BROADCOM ®

Reference Platform Installation Guide
for VxWorks

REVISION HISTORY

Revision	Date	Change Description
STB_Platform-SWUM200-R	12/19/2008	Initial release

TABLE OF CONTENTS

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LIST OF FIGURES

LIST OF TABLES

Section 1: Introduction

This document describes how to set up a Broadcom reference board to run under VxWorks version 6 (Workbench). This includes the Flashing of a ROM boot loader and setting up the environment for running various VxWorks set-top applications.

It is assusmmed that the reader is familiar with the Workbench 2.3 IDE and VxWorks RTOS and is using a Win32-based PC as the *host* system and a Broadcom set-top box or Broadcom reference board as the *target* device. Broadcom provides the following software components for any given VxWorks release:

*   Boot ROM executable
*   VxWorks run-time executable image and symbol table for your target platform
*   Prebuilt Reference Software executables
*   Reference Software source code

The Boot ROM and the VxWorks run-time image are collectively referred to as the Board Support Package (or BSP). The source code for the BSP is released as a separate package. The following sections in this document outline the steps for loading the Boot ROM, VxWorks run-time image, and an application.

Section 2:Prerequisites

The Reference Software refers to the source code delivered by Broadcom to control the features of the Broadcom reference platform

You must have the following to set up the reference platform:

- A Broadcom reference board
- A PC on which you have installed Workbench 2.3/VxWorks 6.1 for MIPS
- Connection of the reference board and PC to the same Ethernet network (using static IP addresses)
- A serial cable connected from the reference board to the PC
- An FTP or TFTP server running on the PC that the reference board can use
- HyperTerm or similar terminal emulation software

Note: The Reference Software is not guaranteed to run on other systems. It may require significant modification.

Section 3: Build System Configuration

Figure 1 shows how your system configuration may look like. The types of RF inputs and A/V outputs depend on the platform.
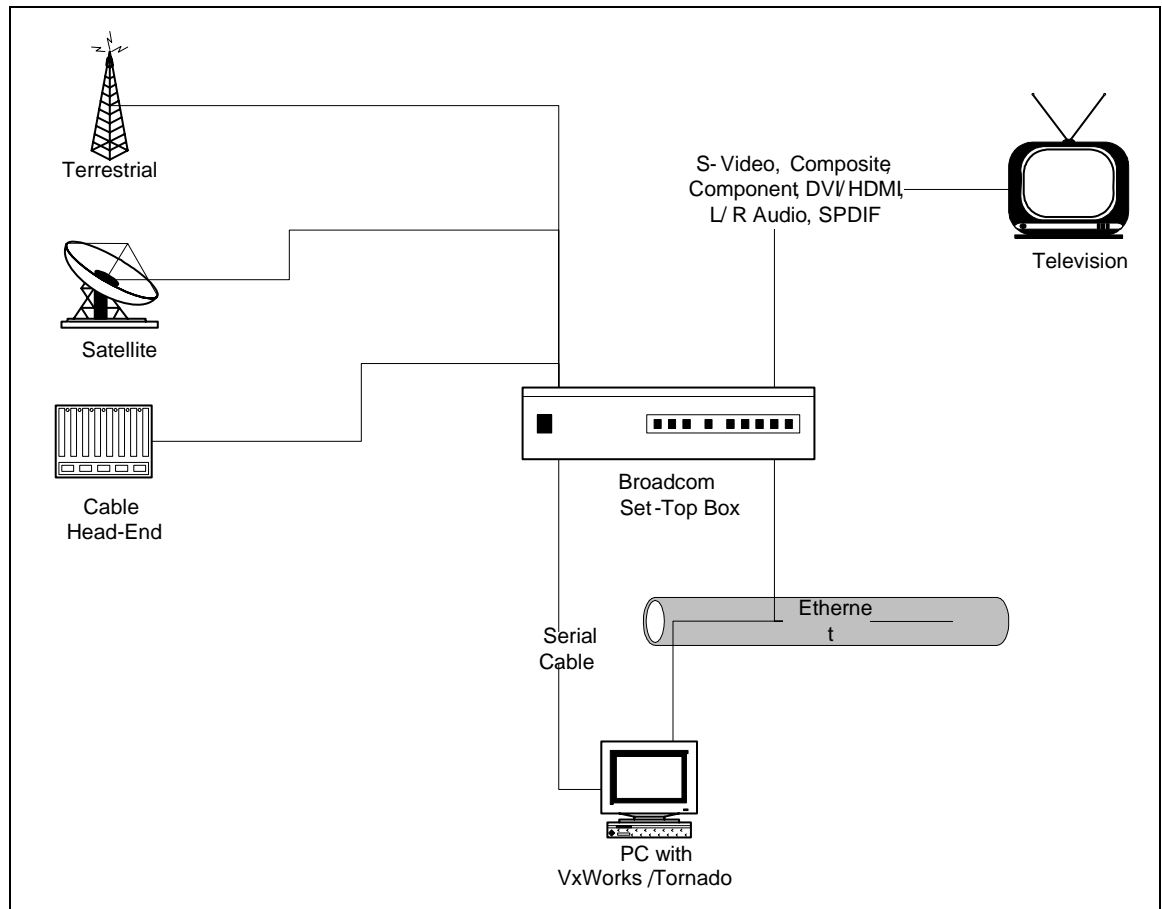

Figure 1: System Configuration Broadcom Platform

Section 4: Preparing your VxWorks-Based System

CONFIGURING THE REFERENCE BOARD

CONNECTING THE REFERENCE BOARD

At this stage of the configuration porocess, you need the following connections to your reference board:

- An Ethernet cable connected to a network that can route to your PC

    - For some platforms the Ethernet port is connected to either a BCM4413 or other networking chip (marked "ENET" on the reference board).

    - For other platforms a USB Ethernet dongle is required.

> **Note:** The VxWorks boot-loader uses static IP addresses for its own address as well as the address to the host PC. If configuring static IP addresses is prohibitive, Broadcom suggests that the host PC and the reference board be placed behind an inexpensive commercially available Ethernet router device or a second Ethernet. A NIC card can be added to the PC to create a local network.

- A serial cable that is connected from RS232 (UART 0/A) on your reference board to your PC.

Later on, you will need to connect the RF input(s) and the A/V outputs.

Next, for the system to work properly, the following items need to be configured:

- RS-232 Terminal
- Boot ROM
- FTP/TFTP Server Setup
- Target Server Setup

CONFIGURING YOUR RS-232 TERMINAL

The RS-232 port (marked UART0 or UARTA on the reference board) is used as the default user console for the VxWorks Boot ROM and run-time image, so you must connect an RS-232 terminal to a serial port on the host PC.

The serial ports operate, by default, at 115200 baud, 8 data bits, 1 stop bit, and no parity.

There are a number of freeware terminal emulation programs available on the market. Teraterm™ is a very good implementation. You can also use (but not suggested) the Windows built-in terminal emulation package called Hilgraeve's HyperTerminal™ application (or HyperTerm).

A sample HyperTerm configuration dialog is shown below.
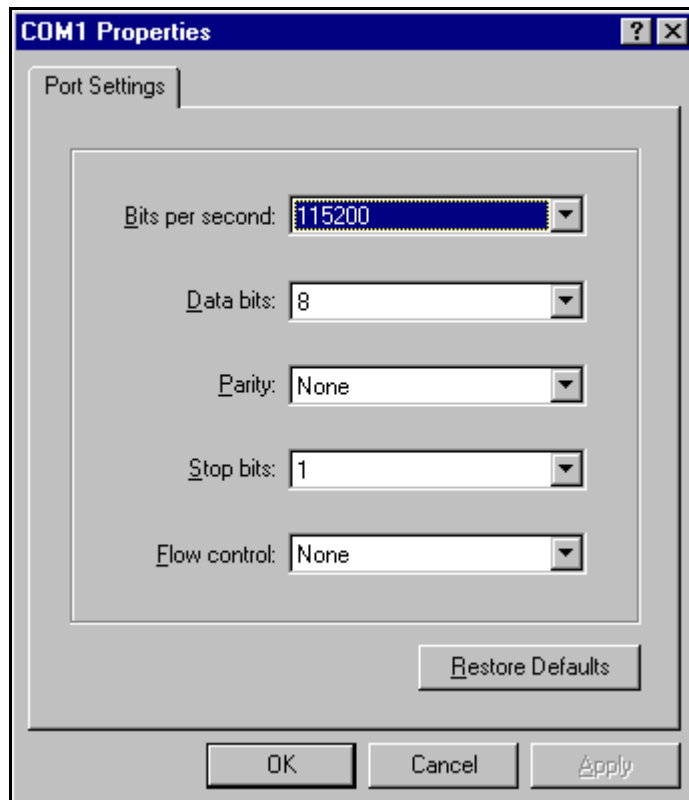
VXWORKS AND BOOT ROM IMAGES

The Reference Software is shipped with pre-built versions of the BSP executables. These executables need to be accessible to the the FTP/TFTP server. This location will be referred to as the "path to your BSP files" when configuring the FTP/TFTP server.

The BSP executables are comprised of a Boot ROM image (bootrom.bin or bootrom.hex), the VxWorks run-time image (vxWorks), and the VxWorks symbol table (vxWorks.sym). You can either use the supplied images or obtain the sources for the Boot ROM executable (boot loader) and VxWorks run-time executable, and follow the supplied instructions for building and installation.

The Boot ROM image must be installed onto the reference board by either programming the PROM device (older reference boards) or Flashing the device.

CONFIGURING AND USING THE BOOT ROM

All Broadcom reference boards are normally shipped with a CFE (Common Firmware Environment) boot loader installed in a ROM socket or in flash. This is the boot loader used with Linux configurations. When you power-up the board and connect via the PC's serial port to the reference board using a serial port console like HyperTerm you should see a `CFE>` prompt.

> **Note:** If the prompt is: `[VxWorks Boot]:`, then you already have the VxWorks boot loader installed and you can skip to "Setting the Boot ROM parameters" on page 7.

If CFE is not working, or if you accidentally got another ROM such as "No-OS Diags," then:

- Make sure your terminal program is talking to the same COM port you plugged into on your PC.
- If your reference board is mounted in a Broadcom set-top box, make sure that the serial port on the outside of the box is actually connected to UART A on the board.
- Try changing the MIPS Endianess jumper to the other position (if available).
- If that fails and you have another known-good Broadcom board, try hooking that up. They all use the same serial port settings.
- If that fails, either your CFE or your board is bad. Consult your FAE for assistance.

Having verified your serial port connection, the next step is to install the VxWorks boot ROM (if required).

Burning and Installing a VxWorks Boot ROM Device (Socket)

Older reference boards included a programmable ROM (PROM) device to hold the boot loader whereas newer reference boards use flash parts. If your board does not contain a socketed ROM device, you should skip this section.

The Boot ROM is provided in an S-Record format (**bootrom.hex**), big endian, in elf format and may be programmed into the boot ROM device using a PROM programmer.

After the boot ROM device is programmed and inserted into the socket on the board, power up the reference board.

Flashing a VxWorks Boot ROM device (Flash)

Newer reference boards use flash parts for storing the boot loader. When the board is first shipped, it is loaded with the "CFE" boot loader (used with Linux systems). VxWorks requires its own boot loader. CFE has the ability to update the flash with the VxWorks boot loader but the VxWorks boot loader cannot update the flash. To over-write the VxWorks boot loader you will need to use the Broadband Studio Application (consult your FAE if necessary). Follow these steps to update (overwrite) the CFE boot loader with the VxWorks boot loader.

> **Note:** This step requires that a TFTP server is running to upload the new boot loader. Workbench includes both a TFTP (Tftpd32.exe) and FTP (wftpd32.exe) server application. Use the TFPT application for this step. Refer to "Configuring Your PC" on page 9 for instructions on setting up the FTP/TFTP server.

- Set up the IP address of the on board Ethernet controller with the following

    CFE> ifconfig eth0 –auto

    if a DHCP server is available. Otherwise use:

    CFE> ifconfig eth0 –addr=xxx.xxx.xxx.xxx –mask=255.255.255.0

    where xxx.xxx.xxx.xxx is a free IP address on your subnet. Use help to list other optional parameters:

    CFE> help ifconfig

- If your flash is configured (jumpered) as big endian then:

    CFE> flash –noheader <ip_address>:bootrom.bin flash0.cfe

    otherwise use the following for little endian:

    CFE> flash –noheader –revend <ip_address>:bootrom.bin flash0.cfe

    where <ip_address> is the address of a host providing the file "bootrom.bin" to be Flashed.

> ⚠️ **Caution!** after you flash the VxWorks Boot ROM, make sure to change the jumper to big endian prior to restarting the reference board if it was previously set to little endian.

Using Broadband Studio to Update Flash

An alternate method for Flashing the VxWorks Boot ROM is to use the Broadcom Broadband Studio application. This can be obtained from your Broadcom FAE. This *must* be used to update the boot loader if an older version of the VxWorks boot loader is already installed.

Starting up the Boot ROM

When the reference board boots with the VxWorks Boot ROM, it will normally try to auto-boot by downloading a VxWorks run-time image via FTP/TFTP. The Boot ROM will display:

    Press any key to stop auto-boot...

Hit any key to stop the auto-boot procedure. You should now be at a VxWorks Boot ROM prompt:

    [VxWorks Boot]:

Before the reference board can download the VxWorks run-time image, you need to perform the following:

- Set the Boot ROM parameters.
- Set up an FTP/TFTP server

Setting the Boot ROM parameters

At the "[VxWorks Boot]:" prompt you can use:

- **?** to display a list of valid commands
- **p** to display the current boot parameters
- **c** to set or modify the boot parameters
- **@** to attempt an auto-boot with the current parameters

Start the configuration by typing **c** to set the boot parameters. To change an entry, just type in the replacement text after it displays the current text (you cannot edit the current values).

The boot device parameter is the device name of your network adapter. Please refer to Table 1 for the parameter name

Table 1: Boot Device Parameter

Device Name	Platform
bcmEnet	BCM97038

- The file name parameter is the name of the run-time image file to download from the host PC via FTP/ TFTP. This will usually be "vxWorks" or the full or relative path (from the FTP home directory) of the VxWorks file.
- The host `inet` parameter is the IP address of the host PC's network interface.
- The `inet on ethernet` parameter is the IP address to use for the reference board's network interface.
- The `user` parameter is the user name to use when logging into the FTP server on the host PC.
- The `password` parameter is the password to use when logging into the FTP server on the host PC.
- The `flags` parameter is used to alter the load process. Use the **?** (or the **help**) command to list the valid flag values. This parameter is normally 0. Use `flag 0x80` to use a TFTP server instead of an FTP server and `flag 0x8` to speed up the boot process (use 0x88 for both).

The following parameters are not used (just hit **<Return>** to leave blank):

- `host name`
- `inet on backplane`
- `gateway inet`
- `target name`
- `startup script`
- `other`

When done, the boot parameters should look similar to the following:

```
[VxWorks Boot]: p
boot device         : bcmEnet
unit number         : 0
processor number    : 0
host name           : host
file name           : vxWorks
inet on ethernet (e) : 192.168.1.32
host inet (h)       : 192.168.1.100
gateway inet (g)    : 192.168.1.100
user (u)            : bcm97038
ftp password (pw)   : password
flags (f)           : 0x0
```

All boot parameters are automatically saved in Flash memory and you do not have to re-enter them after a reboot of the reference board.

CONFIGURING YOUR PC

You can use either an FTP server or TFTP server for downloading the VxWorks run-time image to the reference board. Choose one and follow the appropriate instructions.

FTP SERVER SETUP

Workbench 2.3 comes with a simple FTP Server application: WFTPD by Texas Imperial Software. To use this FTP Server, launch the FTP server from the **Start → Programs → Wind River → VxWorks 6.1** menu.

Select **Users/Rights…** from the Security menu. Click the **New User…** button and enter `target` as the name of the new user. Enter the path to your **BCM97038** BSP files as the Home directory (in this example C:\Tornado2.2.1\target\config\bcm97038).

Enter a password for this user. In this example, `password` is used as the password.
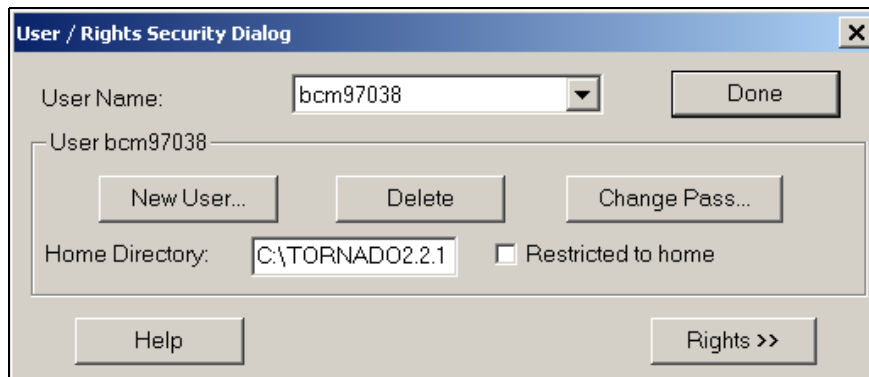
Note: You have to enter a password for the ftp to work, and the password should match the password entered in the boot parameters "ftp password" field.

It is often helpful to enable FTP activity logging. If you want to enable logging in the FTP server you can select the **Logging Options** from the Logging menu. An example Logging Options window with Log options selected is shown in in the screen below.
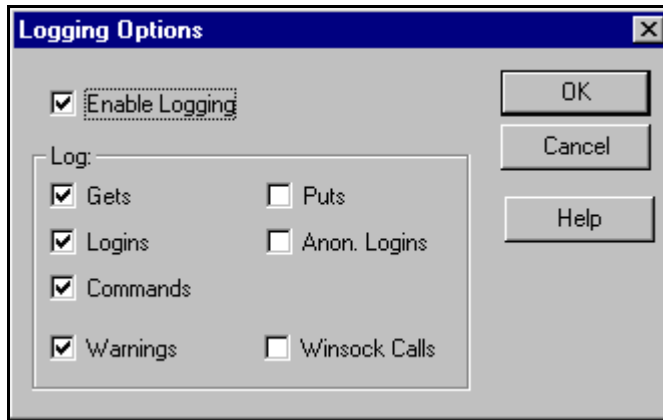

TFTP SERVER SETUP

Workbench 2.3 comes with a simple TFTP Server application Tftpd32 by Ph. Jounin. To use this TFTP Server, launch the TFTP server from the **Start** → **Programs** → **Wind River** → **VxWorks 6.1** menu.

Note: This application may not be installed in your start menu by default. You will need to locate the application in the installation folder (under "C:\WindRiver\vxworks-6.1\host\x86-win32\bin").

Set the "Server interfaces" to your host IP address (should already be set). Set your current directory to the location of your "vxWorks" image. The server setting interface is shown below.
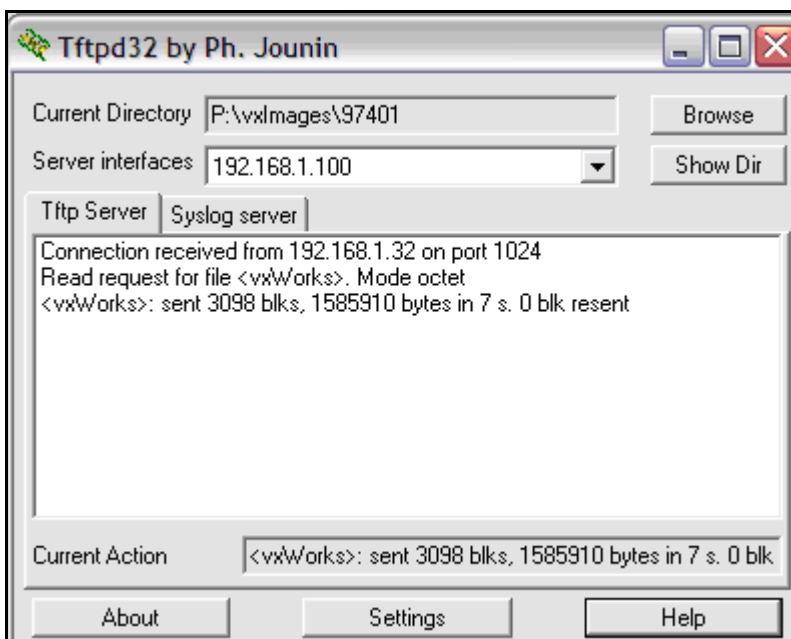
Click on **Settings** to change the application settings. The Setting Dialog box is shown below.
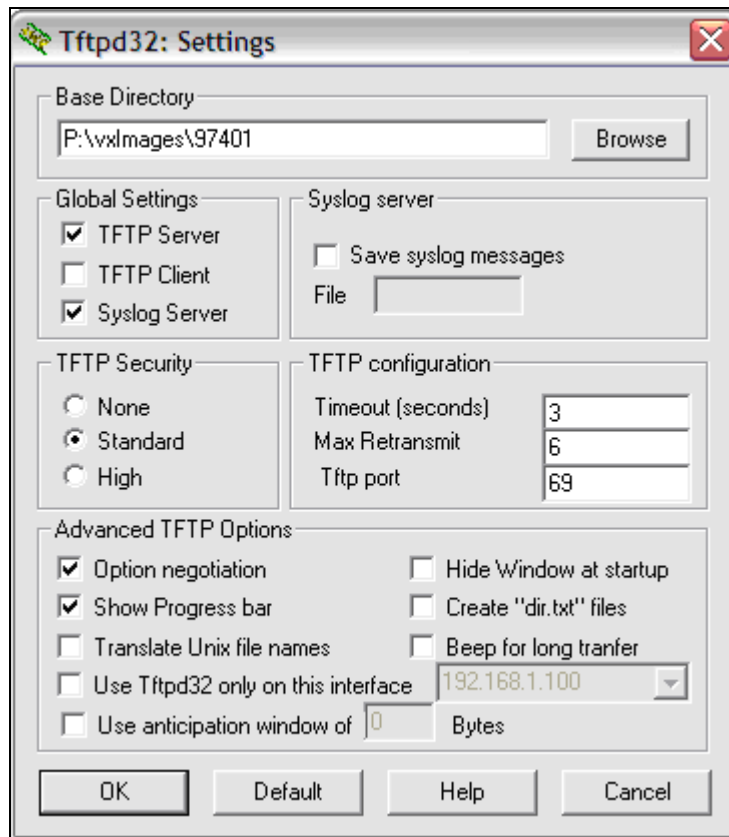
VxWORKS RUN-TIME IMAGE

If everything has been set up correctly, you should be ready to download the run-time image to the target by resetting the target reference board and allowing it to "auto-boot" or by typing @ at the Boot ROM prompt.

As described earlier, the Reference Software includes prebuilt versions of the BSP software for your platform. You can either use the prebuilt image or obtain the source for the BSP and build it by following the supplied instructions. The VxWorks run-time image (vxWorks) should be placed in the FTP/TFTP directory configured above.

After the VxWorks image has been downloaded, you should see something similar to the following output on your RS-232 terminal:

```
Attaching interface lo0... done
BcmEnet: 100 MB Full-Duplex auto-neg
bcmEnet0 MAC address: 00:10:18:72:11:84
Attached IPv4 interface to bcmEnet unit 0
bcmEnetMCastAdd() returning with OK status
Loading... 4 + 1968912
Starting at 0x80010000...

sysHwInit: exitr
sysHwInit2: enter
******** SR =0xf000ff01
sysHwInit2: exit
USB2 Host Stack Initialized.
USB Hub Driver Initialized
USBD  Wind River Systems, Inc. 512 Initialized
OHCI Controller found.
Waiting to attach to USBD...Done.
EHCI Controller found.
Waiting to attach to USBD...Done.
ataDrv: controller 1 of 2
ataDrv: controller 2 of 2
Target Name: vxTarget
Attaching interface lo0... done
BcmEnet: 100 MB Full-Duplex auto-neg
bcmEnet0 MAC address: 00:10:18:72:11:84
Attached IPv4 interface to bcmEnet unit 0
bcmEnetMCastAdd() returning with OK status
usbPegasusEndInit () returned OK
Loading symbol table from host:vxWorks.sym ...done


              VxWorks


Copyright 1984-2005  Wind River Systems, Inc.


           CPU: BCM97038
  Runtime Name: VxWorks
Runtime Version: 6.1
    BSP version: 1.3/12
        Created: Jul 28 2005, 14:56:59
  WDB Comm Type: WDB_COMM_END
           WDB: Ready.
```

You are now ready to download applications to the target and execute/debug them.

TARGET SERVER SETUP

The target server provides a means to communicate with the target device. The target server will be setup using a "Target Server Directory" that contains the run-time files needed by the Brutus application. Create a directory and use this in the Target Server setup and when setting up the Brutus application.

Note: VxWorks version 5.5 (and earlier) starts up a license manager (registry) process on system startup. This registry is incompatible with the registry used by VxWorks 6.x. The result is an error message (unreachable) in the Target Manager window when running the Workbench Application. Refer to "Target Server Setup" on page 13.

To correct this problem you must kill the VxWorks 5.5 Registry process. Use **Ctrl-Alt-Del**, select **Task Manager**, find the image named "wtxregds.exe", and click **End Process** before starting the Workbench Application. This must be done each time the system is restarted.

An alternative option is to stop and disable the service using the Control Panels−Administrator Tools−Computer Management Tool (select **Services** under the section Services and Applications and locate Tornado Registry process).

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TARGET SERVER SETUP FOR VXWORKS 6.1

The following paragraphs describe how to setup a Target Sever in the Workbench IDE. Launch the Workbench application and select **Create a New Target Connection** icon in the Target Manager window (green with yellow plus sign) or select "New Connection" from the **Target** menu. Enter Target Server Properties settings indicated in the window shown below.
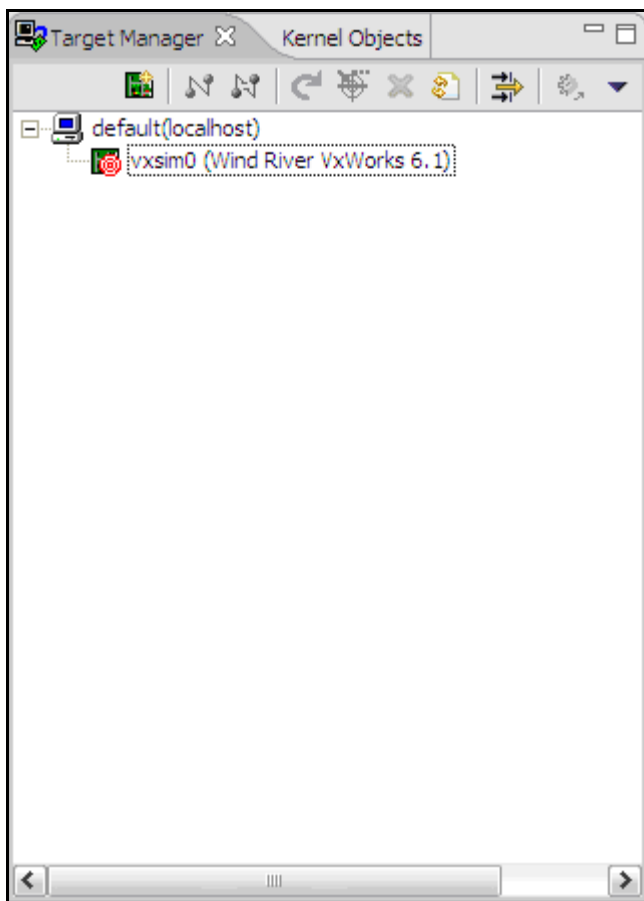
Select **WindRiver Target Server Connection for VxWorks** and select **Next**. Select "wdbrpc" as the backend from the **Back End** menu. Enter value for Target IP Address as shown below.

Select the **File** option and enter the full pathname of the VxWorks run-time image (for example, C:\WindRiver\vxworks-6.1\target\config\bcm97401\vxWorks). Set the appropriate target server directory in the **Options:** window under "Advanced Target Server Options." Ensure that the **Verbose target server output** option is checked. Select **Next** to continue.

Use the defaults for "Object Path Mappings" and select **Next** to continue as shown in in the window below.
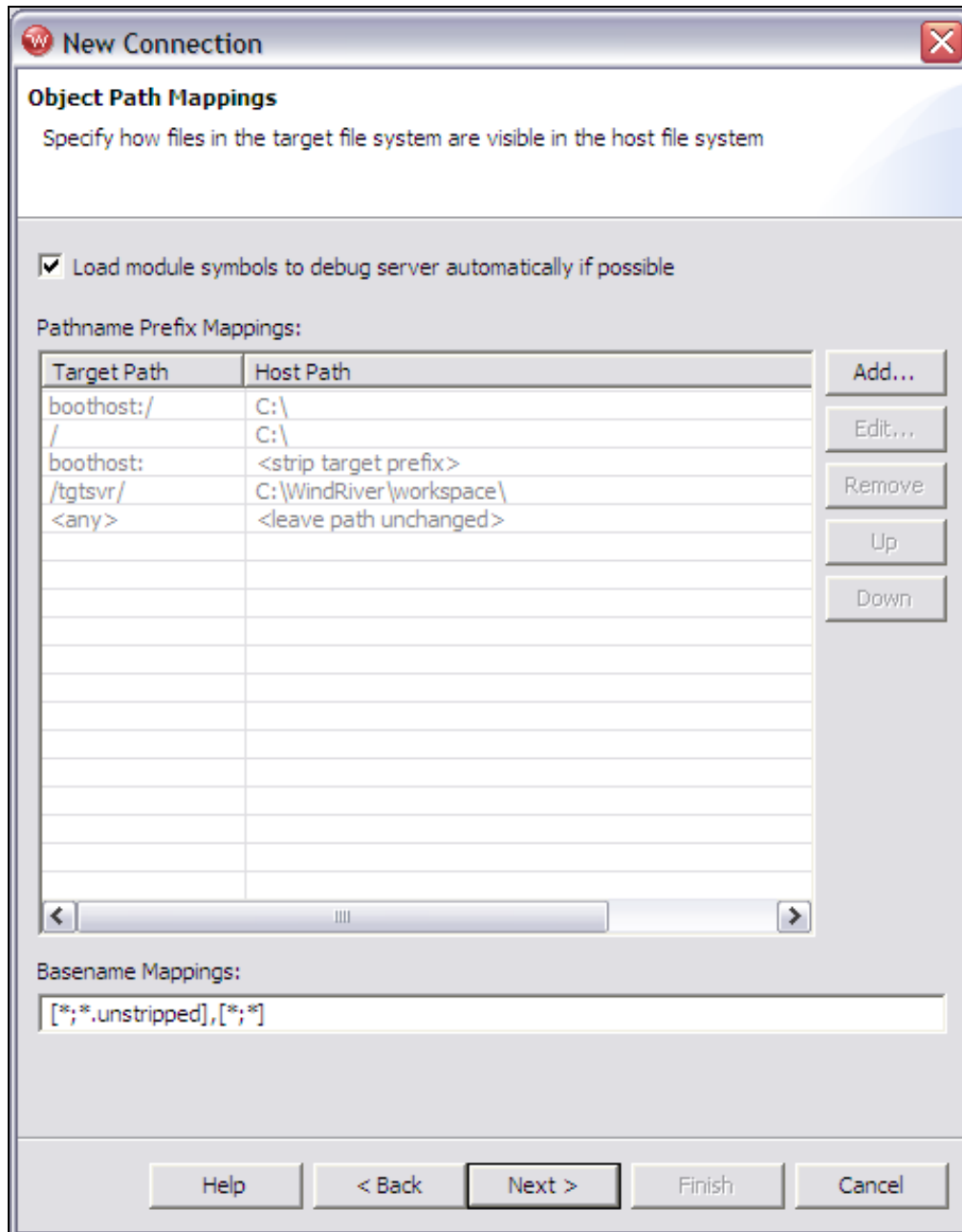
You will be presented with a connection summary window to complete the Target Server creation. Select **Finish** to complete the process. The Workbench Application will automatically attempt to connect to the target (you will see a "connecting…" display in the Target Manager window). On successful connection, the Target Manager window will include status for the connection.

If the connection fails to connect to the target, an error message will be displayed. If this occurs, check the properties of the new connection; ensure that the directory specifying the vxWorks image is correct and that you can successfully communicate with the target.

A successfully connected target is shown below.
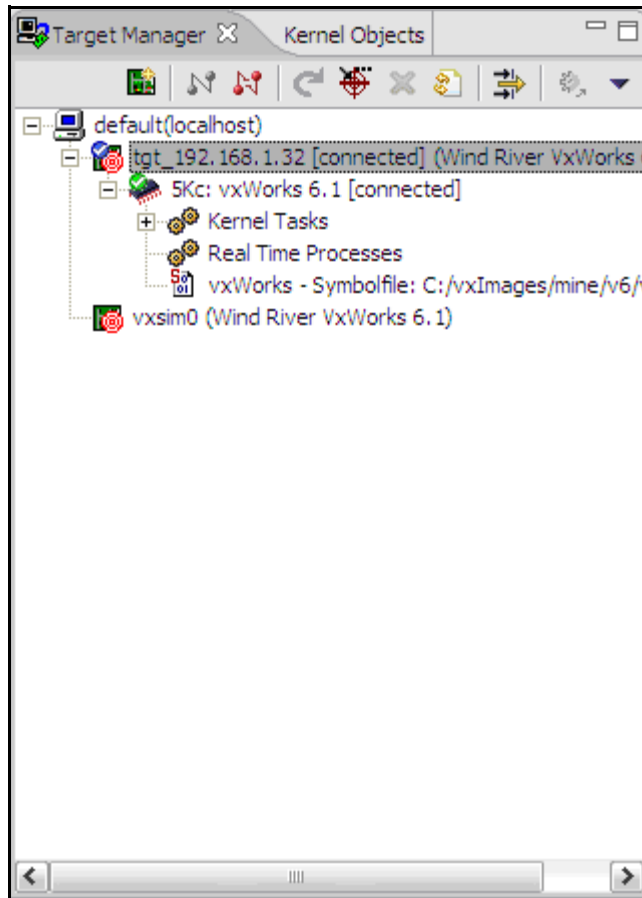
You can manually start the connection process by clicking on the Connect icon (green N like icon) in the Target Manager window or by right clicking on the "Target" icon in the Target Manager window (green square with blue checkmark and a red target) and selecting "Connect tgt-xxx.xxx.xxx.xxx."

A successfully connected target will result in a red "target" icon appearing in your Windows system tray. A yellow exclamation mark (!) over this icon indicates a problem with the target server configuration or the target (reference board) itself.

Section 5: Running Reference Software

APPLICATION

The Workbench utility includes a dynamic linker/loader. This lets you load an object file to a non-specific address. You can also load multiple objects and the loader with automatically perform a dynamic linking operation. If it fails to link the list of "unknown" symbols is displayed. It is suggested that any library module be loaded before loading the application to prevent the warnings of undefined symbols.

DOWNLOADING AND RUNNING AN APPLICATION

In order to run an application it must be downloaded to the target device using the Workbench Application. This requires that the VvxWorks run-time image has been loaded and is running and that the target server is connected.

Use the Workbench IDE to download applications. Perform the following steps to download the application.

- Select the running target server name from the Target Manager window.

- Right click and select **Download** option (looks like a target with an arrow pointing to it)

- Navigate to the directory containing the application, select it, and hit the **OK** button.

- Create a target shell by clicking on the Host Shell icon under the **Target** menu (looks like an arrow pointing to a lowercase 'i').

- Run the application by calling its start function (typically "go") on the Target shell (at the `->` prompt). The application should start.

- Please read the Workbench documentation for more detailed information about the environment.

> **Note:** If the target server is disconnected, you will get the error message: "WTX Exchange Error Transport disconnect" when you try to download the object file. In this case, just click on the **OK** button, reconnect to the target server, and download the object again. In addition, the Host Shell may need to be restarted after resetting the board/target server. Just close the Host Shell window and open a new one by selecting **Host Shell** under the **Target** menu.