

Agenda

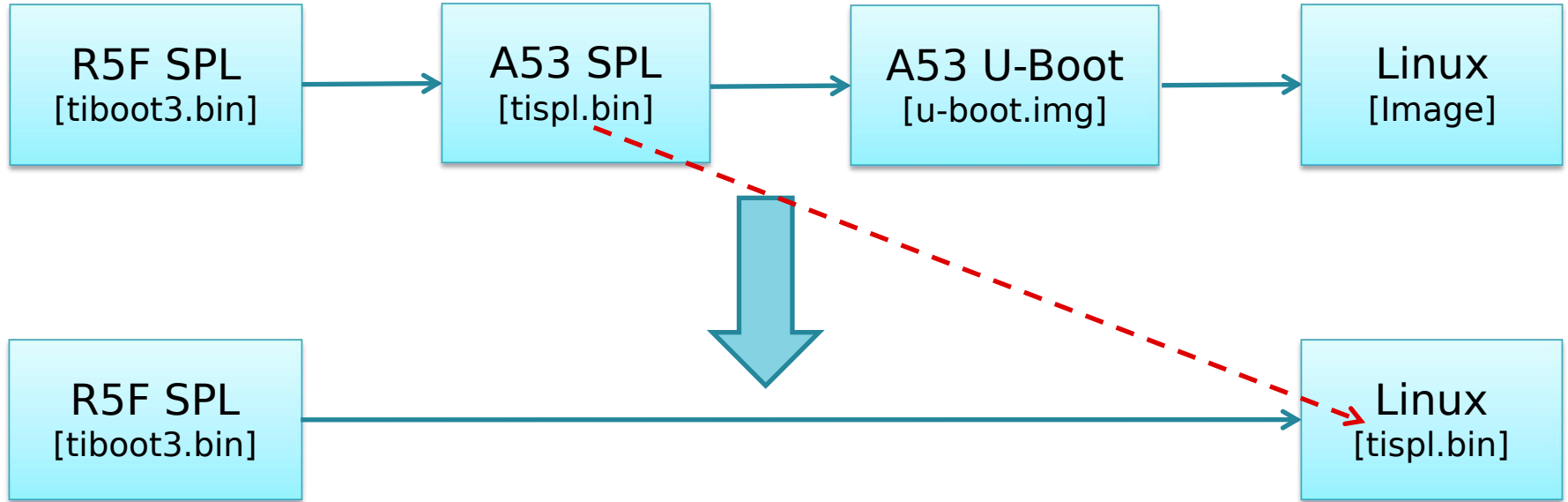
- Boot time optimization outlines
- U-Boot optimization
- Kernel optimization
- Linux init optimization
- Summary

Boot time optimization outlines

- Hardware
 - Use fast boot media and clock
 - OSPI boot: OSPI PHY calibration
- Software
 - Simplify boot flow
 - Improve boot execution time
 - Remove unused components, reduce image size
 - Improve image loading time



SPL + linux boot flow optimization



tispl.bin is a FIT image

```
$ dumpimage -l tispl.bin
```

Image 0 (atf)

Data Size: 45801 Bytes = 44.73 KiB = 0.04 MiB

Load Address: 0x9e780000

Image 1 (tee)

Data Size: 421601 Bytes = 411.72 KiB = 0.40 MiB

Image 2 (dm)

Data Size: 154169 Bytes = 150.56 KiB = 0.15 MiB

Load Address: 0x89000000

Image 3 (spl)

Data Size: 318297 Bytes = 310.84 KiB = 0.30 MiB

Load Address: 0x80080000

Entry Point: 0x80080000

Image 4 (k3-am625-sk.dtb)

Data Size: 20754 Bytes = 20.27 KiB = 0.02 MiB

tispl.bin for kernel

```
$ dumpimage -l tispl.bin
```

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Image 4 (k3-am625-sk.dtb)

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Replace with kernel
Image

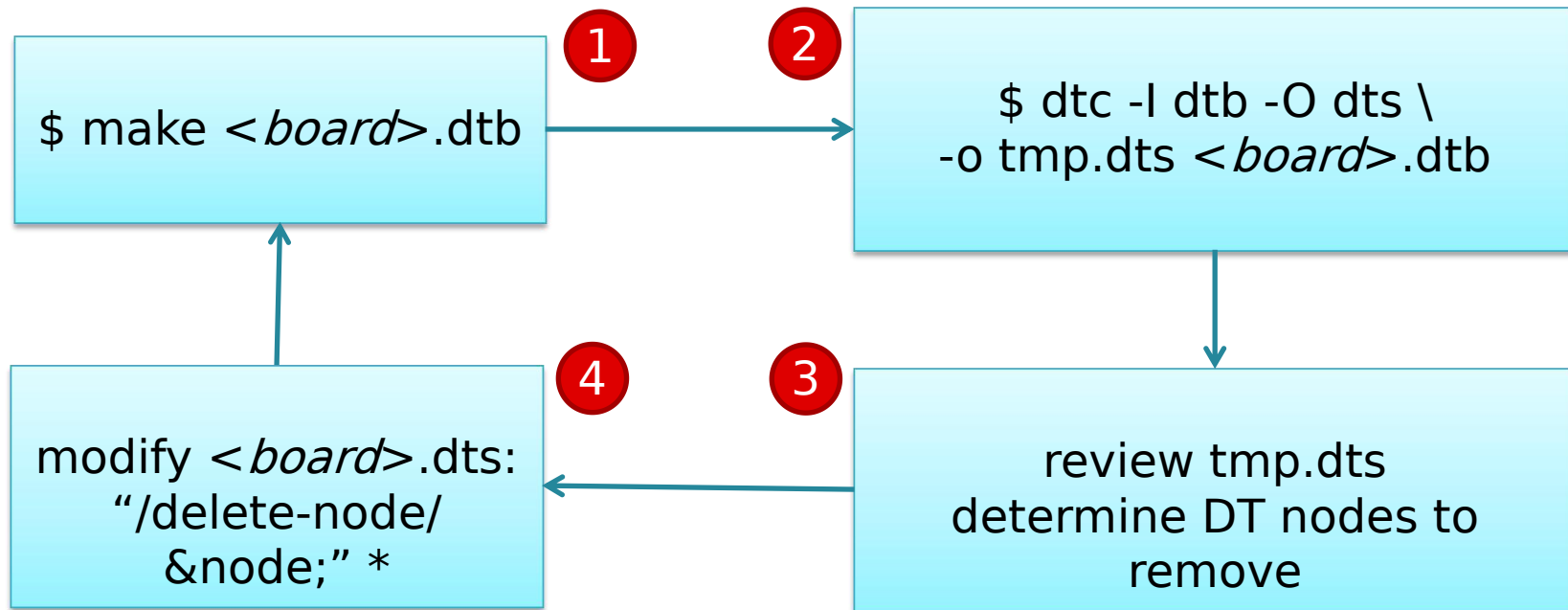
Replace with kernel dtb

Kernel **tispl.bin** creation

- Create ITS file
 - ITS describes binary filename and load location for FIT image
- ```
$ cd <SDK>/board-support/prebuilt-images/
$ DM=<dm_firmware> ../u-boot-202*/tools/k3_fit_atf.sh
 <atf_load_address> <kernel_dtb> > tispl.its
```
- Modify tispl.its to replace spl image/dtb with kernel Image/dtb
  - Generate tispl.bin

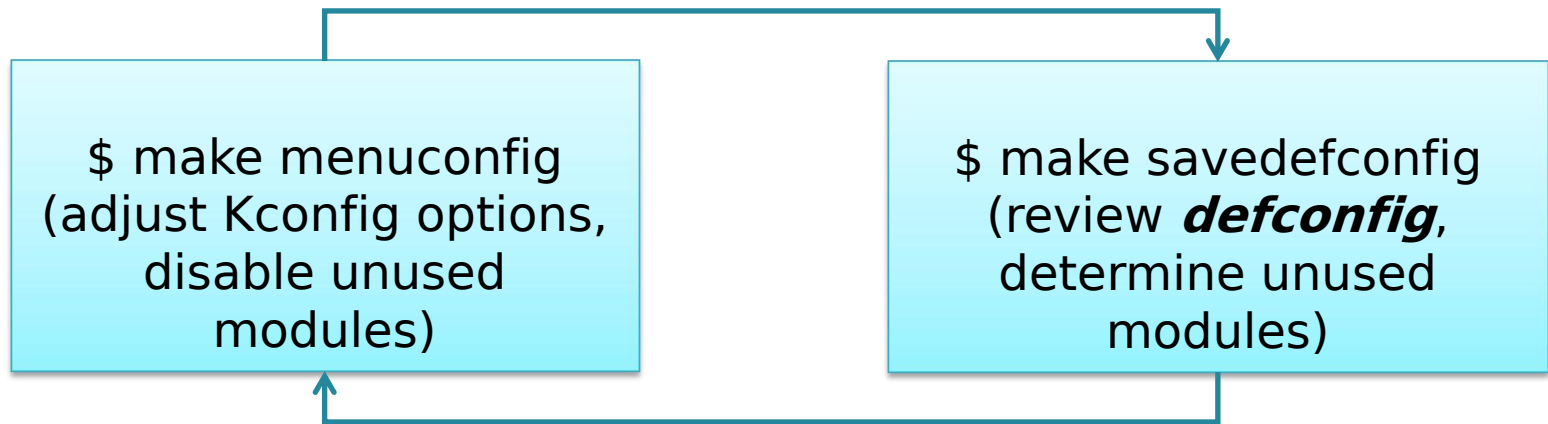
```
$ mkimage -E -f tispl.its tispl.bin
```

# Reduce kernel DTB filesize



\* Use **'/delete-node/ &node;'** instead of **'status = "disabled";'** for unused DT nodes.

# Reduce kernel Image filesize



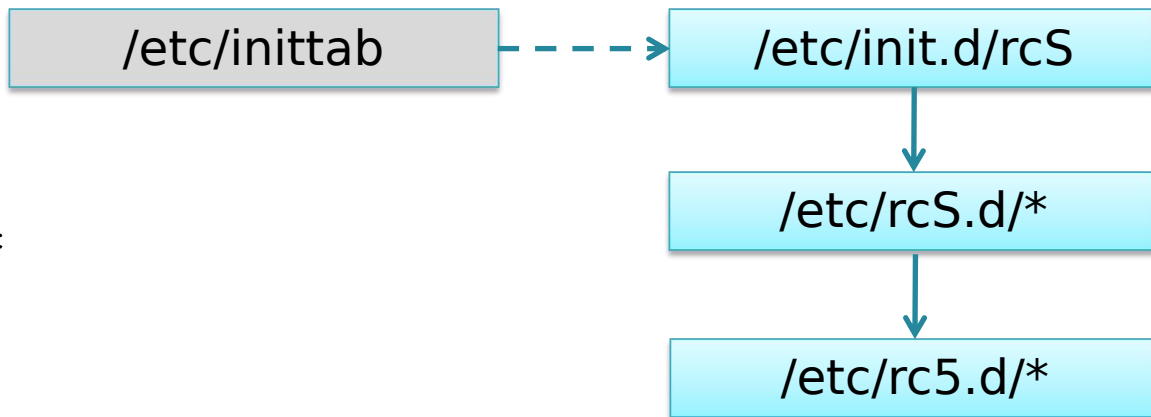


# Linux init optimization

- Linux PID 1 process
  - /sbin/init
- SysVinit vs. systemd

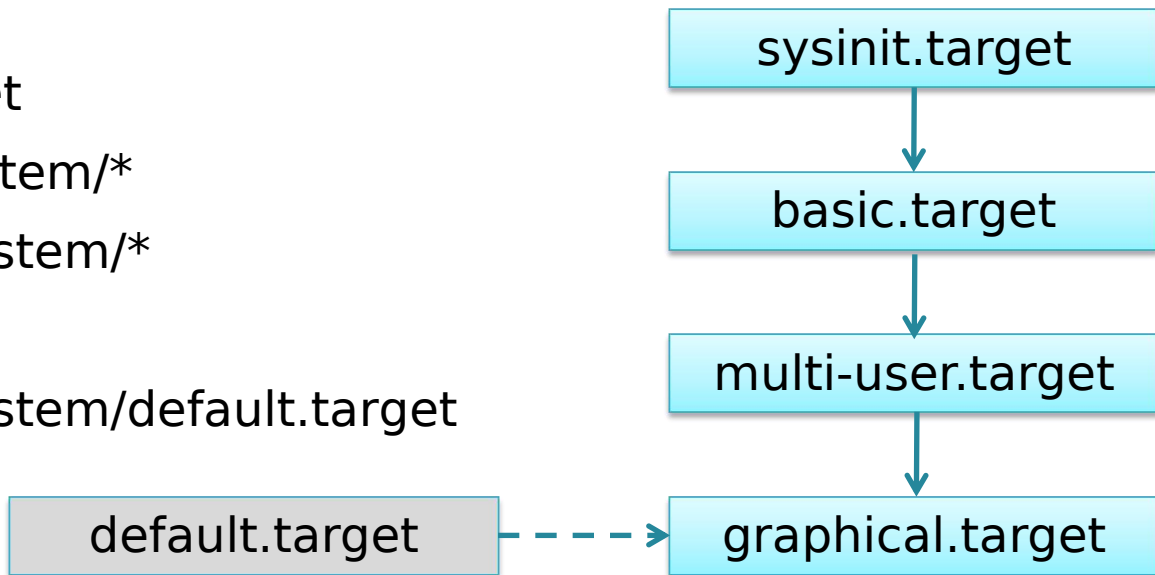
# SysVInit

- System V Unix init process
- Init scripts:
  - /etc/init.d/\*
- Grouping:
  - /etc/rcS.d/\*
  - /etc/rc[0-6].d/\*
- Boot entry:
  - /etc/inittab



# systemd

- systemd is a suite of basic building blocks for a Linux system. It provides a system and service manager that runs as PID 1 and starts the rest of the system. [<https://systemd.io/>]
- Unit files:
  - \*.service, \*.target
  - /lib/systemd/system/\*
  - /etc/systemd/system/\*
- Boot entry:
  - /etc/systemd/system/default.target



# Start application before Linux init

- PID 1 process
  - /sbin/init
- Example: toggle a gpio



```
#!/bin/sh
if [x"$1" == x]; then
 mount -t sysfs sysfs /sys
 cd /sys/class/gpio/
 echo 463 > export
 cd gpio463
 echo out > direction
 echo 'trigger gpio'
 echo 1 > value
fi

for sysvinit init
exec /sbin/init.sysvinit $*

for systemd init
exec /lib/systemd/systemd $*
```

# Optimized Linux boot log example

```
[2023-03-28 10:29:44.680] U-Boot SPL 2021.01-00007-g55a1c1d4dea5-dirty (Mar 27 2023 - 14:09:47 -0500)
[2023-03-28 10:29:44.712] SYSFW ABI: 3.1 (firmware rev 0x0008 '8.6.4--v08.06.04 (Chill Capybar)')
[2023-03-28 10:29:44.744] SPL initial stack usage: 13424 bytes
[2023-03-28 10:29:44.776] Trying to boot from MMC1
[2023-03-28 10:29:44.952] Starting ATF on ARM64 core...
[2023-03-28 10:29:44.952]
[2023-03-28 10:29:44.952] NOTICE: BL31: v2.8(release):v2.8-226-g2fcd408bb3-dirty
[2023-03-28 10:29:44.968] NOTICE: BL31: Built : 05:06:58, Feb 24 2023
[2023-03-28 10:29:45.000] [0.000000] Booting Linux on physical CPU 0x0000000000 [0x410fd034]
[2023-03-28 10:29:45.016] [0.000000] Linux version 5.10.168-00011-g9051c208da73-dirty
[2023-03-28 10:29:45.016] [0.000000] Machine model: Texas Instruments AM625 SK
[2023-03-28 10:29:45.016] [0.000000] earlycon: ns16550a0 at MMIO32 0x0000000002800000 (options "")
[2023-03-28 10:29:45.032] [0.000000] printk: bootconsole [ns16550a0] enabled
[2023-03-28 10:29:45.384] trigger gpio
INIT: version 2.96 booting
INIT: Entering runlevel: 5
[2023-03-28 10:29:45.656] am62xx-evm login:
```

- Reduce console messages -- UART is slow!
  - Add “loglevel=1” to U-Boot ***bootargs*** parameter

# Boot time optimization summary

- U-Boot - SPL Falcon mode
  - Remove A53 SPL/U-Boot
  - R5 SPL directly boot kernel
- Kernel
  - Reduce image size
    - Remove unused device tree nodes
    - Remove unused kernel modules
  - Reduce UART console log level
- Linux Init - Simplify boot scripts
  - SysVInit - init.d scripts
  - systemd - unit files
  - PID 1 customization