# CERN openlab welcomes Siemens as latest partner

CERN has been joining forces with industrial partners for six years in a unique framework for development and prototyping activities, as well as for the evaluation of potential computing solutions for the LHC scientific community.

This initiative, CERN openlab, has been organized into successive three-year phases. In openlab-I (2003–2005) the focus was on the development of an advanced prototype called opencluster, and openlab-II (2006–2008) addressed a range of domains from platforms, databases and interoperability to security and networking. We are now entering the third phase – openlab-III (2009–2011) – which will not only capitalize on and extend the successful work carried out in openlab-II, but it will also tackle new crucial areas.

Siemens is an industrial partner that will collaborate with CERN in openlab-III in one of these new areas: the domain of industrial controls. Some European companies have previously been members of CERN openlab as contributors, but Siemens is the first European company to join as a full openlab partner. In addition to in-kind contributions, Siemens will fund three fellows and one staff position.

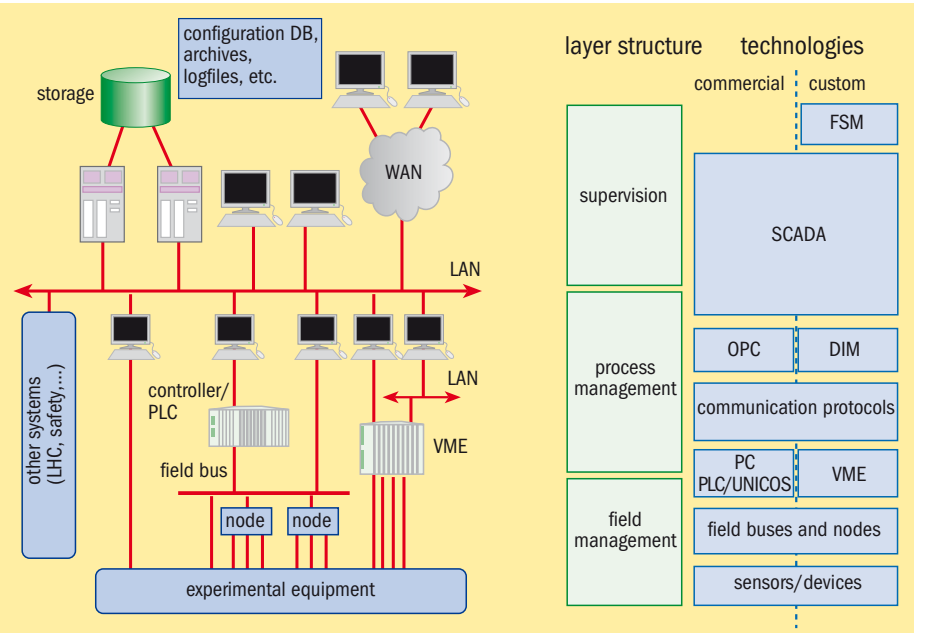


*Fig. 1. The architecture of a typical CERN control system is made of several layers. Siemens components are mainly in two of them: SCADA systems in the supervision layer and Programmable Logic Controllers (PLCs) in the process management layer.*

### Control systems at CERN

At CERN, control systems are deployed for accelerators, experiments and infrastructure. The role of the experiments' control systems is to bring experiments to, and maintain them at the correct conditions to take physics data. The accelerator control systems are used to provide beams with the expected and required luminosity for the experiments.

As illustrated in figure 1, a CERN control system is typically made up of several layers. Various technologies and tools are available to implement these layers. In particular, Siemens provides components for the process layer – Programmable Logic Controllers (PLCs) – and for the supervision layer – Supervisory Control And Data Acquisition (SCADA) systems.

CERN has selected PVSS, the SCADA system from ETM (which is a Siemens company), for its control system. The PVSS architecture is described in figure 2.

Like any SCADA system, PVSS provides facilities to acquire, display and archive control data, and to handle alarms and events. PVSS also has some additional benefits that make it attractive to CERN. Unlike most SCADA systems, PVSS is highly scalable; a PVSS system is composed of managers that can be distributed over many computers when the control applications grow, and, if necessary, several PVSS systems can be federated to implement one large control application. About 150 PVSS systems are required to implement a typical large LHC experiment control system.

PVSS is a particularly open SCADA system; functionalities can easily be added to PVSS either by using the script language or the API to integrate externally developed components. Finally, PVSS applications can be deployed on both Windows and Linux machines.

PVSS applications are currently being used for the LHC machine, LHC experiments

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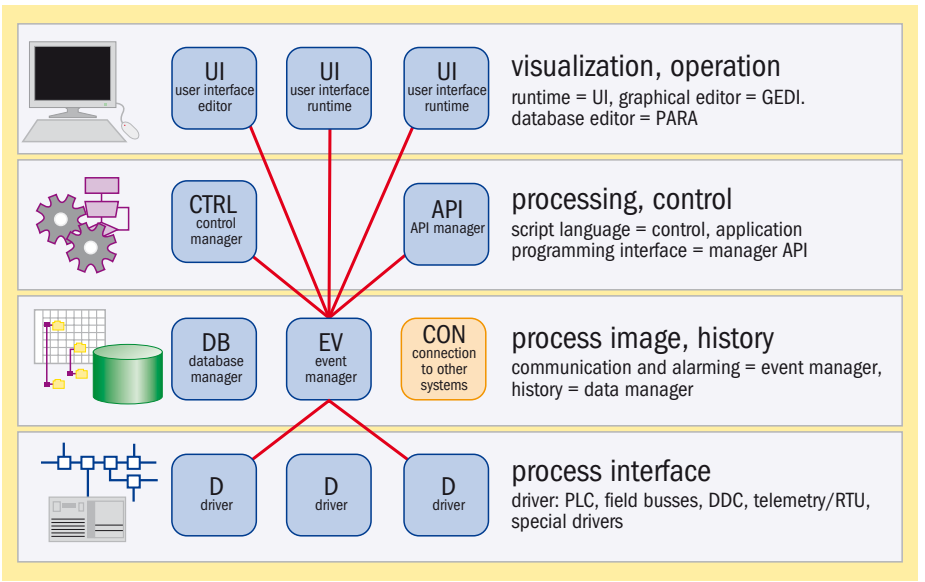


*Fig. 2. This schematic illustrates the PVSS architecture. PVSS provides facilities to acquire, display and archive control data, and to handle alarms and events.*

as well as fixed targets experiments. About 500 licences have been generated.

Siemens is also one of the two PLC manufacturers selected for use at CERN. PLCs are dedicated diskless computers for control. These computers are robust and programmed with specific standardized programming languages. They are used to implement input/output accesses, interlocks, close control loops and automatic action-taking systems (e.g. by means of Finite State Machine programs). About 500 Siemens PLCs (S7-400, S7-300 and S7-200 models) are deployed across CERN in accelerators, experiments and infrastructure control applications.

**openlab and Siemens collaboration**

Siemens and CERN will collaborate on three main topics: security; opening of automation tools towards software engineering; and handling of large environments.

**Security**

Due to the growing usage of Ethernet and TCP/IP in automation devices, and because of the move away from proprietary or dedicated networks, the automation devices and control applications have to become resistant to the common threats on Ethernet cable. These threats can be deliberate (attackers), collateral (viruses and worms), or accidental (misconfiguration, such as an error in the IP address or broken devices flooding the network).

Siemens and CERN have an inherent interest that automation devices (e.g. PLCs) survive these kinds of attacks and they will be investigating the resistance of the devices. More specifically, resistance to malicious network traffic will be analysed through robustness tests, proving that a device can withstand for example ARP and BOOTP floods, and vulnerability tests, proving that a device is not affected by common viruses, worms or known vulnerabilities of the services, protocols and TCP/IP stacks used in these devices. There is a similar interest as far as PVSS-based control applications are concerned.

**Software engineering**

CERN control systems (like many others in industry) will be operated and maintained for a very long period of time (about 15 years). Thus, the PVSS-based control applications and the user programs running in the corresponding PLCs have to follow the same cycle. During this time they have to be managed, maintained, adapted and extended – not necessarily by the same developer(s). In addition, the increasing complexity of the control systems sometimes leads to the production of the PVSS and PLC code with the help of external tools (e.g. model-driven ones).

Siemens and CERN are interested in following the convergence trends between the automation and the information technology worlds. For example, it would be beneficial if the Siemens tools were able to use external (open source or third party) tools to handle proper source code management (e.g. CVS, subversion), code production and analysis (tools highlighting the difference between two versions of code written in graphical language).

**Large environment**

PVSS is used at CERN for large distributed control systems, some with more than 150 computers. PVSS and the controls applications have to be deployed on these computers. This requires an initial installation as well as regular upgrades and patches for both PVSS software and control applications. PVSS does not offer any native facility to deal with this type of environment.

The tools developed at CERN for software deployment – CERN Management Framework (CMF) and Linux for Controls – are only appropriate for initial PVSS installation. The installation of the applications (software + configuration) has to be handled manually. This is also true for the PLC layer. CERN and Siemens will collaborate to build adequate deployment solutions for the supervision and process control layers of large control applications.

**Useful links**

CERN openlab: http://cern.ch/openlab
PVSS at CERN: http://cern.ch/itcobe/Services/Pvss/
Siemens at CERN: http://cern.ch/ab-dep-co-is/Siemens/
Introduction to PLC: http://cern.ch/itcofe/Services/PLC/WhatIsPLC/

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