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# Linux BSP for the Freescale i.MX21ADS

User's Guide

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## About This Book

This User Manual provides information on the basic features supported by the BSP and provides you with instructions about how to accomplish these tasks:

- Install the BSP on a host development system..
- Run Linux Target Image Builder (LTIB) to build target images.
- Deploy built images to the i.MX21ADS board.
- Boot Linux on the i.MX21ADS board.

## Audience

This document is addressed to developers who want to take advantage of the Freescale Linux Target Image Builder (LTIB) for the i.MX21ADS Board Support Package (BSP).

## Organization

This document is organized into four chapters.

Chapter 1	An introduction to the i.MX21ADS BSP.
Chapter 2	Basic information on LTIB.
Chapter 3	Target set-up.
Chapter 4	Host and target-specific build and deployment.

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## Conventions

This document uses the following notational conventions:

- Courier monospaced type indicates commands, command parameters, code examples, expressions, data types, and directives.
- Italic type indicates replaceable command parameters.
- All source code examples are in C.

## Definitions, Acronyms, and Abbreviations

The following list defines the abbreviations used in this document.

ATA	Advanced Technology Attachment
BSP	Board Support Package
DPM	Dynamic Power Management
DVFS	Dynamic Voltage Frequency Scaling
LTIB	Linux Target Image Builder
NFS	Network File System
OSS	Open Sound System
RTC	Real Time Clock
TFTP	Trivial File Transfer Protocol
USB	Universal Serial Bus



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# Introduction

## 1.1 LTIB Overview

The Linux Target Image Builder (LTIB) is a tools framework used to manage, configure, extend and build Linux software elements to easily build a Linux target image and a root filesystem. LTIB runs on an x86 PC running the Linux OS.

The host development system used to run LTIB requires:

- Ethernet card
- Serial port
- 1 gigabyte of free disk space
- NFS Server
- TFTP Server
- rsync
- perl

**NOTE:** Be aware that some host side packages may not function properly on every Linux distribution. The following are platforms on which LTIB has been tested.

- Redhat: 7.3, 8.0, 9.0
- Fedora Core: 1, 2, 3
- Debian: 3.1r0 (stable), unstable
- SuSE: 8.2, 9.2, 10.0

## 1.2 BSP Overview

Once this LTIB BSP is installed and running with its basic configuration, you can use LTIB to customize your i.MX21ADS system with additional features.

The BSP components provide the tools, device drivers, and additional features needed for your embedded Linux project.

Kernel Features:

- Linux-2.4.20 CELF kernel
- Loadable modules
- UART 1 at 115200 baud
- Framebuffer, LCD panel
- Keypad
- TV-OUT VGA, NTSC, PAL
- Ethernet
- Touchscreen
- iMagic IM8012 camera

- 
- Video4Linux: Pre-Processing support, SDC, ADC, iMagic Camera
  - I2C
  - Video Post-Processing
  - Video Pre-Processing
  - OSS
  - USB OTG (limited)
  - USB Host: Mass Storage, Ethernet, HID devices
  - Power Management
  - Battery Gauge
  - NAND Boot, MTD
  - NOR Boot, MTD
  - CodeTEST kernel support
  - Real Time Clock
  - Watchdog
  - PCMCIA
  - Hantro

blob version 2.0.5\_pre2  
NOR, NAND Boot

GNU ARM gcc-3.3.2 glibc-2.3.2

Various user space packages including

base\_libs  
bash  
busybox  
coreutils  
device files  
dhcp  
diffutils  
dropbear  
findutils  
libjpeg  
module-init-tools  
ncurses  
netperf  
net-tools  
openssl  
portmap  
procinfo  
Qtopia  
strace

Documentation. See [START\\_HERE.html](#) on this CD.

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## Chapter 2

# LTIB Basics

### 2.1 Installing the BSP

Please follow the steps below to install LTIB on your host machine.

1. As root, mount the ISO image on your machine:  

```
mount -o loop <target-bsp.iso> <mount point>
```
2. As a non-root user, install the LTIB:  

```
<mount point>/install
```

The install program will first display the BSP EULA. To continue installing, read and accept the license then input the desired LTIB install path. Be sure the user has the correct write permissions for the install path.

There are no uninstall scripts. To uninstall LTIB you need to manually remove the `/opt/freescale/pkggs`, `/opt/freescale/ltib` and the directory in which you installed LTIB.

### 2.2 Running LTIB

To run LTIB, change to the directory in which you installed it and run LTIB.

```
cd <install_path>/ltib  
  
./ltib --configure
```

The first time LTIB runs on your machine a number of host packages are built and installed that support LTIB. This may take a few minutes. Results from the host package install are logged in the file `host_config.log`.

After the host support packages are installed, LTIB displays a configuration screen for choosing the target platform. Hit Enter to display the list of platforms, then use the arrow keys to pick the platform, Enter to close the platform window, then select “Exit” (right arrow key) to save the configuration.

After you save the target platform, LTIB’s next screen shows kernel, bootloader, package, etc. options. Use the arrow keys and Enter to modify the configuration as needed. When you exit, the configuration will be saved in the file `config/platform/imx21ads/defconfig.dev`.

---

**Important Note:** Please be sure to set the “Target System Configuration” options for your network environment the first time you build.

To build your target kernel, file system, and all enabled packages run LTIB with no options:

```
./ltib
```

Once your project is built, you will get the following target files:

- **rootfs** – directory, the root file system that will be deployed on your board.
- **rootfs.jffs2** – JFFS2 filesystem that can be flashed to your board.
- **rootfs/boot/zImage** – kernel image that can be loaded with your bootloader

If you want to change target configuration or enable/disable packages:

```
./ltib -m config
```

If you want to fully re-configure and re-compile all the packages, you can do the following, though this is generally not necessary:

1. Clean up all the configure files and objects thoroughly:

```
./ltib -m distclean
```

2. You will be prompted to confirm that you want to remove all compiled binaries. Type yes to perform a distclean.

3. Run ltib

```
./ltib
```

More information on LITB can be found in `<install path>/doc`, or at <http://savannah.nongnu.org/projects/ltib>.

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## Chapter 3 Target Configuration

### 3.1 Supported Target Revisions

The target system is the i.MX31ADS board. This BSP is known to work on the following board revisions:

M9328MX21ADSE (RoHS)

### 3.2 Target Set-up

1. Plug the i.MX21 CPU card into the ADS baseboard and attach the LCD and keypad boards.
2. Connect your board to the network via the Ethernet port.
3. Connect your board's UART 1 port to your host machine's serial port using a straight-through serial cable.
4. Verify the dip switches and jumpers are set correctly.

---

# Chapter 4

## Target Deployment

### 4.1 Host Set-up

Host setup is critical for your BSP to function. The host must be running tftp and nfs in order for deployment to work. The following instructions are generic and may require root permissions. Your system may be different and the commands should be adjusted accordingly.

1. Turn off your host's firewall for tftp to work. `iptables -F` or type "setup" at the command line.
2. Install tftp-server and nfs-server

3. Create the tftboot directory.

```
Mkdir -p /tftpboot/imx21ads
```

4. Link rootfs to an exportable directory once you have built your project.

```
ln -s <install_path>/rootfs /tftpboot/imx21ads/ltib
```

5. Copy over kernel and flash filesystem images for your deployment to the /tftpboot/imx21ads directory

```
cp <install_path>/rootfs/boot/* /tftpboot/imx21ads
cp <install_path>/<flashfs> /tftpboot/imx21ads
```

6. Edit /etc/exports and add the following line:

```
/tftpboot/imx21ads/ltib/ <target board IP> (rw,no_root_squash,async)
```

7. Edit /etc/xinetd.d/tftp to enable tftp like this:

```
{
disable      = no
socket_type  = dgram
protocol     = udp
wait         = yes
user         = root
server       = /usr/sbin/in.tftpd
server_args  = /tftpboot
}
```

8. Restart the nfs and tftp servers on your host

```
/etc/init.d/xinetd restart
/etc/init.d/nfsserver restart
```

9. Verify that the board is connected to your network and connected to the host serial port.
10. Start and configure `minicom`:
  - Serial Setup: Select correct serial device; Hardware & Software Flow control = No; Bps = 115,200
  - Modem & dialing: Delete text for the following: Init String, Reset String, Hang-up String, No flow control
11. Power on board and see the console prompt.

## 4.2 Flashing the blob Bootloader

### 4.2.1 On a new board

To flash the bootloader on an ADS board without an existing blob bootloader, follow these steps:

1. Build the `hardwaretest` package which contains the serial download utility:

```
./ltib -p hardwaretest-imx
```

The file `imx21_download` will be copied to `<install_path>/bin/`.

2. Make sure the bootloader is built:

```
./ltib -p blob-imx21ads.spec
```

3. Turn off the power switch on the `i.MX21_ADS` board.
4. Make sure the serial cable is connected between the host and target systems.
5. Set the `i.MX21_ADS` board configuration switches labeled S2 on the base board as shown.

Switch	1	2	3	4	5	6	7	8
S2	ON	ON	ON	ON	OFF	OFF	OFF	OFF

6. Turn on the `i.MX21_ADS` board.
7. Execute the download utility on the host using your serial port and location of the bootloader binary. For example (all on one line):

```
<install_path>/bin/imx21_download --port /dev/ttyS0 --addr \
0xc0300000 --stop_auto_boot <install_path>/rootfs/boot/blob
```

8. When downloading is complete, turn off the ADS board and restore the S2 switches.

## 4.2.2 Using an existing bootloader

To reprogram the bootloader using an existing running blob, load the bootloader image into SDRAM and then program it into flash. Be sure to setup your host as outlined in section 4.1. The bootloader commands are:

```
blob> server 192.168.1.5
blob> ip 192.168.1.10
blob> Tftpfile /tftpboot/imx21ads/zImage
blob> tftp blob
blob> flash blob
```

Be sure to use IP addresses for your host and target. Reset your board to use the new bootloader.

You can also use the HAB Toolkit to flash the i.MX21ADS board from MS Windows with a full kernel/file system image. You can find this software on the BSP CD in `flash/`.

## 4.2.3 Bootloader param file

If you wish to save the host/target network parameters, kernel command line, etc. in flash, you must create a special param file. The steps to create and flash a blob param file are as follows:

1. Build the `mkparamblock` utility. Extract the blob source, change to the `mkparamblock` directory and build the utility:

```
$ ./ltib -p blob-imx21ads.spec -m prep
$ pushd rpm/BUILD/blob-2.0.5-pre2/utils/mkparamblock
$ make
$ cp mkparamblock <install_path> /bin/
$ popd
```

2. Create a plain text file `blob.config.param` with network, serial, boot settings. For example:

```
# Config file for Freescale i.MX21
ip 192.168.1.10
server 192.168.1.5
tftpfile /tftpboot/imx21ads/zImage
ramdisk no # default is yes
bootdelay 3 # default is 10
cmdline root=/dev/mtdblock2 noinitrd ip=none
baud 115200, 115200 # best for serial deployment
autoboot ram # "flash" for XIP, "ram" for normal kernel
```

3. Process the plain text file with `mkparamblock` into the binary file `param`, then put the `param` file in the `tftp` directory:

```
$ <install_path>bin/mkparamblock blob.config.param param
$ cp param /tftpboot/imx21ads
```

4. At the bootloader prompt, `tftp` and flash the file:

```
blob> tftp param
blob> flash param
```

5. To verify that the parameters are used correctly, reset power on the board, and at the bootloader prompt, type 'status'.

## 4.3 Development Deployment (NFS)

1. Copy the kernel image from `<install_path>/rootfs/boot/zImage` to the `/tftpboot/imx21ads` directory created during host setup.
2. At the `bootloader` prompt, give the host and target network addresses and set the path to the kernel. For example:

```
blob> server 192.168.1.5
blob> ip 192.168.1.10
blob> Tftpfile /tftpboot/imx21ads/zImage
```

3. Download the Linux kernel binary to SDRAM:

```
blob> tftp kernel
```

4. Boot the kernel. Be sure to use appropriate Ethernet settings for your host, target, network gateway, and netmask. For example (all on one line):

```
blob> boot noinitrd root=/dev/nfs nfsroot=<server \
ip>:/tftpboot/imx21ads/ltib ip=192.<target ip>:<server ip>
```

Note that specifying a command line is unnecessary if you flashed a param file as described in the section “Bootloader param file.” Type 'status' at the bootloader prompt to check.

## 4.4 NOR Flash Deployment

1. When configuring with `./ltib -m config`, make sure that the `jffs2` erase block size in kilobytes matches your hardware on the ‘Target Image Generation’ page. For the M9328MX21ADSE (RoHS) board, use ‘256’. For previous versions of the CPU board with AMD NOR flash parts, use ‘128’ k.
2. Also during configuration, be sure that the option “Support NAND flash deploy” is disabled. Exit to save the configuration, then if you have changed this option, force rebuild blob:

```
./ltib -p blob-imx21ads.spec -force
```

If you rebuild blob, reflash it as described earlier.

3. Copy the kernel image from `<install_path>/rootfs/boot/zImage` to the `/tftpboot/imx21ads` directory.

4. Copy the jffs2 filesystem image from your LTIB install directory to the `/tftpboot/imx21ads` directory. Note that the blob bootloader requires the filename 'ramdisk.gz' so after copying `rootfs.jffs2` to `/tftpboot/imx21ads`, rename it to 'ramdisk.gz' or create a symbolic link.
5. Make sure the boot mode DIP switches are set as shown:

Switch	1	2	3	4	5	6	7	8
S2	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF

If the switches need to be changed, for example if you previously did a NAND deploy, power off the board and change the switches.

6. At the `blobloader` prompt, use the 'status' command to verify that the target IP address, tftp server IP, MAC address, and tftp path to the kernel are set properly.
7. If you want network parameters to be saved in flash, see the section "Bootloader param file." If you update any network settings or paths and regenerate your param file, tftp and flash it with:

```
blob> tftp param
blob> flash param
```

8. Download and flash the filesystem image:

```
blob> erase ramdisk
blob> tftp ramdisk
blob> flash ramdisk
```

9. Download and flash the Linux kernel, then boot:

```
blob> tftp kernel
blob> flash kernel
```

## 4.5 NAND Flash Deployment

1. Configure with `./ltib -m config`, and for the jffs2 option in "Target Image Generation," set the jffs2 erase block size in kilobytes to '16'.
2. Reconfigure the kernel with a command line which specifies the NAND mtd root. For example:

```
noinitrd root=/dev/mtdblock6 ip=None
```

3. In the main ltib configuration screen, enable the option "Support NAND flash deploy," force rebuild and reflash blob.
4. Rebuild the kernel and file system:

```
./ltib
```

- 
5. Copy the kernel image from `<install_path>/rootfs/boot/zImage` to `/tftpboot/imx21ads`.
  6. Copy the jffs2 filesystem image from directory where you installed LTIB to the `/tftpboot/imx21ads` directory. Note that the blob bootloader requires the filename 'ramdisk.gz' so after copying `rootfs.jffs2` to `/tftpboot/imx21ads`, rename it to 'ramdisk.gz'.
  7. Power off the board and set the i.MX21ADS boot mode DIP switches to boot for NAND:

Switch	1	2	3	4	5	6	7	8
S2	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF

8. Power on the board. If Blob autoboot is enabled you will need to type any character in the console window to interrupt the autoboot sequence. Tftp and flash the filesystem and kernel, then boot:

```
blob> erase ramdisk
blob> tftp ramdisk
blob> flash ramdisk
blob> tftp kernel
blob> flash kernel
blob> boot
```