ARMv8-A

Nandan Nayampally
VP Marketing, CPU Group

March 24 2014

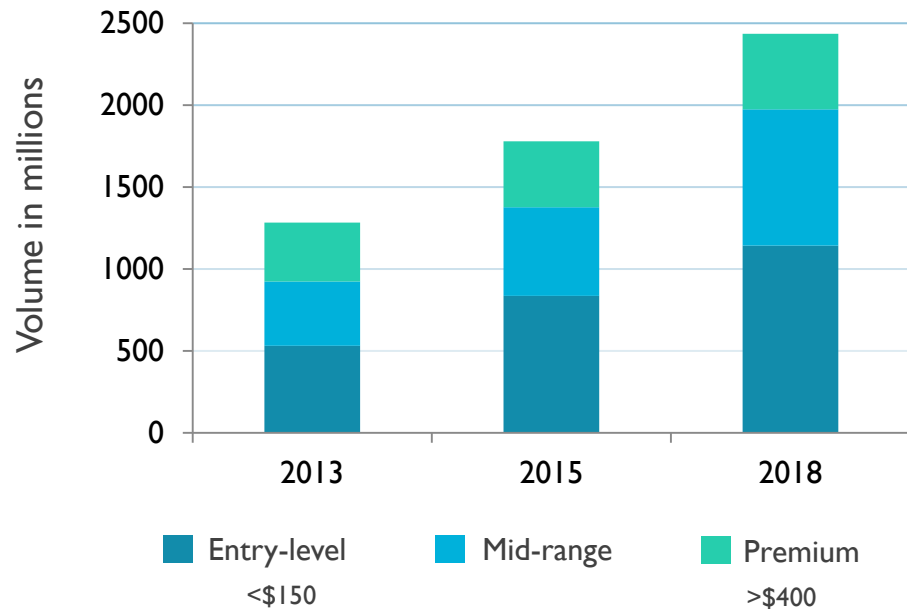The Architecture for the Digital World®   **ARM**

Agenda

- A Brief History of the ARM Architecture

- ARMv8-A Design Requirements

- ARMv8-A Features

- Use Cases

- Performance

- Ecosystem

- Opportunity

ARM

At The Heart Of Modern Computing

- ARM's business model has fostered a wave of innovation in mobile devices
- Advanced personal computers are becoming affordable to all
- Datacentre and network operators are turning to ARM solutions to drive efficiency
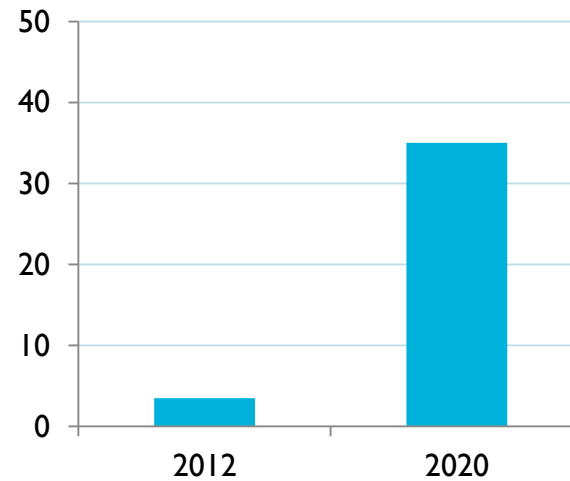
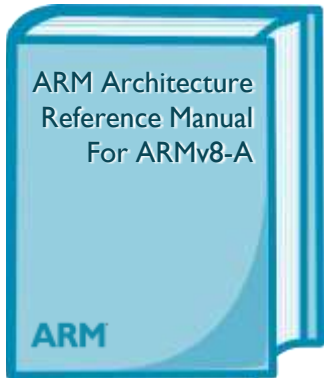Smart Mobile Device Shipments
(Smartphones and Tablets)

Global Data Creation (Zetabytes)

Entry-level <$150   Mid-range   Premium >$400

ARM and Gartner Estimates, CAGR figures based on 2013

Computer Science Group 2013

ARM

Definitions

ARM Architecture Reference Manual For ARMv8-A

ARM

Cortex®-A53

Cortex™-A57

ARM CoreSight™ Multicore Debug and Trace

NEON™ SIMD engine with crypto ext.

ARMv8 32b/64b CPU Virtual 44b PA

Floating Point Unit

48k I-Cache with DED parity | 32k D-Cache w/ECC

Core 1 2 3 4

ACP | SCU | L2 Cache w/ECC (128kB ~ 1MB)

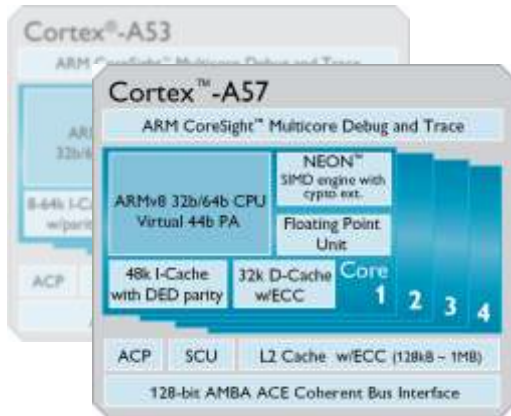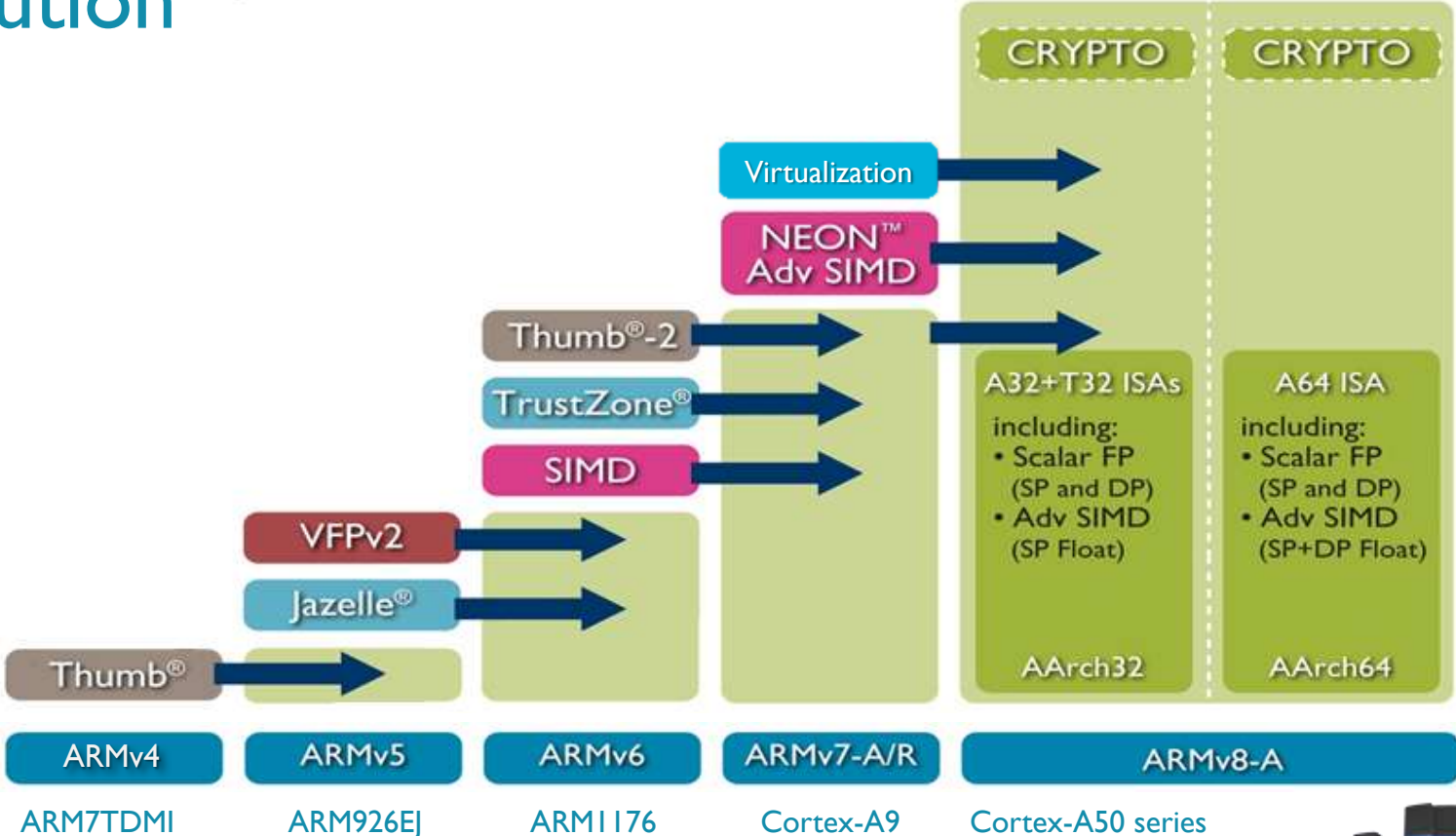128-bit AMBA ACE Coherent Bus Interface

- **Architecture**
  - A set of rules for building and programming a processor
  - The contract between hardware and software
  - Also known as 'Instruction Set Architecture' (ISA)

- **Processor**
  - A processor design that complies with a specific Architecture
  - Examples of processor implementations:

ARMv4	ARMv5	ARMv6	ARMv7-A/R	ARMv8-A
ARM7TDMI	ARM926EJ	ARM1176	Cortex-A9	Cortex-A50 series

ARM

Architecture Evolution

CRYPTO | CRYPTO

Virtualization →

NEON™ Adv SIMD →

Thumb®-2 → →

A32+T32 ISAs
including:
• Scalar FP (SP and DP)
• Adv SIMD (SP Float)

AArch32

A64 ISA
including:
• Scalar FP (SP and DP)
• Adv SIMD (SP+DP Float)

AArch64

TrustZone® →

SIMD →

VFPv2 →

Jazelle® →

Thumb® →

| ARMv4 | ARMv5 | ARMv6 | ARMv7-A/R | ARMv8-A |

ARM7TDMI | ARM926EJ | ARM1176 | Cortex-A9 | Cortex-A50 series
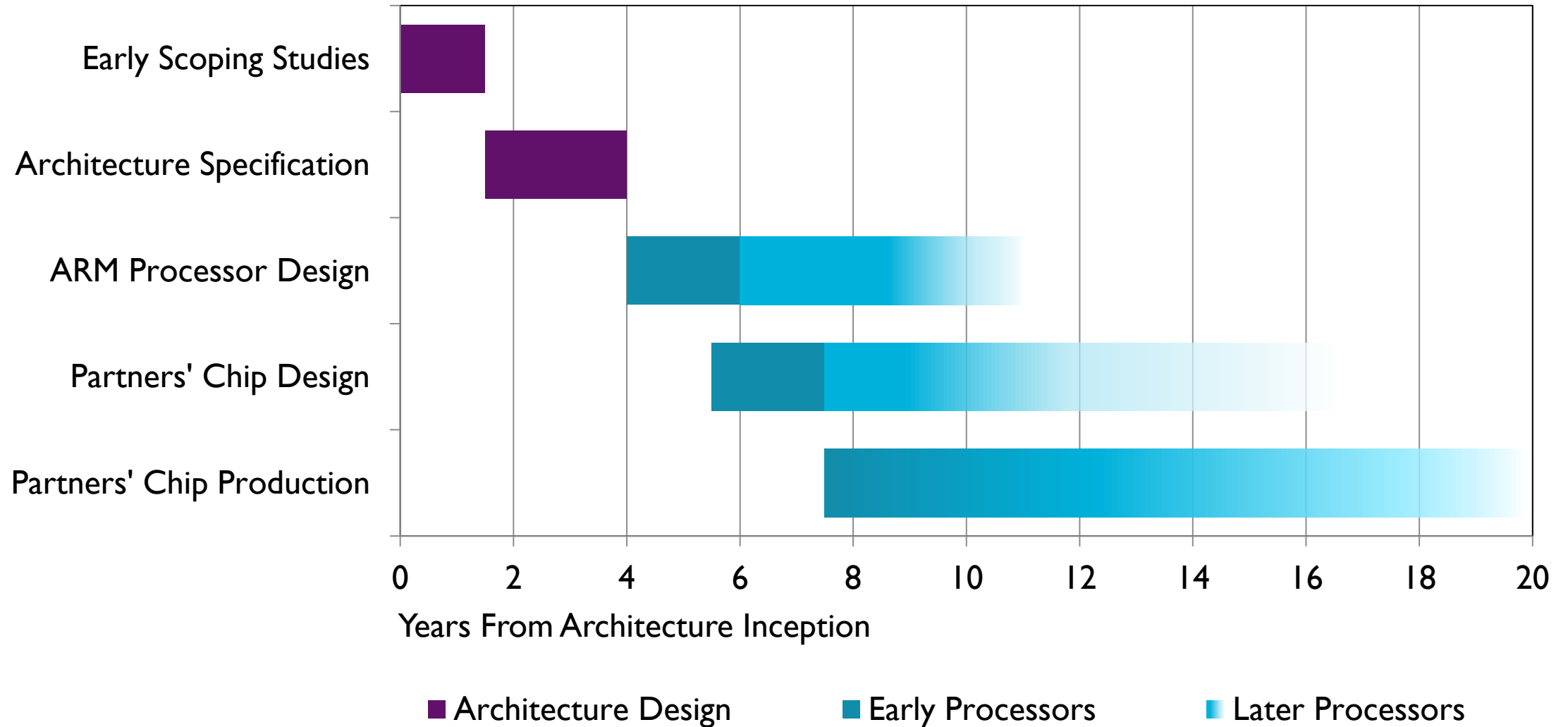
Increasing SoC complexity
Increasing OS complexity
Increasing choice of HW and SW

1995   2005   2015

ARM

Architecture Lifecycle

ARMv8-A Design Requirements

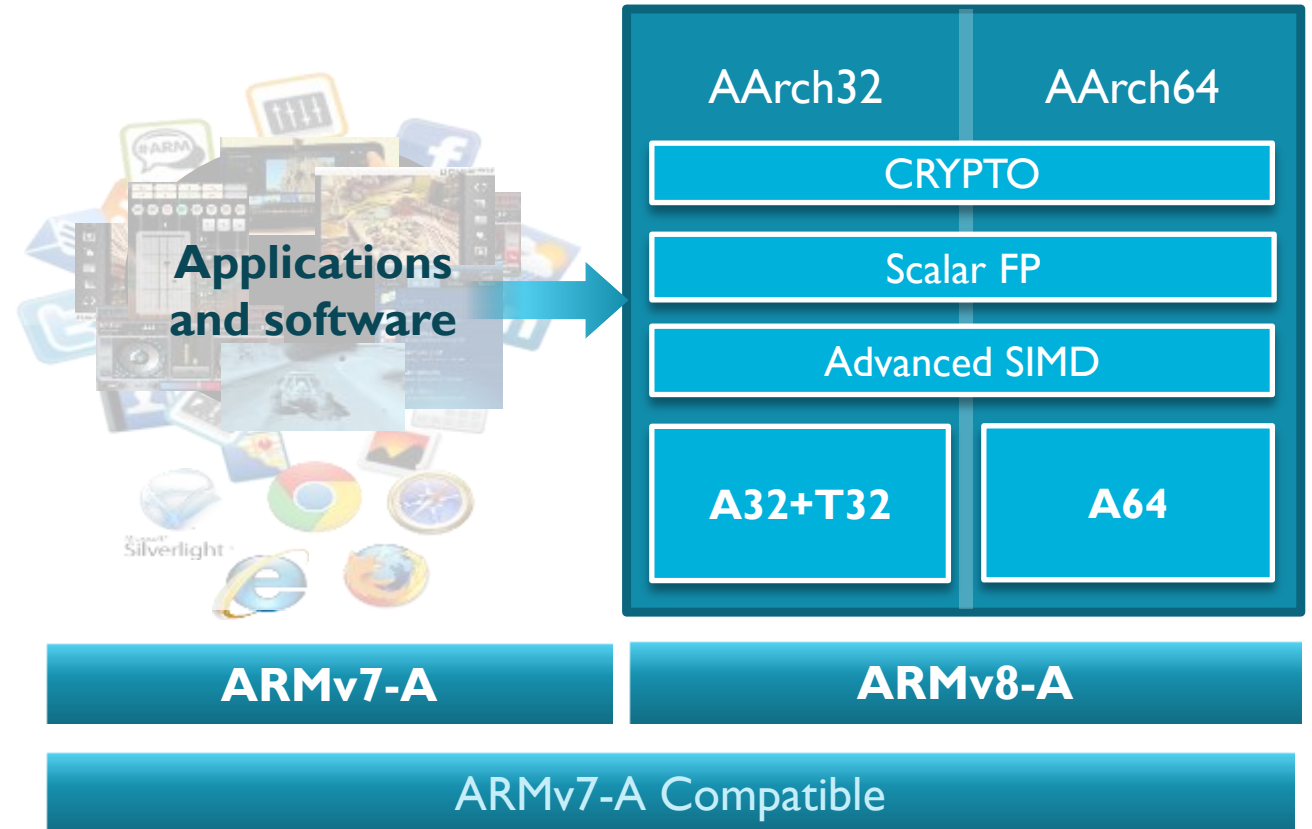|		
Entry-level Computing	Extend OS capabilities to sub-$100 devices	
'Desktop Class' Computing	Performance apps Enhanced multimedia processing	
High-end Enterprise	64-bit memory addressing Virtualisation High bandwidth Enable innovation for hyperscale operators	

ARM

ARMv8-A Instruction Set Enhancements

- ## AArch32
  - ARMv8-A is 100% compatible with 32-bit ARMv7-A software
  - Cryptography support across 32-bit

- ## AArch64
  - Introduces 64-bit support
  - Faster data manipulation for applications in Cloud and Mobile
  - Improved support for virtualisation
  - Better support for multi-threaded software

Applications and software

AArch32	AArch64
CRYPTO	
Scalar FP	
Advanced SIMD	
A32+T32	**A64**

ARMv7-A	**ARMv8-A**

ARMv7-A Compatible

ARM

ARMv8-A Designed for Efficiency

| Enhancement	Why it Matters
64-bit architecture	Efficient access to large datasets
Increased number and size of general purpose registers	Gains in performance and code efficiency
Double the number and size of NEON registers	Enhanced capacity of multimedia engine
Cryptography support	Over 10x software encryption performance New security models for consumer and enterprise

ARM

Desktop-class Apps For All Devices

- Enable new categories of applications
  - 'Unlimited' memory addressing
  - Faster number crunching and better gaming
  - Lower power consumption
  - Complex applications for the enterprise

- Enhanced user interaction
  - Gesture and voice recognition

- Enables OEMs to innovate across
  a broad range of computing platforms
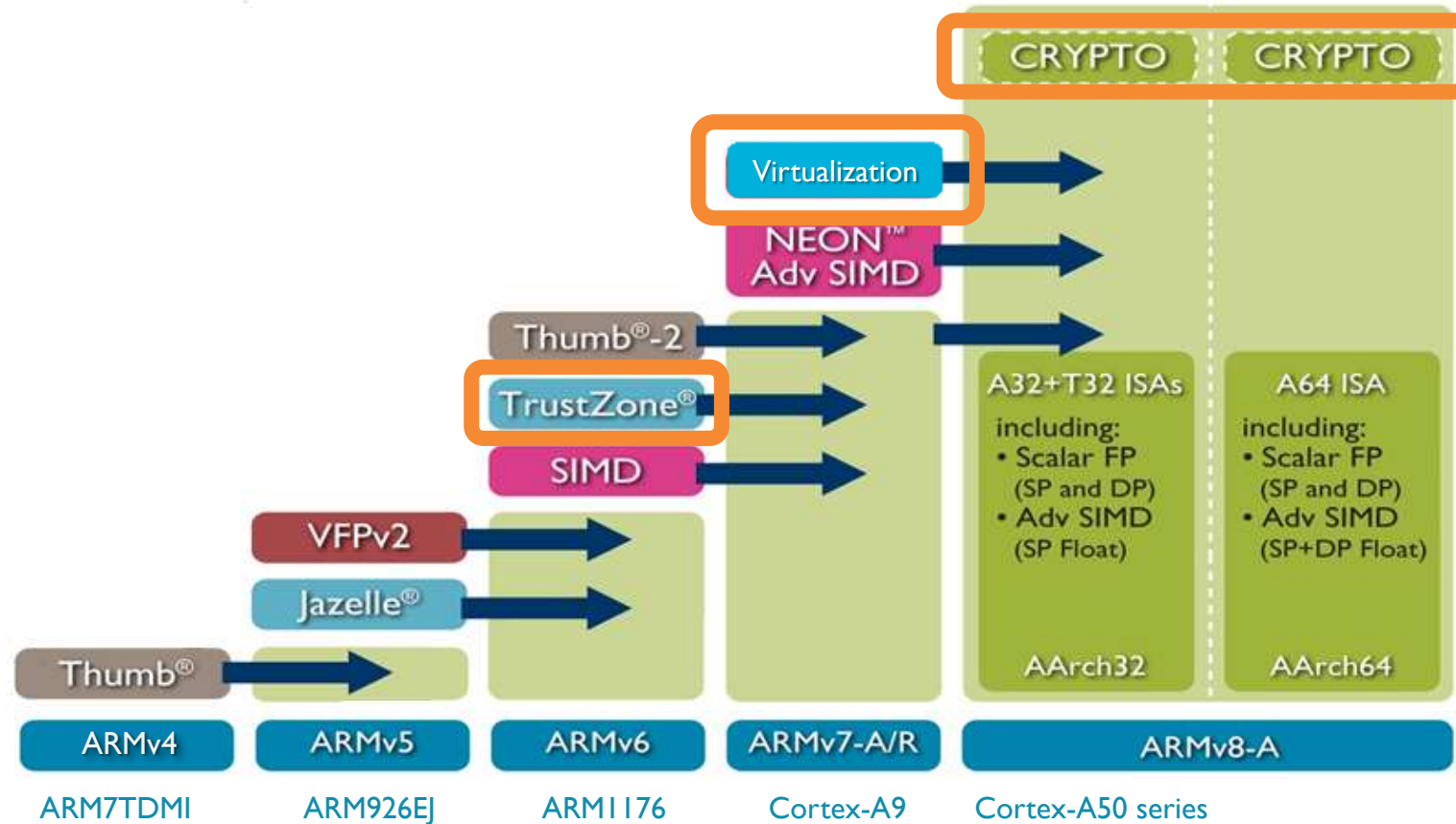
ARM

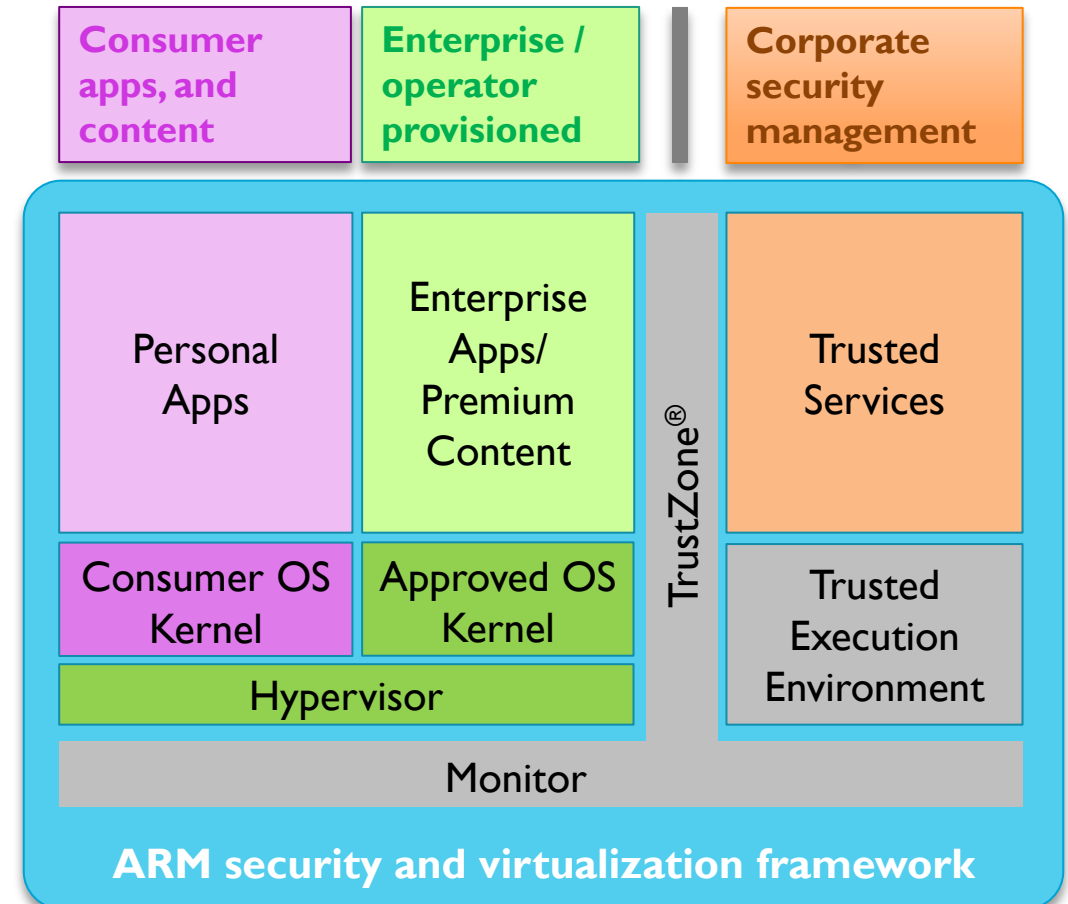# Enhanced Privacy, Security And Personalization

ARM security framework with TrustZone® is available in all ARMv7-A and ARMv8-A processors

ARM security and virtualization framework is available in ARMv8-A and ARMv7-A processors launched since 2010

ARM

Enhanced Privacy, Security And Personalization

- Separation of consumer and enterprise applications and data
  - Enables enterprise control of enterprise assets
  - Enhanced authentication and electronic payment
  - Headroom for future

- Premium content separated from consumer platform
  - Greater protection for high-value content
  - Complements TrustZone® management of sensitive assets

Consumer apps, and content

Enterprise / operator provisioned

Corporate security management

Personal Apps

Enterprise Apps/ Premium Content

TrustZone®

Trusted Services

Consumer OS Kernel

Approved OS Kernel

Trusted Execution Environment

Hypervisor
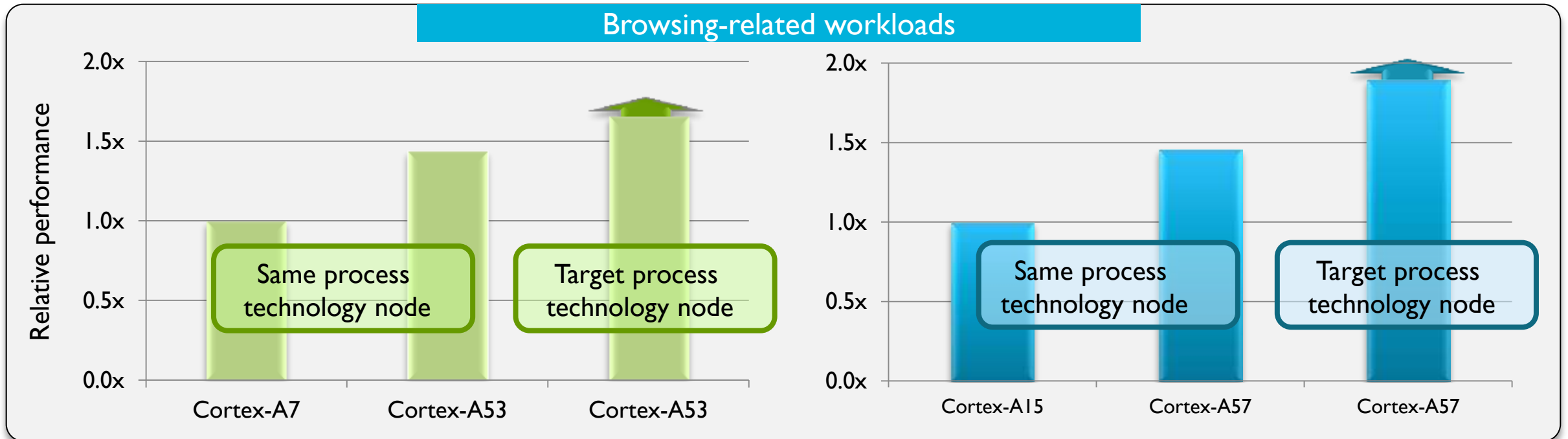
Monitor

ARM security and virtualization framework

ARM security framework with TrustZone® is available in all ARMv7-A and ARMv8-A processors

ARM security and virtualization framework is available in ARMv8-A and ARMv7-A processors launched since 2010

ARM

Significant Performance Uplift

- Existing ARMv7-A 32-bit software runs faster on today's ARMv8-A processors

Browsing-related workloads

Relative performance — Same process technology node / Target process technology node

Cortex-A7 — Cortex-A53 — Cortex-A53

Cortex-A15 — Cortex-A57 — Cortex-A57

- ARMv8-A 32-bit and 64-bit software will provide additional benefits based on use case

- Expect further improvements
  - Process technology, silicon implementation and improved software tools

ARM

ARMv8-A for Software and System Developers

ARM Compiler for ARMv8-A	ARM Fast Model	Open Source Tools	SW Evolution
DS-5™ for ARMv8-A	**Custom virtual platforms**	**Linux Kernel and tools**	**SW Evolution**
• Delivers a suite of professional software development tools for ARM processors • Includes ARMv8-A cores	• Platform for early software development	• Open source tools and compilers • Linux kernel support	• Continued software optimization • Test silicon available • Server Base System Architecture

ARM

Unified and Growing Ecosystem

Mobile Computing and Consumer: MARVELL, MEDIATEK, Rockchip, QUALCOMM, SAMSUNG, NVIDIA, ST, LG Electronics

Enterprise Networking: BROADCOM, nsn, CAVIUM, freescale, HUAWEI, CISCO, ALTERA, ENEA

Server Hardware: AMD, applied micro, DELL, TEXAS INSTRUMENTS, BROADCOM, hp, CAVIUM

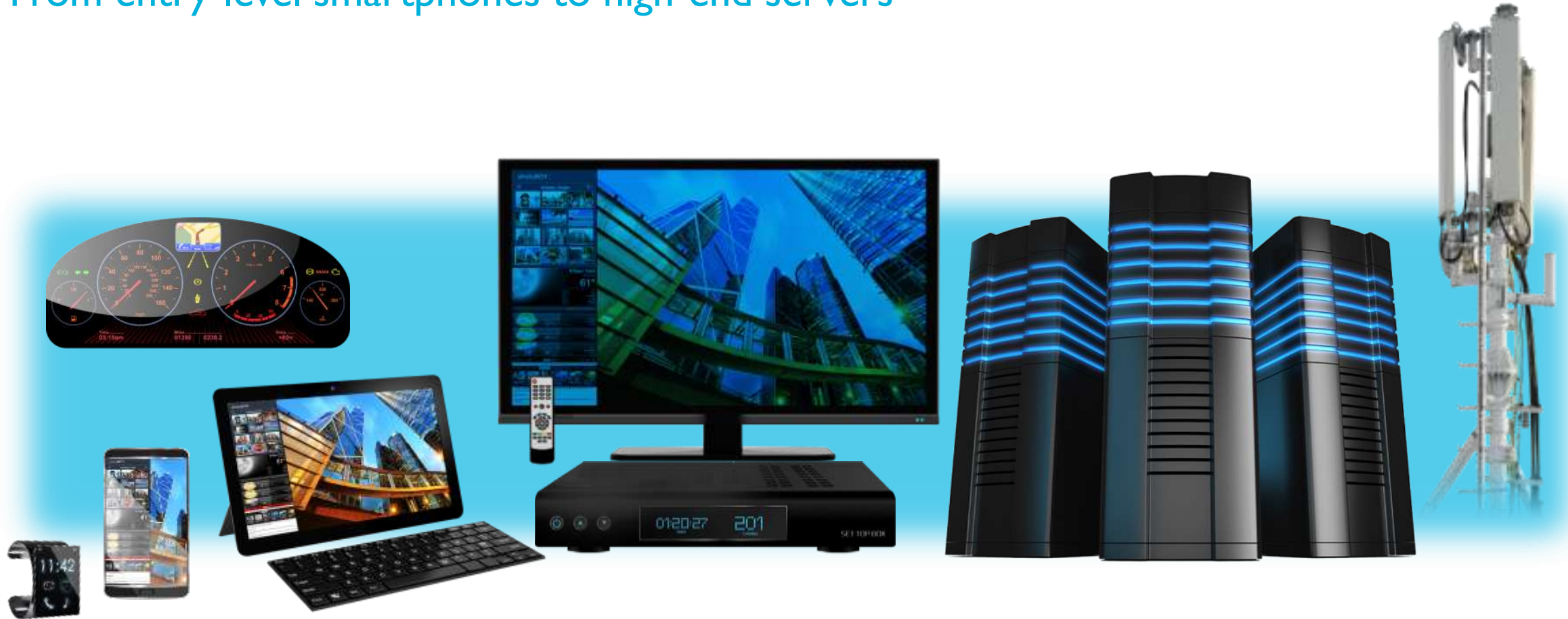Server Software: ORACLE, redhat, facebook, Microsoft, CANONICAL, CITRIX, MontaVista

- Builds on the extensive software assets that already exist in today's 32-bit ARMv7-A ecosystem
- All of these assets are compatible with ARMv8-A processors

ARM

ARMv8-A Everywhere

From entry-level smartphones to high-end servers

ARM

Thank you

The Architecture for the Digital World®   **ARM**