getting started with the Yocto Project and systemd

ESE3005

Yocto Project

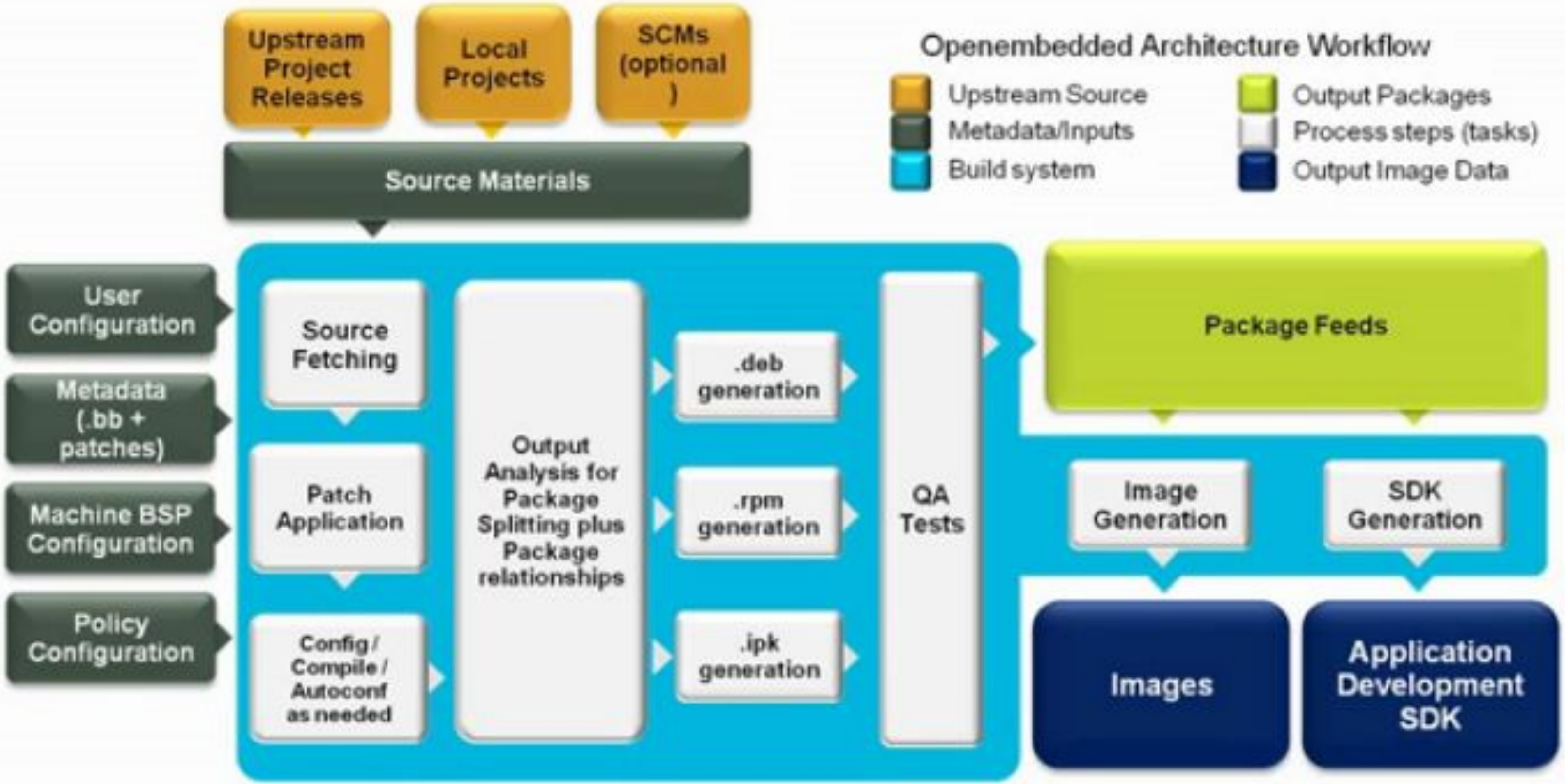
- backed by a number of large tech corporations and individuals, in order to expedite getting embedded Linux systems working!
- hardware companies like IBM and TI have a vested interest in getting IoT hardware systems working (so they can sell their chips!)
- getting a Linux OS working for a newly designed embedded system is not a simple matter (there is no off-the-shelf distribution like Beagleboard Debian or Raspbian!)
- although there are several embedded OS “generic” operating systems available, notably: Android, Angstrom, OpenWrt;

Yocto Project Cont’d

- Yocto is not the only embedded Linux Build System:
    - Baserock
    - Buildroot
    - OpenEmbedded
- What is hard about a custom Linux distribution?
    - Bootloader
    - Kernel
    - Device Drivers
    - Life Cycle Management
    - Application Software Management

Openembedded Architecture Workflow

- 🟧 Upstream Source
- ⬛ Metadata/Inputs
- 🟦 Build system
- 🟩 Output Packages
- ⬜ Process steps (tasks)
- 🟦 Output Image Data



Upstream Project Releases

Local Projects

SCMs (optional)

Source Materials

User Configuration

Metadata (.bb + patches)

Machine BSP Configuration

Policy Configuration

Source Fetching

Patch Application

Config / Compile / Autoconf as needed

Output Analysis for Package Splitting plus Package relationships

.deb generation

.rpm generation

.ipk generation

QA Tests

Package Feeds

Image Generation

SDK Generation

Images

Application Development SDK

yocto PROJECT

THE LINUX FOUNDATION

Yocto: fetch, extract, patch, configure, build...

- essentially, you use various configuration files and special script files called “recipes” to direct the build system in how to construct your Linux image
- the image is then “flashed” on your embedded system
  - in this unit, we’ll be emulating the embedded system, so you won’t have to worry about flashing a physical device!
- the Yocto’s BitBake program then runs, based on the configuration files and recipes goes through a repetitive process involving the same steps:
      - fetch (from many different sources on the Internet)
      - extract (un-zipping, un-archiving)
      - patch (updating the source code)
      - configure (configuring the build)
      - build (compiling, linking)
      - install (placing the program in the right directories, etc.)
      - package (creating the archive or image)

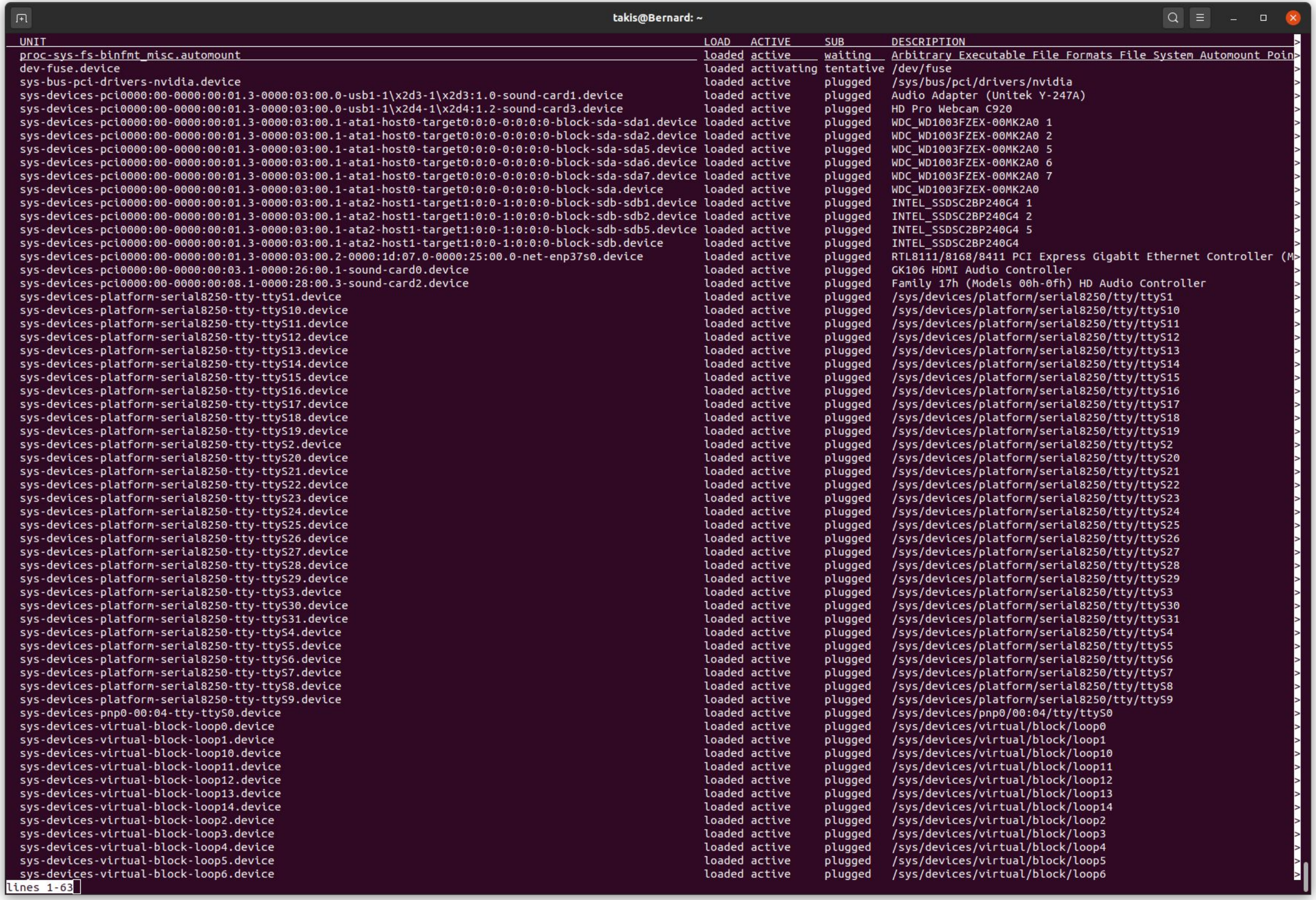
systemd

- originally developed by Lennart Poettering and Kay Sievers, two software engineers working at RedHat
- a software suite consisting of various system components
  - some components work as a “glue” between applications and the kernel
  - the *system and service manager*
- the predecessor to the systemd startup and service manager is System V init (sometimes called “SysV”)
  - drawback of SysV is the slow boot process:
    - SysV waits for one task to complete, before starting the next
    - whereas systemd starts up services in parallel, this was one of systemd’s primary initial aims

systemd cont’d

- What are services? Examples include:
  - webservers (Apache server)
  - ssh (secure shell), interfacing kernel and /bin/bash
  - uart communication management
  - low-level hardware control (graphics, sound, etc.)
- core components:
  - *systemd*: the start-up and service manager itself
  - *systemctl*: a command used to probe *systemd*
  - *systemd-analyze*: system state information, including boot-up performance
  - other components also provide login management, journal logging, device management, and more
- systemd has been criticized for taking on too many functions, diverting from its original mission; nevertheless, this has not slowed its widespread adoption by various Linux distributions

typing the *systemctl* command at the Linux prompt yields:



```
  UNIT                                                                                                  LOAD   ACTIVE     SUB       DESCRIPTION                                                 >
  proc-sys-fs-binfmt_misc.automount                                                                     loaded active     waiting   Arbitrary Executable File Formats File System Automount Poin>
  dev-fuse.device                                                                                       loaded activating tentative /dev/fuse                                                   >
  sys-bus-pci-drivers-nvidia.device                                                                     loaded active     plugged   /sys/bus/pci/drivers/nvidia                                 >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.0-usb1-1\x2d3-1\x2d3:1.0-sound-card1.device              loaded active     plugged   Audio Adapter (Unitek Y-247A)                               >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.0-usb1-1\x2d4-1\x2d4:1.2-sound-card3.device              loaded active     plugged   HD Pro Webcam C920                                          >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.1-ata1-host0-target0:0:0-0:0:0:0-block-sda-sda1.device loaded active     plugged   WDC_WD1003FZEX-00MK2A0 1                                    >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.1-ata1-host0-target0:0:0-0:0:0:0-block-sda-sda2.device loaded active     plugged   WDC_WD1003FZEX-00MK2A0 2                                    >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.1-ata1-host0-target0:0:0-0:0:0:0-block-sda-sda5.device loaded active     plugged   WDC_WD1003FZEX-00MK2A0 5                                    >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.1-ata1-host0-target0:0:0-0:0:0:0-block-sda-sda6.device loaded active     plugged   WDC_WD1003FZEX-00MK2A0 6                                    >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.1-ata1-host0-target0:0:0-0:0:0:0-block-sda-sda7.device loaded active     plugged   WDC_WD1003FZEX-00MK2A0 7                                    >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.1-ata1-host0-target0:0:0-0:0:0:0-block-sda.device      loaded active     plugged   WDC_WD1003FZEX-00MK2A0                                      >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.1-ata2-host1-target1:0:0-1:0:0:0-block-sdb-sdb1.device loaded active     plugged   INTEL_SSDSC2BP240G4 1                                       >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.1-ata2-host1-target1:0:0-1:0:0:0-block-sdb-sdb2.device loaded active     plugged   INTEL_SSDSC2BP240G4 2                                       >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.1-ata2-host1-target1:0:0-1:0:0:0-block-sdb-sdb5.device loaded active     plugged   INTEL_SSDSC2BP240G4 5                                       >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.1-ata2-host1-target1:0:0-1:0:0:0-block-sdb.device      loaded active     plugged   INTEL_SSDSC2BP240G4                                         >
  sys-devices-pci0000:00-0000:00:01.3-0000:03:00.2-0000:1d:07.0-0000:25:00.0-net-enp37s0.device         loaded active     plugged   RTL8111/8168/8411 PCI Express Gigabit Ethernet Controller (M>
  sys-devices-pci0000:00-0000:00:03.1-0000:26:00.1-sound-card0.device                                   loaded active     plugged   GK106 HDMI Audio Controller                                 >
  sys-devices-pci0000:00-0000:00:08.1-0000:28:00.3-sound-card2.device                                   loaded active     plugged   Family 17h (Models 00h-0fh) HD Audio Controller             >
  sys-devices-platform-serial8250-tty-ttyS1.device                                                      loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS1                  >
  sys-devices-platform-serial8250-tty-ttyS10.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS10                 >
  sys-devices-platform-serial8250-tty-ttyS11.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS11                 >
  sys-devices-platform-serial8250-tty-ttyS12.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS12                 >
  sys-devices-platform-serial8250-tty-ttyS13.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS13                 >
  sys-devices-platform-serial8250-tty-ttyS14.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS14                 >
  sys-devices-platform-serial8250-tty-ttyS15.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS15                 >
  sys-devices-platform-serial8250-tty-ttyS16.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS16                 >
  sys-devices-platform-serial8250-tty-ttyS17.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS17                 >
  sys-devices-platform-serial8250-tty-ttyS18.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS18                 >
  sys-devices-platform-serial8250-tty-ttyS19.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS19                 >
  sys-devices-platform-serial8250-tty-ttyS2.device                                                      loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS2                  >
  sys-devices-platform-serial8250-tty-ttyS20.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS20                 >
  sys-devices-platform-serial8250-tty-ttyS21.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS21                 >
  sys-devices-platform-serial8250-tty-ttyS22.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS22                 >
  sys-devices-platform-serial8250-tty-ttyS23.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS23                 >
  sys-devices-platform-serial8250-tty-ttyS24.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS24                 >
  sys-devices-platform-serial8250-tty-ttyS25.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS25                 >
  sys-devices-platform-serial8250-tty-ttyS26.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS26                 >
  sys-devices-platform-serial8250-tty-ttyS27.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS27                 >
  sys-devices-platform-serial8250-tty-ttyS28.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS28                 >
  sys-devices-platform-serial8250-tty-ttyS29.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS29                 >
  sys-devices-platform-serial8250-tty-ttyS3.device                                                      loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS3                  >
  sys-devices-platform-serial8250-tty-ttyS30.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS30                 >
  sys-devices-platform-serial8250-tty-ttyS31.device                                                     loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS31                 >
  sys-devices-platform-serial8250-tty-ttyS4.device                                                      loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS4                  >
  sys-devices-platform-serial8250-tty-ttyS5.device                                                      loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS5                  >
  sys-devices-platform-serial8250-tty-ttyS6.device                                                      loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS6                  >
  sys-devices-platform-serial8250-tty-ttyS7.device                                                      loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS7                  >
  sys-devices-platform-serial8250-tty-ttyS8.device                                                      loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS8                  >
  sys-devices-platform-serial8250-tty-ttyS9.device                                                      loaded active     plugged   /sys/devices/platform/serial8250/tty/ttyS9                  >
  sys-devices-pnp0-00:04-tty-ttyS0.device                                                               loaded active     plugged   /sys/devices/pnp0/00:04/tty/ttyS0                           >
  sys-devices-virtual-block-loop0.device                                                                loaded active     plugged   /sys/devices/virtual/block/loop0                            >
  sys-devices-virtual-block-loop1.device                                                                loaded active     plugged   /sys/devices/virtual/block/loop1                            >
  sys-devices-virtual-block-loop10.device                                                               loaded active     plugged   /sys/devices/virtual/block/loop10                           >
  sys-devices-virtual-block-loop11.device                                                               loaded active     plugged   /sys/devices/virtual/block/loop11                           >
  sys-devices-virtual-block-loop12.device                                                               loaded active     plugged   /sys/devices/virtual/block/loop12                           >
  sys-devices-virtual-block-loop13.device                                                               loaded active     plugged   /sys/devices/virtual/block/loop13                           >
  sys-devices-virtual-block-loop14.device                                                               loaded active     plugged   /sys/devices/virtual/block/loop14                           >
  sys-devices-virtual-block-loop2.device                                                                loaded active     plugged   /sys/devices/virtual/block/loop2                            >
  sys-devices-virtual-block-loop3.device                                                                loaded active     plugged   /sys/devices/virtual/block/loop3                            >
  sys-devices-virtual-block-loop4.device                                                                loaded active     plugged   /sys/devices/virtual/block/loop4                            >
  sys-devices-virtual-block-loop5.device                                                                loaded active     plugged   /sys/devices/virtual/block/loop5                            >
  sys-devices-virtual-block-loop6.device                                                                loaded active     plugged   /sys/devices/virtual/block/loop6                            >
lines 1-63
```

systemd (cont’d)

further reading:

see pp. 85-90, Exploring Beaglebone, 2nd Edition