Moore's Law

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Moore's law predicted that number of transistors in a dense integrated circuit would double every 2 years. This would mean they would become exponentially faster every 2 years. When Gordon Moore first stated this law in 1965, he predicted the density would double every 1 year. But he later revised the law in 1975 to change that to 2 years.

This has slowed in recent times due to physical limitations. Some of these are the power or temperature problem. As the number of transistors increases, the power consumption also increases exponentially, causing the temperature to increase. Air cooling can only do so much to keep the chip from melting. Water and nitrogen cooling work better on gaming devices or supercomputers, but that is not feasible for every device, hence still being an inhibition for regular devices.

The power used by a transistor is defined by

$$P = \propto * CFV^2$$

P = power $[want\ to\ minimize]$

$\propto$ = how often the transistor switches states $[want\ to\ maximize]$

C = capacitance $[\downarrow as\ transistor\ size\ \downarrow]$

F = clock frequency $[want\ to\ maximize]$

V = voltage swing $[\downarrow as\ transistor\ size\ \downarrow]$

Very low voltage has its own limitations, further causing Moore's law to slow down. We need enough voltage to turn the transistor on. Low voltage also increases noise vulnerability.

Due to the smaller size of transistors, the insulation between them also decreases. This causes a power leakage between transistors, causing another limitation to its size.

As mentioned above, Moore's law has slowed down due to temperature, power, insulation, and voltage issues.