Bit-Slice Processor

A microprocessor designed to allow variable word sizes using 2, 4, or 8 bit processor units on a single chip. These devices can be paralleled to yield an 8, 12, 16, 24, or 32 bit processor when assembled with other components. Occasionally used in printers.

It is a technique for constructing a processor from modules, each of which processes one bit-field or "slice" of an operand. Bit slice processors usually consist of an ALU of 1, 2, 4 or 8 bits and control lines (including carry or overflow signals usually internal to the CPU). For example, two 4-bit ALUs could be arranged side by side, with control lines between them, to form an 8-bit ALU. A sequencer executes a program to provide data and control signals.

Bit-slice microprocessors are the Legos of microprocessors. In bit-slice microprocessors the MPU is split apart into CU and ALU chips. At first blush, this may seem to go against the rationale for using a MPU. Splitting these functions apart into multiple increases complexity and expense. After all the MCU was built to shrink a computer and bit-slice seems to be expanding it. Actually it is and does, but there are some interesting advantages to the bit-slice approach.

The bit-slice microprocessor design has three very significant advantages.

1. ALU's can be attached together in horizontal configurations to create computers that can handle very large chunks of data at a time. An example of a bit-slice processor is the AMD 2901. With the AMD 2901 bit-slice, the 2901 is the ALU, the AMD 2910 is the CU. The 2901 was a peer of the Intel 8080, but the 8080 could only handle 8-bits of data at time. The 2901 was a 4-bit ALU, but 4 2901's could be linked together to create a computer that could handle 16-bits at a time, 8 could be put together to create a 32-bit computer and so on. Whereas the 8080 would have to use multiple cycles to process 16 or 32 bits, the appropriate 2901 configuration could handle it in a single cycle giving such a computer significantly more power than the 8080.

2. Advantage of the Bit-slice design is the fact that the two chip design allowed the chips to use bipolar chip technology (example: the Intel 3002). Bipolar is very fast, but consumes lots of power and dissipates lots of heat. Because of the heat dissipation problem, bipolar chips could not be as dense (in number of transistors per area) as the PMOS or NMOS chips. It was not possible to build single-chip CPU's using bipolar technology. So, in addition to the wider data paths the bit-slice devices could achieve, they were inherently faster due the bipolar technology that was employed to build the chips.

3. The bit-slices had the ability to allow users to create their own instruction sets for their applications. Instruction sets could be created to emulate, or enhance, existing processors such as the 6502 or 8080, or to create a unique instruction set specially adapted to maximize performance of a specific application. The combination of the speed and flexibility of bit-slice devices made the very popular and created a cult-like following, especially for the AMD 2901.