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A New Distributed Control System for the Consolidation of the CERN Tertiary Infrastructures

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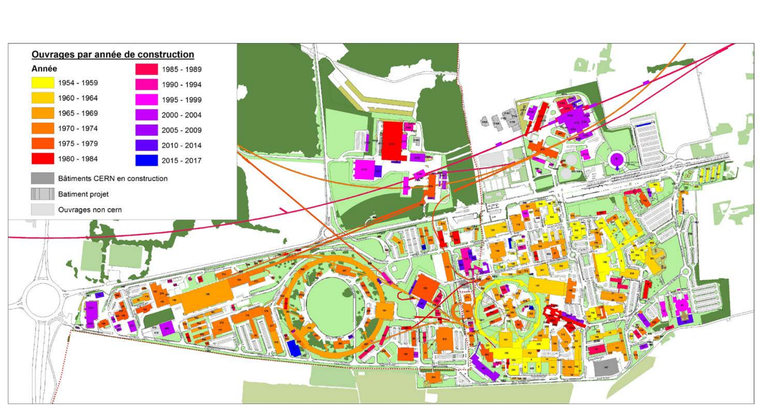
Abstract

The operation of the CERN tertiary infrastructures is carried out via a series of control systems distributed over the two main CERN sites (Meyrin and Prevessin). The scope comprises: ~260 buildings, 2 large heating plants (~50 MW overall capacity) with 27 km district heating network and 200 radiators circuits, ~500 air handling units, ~52 chillers, ~ 300 split systems, ~ 3000 electric distribution boards and ~ 100 000 light points.

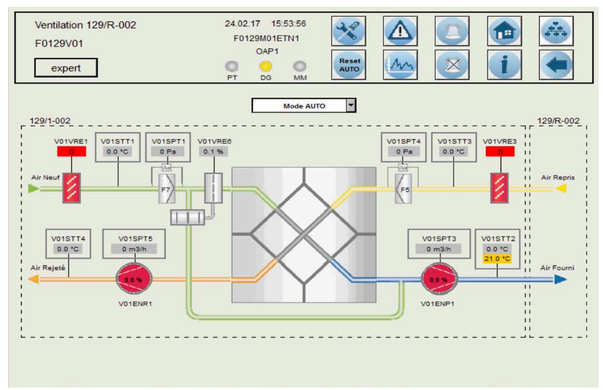
In the last five years and with the launch of major tertiary infrastructure consolidations, CERN is carrying out a migration and an extension of the old control systems dated back to the 70's, 80's and 90's to a new simplified, yet innovative, distributed control system aimed at minimizing the programming and implementation effort, standardizing equipment and methods and reducing lifecycle costs. This new methodology allows for a rapid development and simplified integration of the new controlled building/infrastructure processes. The basic principle is based on open standards PLC technology that allows to easily interface to a large range of proprietary systems. The local and remote operation and monitoring is carried out seamlessly with Web HMIs that can be accessed via PC, touchpads or mobile devices.



CERN buildings ages in Meyrin

Methodology

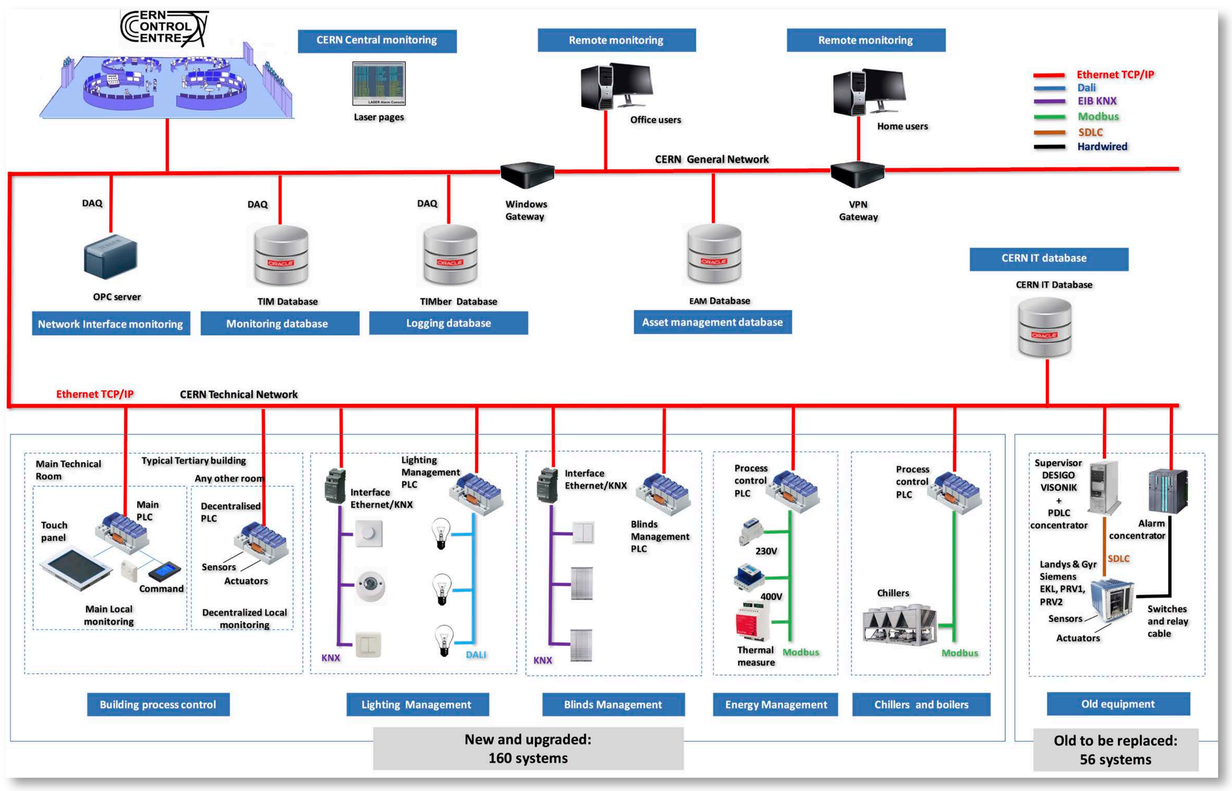
- The core of the methodology is to implement an automation layer that is capable of directly interface with the field layer using standards hardware interfaces with standard protocols and avoid the use of proprietary technologies.
- Another core element of the methodology is the reusability of the code for reducing costs and improving maintainability. To achieve this goal, a number of software modules have been identified and programmed creating software components that can be further specialized in the individual applications: a component-based software architecture.
- The final element of the methodology is linked to the concept of a lean ubiquitous remote monitoring and control: continuous improvement with the aim of increasing value for user and reducing/removing useless functionalities. To achieve this goal the various distributed control systems are monitored without a centralised SCADA but rather using built in functions allowing access from a multitude of different platforms and locations.



Example of control panel interface component

New distributed control system

- The new distributed control system for the CERN building/infrastructure processes is based on an automation model that puts the openness at its centre and, as such, allows the implementation of the methodology.
- This technical solution is based on the Saia Burgess Controls (SBC) product line for the management and automation layer and a multitude of field devices products: all connectable through standards hardware interfaces with standard protocols (DALI, KNX, MODBUS).



Control & monitoring architecture of the CERN tertiary building infrastructure

- All the building/automation processes are connected to the IP network allowing the remote monitoring and control functions. All connected field devices are based on standards hardware interfaces with standard protocols. The remaining old systems with proprietary technologies are being progressively phased out. In addition, by using the standard software components described in the previous chapter, the interoperability between building services is made simple.

Implementation example

The B774 building

B774 Actual implementation of the solar collectors with its control panel interface

Building management system for the CERN building 774. This building can be defined a green smart building for its integrated functions that allow the real-time monitoring and control of its energy management (heating, cooling, lighting and shading). In particular, the building implements an energy concept based on multiple productions (gas district heating, electricity and thermal solar collector) and energy recovery through air circulation. Heat is used to produce hot water for space heating, for sanitary usage and, when sufficient solar energy is available, for the production of chilled water via an absorption system otherwise a traditional compressor-driven cooling system is started to produce the chilled water. Depending of the external weather conditions and the real-time heating/cooling needs of the building areas (technical rooms, conference rooms, etc), the energy flows are managed to maximize the usage of solar energy, hence reducing costs.