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Raytheon's Polymorphic Chip Breakthrough

By [Andy Patrizio](#)

When it comes to technology leaders in semiconductors, Raytheon is not the first name that comes to mind. Or the second, third or fourth. But the company, which specializes in defense and aerospace technology, has come up with a powerhouse of a chip that could find its way into consumer products some day.

The chip is called MONARCH, which stands for Morphable Networked Micro-Architecture. It is a joint effort between Raytheon and DARPA, the Defense Advanced Research Projects Agency, the same group that gave us the Internet.

Unlike most other processors, it can be reprogrammed and reconfigured on the fly to change the kind of processing it does, such as signal processing or data processing. Raytheon calls this a polymorphic computing architecture (PCA).

By functioning as a single processor, it reduces the number of processors needed for a system like a satellite or aircraft. More important, it's designed as an array of chips, which allows for teraflop throughput at a fraction of the wattage needed by today's processors.

The current MONARCH processor prototypes have six microprocessors and a highly interconnected, reconfigurable computing array to provide 64 GigaFLOPs of computing, with more than 60 GB per second of memory bandwidth and more than 43 gigabytes per second of off-chip data bandwidth.

With the high-speed I/O structure of the processor, four chips can be combined on a module to perform 256 GigaFLOPs throughput, and up to eight modules can be combined in a processor unit to provide 2 TeraFLOPs.

Current estimates by Raytheon put the MONARCH chip at somewhere between three and six GigaFLOPs per watt, depending on the application, with an average of five GigaFLOPs. The company claims the Cell processor in the Sony Playstation 3 runs at an estimated 2.2 GigaFLOPs per watt and the Intel Xeon runs at around 0.5 GigaFLOPs per watt, making MONARCH twice as power efficient as Cell and 10 times more efficient than Xeon.

So will we ever see one of these powerhouses? Raytheon says yes. "Right now, it's still early days, but down the road, the dream is we would look at licensing it," Mac Jeffery, a Raytheon spokesman, told *internetnews.com*. "We really do think there's a life beyond Raytheon for this technology."

Raytheon has no interest in getting into the semiconductor foundry business so it would look to license it to Intel, IBM or any other semiconductor manufacturer that was interested. As it is, Raytheon has already partnered with USC/ISI, Mercury Computers, IBM and Georgia Tech for specific intellectual property. IBM will fabricate the MONARCH using a 90nm fabrication process.

In the short to medium term, Jeffery said the technology would be ideal for something like satellites. "If you think about it, once that satellite goes up, it's up there. If you decide you'd like to change the application, with a conventional ASIC, you're out of luck," he said. With the MONARCH, it can be reconfigured for new tasks.

It could also be used in any high-end intensive processing equipment, such as medical imaging, where different types of processing have to be done on one piece of equipment. This would eliminate the need for multiple processing chips in the

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equipment.

Tony Massimini, chief of technology for Semico Research, told *internetnews.com* that reconfigurable processors like MONARCH will be more common. "The ability to reconfigure how the various processing elements work together is going to be a long-term trend for the computing industry." However, he added he didn't think it will change the computing market right away.

Still, trends tend to start well in advance of when the wave of an idea crests. "What we see today in a lot of the PCs, servers and workstations and even in videogames, is commercializing and putting into volume production a lot of work that was done in supercomputing ten and 20 years ago," said Massimini. "It's extremely important in terms of getting people to think along these lines to provide a foundation to build on for future growth."

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