Android System Development Training
X-day session

Title	Android System Development Training
Overview	Understanding the Android Internals (Architecture, Partitions, Filesystems, ADB, Boot, Backup, Recovery, Init, security, emulation etc.,) Understanding the Android Build System Customizing Android for a specific hardware Extending the Android framework Practical labs with the ARM-based Architecture (Ex Raspberry pi) board.
Materials	Check that the course contents correspond to your needs: To be shared later by Vendor, Print and electronic copies of presentations and labs. Electronic copy of lab files.
Duration	**X** days - X hours (X hours per day). % of lectures, % of practical labs.
Trainer	One of the engineers listed on
Language	Oral lectures: English Materials: English.
Audience	Engineers porting Android to new boards Engineers developing products with Android
Prerequisites	**Linux Commands** **Please specify additional inputs as per vendor**

Hardware

The hardware platform should be used for the practical labs of this training session is the **Raspberry pi board**, which features:
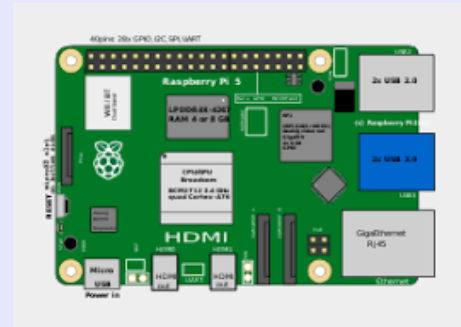
	Pi3 Model B	Pi3 Model B+	Pi4 Model B
Processor	Broadcom BCM2837A1(B0), Quad-core Cortex-A53 64-bit SoC@ 1.2GHz	Broadcom BCM2837B0, Quad-core Cortex-A53 64-bit SoC@ 1.4GHz	Broadcom 2711, Quad-core Cortex-A72 64-bit SoC @ 1.5GHz
Memory	1GB LPDDR2 SDRAM	1GB LPDDR2 SDRAM	1GB, 2GB or 4GB LPDDR4 SDRAM
Connectivity	2.4GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.1, BLE 4 x USB 2.0 ports	2.4GHz / 5.0GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, BLE 4 x USB 2.0 ports, Gigabit Ethernet over USB2.0 (max. 300MPS)	2.4GHz / 5.0GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 5.0, BLE 2 x USB 2.0 / 2 x USB 3.0 ports delivering true Gigabit Ethernet
Access	Extended 40-pin GPIO header	Extended 40-pin GPIO header	Extended 40-pin GPIO header
Video & Sound	1 x full size HDMI, 1 X MIPI DSI display port 1 X MIPI CSI camera port 4 pole stereo output and composite video port	1 x full size HDMI, 1 X MIPI DSI display port 1 X MIPI CSI camera port 4 pole stereo output and composite video port	2 x micro HDMI, 4k video 1 X MIPI DSI display port 1 X MIPI CSI camera port 4 pole stereo output and composite video port
Multimedia	H.264, MPEG-4 decode (1080p30), H.264 encode (1080p30), OpenGL ES 1.1, 2.0 graphics	H.264, MPEG-4 decode (1080p30), H.264 encode (1080p30), OpenGL ES 1.1, 2.0 graphics	H.265 decode (4kp60) H.264 decode (1080p60), H.264 encode (1080p30), OpenGL ES 1.1, 2.0, 3.0 graphics
SD card support	Micro SD format for loading OS & data storage	Micro SD format for loading OS & data storage	Micro SD format for loading OS & data storage
Input Power	5V/2.5A DC via micro USB connector 5V DC via GPIO	5V/2.5A DC via micro USB connector 5V DC via GPIO PoE enabled	5V/3A DC via USB type C connector 5V DC via GPIO PoE enabled

Part 1 - Compiling and booting Android

Lecture - Introduction to Android

- History
- Actors involved.
- Introduction to the Android architecture

Lab - Setup

- Install the tools required to compile
- Fetch the source code
- Get used to Android specific tools

Lecture - Android Source Code and Compilation

- How to use git, repo and gerrit to access sources
- How to find one's way in the code base
- How to compile Android (tools, targets, etc.)

Lab - First Compilation

Using the Android Emulator
- Compile a first root filesystem for the emulator

Lecture - Introduction to the Linux kernel

- Role and general architecture of the kernel
- Kernel features
- Understanding the development process.
- Legal constraints with device drivers.
- Kernel user interface (/proc and /sys)
- Kernel configuration.
- Native and cross-compilation. Generated files.

Lab - Compile and Boot an Android Kernel

Using the Android Emulator
- Compile and Boot an Android Kernel
- Extract the patches from the Android Kernel

Part 2 - Porting Android to a New Board

Lecture - Changes introduced in the Android Kernel

- Major functional changes introduced by Google
- Additions to the kernel
- Mainline kernel status of these patches

Lecture - Android Bootloaders

- What is a bootloader
- Bootloader examples
- The fastboot specifications from Android.

Lab - Supporting a board

Using the Raspberry pi board
- Use the Android's build for the Raspberry pi
- Boot Android on a real board
- Troubleshoot the glitches on the board

Part 3 - Device Development with Android

Lecture – Developing and debugging with ADB

- Presentation of ADB
- Available commands: transfer files, install packages, executing remote commands, log access, networking... all this done from the development machine.
- Examples of commands and combinations useful to debug

Lab – Use ADB

- Learn how to get the system log, to gain access to a shell on the device, push and pull files, etc.

Lecture – Android filesystem layout

- Know where the various software components are installed and mounted, and why it matters.

Lecture – Android build system

- Concepts introduced in the build system
- Architecture of the Makefiles
- Variables and functions available
- Compilation steps
- Add a new device to the build system

Lab – Add a native library to the build

- Create an external library to control a USB/SD based example
- Add this library to the default Android build

Lab - System customization

- Add a device to the build system
- Customize the "About" info, build ID, boot and home screens in your system.

Lecture – Android Native Layer

- Discover the daemons handling the radio, external storage, launching applications, etc.
- Get to know the different components involved in the Android runtime, from the virtual machine to the media framework: Stage-Fright, Flingers, Dalvik...
- Learn how hardware abstraction is done in Android

Lab – Add a native binary to the build

- Get to know the build system and the C library (Bionic) specifics.