MIPS Updates
“Open Source Software”

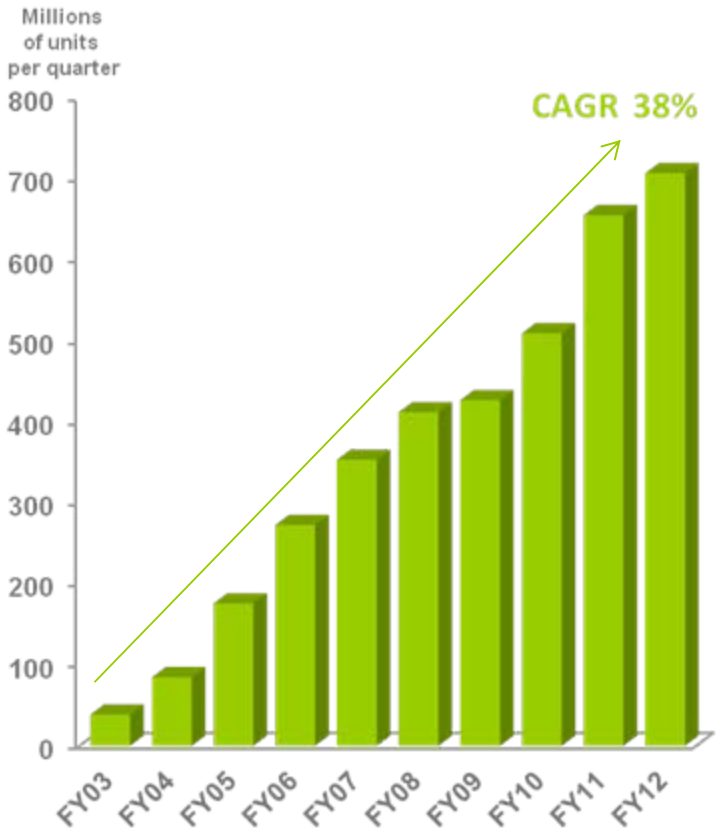
August 2012

MIPS Technologies Corporate Snapshot

Business Overview

- A leading provider of industry-standard processor architectures and cores
  - A leading position in the digital home
  - Strong in wired and wireless networking
  - Growing position in embedded market
  - Expanding into mobile, with millions of units of smartphones & tablets already shipping
- IP business model— licensing + royalties
- Licensees include Broadcom, Cavium, Loongson, Ingenic, Microchip, MStar, MediaTek, Sony, Toshiba, others
- Valuable portfolio of 570+ patent properties worldwide
- Headquartered in Sunnyvale, CA; presence in 11 countries; approx. 160 employees; more than half in R&D

Annual Unit Shipments



*MIPS royalty units reflect previous quarter shipments

- >3.6 billion unit installed base since 2000; 708 million units shipped in FY12

MIPS' Market Presence

MIPS TECHNOLOGIES

Leading Market Share*

Digital TV

Cable, Satellite & IPTV Set-top Boxes

Blu-ray Players

Broadband CPE

WiFi Access Points and Routers

*MIPS and Industry Analyst Data

Leading position in home entertainment; Strong in networking; Aggressively expanding into mobile and embedded

Strategic Growth in Key Market Segments

- Use Android & 4G to dislodge competition
- Make pioneer customers successful
- Invest in connected device ecosystem

- Maintain leading position across the home
- Provide leading-edge connected TV solutions for Android and Linux
- Help to define new product categories

- Maintain leadership in broadband CPE & WLAN
- Facilitate PowerPC transition to MIPS
- Leverage multicore 64-bit & multi-threading

- Leverage lead MCU licensee
- Grow ecosystem & leverage partnerships
- Performance efficiency leadership

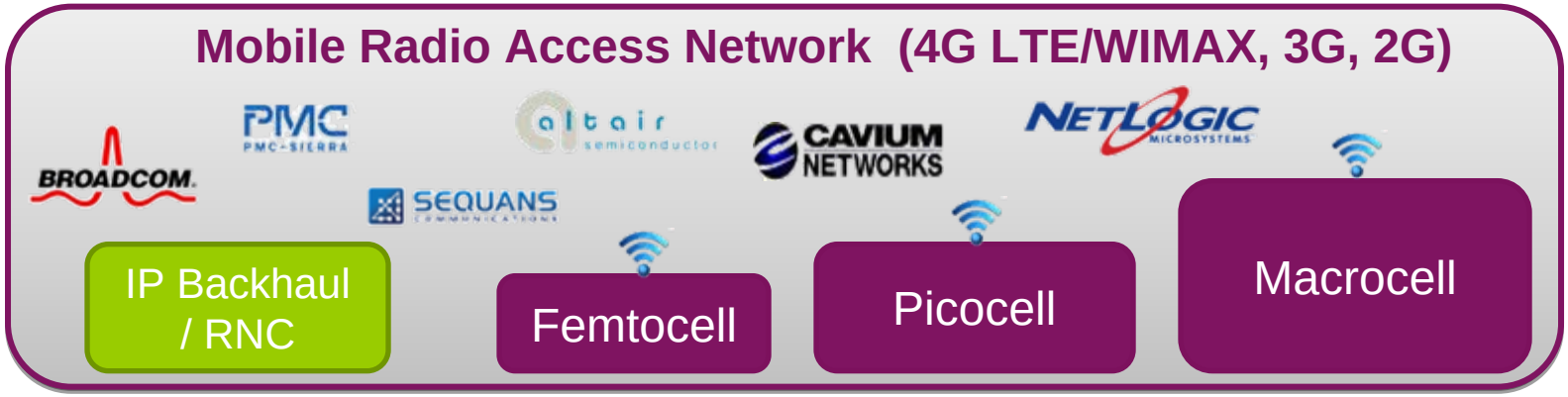
Maintaining lead in traditional markets; aggressive market expansion

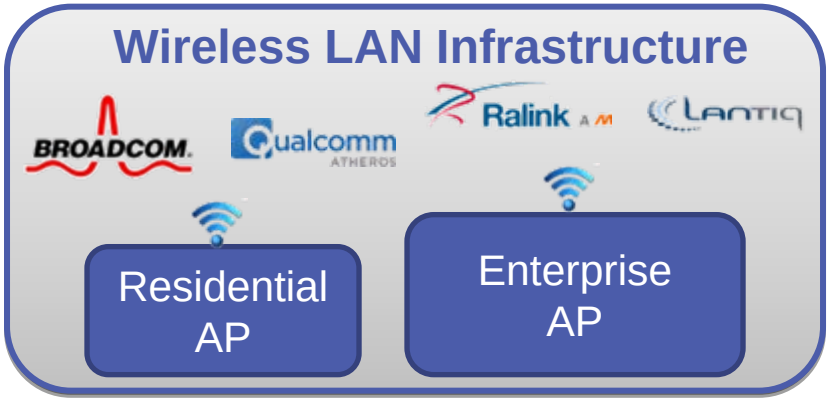
The Cellular Infrastructure and Mobile Spectrum

Key Technology Foundation & Ecosystem

- Multicore + Multithread Processors
- WiFi, 4G, GPS, etc.
- >1GHz CPUs
- Android
- Apps and Games

MIPS in Wireless Infrastructure





- **Multi-core processors (MIPS64) from Cavium & NetLogic; NPUs from PMC-Sierra drive growth in Infrastructure**
  - **Design-ins for eNBs/BTS/RNC for 4G & 3G**
  - **New "Fusion" small cell SoC from Cavium**
- **Growing presence in 3G/4G baseband**
  - **Millions of units shipped in CY11**
- **Leading share in WLAN infrastructure**
  - **60%+ share in wireless access points & routers**

Recent MIPS Mobile Milestones

Millions of units shipped; Mobile is no longer just an ARM world

Breaking tablet price/ performance barrier: 1GHz & sub-$100

MIPS fully supported in Latest release of Android NDK from Google

GAMELOFT

Xamarin

Opera Mobile™

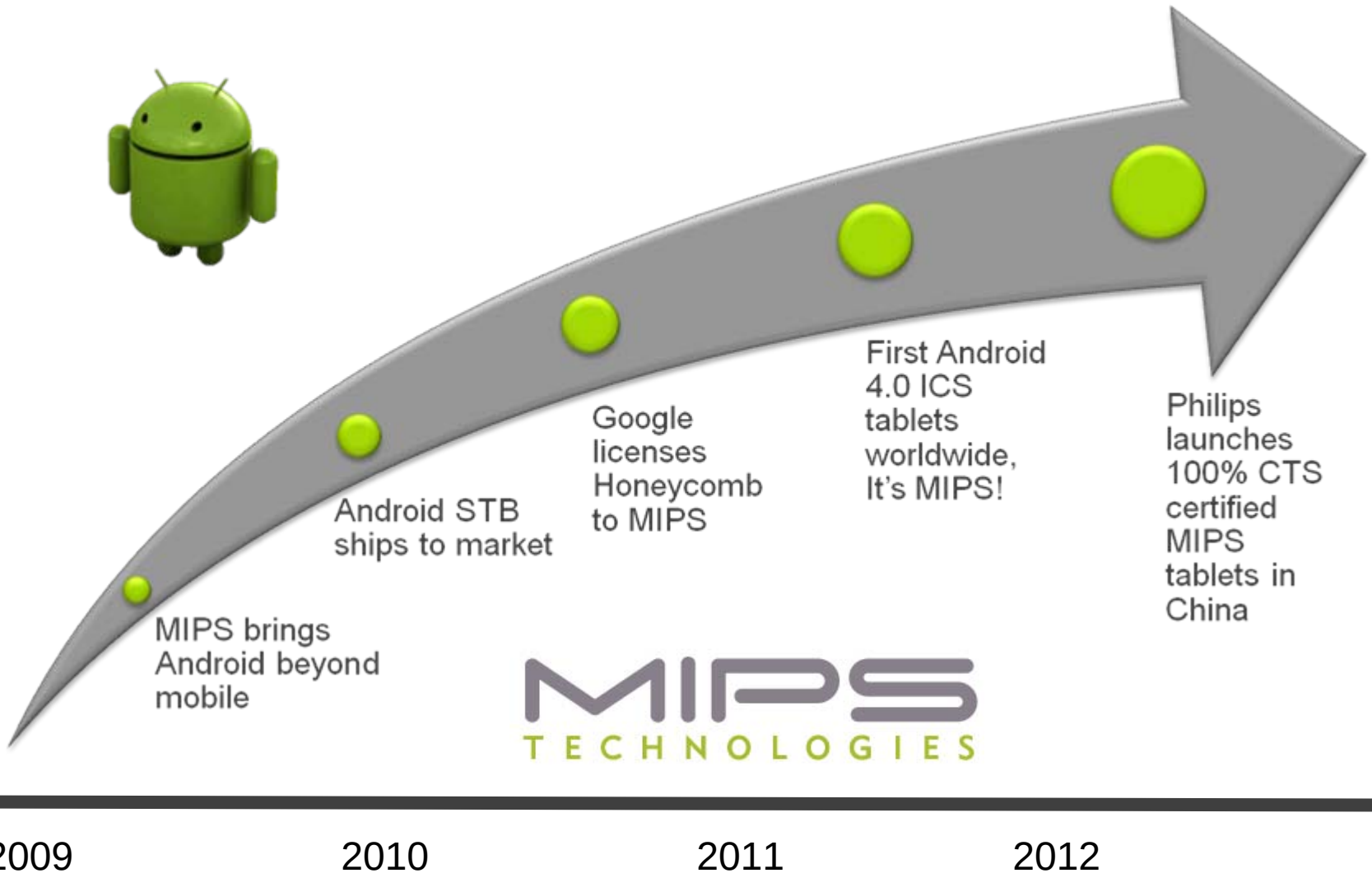
Aggressively building the mobile apps ecosystem for MIPS

Best-in-class Cat 4 LTE chipsets—certification in progress in multiple countries

Growth in emerging markets—new devices in China & Indonesia; evaluations underway in Brazil and Thailand

Mobile momentum continues with new ecosystem developments and new products in the market

Android on MIPS Timeline



World's First Available Android 4.0 Tablet — Yes it's MIPS!

- ✓ *Android 4.0 – Ice Cream Sandwich*
- ✓ *Full functionality*
- ✓ *1GHz performance*
- ✓ *Low power consumption*
- ✓ *Low cost: ASP below $100!*
- ✓ *Android 4.0.3 reference port available at developer.mips.com*

"I'm thrilled to see the entrance of MIPS-Based Android 4.0 tablets into the market. Low cost, high performance tablets are a big win for mobile consumers and a strong illustration of how Android's openness drives innovation and competition for the benefit of consumers around the world."

—Dec 5th, 2011,
Andy Rubin,
Senior Vice President of Mobile,
Google

2 weeks after Google released Android 4.0, MIPS led the market by announcing availability of first ICS tablet

New Philips T7/T7+ Tablet: it's MIPS!

First non-ARM Android 4.0 Devices to Pass Android Compatibility Test Suite (CTS)

GOOGLE OFFICIALLY SUPPORTS MIPS IN ANDROID

MIPS TECHNOLOGIES

First Jelly Bean Tablet

- **On 7/31/12 MIPS announced the world's second JB tablet**
  - Sells for about $125 in India
  - "… With our deep expertise in Android development, we are able to quickly port new versions of Android to MIPS-Based devices, with speed that is second only to Google itself"

More Mobile Momentum in FY12

- **Multiple tablet OEMs in six months!**
  - Ainol (Ainovo), K-touch, Speedup, Philips, Karbonn
  - Millions of devices shipped last year

- **Actions Semiconductor 74Kf based SoC in Ramos tablets coming soon**
- **Complete support for MIPS ABI in Google's NDK**

- **MIPS was part of Google's Platform Development Kit for "Jelly Bean"**
- **Altair and Sequans shipping state-of-the-art 4G LTE solutions based on MIPS**

- **NationZ shipping NFC solutions based on MIPS**
  - More than one million units already shipped!

Mobile Momentum – Looking towards FY13

- **MIPS Jelly Bean sources available on developer.mips.com**

- **All of MIPS Android sources submitted to Google**
  - Next release of Android expected to support MIPS 100% on day 1 of going open source

- **Next release of Android SDK to include MIPS emulator, ICS and JB system images**

Google

- **Delivering ARM to MIPS binary translator (MagicCode) to customers (available on developer.mips.com)**
  - Customers successfully integrated and is able to hit 70% ARMv5 translation to MIPS success

- **Next release of Google Play to include multiple APK support**
  - Includes MIPS ABI being default for native application development

Google play

Mobile Momentum – 3rd Party Support

- Gameloft to release 20 game titles
- Marmalade and Yoyo cross-toolchain support
- Rightware (Basemark GUI, Basemark OS, Basemark ES) available
- Xamarin (.net framework for linux) supports MIPS
- World's most popular browser, Opera Mobile: 100% MIPS support
- Halfbrick, maker's of popular "Fruit Ninja" to support MIPS

Downstream Business Development in Mobile

- **MIPS has a proven track record of facilitating (technical, marketing and PR) launches of successful devices**
  - Speedup launched in Indonesia in four months from first meeting
  - Philips launched in China in four months from first meeting
  - Ainovo shipped the world's first ICS tablet
  - 3G/4G reference designs underway
- **MIPS has very high credibility within Google, to help deliver fast, aggressive results**
  - CTS experience, Widevine knowledge, etc.
  - Up-to-date and timely submissions and patches to AOSP

PHILIPS sense and simplicity

Karbonn SMART

SpeedUp® Keep You Connected

K-Touch 天语

AINOVO

Hanvon

aigo

Bambook 锦书

altair semiconductor

VIA Telecom

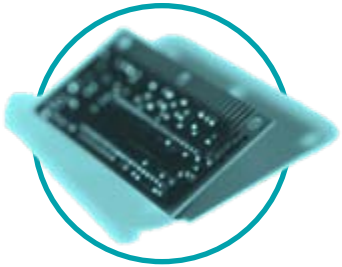
The Importance of Emerging Markets

- **No dominant tablets or smartphones in emerging markets (e.g. China, Indonesia, Brazil, India, Thailand, Brazil and others)**
  - With lower levels of disposable income, devices targeted for developed markets are out of reach for most consumers
  - Significant demand exists if devices have the right price/performance point
- **MIPS enables the "sweet spot" in these markets**
  - Highly-scalable architecture with excellent software platforms
  - Brand name recognition: legendary performance and power efficiency
  - Lower total cost of ownership with small silicon footprint + flexible business model
- **MIPS-Based silicon enables OEMs to create attractive, differentiated solutions**
  - High-performance, feature-rich, high-quality devices
  - Price + capabilities = compelling competitive advantage
  - Appealing, affordable products ultimately benefit consumers worldwide

MIPS' performance-efficient products are "right sized" for emerging markets; poised to drive mass adoption

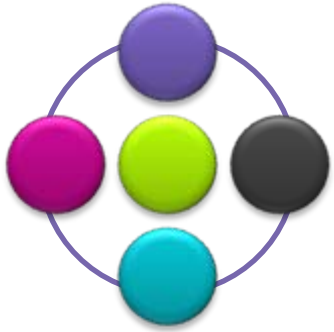
MIPS: the Credible Alternative for Mobile

Technology



- Efficiency of MIPS architecture delivers high performance with compact area, and low power consumption
- Multi-threading technology can provide significant additional benefits
- MIPS architecture delivers the connected multimedia experience

Ecosystem



- Working closely with Google to quickly enable the latest releases of Android –the world's first Android 4.0 tablet is MIPS!
- Bringing the most popular Android apps and games to MIPS
- Best-in-class hardware and software IP partners

Business

- Consumer-focused model, providing the right level of performance with low power consumption and lower total cost of ownership
- Partnering with our customers for mutual success
- Bringing the leading consumer entertainment experience of MIPS to the mobile world

Access to any Content, any Time, Anywhere

MIPS: the architecture of choice for the Converged Consumer Experience

MIPS Shipping in all Major Brands in Digital Home

MIPS-Based Smart TVs in Volume Production

- **Konka, Skyworth, TCL, Hisense and other mainstream TV manufacturers ramping up Android TV production**

Multi-Screen Integration

Smart devices are becoming complementary, integrated/extended systems

The Future of Multi-Screen Entertainment

TV Channel Preview on a Mobile Device

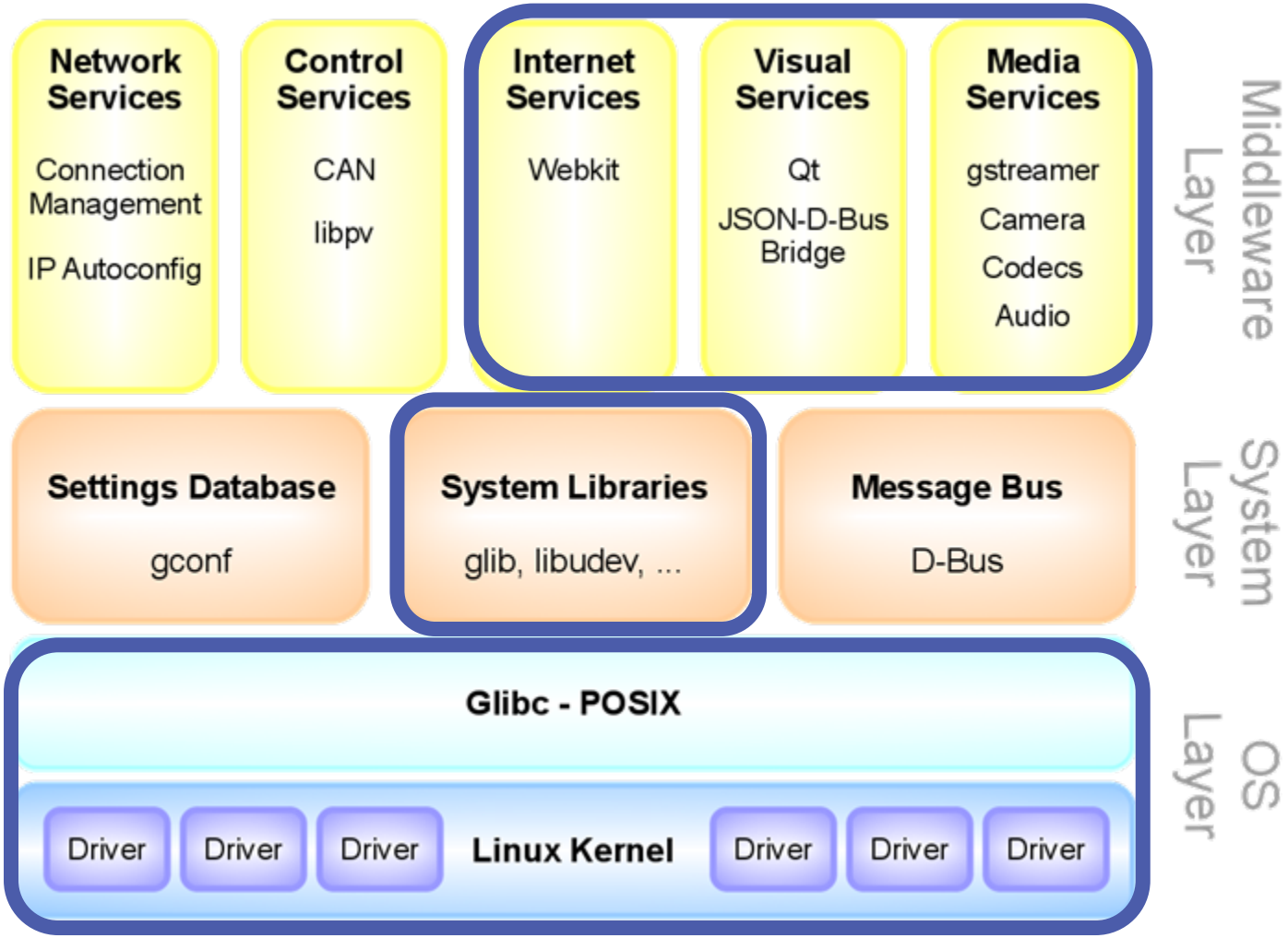
Enhanced Second Screen TV Integration

Social Gaming in home or over social networks

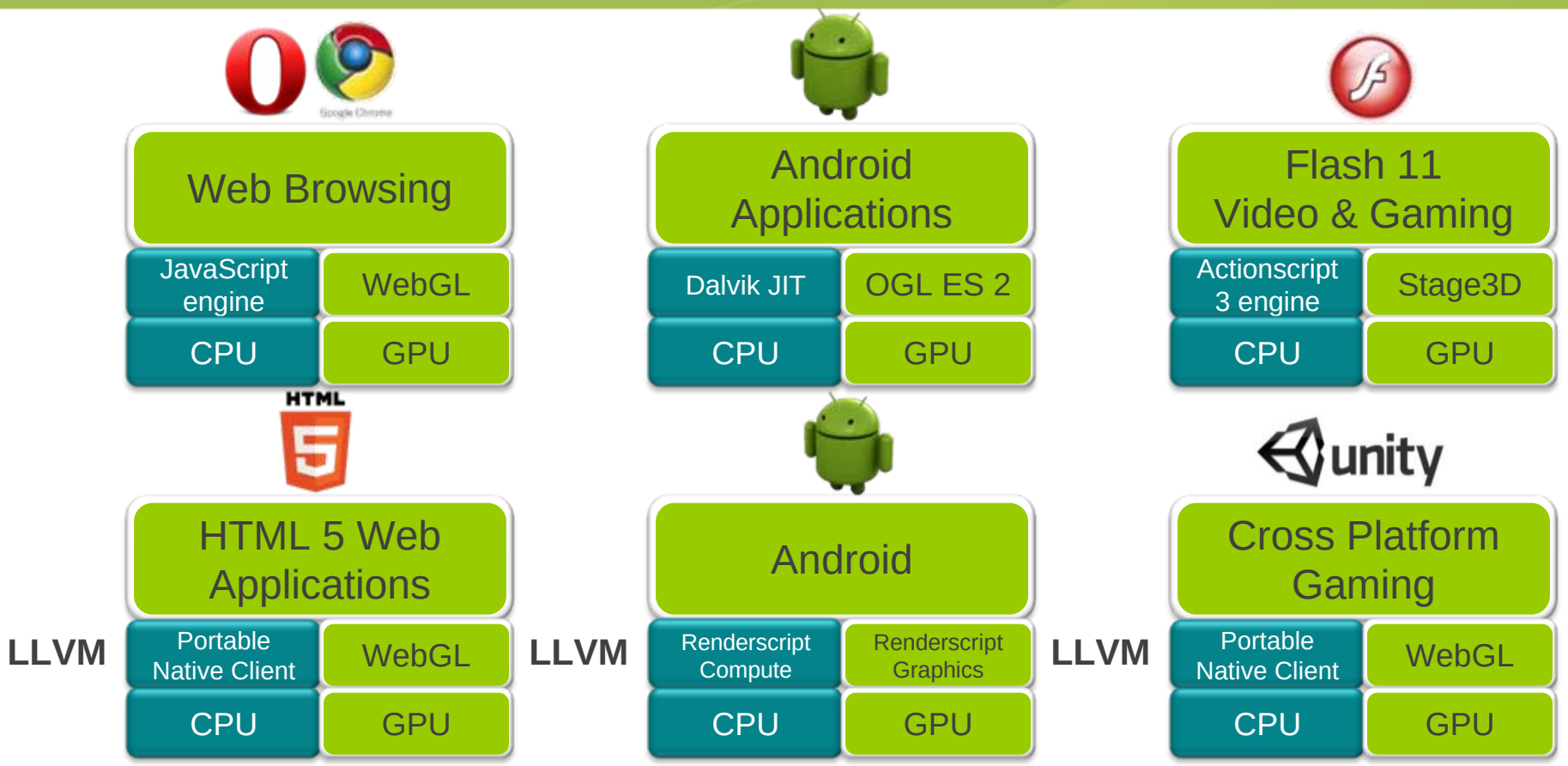
iPPea TV: Smart TV for the Masses

- **Makes any HDMI-enabled DTV a Smart Connected TV**
- **Full Connected HD Entertainment Experience**
  - Access Internet-based movies, music, and photos
- **Brings full Android 4.0 to the TV**
  - Take advantage of the Android ecosystem
- **Extremely low power**
- **<$50**

MIPS focus within a Linux system

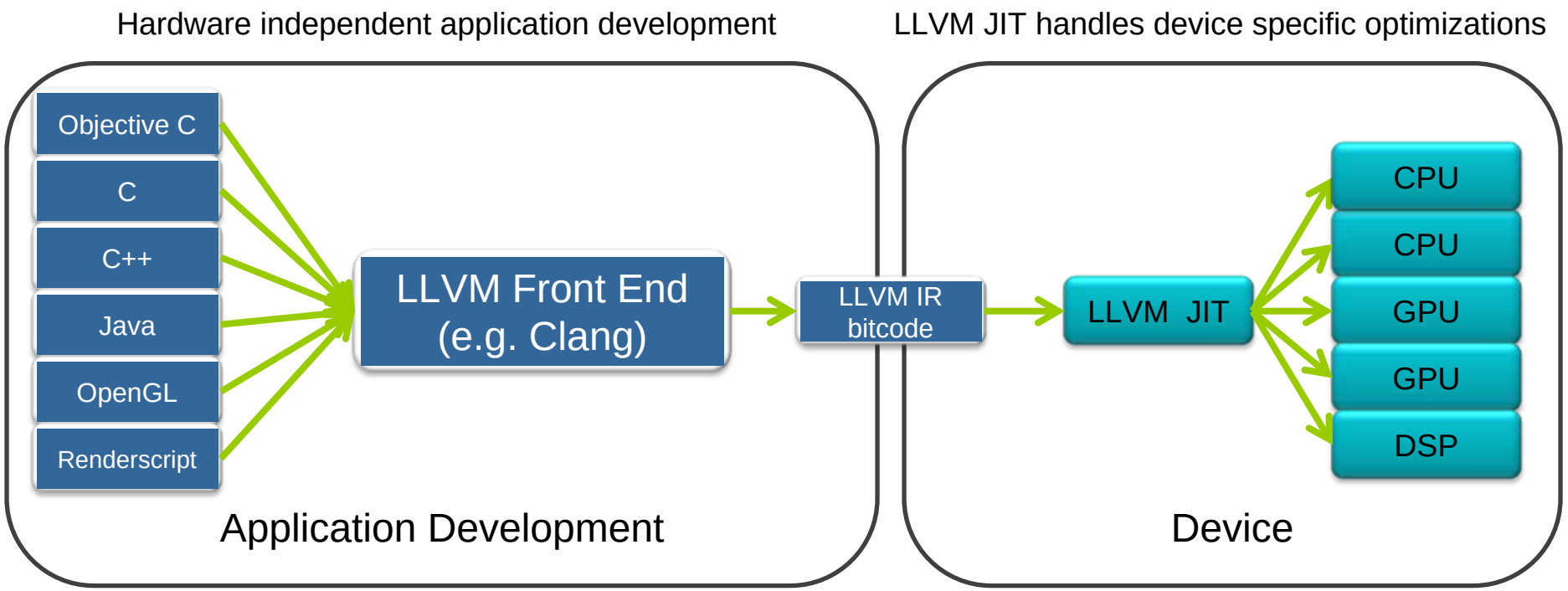


Software Architectures
Cross Platform Compatibility - Native Performance



MIPS processor optimizations available now for web technologies!

The Future of Application Portability - LLVM



MIPS officially supported in LLVM v3.0

ARCHITECTURE AND PRODUCTS

The Heritage of the MIPS Architecture

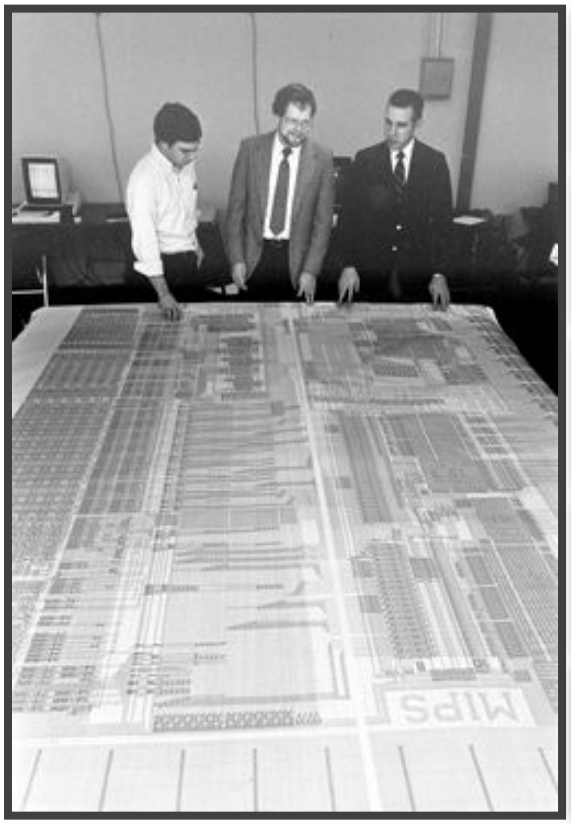
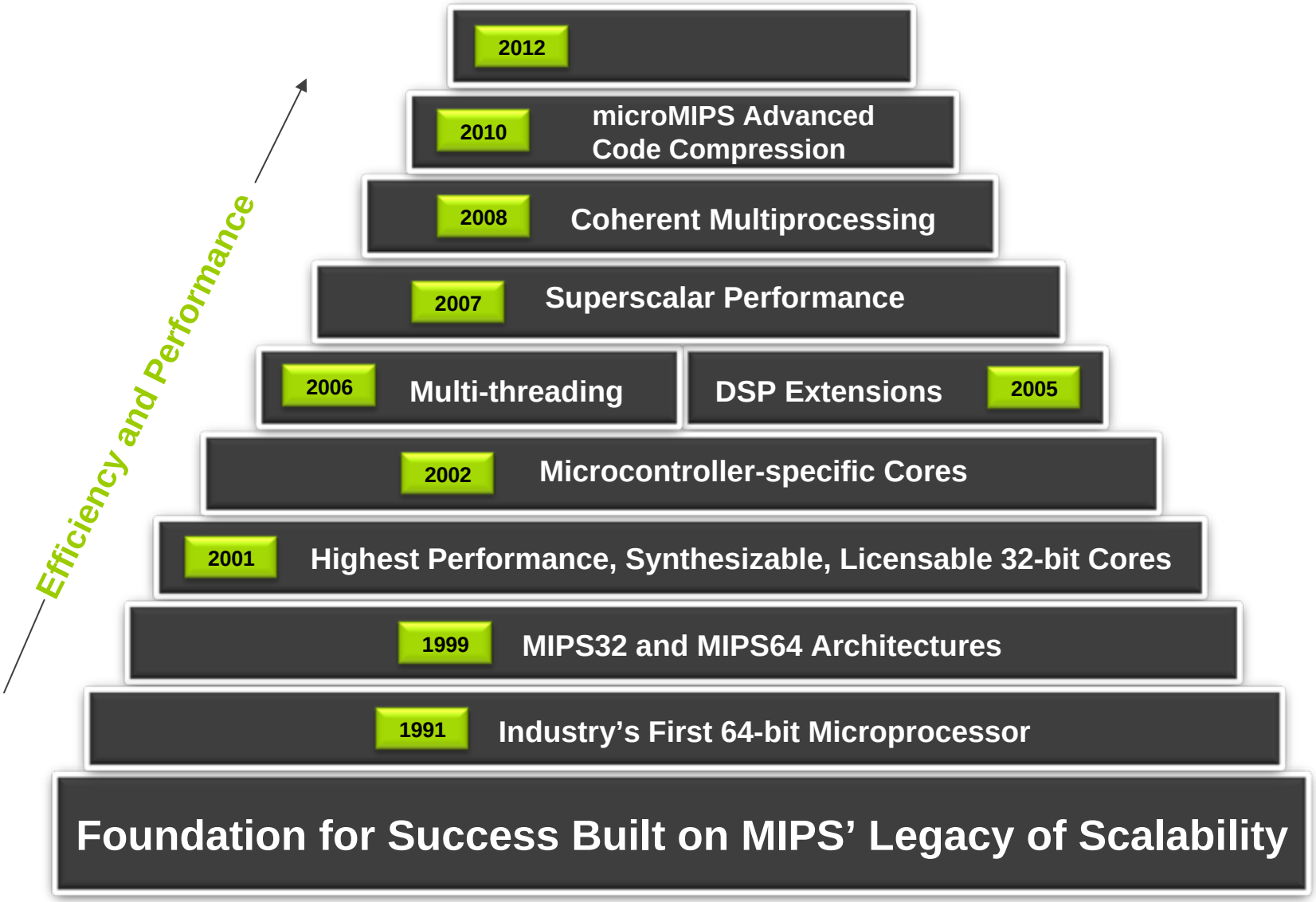


Photo: In 1984, Stanford computer scientists John Shott, John Hennessy and James D. Meindl brainstorm about the MIPS project (Photo: Chuck Painter)

- Pioneered by Stanford President John Hennessy in the 1980s
- Pure, fast, efficient, elegant RISC architecture designed for performance
- Now the architecture of choice for multimedia, home networking & beyond
- Innovation continues by MIPS and architecture licensees—Broadcom, Cavium, Loongson, Ingenic, Renesas, Toshiba, others
- Strong patent position with more than 570 patent properties worldwide

Widely used, widely taught architecture with millions of lines of code written for it

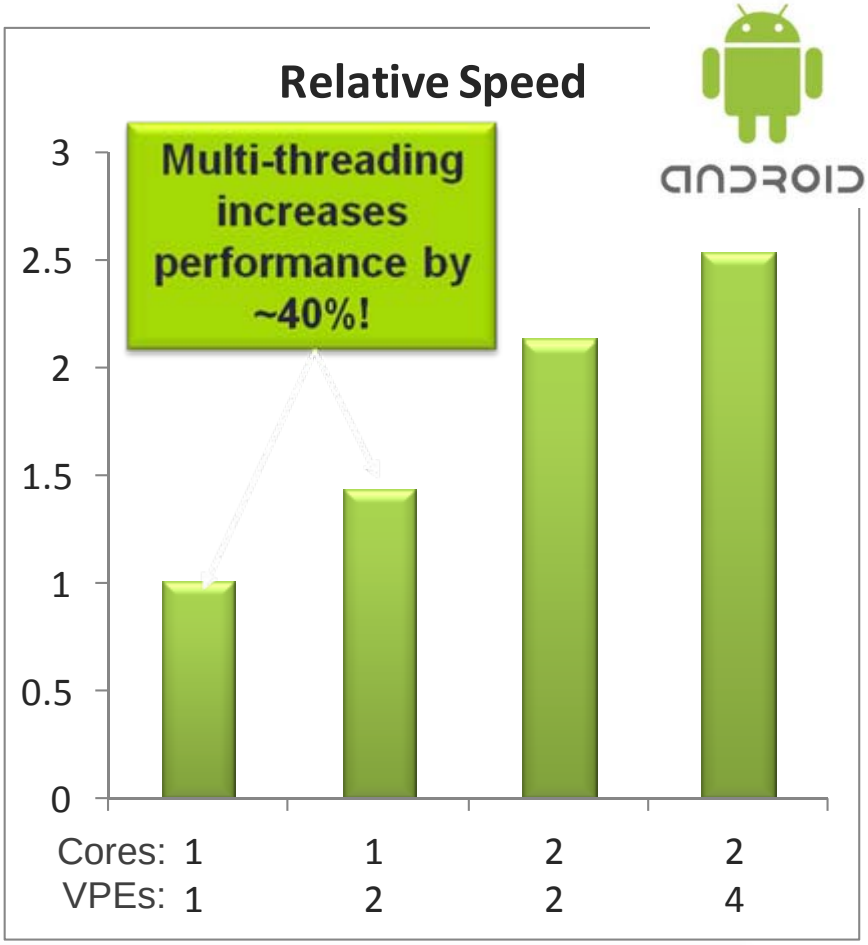
A Systematic Philosophy for Design Success



Industry's Most Scalable Processor Architecture

Benefits of Multi-core and Multi-threading

- **Benefits of Multi-core and Multi-threading shown on Android browser**
  - EEMBC Engineering Subset of BrowsingBench™ workload shown
- **Benefits of more threads**
  - Second core increases performance by **2X**
  - Second thread, or virtual processing element (VPE) increases performance **~40%**
  - For a given performance level, MT generally allows operation at lower frequencies and lower dynamic power
  - MT also saves static power and die cost since it adds less area than a full core



No special instrumentation of software: Simply declared each VPE on the processor as an independent core!!

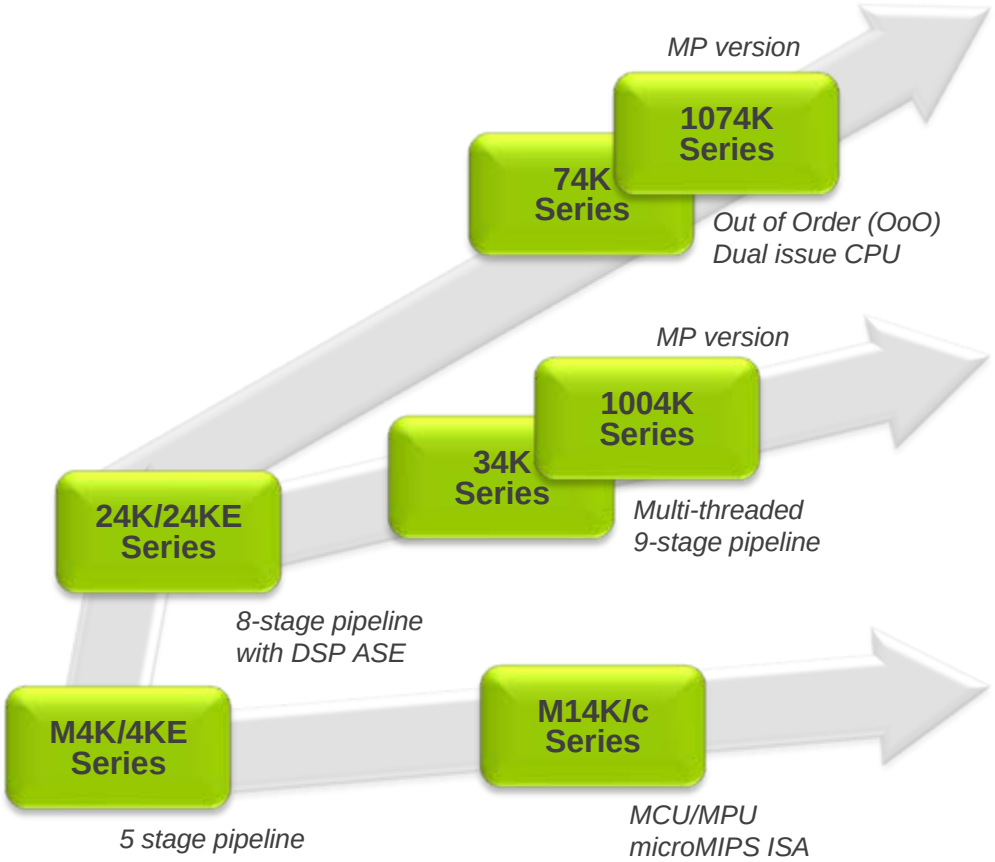
Welcome to the Aptiv™ Generation

Don’t just think it. Do it. Get Aptiv!

MIPS32® Processor Core Portfolio

Classic MIPS Products

Aptiv™ Generation →



proAptiv™ Family

Per Core:
4.5 CoreMark/MHz
3.5 DMIPS/MHZ

Bonded triple-dispatch superscalar Out-of-Order CPU Enhanced Virtual Address (EVA), high-speed FPU, high-performance CM+L2$ 1→6 core versions

interAptiv™ Family

Per Core:
3.2 CoreMark/MHz
1.7 DMIPS/MHZ

Multi-threaded core, ECC, EVA, low power, high-performance CM+L2$, 1→4 core versions

microAptiv™ Family

3.1 CoreMark/MHz
1.57 DMIPS/MHZ

Real-time CPU with DSP and SIMD for microcontrollers and deeply embedded applications

What the Experts had to Say about Aptiv

The Linley Group

MICROPROCESSOR REPORT

www.MPRonline.com

THE INSIDER'S GUIDE TO MICROPROCESSOR HARDWARE

MIPS APTIV CORES HIT THE MARK

New Family Shows Highest CoreMark/MHz for Licensable CPUs

"For now, the MIPS design team seems to have taken the performance lead away from ARM, and it deserves credit for this accomplishment."

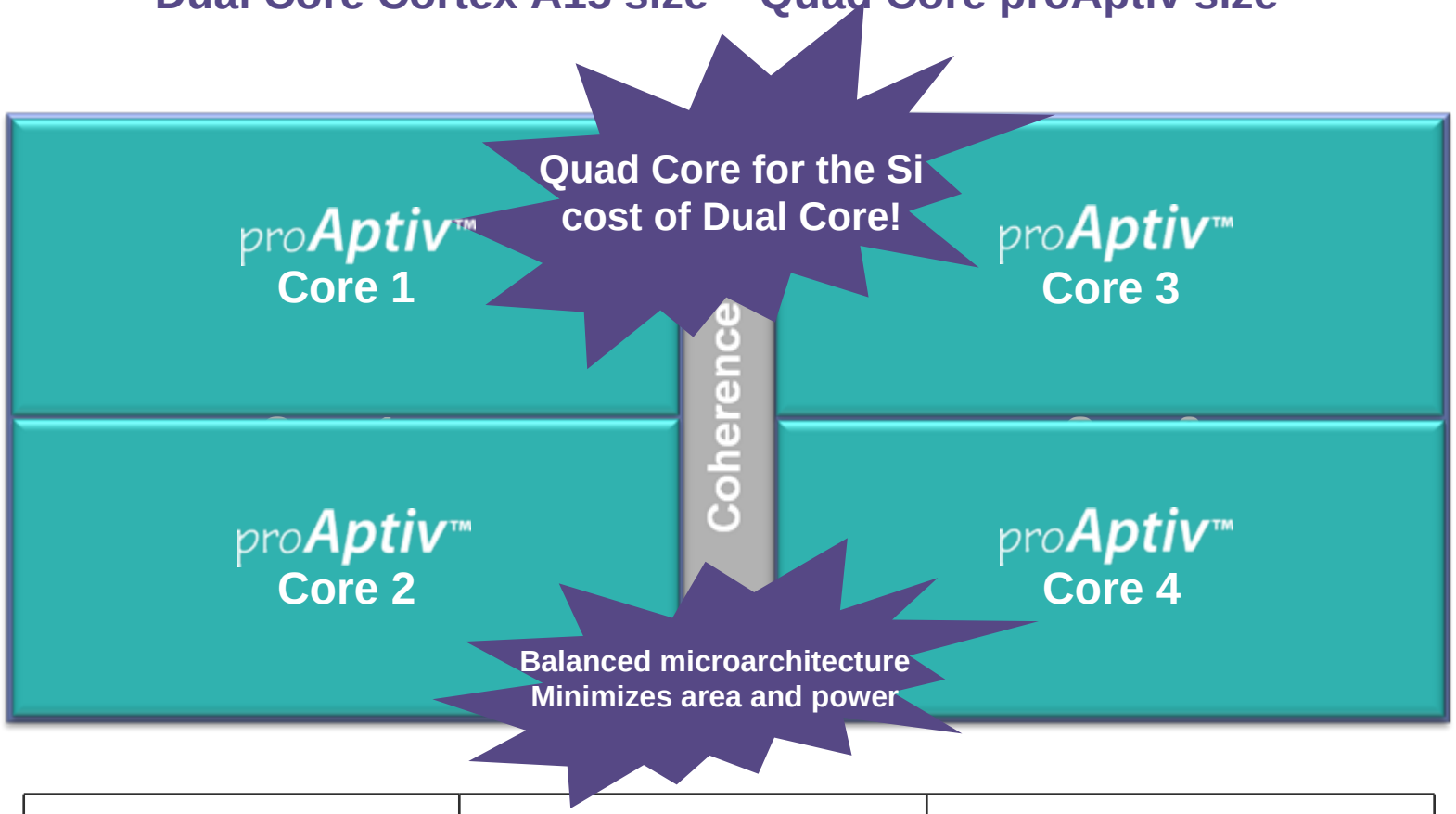
– May 28, 2012

J. Scott Gardner, Senior Analyst at The Linley Group, senior editor for Microprocessor Report

Full article is available for download at:
http://www.mips.com/media/files/aptiv/Aptiv_Cores_Hit_the_Mark.pdf

Competitive Per Core Performance – Half the Size

Dual Core Cortex A15 size ~ Quad Core proAptiv size

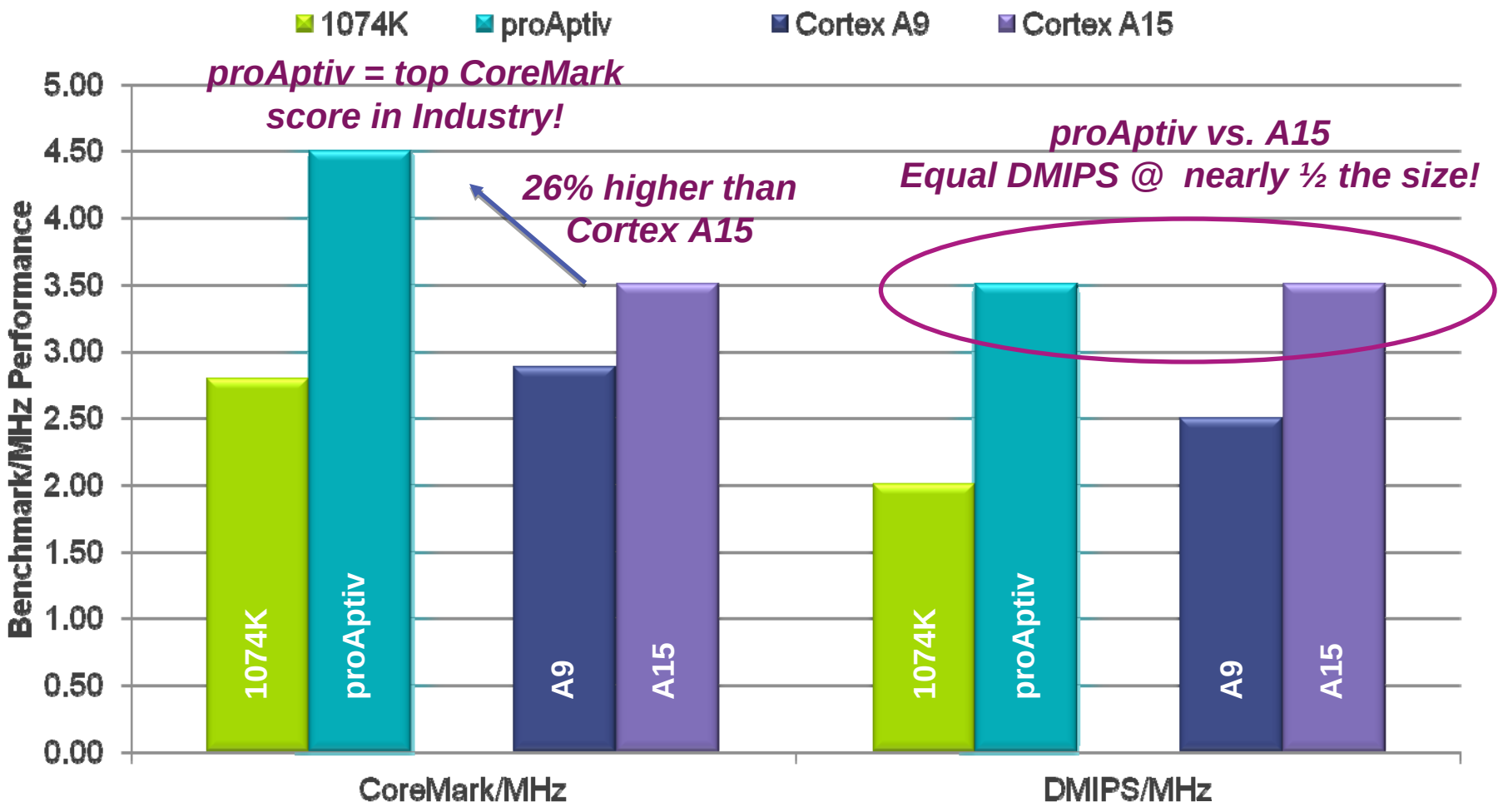


@ 1.0 GHz	proAptiv Quad	Cortex A15 Dual
Total DMIPS	14,000	7,000

No specific process or implementations conditions included in above target frequency, but readily achievable in 40G and 28HPM on both processors, and area assumes common process node

Cortex A15 info – Estimated area, no public info for this core is provided by ARM

proAptiv Delivers High End Performance Efficiently



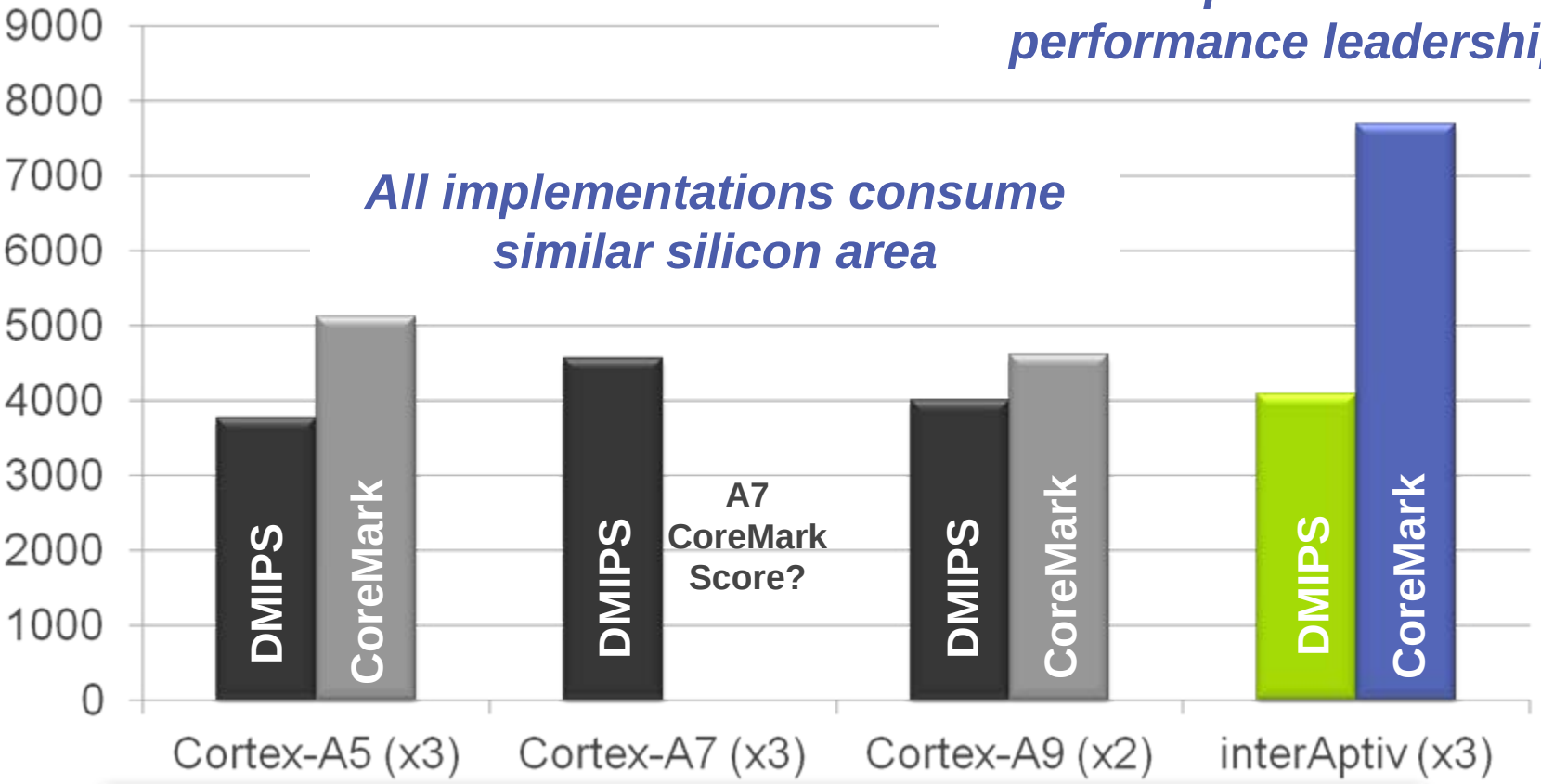
proAptiv -> performance architecture with sophisticated branch prediction

- proAptiv results: prelim/target PPA specs + measured benchmarks on FPGA bitfile of pre-GA RTL
- Cortex A15 CoreMark results as estimated by Microprocessor Report

interAptiv CoreMark Advantage

@ 800 MHz

interAptiv CoreMark performance leadership!

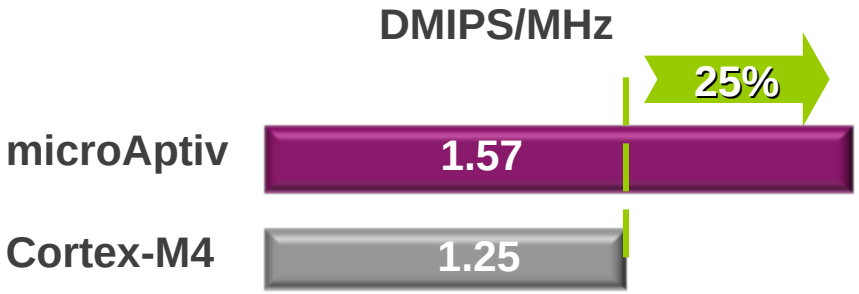


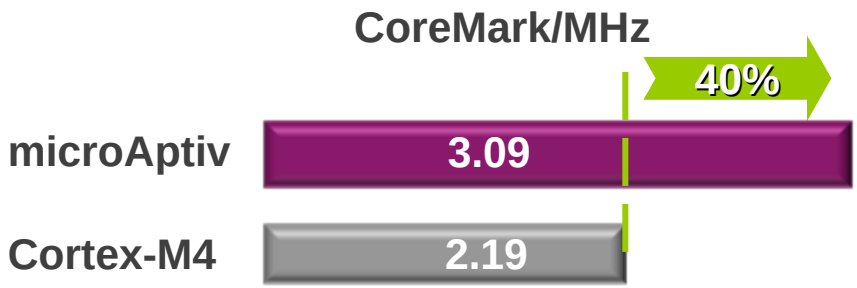
interAptiv exceeds same-class Cortex devices on a CoreMark/MHz per core and CoreMark/mm2 basis

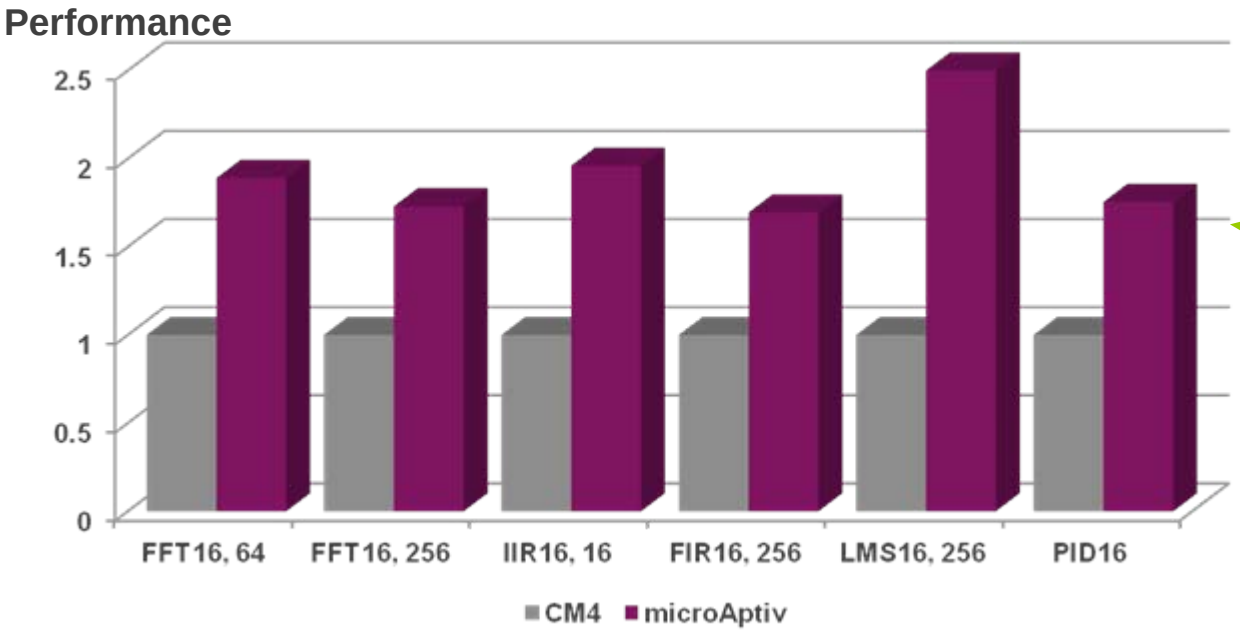
1. ARM = 12T power opt, MIPS = 12T area opt to 800 MHz freq, worst case SS corner with production margins
   Product configs include cores with FPU, 32KB Inst/Data L1$s, coherence fabric, IO coherence, L2$ (no L2 RAM) and debug logic

Source: MIPS and ARM public data; A9 area estimated from published 4.6mm2 data and floorplan, with Neon area removed

microAptiv vs. Cortex-M4 Performance





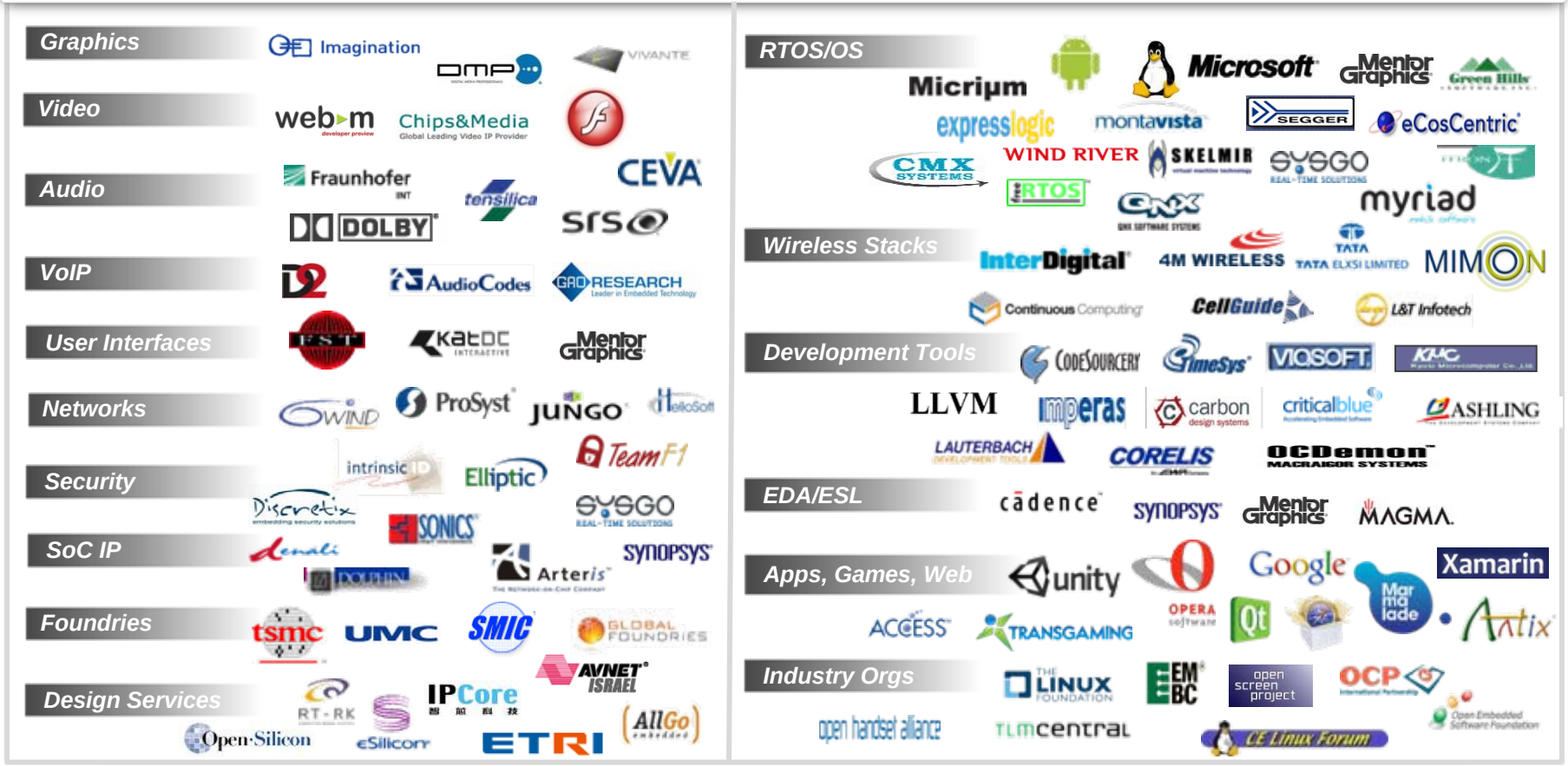


Up to 2.5x higher performance

Comparing DSP performance (higher is better)
microAptiv DSP Library, Cortex M4 CMSIS Library

Strategic Ecosystem in Place

Complementary IP and Enabling Technologies



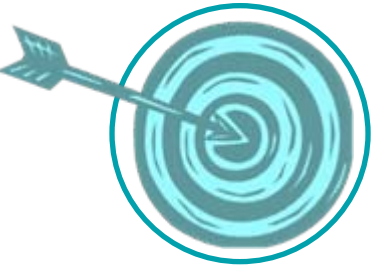
Support for MIPS built over 20+ years

Aptiv Cores Span a Broad Application Range

	Mobile	Home Entertainment	Networking	Embedded
proAptiv™	• High-end smartphone & tablet apps processor	• High-end DTV/STB/BD processor	• Res. Gateway • 802.11ac • 3G/4G cellular infrastructure	• Automotive infotainment
interAptiv™	• Low-to mid-range apps processor • LTE baseband controller	• Mainstream DTV/STB/BD processor • Digital camera	• Broadband CPE • Femtocell • Smart gateway • NAS	• Auto collision avoidance • Auto powertrain • SATA/RAID/SSD
microAptiv™	• Touchscreen • SIM/security • GPS	• Conditional access • WHDMI	• VoIP • MOCA • WLAN	• MCU • Industrial • Smart meters • Automotive body/chassis

Why MIPS? Why Now?

Corporate

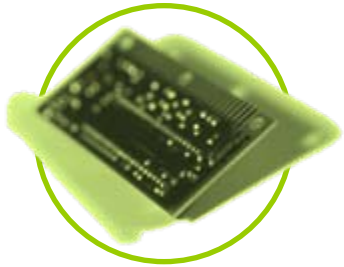


- >3 billion unit installed base since 2000; 708 million units in FY12
- Debt-free; over $110 million cash in bank as of 6/30/12
- Strong patent position with more than 570 patent properties worldwide

Markets

- Strong in networking and home entertainment; leading share in DTV, set-top boxes, broadband CPE, WLAN access points/routers
- Aggressively expanding into mobile: millions of smartphones and tablets shipped to-date

Technology



- More scalable and efficient architecture than the competition: low power consumption and low cost with right-sized performance
- 20+ years' experience in 64-bits—broad ecosystem of support
- Multi-threading provides unique benefits for numerous applications

Thank You

At the core of the user experience®