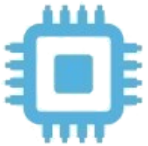
Security, Safety, Update

Diving into SWUpdate: adding new platform support in 30 minutes with Yocto/OE !

Pierre-Jean Texier



Live Embedded 2020

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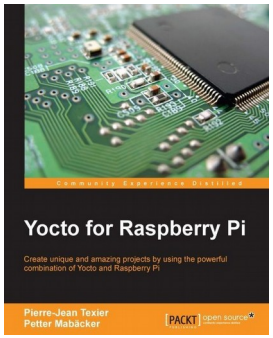
Pierre-Jean Texier

- Embedded Linux Engineer **LAFON** (part of Madic group)

- 30 yo
- **FOSS** enthusiast
- Contributions : U-Boot, Kernel Linux, Yocto/OE, Buildroot ...
- Co-author of "*Yocto for Raspberry Pi*" and author for *GNU/Linux magazine France* and Open silicium (RIP)



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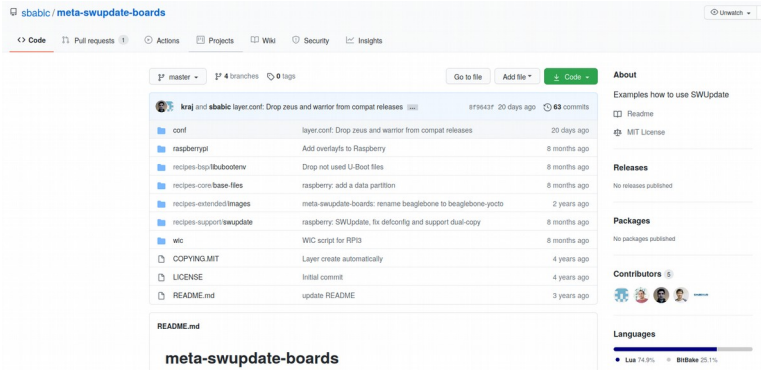
Agenda

- Motivation
- A quick introduction about update process & SWUpdate
- How to generate a clean **Yocto/OE** setup for this session
- SWUpdate practical example with the **Microchip SAMA5D27-SOM1-EK1**
- Deployment and tests !
- Patch submissions !
- Conclusion

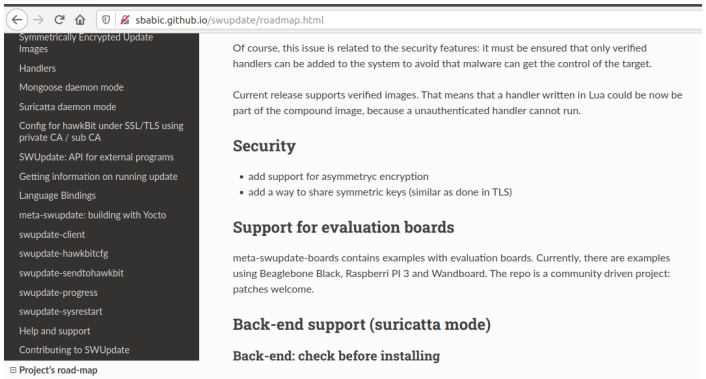
Motivation

Motivation : why ?

- Help people to integrate SWUpdate by giving more examples with **Yocto/OE** (*meta-swupdate-boards*)



- Follow the roadmap



- To contribute to SWUpdate as well !

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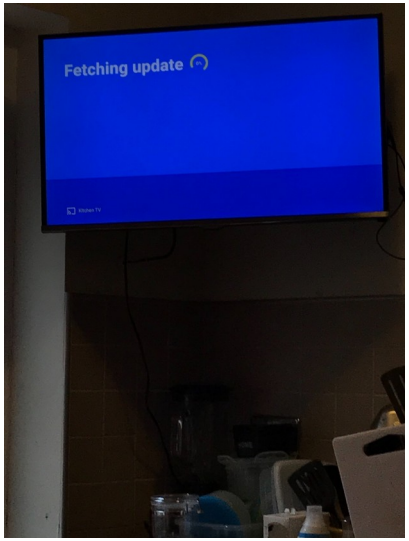
A quick introduction about update process & SWUpdate

Why embedded is special ?

- Accessibility : *sometimes no physical access*
- Availability : *not always easy to take control*
- Power supply : *unreliable in some cases*
- Connectivity : *low-bandwidth*
- Long life span : *more than 10 years*
- …



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Why do we need update ?

- Fixing **bugs**

- New features

- Security updates (***CVE***)

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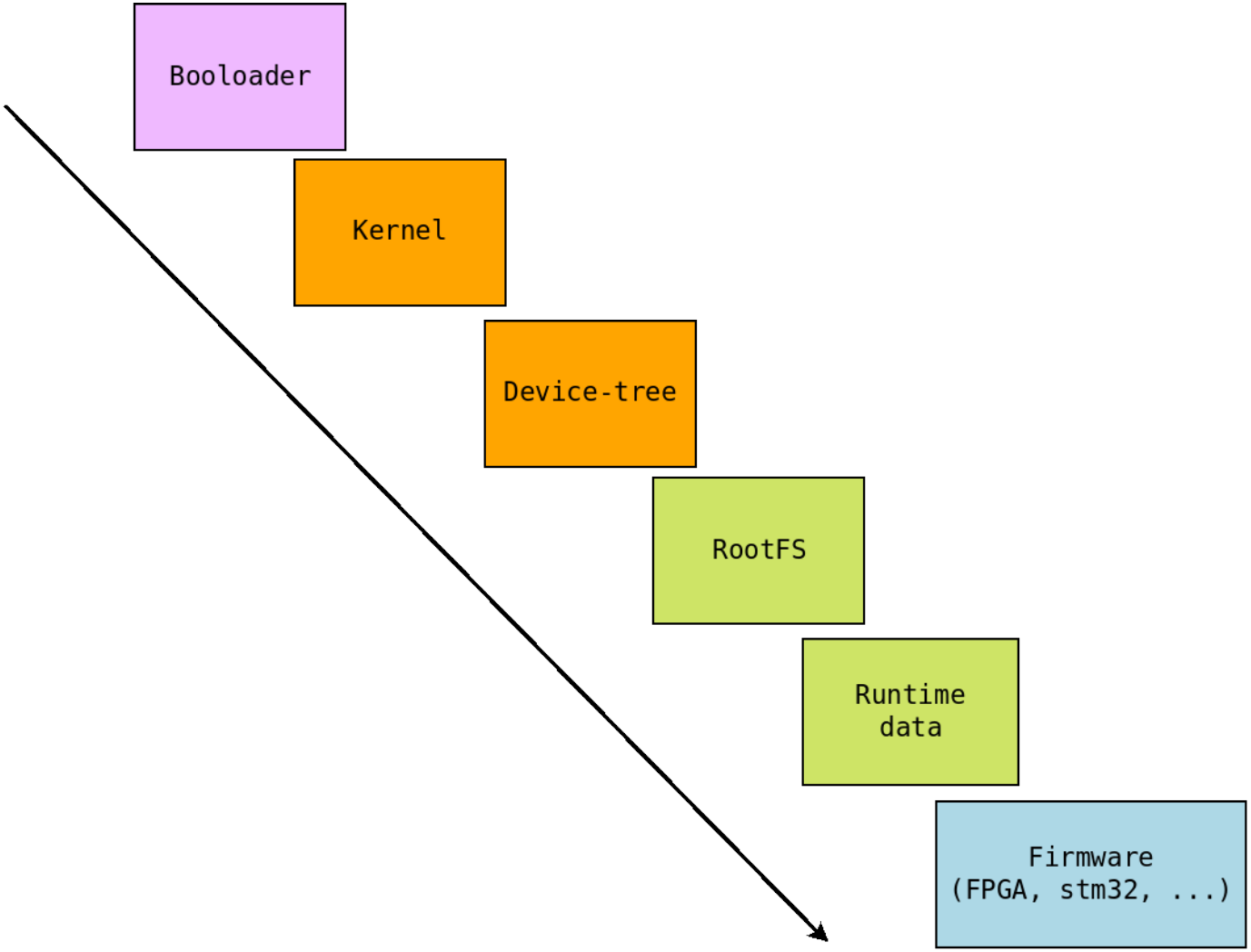
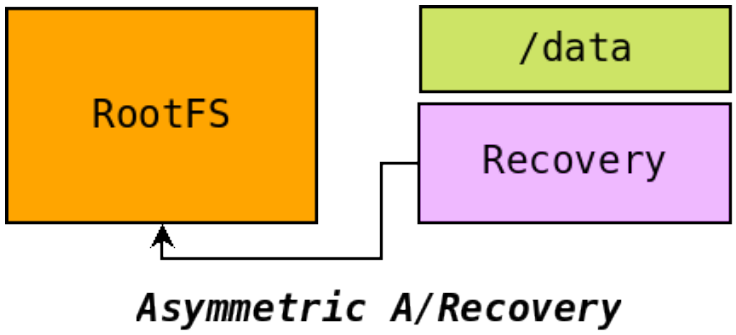
What we need to update ?

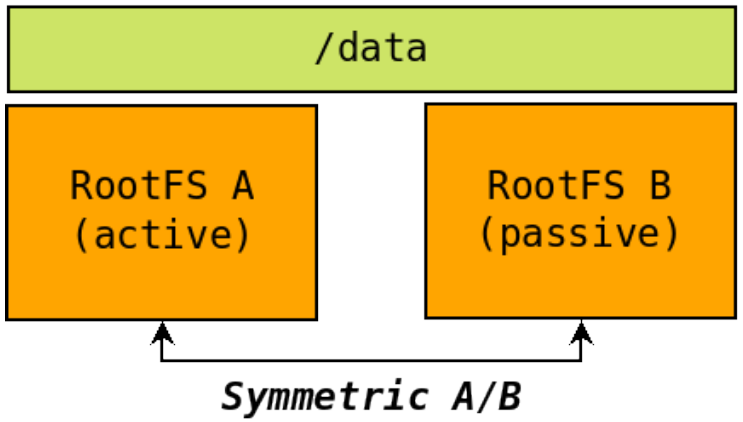


Update strategies

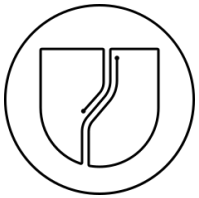
- *Atomic*
- *Downtime (No roll-back if update fails)*
- *Fail-safe*
- *Bootloader interaction is needed*



- *Atomic*
- *No downtime (Roll-back)*
- *Seamless update*
- *Fail-safe*
- *Bootloader interaction is needed*

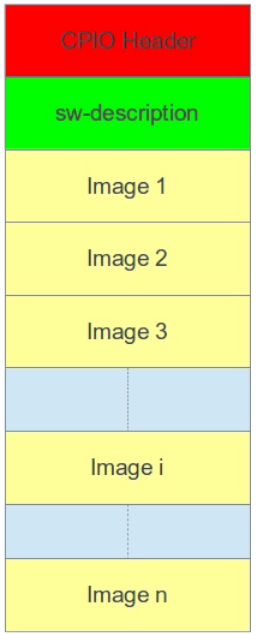


SWUpdate



« software update agent for embedded system »

- https://github.com/sbabic/swupdate
- maintained by **Stefano Babic** from **DENX**
- well documented
- mostly written in **C**, some **LUA**
- Lightweight agent (around **350Ko**)
- simple Format : **CPIO** archive (`.swu`)
- a simple file to describe the update package: `sw-description`
- power-off safe



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SWUpdate : key features

- Bootloader interaction : U-Boot, GRUB, EFI
- Both Asymetric and Symetric strategies are supported
- eMMC, SD, Raw NAND, NOR and SPI-NOR flashes supported
- Support for pre/postinstall scripts
- Security (signature, encryption, hash, ...)
- `embedded-script` for runtime detection (*subsystem topology*, *hardware check*, ...)
- Many handlers (*archive*, *diskpart*, *rdiff*, *ssbl*, *swuforward*, *ucfw*, *uniqueuuid*, ...)
- Custom handler (C or LUA) :

```
foo_handler = function(image)
    local img_path, cp_err = copy_image_to_file(image)
...

    local ri_err = run_process("/usr/bin/foo ", img_path)
 ...
end


swupdate.register_handler("foo", foo_handler, swupdate.HANDLER_MASK.IMAGE_HANDLER)
```

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SWUpdate : how ?

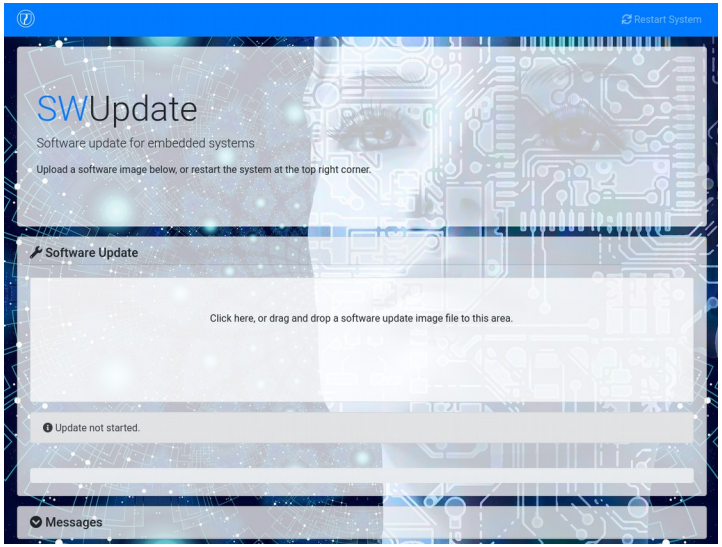
- Local
  - USB drive drive (UDEV), command line

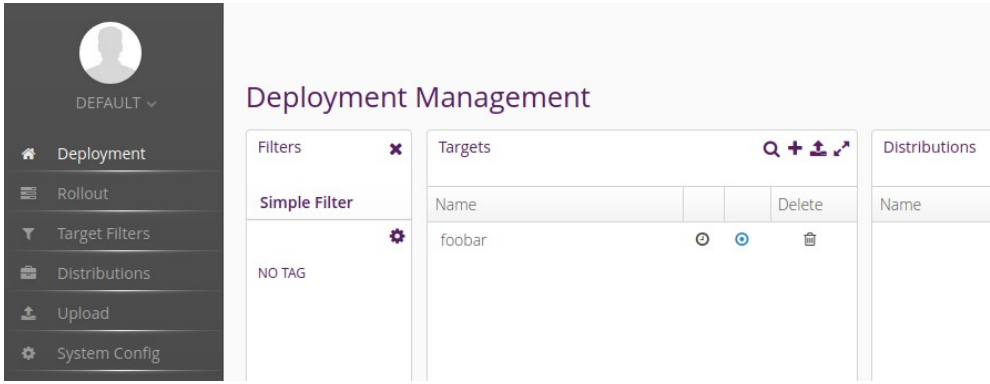
```
root@foo#~ swupdate -i foobar.swu
```

- Remote
  - FTP/SFTP

```
root@foo#~ swupdate -d "-u ftp://10.0.0.112/foobar.swu -a foo:bar"
```

  - Internal Webserver & hawkBit





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*How to generate a clean **Yocto/OE** setup for this session*

KAS

« This tool provides an easy mechanism to setup bitbake based projects »

- a tool developed by **Siemens**
- first release **0.9.0** (on 14 June 2017)
- maintained by **Jan Kiszka**
- well documented
- written in **Python**
- support **Docker** & **Podman** (`kas-container`)
- **27** contributors
- tends to be a reference (**`user++`**)
- **YAML** or **JSON** are supported (YAML preferred)
- useful to customize `local.conf` (`local_conf_header`) and `bblayers.conf` (`bblayers_conf_header`) files

```
header:
  version: 8

repos:

  meta-atmel:
    url: https://github.com/linux4sam/meta-atmel
    refspec: dunfell

  meta-openembedded:
    url: http://git.openembedded.org/meta-openembedded
    refspec: dunfell
    layers:
      meta-oe:
      meta-python:
      meta-networking:
      meta-webserver:
      meta-filesystems:
...
```

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KAS : our needs

- **Poky**, the reference distribution of the **Yocto Project**
  - `git://git.yoctoproject.org/poky`
- **meta-atmel**, the meta-layer that provides support for Microchip microprocessors
  - `https://github.com/linux4sam/meta-atmel`
- **meta-openembedded**, if we need to add some packages
  - `https://git.openembedded.org/meta-openembedded`
- **meta-swupdate{-boards}**, to add **SWUpdate** support
  - `https://github.com/sbabic/meta-swupdate{-boards}`
- We need a way to organize them properly :

```
$: tree .
.
├── board-sama5d27-som1-ek-sd.yml
├── kas-layers.yml
├── kas-poky.yml
└── swupdate-sama5d27-som1-ek-sd.yml
```

https://github.com/texierp/kas-demo

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KAS : let’s try it ! (1/2)

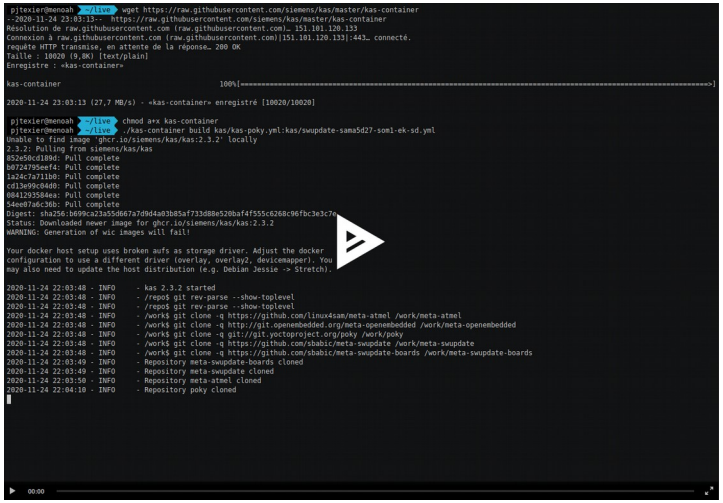
- Download first « `kas-container` » (*instead of native kas*)

```
$: wget https://raw.githubusercontent.com/siemens/kas/master/kas-container
$: chmod a+x kas-container
```

- Once those steps are fine, let’s use our kas files :

```
$: ./kas-container build kas/kas-poky.yml:kas/swupdate-sama5d27-som1-ek-sd.yml
```

- To resume …



https://asciinema.org/a/375102

https://github.com/texierp/kas-demo

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KAS : let's try it ! (2/2)

- Now, we have all the layers to start :

```
$: tree . -L 1
.
├── build
├── kas
├── meta-atmel
├── meta-openembedded
├── meta-swupdate
├── meta-swupdate-boards
└── poky
```

- But with some errors when we try to « bitbake » ...

```
ERROR: Nothing RPROVIDES 'u-boot-default-env' (but /work/poky/meta/recipes-bsp/u-boot/libubootenv_0.3.1.bb RDEPENDS
on or otherwise requires it)
NOTE: Runtime target 'u-boot-default-env' is unbuildable, removing...
...
Missing or unbuildable dependency chain was: ['libubootenv-bin', 'u-boot-default-env']
ERROR: Nothing RPROVIDES 'libubootenv' (but /work/poky/meta/recipes-bsp/u-boot/libubootenv_0.3.1.bb RDEPENDS on or
otherwise requires it)
No eligible RPROVIDERs exist for 'libubootenv'
NOTE: Runtime target 'libubootenv' is unbuildable, removing...
Missing or unbuildable dependency chain was: ['libubootenv']
ERROR: Nothing RPROVIDES 'libubootenv-dev' (but /work/poky/meta/recipes-bsp/u-boot/libubootenv_0.3.1.bb RDEPENDS on
or otherwise requires it)
No eligible RPROVIDERs exist for 'libubootenv-dev'
NOTE: Runtime target 'libubootenv-dev' is unbuildable, removing...
Missing or unbuildable dependency chain was: ['libubootenv-dev']
..
```

- But will fix it now !

KAS, but not the only one

- `git-submodules`
- `repo`
- `combo-layer`
- `yocto-cooker` (maintained by Christophe Blaess & Patrick Boettcher)

SWUpdate practical example with the ***Microchip SAMA5D27-SOM1-EK1***

Practical example

- Creation of a partition scheme for the SD Card
  - We will use a new kickstart file (sama5d27.wks)
  - Previously defined (**`WKS_FILES = "sama5d27.wks"`**)

- Add a new machine « `sama5d27-som1-ek-sd` » in **meta-swupdate-boards** for :
  - Our update package (how is defined) : **sw-description**
  - SWUpdate's runtime configuration file : **swupdate.cfg**
  - The configuration of SWUpdate itself : **defconfig**
  - The behaviour of SWUpdate at runtime (webserver, hawkBit, selection, …)
  - The U-Boot integration : the boot loader must decide which copy should be started

Practical example : WKS

- sama5d27.wks

```
# short-description: Create SD card image with a dual partition
# long-description: Creates a partitioned SD card image. Boot files
# are located in the first vfat partition.

part /boot --source bootimg-partition --ondisk mmcblk0 --fstype=vfat --label boot --active --align 4 --size 16
part / --source rootfs --ondisk mmcblk0 --fstype=ext4 --label rootfs_A  --align 4
part / --source rootfs --ondisk mmcblk0 --fstype=ext4 --label rootfs_B  --align 4

bootloader --ptable msdos
```

Practical example

```
software =
{
    version = "0.1.0";

    sama5d27-som1-ek-sd = {
    hardware-compatibility: ["1.0"];
        stable : {
            copy1 : {
                images: ({
                        filename = "core-image-full-cmdline-sama5d27-som1-ek-sd.ext4.gz";
                        type = "raw";
                        sha256 = "@core-image-full-cmdline-sama5d27-som1-ek-sd.ext4.gz";
                        compressed = "zlib";
                        device = "/dev/mmcblk0p2";
                });
                uboot: ({
                        name = "rootpart";
                        value = "2";
                });
            };
            copy2 : {
                images: ({
                        filename = "core-image-full-cmdline-sama5d27-som1-ek-sd.ext4.gz";
                        type = "raw";
                        sha256 = "@core-image-full-cmdline-sama5d27-som1-ek-sd.ext4.gz";
                        compressed = "zlib";
                        device = "/dev/mmcblk0p3";
                });
                uboot: ({
                        name = "rootpart";
                        value = "3";
                });
            };
        };
    }
}
```

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Practical example

- How SWUpdate should start :

```
rootfs=`mount | grep "on / type" | cut -d':' -f 2 | cut -d' ' -f 1`

if [ $rootfs == '/dev/mmcblk0p2' ];then
       selection="-e stable,copy2"
else
       selection="-e stable,copy1"
fi

state=`fw_printenv ustate | cut -f 2 -d'='`
if [ $state == 1 ];then
       SWUPDATE_SURICATTA_ARGS="-c 2"
else
       SWUPDATE_SURICATTA_ARGS=" "
fi

SWUPDATE_ARGS="-H sama5d27-som1-ek-sd:1.0 ${selection} -f /etc/swupdate.cfg"
```

- selection = indicates which software component should be updated, defined in **sw-description**.
- `SWUPDATE_SURICATTA_ARGS` = to interact with **hawkBit** (in this case `ustate` is used).
- `SWUPDATE_ARGS` = exports all the arguments that are needed at startup. This variable is passed as an argument to **SWUpdate**.

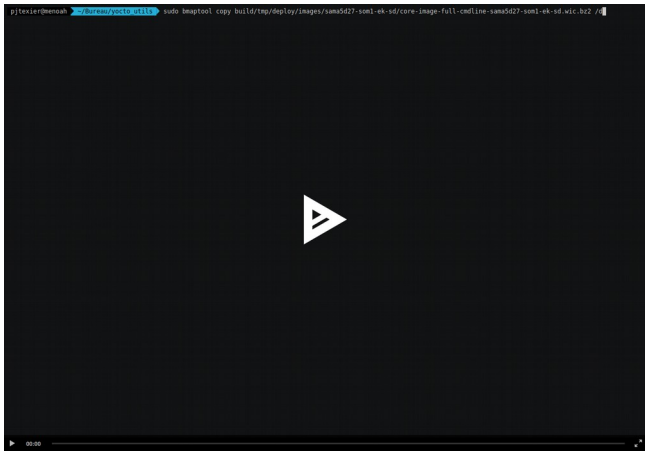
Deployment and tests !

Deployment : image

- Let’s flash our SD card with the disk image :
  - `core-image-full-cmdline-sama5d27-som1-ek-sd.wic.bz2`

```
$: sudo bmaptool copy core-image-full-cmdline-sama5d27-som1-ek-sd.wic.bz2 /dev/mmcblk0
```

- In action :



https://asciinema.org/a/375929

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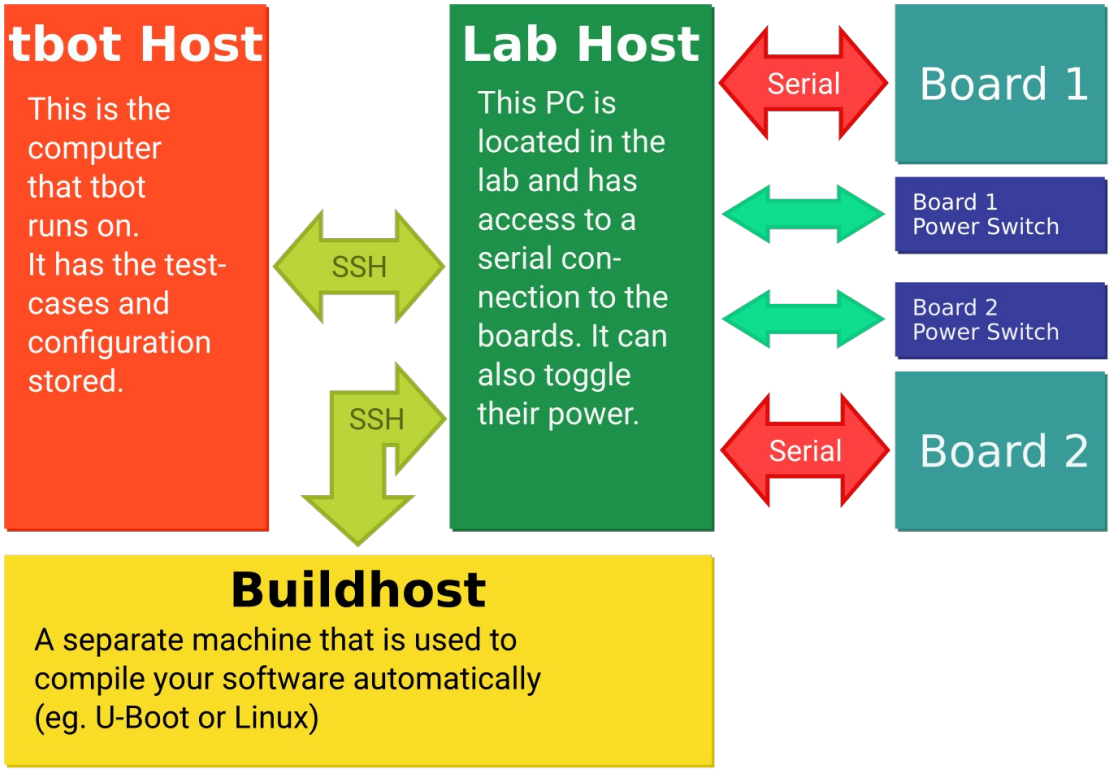
Deployment : TBOT

« tbot is a testing/automation tool that is focused on usage in embedded development »

- a tool developed by **DENX**
- maintained by **Harald Seiler**
- well documented
- written in **Python**
- Interact with U-Boot, Linux
- Using test-case in Python
- Useful for **CI** usage



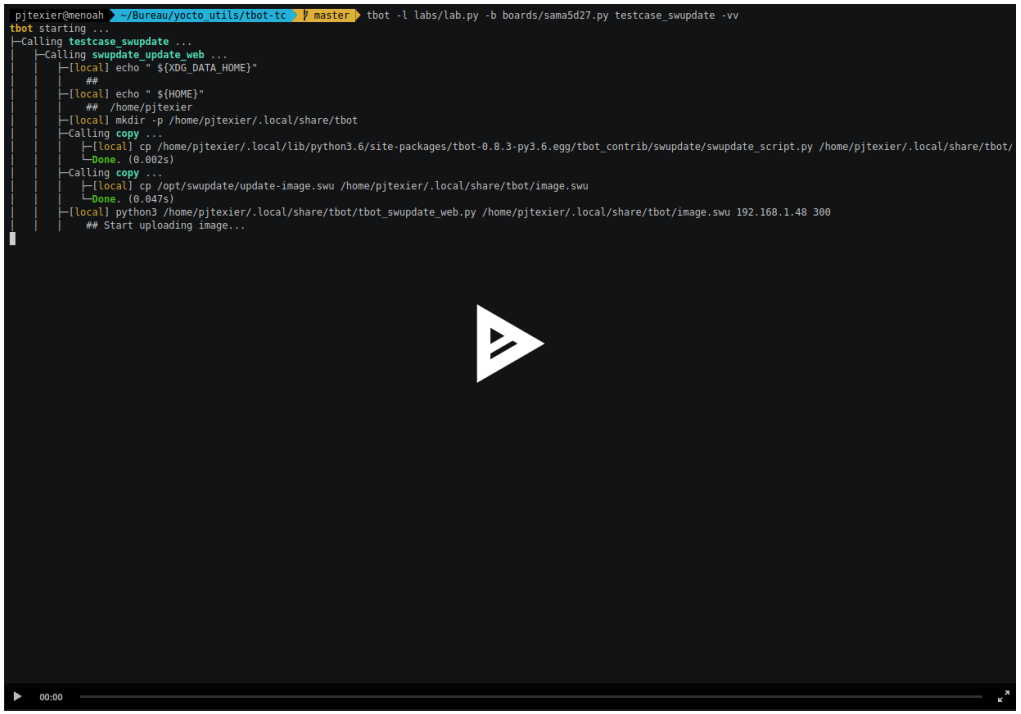
From https://tbot.tools

Deployment : TBOT

```
import tbot
from tbot.machine import board,linux
from tbot_contrib import utils
from tbot_contrib import swupdate

@tbot.testcase
@tbot.with_lab
def testcase_swupdate(lh: linux.LinuxShell) -> None:
    with tbot.acquire_local() as lo:
        swu_path = linux.Path(lo, "/opt/swupdate/update-image.swu")
        swupdate.swupdate_update_web(lo, swu_path, "192.168.1.48")
```

- Board = sama5d27.py
- Lab = lab.py
- Test case = tc.py



https://asciinema.org/a/374587

https://github.com/texierp/tbot-tc

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Patch submissions !

Conclusion

Conclusion

- **SWUpdate** is a great framewok that deserves more examples
- Version 2020.11 just released (**11/28/2020**)
- Going further :

```
diff --git a/configs/sama5d27_som1_ek_mmc_defconfig
b/configs/sama5d27_som1_ek_mmc_defconfig
index 5176dbbb08..1302ebce9a 100644
--- a/configs/sama5d27_som1_ek_mmc_defconfig
+++ b/configs/sama5d27_som1_ek_mmc_defconfig
@@ -50,6 +50,9 @@ CONFIG_SYS_RELOC_GD_ENV_ADDR=y
 CONFIG_DM=y
 CONFIG_SPL_DM=y
 CONFIG_SPL_DM_SEQ_ALIAS=y
+CONFIG_BOOTCOUNT_LIMIT=y
+CONFIG_BOOTCOUNT_ENV=y
+CONFIG_BOOTCOUNT_BOOTLIMIT=3
 CONFIG_CLK=y
 CONFIG_SPL_CLK=y
 CONFIG_CLK_AT91=y
--
```

Q&A

 *@texierp*

 *@pjtexier*