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What Would You Do With a \$120M Supercomputer?



Robert Plant, Associate Professor, School of Business Administration, University of Miami
4/10/2013
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The Los Alamos National Laboratory in the United States, birthplace of the atomic bomb, on March 31 decommissioned one of its supercomputers, nicknamed "Roadrunner." The machine was built at a cost of \$121 million and is capable of a petaflop of operations, or 1,000 trillion calculations a second.

Huge power consumption

While in 2008 it was ranked as the world's fastest machine, the government feels it can no longer afford to run it due to the power bill. It requires 2,345 kilowatts of energy to drive that level of performance. And in case you were thinking of making the government an offer and turning it into a personal computer, you may need to inform your local utility, as the average US household power usage is 908kWh a month.

The computer itself is still ranked as the 22nd fastest in the world and is thus quite a capable device. Los Alamos notes that:

Roadrunner's design was unique, and controversial. It combined two different kinds of processors, making it a "hybrid." It had 6,563 dual-core general-purpose processors (AMD Opterons™), with each core linked to a special graphics processor (PowerXCell 8i) called a "Cell." The Cell was an enhanced version of a specialized processor originally designed for the Sony Playstation 3®, adapted specifically to support scientific computing.

Roadrunner was built to help the United States Department of Energy undertake "stockpile stewardship," which, in English, is the testing and maintenance of nuclear weapons without actually detonating any, a \$4 billion a year activity. During its "shakedown," or initial build phase to verify the system works (which seems a very good idea when performing math model testing of nuclear weapons), the system was used for research including "nanowire material behavior, magnetic reconnection, laser backscatter, HIV phylogenetics, and a simulation of the universe at a 70-billion-particle scale."

The decommissioning of Roadrunner raises several interesting questions:

- The first is: What would you actually do with a petaflop of calculation power? A starting point to address this is based upon making a determination of the break-even value needed to afford the power bill (a potential bargain with power only costing approximately \$275 hour, assuming power is 11c a kW/hr but ignoring building, facilities, and human labor costs). To make money on this computer, organizations would thus need a significant modeling problem.



For example, companies such as GSK pharmaceuticals that have developed and hold 2 million "nameless chemicals" but have yet to find a use for them could run drug efficacy trials by computer model; drug simulations could be attempted, and potentially life-changing medicines result. Other possibilities include modeling the weather; population movements in cities; or looking at the data from commercial high energy physics projects such as the portable nuclear reactor proposed by companies such as Hyperion and IX Power LLC, which have licenses from Los Alamos to develop mini-reactors.

Search engine companies could be linked to IBM Watson-type AI systems; automobile companies could create crash tests and simulations for submission to regulators; airline manufacturers could simulate wind tunnel experiments and design variants; and entrepreneurs can one day perhaps create virtual reality experiences for customers such as those dreamt of in movies such as Total Recall.

- A second issue that this should raise for executives is that Roadrunner was the fastest machine in the world only five years ago, and it has depreciated out, now ranking 22nd. So perhaps the power of Moore's Law makes it such that if you don't need to live at the bleeding edge of

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technology, then delaying deployment may actually be worth the wait. Several factors in this case study point to this area as one worth following.

One is the use of common cell processors in Roadrunner, rather than the custom chips in previous supercomputers, thus its lower price and greater flexibility. Second, prices do keep dropping – the current world heavyweight supercomputer champion **Titan**, which produces 17,590 Tflop/s with its 560,640 Opteron processors, was only \$100 million.

- Finally, in the era of big data, it is inevitable that, as the data gets larger, aggregates, and is universal in format, the need for supercomputing will continue to grow. **IDC estimates** that sales of supercomputers in 2012 grew by 29 percent, for machines priced over \$500,000, developing a market worth \$5.6 billion. As this growth escalates, the potential for a more flexible specialist supercomputer outsourcing provider model thus increases. This too limits the need for ownership except in truly exceptional circumstances.

While Roadrunner has been officially decommissioned, it is still being used by computer scientists at the lab to study memory compression algorithms and operating systems and is thus still alive. Who knows, if you make a cash offer to the DoE, perhaps you may yet be able to get a bargain. Of course, just like buying a supercar, if you have to ask how much it costs to run it, then you probably can't afford it.

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— Robert Plant, Associate Professor, *School of Business Administration, University of Miami*

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 Saul Sherry, User Rank: Blogger
4/15/2013 | 8:35:06 AM

Re: Secondary Markets
Hal! Quite @AlphaCane - For sale, one super computer. One previous owner, non-smoker, powerful but not particularly energy efficient.

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 AlphaCane, User Rank: Bit Player
4/13/2013 | 6:23:45 AM

Secondary Markets
As with any used vehicle the question begs, is there an extended warranty available? ;)

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 netcrawl, User Rank: Petabyte Pathfinder
4/11/2013 | 4:05:44 AM

Re: The Power Issue
I believe in the near future we could see a dramatic increase in development and changes especially in power management, it been a key for most supercomputers, the massive power consumption together with the huge amount of heat generated by those supercomputers may also have effect to the entire system- it could reduce the lifetime of the other system components.

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 netcrawl, User Rank: Petabyte Pathfinder
4/11/2013 | 3:55:54 AM

Re: The Power Issue
Its a machine built for power and speed, primarily purpose is to solve and tackle the toughest computational problem- one of these is the aging nuclear arsenal. Its not cheaper, but it make strategic sense, these supercomputers provides us everything we need to know to solve specific problem.

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 Daniel Gutierrez, User Rank: Blogger
4/10/2013 | 8:04:29 PM

A cure for insomnia
One thing a machine room filled with a super computer could be used for is a very expensive cure or insomnia. I recall my undergrad days at UCLA when they had one of the largest supercomputers in the country. I used to love to sleep on a couch in the back of the machine room; the noisy air conditioning required for the big iron served as a lovely white-noise generator when I had trouble getting to sleep. I still like that sound today, but it is getting more and more rare. So let's fire up the Road Runner and drift into dreamland!

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 Robert Plant, User Rank: Blogger
4/10/2013 | 3:45:13 PM

Re: The Power Issue
Not really, the PUE (Power Usage Effectiveness) measures may be better but the power bill will still be very expensive as the scales are huge, probably a better metric is to consider PUE to Tflops or efficiency, but as these are specialist systems the ability to churn data may not be the only answer as to why they are built, but rather they are built to fulfil sensitive special functions. Probably the really fun and powerful solutions are deep in the NSA vaults, so we will never know how much they cost. But if the ROI is no more terrorist attacks, nuclear meltdowns or accidental explosions of the stockpile then the TOC is good no matter the price.

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legalcio, User Rank: Exabyte Executive
4/10/2013 | 2:16:17 PM

Re: The Power Issue

Can we assume the top 21 supercomputers are cheaper to operate? And how many of them reside with the US gov't? More decommissions on the way?

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Robert Plant, User Rank: Blogger
4/10/2013 | 1:28:14 PM

Re: The Power Issue

Perhaps it would be interesting to give it to a University, the worlds first supercomputer was given to Wolverhampton Technical College, now Wolverhampton University. http://en.wikipedia.org/wiki/Harwell_computer and has been restored residing at Bletchley Park Its a shame the CRAY's and other computers at the Science Museum in London (wonderful collection) dont actually run, that would perhaps inspire another genration and the heat could warm the museum in winter!

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Saul Sherry, User Rank: Blogger
4/10/2013 | 11:21:29 AM

The Power Issue

Ha, Robert, could we use all that computational power to figure out a way to make it consume less electricity? In all seriousness though, I think it might be time to put Roadrunner in a museum. If it's 22nd now, where will it be in another 6 months?

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