Analyst Briefing
October 7, 2008

Warren East, CEO
Simon Segars, EVP & GM, Physical IP Division
Ian Drew, VP, Marketing
Wayne Lyons, Director, Embedded Solutions
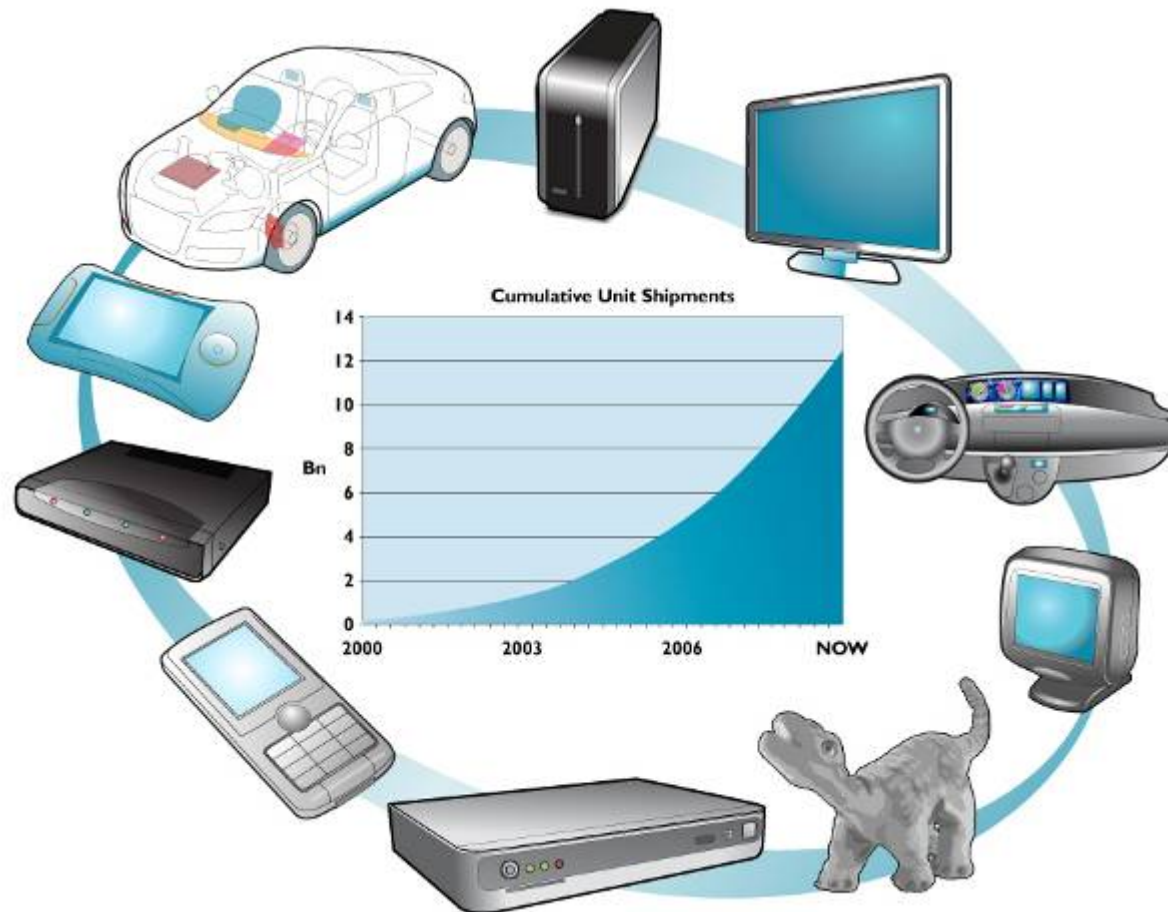
ARM | **2008**
Developers' Conference

Time:12.00pm, Hyatt Hotel, Sonoma Room

- Corporate update/state of the business – Warren East

- Product update – Ian Drew

- Enabling Web 2.0 – Simon Segars

- MCU standards – Wayne Lyons

The Architecture for the Digital World®

- In 2007, ARM® Partners were at the heart of around a quarter of all electronic devices sold in the world

Cumulative Unit Shipments

Developers' Conference – All About Partners

Our Web-Driven Society
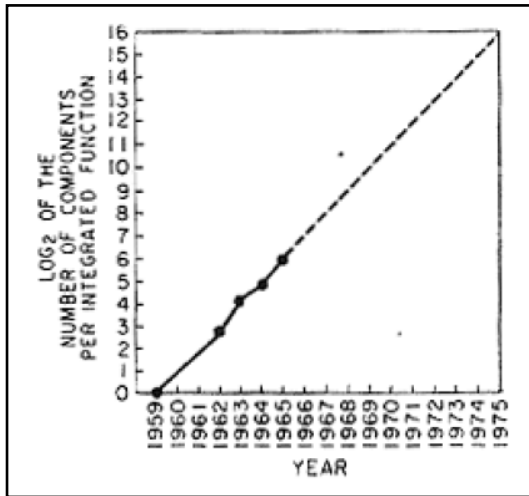
More connections
More data
More platforms
More services
More content

US Online Advertising Spend
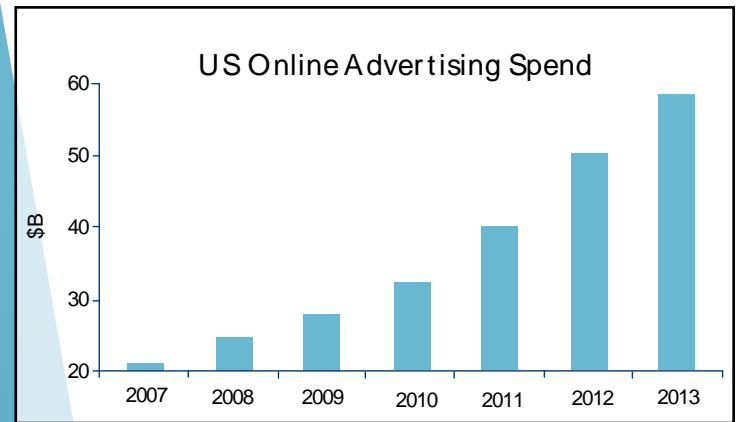
Source: eMarketer Aug 2008

Global IP Traffic

Consumer IP traffic surpasses Business

Total — Consumer — Business

Source: Cisco

Pages transcoded by Opera Mini per month

Source: Opera

ARM 2008 Developers' Conference
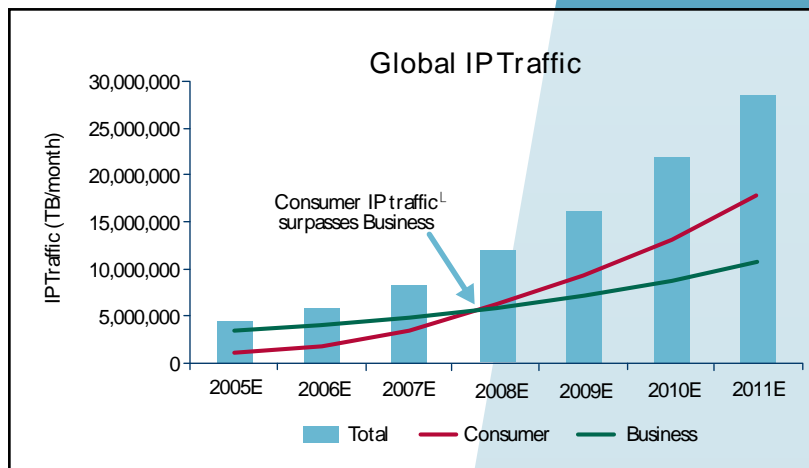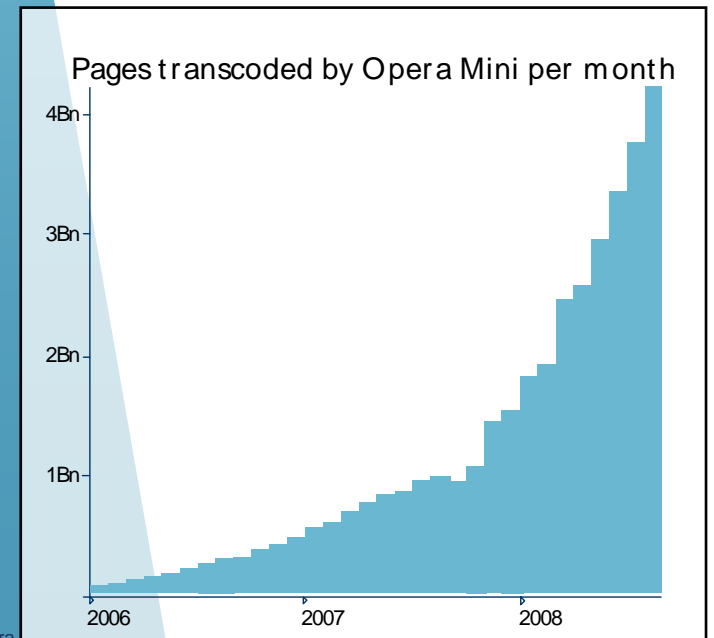
Energy Efficiency – 'New' Killer Feature

Disruption and Opportunity

- Our advantage is the ARM Partnership
  - Choice, innovation and trust
  - Implementation experience – best performance, power and features
- Web is our opportunity
  - Today more smartphones ship than laptops
  - Browser and plug-in investments deliver the Internet on ARM technology

Opera Mini users viewed 4Bn+ pages in August
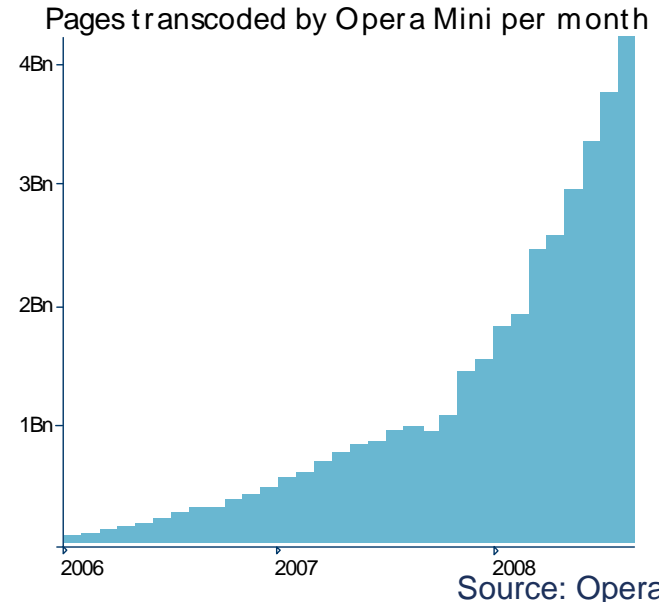
EE Times
Google's browser engine running on ARM

www.news.cn NEWS www.chinaview.cn
Mozilla working on Firefox Mobile

InformationWeek
DEFINING THE BUSINESS VALUE OF TECHNOLOGY
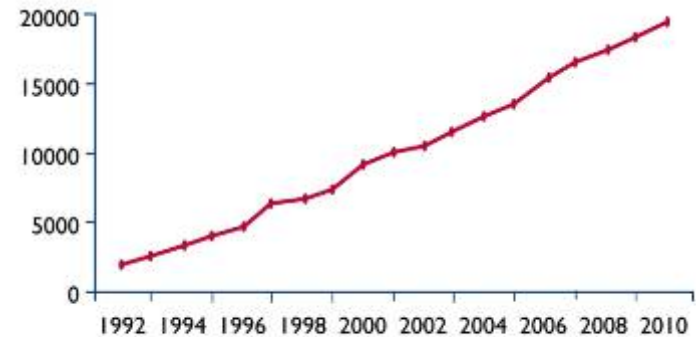Microsoft, Nokia Put Silverlight On Mobile Devices

NEWS ▶ LIVE BBC NEWS CHANNEL
Adobe opens up Flash on mobiles

Pages transcoded by Opera Mini per month

4Bn –
3Bn –
2Bn –
1Bn –

2006   2007   2008

Source: Opera
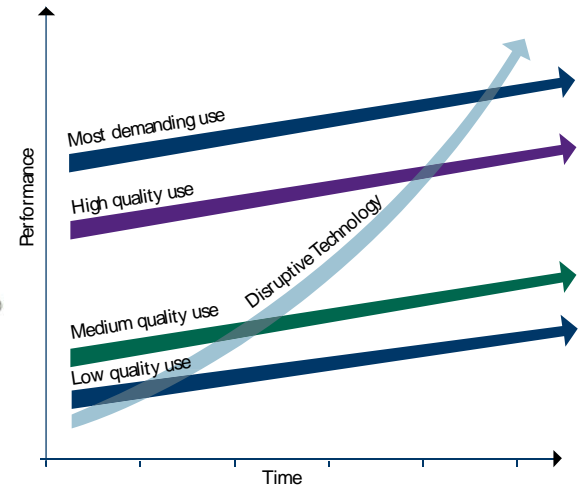
ARM|2008
Developers' Conference

Turbulence and Opportunity

- Short term:
  Macroeconomic challenges

- Longer term: Energy
  supply and demand imbalance

R&D Spend by 20 US Semiconductor Companies ($M)

Source: Companies, Merrill Lynch estimates

Encouragement

Legislation

Performance

Most demanding use

High quality use

Disruptive Technology

Medium quality use

Low quality use

Time

Clayton M. Christensen

- ARM has always been at the heart of low power

Processors to Power Web 2.0

- Handsets become a first-class Internet access device
    - Internet-enabled shipments will surpass the PC by 2010 – 400Mu/yr
    - Enabled by performance, functionality and connectivity
    - Differentiated by battery life and user experience

- Mobile Internet – efficient performance is everything
    - Cortex™-A8 and Cortex-A9 deliver breakthrough web experience
    - Advanced CPU and GPU roadmap will extend our leadership

- Delivering optimized, efficient implementations crucial
    - Physical IP is the means to the best processor implementation

Competition

"Who is to say it will be Intel taking market share from ARM and not the other way?"

Warren East

Financial Times, May 25, 2008

RealView Development Suite 4.0 Pro

- Unleash ARM processor technology

- ARM Compiler – The best gets even better
  - 10-15% performance gain over previous version
  - Profile-driven compilation – automatic optimization
    - EEMBCv2 Networking: 6% faster, 40% smaller
  - Link-time code-generation – up 5% faster

- ARM Profiler – Understand your software
  - Optimizing ARM software made easy
  - Continuous Trace for days @ 450MHz

- Available: Today!
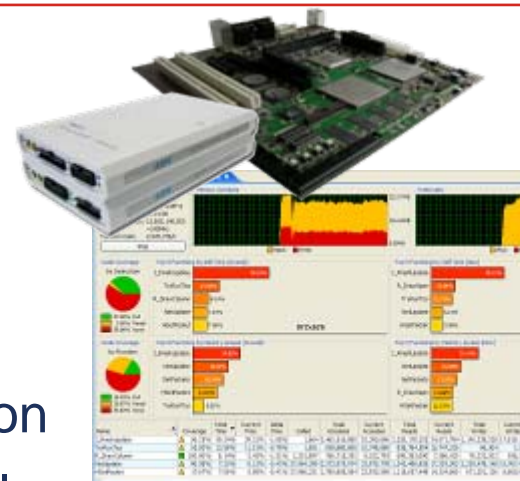
One Billion Unit Opportunity in 2012

Applications (Millions of units)	TAM 2012 Units		H/W GFX S/W GFX
Smartphone	400		
Featurephone	600		
PMP	200		
PND	65		
STB	230		
DTV	110		
Automotive/Infotainment	80		

Source: Gartner, IMS, Semico, Instat, IDC and ARM estimates
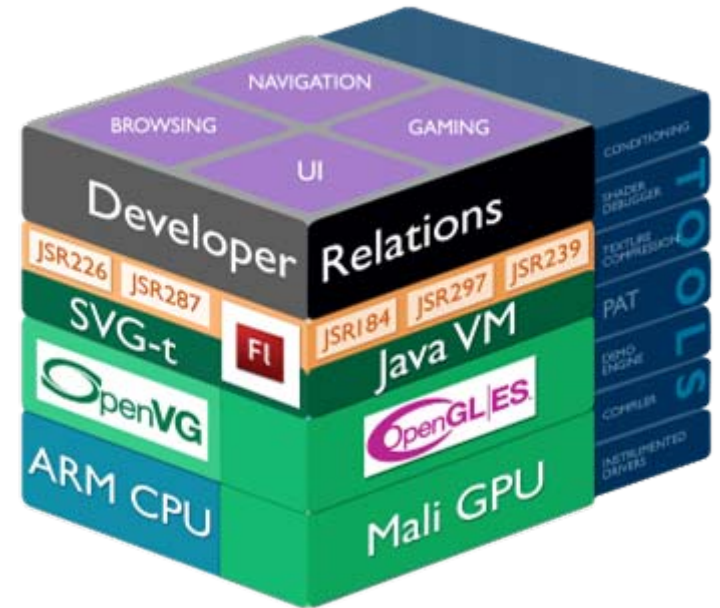
- **"The Complete Graphics Stack"**
  - GPU, drivers, middleware, tools and content partners

- **Scalable architecture - Mali™-55, Mali-200 and Mali-400 MP GPUs**

Embedded Momentum

Developers' Conference – All About Partners

Software, Training and Consortia Partners

Silicon Partners

Design Support Partners

Communicate CONNECT **CREATE**

ARM 2008
Developers' Conference

Product Update

Ian Drew

ARM Powered Products

Albatron Tee (Mini Tablet) Pc
ARM926EJ-S Processor

Nokia 5800 XpressMusic
ARM11 processor

Archos 5 & 7 - Internet Media Tablet's
ARM® Cortex A8™ Processor

HTC G1
Qualcomm® MSM7201A™
ARM11 Processor + Jazelle
OS - Android

Zipit Wireless Wi-Fi Messenger
Marvell PXA270 – ARM Powered

Nokia N96-3
ARM9 Processor

Bluegiga Access Point 3201
ARM9 processor

Nautilus Hyosung NH1800 ATM
ARM9 Processor

LG Secret
ARM9 Processor

Cuol Book (Mini Laptop)
Samsung – ARM Powered

ARM Powered Products

**Beijing Olympics Mascot
Fuwa Intelligent Talking doll**
ST (STM32) – ARM Cortex M3 Processor

Luminary Jaguar - DC Motor Control
Stellaris - ARM Cortex M3 processor

Blaupunkt Travel Pilot 300
SiRF Atlas III Processor – ARM926EJ-S processor

Samsung's MX-20 camcorder
ARM Powered

Maxtor Shared Storage II
Marvell – ARM926EJ-S Processor

Artega - Artega GT (Dual-Dashboard Display)
Fujitsu MB86R01 "Jade" graphics controller
ARM926EJ-S + Jazelle Java Acceleration Technology

(HRI) WV-1 (Waseda wheeled Vehicle-No.1)
ST (STM32) - ARM Cortex M3 Processor

Casio EX-F1 Digital Camera
ARM Powered

Samsung LN40A750 40-Inch 1080p DLNA LCD HDTV
ARM Powered

Sony Bravia L-Series KDL-32L4000 – LCD HDTV
ARM Powered

Demonstrations

Announced Processor Portfolio

- World-class, market-proven technology
- 20+ processors cover every application
- 200+ silicon Partners
- 500+ licenses
- 12Bu+ shipped

ARMv7-Cortex

x1-4
Cortex-A9

Cortex-A8

ARMv6

x1-4
ARM11 MPCore

ARM1176JZ(F)-S

ARM1156T2(F)-S

ARM1136J(F)-S™

ARMv5

ARM1026EJ-S™

ARM968E-S

ARM926EJ-S

ARM946E-S

ARM966E-S™

Cortex-R4F

Cortex-R4

ARM7EJ-S™

SC200

ARMv4

ARM920T™

ARM922T™

Cortex-M3

SC300

ARM7TDMI(S)™

SC100™

Cortex-M1

Mali Solutions Scaleable to >1G Pixel/s

Mali™-400 MP

Mali™-200

Mali™-55

Visual quality

Console 3D Gaming

Next Generation Navigation

HD 3D Gaming

2D/3D Presentations

Mobile Gaming

Flash 10

Flash Lite

HD Video Post Processing

TV HD UI

3D Navigation

Web Browsing

Java Gaming

Video Post Processing

Screen resolution

Developing Growth in Embedded

- Vision: ARM technology-based MCUs become the standard

- The best choice for developers
  - Broadest choice through industry partnership
- The best infrastructure
  - ARM Microcontroller Development Kit: ~380 ARM processor devices supported
  - RTX delivers rapid development: RTOS, TCP/IP stack, USB, CAN, Flash file system support
- The best devices
  - Cortex-M3 and Physical IP extend reach via greater energy efficiency

Cortex-M3 leakage reduction

Normalized leakage

3x

10x

180G Sage-X   180ULL   180ULL with retention

Typical, 25C, 1.8V
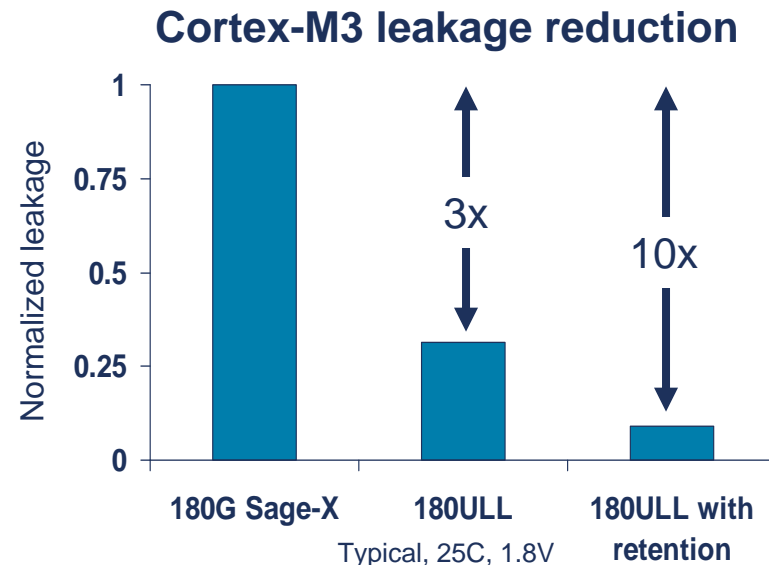
Enabling Web 2.0 Mobile Applications

Simon Segars

The Future in Web 2.0

Personalizing the device

Growth and Opportunity:
Energy efficient performance
Diversity and Innovation

Software Innovation

**Your content,
on your terms**

Business Model Innovation

Consumer Innovation

Cortex-A8 & Atom: Power and Area

- Lots of hype and FUD in press

EETIMES

Go ahead, prove us wrong

"…we examined why ARM would likely win out over Intel for mobile processors…"

Patrick Mannion, US

The New York Times

Intel's Dominance Is Challenged by a Low-Power Upstart

"…each new computing generation has displaced its predecessor by reaching a broader audience and costing far less…"

John Markoff, US

- Atom is more competitive than other Intel CPUs
  - Still a long way behind ARM solutions in power and area (cost)

Feature	S5PC100 Advantages Over Atom
Solution	Single chip, lower integration costs
Avg. Power	25% of the power
Chip Size	25% of the size (PoP Available)
Video Playback	3x+ longer time
Standby time	20x+ longer with IEM & DVFS

Source: Samsung

666mm^2

144mm^2

SAMSUNG S5PC100
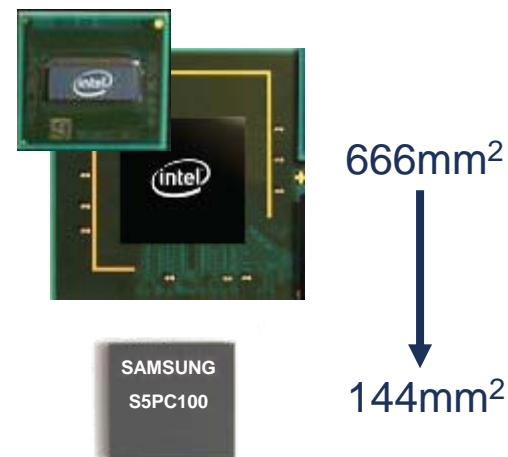
Cortex-A9 – Technology Leadership

- Breakthrough performance and power scalability
  - Second generation 1-4X SMP technology
  - Advanced pipeline with 2.5 DMIPS/MHz
  - Optional floating-point and NEON units
- New system-level integration features for design optimisation
  - Accelerator coherency port
  - Generic interrupt control (GIC) and distribution system
- Suitable for high-end enterprise through to wireless handsets
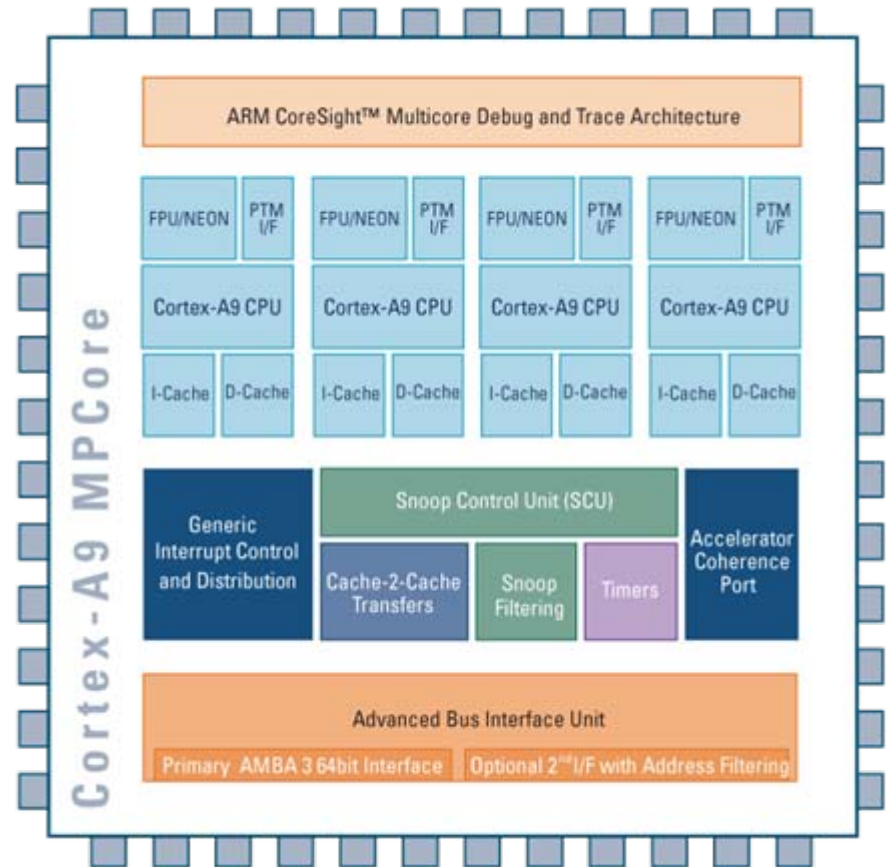
ARM Physical IP Offers Best Implementation

ARM Processor IP

ARM Fabric IP

ARM Media IP

ARM Physical IP
- Logic Products
- Memory Products
- GPIO / SPIO Products
- High Speed Interface Products
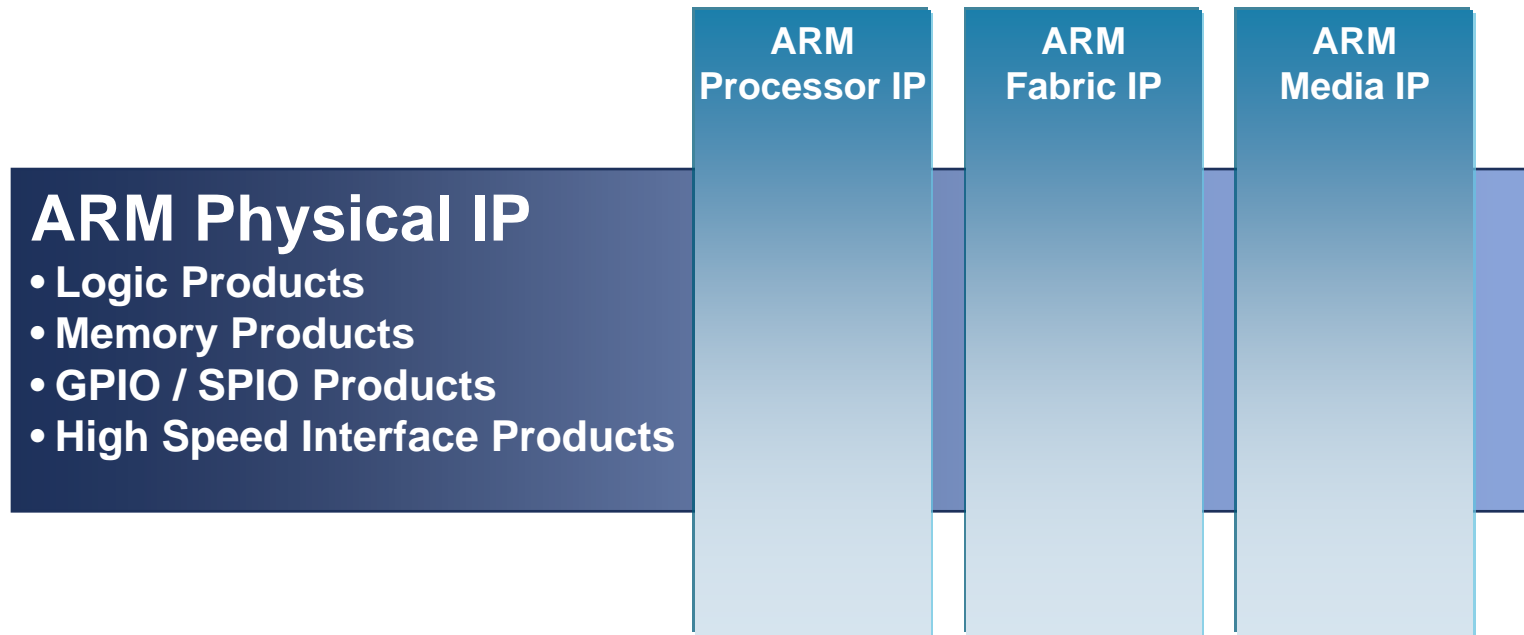
- ARM offers rich Physical IP solutions for all products
  - Enables SoC "Processor to Pads" solutions
- Key Focus Areas:
  - Assure Physical IP are optimized for ARM core implementations
  - Achieve Leadership Power, Performance and Area (PPA)
  - Deliver earliest-possible availability of optimized Physical for new cores

Leading Implementation Needs Partnership

- ARM IP on advanced foundry process uses integrated design

ARM

| Architecture |
| RTL Coding |
| Physical IP |

Optimization
DFM

Performance
Yield

Foundry

| Process Development Kit |
| Transistor / Bitcell / Interconnect |
| Manufacturing Process |

- Architecture through to RTL is co-designed with physical IP
- Physical IP is tightly coupled with process technology development

Implementation

1+ GHz in 32nm low power process

2+ GHz in 32nm generic process

| ARM Processor & Physical IP |
| Advanced HKMG Process |

Innovation and industry leadership thru collaboration

High-κ Metal Gate Technology at 32nm

- First HKMG at 32nm – Innovation to re-enable scaling
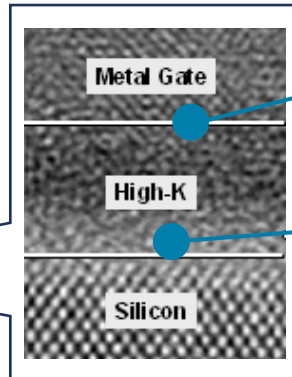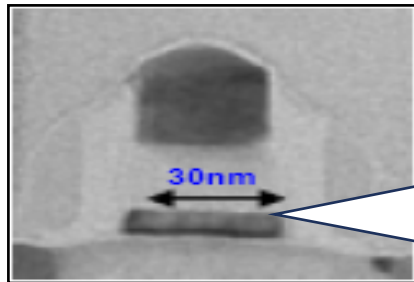
Metal gate replaces the polysilicon-based electrode in the traditional stack

Hafnium-based high-k material replaces SiO_2 for enhanced leakage and scaling

Functional 32nm SRAM – December 07

LP Low Standby Power

Generic Low Op. Power High Perf.

Common Process Technology

Common Design Kits

Joint Development Alliance

Source: Common Platform

High-κ Metal Gate Technology at 32nm

- First HKMG at 32nm – Innovation to re-enable scaling

Metal Gate

High-K

Silicon

Metal gate replaces the polysilicon-based electrode in the traditional stack

Hafnium-based high-k material replaces SiO_2 for enhanced leakage and scaling

20 nm

Functional 32nm SRAM – December 07

LP Low Standby Power

Generic Low Op. Power High Perf.

Common Process Technology

common platform

Common Physical IP, Optimised System IP & DFM/EDA

Common Design Kits

Synchronized Fabs / Foundry Services
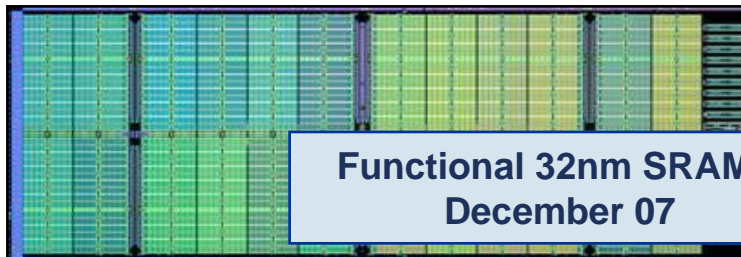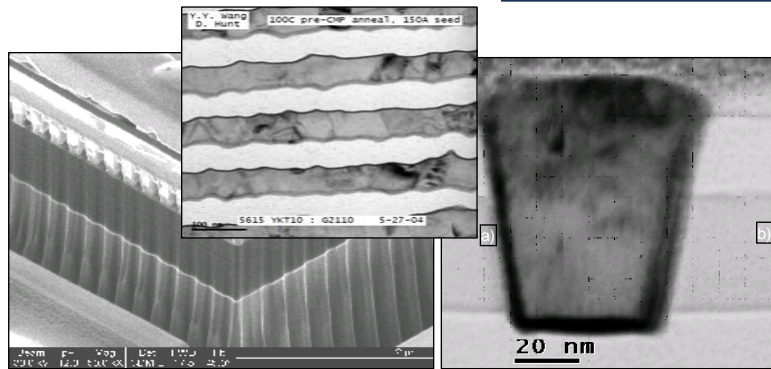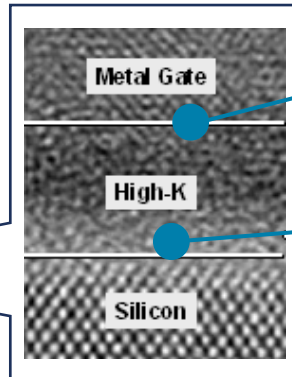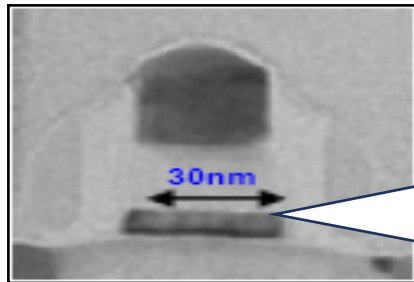
Source: Common Platform

ARM Platform Physical IP Roadmap

28nm 32nm	(legend)
	🟦 Released
	🟢 Development
	🟠 Adv. Planning

2009 column (top, orange/Adv. Planning):
- 🟠 SRAM
- 🟠 Reg. File
- 🟠 ROM
- 🟠 Cache
- 🟠 Logic
- 🟠 Interface
- 🟠 App logic
- 🟠 High speed interface

40nm 45nm — 2008 column:
- 🟦 SRAM
- 🟦 Reg. File
- 🟦 ROM
- 🟦 Interface
- 🟦 Logic
- 🟢 App Logic
- 🟢 Cache
- 🟠 High speed interface

65nm — 2007 column:
- 🟦 SRAM
- 🟦 Reg. File
- 🟦 ROM
- 🟦 Fast Cache Instances
- 🟦 Logic
- 🟦 Interface

90nm 130nm 180nm — 2007 column:
- 🟦 SRAM
- 🟦 Reg. File
- 🟦 ROM
- 🟦 Logic
- 🟦 Interface

Increasing SoC Integration

Memory · Memory · DDR · Standard Cells · ARM CPU · Memory · I/O Cells

2007   **2008**   **2009**

Optimal PPA Through Process & Physical IP

Increased Differentiation
(PPA Benefits / Feature Set)

Implementation with Enhanced IP

+ Optimized Physical IP

+ Optimized Core RTL and Implementation Flows

Implementation with Foundation IP

RF1

+ High-K Metal Gate Process

+ ARM Physical IP

Conventional Poly SiON Process
Third party IP

Baseline performance achieved with conventional process & IP
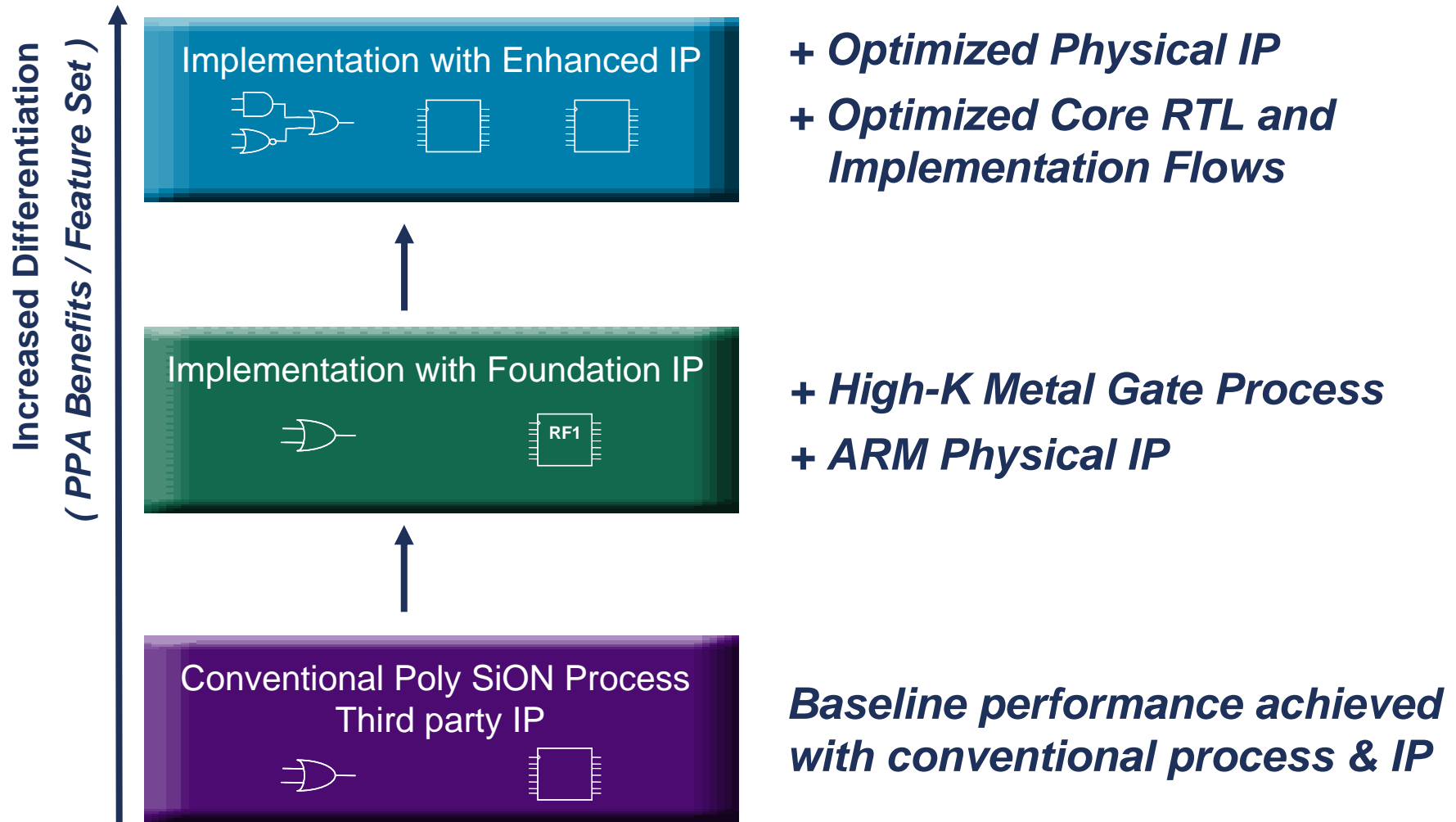
Application Optimized Physical IP

Logical

Physical

- Applications Processor (Cortex-A9)
- Modem Subsystem (Cortex-R4)
- Graphics Processor (Mali)
- Video
- Memory Controller
- Interconnect
- Support IP

Application Optimised Physical IP Yielding Best in Class PPA

- ARM Funded

Specialty & Other IO

DDR Complete PHY

Foundation IP: Logic, Memory, IO

- Foundry Funded, No License Fee
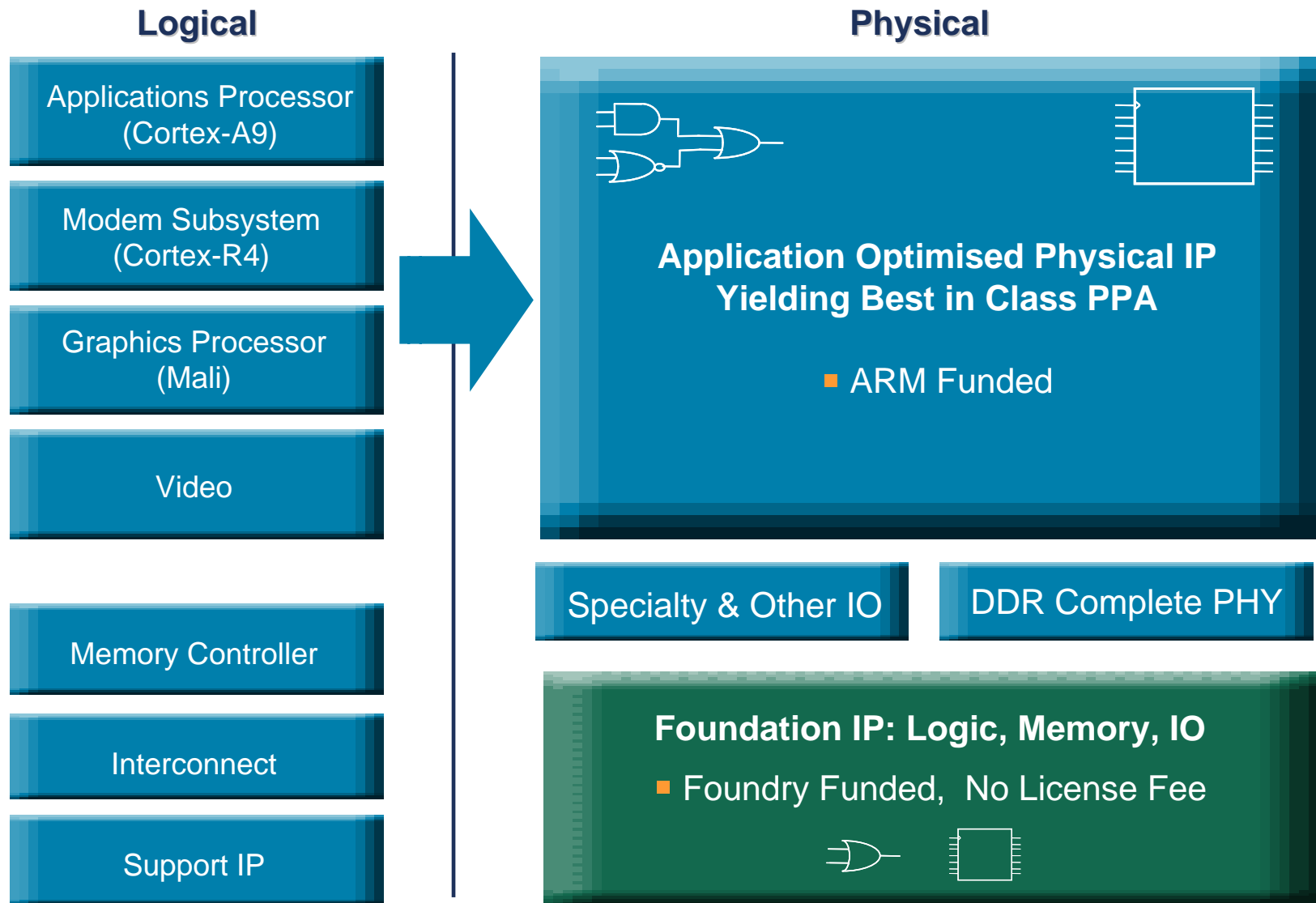
32nm Physical IP in Development Now

Process — Eval / Alpha / Beta / Final

Aggressive 1st 32nm Test Site

32nm Cortex-M3 Implementations

Early 32nm Enablement

Physical IP
- Test Site 1 — TAPED OUT
- Test Site 2 — TAPED OUT
- Alpha Release Standard Cells
- Alpha IP Platform
- Beta IP Platform
- Test Site 3
- Final Release Platform
- Additional Enhanced IP Products

1st Production Tape Out

Customer — Lead Customer Collaboration

1H 2008 | 2H 2008 | 1H 2009 | 2H 2009 | 1H 2010 | 2H 2010

Experiences with 32nm HKMG Design

- 32nm challenges and innovation with Common Platform

  - Beyond design rules
  - Litho simulation
  - Scalability to 28nm
  - 32nm test chip, Q3'08

- Technical track - 1:00pm; Rob Aitken, ARM Fellow
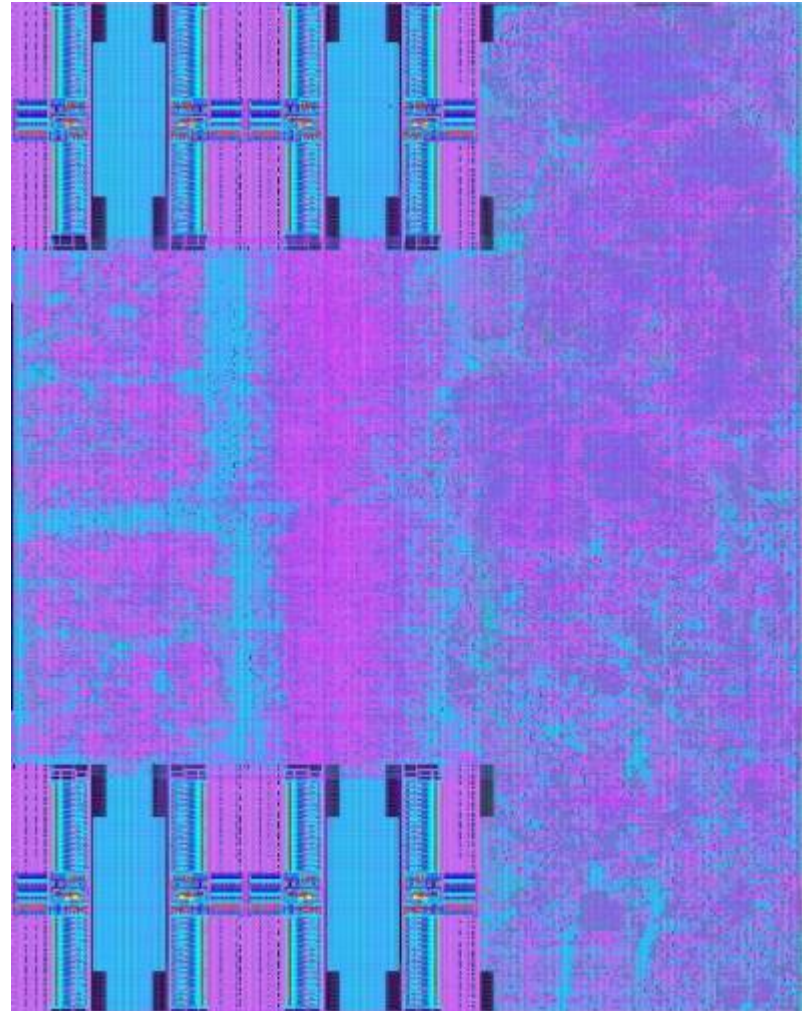
MCU Standards

Wayne Lyons

Why Care About the CPU?

Legacy Code across all Company Products

Toolchain

8-bit

16-bit

32-bit
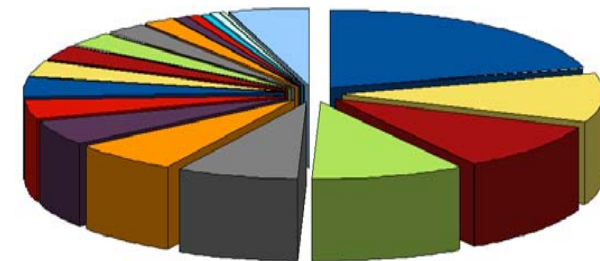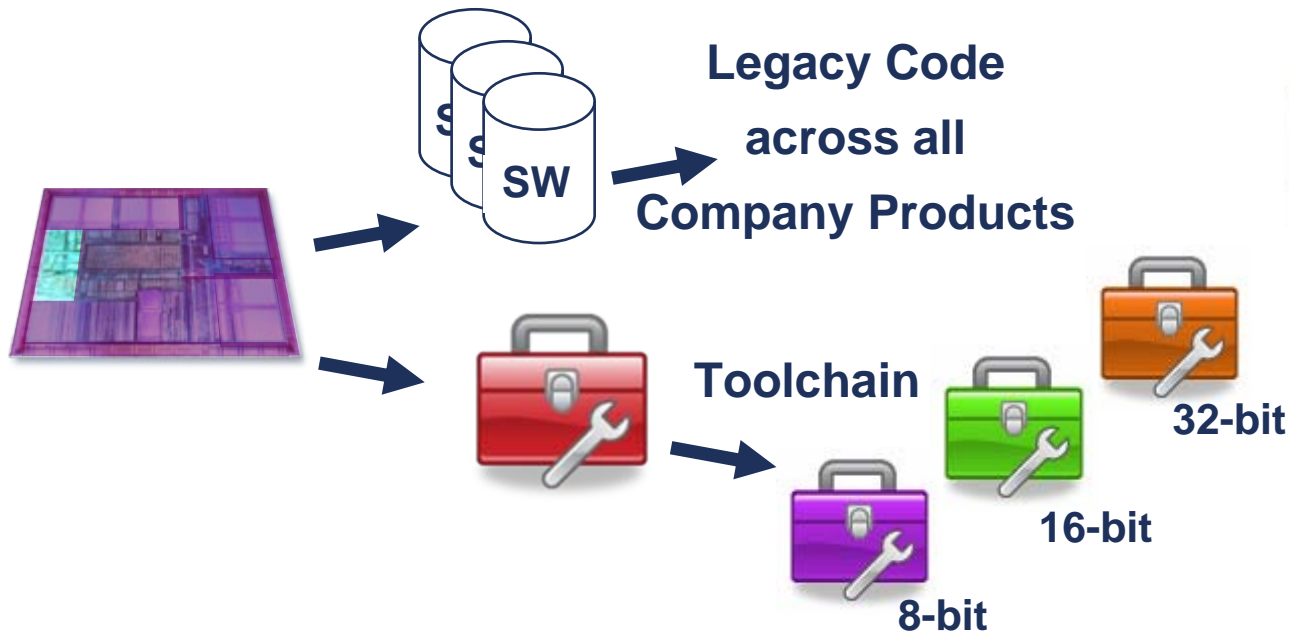
Fragmentation in the 8-Bit MCU market
(By Revenue – Gartner 2006)

- Traditional MCU market very fragmented
- Many vendors have multiple architectures which are incompatible
- Incompatible architectures across organization reduces engineer efficiency
- For each additional toolchain: IT costs increase and reliability reduces
- A consistent CPU architecture enables software and toolchain reuse

ARM Strategy in MCU

Legacy Code across all Company Products

Toolchain

Microcontrollers

FPGAs

Applications Processors, System-on-Chip etc.
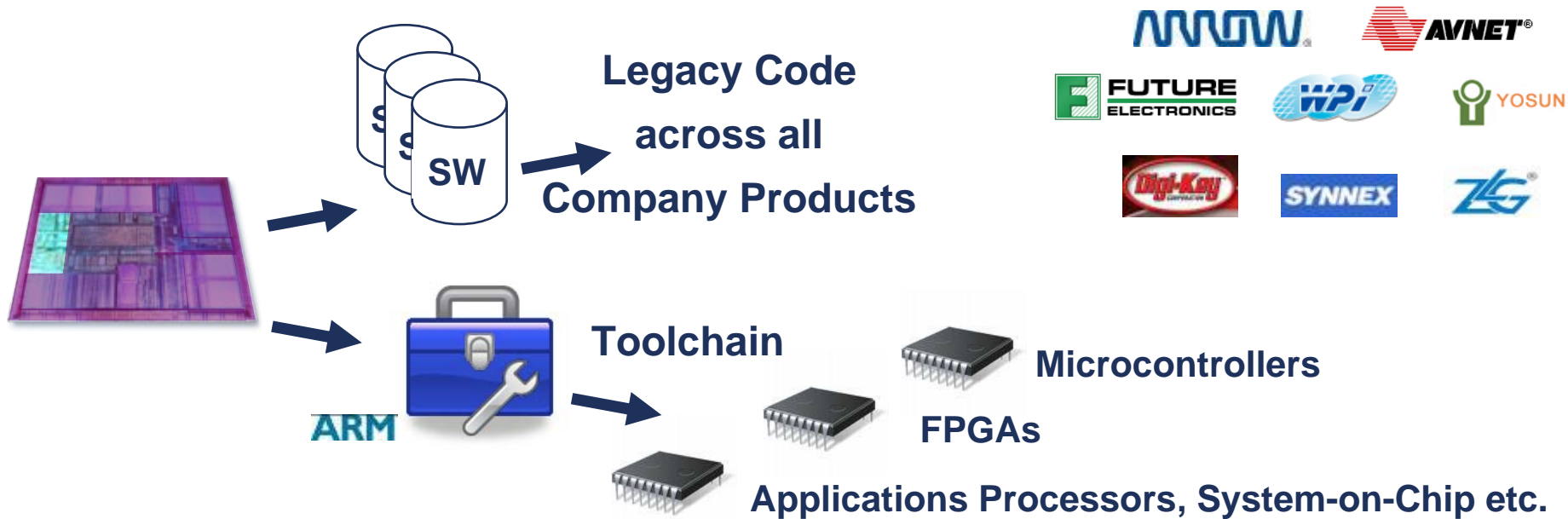
- **Enabling a standard platform for embedded development**
  - Protecting investment in software design
  - Forget traditional 8/16/32-bit perceptions, think of it as a 'Software Engine'
  - Enable reuse, not just from MCU to MCU but onto other digital solutions

ARM Cortex-M Profile Availability

STM32

TOSHIBA

EE Times Asia

Toshiba picks Cortex-M3 for car apps

LUMINARY MICRO™ **Stellaris®**

More than 20 licensees of Cortex-M3 processor
More than 150 Cortex-M3 processor-based devices

ARROW **ALTERA.**

ARM Cortex-M1 Processor

Actel
Actel
ARM Enabled
Flash FPGAs
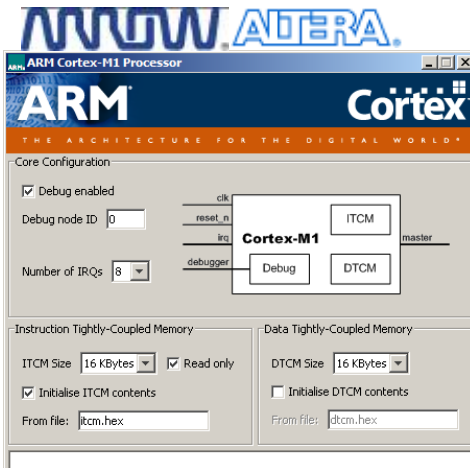Cortex

SoftConsole

…Plus several recent announcements

ENERGY micro   **NXP**   zilog

ATMEL   **TEXAS INSTRUMENTS**   **SAMSUNG**

Market Opportunity in Industrial MCU

- Strong growth forecast for ARM technology-based MCU over the next five years
- Growth opportunities in secure applications, power an energy
- Leading indicators such as 2x sales increase of RealView MDK from '06 to '07

($M)   **ARM based MCU**

($M)   **8/16-bit MCU**

Legend:
- Other Industrial Apps
- Industrial Transport
- Power & Energy
- Medical Imaging/Diagnostics
- Consumer Medical
- Test & Measurement
- EPOS, EFT & ID
- Bldg Lighting, HVAC & Control
- Motor Drives
- Factory Automation
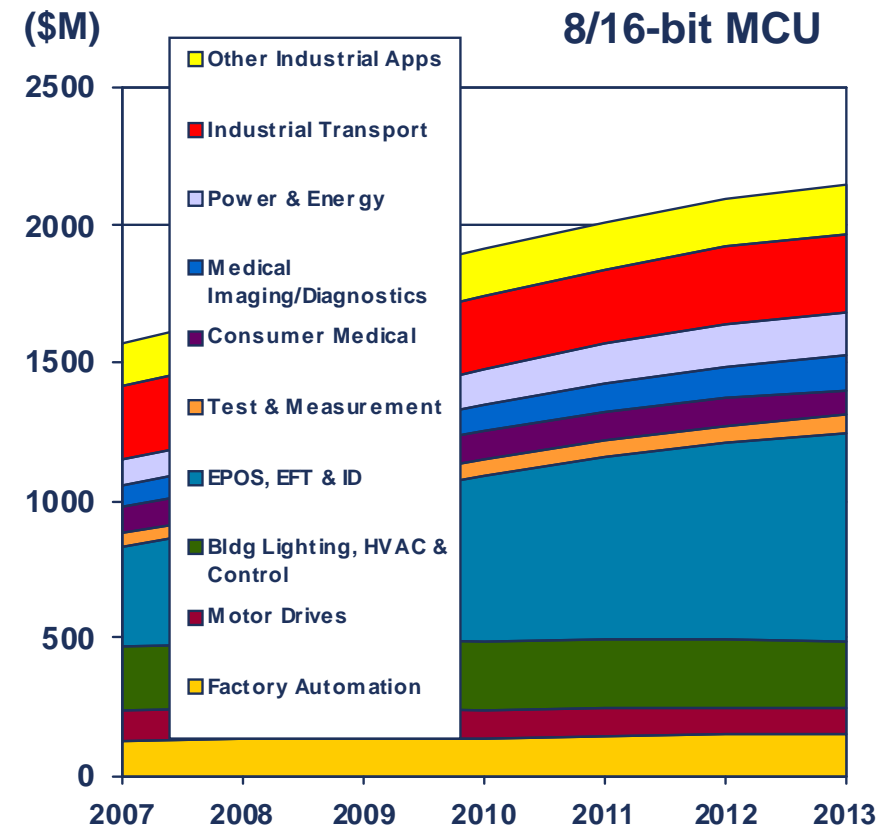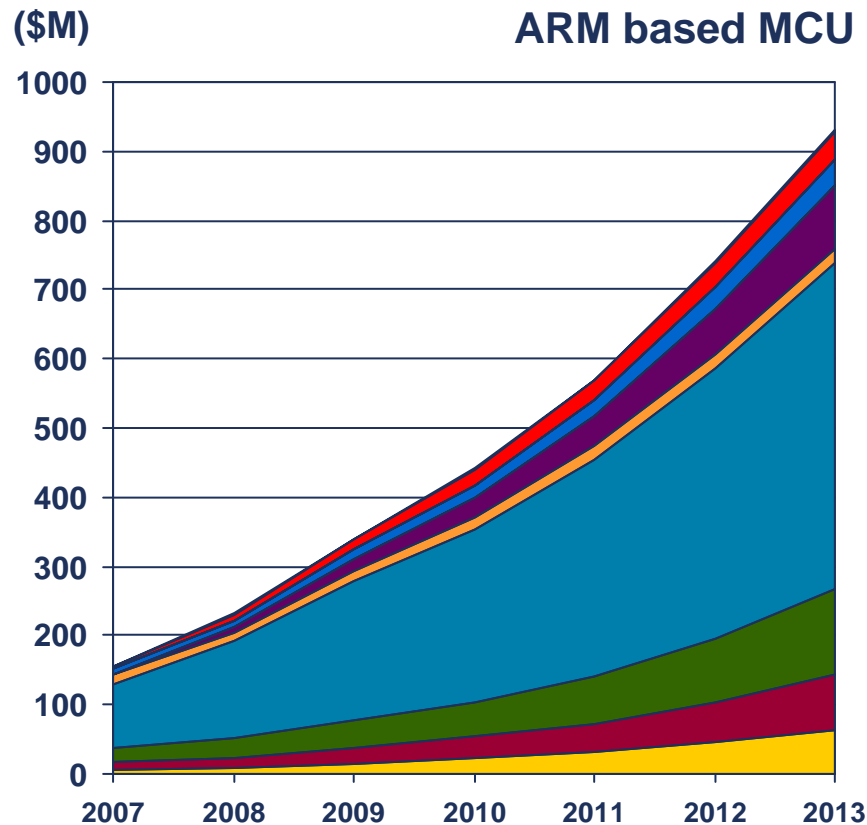
Source: SemiCast 2008

Breaking 32-bit Boundaries in Auto
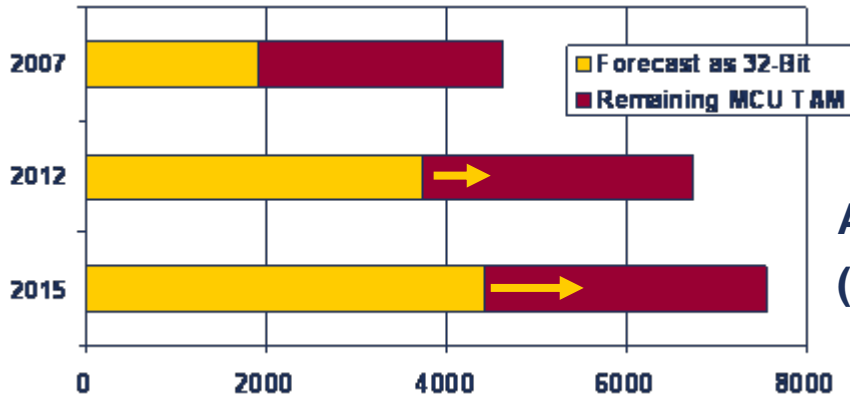
TAM for companies that introduce products with compelling mix of Peripherals, Memory Integration and Support

Automotive ($M)

Demonstrated by diverse product split forecast for 32-bit in automotive by 2015

AUT♥SAR

JasPar

Engine Control represented 33% in 2006

Sources: Gartner & Strategy Analytics 2008

Focus on Software in Embedded MCU

- What can "32-bit" really mean to the end customer

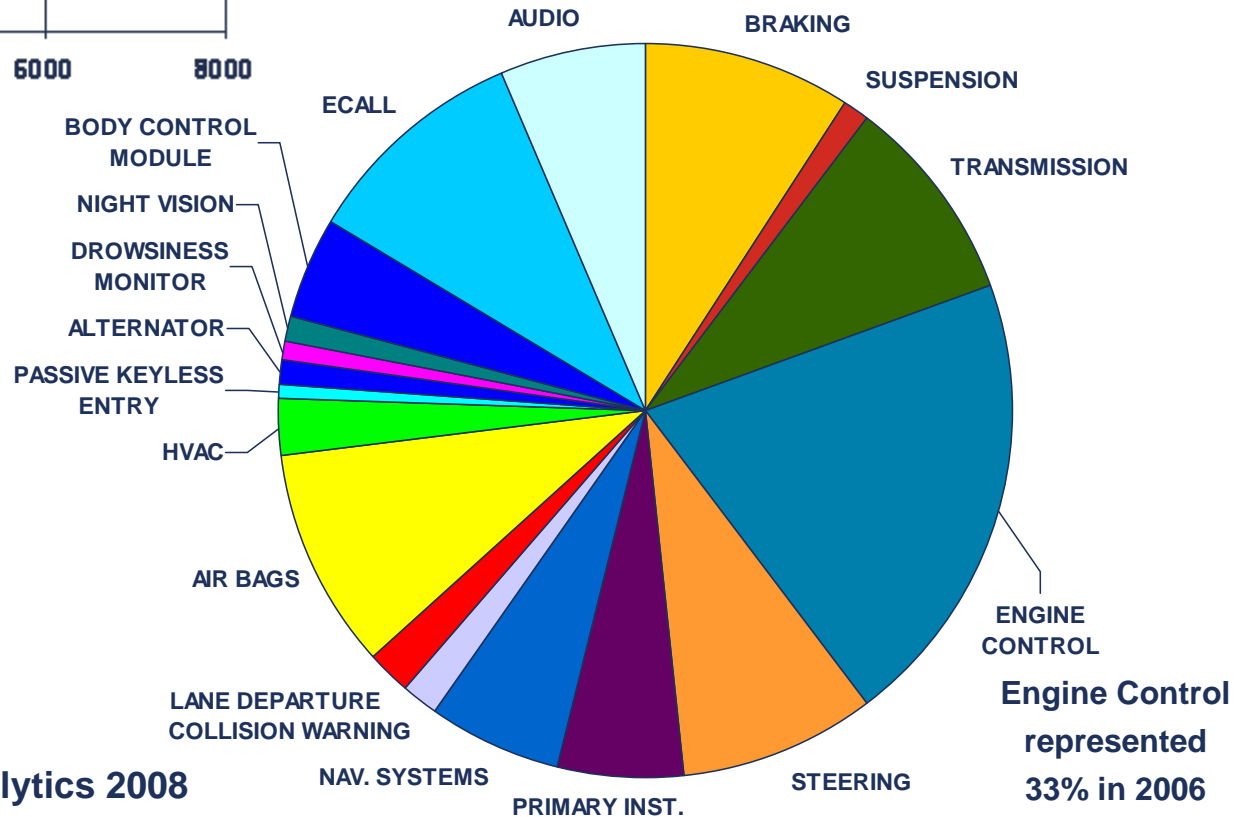|	8-bit	32-bit		
Product Benefits		Intuitive Display More Responsive User Interface	Device Interaction Better Conectivity	Reduced Energy Consumption Lower Product Weight
Chip Features	Motor Control Display Driver Low Power Cost Effective	Faster Operating System	Communication Protocol Stacks	Energy Efficient Motor Control Algorithms
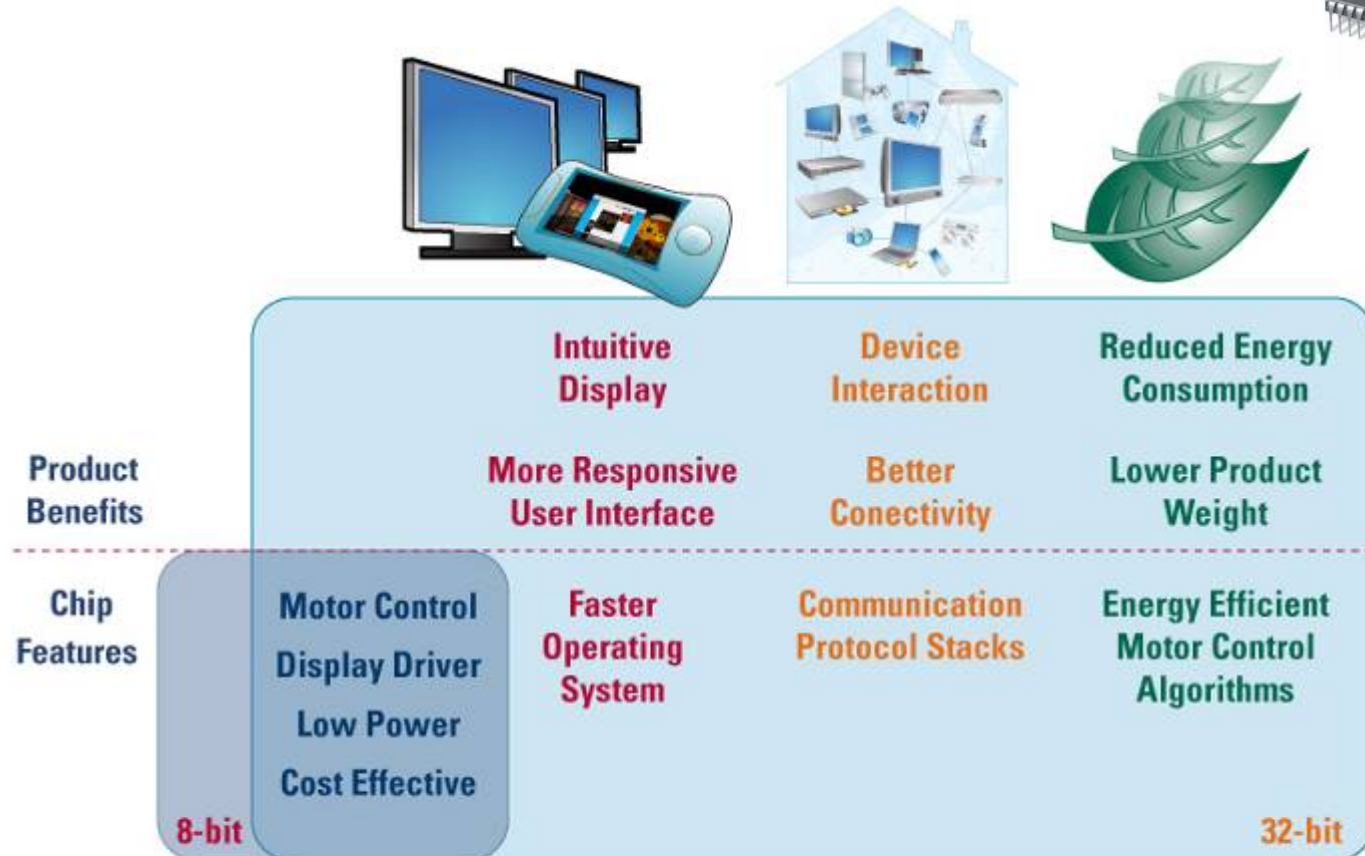
Silicon advances have enabled low power, cost-effective 32-bit Microcontrollers but what truly differentiates these new products is their capability to run more powerful software

Standards Enable Software Reuse

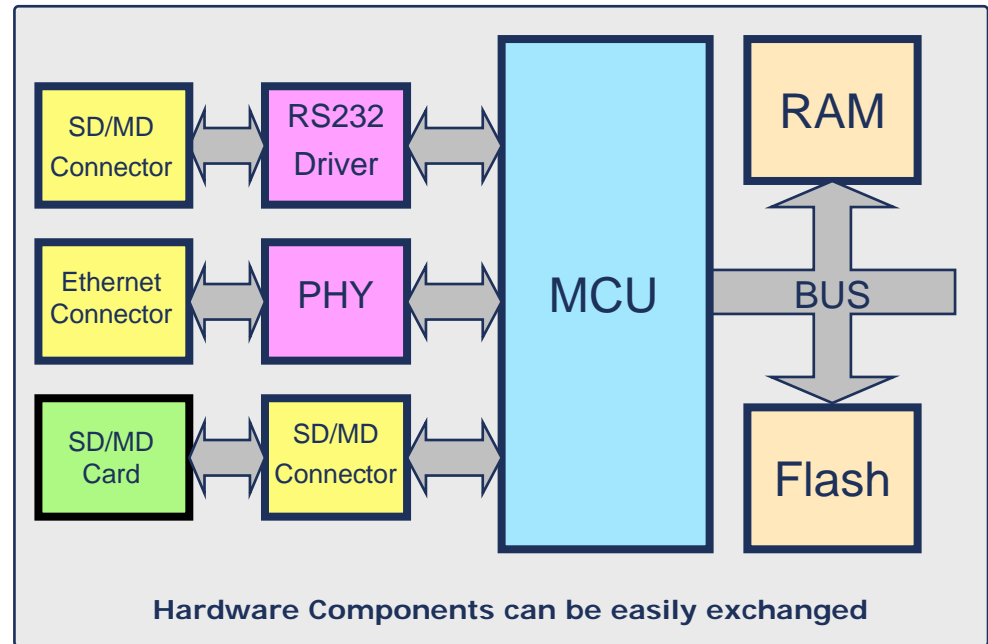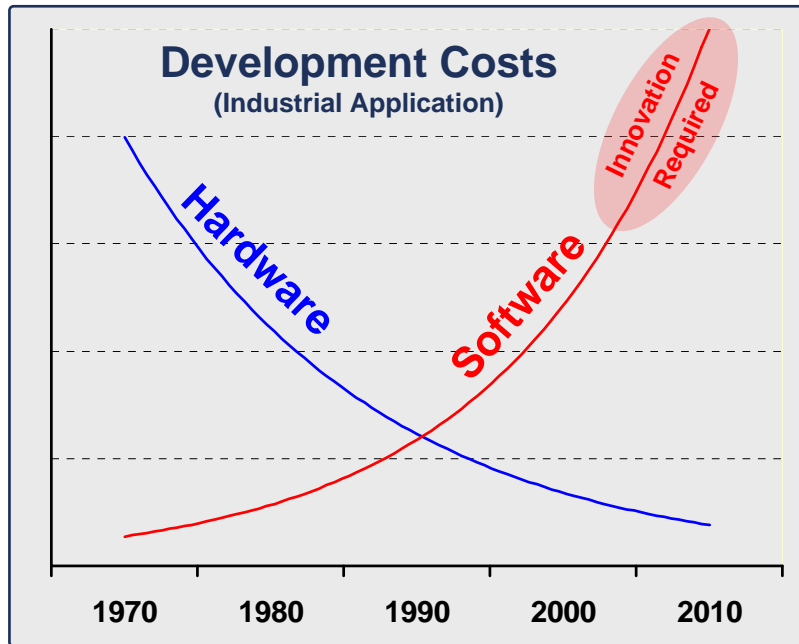- Increasing number of software stacks and protocols already available on ARM technology-based industrial microcontrollers

- Industrial market reusing existing standards when possible to leverage development and software expertise

- Middleware availability and reuse becoming increasingly important

- ARM Application Binary Interface (ABI) for Compiler interoperability

    - Allows middleware reuse across Compiler platforms

    - Allows software to be archived then reused on future platforms

Application-specific protocols	
WS-Discovery	WS-Eventing
WS-Security WS-Policy WS-MetadataExchange WS-Transfer WS-Addressing	
SOAP 1.2 WSDL 1.1, XML Schema	
UDP	HTTP 1.1
	TCP
IPv4/IPv6	

The DPWS Protocol Stack

Software Driver Complexity : The Challenge

Development Costs
(Industrial Application)

Hardware

Software

Innovation Required

1970   1980   1990   2000   2010

SD/MD Connector	⟷	RS232 Driver	⟷			RAM
Ethernet Connector	⟷	PHY	⟷	MCU	BUS	
SD/MD Card	⟷	SD/MD Connector	⟷			Flash

Hardware Components can be easily exchanged

- Well-known issues that drive software costs
  - Increasing product requirements that are implemented by software
  - Hardware inefficiencies often compensated by software work-arounds
- Software components are incompatible and cannot be re-used.

> Software standards are key for the future

…watch this space

ARM Processors
- Overview
- Search

Microcontrollers
- Available Devices
- Parametric Search

Silicon Vendors
- Vendor List
- Sales Offices/Distributors

Tools
- Vendor List
- ARM Connected Community
- Boards, Software, Compilers

News & Events
- Latest News
- Workshops, Seminars

Support
- Forums
- Downloads
- Application Notes
- Books

- **Will be the focal web site for ARM MCU**
  - Target site for community advertising
- **Portal to all microcontroller:**
  - Vendor resources
  - Related Connected Community products
  - Common original material from ARM
- **Dynamic Content**
  - User Forum
  - MCU Parametric Search
  - Ramping to 200,000 visits per month
- **Leverage benefits of ARM community**
  - While giving opportunity to differentiate

Microcontroller Launchpad at DevCon

- Come see for yourself
- Showcase for example platforms and real products
  - Robots thru to Servers
- Based on standard catalog products
- Part of a wider campaign to
  - Demonstrate the industry momentum
  - Encourage microcontroller innovation

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