

# Build the unified end to end IoT solution on ARM



# Agenda

- Linaro
- Linaro's IoT efforts
- Demo

# Business Models

- Design and sell x86 chips
- 2016 \$59.5Bn Revenue



- Large investment in OSS
- Focused effort from single company

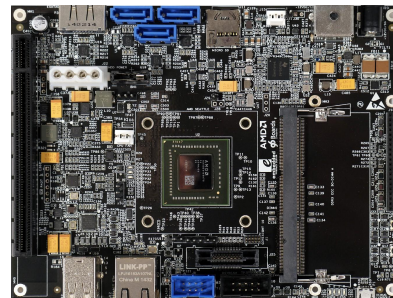
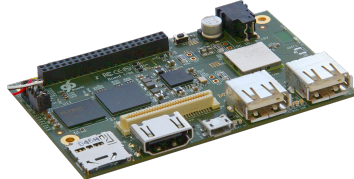
- Sells SoC IP to SiPs
- 2016 \$1.66Bn Revenue



- ARM & SiPs invest in OSS
- Innovation is faster
- Differentiation is greater
- ARM & SiPs need to work together to be competitive and to benefit from the faster innovation

# Linaro Overview

- Linaro leads software collaboration in the ARM ecosystem
- Instead of duplicating effort, competitors share development costs to accelerate innovation and time to market
- Linaro is member funded and delivers output to members, into open source projects, and into the community
- Founded in 2010 with 6 members, now >30 with 140 staff and ~300 OSS engineers distributed globally



LEADING COLLABORATION  
IN THE ARM ECOSYSTEM

# Linaro Influence in the Linux Kernel

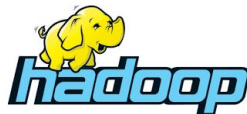
- Linux Kernels 3.19 - 4.11
- Feb 2015 - May 2017
  - >165,000 changesets
  - Linaro contributed 4.7% (>7.8k)
- Linaro consistently in top five company contributors

Top Linux Contributors by Company: Kernel 4.11		
1	Intel	1,608 (12.8%)
2	(Unknown)	1,071 (8.5%)
3	Red Hat	955 (7.6%)
4	(None)	798 (6.4%)
5	Linaro	624 (5.0%)
6	IBM	493 (3.9%)
7	SUSE	482 (3.8%)
8	Google	375 (3.0%)
9	(Consultant)	349 (2.8%)
10	Samsung	303 (2.4%)

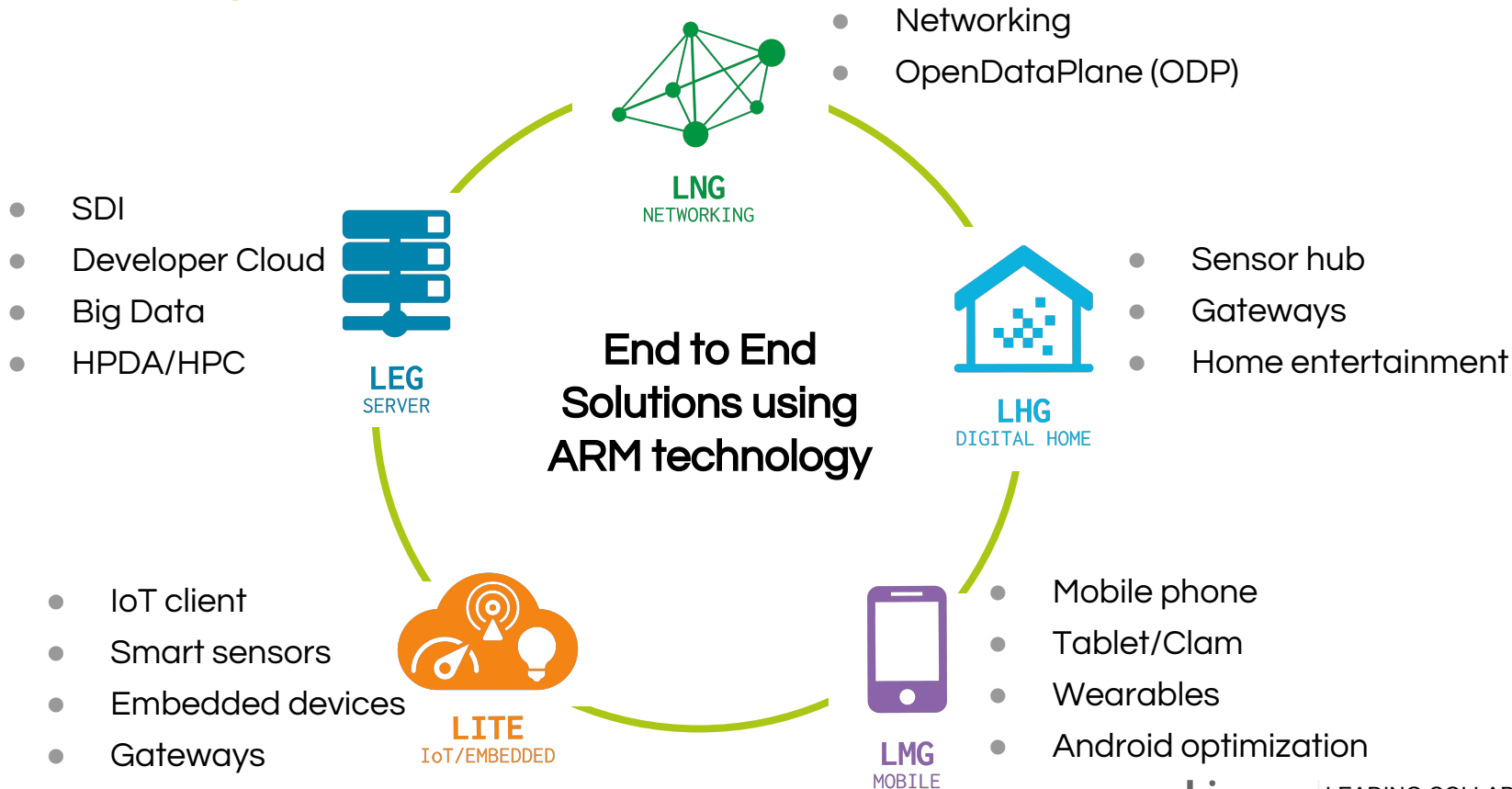
Sources: <https://lwn.net> and [Linux Foundation](#)



# Open Source Project Contributions - Partial List



# Linaro Segment Groups





# Embedded and IoT Fragmentation

- IoT SW increasing complex, connected.. with advanced HW
- 100's of OSes, tens of active, not fundamental difference
- Standard Protocols now exist
  - CoAP, LWM2M, AMQP, MQTT
  - IoTivity, Thread
- Each of these is being ported to each OS
- OS is being ported to thousands of MCUs/SoCs
- Each solution is being ported to each MCUs/SoCs
- Different FOTA, Gateway, vendor lock-in
- Plug-fests don't scale for IoT
  - (due to everything being different)

**We need defragmented IoT platform**





# The Linaro IoT & Embedded Group (LITE)

- Build software and standards for ARM in IoT

Initiatives	Description	Task
Developer Ease of Use	<b>App Framework</b> Configuration tools Simulation/Emulation	Javascript engine Javascript APIs Integration/Build
Secure Update/Operations	<b>Secure Boot</b> Device Authentication Key Management	Mcuboot (mynewt) Signed images
Simplify porting	<b>Device/System Model</b> Executive Agnostic	Zephyr board ports Device Tree, API refactoring
Data collection	HAL - sensors/ <b>connectivity</b>	Ethernet, Bluetooth, WiFi
Cloud service integration	Production ready stacks Cloud integration	Demo AWS, MQTT brokers

- Accelerate deployment
  - IoT Reference Platforms for Cortex-M
  - Smart Device and Gateway Reference Platforms for Cortex-A
  - 96Boards IE



LEADING COLLABORATION  
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# Open Source and IoT

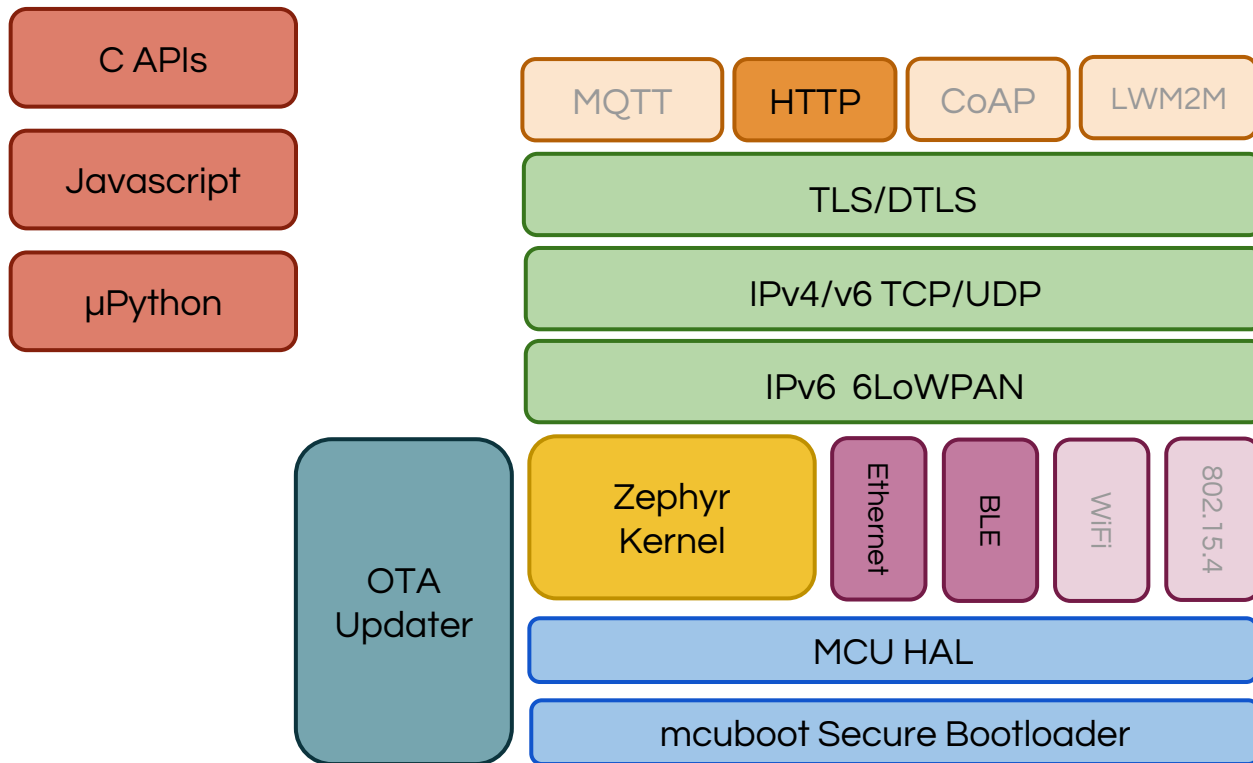
- Linaro is working in the Zephyr Project for IoT innovation
  - Supporting industry device management and cloud platforms

Truly Open Governance	Cross Architecture	Technical Merits
Hosted by LF Apache 2.0 Vendor neutral Open develop	ARM x86 ARC RISC-V Tensilica Nios II	Clean design Modular Linux-alike Security FOTA

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



# Zephyr™ + MCUBoot + FOTA





# Close to 40 ARM boards ... more on the way



FRDM K64F



Arduino Due



Nucleo 103RB



NRF51



Nucleo64 L476RG



Nucleo F411RE



NRF52 pca10040



Nucleo F334R8



Arduino 101



Minnowboard



Altera MAX10



Nucleo 401RE



Hexiwear



ARM V2M MPS2



STM3210c



Atmel SAM E70



Galileo



Synopsys EMSK



NRF52



Seeed Carbon



TI Launchpad Wifi



BBC Microbit



STM32373c



Redbear BLE Nano



Quark D2000



STM32 Olimexino



STM Mini A15



Seeed Nitrogen



ARM V2M Beetle



Zedboard Pulpino



FRDM-KW41Z



tinyTILE





# Enabling IoT Product

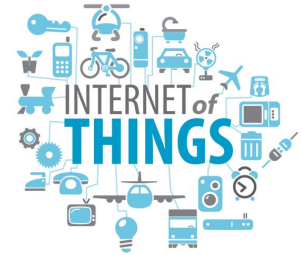
- Zephyr is new, fast-moving, and bleeding edge
- Support many use cases (sensors/controllers)
- Linaro working on end to end use cases
- Goal to accelerate product quality and adoption, reduce fragmentation and get to market faster for ARM devices



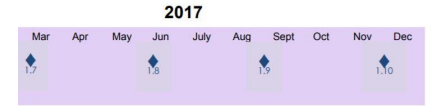
Cloud Providers



Gateways



Endpoints



## Zephyr OS 1.9

- POSIX API Layer
- BSD Socket Support
- Expand Device Tree support to more architectures
- BLE Mesh
- Full Bluetooth 5.0 Support
- LWM2M (→)
- Thread Protocol (initial drop) (→)
- Expand LLVM Support to more architectures
- MMU/MPU (Cont.): Thread Isolation, Paging (→)
- Revamp Testsuite, Increase Coverage
- Build and Configuration System (CMake) (→)
- Zephyr SDK NG
- Eco System: Tracing, debugging support through 3rd party tools

## Zephyr OS 1.10

- SMP Support
- AMP Support
- FOTA Updates, Integration with Bootloader (→)
- IDE Integration
- MMU/MPU (Cont.)



# IoT Demo

- Hardware
  - Support a wide range of MCUs
- Application
  - Publishing sensor data over a common IoT protocol (e.g. MQTT)
  - Supports delivering firmware over the air
  - A/B Partitioning Scheme, including roll back support
  - Interfaces with device management systems in the cloud
- Bootloader
  - Cryptographically validates image updates
    - Rolls back if image update fails or if not signed with the right key
    - Jumps to correct application partition if validation succeeds
- Technical Debt
  - Upstreaming platform code and keeping application changes in sync with upstream APIs



# Demonstration

Sensor Data MQTT  
to Bluemix

Signed FOTA Images  
from Hawkbit

6LoWPAN over  
Bluetooth LE  
communications



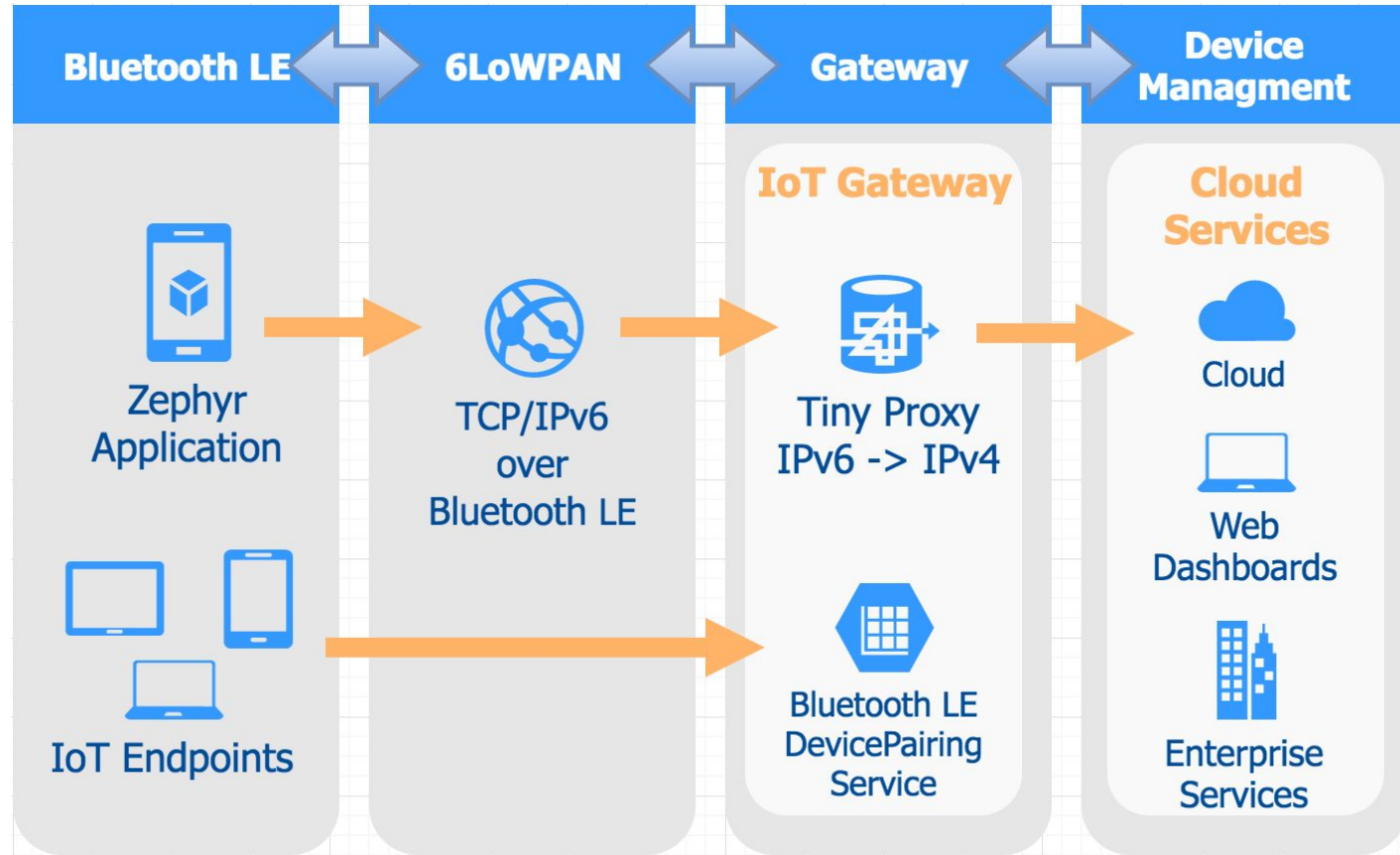
HiKey  
Gateways



IoT Edge Devices



# Demonstration







## 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



# Summary

**Linaro is leading collaboration in the ARM ecosystem,  
working with members and the community to  
deliver industry-leading IoT platform innovation**