CSCS, the Swiss national supercomputing centre

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CEO, CSCS

Switzerland is a country known for its mountains and lakes, three national languages, ski slopes, cheese and chocolate: that is for the postcard description of it. It is also known for the quality of its education and world class research institutions which attract students, post docs and researchers from different horizons. Its industrial scene offers a wealth of players active in high value added goods and services, such as engineering, pharmacy, food and nutrition, financial institutions and biotechnology, a reflection of a country that has virtually no natural resources other than its skilled workforce and grassy landscapes.

The southern slope of the Swiss Alps is the base for the CSCS, the Swiss national supercomputing centre: this region which offers some beautiful scenery and hosts a small thriving university, is a natural bridge towards the vast Lombardy. The centre opened in 1991 and has since then offered resources and services to the Swiss research community. Since 2004, the CSCS is developing its activities along a new strategic quadriennial plan, comprised of the extension and the replacement of the computing infrastructure, complex and massive data analysis, benchmarking, and national hub for the Grid. It participates in European collaborations like EGEE and is actively involved in regular exchanges with leading HPC centres in Europe and beyond, like Manchester Computing.

The centre offers resources to scientists working in varied domains such as physics, chemistry and biochemistry, engineering science, CFD, climate modeling and environmental science. Presently the computing time is being allocated under scientific review to a number of institutions:

- Swiss institutes of Technology in Zurich, Lausanne, state universities (Zurich, Bern, Geneva, Basel, Fribourg, Neuchatel)
- MétéoSuisse for its daily predictions
- Industries, especially through funding agencies for technical transfer
- International research partners, such as EGEE.

In addition, the centre hosts on one of its supercomputers, the Nec SX5, the suite for National weather predictions for MétéoSuisse.

Figure 1: Marie-Christine Sawley, CEO, CSCS.

Extension and renewal of the computing infrastructure

The development plan of CSCS for the years 2004-2007 proposed and secured the funding for a number of developing activities and projects. The first chapter concerned an extension and a replacement of the computing infrastructure. The extension, called Horizon, unfolded during 2004 and was conceived for the installation of a MPP system at CSCS for highly scalable nodes, to be put at the disposal of scientists as a tool for enabling new frontiers in science to be addressed. CSCS conducted this project in collaboration with the Paul Scherer Institute, which is the largest research institute in Switzerland, conducting multi-disciplinary research in areas such as beam and reactor physics, material, environmental and biomedical science. CSCS and PSI wanted to join efforts to buy the first 1000 processors and plus MPP machine in Switzerland, and to be able to deploy this as a first class instrument for some key areas in science. The procurement that we ran had very strict electricity and power requirements, was very demanding on the performance side — benchmarks were based on a mix of the new HPCC suite and user codes — and the total cost of ownership for a period of 3 years played an important role in the evaluation criteria.

CSCS ran a call for tender in 2004, and after the analysis of seven different offers, decided on the purchase of a Cray XT3, comprised of 1100 AMD processors connected via a very fast interconnect toroidal communication network based on the Seastar® chip. The system is currently being installed, hosts some early users and we plan to put the system in production during the first quarter of 2006.

The second project, called Zenith, will target the replacement of the existing computing infrastructure. Very complementary to Horizon, the system must offer capability computing resources for codes that do not scale very well, which need shared memory capacity, but will also exhibit some very good bandwidth between memory and processors.

The user community

The CSCS application portfolio reflects both the history of the centre and the pattern of strong research areas in Switzerland, be it in public or private sector: fundamental sciences (physics and chemistry), as well as material and biomaterial, nanotechnology, environmental and engineering sciences, use the major share. As has already been pointed out, the CSCS hosts the daily suite for National weather services in Switzerland and this long time collaboration has brought a share of mutually beneficial activities, and has ignited natural synergies with some of the world class research community in Switzerland, like the groups working in Climate modeling which make use of the services.

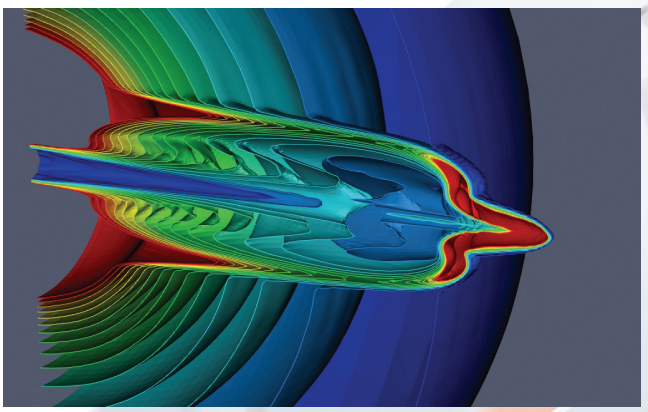

Figure 2: Magnetic jet from a young stellar object.

There exist a wealth of new emerging applications that bring to CSCS new development opportunities. Some of them are compute intensive, like in biomaterial sciences, or data intensive like particle physics or bioinformatics. Today some require the Grid infrastructure, and this was an opportunity for CSCS to enter into close contact with some new partners who require the weaving of a strong SW fabric around services, data and compute. This is the case of the Swiss Biogrid project, a joint initiative between the Biozentrum and the Novartis research institute, the Swiss Institute for Bioinformatics, the Functional Genomics Centre in Zurich and CSCS. It is also the case for the LCG computing since CSCS is hosting the Tier 2 level of national infrastructure used by the nine labs that are conducting research in particle physics. In the long term, we are also working in establishing contacts with the financial community who are making use of more and more complex mathematical modeling for portfolio management.

Figure 3: View of the Horizon system newly installed at CSCS.

The real challenges

For a centre like CSCS, the challenges facing us in the near and medium term future are in two areas:

- capacity to continue deploying capability computing and complementary architectures, which is certainly in synchronism with funding but also in the capacity and the willingness to continue to be a pioneer;
- software, tools, advanced scientific visualization, performance monitoring, mathematical modeling, which gives the unique flavour to the atmosphere our users and partners experience by working with us and in addition the value of the computing cycles we make available.

Both relate to human competencies and skills, they make our work exciting and are the best way for us to face the rapid speed of changes we see in technology and in the way our users, mostly researchers, conduct their research and make their choices. At CSCS, there are 33 of us today, from 10 different nationalities and pluri-lingual (very few up to 6: not the majority!)

We strongly feel that organizing the access to today's Teraflops computers with the right combination of good quality software — scaling to hundreds of processors — , value added tools such as analytic benchmarking, performance tuning and evaluation and advanced visualization is the best way to build a sound road to Petaflop computing.

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