

INSIDERS' GUIDE: FPGAs, TOOLS, AND BOARDS



FEATURED INTERVIEW:

EXCERPTED FROM WWW.EG3.COM



Prepared by:

eg3.com

Jason McDonald, Senior Editor

eg3.com

tel: 510.713.2150

email: info@eg3.com

web: <http://www.eg3.com>



TEKMICROSYSTEMS: HIGH PERFORMANCE FPGA COMPUTING

24 October 2008: High Performance FPGA Computing

INTERVIEWEE. ANDREW REDDIG, PRESIDENT & CTO

TEL. 978-244-9200 x315

EMAIL. ANDYR@TEKMICRO.COM

COMPANY. TEKMICROSYSTEMS, INCORPORATED

WEB. <http://www.tekmicro.com/>**Q. First of all, tell us a little bit about yourself and your responsibilities at Tekmicro.**

A. I was one of the founders of Tekmicro back in 1981. Since then, I have been both the President and Chief Technology Officer for the company. In the early days, I spent a lot of my time on engineering development, and now I spend most of my time on technology and product planning.

Q. Would you tell us a little bit about Tekmicro's focus? What sorts of applications does the company focus on? What kinds of FPGA-based products are offered? Specifically, tell us about your *QuiXilica Digitizers* family.

A. From a market perspective, our focus is on the defense and intelligence markets, serving the needs of prime contractors who use our products to build leading edge systems for their Government customers. Our product focus is the combination of high speed streaming sensor I/O (analog, fiber and digital) with front-end FPGA processing for both laboratory and deployed environments. Our current products are all based on Xilinx's latest FPGA technology, Virtex 5, along with DDR3 memory and the highest fidelity A/D and D/A components from e2v, Euvis, Linear Tech, Analog Devices and Texas Instruments.

Q. What is a typical customer engagement like for Tekmicro? You seem to target high performance data-intensive applications, especially in the military. Is your business 100% military? 80%? 60%? What specific verticals are you most successful in?

A. Our typical customer is a prime contractor / integrator for the defense or intelligence community, building a high performance signal acquisition and processing system for either research purposes or for deployment. Deployment might be in a laboratory type environment (i.e. a ground station or a benign ship borne or airborne environment) or in a more rugged environment (i.e a ground vehicle or a UAV).

A typical customer engagement is highly collaborative, in that our products are almost always tailored to the application through hardware, firmware, software, or a combination of all three. Sometimes, we do some tailoring for the customer and sometimes all of the tailoring is done by the customer. Our business is 90% military, and our specific verticals are all over the map, including radar, sonar, ISR, imaging, SIGINT, COMINT ... pretty much any application that needs high speed streaming I/O and data-intensive FPGA-based processing.

Q. Recently you made news with your announcement of the *QuiXilica V5*, and its production based on the Xilinx *Virtex-5* family of FPGAs. What unique benefits do you get from *Virtex-5*? What new applications does this make possible?

A. Virtex-5 offers some significant advantages over Virtex-II Pro and Virtex-4, some of which are obvious and some are more subtle. The obvious advantages are speed, power and gate density,

which are part of the natural progression of semiconductor technology. Since our customers are all performance-driven, all of these factors are naturally important to them.

The more subtle change, particularly from Virtex-4, is the capability to pick and choose from the various devices (LXT, SXT and FXT) within the Virtex-5 family within a common board design. Xilinx has made those device types pin compatible for a given socket size, which is necessary for board vendors like Tekmicro because it allows us to create one product design that works for a range of applications. In the Virtex-4 family, a designer had to choose between logic-optimized (LX), signal processing optimized (SX) and high-speed serial connectivity (FX). Because our products are highly focused on interconnect, the ability to combine both SX-type DSP and high-speed RocketIO ports is critical. Because Virtex-5 has high-speed connectivity in all of the device types, it is a better choice for board level products that get tailored for multiple applications.

Virtex-5 also has advantages in I/O cell technology that helped enable a shift to DDR3 memory, which was one of our key design decisions both for density and for power efficiency. All of our products now use a common DDR3 memory design with 6.4 GB/s of memory bandwidth (64 bit data path, 400 MHz DDR), which is necessary to match the memory bandwidth to the A/D and D/A speeds that are becoming available.

The end result is that applications can fit more processing into the same Size / Weight / Power envelope, which typically allows applications that “stare” at more signals at once, or have increased resolution and therefore dynamic range, or both.

Q. Much has been made, and disputed, about the military’s movement to COTS. What is Tekmicro’s position on COTS, and how do you see the industry movement to FPGAs intersect with the pressures to do COTS for the military?

A. Well, we may be in a select group since our company was actually doing defense work when the Perry memo came out defining Commercial Off The Shelf, or COTS, products. In some ways, I think that gives us a particularly well-informed perspective on what COTS really means.

At the time COTS was defined, the common practice was for each and every piece of military electronics to be developed to a set of specifications created by the DoD that was specific to that application. So, if the Air Force needed a piece of general purpose computing equipment, it would write a spec and hire a company to design and build something for that purpose. If another program, even another program in the Air Force for the same platform, needed a similar item, it very well might create its own spec and develop a completely different piece of equipment. For each development effort, the DoD used MIL specs to tightly control not only the end result but also every step of the design process from start to finish.

The point of COTS was to replace the DoD-driven development model with a commercial-driven development model. The end items still need to meet stringent *performance* specs, including environmental specs, but the *design* activity and the oversight of the development process moves from a DoD-centric process to a commercial process, ideally one that serves both DoD and commercial customers. Some of the first examples of COTS items were things like ruggedized MicroVAX minicomputers, which obviously incorporate underlying technology that was used by both DoD and commercial customers.

One misunderstood aspect of COTS was the idea of using off-the-shelf commercial items that were not intended for DoD use and deploy them. This was never the point – the focus of the Perry COTS initiative was to drive the development process in a commercial way instead of a DoD-centric way, reduce the overhead of all the specs and oversight, and ideally end up with one product that is used on multiple programs and reduce the cost and schedule impact of custom development.

What Tekmicro has seen is a need for what we call “COTS-on-demand”, where we tailor our off-the-shelf products in minor ways to create exactly what the end user needs for their application. The development model is entirely commercial, so it meets the requirements of a COTS items,

and the products are modular items that get deployed to multiple applications and customers, which reduces overall development cost and schedule.

FPGAs drive COTS in the sense that FPGA-based products are inherently more multi-purpose than ASIC-based products. For example, our JazzFiber V5 PMC/XMC product is an FPGA-based Serial FPD I/O module that can also be used for other protocols, or can be purchased as a QuiXilica PMC and tailored by the customer. A Fibre Channel I/O module looks very similar (fiber in, PCI or PCIe out, bridge in the middle), but because the bridge is an ASIC and not an FPGA it can only support one type of interface. So, both are COTS products, but the FPGA-based product supports a wider range of interfaces and applications within the confines of one product.

Q. Another interesting transition is the transition to 10 Gbit Ethernet. What factors do you see encouraging military engineers to make the transition? What are the pro's and con's of using 10GE rather than more "traditional" fabrics?

- A. We see 10 Gbit Ethernet as a very interesting technology, particularly as a fabric alternative for embedded systems such as VXS. In fact, we are sponsoring and leading the VXS working group, VITA 41.8, to standardize the use of 10 Gbit Ethernet in VXS.

10 Gbit Ethernet has two huge advantages over other fabrics. One is that it completely solves the "out of the box" problem, making it very straightforward to integrate sensors and processors outside the VXS chassis with the processors and I/O inside the chassis. While in theory this is possible with other fabrics, the ecosystem just isn't there to accomplish this easily.

The second is interoperability, both at a hardware level and at a software and protocol level. Hardware interoperability is well defined for all fabrics, but integration between user applications, streaming I/O nodes, and FPGA processors is really accomplished at the software level. Basic software interoperability between network devices is both well understood and very straightforward, and newer protocols such as RDMA allow network-enabled I/O and FPGA devices to achieve wirespeed throughput over a 10 Gbit Ethernet fabric.

A side effect of high level interoperability is the ability to prototype a solution using "traditional" rack-and-stack resources and then to repackage the solution into a higher density solution using VXS for deployment. Using common network architecture such as 10 Gbit Ethernet makes this very easy to do.

And, of course, using 10 Gbit Ethernet as a native fabric meshes directly with the current focus on network-centric warfare, with all of the resources in a system (streaming I/O, FPGAs, GPPs) available as network-addressable devices.

Q. Are there other areas in which you see commercial technologies penetrating military applications? Any particular FPGA-centric developments that you think are interesting?

- A. Intel's initiatives to reduce total system power are interesting, in that they potentially enable Intel family processors in more power-constrained embedded applications. As FPGAs do more of the repetitive front end processing, we are seeing more and more applications shift from a "sea of PowerPCs" architecture to FPGAs with one or two back end Intel processors, typically running Linux.

Some of the efforts underway to better integrate Intel processors and FPGAs, either through direct connection or through enabling network interfaces on FPGAs, will be interesting when they get farther along.

Ultimately, companies like Tekmicro serve a market that will always be much smaller than the larger commercial space, so our value proposition is not to drive commercial technology but to leverage the trends that are driven by the larger commercial space. This is why technologies such as 10 Gbit Ethernet are interesting, not because they have inherent performance advantages

but because the ecosystem (silicon, IP, software, modules) is both larger and more cost effective than the more niche-oriented technologies will ever achieve.

Q. Thank you for this interview.