

# ARM<sup>®</sup>

## ARM Holdings plc 2013 Analyst & Investor Day

21 May 2013

London



The Architecture for the Digital World<sup>®</sup>

**ARM<sup>®</sup>**

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- More information about potential factors that could affect ARM’s business and financial results is included in ARM’s Annual Report on Form 20-F for the fiscal year ended December 31, 2012 including (without limitation) under the captions, “Risk Factors” and “Operating and Financial Review and Prospects,” which is on file with the Securities and Exchange Commission (the “SEC”) and available at the SEC’s website at [www.sec.gov](http://www.sec.gov).

# Agenda

Timing	Topic
10:00 – 10:35	<b>The 2020 Opportunity</b> Simon Segars, President and CEO Designate
10:35 – 11:00	<b>Connected Devices</b> Laurence Bryant, Director Mobile Segment Marketing
11:00 – 11:20	Break
11:20 – 11:40	<b>Connectivity Driving Infrastructure</b> Lakshmi Mandyam, Director of Server Systems
11:40 – 12.10	<b>Energy Efficient System Design</b> Dipesh Patel, EVP and GM PIPD
12:10– 12:45	<b>Q&amp;A</b> Chaired by Warren East, CEO
12:45 – 13:30	Buffet Lunch



# The 2020 Opportunity

**Simon Segars**

**President and CEO Designate**





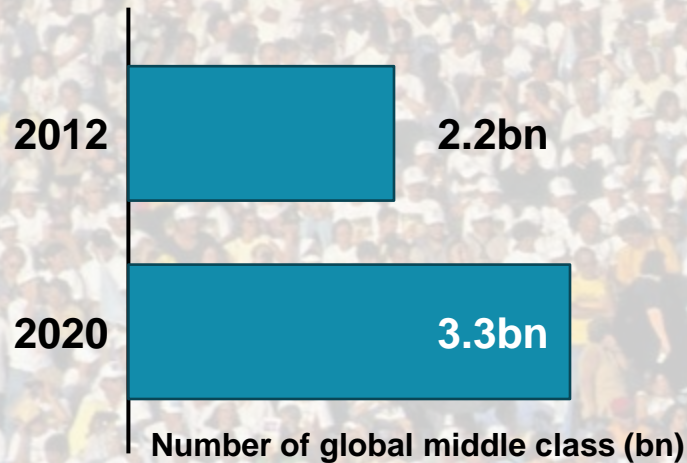


8bn people

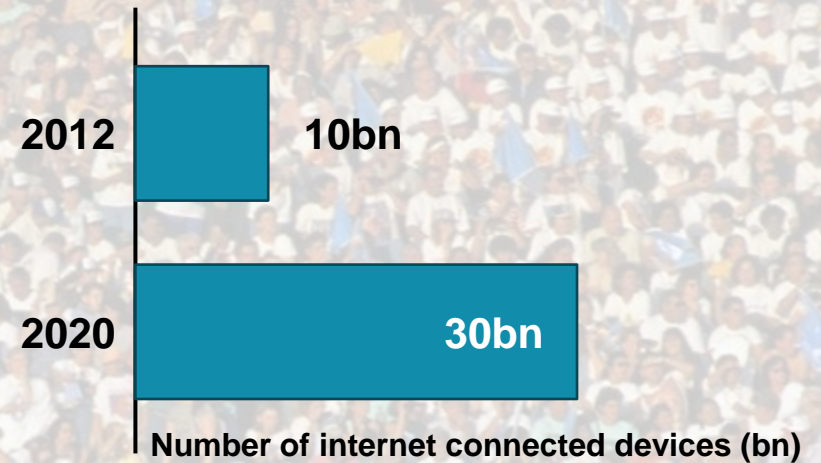


# How the World May Change

1.1bn extra consumers by 2020



30bn internet connected devices by 2020



Continued stress on healthcare budgets



Global energy demand increasing





# Mobile Phones are the World's Computer





# Connecting the Billions

**8 Billion People Worldwide**

**6 Billion People with Mobile Phones**

**1 Billion Smartphones**  
(2012 installed base)

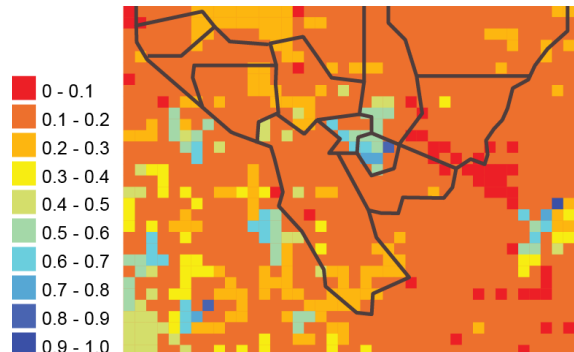
**5 Billion Smartphones**  
(2020 installed base)



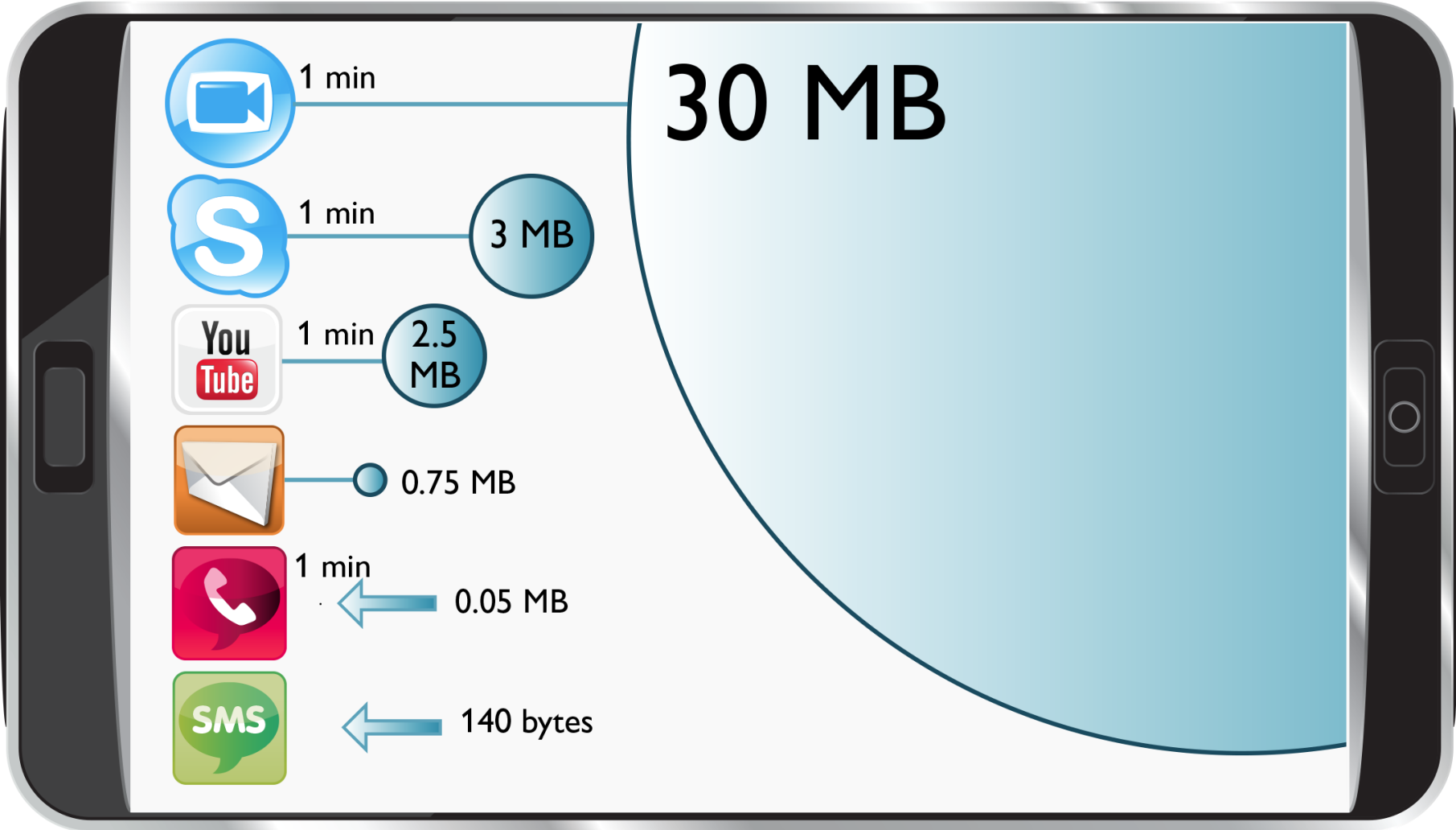
Source: Gartner and ARM estimates

# Connecting the World


- Smartphones connect people to data and services, transforming lives
  - Nomadic farmers sent maps of drought hit areas
  - Spread of crop diseases and pests monitored across Sub-Saharan Africa and Asia
  - Smartphone apps enable doctors to treat patients remotely in Bangladesh
  - Ultrasound probes display medical images on smartphone screens




# Increasing Data Intensity



# A Smarter World

An aerial photograph of a vineyard with a smart irrigation system. Multiple nozzles are spraying water in a grid pattern over the rows of grapevines. The background shows a forested hill under a cloudy sky.

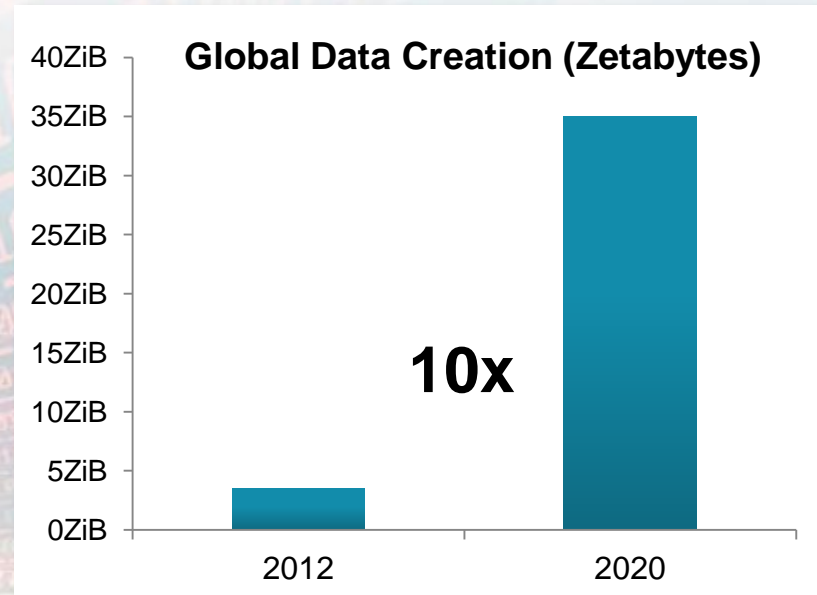
Smart agricultural systems help maximise crop yields, whilst reducing water and pesticides

A photograph of a modern street light. The light fixture is a sleek, curved, rectangular shape, mounted on a tall, silver, cylindrical pole. The background is a clear blue sky with a few white clouds.

Converting 140,000 street lights to LED will save an estimated \$7.5m in annual electricity savings



# Increasing Data Volume



**1,000,000,000,000,000,000,000,000**

● **Byte**

● **Gigabyte**

● **Zetabyte**

Source: Computer Science Corp, 2013



# Facilitating the Flow of Information



# Growing Energy Demand





# Smart Ways to Manage Power

**\$100bn**

Potential savings that smart grids could provide in the US over the next 20 years

**Balancing**

**Managing**

**Storing**

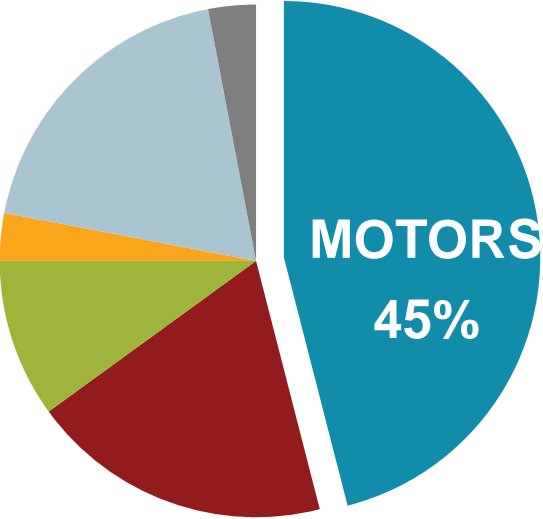
**Processing**

**Sensing**



# Intelligent Motor Control

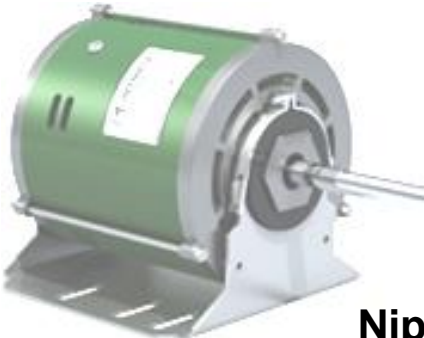
## Worldwide Electricity Consumption



- Motors
- Light
- Electronics
- Electrolysis
- Heat
- Standby

Source: A+B International, 2009.  
International Energy Agency report 2011

- Opportunity: 700 fewer power stations



**Nippon Densan (NIDEC) motor**  
Cortex-M3-based smart motor  
Up to 30% more power efficient than non-smart version

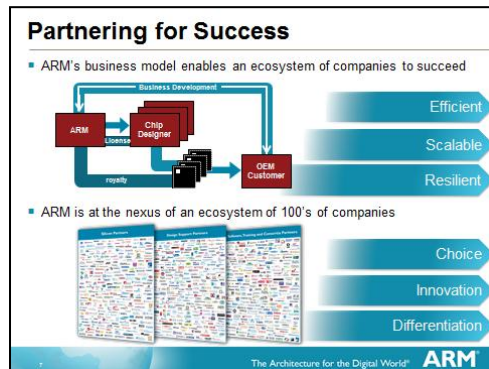
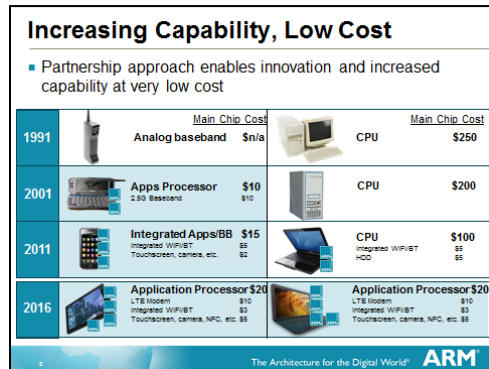
# Semiconductor Industry Opportunity

	Unit Chip Shipments (millions)	2012	2017	2020	2012-2020 Chip CAGR
Consumer/ Home	Mobile	4,800	9,100	10,800	12%
	Home	1,100	2,400	2,400	12%
	Home Networking	650	850	900	5%
Enterprise	Servers	40	50	65	7%
	Enterprise Networking	600	800	900	6%
	Storage	700	1,100	1,400	10%
Emb.	Internet-of-Things	760	2,000	3,000	22%
	Other Embedded	16,500	22,000	24,000	5%
	Other	2,300	3,300	4,300	9%
	<b>Total</b>	<b>27,000</b>	<b>41,000</b>	<b>48,000</b>	<b>9%</b>

Source:  
Gartner, IDC, SIA, and  
ARM estimates

# ARM Opportunity

- ARM has the right **technology**
- ARM has the right **business model**
- ARM has the right **ecosystem**



# ARM<sup>®</sup>

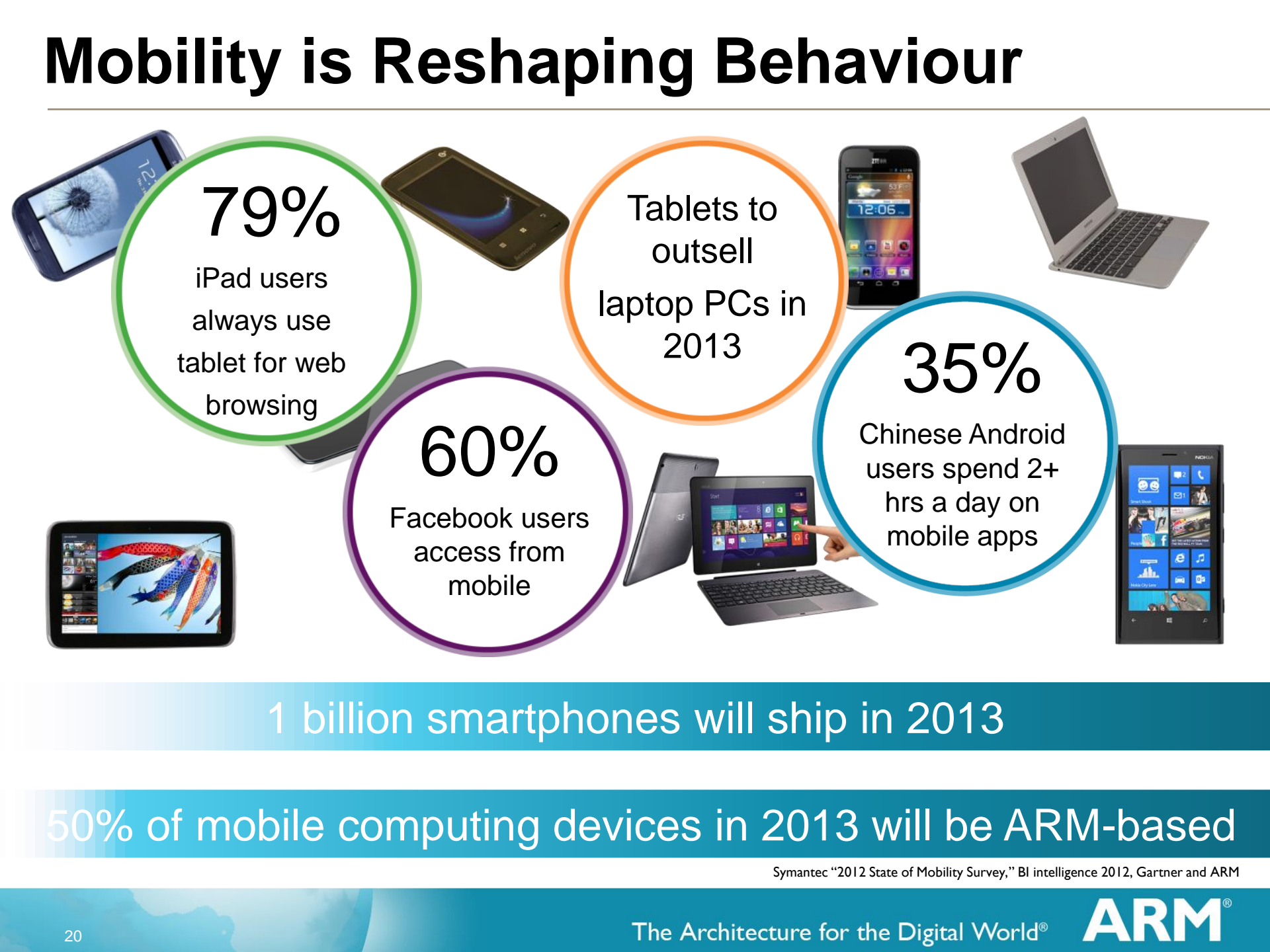
## Connected Devices

**Laurence Bryant**

**Director Mobile Segment Marketing**



# Mobility is Reshaping Behaviour



79%

iPad users  
always use  
tablet for web  
browsing

Tablets to  
outsell  
laptop PCs in  
2013

60%

Facebook users  
access from  
mobile

35%

Chinese Android  
users spend 2+  
hrs a day on  
mobile apps

1 billion smartphones will ship in 2013

50% of mobile computing devices in 2013 will be ARM-based

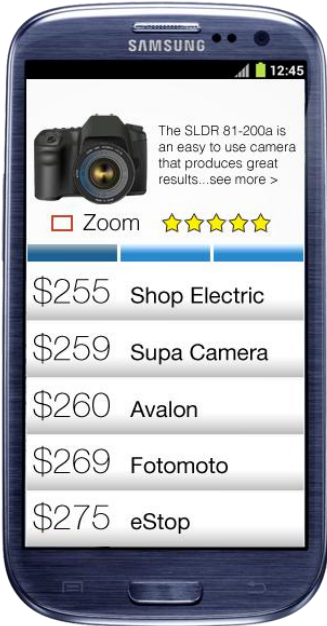
Symantec "2012 State of Mobility Survey," BI intelligence 2012, Gartner and ARM



# Our Life has Changed with Mobile

**Holiday Shopping 2007**  
Legacy Computing  
Home Online Shopping

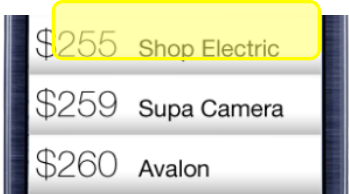
**Holiday Shopping 2012**  
Mobile Computing  
Connected Shopping



Best Price Scanning



Find Best Price Online



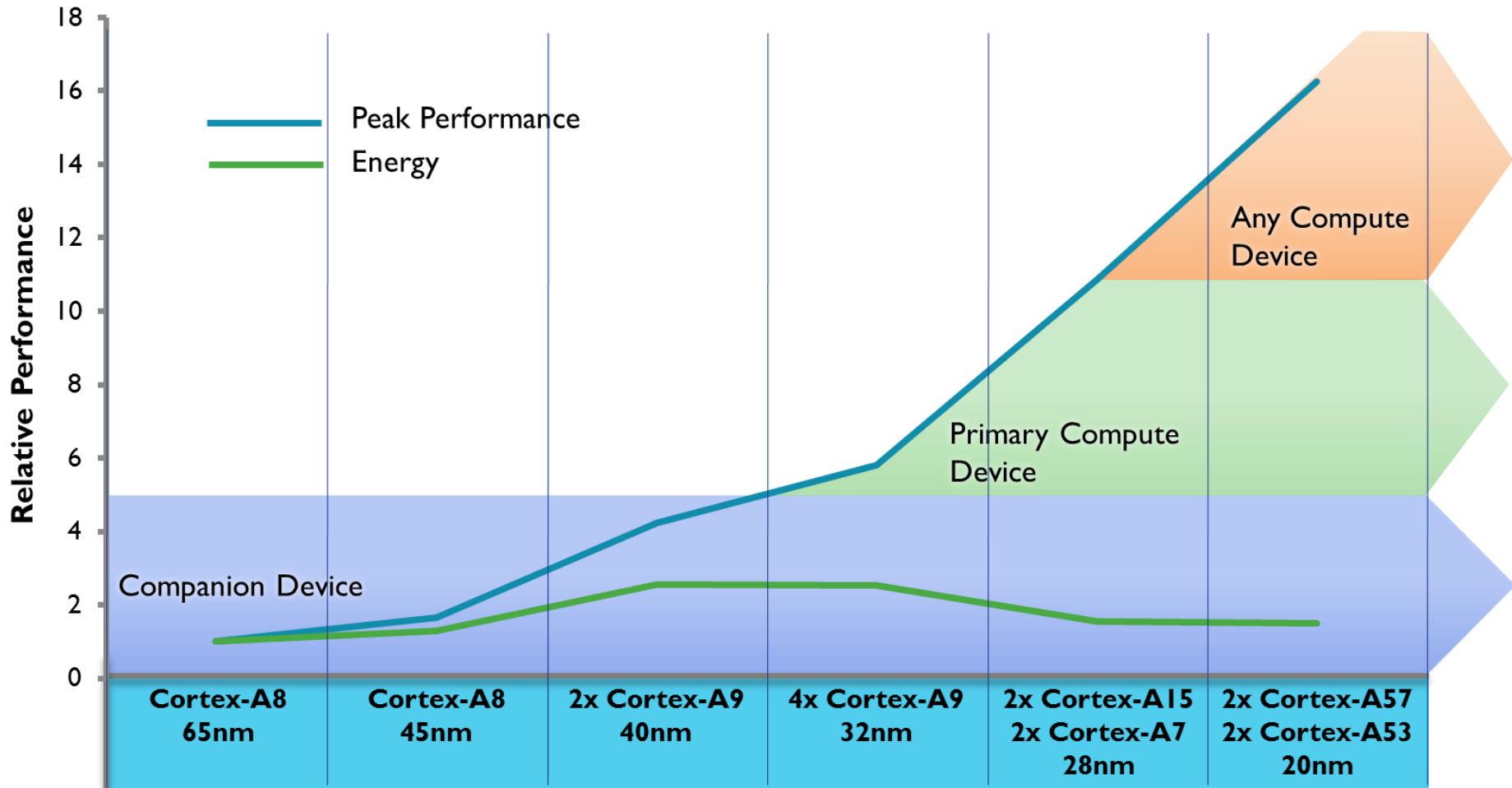
Find Best Price & Shops locally



Offers & Payment

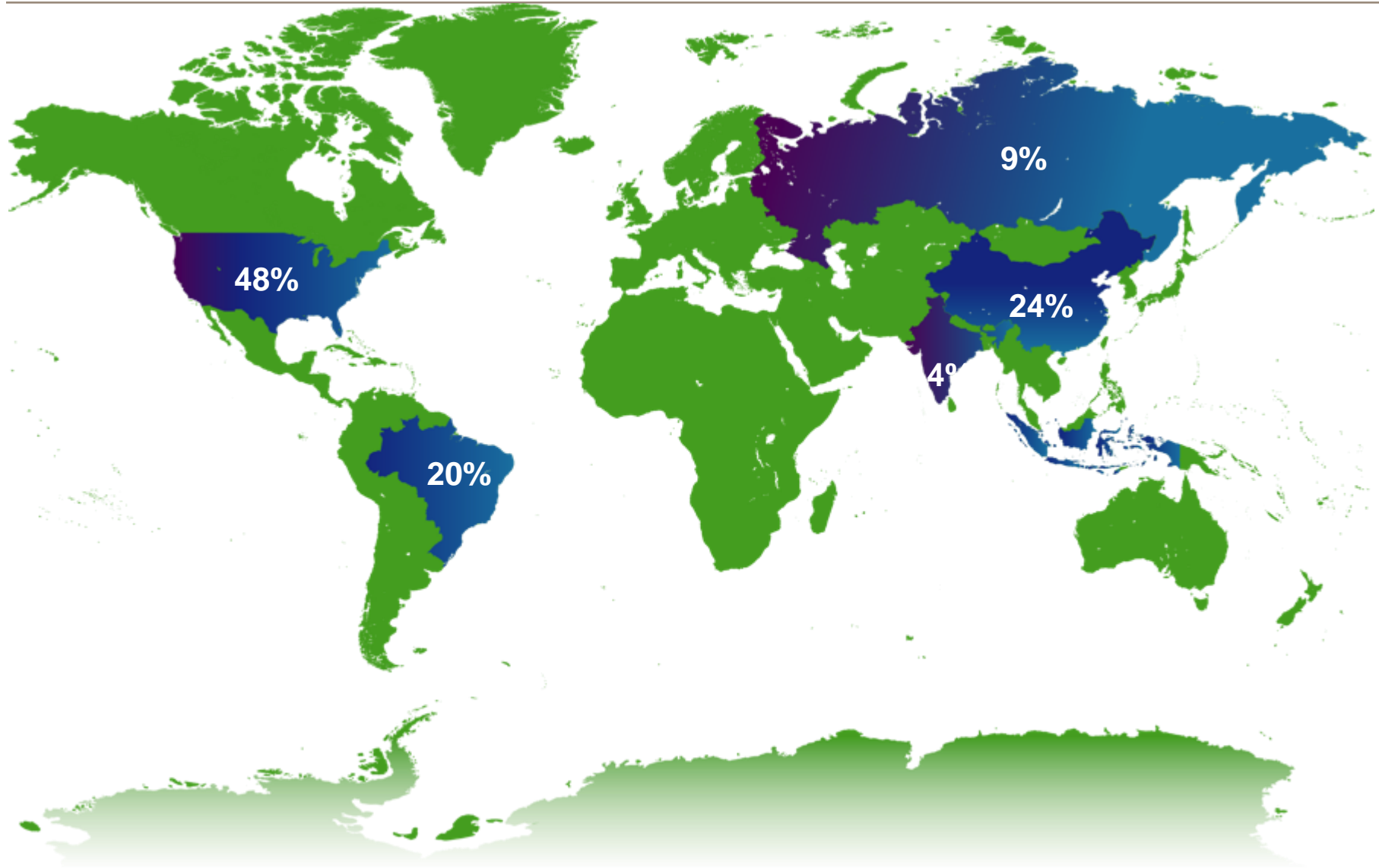


# ARM – Delivering the Post PC Era



ARM estimates

# Smartphone Global Penetration



# What Does \$100 Buy You?

2013:  
Year of entry-level quad-core Cortex-A

ARM Cortex-A processor family in <math><1\text{mm}^2</math>

ARM Mali performance density leadership

Optimum foundry processes at 40nm LP and 28nm LP

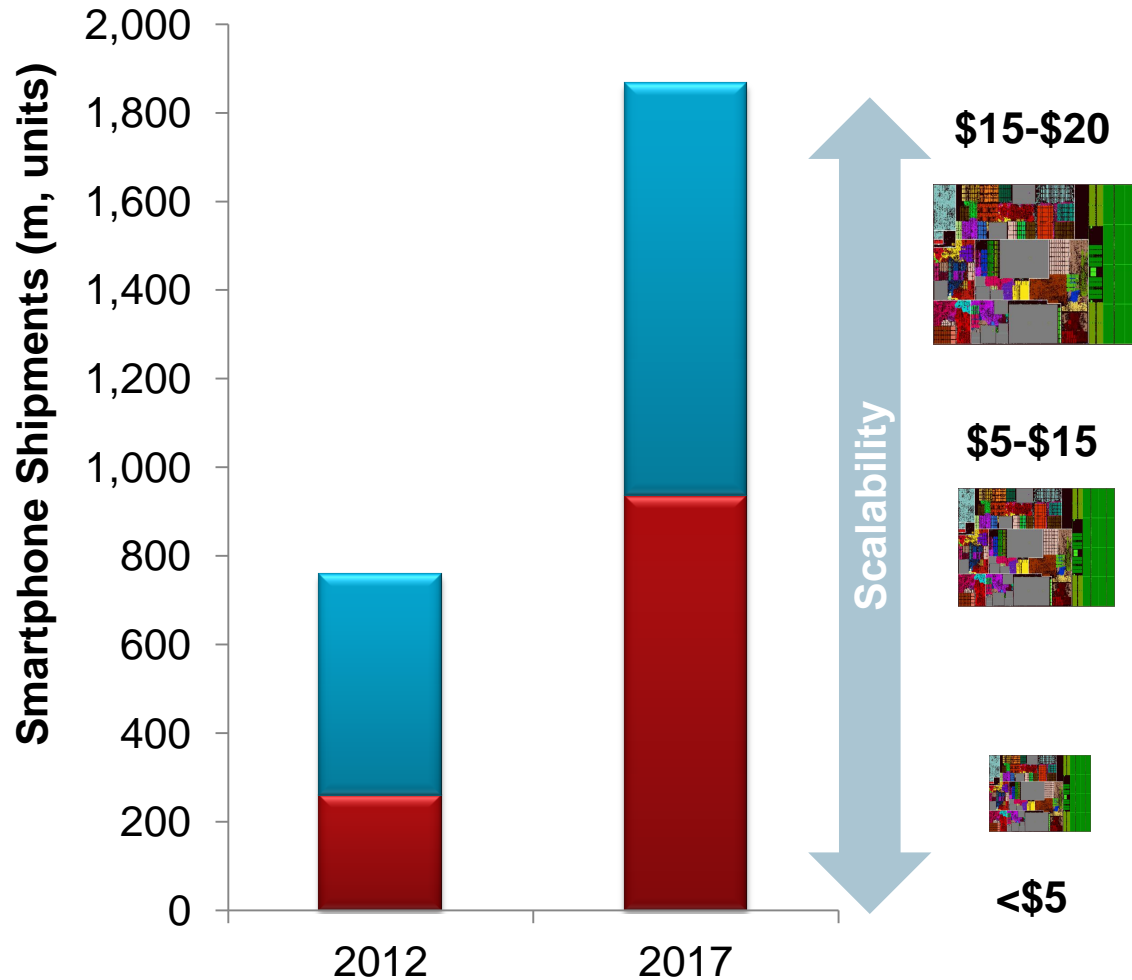
750M mass-market smartphones and tablets shipped since 2010

Android or Firefox OS  
Regional app development

Highly integrated SoCs with 3G modem

# Expanding Smartphone Market

- Utility/Basic Smartphone
- Premium Smartphone

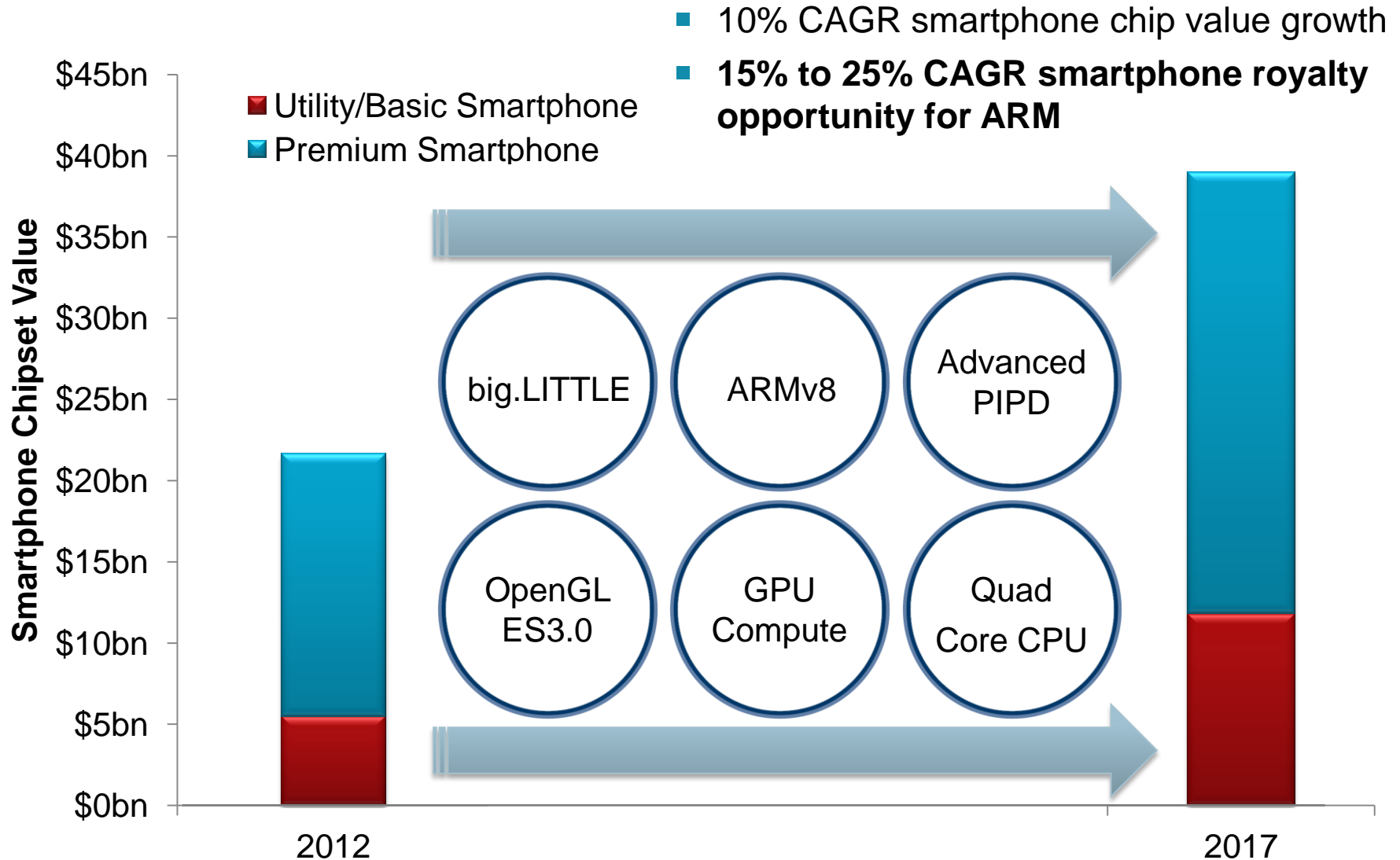


- 20% CAGR smartphone volume
- Growth in volume drives optimised solutions
- Strongest growth in low cost smartphone driving demand for Cortex-A7 and Mali-400

Source: Gartner and ARM



# Increasing Value and Opportunities



Source: Gartner

# Your Smartphone: Your Sensor Hub



**Air Gesture**

Samsung GALAXY S4



## Body Scale

The successful body weight tracker

- \* Measuring weight & sending to the Samsung GALAXY S4 via Bluetooth
- \* Checking weight history with S Health app
- \* Supporting up to 4 users

## Body Weight



## HRM

The effective running coach

- \* Real-time heart rate monitor
- \* Control your exercise intensity by checking your heart rate

## Heart Rate



## S Band

The Health & Fashion manager

- \* Measuring activities and sleep efficiency through 3D sensor
- \* Saved data will be transferred to the mobile via Bluetooth 4.0
- \* Wearing waterproof S Band at anytime

## Activity

Your Smartphone will be the gateway to the Internet of You

# Increasing Connectivity Driving MCUs



Personal devices



Connected Cities

12bn  
internet  
embedded  
devices by  
2020



Connected Medical



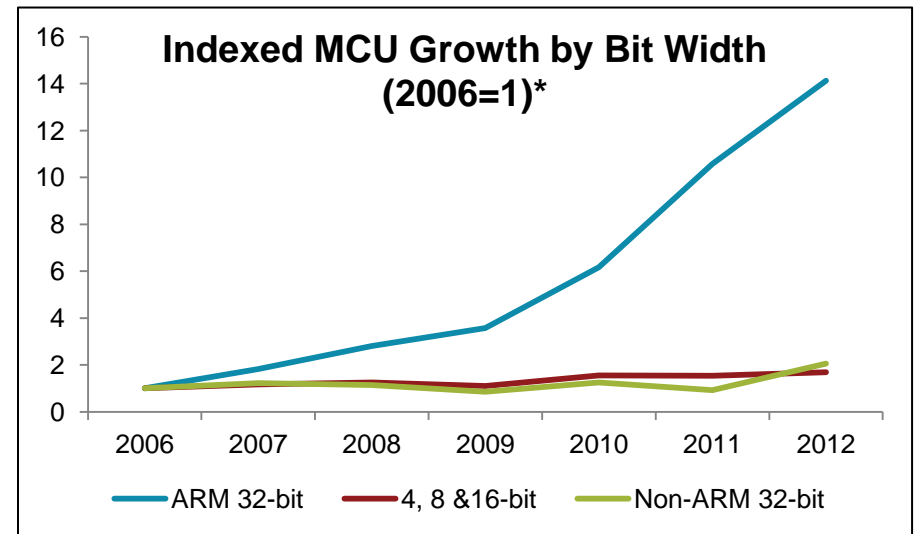
Connected Home

50% growth in all MCUs expected



# Addressing All Price Points

- More than 170 Cortex-M licenses signed with 130 companies
- Cortex-M0 is ARM's fastest licensing processor
- 8 of the 10 top MCU vendors shipping Cortex-M chips from 20c to \$2
- 65% of 32-bit MCU now ARM-based



65%

ARM's share of the 32-bit MCU market in 2012\*

18%

ARM's share of the total MCU market in 2012\*

\* SIA and ARM estimates, 2013

# Connectivity Is Key

- Next generation low power RF using ARM
  - More efficient comms stacks than 8 or 16-bit MCUs
  - Minimize active duty cycle, maximize energy efficiency
  - Remote sensors that work smarter, sleep longer



Freescale KW01  
Sub-1 GHz  
ARM Cortex-M0+ Processor



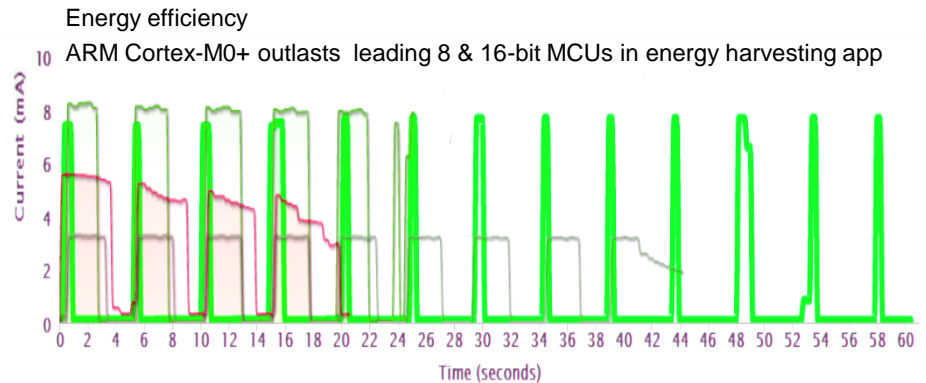
GainSpan GS2000  
WiFi & ZigBee IP (6LoWPAN)  
2x ARM Cortex-M3 Processors



Sierra Wireless AirPrime WP6  
2G EDGE system-on-chip  
ARM Cortex-M0 Processor



Nordic Semi nRF51822  
Bluetooth LE  
ARM Cortex-M0 Processor



Linear LTC5800-IMP  
2.4GHz (802.15.4 / 6LoWPAN)  
ARM Cortex-M3 Processor



Silicon Labs EM35x  
ZigBee system-on-chip  
ARM Cortex-M3 Processor

# Solutions for Connectivity



## Products

Microcontrollers, sensors,  
Single Board Computers

ARM Cortex-A  
ARM Cortex-R  
ARM Cortex-M

## Gateways

Cellular modems, Set-top  
boxes

ARM Cortex-A  
ARM Cortex-R

## Infrastructure

Servers, network  
infrastructure

ARM Cortex-A

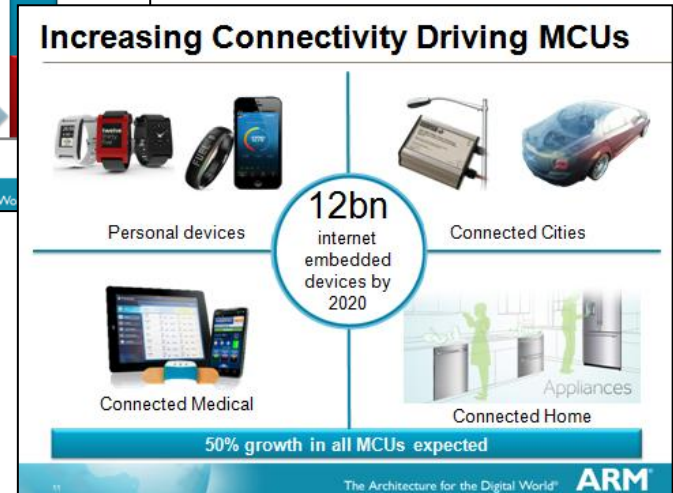
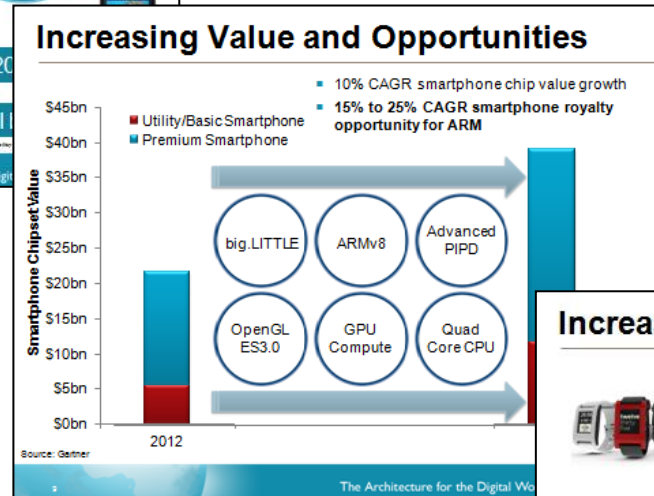
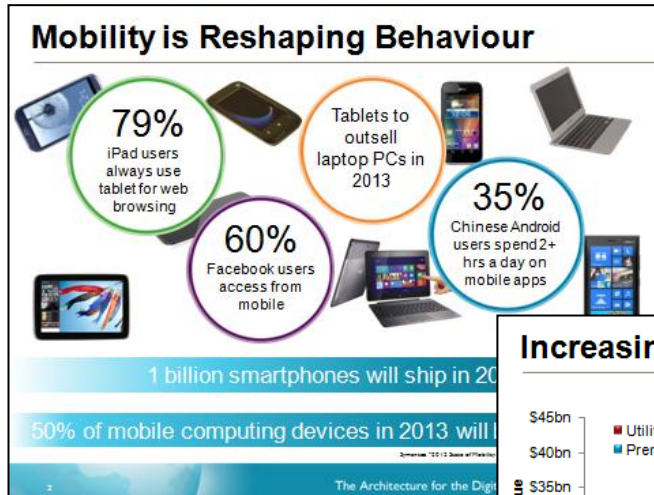
# Case Study: Smart Parking

- Streetline has smart parking deployments in Germany, the United Kingdom, and across the United States
- Battery powered parking bay sensors with ARM Cortex-M3 processor to provide years of continuous operation





# A Smarter, More Connected World





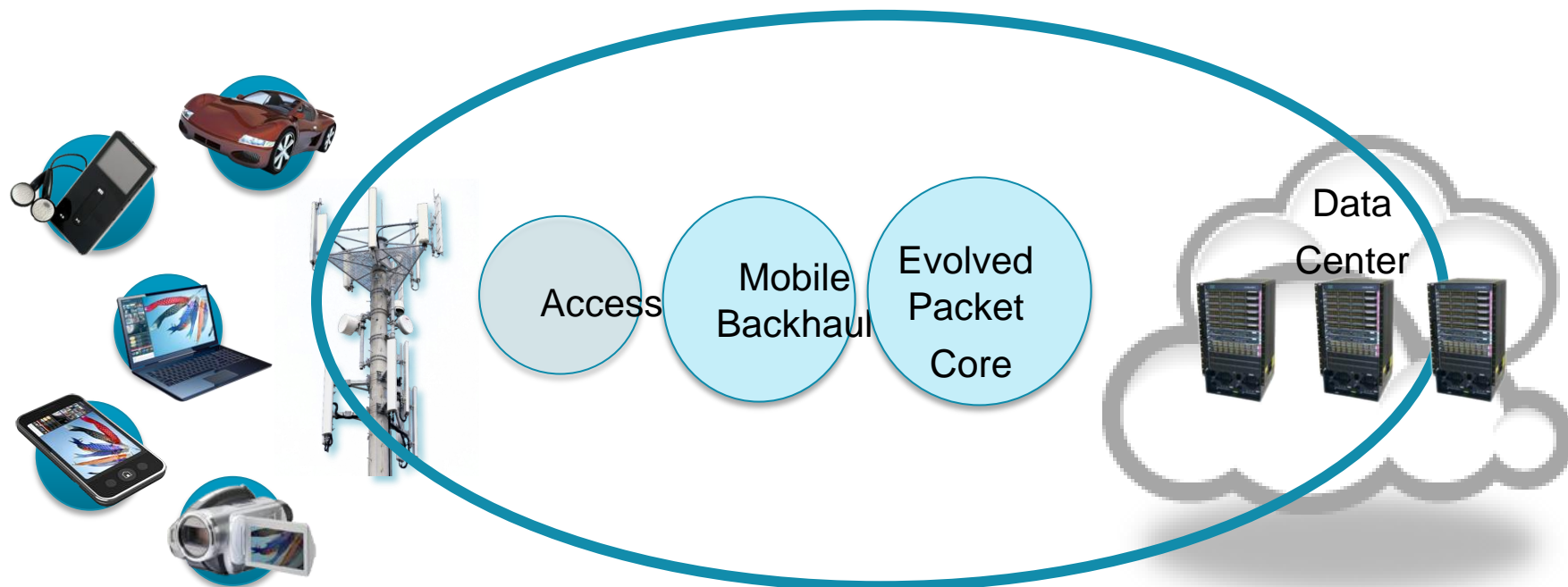
# Connectivity Driving Infrastructure

Lakshmi Mandyam

Director Server Systems & Ecosystems



# Connectivity Drives Data Growth



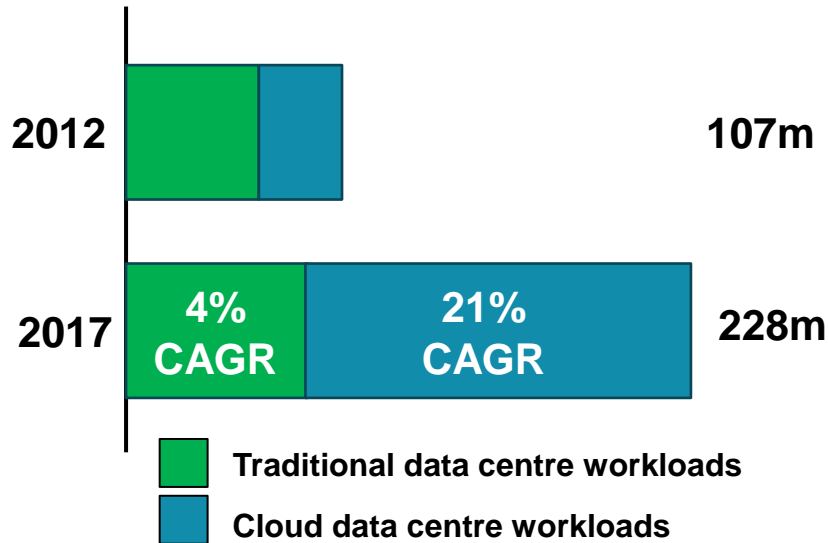
**Global mobile data traffic will increase 13x between 2012 and 2017**

**ARM can scale from end to end**

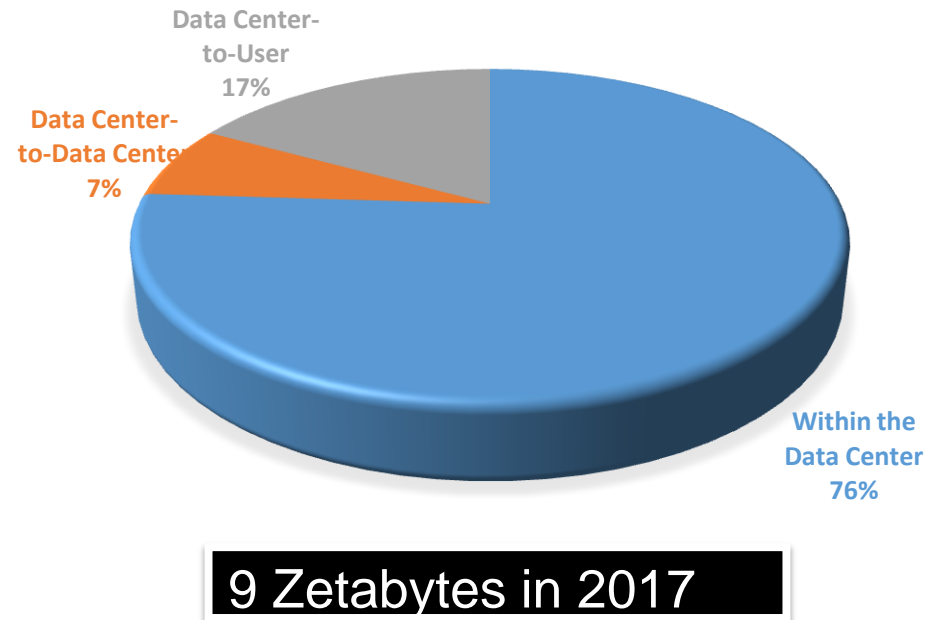
Source: Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2017

# Data Drives Cloud Infrastructure

## DATA CENTER WORKLOAD DISTRIBUTION



## DATA CENTER TRAFFIC DESTINATIONS



Workloads shifting to the cloud and spiralling data center traffic are driving the need for more efficient and cost effective Data Center infrastructure



# Infrastructure Will Evolve

Digital Warehouses  
use 30 Billion Watts  
of Electricity = 30  
Nuclear Power  
Plants

Global demand  
for datacenter  
“white space”  
estimated to grow by  
19.2%  
in 2013

Datacenter  
power grew by  
63% in 2012



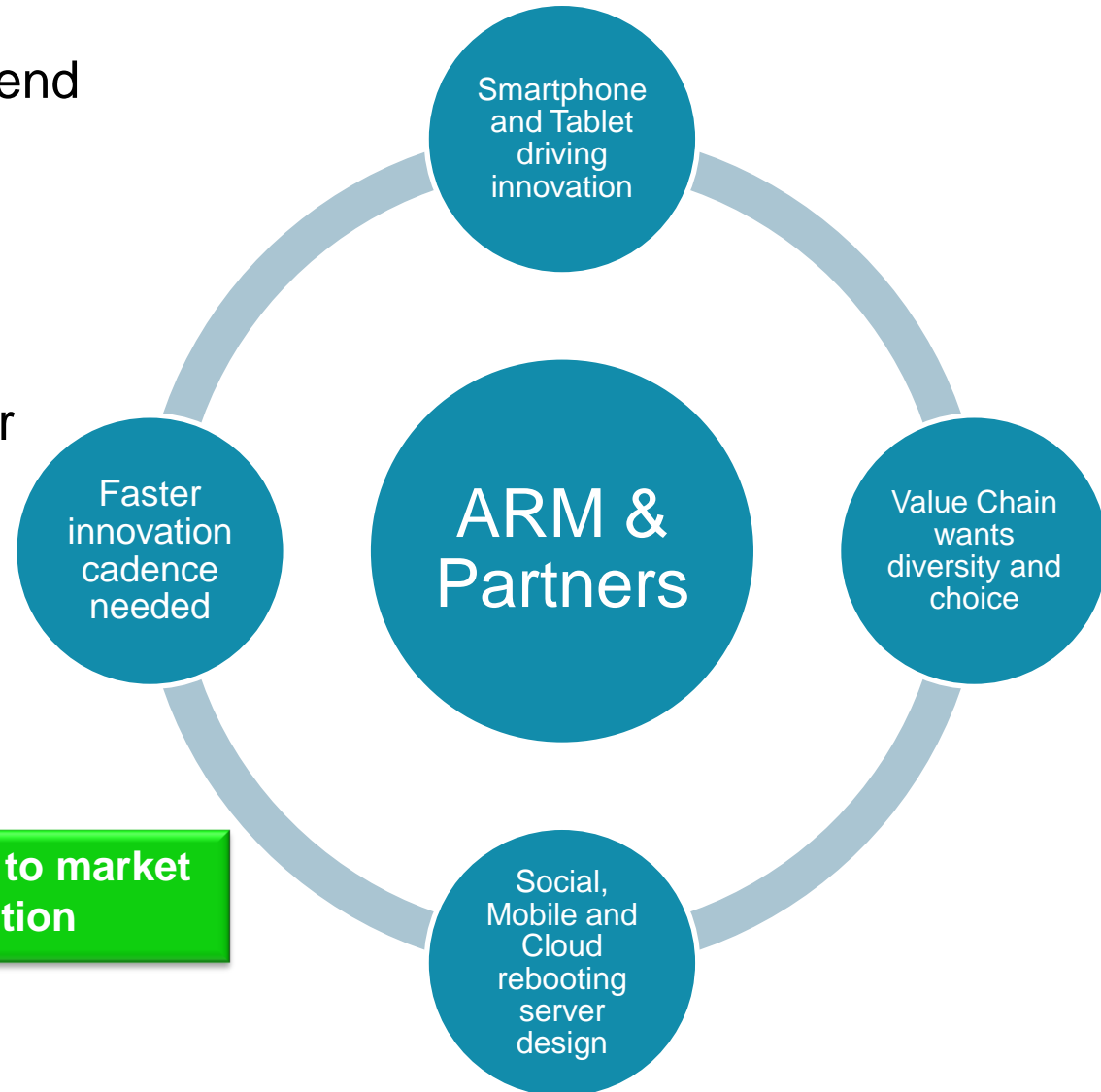
Most IT  
infrastructure is  
underutilized

\* Source NY Times article Power Pollution and the Internet Sept 2012

\*\*Source **DatacenterDynamics 2012 Global Industry Census**

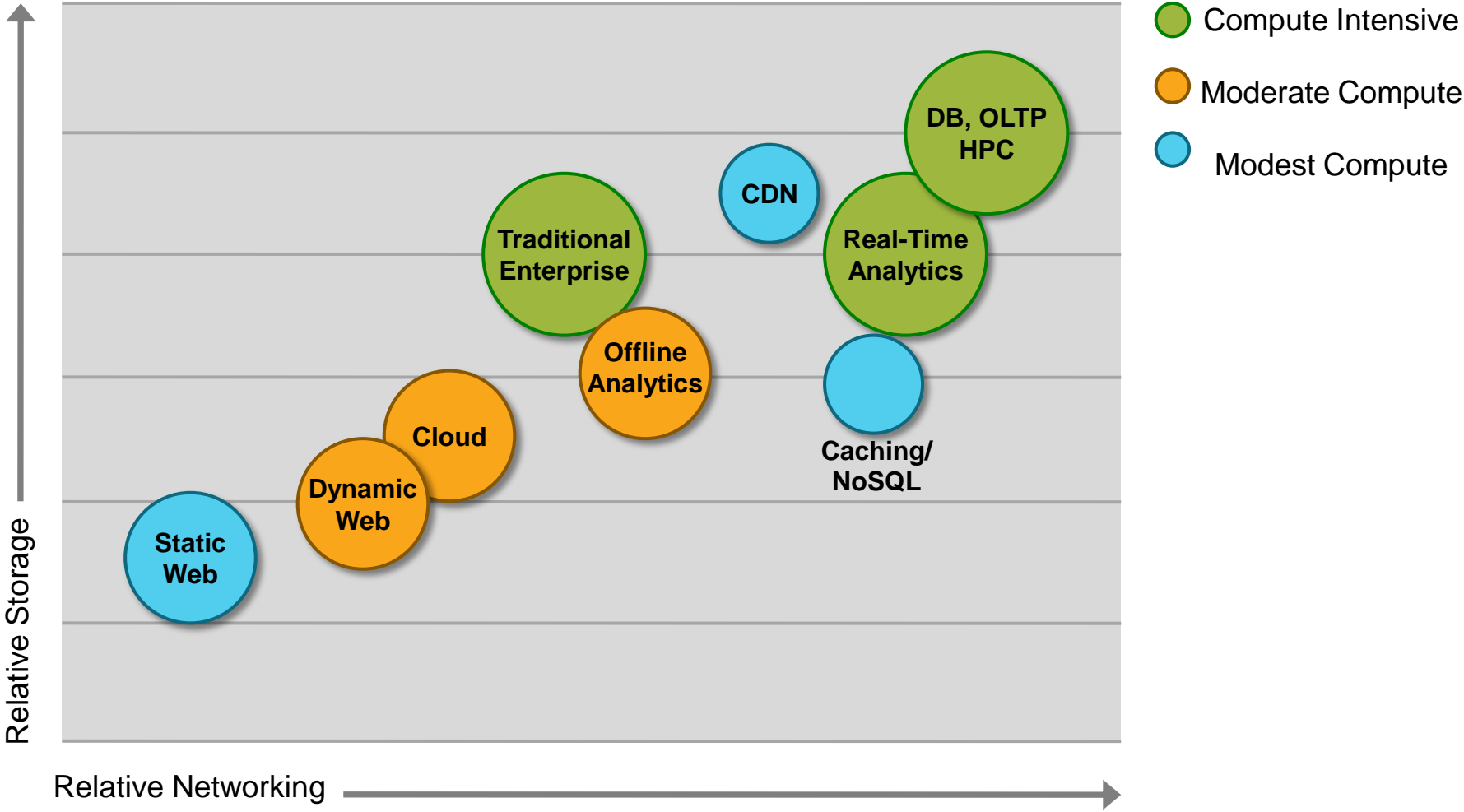
# Efficient Infrastructure Needed

- Efficiency requirements extend beyond the CPU
- Established ARM partners in networking and storage applications leveraging their expertise

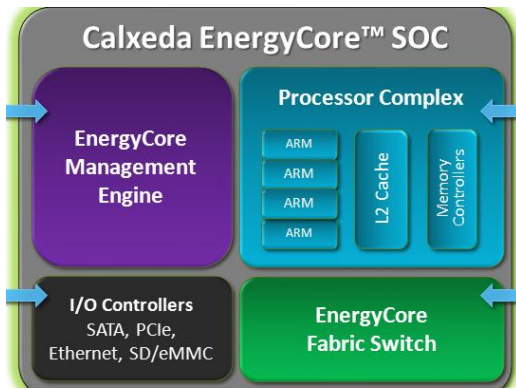


**Many ARM solutions coming to market means healthy competition**

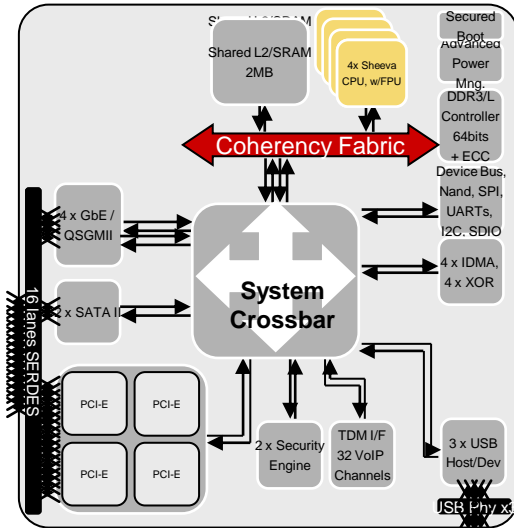
# One Size Does Not Fit All



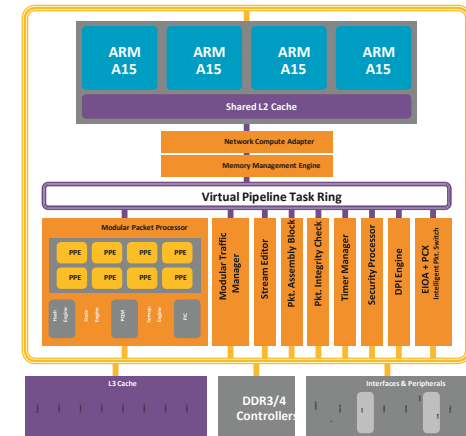
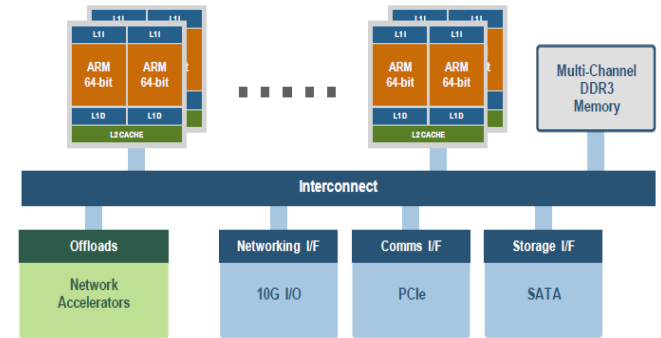
# ARM Partner Designs for the Data Center



CALXEDA

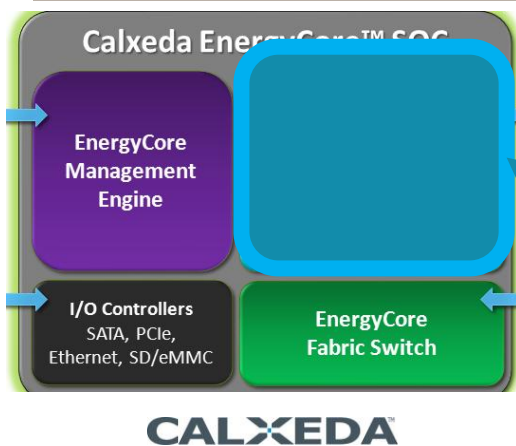


- Partners developing variety of solutions
- Leveraging their expertise
- More choices for applications

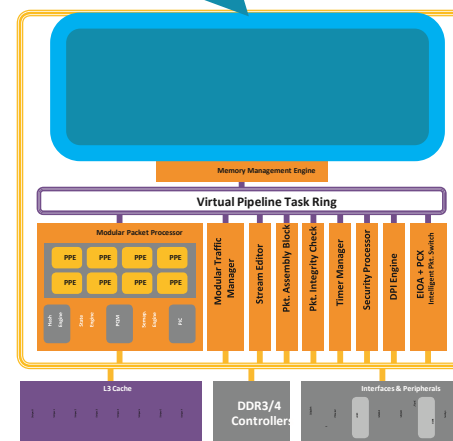
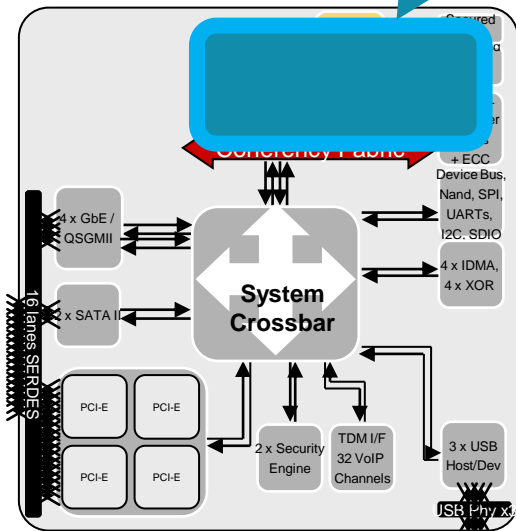
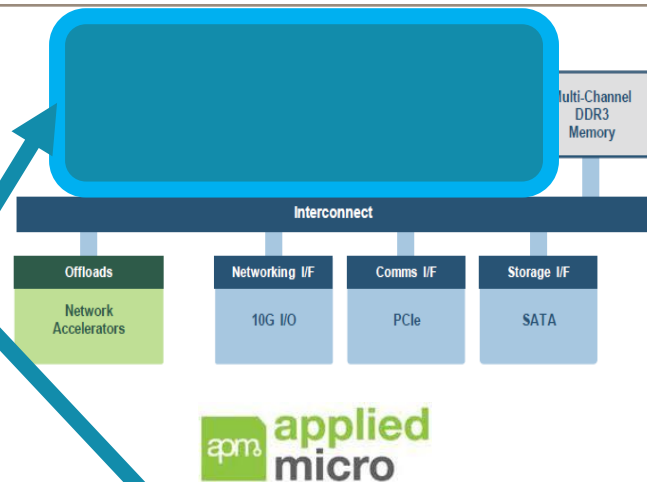


AXE4500 Architecture Diagram

# ARM Partner Designs for the Data Center



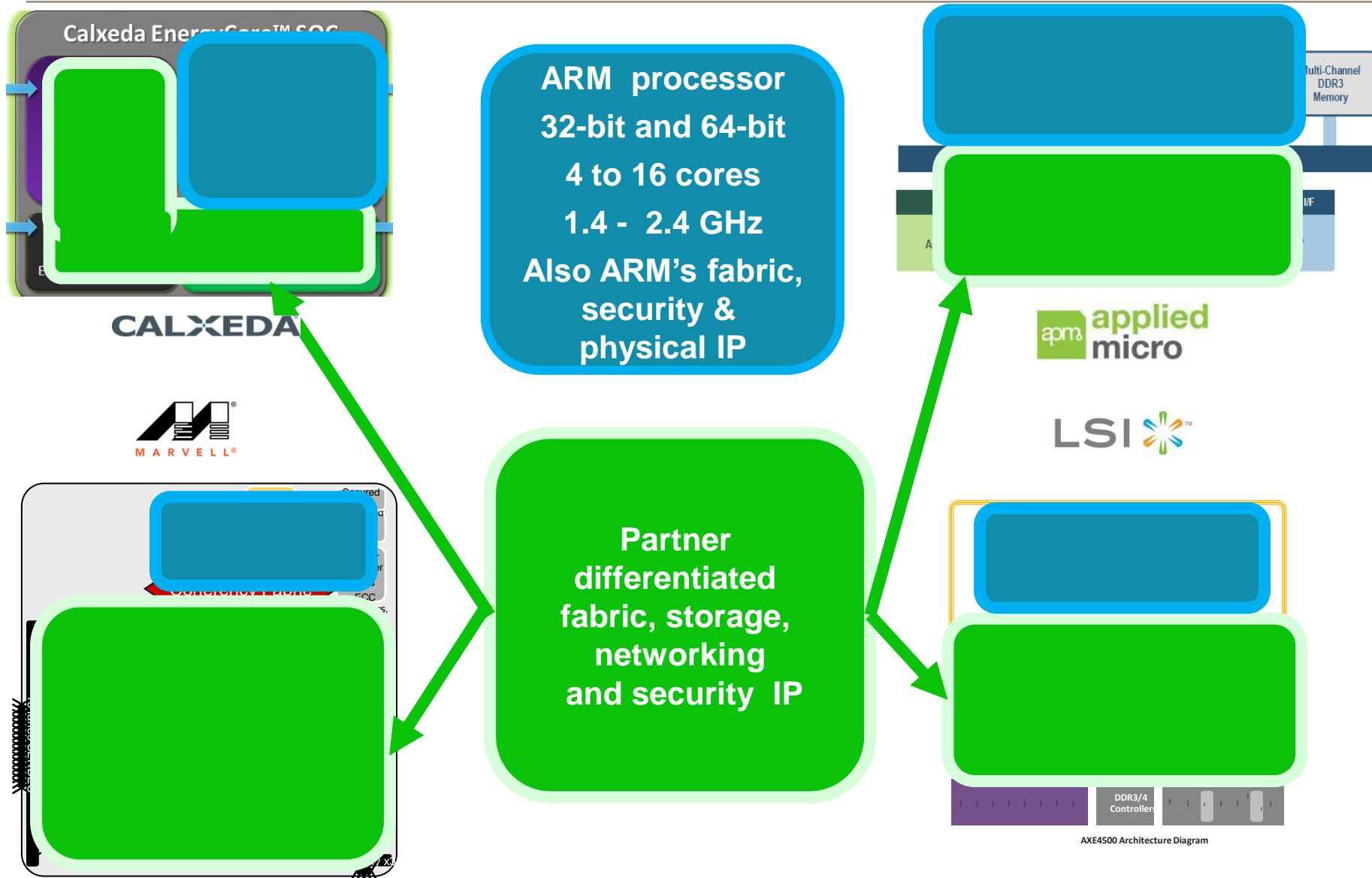
ARM processor  
 32-bit and 64-bit  
 4 to 16 cores  
 1.4 - 2.4 GHz  
 Also ARM's fabric,  
 security &  
 physical IP



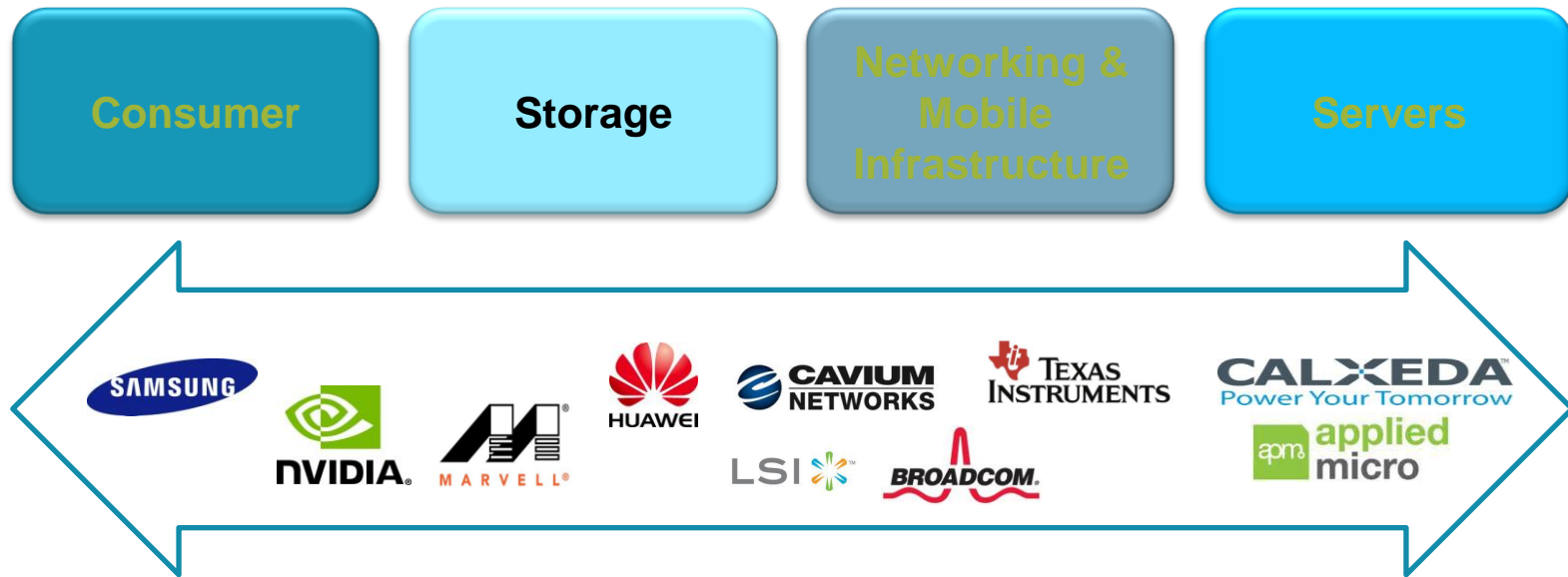
AXE4500 Architecture Diagram



# ARM Partner Designs for the Data Center



# Serving Multiple Markets with ARM



Partner differentiated Market focused IP

ARM CPU + GPU + Security + System Fabric IP

ARM Partner Software and IP Ecosystem

# Four Years of Rapid Change

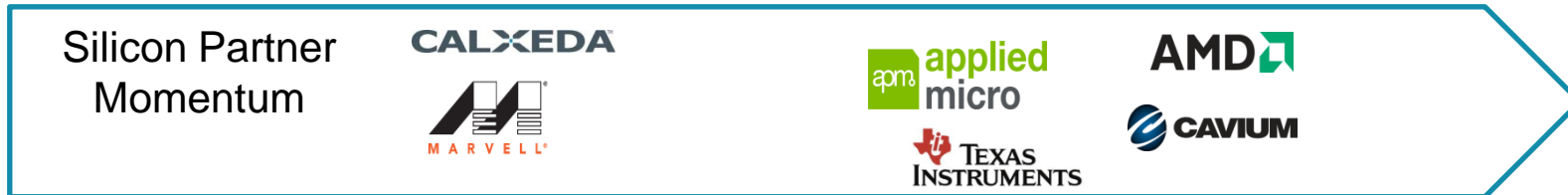
2009-2010

2011

2012

2013

Future



Cloud and Web 2.0 workloads transform Servers  
 Server Metrics shift to Performance/Watt/\$/Cu Ft

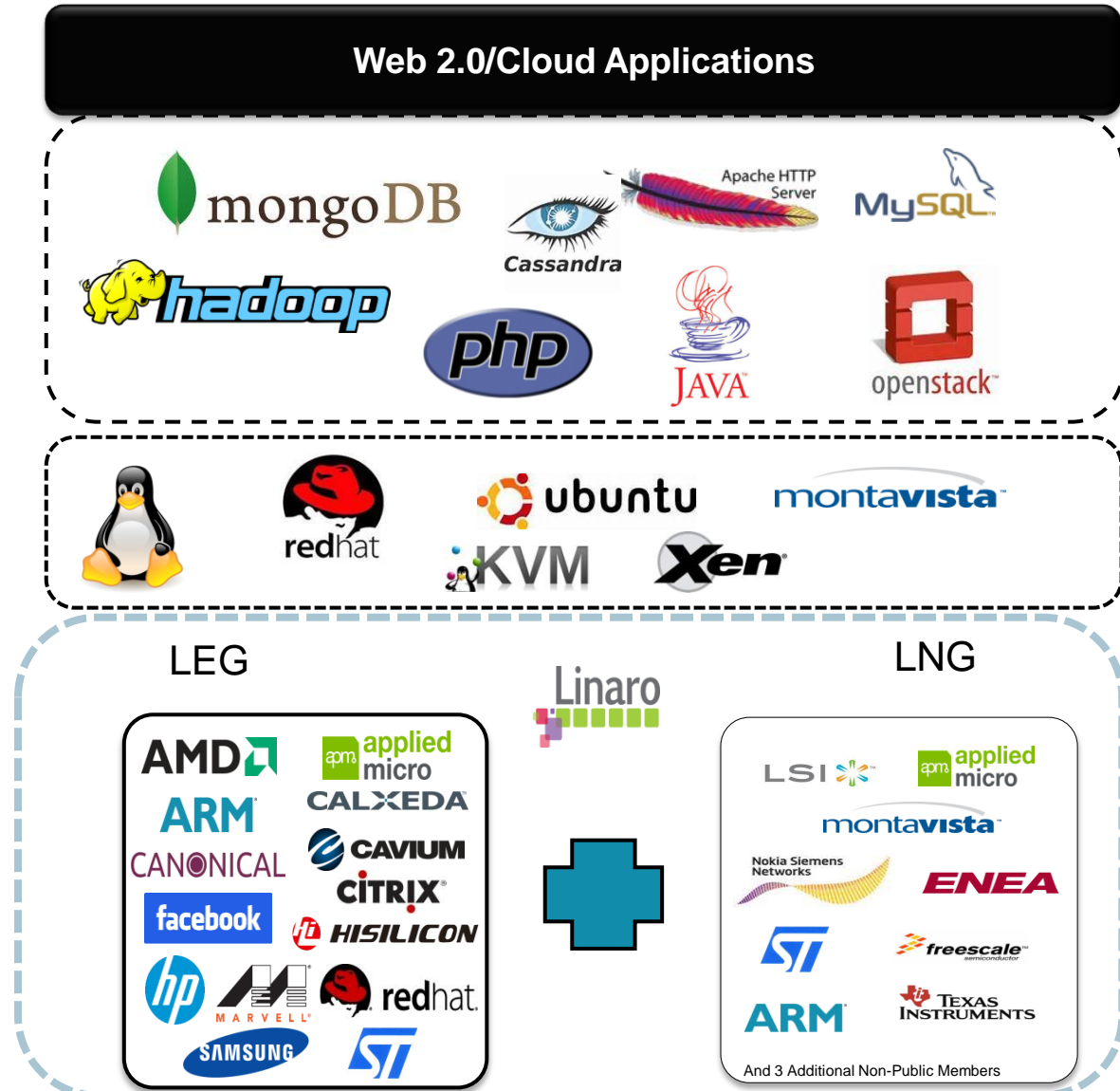
# Rapid Change Continues

- Open source software is allowing new ecosystems within the server community
- End-users can now work directly with equipment providers to develop tailored solutions
  - Facebook created Open Compute Project
- Disruption in the traditional value chain for enterprise equipment



# ARM Ecosystem's Open Source Investment

- ARM and our Partners investing in open source building blocks that are relevant for Enterprise applications
- 32-bit ecosystem already in place
- 64-bit ecosystem developing





# Enabling Innovation in Servers



- Up to 3x Faster time to Market
- Tailored to workloads with use of heterogeneous processing
- Shipping ARM-based 32-bit and 64-bit systems this year
- Baidu is pioneering a new era of cost-effective and environmentally friendly data centers
- 2U chassis with up to 96 TB, **reduced TCO by 25%** vs. previous x86-based server solutions

# Enabling Innovation in Infrastructure



Nokia Siemens Networks and LSI Collaborate on Wireless Infrastructure Solutions

LSI® Axxia® platform and SoC capabilities contribute to higher-performance mobile broadband solutions



- Huawei BTS3900 is deployed today
- HiSilicon developed an 8 core Cortex-A9 Network SoC
- The combination of ARM Multi-core technology and Huawei IP delivers high-performance and cost optimization
- NSN and LSI are building on the open source efforts of LNG
- ARM's Core and System IP is the framework around which they will differentiate
- Enables scalability across all mobile broadband systems and applications beyond

# Server and Enterprise Opportunity

Unit Chip Shipments (Million of Units)	2013 Design Win Status	2017 Chip TAM	2017 Chip Value (\$bn)*	2017 Target Penetration
Servers SoCs	●●●●●●	50	\$3.5	10-15%
Base station equipment	●●●●●●	65	\$3.5	60%
Carrier Infrastructure	●●●●●●	75	\$3.0	<5%
Enterprise Access Points	●●●●●●	270	\$2.0	50%
L2/L3 Switching	●●●●●●	150	\$3.0	20%
Routing	●●●●●●	80	\$2.5	20%
Other	●●●●●●	100	\$2.5	20%
<b>Total</b>		<b>800</b>	<b>\$20.0</b>	

- Shipping mainly ARM-based chips
- Shipping some ARM-based chips
- Public ARM design wins, but not yet shipping
- No ARM design win or not yet public

Source: Gartner and ARM estimates

\* Mainly multi-core Cortex-A9, Cortex-A15 or ARMv8-A based chips



# ARM's Opportunity in Enterprise

ARM and  
Partners  
driving  
innovation

Open  
source  
driving  
disruption

ARM  
technology  
right for  
Enterprise

Market  
opportunity  
for ARM  
and  
Partners

**Presents a large new market opportunity  
for the ARM Partnership**

# ARM<sup>®</sup>

## Energy Efficient System Design

Dipesh Patel

EVP & GM Physical IP Division

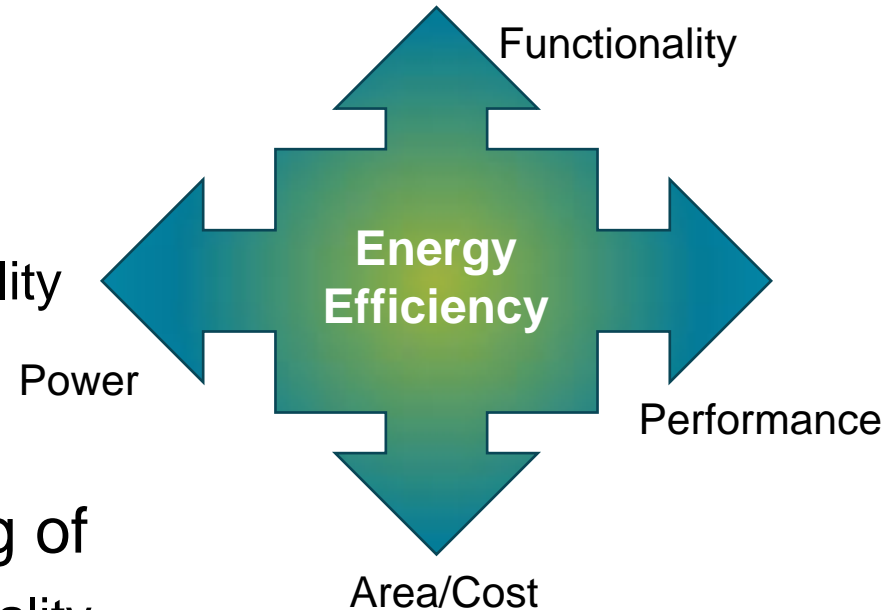




# System-on-Chip Design Challenges

- ARM's Partners need to create a diversity of solutions

- Different performance points
- Different power needs
- Different cost points
- Different market specific functionality
- Different schedules



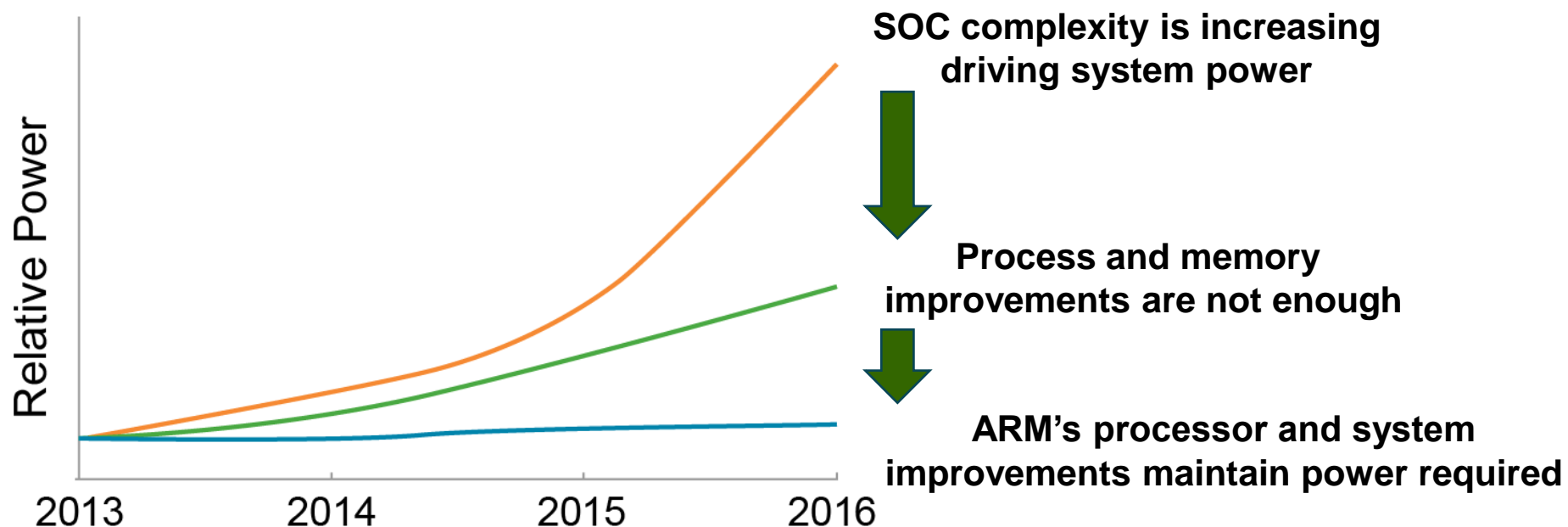
- Ideal solution requires balancing of

- Desired performance and functionality
- Minimization of energy usage and thermal dissipation
- Optimal cost solution

... all while meeting aggressive time to market deadlines

# Addressing the Challenge

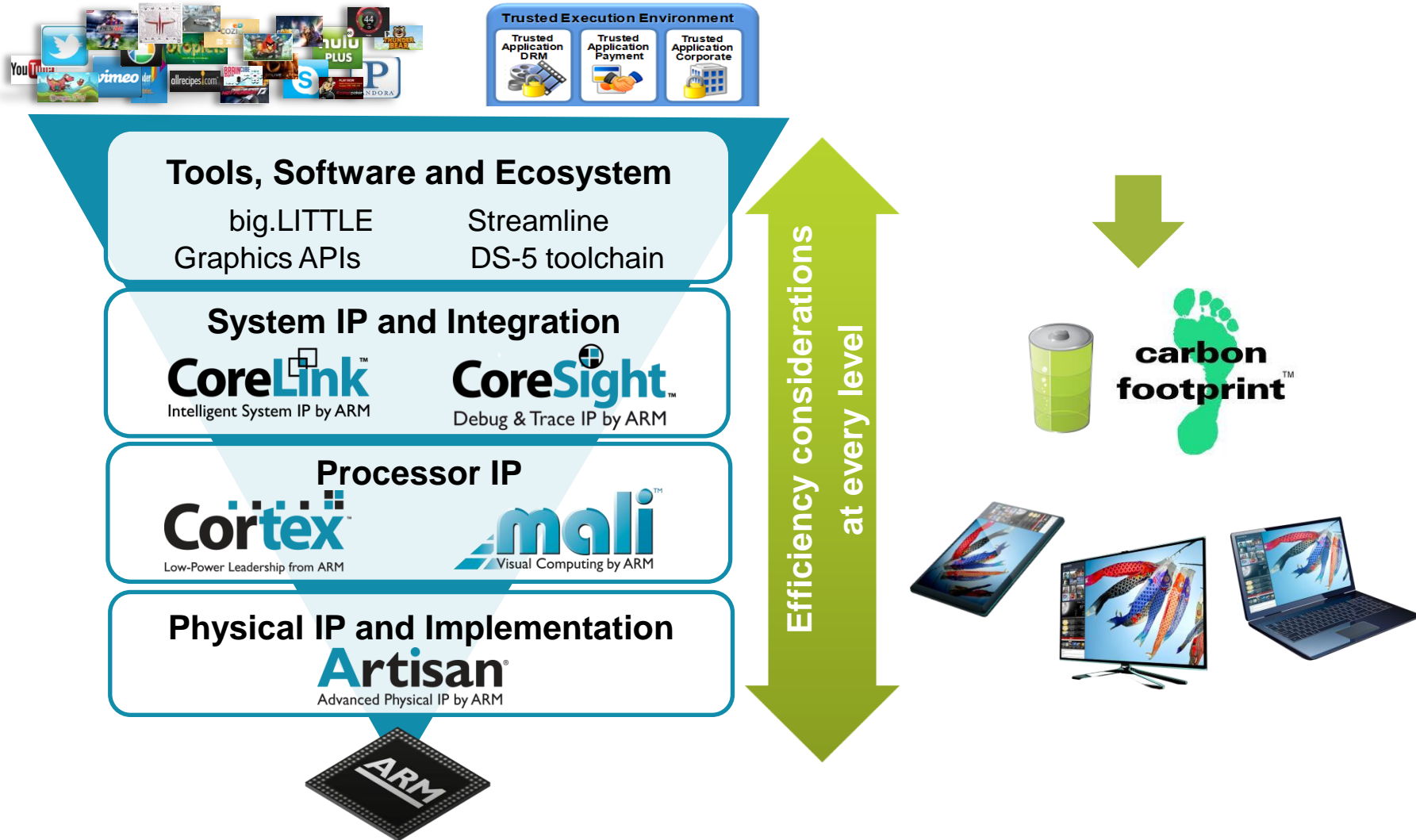
- Requires a view of the whole system
  - Process, micro-architecture and system innovation



- ARM engages and collaborates on system design and process technology
  - Enhance through improved physical IP, processor design & implementation, to provide ongoing system-level efficiency savings

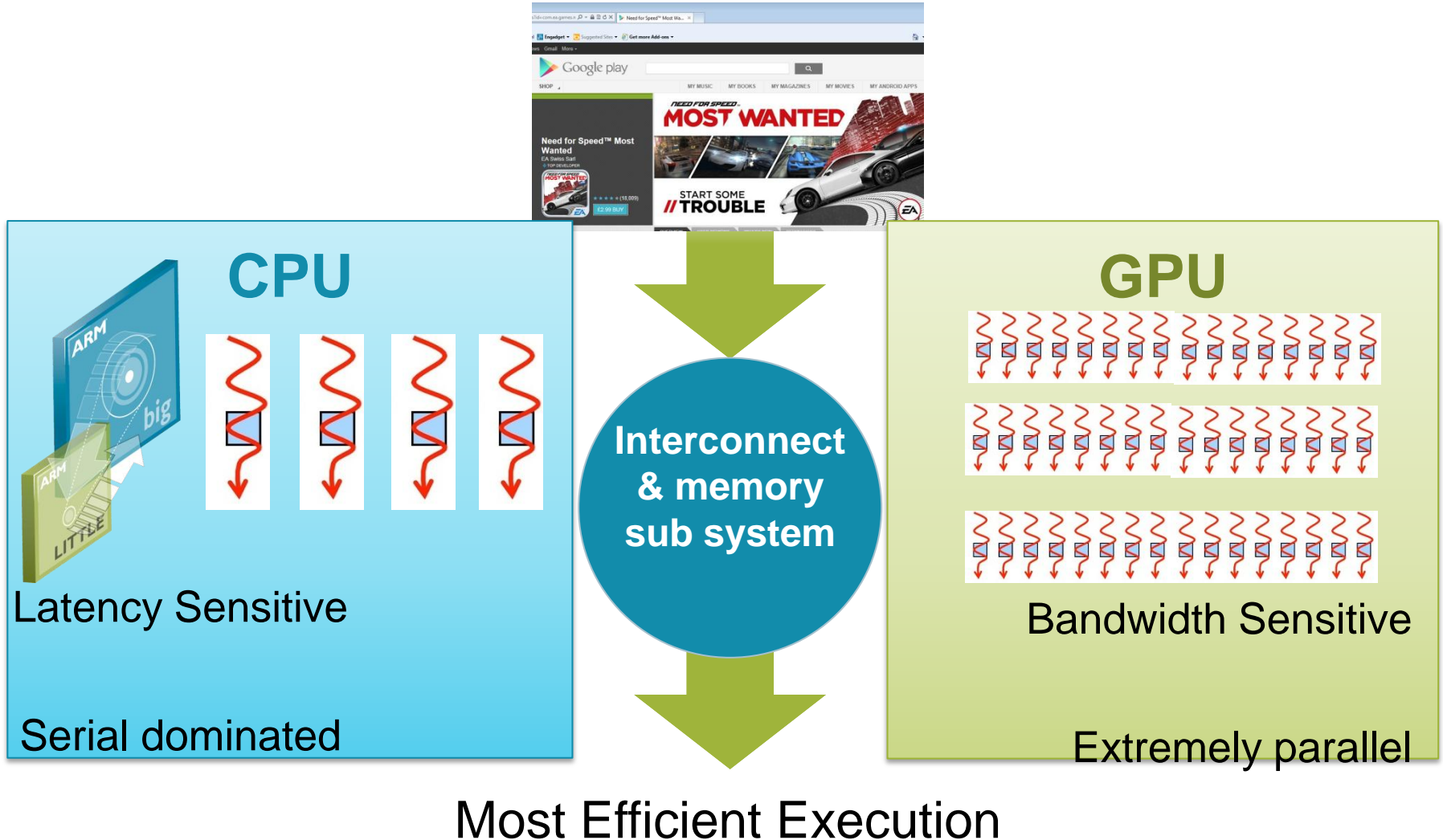
# Holistic Approach to Efficiency

- End-to-end power system savings – save at all points in the system



# Rethinking Computation Efficiency

## Right Processor for the Right Task



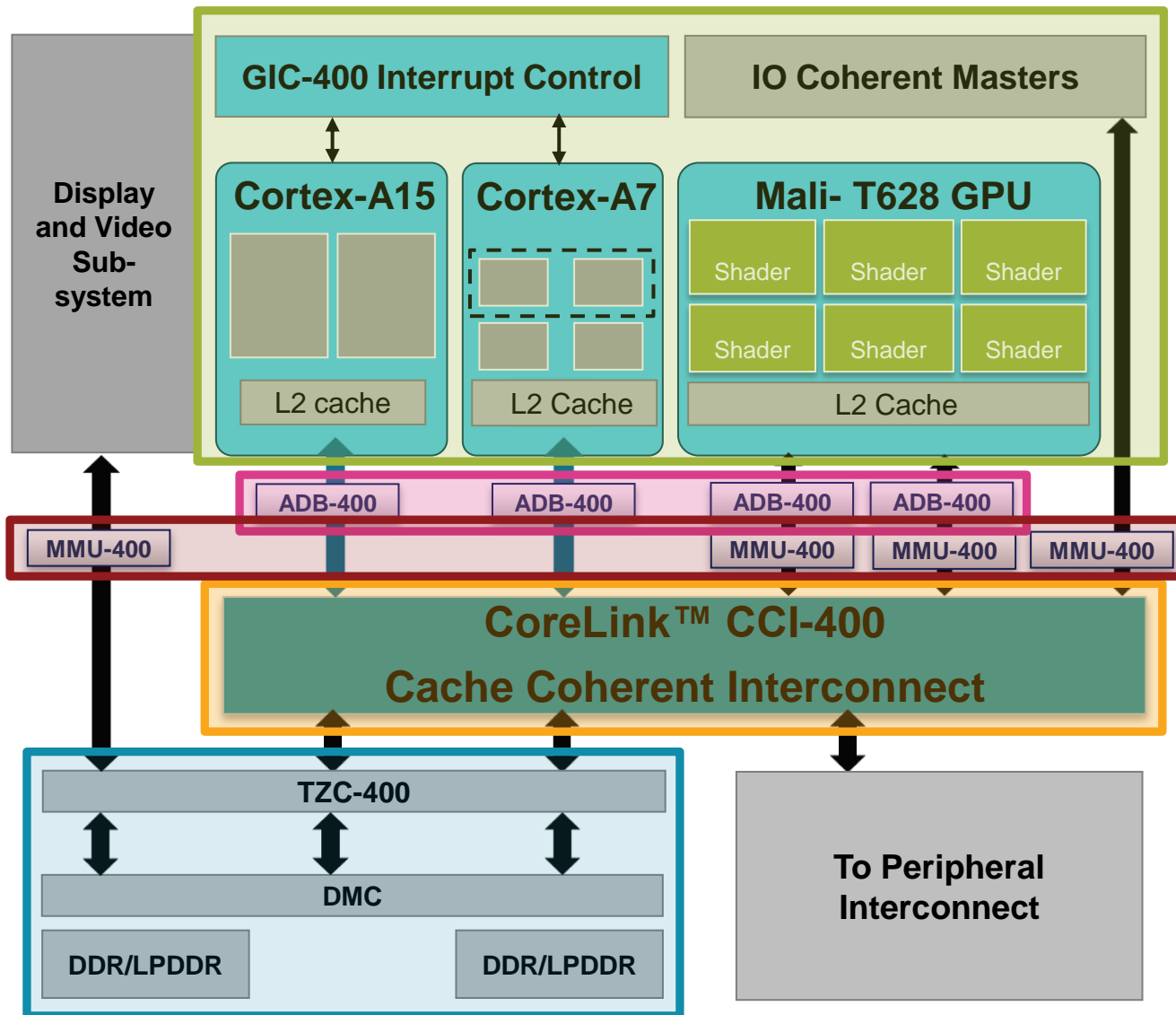
# big.LITTLE Processing

- Tightly coupled combination of two ARM CPU clusters:
  - Cortex-A15 and Cortex-A7 - functionally identical
  - Same programmers view, looks the same to OS and applications
- big.LITTLE combines high-performance and low power
  - Automatically selects the right processor for the right job
  - Redefines the efficiency/performance trade-off





# Integrating an Efficient Compute System

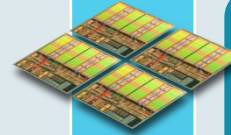


- Simplified view of complex processors
- Coherency maximizes on-chip residency
- Efficient Voltage scaling for power management
- Common memory view for all SoC components
- Optimized path to memory for best performance

# Layering in Benefits of Coherency

## 2012 Devices

- Full coherency within CPU cluster
- I/O coherency
- Entry level coherency for SoC



### Applications

2x or 4x  
Cortex-A9 /  
Cortex-A15

### Graphics

Mali-T604

I/O Coherent

I/O Coherent

## 2014 Devices

- Full coherency for multiple CPU clusters
- I/O coherency with graphics and other
- Simpler software programming model

Greater Performance and interaction  
Lower energy per transaction

### Applications Processor

4x Cortex-A15  
+  
4x Cortex-A7

### Graphics

Mali-T628

Fully Coherent

I/O Coherent

CCI-400

## 2016 Devices

- Full coherency on CPU, GPU and other
- True General Purpose Compute
- Simplest software programming model

### Applications Processor

4x Cortex-A57  
+  
4x Cortex-A53

### Graphics

Next gen  
Mali

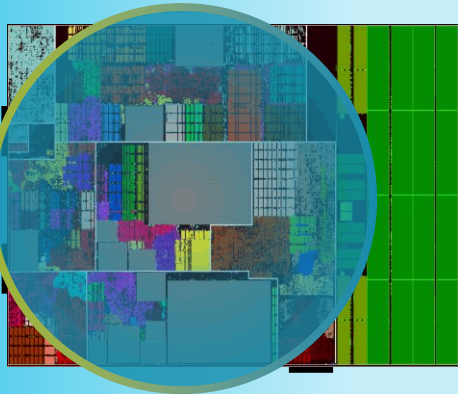
Fully Coherent

Next-gen CCI

# Enhancing Design Efficiency

## Outpacing Moore's Law with micro-architectural innovation

High-end smartphone  
2011



Cortex<sup>®</sup>-A9 processor  
40nm, 1GHz

Micro-architectural  
innovation + process shrink

1/5<sup>th</sup> the Area

Less than 1/3<sup>rd</sup> the Power

Mass-market smartphone  
2013

0.45mm<sup>2</sup> per core



ARM Cortex-A7 processor  
28nm, 1.2GHz

Matching performance

Development already extending to 16/14nm FinFET

# Efficiency at the Implementation Level

**Cortex™**  
Low-Power Leadership from ARM



## POP™ IP

- Core-hardening acceleration technology
- Targeted to optimized Cortex CPU for power or performance

**mali™**



## POP™ IP

- Core-hardening acceleration technology
- Targeted to optimized Mali GPU for power or performance

**Artisan™**  
Advanced Physical IP by ARM

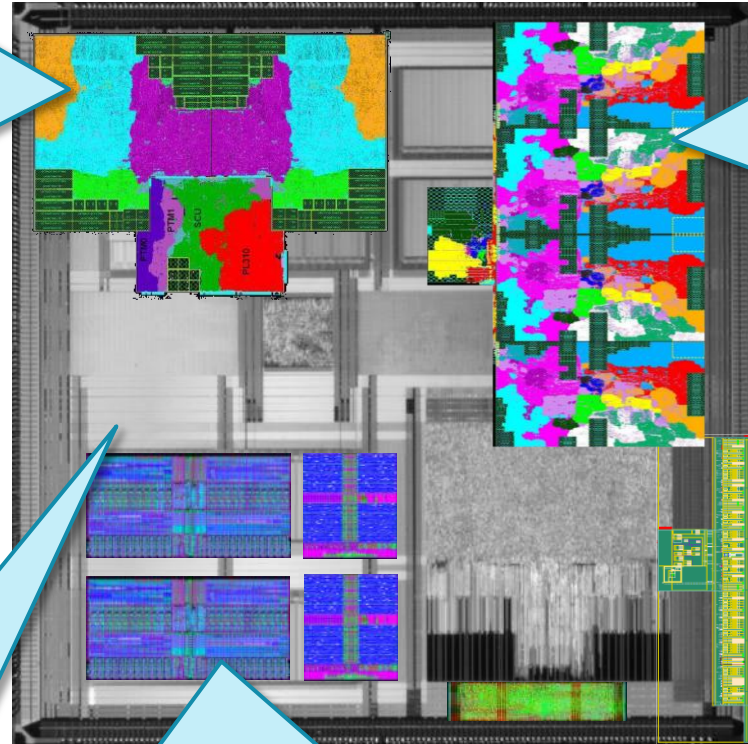
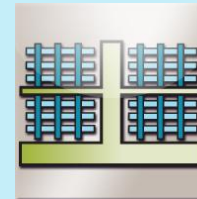
## Standard Cells



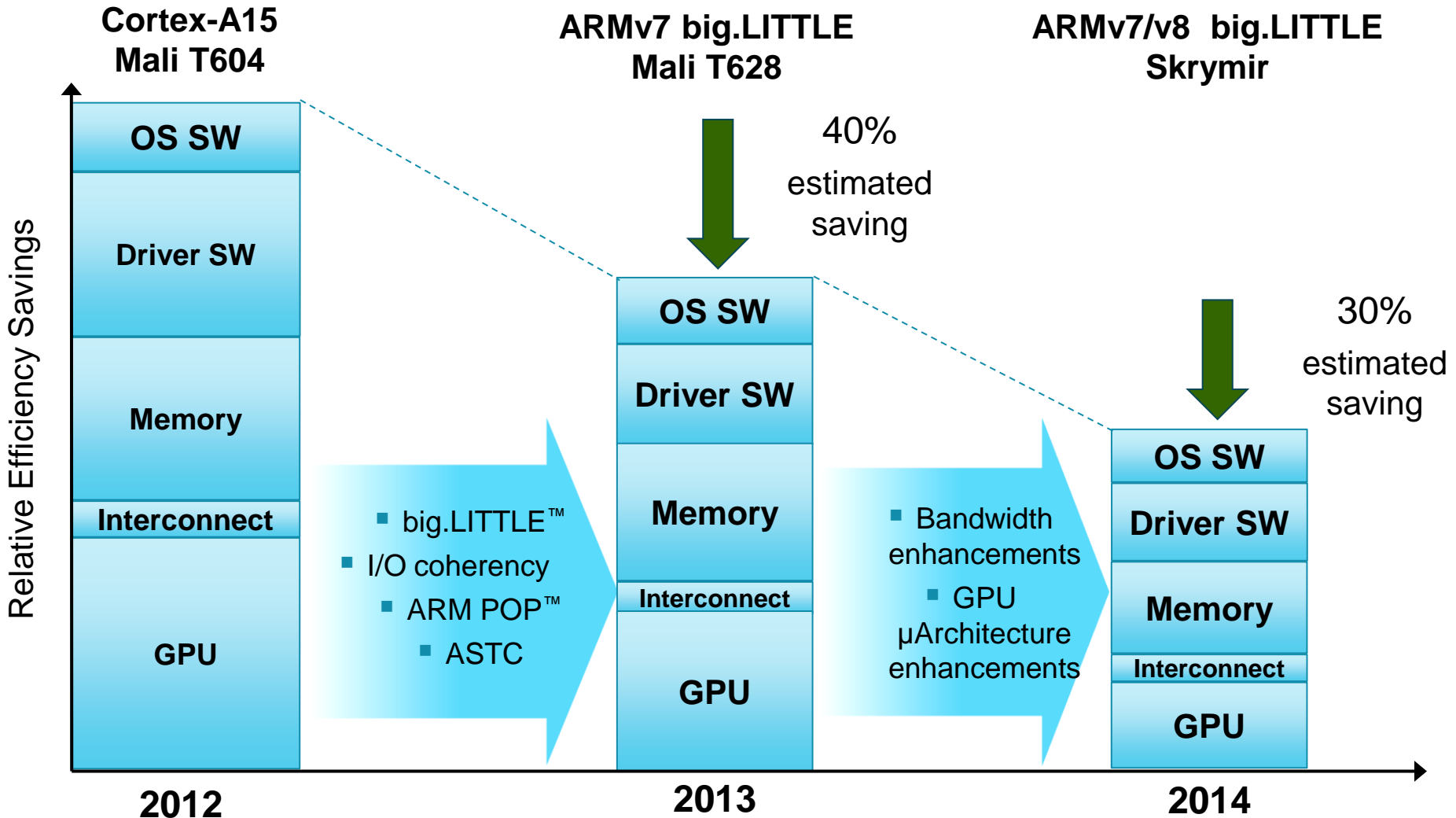
- Multi-Vt cell libraries
- Multi-Channel cell libraries
- Multiple track height libraries

**Artisan™** Memory IP  
Advanced Physical IP by ARM

- HS & Ultra-low Power
- Multiple power modes
- Multi-Vt options



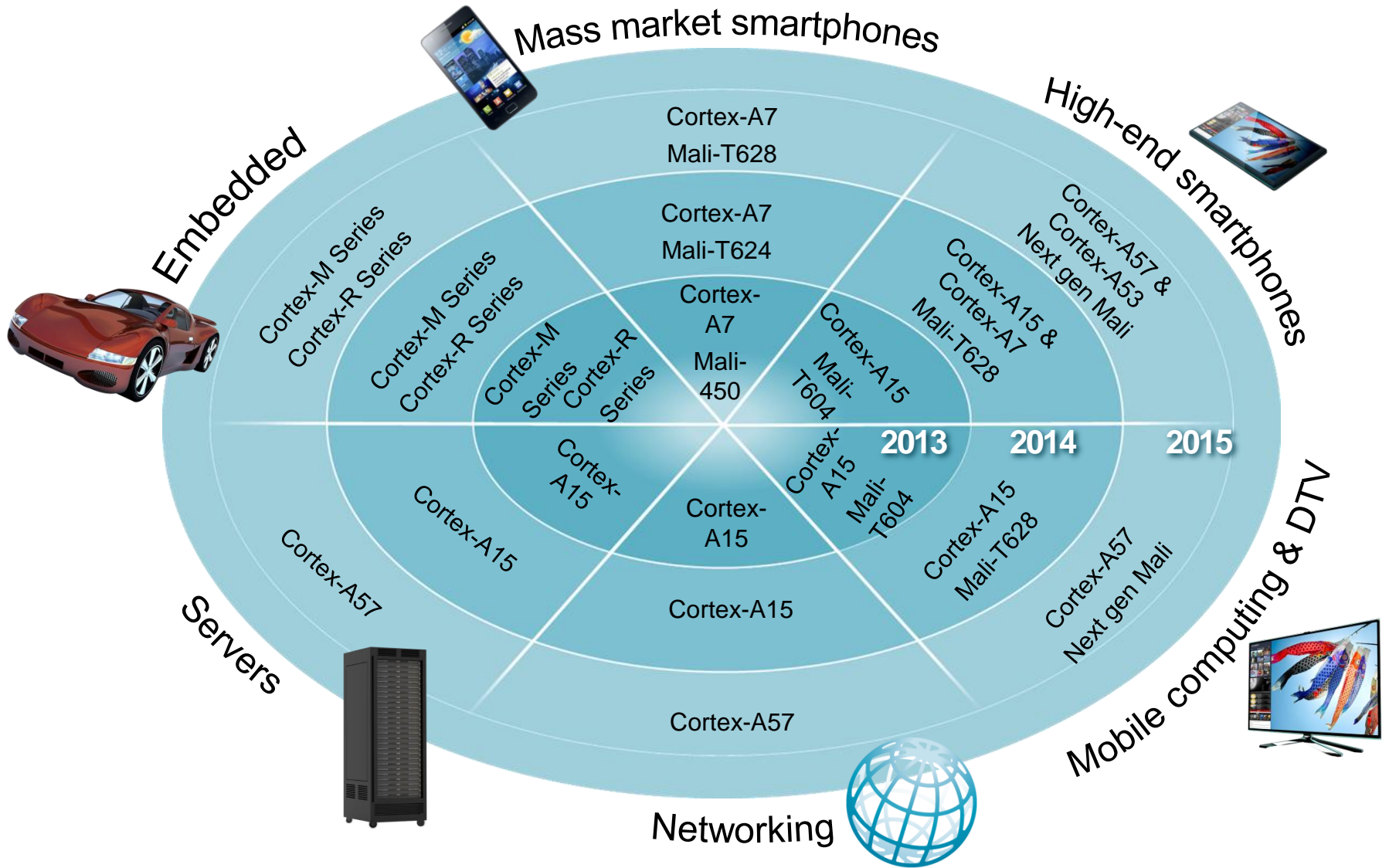
# Compute Sub-system Efficiency Gains



ASTC: Adaptive Scalable Texture Compression



# Tuning Systems for Each Market



# Unmatched Partnership Around ARM

**Software stack optimized for Cortex™ + Mali™ processors**

OpenCL    OpenMAX    OpenVG 1.1    OpenGL ES 1.1, 2.0, 3.0

**Comprehensive range of Operating systems**

Microsoft  
Firefox OS  
ubuntu  
QNX  
QNX SOFTWARE SYSTEMS  
TIZEN™  
webOS™

**Unparalleled software tools support for CoreSight™ debug & trace**

**ARM Compute Sub-system**

Interconnect & memory controllers

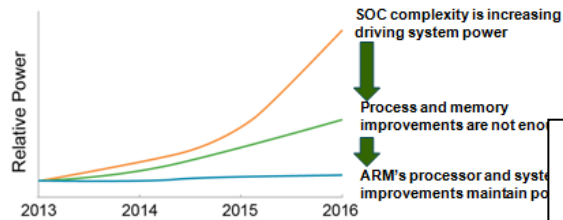
**Coherency and virtualization makes software simpler and more portable**

**Secure systems on TrustZone technology**

# ARM Enabling Efficient Systems

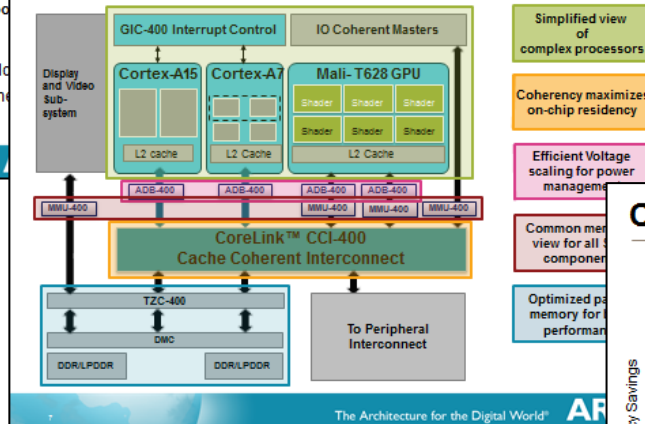
## Addressing the Challenge

- Requires a view of the whole system
  - Process, micro-architecture and system innovation

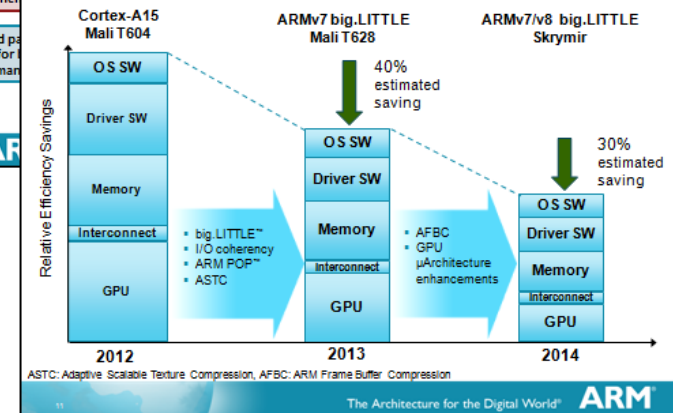


- ARM engages and collaborates on system design and process technology
  - Enhance through improved physical IP, processor design & implementation to provide ongoing system-level efficiency savings

## Integrating an Efficient Compute System



## Compute Sub-system Efficiency Gains



Challenge

Solution

Benefit

# Concluding Remarks

Simon Segars

President and CEO Designate



# The Architecture for the Digital World

**A smarter, more connected world**

**Products**  
Microcontrollers, sensors, Single Board Computers  
ARM Cortex-A  
ARM Cortex-R  
ARM Cortex-M

**Gateways**  
Cellular modems, Set-top boxes  
ARM Cortex-A  
ARM Cortex-R

**Infrastructure**  
Servers, network infrastructure  
ARM Cortex-A

The Architecture for the Digital World<sup>®</sup> **ARM**

**Connectivity Drives Data Growth**

Access Mobile Backhaul Evolved Packet Core Data Center

Global mobile data traffic will increase 13x between 2012 and 2017

ARM can scale from end to end

The Architecture for the Digital World<sup>®</sup> **ARM**

**Facilitating the flow of data**

The Architecture for the Digital World<sup>®</sup> **ARM**

**Integrating an Efficient Compute System**

GIC-400 Interrupt Control IO Coherent Masters  
Cortex-A15 Cortex-A7 Mali-T628 GPU  
L2 cache L2 cache L2 cache  
CoreLink™ CCI-400 Cache Coherent Interconnect  
TZC-400 DMC To Peripheral Interconnect  
DDR/LPDDR

- Simplified view of complex processors
- Coherency maximizes on-chip residency
- Efficient Voltage scaling for power management
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The Architecture for the Digital World<sup>®</sup> **ARM**

**Devices are becoming smarter and more connected**

**Connectivity is driving infrastructure**

**A growing opportunity**

**ARM has the right technology, right business model, right ecosystem**



# Q&A

