MOORE'S LAW

Is the observation and projection of a historical trend that the number of transistors in a dense integrated circuit (IC) doubles about every two years. Rather than a law of physics, it is an empirical relationship.

This can represent reduced fabrication costs and in consequence more people can access to the new technology.

The Moore´s law is accepted as empirical because of physical limitations. This is best described by the relationship between power and transistor density.

Relation between power and transistor density:

Increasing the number of transistor density translates into more processing power and less size.

But there is a catch: **the power wall**. This means that high power leads to higher temperatures, this represent a risk for the ICs given that they can melt or burn.

There is a generic equation for power: **dynamic power.**

$$P = fCV^2$$

P: *dynamic power.*

f: *frequency (the clock speed).*

C: *capacitance (related to transistor's size).*

V: voltage (supplied voltage).

To save power consumption, it is necessary to scale down the voltage (because it is exponential).

But voltage scaling cannot go too low for physical reasons:

1. **First, Voltage swing must be higher than the threshold voltage of the transistor:** Below that threshold they cannot switch on.
2. **Second, Noise problems:** they occur when the voltage is too low. There´s always noise in any kind of IC system.
3. **Third, leakage power:** the transistor leaks power even when it is not switching. The reason for this is because there is an insulator for the circuitry. If this insulation is not thick enough the electrons can jump from one circuit to another. This produce malfunction and in consequence: unexpected errors. Normally this happens when the IC is scaled down below the boundary of 3 nm (nanometers).

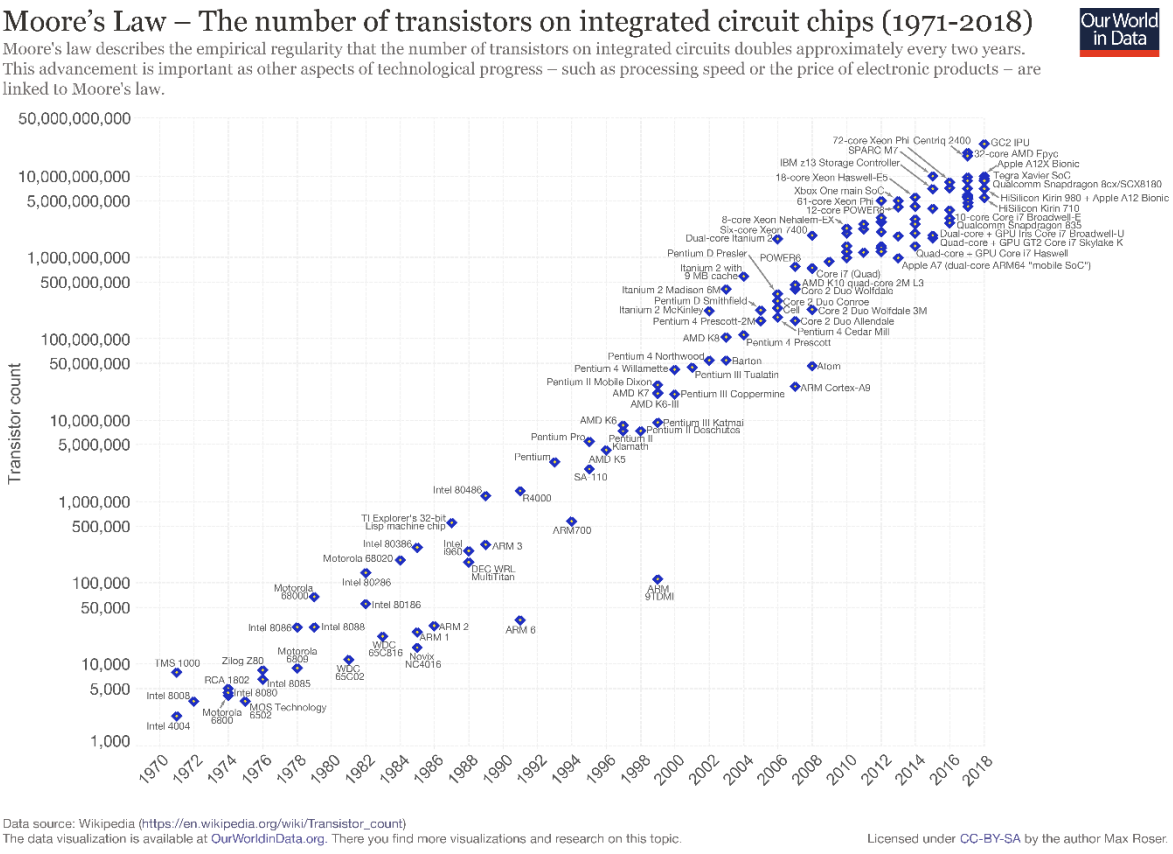

Figure 1 Number of transistors over the time – Wikipedia - Max Roser