# **The physical limitations of Moore's law**

Moore's law - transistor density would double every two years.

It is not a physical law, it's just a projection of a historical trend.

Today, the Moore's law no longer works for several reasons:

1. Increasing the number of transistors increases the power consumption and reducing the size of the transistors does not help. The power has now is a critical issue (Power Wall).
2. An increase in power leads to an increase in temperature. Even if we have more power, the temperature becomes very high, which makes it impossible to use such chips. Liquid cooling can help solve part of the problem but it is only used for HPC and something specific needs.
3. Limits of voltage reducing

***Dynamic Power is: P = α \* CFV2***

* α is percent of time switching
* C is capacitance (related to size)
* F is the clock frequency
* V is voltage swing (from low to high)

According to the formula above, reducing the voltage helps reduce power consumption. It's called Dennard scaling. But Dennard scalling can`t continue too, because the voltage cannot be reduced indefinitely:

* The voltage must be higher than the threshold voltage of the transistor.
* The voltage must be higher than a noise on signals.
* When scaling down the leakage power increase.

All these reasons stopped the work of the Moore's law