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Beauty of supercomputing

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Recently, there has been a lot of buzz surrounding the Eka supercomputer built by Computational Research Labs (CR Labs), a subsidiary of Tata Sons. It was ranked No 4 on a table ranking the world's supercomputers released earlier this month at the Supercomputing conference in Reno, USA. We must all congratulate the team at CR Labs for this achievement. But there was one more achievement which very few have heard of. I have to set the stage before I disclose it.

What makes a computer a "supercomputer"? The Top 500 benchmark ranks computers by the rate at which they perform arithmetic operations on a specific mathematical problem. Anyone can download this benchmark, run it on a computer and send in the results. The top 500 computers then make it to the list. Supercomputers are constructed for a variety of reasons—to solve computational problems, for example, or for political motivations and national pride, among others. This says nothing about the computer's capability to solve real world problems.

There are two general ways to build a supercomputer. One way is to assemble one with a very large number of generic components. Here's how: buy lots of servers with Intel or AMD chips, and connect them with a fast network. These are commonly referred to as clusters. The Eka cluster has 2,000 such servers, each containing eight processors. The other way is to buy a specially designed supercomputer such as SGI Altix, Cray XT4, or IBM Blue Gene. But clusters are relatively economical, offering high performance per unit cost, especially on the Top 500 benchmark. Their drawback? They are hard to programme. The costs of software development are often large, and the resulting performance levels are very low. And it is software that realises the potential of a computer. It is software that sets Apple's iPod and iPhone apart. India's prowess in software services is well known. What do supercomputing and the Indian software industry have in common? It turns out that the skills required to programme the next generation of general purpose computers will be similar to the skills required to programme supercomputers.

A paradigm shift is happening in the world of software. Desktops have traditionally shipped with just one processor. Very soon, they will ship with several of them. Supercomputers typically have thousands of processors. All programmers will now have to learn the art of working on multiple processors. Today, the tools available to programme multiple processors are quite primitive compared to desktop programming tools. What we need are tools that increase programmer productivity, and efforts in that direction have given us the Star-P environment by Interactive Supercomputing, and the X10 by IBM. More will come.

Indian firms that innovate will find themselves well poised to tackle the next generation of software challenges. They will also be in a position to draw on their inhouse talent to serve the global market for supercomputing software and services. High levels of programmer productivity make it possible to write complex software that realistically model scientific phenomena.

Solutions are available for many simulations already, and one need not reinvent the wheel for modelling car crashes, airplane design or oil exploration, for example. We need the capacity to solve problems unique to India. One such problem is Indian ground water hydrology, the accurate modelling of which may help make informed policy decisions. Expertise in climate modelling will help us understand the effects of global warming. For example, what will happen to our rivers that originate from Himalayan glaciers?

A successful supercomputing ecosystem requires three elements: applications, software and hardware. Real applications have to be the driving force. Applications can originate from universities, the industry or the government. Next comes a pool of talented programmers. They need to be well versed in techniques for high performance computing, while equipped with a rigorous math and science educational base to solve scientific problems.

Setting up a supercomputing facility is the last piece of the puzzle. It houses many supercomputers with dedicated support staff that helps users get their applications working. And this brings me to the other fascinating Reno revelation mentioned earlier. Along with the Top 500 challenge that ranks supercomputers, there is another challenge known informally as "the beauty contest". The aim of this is to rank the ease-of-use of software. The winners of this contest were Interactive Supercomputing's Star-P platform and IBM's X10 programming language. Part of the X10 team is located at IBM's India Research Laboratory in New Delhi.

This involves cutting edge technology and requires significant proficiency at diverse functions. To me, this is what truly announces India's entry to the supercomputing big league.

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