FPGAs Then and Now

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These are challenging times for most electronic manufacturers. The current global economic climate has devastating effects on businesses from industrial to consumer electronics alike. Many top tier manufacturers are experiencing unchartered waters such negative profits and mass restructuring for the first time with really no clear end in sight. Despite this gloomy outlook, it is also a time for these companies to rethink their strategies and review all the ongoing projects and product plans. As development schedules are clearly getting pushed out, this window presents an opportunity for design engineers and management to take another look at new offerings from various technology providers. Perhaps adopting some of these new technologies will allow these companies to gain an advantage over their competitors. There have been several key announcements in the last several weeks from FPGA companies. The latest products based on the most advance processes may provide some answers for design engineers in these difficult times. The FPGA industry itself has gone through some up/down cycles but continued innovation and the availability of leading edge technology has allowed it to grow not only in sophistication but also move into brand new markets such as consumer handheld applications.

In 1985 Xilinx first introduced the FPGA to the digital design community. The original XC2064 device consisted of 64 CLBs (Logic Cells) in an 8 x 8 matrix. Back then it was considered a novel idea but with limited application due to lack of density and performance compared to ASICs. Now almost 25 years later the largest member of the just introduced Virtex6 family has over 750K logic cells. Xilinx's main rival Altera's Stratix 4 family also boasts a device with close to 680K logic cells. As long as Moore's law holds true, both vendors will continue to engineer the biggest and the fastest FPGAs as they work together with their respective foundry partners. In the earlier days, other startups and established semiconductor manufacturers tried to enter the market owned by Xilinx and Altera, but only Lattice and Actel remain in the current market. Altera and Lattice are somewhat similar in that they both started out with CPLDs and later entered the FPGA market by either developing their own FPGAs or by acquiring companies or divisions with FPGA products. Actel had and still has a unique AntiFuse technology which addresses the requirements of special applications in military and space. Xilinx started out as an FPGA company first and then later acquired the likes of Plus Logic and the Coolrunner family from Philips Semiconductors to complement their FPGA line with CPLD products. The current trend is for most PLD companies to invest in FPGA type architectures with the latest process technologies.

From the mid 1990's to today, there was dramatic growth in the PLD industry led by Xilinx and Altera. Several factors contributed to this rapid growth, first and foremost is the decision by the big two to develop

advanced FPGAs with the leading process technologies available at the time. Xilinx partnered with UMC and Altera strengthened their relationship with TSMC. The race was on for developing the most advanced FPGAs that challenged ASICs in terms of features, performance and cost. For the wafer fabs, the FPGA architecture became an ideal vehicle to develop leading edge standard CMOS processes. In the late 1990's Xilinx announced the Virtex family and Altera the APEX family (later changed to Stratix). There was insatiable demand for these high end FPGAs to build the Communication and IP infrastructure that support the broadband needs of the internet world. To this day both Xilinx and Altera continue to compete furiously over the leading edge FPGAs for the highest performance, most features and hard embedded IP cores.

The other factor was the decision to develop low cost FPGAs for the high volume market. Low cost FPGAs became reality due to the rapid process advances driven by high end FPGA architectures. Today, annual FPGA shipments of over million units to consumer end products are common. It is very likely that a flat screen LCD or Plasma TV in your living room contain one or more high volume FPGAs. The availability of these low cost FPGAs has led to the dramatic growth of the user base. Today, the overall market for high volume FPGA is over 30% of the total market.

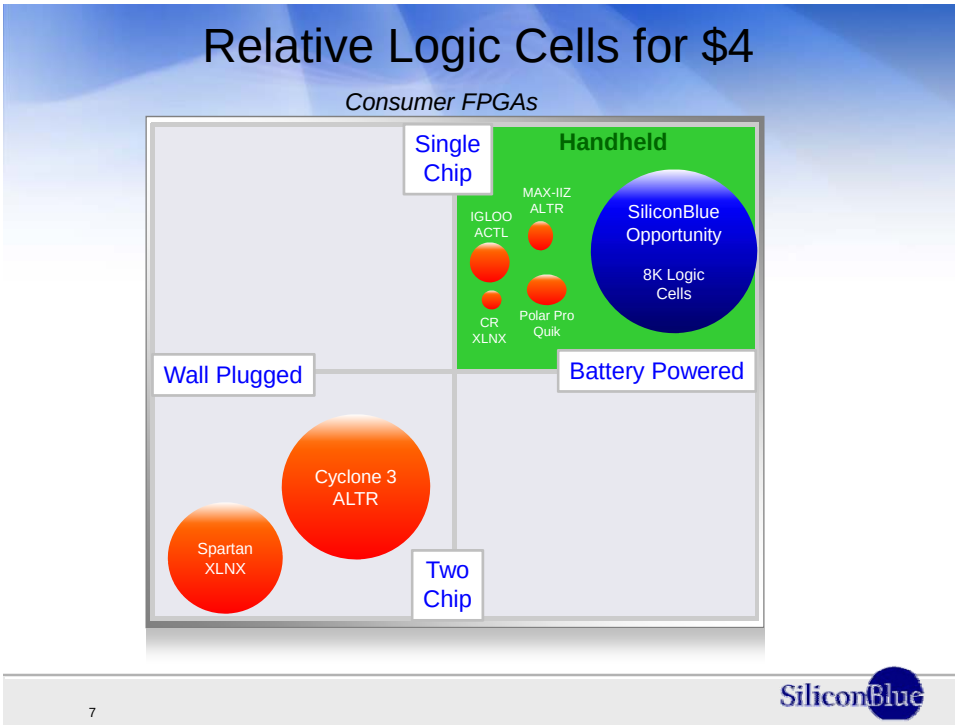
During the high growth period, PLD companies became the darlings of the semiconductor industry, both revenue and profits grew dramatically with Xilinx and Altera topping the $1B revenue line and approaching $2B. It would appear then that there would be competitors and start ups wanting to enter the market. Why weren't there significant new products or companies developing FPGAs to challenge the leading companies during the last 10 years? On one hand there were tremendous barriers to entry, there are intellectual properties protected thousands of patents. Perhaps the lawsuits brought on by Xilinx and Altera against each other scared away potential start ups. The other is the software development effort to create a tool suite for the devices. The initial heavy investment and number of man years necessary to develop a complete standalone system will discourage any new competitor. Thousands of software engineers are involved in developing and improving the tool suite at the existing PLD/FPGA companies.

Things have started to change in the last 4-5 years. Some of the fundamental patents for the FPGA expired. The after effects of the net bubble and the product delays by the leading vendors to release the advanced products on time have stalled the growth of the overall FPGA industry. The jump from 130nm to 90nm was especially painful as issues prevented vendors and their foundry partners from releasing the products against their original schedules. Product strategies and plans were revisited as the dynamics of the industry started to change. The leading edge products became more challenging to design with as they grew in size, functionality and performance. The latest high end offerings from both Altera and Xilinx take complexity to a whole new level at the 45nm and 40nm process nodes. The challenges of designing with these devices can be overwhelming as they become platforms for system level functions. On the business

side, products developed on new process generation required higher investments, support costs, resources and longer time for customers to develop. Design cycles have started to stretch out and taking longer for the manufacturers to get to production revenue. Instead of replacing ASICs, new FPGAs with higher densities and lower price points were used to replace multiple existing FPGA sockets which resulted in lower overall revenue. Many fierce battles were fought between Altera and Xilinx to be the main supplier for the next generation of network and communication gear. In some cases high end FPGA sockets are now being replaced with the lower priced high volume families which can now address higher performance and densities of the previous high end family. To cost reduce their systems, many high end FPGA customers will first evaluate the latest low end offerings to see if they meet their requirements. The recent trend is for the big two to focus on the high density, high performance and fully featured side of the market with their latest products.. On the flip side no significant product releases or announcements have come from top 2 vendors in the CPLD and low end of the high volume FPGA.

Several new programmable logic startups have emerged in the last several years and they can clearly be separated into 2 categories: the high end system level solutions with ease of design and advanced software features as key benefits on one side and the low end high volume solutions with key differentiators on the other. Achronix, XMOS and Tabula can be considered vendors with high performance, feature rich devices and solutions that are targeted for system level designs. On the other side of the spectrum, SiliconBlue Technologies have taken the challenge of developing a low power FPGA for the battery operated consumer handheld market.

SiliconBlue Technologies was founded less than 3 years ago by a team of industry veterans with combined experience of over 300 years in the PLD/FPGA field. There has not been a new FPGA company with a production ready device in over 10 years and SiliconBlue has broken that dry spell. Not unlike other successful FPGA vendors in their early days, SiliconBlue has relied on key partners such as TSMC, Advanced Silicon Engineering and Magma Design Automation to bring to market a complete low power FPGA solution. The availability of proven 65nm LP process from TSMC, leading edge packages in smallest of form factors by ASE and advanced front end tools from Magma are the ingredients for their success. Industry veterans with stellar track records in high volume FPGA/CPLDs have taken advantage of these technologies and developed from the ground up an ultra low power FPGA solution for the consumer handheld market in record time. SilconBlue has just recently announced volume production shipments on 3 members of their iCE65 family. The 3 key benefits that SiliconBlue brings to this market are low power, low cost and secure single chip solutions. Design engineers for these battery operated devices finally have access to higher density FPGA solutions that wall plugged system designers have enjoyed for decades.



Moving forward, innovation should produce FPGAs with highest densities, performance and processing power driven by advanced level system design tools. And it will also bring feature rich flexible design alternatives to the low power, handheld market. Big and small alike for FPGA/PLD vendors to succeed: razor sharp focus, attention to the needs and trends of the market and flawless execution will dictate who will lead the industry in the coming years. It is truly an interesting and challenging time again for the PLD industry. To the electronic design community, it's a great time to take a look and learn about all the new offerings from these innovative vendors as you will be the true beneficiaries of these latest solutions