Snag It, Flash It, Ship It : Rethinking Factory Flashing

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Introduction to the Speakers

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About us: TI Processors and Open Source

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- ✔️Upstream FIRST mentality!
- ✔️Decades of contribution and collaboration
- ✔️Focus on long term, sustainable and quality products
- ✔️Upstream & opensource ecosystem in device architecture
- ✔️Ingrained culture to give back to the community

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Factory Flashing Methods

Before Soldering

Memory Chip is programmed while its standalone.

Requires Specialized hardware like a gang programmer.

Limited flexibility as post production updates are difficult.

Generally faster

After Soldering

Memory chip is programmed after it is soldered to board.

Utilizes standard on board connectors like USB, UART, JTAG.

More flexible as flashing can be done without removing the chip.

Limited by interface speed

Problem Statement

Time-Consuming Flashing

Slow, error-prone processes, delaying production timelines

GUI Centric tools

Tools designed primarily for GUI are not ease to automate.

No Scalability

Legacy tools struggle with high volume of production creating bottlenecks.

Closed Source Tools

Many vendor provided tools are proprietary, difficult to customize and integrate.

Poor Cross Platform

Many existing flashing tools are platform-dependent (e.g., Windows or Linux-only.

Vendor Specific

Tightly coupled to a single vendor, creating compatibility issues.

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U-Boot Flash Writer

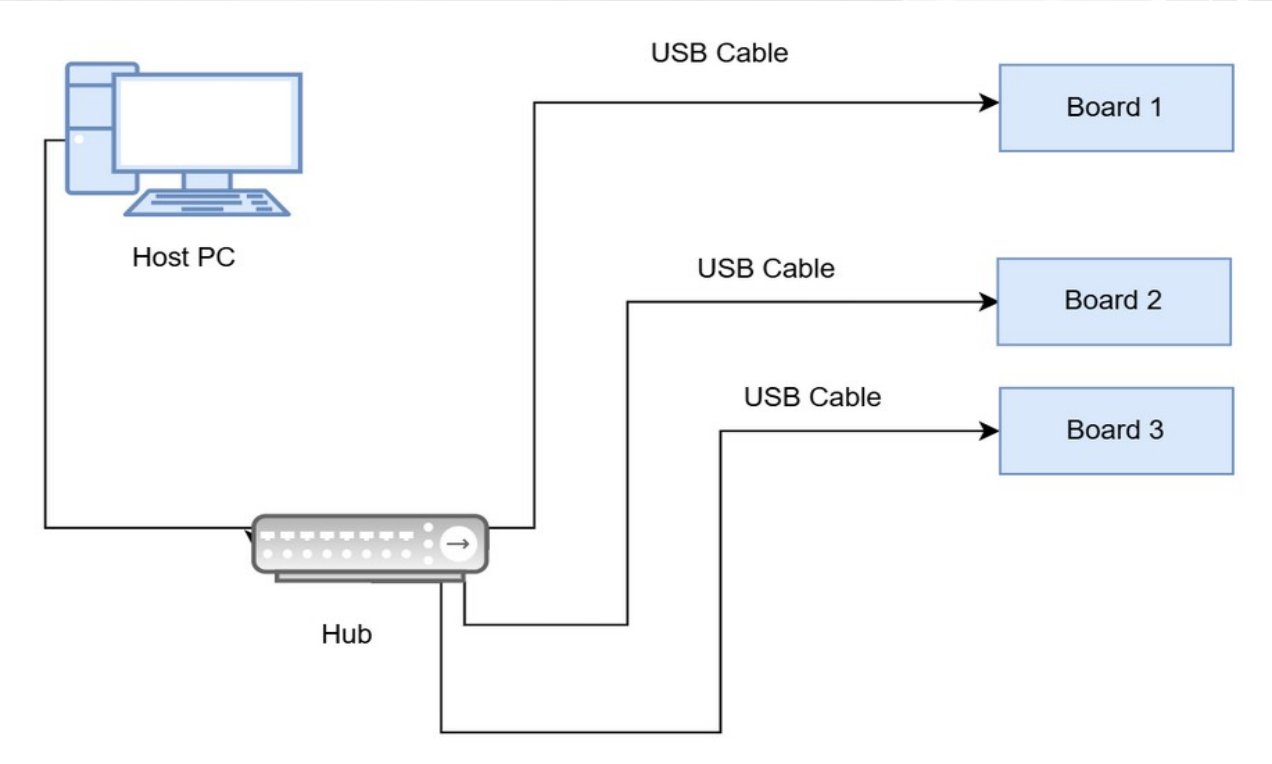
Uses dfu-util - an open source tool for host side implementation of the DFU

Written in python. Supports both Linux and Windows OS

Supports parallel flashing

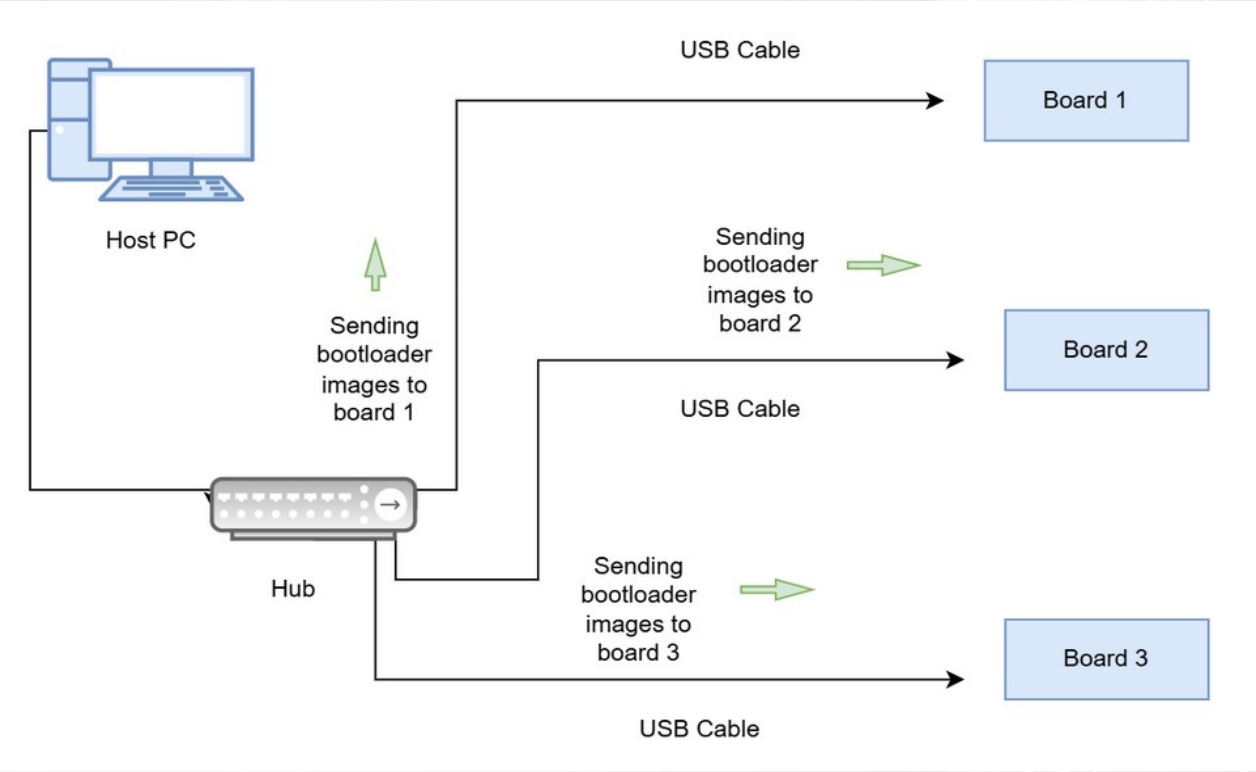
Source - processor-sdk/uboot-flash-writer

Flow



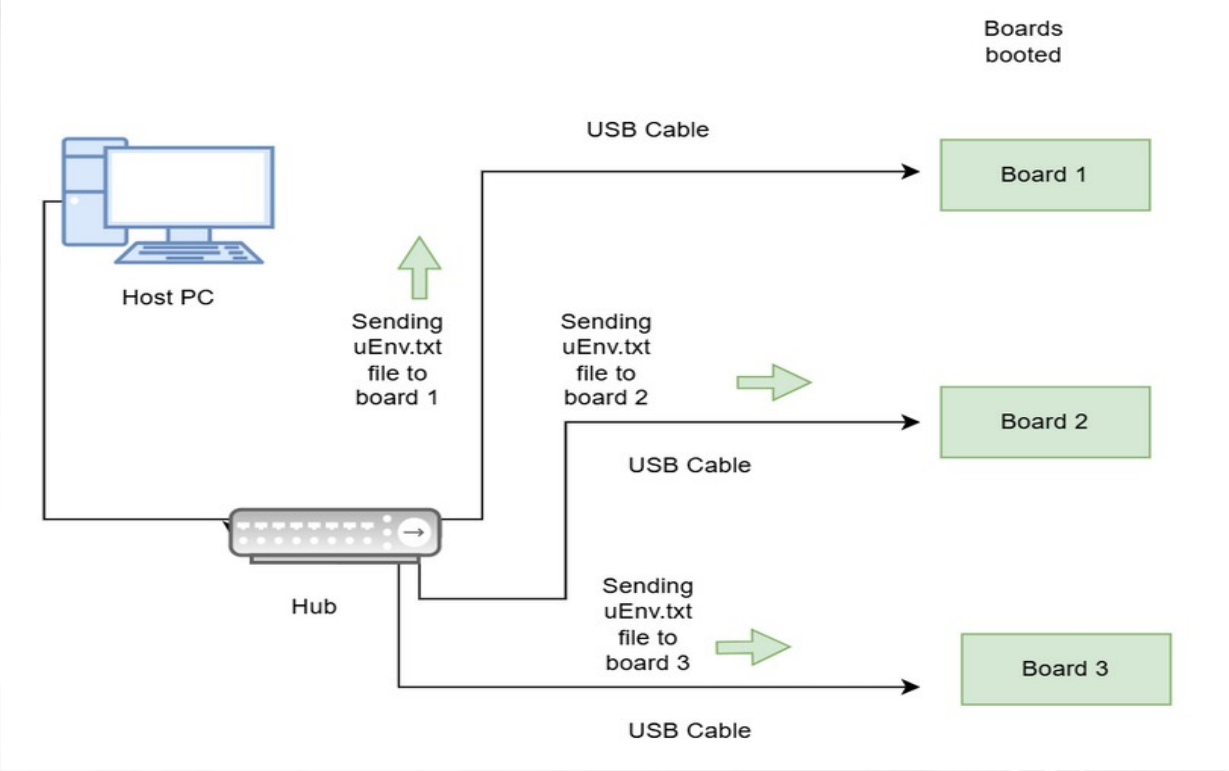
Step 1: Host PC is connected to boards via USB

Flow (continued)



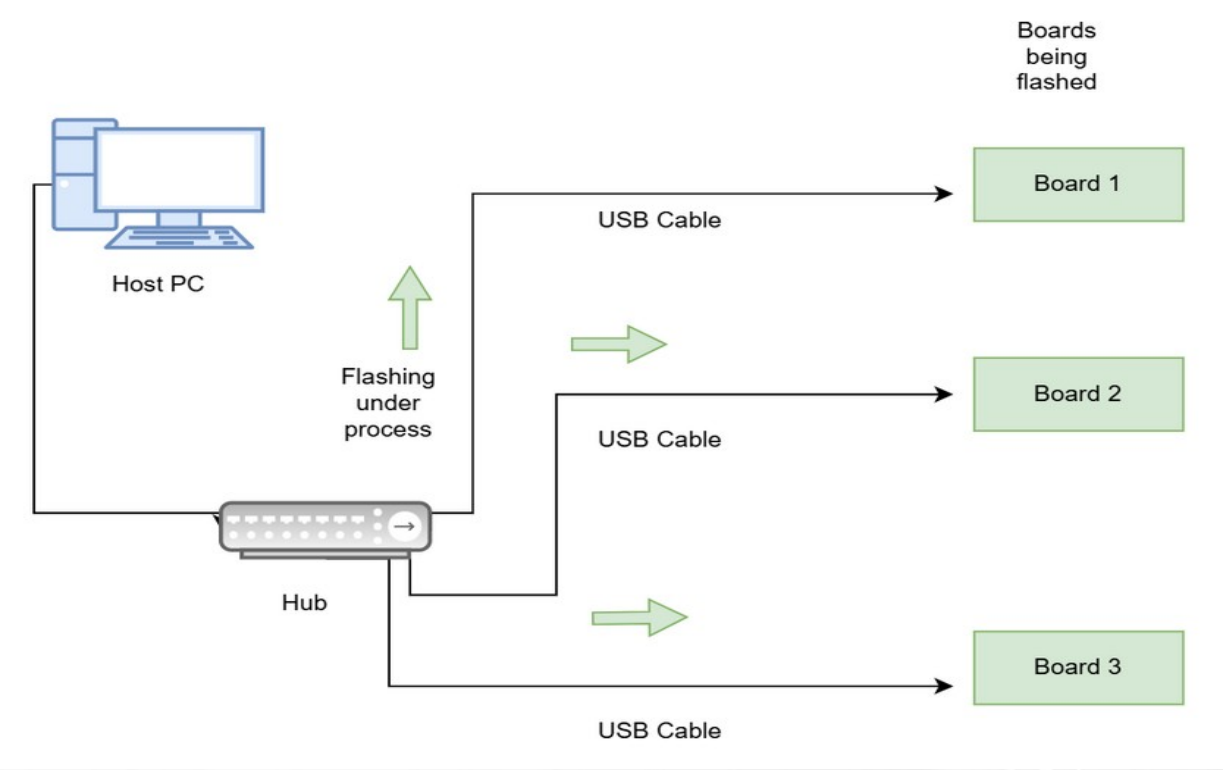
Step 2: Board recovery

Flow (continued)



Step 3: Send uEnv.txt file from host PC to boards

Flow (continued)



Step 4: Flashing under process

Features

- Factory Flashing
- Error Reporting
- Supports both Linux and Windows
- Multiple boot media

Limitations

Needs U-Boot Support

No GUI

Speed

Snagboot

Snagboot in 2023: a CLI tool for Linux

Snagrecover

Targets USB-recovery mode

SoC-specific

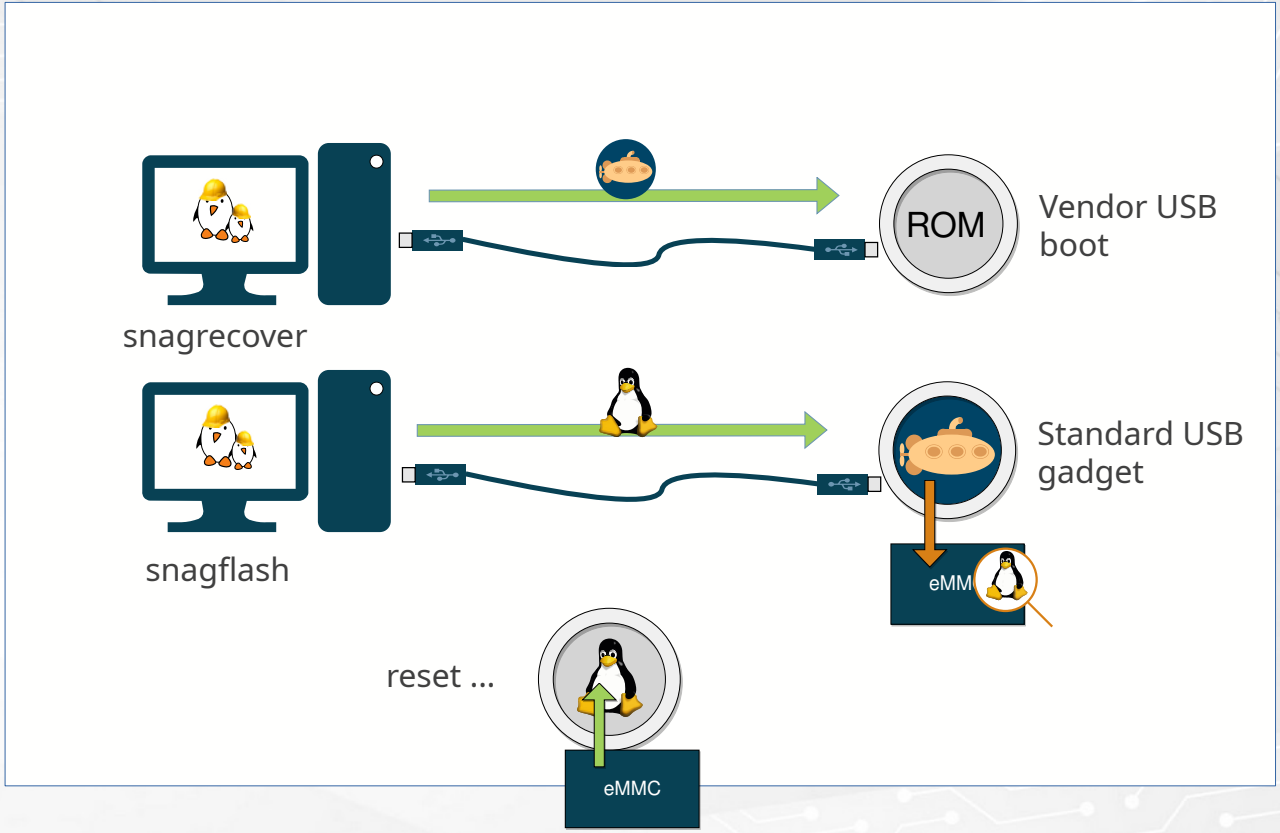
Downloads and runs U-Boot on the target

Snagflash

Targets a standardized USB gadget

Fastboot, DFU or UMS

Writes data to non-volatile storage


ROM
Vendor USB
boot
snagrecover
Standard USB
gadget
snagflash
eMM
reset ...
eMMC

Current support range

- NXP i.MX
- Microchip SAMA5
- TI AM335, AM6x
- ST STM32MP
- Allwinner SUNXI
- Intel KeemBay
- Broadcom BCM2711 /2712
- Xilinx ZynqMP

Firmware Configuration Files

```
tiboot3:

 path: /path/to/tiboot3.bin

tispl:

 path: /path/to/tispl.bin

u-boot:

 path: /path/to/u-boot.img
```

example: AM62x

Snagflash Protocols

DFU:

```
snagflash -P dfu -p 0483:df11 -D 0:binaries/u-boot.stm32
```

UMS:

```
snagflash -P ums -s binaries/u-boot.stm32 -b /dev/sdb1
```

Fastboot:

```
snagflash -P fastboot -p ... -f download:boot.img -f flash:0:1
```

Fastboot-Uboot:

```
snagflash -P fastboot-uboot -p 0483:0afb -I flash.cmd
```

https://github.com/bootlin/snagboot/blob/main/docs/snagflash.md

From Snagboot to Snagfactory

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Building upon Snagboot

Snagboot

Recovery tool
Flashing tool
CLI and Linux-oriented

+ Windows 10/11 support

+ Graphical User Interface

+ Parallelization of tasks

Development milestones

v1.0 Initial Snagboot release

May 23, 2023

Supported 6 SoC families, DFU UMS and Fastboot

v1.3 Last v1 release

Feb 24, 2024

Mostly bug fixes and small improvements

v2.0 Public Snagfactory release

Nov 20, 2024

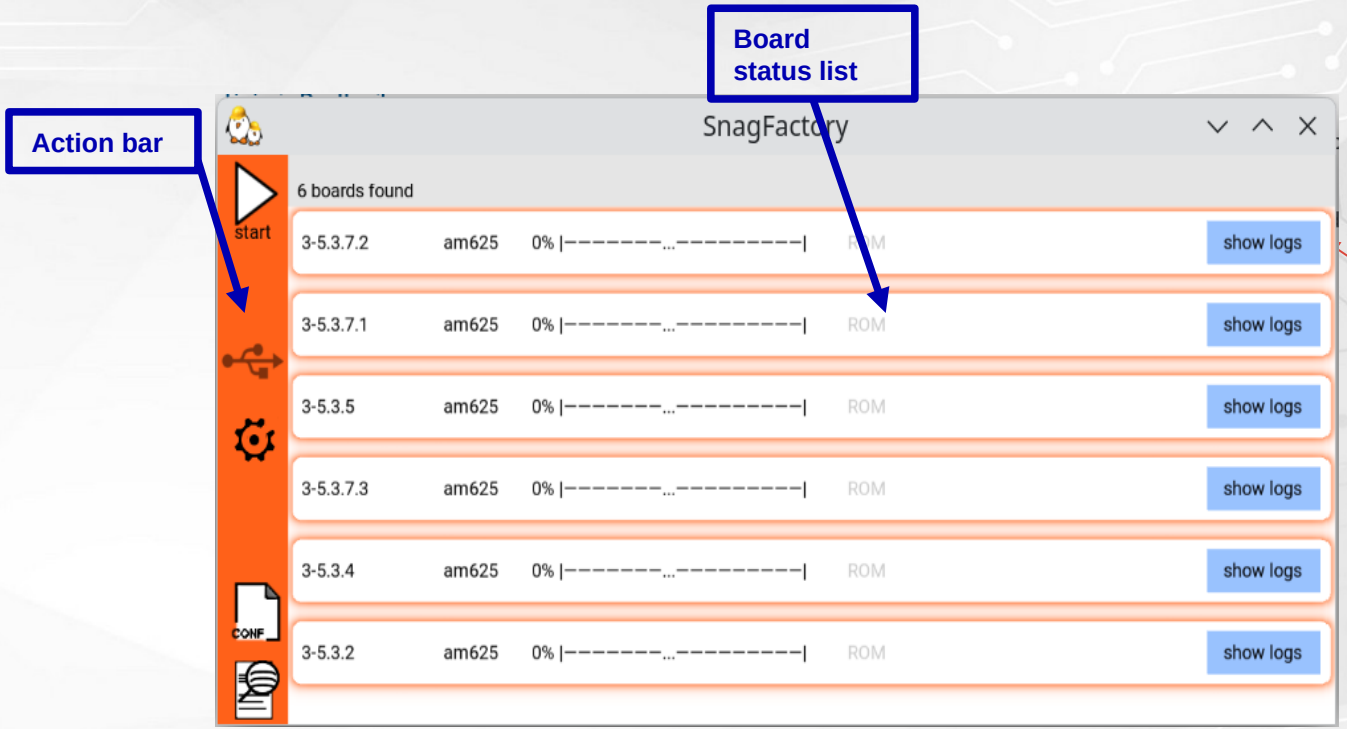
Windows support, Snagfactory tool, AM6x support, fastboot-uboot protocol

v2.4 Latest Snagboot release

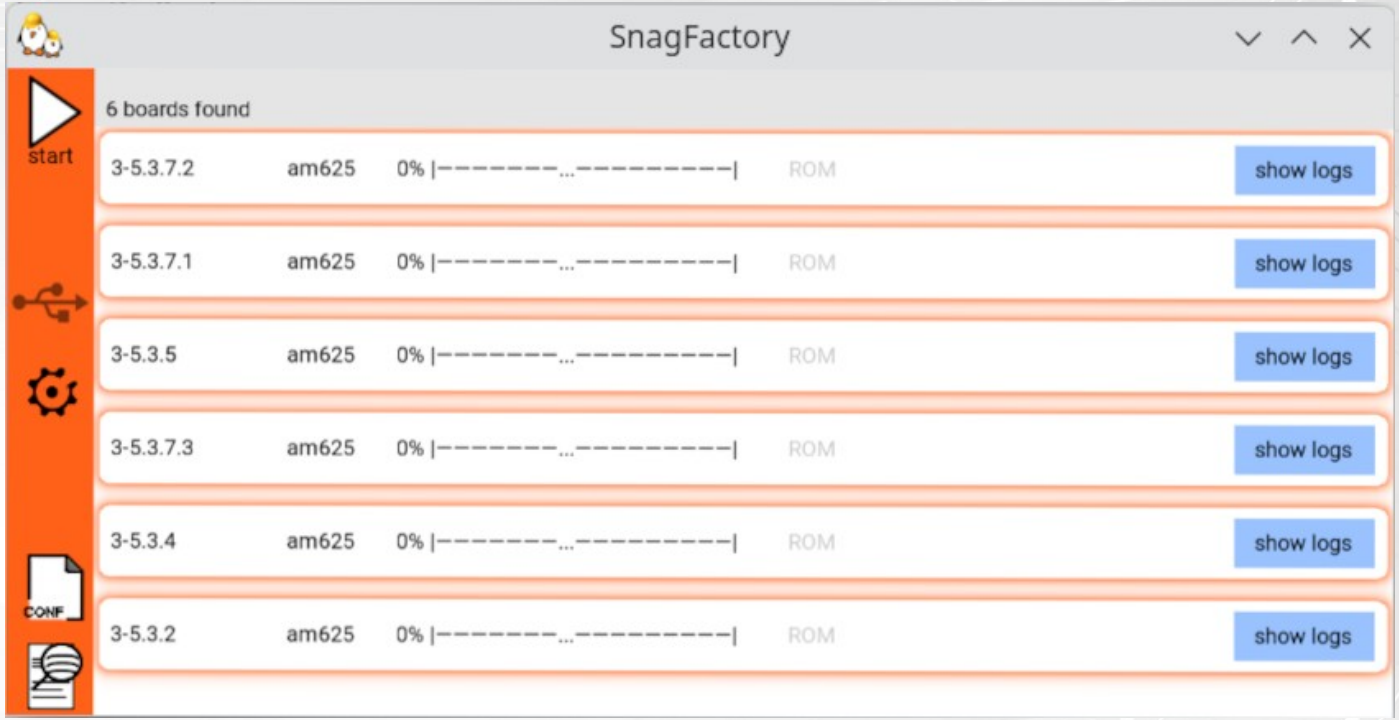
Jul 21, 2025

ZynqMP, STM32MP2, Intel KeemBay support. Various bug fixes and improvements

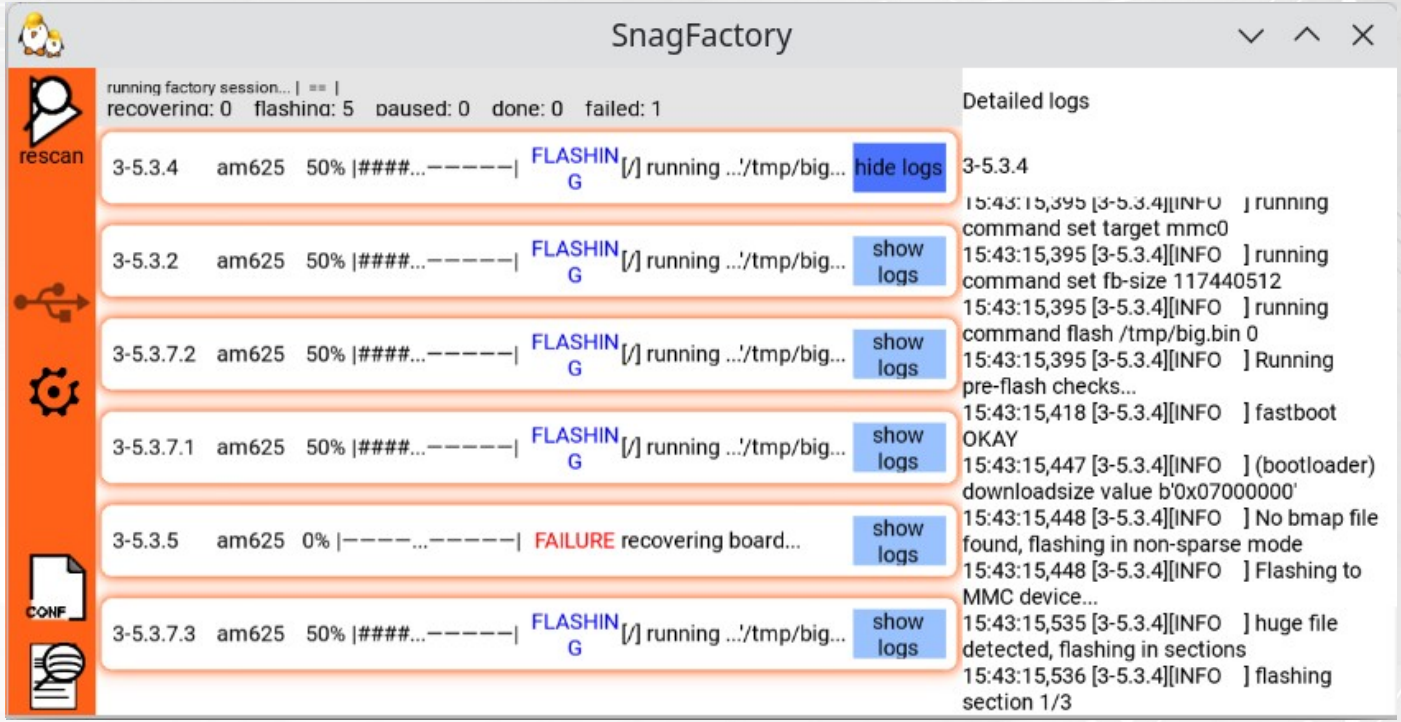
User Interface



Scanning phase



Factory flashing phase



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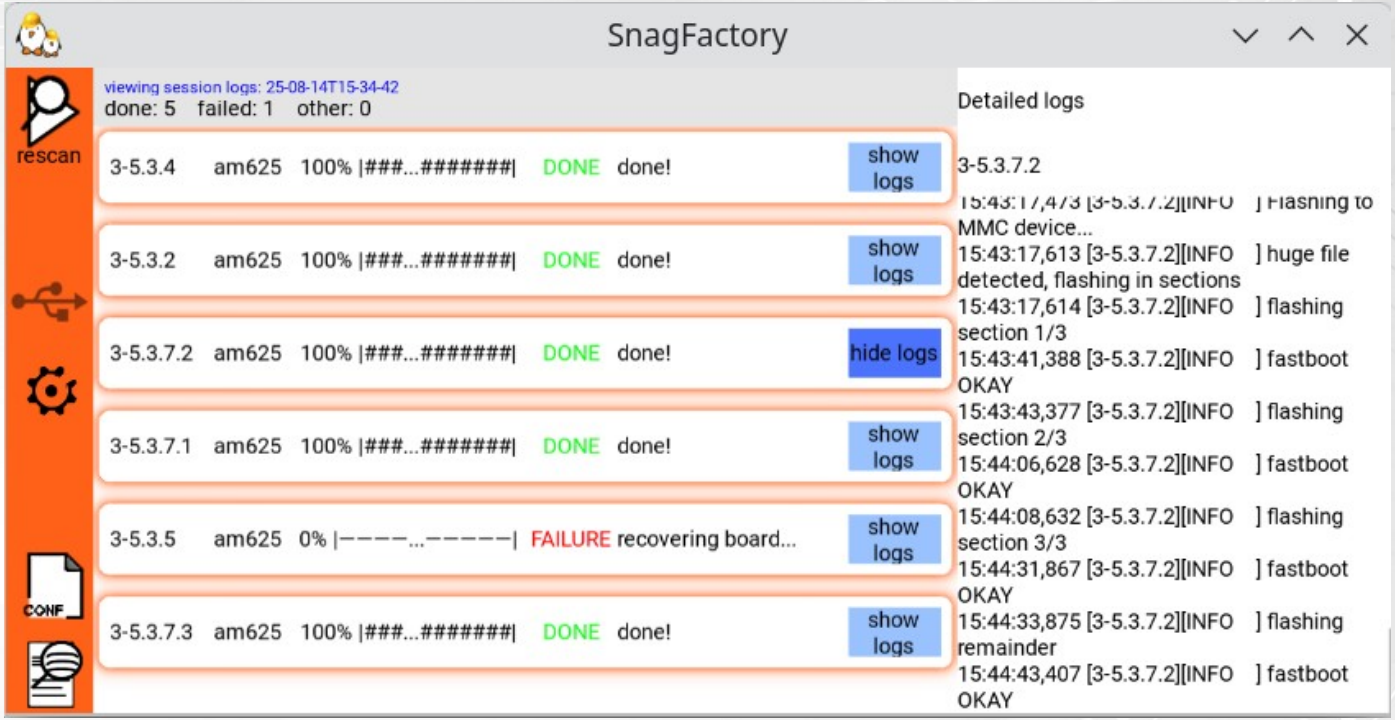
Log view phase



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Using Snagfactory

Installation on Linux

Dependencies

python >= 3.9, pip, ensurepip, libusb

PyPi package

pip install snagboot[gui]

From source

./install.sh --with-gui

Installation on Windows

Dependencies

python >= 3.9, pip, ensurepip, libusb, zadig

PyPi package

pip install snagboot[gui]

From source

pip install .[gui]

Binary installer

snagboot_installer_win64.exe

USB access on Linux

USB recovery tools in general require read/write access to USB devices exposed by the target

Typical solution: per VID:PID udev rules

ROM-exposed VID:PID pairs are provided in snagboot:

snagrecover –udev

Others should be added on a per-device basis

USB access on Windows

On windows, unrecognized USB devices aren't usually directly accessible

Typical solution: binding libusb-compatible drivers to specific VID:PID pairs

The open-source Zadig tool can be used for this

https://zadig.akeo.ie/

Documentation entry points

- Snagboot README
  - Installation instructions + basic usage
- Snagfactory introduction
  - Tour of the Snagfactory GUI and working principles
- Snagfactory configuration
  - Reference for writing YAML configuration files for Snagfactory

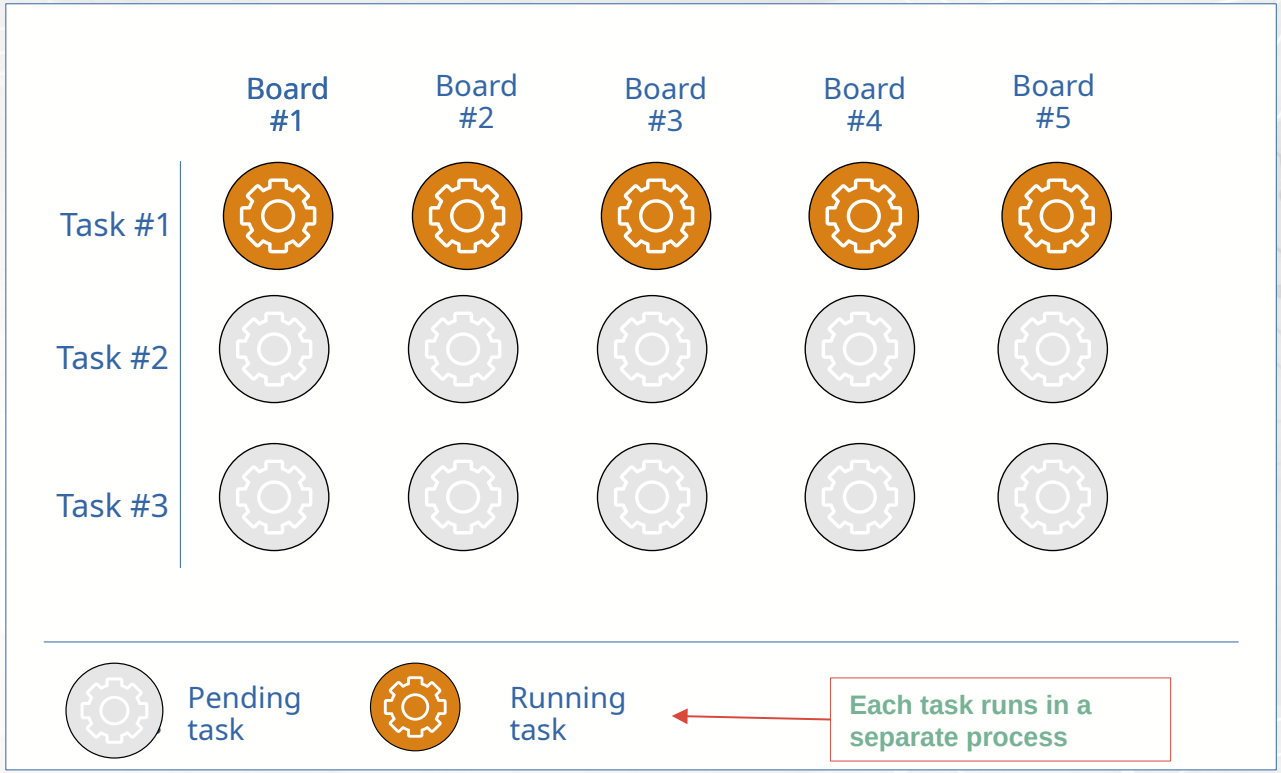
Configuration file

```
boards:
  "0451:6165": am625
  "03fd:0050": zynqmp
soc-models:
  am625-firmware:
  am625-tasks:
```

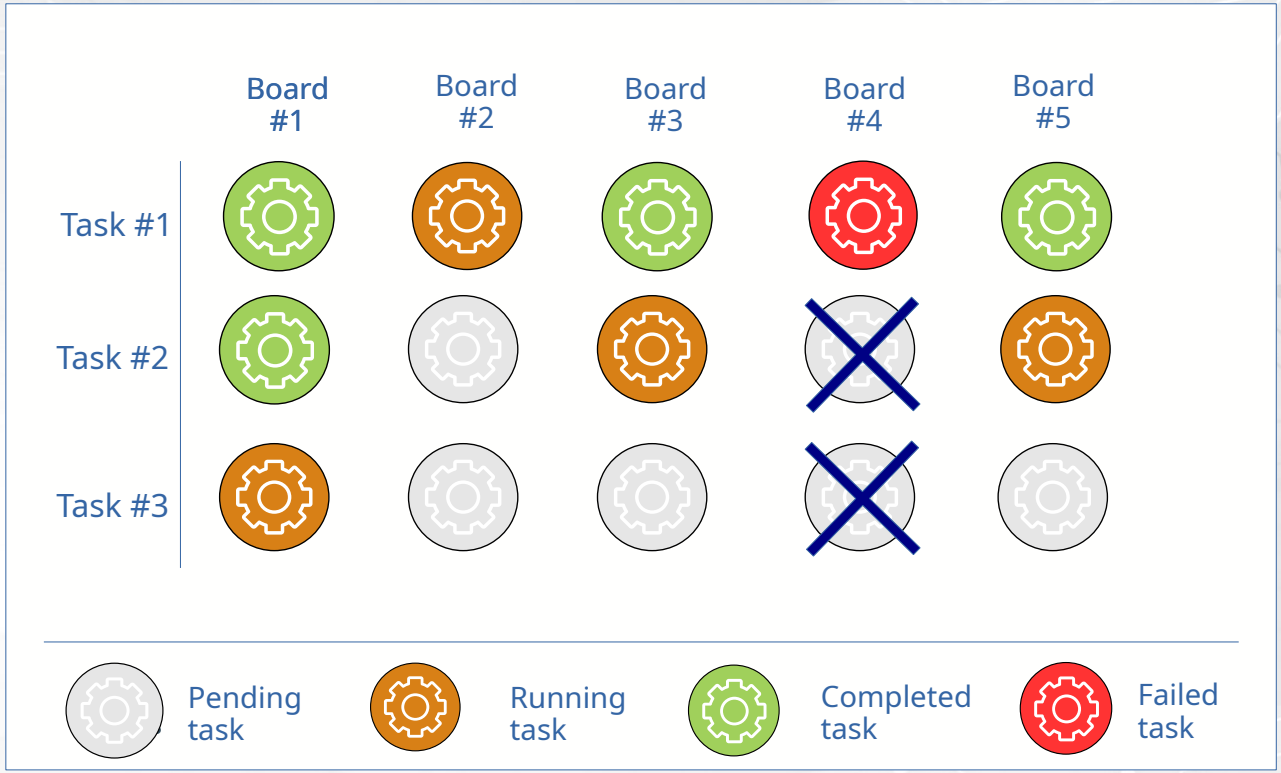
```
am625-firmware :
  tiboot3:
     path: ...
   tispl:
     path: ...
   u-boot:
     path: ...
```

```
am625-tasks :
  - target-device: mmc0
  - task: gpt
    args : …
  - task : flash
    args : ...
  ...
```

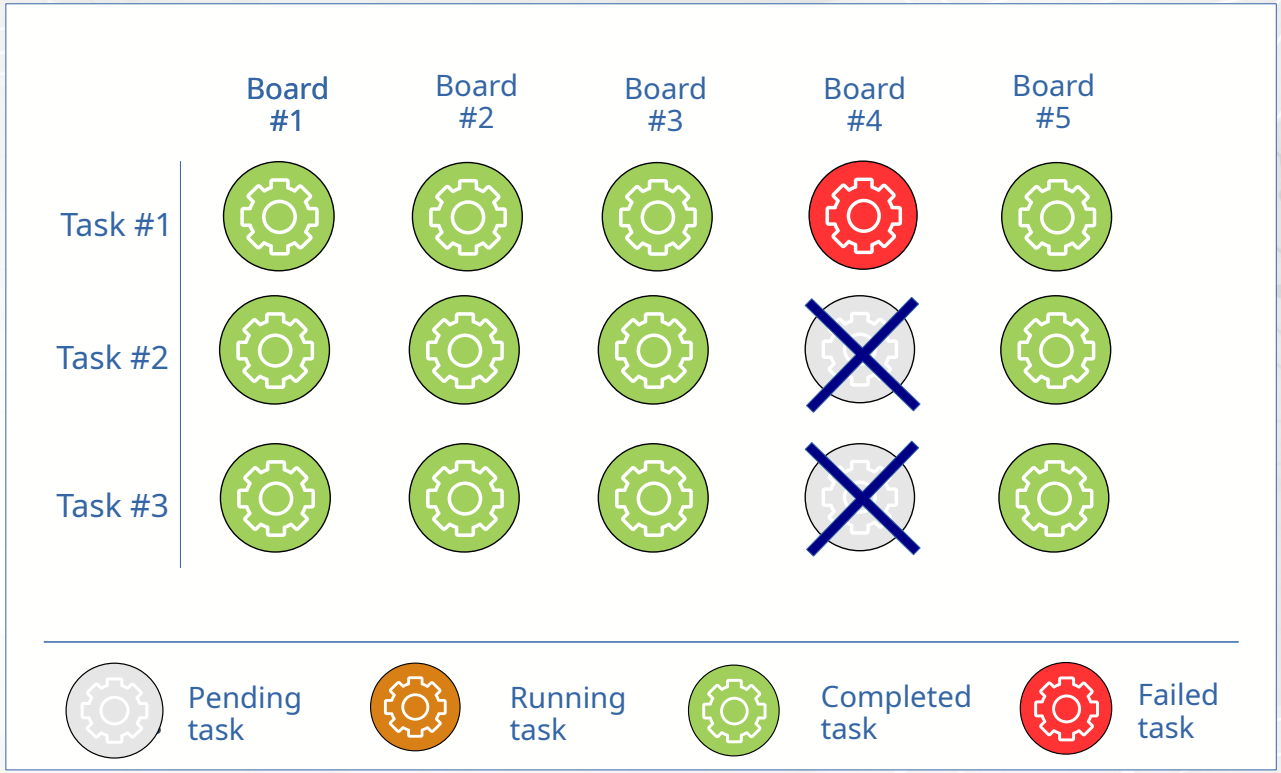
Task Pipelines



Task Pipelines



Task Pipelines



Tasks

Flash

part: entire device
OR GPT partition
OR MTD partition
OR eMMC hw partition
image: /path/to/file
image-offset: optional

Tasks

Flash

- Supports BMAP
- Supports larger-than-RAM files
- Requires U-Boot Fastboot buffer address

Tasks

GPT

- **name:** partition name
  size: partition size
  start: partition offset
  bootable: set GPT “bootable” flag
  uuid: GPT UUID
  type: GPT type UUID
  image: optional file to flash

Tasks

Run

- "snagflash fastboot command"

Main use case: "oem_run: <U-Boot shell command>"

Tasks

Define non-persistent MTD partitions

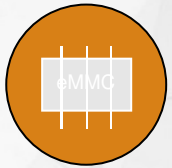
mtd-parts

reset

Send reset command and recover device

Pause task pipeline and request operator action

prompt-operator



emmc-hwpart

Permanently write eMMC hardware partition layout

Log file

```
<session timestamp>
summary: 5 done 1 failed
config: <config used>
results:
0451:6165 at 3-5.3.4: DONE
0451:6165 at 3-5.3.2: DONE
0451:6165 at 3-5.3.7.2: DONE
FACTORY LOG:
BOARD LOG 3-5.3.4:
BOARD LOG 3-5.3.2:
```

```
FACTORY LOG:
<ts> Start
<ts> 3-5.3.4 starting recovery task
<ts> 3-5.3.4 phase: BoardPhase.ROM -> BoardPhase.RECOVERING
<ts> 3-5.3.2 starting recovery task
```

```
BOARD LOG:
<ts> Installing firmware tiboot3
<ts> Searching for partition id…
<ts> Found DFU Functional descriptor: wTransferSize = 512
```

Development goals

- Expand Snagboot's support base
  - The upcoming 2.5 release will include Rockchip and RasberryPi support!
- Improve error reporting
- Improve documentation
- Get community feedback
- Introduce new factory flashing tasks

Thank you for listening!

Q&A

- Contact Information:
  - Paresh Bhagat <p-bhagat@ti.com>
- Also on IRC @ libera.chat #linux-ti

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