Running Android on the Raspberry Pi

Android Pie meets Raspberry Pi

Chris Simmonds

FOSDEM 2019
License

These slides are available under a Creative Commons Attribution-ShareAlike 4.0 license. You can read the full text of the license here http://creativecommons.org/licenses/by-sa/4.0/legalcode
You are free to

- copy, distribute, display, and perform the work
- make derivative works
- make commercial use of the work

Under the following conditions

- Attribution: you must give the original author credit
- Share Alike: if you alter, transform, or build upon this work, you may distribute the resulting work only under a license identical to this one (i.e. include this page exactly as it is)
- For any reuse or distribution, you must make clear to others the license terms of this work
About Chris Simmonds

- Consultant and trainer
- Author of *Mastering Embedded Linux Programming*
- Working with embedded Linux since 1999
- Android since 2009
- Speaker at many conferences and workshops

"Looking after the Inner Penguin" blog at http://2net.co.uk/

@2net_software

https://uk.linkedin.com/in/chrisdsimmonds/
Why?

• Porting Android to a dev board is a great way to learn about Android
• It’s a good testing ground for new ideas
• It’s fun! No, really it is!
What do you need to run Android?

- Hardware from one of the supported architectures
  - ARM, x86 or MIPS, in 32 or 64 bit varieties
- Has a recent version of Linux kernel (v4.4 or later)
- At least 512 MiB RAM
- At least 1 GiB flash storage - e.g. eMMC, SD card
- Touchscreen or external display - e.g. HDMI
- GPU with OpenGL ES 2.0 libraries (more about this later)
Android on dev boards

DragonBoard, Hikey, BeagleBone, WandBoard, Raspberry Pi, Digi ConnectCore ...
Why Raspberry Pi?

- It’s cheap
- Easy to get hold of
- Hackable
- Because it is there
Hasn’t it been done already?

Sure! Here are some notable projects

- **Android RPi**: https://github.com/android-rpi
- **LineageOS**: (unofficial build from KonstaKang) https://konstakang.com/devices/rpi3/LineageOS15.1
- **RTAndroid**: https://embedded.rwth-aachen.de/doku.php?id=en:tools:rtandroid
  - based on research by Igor Kalkov, now merged into emteria.os
- **emteria.os**: https://emteria.com (not open source)
- **Android Things**: https://developer.android.com/things/hardware/raspberrypi (not open source)
What do you need?

- A copy of the Android Open Source Project (AOSP)
- A Linux kernel with Android extensions
- A fair knowledge of the hardware
- All the help you can get from existing projects
- A fairly fast computer
- Time and patience
AOSP and RPi

• What follows is based on Konsta’s port of LineageOS

• My version of the code is at https://github.com/csimmonds/a4rpi-local-manifest

• Challenges posed by the Raspberry Pi
  • Graphics
  • Lack of USB OTG port
Graphics: OpenGL

- We need OpenGL ES 2.0 libraries with Android extensions
- Three options
  - Get a copy of the OpenGLES binaries from the vendor, if they exist (they don’t for Broadcom BCM2708/2835)
  - Use Soft GPU, **Swiftshader**
  - Use Mesa and drm\_hwcomposer
Graphics: Swiftshader

- App 3-D graphics: android.opengl.*
- 2-D graphics: HWUI
- Surface Flinger
- Framework
  - OpenGLES
    - libEGL.so
    - libGLESv1_cm.so
    - libGLESv2.so
- HAL
  - SwiftShader
    - OpenGLES
      - libEGL_swiftshader.so
      - libGLESv1_CM_swiftshader.so
      - libGLESv2_swiftshader.so
- Kernel
  - FBDEV
Graphics: Mesa3d

App 3-D graphics
android.opengl.*

HWUI
2-D graphics

Surface Flinger

libEGL.so
libGLESv1_cm.so
libGLESv2.so

Framework

OpenGLES

mesa
OpenGLES

HAL

drm_hwcomposer
gralloc

libdrm

Kernel

DRM
VC4

Running Android on the Raspberry Pi

Copyright © 2011-2019, 2net Ltd
ADB

• Raspberry Pi only has USB host ports, but ADB needs a USB peripheral port
  • Usually provided by a dual mode USB "On The Go" (OTG) port
  • (Actually, the BCM283x has OTG hardware but it is used internally to bridge the USB host controller, Ethernet, and so on)
• But, we can use ADB over Ethernet instead

```
$ adb connect Android.local
connected to Android.local:5555
$
$ adb shell
rpi3:/ #
```
Current status

- Code for **Android for Raspberry Pi** is at https://github.com/csimmonds/a4rpi-local-manifest
- Android Pie 9.0 r 30
- Using Swiftshader
- Early stages: still many things to do
Delving deeper

- If you would like to discover more about building Android platforms, visit http://www.2net.co.uk/training.html and enquire about training classes for your company
  - 2net training is available world-wide
Relevant links:

Android 4 RPi
https://github.com/csimmonds/a4rpi-local-manifest

My web site
http://www.2net.co.uk

Any questions?