

# Release Notes for the QNX Neutrino 6.4.1 BSP for Freescale i.MX53 EVK#

## System requirements#

### Target system

- QNX Neutrino RTOS 6.4.1

### Host development system

- QNX Momentics 6.4.1
- Terminal emulation program (Qtalk, Momentics IDE Terminal, tip, HyperTerminal, etc.)
- RS-232 serial port or a USB-to-serial adapter, and a straight-through serial cable
- Ethernet link

## System Layout#

The tables below depict the memory layout for the image.

### Memory layout

| Item               | Address    |
|--------------------|------------|
| OS image loaded at | 0x90100000 |

The interrupt vector table can be found in the buildfile located at **src/hardware/startup/boards/mx53evk/build**

## Getting Started#

### Starting Neutrino#

#### Step 1: Build the BSP

You can build a BSP OS image from the source code. For instructions about building a BSP OS image, please refer to the chapter Working with a BSP in the Building Embedded Systems manual.

- When compiling using the command line, the ifs image is in the **images** directory.
- When compiling using the IDE, the IFS image is by default at **/workspace\_root\_dir/bsp-freescale-mx53evk-src/images**.

#### Step 2: Connect your hardware

1. Set up the i.mx53 EVK board in boot mode. Refer to the manual for the correct default jumper settings to use the CPU board.
2. Connect one end of the serial cable to the P5A1 (UART) serial port on the CPU board.
3. Connect the other end of the serial cable to the first available serial port of your host machine (e.g. ser1 on a Neutrino host).

On your host machine, start your favorite terminal program with these settings:

- Baud: 115200

- Bits: 8
- Stop bits: 1
- Parity: none

Then, apply power to the target. You should see output similar to the following:

```
U-Boot 2009.08 (Mar 29 2010 - 04:22:30)
```

```
CPU: Freescale i.MX53 family 1.0V at 800 MHz
```

```
mx53 pll1: 800MHz
```

```
mx53 pll2: 600MHz
```

```
mx53 pll3: 216MHz
```

```
ipg clock : 600000000Hz
```

```
ipg per clock : 500000000Hz
```

```
uart clock : 216000000Hz
```

```
cspi clock : 540000000Hz
```

```
ahb clock : 1200000000Hz
```

```
axi_a clock : 3000000000Hz
```

```
axi_b clock : 2000000000Hz
```

```
emi_slow clock: 2000000000Hz
```

```
ddr clock : 3000000000Hz
```

```
esdhc1 clock : 1200000000Hz
```

```
esdhc2 clock : 1200000000Hz
```

```
esdhc3 clock : 1200000000Hz
```

```
esdhc4 clock : 1200000000Hz
```

```
Board: MX53 EVK 1.0 [POR]
```

```
Boot Device: SD
```

```
I2C:In: serial
```

```
Out: serial
```

```
Err: serial
```

```
Net: FEC0 [PRIME]
```

```
Hit any key to stop autoboot:
```

### Step 3: Boot the IFS image

#### SD Card Initialization#

You will need a properly formatted SD card to boot the MX53. First, U-boot must be installed onto the card. To do this, you will need to download a Linux BSP image release from the Freescale website. As of this writing the most current file is L2.6.31\_10.05.02\_ER\_images\_MX5X.tar.gz. Once you have the BSP images extracted, change into the root directory of the BSP and execute the following command to get U-boot onto the SD card:

```
dd if=u-boot-mx53.bin of=/dev/X bs=512 && sync && sync
```

Replace the X with what your system assigns to the SD device. You can find this information with the dmesg command.

Note that the dd command will delete the partition table on the card. A filesystem is not required to boot, but if you would like one you scroll down to the later section and follow the instructions there.

Now, to get the raw OS image onto the SD card, navigate to your QNX bsp images directory, and execute the command

```
sudo dd if=ifs-mx53evk.raw of=/dev/X bs=512 seek=2048 && sync && sync
```

Again, replacing the 'X' with the proper value. Insert the SD card in the top MMCSD port on the target board and apply power to the board. After U-boot is started, you can change a few environment variables to enable automatic booting. At the U-boot prompt, execute the following commands:

```
set bootcmd_qnx 'mmc read 0 0x90100000 0x800 0x3800;go 0x90100000'
set bootcmd 'run bootcmd_qnx'
```

After these commands have been executed, use the **print** command to verify that they have been set properly and then the **save** command to save them to the memory card. Now, execute **boot** or reset the target board to attempt to boot into QNX.

If the image is successfully loaded U-Boot will display:

```
## Starting application at 0x90100000
```

You also should see QNX Neutrino boot, followed by the welcome message on your terminal screen:

```
CPU0: L1 Icache: 512x64
CPU0: L1 Dcache: 512x64 WB
CPU0: L2 Dcache: 4096x64 WB
CPU0: VFP 410330c2
CPU0: 412fc085: Cortex A8 rev 5 800MHz
fec_disable
init_hwinf
mx51_init_i2c
mx51_aud_mux_init
mx51pdk_fec_init
mx51_usb_host_init
mc51_init_esdhcv2
mx51_cspi_mux_init
init_audio

System page at phys:70011000 user:fc404000 kern:fc404000
Starting next program at vfe044e74
cpu_startnext: cpu0 -> fe044e74
VFPv3: fpsid=410330c2
coproc_attach(10): replacing fe066c84 with fe066444
coproc_attach(11): replacing fe066c84 with fe066444
Welcome to QNX Neutrino 6.4.1 on the i.MX53 EVK (ARM Cortex-A8 core) Board
Starting on-board ethernet with TCP/IP stack...
Getting network address with DHCP...
fec0: flags=843<UP,BROADCAST,RUNNING,SIMPLEX> mtu 1500
    address: XX:XX:XX:XX:XX:XX
    media: Ethernet autoselect (100baseTX full-duplex)
    status: active
    inet xxx.xxx.xxx.xxx netmask 0xfffff000 broadcast xxx.xxx.xxx.xxx
#
```

You can test the OS simply by executing any shell builtin command or any command residing within the OS image (e.g. **ls**).

### Getting a filesystem onto the SD Card#

You can use fdisk to put a filesystem on your SD card as follows:

```
fdisk -l
```

Read through the output until you find the section on the connected SD card, which should look something like this:

```
Disk /dev/sdd: 1967 MB, 1967128576 bytes
61 heads, 62 sectors/track, 1015 cylinders
Units = cylinders of 3782 * 512 = 1936384 bytes
```

Sector size (logical/physical): 512 bytes / 512 bytes  
I/O size (minimum/optimal): 512 bytes / 512 bytes  
Disk identifier: 0x00000000

Disk /dev/sdd doesn't contain a valid partition table

The line we are interested in is

Units = cylinders of 3782 \* 512 = 1936384 bytes

We will use the number of cylinders (in this case, 3782) to calculate the start cylinder of the filesystem. Note that since U-boot and the QNX image are stored in the first 4 megabytes, the filesystem must start after that. First, divide the number of cylinders into 8192 ( $8192/3782 = 2.166049\dots$ ). Then round that number up to the nearest whole number (2.166049 rounded up = 3). Last, add 1 ( $3 + 1 = 4$ ). So in this case, the start cylinder for the filesystem will be cylinder #4.

Now we can use fdisk to create a new partition. Do the following commands

```
fdisk /dev/sdd
```

```
Device contains neither a valid DOS partition table, nor Sun, SGI or OSF disklabel
Building a new DOS disklabel with disk identifier 0x1a249dd3.
Changes will remain in memory only, until you decide to write them.
After that, of course, the previous content won't be recoverable.
```

```
WARNING: DOS-compatible mode is deprecated. It's strongly recommended to
switch off the mode (command 'c') and change display units to
sectors (command 'u').
```

```
Command (m for help): n
Command action\
  e   extended
  p   primary partition (1-4)
p
Partition number (1-4): 1
First cylinder (1-1015, default 1): 4
```

Note that the '4' entered here is the number we calculated earlier. Substitute in your own calculated value.

```
Last cylinder, +cylinders or +size{K,M,G} (4-1015, default 1015):
```

Hit enter here to use the default value.

```
Using default value 1015
Command (m for help): t
Selected partition 1
Hex code (type L to list codes): c
Changed system type of partition 1 to c (W95 FAT32 (LBA))
```

```
Command (m for help): w
The partition table has been altered!
```

```
Calling ioctl() to re-read partition table.
```

```
WARNING: If you have created or modified any DOS 6.x
partitions, please see the fdisk manual page for additional
information.
Syncing disks.
```

Done now with fdisk, just one last command:

```
mkfs.vfat /dev/sdd1
```

And your filesystem is created.

#### Step 4: Boot the IFS image using QNX IPL

##### Booting using the QNX IPL#

After building the BSP Package, you will find the elf32 executable "ipl-mx53evk" in the folder src/hardware/ipl/boards/mx53evk/arm/le/

Change the directory, to the IPL folder using the following command

```
cd src/hardware/ipl/
```

Convert the elf32 executable to the binary format using the following command

```
ntoarm-objcopy --output-format=binary boards/mx53evk/arm/le/ipl-mx53evk boards/mx53evk/arm/le/ipl-mx53evk.bin
```

Place the SD Card, in which you have to burn the IPL, into the SD Slot of the Linux HOST.

Now zero fill the first 10MB of the SD Card (you can fill lesser size also) using the following command

```
sudo dd if=/dev/zero of=/dev/mmcblk0 bs=1M count=10
```

Format the SD card using the following command

```
sudo fdisk /dev/mmcblk0
```

After giving the format command to the SD card, give the following Command Options

```
Device contains neither a valid DOS partition table, nor Sun, SGI or OSF disklabel
Building a new DOS disklabel with disk identifier 0xa17f8c2d.
Changes will remain in memory only, until you decide to write them.
After that, of course, the previous content won't be recoverable.
```

```
Warning: invalid flag 0x0000 of partition table 4 will be corrected by w(rite)
```

```
WARNING: DOS-compatible mode is deprecated. It's strongly recommended to
switch off the mode (command 'c') and change display units to
sectors (command 'u').
```

```
Command (m for help): p
```

```
Disk /dev/mmcblk0: 1977 MB, 1977614336 bytes
4 heads, 16 sectors/track, 60352 cylinders
Units = cylinders of 64 * 512 = 32768 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0xa17f8c2d
```

| Device | Boot | Start | End | Blocks | Id | System |
|--------|------|-------|-----|--------|----|--------|
|--------|------|-------|-----|--------|----|--------|

```
Command (m for help): n
```

```
Command action
```

```
  e  extended
```

```
  p  primary partition (1-4)
```

p  
Partition number (1-4): 1  
First cylinder (1-60352, default 1): 100  
Last cylinder, +cylinders or +size{K,M,G} (100-60352, default 60352): 60352

Command (m for help): a  
Partition number (1-4): 1

Command (m for help): t  
Selected partition 1  
Hex code (type L to list codes): c  
Changed system type of partition 1 to c (W95 FAT32 (LBA))

Command (m for help): p

Disk /dev/mmcblk0: 1977 MB, 1977614336 bytes  
4 heads, 16 sectors/track, 60352 cylinders  
Units = cylinders of 64 \* 512 = 32768 bytes  
Sector size (logical/physical): 512 bytes / 512 bytes  
I/O size (minimum/optimal): 512 bytes / 512 bytes  
Disk identifier: 0xa17f8c2d

| Device         | Boot | Start | End   | Blocks  | Id | System          |
|----------------|------|-------|-------|---------|----|-----------------|
| /dev/mmcblk0p1 | *    | 100   | 60352 | 1928096 | c  | W95 FAT32 (LBA) |

Command (m for help): w  
The partition table has been altered!

Calling ioctl() to re-read partition table.

WARNING: If you have created or modified any DOS 6.x  
partitions, please see the fdisk manual page for additional  
information.  
Syncing disks.

Create a FAT32 filesystem, on the formatted SD Card, using the following command

```
sudo mkfs.vfat -F 32 /dev/mmcblk0p1
```

Now Burn the IPL, to the raw partition of the formatted SD Card, using the following command

```
sudo dd if=boards/mx53evk/arm/le/ipl-mx53evk.bin of=/dev/mmcblk0 skip=2 seek=2 bs=512 && sync && sync
```

Copy the images/ifs-mx53evk.raw, which was built in the BSP package, to the SD card's Mounted partition (mmcblk0p1) and rename it to "QNX-IFS" (As the IPL needs the file to be named as "QNX-IFS")

Now place the SD card, in to the SD/MMC slot of the iMX53 target and apply power to the board. The target runs the IPL as below and waits for the command 'M' to boot the QNX IFS image. After giving the 'M' command, it boots the QNX IFS image as below:

```
Welcome to QNX Neutrino Initial Program Loader for Freescale iMX53 Board
Command:
Press 'M' for SDMMC download, file QNX-IFS assumed.
Load QNX image from SDMMC...
Found image          @ 0x80800008
Jumping to startup    @ 0x90100660

CPU0: L1 Icache: 512x64
CPU0: L1 Dcache: 512x64 WB
```

```
CPU0: L2 Dcache: 4096x64 WB
CPU0: VFP 410330c2
CPU0: 412fc085: Cortex A8 rev 5 800MHz

System page at phys:70011000 user:fc404000 kern:fc404000
Starting next program at vfe044e74
cpu_startnext: cpu0 -> fe044e74
VFPv3: fpsid=410330c2
coproc_attach(10): replacing fe066c84 with fe066444
coproc_attach(11): replacing fe066c84 with fe066444
Welcome to QNX Neutrino 6.4.1 on the i.MX53 EVK (ARM Cortex-A8 core) Board
Starting on-board ethernet with TCP/IP stack...
Getting network address with DHCP...
fec0: flags=843<UP,BROADCAST,RUNNING,SIMPLEX> mtu 1500
    address: 00:04:9f:cc:9a:b5
    media: Ethernet autoselect (100baseTX full-duplex)
    status: active
    inet 10.90.74.70 netmask 0xffffffff broadcast 10.90.74.255
Starting SD1 memory card driver...
Starting SD3 memory card driver...
# Path=0 - FREESCALE MX35 e
target=0 lun=0    Direct-Access(0) - SD:3 SD02G Rev: 8.0
Path=0 - FREESCALE MX35 e

#
```

Driver Command Summary#

The following table summarizes the commands to launch the various drivers.

| Component   | Buildfile Command                                                                                | Required Binaries                             | Required Libraries                    | Source Location                     |
|-------------|--------------------------------------------------------------------------------------------------|-----------------------------------------------|---------------------------------------|-------------------------------------|
| Startup     | startup-mx53evk -d1 -v                                                                           | .                                             | .                                     | src/hardware/startup/boards/mx53evk |
| Serial      | devc-sermx1 -e -F                                                                                | devc-sermx1                                   | .                                     | src/hardware/devc/sermx1            |
| FEC Network | io-pkt-v4 -d mx53 mac=xxxxxxxxxxxx                                                               | io-pkt-v4<br>ifconfig<br>if_up<br>dhcp.client | devnp-mx53.so<br>libsocket.so         | src/hardware/devnp/mx53             |
| SD card     | devb-mmcsd-mx53 mmcsd ioport=0x50004000, irq=1<br>devb-mmcsd-mx53 mmcsd ioport=0x50020000, irq=3 | devb-mmcsd-mx53                               | libcam.so<br>fs-dos.so<br>cam-disk.so | src/hardware/devb/mmcsd             |
| I2C         | i2c-mx35 --u0,0<br>i2c-mx35 --u1,1                                                               | i2c-mx35                                      | .                                     | src/hardware/i2c/mx35               |
| SPI         | spi-master -u1 -d mx51ecspi base=0x50010000, irq=36, waitstate=0, clock=54000000, burst, gpiocsb | spi-master                                    | spi-mx51ecspi.so                      | src/hardware/spi/mx51ecspi          |

|               |                                                                     |                             |                                                                                                          |                                      |
|---------------|---------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------|
| USB           | io-usb -d<br>ehci-mx31<br>ioport=0x53F80300,irq=14                  | io-usb<br>usb<br>usb        | devu-ehci-mx31.so<br>libusbdi.so                                                                         | binary                               |
| CAN           | dev-can-mx35<br>can0 can1                                           | dev-can-mx35<br>canctl*     | .                                                                                                        | src/hardware/<br>can/mx35            |
| Graphics      | io-display -<br>dvid=0,did=0                                        | io-display<br>imx53.conf    | devg-imx51.so<br>devg-soft3d.so<br>libgf.so.1<br>libGLES_CM.so.1<br>libfffb.so.2                         | src/hardware/<br>devg/imx51          |
| WDT           | wtdkick                                                             | wtdkick                     | .                                                                                                        | src/hardware/<br>support/<br>wtdkick |
| SPI DATAFLASH | fs-etfs-imx53<br>-e<br>fs-etfs-imx53<br>-m /fs/etfs                 | fs-etfs-imx53<br>etfsctl    |                                                                                                          | src/hardware/<br>etfs/nand512/       |
| NAND FLASH    | fs-etfs-<br>mx53evk -e<br>fs-etfs-<br>mx53evk -m /<br>nand          | fs-etfs-mx53evk<br>etfsctl  |                                                                                                          | src/hardware/<br>etfs/nand2048/      |
| Audio         | io-audio -<br>d mx-mx53evk<br>ssibase=0x50014000,rate=48000,mixer=0 | io-audio<br>wave<br>mix_ctl | deva-ctrl-mx-<br>mx53evk.so<br>deva-ctrl-mx-<br>mx53evk.so<br>libasound.so.2<br>libdma-sdma-<br>imx53.so | src/hardware/<br>deva/ctrl/mx        |
| DMA           |                                                                     |                             | libdma-sdma-<br>imx53.so                                                                                 | src/lib/dma/<br>sdma                 |

Some of the drivers are commented out in the default buildfile. To use the drivers in the target hardware, you'll need to uncomment them in your buildfile, rebuild the image, and load the image into the board.

Startup, Ethernet, Dataflash, Can, Audio, NAND Flash and Graphics have additional details:

### Startup#

startup-mx53evk [*startup-options*]

Some modules aren't enabled after boot up, so you need to use command line options to startup to enable them. These options must be passed before any other startup options.

| To enable | Use this option | Comment              |
|-----------|-----------------|----------------------|
| WDT       | -W              | Enable WatchDogTimer |

### Ethernet#

io-pkt-v4-hc -d mx53 mac=xxxxxxxxxxxx

MAC address labelled on i.mx53 evk board must be provided with "mac" command line option.

### Dataflash#

Before starting the dataflash driver , spi driver must be started.

To start spi driver run:

```
spi-master -u1 -d mx51ecspi  
base=0x50010000,irq=36,waitstate=0,clock=54000000,burst,gpiocsbases=0x53f8c000,g
```

To erase dataflash run :

```
fs-etfs-imx53 -e
```

To mount etfs filesystem on a mount point run:

```
fs-etfs-imx53 -m /fs/etfs
```

## **CAN#**

There are two CAN interfaces on the i.MX53 EVK board: CAN0 and CAN1 connected to expansion port.

- dev-can-mx35 can0

or can1 if can1 is used or both if both are used.

## **Graphics#**

With the current revisions of the iMX53 EVK (rev B) the VGA output is not supported due to a silicon errata. (ENGcm11165 TVE: TV DAC is not functional - TV DAC is also used for VGA) To run graphics the 'MCIMX51LCD - Hardware Only - i.MX51 WVGA LCD DAUGHTER' from Freescale is required. (see Freescale website for details)

To run the Graphics Driver, please issue the command: `io-display -dvid=0,did=0`

The `display.conf` config file, maps the driver config file `imx53.conf`, to get the output display timing and configuration settings.

## **Accelerated Graphics#**

An archive containing an experimental driver for the GPU ([OpenVG](#) & [OpenGL ES](#)) can be found on the Foundry 27 graphics project:

[http://community.qnx.com/sf/go/projects.graphics/frs.imx51\\_gpu\\_driver](http://community.qnx.com/sf/go/projects.graphics/frs.imx51_gpu_driver)

Please obtain the latest version and follow the corresponding setup instructions.

## **Audio#**

Before starting Audio driver i2c driver must be started.

To start i2c driver run:

```
i2c-mx35 --u1,1
```

```
i2c-mx35 --u0,0
```

To start audio driver run:

```
io-audio -d mx-mx53evk  
ssibase=0x50014000,tevt=25,tchn=3,revt=24,rchn=4,rate=48000,mixer=i2cdev=1:adr0
```

## NAND Flash#

Run

```
fs-etfs-mx53evk -e
```

to erase the NAND device and to create an empty file system that is ready to use. The factory marked bad blocks are not erased. Blocks that become bad during normal use are also skipped during the erasing.

After the erase of the NAND device, run the following command

```
fs-etfs-mx53evk -m /nand
```

This command sets the directory /nand as the mount point.

## Known Issues for This BSP#

- Support for most features is either limited or disabled at this time. These limited features include:
  - Video
- To be determined if these issues remain
  - The audio driver `deva-ctrl-mx-mx53evk.so` doesn't support Synchronous data playback ability since the DMA library doesn't have position information. (Ref# 75488)
  - The i.MX35 (ARM1136) processor doesn't support unaligned accesses in hardware. If an application (e.g. `pwmopts`) tries to access data that isn't aligned on a 32-bit boundary, a bus error will occur. To avoid this memory fault, you can enable the software emulation of unaligned accesses by starting `procnto` with the `-ae` option. (Ref# 71252)