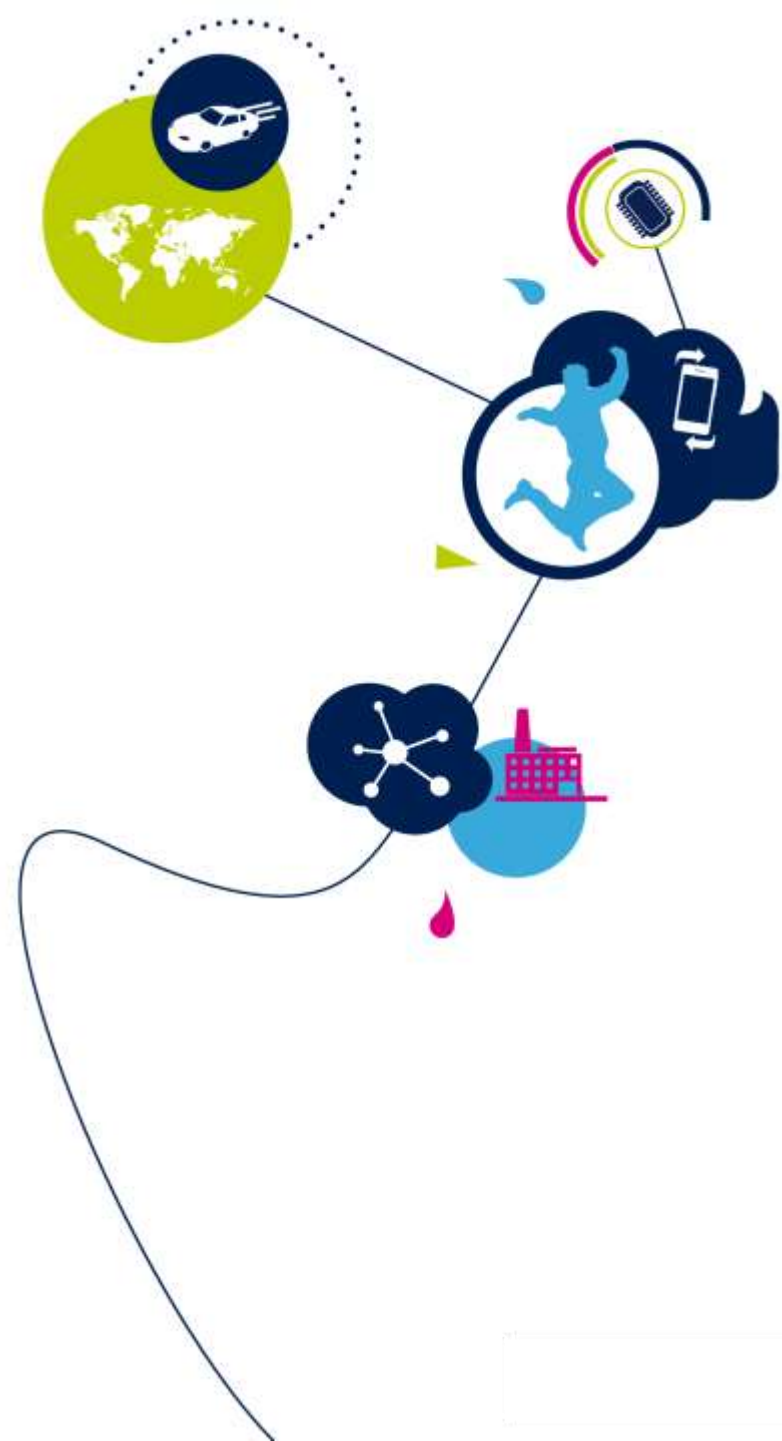


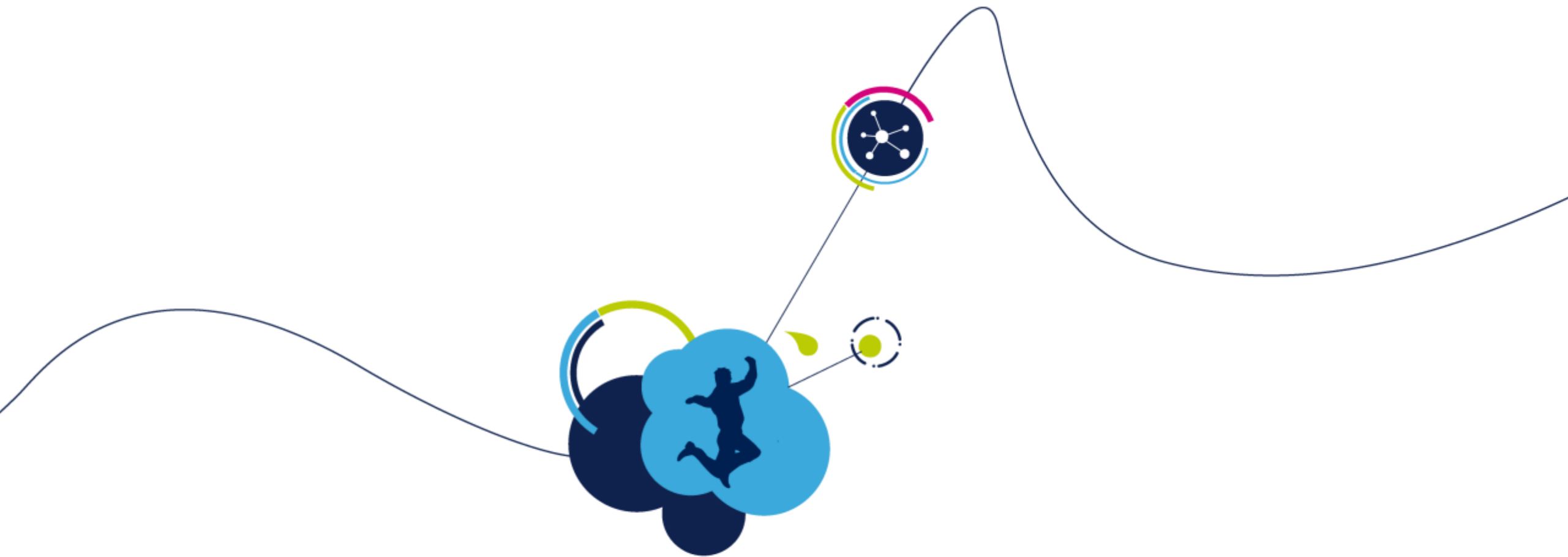
STM32MP1生态资源





STM32MP1生态系统





STM32MP1硬件资源



硬件开发板

4

Evaluation board



Discovery



Community boards & SOMs



全功能评估板

灵活的原型板

开源社区开发板和SOM

Community boards & SOMs





Hardware development boards

5

Evaluation board



Discovery



Community boards & SOMs



全功能评估板

灵活的原型板

开源社区开发板和SOM

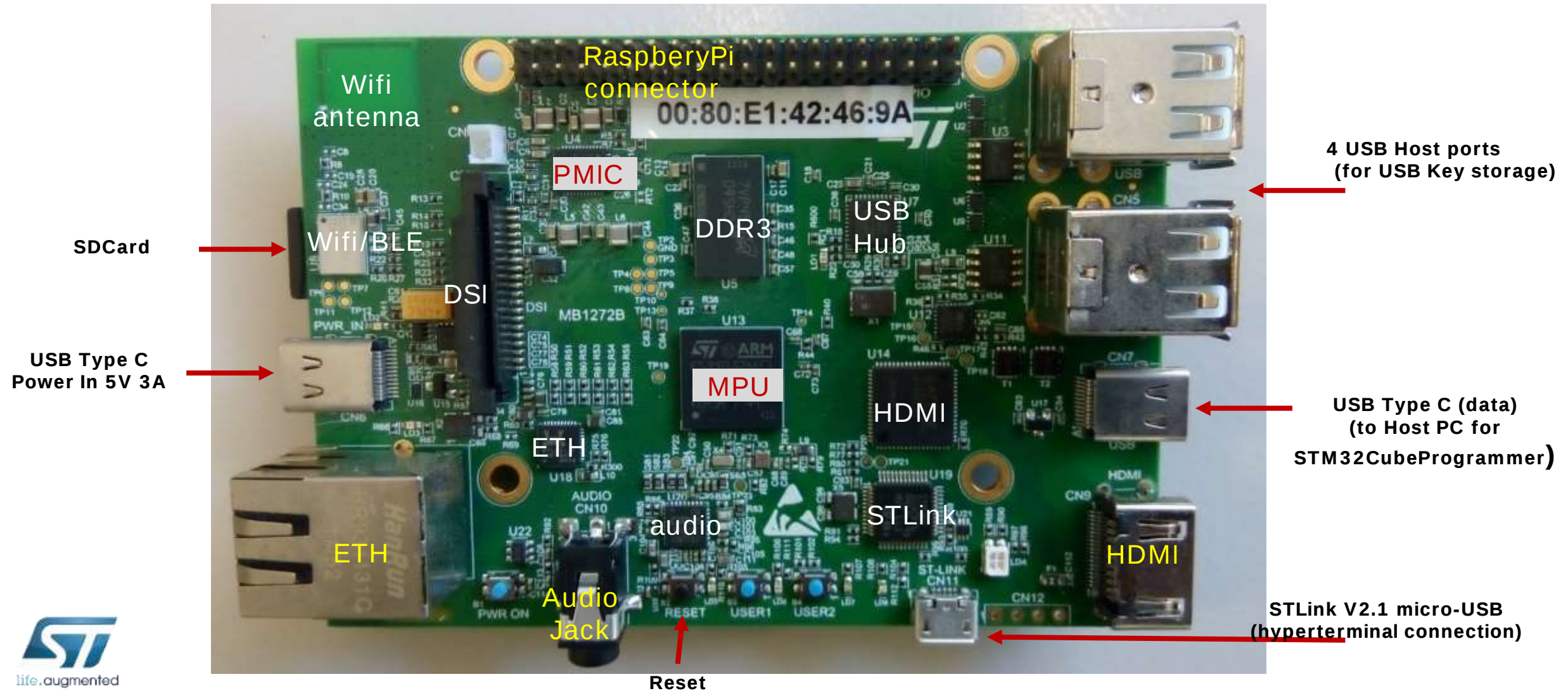
Discovery

- STM32MP157, 12x12mm
- ST PMIC, QFN 6x5mm
- DDR3L 4Gb, 533MHz
- µSD card slot
- Gigabit Ethernet
- USB High Speed Type-C
- WiFi 802.11b/g/n / BT 4.1
- Raspberry Pi DSI connector with touch screen
- Shields capability: 40-pin 2.54mm Rpi and Arduino
- WVGA DSI display 4 inches
- STLink V2.1 (JTAG, USART console) with OpenOCD support
- 5V USB type-C power supply
- Audio CODEC 24-bit/192K with audio IN/OUT analog



STM32MP1 Discovery Kit

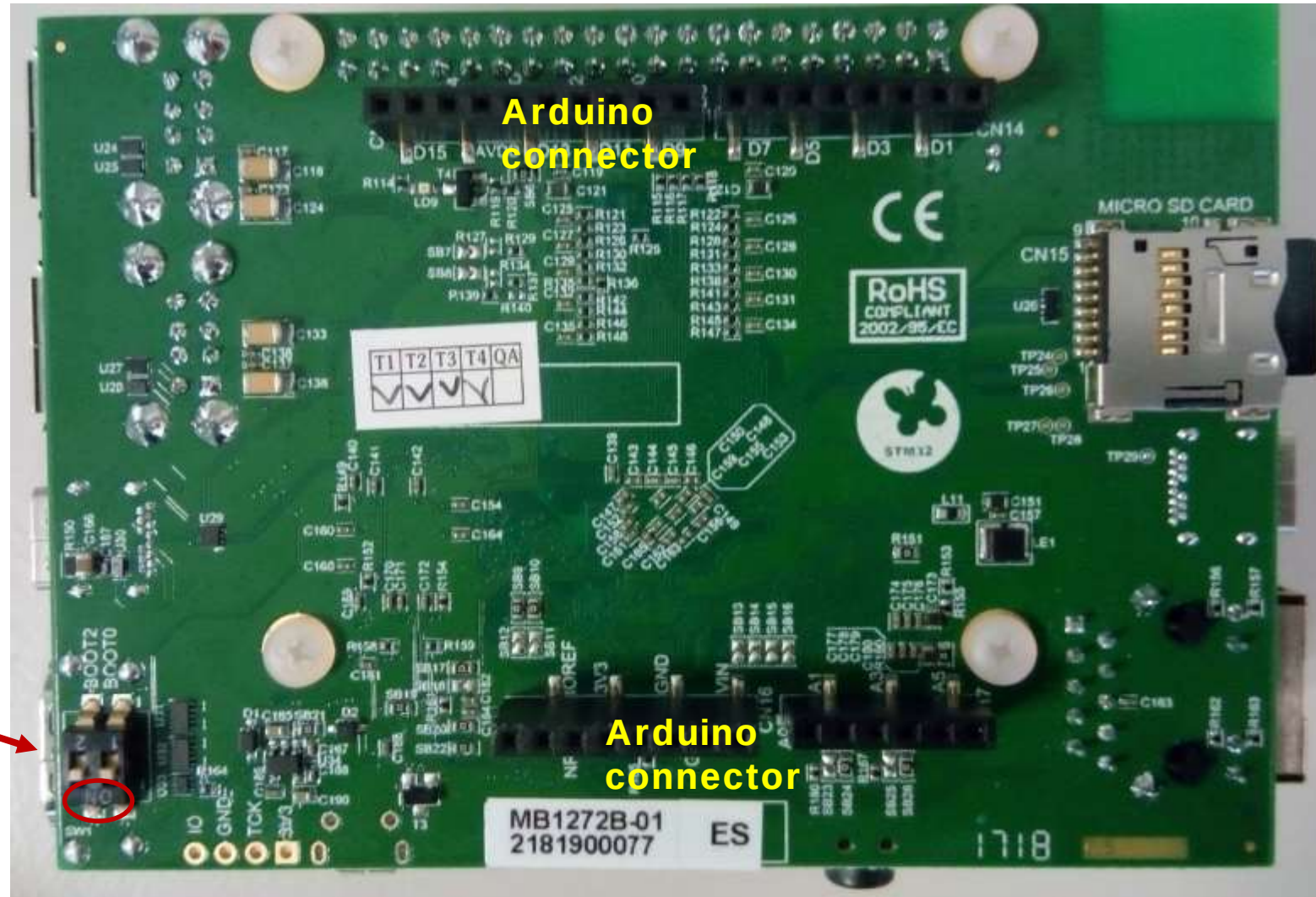
6





STM32MP1 Discovery Kit

7



Boot pins:

00: boot USB/UART

11: boot SDCard (ON)

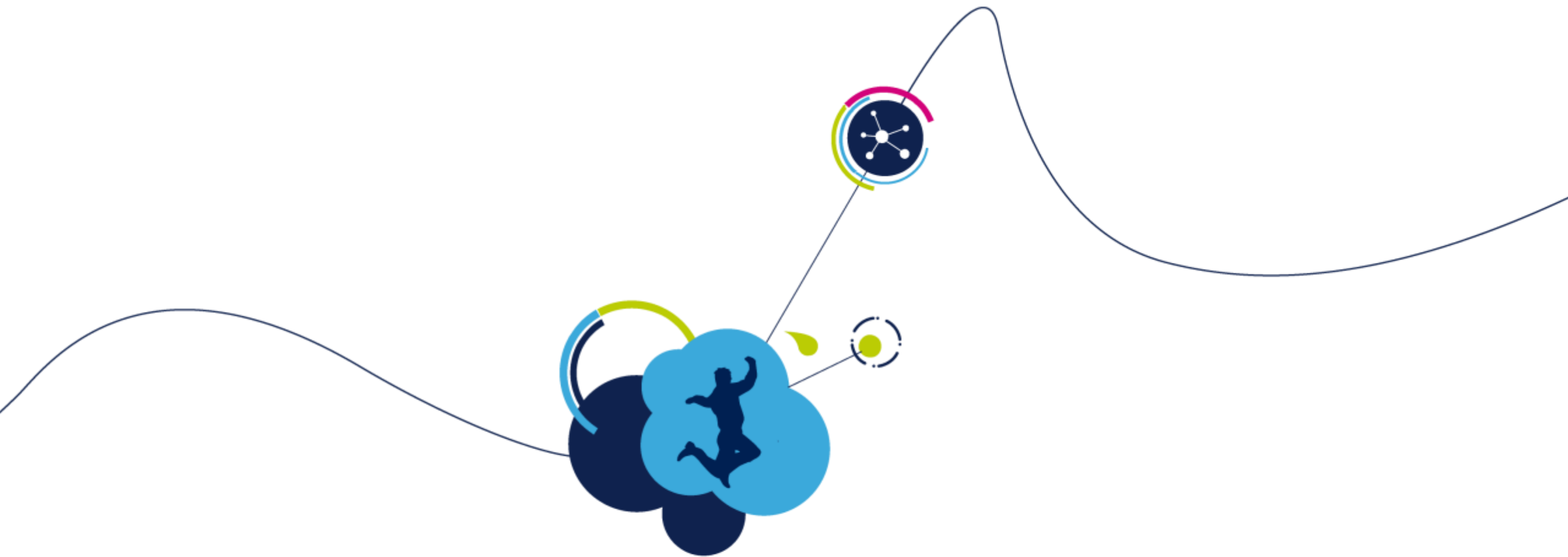


- System in Package
 - DDR
 - STPMIC
 - EEPROM
- 兼容STM32开发工具
 - 使用STM32MP1 DK2开发
 - 使用OSD32MP15x生产

第三方OSD32MP15x

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OSD32MP15x		18mm X 18mm BGA 1mm Pitch
STPMIC1 Power Management IC • 2.8V - 5.5V IN • Integrated 5.2V Boost • System Power: Buck, 4x LDO, 2x Power Switch	STM32MP15x Dual Cortex-A7 • Up to 650MHz • 2x L1 32KB I / 32KB D • 256 KB L2 Cache Cortex M4 • Up to 209MHz • FPU/MPU	Connectivity • 24-bit RGB Display • MIPI DSI - 2 lanes • Camera Interface • 1Gbps Ethernet • 2x USB2.0 HS + PHY • 3x SDIO/SD/eMMC • 2x FDCAN/TTCAN • 6x I2C • 4x UART, 4X USART • 4x SAI • Dual Quad SPI • 6x SPI / 3X I2S • 4x SPDIF Tx/Rx • DFSDM 8 Ch/6 Filters • Up to 148 GPIO
UP TO 1GB DDR3L	Memory • 256KB System RAM • 384KB MCU Sys RAM • 64KB MCU Ret RAM	
4KB EEPROM	Graphics • 3D GPU OpenGL ES2.0	
Oscillator	Security • TrustZone® • TDES, AES-256 • SHA-256, HMAC	Control • 2x 16-bit PWM • Up to 29 timers • Up to 3 Watchdogs
Passive Components	Analog • 2x 22 chan 16bit ADC	• 2x 12bit DAC



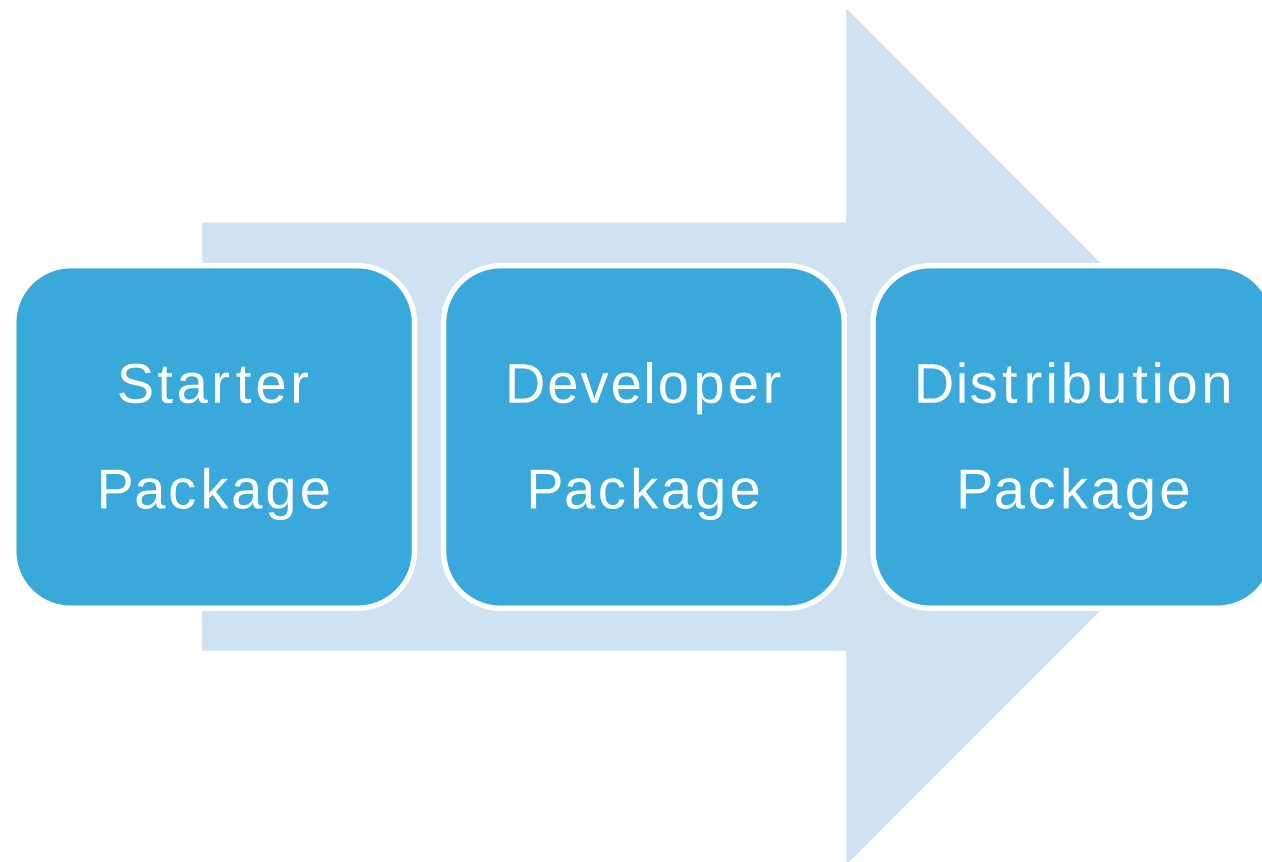
STM32MP1嵌入式软件开发包



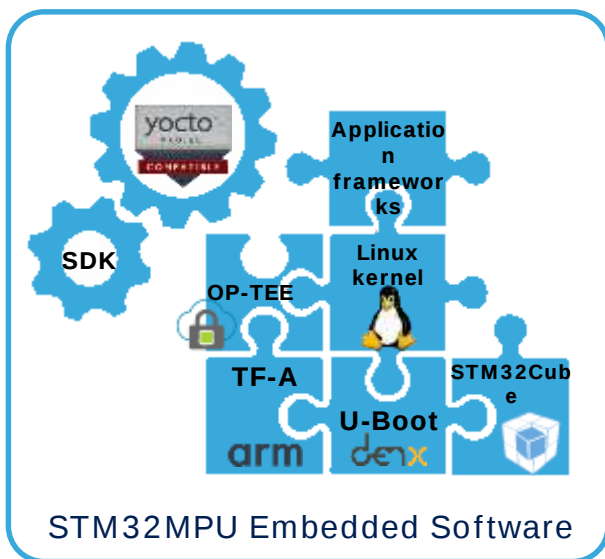
STM32MPU 嵌入式软件开发包

10

三个层次的软件开发包



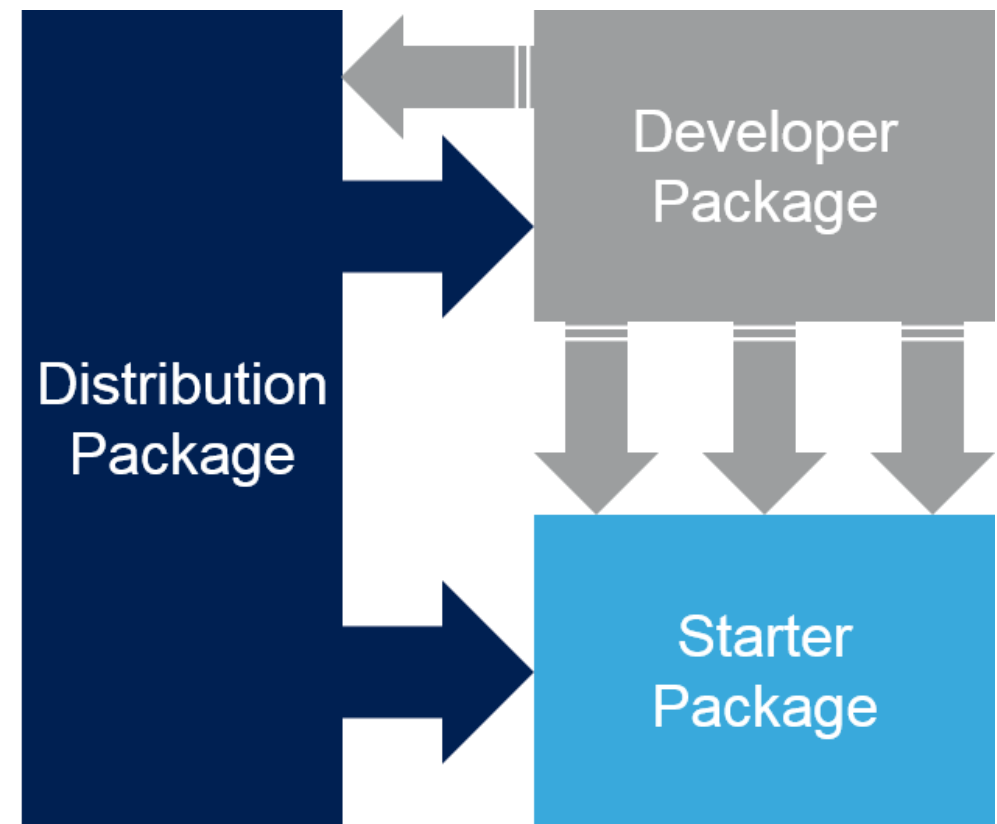
OpenSTLinux





三类软件开发包的特点与联系

11



- **Starter Package**

- 上手快且容易
- 从Distribution Package生成

- **Developer Package**

- 可开发用户自己的应用
- 可替换Starter package预集成的应用
- 从Distribution Package生成

- **Distribution Package**

- 可创建用户自己的Linux发行包
- 可创建用户自己的Starter Package
- 可创建用户自己的Developer Package



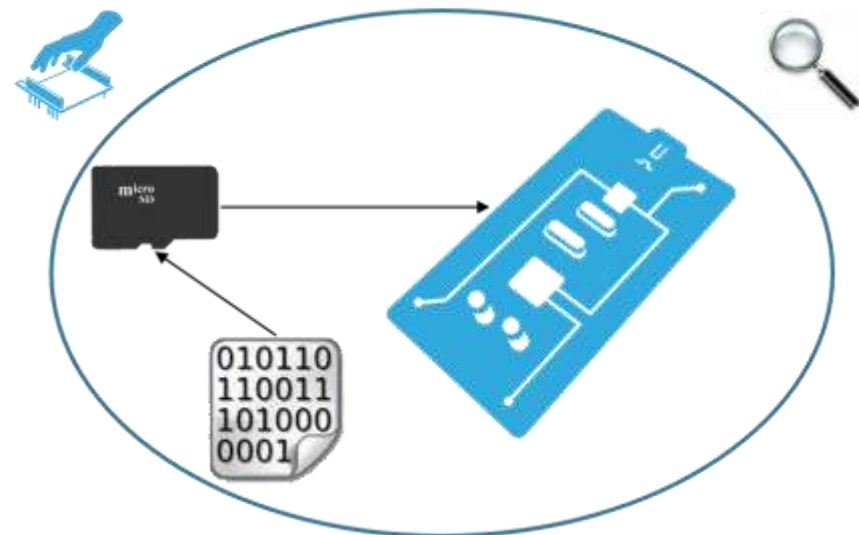
Starter Package

12

它是什么

- Linux的软件映像(固件)，类似于PC上的Linux操作系统安装包
- 可以快速部署在STM32MP1平台上
- 包括了STM32MP1的Cortex-A7以及Cortex-M4的例程
- 不包括SDK

STM32MPU Embedded Software Starter Package



可以用它做什么

- 进行芯片选型与评估，例如功耗以及性能
- 使用STM32CubeProgrammer可将Starter Package烧录多种不同的Flash之上
- 执行并体验Cube M4固件例程
- 可以使用Linux控制开发脚本应用(bash shell, python, ...)

STM32MP1 Starter Package下载

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- 详细步骤请按照
 - https://wiki.st.com/stm32mpu/wiki/Category:Getting_started_with_STM32MP1_boards
- 下载地址
 - https://www.st.com/content/st_com/en/products/embedded-software/mcu-mpu-embedded-software/stm32-embedded-software/stm32-mpu-openstlinux-distribution/stm32mp1starter.html
 - 如果链接失效，可以访问www.st.com搜索STM32MP1Starter得到下载地址

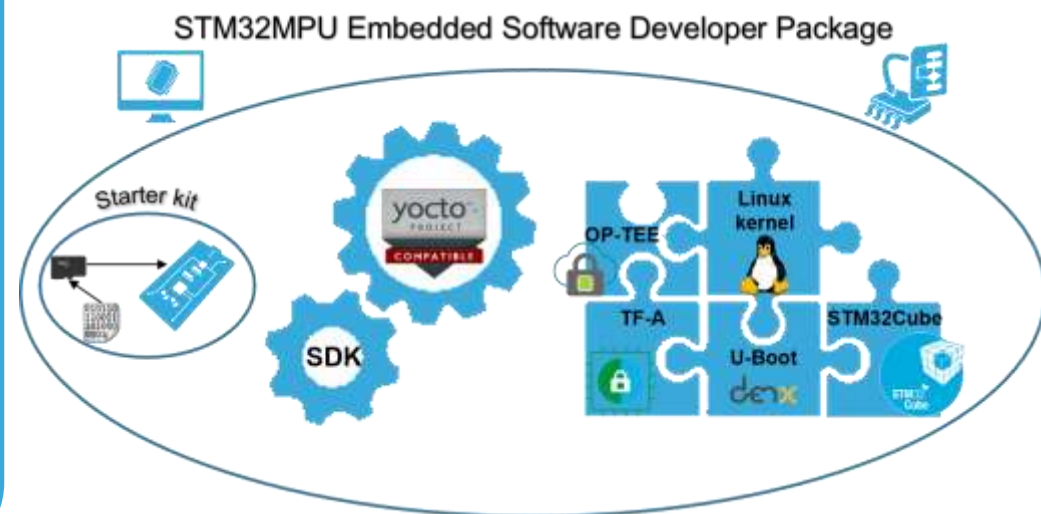


Developer Package

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它是什么

- 提供PC主机上的交叉编译的SDK
- 提供部分软件的源代码
- 允许修改软件开发包中的一部分软件
- 一般用户用来作为STM32MP1开发平台



可以用它做什么

- 可使用STM32CubeMX重新生成Device tree
- 可以定制U-Boot, Trusted Firmware-A (TF-A), Linux® kernel以及可选的OP-TEE
- 可以开发运行在Arm® Cortex®-M的固件
- 可以添加用户自己的应用以及框架

STM32MP1 Developer Package下载

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- 详细步骤请按照

https://wiki.st.com/stm32mpu/wiki/STM32MP1_Developer_Package

- 下载地址1:

- https://www.st.com/content/st_com/en/products/embedded-software/mcu-mpu-embedded-software/stm32-embedded-software/stm32-mpu-openstlinux-distribution/stm32mp1dev.html
- 如果链接失效，可以访问www.st.com搜索STM32MP1Dev得到下载地址

- 下载地址2:

- https://github.com/STMicroelectronics/STM32MPU_EmbSW_Overall_Offer

[linux](#)

STM32MP1 linux kernel

[u-boot](#)

STM32MP1 u-boot

[arm-trusted-firmware](#)

STM32MP1 arm trusted firmware (for A7)

[optee_os](#)

STM32MP1 OPTEE OS



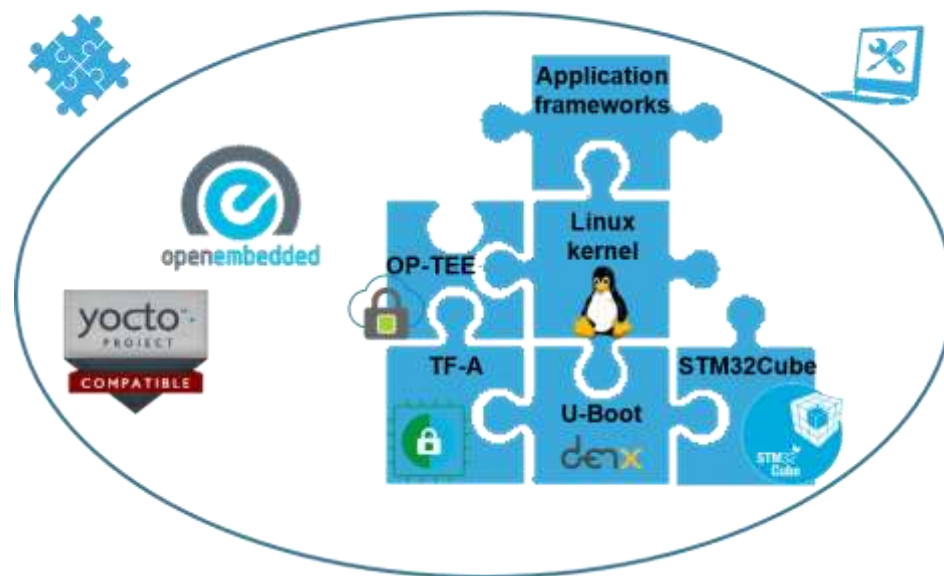
Distribution Package

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它是什么

- 包括所有的STM32MP1嵌入式软件的源代码
- 包括了基于OpenEmbedded集成编译的框架
- 一般需要一个Linux PC使用此开发包

STM32MPU Embedded Software Distribution Package



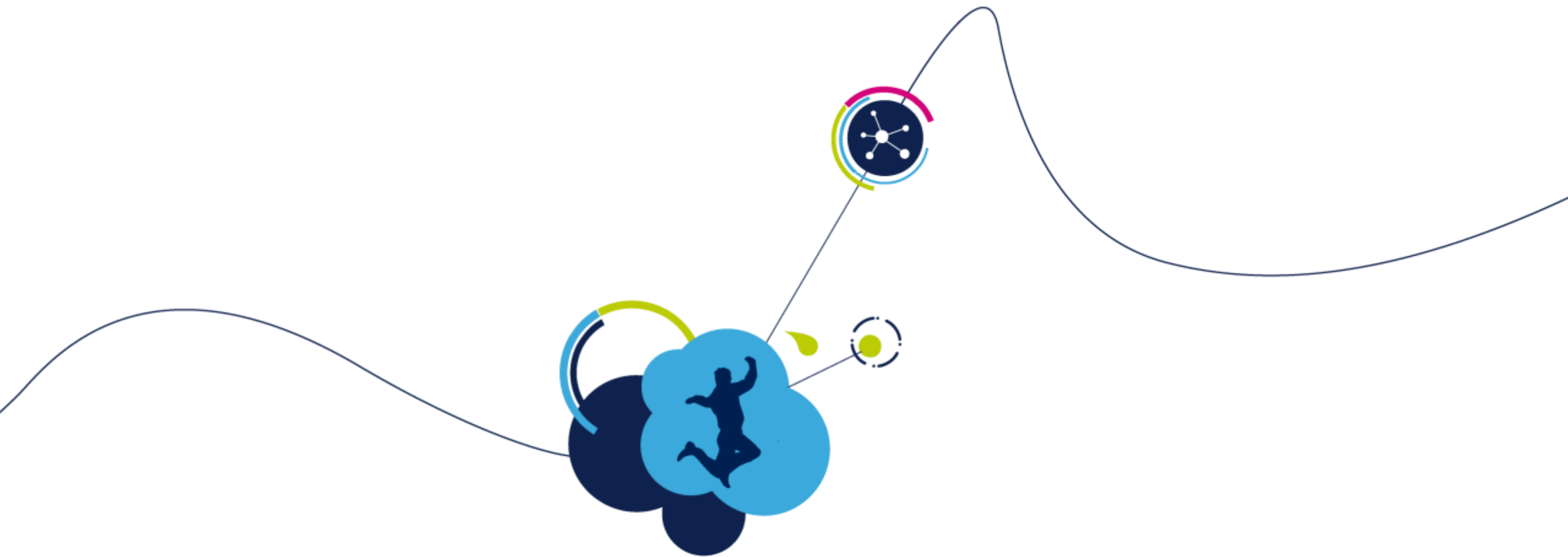
可以用它做什么

- 可以定制用户自己的软件开发包，使其符合特定的内存或者调试需求，包含定制的用户软件。定制的客户软件可基于Developer Package开发验证
- 可以定制用户自己的Starter Package
- 可以定制用户自己的Developer Package

Distribution Package下载

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- 详细步骤请按照
 - https://wiki.st.com/stm32mpu/wiki/STM32MP1_Distribution_Package
- 下载地址
 - <https://www.st.com/en/embedded-software/stm32mp1distrib.html>
 - 如果链接失效，请访问www.st.com搜索



STM32MP1文档



STM32MPU Wiki介绍

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- STM32设立的新的信息交流平台
 - <https://wiki.st.com/stm32mpu>
- STM32MPU wiki旨在向用户提供STM32MP1的开发指南
 - 提供官方开发板Step by Step开发指南
 - Release notes
 - 开发板连线
 - 开发环境设置
 - 源文件下载, 配置, 编译, 调试, 烧录
 - 从四个方面深入STM32MP1解决方案
 - 外设
 - 嵌入式软件
 - 工具
 - How to



STM32MPU Wiki使用技巧

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- 使用Step by Step指南入门STM32MP1
- 使用STM32MP1专题解决特定问题
- 使用Wiki搜索功能找到特定专题



硬件原理图

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MB1262 schematics	STM32MP157C-EV1 motherboard schematics (Evaluation board)	MB1262C-01.pdf	vC-0.1
MB1263 schematics	STM32MP157C-EV1 daughterboard schematics (Evaluation board)	MB1263C-01.pdf	vC-0.1
MB1230 schematics	DSI 720p LCD display daughterboard schematics (Evaluation board)	MB1230B-02.pdf	vB-0.2
MB1379 schematics	Camera daughterboard schematics (Evaluation board)	MB1379A-01.pdf	vA-0.1
MB1272 schematics	STM32MP157x-DKx motherboard schematics (Discovery kit)	MB1272C-01.pdf	vC-0.1
MB1407 schematics	STM32MP157x-DKx daughterboard schematics (Discovery kit)	MB1407C-01.pdf	vB-0.1



DS12505	STM32MP157Cxx (Secure)	DS12505.pdf	v1.0
DS12504	STM32MP157Axx (Basic)	DS12504.pdf	v1.0
DS12503	STM32MP153Cxx (Secure)	DS12503.pdf	v1.0
DS12502	STM32MP153Axx (Basic)	DS12502.pdf	v1.0
DS12501	STM32MP151Cxx (Secure)	DS12501.pdf	v1.0
DS12500	STM32MP151Axx (Basic)	DS12500.pdf	v1.0



RM0436	STM32MP157xxx reference manual (STM32MP157xxx advanced Arm®-based 32-bit MPUs)	RM0436.pdf	v2.0
RM0442	STM32MP153xxx reference manual (STM32MP153xxx advanced Arm®-based 32-bit MPUs)	RM0442.pdf	v2.0
RM0441	STM32MP151xxx reference manual (STM32MP151xxx advanced Arm®-based 32-bit MPUs)	RM0441.pdf	v2.0



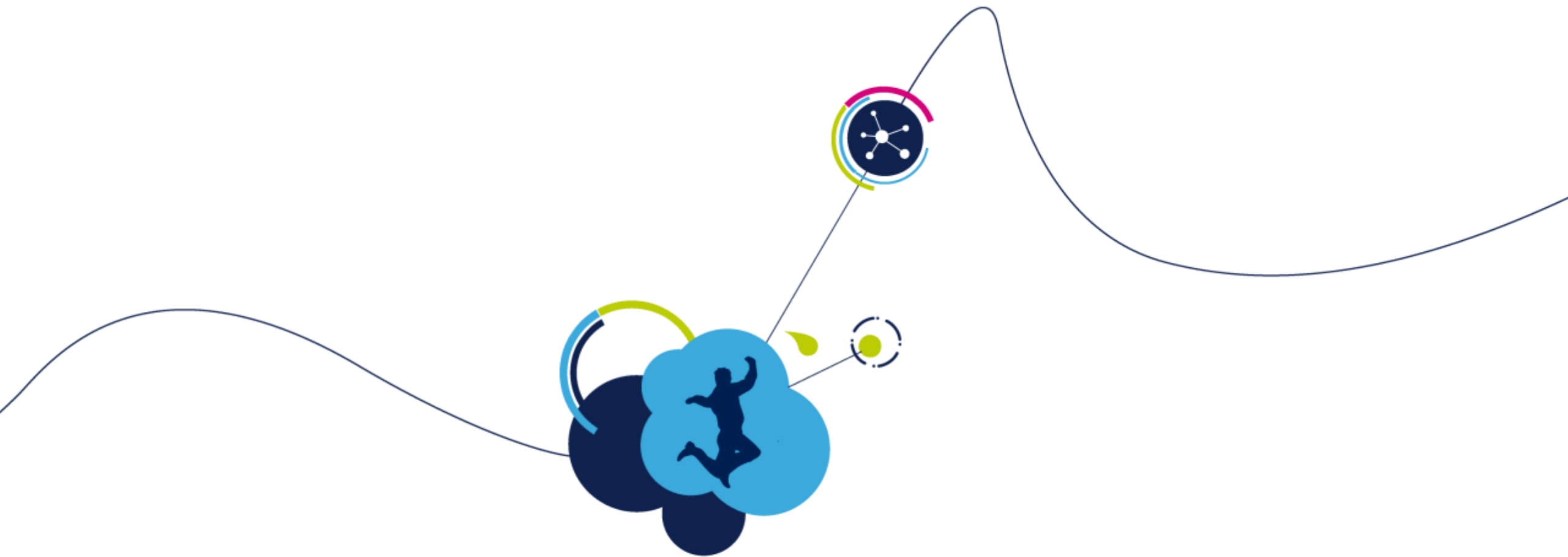
AN5031	Getting started with STM32MP15 Series hardware development	AN5031.pdf	v1.0
AN5109	STM32MP1 Series using low-power modes	AN5109.pdf	v1.0
AN5253	Migration of microcontroller applications from STM32F4x9 lines to STM32MP15x lines microprocessor	AN5253.pdf	v1.0
AN5122	STM32MP1 Series DDR memory routing guidelines	AN5122.pdf	v1.0
AN5168	STM32MP1 series DDR configuration	AN5168.pdf	v1.0



用户手册与勘误

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UM2535	STM32MP157x-EV1 evaluation board user manual	UM2535.pdf	V1.0
UM2534	STM32MP157x-DKx discovery board user manual	UM2534.pdf	V1.0
ES0438	STM32MP15xx device errata	ES0438.pdf	v1.0



STM32MP1工具



STM32CubeMX

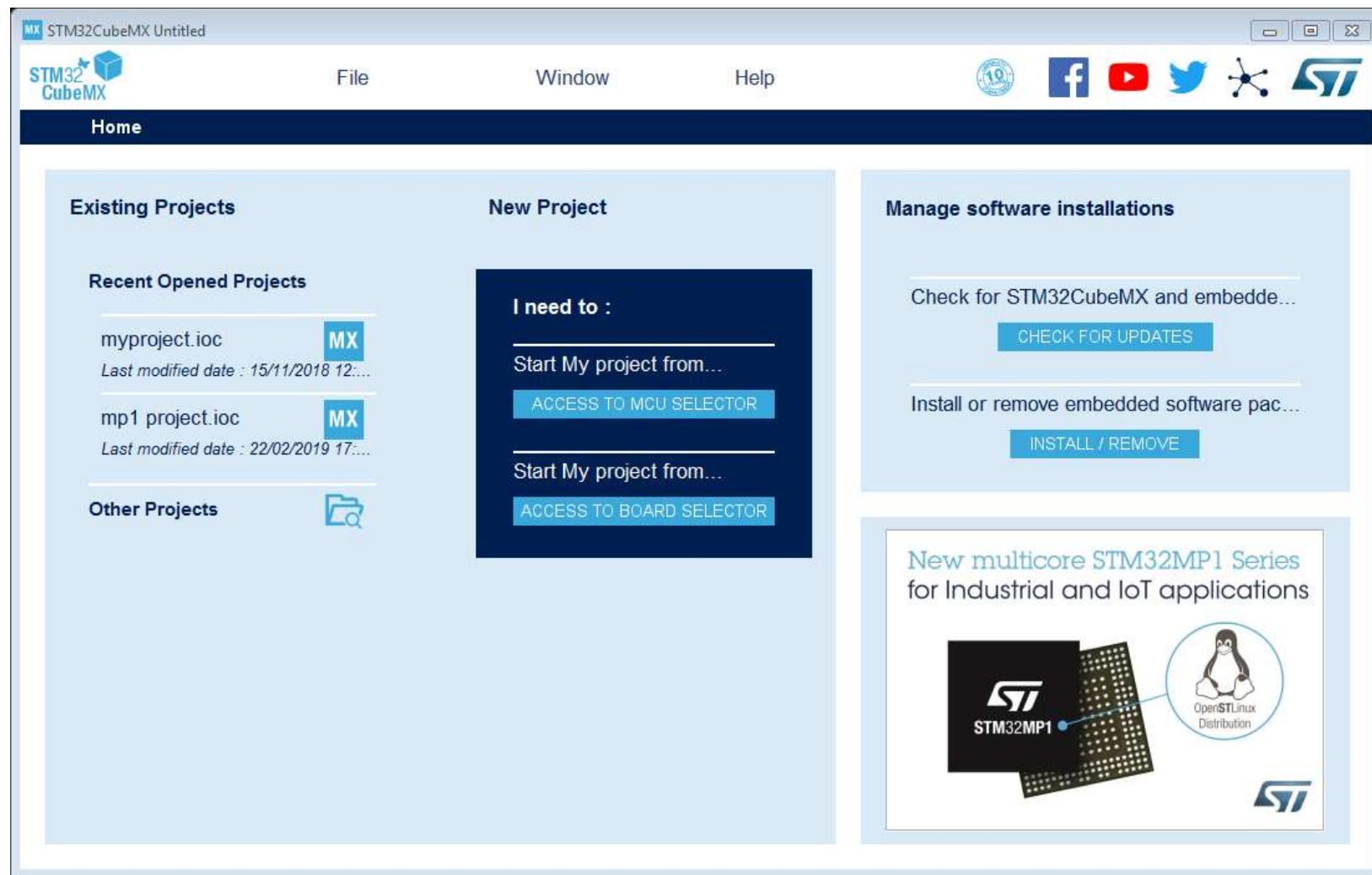
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选择MCU/MPU然后
进行配置:

- 分配外设
- 配置管脚
- 配置时钟树
- 配置MCU外设
- 生成MPU device tree 源码
- 配置中间件
- 配置内存
- 调整DDR参数

优势

- 帮助针对特定应用选择正确的芯片
- 根据所选择的芯片自动生成代码
- 加速开发





通过STM32CubeMX进行外设分配

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Domain	Peripheral	Instance	Cortex-A7 secure (OP-TEE)	Cortex-A7 non-secure (Linux)	Cortex-M4 (STM32Cube)	Comment
Analog	ADC	ADC		☐	☐	Assignment (single choice)
Analog	DAC	DAC		☐	☐	Assignment (single choice)
Analog	DFSDM	DFSDM		☐	☐	Assignment (single choice)
Analog	VREFBUF	VREFBUF		☐		Assignment (single choice)
Audio	SAI	SAI1		☐	☐	Assignment (single choice)
		SAI2		☐	☐	Assignment (single choice)
		SAI3		☐	☐	Assignment (single choice)
		SAI4		☐	☐	Assignment (single choice)

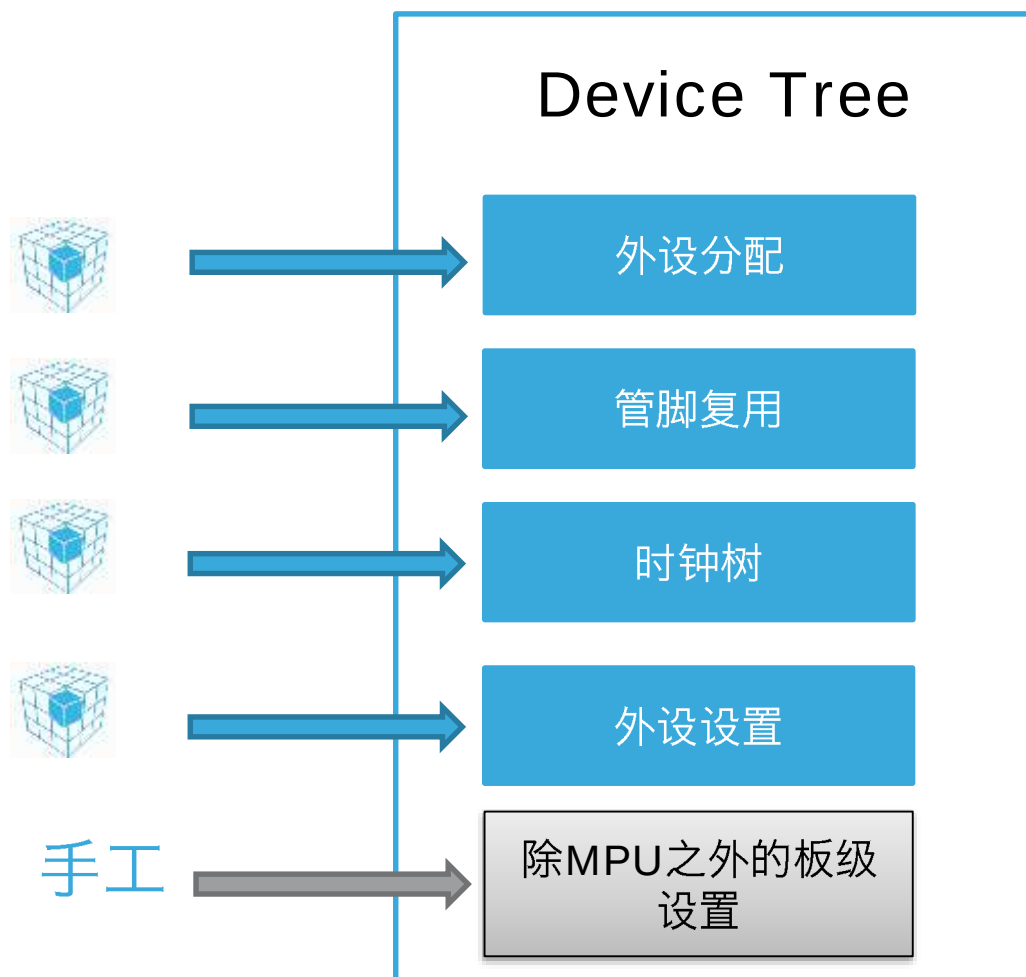
当被选中:

- 生成ATF Device-tree来隔离外设
 - Cortex-A secure
 - Cortex-M
 - Cortex-A none secure.⇒ 有相关的软件服务来检查Linux和Cube固件的隔离
- 生成代码使能Cortex-A以及Cortex-M外设驱动
- 生成代码来初始化共享外设 (clock, regulator, GPIOs)



STM32CubeMX Device Tree 生成

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在生成Cortex-M4代码的同时，
生成Cortex-A7的Device Tree



实例: I2C分配至Cortex-M4 并生成DeviceTree

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Cortex-A

```
@ soc {
    i2c1: i2c@40012000 {
        compatible = "st,stm32f7-i2c";
        status = "disabled";
    }
};
```

在Cortex-A7上I2C外设驱动被关闭

```
@M4_hw_resources {
    compatible = "rproc-srm-core";
    status = "enable";
    M4_IP_I2C@0x400012000 {
        compatible = "rproc-srm-dev";
        status = "okay";
        clocks = <&rcc_clk I2C1_K>;
        pinctrl-0 = <i2c1_pins_a>;
    }
};
```

I2C外设被分配至Cortex-M4并使能所用到的GPIO和时钟



Cortex-M

```
void HAL_I2C_MspInit(I2C_HandleTypeDef *hi2c)
{
    ...

    #if CONFIG_MASTER_MODE
        /*##-1- Enable the HSI clock */
        RCC_OscInitStruct.OscillatorType = RCC_OSCILLATORTYPE_HSI;
        RCC_OscInitStruct.HSIState = RCC_HSI_ON;
        RCC_OscInitStruct.HSICalibrationValue =
        RCC_HSICALIBRATION_DEFAULT;
        if (HAL_RCC_OscConfig(&RCC_OscInitStruct) != HAL_OK)
        {
            Error *
            while(1);
        }

        /*##-2- Configure HSI as I2C clock source */
        RCC_PeriphCLKInitStruct.PeriphClockSelection = RCC_PERIPHCLK_I2Cx;
        RCC_PeriphCLKInitStruct.I2c123ClockSelection = RCC_I2CxCLKSOURCE;
        HAL_RCCEx_PeriphCLKConfig(&RCC_PeriphCLKInitStruct);
    #endif

    /*##-3- Enable peripherals and GPIO Clocks
    #####*/
    /* Enable GPIO TX/RX clock */
    I2Cx_SCL_GPIO_CLK_ENABLE();
    I2Cx_SDA_GPIO_CLK_ENABLE();

    /* Enable I2Cx clock */
    I2Cx_CLK_ENABLE();

    /*##-4- Configure peripheral GPIO
    #####*/

    #if CONFIG_MASTER_MODE
        HAL_GPIO_Init(I2Cx_SCL_GPIO_PORT, &GPIO_InitStruct);

        HAL_GPIO_Init(I2Cx_SDA_GPIO_PORT, &GPIO_InitStruct);
    #endif
}
```

HSI 时钟由Cortex-A7处理

I2C时钟由Cortex-M4处理

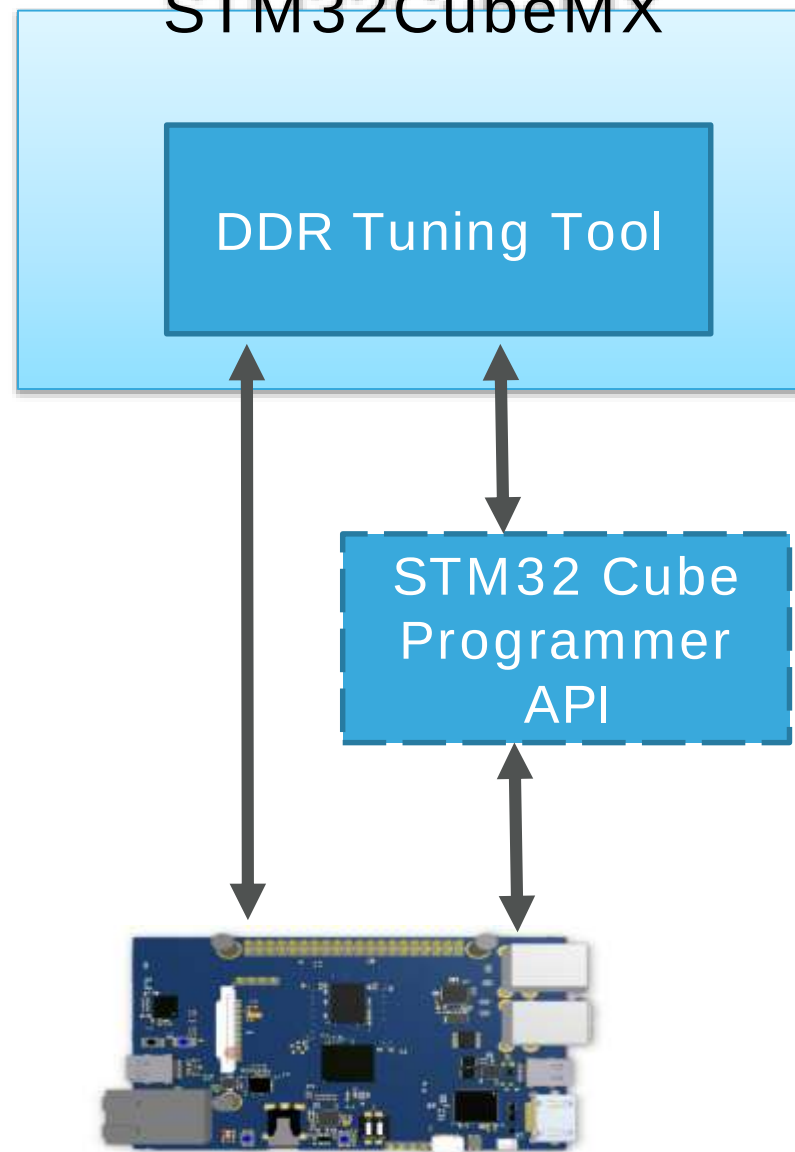
GPIO 配置由Cortex-A7处理

- 配置参数(Target)
 - 支持DDR3/DDR3L/LPDDR2/LPDDR3
 - 下载配置到开发板
 - 显示配置
- 测试参数(DDR Tests)
 - 显示Uboot-SPL的测试列表
 - 执行测试
 - 创建测试集合与执行
 - 生成测试报告
- 调整参数(DDR Tunig)
 - 触发调整, 收集反馈
 - 根据反馈修改默认配置

调整DDR参数

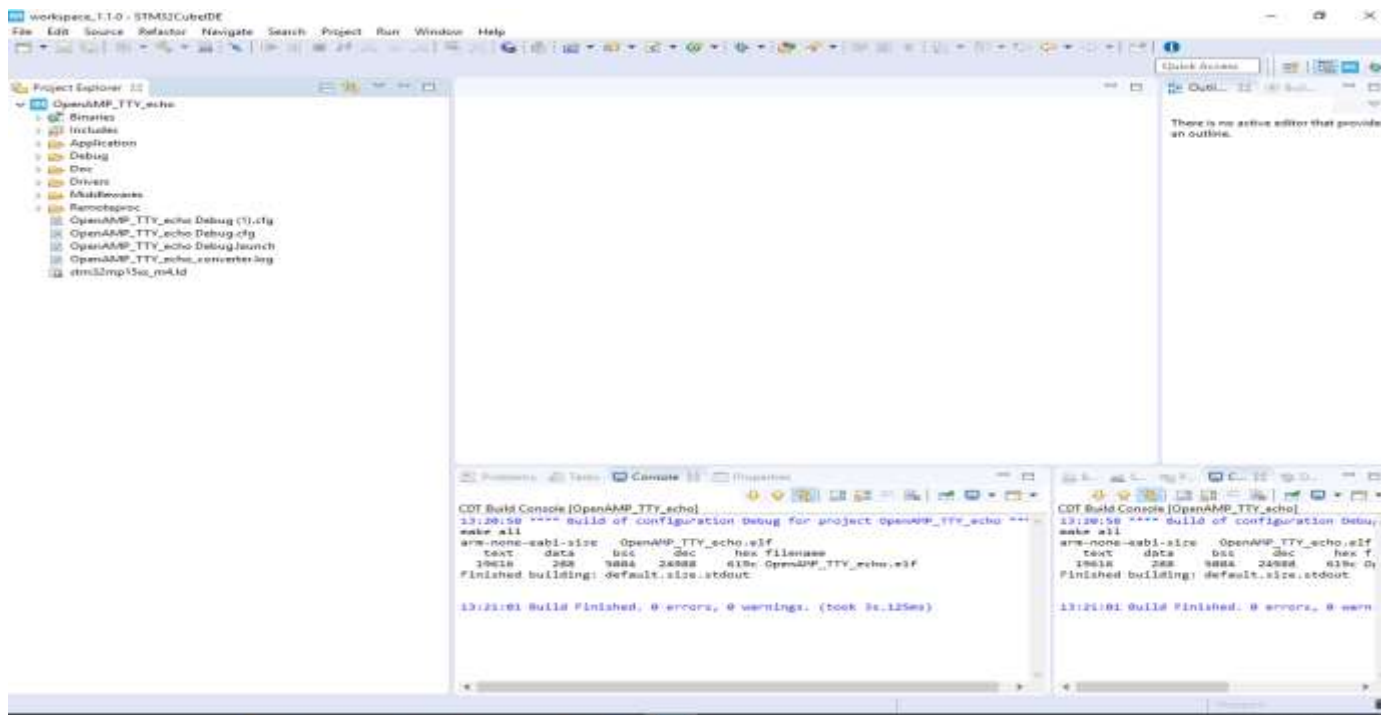
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STM32CubeMX





- 从STM32CubeIDE1.1.0版本起支持STM32MP1
- 使用STM32CubeIDE1.1.0开发STM32MP1 Cortex-M4
 - 可使用STM32CubeIDE1.1.0打开固件库例程
 - 可使用STM32CubeMX生成STM32CubeIDE1.1.0例程



选择.project直接
打开固件库例程



STM32CubeProgrammer

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- 统一的烧录软件工具:
 - 在一个软件里整合了STVP, STM32 ST-LINK Utility和Bootloader软件工具.
- STM32CubeProgrammer可应用于所有STM32 (MCU and MPU):
 - 烧录STM32 Flash, SRAM, OTP以及外部内存 (QSPI, SDMMC, FMC, I2C, SPI)
 - 通过SPI, UART, USB Device (with DFU)和SWD.
 - 提供命令行工具
 - 提供图形界面



STM32MP1生态资源总结

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- STM32MP1硬件开发板
- STM32MP1软件包
- STM32MP1文档
- STM32MP1生态系统工具
 - STM32CubeMX
 - STM32CubeIDE
 - STM32CubeProgrammer