Moore’s law

-- What is the definition of Moore’s law?

Moore's Law refers to Moore's perception that the number of transistors on a microchip doubles every two years, though the cost of computers is halved. Moore's Law states that we can expect the speed and capability of our computers to increase every couple of years, and we will pay less for them. Another tenet of Moore's Law asserts that this growth is exponential.

-- Limitations:

The limitation that invalidates Moore's law these days is the fact that power consumption increases with increasing transistor density. This prevents Moore's law from continuing to hold or be true. With this increased power consumption problem, it is becoming impossible to keep increasing transistor density. Ignoring this limitation could lead to high heat generation in the core, which could cause the system’s inability to completely dissipate the generated heat and that could melt the chip.

-- Why has it now stopped being true?

<u> Electrical Leakage:</u> As transistors get smaller, they become energy efficient. The size of each transistor today prevents the transistors from containing the electrical current through them. The generated heat can reduce the lifespan of the transistors.**

<u> Heat Generated:</u> heat generated by leaking billions of transistors could destroy the chip. Therefore, there is a constant need for the processor to reduce the amount of voltage passed through the many transistors, which limits the chip’s processing power.**

<u> Cooling Cost and Effort:</u> doubling the number of transistors causes increase in the amount of heat generated. Therefore, effort is required in providing a way to cool the system to prevent the chip from melting. In terms of cost, data centers and supercomputers require high cost of providing cooling to dissipate the heat generated by clusters of computer systems.**

Let’s deep in and discuss dynamic power consumption:

Dynamic power consumption is governed by this law: $P = \alpha * CF(V^2)$

α: percent of time switching.

C: Capacitance.

F: Clock frequency.

V: Voltage Swing.

-- <u>Temperature:</u> From the above dynamic power equation, power consumption is directly proportional to frequency, increasing frequency will increase power consumption. Also, increasing transistor density increases power consumption. In other words, temperature increases as power increases. This leads to a large amount of heat generated in the core.

-- <u>Voltage Scaling:</u> Since voltage is inversely proportional to F, Voltage level must be kept below a threshold. If voltage level is not kept below the threshold, it could lead to noise. Therefore, voltage scaling is inevitably limited to noise; increasing voltage level causes an increase in noise level. Since voltage scaling is limited by a threshold or noise, voltage scaling cannot be used to prevent the electrical leakage problem. If not, voltage scaling could have been used to reduce power consumption.