10th LHC Operations "Evian" Workshop: Systems Overview session

# **Controls changes overview**

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### Introduction

Controls has seen significant change throughout.

Wherever practical, it has been backwards compatible.

Based on workshop session chair requests, topics covered:

- Development tools
- GUI strategy
- Logging service
- Post-mortem service



# **Changes in controls**

### Control system must be:

- Fit for purpose
- Adaptable
- Reliable
- Robust

Drivers of change:

- Response to the evolving needs of operations / equipment experts
- Adapting to external technology changes
- Consolidating technical debt

### Some key values:

- User friendly
- Backwards compatible where possible
- External technology exposure managed
- Maintainable



### Always mindful:

Changes in controls can have a major impact across the sector



# **Development languages & tools**



LS2: Major migration from Java 8 to Java 11 (breaking change)

Scope: most applications and services from Run 2

Development modernisation:

- SVN to Git (and Gitlab)
- Devtools (CBNG 4) consolidation
- Acc-Java user meetings

Coordinated controls updates of third-party dependencies. Ready *very* early in the LS, offering stronger JAR compatibility.

> Response to feedback from <u>D. Jaquet & D. Cotte</u> <u>"BE-CO LS1 review: View from BE-OP"</u>



Smooth transition for operations

in 2021

# **Development languages & tools**





C. Roderick 9th LHC Evian Workshop

We've come a long way!

- Fully supported since 2019 in A&T sector
- Foundations, infrastructure and rationalisation
- Development of controls libraries adopted from across ATS  $\Upsilon$
- Creation of new controls libraries to meet user needs



P. Elson et al., Introducing Python as a supported language for accelerator controls, ICALEPCS'21



# Python apps in operations

An example is Linac4 Source Autopilot\*:

- Python GUI based on PyQt
- UCAP processing in Python

	Linac4 Source GUI		
NAP (Autopilot) Window Help			
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**Regular Acc-Py user meetings** 

Over 400 users across the sector in 2021



Further examples: LEIR Console GUIs

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### **Deployment tools**

**2019**: Python app launch temperamental

**2020**: Provision of app deployment tool: common approach, integrated into Console Manager, robust startup

\* Collaboration between BE-APB & BE-CSS



# **GUI Strategy**

Number of applications  $\uparrow$  (*well* over 500), and accelerating

Each application needs to be adapted to change manually (potentially during operation)

Technology evolving at increased pace



### Goal:

Minimise the total maintenance cost of applications across the sector.





Strategy:

Reduce the *number* and *complexity* of manually maintained applications as much as possible.



--> Reduced maintenance cost



# **GUI Strategy: Application platform**

### Key features:

- Integrated with Control System lifecycle, with automatic migrations
- Zero-code applications, shielding users from inevitable GUI change
- Leveraging UCAP for data processing

### Web Rapid Application Platform (WRAP):

- Centralisation is essential for maintainability
- Web being embraced at many labs (as seen at ICALEPCS'21)
- Improved recruitment prospects
- Working on this as quickly as possible

### WRAP over the next 12 months (and beyond):

App platform

Presentation config

Targeting the needs of a significant portion of the applications which are manually maintained today.





#### An early example of the application editor



# **GUI tools and strategy**

# Reduce the *number* and *complexity* of manually maintained applications as much as possible.

Still a need for bespoke (code-based) applications:



Applications will continue to need to be maintained and adapted manually

Landscape is evolving:

- WRAP (in development)
- FESA Navigator replacement (in development)
- Bespoke Applications

Stay informed through <u>GUI strategy user</u> meetings and <u>CTTB forums</u>

Let us know about your requirements: <u>acc-gui-support@cern.ch</u>



# Logging service: Motivation for change



(Industry standard "big data" platform)



# **NXCALS** interfaces

- Programmatic APIs in Java and Python
- 1.3PB migrated and validated. CALS switched off 2021
- User survey review:
  - Extraction performance
    - Significant improvement coming for recent (T-48h) data. Will require NXCALS update in YETS.
  - RBAC authentication
  - Data reduction (downsampling, on-demand logging)
- (new) Logged LSA settings





### Timber (rewritten as a web application) timber.cern.ch

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### Self-service configuration via <a href="https://ccde.cern.ch">ccde.cern.ch</a>







- Dual instances: Core PM & SPSQC
- Improved scalability of data collection
- Replacement of underlying storage
- Introduction of new Data API (REST)
- Backwards compatibility for PM analysis

### Challenging requirements

- Large volumes of data
- Must be processed quickly and reliably
- Difficult to fully test without beam



# Post-mortem refresh

### Outcomes of 2021

PM example from beam test 2021

- Validated during operations, incl. LHC beam test
- Identification and resolution of performance issues
- Unable to dump to both PM storage instances (as required for SPSQC & IQC)

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Injector Quality Check (from Y. Dutheil's talk) with incomplete analysis possibly due to the need for data in both instances (Core PM & SPSQC)

### Plans

- Addressing remaining issues identified in beam test
- Long-term storage of PM data on NXCALS
- Full offline analysis functionality (incl. Pre LS2)



# Software lifecycle management

External technology evolution is accelerating

More frequent releases, shorter lifetime (Java, Python, Linux OS, ...)

External releases don't necessarily align with the Run schedule/duration\_

Software end-of-life is an essential part of maintaining a healthy control system

### LS3 will be a major milestone for software end-of-life

- Linux CentOS7 officially end of life during Run 3:
  - FECs remain CC7 until end of run
  - Consoles and servers to be upgraded mid-Run
- Java upgrade ~2023

The longer the run, the more external change we will be exposed to.







A lot of change during LS2, huge effort and mostly backwards compatible.

Successfully validated by operations in 2021.

Change is essential, but can be disruptive. We try to mitigate impact as much as possible.

Regularly engaging with user communities to:

- Understand and follow-up on user needs
- Raise awareness of changes as early as possible

# We're looking forwards to a successful Run 3, and to continuing our fruitful collaborations throughout the sector!

