

SOFTWARE PACKAGES

Status and commissioning plans

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Software during LSI : a large working site



➤ 3 years of LHC operation

Evian 2012:

beam based systems, what we want.

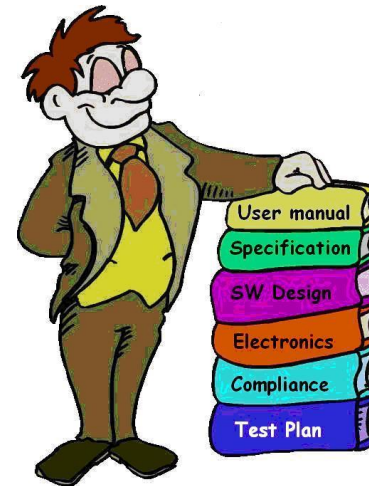
- issues or limitations discovered
- new requirements from operational experience
- Short technical stops : Issues and requests addressed not necessary in the cleanest way
 - Short time for the implementation
 - Only non-breaking changes allowed
- Outside CERN the software world is moving fast

➤ Long shut-down: enough time for major upgrade

- Catch-up on major third party libraries
- Non backward compatible modifications are allowed
 - Clean-up, implementation of new functionality
 - Implementation of the necessary adaption from the users

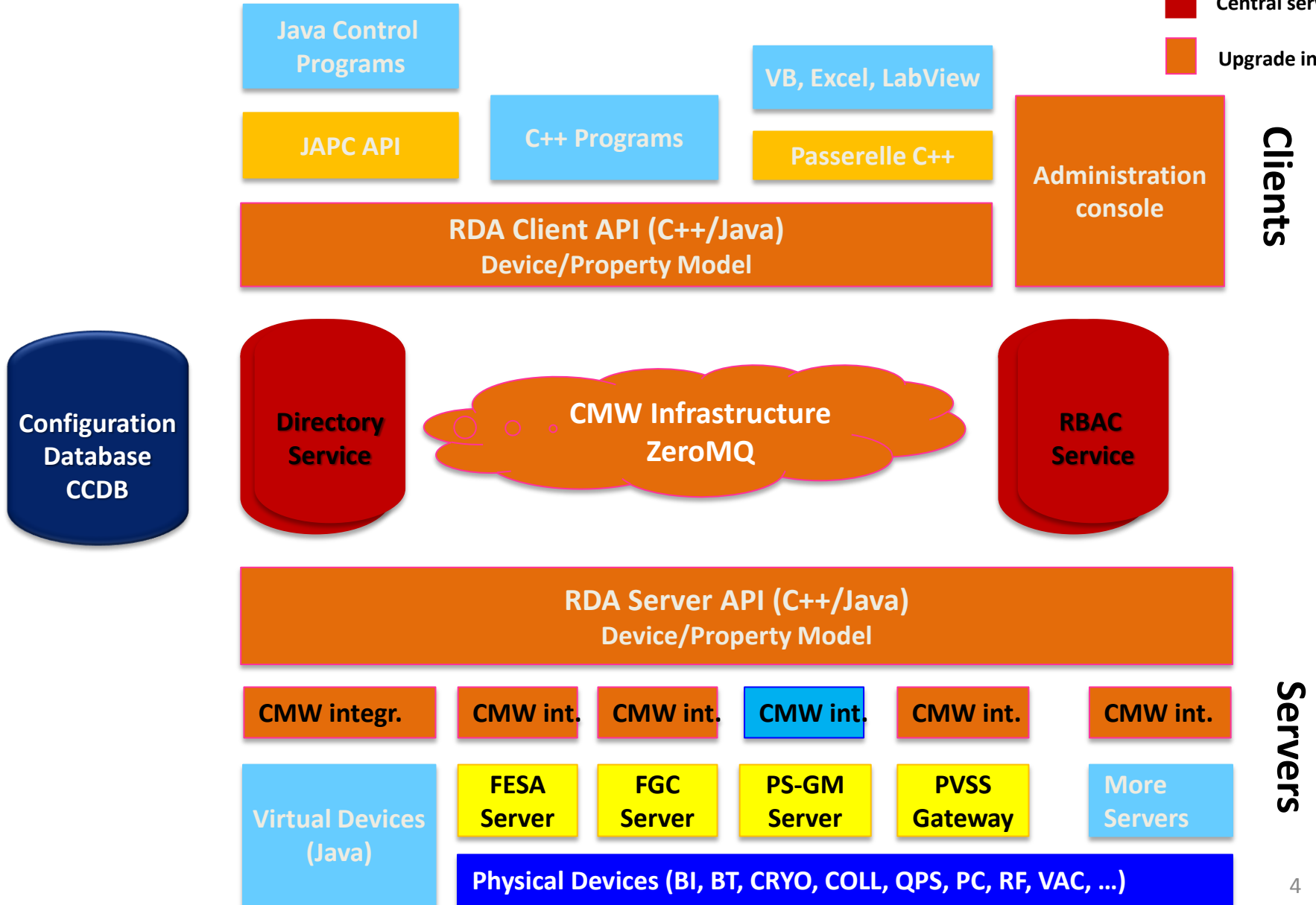
Scope

- What is happening in the control side during LS1
 - Major upgrade of core systems
 - Ameliorations, new functionality of operational applications
 - New projects
- ➡ No time to mention in detail all the LS1 controls activities



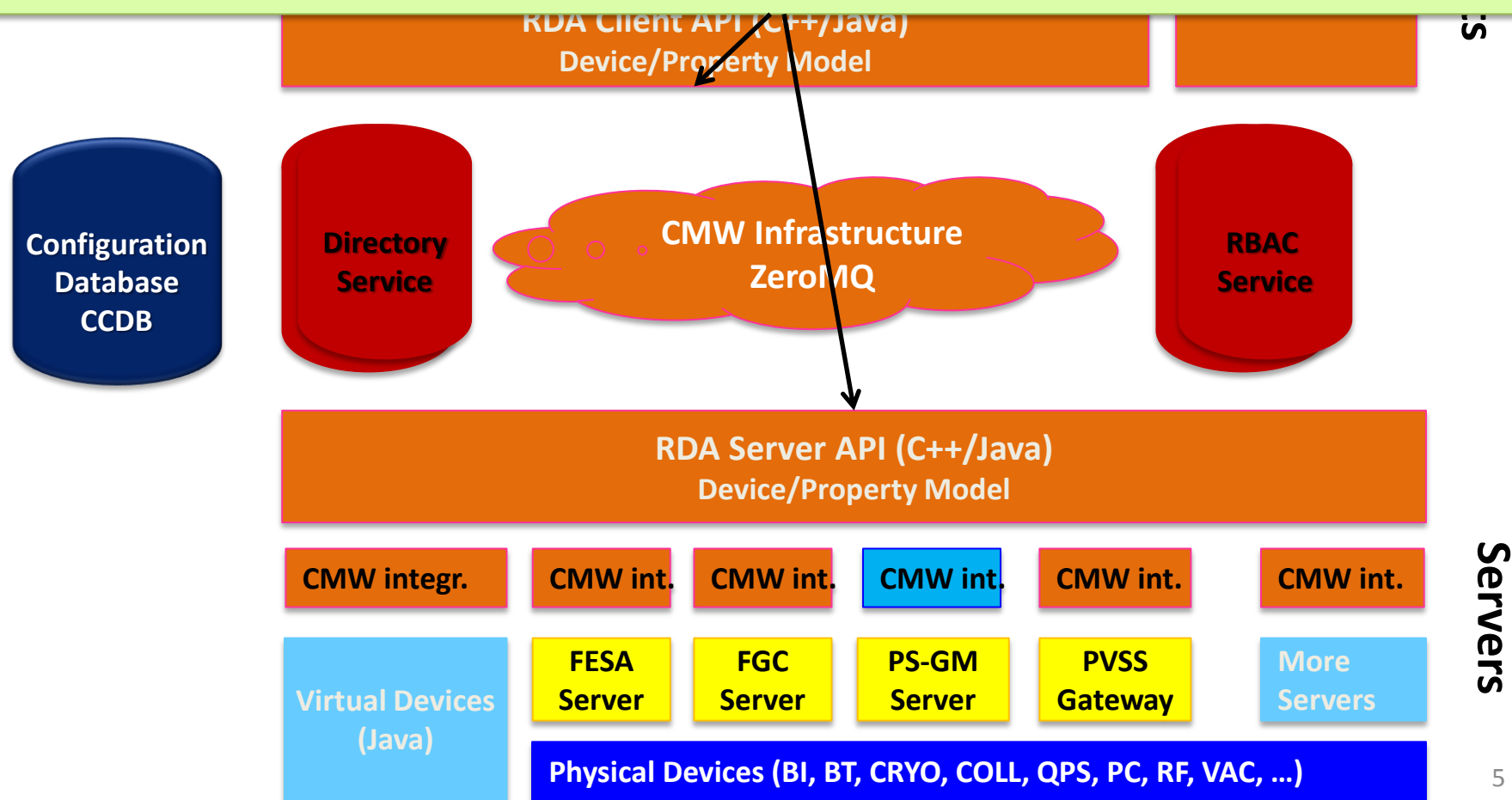
CMW upgrade

- User written
- Middleware
- Central services
- Upgrade in LS1



RDA renovation (RDA2 → RDA3):

- Functional limitations seen during operation : impossible to improve with current implementation (management of bad clients, client number scalability, lack of flexibility for new development)
- RDA3 include new requirements:
 - priority system for the clients
 - improvement of the subscription mechanism
 - new data structure supported (i.e. nDim array)



CMW upgrade: current status

- RDA3 deployed in operation for FGCD gateway in PSB & Linac2, soon in CPS
- June 2014: release of FESA3 v. 2.0.0 with RDA3
- RDA2 will be maintained until LS2

Responsible : W.Sliwinski

web site <https://wikis.cern.ch/display/MW/CMW++Controls+Middleware>

FESA 3

- **Main technical motivation:** FESA3 supports multicore CPU. First version was available on 07/2013
- **All known important issues solved**
- **Status**
 - Many critical systems are planned to restart with FESA3 (i.e. QPS, Cryo, Collimators, kickers, power converters...) and have started the migration
 - Some stay with FESA 2 and will do the migration later (i.e. BIS, most of the BI and RF systems)
- **FESA2 will be supported until end of 2015**

Responsible : S.Deghaye

web site <https://wikis.cern.ch/display/FESA3/Home>

LSA refactoring : Motivations

- With operational experience, many new requirements and fixes have been implemented on top of the first design
- LSA extended (INCA) to PS complex to renovate their control system



- API complexity increased, difficult to stay flexible and add new functionality
- Clean-up and refactoring needed!

LSA refactoring : what has changed?

- Simplification of the software structure
reduction of the number of modules
- Services API : organized in a more coherent way, less exposed methods
- Common concepts have been factored out to a generic package, to facilitate reuse (i.e. Introduction of common domain objects)



LSA refactoring : consequences

- LSA will be easier to maintain and to extend
- All software using LSA needs to be adapted to the new API
 - not a trivial and simple task, quite time consuming
 - Wiki provided by LSA team with full documentation
 - <https://wikis/display/LSA/LSI+refactoring+of+client+controllers+and+Domain+objects>

LSA refactoring : status

- New LSA version released as pro in March 2014
- Most of the operational applications have been released with new LSA version
- LSA core is now being tested and debugged with the injector start-up and the LHC dry runs

LSA/INCA support

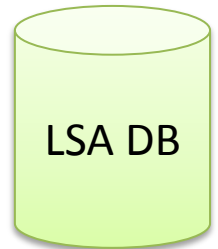
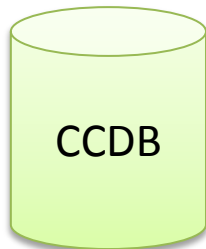
- The same team supports LSA/INCA on 8 machines (support for operation and for developers)
- Requests are addressed in order of priority as **all requests cannot be satisfied at once**
- **OP has to help define the priorities**



LSA Database

- Performance problems in 2011/2012 with access of LSA settings
Evian 2012:
« beam based systems, what we want »
- Actions during LSI
 - Replacement of the hardware : new CPU, new disk, much bigger DB cache: **faster access to the data**
 - Cleaning of the data
 - Keep only **the last operational settings** (p/p, Pb/Pb and Pb/p)
 - Read only LSA database with frozen settings on April 2013. Not converted to the new LSA design, old version of LSA software available to access the data.

Devices and properties configuration



New classes
New, renamed devices
New renamed properties
Migration FESA2 → FESA3

New devices or backward compatible changes :

- straight-forward, automatic process under development

Non backward compatible changes with setting to keep:

- Migration map needed
- Not immediate process, several iteration may be needed

Procedures: <https://wikis/display/config/User+info>

Renovation of LHC central timing

- **Hardware and software upgrade** (simpler design with a single front-end, Linux SLC5, FESA3)

LHC Central
Timing

New protocol for injection request

CBCM

- Solves the dynamic destination issue
- Simpler, secure and more flexible, allows to inject later in the SPS

➤ Status

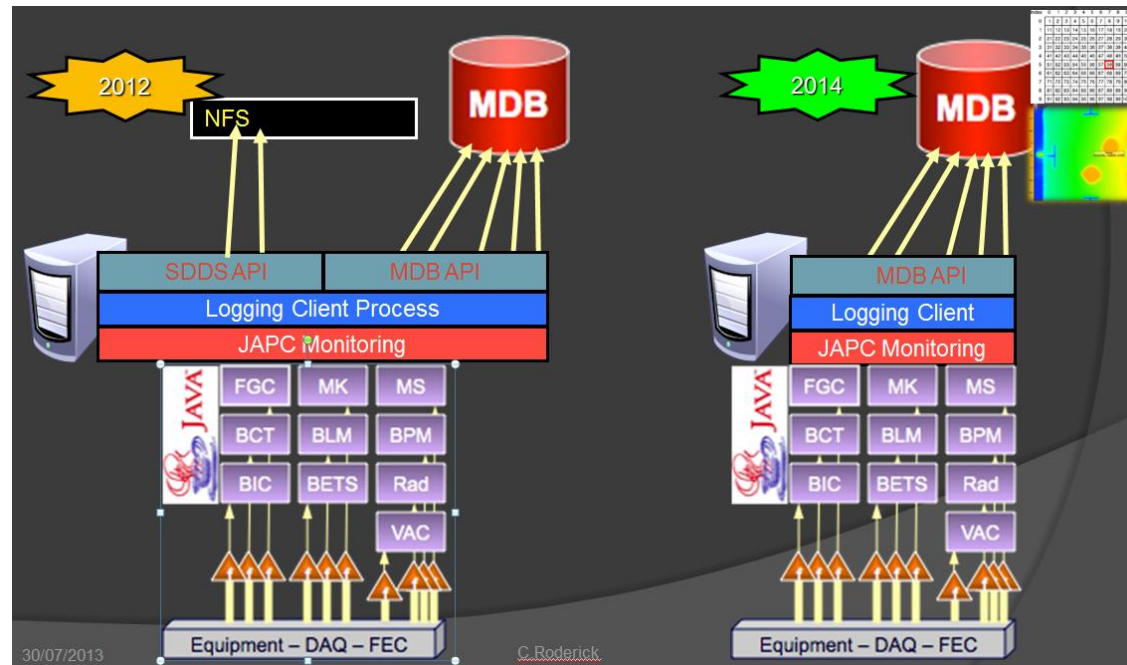
- New protocol ready in CBCM, to be implemented in LHC CT
- The deployment of the LHC central timing is foreseen **the 27th of October** to be ready for the LHC dry run scheduled the first week of November.

Responsible : J.C. Bau

web site <https://wikis.cern.ch/display/HT/Timing+Software>

Logging : SDDS eradication

For simplification and maintainability reasons: SDDS logging replaced by full Parameter Logging in the Measurement & Logging databases



STATUS

- Parameter Logging is fully operational : configured for ~8000 devices
- **SDDS based logging service disabled**
 - Old SDDS data can be transferred to Logging database **on request**

Responsible : J. Wozniak

web site <https://wikis.cern.ch/display/CALS/CERN+Accelerator+Logging+Service>

Diamon

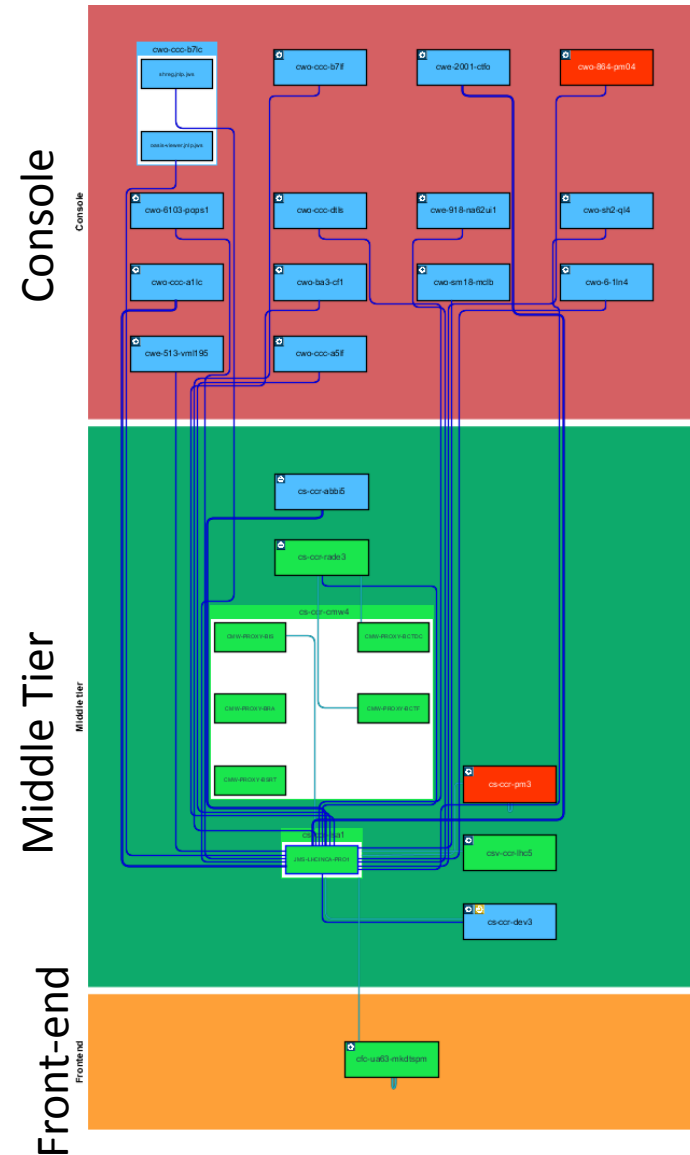
- **Recurrent complaint:** difficult to get the real status of a process or front-end
- **Software improved during LSI, but configuration effort needed** (OP, front end resp in equ. groups)
 - Limits adjustment now possible from the GUI (CPU load, memory, temperature)
 - Any problem has to be reported by OP for correction
 - Missing detection and control points to be added by developers
 - **During cold check out** : make sure the configuration is correct for all servers before the start-up

Connection viewer

➤ New application that complements diamon information

- Dynamically retrieve and visualize dependencies between CO processes
- Great help for diagnostic
- Web site with demo:

<https://wikis/display/ACET/ACET+Connections+Viewer>



Courtesy Gergo Horanyi

Alarms

➤ Not usable mainly due to configuration problem

- To many alarms sent from the equipment
- Configuration by beam mode available but not used

➤ Strategy for the start-up

- Remove **all alarms** from LHC OP configuration
- OP with the equipment's responsible and the LASER team :
select **useful alarms** and add them to the configuration

Online model project

- Taken over by ABP
 - Aperture measurement application will be reviewed for November
 - Many ideas of different tools useful for machine setup and model improvements
 - Requirement, needs and priorities have to be reviewed, and resources gathered

- Knob and optic upload part are taken over by OP

Knobs and optics upload

- **The optics uploader have been rewritten :**
 - PERL script replaced by a java API for optic and elements upload in LSA
 - user Interfaces to compare MADX and LSA optics and elements
 - Same application can be used in injectors

- **New Knob application**
 - based on the two existing applications
 - Include new functionality to facilitate the management of knobs (i.e. add or remove components from a knob)



Heat load display

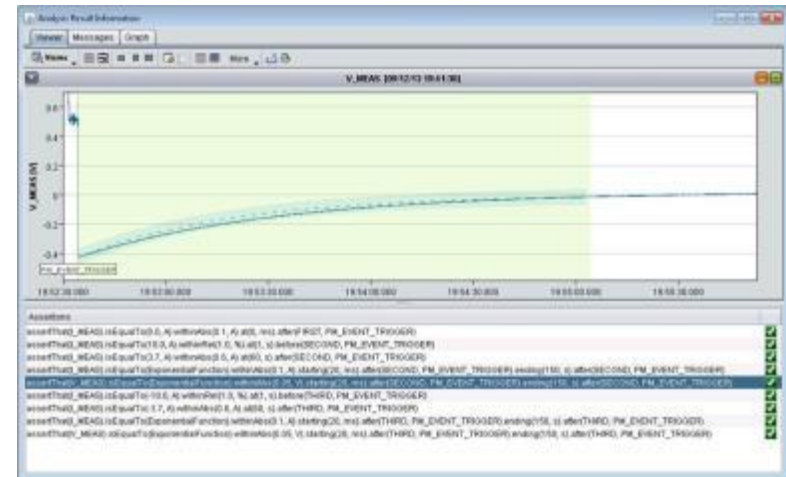
- Heat load : concern for operation at 25ns
- Heat load monitoring will help maximising the scrubbing efficiency
- **New cryo heat load display is under development**
 - Data extracted from the logging DB and heat load computed
 - Timber used for the display for the moment
 - Fixed display in the control room based on timber data will be developed for the start-up
- **bu/bu energy loss measurement from RF phase** : development to start soon



New features on ACCTEST (Accelerator Test framework) –HWC tests

➤ Automatic test analysis based on Java DSL directly in Acctestng

- All sequence + analysis steps for HWC of 60A and I20A circuits will be fully automated (need expert only in case of doubt or problem)
- Gradually automated analysis will be extended to more complex circuits
- Time + dependability gained for HW commissioning



Output of automated test for 60A orbit corrector

- ## ➤ New analysis modules are conceived in generic way to run systematically after any circuit failure, not only on predefined current cycles as used for HWC
- Circuits checked regularly during beam operation
 - Higher chance of timely discovery of problems!

Logging Data Extraction API renovation

- API used by Timber application (+115 custom user apps)
- **Refactoring and cleaning** done during LSI
(previous API had evolved over 10 years)
- Paving the way for **adding new functionality**, particularly in the area of data analysis:
 - **Extraction from multiple sources** : logging, LSA settings, logbook, post mortem, new PVSS DBs...
 - Possibility to store analysis results related to events in the past
 - Increased data aggregation and alignment options
 - Extracting data based on other signals
 - Data value distribution analysis and histograms
 - Extraction of vector elements over time as time series



Under Development
Please check back later

Accelerator Statistics & Data Analysis

➤ Coherent and maintainable solution for accelerator statistics

- Common implementation for all accelerators
- new interactive Web interface with accelerator statistics displays (replacing current statistic web pages for LHC, SPS, and PS Complex)

➤ Status

- Accelerator Statistics are on track
 - PSB data is being collected
 - Data specifications are on-going for other machines
 - Web interface development will start in July
- General Data analysis:
 - Requirements are foreseen to be integrated into Logging Extraction API (previous slide), **further input is welcome**

Responsible : C.Roderick

web site: <https://wikis.cern.ch/display/DAS>

Accelerator Fault Tracking

➤ Actual system (mainly logbook and PM)

- Tools allow only partial fault tracking (first fault and dump only)
- No common rules inside OP and in equipment groups for the fault definition

➔ Fault analysis difficult and incomplete

EVIAN 2012 : 2012 AVAILABILITY (B.TODD)



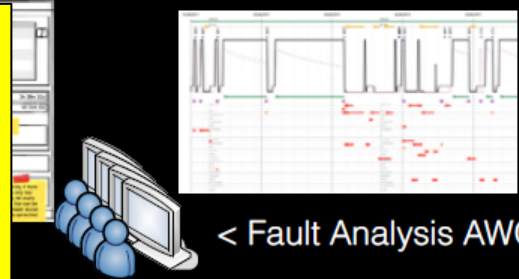
➤ New Accelerator Fault Tracking project

- Common solution for all accelerators
- Automate as much as possible (link with Post mortem, logging and logbook)
- Functionality to highlight inconsistencies or missing information
- Will greatly facilitate fault follow-up, update, and analysis
- **Someone still needs to take responsibility for data completion**

Fault Tracking : Status

Prototype database

Data from previous years uploaded from the logbook



< Analysis Persistence >

Extraction API

ORACLE
AFT

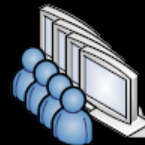
ORACLE
PM

ORACLE
MDB

ORACLE
LDB

ORACLE
E-Logbook

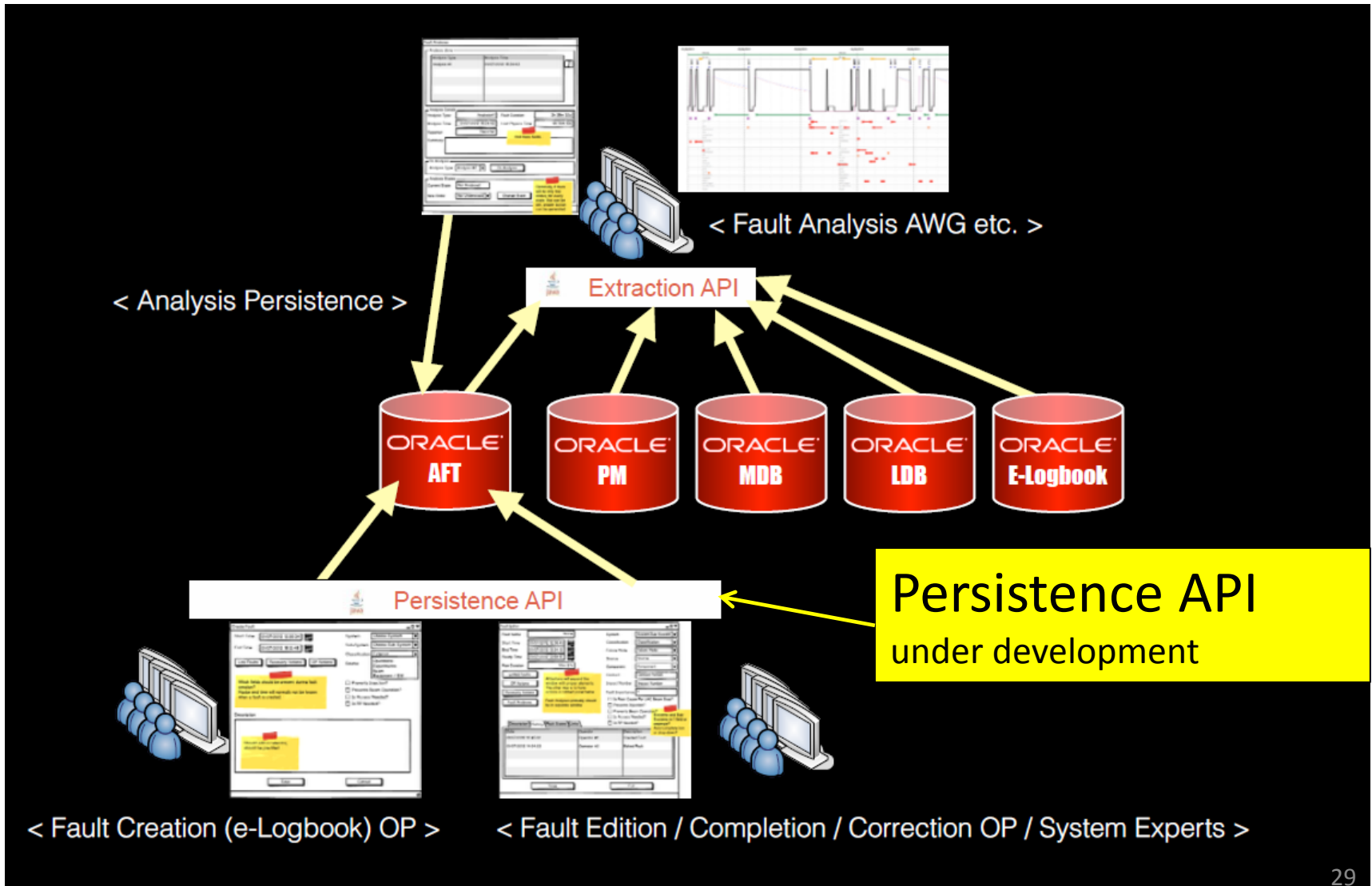
Persistence API



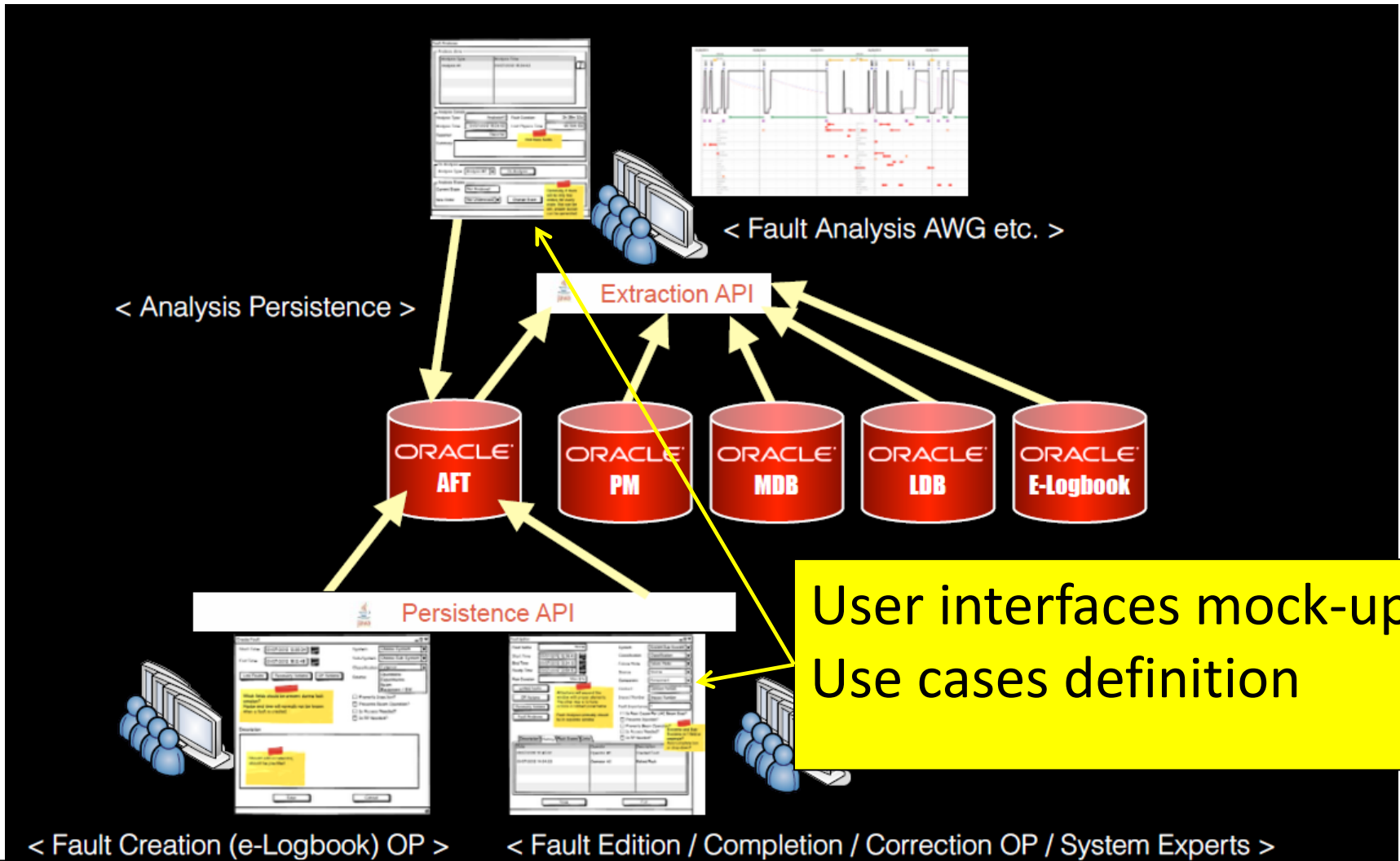
< Fault Creation (e-Logbook) OP >

< Fault Edition / Completion / Correction OP / System Experts >

Fault Tracking : Status



Fault Tracking : Status



Web site : <https://wikis.cern.ch/display/AFT>

Courtesy Chris Roderick

Other useful information

- **Post mortem** : New version of PM client library based on RDA3 is ready
- **BIS**: refactoring & cleaning + new cycle GUI for fast cycling machines, will include gradually functionalities from Jorg's applications + new requests (hidden interlocks, ...)
 - **Power converter interlock GUI** : new reference system with tolerances based on functions
 - **New orbit reference system**: automatic configuration will be implemented
 - **Console manager** : new GUI for menu configuration, mode dependent display of the applications for the start-up
 - **Sequencer** : cleaning of the sequences and tasks, sub-sequence with parameters implemented
 - **A process for automatic start of the abort gap cleaning** will be developed

Conclusion

- Developers have been very busy during LSI, **a lot has changed at every software layer**
- The core software that is common to the accelerator complex will be largely tested and debugged with the injector start-up
- LHC dry-run that already started will track as much bugs and issues as possible well before the start-up
- Still a lot to do in the coming months, but no major problem anticipated!



Reserved slides

Interlocks

- **BIS**

- Refactoring mainly for code cleaning
- BIS GUI will be extended to include the views developed by Jorg and little by little all their functionality like group masking, hidden interlocks etc...

- **SIS**

- RBAC protection added
- New simpler language for the configuration (DSL), but xml can still be used
- Development of the user documentation (<https://wikis/display/SIS/User+Manual>)
- New hardware more powerful for LHC&SPS instances.

Power converter interlock GUI



Fixed tolerance not flexible enough

- Replace by tolerance function parameters
- Makerules and value generator to be defined



Later extend to other power converters.

Console manager: new features

- **New easy tool for menu configuration** will be developed for end of 2014
- **Automatic update** of the console manager in all consoles will be ready this summer
- **Hide or show fixed display according to beam mode:** will be ready for next start-up

YASP: reference orbit management

Reference
orbit

base reference orbit

from measurements and corrections with all separation and crossing bumps to 0



Overlays

theoretical beam position calculated by JMAD from active optic and crossing and separation bumps value

YASP: reference orbit management

- **For each beam process** : manual preparation of the reference orbits
- Will become laborious if we have ramp and squeeze or collide and squeeze beam processes
- **New reference system will be implemented**
 - Automatic reference generation using LSA settings (separation and crossing bump, optics) and JMAD
 - Should be ready for the start-up

Post Mortem

- New version is ready, adapted for RDA3. Old version still available. Transparent for users.
- Adaptation of the analysis modules to the new format of data sent by some equipment (BLM + QPS that goes to standard PM format instead of binary files).