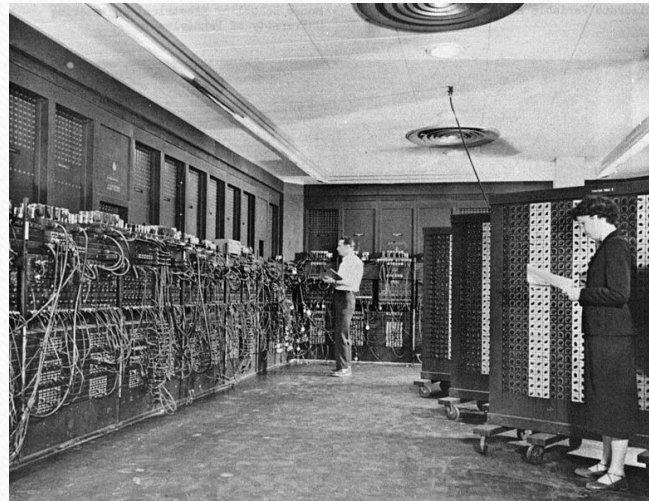# Clock Frequency Scaling Trends
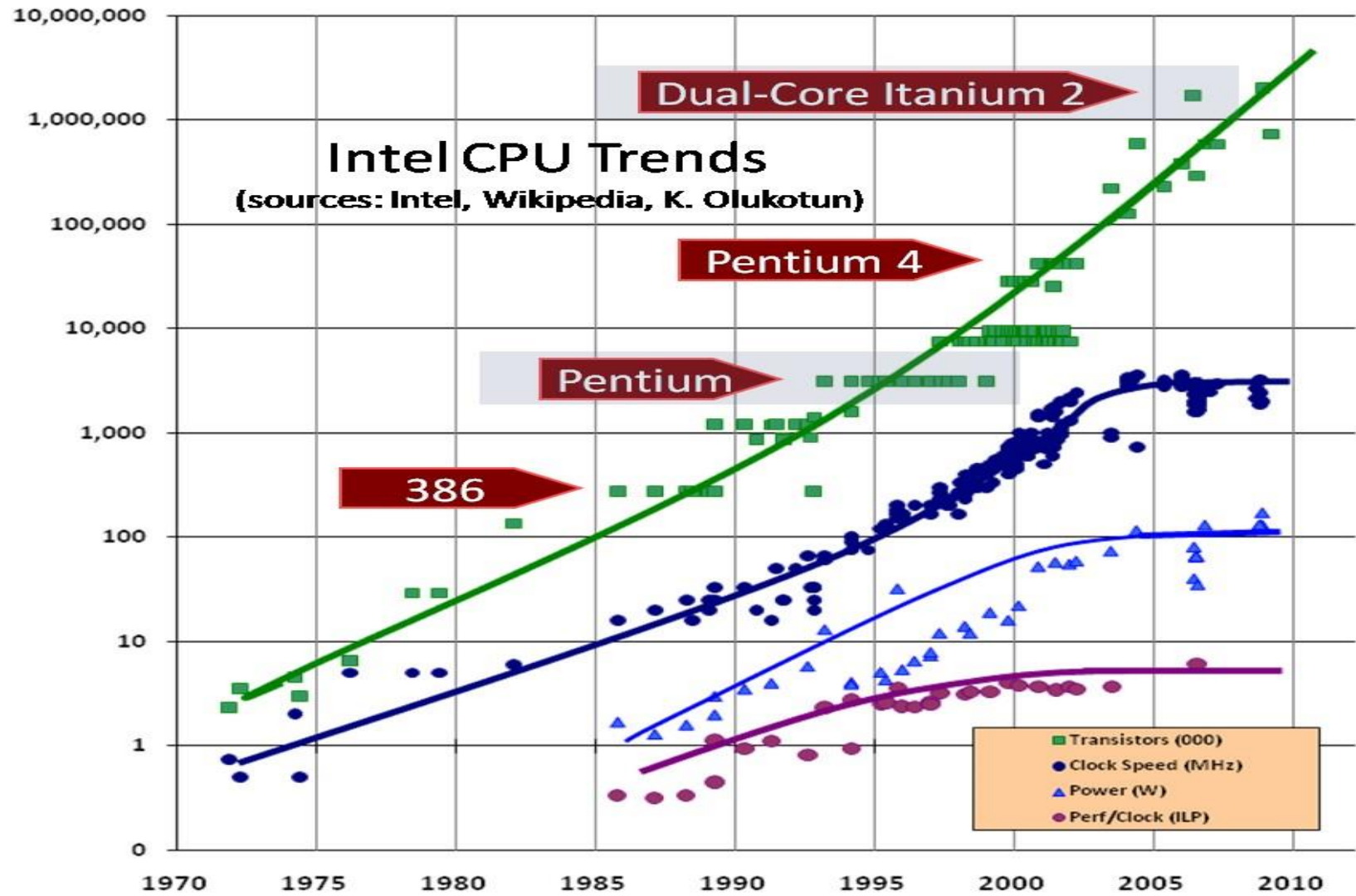
By Malik Eteer and George Tcholakov

History

- ENIAC, 100 kHz, 1946
- Intel 8080, 2MHz, 1974
- IBM PC, 4.77 MHz, 1981
- Intel P5 Pentium, 100MHz, 1995
- Intel Pentium 4, 3 GHz, 2002
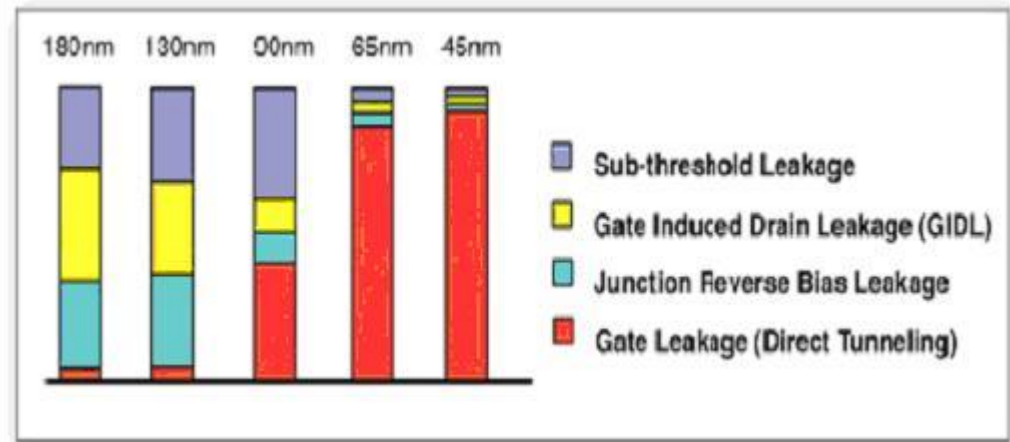- IBM zEC12, 5.5 GHz, 2012

Clock frequency leveling off

Intel CPU Trends
(sources: Intel, Wikipedia, K. Olukotun)

Dual-Core Itanium 2

Pentium 4

Pentium

386

- Transistors (000)
- Clock Speed (MHz)
- Power (W)
- Perf/Clock (ILP)

Constraints

- Power Consumption
- Current Leakage
- Overheating
- Scaling of Transistors

Solutions

- Hyperthreading

- Multicore Architecture

- Overclocking

- Dynamic Frequency Scaling

- Fabrication Processes