16

Laptops Unite!
Supercomputer for climate simulation

Peter Hanappe (Sony Computer Science Laboratory Paris)

FR

How to create the biggest supercomputer for climate simulation without ruining the planet? The combined computing power of all the laptops on this planet is gigantic. If we can tap into that power, we can conceive not only the biggest but also the greenest supercomputer. Why is so much computation needed? To run large-scale simulations of the earth's climate, for example. The current computing centers that are used for such simulations require increasing amounts of energy. This is unsustainable. We think there is a long-term solution. Laptops unite!

The earth's climate system is intrinsically complex. To predict how the earth's sub-systems interact and how that influences the climate, there is only one solution: run computer models. Unfortunately, these sophisticated software programs require supercomputers and the energy consumption of these installations is growing at an unsustainable rate. The Oak Ridge National Laboratory, one of main computing centers in the US, expects that in 2012 they will need 52 Megawatts of energy to run their facilities[1]. That is nearly twice as much as the Flemish wind power production in 2009[2].

We need climate simulations, but can we do it with less energy consumption? One hint of the solution comes from the ClimatePrediction.net project at Oxford University. They ask home users to contribute the idle time of their computers to compute a slice of a much larger set of simulations. The ClimatePrediction.net software runs mostly as a screen-saver when people are not using their machine. It downloads scientific data from a server in Oxford, computes, and then uploads the results. Volunteer computing, as it is called, has allowed the ClimatePrediction.net team to gather a very significant amount of computing power[3].

Considering that 130 million laptops are sold worldwide every year, we think it is possible to push this idea further. If a small percentage of these laptops would participate in scientific computing, the combined effect would be staggering. How can it be achieved without using too much energy? By using the energy saving features of modern processors. A processor that is advertised at a given clock frequency will run at lower frequencies when the machine has little work to perform. Running at a lower frequency reduces the energy consumption.

Consumer devices are over-dimensioned and, most of the time, a laptop is not doing much, even when its owner is working hard. During active use, a laptop is idle 80% of the time and runs in a low-power mode. In this mode it consumes less, but still uses some energy. Suppose we run the scientific computation in the background, while the laptop is in use. We also make sure that the machine stays in this low-power mode. In those conditions, the software can still crunch through a significant amount of data. The energy use will increase but only very little. And the user will hardly notice anything. The amount of computing performed versus the amount of additional energy consumed is comforting. And by combining many laptops the total computing power is virtually unlimited. Can it be done? We think so, for many kinds of simulations, at least.

We talked about laptops. Now what about smart phones, TV set-up boxes, ADSL modems, and other advanced electronic consumer devices? They are next in line!

1 Estimated energy consumption for 2012 at the Oak Ridge National Laboratory and the University of Tennessee. Taken from Jack Dongarra's keynote speech at HPC Asia 2009.
2 According to Ode-Vlaanderen, the more than 100 Flemish wind turbines together produced 260 GWh of energy in 2009. This amounts to an average energy production of 29.7 Megawatts. http://ode.be/index.php?page=windenergie.
3 www.climateprediction.net

↘ www.csl.sony.fr/research/sustainability

Peter Hanappe studied electronic engineering at the University of Ghent, Belgium. He started research in computer music at the IPEM (Institute for Psychoacoustics and Electronic Music). In 1994, he moved to Paris, France, where he wrote his PhD thesis at Ircam – Centre George Pompidou. He joined the Sony Computer Science Laboratory Paris in 2002. His interests cover any topic that deals with computers and networks: from content distribution, to novel energy distribution, to distributed computing. The Sony Computer Science Laboratory in Paris engages in fundamental research in cutting edge areas of science that are relevant for pushing the state of the art in computing. It is a sister laboratory of the Sony Computer Science Laboratory in Tokyo and directed by Prof. Dr. Luc Steels.