Freescale Semiconductor
User's Guide

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i.MX Development Tools

i.MX1/L/S and i.MX21

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1 Abstract

Installing development tools is the basis for beginning a new software project. While Freescale provides documentation on the website for all BSPs and toolchains, this may not be helpful to new developers who are inexperienced in building and installing tools. This document aims to unify this information in a single document that beginners can use to start their i.MX projects with less difficulty.

This document describes the Linux development tools installation procedure as well as both the Linux and WinCE image flashing procedure for the i.MX1/L/S and the i.MX21 processors.

Contents

2 i.MX1/L/S Platform

2.1 Linux Kernel

There are two different BSP versions for i.MX1/L/S platforms. Which one to use on an MX1/L ADS board depends on the tag that is written on the chip. Note that

there is no i.MXS ADS board. As i.MXS is a subset of i.MXL, users should use an i.MXL ADS board for i.MXS development.

Follow the rule below to choose the correct BSP to download:

Table 1. BSP Versions for i.MX1/L

ADS Version	Freescale BSP	Download
i.MX1/L REV A (1.1)	BSP 0.3.6	www.freescale.com/imx i.MX1 or i.MXL link Linux_BSP_0_3_6
i.MX1/L REV B (2.0)	BSP 0.3.8	www.freescale.com/imx i.MX1 or i.MXL link Linux_BSP_0_3_8

2.1.1 Installing Toolchain

The commands must be typed in this order:

1. Copy armLinuxToolchain.tar.gz and glibc2.1.3.tar.gz to /usr/local
2. cd to /usr/local
3. tar –xzf armLinuxToolChain.tar.gz
4. tar –zxvf glibc2.1.3.tar.gz
5. rm –rf arm-elf-linux/lib
6. cp –R arm/gnu/release/arm-linux/lib arm-elf-linux/
7. rm glibc2.1.3.tar.gz

2.1.2 Installing Kernel

1. Download the tar file from kernel.org or use the one included in BSP/kernel/source
2. Unzip kernel with the command “tar -xjf <linux-kernel-name>.tar.bz2”
3. Copy the patches in BSP/kernel/source to the “linux” directory created in Step 2 then “cd” into “linux”
4. Apply the ARM-Linux patch with “patch -p1 < patch-2.4.18-rmk4”
5. Apply the BSP patch with “patch -p1 < patch-2.4.18-rmk4-mx1bsp0.3.6”
6. “cp save.config .config”
7. Select the packages to be built with the command “make config” and press <ENTER> for all options (unless you would like to change the default configuration)
8. ALTERNATIVE: there is a graphic configuration app. Type the command “make menuconfig”
9. “make dep; make clean;”
10. To create image in BIN format, “make boot”
11. ALTERNATIVE: To create image in zImage format: “make zImage”; in bzImage format, “make bzImage”.
12. The resultant kernel image will be generated as “arch/arm/boot/Image”

2.1.3 Flashing Bootloader

1. Configure Hyperterminal to 115200, 8-bit, no parity, 1 stop bit, and no flow control
2. Optional: choose Settings under the File/Properties menu. In ASCII Setup, set “Line delay” to 1 and check the box of “Append line feeds to incoming line ends”
3. Connect either UART to the COM port Hyperterminal is listening to
4. Set the boot mode switch (S22) to all ON for bootstrap mode
5. Power on the ADS
6. Type 'a'. MX1/L will autodetect the baud rate.

   If the board does not respond with ':', please lower the baudrate and try again (*possibly as low as 9600*). You need to reset the ADS after changing the HyperTerminal baudrates, before typing the character ‘a’.
7. Press <ENTER>. The cursor will move to the start of the next line.
8. Select “Transfer/Send Text File” and send BSP/Bootloader/bin/AMDFlash/programBoot_b.txt.

   You will see the program being transferred to the ADS board on HyperTerminal. Please be patient, this step takes a few minutes to complete. **Note:** Linux 0.3.6 path is BSP/Bootloader/bin/programBoot_b.txt.
9. Once the bootloader programmed is transferred, programming will automatically start.

   The messages “Erasing flash...”, “Blank checking...”, “Programming...”, “Verifying flash....”, and “Programming finished” will be displayed one after another to reflect progress during the programming

2.1.4 Flashing Kernel and Root Filesystem

1. Power down the board and set the boot mode switch to ON-OFF-OFF-ON-ON-ON to boot from Flash
2. Power on the ADS
3. Hit <ENTER> as it boots up to enter bootloader menu
4. Choose the appropriate option ('0' for programming bootloader, '1' for programming the kernel image and '2' for programming the rootdisk image) for whatever file you would like to load.

   In the Linux 0.3.8 BSP:

   a) The bootloader is at mx1_Linux_0.3.8\Bootloader\bin\AMDFlash**boot.bin**

   b) The kernel is located at mx1_Linux_0.3.8\Kernel\bin**Image**

   c) The root filesystem is located at mx1_Linux_0.3.8\Rootdisk**rt.cramfs**
5. When “USB drive ready for transfer” is displayed, plug the USB cable into the PC's socket and then connect the other end of the USB cable to the MX1/L board.
6. A new USB removable drive will appear in Windows Explorer. Drag the image (depending on the option chosen in Step 4) to be programmed do this new drive to the USB drive.
7. Right-click on the USB drive and select eject. Make sure the USB drive is deselected or windows will not allow this operation

8. On the console, the message “Press any key to start program...” will be displayed. Press any key to start programming.
9. When the message “Please reset the ADS board…” appears, DO NOT press reset yet. First take the cable off the board and then reset it.

2.2 WinCE

The WinCE image is available on Freescale website, at www.freescale.com/imx i.MX1 or i.MXL link WCE420_BSP_MX1MXL12_REL210_BIN.

2.2.1 Flashing Image to the Board

1. Copy the mx1flash utility (mx1flash.exe and mx1flash.dat) onto your local drive, e.g. C:\flash
2. Copy binary that you want to flash, i.e. Eboot.nb0 and nk.nb0, into mx1flash utility drive. This flash utility is available from the i.MX1/L ADS website. Download the version appropriate to the version of your ADS board.
3. Change to bootstrap mode of ADS board, by setting the jumper settings for switch S22 to the following: ON-ON-ON-ON-ON-ON and enable UART1 by setting the switch S1 – UART to ON.
4. Reset the board
5. Plug one end of the serial cable into the UART1 serial port of the ADS board and the other to any of the COM ports in your workstation.
6. Open Windows Command Prompt (from Windows Start -> Run -> Open, type: cmd.exe).

   The following is the command parameter of mx1flash for MX1/L ADS v2.0:

   mx1flash <COM Port #> 8800000 10000000 <file name>

   For MX1/L ADS v1.0-1.2, the command is as follows:

   ```
   mx1flash <COM Port #> 08800000 0C000000 <file name>
   ```

Example 1. Command Line Text

The binary to be flashed is Eboot.nb0 and located at C:\flash (from step 1) and COM1 of workstation is used. Command line text is as follows:

```
C:\FLASH>mx1flash 1 8800000 C000000 Eboot.nb0
MX1 SyncFlash Programming Utility
Connecting to ADS board...
Loading flashing code...
Loading image...
File size is:  131072 bytes
Loading Eboot.nb0
to address 0x08800000
Bytes Xfered:  131072
Transfer complete!
Flashing in progress....
Erase All completed.
Erase OK.
Flash operation completed.
Validating Data ……
Flash Successfully completed.
```

Eboot, the WinCE bootloader, is built in to the nk.nb0 image, so users wishing to load the WinCE demo image should load nk.nb0 into Flash.

Once flashing is complete, users of version 2.0 boards with AMDFlash should power down the board and set the boot switches to ON-OFF-OFF-ON-ON-ON. Upon power-on, WinCE should load on the QVGA LCD panel.

Users of version 1.0-1.2 boards with SyncFlash should power down the board and set the boot switches to ON-OFF-ON-ON-ON-ON. Upon power-on, WinCE should load on the QVGA LCD panel.

3 i.MX21 Platform

3.1 Linux

For i.MX21 projects, there are two recommended Linux options, depending on the developer's Linux skills. PCS (Platform Creation Suite) is a useful tool to build a kernel with drivers. The Freescale BSP is recommended to experienced developers as it is not as user-friendly as PCS. Both files are downloadable from the Freescale i.MX21 website.

3.1.1 Developing with the Freescale BSP

The BSP provided from Freescale is downloadable from the link www.freescale.com/imx i.MX21 LINUX_IMX21_TO3_REL3_2.TAR.BZ2. This image refers to BSP version TO3.2, which applies to all i.MX21 chip versions.

The Toolchain for this BSP is available in the link www.freescale.com/imx i.MX21 IMX21_LINUX_BSP_GNU_TOOLCHN. The Toolchain should be installed before the BSP files.

3.1.1.1 Installing Toolchain

The Toolchain file contains the ARM and X86 libraries and compilers as well as the ARM QT and QTopia tools. The installation procedure in a Linux hosted machine should be as follows:

1. Extract files from the downloaded .zip file
2. change to root user
3. backup and clear the /usr/local and its sub-directories
4. copy <arm-linux-toolchain-name>.tar.gz and glibc2.1.3.tar.gz to /usr/local
5. cd /usr/local
6. tar zxvf usr-local-gcc.tar.gz
7. tar zxvf usr-local-arm-kernel-headers.tar.gz
8. tar zxvf usr-local-qtopia.tar.gz
9. tar zxvf usr-local-arm-gcc.tar.gz
10. tar zxvf usr-local-arm-qtopia.tar.gz
11. edit /etc/ld.so.conf and put /usr/local/lib at the top

12. run ldconfig -v
13. change to the developer user
14. export:
    PATH=$PATH:/usr/local/bin:/usr/local/arm/bin:/usr/local/qtopia/bin:/usr/local/arm/qtopia/bin
15. tar -zxvf glibc2.1.3.tar.gz (C libraries installation)
16. rm -rf arm-elf-linux/lib
17. cp -R arm/gnu/release/arm-linux/lib arm-elf-linux/.

3.1.1.2 Installing Kernel

The steps suggested from the BSP Release Note are:

1. Unzip kernel with the command “tar -xjf <linux-version-name>.tar.bz2”, where <linux-version-name> should be replaced with the name of the downloaded linux file.
2. Copy the patches in BSP/kernel/source to the “linux” directory created in Step 2 then “cd” into “linux”
3. Apply the BSP patch with “patch -p1 < patch-2.4.20-freescale-mx21”
4. “cp mx2.config .config”.
5. “make config” and press <ENTER> for all options (unless you would like to change the default configuration)

   ALTERNATIVE: there is a graphic configuration app. Type the command “make menuconfig”
6. “make dep; make clean;”

   The resultant kernel image can be generated to two types of image file. You may do either one step to get the image file. Both are different only in size.
7. To create image in BIN format, “make boot”

   ALTERNATIVE: To create image in zImage format: “make zImage”; in bzImage format, “make bzImage”.
8. The resultant kernel image will be generated as “arch/arm/boot/Image”

NOTE

Implementation Hint: to change kernel configurations, compile the original source code first, without previous changes. Because of dependencies, it might get difficult to know which options should be set. Run “make menuconfig” and Exit saving configurations (do not make the changes at first!). Do “make boot” or “make zImage”. After succeeding, slowly choose the new options, and compile it in different steps.

3.1.1.3 Flashing Bootloader

The bootloader can be flashed using the MX21 HAB Toolkit application which loads images to memory via serial or USB communication.

To use this tool, install it from the CD that comes with the board. A complete PDF documentation is included with the tool which details installation steps. A User's Guide is also included with the HAB Toolkit.

NOTE

There are different versions of the HAB toolkit for each silicon tapeout. The TO2 HAB toolkit is available as a stand-alone download from the MX21 website. The TO3 HAB Toolkit is bundled with the WinCE BSP download.

The following instructions will direct you in this process of successfully flashing the bootloader using the HAB Toolkit:

1. On Switch 2 on the ADS board, set switch Boot0-Boot1-Boot2-Boot3 to ON-ON-ON-ON.
2. Power on the ADS board (make sure USB is connected).
3. Open the HAB Toolkit. To verify the USB is connected, you will see the USB box on the top left is checked.
4. Under *"Type of Operation",* check **Flashing**.
5. Click **Browse** and locate the **AMDBoot.bin** binary file. The bootloader is located in the Linux BSP at Binary\AMDBoot.bin
6. Click **Open**, and then click **Execute.**
7. After flashing is complete, Power OFF ADS board and exit HAB Toolkit. On Switch 2 on the ADS board, set Boot0-Boot1-Boot2-Boot3 to ON-OFF-OFF-ON. These switch settings configure the ADS for Run Mode, where the image stored in ROM is immediately jumped to and run on every power reset. The Linux Bootloader load on a hyperterminal connection.

Please refer to the HAB Toolkit User's Guide for further flashing instructions on the i.MX21ADS.

3.1.1.4 Flashing Kernel and Root Filesystem

1. Power off the board and set the boot mode switch to ON-OFF-OFF-ON to boot from NOR Flash
2. Power on the ADS
3. Hit <ENTER> as it boots up to enter bootloader menu
4. Choose the appropriate option ('0' for programming bootloader, '1' for programming the kernel image and '2' for programming the rootdisk image)
5. When "USB drive ready for transfer" is displayed, plug the USB cable into the PC's socket
6. A new USB removable drive will appear in Windows Explorer. Drag the image (depending on the option chosen in Step 4) to be programmed do this new drive to the USB drive
7. Right-click on the USB drive and select eject. Make sure the USB drive is deselected or windows will not allow this operation
8. On the console, the message "Press any key to start program..." will be displayed. Press any key to start programming.
9. When the message "Please reset the ADS board…" appears, DO NOT press reset yet. First take the cable off the board and then reset it.

3.2 WinCE

There are a few WinCE images available on Freescale website, in the link www.freescale.com/imx i.MX21:

- IMX21_DEMO_WCE500_RTM_6 (WinCE 5.0)
- IMX21_DEMO_WCE500_RTM_4-1 (WinCE 5.0)
- WCE420_BSP_MX21_TO3_REL300_BIN (WinCE 4.2)

It is recommended to use the latest RTM6 version for the latest silicon. RTM 4-1 applies to mask M55B and 1M55B silicon.

3.2.1 Flashing Image to the Board

Two tools can be used to flash a WinCE image: HAB Toolkit and EBOOT. This section describes the procedures for flashing, downloading and debugging OS images on the MX21 ADS board. It is assumed that you have followed the steps to build an OS image and configured your development hardware prior to attempting a download and debug session.

3.2.1.1 Flashing an OS Image using HAB Toolkit

This section will discuss how to use HAB Toolkit to flash a WinCE image. First of all, we only use HAB Toolkit after we have built our binary flash “image” files using Platform Builder. Second we must configure the board, power it on, and then flash to the NOR flash.

The following instructions will direct you in this process of successfully flashing an image.

1. Build a binary flash “image” file using Platform Builder. You may also use the pre-built image that comes with the DEMO WinCE downloads available from the Freescale i.MX21 website.
2. On Switch 2 on the ADS board, set switch Boot0-Boot1-Boot2-Boot3 to ON-ON-ON-ON.
3. Power on the ADS board (make sure USB is connected).
4. Open the HAB Toolkit. To verify the USB is connected, you will see the USB box on the top left is checked.
5. Under *“Type of Operation”,* check **Flashing**.

   Click **Browse** and locate your **nk.nb0** binary flash “image” file.
6. Click **Open**, and then click **Execute.**
7. After flashing is complete, Power OFF ADS board and exit HAB Toolkit. On Switch 2 on the ADS board, set Boot0-Boot1-Boot2-Boot3 to ON-OFF-OFF-ON. These switch settings configure the ADS for Run Mode, where the image stored in ROM is immediately jumped to and run on every power reset. The WinCE operating system should load on the QVGA LCD.

NOTE

This is a basic reference to be used as a quick start guide. For any questions and difficulties that may occur during flashing of the WinCE image, please refer to the User’s Guide provided by Freescale in the .zip file.

Appendix A
Reported Errors

The intent of this Appendix is to create a list of known errors to make development faster and easier.

Problem 1:

ARM-LINUX compiler not found: the PATH variable is not correctly set.

```
arm-linux-gcc: cannot find file or directory or similar message
```

Solution 1:

The following command sets the compiler path to the environment variables.

```
>set
PATH=$PATH:/usr/local/bin:/usr/local/arm/bin:/usr/local/qtopia/bin:/usr/local/arm/qtopia/bin
```

Problem 2:

ARM-ELF-COMPILER-GCC Installation error: this error indicates conflict between already installed compiler tools.

`cc: cannot find file or directory` or similar message

Solution 2:

- Backup and delete all filed referred to Toolchain installation, placed in folder /usr/local
- Reinstall Toolchains

In case this procedure does not stop error messages, it will be necessary to reinstall all available C compilers packages (RPM) to the Linux distribution you are working with.

Problem 3:

Error when running ARM patches: the patches were already installed once.

```
Hunk #1 FAILED at 791.
1 out of 1 hunk FAILED -- saving rejects to file kernel/sys.c.rej patching file lib/string.c
```

Solution 3:

If you really want to run the patches that are apparently already installed in your machine, it will be necessary to delete folder <BSP>/Kernel/source/linux, untar it again from <BSP>/Kernel/source/linux.tar.gz and run patches following the instructions.

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