HiKey: A High Performance ARM 64bit Developing Platform

Presented By: David Mandala, Director of Systems, Linaro
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Who am I?

David Mandala

- I work for Linaro, I’ve been working in the Linux arena since 1994
- I’m here today to talk to you about Linaro, 96Boards, and specifically the first 96Board
What is Linaro & what does Linaro do?

- Is a collaborative engineering organization
- Linaro’s Mission:
  - Leading Collaboration in the ARM Ecosystem
  - 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

Linaro Core & Club Members

Plus 20 Group Members
What do we need to accomplish our mission?

- Software Engineers to develop and debug software
  - We have quite a few of those. ;-) 
- Hardware used to develop and debug software
  - 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)
To do our job we needed great ARM hardware

- So Linaro designed the 96Boards specifications as Linaro’s hardware solution
- Currently 2, with more in development
  - CE Consumer Edition (CE)
  - Enterprise Edition (EE)
  - Internet of Things (IE) [future specification]
Consumer Edition 96Boards Specification

- Low cost ~$50-150
- Mobile/Embedded SoCs
- For software developers, maker community, research, universities & OEMs
Why 96Boards?

- A low-cost ARMv7 and ARMv8 open platform specification
- Software maintained by Linaro and community
  - Reference Software Platform
  - Default mechanism for Linaro Collaborative Engineering work
- 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
  - Low speed Mezzanines are compatible across all 96Boards, pushing the boundaries of product design and application development
- The goal is for 96Boards to be fully supported upstream
First 96Boards Consumer Edition Board

- **HiKey (LeMaker version)**
  - A cooperative effort between Huawei, LeMaker and Linaro
  - Used in many groups within Linaro
  - Very little of the board is not open source
HiKey CE Board

- Kirin 620 SoC
  - Integrated octa-core 64-bit ARM
  - Cortex-A53 CPU up to 1.2 GHz per core
  - Embedded Mali 450-MP4 GPU
- 1GB or 2GB 800MHz LPDDR3
- 8GB eMMC on-board storage
- WLAN 802.11 b/g/n 2.4GHz
- 40 pin low speed connector, UART, GPIO, I2C, SPI, Power
- 60 pin high speed connector, SDIO, MIPI_DSI, MIPI_CSI, I2C, USB2.0
HiKey CE Board (continued)

- Micro SD card slot
- HDMI 1080P output
- OS Support
  - Google AOSP
  - Linux - Debian, Ubuntu, Snappy Ubuntu Core, OpenEmbedded (OE), others
  - ROS
  - FreeBSD
HiKey + AOSP!
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.
HiKey in AOSP

- Provides a reference devboard in AOSP!
- Unlike Nexus devices, HiKey will move forward to newer kernel versions
- Takes Linaro’s previous efforts generating Android builds w/ the latest kernels and userspace but does it inside of AOSP
- Provides good testbed for validation

With HiKey, developers can easily use the latest Google AOSP SDK to:
- create and debug new and existing peripheral drivers
- do kernel development
- perform other tasks with fewer OEM encumbrances
CyanogenMod 13.0 on the HiKey

- Reported by @fonic on 96Boards April 6th 2016
OP-TEE Trusted OS on the HiKey

- Trusted Execution Environment for use with ARM TrustZone® technology*
  - Open-source security for the mass market
- HiKey is the recommended board for community development for OP-TEE
  - https://github.com/OP-TEE/optee_os
- Linaro Home Group (LHG) has PlayReady - OPTEE integration on HiKey with PlayReady Android being worked on now

The build uses open source components running on the HiKey to implement an HTML5 browser-based playback of encrypted content using OP-TEE running on ARM TrustZone. The OpenEmbedded build system is employed.

- The Clear Key build is comprised of the following components
  - Chromium v45
  - Wayland (v1.9)-Weston
  - Mali 450MP4 GPU r6p0 release with graphics drivers (supporting drm/kms, dma-buf)
  - OpenCDM
  - OP-TEE v.1.1
  - Sample Trusted Application (AES Decryption)
  - Linux kernel 4.5

Reference W3C EME Clear Key build on HiKey
The Robot Operating System (ROS) is a set of software libraries and tools that help you build robot applications. From drivers to state-of-the-art algorithms, and with powerful developer tools, ROS has what you need for your next robotics project. And it's all open source.

- Ported to HiKey
- Communications Infrastructure
- Message Passing
- Recording & Playback of messages
- Remote Procedure Calls
- Distributed Parameter System
- Robot-Specific Features
  - Standard Message Definitions for Robots
  - Robot Geometry Library
  - Robot Description Language
  - Preemptable Remote Procedure Calls
  - Diagnostics
  - Pose Estimation
  - Localization
  - Mapping
  - Navigation
HiKey + Ubuntu Core = IoT
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Download image from HERE (http://www.lemaker.org/product-hikey-download-54.html)
Xenomai on HiKey

- Xenomai delivers Real Time performance on the HiKey board
- Xenomai is a well established open source Linux project that has been providing GNU/Linux with a number of RTOS emulators for over a decade on almost every processor family; VxWorks, pSOS, VRTX, uTRON and POSIX applications can therefore be run with real-time guarantees alongside native Linux applications.
  - AArch64 support has been merged into Xenomai 3:next
  - early beta releases for the currently available 96Boards using Cobalt on 3.18 and 4.0 kernels.
  - Xenomai: http://git.xenomai.org/xenomai-jro.git branch: hikey
  - IPIPE: http://git.xenomai.org/ipipe-jro.git branch: hikey
Open Source Bootloaders for HiKey

- HiKey by default uses UEFI which is Open Source
  - HiKey UEFI Doc's and Source
- The community has also built U-Boot for Hikey
  - HiKey U-boot Doc's and Source
FreeBSD on the HiKey

- FreeBSD known to support the HiKey board
  - See https://wiki.freebsd.org/arm64
Yang Zhang, Director 96Boards, Linaro did a demo at Linaro Connect BKK16 using:

- **Hardware**
  - HiKey CE 2Gig RAM from LeMaker
  - OSVR headset and tracking devices*

- **Software**
  - OSVR Core and SDK
  - Mesa Driver
  - OpenGL
  - OpenSceneGraph

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Mezzanine Boards and Modules

- Developer support infrastructure
- Enables a developer community around peripheral devices for SoCs (Communications, Sensors, Displays & Cameras)
- Join 96Boards Partner Program

**Mezzanine Products**
- Linker mezzanine card starter kit: Available now. 96Boards starter kit with Linker mezzanine card and I/O modules.
- 96Boards UART Serial Adapter: Available now: a USB to UART interface to be used with any 96Boards Consumer or Enterprise Edition board.
Mezzanine card which make connection easy to modules of Linker kit. There are 8 connectors on the card and these connectors cover Analog, UART, I2C and GPIO. There are bidirectional voltage-level translators which allows for low-voltage bidirectional translation. So it is compatible with 3.3V or 5V modules.
Moreover, this shield has an on-board ADC chip so that analog output modules can be used on 96board. The ADC chip used is MCP3004. It talks to 96Boards using SPI interface.

- LinkSprite Technologies, Inc.
The 96Boards Sensors Mezzanine adapter makes it simple and easy to connect sensors and devices to any 96Boards-compatible base board. With it you can connect your favourite Grove modules and Arduino compatible shields and interface to software running on the 96Boards baseboard. It provides everything you need to start experimenting and prototyping on the 96Boards platform.

- 9 Grove connectors for 96Boards IO (mixed 3.3V and 5V; all 5V tolerant): 5x GPIO, and 4x I2C
96Boards Sensor Mezzanine

- Arduino-compatible shield socket, and two SPI headers. It also includes an ATMega328 microcontroller which can be programmed from the Arduino IDE and will run most Arduino UNO sketches unchanged
  - 9 Grove connectors for ATMEGA328 IO (all 5V): 5x GPIO, 3x ADC, and 1x I2C
  - MicroUSB interface to 96Boards console serial port
- Seeed Studios
96Boards Mezzanine LCD Kit

- Mezzanine card that connects to both the high and low speed interfaces and provides a direct connection to an LCD screen and touch screen
  - Expected 2nd qtr 2016
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
- Pin X is Y or libsoc patches
- Servo Motor Control: generating a
Getting Involved - Yes, we need you!

- Buy a HiKey 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

- [http://www.96boards.org/](http://www.96boards.org/)
- [http://www.96boards.org/products/ce/hikey/](http://www.96boards.org/products/ce/hikey/)
- AOSP - [https://source.android.com/source/initializing.html](https://source.android.com/source/initializing.html)
- OP-TEE - [https://github.com/OP-TEE/optee_os](https://github.com/OP-TEE/optee_os)
- [https://github.com/96boards](https://github.com/96boards)
- [https://github.com/96boards/96boards-build-tools](https://github.com/96boards/96boards-build-tools)
- [https://github.com/jackmitch/libsoc](https://github.com/jackmitch/libsoc)
- [https://github.com/intel-iot-devkit/mraa](https://github.com/intel-iot-devkit/mraa)
- [https://github.com/intel-iot-devkit/upm](https://github.com/intel-iot-devkit/upm)
- Irc: freenode.net #linaro #96boards
Questions?