Selecting a Linux Operating System for CERN Accelerator Controls

THPDP064

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Changing the operating system (OS) for large heterogeneous infrastructures in the research domain is complex. It requires great effort to prepare, migrate and validate the common generic components, followed by the specific corner cases. The trigger to change OS mainly comes from Industry and is based on multiple factors, such as OS end-of-life and the associated lack of security updates, as well as hardware end-of-life and incompatibilities between new hardware and old OS. At the time of writing, the CERN Accelerator Controls computing infrastructure consists of 4000 heterogeneous systems (servers, consoles and real-time embedded computers) running CentOS 7. The effort to move to CentOS 7 was launched in 2014 and deployed operationally 2 years later. In 2022, a project was launched to select and prepare the next Linux OS for Controls servers and consoles.

Computing layers in CERN's Control System

Control Room Consoles (~620)

Virtual Machines for development (~900)

IN SCOPE RHEL 9

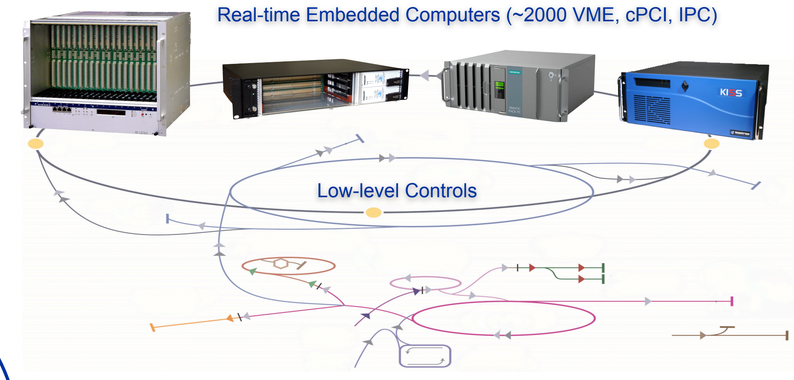
Bare-metal Servers (~600 Intel Quad, Supermicro)

openstack

Virtual Servers (~700)

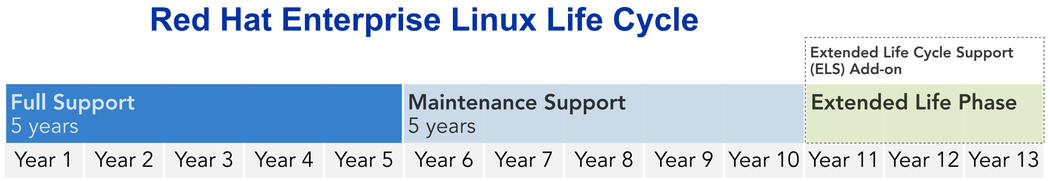
OUT OF SCOPE DEBIAN

Real-time Embedded Computers (~2000 VME, cPCI, IPC)



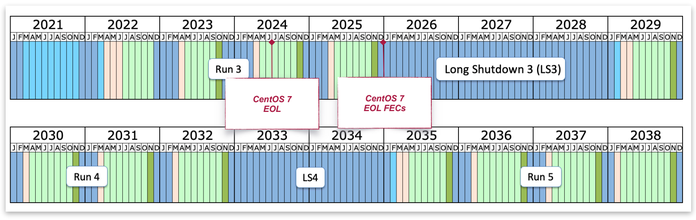
Factors driving the selection of the future Linux OS for Accelerator Controls

Red Hat Enterprise Linux Life Cycle

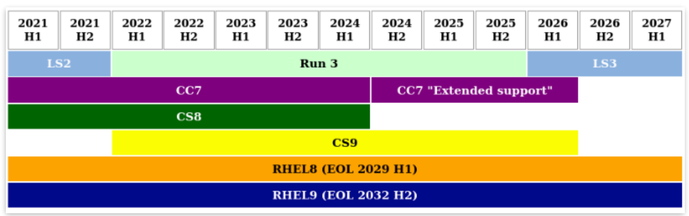


Hardware & OS Compatibility

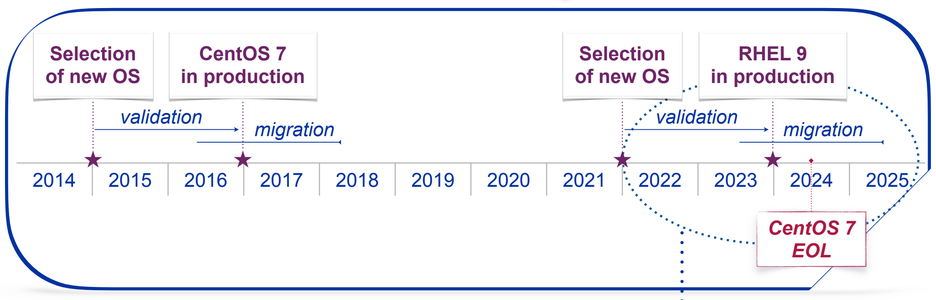
CERN Long-term Accelerator Schedule



CERN IT Future Linux Strategy



Linux OS Life Cycle



Evaluation Phase

Triggering factors
- *Microprocessor chipset deprecation*
- *OS end-of-support / end-of-life*
- *Security*

Additional decisive factors
- *OS Extended Life Cycle Support*
- *Support of Open Source Software Community*
- *Support of third-party industrial controls software solutions*

Constraints
- *Accelerators schedule*
- *Hardware procurement*

Integration & Validation Phase

Technical decisions
- *Adopt modern system administration practices*
- *Replace outdated in-house admin tools with standard solutions*
- *Provide automation infrastructure and tools*
- *Provide plain containerisation solution for legacy software*
- *Modernise process management*

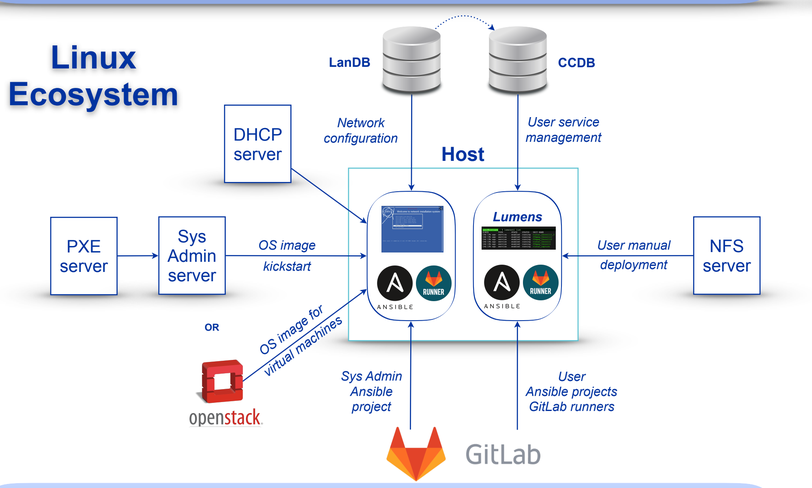
Key milestones at early stage
- *Provide stable testbed covering all categories*
- *Provide OpenStack cloud images*
- *Deploy CI/CD solution based on Ansible and GitLab*
- *Perform early pilot deployment in operation during the accelerators run*
- *Involve key users in the process*

Migration Phase

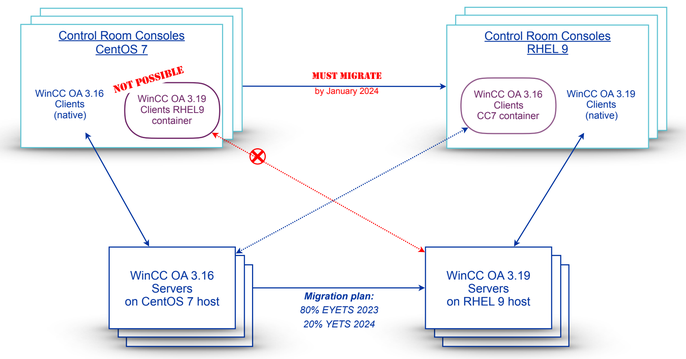
Important aspects covered during the inventory
- *Hardware upgrade necessity*
- *Network configuration*
- *Software configuration and deployment*
- *Services*
- *System availability and target migration period*
- *Migration, validation and rollback strategy*
- *Responsibilities and roles*

Migration optimisation during time-limited End-of-Year Technical Stop
- *Automate migration process*
- *Migrate legacy service management to new systemd solution beforehand*
- *Address large critical systems first, i.e. WinCC OA for industrial control*
- *Perform massive migration of platform-independent Java servers*
- *Pipeline the migration of multiple systems in parallel*
- *Tackle the specific time-consuming cases later*

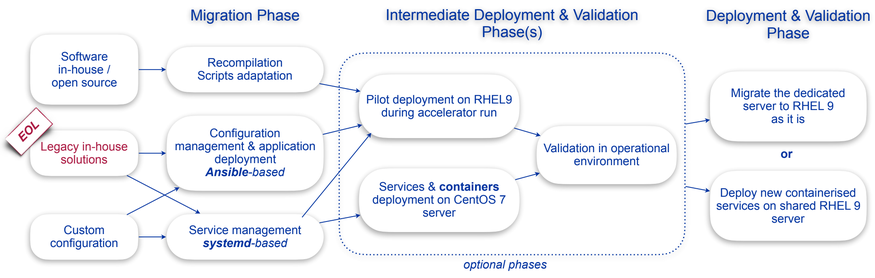
Linux Ecosystem



Transitional Solution for WinCC OA



Process

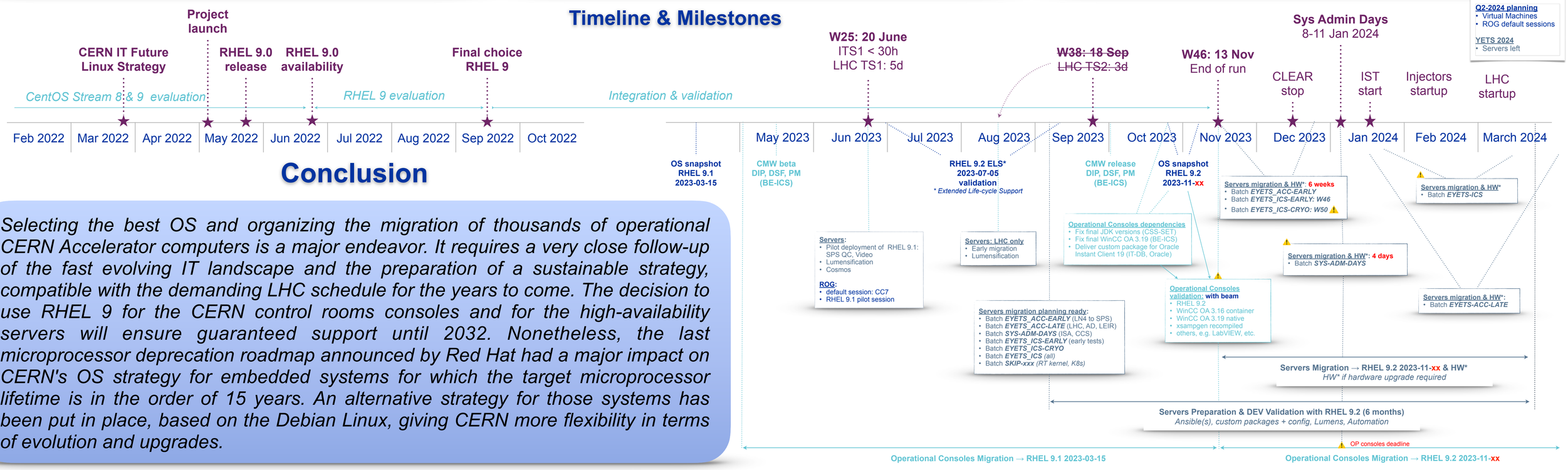


***Highlights**: hardware compatibility, long-term support*

***Highlights**: Ansible, GitLab, systemd, podman*

***Highlights**: automation, inventory, pipelining, planning*

Timeline & Milestones



Conclusion

Selecting the best OS and organizing the migration of thousands of operational CERN Accelerator computers is a major endeavor. It requires a very close follow-up of the fast evolving IT landscape and the preparation of a sustainable strategy, compatible with the demanding LHC schedule for the years to come. The decision to use RHEL 9 for the CERN control rooms consoles and for the high-availability servers will ensure guaranteed support until 2032. Nonetheless, the last microprocessor deprecation roadmap announced by Red Hat had a major impact on CERN's OS strategy for embedded systems for which the target microprocessor lifetime is in the order of 15 years. An alternative strategy for those systems has been put in place, based on the Debian Linux, giving CERN more flexibility in terms of evolution and upgrades.

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