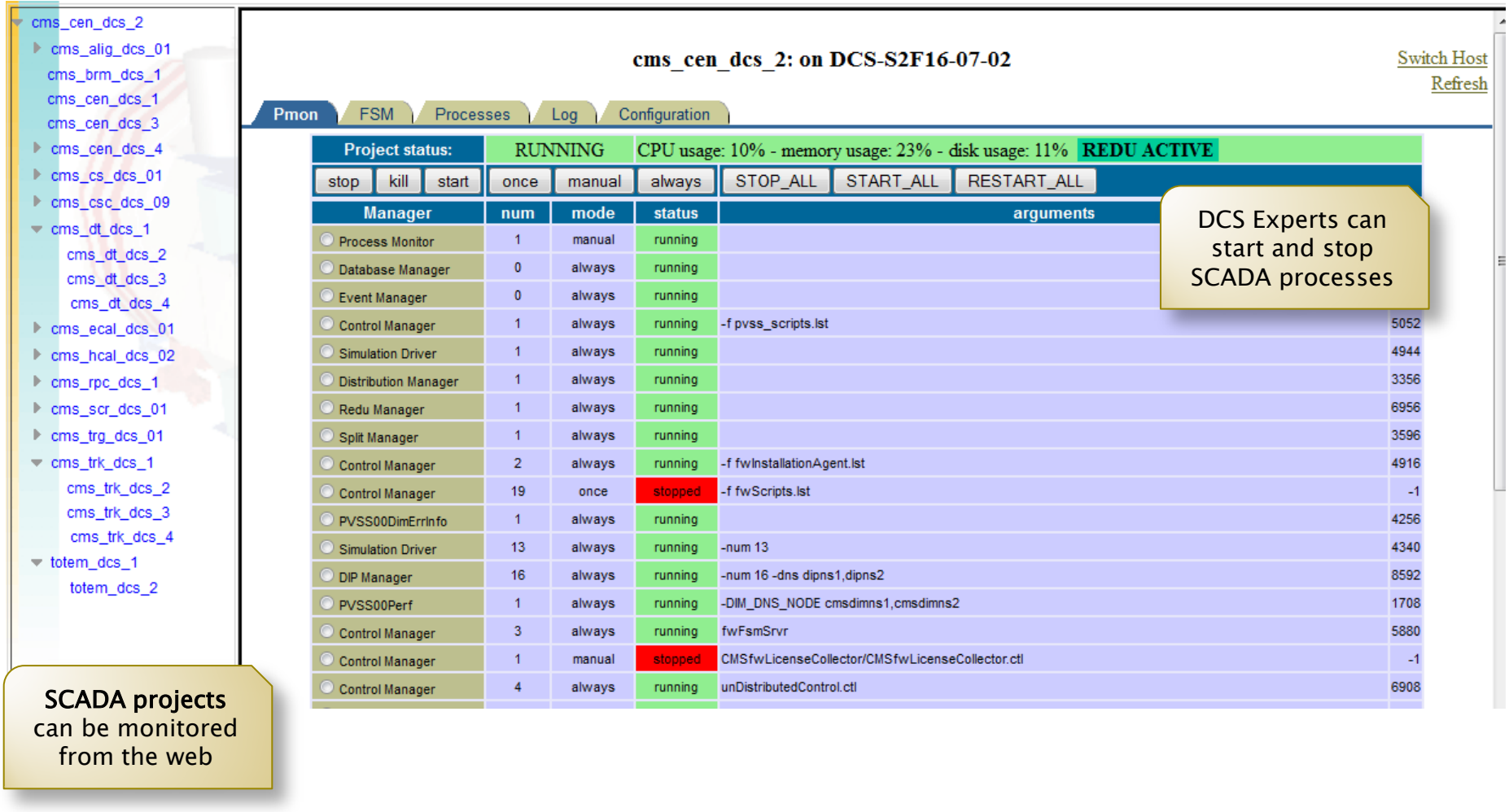

# Enterprise Portal: Advantages

- 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

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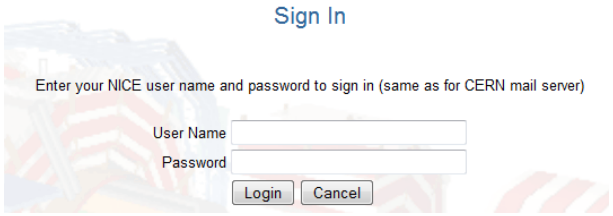


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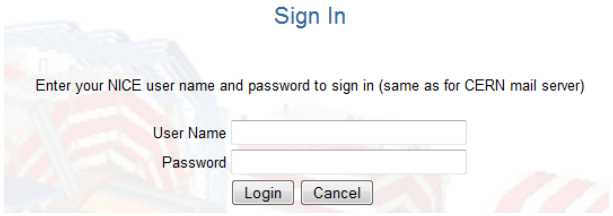


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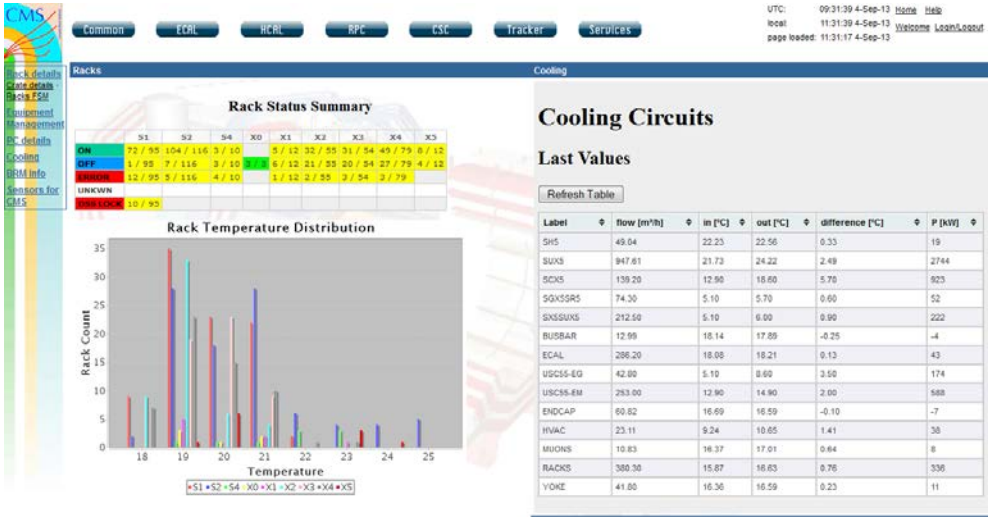

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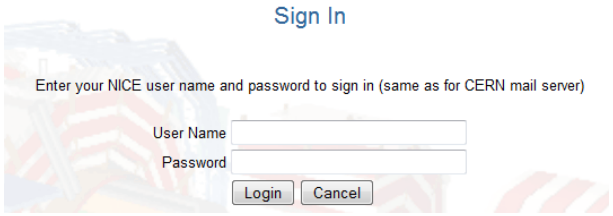


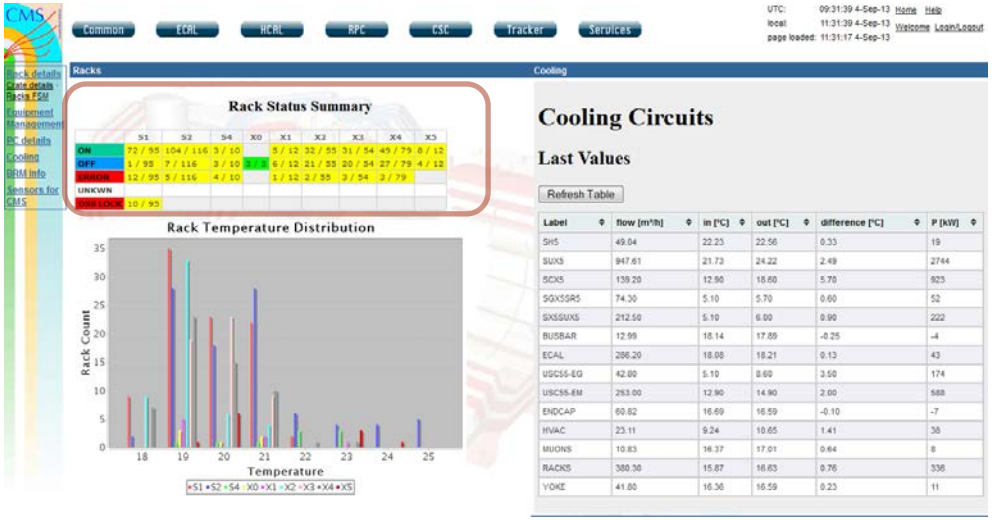

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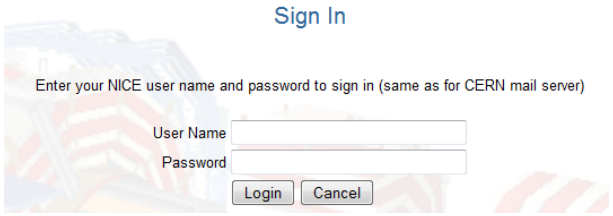


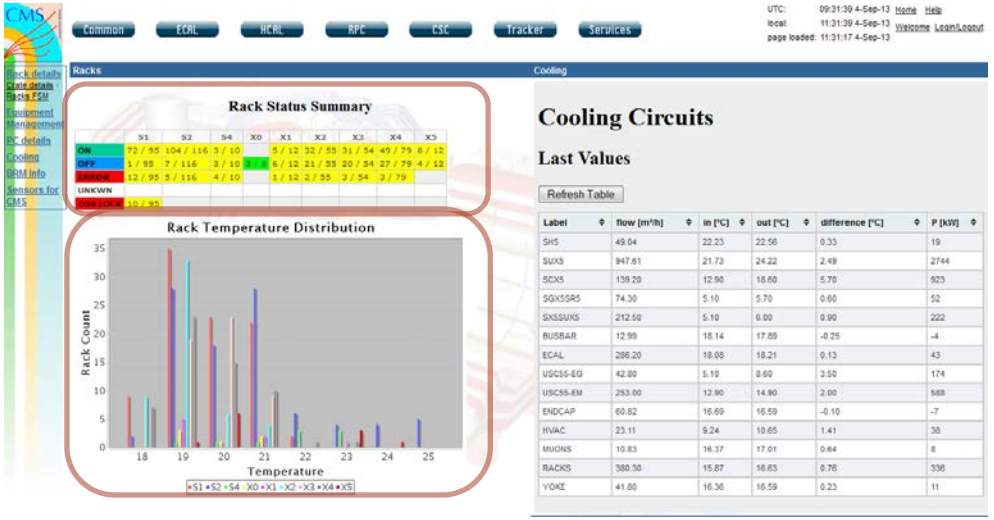

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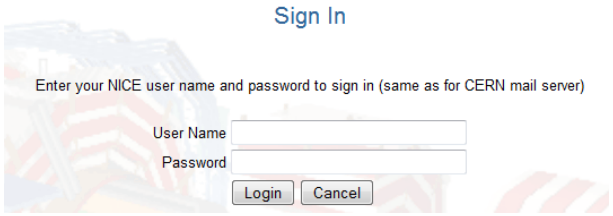


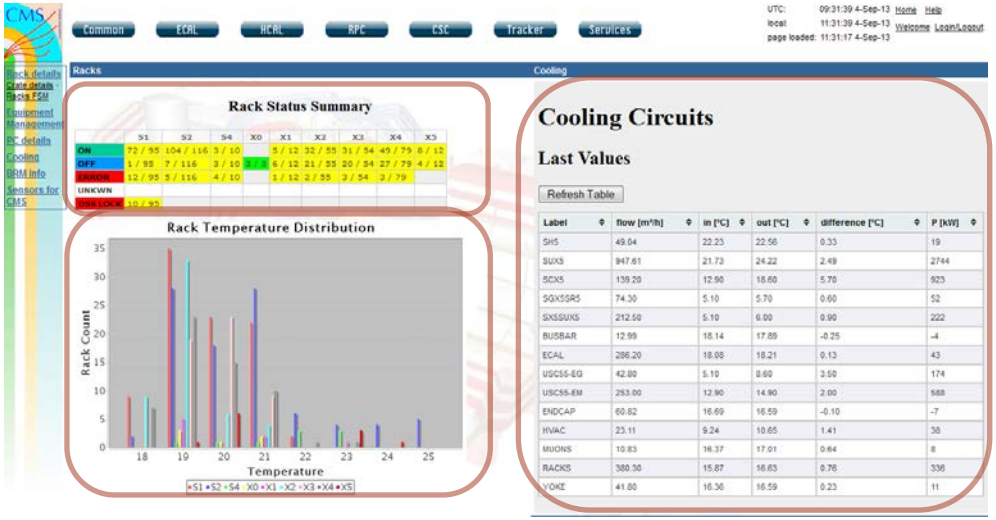

# Summary

- 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