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Getting Started with EDK and Wind River VxWorks

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Summary

This application note covers the steps necessary to set up and run Wind River VxWorks using the Embedded Development Kit (EDK). It covers installation, setup, building a system using the EDK, generating and modifying the VxWorks BSP, and booting VxWorks on the Virtex-II Pro™ ML300 Platform.

Introduction

The Embedded Development Kit (EDK) enables developers to jump-start their designs by providing a VxWorks BSP tailored to their system specifications. The application note is targeted to the Virtex-II Pro ML300 development platform, but can easily be ported to a different platform due to the flexibility of the EDK. The application note provides the necessary steps to get started with the EDK and Tornado 2.2.1/VxWorks 5.5.1 from installation to booting VxWorks on the ML300. When using a different hardware platform, access to serial and Ethernet ports is recommended.

The automatic VxWorks BSP generation is documented in Chapter 13 of the *Processor IP Reference Guide* in the EDK doc directory. The EDK release also contains pre-configured BSPs for the ML300 which are documented in Chapter 11 of the *Processor IP Reference Guide*.

The host system used is Microsoft Windows XP with system administrator privileges. Make sure that the computer used meets the system requirements for the Xilinx and Wind River tools.

Table 1 provides a timetable for each step covered in this application note. Table 2 lists the tools needed to complete the design.

Table 1: **Task Timetable**

Steps	Details	Time Required (in Minutes)
Install ISE 6.3i and service pack	Install the implementation software	40
Install EDK 6.3i and service pack	Install the embedded development software	20
Install Tornado 2.2.1	Install the Wind River tools	15
Build an ML300 design	Use Base System Builder in EDK 6.3i to build a custom system	55
Customize the VxWorks BSP	Modify the automatically generated BSP	10
Build the VxWorks kernel	Use Tornado to create and customize a VxWorks image and bootrom	15
Create an ACE file	Create a configuration file for the ML300	5
Boot VxWorks	Run VxWorks on the ML300	15

Table 2: **Required Tools**

Item	Details
Workstation	Use a PC or laptop with a CD-ROM and sufficient hard drive space to install the required software
CompactFlash writer or PC card adapter	For PCs, use a CompactFlash writer. For laptops, use the CF card adapter that shipped with the ML300
ML300 board	Virtex-II Pro ML300 platform
Cables	Use the serial and Ethernet cross-over cables provided with the ML300 kit
Xilinx ISE 6.3i for Windows Installation CDs	See http://www.xilinx.com/products/design_resources/design_tool/index.htm to purchase ISE Foundation 6.3i
Xilinx ISE 6.3i Service Pack 2 for Windows	See http://www.xilinx.com/xlnx/xil_sw_updates_home.jsp to download the service pack
Xilinx EDK 6.3i Installation CD for Windows	See http://www.xilinx.com/ise/embedded/edk_buynow.htm to purchase Xilinx EDK 6.3i
Xilinx EDK 6.3i Service Pack 1 for Windows	See http://www.xilinx.com/ise/embedded/edk_download.htm to download the service pack
Wind River Tornado 2.2.1/ VxWorks 5.5.1 for PowerPC Installation CD	Order TDK-15060-ZC-00 from Wind River
Wind River BSPs/Drivers for VxWorks 5.5.1 PowerPC Installation CD	Order TDK-14630-ZC-02 from Wind River

Installing the Software

Installing Xilinx ISE 6.3i

Make sure to register the Xilinx ISE and EDK software and write down the registration IDs.

Insert the first CD of ISE 6.3i into the CD-ROM drive and follow the installation instructions. When finished, insert the second CD of ISE 6.3i into the CD-ROM drive and complete the installation.

Continue with the ISE 6.3i Service Pack 2 installation by double-clicking on the downloaded image. Follow the installation instructions.

Installing Xilinx EDK 6.3i

Insert the EDK 6.3i CD into the CD-ROM drive and follow the installation instructions. When finished, install the EDK 6.3i Service Pack 1 by double-clicking on the downloaded image.

Installing Wind River Tornado

Insert the Core Tornado 2.2 CD into the CD-ROM drive. Select a full installation and follow the installation instructions. The license number and number of seats is shown on the Tornado Installation Keys form that shipped with the CDs. Install the default selection for components and parts. Tornado requires a license, so follow the steps to request an automatic license. If using a floating license, a license server must be installed and available on the network.

After completing the license registration process, continue by installing the BSP/driver CD.

Restart the computer.

Starting a Design

Building the PowerPC System for the ML300

The first step is to create a processor system that can be loaded into the FPGA using the EDK. Launch *Xilinx Platform Studio:*

Start Menu → All Programs → Xilinx Platform Studio 6.3i → Xilinx Platform Studio

The EDK provides a wizard called Base System Builder (BSB) which helps users build a system targeted at a specific development board.

Using Base System Builder

1. Select **Base System Builder Wizard**, then click **OK**.
2. The *Create New Project Using Base System Builder Wizard* window pops up. Select a directory for the project. Click **OK**, then click **Next**.
3. The *Base System Builder - Select Board* window lets you choose your target board. Select **Xilinx** as the Board Vendor. Select **Virtex-II Pro ML300 Evaluation Platform** as the Board Name. Click **Next** to accept these settings.
4. In the *Base System Builder - Select Processor* window, click **Next** to use the PowerPC as the processor for this design.
5. The *Base System Builder - Configure Processor* window lets you select the processor and bus frequencies you want to run at. Select **200 MHz** for the Processor Clock Frequency and **66.67 MHz** for the Bus Clock Frequency. Leave the other parameters at their defaults. Click **Next** to accept these settings.

   Choosing higher bus and system speeds would result in longer implementation times. The caches would be enabled using the Tornado project facility.

Selecting Configuration Options

The next few windows present configuration options for the I/O interfaces. The number of windows seen depends on the monitor screen resolution. Click **Next** to advance to the next window.

1. Leave the parameters at their defaults while making the following selections:
   - Enable **RS232 UART 1**, choose **OPB UARTLITE** as Peripheral, select **Configure** with **19200** baud rate, and select **Use Interrupt**
   - Disable **RS232 UART 2**.
   - Enable **Ethernet MAC**, choose **OPB ETHERNET** as Peripheral, and select **Use Interrupt**
   - Enable **DDR SDRAM 32Mx32**, and choose **PLB DDR** as Peripheral
   - Disable **SPI EEPROM**
   - Enable **LEDs 16Bit**
   - Enable **Push Buttons 16Bi**t
   - Enable **Proto Pins LEDs 32Bit**
   - Disable **PCI Arbiter**.
   - Disable **PCI32 Bridge**.
   - Disable **SysACE CompactFlash**
   - Disable **IIC Bus**

   Click **Next** to accept the default settings in the *Base System Builder - Add Internal Peripherals* window.
2. In the *Base System Builder - Software Configuration* window, disable **Generate Sample Application and Linker Script**. Click **Next**.

3. The *Base System Builder - System Created* window shows an overview of the system. Click **Generate** to write the configuration to the disk.
4. Click **Finish** in the *Base System Builder - Finished!* window to complete the *Base System Builder* project.

Modifying the Software Settings

Base System Builder created a complete hardware system with the peripherals specified above. The next few steps are required to change some of the project software options to automatically generate a VxWorks board support package (BSP).

1. Open the software settings dialog box by selecting **Project** → **Software Platform Settings…** from the XPS menu.
2. Choose **VxWorks5_5** as the operating system (OS) in the Kernel and Operating Systems section of the dialog box.
3. Click on the **Library/OS Parameters** tab to set additional parameters necessary for generating the VxWorks BSP.

Setting Additional Parameters

1. Select the **RS232 Uart** for both STDIN and STDOUT.
2. Click on the Current Value box for the connected_periphs option. Click **Add** two times. For each field, select a different peripheral from the drop-down list. The list contains `RS232_Uart_1` and `Ethernet_MAC`. Click **OK**.
3. Click **OK** to accept the settings in the *Software Platform Settings* window.
4. Click on the **Applications** tab, right-click on **Default:ppc405_0_bootloop**, and enable **Mark** to Initialize BRAMs.

Building the BSP and Hardware

To be able to work on the VxWorks kernel while EDK builds the hardware, first generate the VxWorks BSP and then implement the hardware.

1. Build the VxWorks BSP by selecting **Tools** → **Generate Libraries and BSPs** from the menu. The transcript window indicates that the VxWorks BSP has been built.
2. Build the hardware by selecting **Tools** → **Update Bitstream** from the menu. This takes some time. Use this time to customize the BSP and build the VxWorks kernel.

Customizing the Generated VxWorks BSP

Some parameters need to be changed to customize the VxWorks BSP for the system. The `BSP` directory is located inside the XPS project `ppc405_0` directory under the name `bsp_ppc405_0`. The DDR memory is used to store the VxWorks bootrom and the VxWorks image.

1. Open the `config.h` file inside the directory.
   - Change the default memory size

     ```
     #define LOCAL_MEM_SIZE  0x08000000
     ```

   - Change the ROM address settings

     ```
     #define ROM_BASE_ADRS   0x00C00000
     ```

   - Change the RAM address settings

     ```
     #define  ROM_SIZE       0x00800000
     #define  RAM_HIGH_ADRS  0x00C00000
     #define  RAM_LOW_ADRS   0x00010000
     ```

2. Open the `Makefile` file.
   - Change the memory settings to match the `config.h` file

```
ROM_TEXT_ADRS      = 00C00000
ROM_WARM_ADRS      = 00C00008
ROM_SIZE           = 00800000
RAM_LOW_ADRS       = 00010000
RAM_HIGH_ADRS      = 00C00000
```

3. Open the `sysNet.c` file.
   - Enter the address from the ML300 board. The Ethernet address is located on the backside below the Xilinx logo. For an address of `000A35000102` it would be:

```
Static char XemacMacAddr0[6] = {0x00, 0x0A, 0x35, 0x00, 0x01,
0x02}
```

Building the VxWorks Image

VxWorks can be built either in command line mode or GUI mode using the Tornado project facility. The project facility is used to compile the BSP and add components to the image.

Compiling the BSP

1. Copy the `bsp_ppc405_0` directory to the `target\config` directory of the Tornado installation.
2. Start Tornado and select **Create a Bootable VxWorks Image**.
3. Enter a project name and path location, then click **Next**.
4. Click on **A BSP**, then select **bsp_ppc405_0** and **gnu** for the Tool field. Click **Next**, then **Finish**.

Configuring the VxWorks Image

After the BSP is compiled successfully, the *Workspace* window opens. Depending on the application, some components need to be included or excluded. As an example, the Target Shell is added to the image:

1. Select the **VxWorks** tab in the *Workspace* window. The components already selected appear in bold. Open the component tree. To display a component description, double-click on the component name.
2. Open *Development Tool Components*.
3. Right-click on **Target Shell Components**. Select **Include 'target shell components'…**
4. Click **OK** twice.

Building the VxWorks Image and Bootrom

The default VxWorks image is RAM-based and can be loaded using SystemACE, a debugger, or through a VxWorks boot ROM. Using a boot ROM provides a choice in loading the VxWorks image through FTP or with SystemACE when configured as a block device. For the ML300 both the image and boot ROM reside in the DDR memory.

1. Select **Build** → **Build**
2. Select **Build** → **Build Boot ROM…**
3. Select **bsp_ppc405_0**, **bootrom_uncmp**, and **GNU** for the toolchain. Click **OK**.

Generating an ACE File for the ML300

Wait for the Update Bitstream process to be finished before starting. The ACE file contains the bitstream for the FPGA configuration and the VxWorks bootrom executable. The ACE file is stored on the MicroDrive shipped with the ML300. At power-up, the SystemACE controller configures the FPGA then load the VxWorks boot ROM into memory using JTAG commands.

1. Copy the `bootrom_uncmp` image from the Tornado `target\config\bsp_ppc405_0` directory to the XPS project root directory.
2. To generate the ACE file, open a XYGWIN shell using XPS, **Tools** → **Xygwin Shell**.
3. Execute:

```
$ xmd -tcl genace.tcl -jprog -board ml300
-hw implementation/download.bit -elf bootrom_uncmp -ace top.ace
```

4. Connect the MicroDrive to the computer and copy the `top.ace` file into the `XILINX\myace` directory if using the original ML300 CF image. Otherwise, copy the `top.ace` file to the root directory of the CF card. Remove any other `.ace` or `.sys` files.
5. Remove the Microdrive from the CompactFlash writer and plug it into the System ACE CF slot of the ML300. Set the System ACE CF dial to four.

Booting VxWorks on the ML300

1. Connect a serial cable between the ML300 and the host computer.
2. Connect the Ethernet cross-over cable between the ML300 and the host computer.
3. Start HyperTerminal or any other terminal program and connect at 19200 bauds, 8 bits, no parity, 1 stop bit, and no flow control.
4. Power the ML300 board. After a few seconds, the VxWorks boot loader appears in the console window. Press a key to stop the automatic countdown.
5. Press **p** to display the boot parameters. Press **c** to change the default settings if needed. The host computer IP address must be set to **192.168.0.1**.
6. Start the Wind River FTP Server, WFTPD, on the host computer. Select **Security** → **User/rights…** Add a new user called **xemhost** and set the Home Directory to the VxWorks image directory. The VxWorks image is located inside the default directory where the project location was specified in step 3 of "Compiling the BSP." Click **Done**.
7. In the terminal window, press **@** to load the VxWorks image through FTP.
8. After a few seconds, VxWorks boots and the Target Shell appears.

References

1. ML300 evaluation platform website, http://www.xilinx.com/ml300
2. EDK website, http://www.xilinx.com/edk
3. EDK documentation, http://www.xilinx.com/ise/embedded/edk_docs.htm
4. Tornado *Getting Started Guide*
5. Tornado *User's Guide*
6. VxWorks *Programmer's Guide*

Revision History

The following table shows the revision history for this document.

Date	Version	Revision
11/22/04	1.0	Initial Xilinx release.