

Future of Nano CMOS Technology

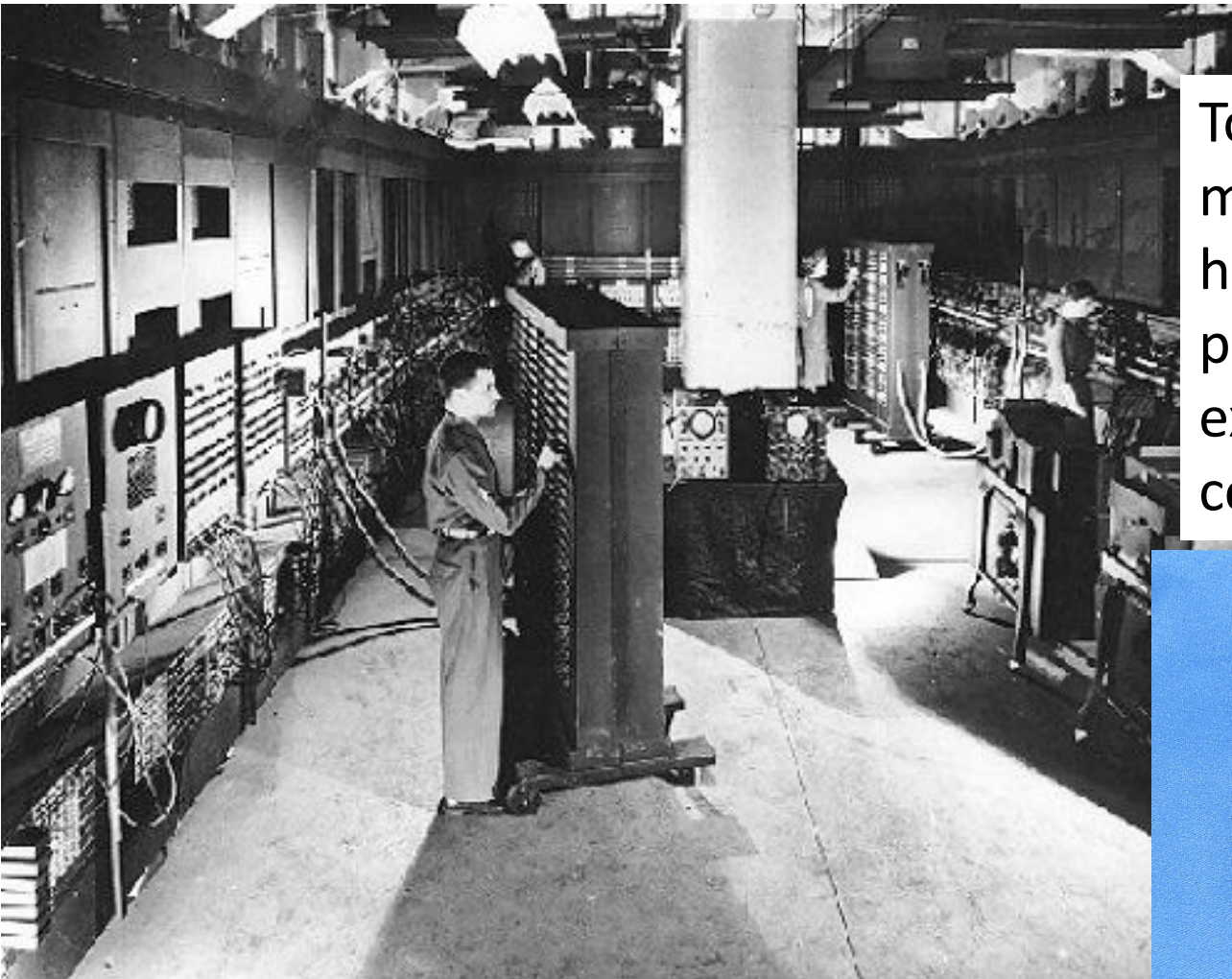
IEEE EDS WIMNACT 31

January 30, 2012

**Hiroshi Iwai,
Tokyo Institute of Technology**

First Computer Eniac: made of huge number of vacuum tubes 1946
Big size, huge power, short life time filament

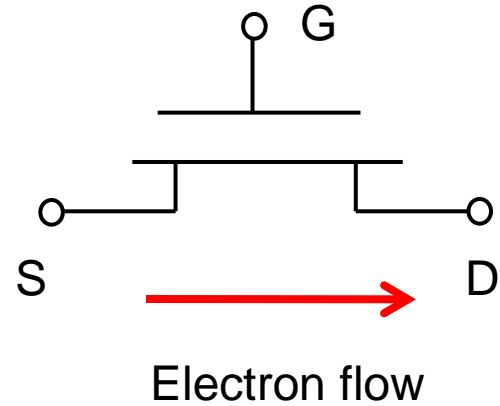
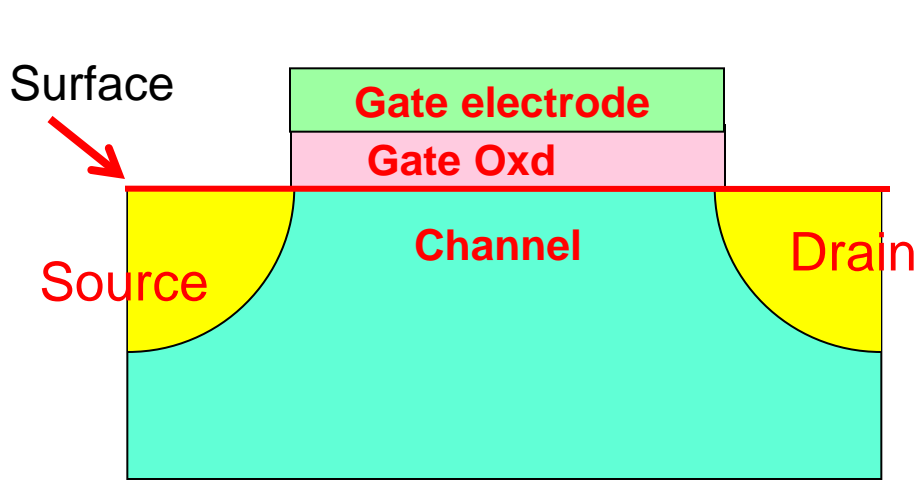
→ dreamed of replacing vacuum tube with solid-state device



Today's pocket PC
made of semiconductor
has much higher
performance with
extremely low power
consumption



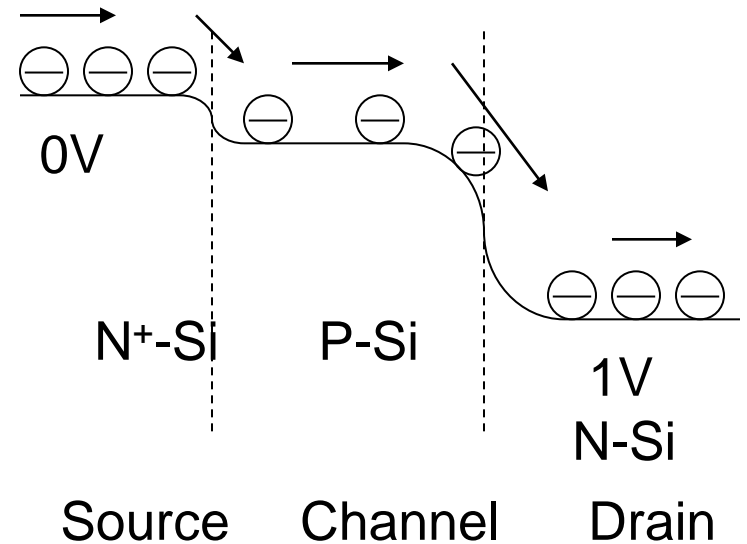
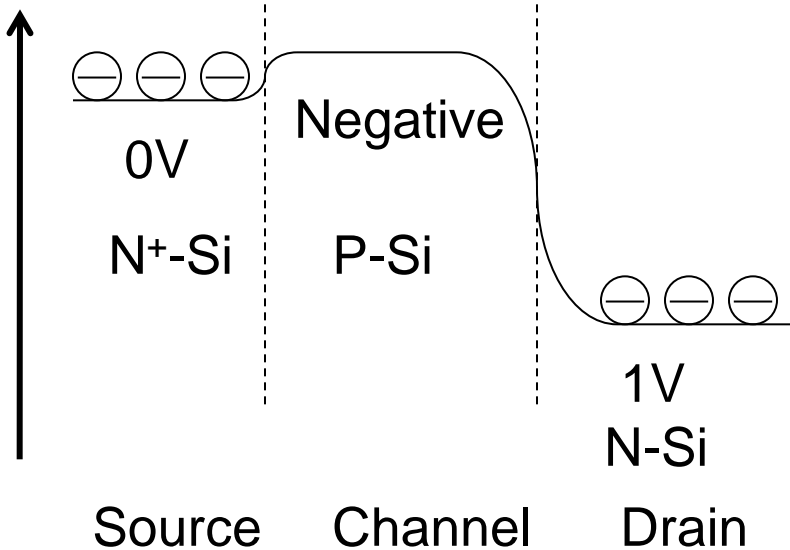
Mechanism of MOSFET (Metal Oxide Semiconductor Field Effect Transistor)



0 bias for gate

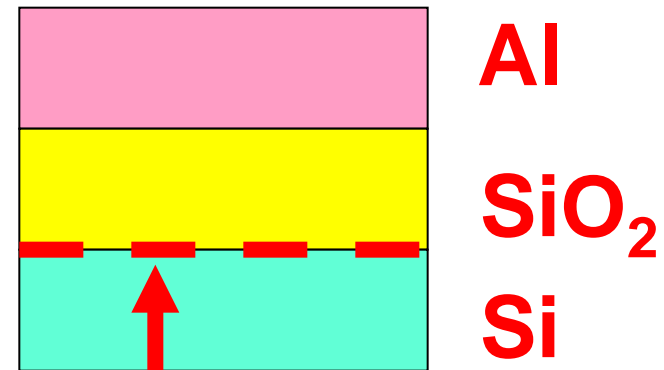
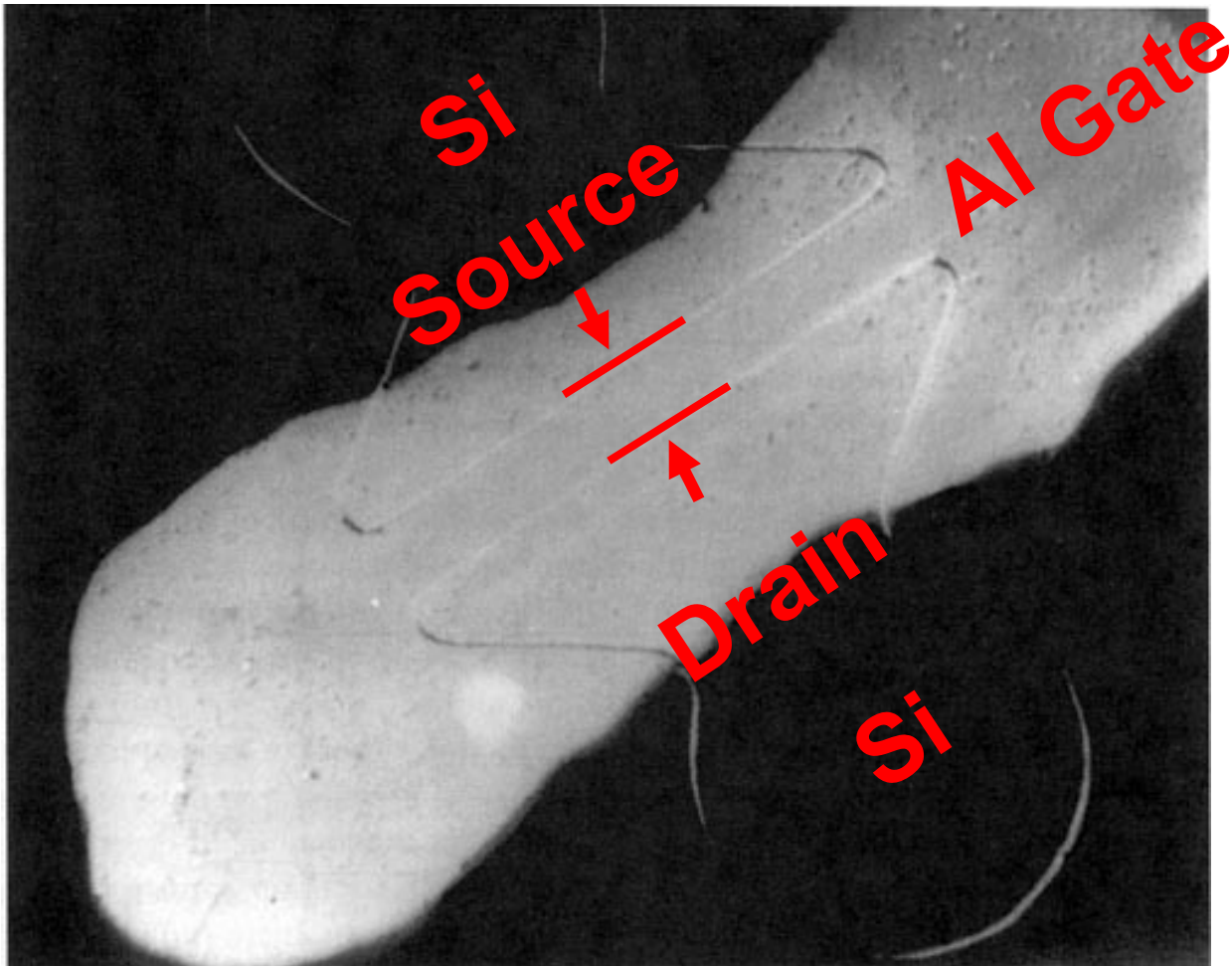
Positive bias for gate

Surface Potential (Negative direction)



1960: First MOSFET
by D. Kahng and M. Atalla

Top View

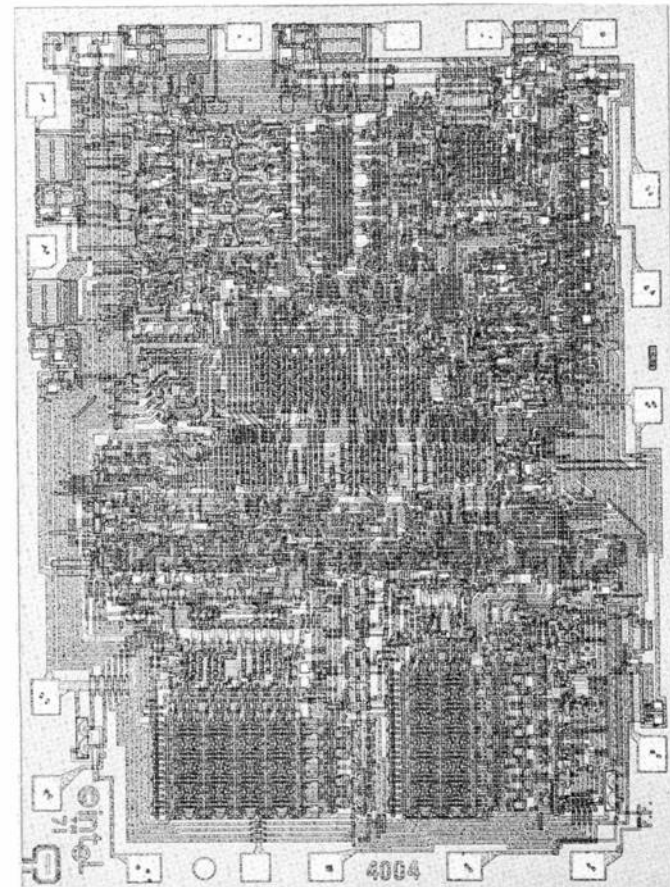
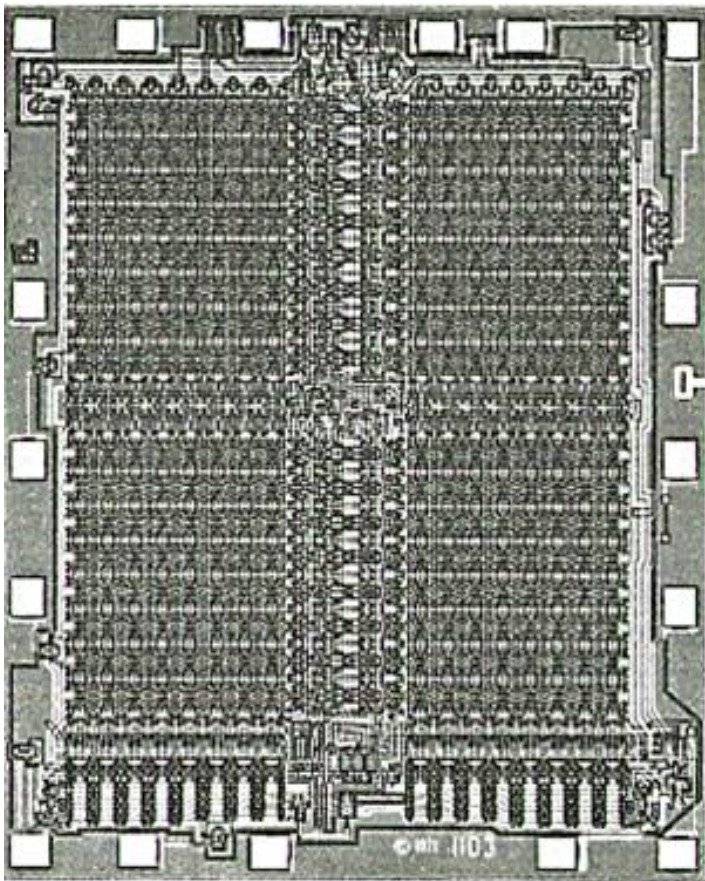


Si/SiO₂ Interface is exceptionally good

1970,71: 1st generation of LSIs

1kbit DRAM Intel 1103

4bit MPU Intel 4004



2011

Most recent SD Card



Most Recent SD Card

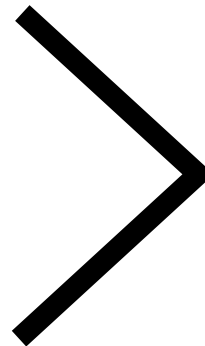


128GB (Bite)
= 128G X 8bit = 1024Gbit
= 1.024T(Tera)bit

1T = 10^{12} = 1 Trillion

World Population : 6 Billion
Brain Cell : 10~100 Billion
Stars in Galaxy : 100 Billion

Most Recent SD Card





2.4cm X 3.2cm X 0.21cm

Volume: 1.6cm³ Weight: 2g

Voltage: 2.7 - 3.6V

Old Vacuum Tube:

5cm X 5cm X 10cm, 100g, 100W

1Tbit = 10k X 10k X 10k bit

Volume = 0.5km X 0.5km X 1km
= 0.25 km³ = 0.25X10¹²cm³

Weight = 0.1 kgX10¹² = 0.1X10⁹ton = 100 M ton

Power = 0.1kWX10¹²=50 TW

Supply Capability of Tokyo Electric Power Company: 55 BW ₉

So, progress of IC technology is most important for the power saving!

Thank you
for your attention!