

CS M151B / EE M116C

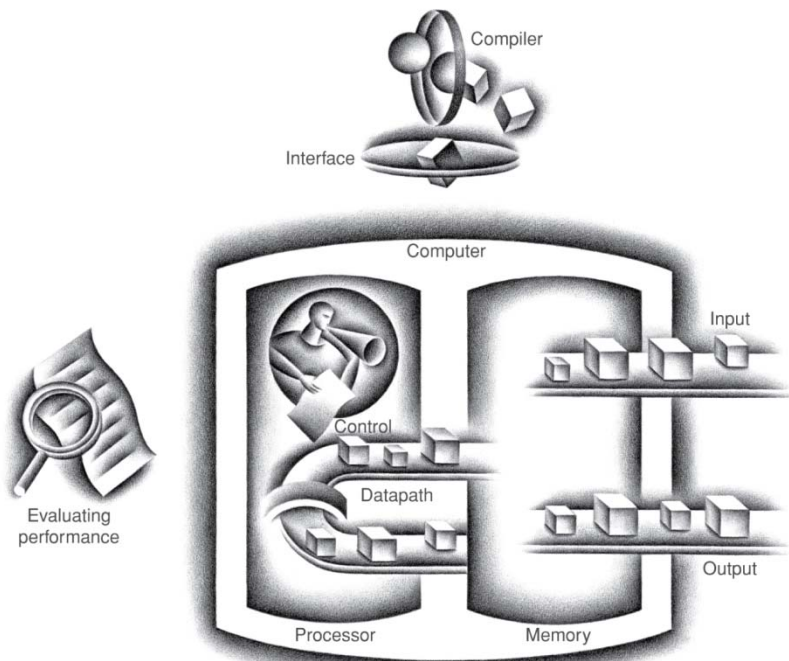
Computer Systems Architecture

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Components of a Computer

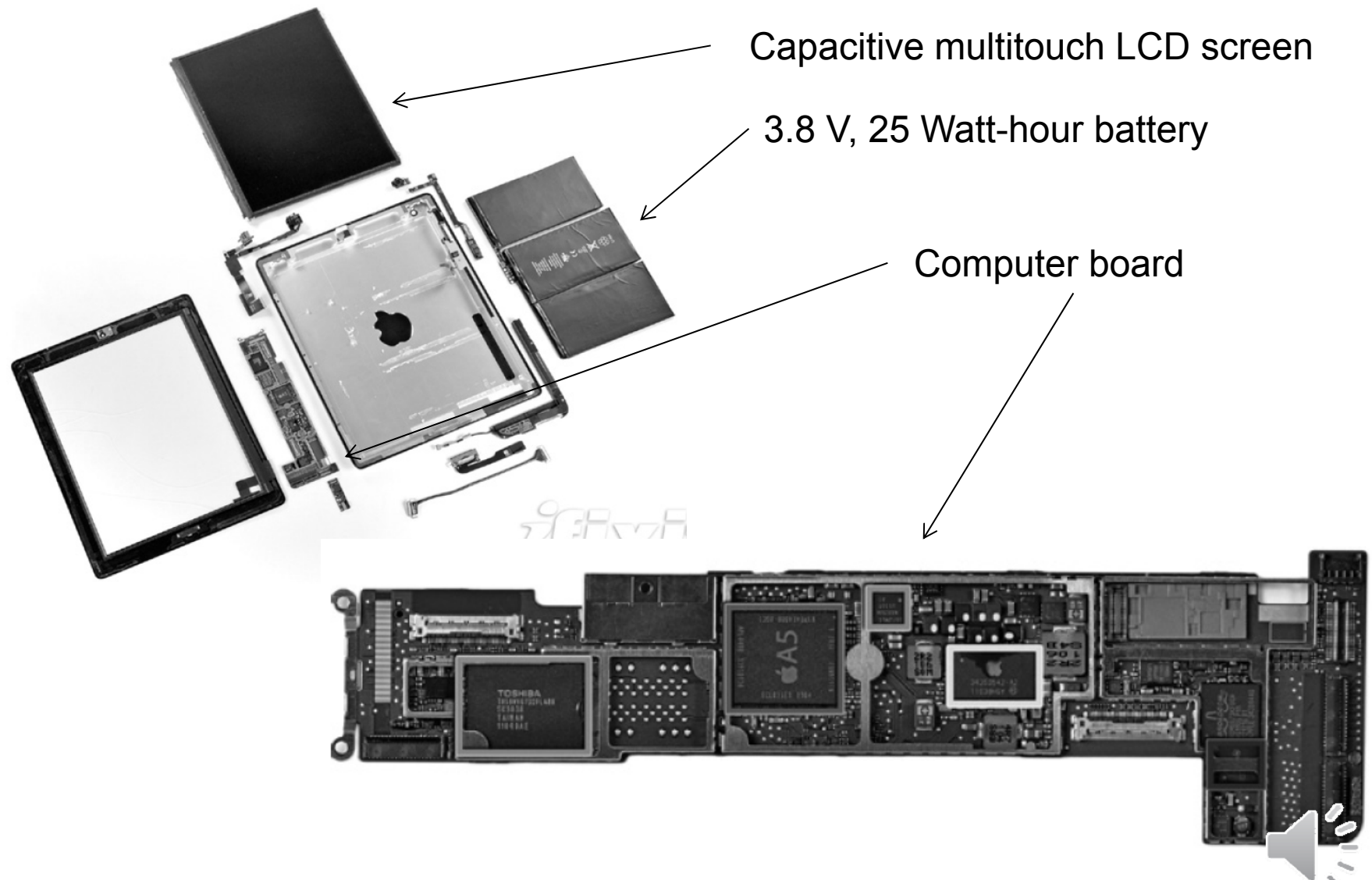
The BIG Picture



- Same components for all kinds of computer
 - Desktop, server, embedded
- Input/output includes
 - User-interface devices
 - Display, keyboard, mouse
 - Storage devices
 - Hard disk, CD/DVD, flash
 - Network adapters
 - For communicating with other computers

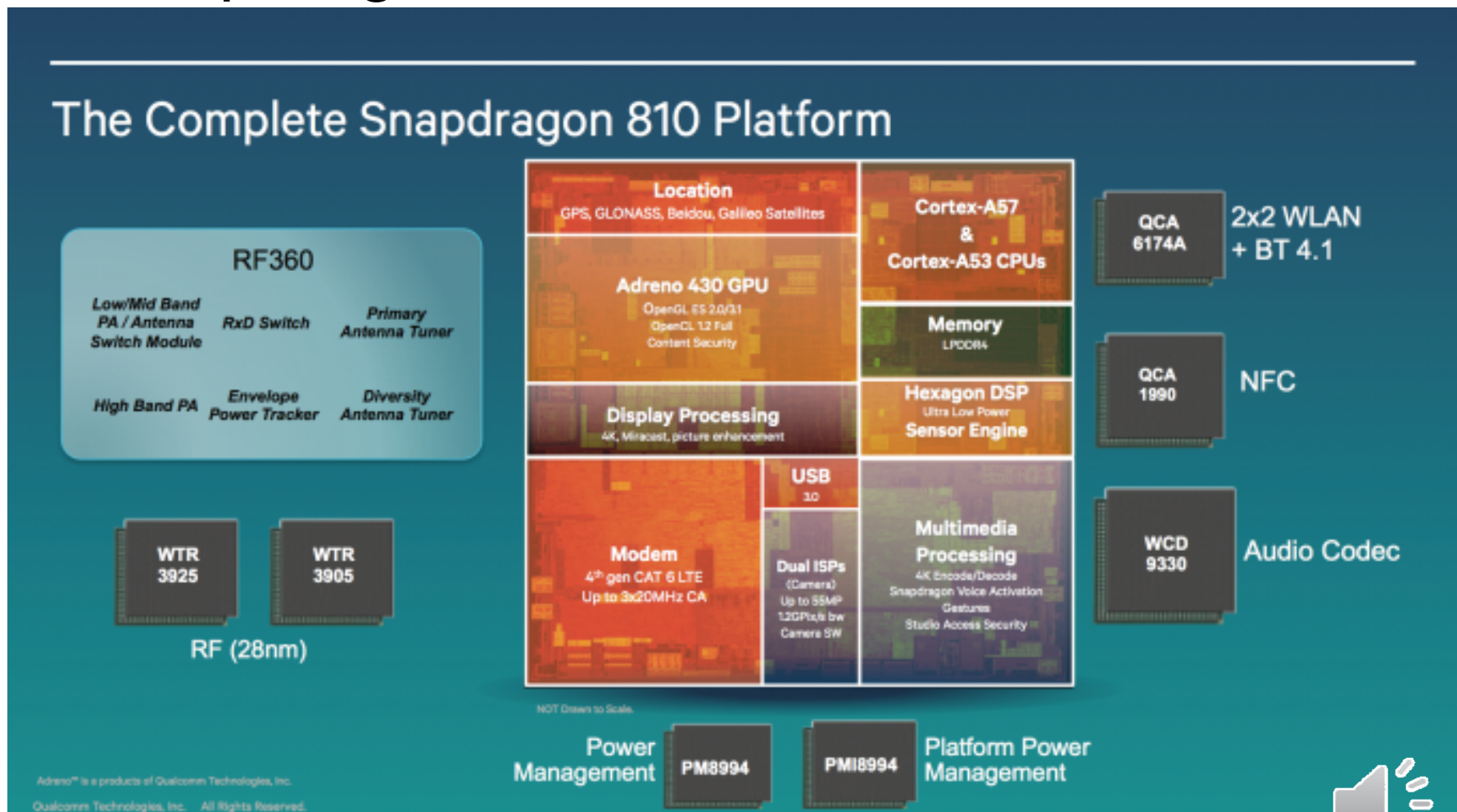


Opening the Box



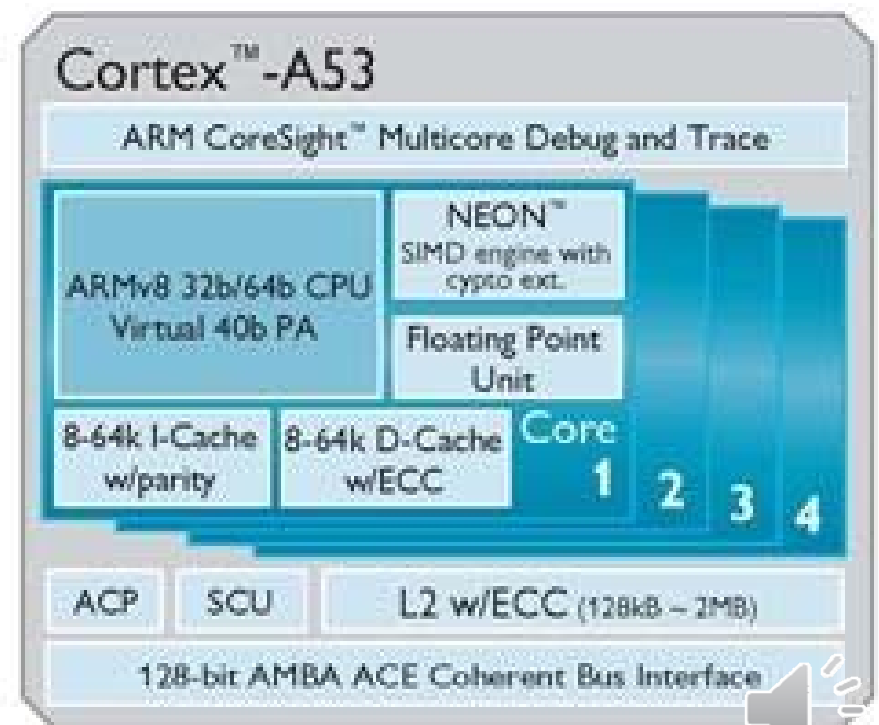
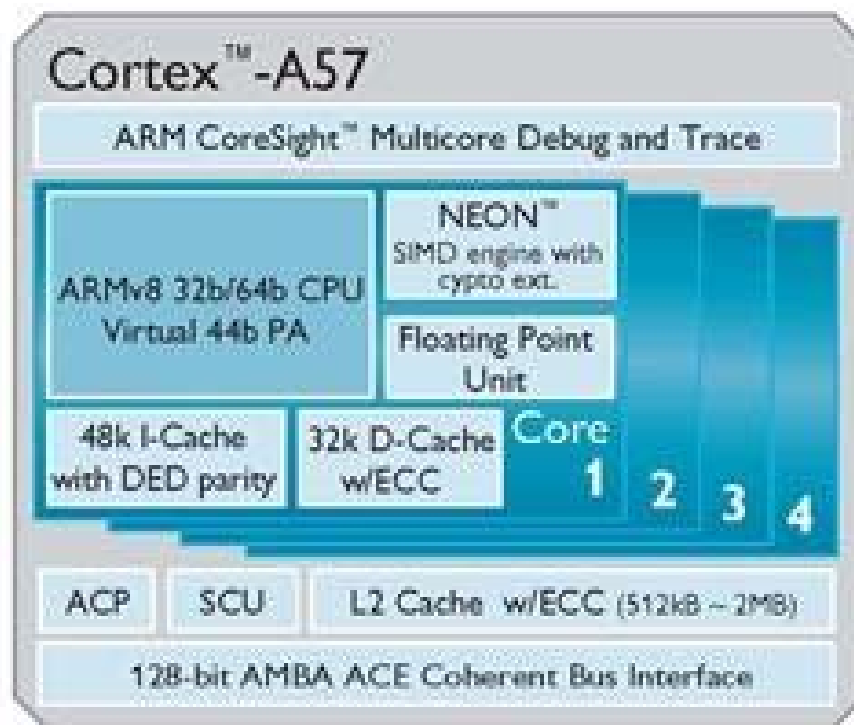
Inside the SoC

■ Snapdragon 810



Inside the Processor (CPU)

- Datapath: performs operations on data
- Control: sequences datapath, memory, ...
- Cache memory
 - Small fast SRAM memory for immediate access to data



Abstractions

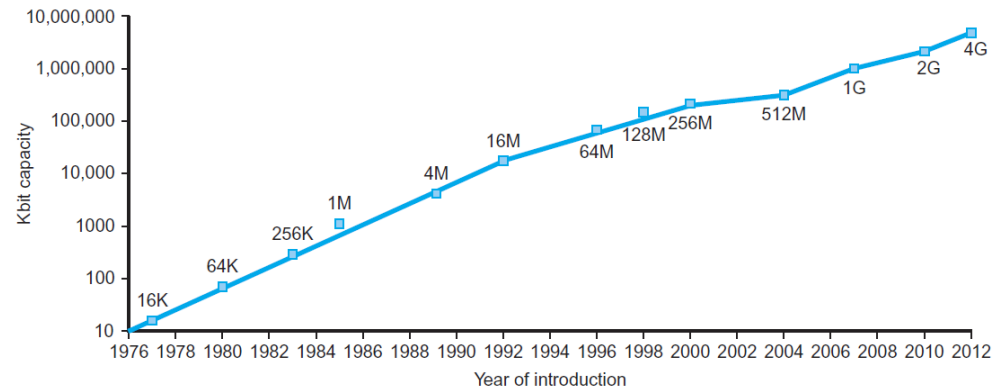
The BIG Picture

- Abstraction helps us deal with complexity
 - Hide lower-level detail
- Instruction set architecture (ISA)
 - The hardware/software interface
- Application binary interface
 - The ISA plus system software interface
- Implementation
 - The details underlying and interface



Technology Trends

- Electronics technology continues to evolve
 - Increased capacity and performance
 - Reduced cost



DRAM capacity

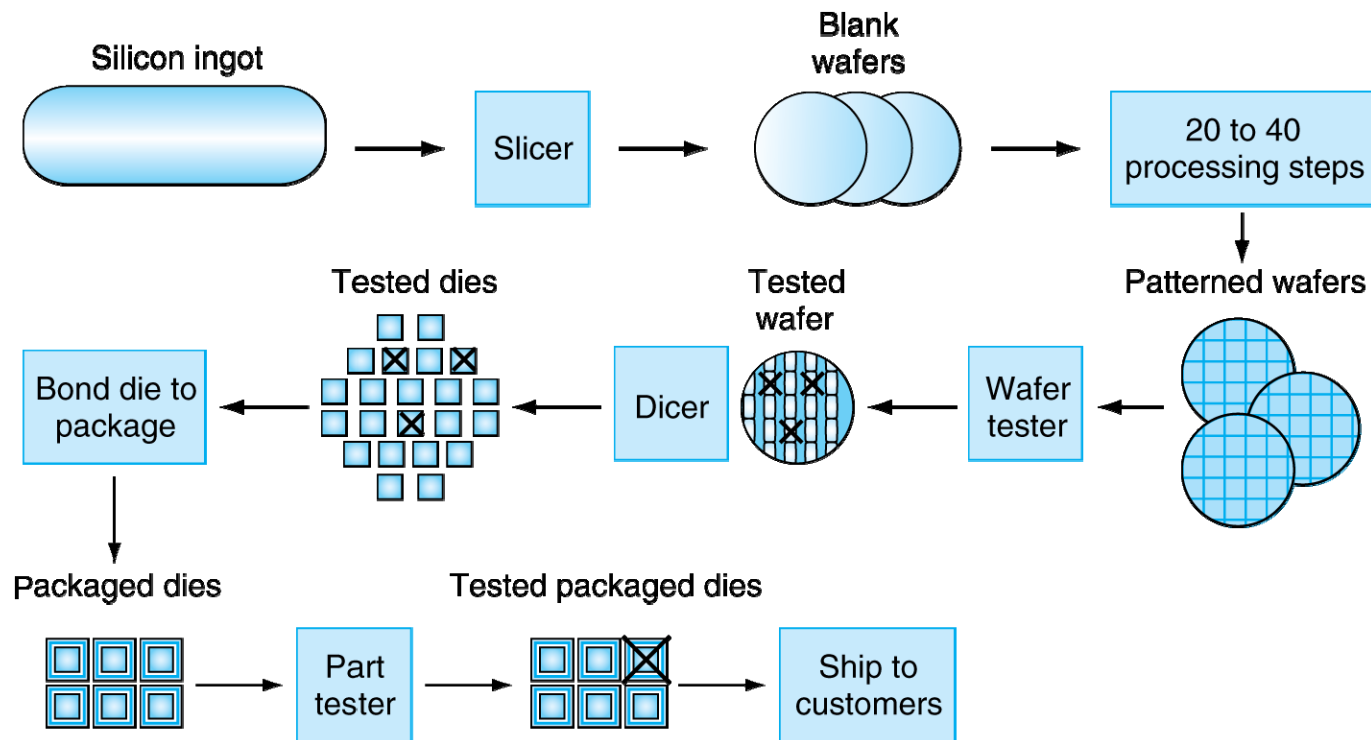
| Year | Technology | Relative performance/cost |
|------|----------------------------|---------------------------|
| 1951 | Vacuum tube | 1 |
| 1965 | Transistor | 35 |
| 1975 | Integrated circuit (IC) | 900 |
| 1995 | Very large scale IC (VLSI) | 2,400,000 |
| 2013 | Ultra large scale IC | 250,000,000,000 |

Semiconductor Technology

- Silicon: semiconductor
- Add materials to transform properties:
 - Conductors
 - Insulators
 - Switch



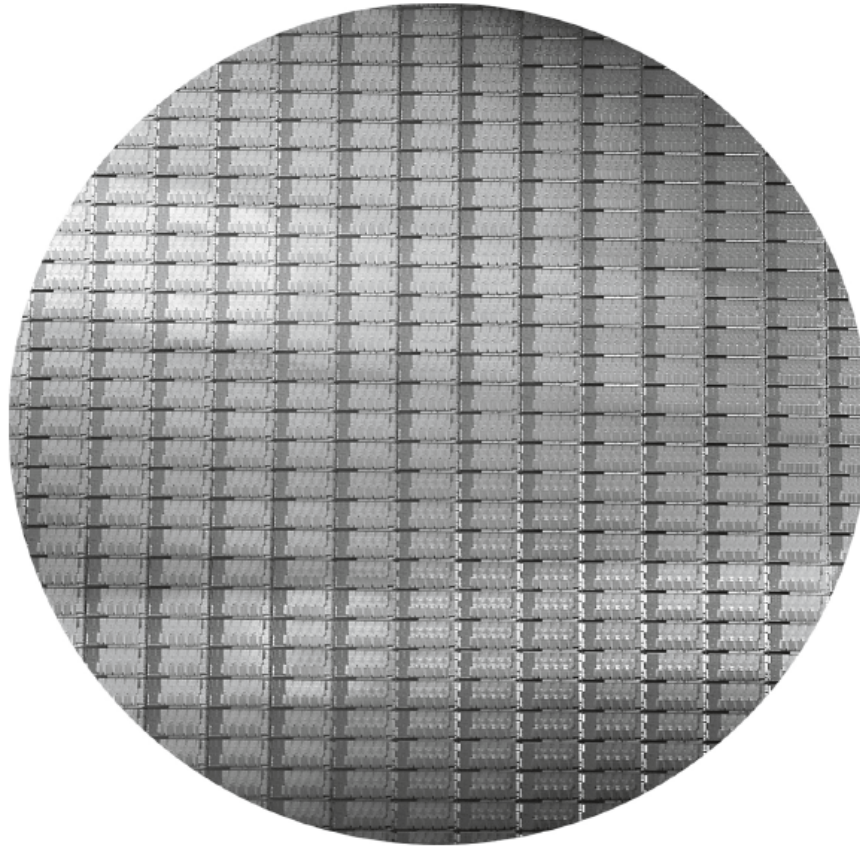
Manufacturing ICs



- Yield: proportion of working dies per wafer



Intel Core i7 Wafer



- 300mm wafer, 280 chips, 32nm technology
- Each chip is 20.7 x 10.5 mm



Integrated Circuit Cost

$$\text{Cost per die} = \frac{\text{Cost per wafer}}{\text{Dies per wafer} \times \text{Yield}}$$

$$\text{Dies per wafer} \approx \text{Wafer area} / \text{Die area}$$

$$\text{Yield} = \frac{1}{(1 + (\text{Defects per area} \times \text{Die area} / 2))^2}$$

- Nonlinear relation to area and defect rate
 - Wafer cost and area are fixed
 - Defect rate determined by manufacturing process
 - Die area determined by architecture and circuit design

