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FPGAs storm military spending

By Jessica Davis, Contributing editor -- 7/14/2009
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ASICs always have ruled the military and defense market as the reliable devices of choice. That's not a surprise. The military has exacting requirements for ruggedness, temperature tolerances, and reliability, among others. But recently FPGAs have been making inroads into the space.

In the late 1980s, FPGAs didn't offer much of an alternative. The devices just didn't provide the higher level of functionality that military customers had grown accustomed to. FPGAs may have only offered a few thousand gates and could only run at 15 to 20 megahertz, according to Ken O'Neill, director of high reliability product marketing at Actel.

But the world has changed. Well before 2009's credo "do more with less," defense leaders in the government were making changes to procurement procedures, including the procurement of electronics that served as the building blocks of systems. United States Defense Secretary William Perry's famous mid-1990s COTS (commercial off the shelf) memo paved the way for a growing use of both commercial products and of PLDs (programmable logic devices) in military applications.

By mandating that government use COTS technology when possible, because of the significantly lower cost, Perry set the stage for the devices such as FPGAs to be used more often in military applications.

And FPGAs themselves have come a long way, with today's biggest devices boasting millions of gates instead of hundreds, and offering features such as hard-coded logic blocks for specialized applications within the chip while leaving other blocks open to programmability.

Today, the military uses FPGAs instead of ASICs in some applications for many of the same reasons that businesses do: When less than 100,000 parts are needed, it's more cost effective to choose FPGAs. Many noted that FPGAs don't incur millions in NRE (non-recurring expense) costs, and the design cycle time is significantly faster than it is for ASICs.

"The problem with the defense industry is low volume, so while some defense contractors generally have the expertise to go off and do complex SOCs, the design costs really price them out of using those ASICS as a viable solution," said Richard Wawrzyniak, senior market analyst covering ASICs and SOCs at **Semico Research Corp**.

For some intelligence-related efforts – perhaps spy satellites – the government may still choose an ASIC even if they only need 10 parts and the design in costs them $50 million, said Wawrzyniak. But for most purposes today, FPGAs will do the job, he added.

And the benefits of field programmability hold some appeal, as well, for military applications. For example, an FPGA in a military field radio can be created to erase its design if the radio is lost or captured by the enemy. That makes it less likely for the enemy to be able to reverse engineer communications equipment, or even weapons, according to Amr El-Ashmawi, senior business unit manager of Altera's military and aerospace business unit.

While no independent third party tracks the use of FPGAs in the military/defense market, probably because that market is deemed to be so small compared with other commercial markets, FPGA makers **Actel**, **Altera**, and **Xilinx** claim that the use of their devices in military applications has grown significantly over the last decade.

According to Altera, military is its fastest growing business, with revenue increasing at 30% per year. Sales to the military market contribute another percentage point to revenue every year, El-Ashmawi said.

And Actel claimed to own about 80% of the space market and about 20% of the military market. Actel's O'Neill attributed the company's success in the space market to its years of work and qualification on radiation-tolerant FPGAs.

Meanwhile, Xilinx owns more than 50% of the aerospace and defense market for PLDs, according to Young Kwon, product manager for the company's aerospace and defense group. One of Xilinx's claims to fame is that radiation-tolerant versions of its Virtex FPGAs were incorporated as the "main brain" in the

Mars Rover robots in 2004.

Radiation tolerant devices are important for space applications because of radiation-induced single event upsets which can flip zeros to ones and ones to zeros, effectively making the chip do the opposite of what it was programmed to do. Actel and Xilinx both offer radiation tolerant FPGAs, but Altera said it does not offer such technologies because the big opportunity for radiation-tolerant and radiation-hardened devices still lies with ASICs.

However, there are plenty of non-rad-tolerant opportunities for FPGAs in the military, and all three of these FPGA vendors are making the most of them.

While these FPGA companies and the analysts who follow them can't offer quantifiable data supporting a greater use of FPGAs versus ASICs in the military and aerospace markets in the last 10 years, there is plenty of anecdotal evidence. For example, Actel's O'Neill said that when his company is competing to win a design, it is a very rare occasion that he is competing against an ASIC designer. Most often he finds himself competing against other FPGA vendors. Vendors and analysts agree that FPGA use has been growing substantially since 1999.

Capitalizing on these growing markets, Actel, Altera, and Xilinx have all released lines of FPGAs and other PLDs to serve the military market, meeting the special requirements mandated by the government. These FPGA makers all base these products on their standard commercially available FPGAs and then add what the government requires, such as anti-tamper features, lead packaging, a guaranteed long lifespan, and the capability to withstand a wide range of temperatures. Industrial grade FPGAs can withstand temperatures from minus 40 degrees Celsius to plus 100 degrees Celsius. The military grade temperature range goes from minus 55 Celsius to plus 125 degrees Celsius.

"So we don't roll out a completely different product line with its own unique process," said El-Ashmawi. "We take our current industrial grade product and qualify it for the military temperature ranges."

That approach ensures that the military is getting the most current technology and getting it at a lower cost than if the product had been specifically designed for military purposes only. The approach takes the best of the COTS initiative and marries it with a few military specifications to create FPGAs for the defense market.

Both Xilinx and Altera recently introduced new lines of PLDs that followed that formula – a commercial release first and then a military version of the same family of devices.

In May, Xilinx introduced its Virtex 5Q family of FPGAs for aerospace and defense, offering a SCC (single-chip cryptography) targeted design platform that the company claimed can accelerate development of next-generation secure communications systems. It offers high performance, large capacity, and ruggedized packaging. Xilinx said the devices are used for secure communications applications; electronic warfare, aircraft, and transport vehicles; C4ISR (Command, Control, Communications, Computer, Intelligence, Surveillance and Reconnaissance) systems; radar; and missiles and munitions.

And at the end of June, Altera announced a low-power Cyclone III LS FPGA that the company said offers the highest logic, memory, and DSP density per board area. Altera claimed the devices are the lowest power FPGAs at less than 0.25W of static power for 200,000 logic elements. They are shipping now and target power and board-space-sensitive application in all market segments including military and industrial, the company said.

"There may be some worry that the military segment we are serving will shrink," said Kwon. "But looking at the overall budget, we believe it is set to increase by about 4%, and the areas that will benefit are some of areas we are key in, like anti-IED and electronic warfare."

And that means all three companies, as well as other companies, will continue to pursue and make the most of the military market opportunity.

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