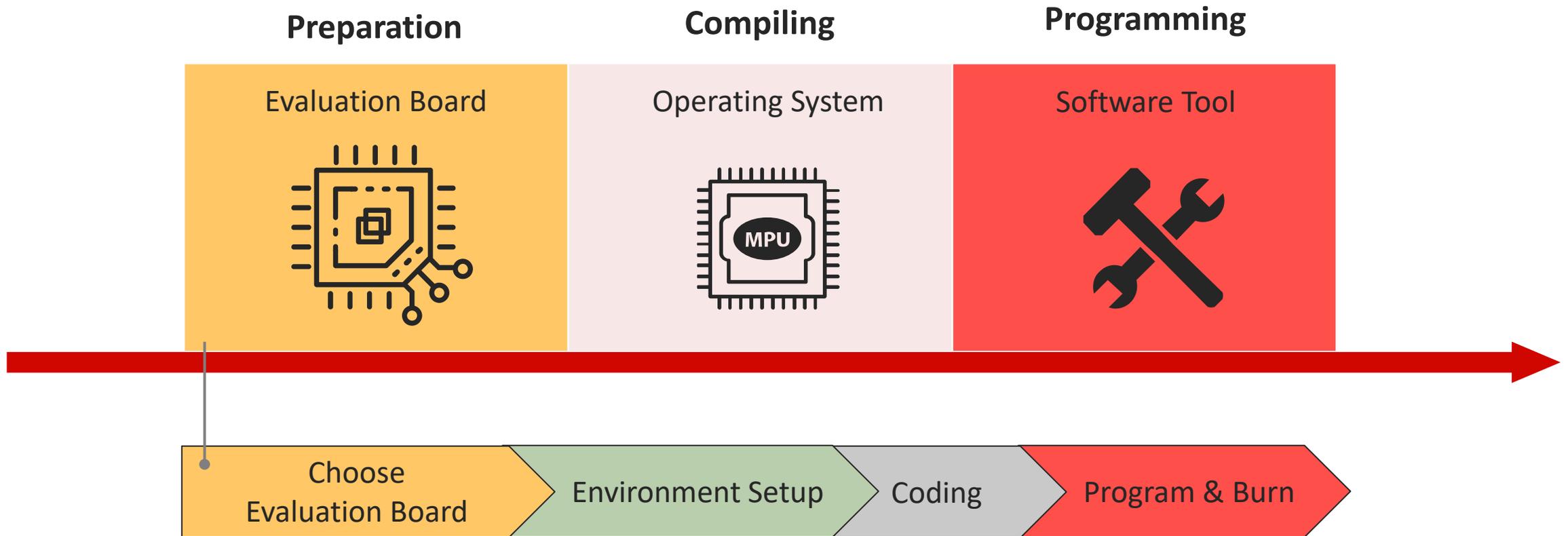


MA35 Family Development Platform

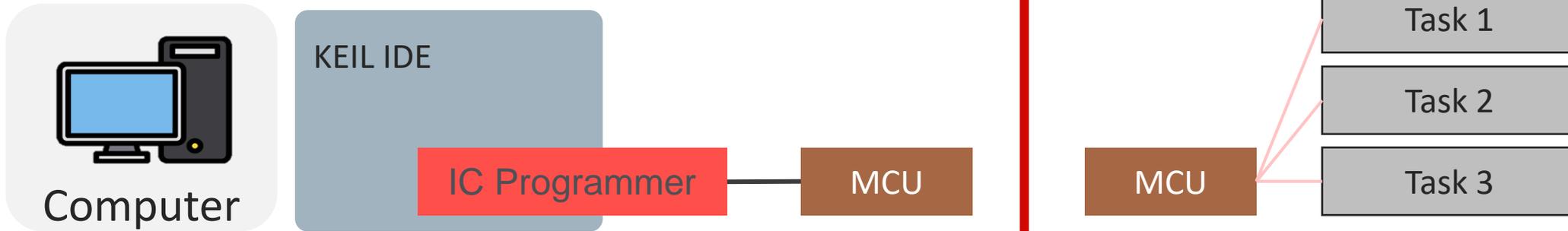
Joy of innovation
nuvoton

| Golden 3 Steps of Evaluation

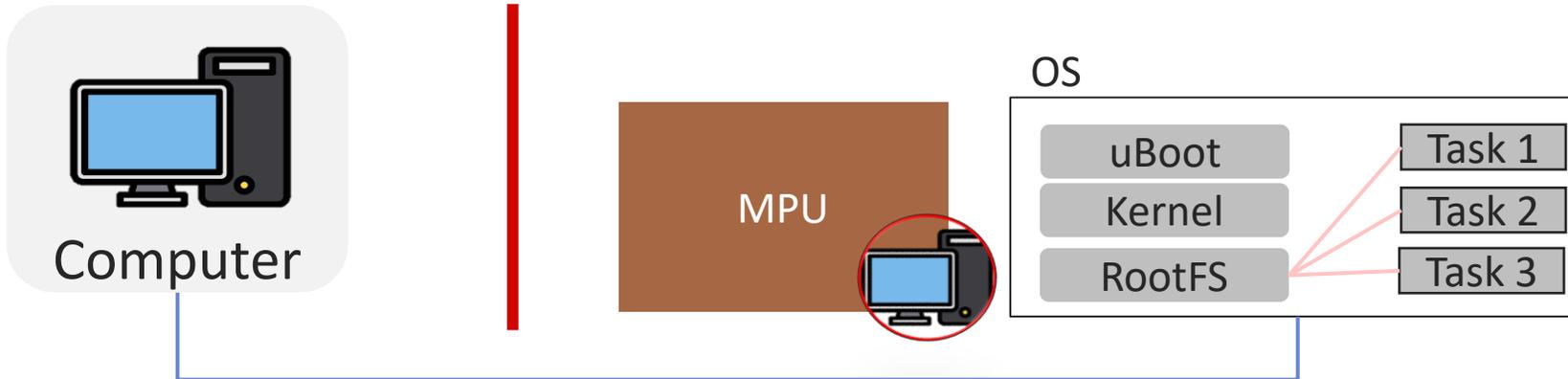


MPU vs. MCU

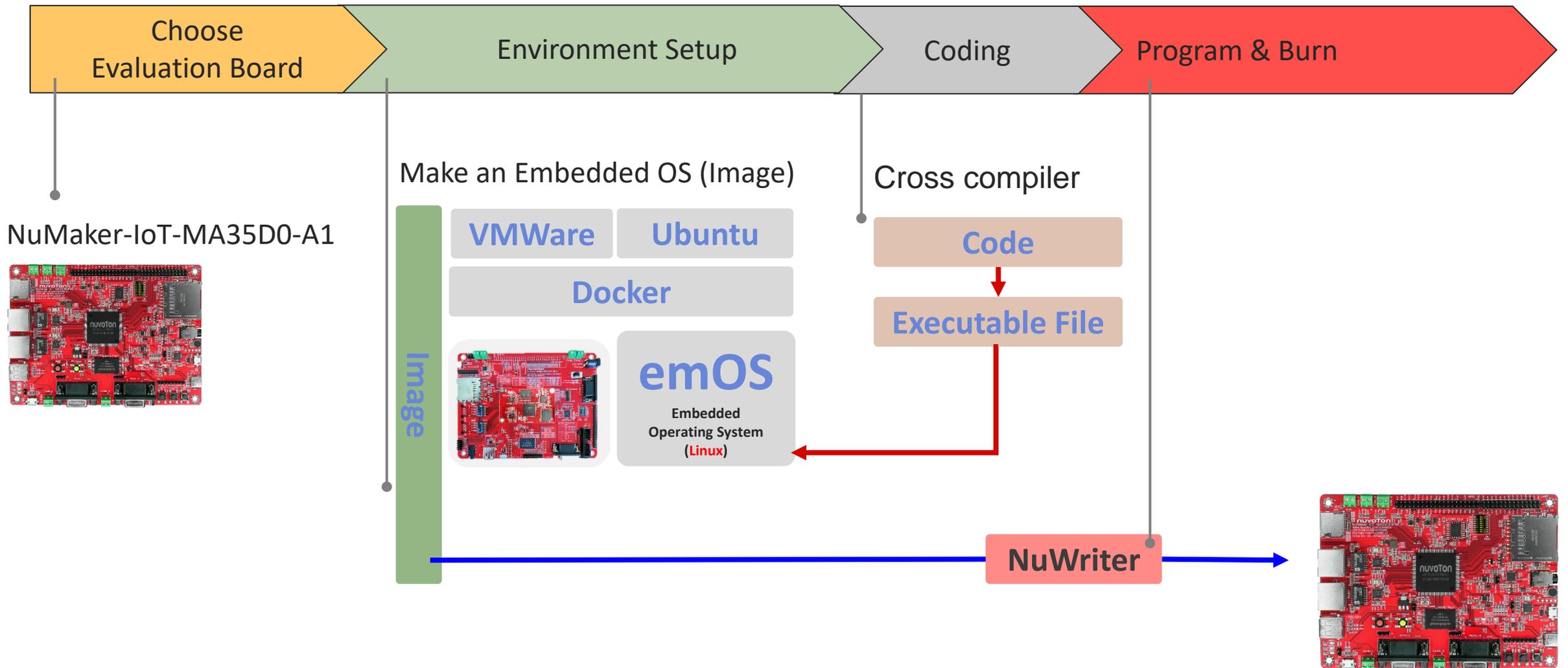
MCU Development Process



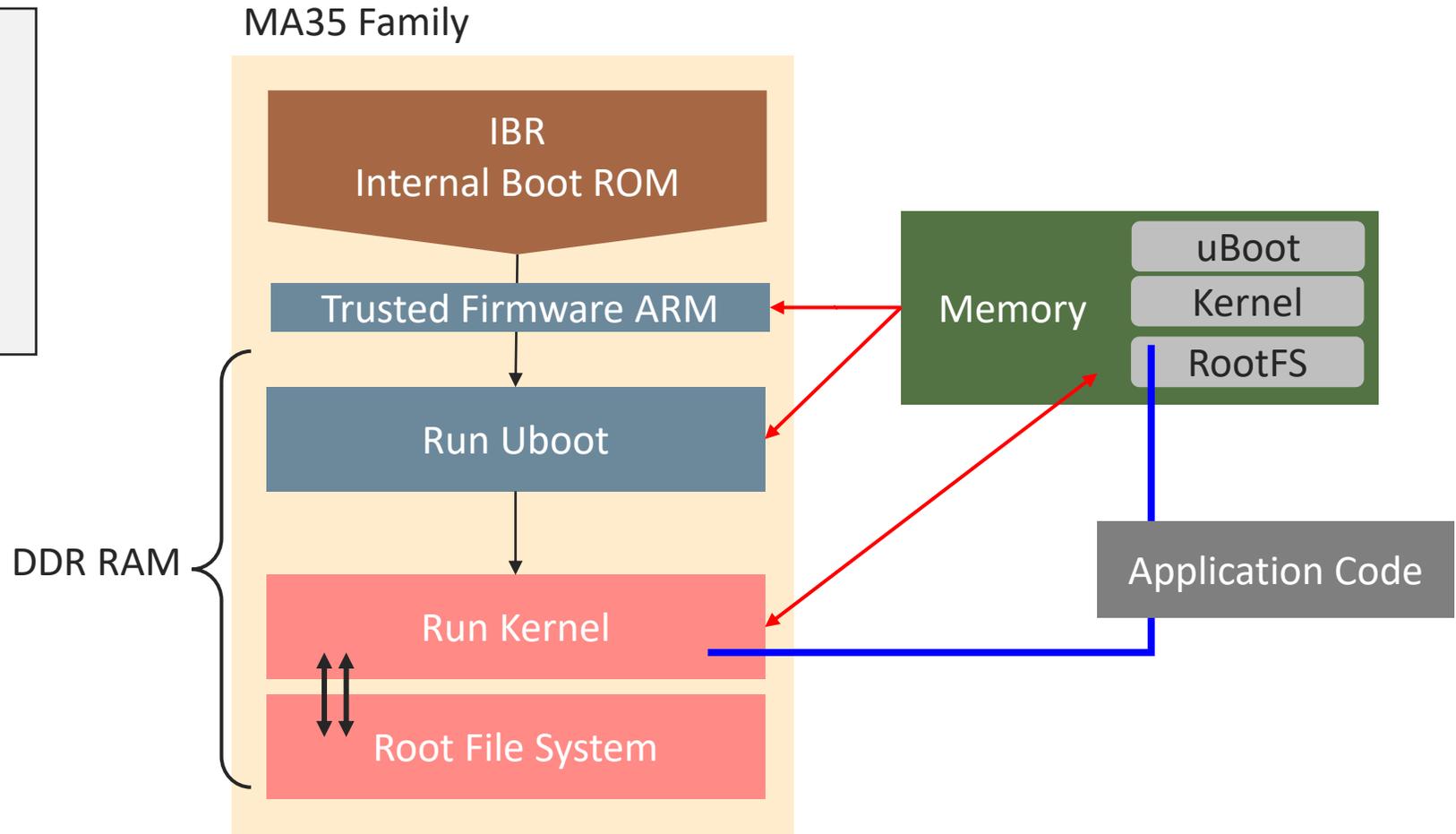
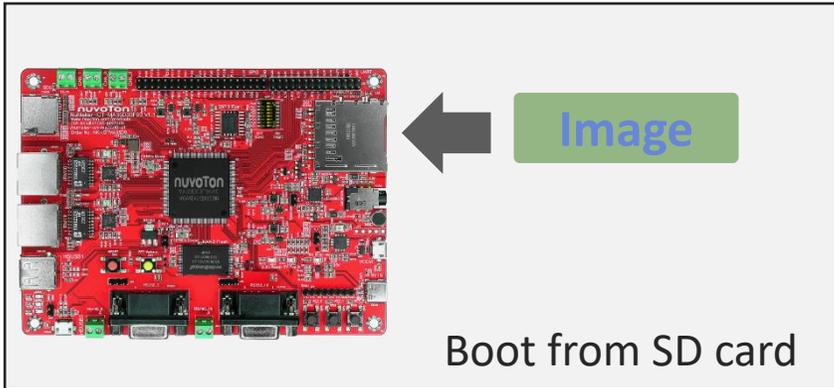
MPU Development Process



MPU Development Process



MPU Boot Flow





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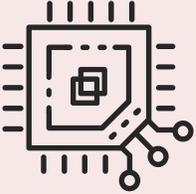
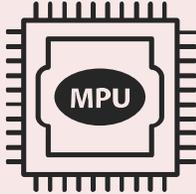
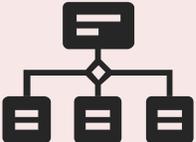
MA35D0 Buildroot Quick Start

| Agenda

- Overview
- Environment Setup
- Programming
- System Boot

MA35H0 Design Resource

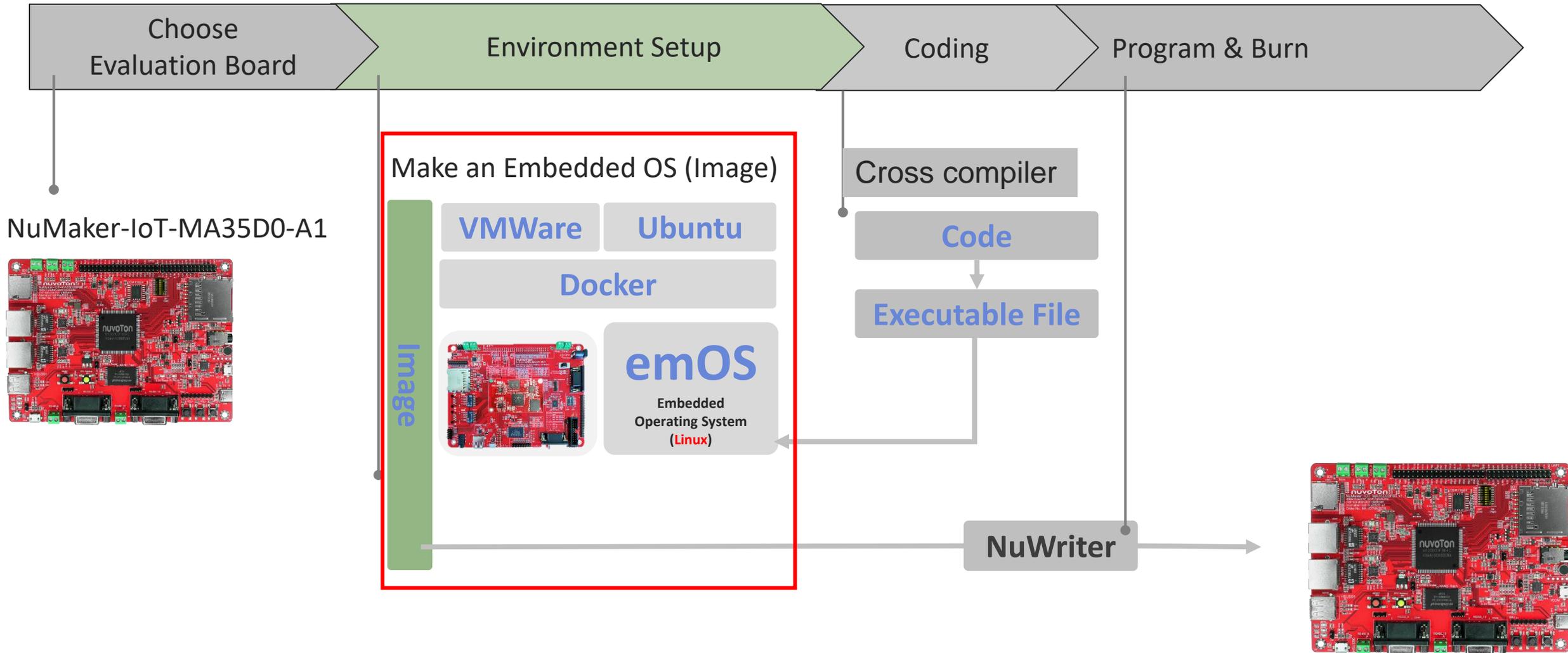
[WEB](#)

<p>Evaluation Board</p> 	<ul style="list-style-type: none">• HMI EVB<ul style="list-style-type: none">• NuMaker-IoT-MA35D0-A1<ul style="list-style-type: none">• User Manual• Default Image	<p>Operating System</p> 	<ul style="list-style-type: none">• Linux<ul style="list-style-type: none">• Buildroot / Quick Start• Yocto / Quick Start• OpenWrt / Quick Start• RTOS<ul style="list-style-type: none">• RT-Thread / README• Non-OS<ul style="list-style-type: none">• Non-OS BSP / Quick Start
<p>Quick Start</p> 	<ul style="list-style-type: none">• Environment Build-Up<ul style="list-style-type: none">• Quick Start• VMware Image• MA35D0 Training<ul style="list-style-type: none">• Training Material Summary• HMI<ul style="list-style-type: none">• emWin AppWizard / Quick Start• QT / Quick Start	<p>Hardware</p> 	<ul style="list-style-type: none">• Programming Tools<ul style="list-style-type: none">• NuWriter• Assistant Tools<ul style="list-style-type: none">• Pin Configure• High-Speed IP Calibration
<p>Software Tool</p> 	<ul style="list-style-type: none">• EVB Schematic, PCB, Gerber File & BOM• Approved Vendor List (AVL)• Hardware Development Guide	<p>Sample Code/GitHub</p> 	<ul style="list-style-type: none">• Nuvoton GitHub• Sample Code<ul style="list-style-type: none">• Example Code• Linux Applications
<p>Document</p> 	<ul style="list-style-type: none">• Technical Documents• Application Notes• User Manuals	<p>Support</p> 	<ul style="list-style-type: none">• Forum<ul style="list-style-type: none">▪ NuForum▪ 牛臥堂

Overview



MPU Development Process

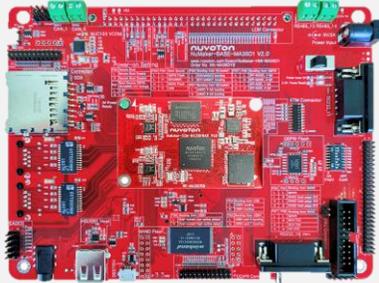


| MA35H0 Quick Start

- Make an Embedded Image



What is the Image?



MA35D0

emOS

Embedded
Operating System
(Linux)

Boot Loader (uBoot)

Kernel

File system (rootfs)

Image

Overview

- This slide provides instructions on how to quickly build an MA35D0 image
- PC specification standard
 - CPU: Intel i5-10400
 - Memory: 16 GB DDR RAM
 - Storage: 1 TB SSD Disk (200 GB of which is empty space)
 - Operation System: Linux OS or Linux Virtual Machine ([VMware provide by Nuvoton](#))
 - A MA35 series Docker container

If you used VMware provide by Nuvoton, you have already created a MA35 series Docker container

- Software Tool
 - Programming – [NuWriter](#)

| MPU Quick Start

- Make an Embedded Image

➤ Start up with VMware

- This VMware Image offers a Linux development environment for MA35H0.
- User Name: **user**
Password: **user**

Open the development environment

1. Click *Vmware player*
2. Click “*Open a Virtual Machine*” and choose *ubuntu image*_(unzip)
3. Enter the password to enter the linux OS



Create a New Virtual Machine

Create a new virtual machine, which will then be added to the top of your library.



Open a Virtual Machine

Open an existing virtual machine, which will then be added to the top of your library.



Upgrade to VMware Workstation Pro

Get advanced features such as snapshots, virtual network management, and more.



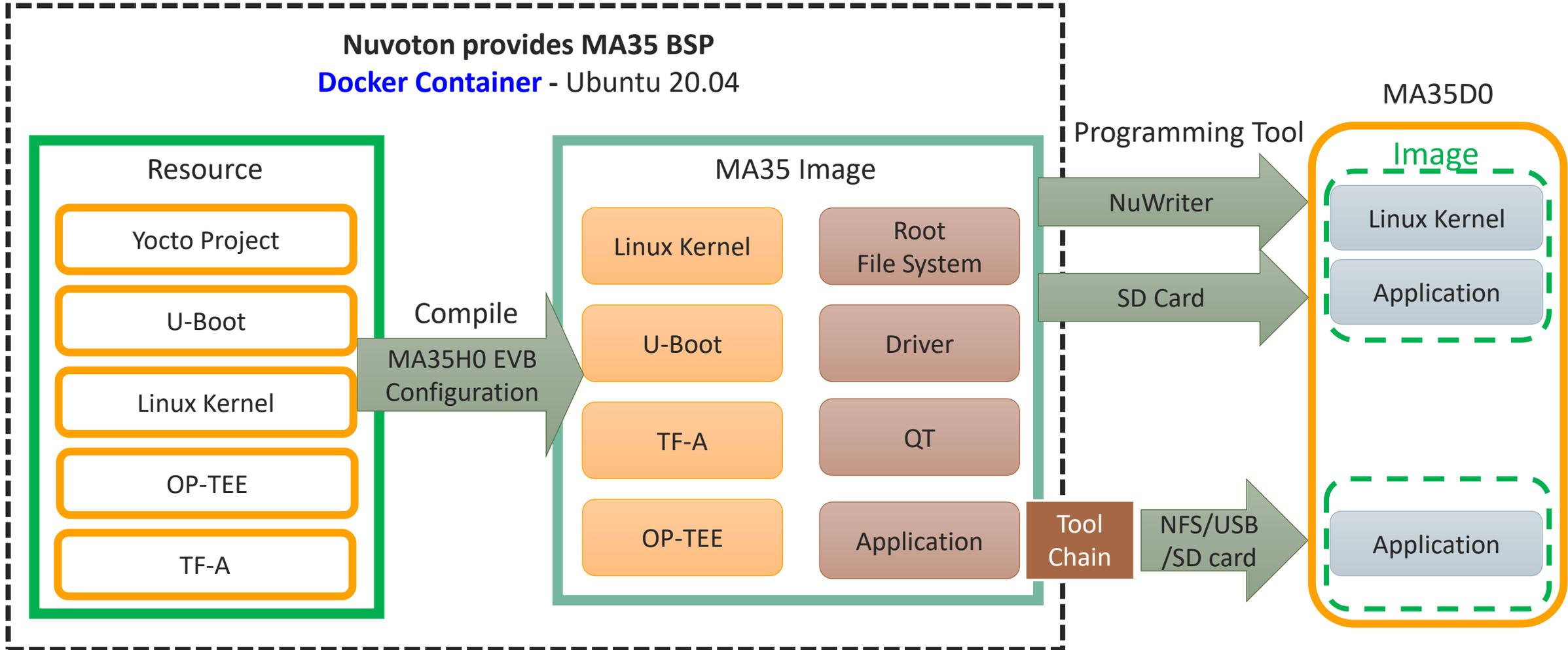
Help

View online help.

MA35 Family Development Scheme

Development Environment

Nuvoton provides MA35 BSP
Docker Container - Ubuntu 20.04

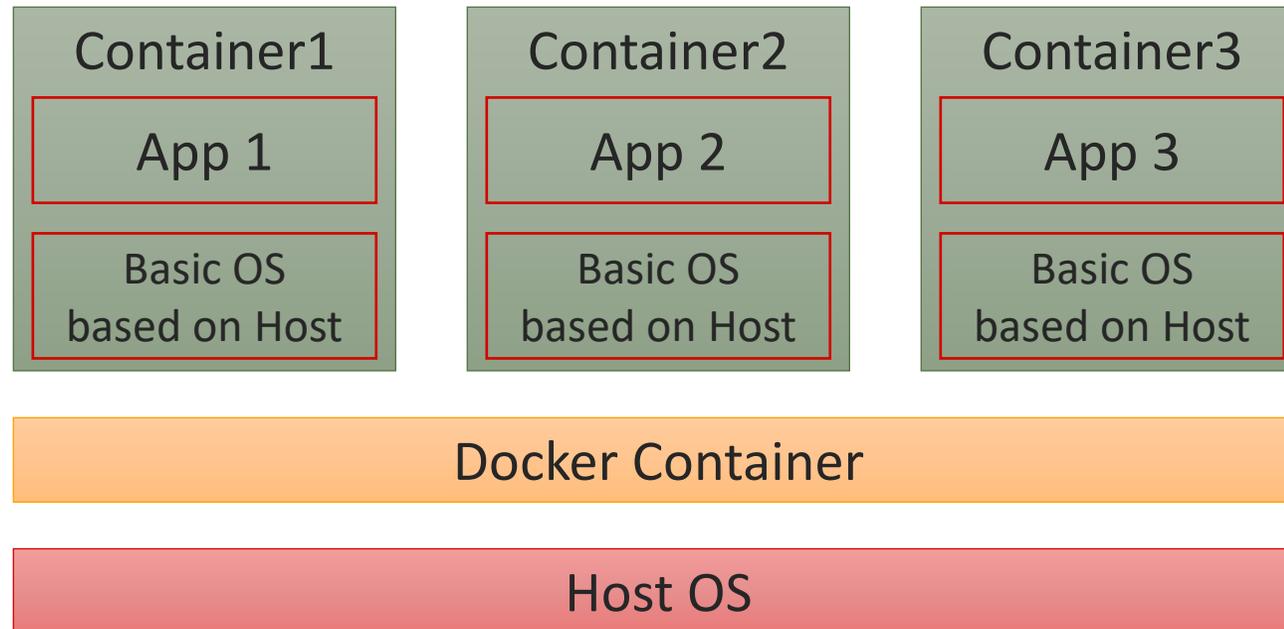


Docker Environment Setup



Development Environment – Docker

- Docker enables the packaging of code and its dependencies into containers.
- Each container is independent and based on the host OS, ensuring they operate in isolation without impacting each other. Containers run more efficiently than virtual machines, resulting in faster performance



| MA35D0 Quick Start

- Make an Embedded Image

➤ Into to the Docker

Buildroot:

```
$ cd ~/MA35D1_Docker_Script/
```

```
$ ./join.sh
```

Password: **user**

```
user@ubuntu:~$ cd ~/MA35D1_Docker_Script/
user@ubuntu:~/MA35D1_Docker_Script$ ./join.sh
[sudo] password for user:
nvt_user
user@aa3c667d7ce6:~$
```

| MPU Quick Start

- Make an Embedded Image

➤ [Docker] Update Buildroot

Buildroot:

Goto MA35D1_Buildroot folder

```
$ cd ~/shared/buildroot/MA35D1_Buildroot/
```

Update Buildroot:

```
$ git pull
```

```
user@aa3c667d7ce6:~/shared/Buildroot/MA35D1_Buildroot$ git pull
Already up to date.
user@aa3c667d7ce6:~/shared/Buildroot/MA35D1_Buildroot$
```

Environment Setup



Set default Configuration

- List all default configurations provide by Nuvoton and choose your target board configuration

```
$ ls configs/n*
```

```
user@aa3c667d7ce6:~/shared/Buildroot/MA35D1_Buildroot$ ls configs/n*
configs/nexbox_a95x_defconfig      configs/numaker_iot_ma35d16f90_defconfig  configs/numaker_som_ma35d16ab1a_defconfig
configs/nitrogen6sx_defconfig     configs/numaker_som_ma35d15a910_defconfig  configs/nuvoton_n9h30_emwin_defconfig
configs/nitrogen6x_defconfig      configs/numaker_som_ma35d15aa10_defconfig  configs/nuvoton_n9h30_matter_defconfig
configs/nitrogen7_defconfig       configs/numaker_som_ma35d15aa1a_defconfig  configs/nuvoton_nuc972_defconfig
configs/nitrogen8m_defconfig      configs/numaker_som_ma35d15ab1a_defconfig  configs/nuvoton_nuc980_chili_defconfig
configs/nitrogen8mm_defconfig     configs/numaker_som_ma35d16a81_defconfig   configs/nuvoton_nuc980_chili_matter_defconfig
configs/nitrogen8mn_defconfig     configs/numaker_som_ma35d16a910_defconfig  configs/nuvoton_nuc980_defconfig
configs/numaker_hmi_ma35h04f70_defconfig  configs/numaker_som_ma35d16a91_defconfig  configs/nuvoton_nuc980_eth2uart_defconfig
configs/numaker_iot_ma35d03f80_defconfig  configs/numaker_som_ma35d16aa10_defconfig  configs/nuvoton_nuc980_iot_defconfig
configs/numaker_iot_ma35d16f70_defconfig  configs/numaker_som_ma35d16aa1a_defconfig  configs/nuvoton_nuc980_iot_g2_defconfig
configs/numaker_iot_ma35d16f80_defconfig  configs/numaker_som_ma35d16aa1_defconfig  configs/nuvoton_nuc980_lorag_defconfig
```

- Set configuration to the target board

```
$ make numaker_iot_ma35d03f80_defconfig
```

```
user@aa3c667d7ce6:~/shared/Buildroot/MA35D1_Buildroot$ make numaker_hmi_ma35h04f70_defconfig
#
# configuration written to /home/user/shared/Buildroot/MA35D1_Buildroot/.config
#
user@aa3c667d7ce6:~/shared/Buildroot/MA35D1_Buildroot$
```

| Install Qt5 Package

- Open Buildroot configuration

```
$ make menuconfig
```

```
Target packages --->
Graphic libraries and applications --->
  [*] Qt5 --->
    [*] qt5base
    [*] Compile and install examples (with code)
    [*-] gui module
    [*] widgets module
    [*-] linuxfb support
    [*] GIF support
    [*] JPEG support
    [*] PNG support
    [*] Enable Tslib support
    [*] quick module
    [*] qt5multimedia
    [*] qt5script
    [*] qt5sensors
    [*] qt5serialbus
    [*-] qt5serialport
```

| Install Gstreamer Related Package

```
Target packages --->
Audio and video applications --->
[*] gstreamer 1.x
-*- enable unit test libraries
[*] enable command-line parser
[*] enable tracing subsystem
[*] enable gst-debug trace support
[*] enable plugin registry
[*] install tools
[*] gstreamer1-mm

-*- gst1-plugins-base --->
[*] audioconvert
[*] playback
[*] audioresample
-*- typefind
[*] videoscale
[*] volume
[*] alsa

-*- gst1-plugins-good --->
[*] audioparsers
[*] auparse
[*] autodetect
[*] avi (*.avi video)
[*] isomp4
[*] wavparse (*.wav audio)
[*] mpg123 (*.mp3 audio)
[*] v4l2
[*] v4l2-probe (m2m)

[*] gst1-plugins-bad --->
[*] jpegformat
[*] videoparsers
```

Compile and Install Package into Image

- If you do not need to install any additional packages to the MA35H0 image, you can start building it

```
$ make
```

```
user@aa3c667d7ce6:~/shared/Buildroot/MA35D1_Buildroot$ make
>>> Finalizing host directory
>>> Finalizing target directory
mkdir -p /home/user/shared/Buildroot/MA35D1_Buildroot/output/host/etc/meson
sed -e 's%@TARGET_CROSS@%/home/user/shared/Buildroot/MA35D1_Buildroot/output/host/bin/aarch64-nuvoton-linux-gnu-%g' -e 's%@TARGET_ARCH@%aarch64%g' -e 's%@TARGET_CPU@%cortex-a35%g' -e 's%@TARGET_ENDIAN@%little%g' -e "s%@TARGET_CFLAGS@%'-D_LARGEFILE_SOURCE', '-D_LARGEFILE64_SOURCE', '-D_FILE_OFFSET_BITS=64', '-Os'@PKG_TARGET_CFLAGS@%g" -e "s%@TARGET_LDFLAGS@%@PKG_TARGET_CFLAGS@%g" -e "s%@TARGET_CXXFLAGS@%'-D_LARGEFILE_SOURCE', '-D_LARGEFILE64_SOURCE', '-D_FILE_OFFSET_BITS=64', '-Os'@PKG_TARGET_CFLAGS@%g" -e 's%@HOST_DIR@%/home/user/shared/Buildroot/MA35D1_Buildroot/output/host%t%g' -e 's%@STAGING_DIR@%/home/user/shared/Buildroot/MA35D1_Buildroot/output/host/aarch64-nuvoton-linux-gnu/sysroot%g' -e 's%@STATIC@%false%g' package/meson//cross-compilation.conf.in > /home/user/shared/Buildroot/MA35D1_Buildroot/output/host/etc/meson/cross-compilation.conf.in
sed -e 's%@PKG_TARGET_CFLAGS@%g' -e 's%@PKG_TARGET_LDFLAGS@%g' -e 's%@PKG_TARGET_CXXFLAGS@%g' /home/user/shared/Buildroot/MA35D1_Buildroot/output/host/etc/meson/cross-compilation.conf.in > /home/user/shared/Buildroot/MA35D1_Buildroot/output/host/etc/meson/cross-compilation.conf
/usr/bin/sed -i -e '/# GENERIC_SERIAL$/s~^.*~ttyS0::respawn:/sbin/getty -L ttyS0 0 vt100 #~' /home/user/shared/Buildroot/MA35D1_Buildroot/output/target/etc/inittab
/usr/bin/sed -i -e '/^#.*-o remount,rw \/$/s~^#\+~' /home/user/shared/Buildroot/MA35D1_Buildroot/output/target/etc/inittab
if grep -q CONFIG_ASH=y /home/user/shared/Buildroot/MA35D1_Buildroot/output/build/busybox-1.33.1/.config; then grep -qsE '^/bin/ash$' /home/user/shared/Buildroot/MA35D1_Buildroot/output/target/etc/shells || echo "/bin/ash" >> /home/user/shared/Buildroot/MA35D1_Buildroot/output/target/etc/shells; fi
if grep -q CONFIG_HUSH=y /home/user/shared/Buildroot/MA35D1_Buildroot/output/build/busybox-1.33.1/.config; then grep -qsE '^/bin/hush$' /home/user/shared/Buildroot/MA35D1_Buildroot/output/target/etc/shells || echo "/bin/hush" >> /home/user/shared/Buildroot/MA35D1_Buildroot/output/target/etc/shells; fi
rm -f /home/user/shared/Buildroot/MA35D1_Buildroot/output/target/usr/share/glib-2.0/schemas/*.xml /home/user/shared/Buildroot/MA35D1_Buildroot/output/target/usr/share/glib-2.0/schemas/*.dtd
/home/user/shared/Buildroot/MA35D1_Buildroot/output/host/bin/glib-compile-schemas /home/user/shared/Buildroot/MA35D1_Buildroot/output/host/aarch64-nuvoton-linux-gnu/sysroot/usr/share/glib-2.0/schemas --targetdir=/home/user/shared/Buildroot/MA35D1_Buildroot/output/target/usr/share/glib-2.0/schemas
```

Building Finishing

- Once the build is complete, you can find the resulting image at /output/image

```
bl2.bin
bl2.dtb
bl31.bin
core-image-buildroot-ma35h0-hmi-128m.rootfs.sdcard
fip.bin
fip.bin-sdcard
header.bin
header-core-image-buildroot-ma35h0-hmi-128m-sdcard.bin
Image
Image.dtb
ma35h0-hmi-128m.dtb
MBR.sdcard.bin
nuwriter
pack-core-image-buildroot-ma35h0-hmi-128m-sdcard.bin
rootfs.ext2
rootfs.ext4
rootfs.tar
rootfs.ubi
rootfs.ubifs
tee.bin
tee-header_v2.bin
tee-pageable_v2.bin
tee-pager_v2.bin
u-boot.bin
uboot-env.bin
uboot-env.bin-sdcard
uboot-env.txt
uboot-env.txt-sdcard
user@aa3c667d7ce6:~/shared/Buildroot/MA35D1_Buildroot_tmp/output/images$
```

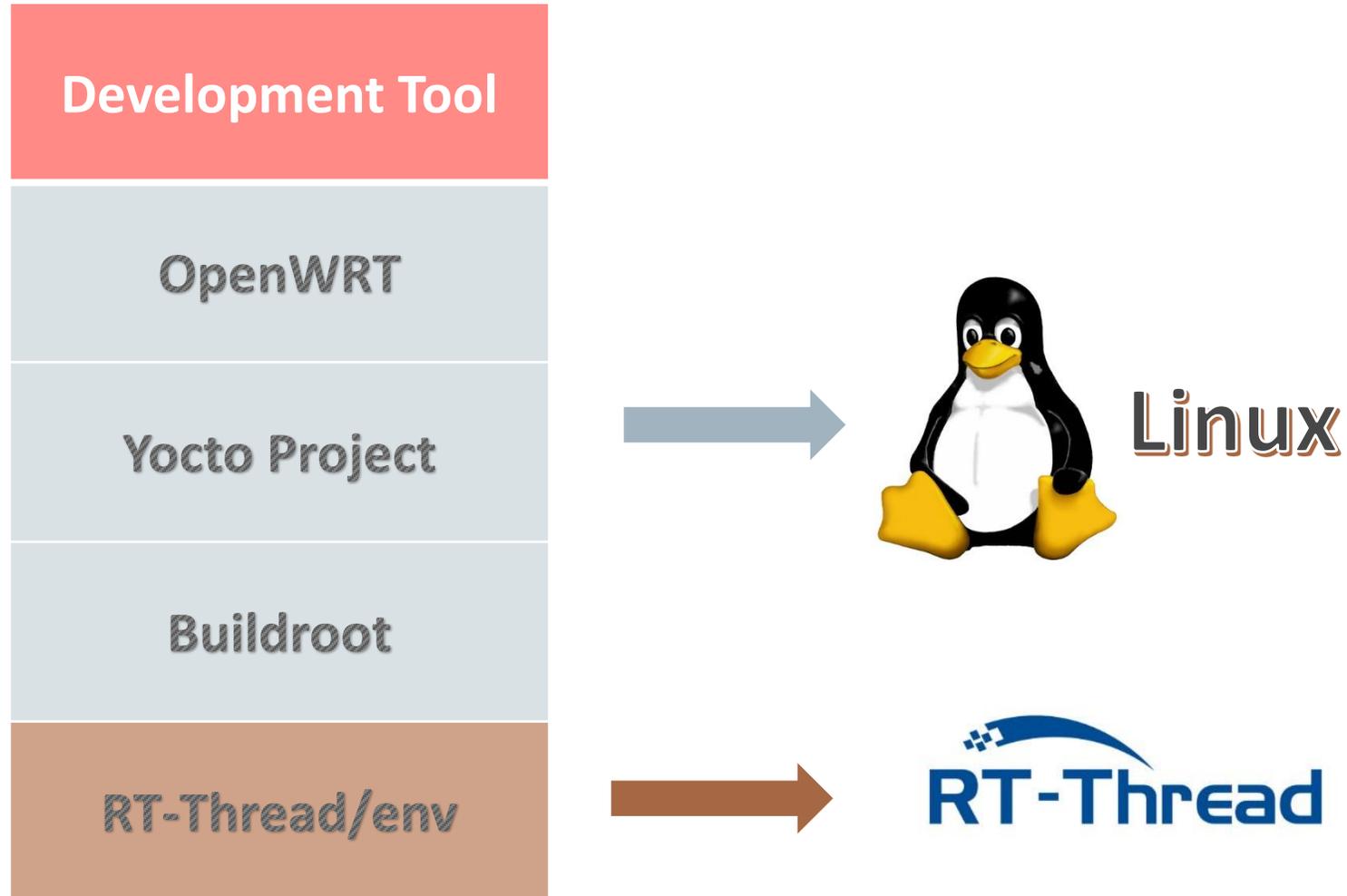
- The core-image-buildroot-ma35d0-iot-256m.rootfs.sdcard can be used to directly program to an SD card
- Alternatively, pack-core-image-buildroot-ma35d0-iot-256m-sdcard.bin can be used to program an SD card through NuWriter

MA35 Family Linux Board Support Package

- This BSP supports Linux operating system for MA35 Family. The peripheral drivers are also included in the BSP allowing applications to access them

Component	Description
Yocto	Version 3.1.3 (Dunfell). A Linux Foundation collaborative open source project to create the Linux distributions
Buildroot	Buildroot is a simple, efficient and easy-to-use tool to generate embedded Linux systems through cross-compilation
OpenWrt	The OpenWrt Project is a Linux operating system targeting embedded devices
RT-Thread	a real-time operating system designed for embedded systems with strict timing requirements
Linux	Version 5.10 An open source operating system based on GPLv2 license
U-Boot	Version 2020.07. An open source bootloader based on GPLv2+ license
OP-TEE	Version 3.9.0. An open source trusted execution environment
TF-A	Version 2.3. A BSD-3-Clause license reference implementation of secure world software
M4 BSP	CMSIS library 4.5.0 and standard driver for RTP BareMetal/FreeRTOS firmware development
NuWriter	A GUI and command line tool supports firmware update and OTP programming for MA35D1

MA35H0 Kernel Development Tools



Programming



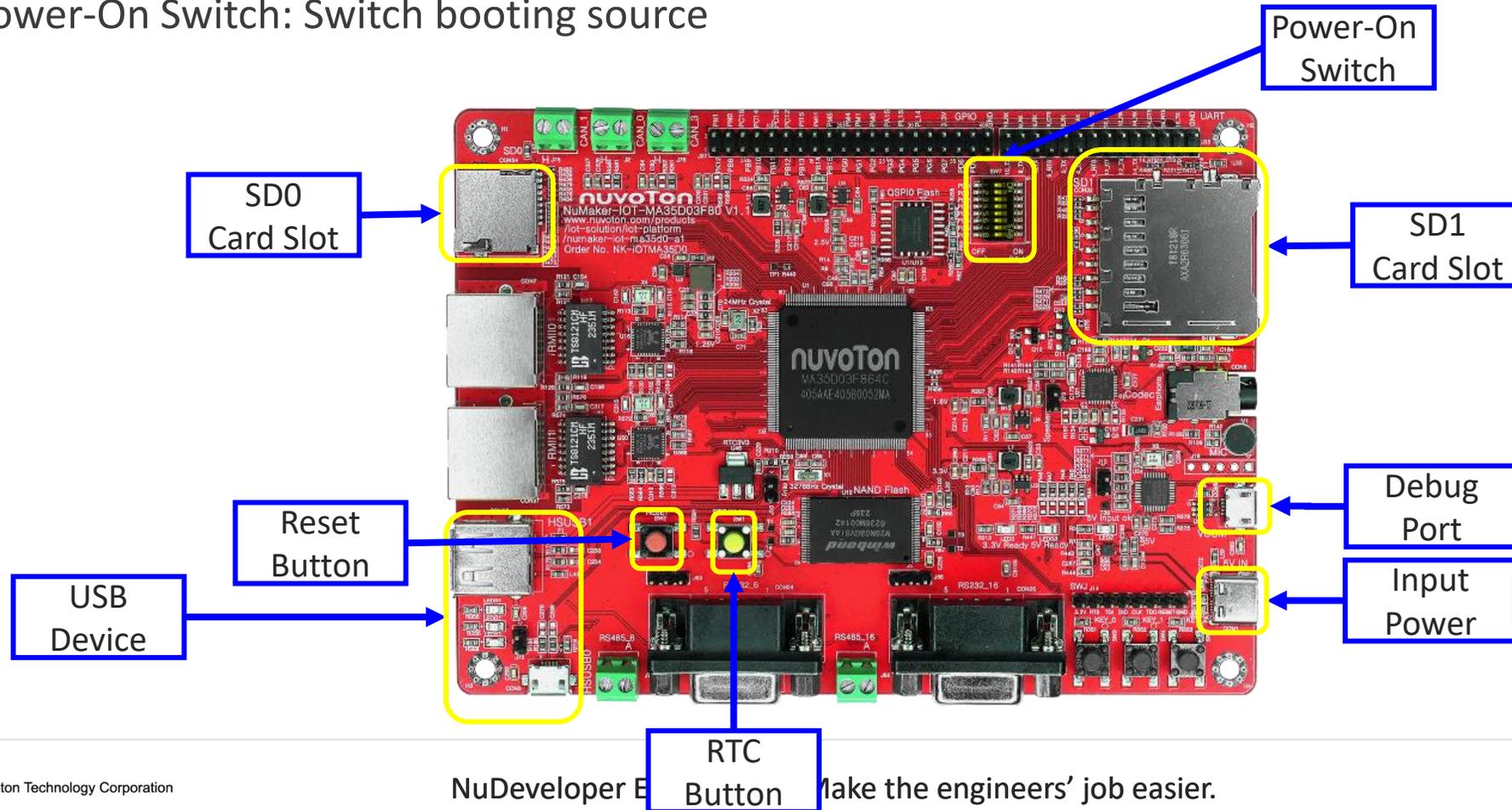
| Image Programming

- Usually, you would use NuWriter for MA35 to program the image, but for debugging purposes, you can also program the image to SD card using a writing tool by PC
- One open-source utility that can be used for writing image files is balenaEtcher, which you can use to program the image



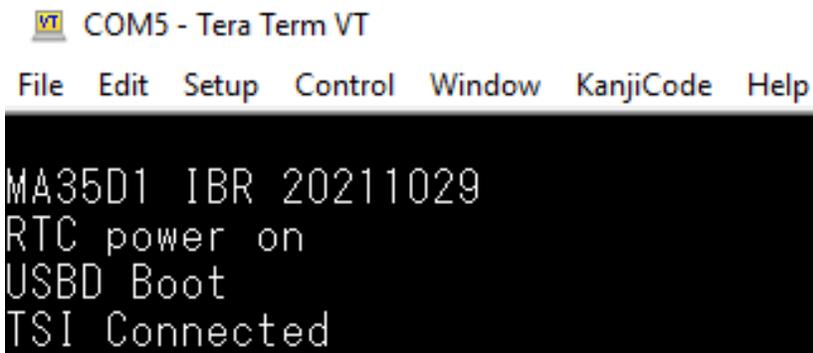
Evaluation Board Introduction

- Debug Port: Show the debug message
- USB Device: Used to program image by NuWriter
- Power-On Switch: Switch booting source
- Reset Button: Reset IC
- RTC Button: Wake up RTC



| Start Programming

- To program an image to an SD card, please ensure the following steps are followed:
 - Connect the power supply
 - Connect the debug port
 - Connect the USB device
 - Insert the SD card
 - Set the power switch to enable USBD Boot
 - [PG 0] [PG 2] [PG 3] High
- Click the RTC button, reset button, and you will see the debug message

A screenshot of a terminal window titled 'COM5 - Tera Term VT'. The window has a menu bar with 'File', 'Edit', 'Setup', 'Control', 'Window', 'KanjiCode', and 'Help'. The terminal output shows the following text:

```
MA35D1 IBR 20211029
RTC power on
USB D Boot
TSI Connected
```

Noted: It indicates MA35D1 IBR 20211029 since MA35D0 utilizes the same bootloader code

NuWriter Programming

- Choose DDR file ddrimg/MA35D03F864C.bin

DDR initialize code

DDR File:

Info.json:

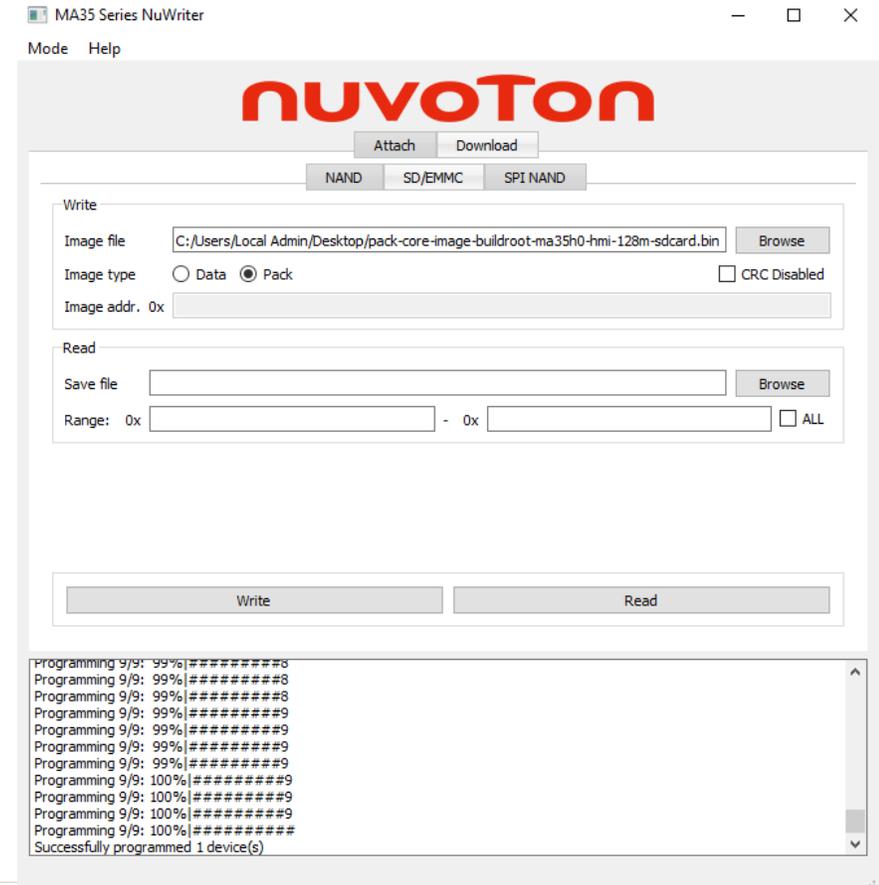
Use Info.json as set info

- Click Attach button, you will see the message below

```
ID: 15710755
Page size: 2048
Spare size: 64
Quad read cmd: 107
Read sts cmd: 5
Write sts cmd: 1
Sts value: 2
Dummy byte: 1
Block per flash: 4096
Page per block: 64
Successfully get info from 1 device(s)
```

NuWriter Programming

- Switch to Download and choose SD/EMMC
- Browse pack-core-image-buildroot-ma35d0-iot-256m-sdcard.bin
- Enable Pack mode
- Click write button to start programming

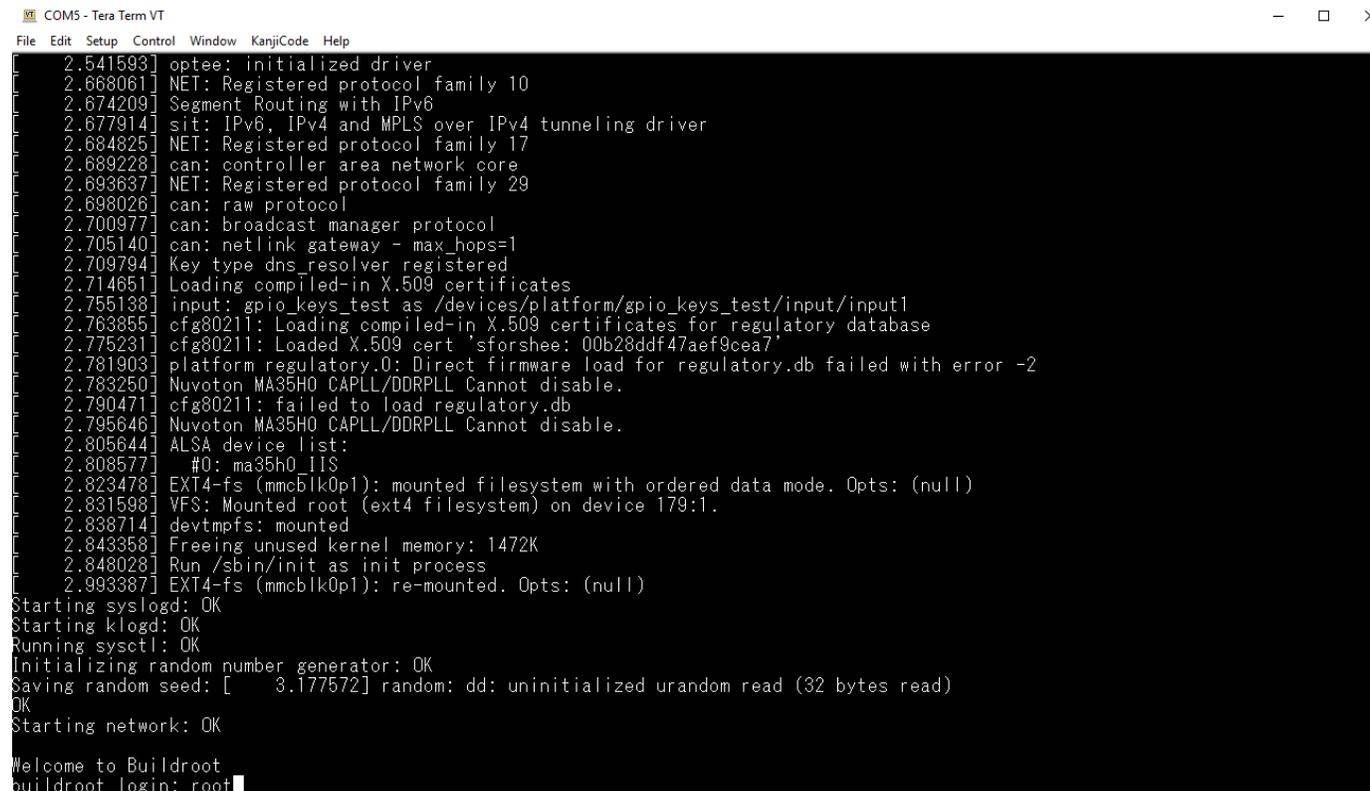


System Boot



System Boot

- Switch power on setting to enable SD 1 Boot, click reset Button, and you can see MA35h0 booting
 - [PG 0] [PG 2] High
- Enter “root” to login



```
COM5 - Tera Term VT
File Edit Setup Control Window KanjiCode Help
2.541593] optee: initialized driver
2.668061] NET: Registered protocol family 10
2.674209] Segment Routing with IPv6
2.677914] sit: IPv6, IPv4 and MPLS over IPv4 tunneling driver
2.684825] NET: Registered protocol family 17
2.689228] can: controller area network core
2.693637] NET: Registered protocol family 29
2.698026] can: raw protocol
2.700977] can: broadcast manager protocol
2.705140] can: netlink gateway - max_hops=1
2.709794] Key type dns_resolver registered
2.714651] Loading compiled-in X.509 certificates
2.755138] input: gpio_keys_test as /devices/platform/gpio_keys_test/input/input1
2.763855] cfg80211: Loading compiled-in X.509 certificates for regulatory database
2.775231] cfg80211: Loaded X.509 cert 'sforshee: 00b28ddf47aef9cea7'
2.781903] platform regulatory.0: Direct firmware load for regulatory.db failed with error -2
2.783250] Nuvoton MA35H0 CAPLL/DDRPLL Cannot disable.
2.790471] cfg80211: failed to load regulatory.db
2.795646] Nuvoton MA35H0 CAPLL/DDRPLL Cannot disable.
2.805644] ALSA device list:
2.808577]   #0: ma35h0_IIS
2.823478] EXT4-fs (mmcblk0p1): mounted filesystem with ordered data mode. Opts: (null)
2.831598] VFS: Mounted root (ext4 filesystem) on device 179:1.
2.838714] devtmpfs: mounted
2.843358] Freeing unused kernel memory: 1472K
2.848028] Run /sbin/init as init process
2.993387] EXT4-fs (mmcblk0p1): re-mounted. Opts: (null)
Starting syslogd: OK
Starting klogd: OK
Running sysctl: OK
Initializing random number generator: OK
Saving random seed: [ 3.177572] random: dd: uninitialized urandom read (32 bytes read)
OK
Starting network: OK

Welcome to Buildroot
buildroot login: root
```

| Change Compiling Image from D1 to H0

- Change board configuration from D1 to H0 and start to compile

- Update the Buildroot

```
$ git pull
```

- Remove the old source code from dl folder

```
$ rm -rf dl/
```

- Clean all the file you have built for MA35D1

```
$ make clean
```

- Remember to set new defconfig and clean all output folder

```
$ make numaker_iot_ma35d03f80_defconfig
```

- Start to compile

```
$ make
```

Joy of innovation
nuvoTon

谢谢

謝謝

Děkuji

Bedankt

Thank you

Kiitos

Merci

Danke

Grazie

ありがとう

감사합니다

Dziękujemy

Obrigado

Спасибо

Gracias

Teşekkür ederim

Cảm ơn