Market Survey of Xilinx

In this survey, the company's current CPLD and FPGA offerings will be discussed. In specific, comparisons are made based on the capabilities of the devices and recommendations are given for use cases.

Xilinx's CPLD offerings include the CoolRunner – II family as well as the XC9500XL family.

The CoolRunner II family has between 750 – 12,000 system gates [1] dependent on the model as well as an impressive 32 – 512 macrocells which are PAL structures, essentially making the CPLD an extension of the PAL. Despite these impressive figures, the CoolRunner-II family only has 56 product terms per microcell whereas the XC9500XL family provides 90 product terms per macrocell for even its baseline unit – the XC9536XL. The CoolRunner-II family is best suited for low-to-medium complexity digital control and signal processing circuits. A good example may be the implementation of a Fourier transform on a limited amount of data points.

The CC9500XL Family finds its strength in the higher number of product terms per macrocell. These means that more complex logic functions may be implemented. Allowing for the possibility of more complex digital signal processing applications and realizations. In addition, the two families differ in their input and output voltage abilities. The CoolRunner-II family accepts and sends a wider range of voltages than the XC9500XL family does. In specific, the CoolRunner-II family accepts and outputs 1.5/1.8/2.5/3.3V while the XC9500XL family only accepts 2.5/3.3/3.5V and outputs only 2.5/3.3V. This difference may be quite significant and may lead the designer's choice ultimately.

Xilinx is best known for its FPGAs of which there are several primary classes in production. The following table displays the FPGA families available by transistor node [2].

45 nm	28 nm	20 nm	16 nm
Spartan-6	Virtex-7	Virtex UltraScale	Virtex UltraScale+
	Kintex-7	KinTex UltraScale	Kintex UltraScale+
	Artix-7		Artix UltraScale+
	Spartan-7		

Because Xilinx offers such a wide range of technologies, it can offer both a cost-optimized and performance optimized portfolio. From the viewpoint of cost, we can see that the Spart-7, Spartan-6, Artix-7 are likely to be superior choices for the user not concerned with speed or optimal, state-of-the-art performance. Were the user to select, for example, a device from the Artix-7 FPGA family, he or she would have access to between 12,800 and 215,360 logic cells, and as many as 12,000 to 269,200 Slices (a slice is the Xilinx terminology for an elementary programmable logic block). For a less sophisticated design, the engineer could choose the aptly named Spartan-7 series. Which would allow for between

6,000 and 102,400 logic cells to be utilized and between 938 to 16,000 slices to be used. Although these may seem small in comparison to the Artix-7 range of 12,000 – 269,200 slices, it is important to keep in mind that a design should use a device of just the right size. Applications for the Spartan family include lower-complexity digital signal process and algorithm testing and design work.

Turning to the higher end models, the UltraScale+ models may be shown to have far and away the most system logic cells as well as CLB flip-flops. A CLB flip-flop is a combinational logic block which are the main logic resource for implementing sequential as well as combinatorial circuits [3]. They may be compared to the Slices described in the previous paragraph. Following that comparison, we see that even the low-end models such as the Virtex UltraScale+ series include CLBs into the hundreds of thousands. The Virtex VU31P by example offers 879,000 CLBs in comparison to the 269,200 slices found in the Artix-7 mentioned previously.

The UltraScale+ devices are all either the 14nm or 16nm fabrication variety and are using FInFET transistor technology. Features of the UltraScale+ line up also include the SSI (stacked silicon interconnect) technology which allows for higher signal processing and serial IO bandwidth. An UltraScale+ device therefore would be suitable for a highly demanding environment or application. One example may be digital signal processing for smart vehicles or other AI applications which require extensive mathematical processing. Other applications may include military or space, for which special versions of the devices are produced. For example, the Space-Grade Kintex UltraScale+ FPGA (RT Kintex UltraScale+) and military grade versions (XQ Kintex UltraScale+) of the Kintex line offer enhanced temperature ranges (–55°C to +125°C for the XQ [4]) as well as additional features such as radiation tolerance.

Bibliography

[1] Xilinx, "XILINX CPLD PRODUCTS," [Online]. Available: https://www.xilinx.com/content/dam/xilinx/publications/matrix/CPLDs.pdf. [Accessed 19 January 2022].

[2] Xilinx, "FPGA Leadership across Multiple Process Nodes," Xillinx, [Online]. Available: https://www.xilinx.com/products/silicon-devices/fpga.html. [Accessed 19 January 2022].

[3] Xilinx, "7 Series FPGAs," 27 September 2016. [Online]. Available: https://www.xilinx.com/support/documentation/user_guides/ug474_7Series_CLB.pdf. [Accessed 18 January 2022].

[4] Xilinx, "Defense-Grade Kintex UltraScale+ FPGA," Xilinx, [Online]. Available: https://www.xilinx.com/products/silicon-devices/fpga/xq-kintex-ultrascale-plus.html. [Accessed 19 January 2022].