# STM32MP25 Microprocessor

## Generate a minimal devicetree with CubeMX v6.13 for OpenSTLinux v6.0

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# Objectives and Contents

## Creation of MP25 device trees for TF-A, OPTEE, U-Boot, Kernel

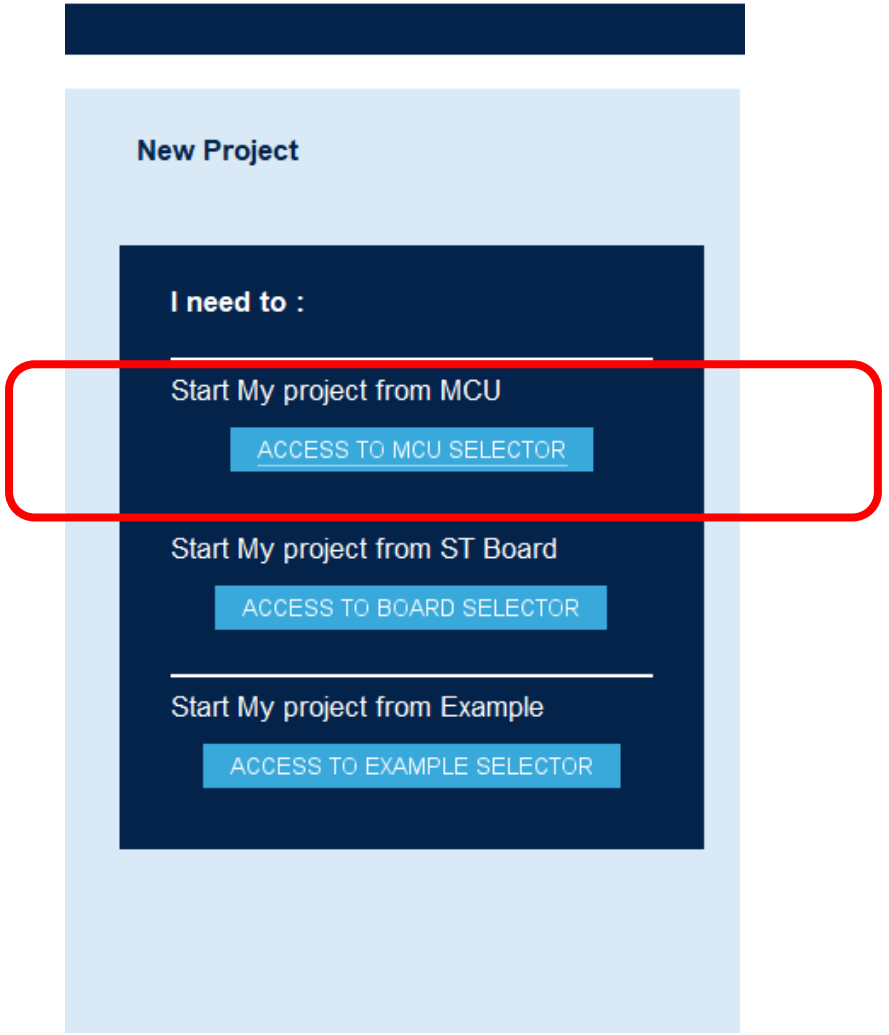
- To be used with OpenSTLinux v6.0 “st-image-weston” image
- Using CubeMx v6.13
- Based on STM32MP257F-EV1 C01 board

1. CubeMx project creation and configuration
2. User-code section configurations in device trees
3. Build with Developer Package and Test
4. Messages to be fixed by more configurations
5. To be completed for your board

# 1 CubeMx project creation and configuration

# 1.1 CubeMx project creation

## Start Project with CubeMx

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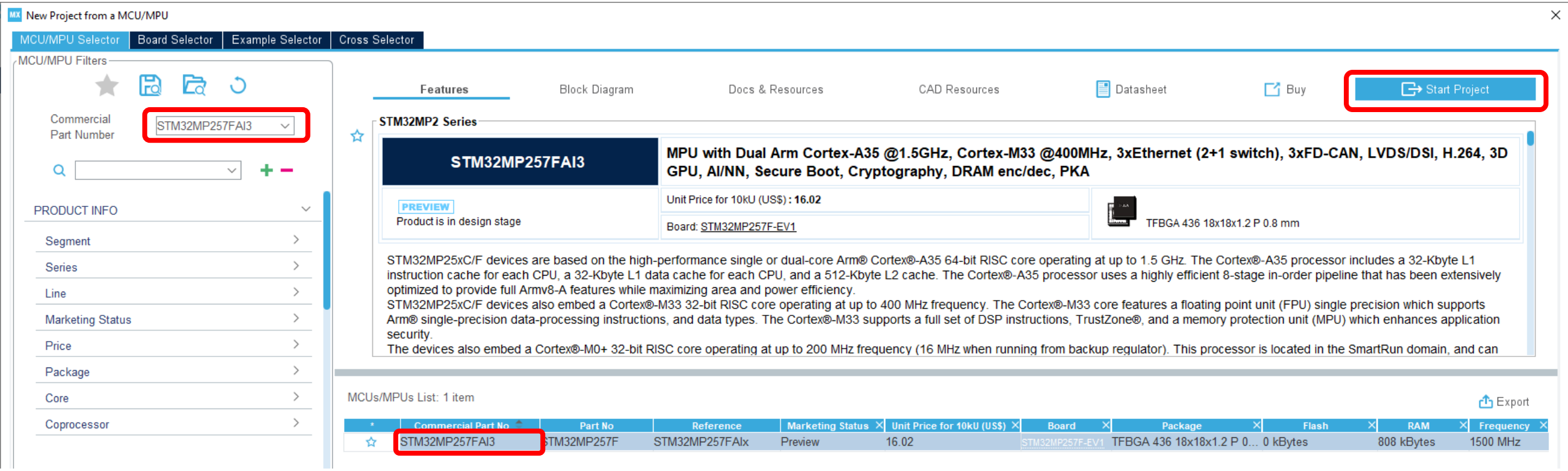
# 1.1 CubeMx project creation

**Select MP25 Part Number, and “Start Project”**

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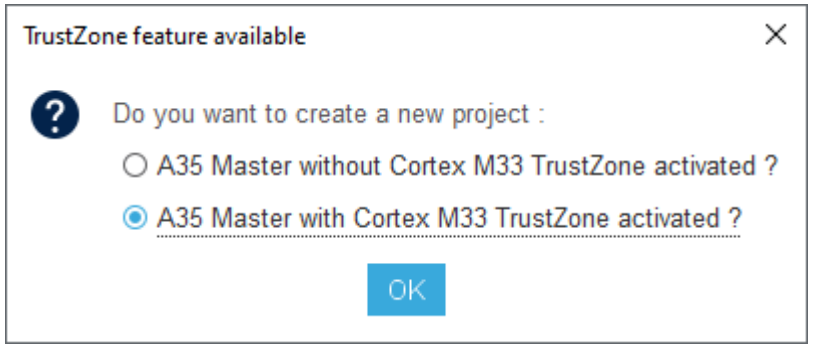
# 1.1 CubeMx project creation

## With M33 TrustZone ?

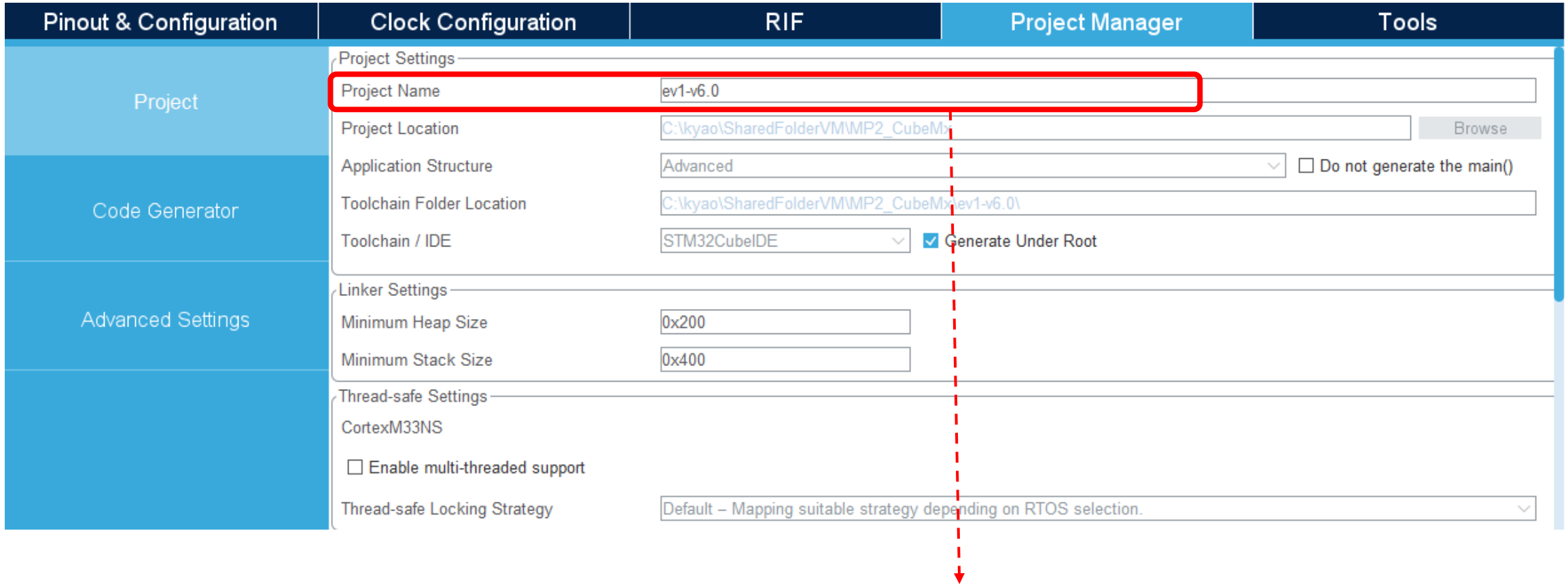



**With Cortex M33 TrustZone activated:**
TrustZone firmware device tree files will be generated at
<Project_folder>\CM33\DeviceTree\<project_name>\tf-m\

**This presentation example is « With Cortex M33 TrustZone activated »**

# 1.1 CubeMx project creation

## Basic project settings




Main device tree file name will be: <part_number>-<project_name>-mx.dts
Inside the file: compatible = "st,<part_number>-<project_name>-mx";

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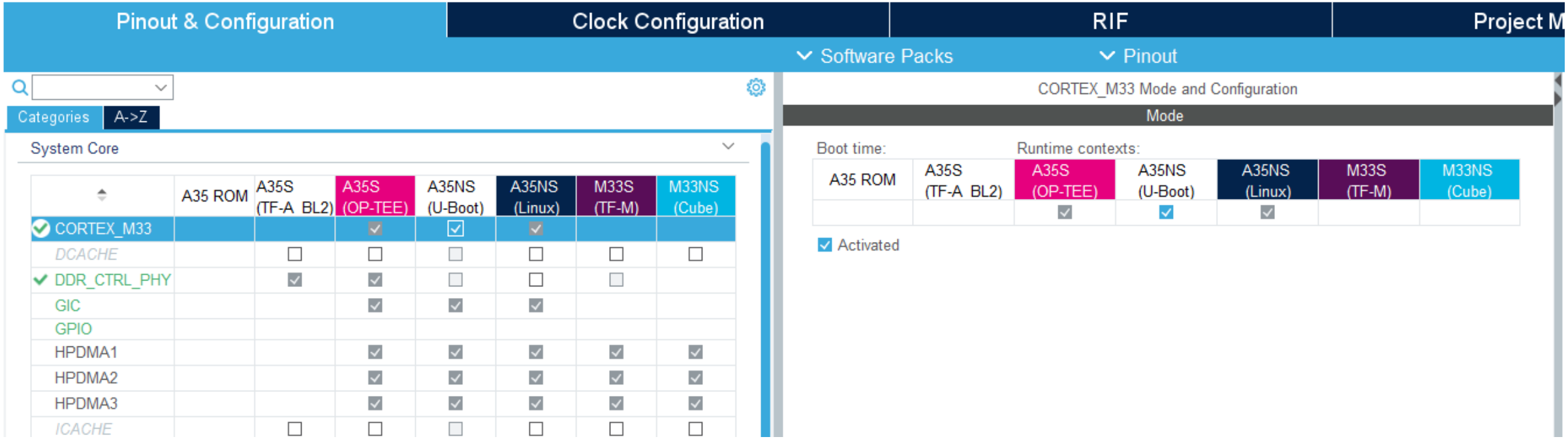
# 1.2 CubeMx project configuration

## Special symbols

- Error to be fixed
- Warning to be checked

# 1.2 CubeMx project configuration : modules

**System Core module : Cortex M33 : enabled**




So that M33 firmware can be loaded and started from U-boot and Linux

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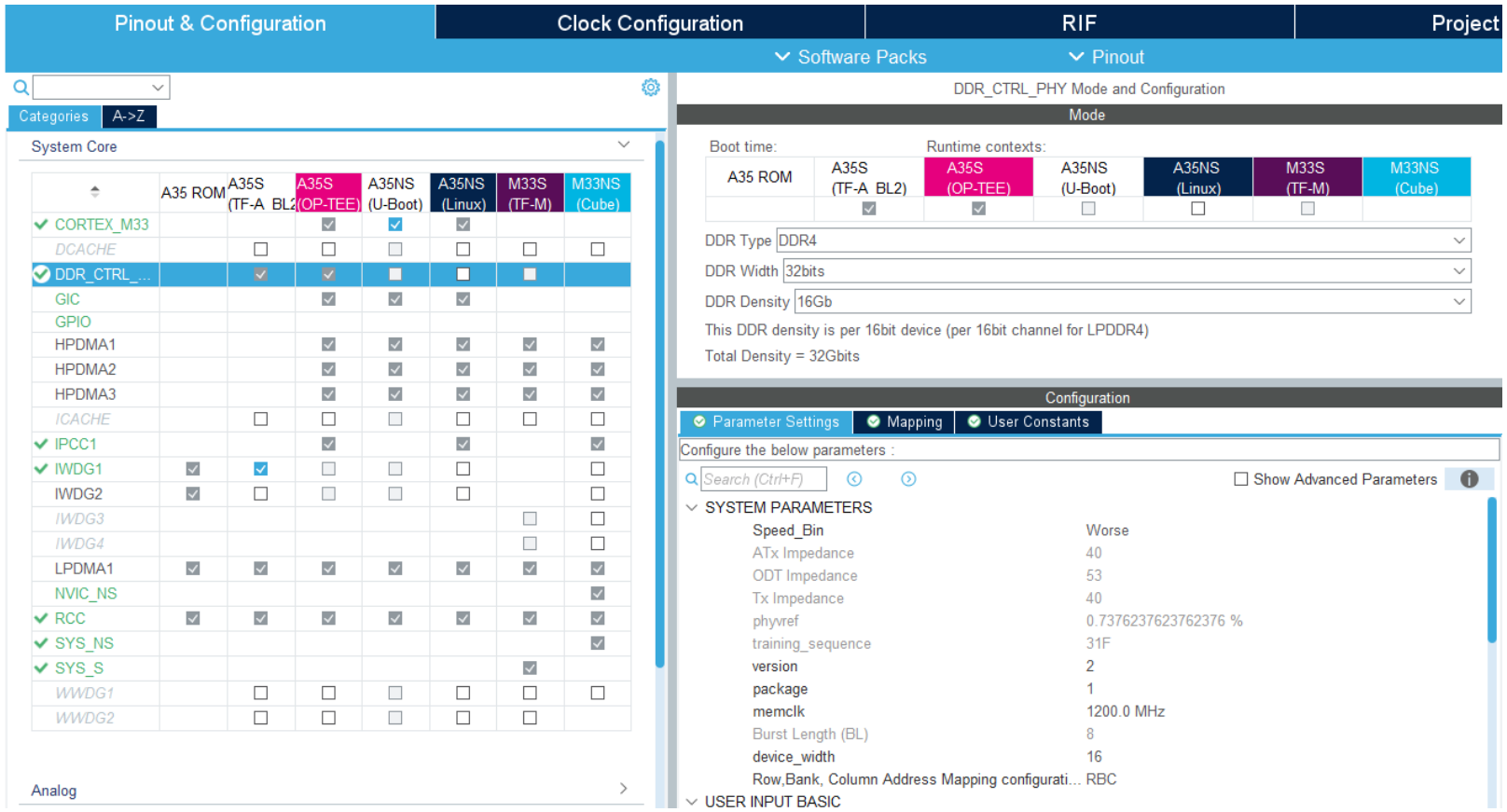
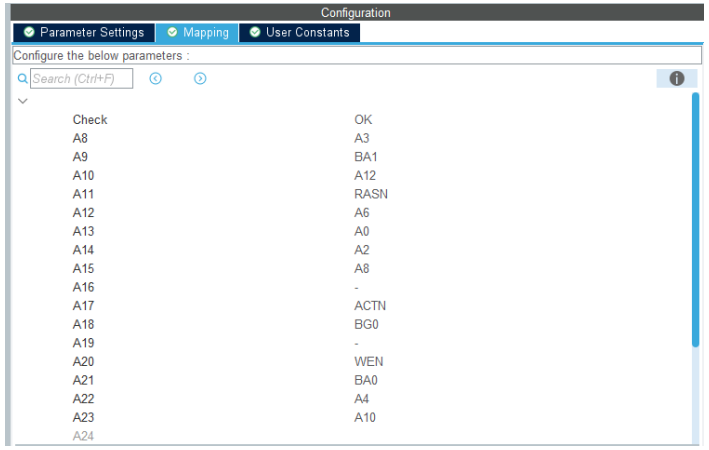
# 1.2 CubeMx project configuration : modules

## System Core module : DDR : Board specific




DDR type, width, density,
Speed bin,
DDR_A8 to DDR_A31 mapping
Must be corresponding to your board

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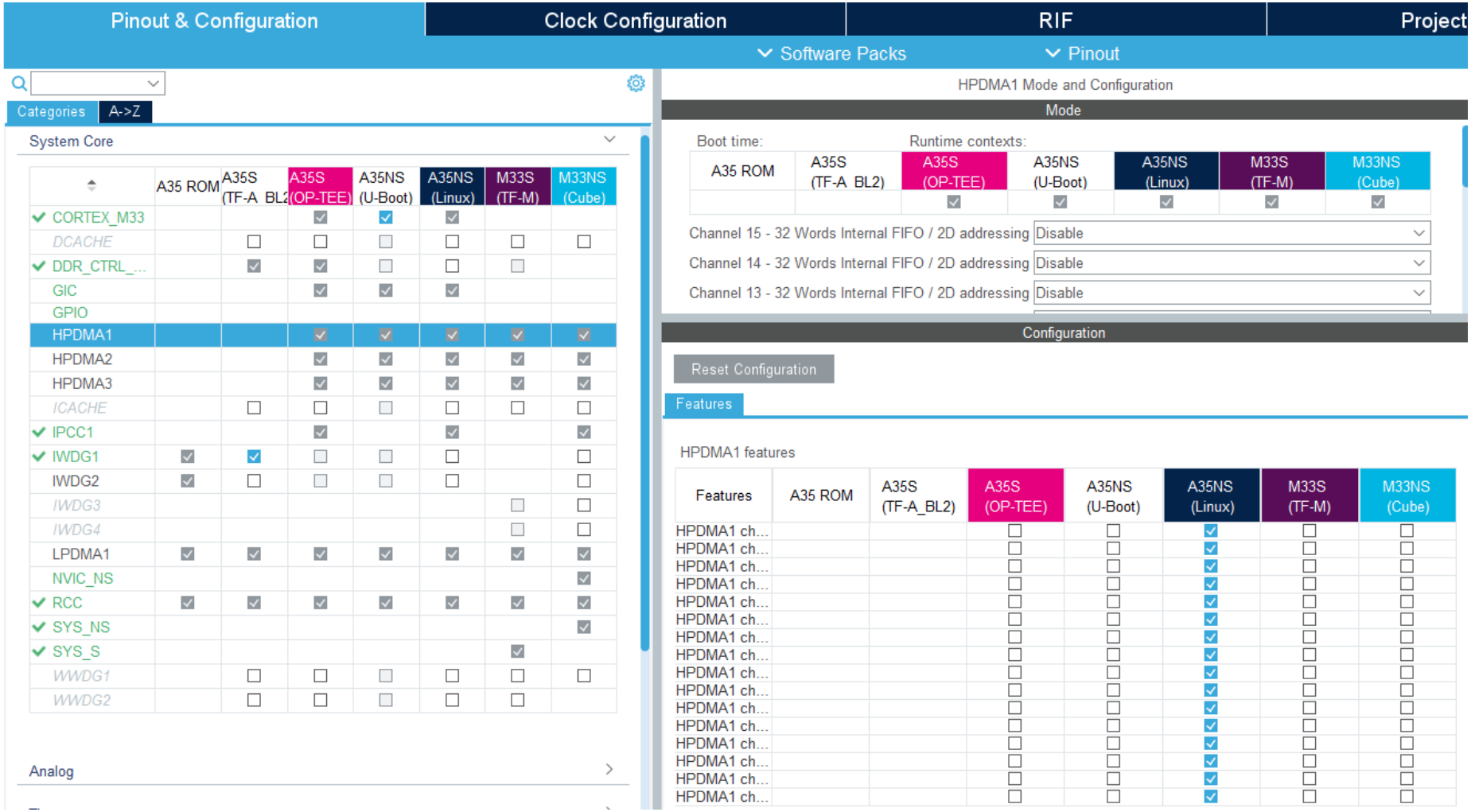
# 1.2 CubeMx project configuration : modules

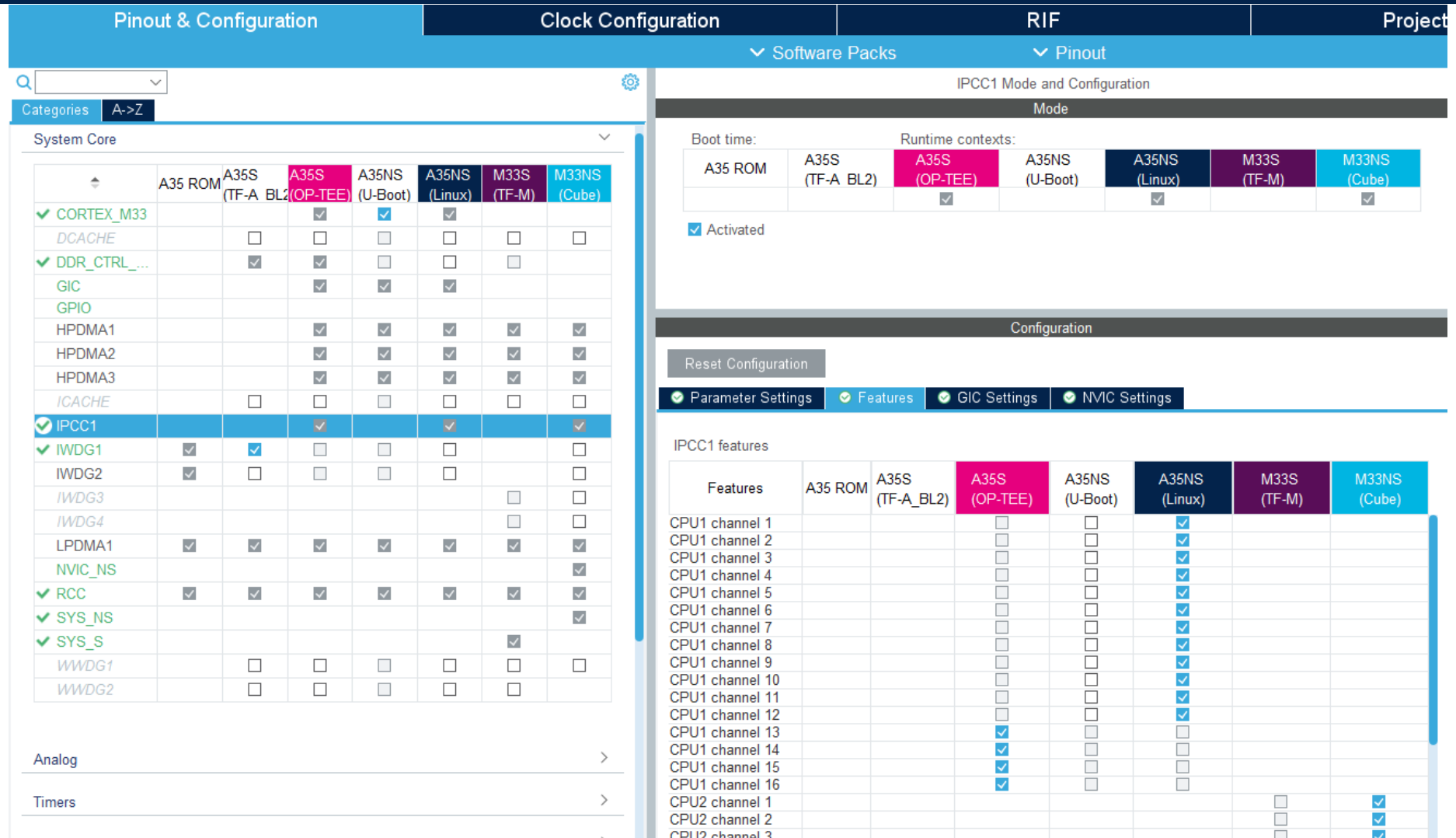
## System Core modules : HPDMA1/2/3




All channels of HPDMA123: disabled, Assigned to Linux

# 1.2 CubeMx project configuration : modules

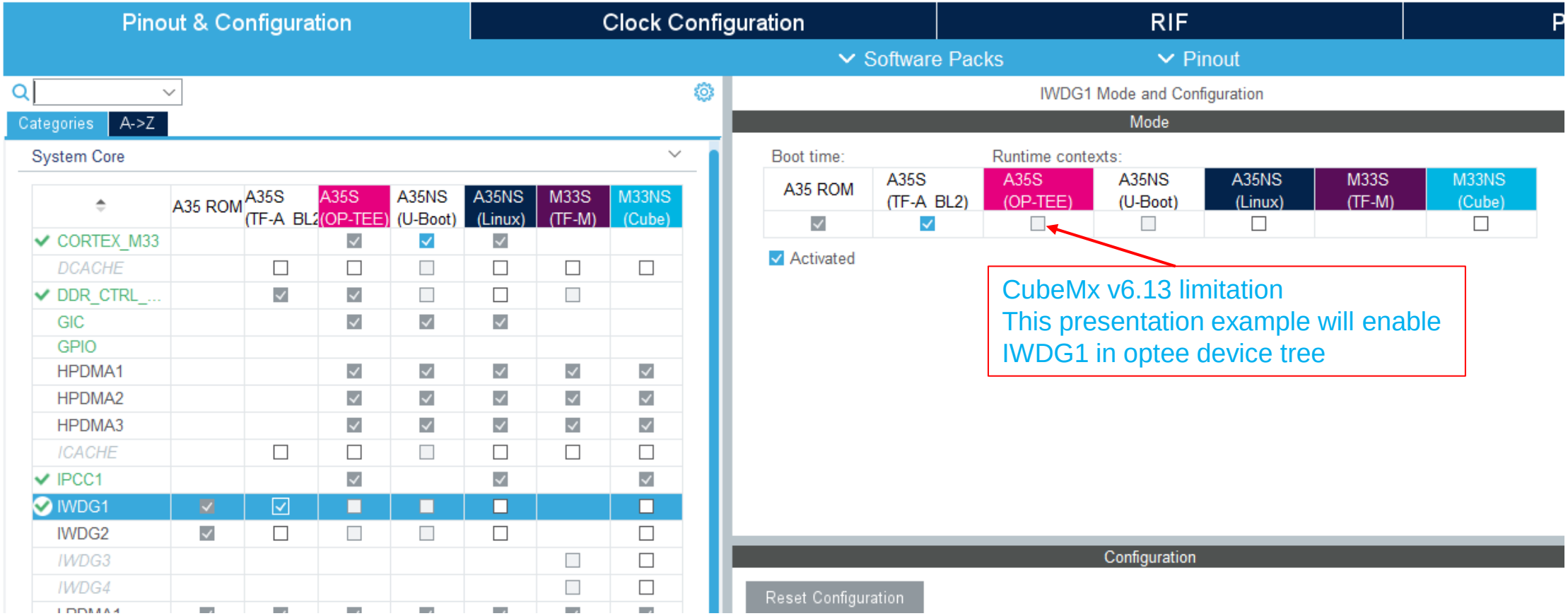
## System Core modules : IPCC1 : enabled




CPU1 ch1-12: for linux
CPU1 ch13-16: for optee
CPU2 ch1-16: for linux

# 1.2 CubeMx project configuration : modules

## System Core modules : WatchDog




IWDG1 activated for TF-A and OPTEE, IWDG2/3/4 not activated
This presentation example will enable arm_wdt for U-Boot and Linux in device tree.

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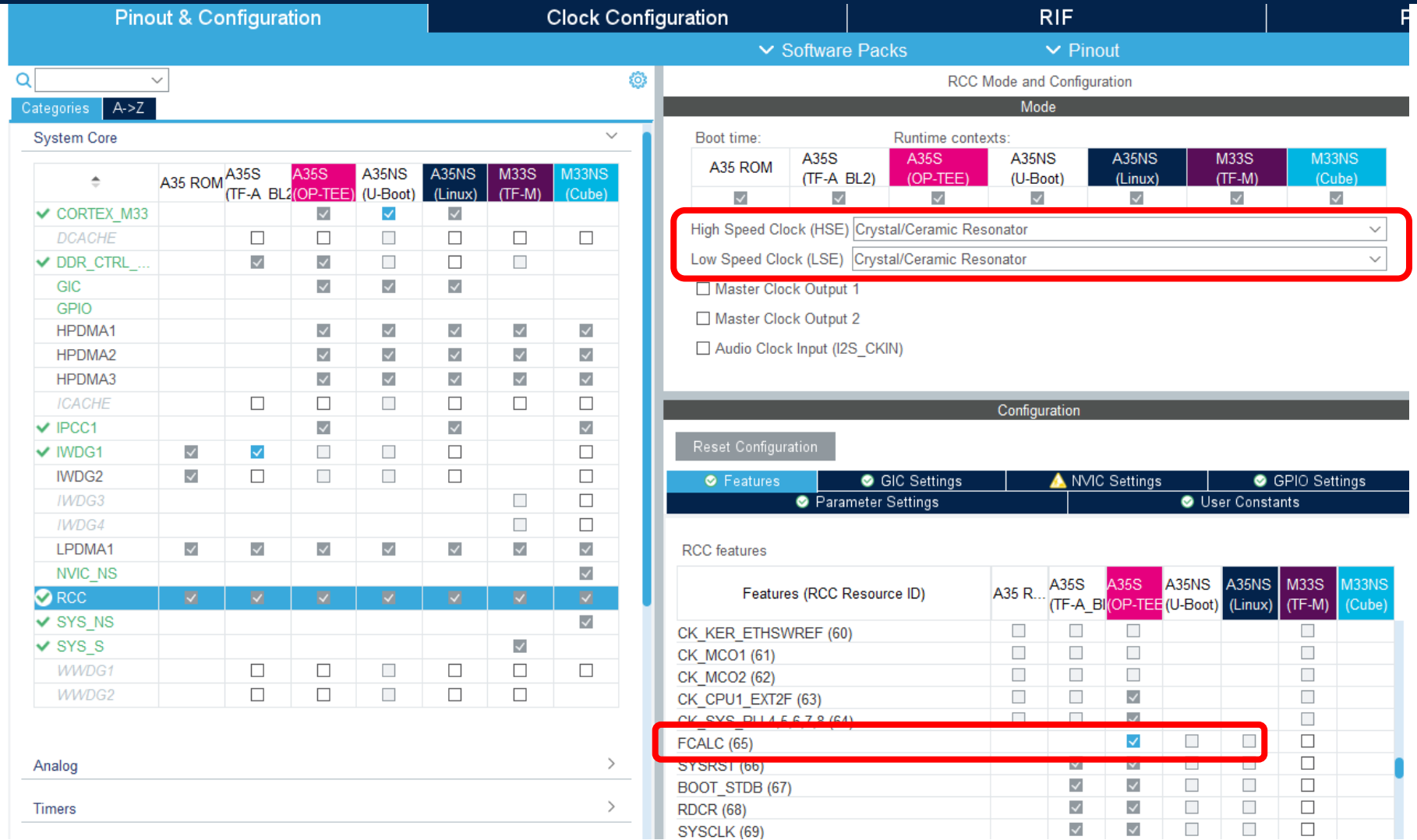
# 1.2 CubeMx project configuration : modules

## System Core modules : RCC : External clock source : board specific



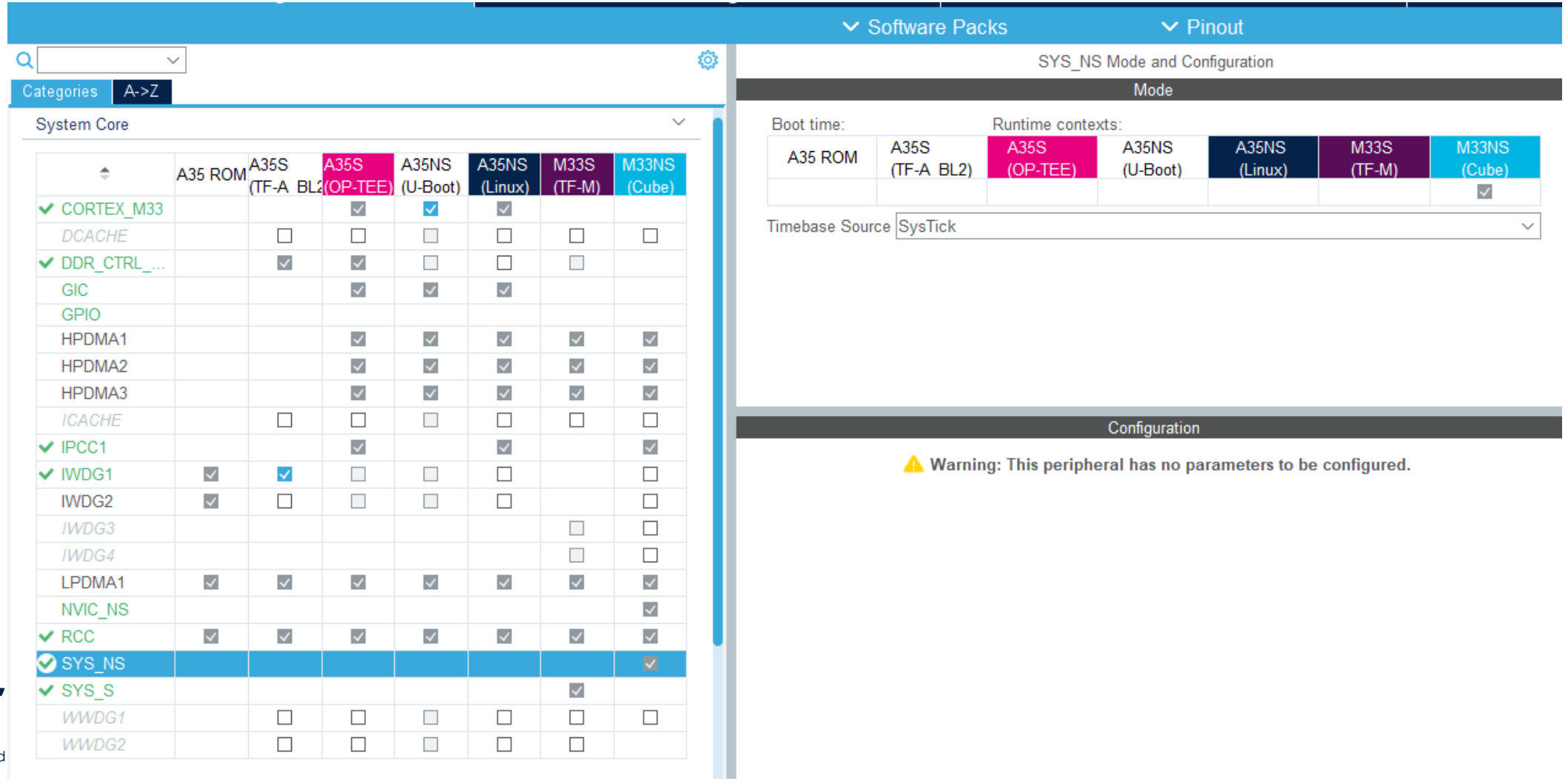

HSE is a must

LSE is recommended for OpenSTLinux v6.0
(if no LES, see section 5)

FCALC should be activated for OPTEE,
for “st-image-weston” image

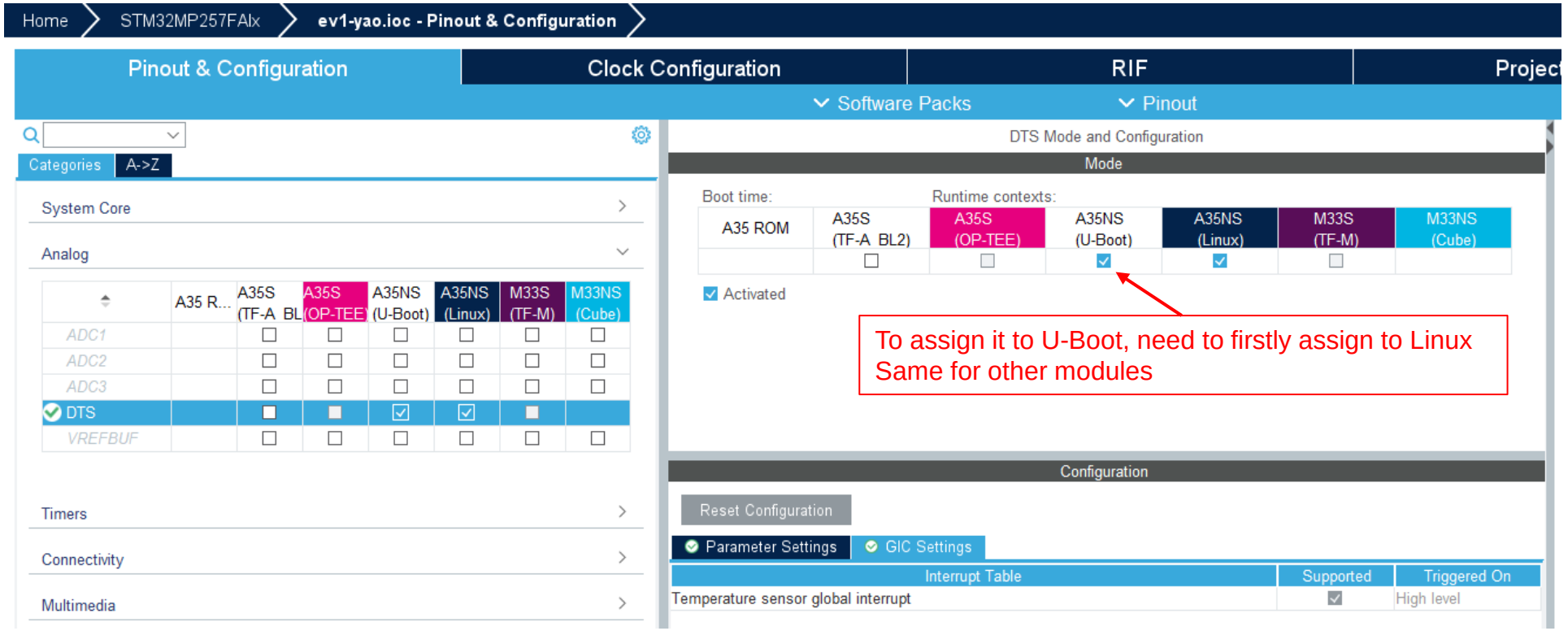
# 1.2 CubeMx project configuration : modules

**System Core modules : GIC / SYS_NS / SYS_S / … : as default for bring-up**



# 1.2 CubeMx project configuration : modules

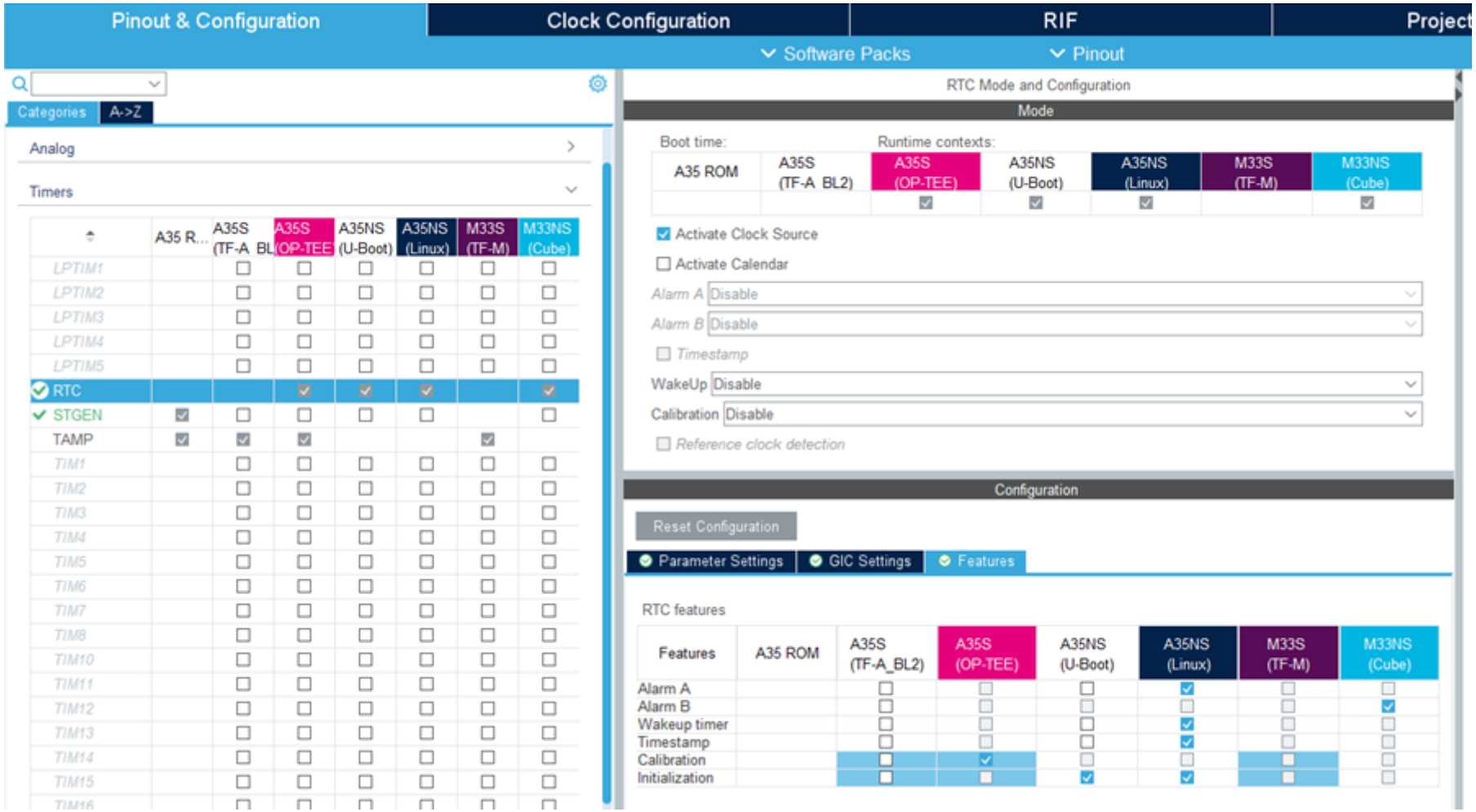
## Analog modules : Activate only DTS




DTS (Digital Temperature Sensors) is used by «st-image-weston» image for CPU temperature monitoring and CPU dynamic frequency management

# 1.2 CubeMx project configuration : modules

## Timers modules : RTC




Clock source should be activated, for OpenSTLinux OPTEE

Features assignement for OpenSTLinux st-image-weston image



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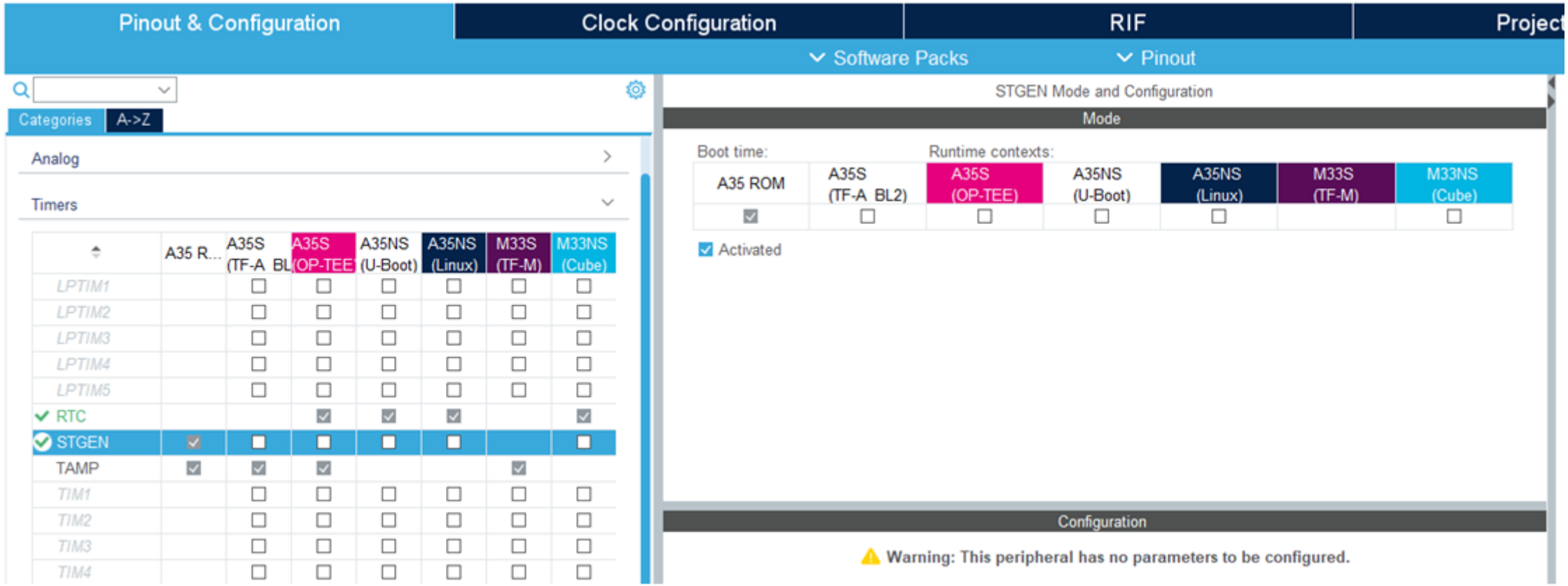
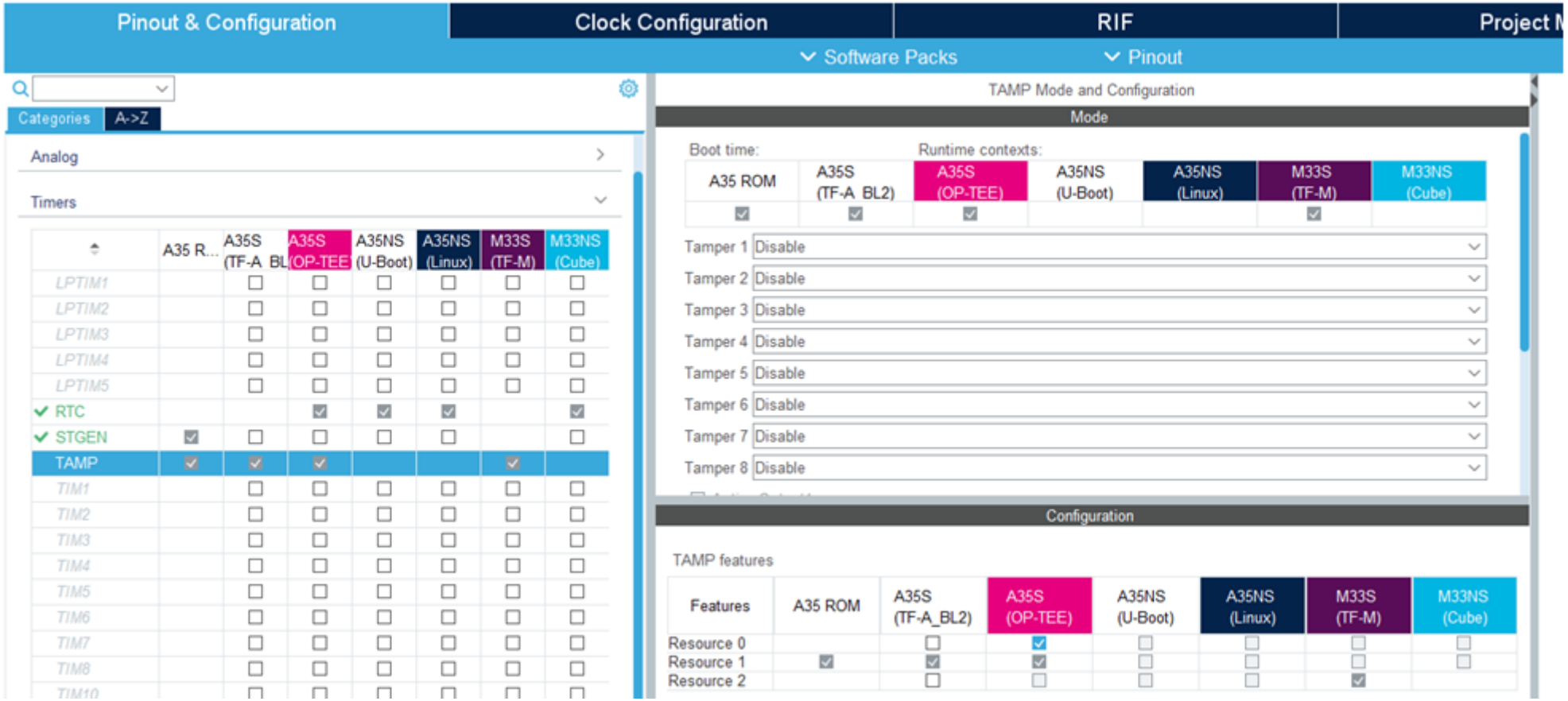
# 1.2 CubeMx project configuration : modules

**Timers modules : STGEN : activated as default**



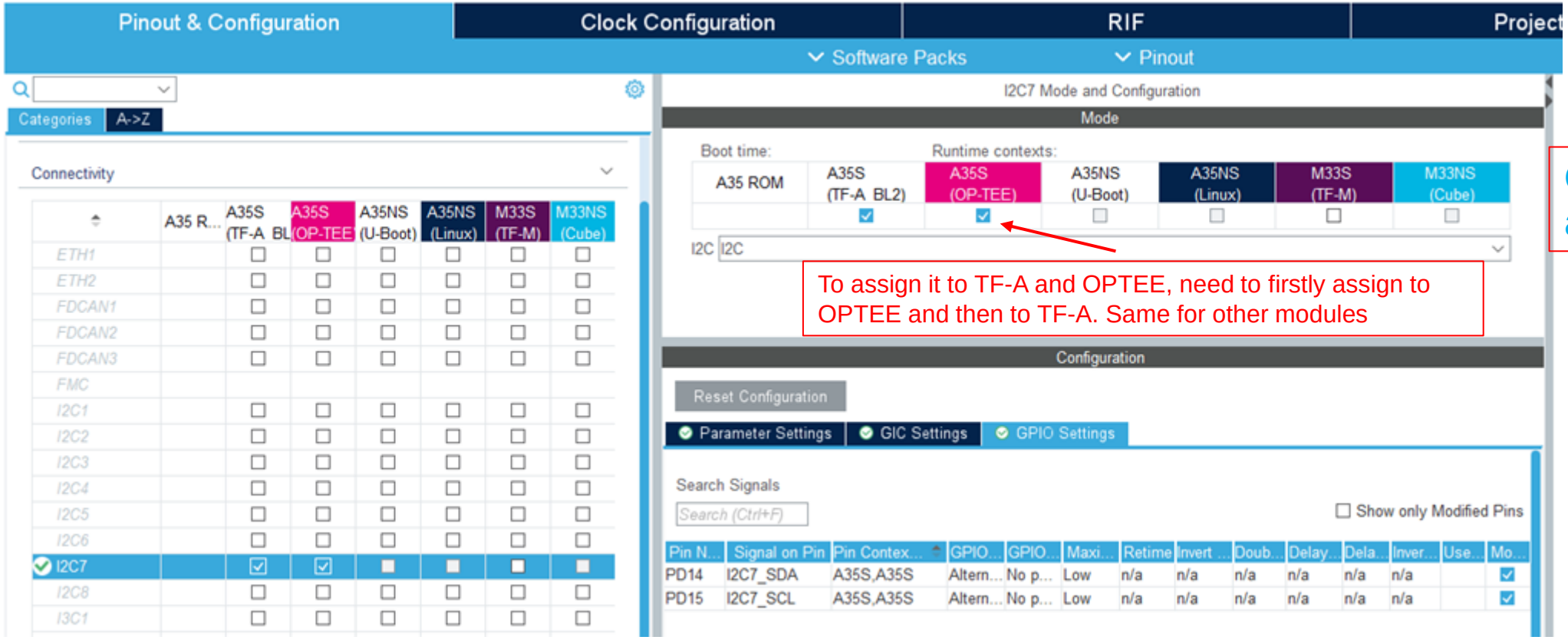
# 1.2 CubeMx project configuration : modules

**Timers modules : Tamper : only allocate resource to OPTEE/TF-M**



# 1.2 CubeMx project configuration : modules

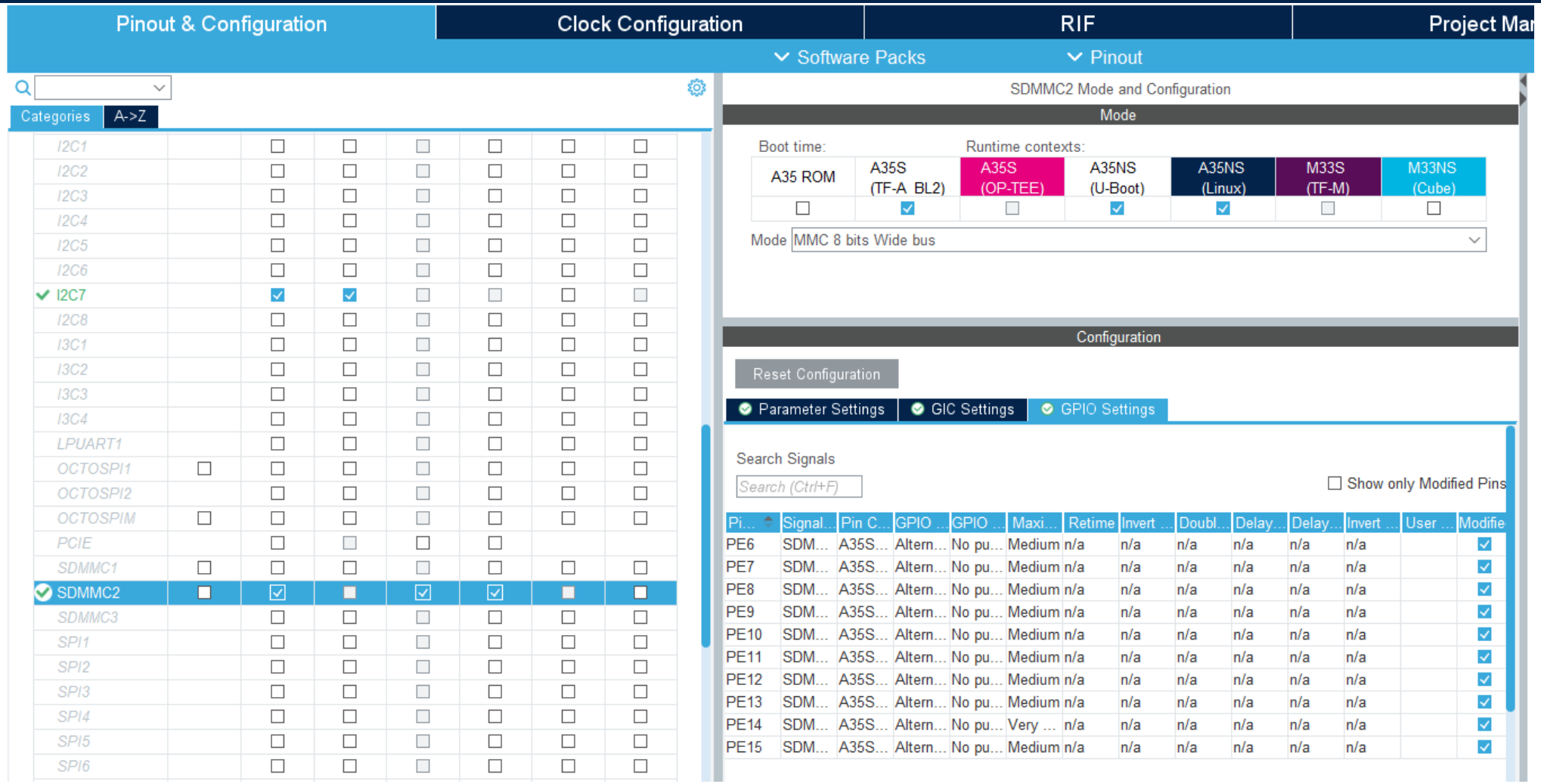
## Connectivity modules : I2C for PMIC : board specific




Only for TF-A and OPTEE

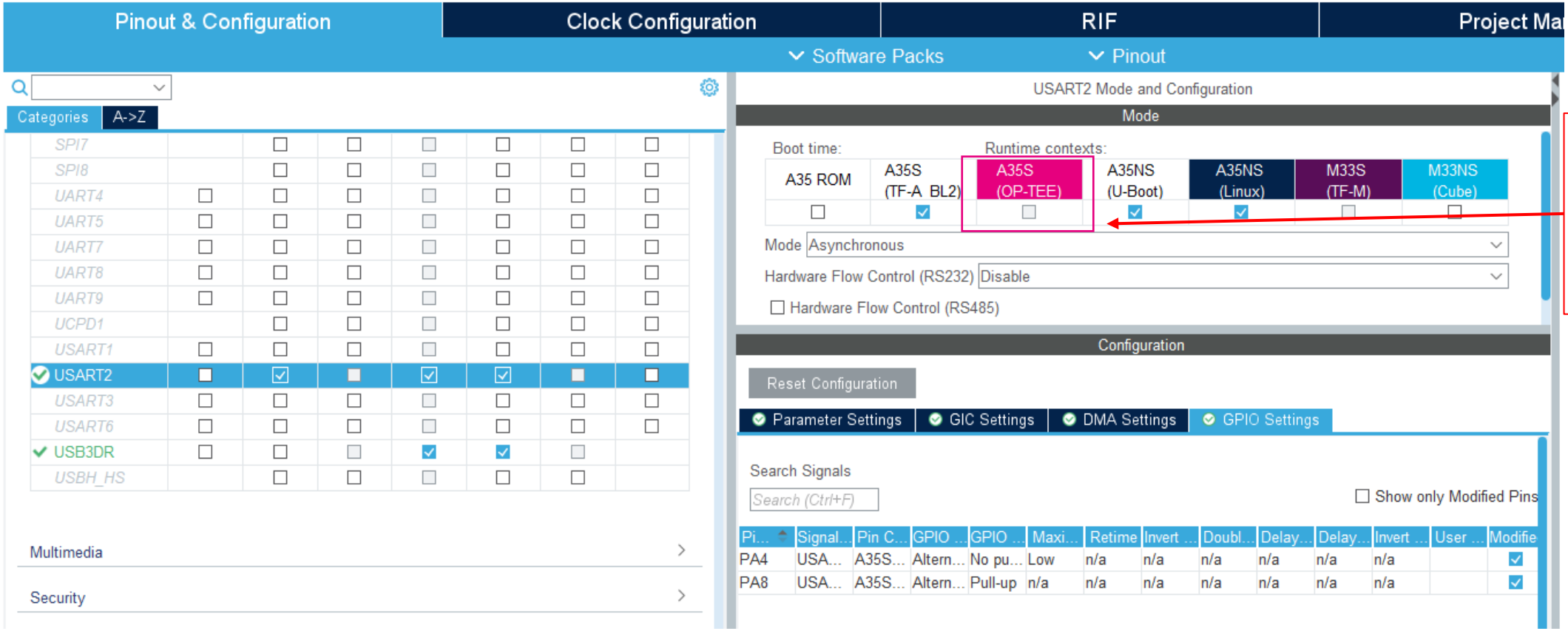
# 1.2 CubeMx project configuration : modules

## Connectivity modules: Boot Device : board specific



# 1.2 CubeMx project configuration : modules

## Connectivity modules : UART for debug console : board specific

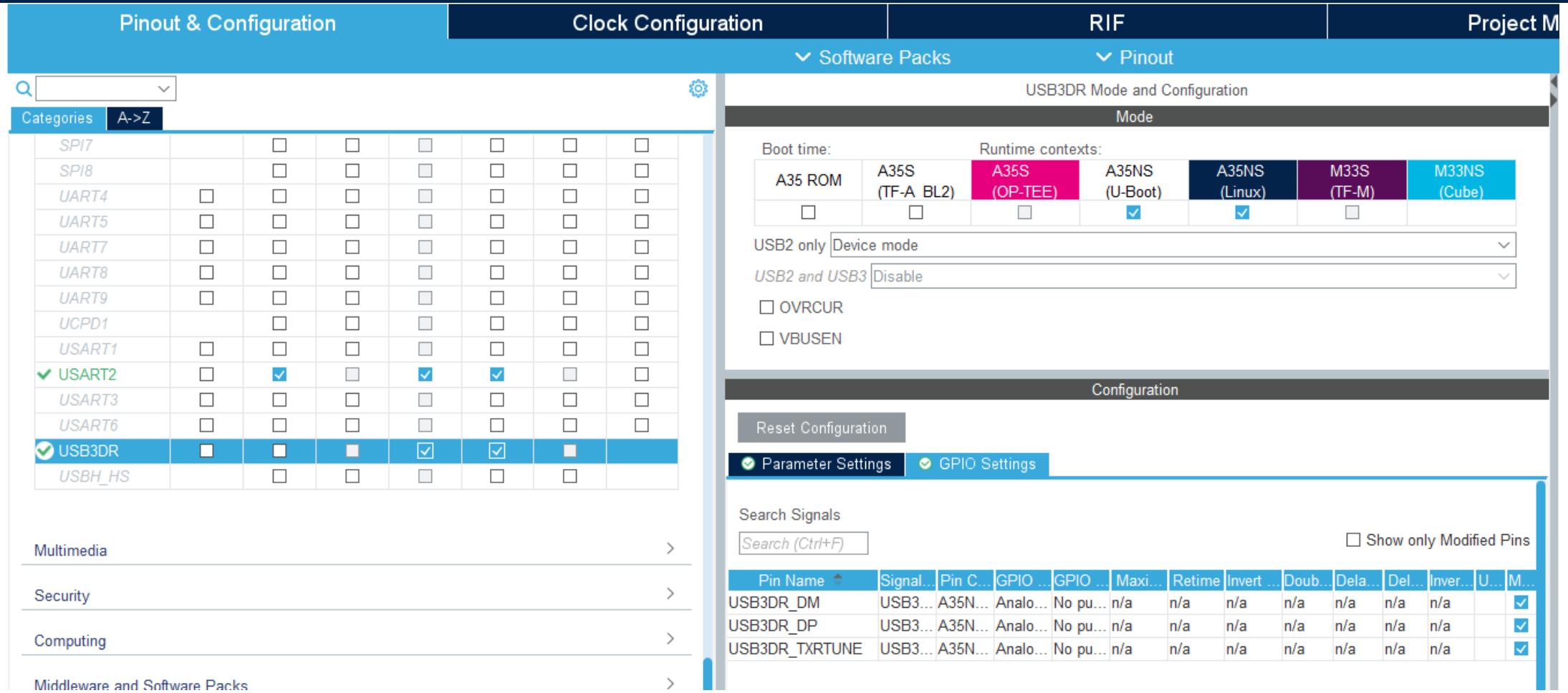



CubeMx limitation

To be added manually in device-tree

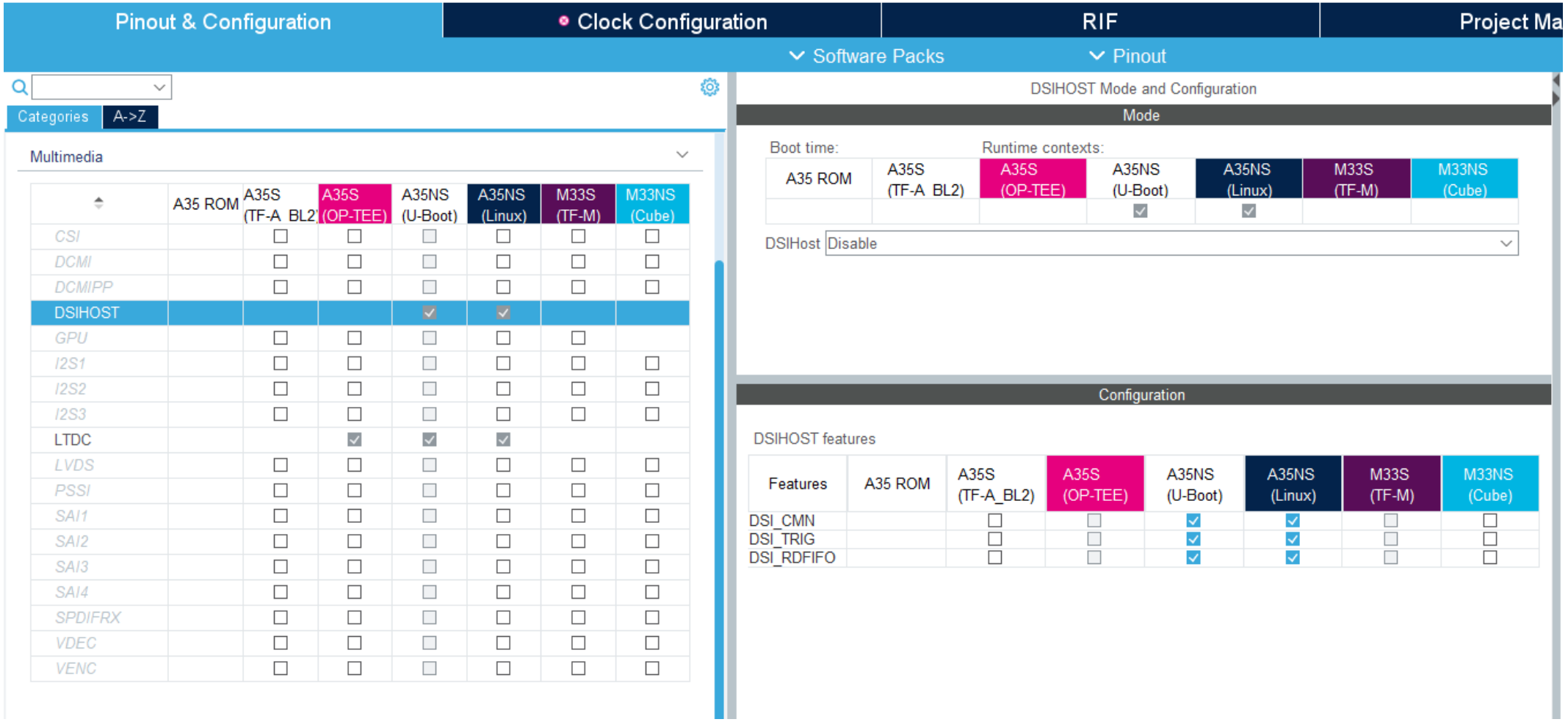
# 1.2 CubeMx project configuration : modules

## Connectivity modules: USB3DR for programming



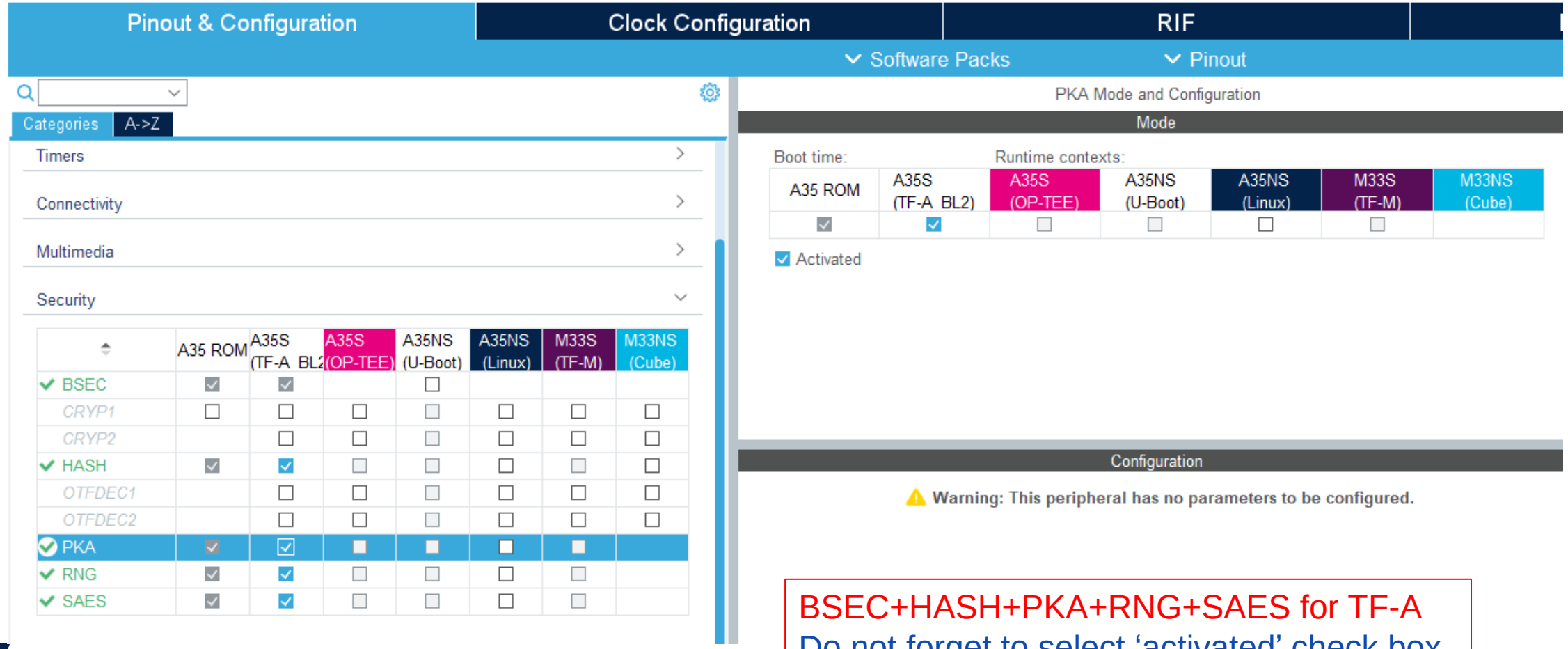
# 1.2 CubeMx project configuration : modules

## Multimedia modules : as default



# 1.2 CubeMx project configuration : modules

**Security modules : must for bring-up**



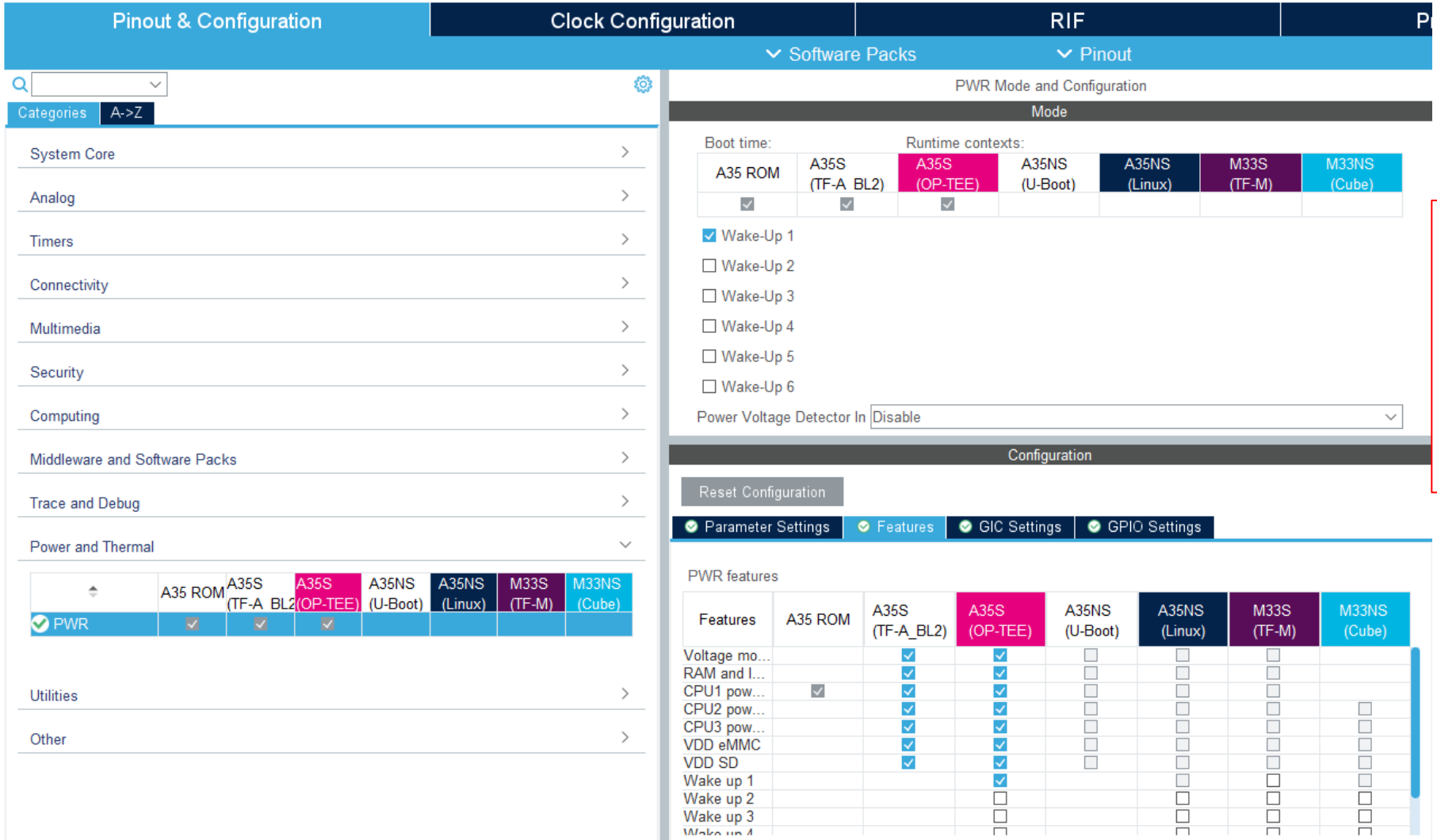

BSEC+HASH+PKA+RNG+SAES for TF-A
Do not forget to select ‘activated’ check box

# 1.2 CubeMx project configuration : modules

**Computing / Middleware and Software Packs / Trace-Debug modules : no need for bring-up**

# 1.2 CubeMx project configuration : modules

## Power and Thermal modules : PWR : allocate features for TF-A and OPTEE




Assign features to TF-A and OPTEE

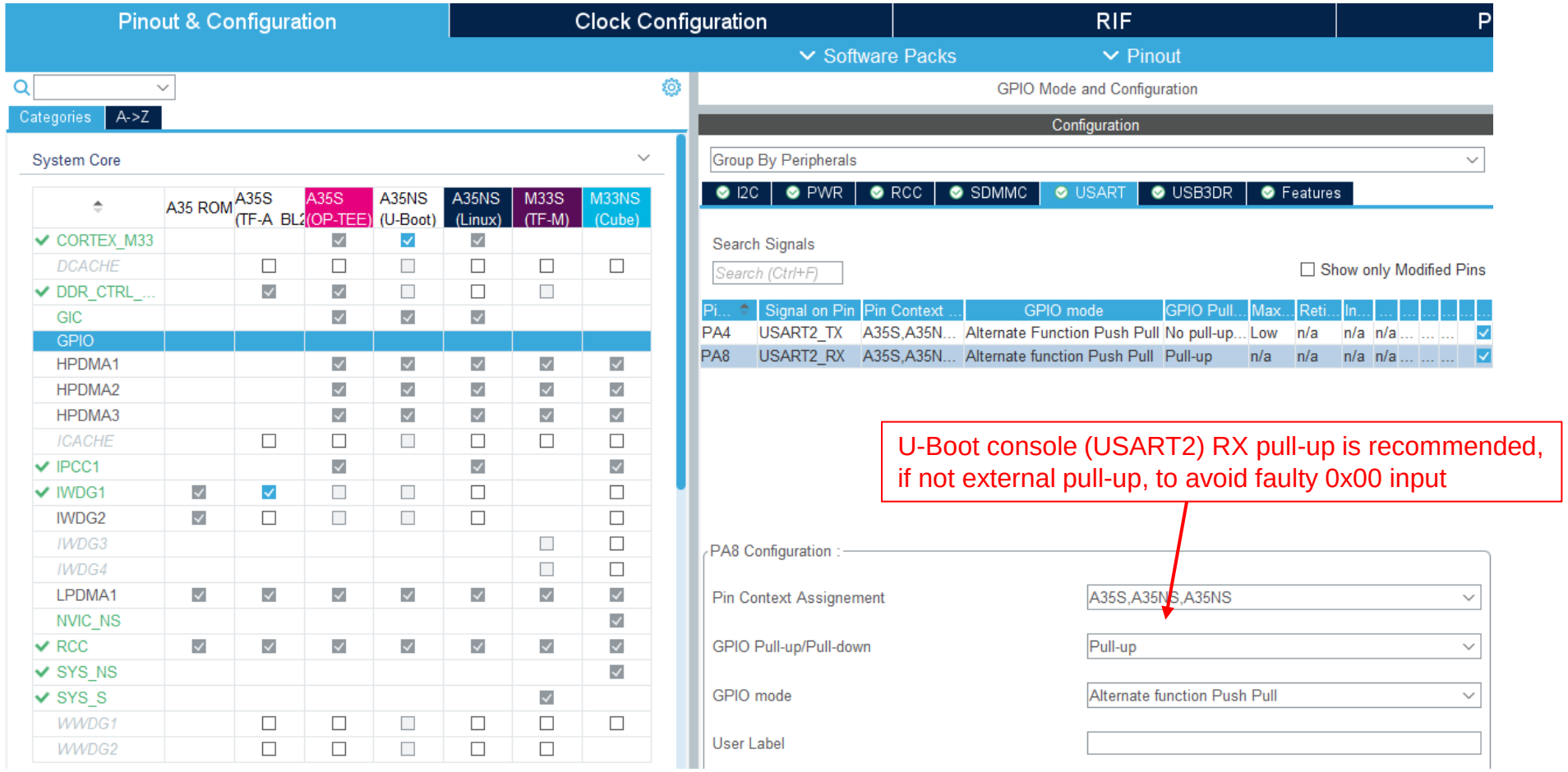
«Wake-Up 1» used by PMIC in OPTEE

# 1.2 CubeMx project configuration : modules

**Utilities and Other modules : no need for bring-up**

# 1.2 CubeMx project configuration : modules

## System Core modules : GPIO : check configuration




Make sure GPIO mode and pull-up/pull-down are good to make the board working

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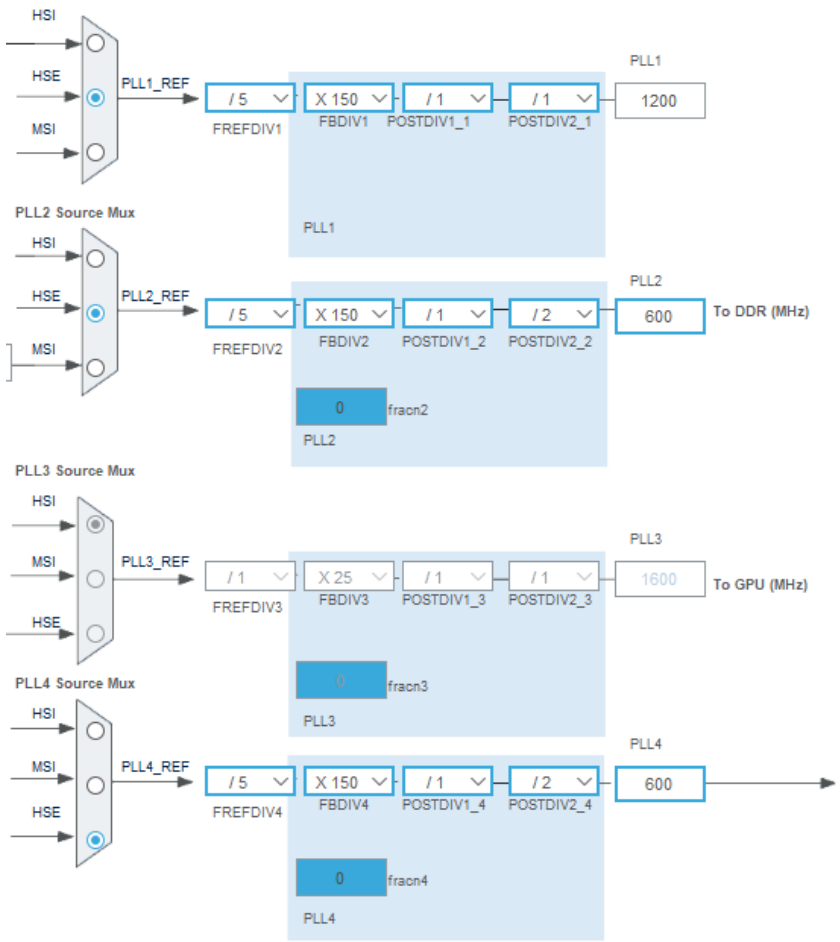
# 1.3 CubeMx project configuration: Clocks

## PLLs




PLL1 is reserved for A35 subsystem
1200MHz is for all STM32MP25x

PLL2 is reserved for DDR subsystem
600MHz here means 1200MHz for memclk

PLL3 is reserved for GPU-NPU subsystem

PLL4/5/6/7/8 are for FlexClkGen, selected firstly by a FlexClkGen channel, then their setting can be modified

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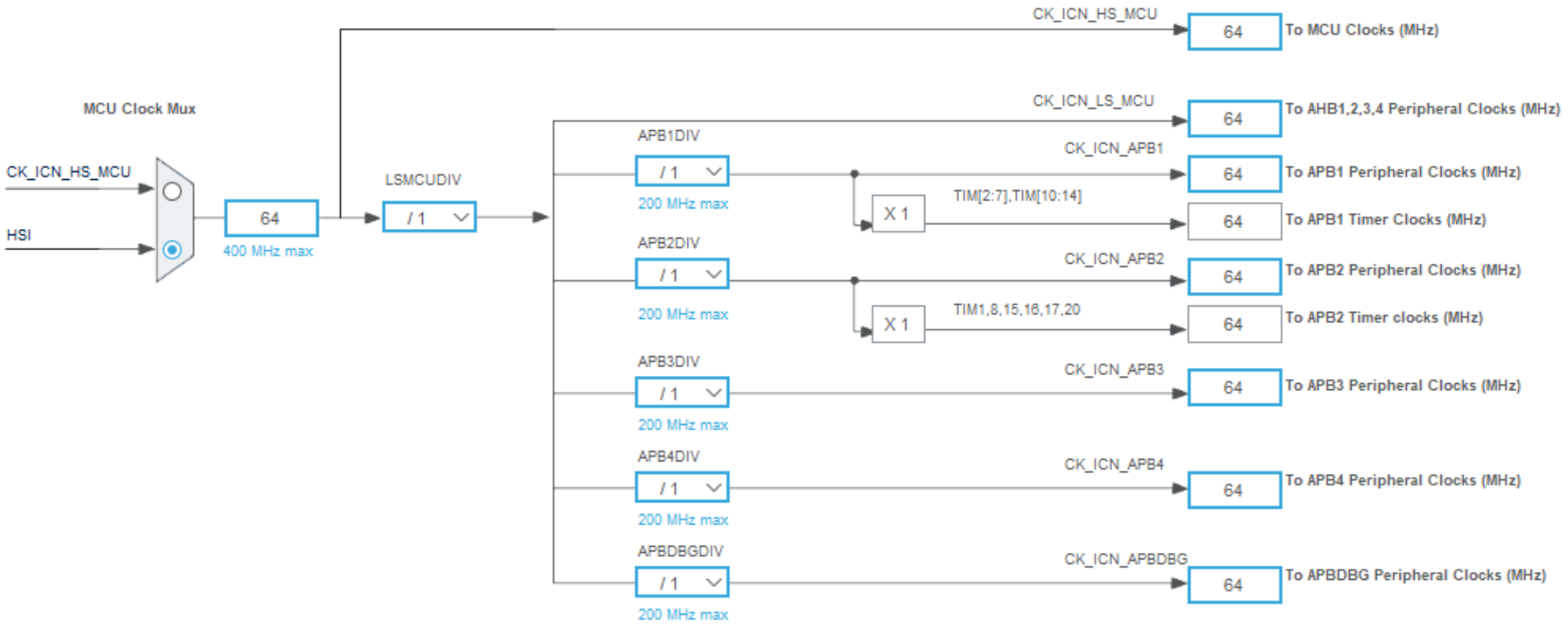
# 1.3 CubeMx project configuration: Clocks

## MCU (M33) Subsystem: as default for bring-up

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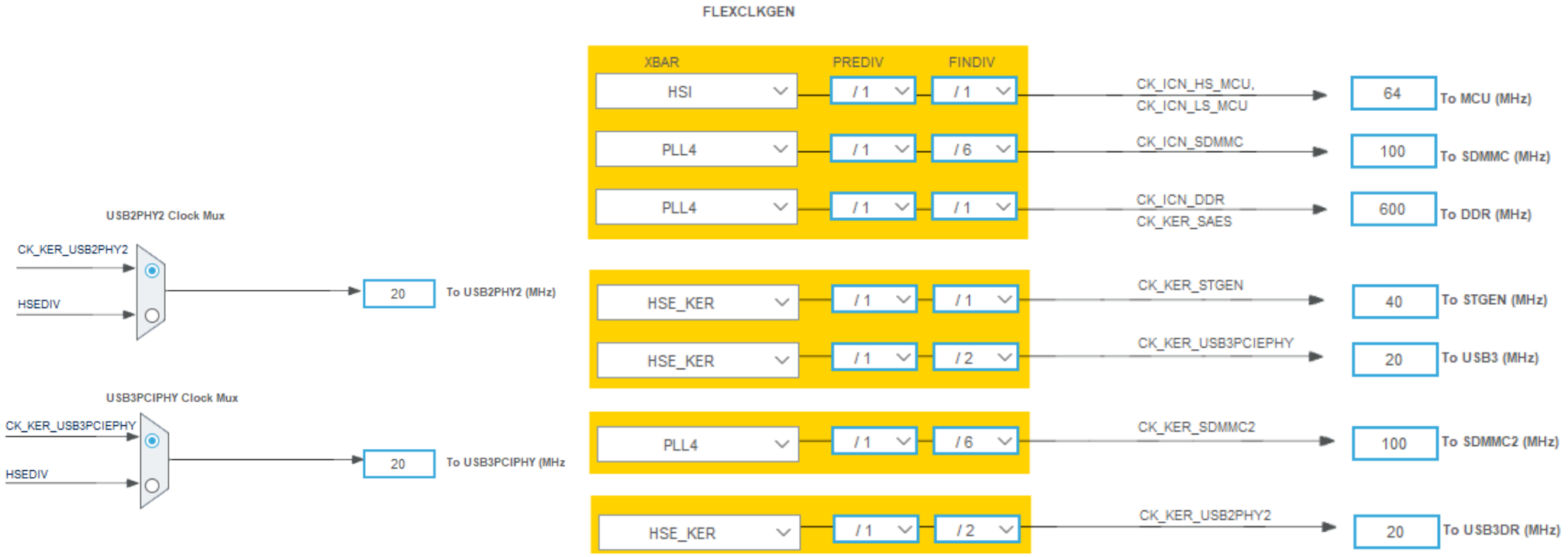
# 1.3 CubeMx project configuration: Clocks

## FlexClkGen



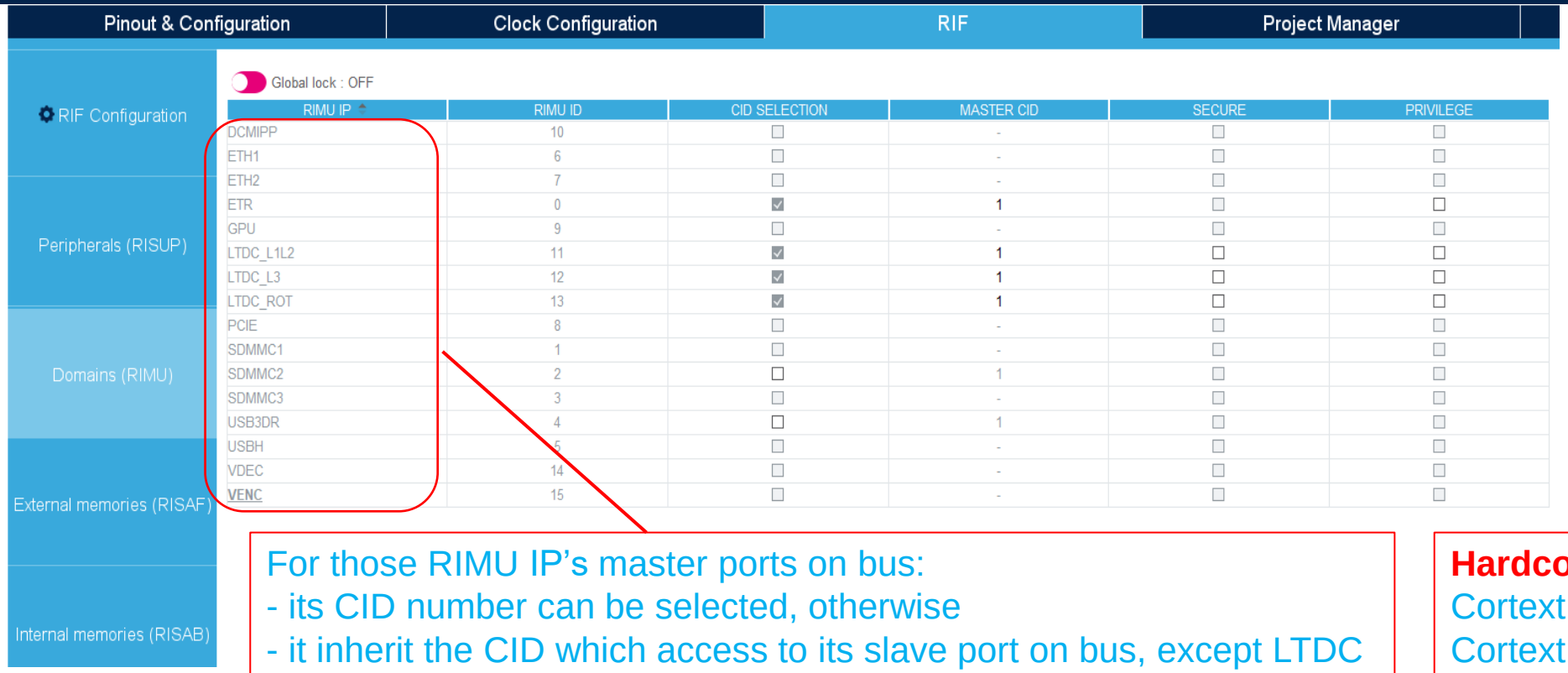

Use PLL4 to provide good clock rate to SDMMC and DDR interconnect

Use HSE_KER to provide good clock rate to STGEN, ComboPHY, USB3DR, USB2PHY2

Others as default

# 1.3 CubeMx project configuration: RIF

## RIMU: Master Ports on BUS: CID (Caller ID) number




For those RIMU IP's master ports on bus:
- its CID number can be selected, otherwise
- it inherit the CID which access to its slave port on bus, except LTDC

**Hardcoded CIDs:**
Cortext A35 : CID1
Cortext M33 : CID2
Cortext M0+ : CID3

HPDMA, LPDMA master ports on bus:
- it inherit the CID who access to its slave port on bus

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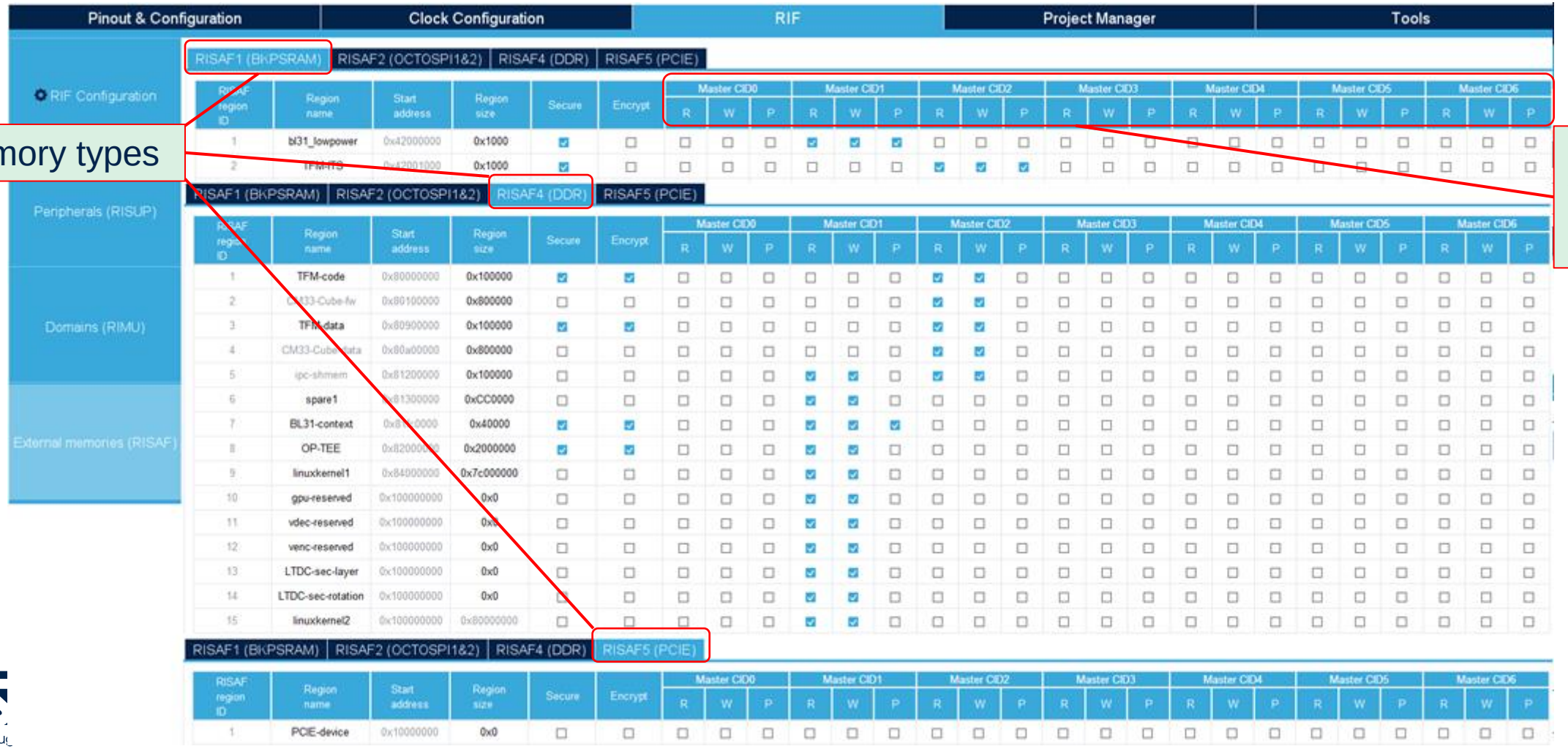
# 1.3 CubeMx project configuration: RIF

## Reserved memory: RISAF

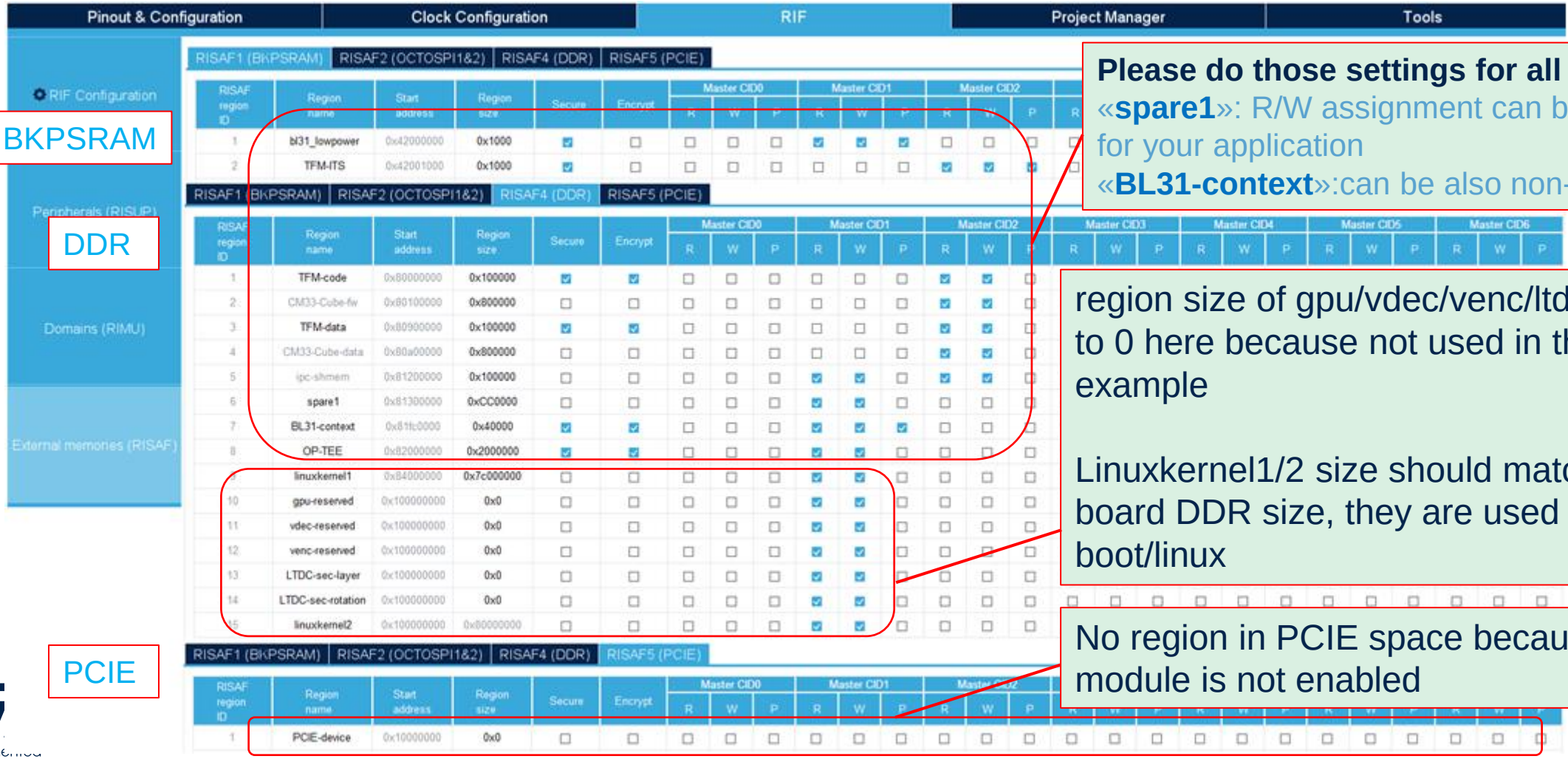



Memory types

R: Read
W: Write
P: Privilege

# 1.3 CubeMx project configuration: RIF

## Reserved memory: RISAF




**Please do those settings for all boards**
«**spare1**»: R/W assignment can be adapted for your application
«**BL31-context**»:can be also non-privilege

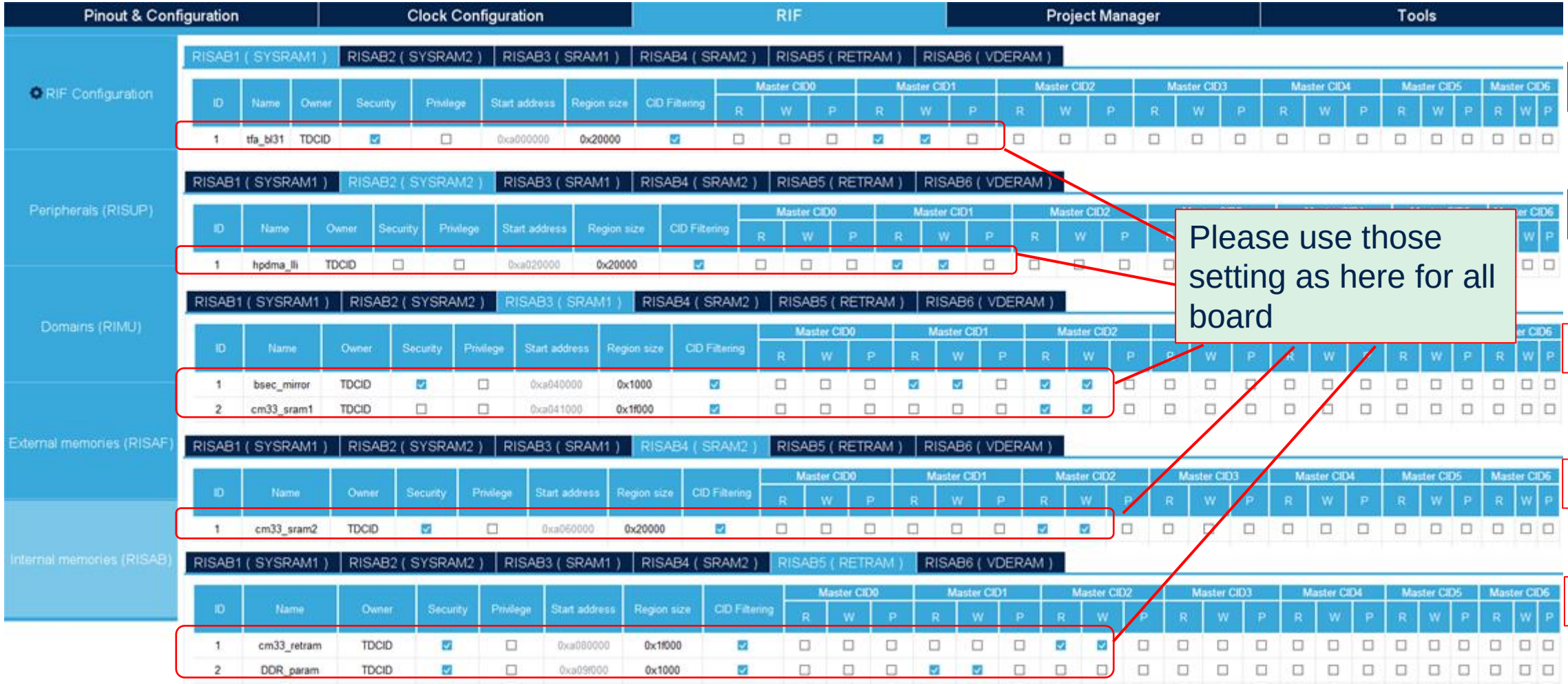
region size of gpu/vdec/venc/ltdc-sec set to 0 here because not used in this example

Linuxkernel1/2 size should match the on-board DDR size, they are used by u-boot/linux

No region in PCIE space because PCIE module is not enabled

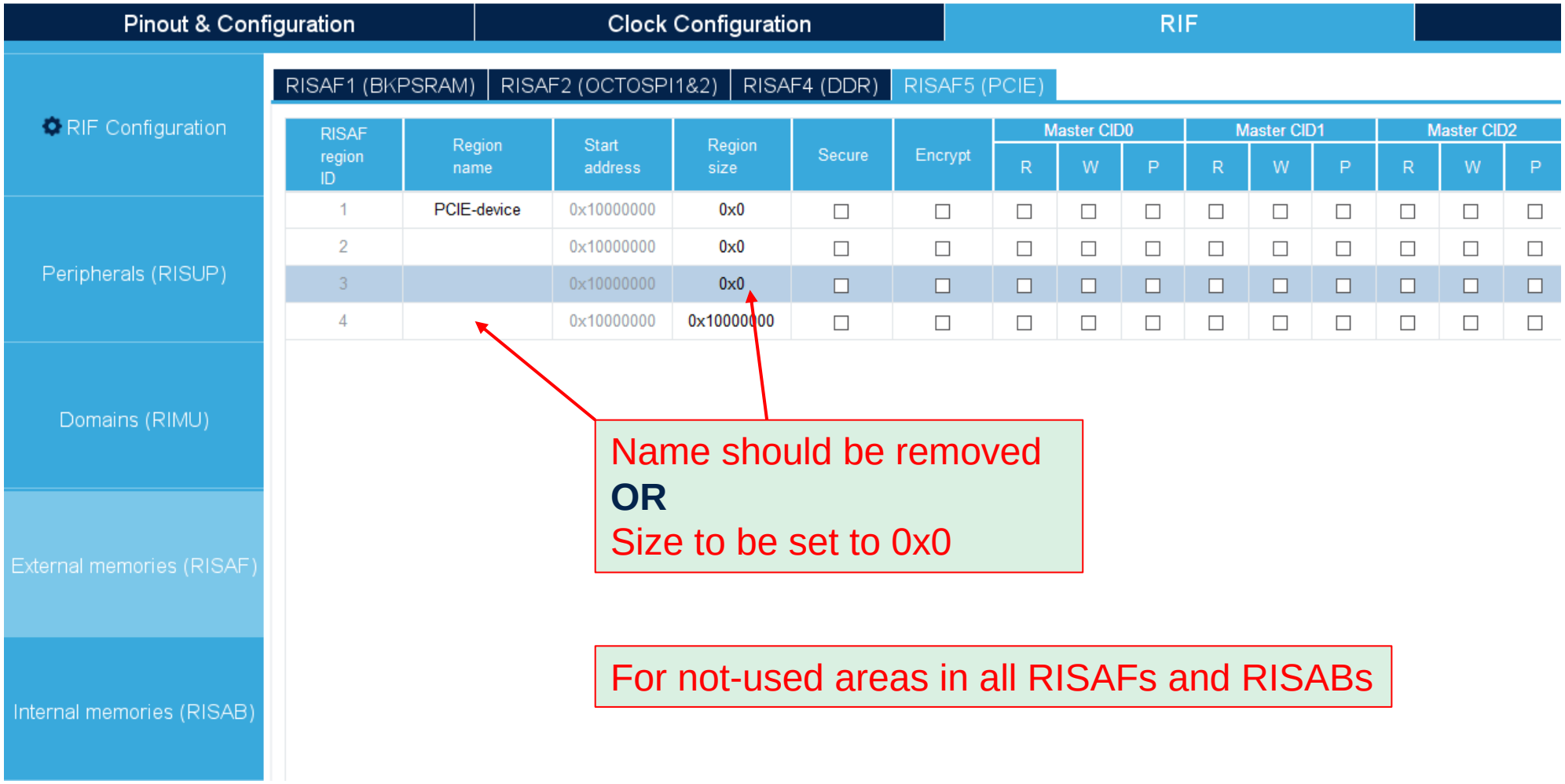
# 1.3 CubeMx project configuration: RIF

## Reserved memory: RISAB



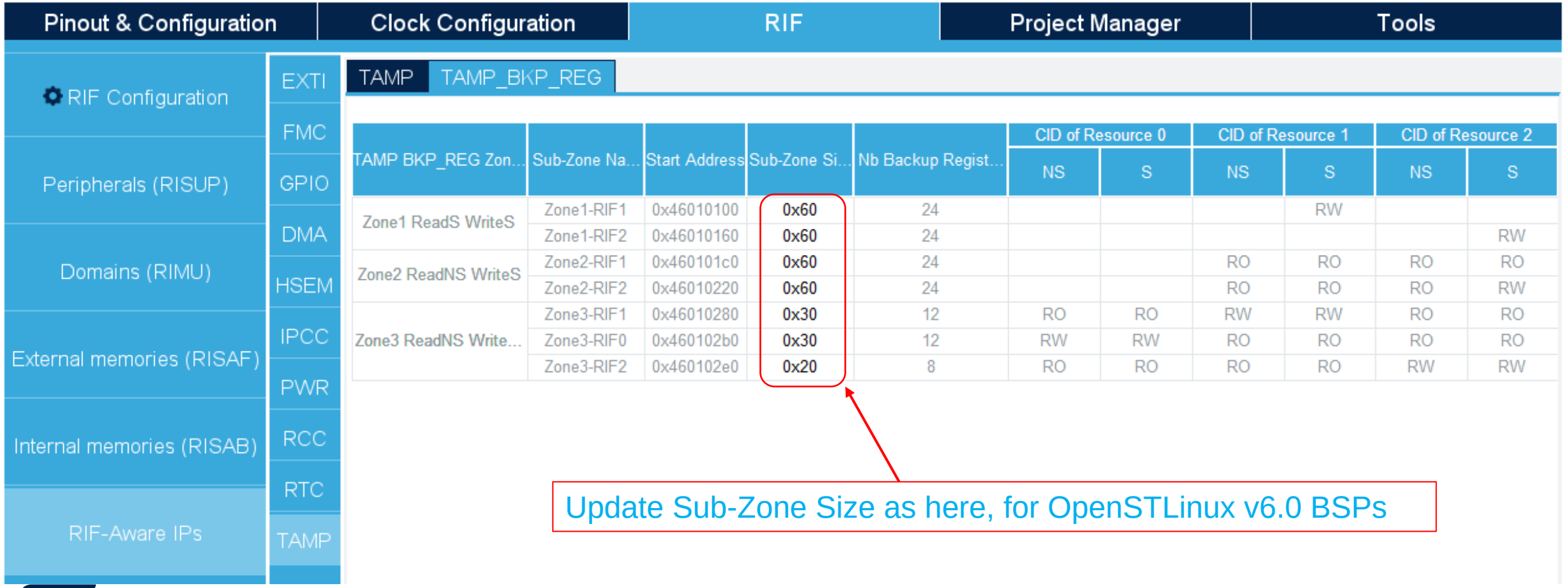
# 1.3 CubeMx project configuration: RIF

## Reserved memory: not-used areas



# 1.3 CubeMx project configuration: RIF

## RIF-Aware Ips: TAMP: TAMP_BKP_REG




| TAMP BKP_REG Zon... | Sub-Zone Na... | Start Address | Sub-Zone Si... | Nb Backup Regist... | CID of Resource 0 | | CID of Resource 1 | | CID of Resource 2 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | NS | S | NS | S | NS | S |
| Zone1 ReadS WriteS | Zone1-RIF1 | 0x46010100 | 0x60 | 24 | | | | RW | | |
| | Zone1-RIF2 | 0x46010160 | 0x60 | 24 | | | | | | RW |
| Zone2 ReadNS WriteS | Zone2-RIF1 | 0x460101c0 | 0x60 | 24 | | | RO | RO | RO | RO |
| | Zone2-RIF2 | 0x46010220 | 0x60 | 24 | | | RO | RO | RO | RW |
| Zone3 ReadNS Write... | Zone3-RIF1 | 0x46010280 | 0x30 | 12 | RO | RO | RW | RW | RO | RO |
| | Zone3-RIF0 | 0x460102b0 | 0x30 | 12 | RW | RW | RO | RO | RO | RO |
| | Zone3-RIF2 | 0x460102e0 | 0x20 | 8 | RO | RO | RO | RO | RW | RW |

Update Sub-Zone Size as here, for OpenSTLinux v6.0 BSPs

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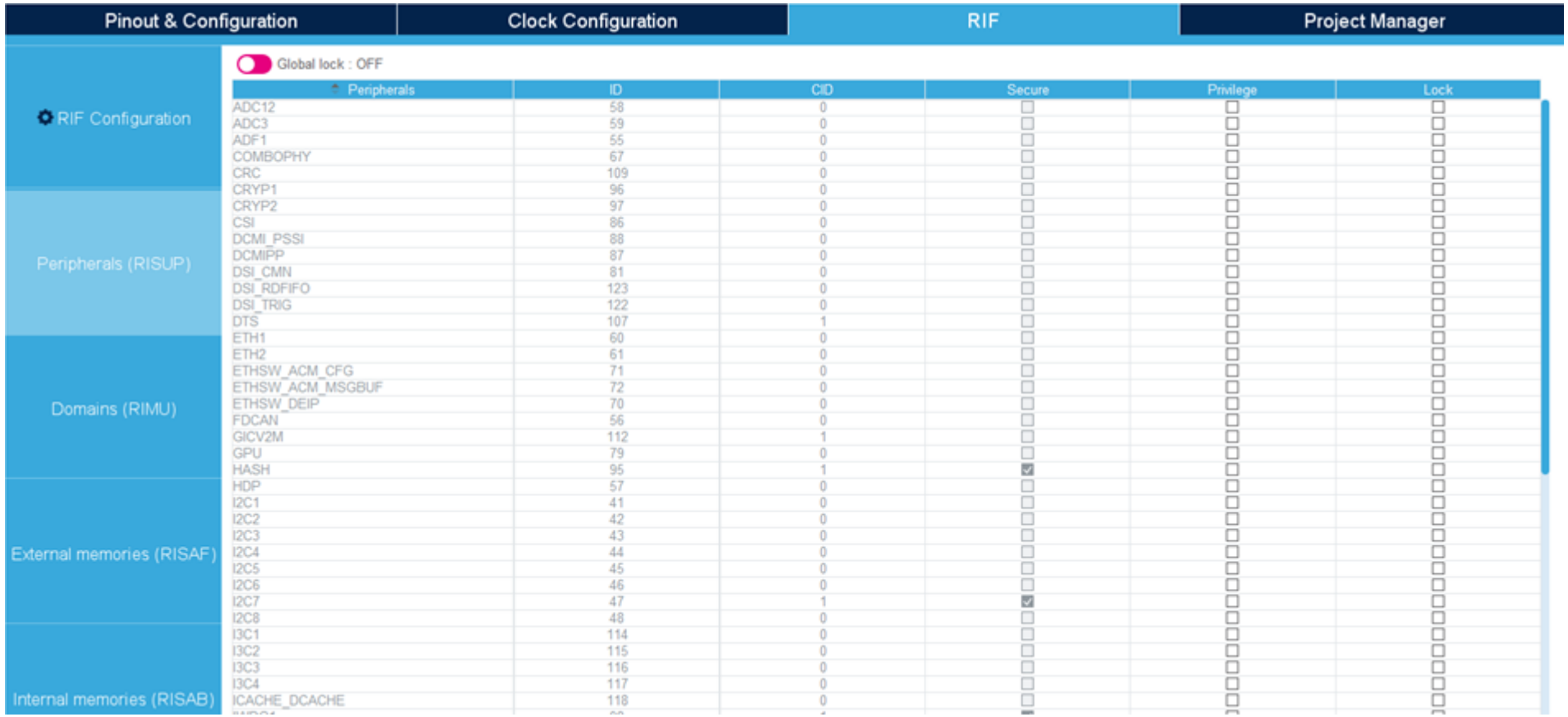
# 1.3 CubeMx project configuration: RIF

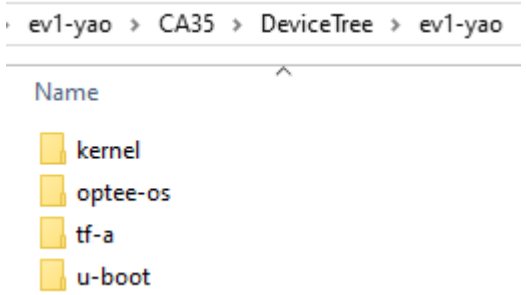
**Others (RISUP, RIMU, …) : as default**



# 1.4 Generate Device Trees

## Generate device tree files : device tree files location


Device tree files location



# 2 User-code section configurations in device trees

# 2.1 User-code section in tf-a/<part_number>-<project_name>-mx-fw-config.dts

```
/* USER CODE BEGIN root */
dtb-registry {
    soc_fw-config {
    load-address = <0x0 0x81fc0000>;
    max-size = <0x40000>;
    };
   tos_fw {
    load-address = <0x0 0x82000000>;
    max-size = <0x2000000>;
    };
};
/* USER CODE END root */
```

Load-address and max-size must be the same as the reserved sections bl31-context

Load-address and max-size must be the same as the reserved section op-tee

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# 2.1 User-code section in **tf-a/<part_number>-<project_name>-mx.dts**

## Debug UART : board specific

```
/* USER CODE BEGIN root */
aliases {
    serial0 = &usart2;
};
chosen {
    stdout-path = "serial0:115200n8";
};
/* USER CODE END root */
```

## VDDIOx HSLV permission, IWDGx freezing

```
/* USER CODE BEGIN root */
shadow-prov {
    compatible = "st,provisioning";
    hconf1_prov {
        // VDDIO2/1 HSLV allowed
        // IWDG4/3/2/1 freeze in Stop/Standby mode
        nvmem-cells = <&hconf1_otp>;
        st,shadow-value = <0x00018DB6>;
    };
};
/* USER CODE END root */
```

## Board ID OTP: board specific

```
/* USER CODE BEGIN bsec */
board_id: board_id@3d8 {
    reg = <0x3d8 0x4>;
};
/* USER CODE END bsec */
```

## DDR supply : board specific

```
/* USER CODE BEGIN ddr */
vdd-supply = <&vdd_ddr>;
vtt-supply = <&vtt_ddr>;
vpp-supply = <&vpp_ddr>;
vref-supply = <&vref_ddr>;
/* USER CODE END ddr */
```

## IWDG1 period

```
/* USER CODE BEGIN iwdg1 */
timeout-sec = <32>;
/* USER CODE END iwdg1 */
```

## Boot Device : board specific

```
/* USER CODE BEGIN sdmmc2 */
non-removable;
no-sd;
no-sdio;
st,neg-edge;
bus-width = <8>;
vmmc-supply = <&vdd_emmc>;
vqmmc-supply = <&vddio2>;
/* USER CODE END sdmmc2 */
```

## VDDIOx supply for UART / I2C / BootDevice : board specific

```
/* USER CODE BEGIN addons */
&pwr {
    vddio: vddio {
    vdd-supply = <&vddio_pmic>;
    };
    vddio2: vddio2 {
    vddio2-supply = <&v1v8>;
    };
};
/* USER CODE END addons */
```

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# 2.1 User-code section in tf-a/<part_number>-<project_name>-mx.dts

**Power supplies : board specific**

```
/* USER CODE BEGIN i2c7 */
clock-frequency = <400000>;

pmic2: stpmic@33 {
   compatible = "st,stpmic2";
   reg = <0x33>;
   status = "okay";

    regulators {
      compatible = "st,stpmic2-regulators";

      vddcpu: buck1 {
         regulator-name = "vddcpu";
         regulator-min-microvolt = <800000>;
         regulator-max-microvolt = <910000>;
         regulator-always-on;
      };
      vddcore: buck2 {
         regulator-name = "vddcore";
         regulator-min-microvolt = <820000>;
         regulator-max-microvolt = <820000>;
         regulator-always-on;
      };
      vddio_pmic: buck4 {
         regulator-name = "vddio_pmic";
         regulator-min-microvolt = <3300000>;
         regulator-max-microvolt = <3300000>;
      };
      v1v8: buck5 {
         regulator-name = "v1v8";
         regulator-min-microvolt = <1800000>;
         regulator-max-microvolt = <1800000>;
      };
      vdd_ddr: buck6 {
         regulator-name = "vdd_ddr";
         regulator-min-microvolt = <1200000>;
         regulator-max-microvolt = <1200000>;
      };
      vref_ddr: refddr {
         regulator-name = "vref_ddr";
      };
      vdda1v8_aon: ldo1 {
         regulator-name = "vdda1v8_aon";
         regulator-min-microvolt = <1800000>;
         regulator-max-microvolt = <1800000>;
         regulator-always-on;
      };
      vdd_emmc: ldo2 {
         regulator-name = "vdd_emmc";
         regulator-min-microvolt = <3300000>;
         regulator-max-microvolt = <3300000>;
         regulator-always-on;
      };
      vtt_ddr: ldo3 {
         regulator-name = "vtt_ddr";
         st,regulator-sink-source;
      };
      vdd3v3_usb: ldo4 {
         regulator-name = "vdd3v3_usb";
         regulator-min-microvolt = <3300000>;
         regulator-max-microvolt = <3300000>;
         regulator-always-on;
      };
      vpp_ddr: ldo5 {
         regulator-name = "vpp_ddr";
         regulator-min-microvolt = <2500000>;
         regulator-max-microvolt = <2500000>;
      };
    };
};
/* USER CODE END i2c7 */
```

Make sure :
DDR chip,
BootDevice ,
MP2 (VDDCPU,
VDDDDR,
VDDCORE,
VDDIOx,
VDDA18PLLx,
VDDA18DDR,
VDDA18AON,
VDD33USB)
are powered

# 2.2 User-code section in optee-os/<part_number>-<project_name>-mx.dts

## Including

```
/* USER CODE BEGIN includes */
// for STPMIC2
#include <dt-bindings/mfd/st,stpmic2.h>
// UART console pins, wakeup_pins
#include "stm32mp25-pinctrl.dtsi"
/* USER CODE END includes */
```

## VDDIOx HSLV permission, IWDGx freezing

```
/* USER CODE BEGIN root */
shadow-prov {
    compatible = "st,provisioning";
    hconf1_prov {
        // VDDIO2/1 HSLV allowed
        // IWDG4/3/2/1 freeze in Stop/Standby mode
        nvmem-cells = <&hconf1_otp>;
        st,shadow-value = <0x00018DB6>;
    };
};
/* USER CODE END root */
```

## Debug UART : board specific

```
/* USER CODE BEGIN root */
aliases {
    serial0 = &usart2;
};
chosen {
    stdout-path = "serial0:115200n8";
};
/* USER CODE END root */

/* USER CODE BEGIN addons */
&usart2 {
        pinctrl-names = "default";
        pinctrl-0 = <&usart2_pins_a>;
        status = "okay";
};
/* USER CODE END addons */
```

## SCMI regulators: board specific

```
/* USER CODE BEGIN addons */
// provided to u-boot/linux via scmi server-client
&scmi_regu {
    scmi_vdd_emmc: voltd-vdd-emmc {
        reg = <VOLTD_SCMI_STPMIC2_LDO2>;
        voltd-supply = <&vdd_emmc>;
    };
    scmi_vdd3v3_usb: voltd-vdd3v3-usb {
        reg = <VOLTD_SCMI_STPMIC2_LDO4>;
        voltd-supply = <&vdd3v3_usb>;
    };
};
/* USER CODE END addons */
```

## System configuration

```
/* USER CODE BEGIN iwdg1 */
timeout-sec = <32>;
status = "okay";
/* USER CODE BEGIN iwdg1 */

/* USER CODE BEGIN addons */
&cpu0 {
    cpu-supply = <&vddcpu>;
};

// RIF config
&risaf1 {
    status = "okay";
};
&risaf4 {
    status = "okay";
};
&risaf5 {
    status = "okay";
};
/* USER CODE END addons */
```

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# 2.2 User-code section in optee-os/<part_number>-<project_name>-mx.dts

## 1.5GHz for stm32mp25xF

```
/* USER CODE BEGIN addons */
// 1500MHz is only for STM32MP25xF
&pll1 {
    pll1_cfg_1500Mhz: pll1-cfg-1500Mhz {
        cfg = <375 5 1 2>;
        src = <MUX_CFG(MUX_MUXSEL5, MUXSEL_HSE)>;
    };
};
&rcc {
    st,clk_opp {
        st,ck_cpu1 {
            cfg_1 {
                hz = <1500000000>;
                st,clksrc = <0>;
                st,pll = <&pll1_cfg_1500Mhz>;
            };
            cfg_2 {
                hz = <1200000000>;
                st,clksrc = <0>;
                st,pll = <&pll1_cfg_1200Mhz>;
            };
        };
    };
};
/* USER CODE END addons */
```

## Internal regulators : board specific

```
/* USER CODE BEGIN addons */
&pwr {
    status = "okay";
    wakeup-gpios = <&gpioa 0
GPIO_ACTIVE_LOW>, <0>, <0>, <0>, <0>, <0>;

    vddio1: vddio1 {
        status = "okay";
        regulator-min-microvolt = <1800000>;
        regulator-max-microvolt = <3300000>;
        vddio1-supply = <&vddio_sdcard>;
    };
    vddio2: vddio2 {
        status = "okay";
        vddio2-supply = <&v1v8>;
        regulator-always-on;
    };
    vddio3: vddio3 {
        status = "okay";
        vddio3-supply = <&vddio_pmic>;
    };
    vddio4: vddio4 {
        status = "okay";
        vddio4-supply = <&vddio_pmic>;
    };
    vddio: vddio {
        status = "okay";
        vdd-supply = <&vddio_pmic>;
    };
    vdd33ucpd: vdd33ucpd {
        status = "okay";
        vdd33ucpd-supply = <&vdd3v3_usb>;
    };
    vdda18adc: vdda18adc {
        status = "okay";
        vdda18adc-supply = <&v1v8>;
    };
    vddgpu: vddgpu {
        status = "okay";
        vddgpu-supply = <&vddgpu_pmic>;
    };
};
/* USER CODE END addons */
```

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# 2.2 User-code section in optee-os/<part_number>-<project_name>-mx.dts

**Power supplies : board specific**

```
/* USER CODE BEGIN i2c7 */
clock-frequency = <400000>;

pmic2: stpmic2@33 {
   compatible = "st,stpmic2";
   reg = <0x33>;
   st,pmic-it-id = <IT_PKEY_FA IT_PKEY_RI>;
   st,notif-it-id = <0 1>;
   st,wakeup-pin-number = <1>;
   wakeup-parent = <&pwr>;
   status = "okay";

   regulators {
      compatible = "st,stpmic2-regulators";
      ldo1-supply = <&vddio_pmic>;

      vddcpu: buck1 {
         regulator-name = "vddcpu";
         regulator-min-microvolt = <800000>;
         regulator-max-microvolt = <910000>;
         regulator-always-on;
      };
      vddcore: buck2 {
         regulator-name = "vddcore";
         regulator-min-microvolt = <820000>;
         regulator-max-microvolt = <820000>;
         regulator-always-on;
      };
      vddgpu_pmic: buck3 {
         regulator-name = "vddgpu_pmic";
         regulator-min-microvolt = <800000>;
         regulator-max-microvolt = <900000>;
         regulator-over-current-protection;
      };
      vddio_pmic: buck4 {
         regulator-name = "vddio_pmic";
         regulator-min-microvolt = <3300000>;
         regulator-max-microvolt = <3300000>;
         regulator-always-on;
      };
      v1v8: buck5 {
         regulator-name = "v1v8";
         regulator-min-microvolt = <1800000>;
         regulator-max-microvolt = <1800000>;
         regulator-always-on;
      };
      vdd_ddr: buck6 {
         regulator-name = "vdd_ddr";
         regulator-min-microvolt = <1200000>;
         regulator-max-microvolt = <1200000>;
         regulator-always-on;
         regulator-pull-down;
      };
      v3v3: buck7 {
         regulator-name = "v3v3";
         regulator-min-microvolt = <3300000>;
         regulator-max-microvolt = <3300000>;
         regulator-always-on;
         regulator-over-current-protection;
      };
      vdda1v8_aon: ldo1 {
         regulator-name = "vdda1v8_aon";
         regulator-min-microvolt = <1800000>;
         regulator-max-microvolt = <1800000>;
         regulator-always-on;
      };
      vdd_emmc: ldo2 {
         regulator-name = "vdd_emmc";
         regulator-min-microvolt = <3300000>;
         regulator-max-microvolt = <3300000>;
         regulator-over-current-protection;
      };
      vtt_ddr: ldo3 {
         regulator-name = "vtt_ddr";
         regulator-always-on;
      };
      vdd3v3_usb: ldo4 {
         regulator-name = "vdd3v3_usb";
         regulator-min-microvolt = <3300000>;
         regulator-max-microvolt = <3300000>;
         regulator-always-on;
         regulator-over-current-protection;
      };
      vpp_ddr: ldo5 {
         regulator-name = "vpp_ddr";
         regulator-min-microvolt = <2500000>;
         regulator-max-microvolt = <2500000>;
         regulator-always-on;
      };
      vddio_sdcard: ldo8 {
         regulator-name = "vddio_sdcard";
         regulator-min-microvolt = <1800000>;
         regulator-max-microvolt = <3300000>;
      };
      vref_ddr: refddr {
         regulator-name = "vref_ddr";
         regulator-always-on;
       };
    };
};
/* USER CODE END i2c7 */
```

# 2.3 User-code section in u-boot/<part_number>-<project_name>-mx.dts

## Reserved memory : board specific

```
/* USER CODE BEGIN includes */
// reuse generated reserved memory regions
#include "../optee/stm32mp257f-ev1-v6.0-mx-resmem.dtsi"
/* USER CODE END includes */

/* USER CODE BEGIN addons */
/ {
    reserved-memory{
        // removed because they are region used by u-boot / linux
        /delete-node/ linuxkernel1@84000000 ;
        /delete-node/ linuxkernel2@100000000 ;
    };
};
/* USER CODE END addons */
```

## UART console : board specific

```
/* USER CODE BEGIN root */
aliases {
    serial0 = &usart2;
};
chosen {
    stdout-path = "serial0:115200n8";
};
/* USER CODE END root */
```

## Boot device : board specific

```
/* USER CODE BEGIN sdmmc2 */
non-removable;
no-sd;
no-sdio;
st,neg-edge;
bus-width = <8>;
vmmc-supply = <&scmi_vdd_emmc>;
vqmmc-supply = <&scmi_vddio2>;
/* USER CODE END sdmmc2 */
```

## USB connection

```
/* USER CODE BEGIN usb2_phy2 */
vdd33-supply = <&scmi_vdd3v3_usb>;
/* USER CODE END usb2_phy2 */

/* USER CODE BEGIN addons */
&dwc3 {
    maximum-speed = "high-speed";
    usb-role-switch;
};
/* USER CODE END addons */
```

## System configuration

```
/* USER CODE BEGIN addons */
&a35ss_syscfg {
    status = "okay";
};

// watch dog
&arm_wdt {
    timeout-sec = <32>;
    status = "okay";
};

/* USER CODE END addons */
```

## Power supplies : board specific

```
/* USER CODE BEGIN addons */
// declare used regulators, from optee scmi server
&scmi_regu {
    scmi_vdd_emmc: regulator@18 {
        reg = <VOLTD_SCMI_STPMIC2_LDO2>;
        regulator-name = "vdd_emmc";
    };
    scmi_vdd3v3_usb: regulator@20 {
        reg = <VOLTD_SCMI_STPMIC2_LDO4>;
        regulator-name = "vdd3v3_usb";
    };
};
/* USER CODE END addons */
```

# 2.3 User-code section in u-boot/<part_number>-<project_name>-mx-u-boot.dtsi

Only included to build u-boot device tree

```
/* USER CODE BEGIN root */
aliases {
    // mmc0/1 used in flash layout file
    // matching to bootfs/mmc?_extlinux/
    mmc0 = &sdmmc1;  // µSD card
    mmc1 = &sdmmc2;  // eMMC
    };
config {
    u-boot,mmc-env-partition = "u-boot-env";
};
fwu-mdata {
    compatible = "u-boot,fwu-mdata-gpt";
    fwu-mdata-store = <&sdmmc2>;
};
USER CODE END root */
```

```
/* USER CODE BEGIN addons */
&dwc3 {
    dr_mode = "peripheral";  // force it to device mode
};

&usart2 {
    bootph-all; // pre-relocation: used for message before relocation
};

&usart2_pins_mx {
    bootph-all;
};
/* USER CODE END addons */
```

# 2.3 User-code section in kernel/<part_number>-<project_name>-mx.dts

The parts same as that for u-boot

## UART console : board specific

```
/* USER CODE BEGIN root */
aliases {
    serial0 = &usart2;
};
chosen {
    stdout-path = "serial0:115200n8";
};
/* USER CODE END root */
```

## Boot device : board specific

```
/* USER CODE BEGIN sdmmc2 */
non-removable;
no-sd;
no-sdio;
st,neg-edge;
bus-width = <8>;
vmmc-supply = <&scmi_vdd_emmc>;
vqmmc-supply = <&scmi_vddio2>;
/* USER CODE END sdmmc2 */
```

## USB connection

```
/* USER CODE BEGIN usb2_phy2 */
vdd33-supply = <&scmi_vdd3v3_usb>;
/* USER CODE END usb2_phy2 */

/* USER CODE BEGIN addons */
&dwc3 {
    maximum-speed = "high-speed";
    usb-role-switch;
};
/* USER CODE END addons */
```

## Power supplies : board specific

```
/* USER CODE BEGIN addons */
// declare used regulators, from optee scmi server
&scmi_regu {
    scmi_vdd_emmc: regulator@18 {
        reg = <VOLTD_SCMI_STPMIC2_LDO2>;
        regulator-name = "vdd_emmc";
    };
    scmi_vdd3v3_usb: regulator@20 {
        reg = <VOLTD_SCMI_STPMIC2_LDO4>;
        regulator-name = "vdd3v3_usb";
    };
};
/* USER CODE END addons */
```

## System configuration

```
/* USER CODE BEGIN addons */
&a35ss_syscfg {
    status = "okay";
};

// watch dog
&arm_wdt {
    timeout-sec = <32>;
    status = "okay";
};

/* USER CODE END addons */
```

# 2.3 User-code section in **kernel**/<part_number>-<project_name>-mx.dts

These parts are different from u-boot devicetree

## Reserved memory : board specific

```
/* USER CODE BEGIN includes */
// reuse generated reserved memory regions
#include "../optee/stm32mp257f-ev1-v6.0-mx-resmem.dtsi"
/* USER CODE END includes */

/* USER CODE BEGIN addons */
/ {
    reserved-memory{
        // Add vdev0xxx for m33_rproc
        /delete-node/ ipc-shmem-1@81200000 ;

        ipc_shmem_1: ipc-shmem-1@81200000 {
            compatible = "shared-dma-pool";
            reg = <0x0 0x81200000 0x0 0xf8000>;
            no-map;
        };

        vdev0vring0: vdev0vring0@812f8000 {
            compatible = "shared-dma-pool";
            reg = <0x0 0x812f8000 0x0 0x1000>;
            no-map;
        };
        vdev0vring1: vdev0vring1@812f9000 {
            compatible = "shared-dma-pool";
            reg = <0x0 0x812f9000 0x0 0x1000>;
            no-map;
        };
        vdev0buffer: vdev0buffer@812fa000 {
            compatible = "shared-dma-pool";
            reg = <0x0 0x812fa000 0x0 0x6000>;
            no-map;
        };

        // removed because they are region used by u-boot / linux
        /delete-node/ linuxkernel1@84000000 ;
        /delete-node/ linuxkernel2@100000000 ;
    };
};
/* USER CODE END addons */
```

## m33_rproc

```
/* USER CODE BEGIN m33_rproc */
mboxes = <&ipcc1 0x100>, <&ipcc1 0x101>, <&ipcc1 2>;
mbox-names = "vq0", "vq1", "shutdown";
memory-region = <&cm33_cube_fw>, <&cm33_cube_data>,
                <&ipc_shmem_1>, <&vdev0vring0>,
                <&vdev0vring1>, <&vdev0buffer>,
                <&cm33_sram2>;
st,syscfg-nsvtor = <&a35ss_syscfg 0xa8 0xffffff80>;
/* USER CODE END m33_rproc */
```

# 2.4 User-code sections : Methods in this example

- tf-a/<part_number>-<project_name>-mx-fw-config.dts :
  - Inside the file because only one modified section

- tf-a/<part_number>-<project_name>-mx.dts :
  - all in one file : <part_number>-<project_name>-mx-usercodes.dts
    - To be simple
  - included at the end of <part_number>-<project_name>-mx.dts
    - So those setting are not over-written by others

- optee-os/<part_number>-<project_name>-mx.dts
  - Same method as above
- u-boot/<part_number>-<project_name>-mx.dts
  - Same method as above
- u-boot/<part_number>-<project_name>-mx-u-boot.dtsi
  - Same method as above
- kernel/<part_number>-<project_name>-mx.dts
  - Same method as above

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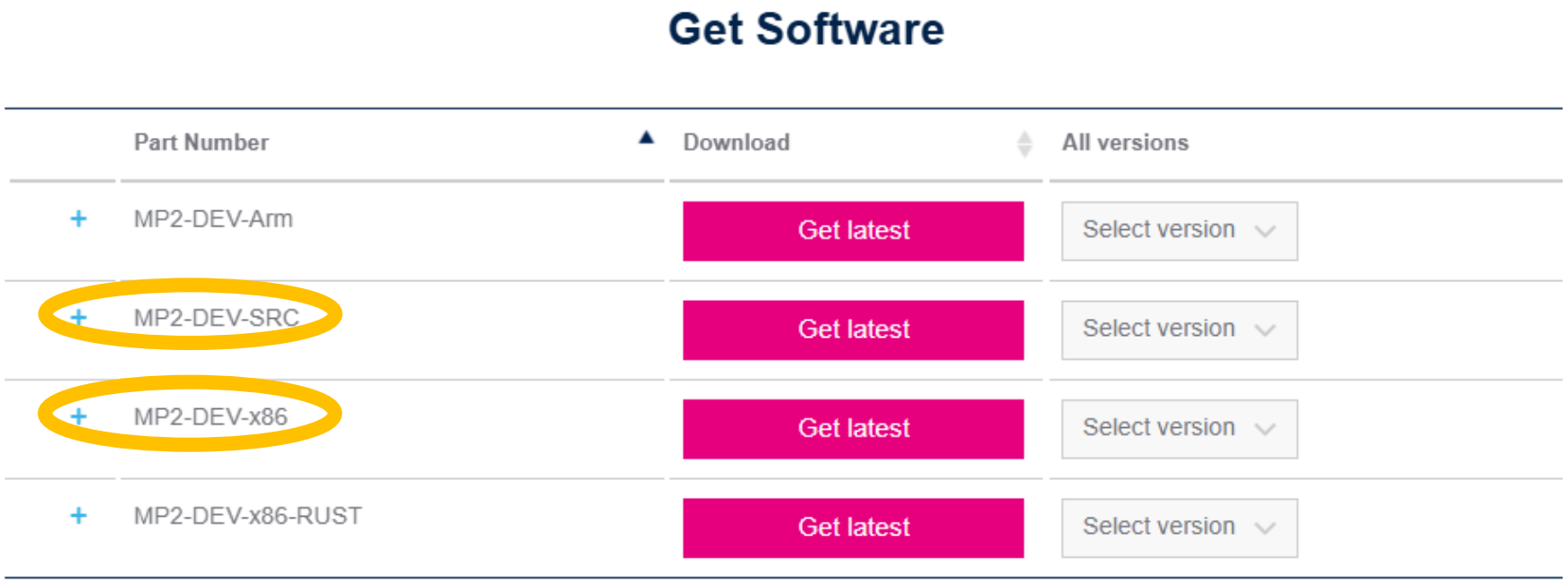
# 3 Build with Developer Package and Test

# 3a. OpenSTLinux Developer Package - **DOWNLOAD**

Refer to:

https://www.st.com/en/embedded-software/stm32mp2dev.html

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# 3a. OpenSTLinux Developer Package - **SETUP**

## 1. Unpack tar.gz archives

```
$ cd ~/OSTL_v6.0/DEVELOPER_PKG/Downloads/
$ tar xzf en.SDK-x86_64-stm32mp2-openstlinux-6.6-yocto-scarthgap-mpu-v24.11.06.tar.gz &
$ tar xzf en.SOURCES-stm32mp2-openstlinux-6.6-yocto-scarthgap-mpu-v24.11.06.tar.gz -C ../ &
```

## 2. Install cross compiler toolchain

```
$ cd stm32mp2-openstlinux-6.6-yocto-scarthgap-mpu-v24.11.06/sdk/
$ sudo ./st-image-weston-openstlinux-weston-stm32mp2.rootfs-x86_64-toolchain-5.0.3-openstlinux-6.6-yocto-scarthgap-mpu-v24.11.06.sh
```

## 3. Extract and patch firmware components (*)

```
$ cd ../stm32mp2-openstlinux-6.6-yocto-scarthgap-mpu-v24.11.06/sources/aarch64-ostl-linux/
$ git clone https://github.com/stm32-hotspot/STM32MPU-OSTL-DEV-helper.git
$ ./STM32MPU-OSTL-DEV-helper/unpack.sh
```

(*) Using the STM32MPU DEV helpers: https://github.com/stm32-hotspot/STM32MPU-OSTL-DEV-helper

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# 3a. OpenSTLinux Developer Package - **BUILD**

## 1. Configure helper scripts:

- Edit the following scripts according with your configuration:
  - STM32MPU-OSTL-DEV-helper/make_mp25x_FIP.sh
  - STM32MPU-OSTL-DEV-helper/make_mp25x_KERNEL.sh

## 2. Build TF-A and FIP (*):

$ ./STM32MPU-OSTL-DEV-helper/make_mp25x_FIP.sh

## 3. Build kernel (*):

$ ./STM32MPU-OSTL-DEV-helper/make_mp25x_KERNEL.sh

## 4. Flash the board:

- Flash the board using the binary files collected in the **BUILD_OUTPUT/** folder

(*) Using the STM32MPU DEV helpers: https://github.com/stm32-hotspot/STM32MPU-OSTL-DEV-helper
A minimal device tree is already available in the folder: **DEVICETREE/STM32MP25x_CubeMX/**

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# 3a. OpenSTLinux Developer Package - **BUILD OUTPUT**

- BUILD_OUTPUT/tfa/tfa_usb.stm32
- BUILD_OUTPUT/tfa/tfa_emmc.stm32

- BUILD_OUTPUT/fip/fip.bin
- BUILD_OUTPUT/fip/fip-ddr.bin
- BUILD_OUTPUT/fip/fip_usb.bin

- BUILD_OUTPUT/kernel/Image.gz
- BUILD_OUTPUT/kernel/stm32mp257f-dk.dtb
- BUILD_OUTPUT/kernel/lib/modules/

```
[gpaga@CTOCWL00617 ~/OSTL_v6.0/DEVELOPER_PKG/stm32mp2-openstlinux-6.6-yocto-scarthga
$ ls -lh BUILD_OUTPUT/fip/* BUILD_OUTPUT/tfa/* BUILD_OUTPUT/kernel/*
-rw-r--r-- 1 gpaga gpaga 2.6M Dec  1 00:20 BUILD_OUTPUT/fip/fip.bin
-rw-r--r-- 1 gpaga gpaga  34K Dec  1 00:20 BUILD_OUTPUT/fip/fip-ddr.bin
-rw-r--r-- 1 gpaga gpaga 2.6M Dec  1 00:20 BUILD_OUTPUT/fip/fip_usb.bin
-rw-r--r-- 1 gpaga gpaga 5.8M Dec  1 00:00 BUILD_OUTPUT/kernel/Image.gz
-rw-r--r-- 1 gpaga gpaga 113K Dec  1 00:00 BUILD_OUTPUT/kernel/stm32mp257f-dk.dtb
-rw-r--r-- 1 gpaga gpaga  120 Dec  1 00:20 BUILD_OUTPUT/tfa/metadata.bin
-rw-r--r-- 1 gpaga gpaga 195K Dec  1 00:20 BUILD_OUTPUT/tfa/tfa_emmc.stm32
-rw-r--r-- 1 gpaga gpaga 191K Dec  1 00:20 BUILD_OUTPUT/tfa/tfa_usb.stm32

BUILD_OUTPUT/kernel/lib:
total 4.0K
drwxr-xr-x 3 gpaga gpaga 4.0K Nov 30 22:51 modules
[gpaga@CTOCWL00617 ~/OSTL_v6.0/DEVELOPER_PKG/stm32mp2-openstlinux-6.6-yocto-scarthga
```

FLASH HELPERS

| Opt | Part | Name | Type | Device | Offset | Binary |
|---|---|---|---|---|---|---|
| - | 0x01 | fsbl-boot | Binary | none | 0x0 | tf-a-usb.stm32 |
| - | 0x02 | fip-ddr | FIP | none | 0x0 | fip-ddr.bin |
| - | 0x03 | fip-boot | FIP | none | 0x0 | fip.bin |
| P | 0x04 | fsbla1 | Binary | mmc1 | boot1 | tf-a-emmc.stm32 |
| P | 0x05 | fsbla2 | Binary | mmc1 | boot2 | tf-a-emmc.stm32 |
| P | 0x06 | metadata1 | FWU_MDATA | mmc1 | 0x00080000 | metadata.bin |
| P | 0x07 | metadata2 | FWU_MDATA | mmc1 | 0x00100000 | metadata.bin |
| P | 0x08 | fip-a | FIP | mmc1 | 0x00180000 | fip.bin |

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# 3a. OpenSTLinux Developer Package – **FLUSH OPTION1**

```
CTOCWL00617:~/OSTL_v6.0/DEVELOPER_PKG/stm32mp2-openstlinux-6.6-yocto-scarthgap-mpu-v24.11.06/sources/aarch64-ostl-linux
gpaga@CTOCWL00617 ~/OSTL_v6.0/DEVELOPER_PKG/stm32mp2-openstlinux-6.6-yocto-scarthgap-mpu-v24.11.06/sources/aarch64-ostl-linux]
$ cp -rvL BUILD_OUTPUT /mnt/c/Users/
BUILD_OUTPUT/flash.bat' -> '/mnt/c/Users/
BUILD_OUTPUT/flash.sh' -> '/mnt/c/Users/
BUILD_OUTPUT/FLASH_LAYOUT/flash_layout_emmc.tsv' -> '/mnt/c/Users/
BUILD_OUTPUT/FLASH_LAYOUT/flash_layout_sdcard.tsv' -> '/mnt/c/Users/
BUILD_OUTPUT/FLASH_LAYOUT/metadata.bin' -> '/mnt/c/Users/
BUILD_OUTPUT/kernel/Image.gz' -> '/mnt/c/Users/
BUILD_OUTPUT/kernel/stm32mp257f-dk.dtb' -> '/mnt/c/Users/
BUILD_OUTPUT/fip/fip-ddr.bin' -> '/mnt/c/Users/
BUILD_OUTPUT/fip/fip.bin' -> '/mnt/c/Users/
BUILD_OUTPUT/tfa/metadata.bin' -> '/mnt/c/Users/
BUILD_OUTPUT/tfa/tfa_emmc.stm32' -> '/mnt/c/Users/
BUILD_OUTPUT/tfa/tfa_sdcard.stm32' -> '/mnt/c/Users/
BUILD_OUTPUT/tfa/tfa_usb.stm32' -> '/mnt/c/Users/
gpaga@CTOCWL00617 ~/OSTL_v6.0/DEVELOPER_PKG/stm32mp2-openstlinux-6.6-yocto-scart
```

Rif.
https://wiki.st.com/stm32mpu/wiki/STM32CubeProgrammer_flashlayout

- : no action
P : update = program the partition or the flash device
PE : do not update (also EP) = allow the GPT
PD : delete and update (also DP)
PDE : delete and keep empty (also PED / DPE / DEP / EPD / EDP)

```
Command Prompt
C:\Users\ \BUILD_OUTPUT>flash.bat

C:\Users\ \BUILD_OUTPUT>"C:\Program Files\STMicroelectronics\STM32Cu
Programmer\bin\STM32_Programmer_CLI.exe" -c port=USB1 -w FLASH_LAYOUT\flash
.tsv
      -------------------------------------------------------------------
                        STM32CubeProgrammer v2.17.0
      -------------------------------------------------------------------

USB speed   : High Speed (480MBit/s)
Manuf. ID   : STMicroelectronics
Product ID  : DFU in HS Mode @Device ID /0x505, @Revision ID /0x2000
SN          : 002F002C4136500800373653
DFU protocol: 1.1

Download in Progress:
                                                                  100%

File download complete
Time elapsed during download operation: 00:00:00.900

RUNNING Program ...
  PartID:       :0x08
Start operation done successfully at partition 0x08
Flashing service completed successfully

C:\Users\ \BUILD_OUTPUT>rem "C:\Program Files\STMicroelectronics\S
```

flash_layout_emmc.tsv ~\BUILD_OUTPUT\FLASH_LAYOUT) - GVIM

File Edit Tools Syntax Buffers Window Help

| #Opt | Id | Name | Type | IP | Offset | Binary |
|---|---|---|---|---|---|---|
| - | 0x01 | fsbl-boot | Binary | none | 0x0 | tfa/tfa_usb.stm32 |
| - | 0x02 | fip-ddr | FIP | none | 0x0 | fip/fip-ddr.bin |
| - | 0x03 | fip-boot | FIP | none | 0x0 | fip/fip.bin |
| P | 0x04 | fsbla1 | Binary | mmc1 | boot1 | tfa/tfa_emmc.stm32 |
| P | 0x05 | fsbla2 | Binary | mmc1 | boot2 | tfa/tfa_emmc.stm32 |
| PE | 0x06 | metadata1 | FWU_MDATA | mmc1 | 0x00080000 | tfa/metadata.bin |
| PE | 0x07 | metadata2 | FWU_MDATA | mmc1 | 0x00100000 | tfa/metadata.bin |
| P | 0x08 | fip-a | FIP | mmc1 | 0x00180000 | fip/fip.bin |
| PED | 0x09 | fip-b | FIP | mmc1 | 0x00580000 | fip/fip.bin |
| PED | 0x0A | u-boot-env | ENV | mmc1 | 0x00980000 | none |
| PE | 0x10 | bootfs | System | mmc1 | 0x00A00000 | none |
| PE | 0x11 | vendorfs | FileSystem | mmc1 | 0x04A00000 | none |
| PE | 0x12 | rootfs | FileSystem | mmc1 | 0x14400000 | none |
| PE | 0x13 | userfs | FileSystem | mmc1 | 0xD4400000 | none |

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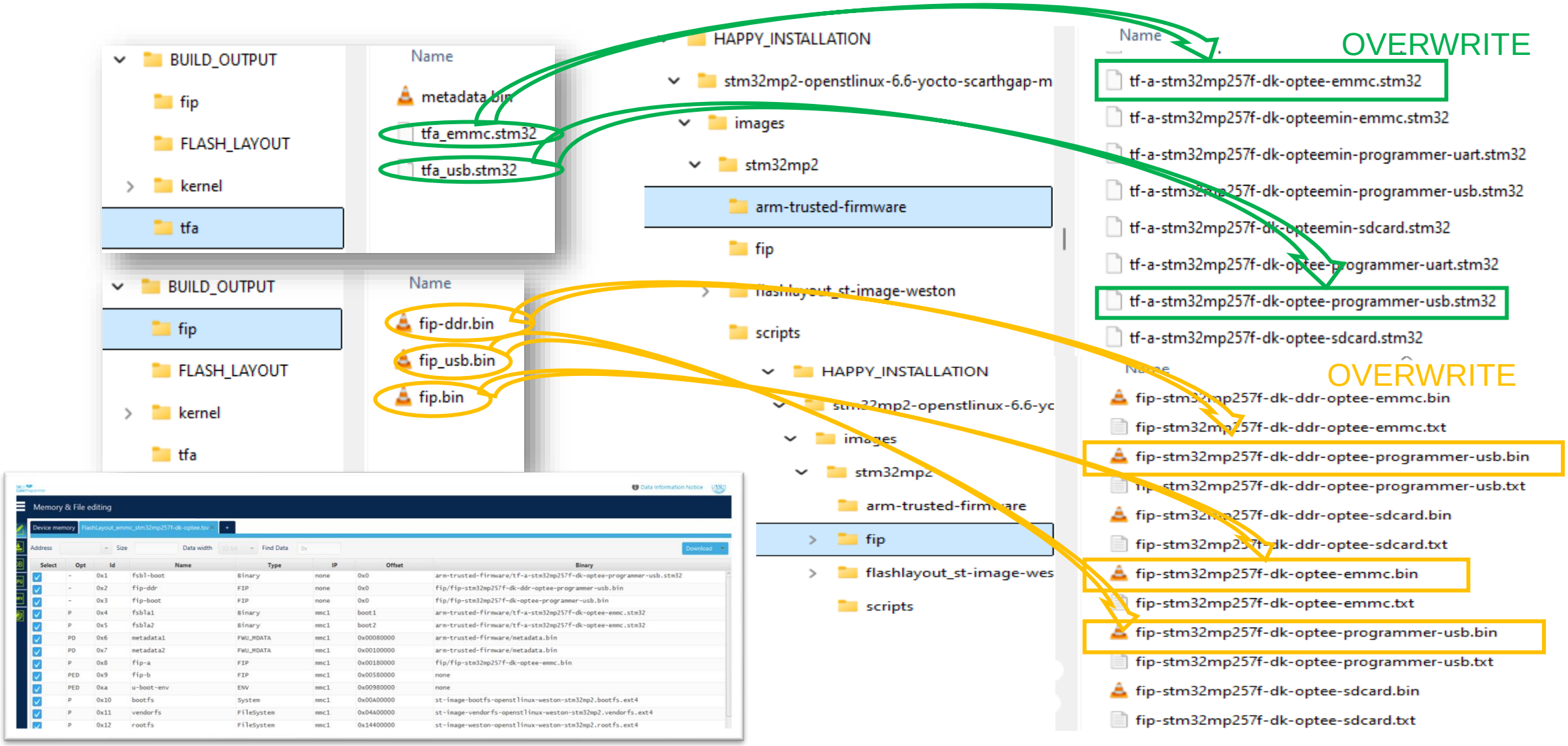
# 3a. OpenSTLinux Developer Package - **FLUSH OPTION2**

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# 3b. Alternative method: Build with Developer Package

1) Assume the build environment with Developer Package is already prepared
2) Copy device tree files to external device tree folder
   And update external device tree folder u-boot/Makefile and linux/Makefile, To include <part_number>-<project_name>-mx.dtb
3) Linux/<part_number>-<project_name>-mx.dtb
   Generated by building of « dtbs » target
4) U-Boot
   - cd <U-boot source path>
   - make -f $PWD/../Makefile.sdk DEPLOYDIR=$FIP_DEPLOYDIR_ROOT/u-boot all UBOOT_DEFCONFIG=stm32mp25_defconfig DEVICE_TREE=stm32mp257f-ev1-v6.0-mx FIP_CONFIG="optee-emmc"
5) OPTEE
   - cd <OPTEE source path>
   - make -f $PWD/../Makefile.sdk DEPLOYDIR=$FIP_DEPLOYDIR_ROOT/optee all CFG_EMBED_DTB_SOURCE_FILE=stm32mp257f-ev1-v6.0-mx CFG_WITH_TUI=n CFG_DRAM_SIZE=0x100000000 FIP_DEVICETREE=stm32mp257f-ev1-v6.0-mx FIP_CONFIG="optee-emmc"
6) TF-A
   - cd <TF-A source path>
   - make -f $PWD/../Makefile.sdk DEPLOYDIR=$FIP_DEPLOYDIR_ROOT/arm-trusted-firmware all TF_A_DEVICETREE=stm32mp257f-ev1-v6.0-mx TF_A_CONFIG="optee-emmc optee-programmer-usb" FIP_CONFIG="optee-emmc" STM32MP_DDR4_TYPE=1

# 3b. Test

1) Assume the on-board eMMC is programmed with Starter Package FlashLayout_emmc_stm32mp257f-ev1-optee.tsv
2) Boot STM32MP257F-EV1 MP2 from eMMC, stop at U-Boot console
3) In u-boot console, run « dfu 0 »
   On PC, use dfu-util to program the following binary files to eMMC tf-a / fip partitions:
   - arm-trusted-firmware/tf-a-stm32mp257f-ev1-v6.0-mx-optee-emmc.stm32
   - fip/fip-stm32mp257f-ev1-v6.0-mx-optee-emmc.bin

   They are in $FIP_DEPLOYDIR_ROOT
4) In u-boot console, run « ums 0 mmc 1 »
   On Ubuntu PC,
   cp <linux_source_path>/../build/install_artifact/boot/stm32mp257f-ev1-v6.0-mx.dtb /media/<user>/bootfs/
5) In u-boot console, run «reset» to reset the board
   Check the boot log messages …

# 4 Messages to be fixed by more configurations

# 4 Messages to be fixed by more configurations

U-Boot:
stm32_rifsc rifsc@42080000: phy@480c0000 not allowed on bus (-13)
stm32_rifsc rifsc@42080000: vdec@480d0000 not allowed on bus (-13)
stm32_rifsc rifsc@42080000: venc@480e0000 not allowed on bus (-13)
⇒ ComboPHY, VDEC, VENC modules to be activated for U-Boot
Net:  No ethernet found.
⇒ Ethernet module to be activated for U-Boot

Linux:
stm32-rifsc 42080000.bus: phy@480c0000: Device driver will not be probed
stm32-rifsc 42080000.bus: vdec@480d0000: Device driver will not be probed
stm32-rifsc 42080000.bus: venc@480e0000: Device driver will not be probed
⇒ ComboPHY, VDEC, VENC modules to be activated for Linux
Board is not a valid BOARD (stm32mp257f-dk, stm32mp257f-ev1)
⇒ Only a warning: mismatch between device tree compatible
stm32-rproc 0.m33: pdds sys config not defined
stm32-rproc 0.m33: rsc tbl syscon not supported
stm32-rproc 0.m33: mbox_request_channel_byname() could not locate channel named "detach"
remoteproc remoteproc0: cannot get detach mbox
⇒ As stm32mp257f-ev1.dtb, can be ignored for this moment

# 5 To be completed for your board

# 5 To be completed for your board

**Main steps:**

1) In CubeMx project, Allocate related module for secure/non-secure domain, and active the module with its configuration.
2) Generate device tree by CubeMx, and compare to the wiki page to see what is missing.
3) Finally test on the target to confirm the fonctionalities.

1. **No LSE** : Select «Disable» in RCC->LSE in CubeMx, and then remove lse from optee device tree &rcc «clocks» and «clock-names» lists.
2. **RTC** : RTC device tree configuration - stm32mpu
3. **Regulators** : Regulator overview - stm32mpu
   **STPMIC2** : stm32mp257f-ev1 example
4. **Timer / PWM** : TIM device tree configuration - stm32mpu
5. **GPIO** : GPIO device tree configuration - stm32mpu
   **LED / Button** : stm32mp257f-ev1 example
6. **Serial** : Serial TTY device tree configuration - stm32mpu
7. **SPI + I2C/I3C** : SPI device tree configuration - stm32mpu
   I2C device tree configuration - stm32mpu
   I3C device tree configuration - stm32mpu

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# 5 To be completed for your board

8. **NAND/NOR on OSPI** : OCTOSPI device tree configuration - stm32mpu
   OCTOSPIM device tree configuration - stm32mpu
9. **NAND/NOR on FMC** : FMC device tree configuration - stm32mpu
10. **eMMC/uSD-card** : SDMMC device tree configuration - stm32mpu
11. **USB : USBH + USB 3.0** : USB3DR device tree configuration - stm32mpu
    USBH device tree configuration - stm32mpu
    COMBOPHY device tree configuration - stm32mpu
    USB2PHY device tree configuration - stm32mpu
12. **Ethernet** : Ethernet device tree configuration - stm32mpu
    Ethernet switch device tree configuration - stm32mpu
13. **Audio** : I2S device tree configuration - stm32mpu
    SAI device tree configuration - stm32mpu
    DFSDM device tree configuration - stm32mpu
    SPDIFRX device tree configuration - stm32mpu
14. **Camera** : CSI device tree configuration - stm32mpu
    DCMI device tree configuration - stm32mpu
    DCMIPP device tree configuration - stm32mpu

# 5 To be completed for your board

17. **Display** : LTDC device tree configuration - stm32mpu
    DSI device tree configuration - stm32mpu
    LVDS device tree configuration - stm32mpu
18. **Graphic acceleration** : GPU device tree configuration - stm32mpu
    VDEC device tree configuration - stm32mpu
    VENC device tree configuration - stm32mpu
19. **ADC** : ADC device tree configuration - stm32mpu
20. **CAN** : FDCAN device tree configuration - stm32mpu
21. **WAKEUP pin** : How to configure PWR Wake-up pins - stm32mpu
22. **Tamper** : TAMP device tree configuration - stm32mpu
23. **Low Power modes** : to be done
24. **SRAM usage / DMA / M33_rproc** : to be done
25. **Secure-boot** : to be done

# Thank you!

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