FOCUS ON

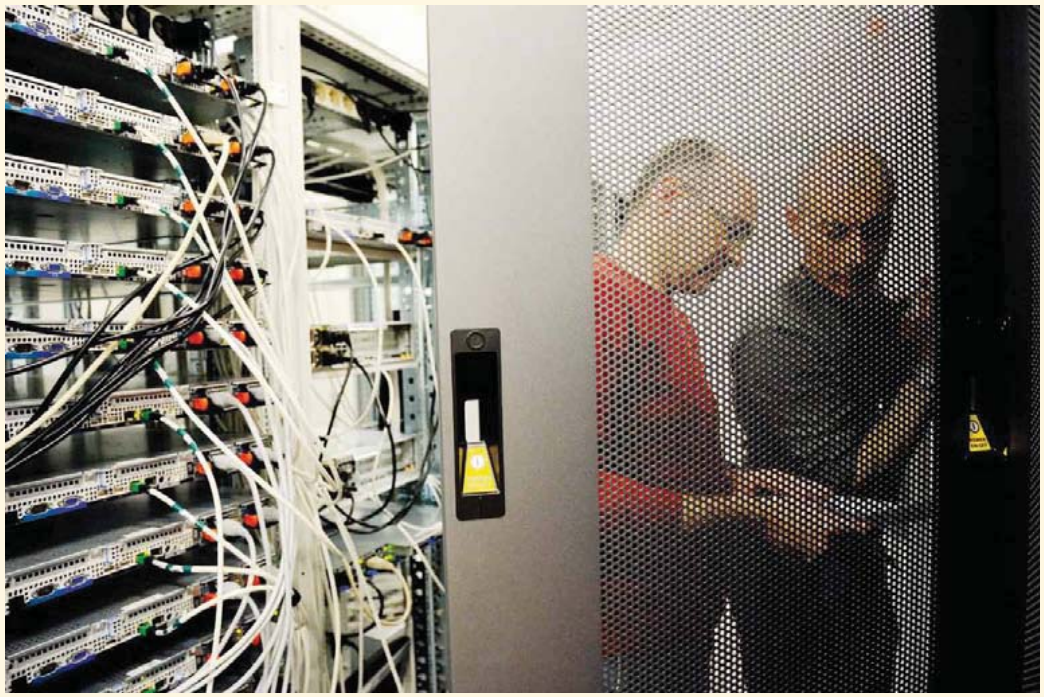
Computing and controls at SOLEIL

A little over 10 years ago, nothing had yet been set up in terms of computer networks or control systems. The Computing Division was faced with a tight schedule and limited resources. A look back at the choices made and their consequences today.

From the start, the creed of (then limited!) computing and controls groups was to "standardize what can be standardized" to optimize the installation and maintenance requirements, and reduce costs; "in modern, open and adaptable structures" in order later to be able to easily integrate new needs and new technologies. Although it is not always easy for a prospective user of a system to look beyond solutions either already practiced or standardized, a look back on the past 10 years shows that this approach made it possible to provide the systems needed in a reasonable time.

Very quickly the first computer systems were installed in temporary buildings that housed the fledgling Synchrotron SOLEIL company (see Rayon de SOLEIL #7). This was to support the daily activities of each member of the project in issuing the first orders and the first pay slips.

In parallel, studies were initiated on how best to control the machine and beamlines, and experimental data acquisition: first assessments of needs, evaluating existing technology and systems in other facilities or under development. In the end we chose TANGO1 software as the basis of all control and acquisition systems (see Rayon de SOLEIL #11 & 12).



At the heart of the synchrotron building, one of the secure air-conditioned computer rooms housing the servers managed by the Computing Division.

State of affairs in 2012

The three computer networks at SOLEIL- the site network (Intranet, visitors), the network dedicated to control the machine, and the one dedicated to experiments (subdivi-

TANGO

Originally developed by the ESRF and then through international cooperation, TANGO software has now been adopted by nine large installations, installed in many laboratories and proposed by industrial companies in response to calls for tenders on large projects.

It is a distributed object-oriented control system based on software entities called "devices" representing equipments. TANGO includes generic configuration, testing and storage tools, and is interfaced with tools such as Matlab, LabView, Igor, or Python.

In addition, SOLEIL has linked TANGO with GlobalSCREEN software from ORDINAL, to build supervisory GUIs that can go as far as integrating data preprocessing applications, as well as Passerelle, a graphical sequencing tool from ISENCIA.

http://www.tango-controls.org/

Interaction between the Accelerators & Sources and Computing Divisions: test, in laboratory, of a control system for the electron beam.

ded by beamline) – add up to over 6,000 connection points. These rely on a 2x10Gb/s redundant core architecture, providing high availability, and distributing the associated services to each network. Over 800 workstations (desktop and laptop ones) are deployed and maintained. The intranet also supports IP telephony traffic used since 2005. More recently, Wi-Fi infrastructure has been gradually developed and now covers all buildings.

SOLEIL has over 25 data acquisition and control systems, bringing together 2,500 computer and electronic subsystems: servers and X-ray terminals, CompactPCI electronics for fast acquisition and control needs; programmable logic controllers to automate industrial control; motorization and specific electronic developments. This has led to the deployment of more than 30,000 TANGO devices. This is the first installation to have used TANGO on such a large scale.

Another aspect is the means of calculating and storing experimental data3 available to SOLEIL scientists and beamline users: cluster calculations of 11.9 Tflops (1T = 10^{12}), 1 petabyte (10^{15} bytes) of primary storage on mirrored disks between the two computer rooms, LTO libraries to ensure secondary storage (and archiving on request).

Meanwhile, the initial management computer system has been upgraded to manage all SOLEIL's personnel and material resources, but also all the services related to beamline user and project administration: from submitting proposals up to final reports.

A story that doesn't stop there

It is now necessary to maintain these systems at the best operational level. Thus, over the years, virtualization techniques have been introduced to optimize the number of servers and intense reliability campaigns divided by 2 the calls to computing support when the number of beamlines in service continued to grow etc...

The current challenge is the explosion in the volume of experimental data, because of the simultaneous introduction of 2D detectors and the FlyScan acquisition system (see article p6): the expected daily volume will exceed one Terabyte of data on each beamline involved, with high speed bursts, so the technical means currently in place will need to be adapted.

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Experimental data

The experimental data are stored on dedicated infrastructure, distributed between local beamline storage and primary and secondary central storage: Active Circle software manages the security and archiving of data on it. The data are kept for at least 100 days after the end of an experiment. A dedicated application, SOLEIL Data Retrieval, provides remote access to directories associated with an experimental project and the download of data files, when the volumes concerned are compatible with a transfer over the network.

Experimental data are stored on this infrastructure, preferentially in NeXus standard (see Rayon de SOLEIL #20). Based on the HDF5 Format, chosen by the European collaboration PaNData to harmonize data formats, NeXus allows the creation of self-supporting files including the metadata necessary for exploiting raw data. More than two million NeXus files have already been produced at SOLEIL. However, all the existing analysis applications do not yet use this format: developed in partnership with the Australian ANSTO neutron source and recently DESY and ANKA, an interface called CDMA or Common Data Model Access will allow the file format and data organization of these files to be hidden in order to share data and applications between research institutes. This unified data access layer is implemented in data reduction applications already operational on some beamlines.

http://sunset.synchrotron-soleil.fr/sun/

Motion systems

SOLEIL has over 1,500 motors currently operating, mainly on the beamlines to drive monochromators, mirrors, etc. Today, 84% of them are controlled by a standardized SOLEIL solution: a commercial controller integrated in a ControlBox chassis linked to a power unit- DriverBox for stepper motors (VacuumBox for those under vacuum) and ServoBox for actuators.

In partnership with the future Swedish synchrotron MAX IV, SOLEIL has launched a project, called REVOLUTION, to renew the current controller selected in 2004 in order to extend the performance and capabilities of the standard solution: complex trajectories, nanopositioning, etc.