Moore's Law and the Microcomputer Invasion

The density of RAM (random-access memory chips) follows a curve that is predictable. As higher-density chips (usually two or four times the capacity of the previous generation) are introduced, they tend to cost about the same as the previous generation chips and, therefore, deliver a declining cost per byte. More than thirty years ago, Gordon Moore of Intel asserted that the number of transistors on a chip would double each year or year and a half. This projects that the capacity of a memory chip selling for, say, $10, is roughly 2 to the power (this year minus 1964). In other words, the chips quadruple in density every two years. In fact, the density of RAM chips increased faster than this for a while, then slowed, but it was a good benchmark for time periods up to six to eight years from now.

Why does it matter to a computer designer how dense the RAM chips are? In computer systems, the survivability of a design depends on being able to address (connect to) enough RAM. As the density of RAM increases, the number of bits needed to access the RAM increases. For example, 20 bits of address are enough to access a megabyte of RAM; 30 bits of address are enough to access a gigabyte of RAM. When the computer runs out of address bits, its life is terminated.

In 1976, Gordon Bell, who was then VP of Engineering for Digital Equipment Corporation (DEC), visited Intel to see the new 8086 processor chip, which subsequently was the basis for making the IBM PC. He found out that the Intel processor chip had planned on 20-bit addressing. Around that time, minicomputers such as ones built by DEC, had between 16 and 22 bits of addressing capability. Bell knew when he saw the 8086 that the minicomputer's days were numbered, because the single-chip computer from Intel had a capacity for memory addressing that was previously "owned" by minicomputers. By understanding Moore's Law and the growth of memory address sizes, Bell was able to foresee the invasion of the minicomputer market by systems with a single-chip processor.

DEC's next generation, the VAX, had 32 bits of addressing, but that did not permit the minicomputer makers to retain market share in the "low end" of the computer market, once systems with single-chip processors entered it.

DEC became a victim of the same technology forces that, twenty years earlier, had enabled DEC to take significant market share from mainframe computer makers.

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How to Manage Development
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