Definition and Limitation of Moore's Law

About Its Definition:

Although it is called a Law, Moore's law is actually a postulate/observation regarding computer's speed, that describes the evolution of transistors (and subsequently, processors) through time.

Moore predicted that the density of the transistors on a IC (integrated Circuit) or CPU (Central Processing Unit) would double every two years. This density impacts speed directly, as smaller transistors switch faster between their I/O (1/0) status.

About its Limitations:

Moore's Law has become more and more incorrect for the past ten years, as the size of transistors have become smaller and smaller. There are several limitations (including in the field of physics) that made impossible to decrease the size of transistors, as they are becoming closer and closer to having just a few atoms.

The reduction of transistors come with several problems, being those:

1. As transistors consume power with every switch of state (I/O), and the density of transistors in IC's and CPU's cause a increase in electric consumption. Although the individual transistors tend to consume less power as they get smaller, since you have more of them per square millimeters , the power consumptions goes up.
2. Due to physical properties of energy an matter, heat is a underlying problem with the increase of power consumption. The higher power consumption gets, bigger are the requirements to keep the CPU in acceptable working temperatures, since a CPU can actually melt for too much heat, damaging it definitely. Air coolers and water coolers currently can remove the generated heat, but his can become almost impossible without complex dedicated cooling hardware in the coming years, which is expensive.
3. Although transistors get smaller, their power consumption can't go too low due to interference (circuit noise) generated by the components. In the old days of Amiga and Commodore computers, it was common to see metal covers on certain circuit to avoid electronic noise from the board itself, but in the current days, although technology have got a lot better in controlling noise. It has become increasingly impossible to add the necessary shielding on transistors to avoid incorrect readings due to interference.
4. Lower power consumption by transistors cause results from it's calculations to become hard to read due to electric properties of transistors, like leakage for example. the threshold of 0.5 volts in a circuit with 2 volts allow designers to extrapolate, since on conditions in a transistor would still be between 1.5 and 2.5 volts, and off conditions in a transistor can be between -0.5 and 0.5 volts. if the working voltage of circuits become too small, it becomes almost impossible to discern between a leaking off status and a leaking on status on certain transistors. This is a direct problem of miniaturization of transistors and can't be solved with current technology.

Author: Gustavo H. M. Silva

LinkedIn: http://linkedin.com/in/gustavohmsilva