HPC: ADVANCED RESEARCH

# Extreme computing: technological innovation and European leadership

## Bull R&D at the heart of European projects and competitiveness clusters

**Technological innovation? It's the very foundation of Bull's existence, from the world's first mainframes in the 1960s, to the invention of microprocessor boards in 1979, to globull™, the world's most secure mobility platform launched in 2008 and now bullx™, a new-generation of ultra-dense, ultra-modular supercomputers, designed with particular care.**
**All this goes hand in hand with Bull's proven experience of worldwide collaborations with its technology partners (through its R&D centers in Europe, America and Asia), as well as with Open Source Communities, major industrial companies, prestigious research laboratories, and innovative small-to-medium sized enterprises as part of numerous European research programs and competitiveness clusters.**

**Bull Direct interviewed three research directors, who talk about the high-level cooperative research projects they are involved in. Each illustrates just how high performance computing is making inroads in every sector of the economy, for businesses of different sizes.**

### THE HIPIP (High Performance Imaging Processing) PROJECT, with avec Jean-Claude Bourhis

Launched in October 2008, this ITEA2 European Union project brings together partners involved in the French SYSTEM@TIC competitiveness cluster: Bull, the French Atomic Energy Authority (the CEA), IMSTAR and DOSISOFT, and the Dutch cluster Point-One: Philips Healthcare, Technolution and FEI, who have been chosen for their expertise in high-performance image processing in the field of bio-medical imagery.
Coordinated in France by Bull, the project draws on High-Performance Computing (HPC) technologies to support advances in medical image processing. The objective? To show the advantages these technologies offer when it comes to establishing a reliable diagnosis, applying radiotherapy or monitoring a treatment in real time, and even analyzing biopsy tissue samples at cellular level.
The potential is huge, and there are numerous possible applications. What they all have in common is the need for increasingly precise 4D images (three spatial dimensions, plus time) for the different types of therapy used (X-rays, PET[1], MRI[2], and TDM[3]). Because the imagery is so much more precise, a great deal more data has to be processed in the short time that the patient is actually present during a consultation or examination. This is one reason why Bull has suggested standard multi-core systems packaged in different configurations ("one box", server, cluster) and helps partners to set up their applications in parallel so they can benefit to the maximum from the inherent power of their configuration.

**Here are a few examples of possible applications, which illustrate the relevance of these technologies:**

- **Computer-aided surgical procedures.** The aim is to eliminate the "noise" present on the image in real time. This noise is caused by lower doses of the ionizing products to which patients are exposed; for example during a procedure to implant a stent (the weaker the signal is, the greater the interference and the more the noise increases).
- **Computer-aided diagnosis**, providing the practitioner with information just minutes after a clinical examination: information which would currently require hours of processing time (the reconstruction of 4D images from PET images, by analyzing a series of images taken sequentially, or the reconstruction of an image showing the cortical folds following an MRI scan).
- **Real-time radiotherapy simulation** to assist practitioners with medical procedures. This simulation works as an interactive aid during radiotherapy treatment, with MRI, PET or TDM images being analyzed directly to help determine the ideal position and shape of the radiation beams. This means that non-target organs at risk of being irradiated can be avoided, that minimally invasive interventions can be visualized in real time, and very precise restitutions and rapid analyses of malignant cells during a sampling procedure can be carried out.
- **Early detection of disease** with the construction of cognitive models to enable early detection of certain illnesses such as cancer (using multiplex cellular analysis) or neuro-degenerative illness's such as Alzheimer's disease.

The project will deliver demonstrators for all types of treatment (X-rays, MRI, PET and CT-SCANs[4] and cellular imagery) and an innovative stand-alone workstation for virtual simulation in radiotherapy.
On a technical level, the project is particularly interesting in its use of application parallelization techniques and real-time applications.

3D IMAGING OF A BRAIN'S FIBER NETWORKS WITH MRI


(1) PET: Positron Emission Therapy.
(2) MRI: Magnetic Resonance Imagery.
(3) TDM: Tomodensitometry.
(4) CT-SCAN: Computed Tomography SCAN.