Our mission: LEADING COLLABORATION IN THE ARM ECOSYSTEM
Trends

- Linaro initial focus was mobile
- ARM in everything
  - From Sensors to the Datacenter
- Open Source in everything
- Product developers need multi-vendor device, gateway and cloud software solutions
The Embedded Software Problem

- ARM Servers
  - Must “just work” using established industry standards
  - ARM, the Linaro Enterprise Group and the ARM server vendors have worked hard to make this happen
  - The Developer Cloud demonstrates enterprise open source software running on multiple ARM vendor products
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- The Embedded World
  - Proprietary tools
  - Hundreds of OSes
  - Multiple implementations of the same standards
  - Silos everywhere
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- Why can’t embedded devices “just work” too .... ?
A Connected World

● Linaro’s DNA is to work together on software platforms that are needed by everyone
  ○ Share cost of open source development
  ○ Do the engineering once
  ○ Then compete on value-add and differentiation

● Connected devices …
  ○ MUST work together
  ○ Need to be secure
  ○ Need to be maintained over the product lifetime without return to factory upgrades
What do we need to do

- Collaborate, Work together
- Leverage open source software
- Build shared platforms for developers
  - Enable easy cross vendor support
  - Build in security
  - Build in over the air/wire updates
- Maintain products by keeping them updated
  - Improves security
  - Lowers life-time costs
  - Enables delivery of new functionality
What do we need to do

- Automatic updates for 4+ years
- Security fixes
- New features
- Excellent user experience
- Extends product life but still allows innovation

- Let’s aim to do this with Open Source Software for all Connected Devices
Reference Platform (RP) Program

- End to End Open Source Reference Software
  - Firmware, Kernel, Distribution, Middleware & Hello World Applications
- Build on upstream technology
- Product level quality goals
- 16.06 CE and Enterprise Releases
- Coming soon
  - IoT Device, Networking, Digital Home and Gateway Reference Platforms
  - CI Loops on 96Boards Hardware
    - RP-Certified program for 96Boards
Linaro Segment Groups

- **LITE**: IoT/EMBEDDED
- **LMG**: Mobile
- **LHG**: Digital Home
- **LNG**: Networking
- **LEG**: Server
Linaro IoT and Embedded Group - LITE

- Launches today
- End to end focus on the IoT
- Initial members:
The ARM Perspective

Mark Hambleton
ARM Director, Software Engineering
Systems and Software Group
A lesson from science fiction?

2029 hardware
running 2015 software
Embedded now and then

- **Embedded in 1990s**
- **Embedded today**
- **Embedded today (1990 methods)**
Embedded requirements for today

- Security
- Maintainability
- Safety
Lifetime value, minimizing lifetime costs

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ARM architecture for diverse computing needs

**Cortex-A**
- Highest performance
- Optimized for rich operating systems

**Cortex-R**
- Fast response
- Optimized for high performance, hard real-time applications

**Cortex-M**
- Smallest/lowest power
- Optimized for discrete processing and microcontrollers
ARMv8-R real-time deterministic safety

- Builds on the 32-bit ARMv7-R
- Introduces a ‘bare metal’ Hypervisor mode enabling strict isolation between tasks
- Provides isolation of safety critical code
- Enables consolidation of software
ARMv8-M for real-time deterministic embedded

• Builds on the ARMv6-M and ARMv7-M architectures with

• Introduces ARM TrustZone™ to Cortex-M
Common software is vital

- Differentiation costs. Only differentiate on the parts that bring value

- Use IP and configurations that have good upstream software support

- Make it easy for developers to adopt your hardware and software
Collaboration reduces software effort

▶ Collaborative open-source projects on ARM are what Linaro is all about...

▶ Linaro LITE will become key to delivery in the embedded space

▶ Reducing costs for ecosystem partners and end developers
Ask yourself...

Security

How are you building security into the heart of your products?

Maintainability

How are you lowering lifecycle costs?

Safety

How are you building in functional safety?
Progress and Plans

- LITE engineering has already started
- Linaro has joined the Zephyr Project
  - Kumar Gala is an ARM maintainer
  - Linaro has started making upstream contributions
- Also exploring
  - Smart Devices
    - High end Cortex-M running Zephyr/mbed etc.
    - Low end Cortex-A running Linux
    - Connectivity and Optional UI
    - Small footprint and low power consumption
96Boards IoT Edition

- Small form factor board
- Minimum mandatory functionality
  - Cortex-M MCU
  - microUSB or Type C port for power and communications
  - 40 pin 1.8V and 30 pin 3.3V 0.1” expansion connector options
- Cortex-R/M and Cortex-A profiles
96Boards IoT Hardware

- **Carbon**
  - STM32F401 Cortex-M4 MCU with 512KB Flash, 96KB RAM
  - USB power supply with fuse protect
  - 6 LEDs
    - USR1/2, BT, PWR, RX, TX
  - Two push buttons
    - USR and RESET
  - SWD debug connectors
  - On board BLE with chip antenna
  - 3.3V I/O
  - 2x15pin 0.1” expansion connector
96Boards IoT Edition

Yang Zhang
Director 96Boards
96Boards IoT Hardware

- Coming Soon - Orange Pi i96
  - RDA ARM Cortex-A5 32bit
  - Integrated 2GB LPDDR2 SDRAM, 4GB Nand Flash
  - MicroSD
  - MicroUSB or VBAT 5V POWER
  - 2x USB 2.0
  - CSI camera 24pin 0.5mm FFC
  - 40pin LS Expansion Connector, 1.8V
  - WIFI (RTL8189FTV)
  - Orange Pi Ubuntu build

$9.99!
IoT Gateway Project

● Gateway Vision and initial Lead Project
  ○ Universal, not one per product line
  ○ Container-based applications
  ○ Secure and OTA updatable

● IoT Gateway Reference Platform for ARM
Linaro Mobile Group LMG

- AOSP Optimization
- AOSP Board Project
  - HiKey 96Boards
    - Supported in AOSP tree
- MediaTek X20 Deca-core Cortex-A72/A53, Mali-T880
- New Initiatives
  - ART Performance including 32 bit
  - Codec 2.0
  - OpenFastPath networking
  - Reducing out-of tree patches (kernel and user space)
AOSP Concept Demonstration

Rob Herring - CTO Office

- Part of Android HAL Consolidation initiative
- Supporting AOSP in adjacent markets
  - One Android build/filesystem per CPU Arch
  - Supporting DB410c, HiKey, Nexus 7, QEMU, Raspberry Pi 3
  - KConfig based target feature configuration
  - Mesa (open source OpenGL) Android support improvements
  - QEMU host accelerated graphics with upstream components (QEMU, kernel, Mesa GL)
- More Information
  http://tinyurl.com/zscbbrx
AOSP Concept Demonstration

● What’s Next
  ○ Incremental to no effort to support more boards
  ○ HWC2 and explicit sync fences for DRM (graphics) (goodbye Atomic Display Framework)
  ○ Better kernel support for UART devices (e.g. Bluetooth, NFC)
  ○ More Android kernel upstreaming and additional HAL support

● AOSP Miniconf Thursday
Linaro Digital Home Group LHG

- Comcast RDK (Linaro RDK)
- AOSP/Android TV
- China TVOS
- Security Solutions
  - OPTEE on Linux and Android, W3C EME Clear Key, Microsoft PlayReady PK3.0, Widevine
- LHG OpenSDK
  - Chromium, Wayland/Weston, OpenCDM, OPTEE, GStreamer, V4L2
MStar Kava 96Boards EE Digital Home

- Announced today
  - K7 STB SoC - quad-core Cortex-A53 SoC 1.5 GHz, Mali-T820
  - 2 GB DDR3, 8GB eMMC, 8MB SPI
  - micro SD card slot (3.0), PCIe 2.0
  - HDMI 2.0 Input/Output with HDCP 2.2 up to 4K @ 60Hz
  - H.265/VP9 up to 4Kx2K@60fps
  - H.264 HP/5.0 up to 4K2K@30fps
  - S/PDIF (optical) Audio
  - 10/100/1000 Base-T
  - USB 3.0, 2x USB 2.0 host, UART
  - Smart Card and 2x12pin Tuner Interface
  - 96Boards LS connector
LHG 96Boards EE TV Version

Mark Gregotski
Director LHG
Demonstration - Poplar

- Poplar 96Boards EE Digital Home
  - Hi3798CV200 4 Core Cortex-A53 and Mali T720
  - 2GB RAM, 8GB eMMC
  - 4K HDMI 2.0a with HDCP 2.2 @ 60fps
  - Gbit Ethernet, 802.11AC WiFi, Bluetooth
  - PCIe G2 (needs software support)
  - USB2.0 and 3.0 ports
  - Smart Card and Tuner expansion module
    Interfaces
  - 96Boards LS Connector
  - $79 from AliExpress
Linaro Network Group LNG

- ODP - Software Defined Dataplane
  - Leverages proprietary dataplane acceleration hardware
  - Monarch LTS Release August 2016
  - Deployment into networking applications and infrastructure
  - Next Release is TigerMoth
    - Applications transparent acceleration
    - Virtual networking acceleration

- New Additional Initiative on Time Sensitive Networking
  - Linux kernel networking
  - For automotive, industrial and media markets
Linaro Enterprise Group LEG

- Enterprise Reference Platform
- Developer Cloud
  - Austin, Cambridge
  - China next
- Lead Projects
  - SDI
  - Big Data
- Coming next
  - Enterprise CI
  - More storage - CEPH
  - HPC Session
The Developer Cloud

Martin Stadtler
Director LEG
Linaro

- Open Source Collaborative Engineering
  - Core engineering & Segment Groups
  - “DNA of all Linaro work”
- LITE launch and IoT Reference Platform
- AOSP Mobile Optimization and Community Board support
- Poplar and Kava Digital Home Community Boards
- OpenDataPlane Monarch Release
- Enterprise Reference Platform running the Developer Cloud
- 32 Members, 300+ Engineers
  - 150 employees, 94 assignees & 89 member engineers
LITE IoT Reference Platform Technology Preview
End to End Demonstration

- Hello World Application
- Zephyr 1.6 Build
  - LAVA CI Test & Validation
- Multi Vendor Hardware
- Linux Gateway Build
- 96Boards CE Gateway
- Cloud Deployment
Development Workflow and CI

1. Checkout IoT RP
   Modify Code
   Local build & test

2. Git push

3. Automated builds
   Automated tests
   Fully scalable

4. Test results

5. Production Image

6. Deploy

7. Deployment

8. Deployment Report

Gateway (DragonBoard 410C)

Devices in the field

Build Servers

LAVA VM Servers

Board Test Farm
Development Workflow and CI

● Services
  ○ LAVA for test automation (Virtual and Real HW)
  ○ Git server for code storage & coordination
  ○ Custom builder systems, tuned to build Zephyr
    - ~3x faster than a developer laptop system
  ○ Cloud Server for storing artifacts
  ○ IoT Device deployment
    Demonstration using Apache Hawkbit
Secure Dual-bank OTA Update

- Generic FOTA architecture and implementation
  - Common bootloader across different vendor MCUs
  - Reference boot sequence and rollback
  - Main application open source module responsible for receiving and writing the new image
  - Image integrity (via hashing) and authentication (via signing)
IoT RP - Technology Preview

- Zephyr 1.6 - [https://www.zephyrproject.org/](https://www.zephyrproject.org/)
- Open source boot loader
- Raw Host-Controller Interface (HCI) over SPI on Carbon
- IPv6 6LoWPAN Network over BLE
- Signing and authentication
- HTTP Client libraries
- microPython & JerryScript
- Hello World application

Pick up a Carbon board at LAS16
[http://linaro.co/getcarbon](http://linaro.co/getcarbon)

Sign up at
[http://gitci.com](http://gitci.com)
Thank you