MA35 Family Development Platform

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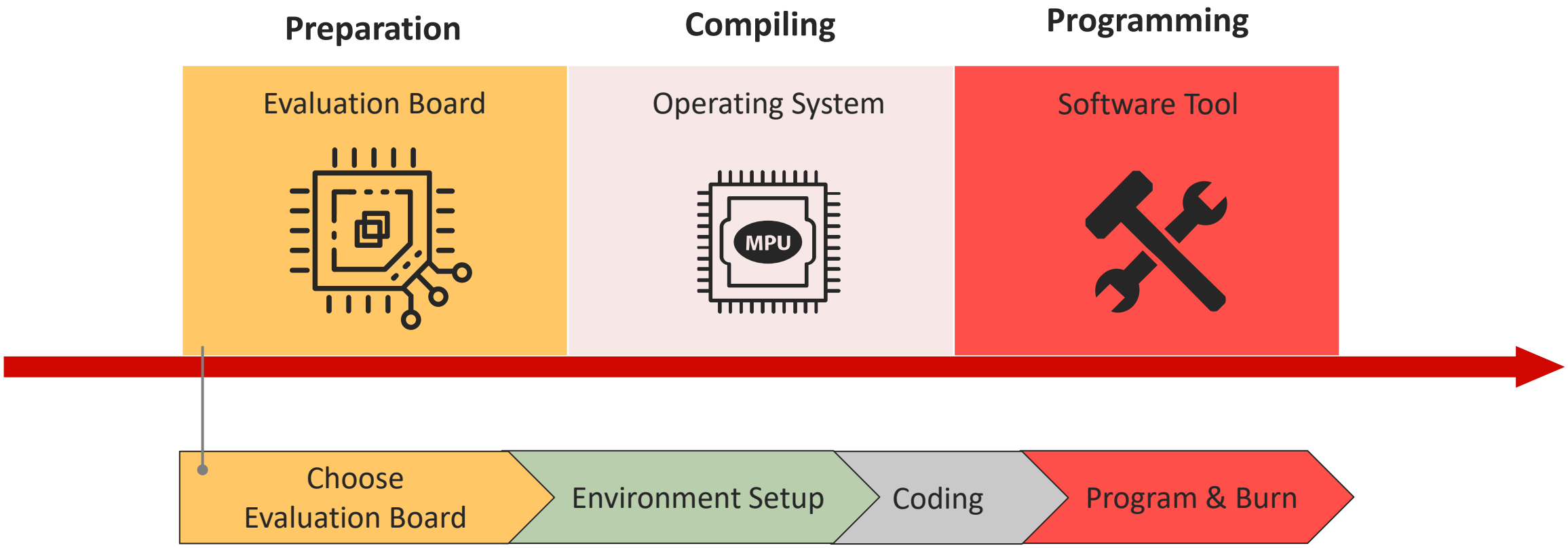
Golden 3 Steps of Evaluation



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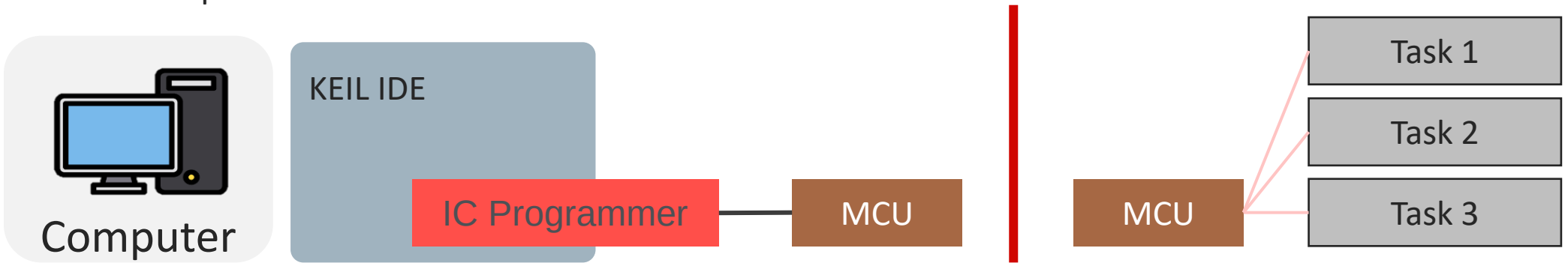
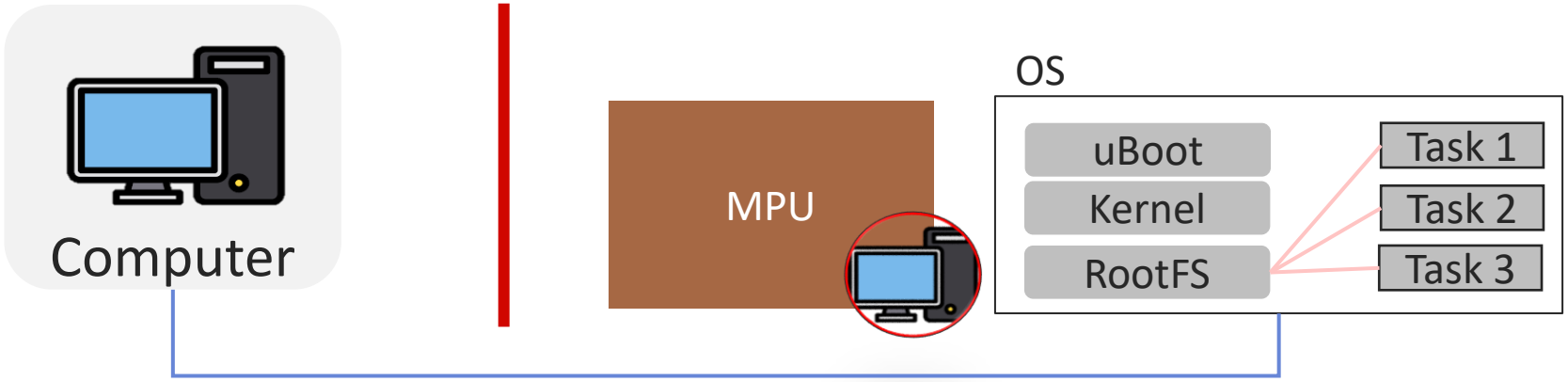
MPU vs. MCU

MCU Development Process



MPU Development Process



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MPU Development Process

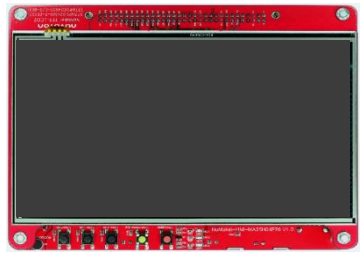
Choose Evaluation Board

Environment Setup

Coding

Program & Burn

NuMaker-HMI-MA35H0-A1



Make an Embedded OS (Image)

Image

VMWare

Ubuntu

Docker

emOS

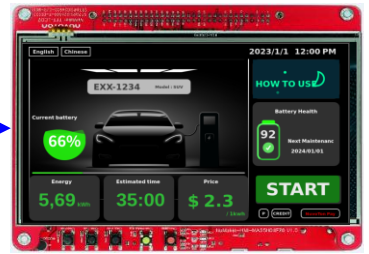
Embedded Operating System (Linux)

Cross compiler

Code

Executable File

NuWriter



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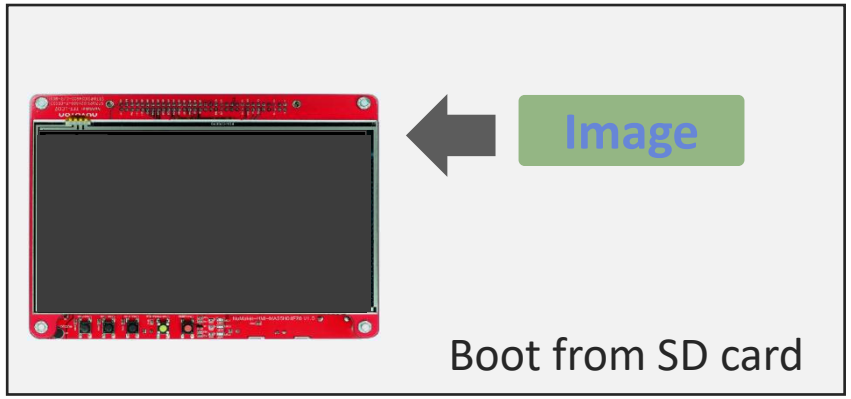
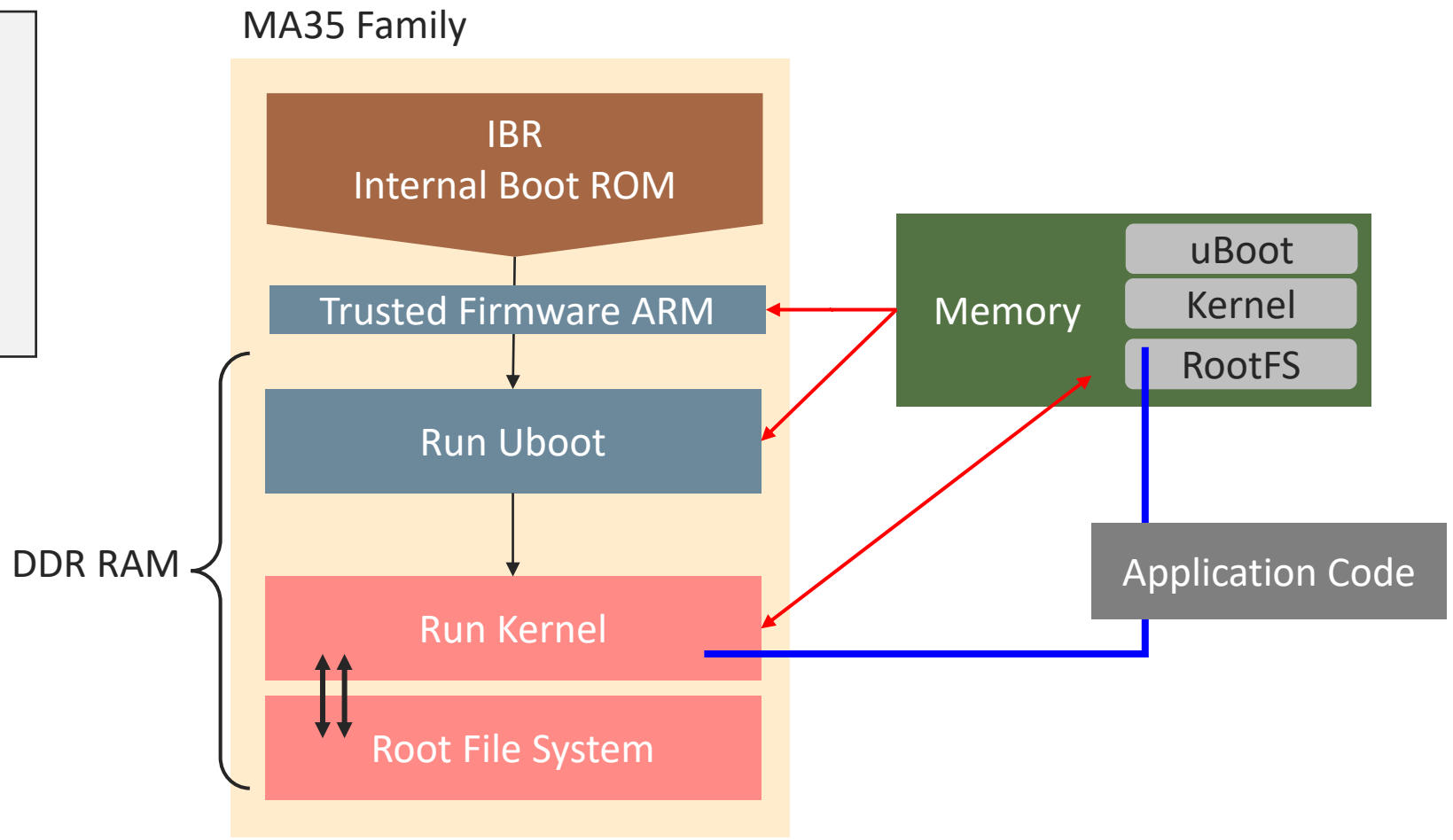
MPU Boot Flow





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MA35H0 Buildroot Quick Start

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Agenda

- Overview
- Environment Setup
- Programming
- System Boot

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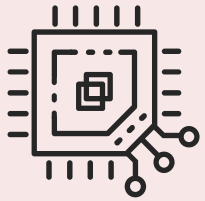
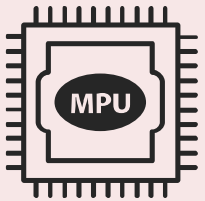
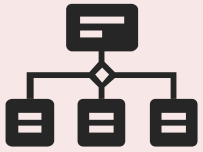
MA35H0 Design Resource

WEB

Evaluation Board 	• **HMI EVB**
	  • NuMaker-HMI-MA35H0-A1
	  • User Manual
	  • Default Image
		Operating System 	• **Linux**
			  • Buildroot / Quick Start
			  • Yocto / Quick Start
			  • OpenWrt / Quick Start
			• **RTOS**
			  • RT-Thread / README
			• **Non-OS**
			  • Non-OS BSP / Quick Start

Quick Start	• **Environment Build-Up**
	  • Quick Start
	  • VMware Image
	• **MA35H0 Training**
	  • Training Material Summary
	• **HMI**
	  • emWin AppWizard / Quick Start
	  • QT / Quick Start
		Hardware	• **Programming Tools**
			  • NuWriter
			• **Assistant Tools**
			  • Pin Configure
			  • High-Speed IP Calibration
			• **HMI Graphic Tool**
			  • emWin AppWizard

Software Tool	• EVB Schematic, PCB, Gerber File & BOM
	• Approved Vendor List (AVL)
	• Hardware Development Guide
		Sample Code/GitHub	• Nuvoton GitHub
			• **Sample Code**
			  • Example Code
			  • Linux Applications

Document 	• Technical Documents
	• Application Notes
	• User Manuals
		Support	• Forum
			  ▪ NuForum
			  ▪ 牛臥堂

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Overview

MPU Development Process

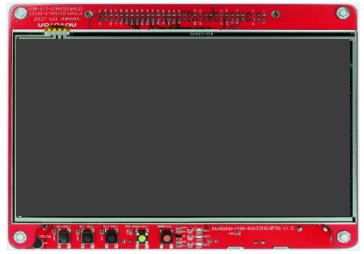
Choose Evaluation Board

Environment Setup

Coding

Program & Burn

NuMaker-HMI-MA35H0-A1



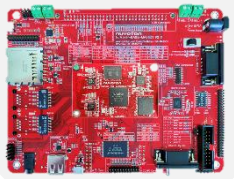
Make an Embedded OS (Image)

Image

VMWare

Ubuntu

Docker



emOS

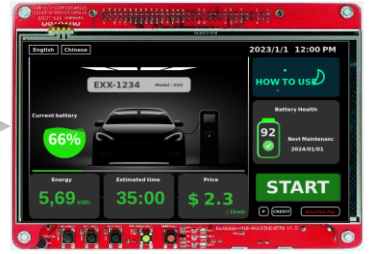
Embedded Operating System (Linux)

Cross compiler

Code

Executable File

NuWriter



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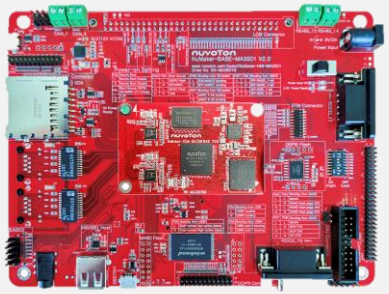
MA35H0 Quick Start

- Make an Embedded Image

What is the Image?



MA35D1

emOS

Embedded Operating System (Linux)

Image

- Boot Loader (uBoot)
- Kernel
- File system (rootfs)

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Overview

- This slide provides instructions on how to quickly build an MA35H0 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

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MPU Quick Start

- Make an Embedded Image

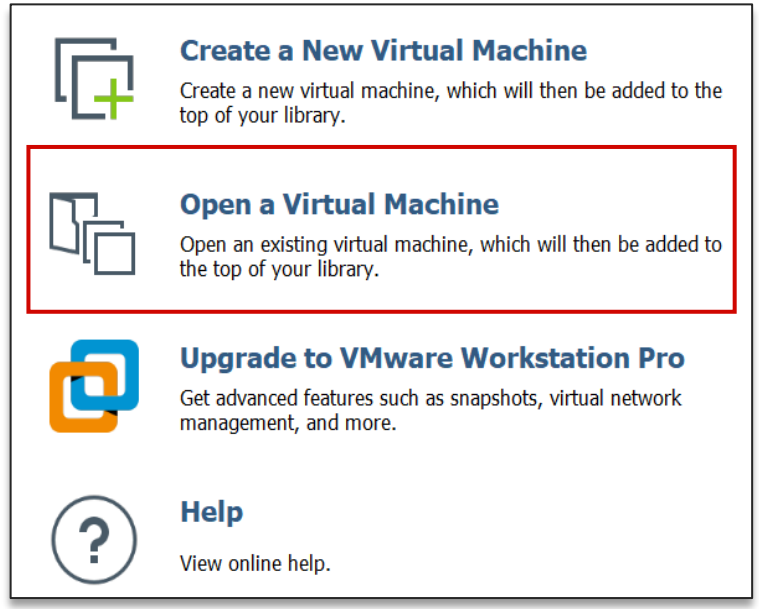
➢ Start up with VMware

- 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



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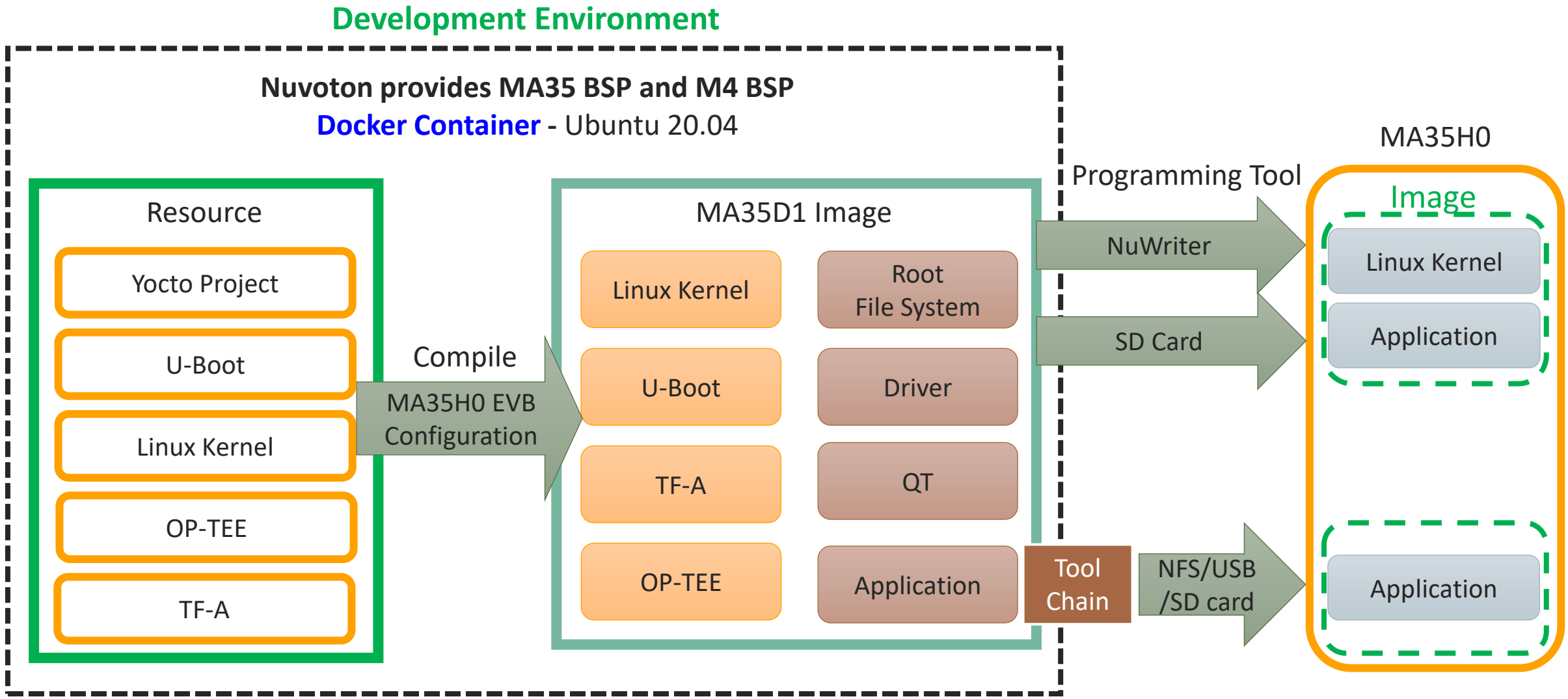
MA35Family Development Scheme



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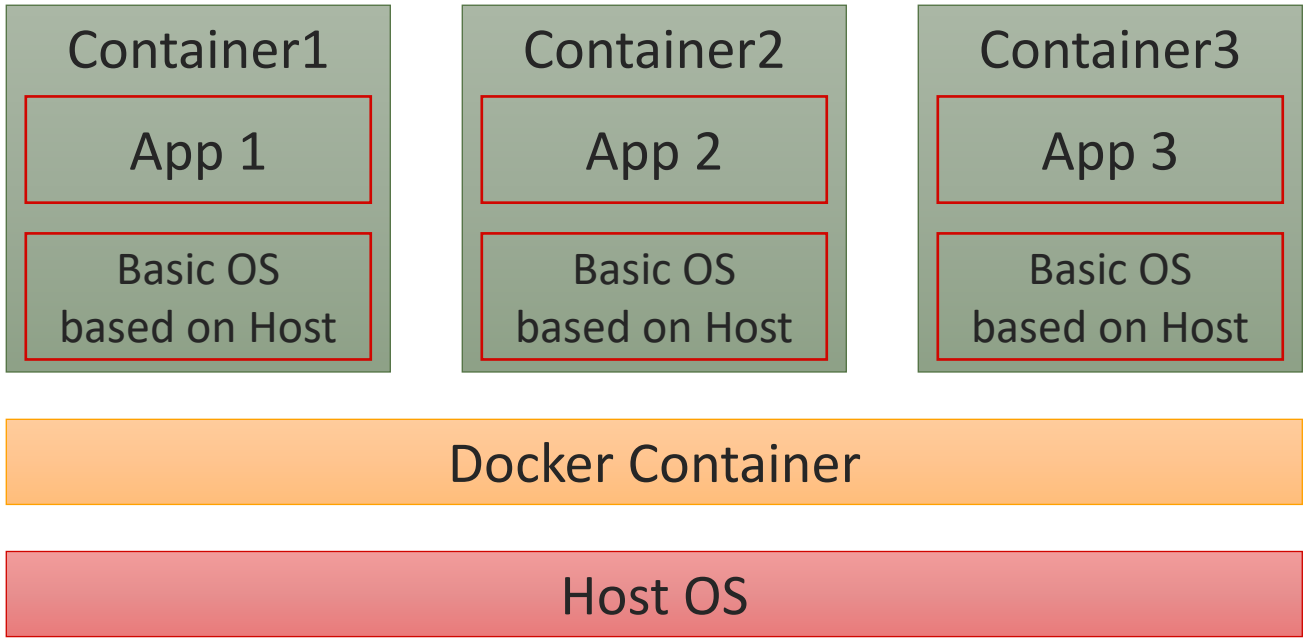
Docker Environment Setup

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



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MA35H0 Quick Start

- Make an Embedded Image

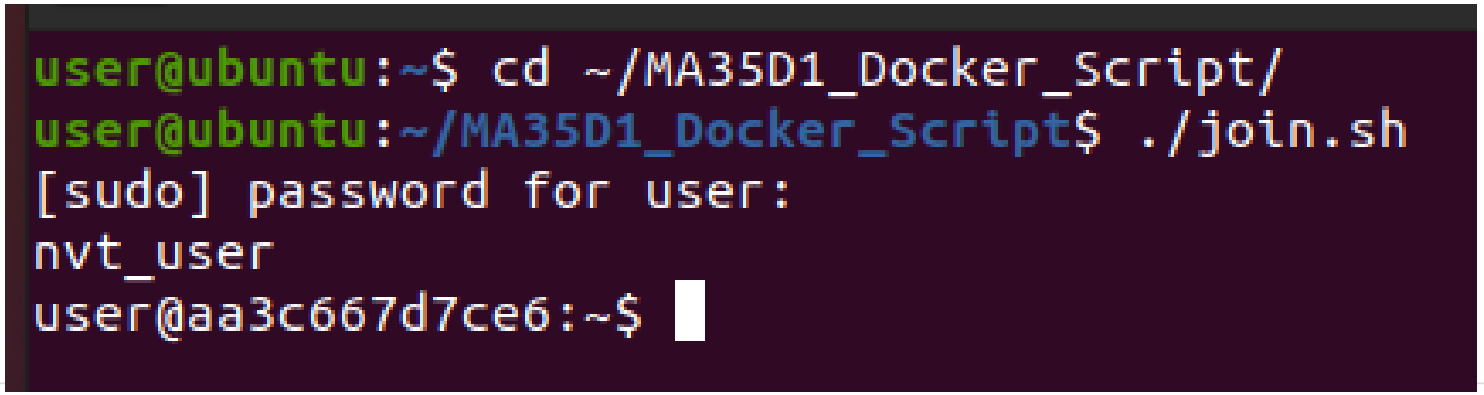
➢ Into to the Docker

Buildroot:

$ cd ~/MA35D1_Docker_Script/

$ ./join.sh

Password: user



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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$
```


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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_hmi_ma35h04f70_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$
```


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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
```


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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
```


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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_LA
RGEFILE64_SOURCE', '-D_FILE_OFFSET_BITS=64', '-Os'@PKG_TARGET_CFLAGS@%g" -e 's%@HOST_DIR@%/home/user/shared/Buildroot/MA35D1_Buildroot/output/hos
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' pa
ckage/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/out
put/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$/s~^.*#~ttyS0::respawn:/sbin/getty -L  ttyS0 0 vt100 #~' /home/user/shared/Buildroot/MA35D1_Buildroot/outpu
t/target/etc/inittab
/usr/bin/sed -i -e '/^#.*-o remount,rw \/$/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$' /home/user/
shared/Buildroot/MA35D1_Buildroot/output/target/etc/shells || echo "/bin/ash" >> /home/user/shared/Buildroot/MA35D1_Buildroot/output/target/etc/s
hells; fi
if grep -q CONFIG_HUSH=y /home/user/shared/Buildroot/MA35D1_Buildroot/output/build/busybox-1.33.1/.config; then grep -qsE '^/bin/hush$' /home/use
r/shared/Buildroot/MA35D1_Buildroot/output/target/etc/shells || echo "/bin/hush" >> /home/user/shared/Buildroot/MA35D1_Buildroot/output/target/et
c/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/ou
tput/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/aarch6
4-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
```


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Building Finishing

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

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

- The core-image-buildroot-ma35h0-hmi-128m.rootfs.sdcard can be used to directly program to an SD card
- Alternatively, pack-core-image-buildroot-ma35h0-hmi-128-sd.bin can be used to program an SD card through NuWriter

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MA35Family 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

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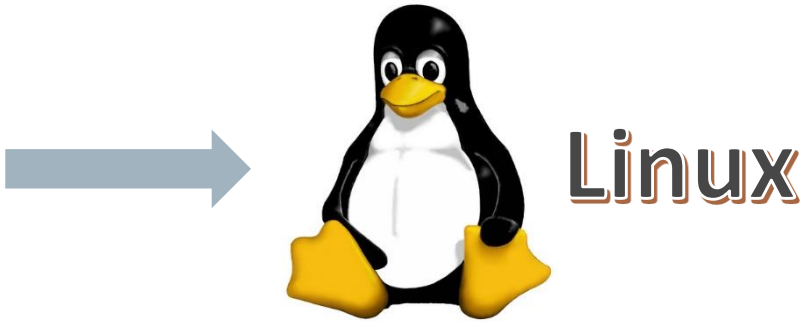
MA35H0 Kernel Development Tools

Development Tool
OpenWRT
Yocto Project
Buildroot
RT-Thread/env



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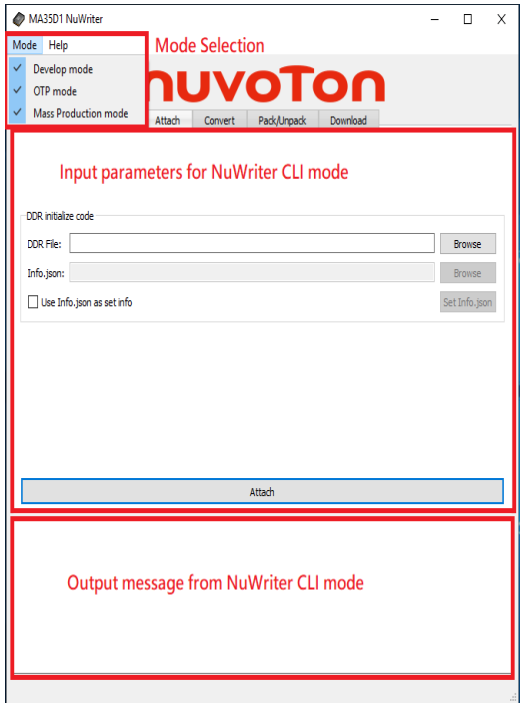
Programming

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



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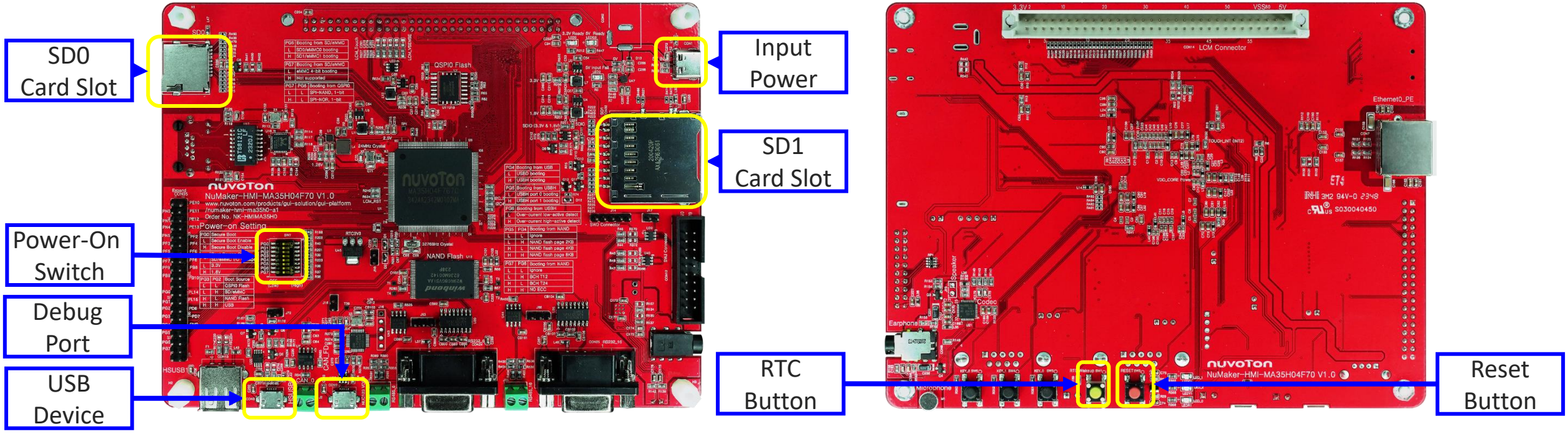
Evaluation Board Introduction

- 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



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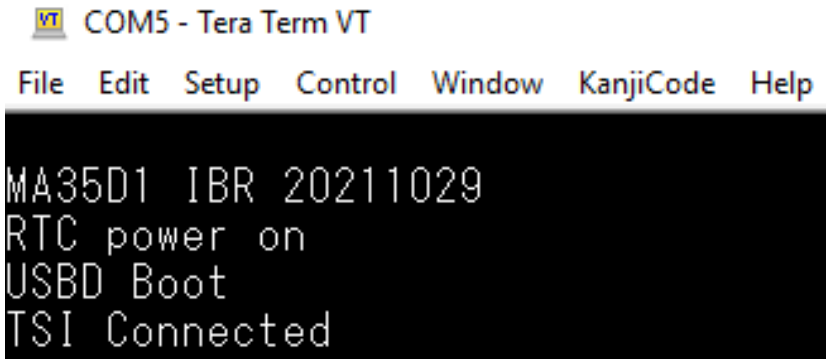
Start Programming

- 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



Noted: It indicates MA35D1 IBR 20211029 since MA35H0 utilizes the same bootloader code

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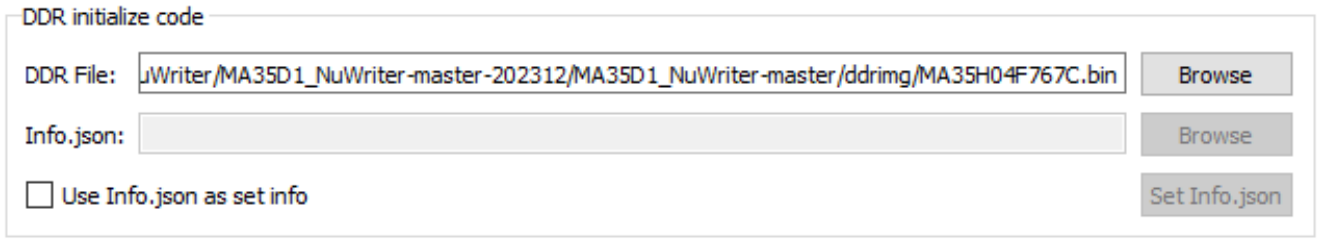
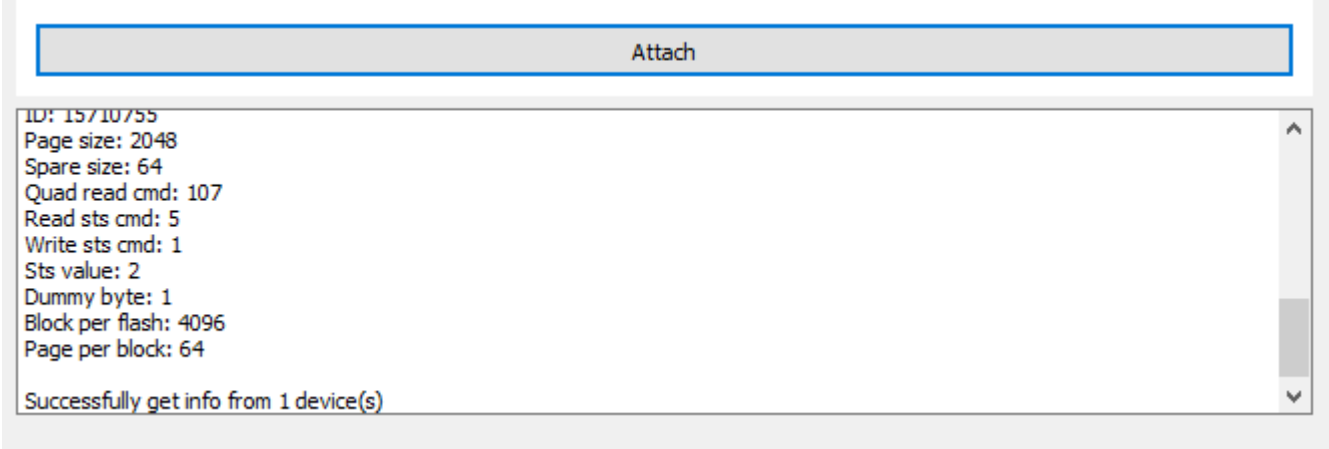
NuWriter Programming

- Choose DDR file ddrimg/MA35H04F764C.bin



- Click Attach button, you will see the message below



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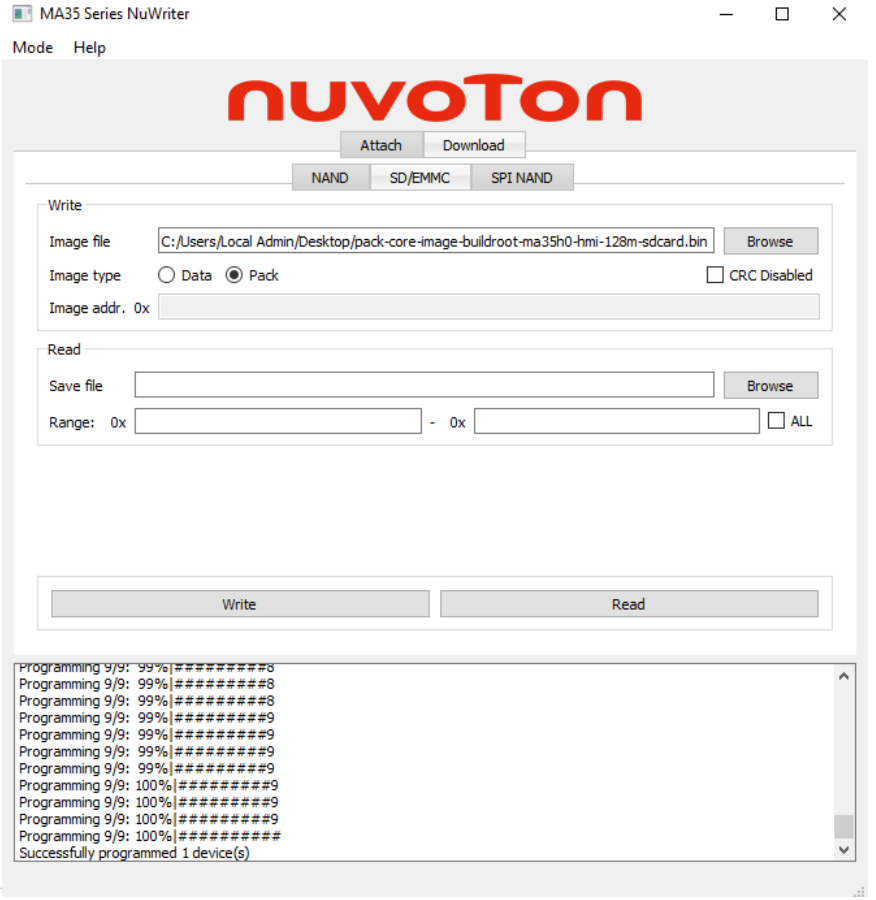
NuWriter Programming

- Switch to Download and choose SD/EMMC
- Browse pack-core-image-buildroot-ma35h0-hmi-128m-sdcard.bin
- Enable Pack mode
- Click write button to start programming



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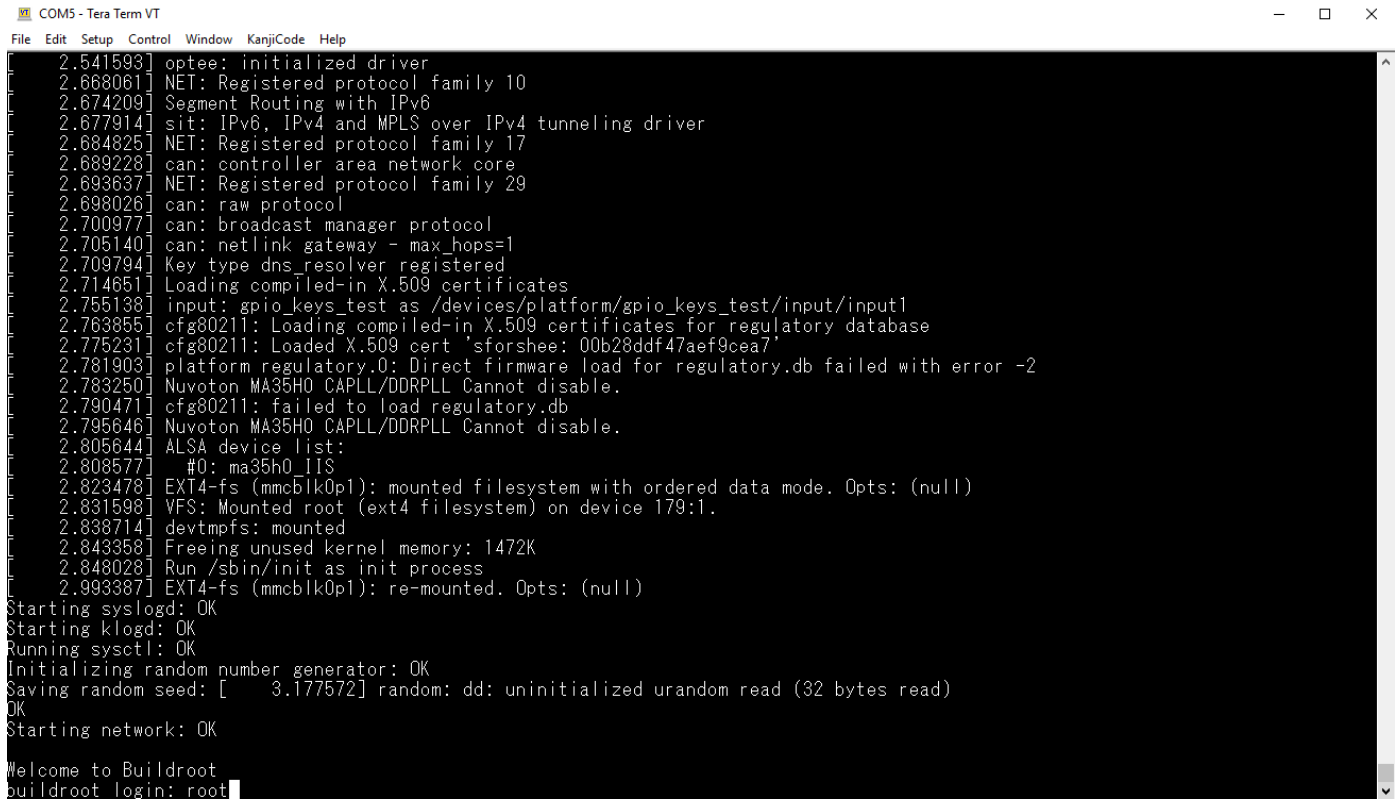
System Boot

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



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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_hmi_ma35h04f70_defconfig
```

  - Start to compile

```
$ make
```

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MA35H0 RAM Status

- MA35 series available ram size table

	MA35H0 (128 MB)	MA35D1 (256 MB)
Yocto (Linux with systemd)	24 MB	92 MB
Buildroot(Linux with busybox)	47 MB	116 MB

- MA35 series reserved part of memory for video decoding and display buffer
- output/build/linux-custom/arch/arm64/boot/dts/nuvoton/ma35h0-hmi-128m.dts

```
reserved-memory {
        display_buf: display_buf@0 {
                reg = <0x0 0x84FF0000 0x0 0x1010000>; /* 17MiB */
                no-map;
        };
        vc8k_buf: vc8k_buf@0 {
               reg = <0x0 0x86000000 0x0 0x1800000>; /* 24MiB */
                no-map;
        };
};
```

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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