From 96Boards to the Cloud

Presented By: David Mandala, Director of Systems, Linaro

Event: Embedded Linux Conference 3 April 2016
Who is Linaro
Who is Linaro?

- Linaro is a collaborative engineering organization
- Our Mission: Leading Collaboration in the ARM Ecosystem
Why do we need Linaro?

ARM’s business model leads to an unprecedented level of innovation in SoCs.

Intel’s quarterly R&D budget is over 2x ARM’s annual revenue. Linaro is where the ARM partnership works together to invest in the ecosystem.
What does Linaro do?

- Focus on Open source software
- Linaro members fund 220 OSS engineers to develop software collaboratively
- Software is built once and shared by all
- Work is open, tested and upstreamed
Celebrating 5 years of Open Source Engineering on ARM

24TB
- Data from June 2014 - May 2015
- 615,000 downloads from >100 countries

1,141,014
- Minutes of videos showing demos, talks and training sessions watched

11,589
- Patches upstream since 2011

50,217
- Wiki pages

>1 Million
- Website users

4,410
- Gallons consumed at Linaro Connects

16 Connects
- 14 Cities on 3 continents
- Six members at launch

32 member companies

More than 220 Engineers from seed of twenty

Company contributor for
- Linux Kernels 3.11 - 3.18

www.linaro.org
www.96boards.org

“"The ARM situation has just improved tremendously over the last several years. It used to be a major pain to me, it has gone to almost being entirely painless.”

- Linus Torvalds
- May 2015
Linaro: End-to-end ARM-based Solutions

- LITE
  - IoT client
  - Smart sensors
  - Embedded devices

- LMG
  - Phone
  - Tablet
  - Wearable

- LHG
  - Home entertainment
  - Sensor hub
  - Gateways

- LNG
  - Networking Data plane (ODP)

- LEG
  - SDI
  - Developer Cloud
  - Big Data
  - HPDA
LITE IoT and Embedded

- Proposed new Linaro Segment Group
- Interim SC and projects underway
  - Reference IoT software across Cortex A and R/M
    - RTOS, GPIO, I2C, SPI, BLE, 6LoWPAN, CoAP, DTLS, Thread, MQTT...
    - Sensor/Smart Device/Gateway
  - Open Source Software from the sensor to the cloud
Continued focus
Volume, competition, drives innovation
  - Google Android, Acadine H5OS
  - Performance, power management, footprint
  - Project Ara
Features migrate to IoT and Enterprise
LHG Digital Home

- Open Source Platforms
  - Android
  - Comcast RDK
  - China TVOS
- Focus on security and media frameworks
LNG Networking

- ODP - APIs for dataplane SoC acceleration
  - “Monarch” release Q2
  - “Tiger Moth” release Q4
- ToR switch, Smart NICs, Edge devices/NFV
  - Leverage ODP for HW acceleration
LEG Enterprise

- Platform for the data center
  - ARM SoCs for the data center & cloud computing
- Firmware
- SDI (OpenStack), OPNFV, Big Data (Hadoop, Spark/MapR), HPC
What do we need to accomplish our mission?

- Software Engineers to develop and debug software
  - We have quite a few of those. ;-)  
- Hardware to develop and debug software on
  - This is slightly harder
  - In many cases it’s easier for software developers to work on local hardware; to give all of our software folks a local system it needs to be inexpensive (to some meaning of the word)
96Boards
96Boards

- Linaro designed the 96Board specification
  - Currently 2, with more in development
    - CE Consumer Edition (CE)
    - Enterprise Edition (EE)
    - Internet of Things (IE) [future specification]

More about this later...
Why 96Boards?

- A low-cost ARMv7 and ARMv8 open platform specification
- Software maintained by Linaro and community
- A single developer community, sharing solutions
- Open to all developers
- Hardware modules are portable across all 96Boards: choice leads to lower cost, faster innovation and larger market
- The goal is for 96Boards to be fully supported upstream
Why does 96Boards matter?

- An SoC independant open platform for a single ecosystem
- Active engagement and contribution from communities
- Reference Software Platform
  - It’s not just about Hardware - **it never was**!
  - Unified Kernel and boot firmware roadmap promoting upstream
  - Default mechanism for Linaro Collaborative Engineering work
- Targeted platform for segment specific requirements
- Low speed Mezzanines are compatible across all 96Boards, pushing the boundaries of product design and application development
- If you use any one of 3 libraries to access GPIO, I2C or SPI you will have binary compatibility across boards
  - 96BoardsGPIO
  - Libsoc
  - Mraa & upm
Target Markets for 96Boards

- Commercial & higher education software development
- OEM/ODMs - for IoT, mobile, compute, enterprise
- Maker market - Robotics, UAV, HPC, etc

Software >60% of cost of SoC development

Sources: *IDC 2013, **ITRS 2007, **IBS 2009
Cross vendor community hardware

- Key enabler for reference software platform
- Mezzanine ecosystem for peripherals & sensors
Two Open 96Boards Specifications*

- Low cost ~$50-150
- Mobile/Embedded SoCs
- For software developers, maker community, research, universities & OEMs

- Low cost ~$300
- Server/Networking SoCs
- For software developers, universities & research, SoC evaluation and test/build farms

* Currently
96Boards Consumer Edition Goals

- An SoC independent low cost platform
  - Develop a larger hardware ecosystem & enable longer platform life
  - Reduce costs of embedded product development
  - Enable vendor differentiation

- Enable low cost ($50-150 MSRP) community boards

- Delivery of a small form factor physical design
  - Standardized footprint
  - User connectors/access on front edge only
  - Small form factor (85 x 54 x 12mm total) with very low profile
    (7mm board to board separation), suitable for embedded product use
Consumer Edition Use Cases

- Out of the box Single Board Computer for software developers
- Expansion and customization options for the maker community
- Low-cost Single Board Computer for embedded OEM products
DragonBoard 410c

Supported OSes

- Android
- Snappy
- Brillo
- Windows 10

Supported IoT Platforms

- AT&T
- Amazon Web Services
- IBM Bluemix
- Microsoft Azure
- M2X
Support for HiKey 64 bit Octa Cortex-A53 96Boards is now available in AOSP public tree
http://source.android.com/

A community board with ongoing support in AOSP will help developers and peripheral vendors to accelerate adoption in new Android versions
96Boards Enterprise Edition

Coming in Q2 2016

LeMaker Cello

96Boards EE
Quad Cortex-A57
GBit Ethernet
SATA/eSATA
x16 PCIe G3
SO-DIMMs up to 16GB
Enterprise Edition

- For Server/Networking Enterprise SoCs
- Low cost standalone format or microATX format
- 2-16GB DRAM or more with SO-DIMMs
- 1Gbit Ethernet port
- 2 USB 3.0 ports
- PCIe and display options
- Optional multiple SATA and networking ports
- Standardized 96Boards Maker IO interface
- 12V DC @ 5A -15A off the shelf power supply (or ATX)
Mezzanine Boards and Modules

- Build once and run on any 96Boards Compliant hardware
- Developer support infrastructure
- Enables a developer community around peripheral devices for SoCs (Communications, Sensors, Displays & Cameras)
- Join 96Boards Partner Program

**Mezzanine Products**

OS Distributions

- 96Boards is distribution agnostic and welcomes community participation from all distributions and operating systems.
- 96Boards products initially provide support for at least one of:
  - Debian, Ubuntu, Fedora, Android (AOSP), RedHat (EA) or an OE/Yocto Linux build
- Supported distributions will be available from 96Boards.org as pre-built images and build from source instructions.
96Boards.org

- Community Web Site
  - Open to all
  - Specifications
  - Where to buy
  - Documentation
  - Developer forum
  - Software downloads
- Reference Software Platform
- Developer Cloud

Open Platform Specifications and Reference Software for the ARM ecosystem
For software developers • For the maker community • For embedded OEMs

Download Specifications
- CE Specification
- EE Specification

On the Forum
- Ping is needed to keep WiFi connection.
- Windows 10 DragonBoard 410C Support Help
- Windows 10

On the Blog
- Reference Software Platform 15.12 Release!
- 96Boards 3D printable EE case
- Pi X is Y or libsoc patches
- Servo Motor Control: generating a
Reference Platform

- End to end reference open source software
  - To provide cross-SoC reference implementation
  - Firmware to application use cases

- Why?
  - A reference “how to” implementation
  - Over time will benefit from multi-vendor and community participation
  - Saves duplicated engineering effort
Reference Platform

- Tested on 96Boards & member hardware*
  - Releases for Mobile/Embedded & Enterprise
    - Include latest Linux distributions - Android, Debian, CentOS
    - IoT, Digital Home and Networking versions coming soon
  - Designed to be easily ported for new SoC enablement
- Quarterly release cadence


*Selected member-requested hardware by arrangement
16.03 RPB Kernel

- Unified kernel tree for CE and EE Builds
  - Supports HiKey, DragonBoard 410c, Huawei D02, APM X-Gene, HP Proliant m400 and AMD Overdrive

- Linux 4.4.0 based
  - Including under-review topic branches to extend hardware support for the available platforms
  - Device-Tree support for CE
  - UEFI, ACPI and PCIe support for Enterprise
  - Single kernel config for all platforms in arch/arm64/configs/distro. config
Linaro ARMv8 Server Cluster for Developers

- Want access to an ARM Server to test your software?
  - Linaro can help you with that:
    - The Linaro ARMv8 server cluster is a virtual resource available to ISVs and other software developers who need access to enterprise-class 64-bit ARMv8 hardware before they can get hardware in-house. This server cluster will allow porting and verification of enterprise software on ARM 64-bit servers running standard Linux distributions.

- http://www.linaro.org/leg/servercluster/
Linaro Developer Cloud

Linaro Cloud for Developers

Why?

- A reference “how to” OSS implementation
- To provide public and restricted access to ARM servers
- For developers, ISVs and end users to evaluate/utilize member hardware with forums and developer support
- For Cloud providers who want a known starting point to provide ARM server infrastructure
Linaro Developer Cloud

- Run on Linaro and Member/Partner facilities
  - Linaro Cambridge and Austin locations today
    - Linaro China in Q2/Q3
    - We expect members & member partners to participate
  - All participating facilities can be federated
  - Users will be able to request and purchase instances

- By developers for developers

- Quarterly release cadence
Getting Involved - Yes, we need you!

- Buy a board and contribute on the 96Boards.org forums
- 96Boards Steering Committee member Group, maintaining 96Boards Specifications as well as their evolution
  - For SoC vendors and Board developers
- Manufacturer and Partner programs for Board, mezzanine board and module developers, software companies and universities
Resources

- www.linaro.org
- http://www.linaro.org/leg/servercluster/
- https://wiki.linaro.org/FrontPage
- http://www.96boards.org/
- https://github.com/96boards
- https://github.com/96boards/96BoardsGPIO
- https://github.com/96boards/96boards-build-tools
- https://github.com/jackmitch/libsoc
- https://github.com/intel-iot-devkit/mraa
- https://github.com/intel-iot-devkit/upm
- Irc: freenode.net #linaro #96boards
## Other Linaro Presentations here at ELC

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Questions?