

Application diversity demands accelerated Linux



Embedded Linux Conference 2013

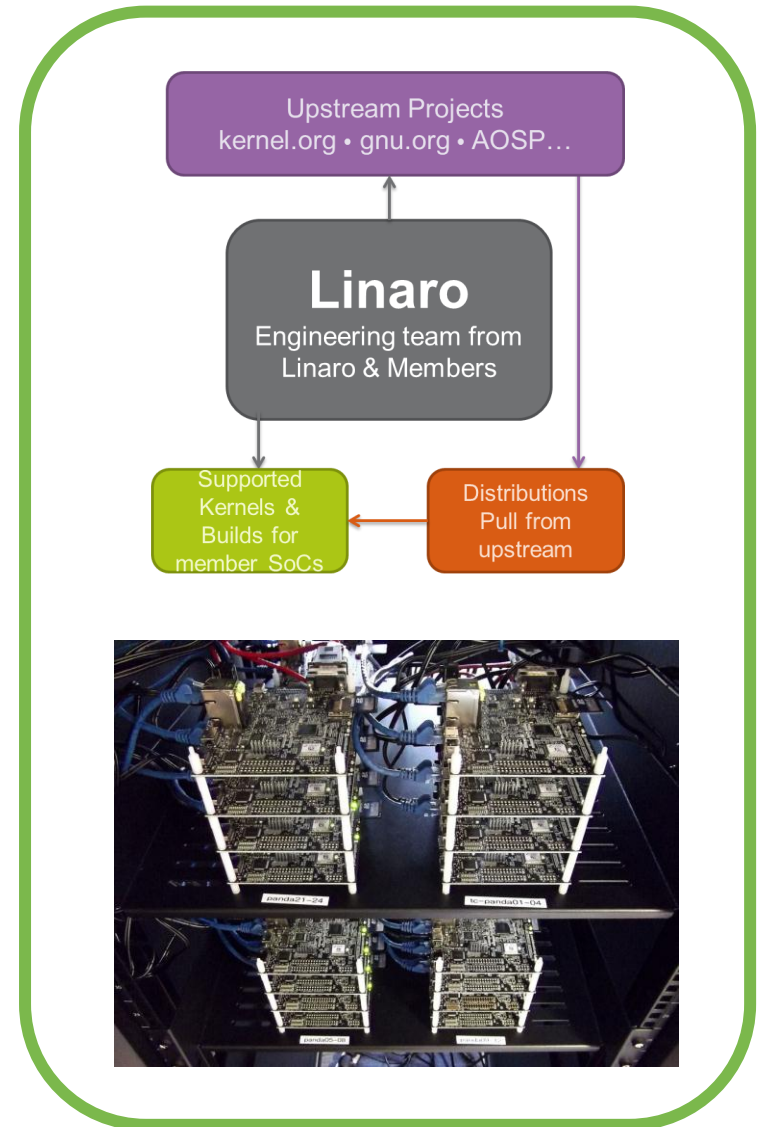
Mark Orvek - Director, Linaro Working Groups



Group photograph at Linaro Connect in Copenhagen
Monday 29 Oct 2012

Linaro – Working Together

- Linaro founded in 2010 by a group of ARM SoC vendors to consolidate and optimize open source software for the ARM architecture
- Increase collaboration; reduce duplication, fragmentation and costs
 - Shared software engineering for common Linux software for ARM
 - Kernel, toolchain, middleware, testing & validation
 - Embedded, Mobile, Server and Network Equipment segments
 - Works in the open, delivers upstream and in monthly developer releases



Linaro – Working Together in Groups

- Enterprise Group (LEG)
 - Members deliver optimized open-source software for ARM servers
- Groups for specific market segments
- Shared investment in open software engineering team



Linux is Key To Industry Growth Areas

- Majority of key ARM growth areas are opportunities for Linux
 - Mobile, home and enterprise (networking)

Markets for ARM in 2017

	Devices Shipped (Million of Units)	2017 Devices	Device CAGR	Chips/ Device	2017 Chips	Chip CAGR	Key Growth Areas for ARM
Mobile	Smart Phone	1,700	20%	3-5	6,800	20%	←
	Feature Phone	-	-	-	-	-	
	Low End Voice	710	-1%	1-2	1,400	15%	
	Portable Media Players	90	-10%	1-3	180	-5%	
	Mobile Computing* (apps only)	850	20%	1	850	20%	←
Home	Digital Camera	130	-5%	1-2	200	-5%	
	Digital TV & Set-top-box	600	10%	1-4	2,000	25%	←
Enterprise	Desktop PCs & Servers (apps)	200	Flat	1	200	Flat	
	Networking	1,500	5%	1-2	1,700	5%	←
	Printers	130	2%	1-3	130	2%	
	Hard Disk & Solid State Drives	1,100	10%	1	1,100	10%	
Embedded	Automotive	3,800	10%	1	3,800	10%	
	Smart Card	8,500	10%	1	8,500	10%	
	Microcontrollers	11,400	5%	1	11,400	5%	←
	Others **	3,000	10%	1-2	3,000	10%	
Total		34,000	5%		41,000	10%	

* Including tablets, netbooks and laptops ** Includes other applications not listed such as headsets, DVD, game consoles, etc

Source: Gartner, IDC, SIA, and ARM estimates

Source:
ARM earnings
announcement
5 Feb 2013

Challenges – Linux and ARM

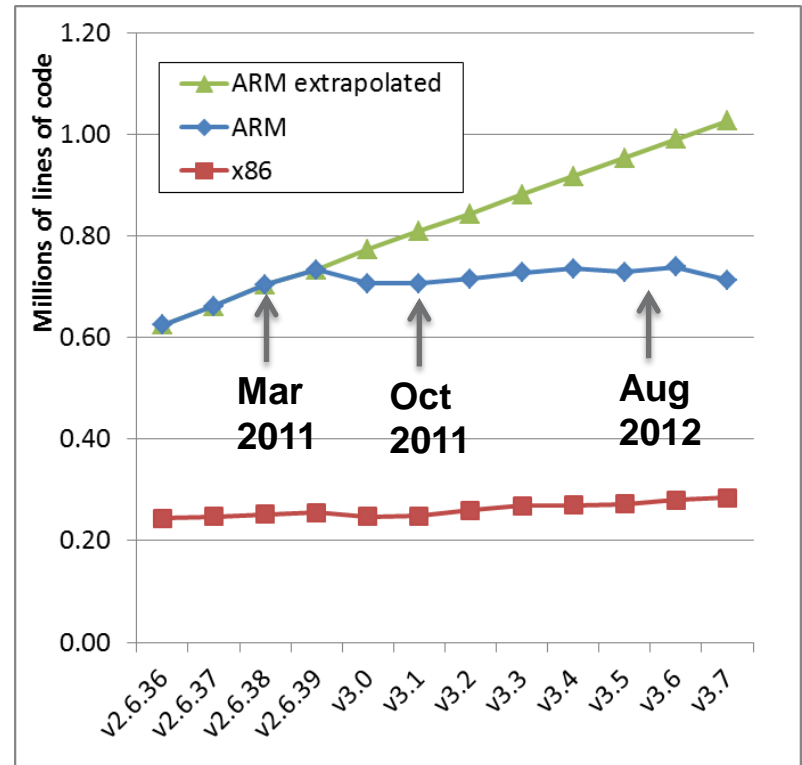
- Consolidation
 - Reduce / eliminate code duplicated across SoC implementations
 - Single memory management scheme – UMM (dmabuf, CMA)
 - Single zimage on multiple server and mobile platforms
 - Prevent future fragmentation
- Working in upstream
 - Increase in new developers without community experience
 - Patches need to be reviewed and refactored – rinse and repeat
 - Tendency to create internal implementation then refactor for upstream
 - Wastes time and increases effort

Challenges: ARM Encourages Differentiation

Linus Torvalds

- “Gaah. Guys, this whole ARM thing is a f*cking pain in the ass.”
Mar 2011, <http://lwn.net/Articles/437170/>
- “ARM Linux is getting better, and the ARM community seems to be making progress.”
Oct 2011, <http://lwn.net/Articles/463908/>
- “Over the last year, ARM has gone from a constant headache every merge window to an outstanding citizen in the Linux community,…”
Aug 2012, <http://www.zdnet.com/torvalds-touts-linuxs-advances-in-power-arm-and-cell-phones-7000003509/>

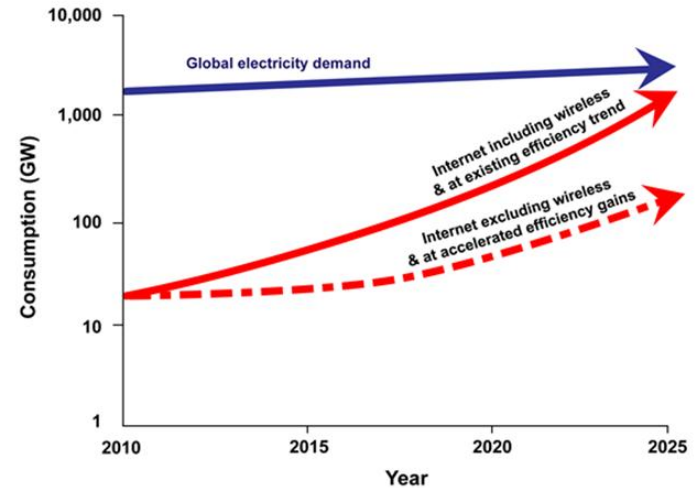
Lines of code in the Linux kernel



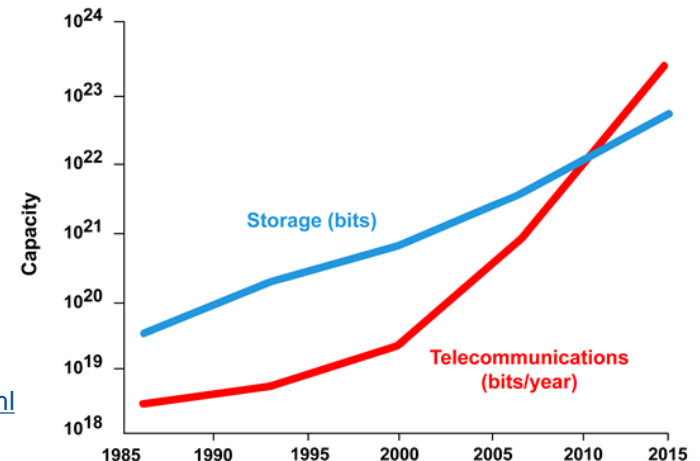
arch/arm in kernel: 250k lines less than the past trend

Challenges – Power Management

- Power Management
 - Billions of embedded and mobile devices
 - ARM partners shipped 8.7 Billion chips in 2012^[1]
 - Smartphone and tablets generating a mobile data explosion
 - Mobile data to hit 134 Exabytes by 2017 ^[2]
 - The Cloud requires massive data centers
 - Power consumption is no longer just about mobile devices
 - 3 million data centers, 2.2% of US power consumption^[3]
 - Doubling of big data growth by 2014 ^[4]



<http://www.marshall.org/article.php?id=1133>



[1] Source: ARM

[2] <http://www.datamation.com/mobile-wireless/mobile-data-set-to-hit-134-exabytes-by-2017.html>

[3] Source: Fortune

[4] <http://www.clouDEXPOEUROPE.com/news/idc-reports-doubling-big-data-growth>

Challenges – Power Management

- SoC Innovation

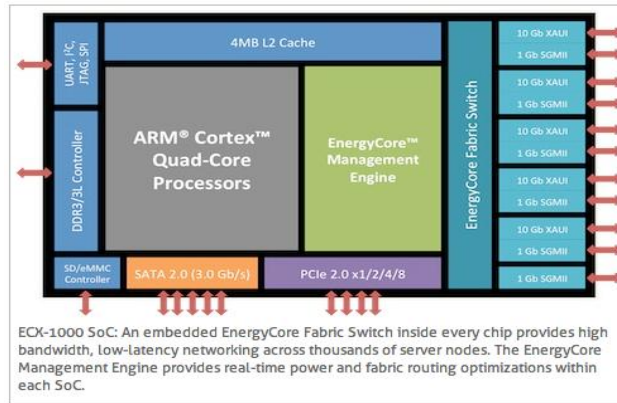
ARM's DNA is in low power design

- big.LITTLE

- HMP (Heterogeneous Multiprocessing) - clusters of low power and high performance cores on a single chip to accomplish both high intensity and low intensity tasks in the most energy efficient manner

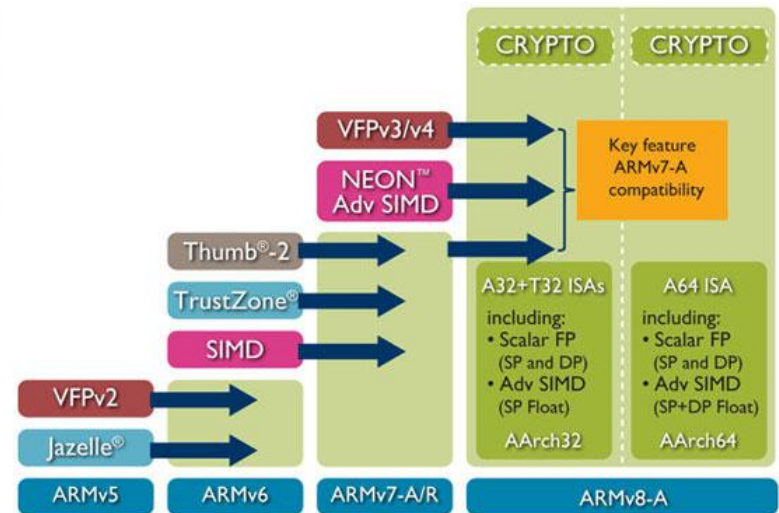
- SoCs become "Server on Chips"

- Smaller footprint, lower power, lower cost, high reliability



- ARMv8

- ARM 64-bit architecture designed for high performance and power efficiency while maintaining compatibility with existing 32-bit software



Challenges – Networking Infrastructure

- Explosive growth in mobile data
- Adapting to dynamic workloads
- Product cycle time is 2-3+ years, how to keep pace with technology innovation?
 - Legacy code – Big Endian data
 - Long validation/certification cycles
 - Need for higher performance and lower power consumption with existing software applications
- Different software environments to meet the requirements of control and data plane

Challenges – Organizing Groups

- Collaborative software engineering among companies which naturally compete
- Identifying the boundaries between common (commodity) and differentiating software
 - Competing companies need room to differentiate
- Defining common requirements, goals and objectives
- Building Teams
- Agreeing on need to work upstream

Technology Roadmap – Power Management

- big.LITTLE MP vs. In-Kernel Switcher (IKS)
 - MP^[1] = all cores can be scheduled and used at the same time
 - Touches many subsystems in the kernel
 - Will require much discussion and testing to achieve final upstream implementation
 - Commercial products in 2H'2013 or early 2014
 - IKS^[2,3] = manage pairs of cores between A7 and A15 clusters to balance performance versus power consumption
 - Migrating execution states between the two clusters.
 - Less complex than MP while still providing excellent power-performance results
 - Commercial products in 1H'2013
- Less about the processor architecture, more about kernel re-factoring

[1] <https://wiki.linaro.org/projects/big.LITTLE.MP>

[2] <http://www.linaro.org/documents/download/d364018e38b473315767d5479039751a50925b90d6cc6>

[3] In Kernel Switcher: A Solution to Support ARM's New big.LITTLE Implementation - Mathieu Poirier, Linaro – Friday, Feb 22nd @ 9:00AM PT

Technology Roadmap - Server

- Common UEFI & ACPI development for ARM
- Virtualization including KVM
- ARM single kernel zImage
- ARM architecture optimization for key server workloads
 - LAMP
 - Hadoop
 - HipHop
 - OpenStack
- AArch64 ARM 64 bit architecture software development
- Test & Validation using OE, Ubuntu and Fedora/Red Hat

Technology Roadmap - Virtualization

- KVM running on ARMv7a^[1]
 - Tested on ARM Fast Models and Versatile Express TC2
 - Fully boots both Ubuntu (user space Thumb-2) and Debian (user space ARM) guests



<http://systems.cs.columbia.edu/projects/kvm-arm/>

- Linaro Mini-Summit Feb 2013^[2]
 - <https://wiki.linaro.org/LEG/Engineering/Virtualization/201302MiniSummit>
 - Initial focus areas:
 - Continuous integration and validation for ARMv7 / ARMv8 (models)
 - Booting in HYP-mode^[3,4]
 - QEMU model for ARMv8
 - Ensure libvirt works properly with KVM on ARMv7 / ARMv8 (models)
 - Support for VM migration
- Sessions at Linaro Connect Asia (LCA13 Hong Kong)
 - KVM for Core and LEG
 - KVM Status and Plans
 - Information and registration at: <http://www.linaro.org/connect>

[1] <http://lwn.net/Articles/516652/>

[2] <http://www.linaro.org/linaro-blog/2013/02/08/linaro-takes-an-active-role-in-virtualization-on-arm/>

[3] <http://www.linuxplumbersconf.org/2012/wp-content/uploads/2012/09/2012-lpc-arm-zyngier.pdf>

[4] <http://lwn.net/Articles/516652/>

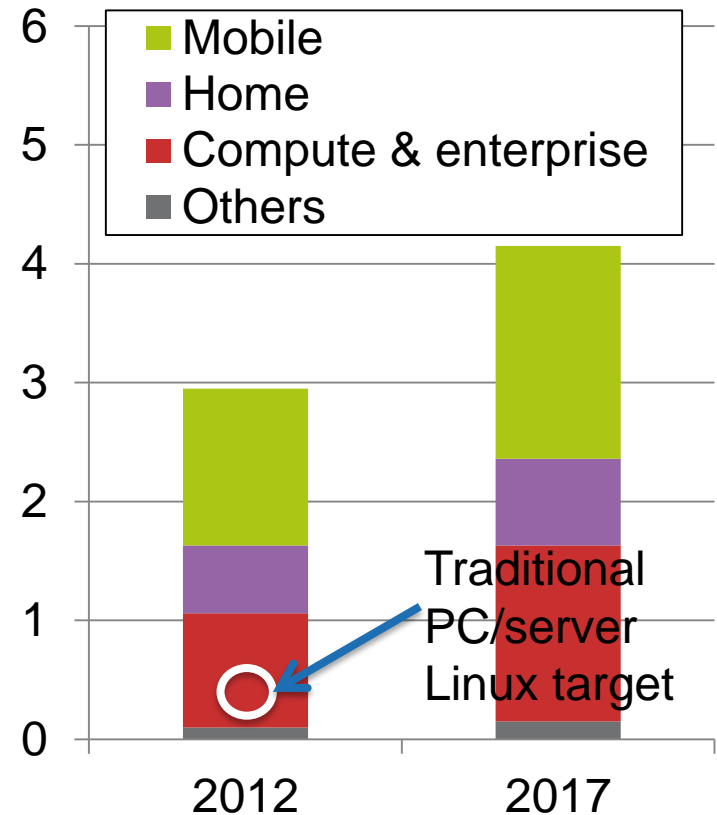
Technology Roadmap – Real Time

- Although real-time has been available since Linux 2.4, it is a new technology for Linaro
- Define requirements
 - Who needs it and why?
 - Soft vs. hard deadlines (“uncertainty about determinism”)
 - Single or segregated environments
 - Virtual or physical platforms
- Understand current status
 - PREEMPT_RT
 - https://rt.wiki.kernel.org/index.php/Main_Page
 - Is not yet, and may never be, fully integrated into the mainline kernel tree
 - ARM Platform support variable
 - Interactions with virtualization
- Review existing research
 - Example, <http://www.linux-kvm.org/wiki/images/0/03/KVM-Forum-2011-RT-KVM.pdf>
- Create a plan and execute

Summary

- Challenges create opportunities
 - ARM innovation and diversity
 - Growth in data; more data centers
 - Higher performance and lower power consumption
 - Linux everywhere in everything
- Differentiation is necessary and shifts over time
- Work together to solve common problems
- Solve common problems in the open

Potential TAM For Linux across all architectures and segments (billion units)



Source: Estimated from ARM Feb 2013 analyst presentation

Find out more about Linaro

- Linaro membership
 - www.linaro.org/members
- Linaro Enterprise Group
 - www.linaro.org/engineering/leg
- Linaro Software
 - www.linaro.org/downloads
- ARMv8 64 bit
 - www.linaro.org/engineering/armv8

Questions?

Thank you!