Welcome

- To the 21st Connect
- To the first European Connect since Copenhagen, Oct 2012
- To new Linaro Members
Our Mission

- Leading collaboration in the ARM ecosystem
- The Good ...
  - Open source software is changing the software world
  - Understanding that connected devices require secure, updatable software
  - The best secure software is open
  - Linaro was the top company contributor to the Linux 4.9 kernel, contributing over 10% of the changes
Open Source Project Contributions - Subset
Our Mission

● Leading collaboration in the ARM ecosystem

● ... the hard
  ○ It’s not easy ...
  ○ Competitors don’t naturally work together
  ○ Open source is global, 24 hour timezones
    - Face to face, Linaro Connect is key

● ... and the harder
  ○ Open source software disrupts existing business models
  ○ Are we skating TO where the puck is going to be ... ?
  ○ Are we doing enough? Innovation in open source is hard - it needs collaborative not single company effort, influence not control, participation now not wait and see
  ○ We need to work on the ARM way, not in the x86 way
Our Mission

- Leading collaboration in the ARM ecosystem
- New industry platforms are open source

Platforms are by definition non-differentiating
  - They are now “free”
  - Value is from innovation on top of platforms:
    - Value added technology
    - Applications
    - Data and analytics
Dispelling Myths

● Linaro is expensive compared to other industry efforts

● Our model is unique and is focused on engineering

● What we provide
  ○ A $40M+ expert open source engineering team
  ○ Reducing “non-differentiating” engineering effort
  ○ Access to Linaro, ARM and other member engineers
  ○ Working upstream on multiple member-prioritized projects
  ○ Influencing and working on the future of open source
  ○ Knowledge and software for member businesses and products
  ○ All shared funding is used for collaboration and growth
Dispelling Myths

- Linaro is for ARM-only projects
- Linaro works collaboratively in upstream projects across the industry
- Examples of cross-architecture upstream work
  - Kernel
  - ODP.org
  - DPDK
  - UEFI/ACPI
  - Zephyr
- CI and testing on ARM and Intel platforms
  - kernelci.org
Dispelling Myths

● Linaro is not always inclusive of the community
  - it should not be members only/first

● Linaro doesn’t give its members enough advantage
  - it should be member first

● Open Collaborative Engineering Division (OCE) focuses on working in the upstream for the benefit of members and the ARM ecosystem

● Services Division is available for Linaro related work

● Linaro membership is participation in the open source tsunami that is sweeping the software industry and delivering platforms to enable innovation
Linaro Collaboration Ideas ... 

● What a Company does today
  ○ Delivers embedded ARM hardware to hundreds of customers based on multiple vendor Cortex-A SoCs
  ○ Has a partnership ecosystem taking vendor BSPs (based on 1 to 3+ year old Linux kernels) and creating a custom software build for every customer product (SoC + distribution + customer specific hardware/software)

● Why not ...
  ○ Collaborate with Linaro (SoC vendor members) to create a unified software platform based on good upstream support, with security and OTA update capability
  ○ Leverage the partnership ecosystem to deliver value add services

● Result
  ○ Lower maintenance costs, speed time to market, enable a trusted hardware and software ecosystem that works cross SoC vendor
Linaro Collaboration Ideas …

● What another Company does today
  ○ Evaluates 4 enterprise distributions on 4 enterprise SoC vendor platforms
  ○ Each SoC vendor provides a customized system with latest firmware, upstream kernel, distro and some recent in-house “tweak” patches
    ■ Some patches from different vendors address the same problem :(  
  ○ Company has 16 different software/system combinations to evaluate and they do not all plug and play (BTW … they should)

● Why not …
  ○ Collaborate inside Linaro to establish an upstream baseline
    ■ Collaboratively manage any necessary in-flight patches
  ○ Have a common and agreed validation/test platform that runs on every SoC vendor’s hardware and includes customer test software/use cases
    ■ Results and benchmarks can be public or private

● Result
  ○ A common baseline that works
  ○ One place to resolve questions and issues, in addition to each vendor
Linaro Technical Landscape

Core Technologies - Cross Linaro

- **Kernel**
  
  Linux Real-time has been +20 years in the making. It’s time to finish the job

- **Power Management**
  
  Energy awareness across SoC and system, it’s not just about the CPU core

- **Security**
  
  Let’s make OP-TEE the preferred industry-wide TEE

- **Virtualization**
  
  We’re now at parity with x86, let’s pull away

- **Tools - GCC, Clang, Debugging, IDE**
  
  GCC will be here for a long time but LLVM is the future

- **Automation and CI**
  
  Automation is the only way to scale development, validation and certification
Linaro Technical Landscape

- Servers - LEG
  - Working upstream is mandatory
  - ARM servers now just “work”, but that’s not enough
  - ARM servers have to bring innovation and benefit
    Examples: High core counts, lower power/workload
  - Opportunity in both existing (datacenter) and in new markets
    Examples: HPC, machine learning, innovative storage

- Accelerator standards - e.g. CCIX, Gen-Z

- Enterprise is an enabler for IoT, Smart Devices and Gateways
  - Linaro Core Engineering teams contribute
Linaro Technical Landscape

- Networking - LNG
  - Dramatic IPsec RoI gains leveraging hardware accelerators (now)
  - Telecom Grade ODP and accelerated virtual Switching (SFO17)
  - Innovative networking virtualization technologies (2018)
  - vCPE opportunity - 5,000 VMs and 100Gbps on one server socket
  - CloudRAN opportunity - real-time guaranteed bandwidth above 50Gbps
  - Resistance to “platform distribution” vs embedded DIY
  - Increases costs of development, deployment and maintenance
Digital Home - LHG

- Accelerated media on ARM should "just work" with any middleware
  - Build on FFmpeg, V4L2
- Reference Secure Video Path with OP-TEE and 3rd party DRM
- Reference set-top open source solution with RDK and OpenSDK

- Best-in-class reference Android/AOSP TV experience
  - Leverage the work on unified accelerated media and secure video path
  - Focus on Premium Viewer Experience, not a cheap me-too clone
  - Target top-tier DRM-enabled official set-top platforms
Linaro Technical Landscape

- **Mobile - LMG**
  - Collaborate with the kernel community to extend Long Term Support (eLTS)
  - Continue backporting key SoC product features into LSK for Mobile
  - Continue reducing the gap between Android Common and mainline
  - Complete boot time optimization (20% speed up so far)
  - Investigate new opportunities with file systems, compression
  - Upstream all optimizations to AOSP
  - Improve CI Testing and Validation, improve base kernel quality, catch regressions faster
Linaro Technical Landscape

- **LITE - Embedded, Automotive, Gateway, IoT**
- **IoT client**
  - Tens of RTOS, middleware and network options
  - Hundreds of Cortex-M MCUs and boards
  - Secure OTA update and secure sensor data connection to the cloud
  - Drive consolidation with a complete secure open source solution
  - Meet time-to-market schedule with a new code base in full development
- **IoT Gateway**
  - Different protocol and vendor lock-in gateways from each provider
  - Lead the development of a flexible unified open source gateway solution based on containers
  - Ally with the right Industry partners and consolidate across many ongoing gateway initiatives
Key Themes - Security

- **Cortex-A** Linux
  - SELinux
  - Seccomp (Docker)

- **Cortex-M** Zephyr
  - Public Key Infrastructure (PKI)
  - ARMv8-M Architecture - adds TrustZone
  - MCU specific secure hardware
    - Key generation, key storage, certification management, crypto

- **OP-TEE**
  - Secure world open source OS

- **OTrP**

- **ARM Platform Security Architecture (PSA)**
Key Themes - Automated Testing

● Increasing requirement for Connected Products
  ○ No longer just in product development
  ○ Security, bug fix and feature updates during product lifetime

● Enterprise to IoT

● KernelCI.org - build & boot 64 unique Linux kernel trees on 249 unique boards, across 3 architectures and 33 unique SoCs
  ● Not just build & boot - more functional testing

● Continuous Integration
● Continuous Testing
● Continuous Deployment
● Linaro Lab and Developer Cloud
Key Themes - The Rise of the Containers

- Software is now deployed globally into virtual environments where it is instantiated and destroyed instantaneously
- This has revolutionized the data-center
- Containers are an enabling technology for deployment and orchestration
  - Applications to enterprise distributions
- Container platform - firmware, kernel & minimal services
  - Lightweight, Secure and Updatable
- Beyond the data-center: Home, Factory, Cars
Key Themes - Hosting on ARM not x86

- How do we get developers to work on ARM first?
- Where is the ARM box that leverages the PC industry that can be used as a desktop development machine/server?
- Where is the ARM hyperscale (64+ core) box for developers?
- Could a Chromebook design derivative give an 8 or 16GB ARM laptop with good Linux upstream support?
- Where is the ARM equivalent of the Intel NUC?
- There is a session to gather requirements on Friday
96Boards

- Latest SoCs and MCUs being enabled on 96Boards
  - Other new boards are being previewed at the event

BlueSky IE with Zephyr
- RDA5981A
- Cortex-M4
- WiFi inc. PHY and MAC
- 64K ROM/8Mb NOR Flash
- 448KB SRAM/32KB cache
- Crypto security HW

WRTnode IE with Zephyr
- Mediatek MT7697
- Cortex-M4, WiFi bgn and BT LE MCU
- 4Mb NOR Flash
- 353KB SRAM
- 64K ROM
- Crypto security HW

Archermind X20 Pro
- CE Spec
- Mediatek X20
- 10 core A72/A53
- Mali T880 GPU
- LTE radio module
- Available from AliExpress.com

ToCoding Neon 1.8V Mezzanine
- STM Cortex-M4 & LED controller
- Accelerometer/Gyro
- Magnetic/Pressure
- ALS/Proximity
- Microphone
- Temperature
- Humidity
96Boards Demonstration

- Orange Pi i96
  - RDA ARM Cortex-A5 32bit
  - Integrated 256MB LPDDR2 SDRAM, 512MB 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
Embedded and IoT Fragmentation

- 100’s of OSes
- Standard Protocols now exist
  - CoAP, LWM2M, AMQP, MQTT
  - IoTivity, Thread
- Each of these is being ported to each OS
- Each OS can run on thousands of MCUs/SoCs
- Plug-fests don’t scale for IoT
- What can we do?
Open Source and IoT

● Linaro is working in the Zephyr Project for IoT innovation
  ○ Cross industry, Open governance, Linux kernel model
  ○ Permissive license enables proprietary innovation using the Zephyr platform as a base
  ○ Building in security and FOTA updates from the outset
  ○ Supporting industry device management and cloud platforms

● LITE is delivering technology into the Zephyr project
  ○ Working upstream
  ○ Technologies and APIs available for reuse by other OSes
    - FreeRTOS, mbed-OS etc.
Enabling IoT Product

- Zephyr is new, fast-moving, and bleeding edge
- Many use cases (sensors/controllers) can be met with core functionality
- Small Linaro team working on building end to end use cases
- Goal to accelerate product quality and adoption, reduce fragmentation and get to market faster for ARM devices
Technology Preview Release
Technology Preview Release

- C APIs
- Javascript
- μPython
- OTA Updater
- OTA
- mcuboot Secure Bootloader
- Zephyr Kernel
- Ethernet
- BLE
- WIFI
- 802.15.4
- MCU HAL
- IPv6 6LoWPAN
- IPv4/v6 TCP/UDP
- TLS/DTLS
- HTTP
- MQTT
- CoAP
- LWM2M
- IPv6 6LoWPAN
- MCU HAL
- mcuboot Secure Bootloader
- Zephyr Kernel
- Ethernet
- BLE
- WIFI
- 802.15.4
Technology Preview Release

- Documentation
- Code
  - Hawkbit
  - HiKey Gateway Debian Stretch build
  - Zephyr 1.7 build

- http://docs.linarotechnologies.org
Demonstration

- Builds on Technology Preview Release
- Hawkbit open source device management
- Connection to commercial IBM Bluemix cloud services using MQTT
Demonstration

Sensor Data MQTT to Bluemix

Signed FOTA Images from Hawkbit

6LoWPAN over Bluetooth LE communications

HiKey Gateways

IoT Edge Devices
IBM Watson IoT Platform

### Devices

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Demonstration

Bluetooth LE → 6LoWPAN → Gateway → Device Management

Zephyr Application

TCP/IPv6 over Bluetooth LE

Tiny Proxy IPv6 -> IPv4

IoT Gateway

IoT Endpoints

Cloud Services

Cloud

Web Dashboards

Enterprise Services
CI and Automation

● Keeping track of the sources
  ○ Zephyr - Three branches to test
    ● master (upstream)
    ● master-upstream-dev (upstream + linaro staged patches)
    ● v1.7-dev (upstream dev branch + linaro staged patches)
  ○ MCUBoot - Two branches to test
    ● master (upstream)
    ● master-upstream-dev (upstream + linaro staged patches)
  ○ FOTA Application - One branch to test
    ● master (upstream)

● These combinations generate a matrix of permutations that constantly need to be validated

● Integrate our CI with GitHub workflow
# Linaro Firmware Over The Air Programming Example

Example application that uses Hawkbite to implement FOTA.

## Build Status:

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## Dependencies

View the build status of this project's [dependencies](#).
Demonstration

- Upstream Zephyr 1.7 RC3 running on multiple ARM MCU boards
- Unified Secure boot and FOTA update
- Real-time IoT device data transfers from multiple vendor IoT boards to commercial IBM Bluemix Cloud
- See bigger scale and more boards on Demo Friday!
What’s Next - 2017 Plans

- Cortex M Technology Preview code release - now
- Initial 1.0 code release for products - Q3 2017
  - Larger footprint - more functionality - TCP/MQTT/HTTP
  - Smaller footprint - lower power - UDP/CoAP/LWM2M
  - BT, WiFi and LoRa Support
  - Many more devices/vendors
  - Choice of cloud providers using a common cloud platform API