

PROGRAMMABLE LOGIC DEVICES
VS.
MICROCONTROLLERS

On the next page are shown two “identical” controllers. One is implemented in a cYC371i CPLD, the other in a 80C51A Microcontroller. What is the difference?

A minor, yet important, distinction is that the silicon is programmed using different languages. The CPLD is programmed in some Hardware Description Language (VHDL) while the microcontroller is programmed in a more traditional programming language.

Once programmed, the CPLD synthesizes traditional hardware logic. The propagation delay for $X = A * B + C$ is typically only a few nS. The time to set or clear Y is, likewise, only a few nS. The clock rate may be as high as 50 to 100MHz (or even higher).

The microprocessor has to be programmed, using “traditional” CPU instructions to perform the same logic. If A, B, and C are fed to a common 8-bit INPUT PORT, they may be read in all at one time and stored in memory as a whole. To check to see if A and B are both 1's, this data “ABC” is ANDed with an “ABMASK” containing 2 1's in the locations representing A and B. If the result of this ANDing is equal to the mask, then A and B were both set. The same sort of operation is done on C. Finally, if Y should be 1, the data at the OUTPUT PORT supplying Y and Z is Ored with a bit representing Y. If Y should be 0, then that bit is cleared by ANDing the complement of the Y mask with the port data. The operations for C are similar except only performed when an internal timer says “it’s time to do it.” (An external signal could also be used to simulate the clock). Note that the CLK input shown is to clock the microcontroller, not the inputs and outputs. Obviously, it takes many CPU clock cycles to perform one of these operations so the delay between A and Y is no longer in nS but in uS (if not mS). And, also, is not necessarily predictable.

Why use a microcontroller if a CPLD is faster? Microcontrollers have many features that are not found in CPLD's (or hard to synthesize). One of the principal features is MEMORY. Even a simple 80C51 has over 100 bytes of RAM which is often useful to have available. It also has other features such as UARTS to communicate with serial devices.

In summary, a microcontroller (on a chip-per-chip basis) has a lot of features not found on a CPLD but is also a lot slower. If speed is not an important factor, the many features of a microcontroller may be desirable. If speed is critical, then the CPLD is the only viable choice.