

## Towards a greener TERA

The installation and operation of large scale computing machines not only requires a supercomputer, but also a suitable infrastructure to receive it. The machine rooms, electricity distribution and air conditioning together represent a significant acquisition and operation cost on the same scale than the initial investment in computer hardware. The advent of petaflop class supercomputers has made the operation and control of these surrounding devices essential.

### The challenge is to reduce electricity consumption

The total electrical consumption of the facility may represent up to twice that of the actual computer equipment installed. This results mainly from:

- the losses caused by air-conditioning and electricity distribution equipment: transformers, inverters, etc.
- the energy required to cool the facility: refrigeration units, air handling units, etc.

Since 2007, computer architecture experts and specialists in computer room engineering, attached to the CEA-DAM (DSSI and DP2I) and to the computer manufacturer BULL, have come together to tackle these issues through the POPS project<sup>1</sup> of the System@tic competitiveness cluster.

Three areas are being investigated to improve the energy efficiency of computing infrastructures: the cooling, the electricity distribution and, finally, the energy consumption of the computer itself.

### Cooling water

The energy efficiency of air conditioning, achieved by circulating cooled air, is difficult to improve. Therefore, a water-cooled technology has been investigated because it is potentially more efficient. It involves replacing the standard door of a computer cabinet by a door which includes a chilled water circuit, an air-water heat exchanger and some fans.

The value of this device has been demonstrated for a 1 petaflop computer. The number of cabinets can be reduced by a factor of two, whilst improving the energy efficiency by more than 5%.



 COLD DOOR FITTED TO A COMPUTER CABINET

### Greater need for inverters

The efficiency of the inverters, devices which mask the effects of short-duration power cuts, is an area for significant improvement. Tests are currently being performed to partially remove these inverters and replace them with an alternative solution, without loss of energy, installed close to the computer racks.

### Promising avenues

The advantages of adjusting the energy consumption of the computer as a function of its load still need to be explored. The machine can be seen as adjusting its consumption according to the level of usage of the processors, memory, discs, fans etc. This is one of the topics of the TERA-100 R&D project, which has recently been agreed between the CEA and the Bull company.

---

<sup>1</sup> POPS: petaoperations per second.