Nanotechnology for Nanoelectronics

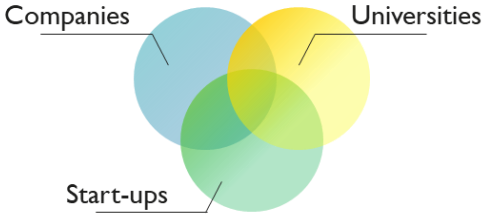
UMBERTO CELANO

Senior Scientist & Metrology Liaison

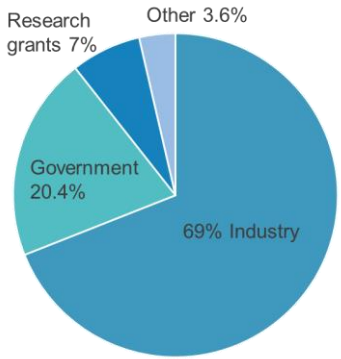
Materials & Components Analysis, IMEC
umberto.celano@imec.be

IMEC

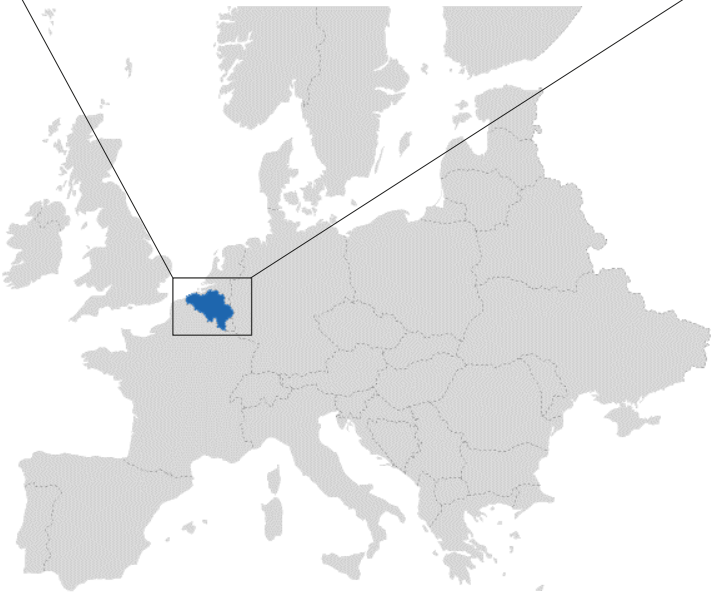
- R&D hub in nanoelectronics
- Founded in 1984
- 3500 employees
- Cleanroom 12000m^2
- Focus on sub-10 nm CMOS



REVENUE 2019 > 500M€

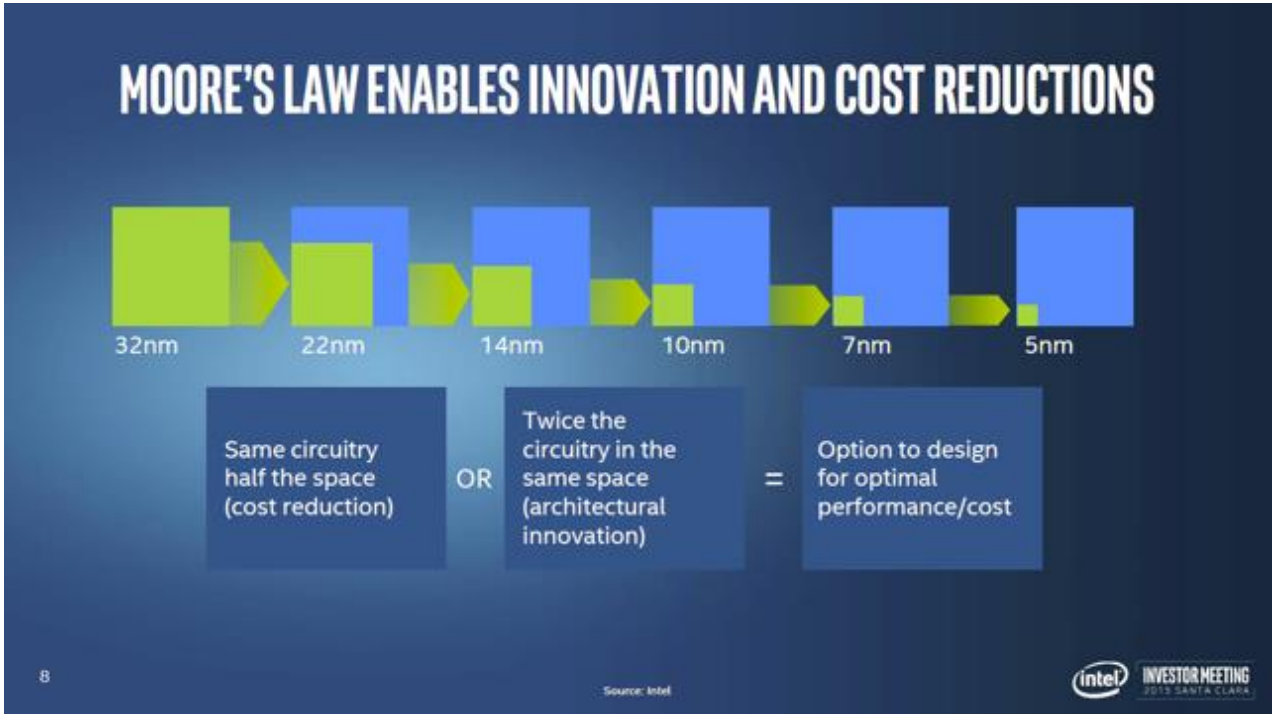


OSAKA UNIVERSITY



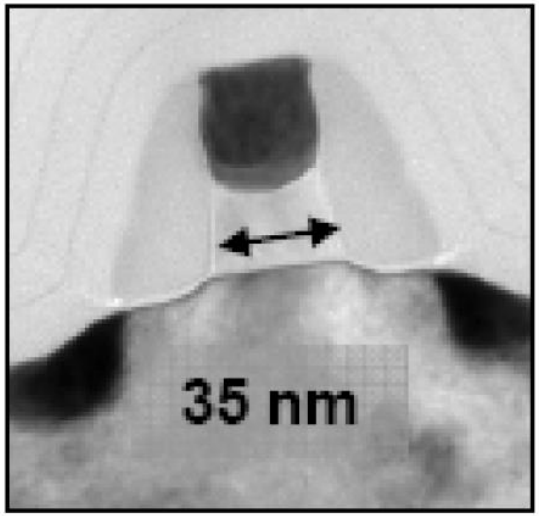
imec

THE POWER OF SCALING

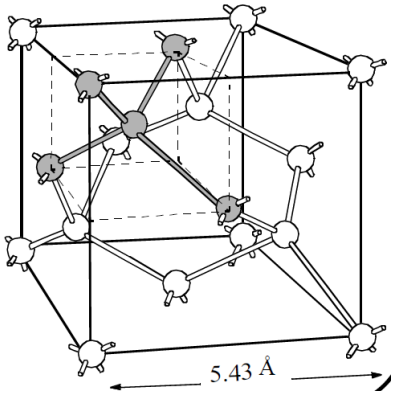


EVOLUTION OF TANSISTOR DEVICES

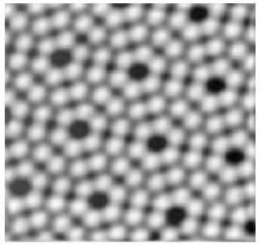
Yesterday's Transistor (1947)



Today's Transistor (2006)



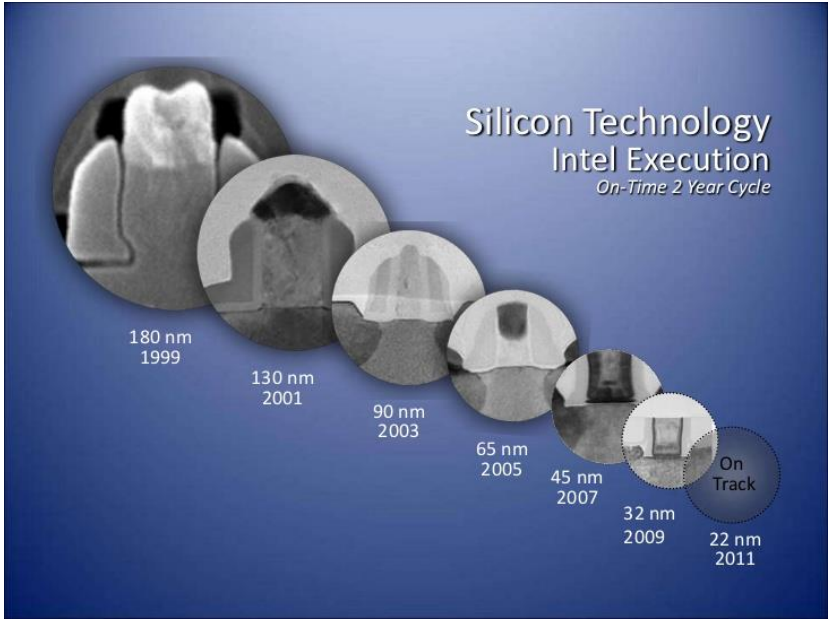
The magic of Si with its cubic lattice and 4 nearest neighbors

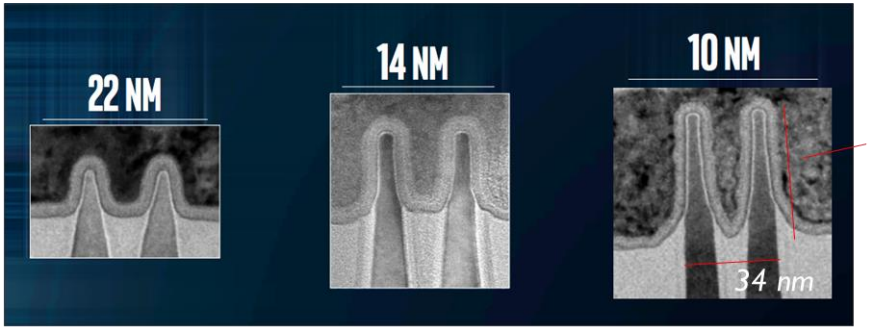


Si (111) plane

THE QUEST OF SCAILNG THE BULK-Si MOSFET

Twenty years of MOSFET innovation leading to FinFETs introduction and exiting future technologies





Source Intel

2.7x transistors density improvement


Every second of the year, on average, over 8 trillion transistors are produced

IF TRANSITORS WERE CARS..

The evolution in technology has enabled the electronic industry to continually produce devices and system that are smaller, more power efficient, richer features and lower in prices.

- *If Automotive industry had achieved similar improvements in the last 30 years, a* ***Rolls-Royce****:*
  - *Would* ***cost $ 40***
  - *Could circle the globe* ***2 times*** *on* ***one liter gasoline***
  - *Could have a top speed of* ***2.4 million miles/h***

[McKinsey]

THE ECONOMICS OF SCALING

TSMC Nanjing fab ~ 15-20 Billion USD investment for high volume manufacturing of 7nm and 5nm nodes