



XAPP969 (v1.1) February 23, 2007

Getting Started with EDK and Linux 2.6

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Summary

This application note outlines the steps for setting up and using the Embedded Development Kit (EDK) and Linux 2.6. It shows how to set up a development environment and how to run Linux 2.6 on the embedded IBM PowerPC™ 405 (PPC405) processor available on the ML405 Evaluation Platform.

The document consists of the following sections:

- [“Introduction”](#)
- [“Installing the Software”](#)
- [“Setting up the Development Environment for Linux 2.6”](#)
- [“Starting a Design”](#)
- [“Building the Linux 2.6 Kernel”](#)
- [“Generating an ACE File and Booting Linux on ML405”](#)

Included Systems

This application note includes a Temac adapter in the following file:

www.xilinx.com/bvdocs/appnotes/xapp969.zip

Introduction

This application note outlines the steps for getting started with the EDK (8.2.02i version and later) and Linux 2.6 for both MontaVista and Wind River Linux distributions.

Table 1 lists the required tools for getting started.

Table 1: Required Tools

Item	Details
Host Workstation	A desk PC or a laptop with a CD-ROM drive and sufficient hard disk space. The WindRiver Linux Edition 1.3 can be installed on a Red Hat Enterprise Linux(RHEL) WorkStation(WS) 3, update 5, and WS 4, update 1, for the Intel X86 platform. The MontaVista Linux Professional Edition 4.0.1 can be installed on Microsoft Windows 2000 XP SP1 & SP2, Red Hat 9.0, RHEL WS 3, RHEL ES 3, Solaris 8, Suse Pro 9.2, and Suse Enterprise 9.2 for the Intel X86 platform.
CompactFlash writer	A CompactFlash writer. Most of these writers are USB-based.
ML405 including the factory Compact Flash card	See http://www.xilinx.com/ml405 .
Xilinx ISE installation CDs	See http://www.xilinx.com/ise to purchase or evaluate the latest Xilinx ISE tools.

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Table 1: Required Tools (Contd)

Item	Details
Xilinx EDK installation CDs	See http://www.xilinx.com/edk to purchase or evaluate the latest Xilinx EDK tools.
Linux 2.6 CDs and patches	MontaVista Professional Edition 4.0.1 for Xilinx ML40X LSP Installation CDs or Wind River Linux Edition 1.3 Installation CDs and ML405 BSP patches

Installing the Software

Installing Xilinx ISE

Insert the ISE CD into the CD-ROM drive and follow the installation instructions. When finished, install any required Service Packs.

Installing Xilinx EDK

Insert the EDK CD into the CD-ROM drive and follow the installation instructions. When finished, install any required Service Packs.

Installing Linux 2.6

Installing MontaVista Linux Professional Edition 4.0.1 for ML40x

Follow the installation instructions given in the *MontaVista® Linux® Professional Edition 4.0* which is available on the MontaVista website at www.mvista.com.

Install the following CDs:

1. MontaVista Pro 4.0.1 Host Binaries CD for ppc_405
2. MontaVista Pro 4.0.1 Cross Binaries CD for ppc_405
3. MontaVista Pro 4.0.1 Target Binaries CD for ppc_405
4. MontaVista Pro 4.0.1 Xilinx ML40x LSPS CD

The installation of the following CDs is optional:

1. MontaVista DevRocket Version 2.0.1 CD
2. MontaVista Pro 4.0.1 Documentation CD

Installing Wind River Linux Edition 1.3

Follow the installation instructions given in the *Wind River Linux Platforms Getting Started 1.3* which is available on the Wind River website at www.windriver.com.

Install the following CDs:

1. Wind River Workbench 2.5.0.2.
Note: Install this CD first. The installation directory must be specified by the user during the setup.
2. Wind River GNU Compiler 3.4.4 for All Platforms, Linux Edition 1.3 for All Architectures
3. Setup Files, Utilities, Reference Source, and Documentation for All Platforms, Linux Edition 1.3 for All Architectures
4. Cross Build System for BusyBox Root File Systems for All Platforms, Linux Edition 1.3 for MIPS and PowerPC
5. Cross Build System for Standard Root File System for All Platforms, Linux Edition 1.3 for PowerPC

Apply the following patches:

1. Apply the PPC405 Architecture Support Patch required by Xilinx ML300/ML403. The patch is available on the Wind River website as a zip file (gppl_pnele_1_3-ppc405_common.zip). Follow the instructions in the zip file for applying the patch
2. Apply the GPP-LE 1.3 for Xilinx ML403 BSP patches: The patches are available on the Wind River website as a zip file (gppl_pnele_1_3-xilinx_ml403.zip). Follow the instructions in the zip file for applying the patch

Setting up the Development Environment for Linux 2.6

Set up the development environment for Linux 2.6 before starting the design.

Create a project directory called `m1405_demo`. From this point on, this project directory is referred to as `<edk_proj>`. Create a subdirectory named `linux` in `<edk_proj>`.

Setting Up the Development Environment for MontaVista Pro 4.0.1 Linux

1. Open a new shell on the Host PC and set up the environment by executing the following commands:

```
$ cd <edk_proj>/linux
$ export PATH=$PATH:/opt/montavista/pro/devkit/ppc/405/bin
```

Note: It is assumed that the MontaVista Pro 4.0.1 has been installed in the `/opt/montavista` directory. If MontaVista Linux has been installed on a Windows machine, the commands to open a new must be run on a MontaVista Cygwin shell.

2. Copy the Xilinx ML40x LSP to the linux subdirectory of the project directory by executing the following commands in the shell:

```
$ tar cf - -C /opt/montavista/pro/devkit/lsp/xilinx-ml40x-ppc_405/linux-2.6.10_mv1401 . | tar xf -
```

Setting Up the Development Environment for Wind River Linux Edition 1.3

1. Open a new shell on the Host PC and set up the environment by executing the following commands:

```
$ cd <edk_proj>/linux
$ <WINDRIVER_INSTALL_DIR>/wrenv.sh -p wrlinux-1.3
```

Note: Read the `<WINDRIVER_INSTALL_DIR>/readme.txt` file for more information on running the Wind River tools.

2. If `perl` is invoked from the current shell, confirm that `/usr/bin/perl` is executed. Otherwise, BSP building process may abort with errors.

```
$ which perl
```

3. Copy the Xilinx ML403 BSP to the linux directory in the project directory by executing the following command:

```
$ <WINDRIVER_INSTALL_DIR>/wrlinux-1.3/wrlinux/configure --enable-kernel=cgl --enable-board=xilinx_ml403 --enable-rootfs=glibc_full
```

4. Build the linux kernel tree and root file system by running the following command in a shell opened on the Host PC in the `<edk_proj>/linux` directory:

```
$ make all 2>&1 | tee linux_and_fs.log &
```

5. Follow the instructions given in *Chapter 4. Deployment of the Wind River Linux Platforms Getting Started 1.3* to deploy the root file system.

Starting a Design

This section outlines the steps to create the hardware design, to generate the Linux 2.6 BSP, and to generate the hardware bitstream for the ML405 evaluation platform.

Building the PowerPC 405 system for ML405

Start the Xilinx Platform Studio (XPS) and create the EDK project in the <edk_proj> directory.

Using the Base System Builder

1. Click **OK** to start a new design with the Base System Builder wizard.
2. In the Create New XPS Project Using BSB Wizard window, click **OK** to accept the default settings.
3. In the Base System Builder - Welcome window, click **Next** to create a new design.
4. In the Base System Builder - Select Board window, choose the target board. Select **Xilinx** as the Board Vendor. Select **Virtex 4 ML405 Evaluation Platform** as the Board Name. Click **Next** to accept these settings.
5. In the Base System Builder - Select Processor window, click **Next** to accept the PowerPC controller as the processor for the design.
6. In the Base System Builder - Configure PowerPC window, select the processor and bus frequencies to run. Select **200.00 MHz** for the Processor Clock Frequency and **66.67 MHz** for the Bus Clock Frequency. Click **Next** to accept these settings.

Selecting Configuration Options

The configuration options for the I/O interfaces are displayed in the subsequent windows. The number of windows displayed depends on the screen resolution. Click **Next** to advance to the next window. Accept the parameters at their default values while making the following selections:

- Enable **RS232 UART**, choose **OPB UART 16550** as Peripheral, select **Configure as UART 16550**, and select **Use Interrupt**.
 - Disable **LEDs 4Bit**
 - Disable **LEDs Position**
 - Disable **Push Buttons Position**
 - Enable **IIC EEPROM** and select **Use Interrupt**
 - Enable **SysACE CompactFlash** and select **Use Interrupt**
 - Disable **Cypress USB**
 - Enable **DDR SDRAM 64Mx32**, and choose **PLB DDR** as Peripheral
 - Disable **Ethernet MAC**
 - Enable **TriMode MAC GMII**, choose **PLB TEMAC** as Peripheral, choose **Scatter gather DMA**, and select **Use Interrupt**
 - Disable **TriMode MAC GMII**
 - Disable **SRAM 256Kx32**
 - Disable **FLASH 2Mx32**
1. In the Click **Next** to accept the default settings in the Base System Builder - Add Internal Peripherals window.
 2. In the Base System Builder - Software Setup window, disable the **Sample application selection** for both the Memory test and Peripheral selftest. Click **Next**.
 3. In the Base System Builder - System Created window, where an overview of the system is shown, click **Generate** to write the configuration to the disk.
 4. In the Base System Builder - Finish window, click **Finish** to complete the Base System Builder.

Modifying the Software Settings

After returning from Base System Builder to Xilinx Platform Studio, the user has a complete hardware project. Make the changes outlined in the subsequent steps to the software part of the project to automatically generate a Linux Board Support Package (BSP).

1. In XPS, select **Software**→**Software Platform Settings** to open the software settings dialog box.
2. In the OS & Library Settings section of the dialog box, choose **linux_2_6** as the operating system (OS) and **1.00.a** as the OS Version.
3. Click on the OS and Libraries pane for setting some additional parameters necessary for generating the Linux BSP.
 - a. Click the button in the `connected_periphs` field. In the Add/Delete List of Parameter-Values dialog box. The following list of peripherals is displayed:
 - RS232_Uart
 - IIC_EEPROM
 - SysACE_CompactFlash
 - TriMode_MAC_GMII
 - opb_intc_0Click **OK** to accept the settings in the Add/Delete List of Parameter-Values window.
 - b. The ML405 has 64 MB of memory. Enter `0x04000000` to the memory size parameter to assign all the memory for Linux.
 - c. Set the `uart16550` bus clock freq parameter to the same value as the Bus Clock Frequency in the Base System Builder. Enter `66666667` into this field.
 - d. The target directory parameter specifies the location where the Linux BSP is copied. Copy the Linux BSP directly into the Linux kernel being used for the design. Enter `<edk_proj>/linux` for MontaVista Linux and `<edk_proj>/linux/dist/linux-2.6.14-cgl` for Wind River Linux.

Note: Do not change the values for the remaining parameters.
4. In the Software Platform Settings window, click **OK** to accept the settings.
5. Click on the Applications tab, right-click on `Default:ppc405_0_bootloop`, and enable **Mark to Initialize BRAMs**.

All the hardware and software settings for the project have been successfully set up.

Building the BSP and Hardware

First generate the Linux BSP and then implement the hardware to be able to work on the Linux kernel while EDK builds the hardware.

1. Build the Linux BSP by selecting **Software**→**Generate Libraries and BSPs** from the menu. By scrolling through the log window, the user is able to see that the Linux BSP has been built.
2. Copy the Temac adapter attached with this application note to the `<edk_proj>/linux/linux-2.6.10_mv1401/drivers/net/xilinx_temac` directory for MontaVista Linux or to the `<edk_proj>/linux/dist/linux-2.6.14-cgl/drivers/net/xilinx_temac` directory for Wind River Linux.

Note: This step is not necessary for EDK versions later than 8.2.02i.
3. Build the hardware bitstream by selecting **Device Configuration**→**Update Bitstream** from the menu.

Building the Linux 2.6 Kernel

Building the MontaVista Pro 4.0.1 Kernel for ML405

To build the linux kernel, run the following commands in the shell opened on the Host PC in the <edk_proj>/linux directory:

```
$ export PATH=$PATH:/opt/montavista/pro/devkit/ppc/405/bin
$ make bzImage
```

Note: These commands are run on a MontaVista Cygwin shell if MontaVista Linux has been installed on a Windows machine.

Building the Wind River Linux Edition 1.3 Kernel for ML405

Rebuild the linux kernel by running the following commands in the shell opened on the Host PC in <edk_proj>/linux directory:

```
$ <WINDRIVER_INSTALL_DIR>/wrenv.sh -p wrlinux-1.3
$ make -C dist linux.rebuild 2>&1 | tee linux.kernel.log &
```

Generating an ACE File and Booting Linux on ML405

The hardware bitstream created with the hardware design and the ELF file created when compiling Linux are combined into an ACE file. The ACE file will then be stored on the Compact Flash that is shipped with the ML405 and the kernel booted.

Generating an ACE File for MontaVista Pro 4.0.1 Kernel

To generate the ACE file (top.ace), open the EDK shell by selecting **Project**→**Launch EDK Shell** and execute:

```
$ xmd -tcl genace.tcl -jprog -board ml405 -hw
implementation/download.bit -elf
linux/arch/ppc/boot/images/zImage.elf -ace top.ace
```

Booting MontaVista Pro 4.0.1 Linux on ML405

Insert the Compact Flash from the ML405 into the Compact Flash card writer. Copy the top.ace file into the ml405/myace directory of the compact flash. Remove any other ACE files in the myace directory.

Remove the Compact Flash from the Compact Flash writer and plug it into the System ACE CF slot of the ML405 board. Set the System ACE CF switch on the ML405 board to **System ACE** and apply power to the board. Set the terminal to **9600, 8N1**, and **no handshake**.

In the bootup menu, select the option **My own ACE file**. The user can observe the Linux boot.

Login with username as **root** using the password **405m1** for the root account.

Generating an ACE File for Wind River Linux Edition 1.3 Kernel

The file system on the Compact Flash provided with the ML405 board does not work for the WindRiver Linux Edition 1.3. To deploy the root file system on the Compact Flash, follow the instructions given in *Chapter 4. Deployment of the Wind River Linux Platforms Getting Started 1.3*.

To generate the top.ace ACE file, open the EDK shell by selecting **Project**→**Launch EDK Shell** and executing:

```
$ xmd -tcl genace.tcl -jprog -board ml405 -hw
implementation/download.bit -elf linux/dist/linux-2.6.14-
cgl/arch/ppc/boot/images/zImage.elf -ace top.ace -start_address
0x00400000 -target ppc_hw
```

Booting Wind River Linux Edition 1.3 on ML405

Insert the Compact Flash from the ML405 into the Compact Flash card writer. Copy the `top.ace` file into the `ml405/myace` directory of the compact flash. Remove any other ace files in the `myace` directory.

Insert the Compact Flash from the Compact Flash writer into the System ACE CF slot of the ML405 board. Set the System ACE CF switch on the ML405 board to **System ACE** and apply power to the board. Set the terminal to **9600, 8N1**, and **no handshake**.

In the bootup menu, select the option **My own ACE file**. The user can observe the Linux boot. Log in with username as `root` using the password `root` for the root account.

Conclusion

This application note describes the steps necessary setting up and using the Embedded Development Kit (EDK) and Linux 2.6 from installation to booting the Linux kernel on a PowerPC 405 processor available on the ML405 Evaluation Platform.

References

1. *ML405 Development System*, Xilinx, Inc., <http://www.xilinx.com/ml405>
2. *MontaVista Linux Professional Edition 4.0.1*
3. *Wind River Linux Platforms Getting Started 1.3*
4. *Automatic Generation of Linux 2.6 Board Support Packages* in the OS and Libraries Document Collection, provided as a part of the EDK installation in `/doc/oslib_rm.pdf`.

Revision History

The following table shows the revision history for this document.

Date	Version	Revision
12/4/06	1.0	Initial Xilinx release.
2/23/07	1.1	Revised from ML403 Evaluation Platform to ML405 Evaluation Platform. Included <code>adapter.c</code> source.