Linaro, servers and networking

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Linaro
Connect,
Hong Kong
March 2013

ARM Business Model

- Develops IP; Licenses vendors to build ARM SoCs

- ARM vendors delivered 8.7 billion ARM SoCs in 2012
- Many Cortex-A series licensees
  - 32- and 64-bit multi-core designs
- Model drives rapid innovation from both large companies and startups
- ARM's DNA is in low power design
- Value creation through differentiation & innovation

- Many vendors + many markets + many chips
  = massive ecosystem

Linux on ARM (Before Linaro)

- One (or multiple) Linux implementation(s) per vendor, each with own kernel, memory management, drivers, middleware, and non-value adding differences

  - Clock drivers
  - I^2C drivers
  - PinMux drivers
  - Power Management
  - Kernel Memory Management
  - Graphics & Multimedia framework
  - ...more non-value adding differentiation

  ARM SoC Software – "A Waddle of Penguins?"

- Fragmentation of core software = multiple patch sets + little upstreaming + high maintenance costs + wasted resources + delays to products

Linaro 2010-2013

- Linaro is a not for profit engineering company
- Formed in 2010 as an OSS engineering organization

- Provide a safe collaborative environment where competitors can jointly develop common open source software

- Shared investment to provide high ROI to members
- Reduce Linux fragmentation
- Work closely with ARM

Challenges: ARM Encourages Differentiation
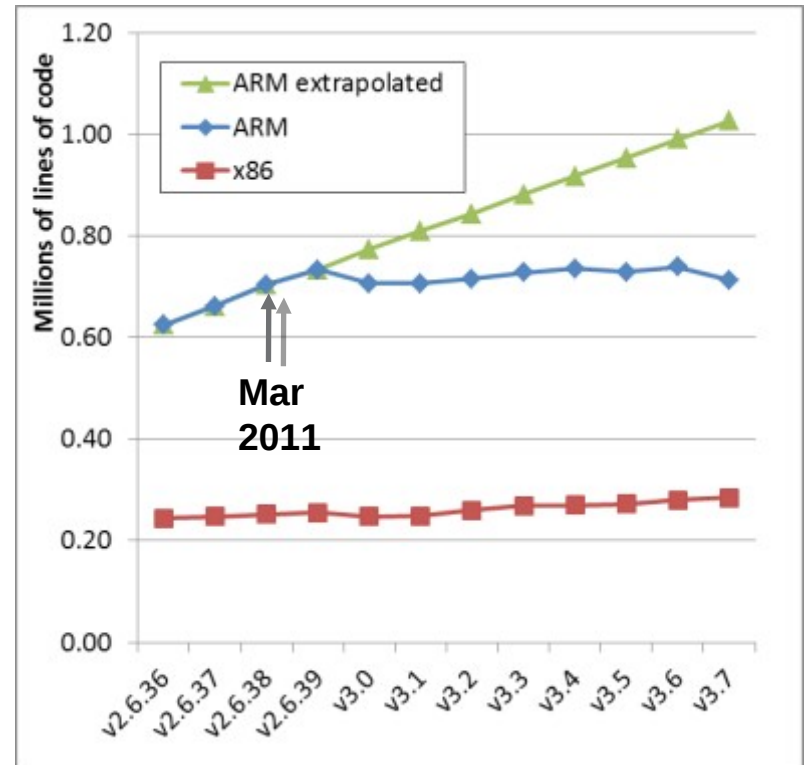
- ## Linus Torvalds

  - "Gaah. Guys, this whole ARM thing is a f*cking pain in the ass."
    Mar 2011
    http://lwn.net/Articles/437170/

Lines of code in the Linux kernel

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

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Challenges: ARM Encourages Differentiation

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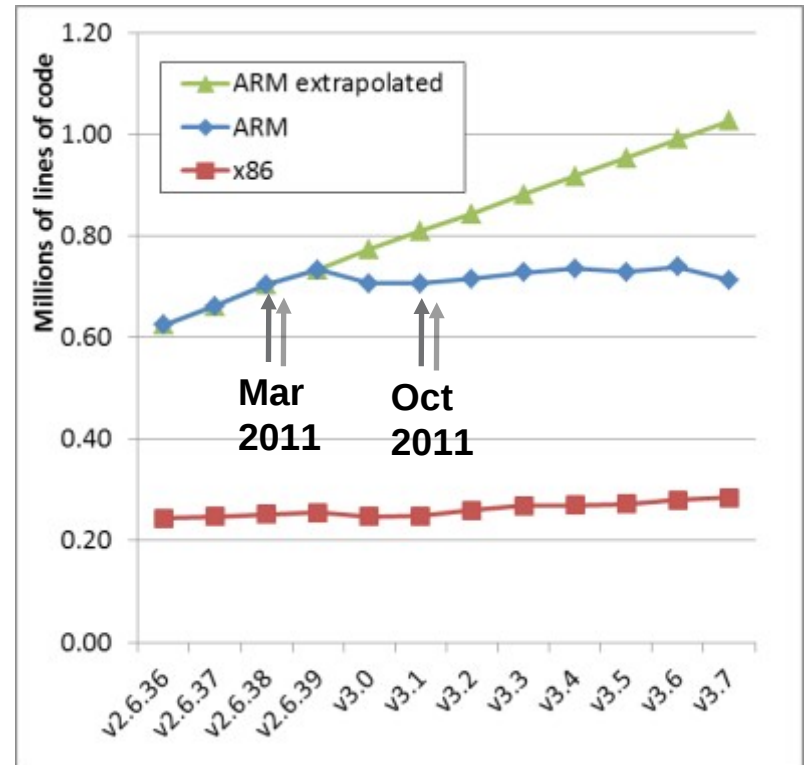   Mar 2011
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  - "ARM Linux is getting better, and the ARM community seems to be making progress."
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  - "Over the last year, ARM has gone from a constant headache every merge window to an outstanding 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
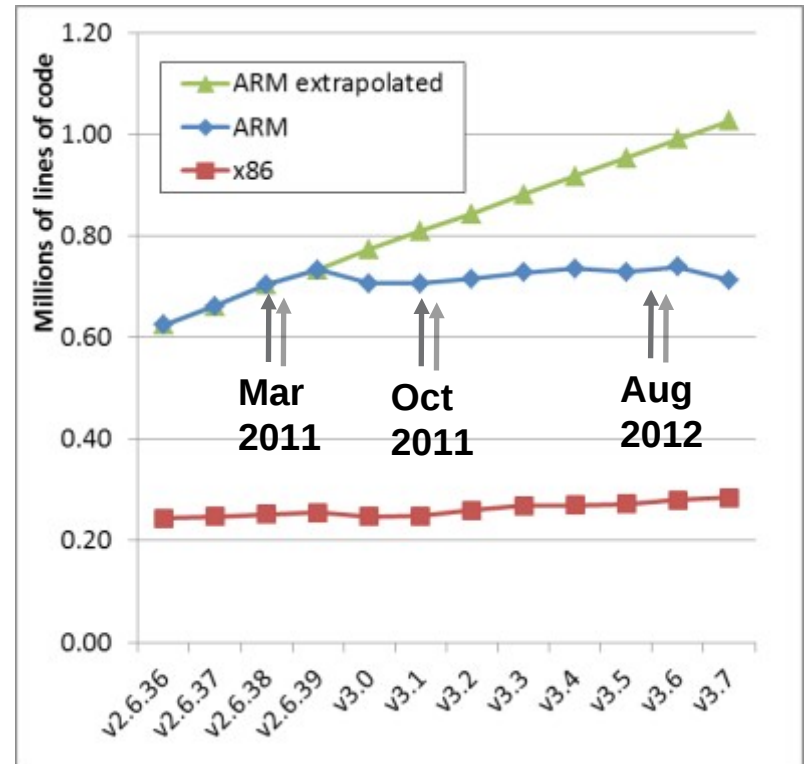
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Linaro Members

CORE

ARM · HISILICON · TEXAS INSTRUMENTS

CLUB

FUJITSU · SAMSUNG · BROADCOM · LG Electronics · ST ERICSSON

GROUP

AMD · applied micro · CALXEDA · CAVIUM
CANONICAL · CITRIX · ENEA · facebook
freescale semiconductor · hp · LSI · MARVELL · montavista
Nokia Siemens Networks · redhat · ST · +1 not yet public

COMMUNITY

IBM

What does Linaro do?

- Linux kernel and architecture specific software
- Focus on consolidation & optimization
  - Latest ARM SoCs, Cortex-A series
- ARM GCC toolchain: best in class
- New ARM technology: big.LITTLE, 64-bit
- Delivers upstream
- LAVA – test & validation
  - Continuous Integration framework for distributions/build systems
- Build & test on member SoCs
  - OE/Yocto, Linux, Android & Ubuntu

Upstream Projects
kernel.org • gnu.org • AOSP…

Linaro
Engineering team from Linaro & members

Supported kernels & builds for member SoCs

Distributions pull from upstream
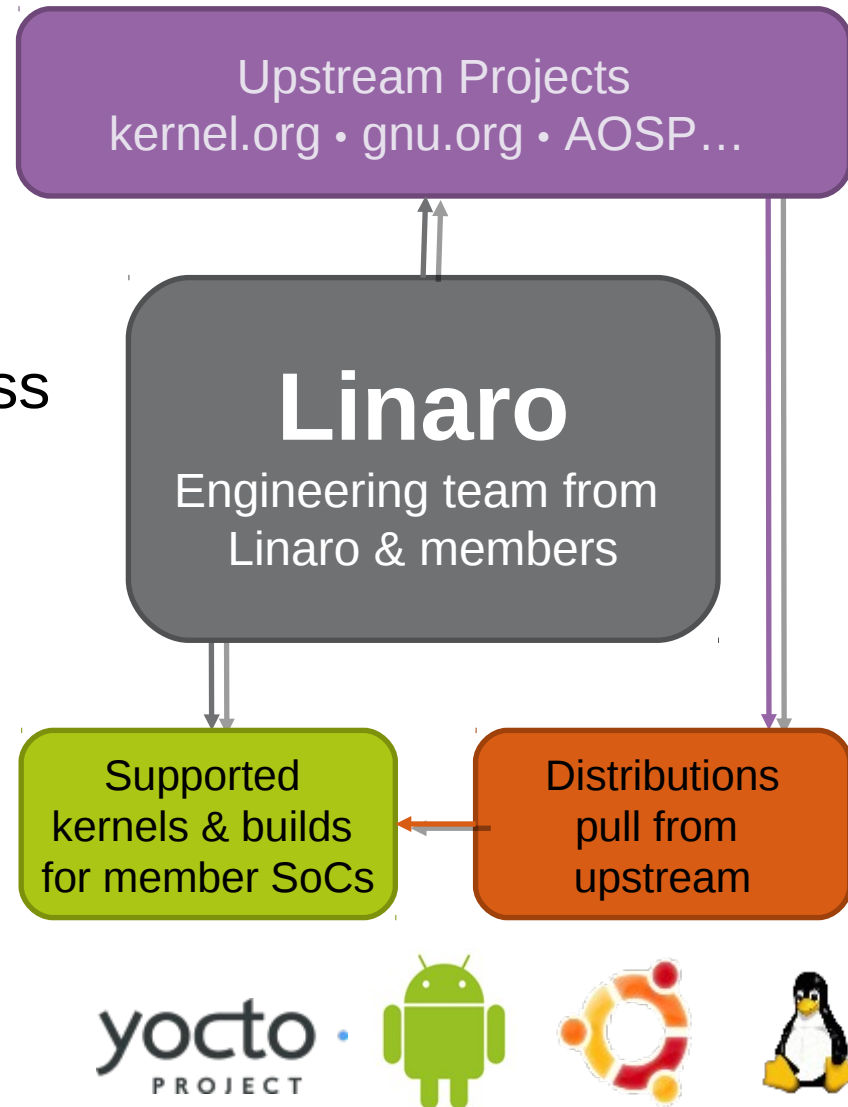
Distributions

- Linaro is <u>not</u> a distribution

- Linaro uses distributions to test its engineering

- Linaro encourages distributions to make use of its engineering

Linaro Organisation

Technical Steering Committee (TSC)

Office of the CTO (OCTO)

Working Groups	Platform Engineering	Landing Teams working under NDA
Kernel Consolidation	LAVA Validation & Benchmarking	ARM
Toolchain		BROADCOM.
Graphics	Engineering Builds OE/Yocto, Android, Fedora, Ubuntu	FUJITSU
Power Management		HISILICON
Segment Groups		SAMSUNG
LEG (16 companies)	Infrastructure Continuous Integration for Linaro output	ST ERICSSON
LNG (12 companies)		TEXAS INSTRUMENTS
Optimization, consolidation & innovation	Validation, benchmarking, release management	SoC support and optimization

Linaro: Proven Success in Linux

- #5 contributor to Linux Kernel 3.9

- ARM GCC toolchain for v7 and v8

- Facilitated arm-soc sub-architecture maintainers group

- Single zImage and Device Tree for ARM

- Common kernel memory management framework (UMM)

- Big.LITTLE IKS

Linaro Open Source Testing & Validation

- Open Source Software traditionally has limited testing
- LAVA – Linaro Automated Validation Architecture
- Lab is populated by Linaro member hardware
  - Continuous Integration for daily build & testing
  - Smoke, System and Regression testing
  - Web dashboard for results and trends
  - Measurable distribution quality & trends
  - Open source framework
  - Large and expanding farm of latest Member SoC boards, servers, models and consumer devices
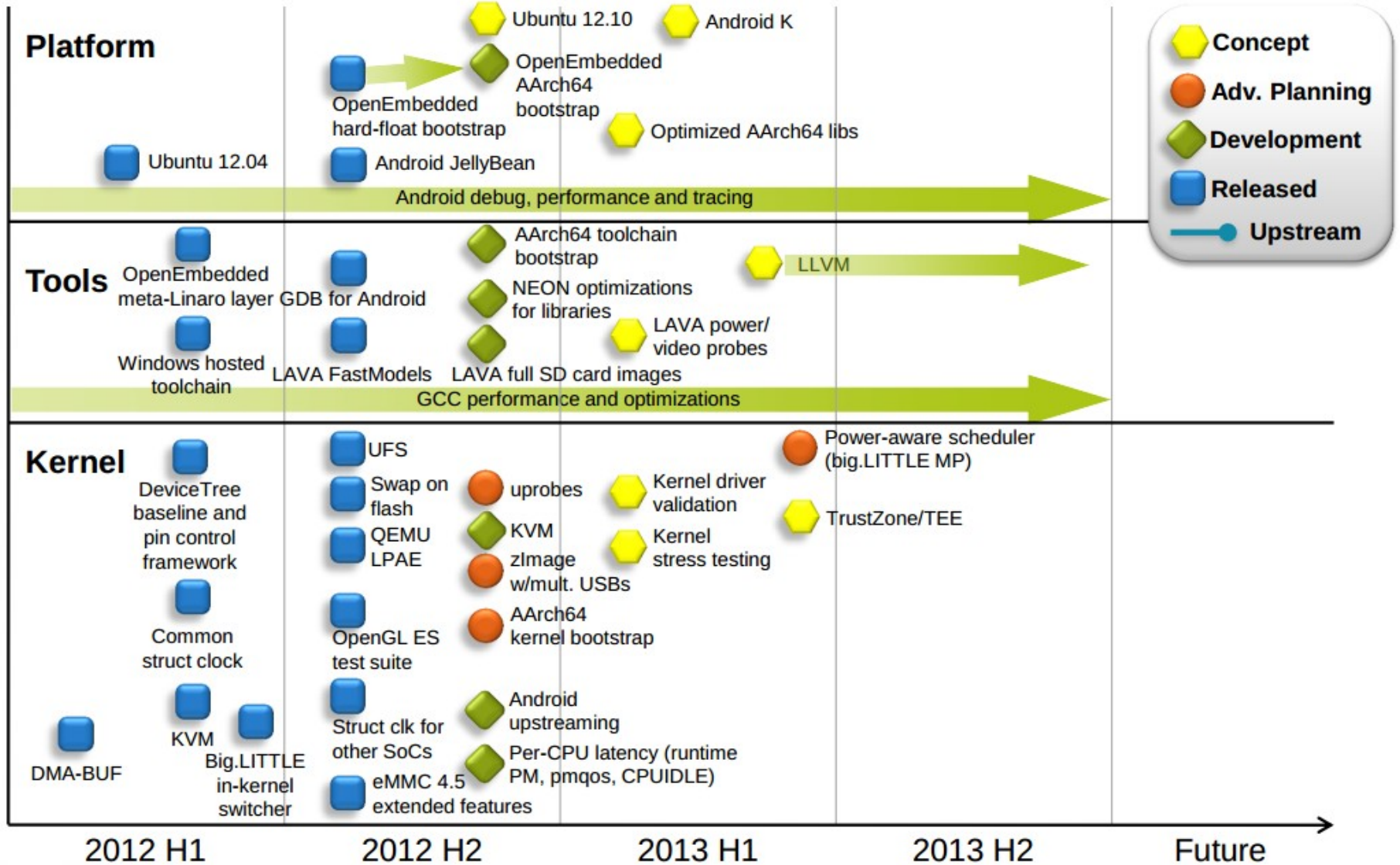
Linaro: Ongoing projects

- ARM v8 bringup, validation and upstreaming support

- QEMU, KVM and Xen for ARM v8

- arm-soc tree 32 bit and 64 bit maintenance

- Improving kernel latency for ARM – runtime PM, CPUidle, hotplug

Linaro Connect

- Linaro shared work is engineered in the open
- Linaro holds multiple in-person conferences per year
  - For engineers worldwide: USA, Europe, Asia
  - Attendance is free for members, nominal charge for non-members
  - 300 attendees from 80 companies
  - Week-long event: up to 95 morning sessions;
    5 afternoons of hacking in working groups
  - Committee, team and member meetings
  - Opportunities for networking and side discussions
  - Demos
  - Sponsorships available
- Linaro's members drive the technical agenda & participate in the engineering effort

Linaro Connect Dates	Location
4-8 Mar 2013	Hong Kong
8-12 Jul 2013	**Dublin**
28 Oct – 1 Nov 2013	US (ARM TechCon)

Roadmap - https://wiki.linaro.org/TSC/Roadmaps

Platform

- Ubuntu 12.10 — Concept
- Android K — Concept
- OpenEmbedded AArch64 bootstrap — Development
- OpenEmbedded hard-float bootstrap
- Optimized AArch64 libs — Concept
- Ubuntu 12.04 — Released
- Android JellyBean — Released
- Android debug, performance and tracing

Tools

- AArch64 toolchain bootstrap — Development
- LLVM — Concept
- OpenEmbedded meta-Linaro layer — Released
- GDB for Android — Released
- NEON optimizations for libraries — Development
- LAVA power/ video probes — Concept
- Windows hosted toolchain — Released
- LAVA FastModels — Released
- LAVA full SD card images — Development
- GCC performance and optimizations

Kernel

- UFS — Released
- Power-aware scheduler (big.LITTLE MP) — Adv. Planning
- DeviceTree baseline and pin control framework — Released
- Swap on flash — Released
- uprobes — Adv. Planning
- Kernel driver validation — Concept
- QEMU LPAE — Released
- KVM — Development
- TrustZone/TEE — Concept
- zImage w/mult. USBs — Adv. Planning
- Kernel stress testing — Concept
- Common struct clock — Released
- OpenGL ES test suite — Released
- AArch64 kernel bootstrap — Adv. Planning
- KVM — Released
- Big.LITTLE in-kernel switcher — Released
- Struct clk for other SoCs — Released
- Android upstreaming — Development
- DMA-BUF — Released
- eMMC 4.5 extended features — Released
- Per-CPU latency (runtime PM, pmqos, CPUIDLE) — Development

Legend:
- Concept
- Adv. Planning
- Development
- Released
- Upstream

2012 H1 | 2012 H2 | 2013 H1 | 2013 H2 | Future

Linaro

Requirements – http://cards.linaro.org

Drafting	Review	Planning	Engineering work in progress	Change review	Closing out	Release... Delivered
199	47	22	35	6	10	67

KWG 33 issues

Drafting
- CARD-117 — TrustZone kernel driver
- CARD-166 — System Trace Macrocell Consolidation
- CARD-177 — Develop unified device probing and management
- CARD-442 — Upstream Android Kernel Patchset

Review
- CARD-180 — EPIC: ARM64 kernel feature enablement
- CARD-198 — Fastboot for UEFI
- CARD-277 — EPIC - Improve and validate F2FS
- CARD-501 — EPIC: Android Upstreaming
- CARD-509 — RAM console upstreaming
- CARD-510 — ashmem compat_ioctl upstreaming to
- CARD-511 — sync driver upstreaming to

Planning
- CARD-106 — Android ASHMEM upstreaming
- CARD-107 — Android logger upstreaming
- CARD-108 — Android OOM killer upstreaming
- CARD-153 — Add uprobes support for ARM
- CARD-202 — Improve eMMC Power Management

Engineering work in progress
- CARD-207 — Android Key Reset Upstreaming

Change review
- CARD-114 — Single kernel binary

Release... Delivered
- CARD-96 — Pin control framework support
- CARD-103 — Baseline Device tree support
- CARD-109 — Android WAKELOCK upstreaming
- CARD-111 — Support RPMSG across member platforms
- CARD-118 — big.LITTLE task migration
- CARD-119 — EMMC 4.5 kernel support
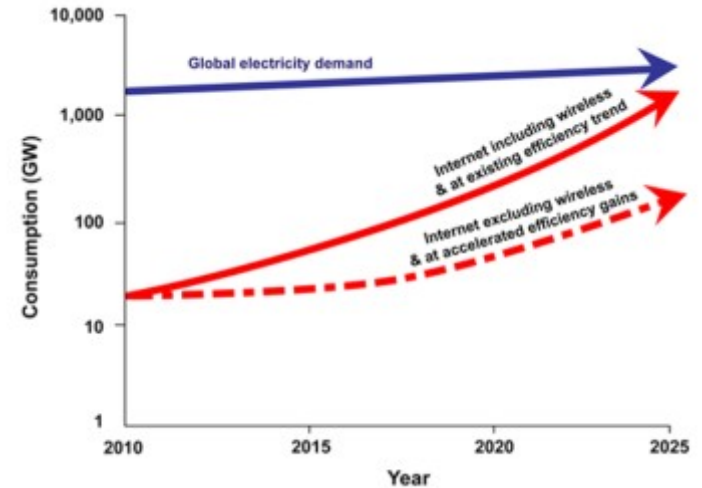- CARD-132 — big.LITTLE System Features

Industry Disruption

- Mobile - Phones, Tablets
- Embedded markets - TV, Consumer electronics, Cars
- Networking - Routers, Switches, Cloud
- Servers - Micro, Hyperscale, HPC
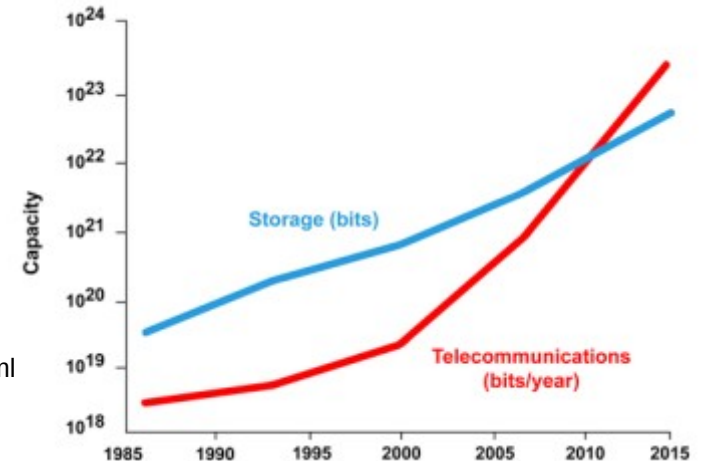- IOT - Huge future impact on cloud, data, analysis

Challenges – Power Management

- Power Management
  - Billions of embedded and mobile devices
  - Smartphone and tablets generating a mobile data explosion
    - Mobile data to hit 134 Exabytes by 2017 [1]
  - 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[2]
    - Doubling of big data growth by 2014 [3]

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

[1] http://www.datamation.com/mobile-wireless/mobile-data-set-to-hit-134-exabytes-by-2017.html
[2] Source: Fortune
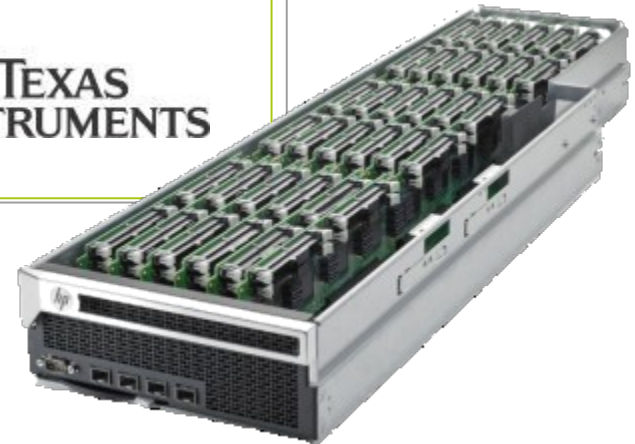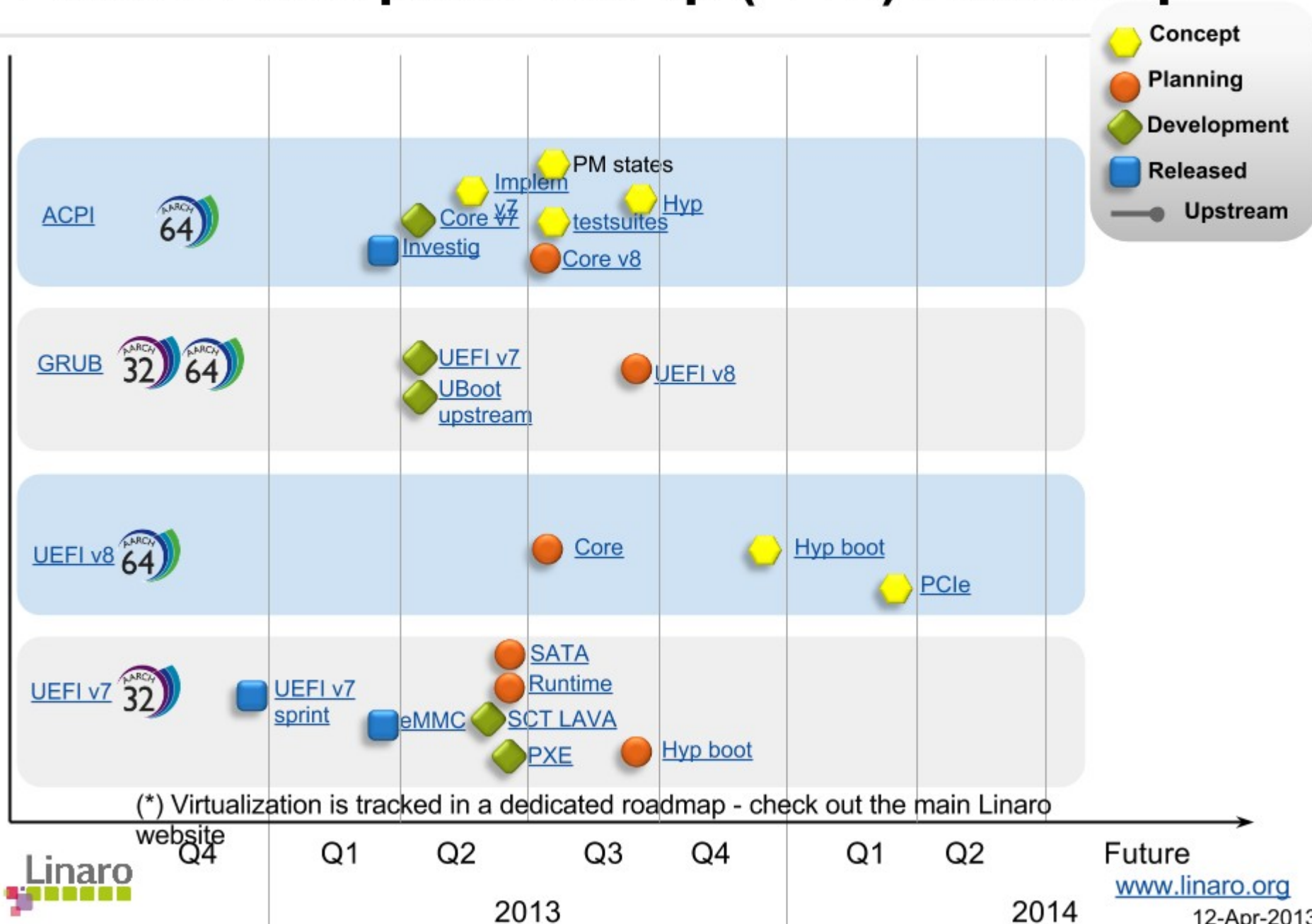[3] http://www.cloudexpoeurope.com/news/idc-reports-doubling-big-data-growth

Challenges – Power Management

http://www.wired.com/wiredenterprise/2012/10/ff-inside-google-data-center/

www.linaro.org

Linaro Enterprise Group (LEG)

Linaro Enterprise Group (LEG) Roadmap

Legend:
- Concept (yellow hexagon)
- Planning (orange circle)
- Development (green diamond)
- Released (blue square)
- Upstream (arrow)

ACPI (AARCH 64)
- Core v7 — Development
- Implem v7 — Concept
- PM states — Concept
- testsuites — Concept
- Hyp — Concept
- Investig — Released
- Core v8 — Planning

GRUB (AARCH 32, AARCH 64)
- UEFI v7 — Development
- UBoot upstream — Development
- UEFI v8 — Planning

UEFI v8 (AARCH 64)
- Core — Planning
- Hyp boot — Concept
- PCIe — Concept

UEFI v7 (AARCH 32)
- UEFI v7 sprint — Released
- eMMC — Released
- SATA — Planning
- Runtime — Planning
- SCT LAVA — Development
- PXE — Development
- Hyp boot — Planning

(*) Virtualization is tracked in a dedicated roadmap - check out the main Linaro website

Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Future

2013 | 2014

www.linaro.org
12-Apr-2013

Linaro Enterprise Group (LEG) Roadmap

Legend:
- Concept (yellow hexagon)
- Planning (orange circle)
- Development (olive diamond)
- Released (blue square)
- Upstream (line with dot)

Builds and Baselines
- OpenStack v7 (Concept)
- OpenStack v8 (Concept)
- LAMP (Concept)
- Fedora (Development)
- Calxeda (Development)
- Hadoop (Concept)
- AARCH 32 / AARCH 64

Optimizations
- NUMA v7 (Released)
- GZIP CRC v7 (Released)
- HDFS CRC v7 (Development)
- OpenSSL v7 (Concept)
- LAMP profiling (Development)
- NUMA v8 (Concept)
- Hugepages v8 (Concept)
- LibTBB v8 (Concept)
- Assembly (Concept)
- Package scan (Released)
- Package study (Released)
- Galois (Concept)
- Crypto (Concept)
- AARCH 32 / AARCH 64

OpenJDK
- Template Interpreter (Concept)
- 0-port (Development)
- Compatibility Kit (Concept)
- Test Regression (Concept)
- AARCH 64

HipHop App Server
- HHVM interpreter (Development)
- JIT core (Planning)
- JIT ph1 (Planning)
- HHVM JIT (Planning)
- AARCH 64

Timeline: Q4 | Q1 Q2 Q3 Q4 (2013) | Q1 Q2 (2014) | Future

Resources

- UEFI
  - Test enterprise use cases, track ARM Tianocore and maintain board support tree, GRUB, DMIDecode
  - git://git.linaro.org/arm/uefi/uefi.git
  - git://git.linaro.org/arm/uefi/uefi-next.git
- ACPI
  - Port ACPICA and key tables, bus drivers, PM states
  - https://wiki.linaro.org/LEG/Engineering/Kernel/ACPI
- RAS
  - RAS Daemon based on perf, ACPI error sources
  - https://wiki.linaro.org/LEG/Engineering/Kernel/RAS
- Virtualization
  - https://wiki.linaro.org/LEG/Engineering/Virtualization

Resources

- LAMP stack
  - CRC, openSSL, RAID
  - PHP, Python
  - https://wiki.linaro.org/LEG/Engineering/vertical-web
- Assembly scanning
  - http://lca-13.zerista.com/files_user/attachments/9265/lca13-asm.pdf
- OpenJDK
  - https://wiki.linaro.org/LEG-SC/2013-01-31#OpenJDK_on_AArch64

Networking Challenges

- 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

Linaro Network Group (LNG)

+1 not yet public

LNG Brief History

- Started talking late 2012
- Formed Linaro Networking Group 20th February 2013
- Leverages Linaro's shared engineering model
- LNG Steering Committee formally started meeting at the Linaro Connect in Hong Kong w/o 4th March 2013
    - First formal face to face meetings
    - Technical sessions exploring the problem space
    - Initial key problems to solve agreed as legacy big endian, real time Linux and user space networking
    - Will follow networking initiatives (such as Software Defined Networking)

LNG Initial Scope of Work

Agreed by LNG Technical Steering Committee:

- Big Endian support
  - Short term: Pure big endian systems – see these as restricted to 'closed' systems
  - Mid term: Mixed endian systems (perhaps via virtualization)
  - Long term: Migrate to little endian

- User Space Networking
  - Many companies run the main networking code in user space
  - Linux kernel 'keeps out of the way'; improved kernel infrastructure

- Real Time Kernel
  - LNG will be supporting PREEMPT_RT
  - Aims to bring patches into mainline and ensure Linaro member platforms well supported
  - Will work directly with the upstream project: Offering help, Working in the open

Questions?

More about Linaro: http://www.linaro.org/about/
More about Linaro engineering: http://www.linaro.org/engineering/
How to join: http://www.linaro.org/about/how-to-join
Linaro members: http://www.linaro.org/members
IRC #linaro, #linaro-enterprise
Mailing list: linaro-enterprise@lists.linaro.org