"WHAT YOU GET" – CONTROLS SOFTWARE,

S. Jensen on behalf of BE-CO, CERN, Geneva, Switzerland

Abstract

The control system is ready for running the LHC at increased intensity at 6.5TeV and 25ns bunch spacing. Still, BE-CO will carry out a range of activities during LS1 for adding functionality and to further improve performance and availability of the controls system while meeting required security standards. This paper presents those BE-CO activities foreseen for LS1, which will have a direct or indirect impact on LHC operation.

INFRASTRUCTURE IMPROVEMENTS

A large scale renovation of low-level hardware and software will be carried out during LS1 both in LHC and the Injectors:

- LHC: 500+ CPU upgrades towards multi-core CPUs, Linux and 64 bits.
- Injectors (ACCOR project): Upgrades of some 350 CPUs, the timing system and a range of electronic modules.

In addition, a new version of FESA will be released providing:

- Support for multi-core CPUs.
- Improved thread priority management.
- Inheritance.

Comments have been reported concerning the "FESA Navigator" tool relating to its usability and functionality for OP. While this tool was intended for use by system experts, i.e. FESA class developers, BE-CO recognizes that it has become a useful tool for operators as well. The FESA Navigator tool and its usage will be reviewed during LS1 in collaboration with BI.

A new major rewrite of the middleware will be released, improving amongst others the handling of slow clients (non-blocking communication).

Finally, BE-CO will – in collaboration with BI and BE-OP – carry out a technical review of the orbit feedback system (OFSU).

BETTER DEVELOPMENT ENVIRONMENT

The following development environment improvements will be provided:

- Faster virtual machines.
- Better development platforms. BE-CO will review the development platform situation and determine whether virtual machines or office machines are preferable. In the future, almost all development shall be done on the GPN and only final validation shall be done in the TN.
- A unified commonbuild system for Java and C++ will be put in place, offering improved functionality and maintainability.
- All core software will be submitted to a rigorous Testbed system, including CMW, FESA, Timing and LSA.
- Better documentation will be put in place providing amongst others developer guidelines, quality assurance instructions and software API descriptions.
- A BE-optimized version of the Eclipse development environment is in place and ready for use.

IMPROVED CCC ERGONOMICS

- All consoles will be upgraded to more powerful machines.
- A review in 2013 will be carried out in order to determine how to improve ergonomics in the CCC. Current proposals include:
  - More mobile keyboards/mice to avoid cable cluttering.
  - Wireless phone headsets to keep hands free.
  - Review monitor size and orientation for better usability.
- Common Console Manager major rewrite.
  - A review of the CCM will be organized in order to formalize requirements.

TIMING

In addition to moving the central timing system from LynxOS to Linux, a number of reported issues will be addressed, including:

- "Time lost when requesting mastership and changing sequence" - this issue goes beyond timing and relates to PS/PSB operation as well. The situation will be reviewed, also in order to collect formal OP requirements to optimizing the Cycle Editor GUI.
- "Injection into wrong ring" (SPS timing)
  - A proposal involving changes in Timing and uses of SIS have been approved by the Machine Protection Working group and will be implemented.

A general timing review will be carried out, and this is the occasion for stating any new requirements. The Injector timing system will be renovated via the openCBCM project.

IMPROVED LSA PERFORMANCE

Concerning the regeneration of settings being too slow, this will be addressed in a number of ways:

- OP will clean up settings, i.e. reduce the number of settings to regenerate.
- CO will provide faster computers with more RAM.
- CO will provide a smarter implementation, regenerating only the settings that have changed.
- CO will provide tools to simplify the cleaning up of settings, based on OP input.

Additional LSA operations can be RBAC-protected as requested by OP.

DATA ANALYSIS

These activities were triggered by the Evian 2011 workshop, with two main work items:

- The Logging service will be improved as follows:
  - Accepting more data and data types, e.g. Bunch-by-Bunch, QPS, LHC wirescans, Statistics.
  - Month-long storage will be supported, based on a concept of data-owners who must be assigned by OP.
  - Data owners will be responsible for permitting deletion of data.
- Concerning the analysis framework:
  - A generic framework for data analysis and visualization (e.g. run statistics) will be provided.
  - The framework will be integrated with a wider range of data sources such as Post-Mortem and the eLogBook.

These solutions should facilitate minimizing ad-hoc solutions and use of SDDS. The implementation depends on continued strong collaborations with OP (A. McPherson).

SEQUENCER FUNCTIONALITY

The Sequencer functionality will be extended as follows:

- Parameterized (sub-) sequences.
- Parallelizable sub-sequences.
- Increased integration with the State Machine. Further clarification with OP is needed.
- The GUI which occasionally freezes is under active investigation. Currently, XWindows seems to be the cause, not the Java source code.

Also, the State Machine may see improvements based on further discussions with OP. Current ideas include:

- Checks can depend on cycle type, i.e. nominal vs. MD.
- Checks can be categorized as “Blocking” vs. “Performance”.

INCREASED FLEXIBILITY FOR ALARMS DEFINITION

A new implementation of LASER will offer:

- Mode-dependent alarms.
- More OP influence concerning alarms declarations.

Current alarms will be migrated by the LASER team.

It is important to note that OP effort is essential in improving alarm quality.

New tools to assist clean-up of alarms will be provided and the LASER team will actively assist the clean-up.

ACCELERATOR CONTROLS EXPLOITATION TOOLS (ACET)

The ACET project is active and aims at improving the diagnostic facilities of the controls system in preparation of the new LHC-style exploitation model in injectors. Current areas of focus include:

- Visualization of services and their relations.
- Accessible and useful documentation.
- Centralized tracing analysis.
- FEC configuration feedback and analysis.
- Process instrumentation (metrics).
- Dependency analysis and visualization.

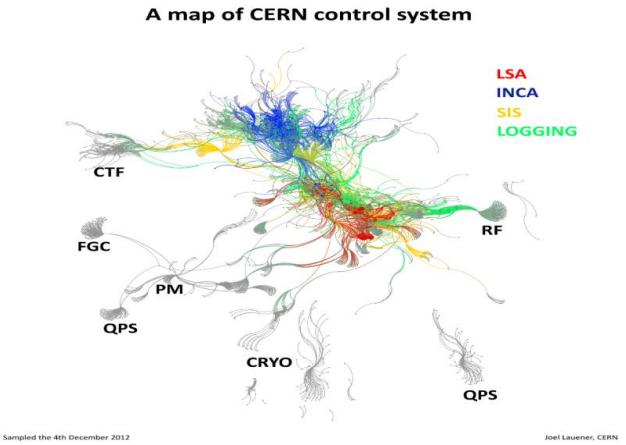

Figure 1: A view of control system dependencies.

BETTER EXPLOITATION

A number of steps will be taken to further facilitate rapid diagnostic and troubleshooting, including:

- DiaMon will become more user friendly and will provide more information and functionality, as follows:
  - A dependency view of the control system which shall help OP understand the structure of the controls system and facilitate troubleshooting.
  - OP can create custom views.
  - Easy mechanism for reporting wrong states displayed by DiaMon (feedback button).

    - More diagnostic data will be available such as dependencies, process metrics and configuration feedback.
- A pro-active exploitation approach will be taken with early detection of problems thanks to:
    - Process monitoring in DiaMon.
    - Configuration analysis.
    - Centralized trace analysis.
- Better contact information – up to date and available.

EASY ACCESS TO BETTER DOCUMENTATION

A portal will be implemented, as entry point for accessing various CO documentation, including:

- Developer guidelines.
- Useful links.
- Procedures relating to security, intervention, …
- Exploitation specific pages.
- Contact information (consistent with the OP "Web piquet" pages).

The portal can be adapted to OP needs.
In addition to the portal, the CO internal wiki structure will be improved by contribution from all major CO projects.

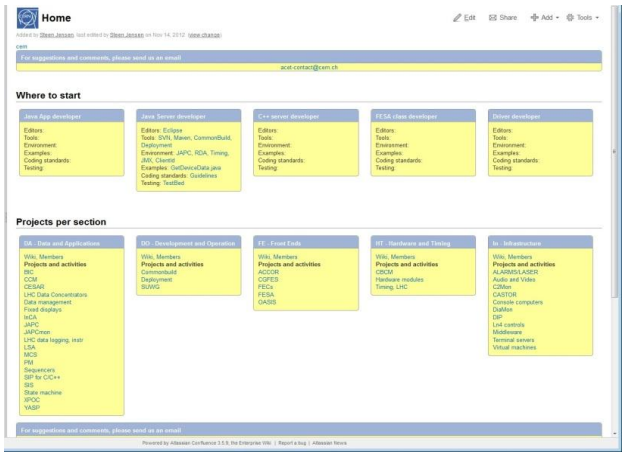

Figure 2: An example prototype page.

SMOOTH VERSUS RADICAL CHANGES

Since 2009, all high impact and importnat changes to the controls system have essentially been deferred to LS1. During Technical Stops, only backward-compatible changes with possible roll-back were implemented after careful planning and discussion in the sector-wide "Smooth Upgrades Working Group" (SUWG).

During LS1 radical, global and "big-bang" changes have to be carried out, with changes at all layers of the controls system (hardware, operating systems, Middleware, FESA3, Java and Oracle).

CO will thoroughly test software in the Controls Testbed and the core components will be validated in the Injectors, but it is important to state that OP-lead dry runs are vital for final validation.

In addition, tools for supporting smooth upgrades (showing what has changed and providing better roll-back) will be utilized.

CONCLUSIONS

- The control system is not energy/intensity dependent and therefore considered ready for 6.5TeV, 25ns and increased intensity.
- New development and consolidation work are planned both in hardware and software at all levels of the control system. Input and participation from OP is essential.
- The work planned for LS1 should bring extensive improvements and additional functionalities with evident amelioration in the availability and performance of the overall control system.
- Rigorous test procedures and tools are in place.
- OP-organized dry runs are essential.

CONTACT PERSONS

- CCM: V. Baggiolini
- Centralized tracing: S. Jensen
- CommonBuild: N. Stapley
- Data analysis: J. Wozniak, A. McPherson
- Dependency view: S. Jensen
- Development platforms: L. Gallerani
- DiaMon: M. Buttner
- Documentation portal: S. Jensen
- Eclipse: N. Stapley
- Ergonomics: P. Charrue
- FESA: S. Deghaye
- Hardware renovation: M. Vanden Eynden
- LASER: M. Buttner
- Logging: C. Roderick
- LSA/InCA: G. Kruk
- Middleware: W. Sliwinski
- Security: L. Gallerani
- Sequencer: R. Gorbonosov
- SIS: J. Wozniak
- Smooth upgrades: V. Baggiolini
- State machine: R. Gorbonosov
- Timing: J.-C. Bau
- Testbed: J. N. Xuan
- Virtual machines: L. Gallerani