UM0844
User manual

Getting started with SPEAr® Linux support package (LSP2.3)

Introduction

This manual provides application developers with a first introduction to the Linux-based reference software installed in the Flash memory of the SPEAr evaluation boards. It is not intended to be a tutorial on Linux operating system or embedded software design. It only covers topics that are specific to the implementation on SPEAr embedded MPUs and boards.

The purpose of the evaluation board software is to quickly and easily evaluate the capabilities of SPEAr embedded MPUs, as well as to provide a starting point for the software development for your own applications.

Note: For information on downloading the SPEAr Linux Support Package (LSP2.3) from www.st.com, refer to *Section 3.5 on page 25*

Contents

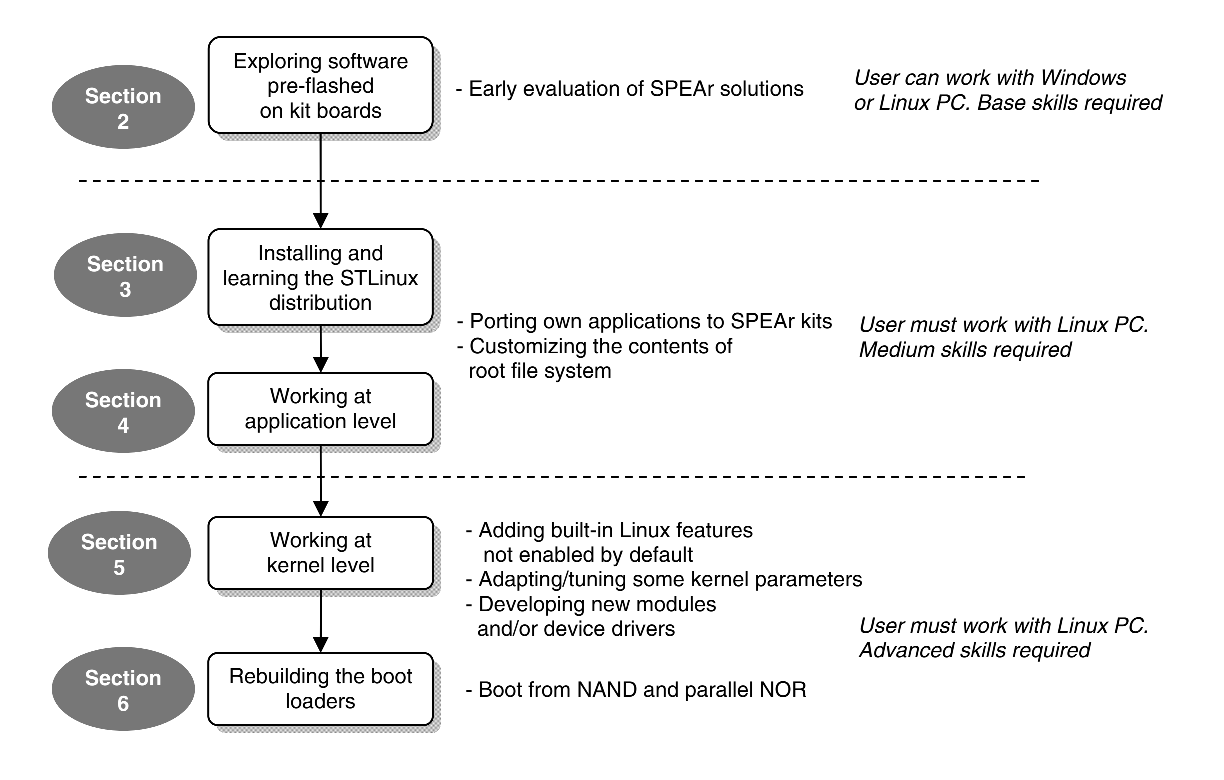
List of tables

List of figures

1 About this manual

This manual is organized as a sequence of chapters going from a description of the first steps and then covering more complex subjects.

Figure 1. Step-by-step approach to using the manual



This guide applies to all currently available SPEAr evaluation boards.

However, each different evaluation board is based on a specific member of SPEAr embedded MPU family and provides, in general, a different selection and combination of hardware devices on the board (and companion boards, wherever applicable). For a detailed description of hardware features for each evaluation board, please refer to the corresponding evaluation board user manual.

1.1 Glossary

Table 1. List of abbreviations

Term	Definition
API	Application programming interface
ARM	Advanced RISC machine
BSP	Board support package
DDR	Double data rate (RAM)
DHCP	Dynamic host configuration protocol
FAT	File allocation table
FTP	File transfer protocol
GCC	GNU compiler collection
GPL	General public license (GNU)
IDE	Integrated development environment
IP	Internet protocol
LAN	Local area network
LGPL	Lesser GPL
LSP	Linux support package
MAC	Media access control
MTD	Memory technology device
NFS	Network file system
OS	Operating system
RAM	Random access memory
RPM	RPM package manager
RTC	Real time clock
SDK	Software development kit
SRAM	Static RAM
TFTP	Trivial file transfer protocol
UART	Universal asynchronous receiver transmitter
USB	Universal serial bus

2 The pre-flashed software

SPEAr evaluation boards come with default embedded Linux software already stored in (serial NOR) Flash memory, according to a pre-defined generic configuration. Using a SPEAr board with pre-flashed software is initially useful to get familiar with the target hardware platform and the embedded Linux environment.

This activity does not strictly require the installation of the SPEAr Linux Support Package (LSP2.3) (software development environment). This can be performed later as, described in *Chapter 3* of this document.

Note: It is highly recommended, as a first step, to check the ST website www.st.com for new versions of default software Flash images. The procedure for updating the evaluation board Flash memory is described in Section 2.8 on page 18.

Before powering-on target hardware, hence booting the pre-flashed software, please carefully check the specific hardware configuration (for example, DIP switches) according to what is described in the relevant hardware manuals.

2.1 Host PC requirements

2.1.1 Windows PC

In order to control the target hardware, you can use a PC with a Microsoft Windows operating system (XP, Vista, Windows 7).

The first step is to set up a serial port for interacting with the embedded consoles (Linux shell or U-Boot boot loader). If a RS232 serial port is not available on the PC, you can use a USB/RS232 adapter (not provided in the kit).

The second step is to obtain a terminal emulation program. Windows comes with the built-in HyperTerminal, but any equivalent tool can be used as an alternative. For instance, Tera Term is an open source free application with more features and higher flexibility, especially its scripting capability.

You can download and find more technical information about Tera Term on:

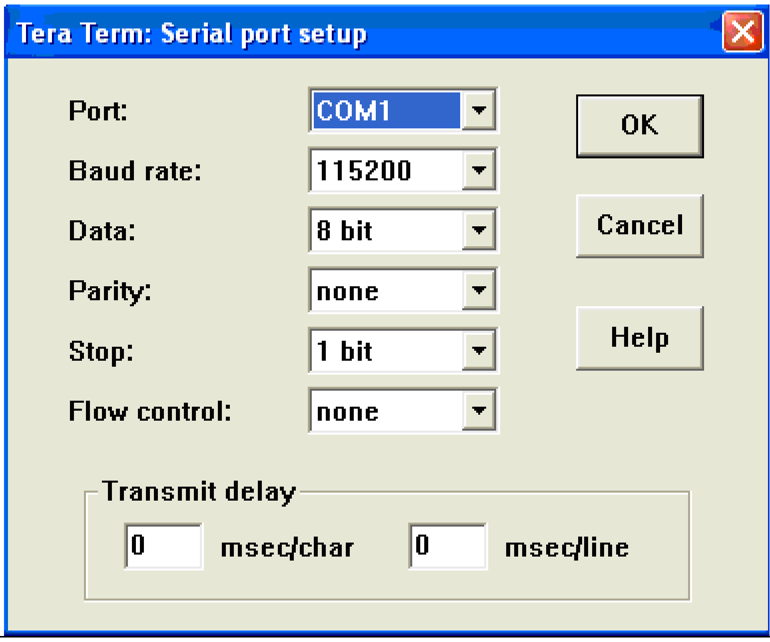
http://en.wikipedia.org/wiki/Tera_Term

In order to configure the serial port with TeraTerm;

1. Launch the tool
2. Click on "Setup > serial port"

   The configuration must reflect that shown in *Figure 2*.
3. To save the proper setting, click on "Setup > save setup".

Figure 2. Tera Term configuration for serial port (Windows PC)



Using HyperTerminal is very similar. To configure the serial port with HyperTerminal:

1. Enter the "File > Properties" menu
2. Select the COM port (for example COM1) in the "Connect Using" dialog box
3. Press the "Configure" button
4. Enter the 'Port Setting' fields accordingly
5. To save the current configurations select the "File >Save As" menu item.

2.1.2 Linux PC

As an alternative to Windows, you can use a PC with Linux OS.

In the examples below, a '$' symbol represents a normal user prompt while a '#' symbol means a root level prompt. Please note that you need read/write access to the PC serial port. If necessary, check your distribution documentation to enable it (for example, on Fedora Linux systems you have usually to add your user to the "dialout" system group).

Minicom is one of the most commonly used terminal emulators for Linux. Assuming a Fedora distribution for the host PC, to check the availability of Minicom, execute the following command:

```
$ rpm -q minicom
```

To install minicom, if not found, execute this command from a root shell:

```
# yum install minicom
```

To start minicom, type the command:

```
$ minicom
```

To enter the configuration menu for the first time, press the key combination "Ctrl-A" and then "Z" (in sequence).

Note: If there is no global configuration file, minicom will not start. You first need to create one by running the following command from a root shell:

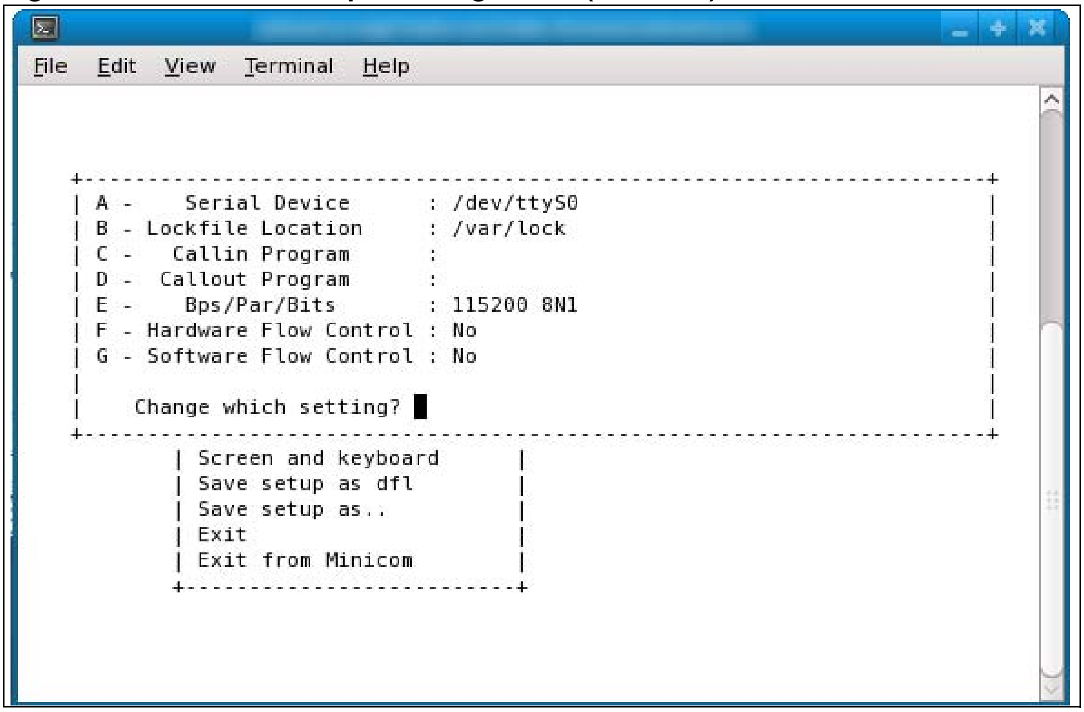
```
# minicom -s
```

and then follow the normal configuration procedure.

The serial connection information can be configured in the 'configure minicom' submenu and then 'Serial port setup'. After that, the configuration must be saved using the 'Save setup as' option. The serial device name to be entered must match the one used for the link to the SPEAr evaluation board. For example, the first serial port on Linux PC is named /dev/ttyS0.

Select the serial speed as 115200 bps with 8 bit, no parity and 1 stop bit (115200 8N1) and disable both hardware and software flow control.

Figure 3. Minicom serial port configuration (Linux PC)



To save a new default configuration which is automatically used by minicom, select "Save setup as dfl".

Alternatively, to create a new configuration file select "Save setup as..". In order to use it, you have to specify the configuration file name in the command line when invoking minicom.

Please note that by default minicom tries to initialize a "modem" connected to the specific interface you have chosen. To skip this step you can invoke minicom with the -o option as follows:

```
$ minicom -o
```

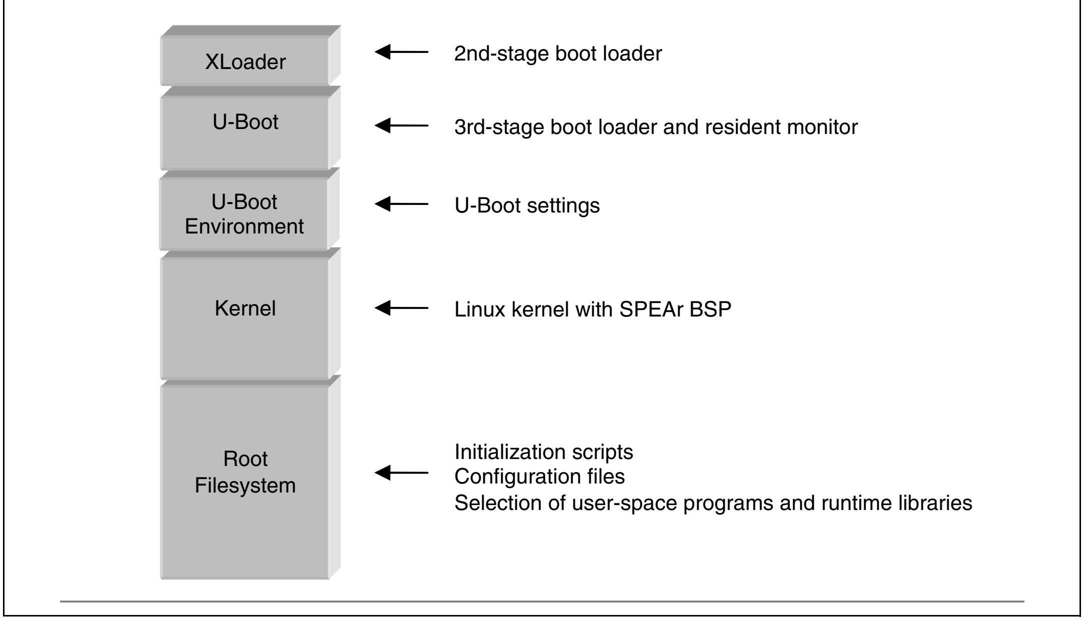
2.2 Overview of Flash contents and structure

On all evaluation boards, the default software is only pre-stored into serial NOR Flash. The use of other memory types available on some evaluation boards (NAND, parallel NOR) requires the installation and usage of the SPEAr Linux Support Package (LSP2.3), as described in *Section 3*.

This subsection only provides an overview of the Flash contents and structuring. Details on this subject (like offsets and sizes for each partition, as well as differences between serial NOR, parallel NOR and NAND) is provided in the corresponding SPEAr device datasheet and user manual.

Whatever the Flash memory type, software installed in the SPEAr evaluation boards is logically structured into 5 partitions, as depicted in *Figure 4*.

Figure 4. Flash memory organization



To understand the rationale behind this Flash memory organization, it is necessary to know how the overall booting process works.

After power-on, a SPEAr embedded MPU starts to execute an on-chip firmware known as BootROM (kept in internal SPEAr ROM area, not in Flash memory). This is the first stage. When a board is configured in Flash booting mode, BootROM terminates by loading a 2nd stage component (XLoader) from Flash memory to on-chip SRAM and then gives control to it.

XLoader is a small ST-specific firmware (also available in source code) that executes in internal SRAM and configures the PLLs and the specific DDR memory available on each board. Once performed its task, XLoader loads a third stage boot loader (U-Boot) from Flash and jumps to its entry point.

The widely used open source U-Boot program is used as a third-stage boot loader in the SPEAr evaluation boards. The U-Boot version provided is extended with support for the required SPEAr-specific hardware. In addition to its role in the overall booting process, U-Boot also operates as a resident monitor. To start the monitor function after power-on, stop U-Boot execution before Linux is started. U-Boot is mainly in charge of loading and executing the Linux kernel. This stage is configured in a special Flash partition known as U-Boot Environment, basically a collection of parameter/value pairs.

When not interrupted after board power-on, U-Boot loads the Linux kernel to DDR memory and then starts its execution. The kernel, after further preliminary initialization, mounts the so-called root filesystem. This is the binary image containing all software and data that comprise the operating system complementing the kernel. The root filesystem is the hierarchical file structure that end users see from the familiar Linux shell prompt. For pre-flashed software, it contains a generic subset of initialization scripts, system commands and runtime libraries.

There is a wide choice of file system standards for Flash memories in the Linux world (for example, CRAMFS, JFFS2, YAFFS2, LogFS, UBIFS).

The pre-flashed software is based on the most commonly used standard, namely JFFS2. The main advantage of JFFS2 is the built-in support for compression. It is also the most consolidated filesystem, while generally not providing the best performance in terms of booting time.

By using the SPEAr Linux Support Package (LSP2.3), evaluation boards with NAND Flash can be also configured to use YAFFS2. YAFFS2 aims at providing better support for NAND Flash devices and faster boot time. However, YAFFS2 is not yet part of official open source Linux kernels and requires a dedicated patch, however this patch is already applied to SPEAr-ported Linux kernels.

2.3 Booting up to the Linux prompt

To boot Linux just power up the board. You then see the bootloader messages and prompt. If you press a key in this phase, you stop the bootloader execution and display the U-Boot command prompt (see next section). Instead, wait for a few seconds while the Linux kernel is loaded and launched. Progress is displayed by a sequence of kernel boot messages. The root filesystem is mounted automatically, the system shell is run and a prompt appears when it is ready to accept commands.

The pre-flashed software provides a default set of system commands and runtime libraries.

System commands are the familiar basic utilities mainly provided to support the development and debugging stages. They are all stored under standard Linux paths. They may be not strictly needed in a final product, however their small size allows them to be kept in production devices without a significant penalty in terms of memory footprint.

As is typical for embedded Linux environments, STLinux uses BusyBox, an open source program combining tiny versions of many common user-space Linux utilities into a single small executable, an important factor when minimized Flash footprint is required.

BusyBox has been developed with size-optimization and limited resources in mind, for this reason the available commands typically have fewer options than their full-featured GNU counterparts. However, the most important options are still available with all the functions needed for developing and testing embedded products.

As well as the features of BusyBox, a number of additional executable programs are also included.

In addition to playing with commands, it can be also helpful to explore the Linux standard /proc pseudo-filesystem. This subtree contains user-accessible entries that pertain to the runtime state of the kernel and, by extension, the executing processes that run on top of it. The "pseudo" term is used because the proc filesystem exists only as a reflection of the in-memory kernel data structures it displays. This is why most files and directories within /proc are zero bytes in size.

In practice, the proc file system is intended to be populated at runtime with system information and statistics. Proc files may be either read-only or read-write. Each numerically named directory within /proc corresponds to the process ID (PID) of a process currently executing on the system. This part of the proc filesystem totally depends on the runtime state of the target. Each numeric entry contains subfiles that provide process-specific information. The other (non-numeric) entries describe some aspects of kernel operation.

Some of the common user commands performed on the proc filesystem are:

```
# cat /proc/version             Displays full Linux kernel version information
# cat /proc/sys/kernel/osreleaseDisplays Linux kernel release
# cat /proc/sys/kernel/version  Displays Linux kernel build date and time
# cat /proc/cpuinfo             Displays information about the SPEAr CPU
# cat /proc/meminfo             Displays information about memory usage
# cat /proc/modules             Displays information about kernel extension modules
# cat /proc/mtd                 Displays information about Flash partitions
# cat /proc/partitions          Displays other information about Flash partitions
# cat /proc/stat                Displays OS status information
# cat /proc/bus/usb/devices     Displays information about USB Host ports
# cat /proc/net/dev             Reports Ethernet information.
# cat /proc/net/tcp             Reports TCP sockets information.
# cat /proc/net/udp             Reports UDP sockets information.
# cat /proc/net/arp             Reports ARP table.
# cat /proc/net/route           Reports IP routing table.
# cat /proc/kallsyms            Lists all kernel symbols
```

The standard /proc/bus/usb subtree is also made available. This is used to access USB Host controllers and plugged devices from user-space applications.

For more details about the functionality provided by pseudo filesystems, please refer to standard Linux documentation.

2.4 Using a USB pendrive

USB pendrives can be accessed in a standard Linux way, connecting them to a USB host port and mounting their filesystem under root filesystem. An example of operational sequence for a standard pendrive connected as "sda" device (only one pendrive present) is the following:

1. Plug the pendrive in a USB port. and wait for the Linux kernel to autodetect it (you can see active kernel messages on the terminal)
2. Mount the pendrive filesystem:

   ```
   # mount /dev/sda1 /mnt
   ```

   Now the pendrive filesystem can be accessed under /mnt directory.
3. Transfer files as usual (for example, cp command).
4. When finished, unmount the pendrive:

   ```
   # umount /mnt
   ```

Now you can physically unplug the pendrive

2.5 Using a MMC/SD Card

Some evaluation boards (currently EVALSPEAR300 and EVALSPEAR320PLC) provide a MMC/SD card reader slot.

An example of operation sequence for a MMC/SD card is the following:

1. Plug the card into the board slot and wait for the Linux kernel to autodetect it (you can see active kernel messages on the terminal)
2. Mount the card's filesystem:
   ```
   # mount /dev/mmcblk0p1 /mnt
   ```
   Now the card's filesystem can be accessed under the /mnt directory.
3. Transfer files as usual (for example, cp command)
4. When finished, unmount the card:
   ```
   # umount /mnt
   ```

Now you can physically remove the card.

2.6 Entering the U-Boot resident monitor

The U-Boot resident monitor offers an interactive command-line interface that can be used through the serial console. U-Boot is executed before starting the Linux OS. In order to interrupt the normal boot process and enter U-Boot operation mode, press a key from the virtual terminal on the Windows or Linux PC during the initial period (after hardware reset) when the following message is displayed:

Hit SPACE to stop autoboot: _

To obtain a full list of U-Boot commands available on SPEAr board, enter the "help" command or simply type the "?" character. When "help" is followed by a command name, a description of that specific command is displayed.

The following subsections describe basic usage scenarios. Please note that command results are only shown as examples and can look slightly different depending on the evaluation board and software version you use.

Detailed documentation about the described commands, as well as additional ones, may be found on the main U-Boot Web site: http://www.denx.de/wiki/U-Boot

2.6.1 Information commands

To report the U-Boot version currently available on the evaluation board Flash memory, execute the "version" command:

```
> version
```

```
U-Boot 1.3.1 (Oct  1 2009 - 14:52:19)-SPEAr300-LSP2.1
```

To list all Flash memory partitions, use the "imls" command:

```
> imls
```

```
********************   NOR Flash Images   ********************
```

```
Image at F8000000:
   Image Name:   XLOADER
   Image Type:   ARM Linux Kernel Image (uncompressed)
   Data Size:    4524 Bytes =  4.4 kB
   Load Address: d2800b00
   Entry Point:  d2800b00
   Verifying Checksum ... OK
Image at F8010000:
   Image Name:   U-Boot 1.3.1 for spear300 board
   Image Type:   ARM Linux Firmware (uncompressed)
   Data Size:    154084 Bytes = 150.5 kB
   Load Address: 00700000
   Entry Point:  00000000
   Verifying Checksum ... OK
Image at F8050000:
   Image Name:   Linux-2.6.27-sdk2.0-0.3457
   Image Type:   ARM Linux Kernel Image (uncompressed)
  Data Size:    1663040 Bytes =  1.6 MB
   Load Address: 00008000
   Entry Point:  00008000
   Verifying Checksum ... OK
```

2.6.2 Environment commands

A specific subgroup of U-Boot commands very often invoked by end users is related to the management of environment variables. Such variables are string-type fields that may be read and written, as well as stored on Flash to guarantee their persistence across system reboots. Some of these variables have a predefined purpose, but users may also add their own custom variables.

It is important to know that a current environment maintained in DDR RAM memory can be sometimes different from the persistent environment stored on Flash.

To create a new variable or change the value of an existing one, run the "setenv" command:

```
> setenv MYVAR=MYVALUE
```

To make the current values of all variables persistent in Flash memory, run the "saveenv" command:

```
> saveenv
```

Finally, to report all current environment settings, use the "printenv" command:

```
> printenv
```

```
bootargs=console=ttyS0 mem=128M root=/dev/mtdblock3
rootfstype=jffs2

bootcmd=bootm 0xf8050000

bootdelay=1

baudrate=115200

ethaddr=00:11:22:33:44:55

ipaddr=192.168.1.10

serverip=192.168.1.1

gatewayip=192.168.1.1

netmask=255.255.255.0

stdin=serial

stdout=serial

stderr=serial

verify=n


Environment size: 283/8188 bytes
```

2.6.3 Advanced commands

More advanced usage of U-Boot includes commands for:

- Reading and writing embedded MPU registers and memory areas
- Executing the contents of an environment variable, handling it as a script (sequence of U-Boot commands)
- Checking Ethernet link between the target board and the host PC (ping)
- Booting the Linux kernel from Ethernet network (by TFTP) instead of using a kernel on Flash memory (bootm, tftp, tftpboot).

2.7 Connecting the evaluation board to a LAN

The evaluation board should be connected to a developer's host PC over a private LAN or even a point-to-point link. Commonly used private IP addresses (Class C) are in the range of192.168.0.0 - 192.168.255.255.

Note: Some SPEAr evaluation boards (currently EVALSPEAR310 and EVALSPEAR320) provide multiple Ethernet ports. Each port requires a different IP address. The procedure described below is applicable to a single port, usually the one used for software development.

As an example, let's assume an IPv4 local area network with the following characteristics:

Network IPs: 192.168.1.X

Host PC IP: 192.168.1.1

Evaluation board IP:192.168.1.10

On a Linux PC, you must configure the host address as follows:

```
# ifconfig eth0 192.168.1.1 broadcast 192.168.1.255 netmask
255.255.255.0
```

You have the option to configure the IP on the evaluation board side in a static or dynamic way.

For a static configuration, the procedure is as follows:

1. Reset the board and enter U-Boot mode
2. Use the following commands to configure environment variables:
```
> setenv ipaddr 192.168.1.10
> setenv serverip 192.168.1.1
> setenv gatewayip 192.168.1.1
> setenv netmask 255.255.255.0
> setenv hostname SPEAR
> setenv ip_settings
\$(ipaddr):\$(serverip):\$(gatewayip):\$(netmask):\$(hostname):
\$(netdev):off
```
3. Modify the existing "bootargs" variable by adding the "ip" argument, as in the following example, then save the environment:
```
> setenv bootargs console=ttyS0 ... ip=$(ip_settings)
> saveenv
```

In this way, network settings work inside U-Boot and are also automatically passed to Linux.

The dynamic configuration requires a DHCP server running on the LAN (for example, on a Linux host PC) so that the evaluation board automatically gets an IP address at each bootstrap.

To check if DHCP server (daemon) support is available on the PC-side, use the following command:

```
$ rpm -q dhcp
```

If the DHCP package is not available, install it on the PC from your distribution media (for example, Fedora Linux CDROM or website).

The next step is to create or change the DHCP configuration file /etc/dhcp/dhcpd.conf that matches a specific network setup, as shown in the following example:

```
#
# DHCP Server Configuration file.
#   see /usr/share/doc/dhcp*/dhcpd.conf.sample
#   see 'man 5 dhcpd.conf'
#
default-lease-time 600;
max-lease-time 7200;
option subnet-mask 255.255.255.0;
option broadcast-address 192.168.1.255;
allow bootp; #allows kernel download using tftp
```

```
ddns-update-style ad-hoc;

subnet 192.168.1.0 netmask 255.255.255.0 {
  option routers 192.168.1.1;
  option subnet-mask 255.255.0.0;
  option domain-name "local.net";
  option domain-name-servers ns.local.net;
  host SPEAr300 {
    hardware ethernet 00:11:22:33:44:55;
    fixed-address 192.168.1.10;
    option host-name "SPEAR";
    next-server       192.168.1.1;
    filename "uImage_300.img"; #kernel image filename in tftp path
    }
}
```

With this configuration, the DHCP server replies to a request from a SPEAr evaluation board with Ethernet MAC address 00:11:22:33:44:55 (just as in the example) by passing the entire network configuration.

The "allow bootp" and "filename" parameters enable uBoot to download and boot a kernel image from the host using the TFTP file transfer protocol (you will need a TFTP server on the host, see below).

In order to apply the new configuration settings, restart he DHCP server. To do this, first check the status of the DHCP daemon using the following commands from the Linux PC shell:

```
# /etc/rc.d/init.d/dhcpd status
```

If the DHCP daemon is stopped, start it with the following command:

```
# /etc/rc.d/init.d/dhcpd start
```

Please be sure to disable your firewall or setup new firewall rules in order to enable DHCP/TFTP traffic.

2.8 Updating the pre-flashed software

This section focuses on updating the contents of serial NOR Flash with default binary images available on www.st.com.

Updating the contents of Flash memory on SPEAr evaluation boards is a recommended step. It is possible to update the pre-flashed software coming by default with a SPEAr evaluation board without installing the SPEAr Linux Support Package (LSP2.3).

The procedure for the update involves the installation and use of the USB flasher tool provided by ST. This tool is a graphical interactive application, which can be downloaded from www.st.com.

The link for downloading the software can be found on www.st.com on the web page containing the literature and other resources for the related SPEAr device (product pages).

The product web page also provides a download for updated binary images (for each evaluation board type) to be used with the USB flasher.

The use of the USB flasher for other purposes and scenarios is intended to be explained by the help pages embedded in the tool itself.

2.8.1 Installing the USB flasher

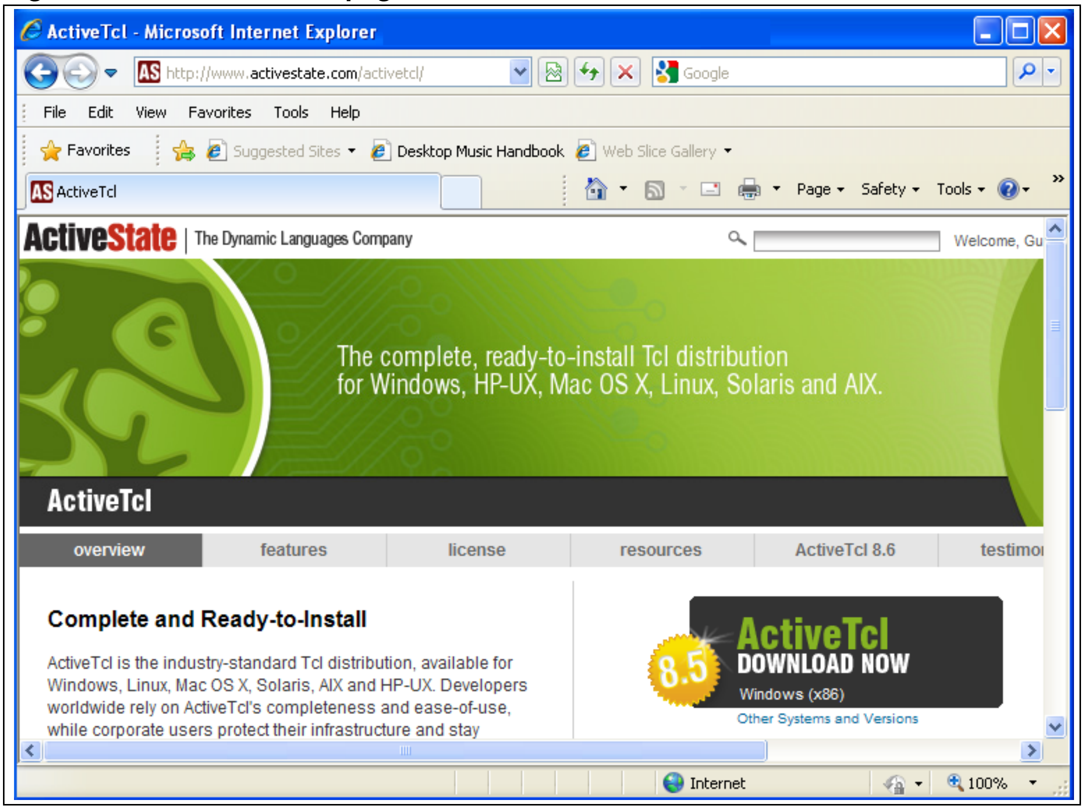
The USB flasher tool must be installed on a Windows PC.

Before setting up the flasher tool, you must download and install an updated TCL package. The recommended TCL software is ActiveTCL, available free of charge. The latest TCL version (8.5) can be downloaded from the following supplier site:

http://www.activestate.com/activetcl/

The download page is shown in *Figure 5*.

Figure 5. TCL download page



You can now start the procedure to install the USB flasher:

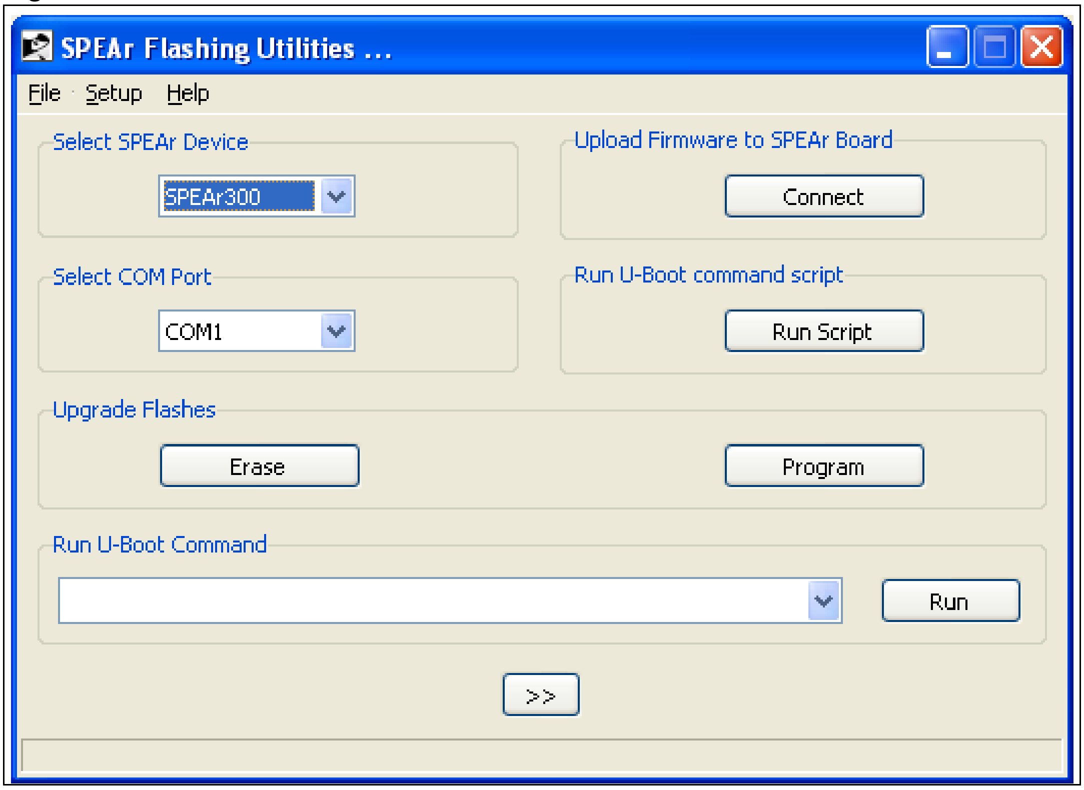
1. Create a new folder under any path on the PC and extract into it the contents of the flashing_util.tar.gz file as obtained from ST Web site.

   Let's assume for example that the selected folder path is c:\flashing_util
2. Before power-on, you must configure the evaluation board for USB bootstrap mode. This is done through DIP switches. Details on switch setting for each evaluation board can be found on board-specific user manuals.
3. Connect the evaluation board to the Windows PC using a USB cable. The USB host port on the PC has to be connected with the USB device connector of the evaluation board.
4. Switch on the evaluation board.

   After few seconds, the PC asks for a device driver.
5. Specify the path of the proper .inf file as found under: c:\flashing_util\Setup folder.
   - For EVALSPEAR300, EVALSPEAR310 and EVALSPEAR320PLC evaluation boards, the file is Spear300.inf.
   - For EVALSPEAR600 evaluation board, the file is Spear600.inf.
6. Double click on c:\flashing_util\SPEAr-Utils.tcl file. This the TCL-based application implementing the USB flasher GUI.

The initial USB flasher screen is shown in *Figure 6*.

Figure 6. USB flasher first screen



7. In the SPEAr Flashing utilities window, select the target device (SPEAr300 in the example).
8. Click on the Connect button.

   The PC now asks for a new driver.
9. Select the following path: c:\flashing_util\Setup\g_serial.inf

A new COM port should be now visible inside Windows Device Manager. The same COM port must be used in next tasks with USB flasher.

The USB flasher tool is now ready for normal operation.

2.8.2 Installing the Flash images

For each evaluation board, default binary images for serial NOR Flash are available on ST Web site (see *Figure 2.8.1* above) for usage in combination with the USB flasher tool.

To install the Flash images, download the ZIP file for a specific evaluation board and extract its contents under the same folder as the one used for USB Flasher.

For example, if you use the EVALSPEAR300 evaluation board, the ZIP file with the Flash images should be extracted to the following path:

c:\flashing_util\evalspear300_Flash_images

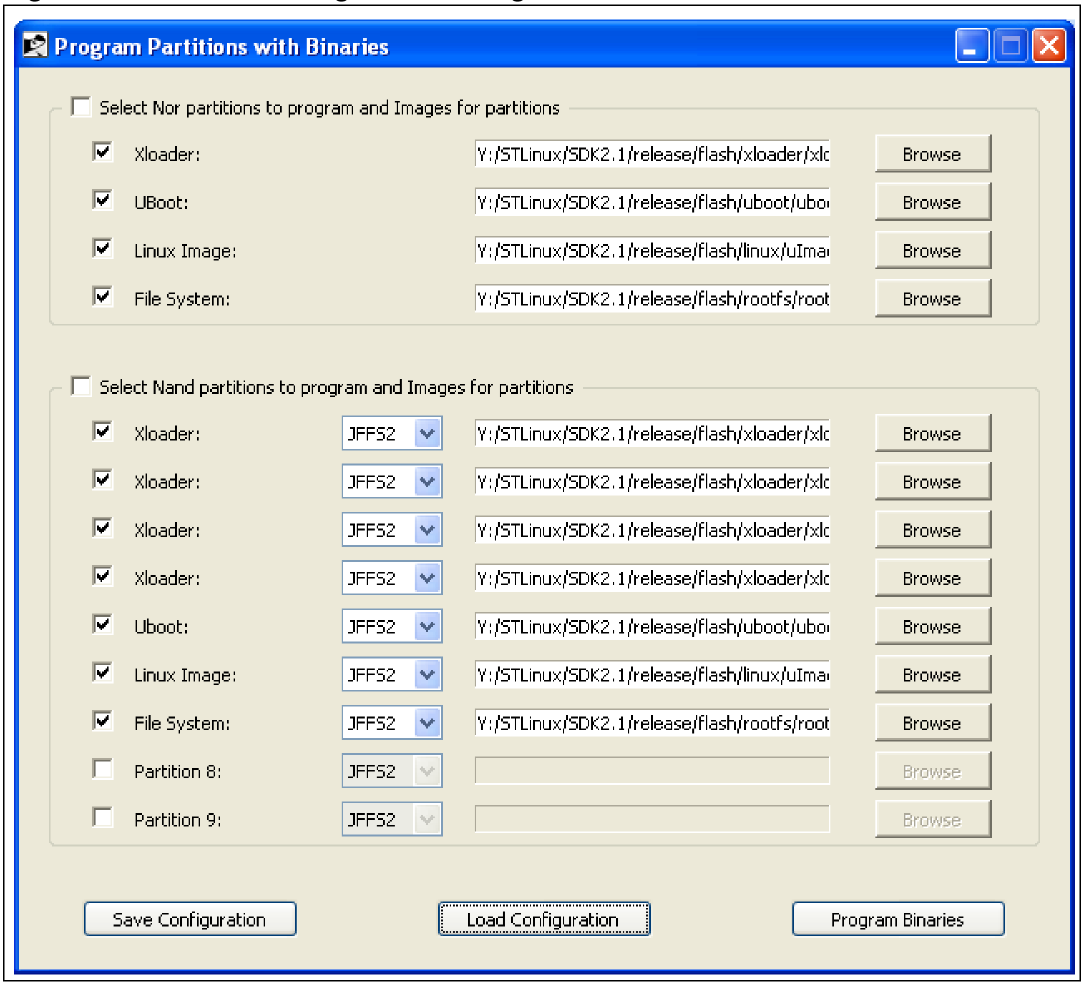
The subfolder should contain 4 binary images (xloader, U-Boot, kernel and default root filesystem) as well as a USB flasher configuration file, for example, s300_defconfig.conf

2.8.3 Updating the Flash

To update the Flash, use the following procedure.

1. Click on the Program button. A new dialog window opens, as in *Figure 7*.

Figure 7. Partition configuration dialog



2. Click on the Load Configuration button and select the configuration file suitable for the target evaluation board:

```
EVALSPEAR300:     s300_defconfig.conf
EVALSPEAR310:     s310_defconfig.conf
EVALSPEAR320PLC: s320_defconfig.conf
EVALSPEAR600:     s600_defconfig.conf
```

3. Click on Program Binaries to start the flashing procedure.

3 The SPEAr Linux Support Package (LSP2.3)

3.1 Overview

The SPEAr Linux Support Package (LSP2.3) provides all the host-side (PC) and target-side (evaluation board) software components enabling system designers to develop their own applications for SPEAr-based platforms, as well as to customize the various aspects of the embedded software architecture.

The components can be summarized as follows:

- Command-line cross-development toolchain (compiler, linker, building tools, etc.), running on a Linux x86 PC
- Graphical IDE (ST Workbench), running on a Linux x86 PC
- Software for incremental online update of SPEAr Linux Support Package (LSP2.3) components
- A set of open source user-space ARM packages (programs and runtime libraries) to be promptly reused in root filesystems as support to specific applications
- Linux kernel (2.6.27 or higher), configurable for the different SPEAr evaluation boards; it includes BSP/device drivers for the SPEAr hardware features
- U-Boot boot loader, with added support for SPEAr evaluation boards
- XLoader firmware, configurable for the different SPEAr evaluation boards

Most distribution components are also available as source code (SRPM files).

Full details about STLinux components are reported in other specific documents.

3.2 Licensing

The SPEAr Linux Support Package (LSP2.3) includes a wide number of packages, each having a relative license. The most common licenses are the GNU Public License (GPL) and the GNU Lesser Public License (LGPL). Even if there are different versions of the GPL and the LGPL packages, they are all licensed under Version 2 (or earlier) of the GPL or the LGPL. The GNU licenses are administered by the Free Software Foundation.

Another commonly used license type is the Berkeley Software Distribution (BSD) developed by the University of California in order to ensure academic freedom relating to software works. The remaining packages are covered by a variety of open source licenses, most of which are simple and straightforward. Further information can be found on the Web sites of these packages.

While license information is given in good faith, ST cannot guarantee the accuracy of this information, which has been collated from a variety of open source projects and other sources. ST hereby expressly disclaims any responsibility for error, omission, or misinterpretation, and for any or all loss or damages caused by reliance on this license information. Confirmation of the accuracy of this license information should be confirmed independently by the licensee. It remains under responsibility of the licensee to ensure that all software obtained from this site is used in accordance with the appropriate license conditions, as provided from the original master source.

3.3 Host PC requirements

The SPEAr Linux Support Package (LSP2.3) for SPEAr family has been qualified on Fedora Core 11 Linux. Using the SPEAr software with other Linux distributions or older Fedora versions is feasible, but it could require additional preliminary activities, so it is not recommended.

Please note that the SELinux option has to be disabled.

3.4 The stmyum tool

Yum is an automatic updater and package installer/remover for RPM Linux host systems (like Fedora). It automatically computes dependencies and figures out what things should occur to install packages. Yum has a number of advantages over using RPM directly, such as:

- Automatic updates of installed packages
- Automatic checks for newly available and updated packages
- Automatic installation of all the dependency packages for each new package installed installation of groups of packages as a single unit
- Increased security as all packages are signed.

The SPEAr Linux Support Package (LSP2.3) relies on a slightly customized version of yum, known as stmyum, to ensure that it does not interfere with any native yum installation.

It is automatically installed under the path /opt/STM/STLinux-X.X/host/bin. The PATH environment variable must include this directory to be able to use it.

3.5 How to install the SPEAr Linux Support Package (LSP2.3)

The SPEAr Linux Support Package (LSP2.3) is needed to develop software running on a SPEAr target boards when embedded Linux is to be used as the target's operating system.

The SPEAr Linux Support Package (LSP2.3) is not needed in order to use the software pre-flashed on SPEAr boards or to update the Flash memory with default predefined contents.

Note: The SPEAr Linux Support Package (LSP2.3) software must be installed on a Linux PC. Windows® PCs are not supported.

3.5.1 First-time installation

To install the SPEAr Linux Support Package (LSP2.3) for the first time, perform the following steps:

1. Read the software licence agreement provided in *Appendix A: Software license agreement on page 38* of this manual.

Note: This Software License Agreement ("Agreement") is displayed for you to read prior to downloading and using the Licensed Software. If you choose not to agree with these provisions, do not download or install the enclosed Licensed Software and the related documentation and design tools. By using the Licensed Software, you are agreeing to be bound by the terms and conditions of this Agreement. Do not use the Licensed Software until you have read and agreed to the following terms and conditions. The use of the Licensed Software implies automatically the acceptance of the following terms and conditions.

2. Connect to the www.st.com and navigate to the product pages for **embedded microprocessors**. The link for downloading the SPEAr Linux Support Package (LSP2.3) can be found by navigating to the web page containing the literature and other resources for the related SPEAr device (product pages).

Note: To download the file, you have to use a browser running on the Linux development PC.

3. Click on link below to download the initial installation script to your Linux PC: install script download:

   ftp://stlinux.com/pub/stlinux/2.3/install

4. Run the downloaded script on your Linux PC as follows: ./install all-arm-spear

   This procedure automatically starts the overall download and installation of the required software components (remotely available as RPM packages). The entire procedure takes several minutes, depending on the network speed. The distribution is installed by default under path /opt/STM.

5. When the installation is completed, configure the Linux shell environment as follows:

   a) export PATH=$PATH:.:/opt/STM/STLinux-2.3/devkit/arm/bin:/opt/STM/STLinux-2.3/host/bin

   b) export CROSS_COMPILE=arm-linux-

   In order to preserve this configuration, the same commands should be also be put in a bash shell initialization file.

3.5.2 Keeping the distribution updated

After the first installation, any software update for the distribution is performed through the stmyum tool.

To update the distribution, use the following command line:

```
# stmyum update <packagename>
```

4 Working at application level (userland)

4.1 Workflow models

When working at application level (the so-called "userland") developers are only concerned with programs and libraries stored in a root filesystem. Instead, boot loaders and the kernel are assumed to be stable and stored in Flash memory.

There are many approaches (workflows) to modify/extend the root file system for specific application scenarios; the main ones are described in the following subsections.

4.1.1 Remote mounting of the root filesystem (NFS)

If the board can be connected to the development PC through a Ethernet LAN, the most practical solution is to leave the root filesystem stored on the PC and remotely mount it on the target embedded Linux OS through the NFS protocol.

The advantages of this approach are the following:

- The root filesystem has no global size constraints. Developers can keep hundreds or thousands of packages (programs and libraries) in a directory of their PC disk. All file access from the Linux OS running on the board is performed over the network in a transparent way. Files are not copied to Flash memory, but loaded to DDR RAM strictly on demand.
- A program or library can be simply built (compiled and linked) with the output file on the PC disk; the new version is then available for execution on the board without any need for manual transfer or board reboot

The drawbacks are:

- File access by NFS over LAN can be slower than direct Flash memory access
- There is no early assessment of which files are actually used and of the overall required size for future migration to Flash memory

To remotely mount the root filesystem, you have to configure and start the NFS server on Linux PC.

Assuming the NFS server functionality is already provided by your host, the only configuration is an entry for your target root directory to your /etc/exports file, for example:

/opt/STM/STLinux-2.3/devkit/arm/target 192.168.0.0/24 (rw,no_root_squash,sync)

This line exports the /opt/STM/STLinux-2.3/devkit/arm/target directory with read and writes permissions to all hosts on the 192.168.0.0 subnet.

To check NFS availability and start the services, use the following commands (from user root account):

```
# rpm -q nfs-utils
```

After modifying the /etc/exports file, you must make sure the NFS system is notified about the change, for example by running the command:

```
# service portmap start

Starting portmap: [ OK ]
```

followed by the command:

```
# service nfs start
Starting NFS services: [ OK ]
Starting NFS quotas: [ OK ]
Starting NFS daemon: [ OK ]
Starting NFS mountd: [ OK ]
```

Every time you change that file and NFS service was already started, you need either to restart it or to force NFS daemon to reload the new configuration:

```
# exportfs -a
```

4.1.2 Incremental changes to Flash filesystem

If the root filesystem is stored on Flash memory, it is possible to transfer files from the PC to the target board in the following ways:

- Transfer by USB pendrive
- Transfer by MMC/SD card
- Transfer by LAN (TFTP)

4.1.3 Flash filesystem full replacement

To replace the entire filesystem on Flash memory, you can:

- Rewrite the root filesystem partition by USB Flasher tool
- Rewrite the root filesystem partition from U-Boot

4.2 Command line cross-development

The most important item concerning host packages is the cross-development toolchain, a set of programs running on a host PC, but targeting ARM-specific code output with support for:

- Cross-compilation of source code to generate native object code for the ARM CPU cores integrated into SPEAr embedded MPU family
- Cross-linking of ARM object code to generate executable programs or (dynamically linkable) shared libraries
- Managing object code archives, incremental rebuilding and other auxiliary tasks

The provided toolchain is based on the widely adopted open source GNU toolset. A summary of the main available command-line tools is reported in *Table 1*. For detailed documentation please consult the GNU Web site: http://www.gnu.org/manual/manual.html.

Table 2. Main toolchain commands

Package	Tool	Description
GCC	gcc	C Cross-compiler for ARM
	gcov	Code coverage
binutils	ar	Archiver
	as	Cross-assembler for ARM
	gprof	Profiling tool
	ld	Cross-linker for ARM
	nm	Lists symbols in object files
	objcopy	Copies a binary file.
	objdump	Displays information from object files.
	ranlib	Generates an index to speed access to archives.
	readelf	Displays the information about the contents of ELF format files
	strip	Remove symbols and sections from files.
GNU Make	make	Incremental build management
GDB	gdb	Debugger

4.3 Using the graphical IDE

4.3.1 Launching ST Workbench

ST Workbench is an IDE (Interactive Development Environment) derived from the popular open source Eclipse tool, specifically targeted at cross compilation for ST products.

After the STLinux installation, it should be located under the path:

```
/opt/STM/STLinux-2.3/host/stworkbench
```

You can launch it from terminal or create a desktop launcher. For example, to create a desktop launcher on a Fedora PC:

1. Right-click on the Desktop and select "Create Launcher..."
2. In the "Name" field type "STWorkbench"
3. In the "Command" field type;
   ```
   opt/STM/STLinux-2.3/host/stworkbench/stworkbench
   ```
4. Select "OK"

Now double-click on the launcher icon on the desktop to start the application.

The first time you launch STWorkbench you need to configure at least one "workbench", a directory where your project will be stored: select a directory from the "Select Workspace" windows that appears. You can mark this as your default workbench that will be automatically used at startup selecting the "Use this as the default" checkbox.

From the "Welcome" window select the "Workbench" icon to enter the selected workbench.

4.3.2 Testing a simple application example

In order to check the STLinux installation and start to learn the environment, it is useful to write and test a simple user-space application. For example:

1. Right click in the "Project Explorer" window and select "New -> Project" from the menu
2. Select your programming language (for the purpose of this tutorial we use C)
3. Insert your Project name in "Project name" field ("Hello")
4. Select "Hello World ANSI C Project" as Project Type
5. Select "ARM926 Linux GCC" as toolchain
6. Click on "Finish"

In the Project Explorer you now see the newly created "Hello" project, with includes and a source file in the "src" subdirectory. To open the src/Hello.c file double-click on it. It is now ready to be modified.

4.3.3 Building a project

To build your project completely with the provided cross-compilation toolchain you can do one of the following:

- From the STWorkbench menu, select "Project -> Build Project"
  - Or -
- In the Project Explorer window, right click on your project name, then select "Build Project"
  Build messages are displayed in the "Console" tab at the bottom of the screen.

4.4 Userland packages

The general SPEAr Linux Support Package (LSP2.3) comes with a set of user-space packages prebuilt for the ARM target. This set includes programs and libraries for:

- Graphics: for example, X Server, SDL, Cairo, DirectFB, GTK+, Qt Embedded
- Programming language runtimes: for example, micro Perl
- Connectivity: for example, usblib, Bluetooth (Bluez)
- Multimedia frameworks: for example, ALSA, GStreamer
- Database: for example, sqlite
- Benchmarking tools: for example, IOZONE, netperf

Some of these packages are not supported on SPEAr evaluation boards yet, especially the ones requiring specific hardware for audio, video, wireless connectivity.

4.5 Rebuilding the root filesystem

The default root filesystem provided as pre-flashed on all SPEAr evaluation boards, as well as binary image on ST Web site for upgrades, is built for serial NOR Flash and formatted according to JFFS2 structure.

In order to rebuild this configuration, the procedure to be run on Linux host PC is as follows:

```
$ mkfs.jffs2 -n -p -l -s 0x200 -e 0x10000 -r $BUSYBOX/_install/ -o
rootfs_nor.img
```

The same procedure and results can be directly used in case of parallel NOR Flash, always assuming JFFS2. Note that there is no dependency on the specific SPEAr embedded MPU or evaluation board.

For evaluation boards provided with NAND Flash, there are two options: JFFS2 and YAFFS2.

In order to rebuild a JFFS2 root filesystem for NAND, the procedure to be run on Linux host PC is as follows:

```
$ mkfs.jffs2 -n -p -l -s 0x200 -e 0x4000 -r $BUSYBOX/_install/ -o
rootfs_nand_smallpage.img
```

In order to rebuild a YAFFS2 root filesystem for NAND, the procedure to be run on Linux host PC is as follows:

```
$ utils/mkyaffsimage 2 $BUSYBOX/_install/ rootfs_nand_smallpage.img
```

For all cases above, the root filesystem contents are assumed to be stored under the path:

```
$BUSYBOX/_install/
```

5 Working with customized kernels

When working with SPEAr evaluation boards, making modifications to supplied Linux kernel is only needed when:

- Changing kernel configuration, by enabling or disabling some options or features
- Developing new drivers on top of existing ones, in order to interface peripherals that can be added through custom add-on boards connected to SPEAr evaluation boards (where applicable)
- Rewriting partially or totally some existing reference device drivers (for example, for further optimization or special needs)
- Developing custom kernel modules

On the other hand, any other usage of kernel-level software with hardware platforms different from SPEAr evaluation boards is not discussed in this section.

When working at kernel level, developers are concerned with the kernel source code tree from which a single binary image file must be generated by "rebuilding" the kernel.

The main tasks to be performed are:

- Kernel reconfiguration
- Kernel rebuild
- Kernel loading and execution on a target evaluation board (different possible workflows)

For general information about Linux kernel, please refer to public Linux documentation.

For information about SPEAr-specific code integrated into Linux kernel, please refer to the Linux Support Package (LSP) user manual (UM0851).

5.1 Reconfiguring the kernel

The kernel configuration is managed with standard Linux Kernel configuration tools, like "make menuconfig".

Each SPEAr evaluation board has a default kernel configuration file in the kernel source tree directory arch/arm/configs, as shown in following table:

Table 3. Kernel configuration files

Evaluation board	Kernel configuration file
EVALSPEAR300	spear300_defconfig
EVALSPEAR310	spear310_defconfig
EVALSPEAR320PLC	spear320_defconfig
EVALSPEAR600	spear600_defconfig

To configure the kernel using a default configuration (for example, for SPEAr300), enter the kernel source tree directory and run the commands:

```
$ make distclean
```

```
$ make spear300_defconfig
```

To modify the default configuration, run from the terminal the "make menuconfig" tool in the kernel source tree root directory. Now you can change all the configuration options.

To navigate in the menu structure and change the options you need, use the arrows keys. When all changes are done, you can save the configuration and exit. The new configuration is saved in a hidden ".config" file. If you like, you can choose another name.

5.2 Rebuilding the kernel

After the configuration step is finished, kernel can be rebuilt with a "make" command:

```
$ make uImage
```

If you configured some components as modules, you also need a "make modules" command afterwards.

Time required for the build process is highly variable, depending on the number of features you choose during the configuration step and your PC speed (usually it takes some minutes).

When the build process is completed, you can find the kernel images in the arch/arm/boot subdirectory of the kernel tree, both as uncompressed (Image) and compressed (zImage, uImage) kernel image.

5.3 Workflow models

The kernel binary image is always generated on the development PC. However, there are many approaches (workflows) to make the kernel operating on the target evaluation board. The main ones are described in following subsections.

5.3.1 Booting the kernel on-demand

If the board can be connected to the development PC through an Ethernet LAN, one solution is to load the kernel binary image file just after reset by configuring U-Boot for automatic file transfer by TFTP protocol.

This approach is especially useful when frequently modifying the kernel, for instance during adaptations to a device drivers that are statically linked with kernel code.

To enable TFTP support on the development PC, you must make sure that the TFTP daemon program /usr/sbin/in.tftpd is installed. On Fedora Core systems you can verify this by running:

```
$ rpm -q tftp-server
```

If necessary, install the TFTP daemon program from your distribution media.

Most Linux distributions disable the TFTP service by default. To enable it, for example on Fedora systems, edit the file /etc/xinetd.d/tftp and remove the line

```
disable = yes
```

or change it into a comment line by putting a hash character in front of it. An example of TFTP file configuration is shown below:

```
service tftp
{
        socket_type             = dgram
        protocol                = udp
        wait                    = yes
        user                    = root
        server                  = /usr/sbin/in.tftpd
        server_args             = -c -v -s /tftpboot
        disable                 = no
        per_source              = 11
        cps                     = 100 2
        flags                   = IPv4
}
```

Also, make sure that the /tftpboot directory exists and is world-readable (permissions at least "dr-xr-xr-x"), and remember to disable the firewall if present (or make new rules to allow TFTP traffic).

The firewall can be disabled as in the following example command:

```
# /etc/init.d/iptables stop
```

Please note that server_args keeps the default search path for TFTP daemon. It is quite useful since on TFTP client side (target) we can specify file names omitting this path. After that you need to restart the xinetd daemon to force it to reload the new configuration. You need to type the following command from host PC prompt:

```
# service xinetd restart
Stopping xinetd: [OK]
Starting xinetd: [OK]
```

5.3.2 Updating the kernel on Flash memory by U-Boot

You can use U-Boot and TFTP transfer to write on Flash memory a new kernel image.

For example, use the following procedure to update the kernel on serial NOR Flash for the SPEAR300EVAL evaluation board:

1. Press a key to enter U-Boot autoboot
2. Configure network parameters (statically or with DHCP, see relevant sections)
3. Start the TFTP server on the host machine
4. Place the desired image in the host PC's TFTP root directory
   (for example, /tftpboot/uImage_new.img)
5. From U-Boot console, download the image to RAM (here we use address 0x0) with TFTP client:
   ```
   > tftp 0x0 uImage_new.img
   ```
6. Erase the specified kernel area on serial NOR:
   ```
   > erase 0:5-31
   ```
   Write the image on serial NOR (you need to know the image size). In this example we copied 1663104 bytes (0x196080 in hexadecimal) to the start of the kernel area on serial NOR (0xF8050000 in hexadecimal):
   ```
   > cp.b 0x0 0xF8050000 0x196080
   ```
7. Reboot the evaluation board

6 Rebuilding the bootloader

6.1 XLoader

The default XLoader provided as pre-flashed on all SPEAr evaluation boards, as well as binary image on ST Web site for upgrades, is built for serial NOR Flash.

If needed, the XLoader firmware image has to be rebuilt taking into account each specific embedded MPU and memory types. Therefore, there are many cases and relevant commands to be run on Linux PC, as described below.

EVALSPEAR300

```
$ make clean
$ make SOC=SPR300 DDRFREQ=333 DDRSIZE=128M
$ cp obj/xloader_image.bin
./../Flash/xloader/xloader_s300_333DDR.uimg
```

EVALSPEAR310

```
$ make clean
$ make SOC=SPR310 DDRFREQ=333 DDRSIZE=128M
$ cp obj/xloader_image.bin
../../Flash/xloader/xloader_s310_333DDR.uimg
```

EVALSPEAR320PLC

```
$ make clean
$ make SOC=SPR320 DDRFREQ=333 DDRSIZE=128M
$ cp obj/xloader_image.bin
../../Flash/xloader/xloader_s320_333DDR.uimg
```

EVALSPEAR600

```
$ make clean
$ make SOC=SPR600  DDRFREQ=333 DDRSIZE=128M
$ cp obj/xloader_image.bin
../../Flash/xloader/xloader_s600_333DDR_128M.uimg
```

6.2 U-Boot

The default U-Boot provided as pre-flashed on all SPEAr evaluation boards, as well as binary image on ST Web site for upgrades, is built for serial NOR Flash.

If needed, the U-Boot firmware image has to be rebuilt taking into account each specific embedded MPU and Flash memory type. Therefore, there are many cases and relevant commands as described below.

EVALSPEAR300

To rebuild U-Boot for serial NOR on a Linux host PC, run the following commands:

```
$ make mrproper; make spear300_config; make ENV=NOR
$ cp u-boot.img ../../Flash/uboot/uboot_s300_NOR.uimg
```

To rebuild U-Boot for NAND Flash on a Linux host PC, run the following commands:

```
$ make mrproper; make spear300_config; make ENV=NAND
$ cp u-boot.img ../../Flash/uboot/uboot_s300_NAND.uimg
```

EVALSPEAR310

To rebuild U-Boot for serial NOR on a Linux host PC, run the following commands:

```
$ make mrproper; make spear310_config; make ENV=SNOR FLASH=SNOR
$ cp u-boot.img ../../Flash/uboot/uboot_s310_SNOR.uimg
```

In order to rebuild U-Boot for parallel NOR on a Linux host PC, run the following commands:

```
$ make mrproper; make spear310_config; make ENV=PNOR FLASH=PNOR
$ cp u-boot.img ../../Flash/uboot/uboot_s310_PNOR.uimg
```

In order to rebuild U-Boot for NAND Flash on a Linux host PC, run the following commands:

```
$ make mrproper; make spear310_config; make ENV=NAND FLASH=NAND
$ cp u-boot.img ../../Flash/uboot/uboot_s310_NAND.uimg
```

EVALSPEAR320PLC

In order to rebuild U-Boot for serial NOR on a Linux host PC, run the following commands:

```
$ make mrproper; make spear320_config; make ENV=SNOR FLASH=SNOR
$ cp u-boot.img ../../Flash/uboot/uboot_s320_SNOR.uimg
```

EVALSPEAR600

In order to rebuild U-Boot for serial NOR on a Linux host PC, run the following commands:

```
$ make mrproper; make spear600_config; make ENV=NOR
$ cp u-boot.img ../../Flash/uboot/uboot_s600_NOR.uimg
```

In order to rebuild U-Boot for NAND Flash on a Linux host PC, run the following commands:

```
$ make mrproper; make spear600_config; make ENV=NAND
$ cp u-boot.img ../../Flash/uboot/uboot_s600_NAND.uimg
```

Appendix A Software license agreement

This Software License Agreement ("Agreement") is displayed for you to read prior to downloading and using the Licensed Software. If you choose not to agree with these provisions, do not download or install the enclosed Licensed Software and the related documentation and design tools. By using the Licensed Software, you are agreeing to be bound by the terms and conditions of this Agreement. Do not use the Licensed Software until you have read and agreed to the following terms and conditions. The use of the Licensed Software implies automatically the acceptance of the following terms and conditions.

A.1 Definitions

Licensed Software: means the enclosed demonstration software and all the related documentation and design tools licensed in the form of object and/or source code as the case maybe.

Product: means a product or a system that includes or incorporates solely and exclusively an executable version of the Licensed Software and provided further that such Licensed Software executes solely and exclusively on ST products.

A.2 License

STMicroelectronics ("ST") grants you a non-exclusive, worldwide, non-transferable (whether by assignment, law, sublicense or otherwise), revocable, royalty-free limited license to: (i) make copies, prepare derivatives works, display internally and use internally the source code version of the Licensed Software for the sole and exclusive purpose of developing executable versions of such Licensed Software only for use with the Product; (ii) make copies, prepare derivatives works, display internally and use internally object code versions of the Licensed Software for the sole purpose of designing, developing and manufacturing the Products; (iii) make, use, sell, offer to sell, import or otherwise distribute Products.

A.3 Ownership and copyright

Title to the Licensed Software, related documentation and all copies thereof remain with ST and/or its licensors. You may not remove the copyrights notices from the Licensed Software. You may make one (1) copy of the Licensed Software for back-up or archival purposes provided that You reproduce and apply to such copy any copyright or other proprietary rights notices included on or embedded in the Licensed Software. You agree to prevent any unauthorized copying of the Licensed Software and related documentation.

A.4 Restrictions

Unless otherwise explicitly stated in this Agreement, You may not sell, assign, sublicense, lease, rent or otherwise distribute the Licensed for commercial purposes, in whole or in part purposes (unless you are an authorized ST distributor provided that all the other clauses of this DEMO PRODUCT LICENSE AGREEMENT shall apply entirely).

You acknowledge and agree that any use, adaptation translation or transcription of the Licensed Software or any portion or derivative thereof, for use with processors manufactured by or for an entity other than ST is a material breach of this Agreement and requires a separate license from ST.

No source code and/or object code relating to and/or based upon Licensed Software is to be made available by You to any third party for whatever reason.

You acknowledge and agrees that the protection of the source code of the Licensed Software warrants the imposition of security precautions and You agree to implement reasonable security measures to protect ST's proprietary rights in the source code of the Licensed Software. You shall not under any circumstances copy, duplicate or otherwise reproduce the source code of the Licensed Software in any manner, except as reasonably necessary to exercise Your's rights hereunder and make one back-up copy. You are granted the right to make one archival or backup copy of the source code of the Licensed Software, which copy shall be marked as an archival copy and as the confidential information of ST. Access to the source code of the Licensed Software shall be restricted to only those of Your employees with a need-to-know for the purpose of this Agreement. You will not under any circumstances permit the source code of the Licensed Software in any form or medium (including, but not limited to, hard copy or computer print-out) to be removed from your official premises as you have informed us. The source code of the Licensed Software must remain inside your official premises, as you have informed us. You will lock the source code of the Licensed Software and all copies thereof in a secured storage inside your official premises at all times when the source code of the Licensed Software is not being used as permitted under this Agreement. You will inform all Your employees who are given access to the source code of the Licensed Software of the foregoing requirements, and You will take all reasonable precautions to ensure and monitor their compliance with such requirements. You agree to promptly notify ST in the event of a violation of any of the foregoing, and to cooperate with ST to take any remedial action appropriate to address the violation. You shall keep accurate records with respect to its use of the source code of the Licensed Software. In the event ST demonstrates to You a reasonable belief that the source code of the Licensed Software has been used or distributed in violation of this Agreement, ST may by written notification request certification as to whether such unauthorized use or distribution has occurred. You shall reasonably cooperate and assist ST in its determination of whether there has been unauthorized use or distribution of the source code of the Licensed Software and will take appropriate steps to remedy any unauthorized use or distribution. You agree that ST shall have the right (where ST reasonably suspects that the terms and conditions of this Agreement with reference to Restriction clause have not been complied with) upon reasonable notice to enter Your's official premises in order to verify your compliance with this Restriction clause.

A.5 No warranty

The Licensed Software is provided "as is" and "with all faults" without warranty of any kind expressed or implied. ST and its licensors expressly disclaim all warranties, expressed, implied or otherwise, including without limitation, warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights. ST does not warrant that the use in whole or in part of the Licensed Software will be interrupted or error free, will meet your requirements, or will operate with the combination of hardware and software selected by You.

You are responsible for determining whether the Licensed Software will be suitable for your intended use or application or will achieve your intended results.

ST has not authorized anyone to make any representation or warranty for the Licensed Software, and any technical, applications or design information or advice, quality characterization, reliability data or other services provided by ST shall not constitute any representation or warranty by ST or alter this disclaimer or warranty, and in no additional obligations or liabilities shall arise from ST's providing such information or services. ST does not assume or authorize any other person to assume for it any other liability in connection with its Licensed Software.

Nothing contained in this Agreement will be construed as : (i) a warranty or representation by ST to maintain production of any ST device or other hardware or software with which the Licensed Software may be used or to otherwise maintain or support the Licensed Software in any manner; and (ii) a commitment from ST and/or its licensors to bring or prosecute actions or suits against third parties for infringement of any of the rights licensed hereby, or conferring any rights to bring or prosecute actions or suits against third parties for infringement. However, ST has the right to terminate this Agreement immediately upon receiving notice of any claim, suit or proceeding that alleges that the Licensed Software or your use or distribution of the Licensed Software infringes any third party intellectual property rights. All other warranties, conditions or other terms implied by law are excluded to the fullest extent permitted by law.

A.6 Limitation of liabilities

In no event ST or its licensors shall be liable to You or any third party for any indirect, special, consequential, incidental, punitive damages or other damages (including but not limited to, the cost of labour, re-qualification, delay, loss of profits, loss of revenues, loss of data, costs of procurement of substitute goods or services or the like) whether based on contract, tort, or any other legal theory, relating to or in connection with the Licensed Software, the documentation or this Agreement, even if ST has been advised of the possibility of such damages.

In no event shall ST's liability to You or any third party under this Agreement, including any claim with respect of any third party intellectual property rights, for any cause of action exceed 100 US$. This section does not apply to the extent prohibited by law. For the purposes of this section, any liability of ST shall be treated in the aggregate.

A.7 Termination

ST may terminate this license at any time if You are in breach of any of its terms and conditions. Upon termination, You will immediately destroy or return all copies of the software and documentation to ST.

A.8 Applicable law and jurisdiction

In case of dispute and in the absence of an amicable settlement, the only competent jurisdiction shall be the Courts of Geneva, Switzerland. The applicable law shall be the law of Switzerland.

A.9 Severability

If any provision of this agreement is or becomes, at any time or for any reason, unenforceable or invalid, no other provision of this agreement shall be affected thereby, and the remaining provisions of this agreement shall continue with the same force and effect as if such unenforceable or invalid provisions had not been inserted in this Agreement.

A.10 Waiver

The waiver by either party of any breach of any provisions of this Agreement shall not operate or be construed as a waiver of any other or a subsequent breach of the same or a different provision.

A.11 Relationship of the parties

Nothing in this Agreement shall create, or be deemed to create, a partnership or the relationship of principal and agent or employer and employee between the Parties. Neither Party has the authority or power to bind, to contract in the name of or to create a liability for the other in any way or for any purpose.

Revision history

Table 4. Document revision history

Date	Revision	Changes
05-Nov-2009	1	Initial release.
21-May-2010	2	Removed section “User-space APIs”. Replaced “usb_flasher” by “flashing_util” and “flashing_util.zip” by “flashing_util.tar.gz”. Updated *Figure 2.8.1* and *Figure 9*.
18-Oct-2010	3	Updated procedure for downloading the SPEAr Linux Support Package (LSP2.3) in *Section 3.5: How to install the SPEAr Linux Support Package (LSP2.3) on page 25*. Added *Appendix A: Software license agreement on page 38*