Smartphone Hardware Architecture

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Agenda

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  - Snapdragon
  - Comparison to PCs
- Developments
- Introduction and History
  - System On Chip
  - Multi-Core
- Challenges
  - Is hardware evolution slowing?
  - Moore’s law
  - Miniaturization vs improving performance
- Conclusion

Introduction

No standard exists to define what makes a phone a smartphone.

- GSM/CDMA/etc mobile phones
- run a high-level operating system
- Features:
  - WiFi
  - Bluetooth
  - internet access
  - custom application software
  - cameras

History

- 1997 - Term smartphone is coined
- 1999 - RIM begins making BlackBerries
- 2007 - iPhone 1 released
- 2008 - Android v1.0 released
- Now - iPhone 5 and Android v4.2

History

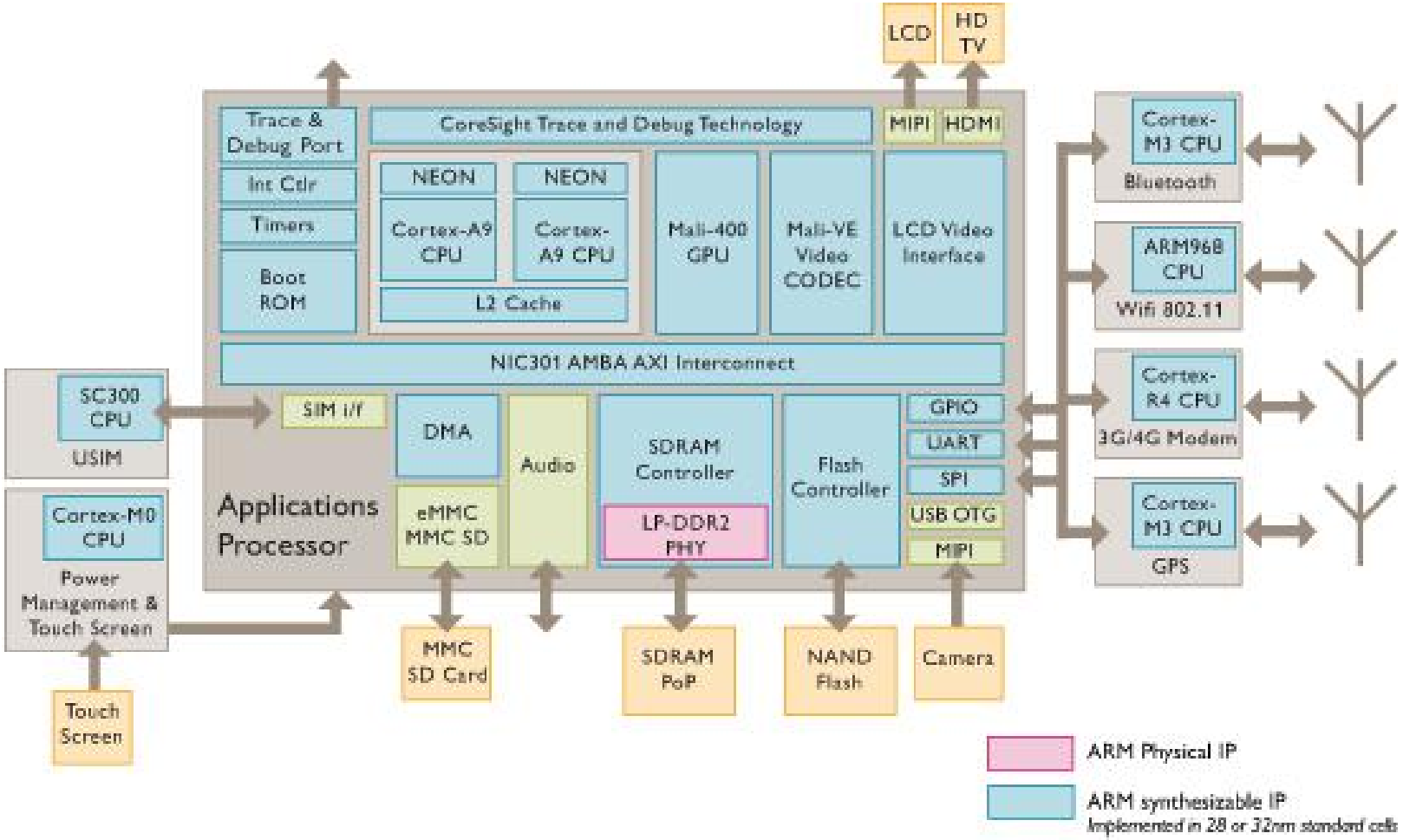
- 2007
  - smartphones are 12% of total sales of phone handsets
- 2012
  - smartphones are 37% of total sales of phone handsets
  - 45% of American adults own smartphones
  - In the age range of 18-29, the number is 66%

Architecture

Architecture - ARM

- RISC Based Processor conceived in the 80s
- Android first utilized ARM in 2008
- Since 2008, 190 million Android devices shipped with ARM
- Great performance with low power costs
- NVIDIA Tegra 3 - 4 ARM Cortex A9 cores at 1.5 GHz on HTC One X Device

Architecture - ARM



Architecture - Snapdragon

- Similar to ARM processors, ARM Cortex A15
- Developed by Qualcomm
- Built with 28 nm process
- Uses ARMv7 ISA
- Up to 1.7 GHz quad core with 2MB L2

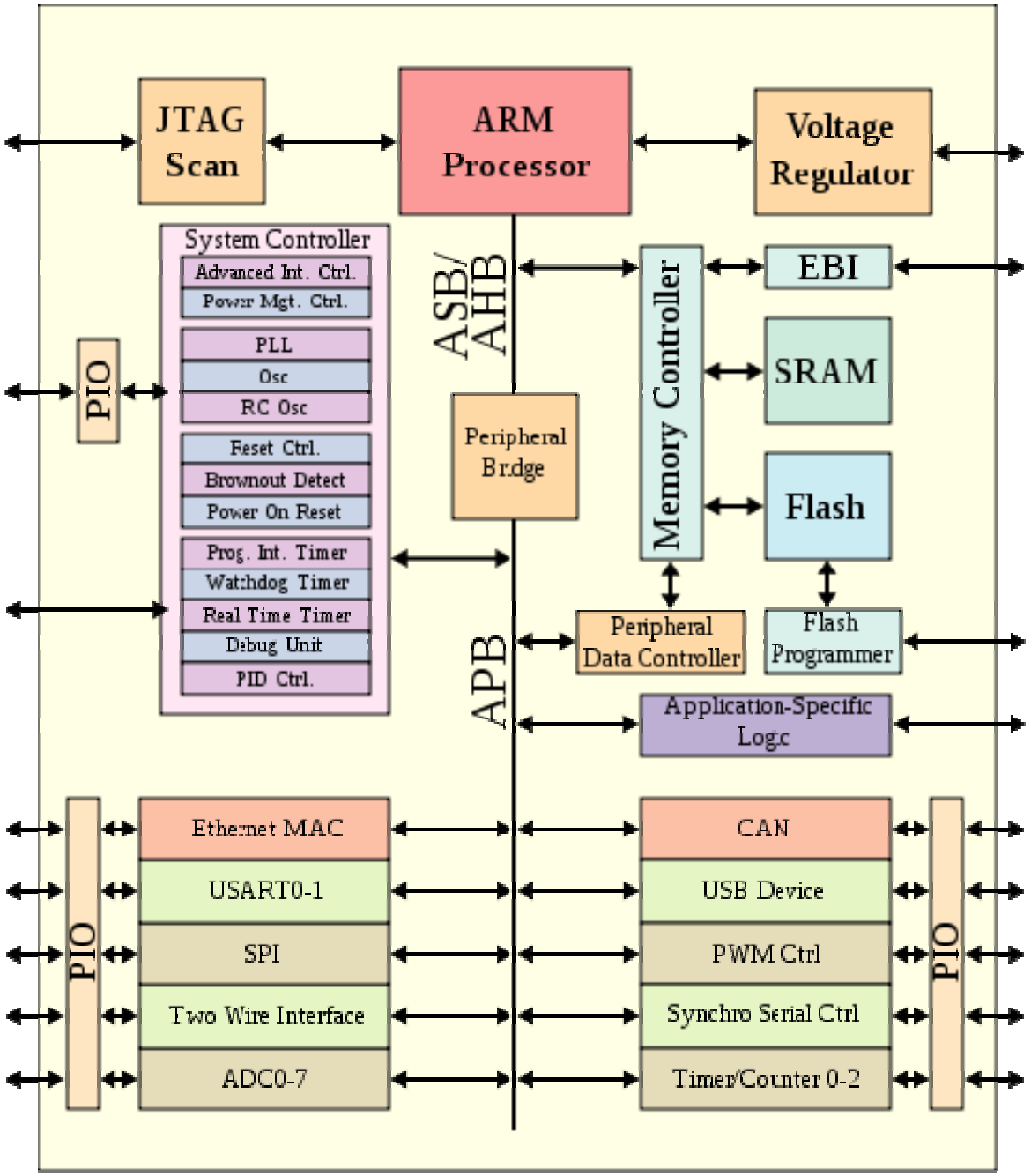
Architecture - PCs

- Smartphones constrained by power demands - battery vs. wall power
- Smartphones constrained by size
- PCs losing popularity due to increased portability
- Replace PCs in the future

Developments

Developments - SoC

- System on a Chip
  - Whole-system ICs
  - Reduced cost
- Contrast with microcontrollers
  - generalized
  - higher performance
  - matter of scale


JTAG Scan
ARM Processor
Voltage Regulator
System Controller
Advanced Int. Ctrl.
Power Mgt. Ctrl.
PLL
Osc
RC Osc
Reset Ctrl.
Brownout Detect
Power On Reset
Prog. Int. Timer
Watchdog Timer
Real Time Timer
Debug Unit
PID Ctrl.
PIO
ASB/ AHB
Peripheral Bridge
Memory Controller
EBI
SRAM
Flash
Peripheral Data Controller
Flash Programmer
APB
Application-Specific Logic
Ethernet MAC
USART0-1
SPI
Two Wire Interface
ADC0-7
CAN
USB Device
PWM Ctrl
Synchro Serial Ctrl
Timer/Counter 0-2
PIO
PIO

Developments - Cores

- Dual and Quad core
  - Qualcomm Snapdragon
  - Nvidia Tegra 3
- Untested performance improvement
  - *"The reality is that the quad-core could be better, it could be equal, or it could be appreciably worse."*
    - Nick DiCarlo, VP Marketing at Samsung
  - *"...the so-called dual-core, quad-core mobile phones can only waste batteries, but not be useful for consumers all the time."*
    - Stephen Elop, CEO at Nokia

Challenges

- Hardware evolution is slowing
  - “it is becoming increasingly difficult for handset makers to differentiate their smartphones in terms of hardware specifications.”
- Moore's Law
- Consumer demands shifting away from hardware performance

Conclusion

- Demographics show smartphones are quickly permeating daily life
- Raw performance may be losing priority for new developments
- Portable computing may eliminate stationary/desktop computing for consumers

Questions?