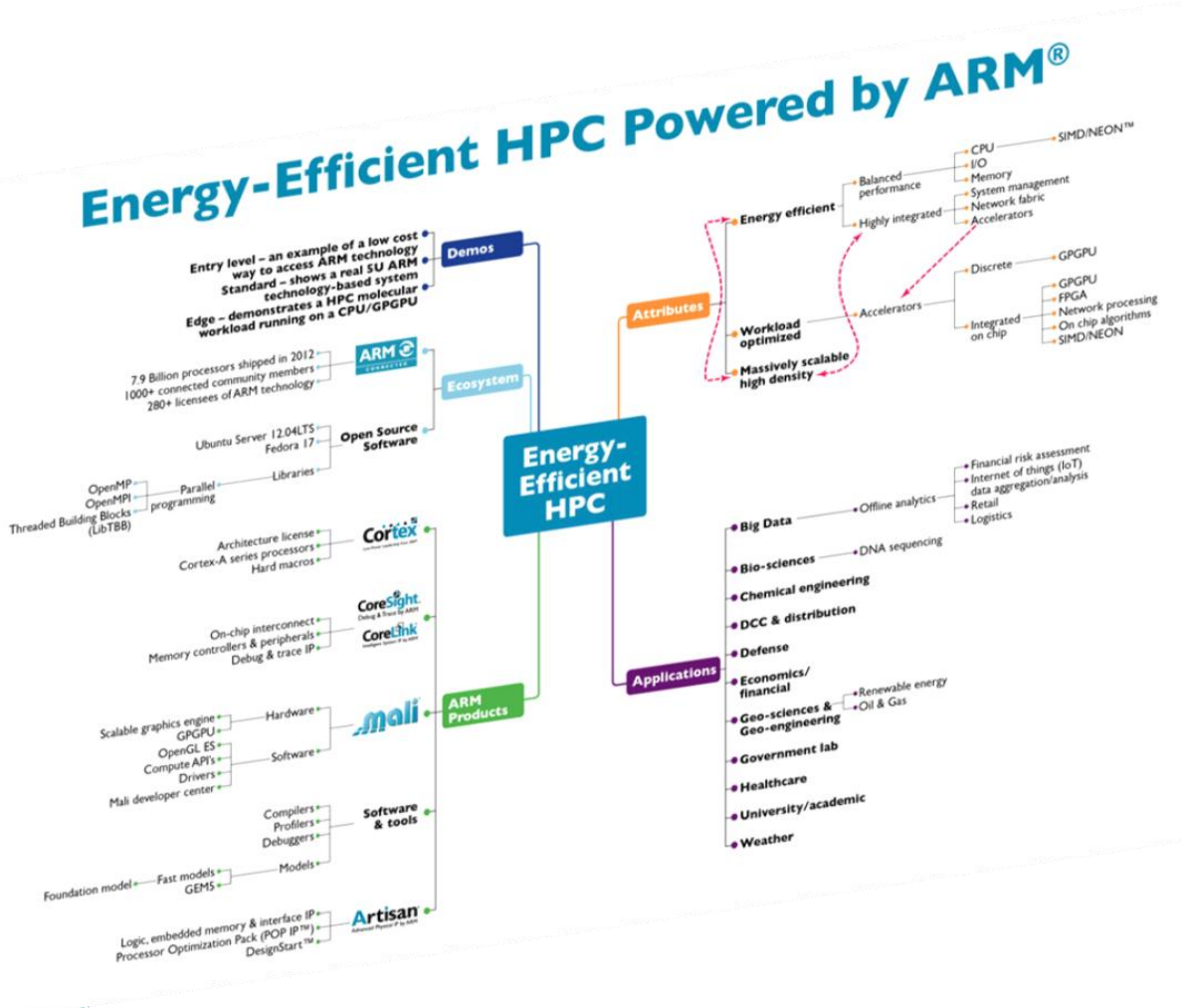


A balanced approach to BIG Data

(using COTS-on-Silicon)

AGENDA

- **What is today's agenda?**
  - introduction
  - economics
  - terminology
  - technology
  - direction

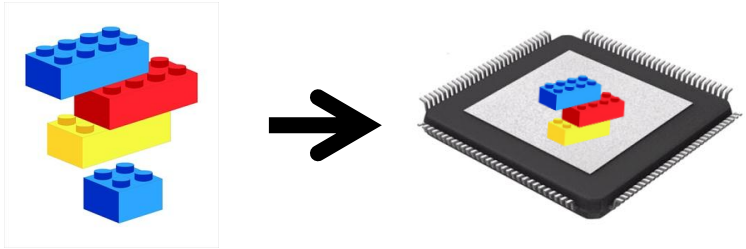
introduction

INTRODUCTIONS

- **Andrew N. Sloss** : andrew.sloss@arm.com
  - Seattle, Senior Principal Engineer
  - Marketing, Strategic Alliances
- **Nigel C. Paver** : nigel.paver@arm.com
  - Austin, ARM Fellow
  - R&D, Leading R&D HPC activity in ARM
- **Eric Van Hensbergen** : eric.vanhensbergen@arm.com
  - Austin, Principal Design Engineer
  - R&D, ARM Research for US/HPC

STATE

- **SHIFT**
  - No longer solely rely on **Process Reduction** to improve performance
  - Performance/Power/Cost will increasingly become reliant on **Integration**

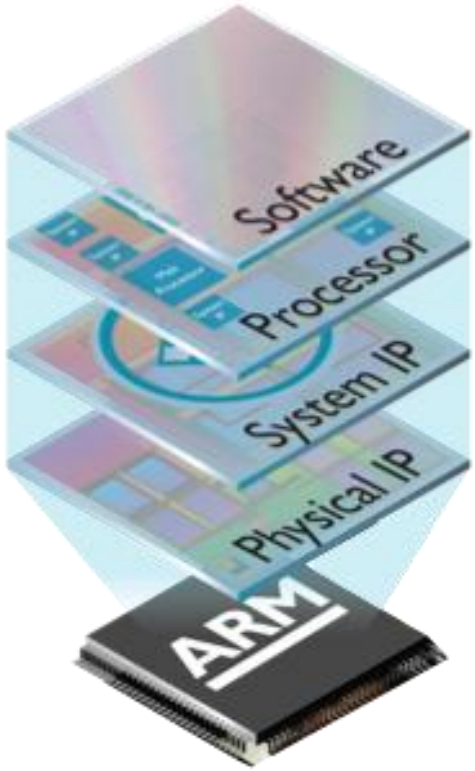


- **ARM**
  - Focuses on Design & Licensing of IP Building Blocks for SoCs (=LEGO's)
  - Fosters an eco-system of standard pieces, acting as *COTS-on-Silicon*
  - *COTS-on-Silicon* encourages multi-suppliers through the eco-system
  - Allowing the eco-system the ability to deliver cost effective solutions
    - Enforcing localized optimized end designs
  - Enabling circuit-boards to be miniaturized onto a single chip
  - While retaining the technology DNA of Energy-Efficiency

economics

FLEXIBILITY

- **Build what you want?**
  - Target your SoC to solve your problem
    - One size does not fit all
    - Optimize power/performance for the domain
  - Utilize common infrastructure and components
    - Leverage SW ecosystem and portability
    - Leverage validated IP
    - Proven design flows
  - Focus on adding value to solve your problems
    - Adding you application specific IP
    - Everything else off the shelf
      - Rich IP libraries
  - Diverse and competitive IP vendors
    - Leverage the ARM ecosystem



STATUS

- **What are the ARM numbers?**

ARM “the company”	: **>22-years**
Processors shipped in 2012	: **~8.7 Bu (~7.9 Bu`11)**
Processors shipped in total	: **>38 Bu**
Processor licenses	: **~960**
Semiconductor partners	: **310**
Foundry partners	: **5+**
Process technology	: **14 – 250 nm**
Connected community members	: **1000+**

COLLABORATION

COTS-on-Silicon

38+ billion cores to date

100+ billion by 2020

1998 2010 2020

MARKETS

Mobile

4.6bn

3%

in 2011

Home

0.4bn

40%

in 2011

Embedded

2.3bn

25%

in 2011

Enterprise

1.4bn

10%

in 2011

terminology

PROCESSORS

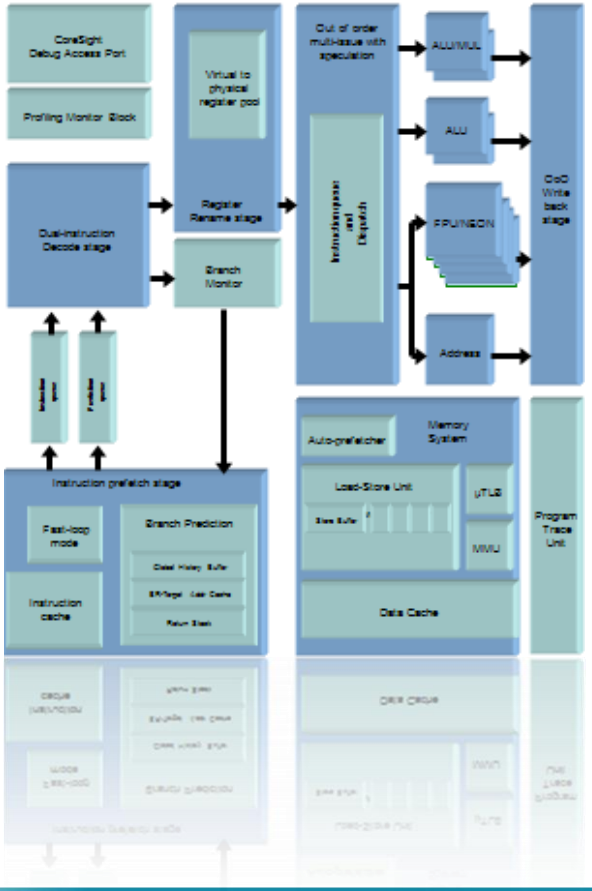
Architecture "ARMv8"

ARM® Architecture Reference Manual

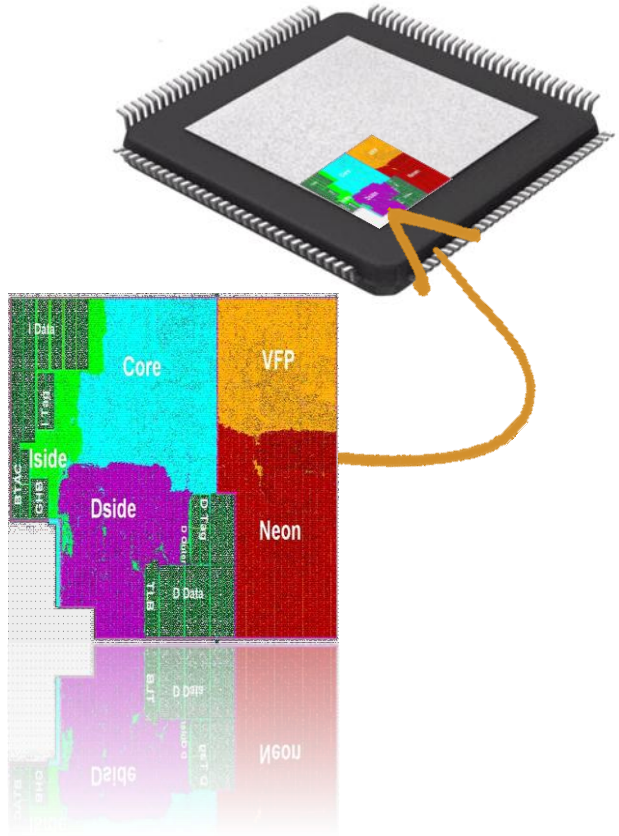
ARM®v7-A and ARM®v7-R edition

ARM®

Processor Micro-Architecture "Cortex-A57"



Processor Hard-Macro Implementation

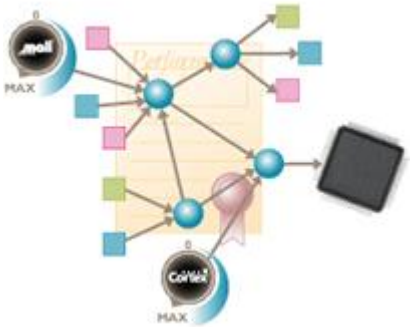


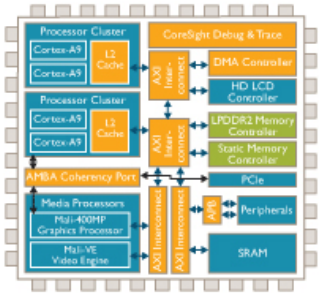
technology

WIDTH

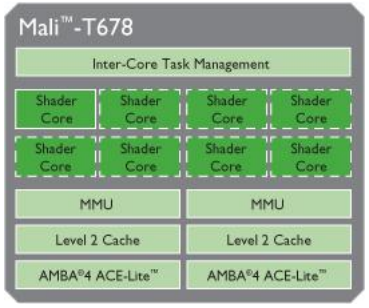
Physical IP

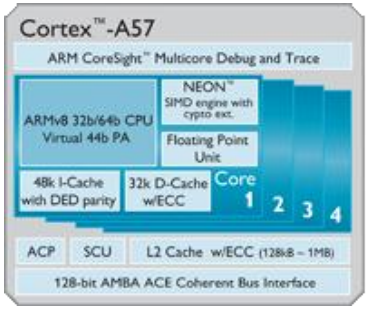
System IP





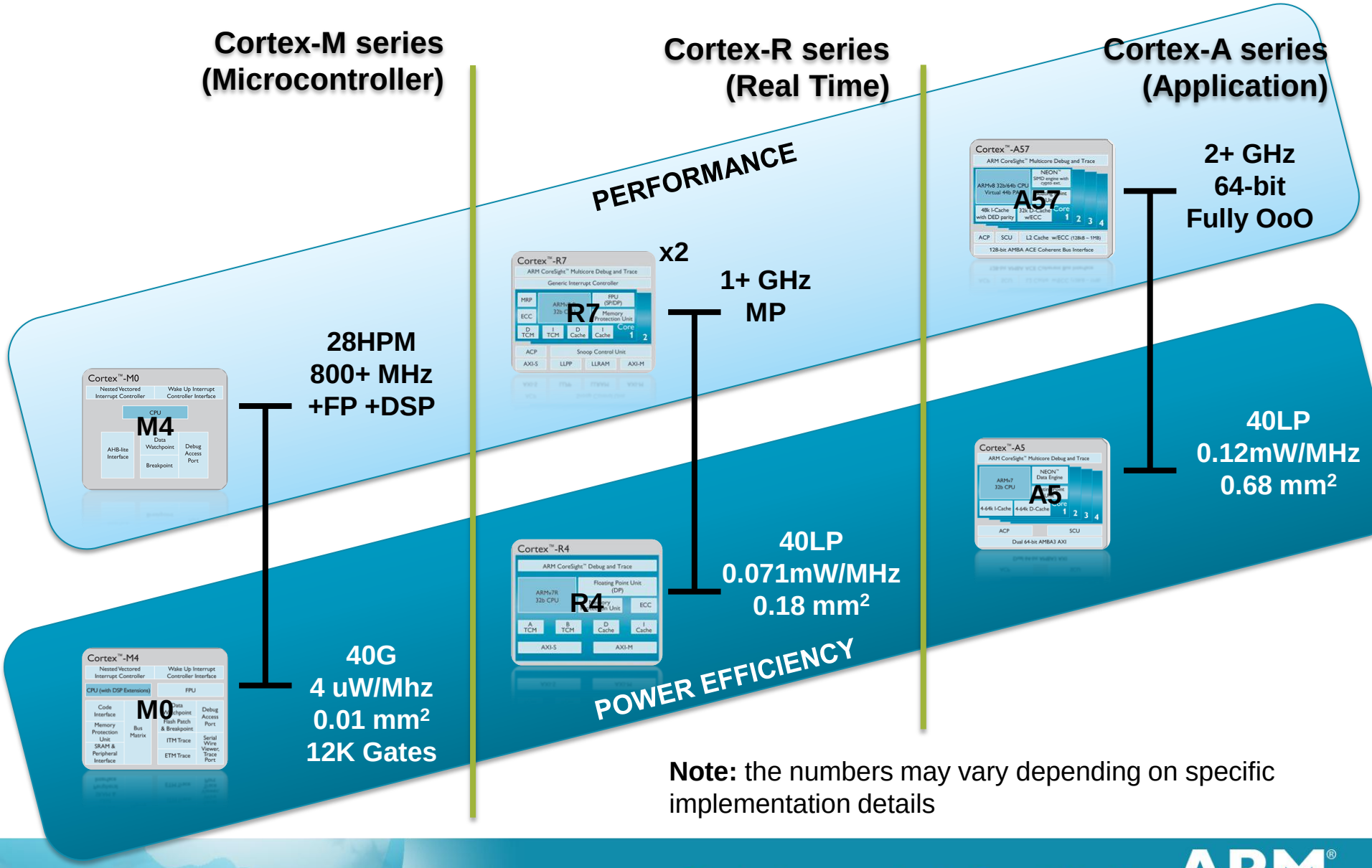
Processor & Graphics IP





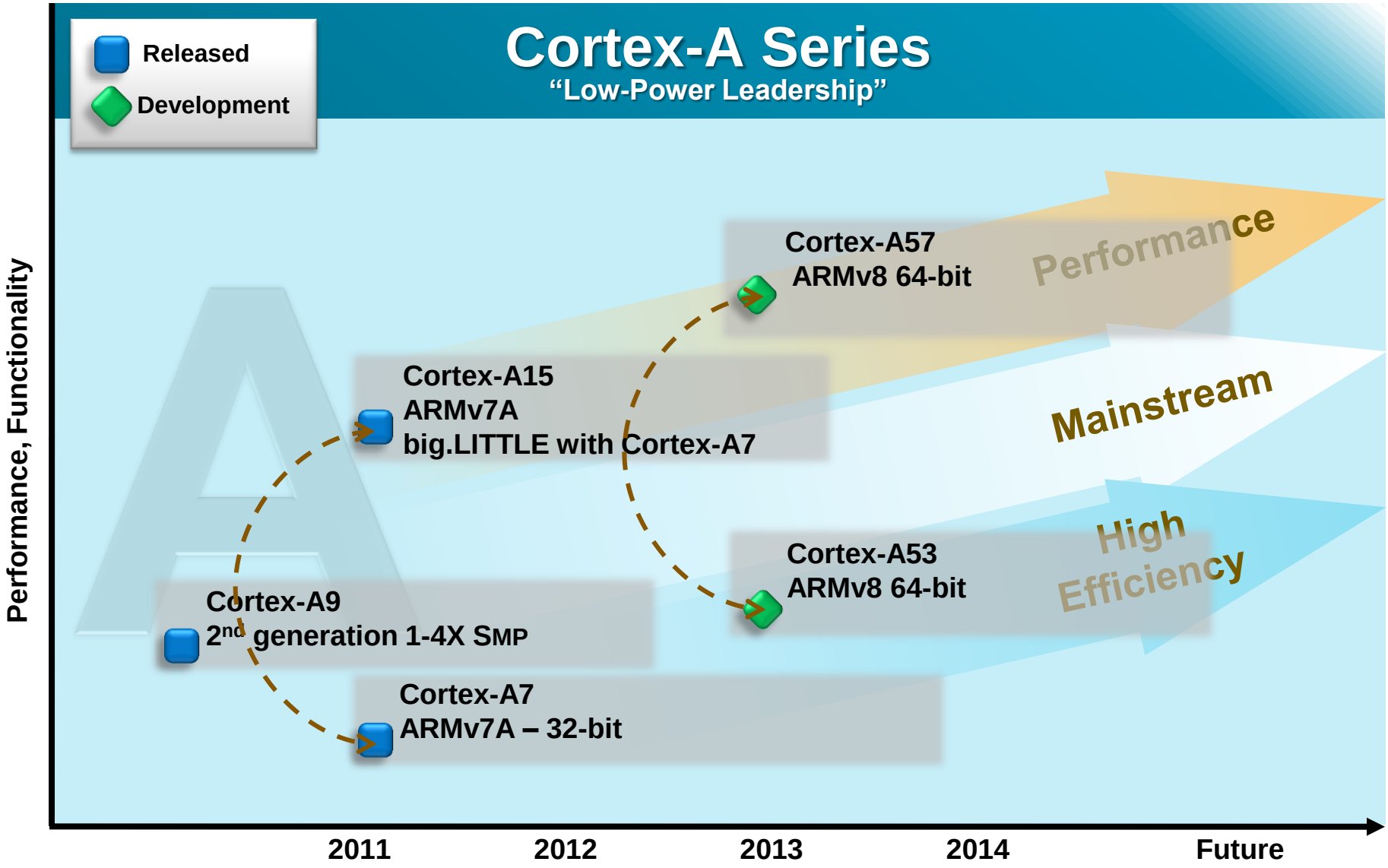
Development Systems (software)

SPECTRUM



Note: the numbers may vary depending on specific implementation details

ROADMAP



direction

BALANCED

- **ARM is aiming for a balanced approach?**
  - Bring the advantages balanced technology into new areas
  - Technology has to balance performance, power and area (=cost)
  - Efficiency through a careful technology balance e.g. big.LITTLE solutions
  - Companies can select the right PPA* fit-for-purpose
  - Stacked die : CPU+MEMORY+IO
  - Adopting new memory technologies/interfaces:
    - emerging non-volatile technology
  - Balancing the new and old workloads
    - Old: SIMD / Fortran / Vectorizing
    - New: Map-reduce and beyond / Sparse Matrices / Pointer Chasing

PPA : Power Performance Area

summary

RECAP

- **What to take away?**

  - No longer solely rely on Process Reduction to improve performance
  - Performance/Power/Cost will increasingly become reliant on Integration
  - ARM designs and licenses IP building blocks for >22-years
  - IP Business Model fosters a eco-system of tested components
  - Allowing tailored solutions to be created for HPC/Big Data problems
  - Building Blocks include Processor IP, Physical IP, System IP & Software
  - Bringing the cross-pollination balanced technology from other segments
  - *COTS-on-Silicon* encourages multi-suppliers throughout the eco-system
  - Eco-system can deliver cost effective solutions in sensitive markets
    - Enforcing localized optimized end designs

Energy Efficiency Underlies It All

end