The Future of the ARM Processor in Military Operations

ARMs for the Armed

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What We Will Talk About

- The ARM architecture
- ARM performance
- ARM Extensions
- Power consumption
- ARM and the cloud
- CONOPs for the war fighter
- Summary
The ARM Architecture

The Advanced RISC Machine (ARM) architecture was first introduced in 1987 by Acorn Computers.


- 32-bit processor with both 32-bit (ARM) and 16-bit (Thumb) instructions.
  - Thumb instructions allow for very low memory footprints.

- Unlike x86, ARM, Ltd. licenses over 25 different companies.
  - Licensees include TI, FreeScale, IBM, Marvell, NXP, Samsung, Apple, Qualcomm, Nvidia, and more.
  - Each is free to develop silicon around the ARM core.
ARM in the Marketplace

ARM processors can be found in over 98% of all mobile phones and tablets

- ARM accounts for more than 90% of all embedded 32-bit RISC processors

Used in mobile phones, hand-held game consoles, music players, routers, hard drives and many other consumer electronics devices

- You’ve probably got many ARM-based devices already

Available in A (application), R (real-time), and M (microcontroller) variants
ARM Extensions

ARM cores have a number of extensions available:

- **Jazelle**
  - Allows direct execution of Java Bytecode

- **Vectorized Floating Point (VFP)**
  - High-performance floating-point operations

- **NEON**
  - Advanced SIMD supporting both 64- and 128-bit single instruction, multiple-data operations like DSP FFTs and multi-media applications

- **TrustZone**
  - Hardware-enforced, security execution mode
Supported Operating Systems

The ARM architecture is supported by a number of operating systems including:

- Google’s Android™
- Apple’s iOS™
- Linux
- FreeBSD, NetBSD, OpenBSD
- Windows Phone 7
- Windows 8
- Real-time O/S support from VxWorks™, Integrity™, ThreadX™, QNX™, Nucleus™ and more

Instruction Set Simulator (QEMU) available for Windows, Linux and OS/X
ARM Performance

*Benchmarks show that ARM (Cortex A8) beats Intel Atom (N330) in a number of integer benchmarks*
  - Intel still beats ARM in raw floating point performance

*ARM Cortex A9 is 1/3 the size of Atom*
  - More room on PCB for other components

*Atom uses 6x the power of Cortex A9*
  - Atom is getting better, but so is ARM
  - However, typical ARM platforms can run several days without charging

*NEON unit allows for full 720p video in less than 253 mw of power on Cortex A8*
Accelerator Support

Intel has had multi-processor and multi-thread support for some time

ARM supports both dual and quad-core processors now
  - Support is relatively new, however

Newer ARM cores from Nvidia are coming bundled with GPU and GPGPU support
  - Handheld super-computers are possible

Many ARM licensees are including hardware accelerators for radios, DSP, cameras and more into their SoCs
Typical ARM SoC

OMAP4470

- ARM Cortex®-A9 MPCore™
- ARM Cortex®-A9 MPCore™
- IVA3 Hardware accelerator
- 2D HW
- POWERVR™ SGX544 graphics accelerator
- Image Signal Processor (ISP)
- Shared memory controller/DMA
- Timers, Interrupt controller, mailbox
- Boot/secure ROM
- M-Shield™ Security Technology: SHA-1/MD5, DES/3DES, RNG, AES, PKA, secure WDT, keys

WiLink™ wireless connectivity
- GPS
- FM radio
- Wi-Fi®
- Bluetooth®
- 3G/4G Modem

Fast IRDA

Trace, Emulator pod, NOR flash, NAND flash, LPDDR2, LPDDR2

Keypad, USB

GPIO, MIPI™ CSI-2

Camera, MIPI™ CSI-2

Sub camera

TWL6032
- Power
- Monitor
- Charger

TWL6041
- Audio
- Headset
- Speakers
- Vibrators
- Amplifiers
- Micro

32 kHz Crystal

In/Out

HF Speakers

Handsset microphone

REF/CLK, CDC3S04 clock driver, MMC/SD card, eMMC

HDMI™, Display controller parallel-serial

TPD1S015, Touch screen controller

WUXGA, HD television

SPI
Trends that Favor ARM

- We’ve heard a lot of discussion about the “cloud”
  - High-speed back end with lower-power front end
- Small, hand-held computers are now commonplace
  - You’re probably carrying one of them now
- User base is already familiar with their use
  - Apple has seen to that
  - Training is minimal
- The move to an “AppStore” model
  - Smaller applications that are easily downloaded
  - No need for massive CPU horsepower
- We are entering into the “post-PC era”
  - Touch screens replace mice and keyboards
  - Desktop and laptop sales are declining in favor of tablets and smartphones
CONOPs for War Fighter

- Specialized “battle phone” running Android or similar platform
  - Capable of operating MLS with compartments
  - Recharge phone with solar panel in rucksack
- Syncs OTA with firebase main system
  - RoEs, mission objectives, waypoints, etc.
  - Built-in GPS and map support
- Mesh network established with squad
  - Allows for secure SMS with LPI/LPD
- Use orbital Predator for communications relay
  - Literally phone-in support missions
- War fighter can update Facebook from foxhole ;–)
Intel not Going Away, but…

- In spite of advances in the ARM architecture, Intel still has the highest overall processor performance
  - Ideally suited for back-end, cloud processing
- Intel has a large number of available developers
  - PC developers abound
- However, ARM Cortex A15 is approaching Intel’s performance numbers in floating point
  - Use of processing accelerators may surpass existing Intel performance in next year
Summary

- The ARM architecture is with us now
  - Many of us just didn’t know it
- The transition to cloud computing favors smaller hand-held devices
  - ARM is already there in the handset with great battery life
- Major players like Google, Apple and Microsoft already support ARM
  - Linux has been there for over a decade
- Software is available and developers are coming up to speed