CMP Conference
25th January 2012
Research - Education

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Recent ARM Powered Products (Q3 11)

Internet Connected Screens

4bn in 2015

- Samsung Galaxy SII
- Motorola Atrix
- Samsung Smart TVs
- Skyworth Android TV
- Asus Eepad Transformer

Real-time Processors

11bn in 2015

- Western Digital My Passport disk drives
- Bluetooth Headsets
- HP Photosmart Printer
- WiFi Routers

Embedded Computers

19bn in 2015

- BlueLibris Remote Medical Monitor
- Embedded Labs Industrial Network Server
- Braun Coffee Machine
- Audi A8 (2012) Infotainment
- Verifone Cash Terminal
Connectivity is Driving The Future

Computing Growth Drivers Over Time, 1960-2020E

1st Era
Mainframe
1MM+ Units

1960

100MM+ Units
Minicomputer
10MM+ Units

1970

1B+ Units
Personal Computing

1980

10B+ Units
Desktop Internet

1990

3rd Era
Computing as part of our lives

2000

Mobile Internet

2010

The Internet of Things

2020

100B+ Units

Source: Adapted from Morgan Stanley, Nov 2009
Visual Computing is Coming to Life

- Constant connectivity
- Energy efficiency
- Cloud storage and processing
- Seamless user interfaces
- Everything contextual
  - Software applications
  - Content

The Mobile Internet

Smartphones

Mobile computing, enterprise

Automotive, smart energy

DTV, STB, BluRay, appliances

The Internet of Things
Exceptional Licensing Momentum...

Cumulative license counts
(1Q 2011 licensing shown in parentheses)

- **ARMv5 Family**
  - ARM7™ Family
    - 172 (+1)
  - ARM9™ Family
    - 268 (+5)
- **ARMv6**
  - ARM11™ Family
    - 81
- **ARMv7**
  - Cortex-Family
    - 68 (+8)
  - Cortex-R Family
    - 21 (+1)
  - Cortex-M Family
    - 97 (+15)

**2011**
- **Cortex-A15**
  - Smartphone, mobile computing, DTV and infrastructure
  - Strong licensing pipeline
- **Cortex-A7**
  - ARMv7
- **Cortex-R7**
  - Engine management systems, LTE baseband and hard disk drives
  - Multiple designs underway
- **Cortex-R5**
  - ARMv5
- **Cortex-M4**
  - CM0 SDK
  - Motor control, industrial control, embedded audio
  - Ramping towards production

Subscription license numbers not shown
H1 2011: ARM Outperforms Industry

- H1-2011 royalty revenue up 32%*
  - Industry up 11% over the relevant period †

2Q 2011: 1.9bn units (up 32%)

- Industry units (ex-memory) up ~8%
- ARM mobile shipments up ~20%
  - 2.5 ARM-based chips per phone
  - BT/WiFi combo chips up 300%
- ARM STB/DTV shipments ~flat
  - End market shipments ~flat
- ARM hard disk shipments up ~2%
  - End market shipments down ~2%
- ARM MCU shipments up >100%
  - Overall MCU market up ~10%

ARM $ Royalty CAGR (06-10) = 12%  
Industry $ Revenue CAGR (06-10) = 3%

* Excludes $9m of royalty catch-up in 2010. PD royalty growth rate in H1-2011: 24%
† Source: SIA May 2011, excludes memory
Offset 1 quarter to align with ARM’s royalty revenue

Sources:
SIA, May 2011
Gartner, May 2011
ARM Physical IP Ships by the Billions

ARM is the leading supplier of Physical IP solutions

- Physical IP delivered for 91 processes from 250nm to 20nm
- Spanning more process families than any other provider

![Number of Die Shipped Using ARM Physical IP](chart.png)

- ARM Estimates
  - From Usage reports
  - 2007: 3.2 Billion
  - 2008: 4.1 Billion
  - 2009: 3.5 Billion
  - 2010: 5.1 Billion
Cortex-A9 Dual Core TSMC 40G – 2.0 GHz

POP and Osprey Silicon Successes

- 0.95 GHz SVt
  - Implemented using generic Physical IP
  - SS, 0.81V, 125C

- 1.29 GHz Mixed Vt
  - POP Physical IP and ARM Implementation Knowledge
  - SS, 0.81V, 125C

- 1.7 GHz Mixed Vt and OD
  - Osprey Hard Macro
  - POP Physical IP and ARM Implementation Knowledge
  - SS, 1.0V, 105C

- 2.0 GHz
  - Typical Silicon Osprey Hard Macro
  - TT, 1.0V, 25C
ARM Enabling Partnership for Growth

- Continuous investment in R&D
- Robust roadmaps for processors, implementation, system IP, graphics, tools and more
- The ARM Connected Community®
- DesignStart™ online access to IP
- Solution Center for Android™ (SCA)
- CMSIS – MCU software interface standard
- Linaro™
  - Founding Partners: ARM, Freescale, IBM, Samsung, ST-Ericsson and Texas Instruments
  - Collaborative engineering enables easier, quicker development of optimized open source devices
Development platforms

Academic pricing on:
Baseboards
Core Tiles
Multi-ICE/RealView ICE
Keil evaluation boards

Hundreds of 3rd-party boards
for students and courses
Cortex-M0 netlist available

Forget traditional 8/16/32-bit classifications!

ARM Cortex-M4
“32-bit/DSC” applications
Efficient digital signal control

ARM Cortex-M3
“16/32-bit” applications
Performance efficiency

ARM Cortex-M0
“8/16-bit” applications
Low-cost & simplicity
The M0 Netlist is a retargetable netlist of one implementation of Cortex-M0

<table>
<thead>
<tr>
<th>ARM Cortex-M0 processor features</th>
<th>Full product options</th>
<th>Netlist implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero jitter 32-bit RISC core</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>AMBA AHB-lite interface</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>ARMv6-M instruction set architecture</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>NVIC Interrupt controller</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Interrupt line configurations</td>
<td>1 to 32</td>
<td>16 only</td>
</tr>
<tr>
<td>Debug (SWD, JTAG) option</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Up to 4 breakpoints, 2 watchpoints</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Low power optimisations (ACG)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Multiple power domain support with WIC</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Fast multiplier (1 cycle) option</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>System timer</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Area (gates)</strong></td>
<td><strong>12k – 25k</strong></td>
<td><strong>16K</strong></td>
</tr>
</tbody>
</table>

Available as a verilog netlist targeting FPGAs / ASIC
Faculty to ask for deliverables

ARM® IP Solutions

DesignStart provides fast and efficient access to industry leading ARM IP ranging from comprehensive Physical IP libraries to array of processor design kits and other design critical information. The DesignStart portal additionally extends to multimedia processor IP and enabling tools suite demonstration software enabling a one stop virtual shop for future SoC designs.

Processor IP

ARM processors are based on a common architecture that delivers high performance, industry leading power efficiency and reduced system cost. The ARM DesignStart Processor IP portfolio consists of: ARM Cortex-M0 Processor Kit, ARM Cortex-M3 Processor Kit, and ARM926EJ Processor Kit.

Physical IP

ARM® is the world’s leading provider of physical intellectual property (IP) for processor design and manufacturing, accelerating the design of complex System on Chip (SoC) integrated circuits. ARM® Physical IP platforms consist of Logic IP, Embedded Memory IP and Interface IP all optimized for a specific foundry process.

Tools IP

ARM offers a broad portfolio of development tools enabling developers to get the best from their ARM technology-based systems. Whether implementing an ARM processor-based SoC, writing software for an Applications Specific Product (ASSP) or embedded microcontroller (MCU), ARM tools help developers rapidly create high quality optimized code.

Multimedia IP

The ARM® Mali™ family GPUs provides a complete solution for all embedded graphics IP and video IP needs, enabling device manufacturers and content developers to deliver the highest quality, cutting-edge multimedia solutions across the broadest range of consumer devices.
ARM University Program

Benefit from using ARM in your next engineering or computer science course

- SoC Design
- Systems Development
- Assembly Programming
- Computer Architecture
- Research and Student Projects
- Embedded Applications Programming

www.arm.com/support/university/
ARM University Program

The aim of the ARM University Program is to encourage the use of ARM processors as teaching and research aids in universities and other higher education establishments. University courses, projects, and research which focus on SoC design, computer architecture, embedded systems, microprocessors/controls, assembly programming, OS application development, robotics, or mechatronics can benefit from using ARM IP and development systems. Students benefit from using today's development tools and technology.

The program provides a variety of starting points, tools, and materials to both students and faculty, including development systems, core and physical IP components, OS's, system-level tools, training materials, as well as a variety of lab samples, example curricula, and student application notes.

Contact ARM University Relations

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New! ARM Enables Cortex-M0 Processor IP Availability via ARM DesignStart Portal!

ARM has announced the availability of the ARM® Cortex™-M0 DesignStart processor via the ARM DesignStart™ online IP portal. Note that due to internal updating of the DesignStart portal, the Cortex-M0 DesignStart processor is not currently available. Please check back here soon, as we will announce when it’s available again. The special configuration of the processor is designed for universities, start-ups and ad-hoc technology teams looking to teach or prototype with the popular ARM Cortex-M0 processor. Through this online access model ARM will accelerate the proliferation of ARM technology in university curriculums and research projects, while also providing a starting point to evaluate ARM Cortex-M0 processor design and implementation.

New! DS-5 Application Edition is Available Now for Free for Qualified Universities!

At the moment, we are only considering license requests from faculty members. DS-5 Application Edition makes it easy to
Questions?