Welcome

China Electronics Corporation (CEC)

- Joining Linaro as a Core Member
- Major Chinese Global IT Supplier
- China GCC Board Member
- 100+ companies, 14 listed
- 130,000 employees
Welcome

- Joining Linaro as a LITE Member
- 96Boards SC Appointment
- LITE Group Associate
Engineering Highlights - a few of many

IOTL/Tiny Linux

LNG Networking

OpenDataPlane.org

DPDK

LEG Server

DeveloperCloud

www.linaro.cloud

Linaro Downloads
linaro.org/downloads
Zephyr

Rosefinch 7100
NB-IoT Chip
Linaro Value

Unique Company where competitors in the Arm Ecosystem can collaborate on Open Source projects of benefit to all

Over 300 engineers from companies across the world working together in over 70 Open Source Projects
Some of our work ...
I skate to where the puck is going to be, not where it has been

Wayne Gretzky
Our world is changing
Unprecedented Connectivity
Increasing Product Complexity
Data Everywhere - Cloud, Edge, Device

5G
<table>
<thead>
<tr>
<th>Feature</th>
<th>Version</th>
<th>Release Date</th>
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<tbody>
<tr>
<td>Last stable Linux kernel</td>
<td>4.15.10</td>
<td>Mar 2018</td>
</tr>
<tr>
<td>Most recent LTS kernel</td>
<td>4.14</td>
<td>Nov 2017 first release</td>
</tr>
<tr>
<td>SoC BSP #1</td>
<td>4.4</td>
<td>Jan 2016 first release</td>
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<tr>
<td>SoC BSP #2</td>
<td>3.18</td>
<td>Dec 2014 first release</td>
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<tr>
<td>Oldest current LTS kernel</td>
<td>3.2</td>
<td>Jan 2012 first release</td>
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How About Security?

Latest kernel software (upstream)
Has the latest security features
Gets security patches first
Supports the most hardware

LTS kernels get key patches backported
A Real (Embedded) Kernel

SoC BSP kernel (say 3.18)
SoC vendor code (inc. blobs)
Dev Board vendor code
End Product kernel changes
Updated LTS patches
SoC vendor updates
Final “Product Kernel” patches

Tested Product Kernel
“Based on Linux”

3.18 is about 150,000 patches behind upstream
Expect 100K-1M+ lines of “vendor code”
The result is a completely custom kernel
An industrial or automotive product lifetime is 10+ years

High lifetime maintenance costs
Delays to security updates
A Not Uncommon Example

2017 Model Car

IVI System with Bluetooth uses kernel version 3.1.10
Released January 18th 2012
We Can Do Better

Is LTS still the best approach?
If the best software is the latest software why can’t we use it?

The development cycle is too long
Certification and Compliance
Risks of making changes late in the process
And, unless it’s an enterprise SoC, users don’t have the option
Could we solve this?

Start with the latest (upstream) software
Design for continuous updates through the product lifetime
Use CI with use case and regression testing

Security updates, bug fixes and new features
Deliver more secure products at lower cost
What do we need to do?

Support new SoCs upstream
Improve CI testing - starting with the Kernel
Build better and better functional & regression tests
Test upstream - nothing else scales
Test in minutes, not hours or days
SoC Vendors

Every vendor should have an upstream focused team

Linaro can help

Reference Development Builds staging to upstream (like ERP)
Developer Services and Landing teams to help your engineers
Machine Intelligence
Early Market Adoption

AI/ML software is largely open source software
Algorithms & hardware IP are proprietary
Need to interface hardware IP to AI/ML frameworks
We need developer platforms for Datacenter, Edge & Fog
High performance, low power
Linaro Machine Intelligence Project

Provide best in class Deep Learning performance by leveraging Neural Network acceleration in IP and SoCs from the Arm ecosystem, through collaboration on the most widely adopted AI/ML software frameworks and libraries.
96Boards
DragonBoard 820C
DragonBoard 820C

- Uses Snapdragon 820E
  - Quad core Kryo CPU
  - 96Boards CE Extended Version
  - 3GB LPDDR4 RAM
  - 32GB UFS Flash
  - WLAN 802.11ac, Bluetooth 4.2, GPS
  - GBit Ethernet, USB 2.0/3.0
  - HDMI 4K@60fps
  - mini-PCIe

- CPU, Adreno 530 GPU and Hexagon 680 DSP
  - Heterogeneous processing
  - Linux developer support later in 2018

- Now shipping to developers
- Plan to support 96Boards.ai

Built by Arrow
96Boards Manufacturing Partner
96Boards.ai
Announcing 96Boards.ai
Hardware for AI/ML Developers
Socionext Synquacer + Gyrfalcon Lightspeeur

Synquacer SC2A11
- A53@1GHz x24, 5W

96Boards EE Card
- microATX format
- up to 64GB RAM
- SATA, GBE
- DeveloperBox

Gyrfalcon Lightspeeur
- Neural Compute
- 28K cores/chip
- 9.3TOPS/W
- 8 chips on PCIe card
Demo - Object Recognition in Multiple Simultaneous Video Streams
Kirin 970

Huawei's first mobile AI computing platform

Intelligent Computing Power
Ultra-fast Connection
HD Audio-visual Effects
Long Battery Life

Boards
First Super Edge AI Computing Platform with NPU
HiKey 970

● Huawei HiAI SDK
  ○ Up to 25x Performance
  ○ Up to 50x Power Efficiency
● Dedicated Neural-network Processing Unit (NPU)
● Heterogeneous Resource Management
Huawei HiAI SDK Empowers Developers

Huawei HiAI SDK provides **AI compute libraries and APIs** which enable developers to easily and effectively develop new AI applications instead of focusing on performance tuning on edge devices.

- **APP**
- **Robot**
- **Smart City**
- **TensorFlow Lite**
- **Caffe/Caffe2**
- **TensorFlow Lite**

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**Tool Chain**

**Documentation**

**Rich set of APIs**

**Easy-to-use Source Code**
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<th>HiAI SDK V100</th>
<th>HiAI SDK V150</th>
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<tr>
<td>Framework</td>
<td>Caffe, TensorFlow</td>
<td>Caffe, TensorFlow, TensorFlow Lite,</td>
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<td>Huawei HiAI SDK, Android NN</td>
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<td>More FAE</td>
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HiKey970 Empowers More Product Lines

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<th>Popular AI Stacks</th>
<th>Mainstream OS</th>
<th>More Hardware Interfaces</th>
<th>High Performance Compute</th>
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Ultra96 Features the Zynq® UltraScale+ MPSoC

ARM® Cortex® A53
Application Processor
64-bit Quad-Core

ARM® Cortex® R5
Real-Time Processors
32-bit Dual-Core

Memory Subsystem
High Bandwidth
Low Latency

mali Graphics Processor
ARM Mali-400MP2

Fabric Acceleration
Customizable Engines
High Speed Connectivity

Programmable Logic

Platform & Power Management
Granular Power Control
Functional Safety

Configuration & Security Unit
Anti-Tamper & Trust
Industry Standards

Image processing
Machine learning
Computer vision
…virtually anything else

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XILINX ALL PROGRAMMABLE.
FPGA Logic Example Application: Tiny YOLO Object Detection

Dotted line encapsulates FPGA logic

Trained using PASCAL Visual Object Classes

- Person: person
- Animal: bird, cat, cow, dog, horse, sheep
- Vehicle: airplane, bicycle, boat, bus, car, motorbike, train
- Indoor: bottle, chair, dining table, potted plant, sofa, tv/monitor

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Tiny Yolo On An Image: Performance

![Image showing detection of objects (bicycle, dog, car) in a photo.]
Demo - Ultra96 Live HDMI Feed

ultra96.org
Introducing ROCK960 - AI Ready Platform

Empower your intelligence

www.96rocks.com
ROCK960

- RK3399PRO CPU Complex*
  - 2x Cortex-A72 2GHz
  - 4x Cortex-A53 1.5GHz
  - Mali-T860-4
  - Up to 4GB RAM

- Dedicated NPU
  - Up to 2.4 TOPs

- High Speed Interfaces
  - USB 3.0
  - mini-PCIe
  - 802.11ac WIFI

*PRO version Release Q2 - see www.96rocks.com/blog
ROCK960 - Enterprise Edition (Release Q2)

- RK3399PRO CPU Complex
  - Up to 8GB RAM

- Dedicated NPU
  - Up to 2.4 TOPs

- High Speed Interfaces
  - USB 3.0 x3, USB 2.0 x5
  - PCIe 2.1 x16 slot
  - Dual SATA 3.0, RAID 0/1
  - GBE, 802.11ac WIFI
  - HDMI 2.0/eDP 4K @ 60Hz
  - Dual MIPI CSI

- Remote Management
  - 4G LTE
  - Management Port
Open AID on ROCK960

Open AID simplifies the application development of Vision and Speech on the edge. It brings Domain Libraries for Vision and Speech inferences along with a unified API for developers, Tengine with improved DL frameworks on Caffe, MXNet and TensorFlow for inference, and Heterogeneous Computing Library (HCL) for optimized Arm CPU and Mali GPU utilization.
Jelly, an industry-oriented business robot with remarkable openness and customizability, is widely used in banks, hospitals, restaurants, shopping malls, etc.

The China Merchants Bank customization project has successfully been completed. It would provide customized services in greeting clients and presenting business and other scenarios.
96Boards.ai

Socionext Synquacer EE with Gyrfalcon PCIe AI accelerator
HiKey970 CE Extended
Xilinx Ultra96 CE
Vamrs ROCK960 CE and EE
Arrow Qualcomm DragonBoard820C CE Extended*

* Support planned 2018 H2
Automotive
Linaro Autonomous Vehicle Project

Accelerate the Arm ecosystem in autonomous vehicle control by defining, adopting, improving and promoting open software platforms and scalable software architecture suitable for cars, other vehicles, robotics & drones.
Where is the puck going to ... 2021-2025
Where is the puck going to ... 2021-2025

- Safety & Control Complex
  - Cortex R

- Compute Complex
  - Cortex A
  - AI/ML HW

- Peripheral Interfaces
  - Display
  - Storage
  - Networking

- Sensor Fusion
Architecting an Open Platform

Identify key open source technologies
Involve the OEMs/Tier I & II vendors
Build working Proof of Concept on commodity hardware Boards, Software and Simulators/Cars
Iterate architecture and components
Enable substitution of proprietary technologies
Architecting a Platform

- Secure, Trusted Firmware
- Certified uKernel/L1 Hypervisor
- Secure, OTA Updatable minimal Linux
- Certified Safety RTOS
- OTA Managed Containers
  - IVI • L5 Autonomy
  - Sensor Fusion • AI/ML Inference
- Secure, Trusted Firmware
Evaluating PoC Components

- Kernkonzept L4RE microkernel • ACRN
- Certifiable Zephyr
- Open Source Foundries Linux microPlatform
- Uptane • TUF
- AGL
- OSRF ROS 2.0 • Gazebo
- PX4 Autopilot
- Tier IV Autoware • Baidu Apollo
- Streetdrone Autonomous EV
Please Collaborate, and Enjoy HKG18