Smart Devices

Smartphone Chipsets

Samsung Exynos 8895

❖ **Samsung Exynos Octa 8895**

- Released in 2017

- Developed & Manufactured by Samsung

- Based on the ARMv8-A architecture

Samsung Exynos 8895

❖ **Samsung Exynos Octa 8895**

- Based on the big.LITTLE heterogenous
  computing architecture, the
  Samsung Exynos Octa 8895 has
  4 "big" cores and 4 "little" cores

big.LITTLE Technology

❖ **ARM® big.LITTLE ™**   **ARM**

- Launched by ARM® in 2011

- ARM® big.LITTLE™ processing is a
  power-optimization technology

- High-performance from ARM CPU cores
  - Fast hardware processing speeds
  - Very efficient firmware

big.LITTLE Technology

❖ **ARM® big.LITTLE ™**   **ARM**

ARM CPU cores characteristics

- Peak-performance capacity
- Higher sustained performance
- Increased parallel processing performance
- Significantly lower average power consumption

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big.LITTLE Technology

❖ **ARM® big.LITTLE ™**   **ARM**

- big vs. LITTLE
  - The "big" or faster cores are used for computation-intensive tasks (threads)
    - Example: Games, AR (Augmented Reality)
  - The "little" or slower cores are used for less intensive tasks (threads)
    - Example: Daemons are programs that run in background processes of the smartphone

big.LITTLE Technology

❖ **Threads**

- Thread is a sequence of program instructions that are scheduled and processed independently by the Scheduler

- In Smart Devices, the Scheduler is commonly the OS (Operating System)
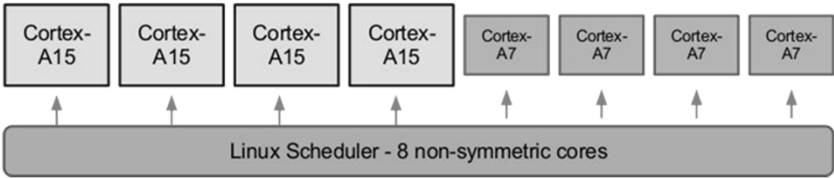 - OS Examples: Android, iOS, etc.

big.LITTLE Technology

❖ **ARM® big.LITTLE ™** **ARM**

- Advantages of using the big.LITTLE software and platforms

  - Can save 75% of CPU energy in low to moderate performance scenarios

  - Can increase performance by 40% in highly threaded workloads

big.LITTLE Technology

ARM

| Cortex-A15 | Cortex-A15 | Cortex-A15 | Cortex-A15 | Cortex-A7 | Cortex-A7 | Cortex-A7 | Cortex-A7 |

Linux Scheduler - 8 non-symmetric cores

	1st Generation: ARMv7	2rd Generation: ARMv8
High-performance CPU (big)	Cortex-A15, Cortex-A17	Cortex-A57, Cortex-A72
High-efficiency CPU (LITTLE)		Cortex-A53
Ultra high-efficiency CPU (LITTLE)	Cortex-A7	Cortex-A35

Qualcomm Snapdragon 835

❖ **Qualcomm MSM8998 Snapdragon 835**

- Released in 2017

- Designed by Qualcomm,
  Manufactured by Samsung

Qualcomm Snapdragon 835

❖ Qualcomm MSM8998 Snapdragon 835

- Based on the ARMv8-A architecture

- Based on the big.LITTLE heterogenous
  computing architecture
  - 4 "big" cores
    4 "little" cores

Apple A11

❖ Apple A11 Bionic

- Introduced on 2017

- Designed by Apple, Manufactured by TSMC

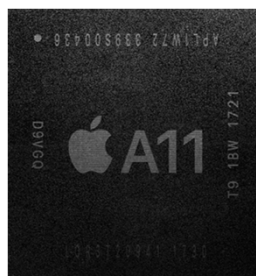- Based on the ARMv8-A architecture

Apple A11

❖ **Apple A11 Bionic**

- 2nd generation Apple-designed
  performance controller
  - 70% faster multi-thread workloads

Apple A11

❖ **Apple A11 Bionic**

- A11 compared to the A10
  - 70% faster 4 efficiency cores
  - 25% faster 2 performance cores

Smartphone CPUs & GPUs

❖ Kryo 280

- Announced in November 2016
  - Announced with the Snapdragon 835 chipset
- Customized derivative design of the ARM's Cortex-A73 architecture
- Enhanced IPS (Instructions Per Second) performance
  - But lower FLOPS (Floating Point Operations per Second) performance compared to the original Kryo CPUs

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Smartphone CPUs & GPUs

❖ Adreno 540

- Introduced in early 2017
- Improved clock speeds (710 MHz)
- Enhanced stability
- Designed with 10 nm technology
- 256 ALUs (Arithmetic Logic Units)
- 567 GFLOPS (10^9 = Giga FLOPS)

Smartphone CPUs & GPUs

❖ **Monsoon & Mistral**

- Monsoon
  - High performance core (2.39 GHz)
  - 25% faster than Apple A10

- Mistral
  - Energy efficient cores (2.39 GHz)
  - Up to 70% faster than the energy efficient cores in Apple A10

Smartphone CPUs & GPUs

❖ **Apple-Designed GPU (Three-Cores)**

- Designed with 10 nm technology
- Up to 30% faster graphics performance than the Apple A10
- Can provide A10 performance at half the power

10 nm Technology

❖ Moore's Law

- Gordon E. Moore, co-founder of
  Intel and Fairchild Semiconductor

- In his 1965 paper, he wrote that the number
  of transistors in a dense integrated circuit
  will double approximately every two years,
  and this rate of growth is projected to
  continue for at least another decade

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10 nm Technology

Microprocessor Transistor Counts 1971-2011 & Moore's Law

- Xeon is a brand of x86 microprocessors designed and manufactured by Intel
- Xeon is targeted at the non-consumer workstation, server, and embedded system markets

- Itanium is a family of 64-bit Intel microprocessors
- Itanium2 was jointly developed by HP and Intel

- Intel Atom is the brand name for a line of ultra-low-voltage 32-bit and 64-bit CPUs (or microprocessors)

- K5 was AMD's first x86 processor to be developed entirely in-house

- Pentium is a brand used for a series of x86-compatible microprocessors produced by Intel
- Pentium processor is an entry-level product (e.g., for PCs)

10 nm Technology

❖ **10 nm Technology**

- The 10 nm (nanometer) semiconductor device fabrication technology follows the 11 nm and 14 nm technology

- The original naming of "10 nm" technology came from the ITRS (International Technology Roadmap for Semiconductors)

- Samsung first released their version of a "10 nm" process node in 2017

10 nm Technology

❖ **ITRS**

- The ITRS is sponsored by the five leading chip manufacturing regions in the world: Europe, Japan, Korea, Taiwan, and the United States

- The objective of the ITRS is to ensure cost-effective advancements in the performance of integrated circuit and advanced products and applications that employ such devices, to continue consistent growth and success of the semiconductor industry

10 nm Technology

❖ **Why 10 nm?**

- By reducing the distance between transistors, power reduction is gained in signal transfer across units and also transistor activation

- Slimmer and lighter chips

- Longer battery life

10 nm Technology

❖ **Why 10 nm?**

- The smaller the transistors are, more transistors can be designed into the same chip area

- Transistors switch faster

- Less energy is consumed

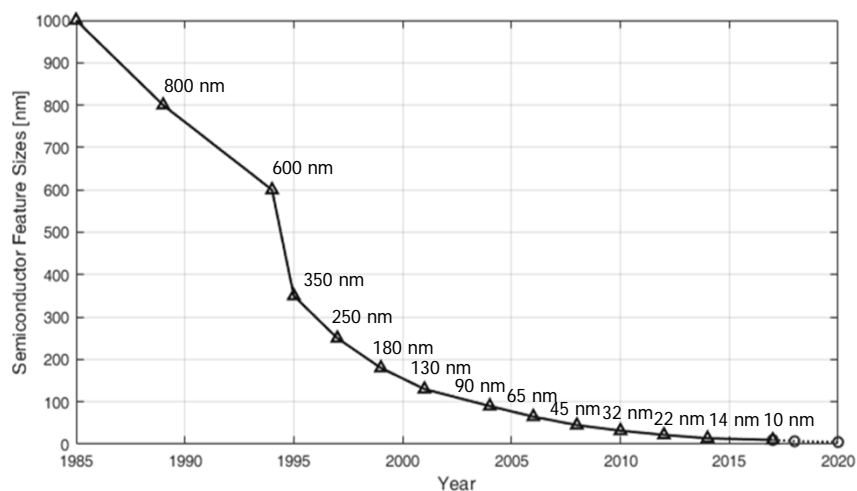- Given an equal numbers of transistors, the chip runs cooler

10 nm Technology

❖ How much smaller?

- A normal red blood cell is
  6~8 μm in diameter

- A typical human eye will respond to
  wavelengths from about 390 to 700 nm

- Bacterial ribosome is about 20 nm

- Unit Comparison
  - μm = 10^{-6} m
  - nm = 10^{-9} m

10 nm Technology

❖ Size History of Semiconductors

Smartphones

		Galaxy Note8	iPhone X
Manufacturer		Samsung	Apple
Released Date		August 2017	September 2017
Platform	Chipset	Qualcomm MSM8998 Snapdragon 835 / Exynos 8895 Octa	Apple A11 Bionic

Smart Devices

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