Introduction and Agenda

- What do we mean by embedded systems?
- High level tour of embedded related projects
  - Systems
  - OSs
  - Individual programs
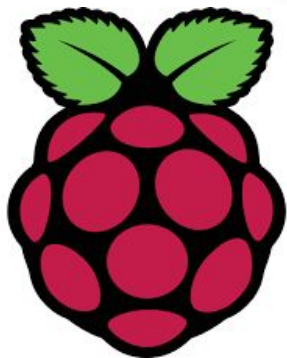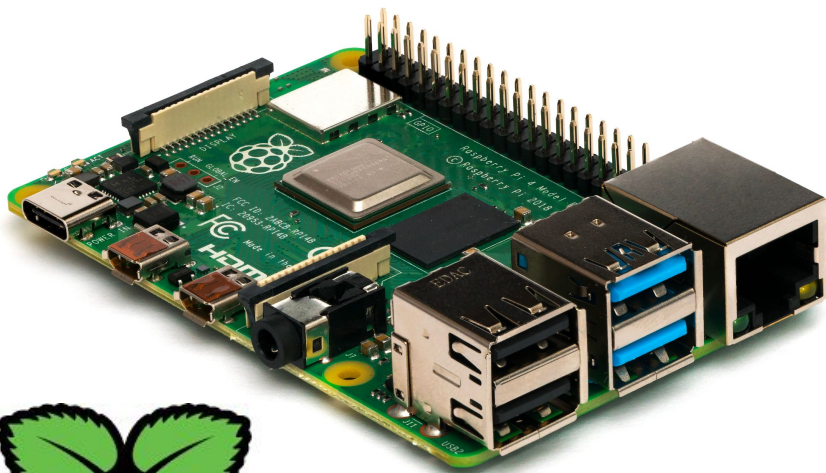
Scope and Expectations

- High level introduction to the embedded Linux landscape
- Pointers to useful information and projects
- No experience or knowledge needed
- Focus on free software

What is an embedded system?

- Developers focus on specific hardware
- Black box experience for the user

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Systems

Android

- Not just for phones
- Development areas
    - Device support
    - OS features
- LineageOS
    - https://lineageos.org/

Other phone/tablet OSs

- Postmarket OS (https://postmarketos.org/)
- Ubuntu Touch (https://ubuntu-touch.io/)
- Plasma Mobile (https://plasma-mobile.org/)

Networking

- DD-WRT (https://dd-wrt.com/)
- OpenWRT (https://openwrt.org/)
- IPFire (https://www.ipfire.org/)

Home automation

- Home Assistant
  - https://www.home-assistant.io/
- openHAB
  - https://www.openhab.org/

Storage

- RockStor
  - https://rockstor.com/
- OpenMediaVault
  - https://www.openmediavault.org/
- Enterprise Storage OS (ESOS)
  - https://www.esos-project.com/

Distributions

Standard desktop distributions

- Can work well, often a good choice
- Familiarity
- Designed for laptops, desktops and servers

Android

- Independent ecosystem
- Build system
- Core OS functionality

Buildroot

- Small, lightweight and simple
- https://buildroot.org/

Yocto

- Very flexible tool for building OSs
- Designed around layering
    - Base OS, board support, applications
- https://www.yoctoproject.org/

Projects

Linux kernel

- Hardware enablement
  - Describe the hardware
    - Upstreaming code from vendor trees
  - Drivers
  - Subsystem features
- Performance and application support

Device Tree

```
gpu: gpu@14ac0000 {
    compatible = "samsung,exynos5433-mali", "arm,mali-t760";
    reg = <0x14ac0000 0x5000>;
    interrupts = <GIC_SPI 241 IRQ_TYPE_LEVEL_HIGH>,
                 <GIC_SPI 242 IRQ_TYPE_LEVEL_HIGH>,
                 <GIC_SPI 240 IRQ_TYPE_LEVEL_HIGH>;
    interrupt-names = "job", "mmu", "gpu";
    status = "disabled";
    /* TODO: operating points for DVFS, cooling device */
};
```

```
mmc_0: mmc@15740000 {
    compatible = "samsung,exynos7-dw-mshc-smu";

    …

    clocks = <&clock_fsys1 ACLK_MMC0>,
            <&clock_top1 CLK_SCLK_MMC0>;
    clock-names = "biu", "ciu";
};


clock_top1: clock-controller@105e0000 {
    compatible = "samsung,exynos7-clock-top1";

    …

};
```

Kernel subsystems

- GPIO
- PWM
- IIO
- Input
- Display
- Audio

Firmware

- u-boot (https://u-boot.readthedocs.io/en/latest/)
- TianoCore (https://www.tianocore.org/)

Zephyr

- Real Time OS for small devices/utility processors
- https://zephyrproject.org/

- Sound Open Firmware
- https://www.sofproject.org/

Summary

Application focused
- Solve a problem
- Web apps to building your own hardware

Hardware focused
- Hardware description
- Drivers
- Running existing applications

Endless playground!

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Thank you for joining us today!

We hope it will be helpful in your journey to learning more about effective and productive participation in open source projects. We will leave you with a few additional resources for your continued learning:

- The LF Mentoring Program is designed to help new developers with necessary skills and resources to experiment, learn and contribute effectively to open source communities.
- Outreachy remote internships program supports diversity in open source and free software
- Linux Foundation Training offers a wide range of free courses, webinars, tutorials and publications to help you explore the open source technology landscape.
- Linux Foundation Events also provide educational content across a range of skill levels and topics, as well as the chance to meet others in the community, to collaborate, exchange ideas, expand job opportunities and more. You can find all events at events.linuxfoundation.org.