

Getting Started with the MicroBlaze Development Kit - Spartan-3E 1600E Edition

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Revision History

The following table shows the revision history for this document.

	Version	Revision
08/22/06	1.0	Initial Xilinx release.
11/06/06	1.1	Updated command code in the Generating the MFS Image section of Chapter 3.
4/24/07	1.2	Updated for EDK 9.1i
11/30/07	1.3	Updated for EDK 9.2.01i

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About This Guide

The MicroBlaze™ Development Kit - Spartan™-3E 1600E Edition showcases various features of the SP3E1600E Development Platform. This kit includes reference systems and demonstrations. This document describes how to use and run them.

Guide Contents

This manual contains two chapters:

- [Chapter 1, “MicroBlaze Development Kit - Getting Started,”](#)
- [Chapter 2, “MicroBlaze Development Kit BlueCat Linux Reference System,”](#)

Additional Resources

To search the database of silicon and software questions and answers, or to create a technical support case in WebCase, see the Xilinx website at: <http://www.xilinx.com/support>.

Conventions

This document uses the following conventions. An example illustrates each convention.

Typographical

The following typographical conventions are used in this document:

Convention	Meaning or Use	Example
Courier font	Messages, prompts, and program files that the system displays	<code>speed grade: - 100</code>
Courier bold	Literal commands that you enter in a syntactical statement	ngdbuild <i>design_name</i>
Helvetica bold	Commands that you select from a menu	File → Open
	Keyboard shortcuts	Ctrl+C

Convention	Meaning or Use	Example
Italic font	Variables in a syntax statement for which you must supply values	<code>ngdbuild design_name</code>
	References to other manuals	See the <i>Development System Reference Guide</i> for more information.
	Emphasis in text	If a wire is drawn so that it overlaps the pin of a symbol, the two nets are <i>not</i> connected.
Square brackets []	An optional entry or parameter. However, in bus specifications, such as <code>bus [7:0]</code> , they are required.	<code>ngdbuild [option_name] design_name</code>
Braces { }	A list of items from which you must choose one or more	<code>lowpwr = {on off}</code>
Vertical bar	Separates items in a list of choices	<code>lowpwr = {on off}</code>
Vertical ellipsis .	Repetitive material that has been omitted	IOB #1: Name = QOUT' IOB #2: Name = CLKIN' . . .
Horizontal ellipsis ...	Repetitive material that has been omitted	<code>allow block block_name loc1 loc2 ... locn;</code>

Online Document

The following conventions are used in this document:

Convention	Meaning or Use	Example
Blue text	Cross-reference link to a location in the current document	See the section “ Additional Resources ” for details. Refer to “ Title Formats ” in Chapter 1 for details.
Red text	Cross-reference link to a location in another document	See Figure 2-5 in the <i>Virtex-4 User Guide</i> .
Blue, underlined text	Hyperlink to a website (URL)	Go to http://www.xilinx.com for the latest speed files.

MicroBlaze Development Kit - Getting Started

Overview

The MicroBlaze™ Development Kit - Spartan™-3E 1600E Edition is designed to aid the user in utilizing the SP3E1600E development board more efficiently. This getting started guide provides a detailed description of what is included in the kit along with instructions on how to use the resources included in this kit. The development kit comes with a number of pre-installed demonstrations and examples. This document describes how to use and run them.

The development kit includes reference systems and demonstrations. These Reference systems are available from the Xilinx Spartan-3E MicroBlaze Development Kit Reference Designs website:

http://www.xilinx.com/products/boards/s3e1600e/reference_designs.htm

The demo systems are also pre-loaded in the Xilinx Platform Flash and the Intel StrataFlash on the development board. Please read the remainder of the document for specific details on these resources.

The reference systems included in this kit require the use of a computer installed with the following software:

- Integrated Software Environment™ (ISE) 9.2i, including Service Pack 3
- Xilinx Embedded Development Kit (EDK) 9.2.01i

Note: These software configurations are *required* for the reference systems to function properly. Please ensure the proper versions are installed prior to working with the reference systems. Detailed information about how to properly install your software is included in the Software Installation section later in this document.

For current information about the included development platform, visit the following Web page:

<http://www.xilinx.com/sp3e1600e>

Quick Start Information

The following section is provided to help the user get up and running with the development kit quickly. It contains basic instructions and requirements to get started with the development kit without having to read the entire manual. This is recommended for users familiar with Xilinx products. For a user that is new to Xilinx products, it is recommended that the user read the rest of this document as it contains more detailed information and instructions on the resources included in this development kit.

Step 1 - Install the ISE 9.2i WebPack or ISE 9.2i Foundation and Xilinx Platform Studio™ (XPS/EDK) software. Please make sure to install the necessary software as indicated below:

- ISE 9.2i WebPack or ISE 9.2i Foundation, including Service Pack 3
- EDK 9.2i, including Service Pack 1

The Software Service packs can be downloaded from the Xilinx website at the following location:

http://www.xilinx.com/xlnx/xil_sw_updates_home.jsp?update=sp

Step 2 - Set up the development board and connect it to the host machine. This includes connecting the following:

- Board power supply
- Download cable - host to target
- Null modem serial cable - host to target
- Cross-over ethernet cable - host to target

Detailed instructions of how to accomplish these tasks are found later in this document.

Step 3 - Choose the reference system or demonstration of choice. Demonstrations are located in the Xilinx Platform Flash and the Intel StrataFlash on the development board. These demonstrations are selected by changing the configuration mode jumpers. The following demonstrations are pre-loaded on the development board:

- Hello World Demonstration - Master Serial configuration mode
- μ Clinux Demonstration - BPI Up configuration mode

Note: To get access to the EDK 9.1 μ Clinux source files please send email to sp3e1600e@xilinx.com.

The BlueCat Linux reference system for this kit is available from the Xilinx website at the following location:

<http://www.xilinx.com/bvdocs/desfiles/ug258.zip>

In addition to the demonstrations, the Development Kit website also has the source files for the following reference system:

- ♦ **sp3e1600e_mb>HelloWorld** – contains the bit file and HyperTerminal setup file for this demonstration
- ♦ **sp3e1600e_mb/BlueCatLinux** – contains the XPS source project for the BlueCat Linux reference system

This design can be downloaded from the provided link. Once downloaded, extract the ZIP file to the local machine. Then invoke Xilinx Platform Studio (XPS) and open the project file.

Note: A directory called **ready_for_download** is included under the BlueCat Linux reference system project root directory. The **ready_for_download** directory contains the compiled bitstream file that can be quickly downloaded using iMPACT. Also included in this directory is an example HyperTerminal settings file.

Detailed instructions for these reference systems are included in the remaining chapters of this document. Please refer to these chapters for more information.

Kit Contents

The information below describes the contents of the development kit. The development kit contains all of the following items.

- Spartan-3E SP3E1600E development board
- ISE WebPack Software
- EDK/Xilinx Platform Studio Software
- Universal power supply and EU and UK power adaptors
- USB download cable
- Null modem serial cable
- Cross-over ethernet cable
- Development Kit Reference systems and documentation -- The Reference System and documentation can be directly downloaded from the following Xilinx Spartan-3E Development Kit Reference Designs website:

http://www.xilinx.com/products/boards/s3e1600e/reference_designs.htm

Software Installation

The development kit includes the required design software to work with the reference systems. To use the reference system provided for this kit, both software packages are required to be installed. To properly install the software service packs, please download the required software service pack from from the following location:

http://www.xilinx.com/xlnx/xil_sw_updates_home.jsp?update=sp

After downloading the required software package, double click on the `setup.exe` file. This will launch the service pack installer. Follow the installation directions to complete the process.

Demo Description and Configuration Mode Settings

Demo Description

The demos that are available in the various PROM devices on the board are described below. All of the code for these demos are loaded into the PROM devices at the factory. The configuration setting from the factory is for the Hello World Demo. The PROM files for these demos can be found on the following Spartan-3E Web page link:

<http://www.xilinx.com/sp3e1600e>

HelloWorld Demo

This is the design shipped with the board. This is a simple demonstration that exercises a few of the board features. The embedded MicroBlaze Processor prints messages on the character LCD screen. Flashes the LEDs, reads the Switches and Buttons and sends text data as standard out over a DTE UART with following settings, Baud rate of 115200, 1 Stop bit, No Parity, and No Flow Control. This application is loaded into the Platform Flash PROM.

μClinix Demo

This is a demonstration of μClinix running on the MiroBlaze soft processor. The μClinix Reference System supports many basic linux commands. The list of commands and tools available to run can be found in the `/bin` directory. The μClinix kernel supports several network utilities when connected to a live network or to a remote computer. The μClinix image is loaded into the Intel StrataFlash PROM.

BlueCat Linux Demo

This is a demonstration of LynuxWorks BlueCat Linux running on the MiroBlaze soft processor. Refer to the BlueCat Linux Reference System chapter for details and instructions on how to run the BlueCat Linux demo. The BlueCat Linux image is **not** loaded into the Intel StrataFlash PROM.

Note: The μClinix image is pre-loaded into the Intel Strata Flash PROM using the BPI Up configuration mode. Therefore, for booting the system using the the Lynuxworks Bluecat Linux, the Intel Strata Flash PROM must be re-programmed with the BlueCat linux image in the BPI Up Configuration mode.

Address Map for the BPI Flash PROM

[Table 1-1](#) shows the address map for the PROM files in the StrataFlash PROM device. The Address Map is shown for the Pre-loaded μClinix kernel and also for the BlueCat Linux Demo System after re-programming the Flash.

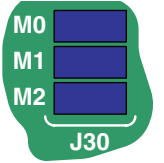
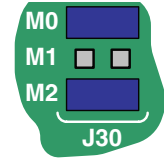
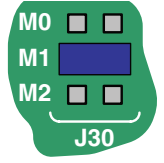
Table 1-1: StrataFlash PROM Address Map

PROM File	Start Address	End Address	Total Space
Address Mapping of Pre-loaded μClinix Demo			
μClinix Design (Bit file)	0x00000000	0x000B62E3	746KB
Unused	0x000B62E4	0x000FFFFFFF	302KB
μClinix Kernel Image	0x00100000	0x006D24A7	6104KB
Unused	0x006D24A8	0x006FFFFFFF	187KB
Address Mapping for BlueCat Linux Demo			
BlueCat Linux Design (Bit file)	0x00000000	0x000B6400	729KB
Unused	0x000B6400	0x007FFFFFFF	7463KB
BlueCat Linux Kernel Image	0x00800000	0x00DBD200	5877KB
Unused	0x00DBD200	0x00FFFFFFF	2316KB

Configuration Mode Settings

Table 1-2 shows the jumper block settings used to control the FPGA's configuration mode. They select the configuration memory source for power-up and for depressing the PROG button.

Table 1-2: Development Kit Demo and Configuration Mode Jumper Settings

Demo	Configuration Mode	Configuration Image Source	Jumper Settings (J30)
Hello World Demo	Master Serial	Platform Flash PROM	
μ Clinux Demo / BlueCat Linux Demo ^[1]	BPI Up	StrataFlash PROM	
Not Applicable	JTAG	Downloaded from host via USB-JTAG port	

Note: 1. The μ Clinux image is pre-loaded into the Intel Strata Flash PROM using the BPI Up configuration mode. Therefore, only after re-programming the Intel Strata Flash PROM with the Lynuxworks Bluecat Linux image in the BPI Up Configuration mode, the FPGA will boot up with the BlueCat Linux demo in the BPI Up mode.

Executing the Demos

1. Position the SP3E1600E board so the SPARTAN-3E and XILINX logos are oriented upright.
2. Make sure the power switch, located in the upper left corner of the board, is in the *off* position.
3. Plug the power supply adapter cable into the SP3E1600E board. Plug in the power supply to AC power.
4. Ensure that the configuration jumpers are set to Master Serial mode, as shown in Table 1-2, for the Hello World Demo.
5. Connect a null modem serial cable between your PC and the SP3E1600E board's DTE connector (J10) and open a serial terminal program.

- a. The serial configuration settings need to be set as follows:
 - Bits per second = **115200**
 - Data bits = **8**
 - Parity = **None**
 - Stop bits = **1**
 - Flow control = **None**
6. Turn on the SP3E1600E board's main power switch. If the configuration jumpers are set to Master Serial mode, then the Hello World Demo will automatically start.
7. To restart or load another demo, set the configuration jumpers to the proper settings for the desired demo, and depress the PROG pushbutton or simply power-cycle the main power switch.
 - a. The selected demo will load from the appropriate PROM and the DONE LED will light upon completion of the download.

MicroBlaze Development Kit BlueCat Linux Reference System

Introduction

This reference system demonstrates BlueCat Linux running on the MicroBlaze™ soft processor and was designed using the Embedded Development Kit (EDK).

An example basic BlueCat Linux kernel is provided that is tailored to the Spartan™-3E 1600E Edition Development Kit board and this reference design.

The Spartan™-3E 1600E Edition Development Kit boards are pre-loaded with the μ Clinux kernel in the BPI Up configuration mode from the factory. Therefore, the Intel Strata Flash PROM must be re-programmed with the BlueCat linux kernel image in the BPI Up Configuration mode.

The kernel and file system are downloaded into the DDR memory and run completely out of the external memory.

The methods for downloading and running the BlueCat Linux kernel demonstration are:

- By using a debugger, such as XMD (provided as part of the EDK tools), and downloading the image file directly into DDR, through the MicroBlaze Debug Module

Once the Flash is re-programmed with the BlueCat linux image, then:

- By powering up from the Intel StrataFlash PROM with the FPGA configuration mode pins set to BPI-up mode
- By depressing the PROG button on the board with the FPGA configuration mode pins set to BPI-up mode, thereby invoking download from the Intel StrataFlash PROM

Note: The Flash files for the BlueCat Linux Reference system are available in the `/ready_for_download/Flash_files` directory.

Details on how to use and create Flash files for the MicroBlaze Spartan™-3E 1600E Edition Development Kit can be found in the following Application note:

<http://www.xilinx.com/bvdocs/appnotes/xapp963.pdf>

Note: Warning: If you download and update the FLASH with the BlueCat Linux image, you will overwrite the μ Clinux image. To get access to the μ Clinux Flash files, please send an email to sp3e1600e@xilinx.com

Hardware Specifics

This reference system targets the Spartan-3E 1600E Edition development board. The system uses the MicroBlaze processor with cache turned on for both the instruction cache (I-cache) and the data cache (D-cache). As shown in [Figure 2-1](#), the system also includes the MPMC memory controller, the XPS Ethernetlite, the XPS MCH EMC memory controller, and the XPS UART Lite IP cores. An XPS Timer and XPS Interrupt controller are also needed for the BlueCat Linux kernel.

See [Table 2-1](#) for the address map of the system.

Block Diagram

The system is shown in [Figure 2-1](#).

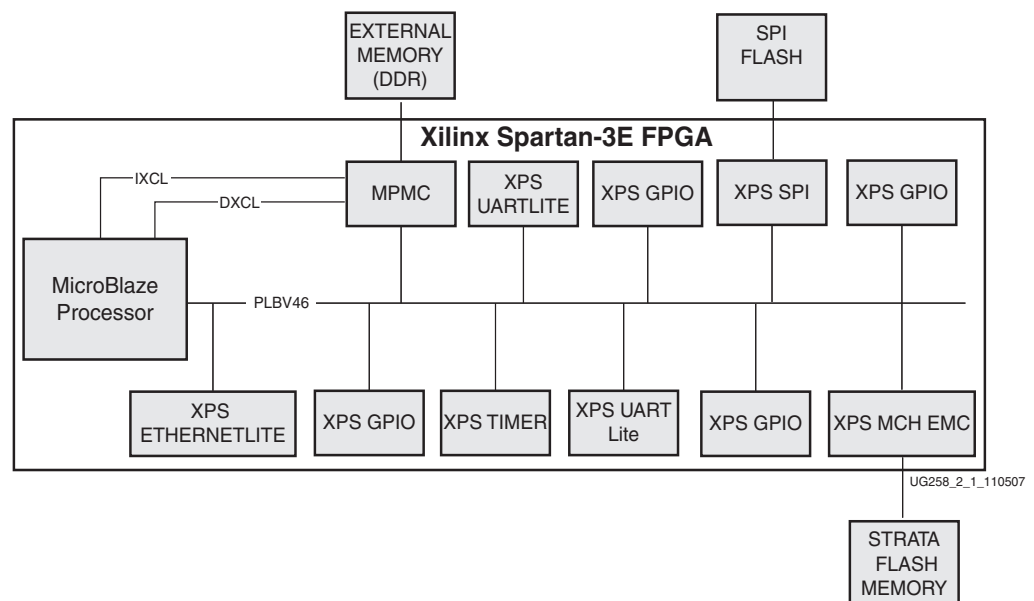


Figure 2-1: Block Diagram

Address Map

The address map for the IP cores in the reference system is given in [Table 2-1](#).

Table 2-1: Reference System Address Map

Instance	Peripheral	Base Address	High Address
debug_module	mdm	0x41400000	0x4140FFFF
dlmb_cntlr	lmb_bram_if_cntlr	0x00000000	0x00001FFF
ilmb_cntlr	lmb_bram_if_cntlr	0x00000000	0x00001FFF
RS232_DTE	xps_uartlite	0x40600000	0x4060FFFF
FLASH	xps_mch_emc	0x85000000	0x85FFFFFF
SPI_FLASH	xps_spi	0x40A00000	0x40A0FFFF

Table 2-1: Reference System Address Map

Instance	Peripheral	Base Address	High Address
DDR_SDRAM	mpmc	0x20000000	0x23FFFFFF
Ethernet_MAC	xps_ethernetlite	0x40C00000	0x40C0FFFF
xps_timer_1	xps_timer	0x41C00000	0x41C0FFFF
xps_intc_0	xps_intc	0x41200000	0x4120FFFF
LEDs_6Bit	xps_gpio	0x42000000	0x4200FFFF
DIP_Switches_4Bit	xps_gpio	0x42400000	0x4240FFFF
Buttons_3Bit	xps_gpio	0x42600000	0x4260FFFF
LEDs_1Bit	xps_gpio	0x42800000	0x4280FFFF
xps_bram_if_cntlr_1	xps_bram	0x41A08000	0x41A09FFF

System Configuration

This reference system runs off a reference clock frequency of 50 MHz from the auxiliary oscillator on the board. The PLB bus, Ethernet MAC, and the MicroBlaze processor run at 50 MHz, while the DDR runs at 100 MHz.

MicroBlaze Processor Configuration

The MicroBlaze processor is configured with with Memory Management Unit (MMU) enabled and also the I-cache and D-cache enabled. The MMU is enabled by setting the MicroBlaze parameter `C_USE_MMU` to 3. This parameter implements the MMU in Virtual mode. In Virtual mode, the MMU controls effective-address to physical-address mapping and supports memory protection. Virtual mode provides greater control over memory protection. Protection and relocation enable system software to support multitasking. This capability gives the appearance of simultaneous or near-simultaneous execution of multiple programs.

A cache size of 8KB is set for both the instruction cache (I-cache) and the data cache (D-cache). The cacheable block of main memory resides between `0x20000000` and `0x21FFFFFF` and are accessed via the XCL Port Interface Modules (PIM) of the Multi-ported Memory Controller (MPMC).

More information about the MMU, the Instruction Cache and Data Cache can be found in the *MicroBlaze Processor Reference Guide*.

XPS Ethernetlite Configuration

The BlueCat Linux RTOS requires that the XPS Ethernet has the interrupts be set to *on*. In the BlueCat Linux demonstration, the Ethernet MAC can run at 10 Mb/s or 100 Mb/s, depending on the attached network. No other special settings are needed.

XPS MCH EMC Configuration

The XPS MCH EMC memory controller is connected to an external Intel StrataFlash PROM, which is used to store the hardware configuration bitstream and bootloader application, as well as the BlueCat Linux kernel image file.

XPS UART Lite Configuration

The XPS UART Lite core is configured to use interrupts. It is set up to use the DTE-Style serial port with the baud rate set to **115200**. This requires the use of the Null-modem serial cable provided with this Kit.

Flash IO Multiplexer

In the Spartan-3E 1600E Edition development board, the SPI Flash (XPS SPI) MISO pin and the MSB of the Parallel Flash (XPS MCH EMC) data pin are multiplexed on the board.

The Flash IO Multiplexer is a custom pcore that is used to select between the Parallel Flash data (DQ) signals and SPI Flash data (MISO) signals based on Memory Chip Enable (Active Low) of the Parallel Flash. If the Memory Chip enable is Low, then the Parallel Flash Data signals are sent to the external connection, else the SPI Data signals are sent to the external data pin connections.

Software Applications

The software sources and executable files for simple memory and peripheral tests have been provided for use in basic functional testing.

The source code for the memory and peripheral tests are located under the project root directory as `/TestApp_Memory/src/TestApp_Memory.c` and `/TestApp_Peripheral/src/TestApp_Peripheral.c`, respectively.

The executable files for these tests are located under the project root directory as `/TestApp_Memory/executable.elf` and `/TestApp_Peripheral/executable.elf`, respectively.

A BlueCat Linux-ready MicroBlaze system and BlueCat Linux kernel are provided in this reference system. This basic BlueCat Linux implementation is built using the BlueCat Linux version 5.4.1 distribution.

The BlueCat Linux kernel image is stored in the Intel StrataFlash PROM and is available in `/bclinux_images` under the project root directory.

Note: The method and details for building a BlueCat Linux kernel are beyond the scope of this document.

Executing the BlueCat Linux Reference System

To execute the BlueCat Linux reference system, the hardware bitstream and the BlueCat Linux kernel image must be downloaded into main memory (DDR) by:

1. Downloading the bitstream directly from the `/ready_for_download` directory or by generating it from the project in XPS. The bitstream is composed of the hardware configuration and a simple bootloop software application, which loops the MicroBlaze processor at a known location until another application is executed.
2. Downloading the BlueCat Linux kernel image from the directory `/bclinux_images` under the project root directory.

Note: Make sure that the jumper settings (J30) are set to JTAG configuration mode for downloading the bitstream or kernel image.

Generating the Bitstream

The system netlist and bitstream can be generated by:

1. Opening the BlueCat Linux project in XPS, then
2. Generating the bitstream by selecting **Hardware** → **Generate Bitstream** in XPS

Downloading the Bitstream

To configure the Spartan-3E device, the bitstream can be downloaded by using one of two methods:

1. Using the download option in XPS, then connecting the USB cable from the PC to the board and selecting the **Device Configuration** → **Download Bitstream** option
2. Using the iMPACT configuration tool and downloading the bitstream.

From an EDK shell, change directory to the `/ready_for_download` directory:

```
cd ready_for_download
impact -batch s3e1600e_bclinux.cmd
```

Downloading the BlueCat Linux Kernel

Before the BlueCat Linux demonstration can be executed, a serial communications utility, such as HyperTerminal, must be set up. To configure the HyperTerminal and run the BlueCat Linux demonstration on MicroBlaze, the following steps are followed:

1. A serial cable from the COM port of the PC to the DTE serial port on the board (J10) is connected.
2. A HyperTerminal or similar program is set to a Baud Rate of **115200**, Data Bits to **8**, Parity to **None** and Flow Control to **None**, as shown in [Figure 2-2](#).
3. A crossover Ethernet cable to the host PC and the board's Ethernet port is connected. The USB cable must remain connected from the PC to the board.

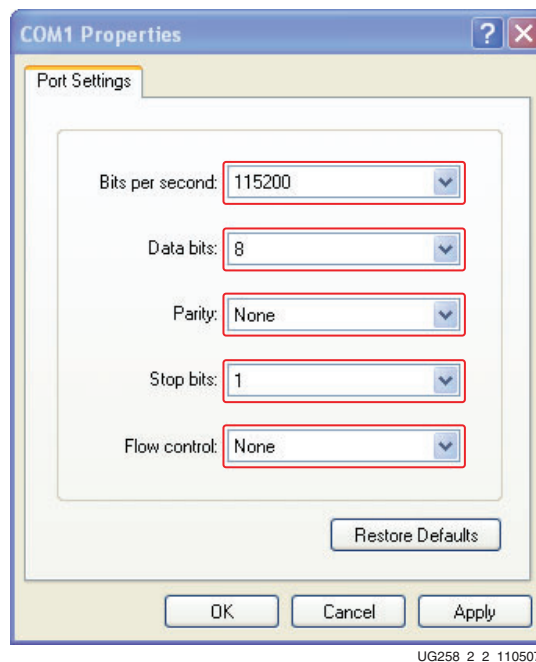


Figure 2-2: HyperTerminal Settings

Downloading the BlueCat Linux Kernel through XMD

To download and boot-up the BlueCat Linux kernel image via XMD, the following commands listed below are invoked in an XMD window. The image file can be found under the project root directory as `/bclinux_images/standalone.kdi`.

1. In XPS, **Debug** → **Launch XMD** is selected.
2. In the XMD command window, the directory to the project's `/bclinux_images` directory is changed as follows:

```
cd bclinux_images
```

The Bluecat Linux image into DDR memory at the starting location `0x20000000` is downloaded using the command:

```
dow -data standalone.kdi 0x20000000
```

Note: This step could take several minutes to download the BlueCat Linux image to the memory.

3. To start the kernel image running, which will boot-up BlueCat Linux on the HyperTerminal, the following command is used:

```
con 0x20000000
```

- a. After the BlueCat Linux Kernel boots up, the output on the HyperTerminal will be as shown in [Figure 2-3](#).

```

Linux version 2.6.13.4 (imanouil@cash.auriga.ru) (gcc version 4.1.1) #2 Mon Oct 22 19:07:27 MSD 2007
On node 0 totalpages: 8192
  DMA zone: 8192 pages, LIFO batch:3
  Normal zone: 0 pages, LIFO batch:1
  HighMem zone: 0 pages, LIFO batch:1
Built 1 zonelists
Kernel command line: ramdisk_size=15360 xilinx_emac_mac=00:0E:B6:6E:6C:00 hda=bswap hdb=bswap hdc=bswap
hdd=bswap root=101
xps_intc_1.00.a INTC at 0x41200000 mapped to 0xFDF000
PID hash table entries: 256 (order: 8, 4096 bytes)
xps_timer_1.00.a TIMER at 0x41C00000 mapped to 0xFDFFE000
Console: Xilinx OPB UART Lite
Dentry cache hash table entries: 8192 (order: 3, 32768 bytes)
Inode-cache hash table entries: 4096 (order: 2, 16384 bytes)
Memory: 26428k available
Calibrating delay loop... 24.57 BogoMIPS (lpj=122880)
Mount-cache hash table entries: 512
NET: Registered protocol family 16
xilinx_spi 0: at 0x40A00000 mapped to 0xC2000000, irq=0
xgpcio0 #0 at 0x42000000 mapped to 0xC2020000 device: 10,185 not using IRQ

xgpcio1 #1 at 0x42400000 mapped to 0xC2040000 device: 10,186 using IRQ#5

xgpcio2 #2 at 0x42600000 mapped to 0xC2060000 device: 10,187 using IRQ#4

xgpcio3 #3 at 0x42800000 mapped to 0xC2080000 device: 10,188 not using IRQ

ttyS0 at MMIO 0x40600000 (irq = 3) is a Xilinx OPB UART Lite
io scheduler noop registered
io scheduler anticipatory registered
io scheduler deadline registered
io scheduler cfq registered
RAMDISK driver initialized: 16 RAM disks of 15360K size 1024 blocksize
eth0: using fifo mode.
eth0: No PHY detected. Assuming a PHY at address 0.
eth0: Xilinx EMACLite #0 at 0x40C00000 mapped to 0xC20A0000, irq=2
EMC Flash on Xilinx board: Found 1 x16 devices at 0x0 in 8-bit bank
  Intel/Sharp Extended Query Table at 0x0031
Using buffer write method
cfi_cmdset_0001: Erase suspend on write enabled
0: offset=0x0,size=0x20000,blocks=128
Registering a 16MB EMC Flash at 0x85000000
NET: Registered protocol family 2
IP route cache hash table entries: 512 (order: -1, 2048 bytes)
TCP established hash table entries: 2048 (order: 2, 16384 bytes)
TCP bind hash table entries: 2048 (order: 1, 8192 bytes)
TCP: Hash tables configured (established 2048 bind 2048)
TCP reno registered
TCP bic registered
NET: Registered protocol family 1
RAMDISK: Compressed image found at block 525768
Freeing BlueCat RFS memory: 4440k freed
VFS: Mounted root (ext2 filesystem).
Freeing unused kernel memory: 72k freed
emac is started

bash-3.00#

```

UG258_2_3_110507

Figure 2-3: BlueCat Linux Boot-Up Screen

Executing BlueCat Linux Commands

This build of BlueCat Linux supports many basic Linux commands. The list of commands and tools available to run can be found in the `/bin` directory.

The file system is read-only, except for the `/var` directory and its sub-directories. New directories can be created under the `/var` directory using the `mkdir` command. Files under the `/var` directory structure can be created or edited using the `vi` editor. Text files can be viewed using the `cat` command.

This BlueCat Linux kernel was built with networking support enabled, therefore it supports several network utilities when connected to a live network or connected directly to a remote computer.

To turn on the ethernet port 0, `eth0`, and assign the board IP address to `1.2.3.4`, the command, `ifconfig eth0 up 1.2.3.4`, is issued.

To confirm the ethernet configuration settings, the command, `ifconfig`, is issued.

The result on a HyperTerminal of the configuration settings for the `eth0` (Ethernet) and `lo` (Local Loopback) ports are as shown in [Figure 2-4](#).

```
bash-3.00# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:00:C0:A3:E5:44
          inet addr:172.16.1.227  Bcast:172.16.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
          Interrupt:2

bash-3.00# ifconfig lo
lo        Link encap:Local Loopback
          LOOPBACK MTU:16436  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
```

Figure 2-4: Ethernet Configuration Settings

To *ping* a remote computer at IP address `1.2.3.9` from the development board, this example command string, `ping -c 4 1.2.3.9`, is used to *ping* the remote computer 4 times.

To *telnet* from a networked computer to the board, issue the command, `telnet 1.2.3.4`. All of the Linux commands can now be performed remotely as if the user were logged into the console on a HyperTerminal.