Controls issues experienced during the LHC start-up: status report

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Abstract

- During 2009 the LHC control system became operational through several dry runs and injection tests and contributed to the successful LHC start-up

- Today is a good opportunity to assess the quality and performance of the various components of the controls infrastructure both software and hardware

- The presentation will give a summary of the controls issues experienced during the LHC start-up and will outline applied and planned actions needed to resolve them

Emphasis on few critical systems

- Infrastructure – disk space, consoles, …

- CMW – proxies, subscriptions, …

- FESA – front-end instabilities

- RBAC – introduction of STRICT policy

- JMS – data publishing

- BE–CO Development Process

Infrastructure – NFS disk space

- **Massive increase of the total amount of controls operational data**
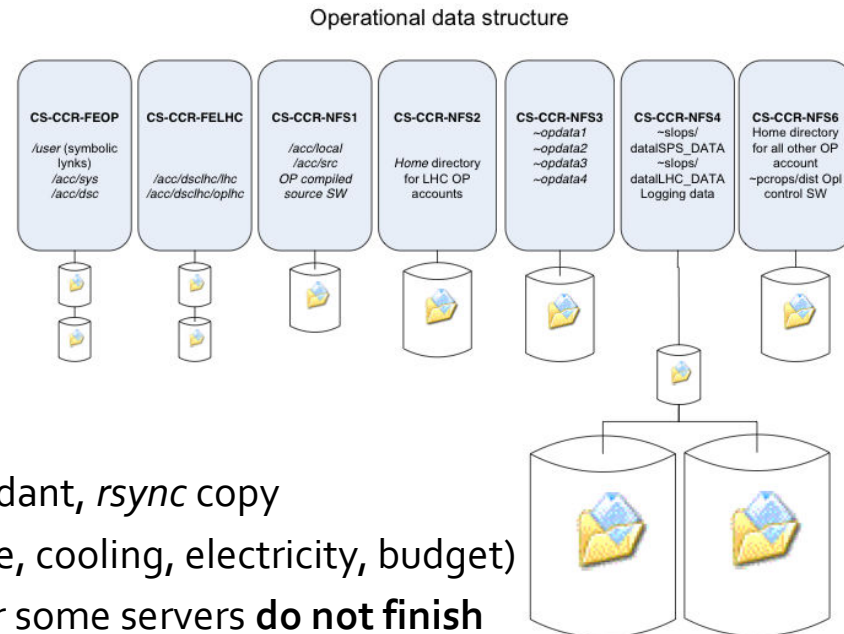 - 2005 => ~400 GB, 2010 => 4Tb
  - The last 2Tb were filled in only 2 months by users and application data

- **Problem description**
  - Data is duplicated **three times**: source, redundant, *rsync* copy
  - Reaching the **physical limits** of the CCR (space, cooling, electricity, budget)
  - The tape backups take **too much time** and for some servers **do not finish** during the night!

- **Planned action**
  - CO-IN **analyses** the disk space usage and **will propose** a long-term solution (February 2010) based on **new storage** technology from HP

Operational data structure

| CS-CCR-FEOP	CS-CCR-FELHC	CS-CCR-NFS1	CS-CCR-NFS2	CS-CCR-NFS3	CS-CCR-NFS4	CS-CCR-NFS6
/user (symbolic lynks) /acc/sys /acc/dsc	/acc/dsclhc/lhc /acc/dsclhc/oplhc	/acc/local /acc/src OP compiled source SW	Home directory for LHC OP accounts	~opdata1 ~opdata2 ~opdata3 ~opdata4	~slops/ dataISPS_DATA ~slops/ dataILHC_DATA Logging data	Home directory for all other OP account ~pcrops/dist Opl control SW

Infrastructure – Operational Consoles

- **High load on consoles**
  - **Problem:** Consoles became **slow** and **not responsive,** even with only few apps. running
  - **Performed actions**
    - Introduced visual **indicator** in CCM
    - Identified an issue (Vistar zombie processes) and **fixed it promptly** before the start-up
    - Memory of all LHC consoles was **doubled** (4GB)
    - EIC consoles were upgraded to **the latest HW** configuration

Since then … green indicators and …. happy people

- **Java cache for applications on consoles**
  - **Problem:** Applications started via CCM may use older jar versions from the local cache
  - **Performed action:** Provided context menu to **completely clean** the local Java cache
  - **Planned action:** Validate with **the latest Java** version installed in January 2010
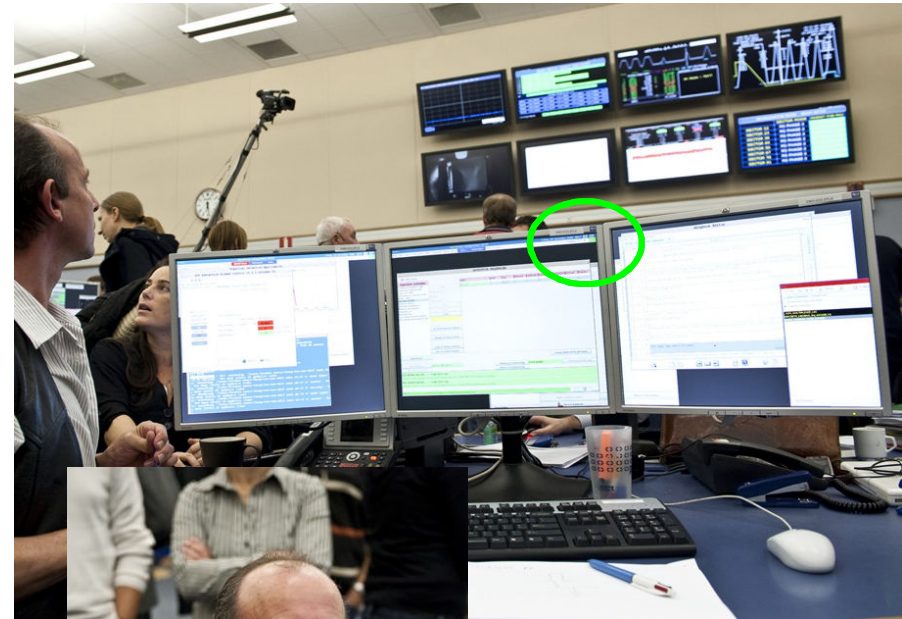
CMW – Unstable Proxies
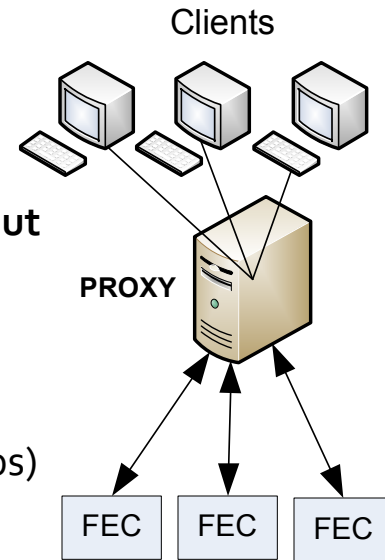
Clients

- **Problem description**
  - Under high load Proxy **did not respond** promptly to a calling client
  - Client used to interpret it as Proxy being **down** or **unreachable** or **timeout**
  - Observed particulary when setting up new subscriptions
    - E.g. in Fixed Displays applications (e.g. LHC Page1)
- **Performed actions**
  - Performed several iterations to solve the problem (with OP & eqp. groups)
  - Improved significantly level of **concurrent processing** in Proxy
  - Increased the **client timeout** for RDA calls
  - Added dedicated **diagnostics** to monitor current client connections
  - **Validated new Proxy** during the dry-run of 13th Jan. on selected BI front-ends (BTV, BCT)
- **Planned actions**
  - Provide **statistics of traffic** in order to detect early the overloaded Proxies
  - Integration of statistics/diagnostics info with the **DIAMON** facilities

PROXY

FEC   FEC   FEC

CMW – Proxy Redirection

- **Problem description**
 - It was **not possible to mix** direct & Proxy connections from the same client application
  - Proxy redirection was *"all or nothing"*
    - Either all via **the same Proxy** or all connect **directly**
- **Performed actions**
  - **New centralized** architecture for Proxy resolution
    - New CMW-RDA (C++ 2.8.9 & Java 2.8.5) released on 07.01.2010
  - Now **possible to mix** direct & Proxy connections from the same client application
  - Redirection granularity set on **front-end server** level
  - Proxy configuration is **database driven** (Configuration DB)
    - If proxy defined for a given front-end server, by default all client connections go via this Proxy
  - Experts **can force** old behavior via system properties
- **Planned actions**
  - New **expert** feature: **disable Proxy handling** for selected front-end servers directly from the expert application (requested by BI)
  - Contact eqp. groups and **configure Proxy redirection** for their front-end servers
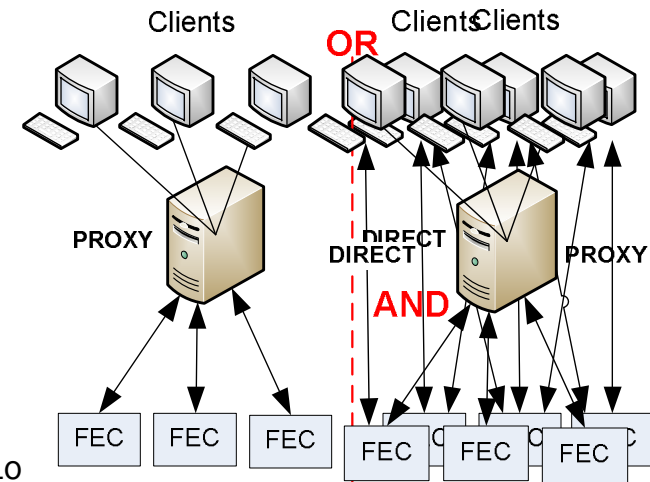
CMW – Unreliable Subscriptions

- **Problem description**
  - **Disconnected** subscriptions caused **loss of important data**
  - Observed in several **critical systems**: BLM concentrators, BCT, RF
  - Problem was also impacted by some **faulty** network switches
- **Performed actions**
  - **Significant troubleshooting** and investigation to locate the cause of the problem
  - Identified faulty network switches **were replaced**
  - Identified CMW timeout was **too short** for the front-end servers to process the notifications
    - Increased CMW timeout to 4 seconds to give **more time** to server **to push the notifications**
    - **Reduced** the subscription disconnections & drastically improved the situation
  - Identified the **configuration parameters** (CORBA) which were impacting the performance
    - New set of CORBA configuration parameters **were deployed** on the front-end side
  - The major clients (BLM,BCT, …) **highly appreciated** the efforts & final outcome

# FESA – Crashing Front-End Servers

- **Problem description**
  - Front-end server was occasionally **crashing** in several situations
    - **Many clients** were **directly subscribed** to a front-end publishing data with a high rate
    - At the front-end **start-up** time when many clients were **re-establishing** the subscriptions
  - Observed several times for **RF FESA** servers
- **Performed actions**
  - FESA team investigated the issue and managed to locate the cause of the problem
  - The bug was fixed and released as a patch to FESA 2.10 on 14.01.2010
  - The **new fixed** FESA version was validated together with the RF team
    - RF front-end server was stressed with many clients connected and publishing rate 10 times higher than in operational mode
    - Front-end was restarted to test the behavior at the **start-up time**
 - **Stability** of the FESA servers **was improved**

RBAC – introduction of STRICT policy

- **From March 2009 ongoing campaign to introduce STRICT policy in LHC**
  - **Several dry runs** and tests in collaboration with OP & equipment groups
  - End July 2009: default RBAC policy for LHC => STRICT
    - RBAC token **mandatory**
    - Protection of **SET operations** on properties
  - Main goal for the start-up => **STRICT mode everywhere**
  - All LHC applications and majority of equipment became **RBAC enabled**
  - **Already in STRICT**: PO, BI (BLM, BPM, BCT, BTV, …), BT, Collimators, BIS, QPS, most of RF
  - **TODO**: Rest of RF (~55 FECs), BI(2 FECs), PVSS-Cryo (~69 FECs), PVSS-Survey (10 FECs), IPOC (8 FECs)
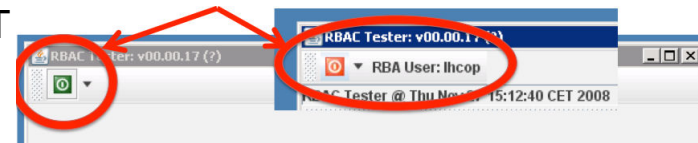
moreover …
- New RBAC **piquet ROLE** with Expiry Time
- Access maps dependent on the **Operational Mode**
- New Central CMW Configuration server
  - **Distribution** of the **Operational Mode and RBAC policy**
- **NEW!** Proxy extension: RBAC token for **get/set** comes from a client but for **monitor** Proxy token is used
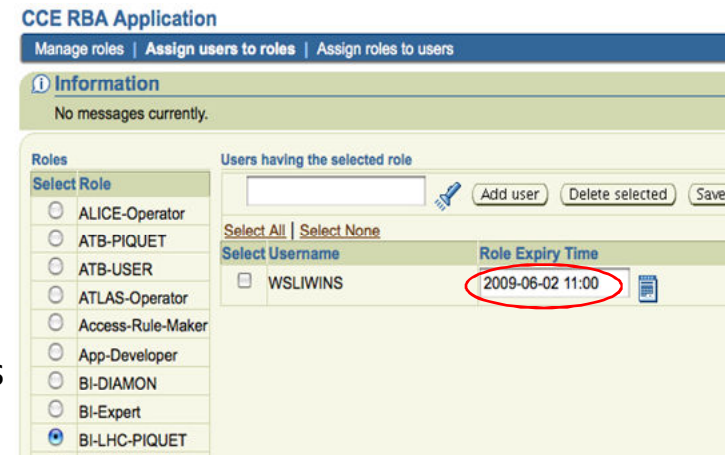
JMS – data publishing

- **Problem description**

  - Overloaded brokers **stopped publishing** the data
    - It was seen by BLM and Logging
  - Both brokers **CO** (TN) & **Public** (GPN) were on the same machine
  - **Too many** client connections => high CPU & memory usage
  - Machine (hardware) **was not able** to process all requests in a timely manner
- **Performed actions**
  - **Physical separation** => **CO** broker moved to a new 16 core machine, **Public** broker stayed on old machine
  - Brokers are constantly **monitored** for performance
- **Possible improvements**
  - Need to evaluate different broker configurations (Load Balancing & Hot Backup)
  - Usage of **dedicated brokers** for „*special"* clients e.g. for Concentrators
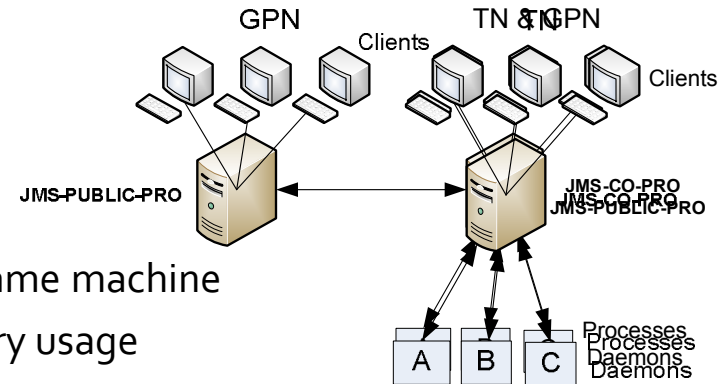
Improving BE-CO Development Process

- **Identified issues**
  - Poorly **coordinated** and **communicated** upgrades
  - Upgrades **break existing** controls software (side-effects, bugs)

- We cannot **freeze** the controls system and **stop** all our developments
  - Operations request new /enhanced functionality
  - Bug fixes

- Better development and deployment procedures
  - **Coordinated** development, testing and releases for the controls system core (FESA, CMW, RBAC, JAPC, LSA)
  - Changes must be **motivated**, **prioritized** and **traced** in **JIRA**
    - Cooperation of the clients (OP, eqp. specialists) is essential for this
  - **Testbed** to validate Control System **core**
  - Rules and tools to manage **dependencies** and guarantee **backward compatibility**

- To be presented soon in the BE-CO Technical Committee

Summary

- Overall, the Controls system was stable and performed reliably during the LHC start-up and commissioning

- During operations certain shortcomings were identified in the Controls infrastructure which were thoroughly followed-up and solutions were rapidly applied

- In 2010 the emphasis will be on:
  - Consolidate the communications infrastructure to withstand reliably the load
  - Push for the remaining equipment to go to the RBAC STRICT policy
  - Develop and deploy a solid development and release process across the whole Controls infrastructure

DIAMON – inconsistent host status info.

- **Problem description**
  - State of a host displayed as **correct** (green) but sometimes one of the servers (running on that host) is in an **error state** (red)

- **Planned actions**
  - **Known bug**: after **searching** for a host, host state **does not change** even if one of the server processes goes down (host status should become also red)

LHC ALARMS – Known Issues

- **Problem description**
  - Flooding of the Alarm screen with **hundreads** of alarms (many not relevant to Operations)
  - OP are **not looking** to the Alarm screen when there is a **problem**

- **Planned Actions**
  - A **new** LASER **admin tool** to aid OP to manage the **configuration** of alarm categories (PC alarms) is under development by CO for 2010
  - **Clean-up** unnecessary alarms