

Tornado[®]

2.2

GETTING STARTED GUIDE

UNIX VERSION



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Documentation Guide

Introduction

Documentation for Tornado falls into the following general categories:

- release and migration information
- Tornado IDE and tools
- VxWorks operating system
- GNU compiler and tools
- Diab compiler and tools

Each of these categories is described in this chapter. Online documentation and documentation conventions are also discussed.

Release and Migration Information

Tornado Release Notes

The *Tornado Release Notes* contain the latest list of supported hosts and targets, as well as information on compatibility with older releases, an outline of new features, and any caveats concerning the current release.

Tornado Migration Guide

The *Tornado Migration Guide* contains information designed to help VxWorks developers in moving from Tornado 2.2.x and VxWorks 5.4.x to Tornado 2.2 and VxWorks 5.5.

GNU Toolchain Release Notes

The *GNU Toolchain Release Notes* contain information about changes made to the GNU toolchain since the Tornado 2.0 release.

Diab Release Notes

The *Diab C/C++ Release Notes* contain information about changes made to the Diab compiler suite since the Diab 4.4 release.

Tornado Web Page

A Tornado 2.2/VxWorks 5.5 product information Web page is available at:
<http://www.windriver.com/corporate/support/prodbullet/T2.2/>

Tornado IDE and Tools

Tornado Getting Started Guide

The *Tornado Getting Started Guide* (this manual) provides instructions on installing Tornado and other Tornado products, as well as tutorial introductions to both the Tornado tools and VxWorks.

Tornado User's Guide

The *Tornado User's Guide* is the central document for the Tornado IDE. It includes:

- A global overview of Tornado and its capabilities.
- Instructions on how to configure your environment and set up communications with a target system.
- The Tornado development environment and its major interactive features—simulator, editor, project facility, target server management, shell, browser, and debugger.
- Command-line tools for project creation and debugging.
- COM and DCOM.
- Customizing Tornado.
- Tornado directories and files, the use of Tcl (Tool Command Language) in Tornado, and reference information for host tools.
- Wind River coding conventions.

Tornado API Programmer's Guide

The *Tornado API Programmer's Guide* is for developers who wish to extend the Tornado development environment. It contains descriptive information about:

- The run-time agent.
- Its host-system counterpart, the target server.
- The WDB protocol that supports the target agent and target server.
- The WTX C and Tcl protocols used by the Tornado tools to communicate with the target server.
- Client Component Architecture (CCA), which is the new architecture of the Tornado IDE.

Tornado API Reference

The *Tornado API Reference* is the reference companion to the *Tornado API Programmer's Guide*.

Tornado Reference

The *Tornado Reference* describes the host tools and utilities.

Tornado SETUP Developer's Guide

The Tornado SETUP Developer's Guide provides instructions for creating an installation image that can install products on top of Tornado.

WindView User's Guide

The *WindView User's Guide* describes the features and use of the WindView software logic analyzer, which is integrated with the Tornado IDE. The companion *WindView User's Reference*, describes WindView and networking events.

VxWorks Operating System**VxWorks Programmer's Guide**

The *VxWorks Programmer's Guide* describes the VxWorks operating system and associated run-time facilities. This guide is the best starting point for learning about VxWorks from a problem-solving perspective because it is organized by the function of VxWorks components. It includes the following topics:

- The fundamentals of the VxWorks kernel and run-time environment.

- The I/O system and the device drivers that underlie it.
- Local file systems, including the DOS-compatible file system and the CD-ROM file system.
- POSIX standard interfaces, which are real-time extensions to the VxWorks kernel facilities.
- Target tools, which include the target-resident shell, loader, and symbol tables; as well as VxWorks show routines.
- C++ development, with guidelines for creating VxWorks applications in C++ and configuring VxWorks to support them.
- TrueFFs, a flash memory interface, which provides a block device interface to a wide variety of flash-memory devices.
- Configuring and writing COM and DCOM applications for VxWorks.
- VxMP, which provides shared-memory objects dedicated to high-speed synchronization and communication between tasks running on separate CPUs.
- VxFusion, a lightweight, media-independent mechanism, based on VxWorks message queues, for developing distributed applications.
- VxVMI, a virtual memory interface, which provides write protection and an architecture-dependent interface to the CPU's MMU.

VxWorks Architecture Supplements

The VxWorks architecture supplements provide additional information specific to target architectures.¹

VxWorks Network Programmer's Guide

The *VxWorks Network Programmer's Guide* describes the networking facilities available with VxWorks. It includes the following topics:

- Configuring the network stack.
- Network configuration protocols.
- Dynamic routing protocols.
- Networking APIs.
- Booting over the network.

1. For example, *VxWorks for PowerPC Architecture Supplement*.

- Creating a new data link layer driver or network service.



NOTE: If you have installed Tornado with the default networking component, the networking guide is titled *VxWorks Network Programmer's Guide*. If you have installed an optional networking product, the title is slightly different.

VxWorks API References

The *VxWorks OS Libraries API Reference* and the *VxWorks Drivers API Reference* include reference descriptions of all VxWorks libraries that apply to all targets. Each entry lists the routines found in a given library, including a one-line synopsis of each, along with a general description of their use.

In addition to HTML and print formats, the API references are available in UNIX-style man pages. For details on using **man** with VxWorks documentation, see *Man Pages*, p. xii.

VxWorks BSP Reference

The *VxWorks BSP Reference* consists of reference descriptions for BSP-specific libraries and routines for all installed BSPs. This section also contains entries for the serial, Ethernet, and SCSI drivers available with VxWorks Board Support Packages (BSPs).

VxWorks Errno Code List

The *VxWorks Errno Code List* provides a description of VxWorks errno codes, by number, by routine name, and alphabetically.

VxWorks BSP Developer's Guide

The *VxWorks BSP Developer's Guide* provides instructions on creating, documenting, and testing new BSPs, components, and projects.

GNU Compiler and Tools

The *GNU ToolKit User's Guide* is a convenient collection of manuals for the GNU C and C++ compiler and its supporting tools: the C preprocessor, assembler, static linker, and binary utilities. Specific versions are provided for each architecture family. The *GNU Make User's Guide* is the Free Software Foundation's (FSF) manual for the **make** utility. The *GDB User's Guide* is the FSF manual for the command-line interface to the GNU debugger GDB, which is the foundation for the Tornado graphical debugger, CrossWind.



NOTE: The FSF develops software under UNIX, and examples in their manuals reflect this. Nevertheless, the GNU tools operate reliably under Windows.

Diab C/C++ Compiler and Tools

The *Diab C/C++ Compiler Guide* describes the tools in the Diab C/C++ Optimizing Compiler Suites, including the compilers, assembler, linker, and utilities. The Diab suite is provided as the standard compiler for ColdFire, and is available for other architectures as an optional product.

Online Documentation

Online Manuals

Tornado includes a collection of all Tornado and VxWorks manuals in HTML format. You can open the online manuals from the Help>Manuals Contents menu in the Tornado IDE or at *installDir/docs/books.html*. An index and full-text search are available.

Online Help

Help buttons in every Tornado dialog box and the Help menu on the menu bar provide information on the Tornado component you are currently executing. In addition, from the shell, you can hot-key to the reference entry for the VxWorks routine you have entered.

Man Pages

UNIX-style man pages for API reference entries are available for Solaris hosts. The most convenient way to access these pages is to create an alias for **man -M** such as **vxman**:

```
alias vxman 'man -M installDir/man'
```

You can then display entries, such as the one for **printf()**, from a shell prompt as follows:

```
% vxman printf
```

PDF Documents

PDF versions of most books in the standard Tornado documentation set, as well as the Diab compiler guides, are provided in *installDir/SETUP/DOCS*. They are also available in the **DOCS** directory at the base of the Tornado core product CD.

Documentation Conventions

Cross-References

In the Tornado guides, cross-references to a *reference entry* for a specified tool or module refer to an entry in the online *VxWorks API Reference* (for target libraries or subroutines) or to the *Tornado API Reference* (for host tools).

Cross-references between books take the form *Book Title: Chapter Name*, and are not linked in the HTML version.

Pathnames

In general, all manuals refer to Tornado directories and files with pathnames starting at the installation directory *installDir*. Use the pathname chosen on your system for Tornado installation. Your working directory is referred to as *projDir*.

Screen Displays

The screen displays in this book are for illustrative purposes. They may not correspond exactly to the Tornado environment you see on your computer, because both Tornado and the UNIX environment in which it runs can be customized. Tornado is also designed to permit easy integration with added tools.

Command-Line Examples

Tornado allows you to execute most functions either from within the IDE or from the command line. The command syntax is usually the same for Windows and UNIX command lines. For this reason these documents use the following default format for command lines:

```
% prjCreate
```

When a particular command syntax applies to UNIX only, this is stated. When a command syntax applies to Windows only, or when the Windows version differs from the UNIX version, the Windows format is as follows:

```
C:\> winFooRun param
```

Typographical Conventions

Tornado manuals use the font conventions in the following table for special elements. C subroutine names always include parentheses, as in **printf()**. Combinations of keys that must be pressed simultaneously are shown with a + linking the keys. For example, **CTRL+F3** means to simultaneously press the key labeled **CTRL** and the key labeled **F3**.

Table 0-1 **Typographical Conventions**

Term	Example
files, pathnames	<i>installDir/host</i>
libraries, drivers	memLib.c
Command-prompt tools	dir
Tcl procedures	wtxMemRead
C subroutines	semTake()
VxWorks boot commands	p
code display	main ();
keyboard input display	[vxKernel] -> wtxregd -V
output display	value = 0
user-supplied values	<i>name</i>
components	INCLUDE_NFS
keywords	struct
named key on keyboard	RETURN
key combinations	ALT+SHIFT+F5
lower-case acronyms	<i>fd</i>
GUI titles and commands	Help
GUI menu path	Tools>Target Server>Configure
references to other manuals	<i>VxWorks Programmer's Guide: Basic OS</i>

1

Overview

1.1 Introduction

Thank you for purchasing Tornado!

Tornado 2.2 provides a greater level of accessibility for users unfamiliar with Tornado, and increased productivity for experienced developers. Key features of this release are:

- the integrated version of the VxWorks target simulator (VxSim) introduced in Tornado 2.0
- the integrated version of the WindView logic analyzer for the target simulator introduced in Tornado 2.0
- an improved project facility
- a new debugger engine

The target simulator allows you to experience Tornado — as well as begin developing hardware-independent modules — without target hardware. The integrated version of WindView provides dynamic visualization of application behavior on the simulator. The new project facility provides automated graphical features for managing project files, configuring VxWorks, and building applications. The new debugger GUI is easier to use and provides more direct access to debug information.

This guide describes how to install Tornado and other compatible products. It also provides a simple tutorial that demonstrates the use of the project facility, the integrated versions of the target simulator and WindView, and the Tornado debugger. The tutorial is designed to provide new users with an accessible introduction to the key features of Tornado and their use in application

development. It is also intended to provide experienced Tornado users with an introduction to major innovations in the development environment.



NOTE: The integrated target simulator (VxSim-Lite) runs as a single instance per user, without networking support. Optional products such as SNMP and other network products are not available for this version. The full-scale version of the simulator, VxSim, is available as an optional product. It supports multiple-instance use, networking, and other optional products.

The integrated version of WindView is designed solely for use with the VxWorks target simulator. WindView is available as an optional product for all supported target architectures.

1.2 Terminology and Conventions

The following terms are used in this document:

host

A computer on which the Tornado development tools run.

target

A processor board that runs VxWorks (Tornado's real-time operating system) and applications developed with Tornado.

target server

A service that runs on the host and manages communications between host tools (such as the Tornado shell, debugger, and browser), and the target system itself. One target server is required for each target.

Tornado registry

A Tornado service that keeps track of, and provides access to, target servers. One registry may serve a network, or registries may run on each Tornado host.

The following conventions are used in this document:

- The root installation directory is identified as *installDir* in this document, but the environment variable **WIND_BASE** must be set to the root installation directory for Tornado to work.
- A series of items to be selected from the GUI is denoted by A>B>C. The elements A, B, and C may be menu items, buttons, or tabs.

2

Installing Tornado

2.1 Introduction

This chapter provides step-by-step instructions for installing Tornado 2.2 and obtaining a license. It also tells a system administrator how to set up a floating license server and how to manage the server. This information is also available as online help for **SETUP**.

For a floating license installation, license server software must be installed and running on a host on your network *before* Tornado can run. A system administrator should install the license server software on a host designated for that purpose, using the same **SETUP** program that installs Tornado. System administrators installing the floating license server should refer to *2.5.1 Installing and Configuring a License Server*, p.21 for step-by-step instructions.

If you are going to use a node-locked license, you will do the required configuration when you obtain the license as the final step of installation.

Installing Tornado 2.2 involves:

- (1) Setting up your Solaris workstation with the correct patches.
- (2) Locating the installation keys. You will be installing from the Tornado core CD and from a BSP CD. Each has its own key.
- (3) Selecting a user account to use for installation.
- (4) Running the **SETUP** program. **SETUP** can be used to install either Tornado 2.2 or the floating license server. The program requires an installation key and some other information about your host.

- (5) Configuring Tornado to obtain a license, which may include some manual steps after the **SETUP** program completes. An optional authorization code may also be required for some installations.



NOTE: The installation instructions in this section also apply to any Tornado-compatible Wind River product that you have purchased separately. Optional products should be installed in the same directory tree as the version of Tornado for which they have been released.

2.2 Before You Start

If you are a system administrator installing license management on a server, go to *2.5.1 Installing and Configuring a License Server*, p.21.

If you are installing Tornado 2.2 on your own machine, be sure you are installing on a supported host that meets minimum system requirements for both hardware and software, including patch levels. See the *Tornado Release Notes* for information about minimum system requirements and about using Tornado 2.2 in combination with other Wind River products.

Licensing

Tornado 2.2 and some optional components require a license. If you are installing on a host with access to the Internet, the setup and installation program obtains the license for you; but before you start **SETUP** you should know:

- Whether the software you are installing requires a license. (Tornado 2.2 requires a license; some optional components do not.)
- If a license is required, what kind to use: *floating* or *node-locked*. (Refer to your purchase order.)
- If you will use a floating license, whether a floating license server is installed on a host in your network.
- If your system is running in 32-bit mode. (Tornado 2.2 runs *only* in 32-bit mode.)

If you do not know the answers to these questions, check with your system administrator.

Installing with Previous Versions of Tornado

If you plan to install Tornado 2.2 on a host that has another version of Tornado installed, see the *Tornado Release Notes* for information about correctly installing alongside your current version. You can never install a new Tornado in an existing Tornado tree.



NOTE: If you plan to install Tornado 2.2 on a system that has the Beta version already installed, you must first *uninstall* the Beta version.

Obtaining the Installation Keys

If you have purchased Tornado, your installation keys are printed on the Installation Keys sheet in the *Getting Started* portfolio that includes the Tornado 2.2 CD-ROM and this guide.

If you cannot find the installation keys, contact Wind River by e-mail at **license@windriver.com**. Please include your sales order number if you have purchased Tornado.

You can also call 800/545-WIND (800/545-9463) if you are in North America and ask for Key Administration. In other locations, contact the nearest Wind River office.

2.3 Product Installation Procedure

2.3.1 Preliminary Installation Steps

Step 1: Start the SETUP Program

Insert one of the Tornado 2.2 CD-ROMs in the drive. Install the Core CD first, followed by the BSP/driver CD.

The **SETUP** program has online help that provides detailed information about the installation and license configuration process. Click on the **Help** button to access help from any dialog where the button is enabled (starting with the User Registration page).

Each **SETUP** dialog box also has a **Cancel** button, which you can use to exit from the installation program. To continue to the next box, click the **Next** button. To return to the previous box to review or change information you have entered, click the **Back** button (which is grayed-out if it cannot be used).

Run **SETUP** manually from the command prompt. The **Welcome** dialog box appears. To continue, click **Next**.

Step 2: Review the Readme Information

The **README.TXT** window appears next. When you have finished reviewing the information contained in the window, click **Next**.

Step 3: Review the License Agreement

Read the license agreement. If you agree with its conditions, click **I Accept** and **Next** to proceed with installation.

Step 4: Enter User Information and Installation Key

In the **User Registration** dialog, enter the primary user name, your company name, and the installation key.



NOTE: Enter the key exactly as it appears on the Installation Keys sheet. The key is case sensitive, and all characters must be entered, including non-alphanumeric characters.

If you have already installed other products from the same CD-ROM, you can select the installation key from the drop-down list. Otherwise, copy it from the Installation Keys sheet.



NOTE: The two CD-ROMs associated with Tornado 2.2 require different keys. Both are on the Installation Keys sheet.

To continue, click **Next**.

Step 5: Choose the Type of Installation

In the Installation Options dialog, choose one of the following:

- Full Installation. Choose this option to install a complete version of Tornado 2.2 for an end user on the local host. Click **Next** to continue. (This is the option most users will use.)
- License Management Server Installation. This option installs and configures a floating license server on the local host. The floating license server manages a pool of licenses for use by installations on other hosts in a network. System administrators installing a floating license server should select this option and click **Next** to continue. See *2.5.1 Installing and Configuring a License Server*, p.21, then follow the steps listed there.



NOTE: A license server must be installed and available on a network before Tornado 2.2 can be configured to use floating licenses. Before you install Tornado and attempt to configure it to use a floating license, you should ensure a license server has been installed.

To continue, click **Next**.

Step 6: Enter the Project Information

The license number and number of seats is shown on the Tornado Installation Keys form that shipped with your product. Enter this information and click **Next**.

2.3.2 Installing Tornado

Step 7: Specify the Installation Directory

Tornado 2.2 and its related products are designed to be installed in a single directory tree. Specify the base directory for that tree in the **Select Directory** dialog box, for example, `/usr/bob/tornado2.2`.



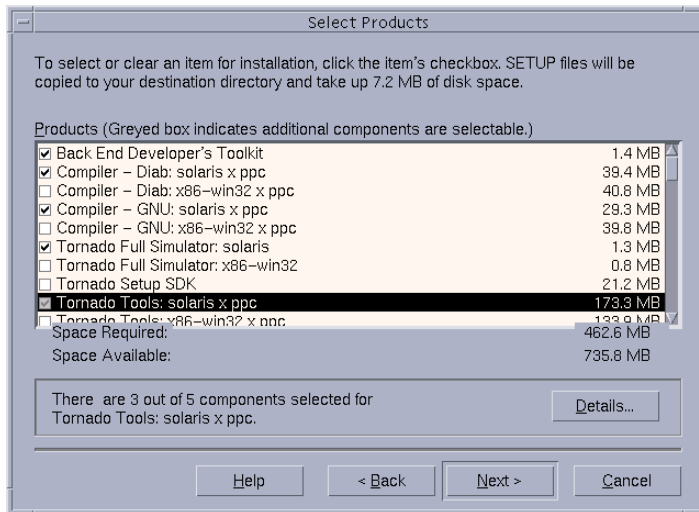
WARNING: Do not install Tornado 2.2 in the same directory as any prior installation of Tornado, or in the same directory as versions of Tornado for other target operating systems (such as Tornado for I₂O). Unpredictable behavior may result. For more information about installing Tornado 2.2 alongside existing installations of Tornado, refer to the *Tornado 2.2 Release Notes*.

You can use the Browse button to display a file browser for locating and choosing the installation directory. If the directory you specify does not exist, you will be prompted to create it.

To continue, click Next.

Step 8: Review the Product List for Installation

All of the products you ordered are marked as selected in the Select Products dialog box by a check in the box to the left of the product name. Each item in the list represents a single product. To include or omit a product, click the checkbox next to the product name.



The line at the bottom indicates how many components comprise the selected product. If you highlight a product by clicking on it, the line at the bottom displays how many components within that product are selected. For example, in the Select Products dialog box, if Tornado Tools: Solaris x ppc is highlighted, the dialog shows 3 out of 5 components are selected. To see a list of the individual components for a product, click the Details button. See *Selecting Parts*, p.9 for more information.

A Tornado 2.2 installation requires the following minimum components:

- Tornado tools for the host system
- target processor and family
- driver objects and headers for the selected target (These are on your second, BSP/driver CD-ROM.)

By default, these components are chosen for installation. This ensures that the necessary base product is installed, and that other products will install successfully later. This is especially important when:

- Your installation key covers more than one product, or multiple run-time components such as TrueFFS or individual BSPs, and you choose to install them separately.
- You have more than one installation key covering different products.
- You have separate CD-ROMs containing add-on products.

Click Next to continue.

If there is not enough space for the selected products, **SETUP** warns you and gives you the option of going back to specify a directory on a larger disk or partition. You can also go back and omit some products. Click Go Back to return to the Select Directory dialog box, or No to continue. If you click No and continue, you will be prompted later to free up disk space.



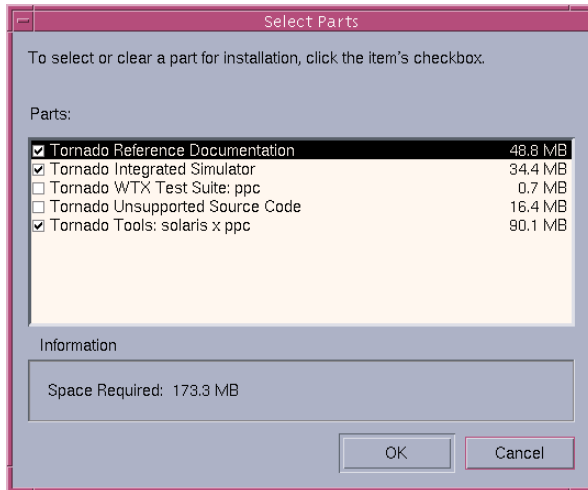
NOTE: Some components rely on other components. If you select one component without also selecting others it relies on, the **SETUP** program warns you and may require you to go back and change your selections before continuing to the next step.

Click Next to continue.

- **Selecting Parts**

If a product has more than one part, clicking Details opens the Select Parts dialog, which displays all the parts in a list. You can modify the default selection of parts using this list. Check or uncheck the boxes to the left of the names.

This dialog also displays the approximate amount of disk space required for the selected parts.



Click OK to accept any changes you make to the list of parts, or Cancel to ignore any changes.

Step 9: Set File Permissions

Specify the file system permissions for the installation. When **SETUP** copies the files from the CD-ROM to the host system, it assigns these permissions to the files and directories it creates.



NOTE: These permissions do not apply to files and directories Tornado 2.2 creates after it is installed. The **umask** of the user running Tornado 2.2 determines the permissions assigned to them.

Click Next to continue.

Step 10: Remote Tornado Registry

If the Tornado registry will be installed on another machine, change **localhost** to the name of the remote host and click Next.

Step 11: Backward Compatibility

If you are going to use Tornado 1.0.1 and Tornado 2.2 tools in the same development environment, you must select **yes** in the Backward Compatibility dialog box. See the *Tornado Release Notes* for information about mixed-release development environments and portmapper usage.

Step 12: SETUP Installs Files

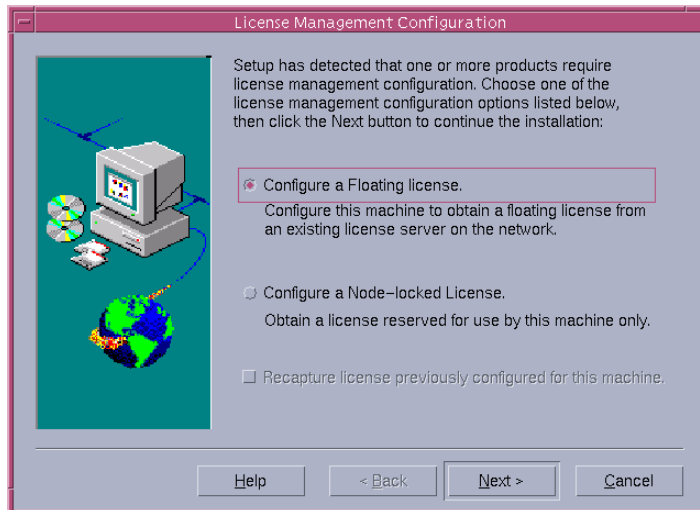
SETUP begins to copy files from the CD-ROM. As installation progresses, the program displays information about the product as well as the names of the files being installed. The process may take several minutes.

When SETUP has finished copying files, a dialog confirms installation of the products you selected for Tornado 2.2. You still need to install one or more BSPs from the second installation CD-ROM you received; but first, complete license manager installation. Click OK to close the dialog.

Next, SETUP configures Tornado 2.2 to reserve a license.

2.3.3 Obtaining a Tornado License

If the product you have installed (such as Tornado 2.2) requires a license, the SETUP program presents additional dialogs to select the type of license and to obtain one for use.



Step 13: Choosing a Licensing Method

Tornado 2.2 obtains a license using one of two methods. In the License Management Configuration dialog, you choose the method for your installation to use. If you are unsure of which one to use, ask your system administrator or refer to your purchase order.

Configure a Floating License

Choose this method to reserve a license from a pool of shared licenses every time you run Tornado 2.2. When you exit Tornado 2.2, the license is released for other installations to use.



NOTE: A license server must be installed and available on your network before Tornado 2.2 can be configured to use floating licenses. Before you install Tornado 2.2 and attempt to configure it to use a floating license, you should first ensure that a license server has been installed. See *2.5.1 Installing and Configuring a License Server*, p.21 for more information.

Configure a Node-Locked License

Choose this method to obtain a license and reserve it for use only on this computer. Laptop computers that are often disconnected from the local network (and therefore cannot connect to a floating license server) should use this method. The license is contained in a file stored in the local installation, and the installation uses it exclusively thereafter.

Recapture license previously configured for this machine

If a node-locked license for Tornado 2.2 was previously reserved for the host, and you want to configure the present installation to reuse that license, then check the box.

Choose an option and click **Next** to continue

To proceed with the floating license option for typical end users, see *Obtaining a Floating License*, p.12. Otherwise, see *Obtaining a Node-Locked License*, p.15.

Obtaining a Floating License

This section describes the steps to configure Tornado 2.2 to obtain a floating license from a license server on your network. For instructions on obtaining a node-locked license, see *Obtaining a Node-Locked License*, p.15.



NOTE: A license server must be installed and available on your network before Tornado 2.2 can be configured to use floating licenses. Before you install Tornado 2.2 and attempt to configure it to use a floating license, you should first ensure that a license server has been installed. See 2.5.1 *Installing and Configuring a License Server*, p.21 for more information.

1. Query the License Database

SETUP can automatically retrieve information from Wind River about the licenses you have purchased. In the Database Query Permission dialog, you give permission for **SETUP** to contact Wind River for this purpose. Your computer must have an active connection to the Internet to complete this step.

Yes, contact Wind River web site

Select this option to retrieve the information automatically, then click **Next**. **SETUP** transfers only the information necessary to configure a license for Tornado 2.2, and no other data from your computer. See 2. *Select License Server(s)*, p.13 to continue.

No, do not contact the Wind River web site

If you select this option, the installation of Tornado 2.2 is complete but it has not obtained a license. If you do not obtain your license now, there are two ways to initiate license configuration later:

- Start **SETUP** with the **-L** option.
- Start Tornado. When you run any Tornado 2.2 tool that is under license management, **SETUP** starts and steps you through obtaining a license.



Click **Next** to continue.

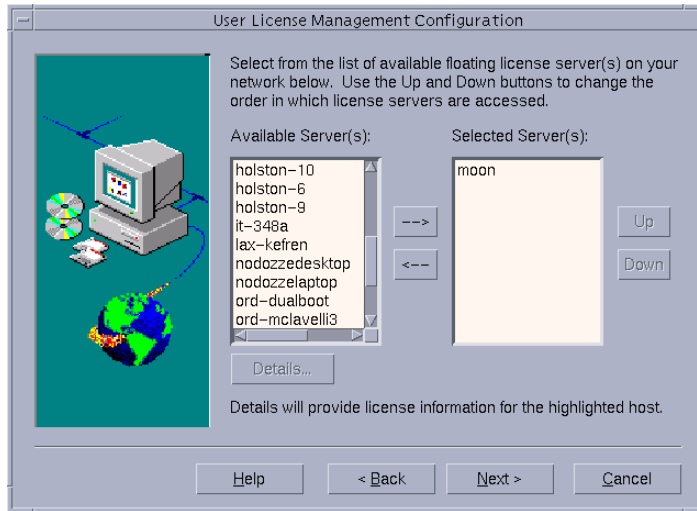


NOTE: In the Finish dialog that appears when you choose not to contact the Wind River web site, **SETUP** displays information about manually configuring Tornado 2.2 to use a floating license. Make a note of the instructions, then click **Exit**.

2. Select License Server(s)

The User License Management Configuration dialog displays the license servers available on your network, from which Tornado 2.2 can request a floating license.

Click one or more server names listed in Available Server(s). To add them to the list of Selected Server(s) click on the  button. Click on the  button to move them back. Use the Up and Down buttons to prioritize the selected servers. Tornado 2.2 sends its request for a license to the server at the top of the list first.



To see more information about an individual server and the licenses available on it, click to highlight the server; then click the Details button while the server name is highlighted.

No Servers Available

If no entries appear under Available Server(s), this means **SETUP** cannot locate any license servers. Possible reasons for this and their solutions are:

- No license server is installed on an accessible host in your network; contact your system administrator to have one installed.
- The license server is installed on an accessible host but is not active; contact your system administrator to activate it.
- The host is not connected to the network; troubleshoot the connection. If the machine is normally not connected to the network (for example, a laptop), consider assigning a node-locked license. See *Obtaining a Node-Locked License*, p.15.

Click Next to continue.

3. Confirm License Servers

In the License Management Registration dialog you can review your choice of license servers. Click **Next** to accept the choice, or **Back** to modify it. When you click **Next**, **SETUP** displays the **Finish** dialog.

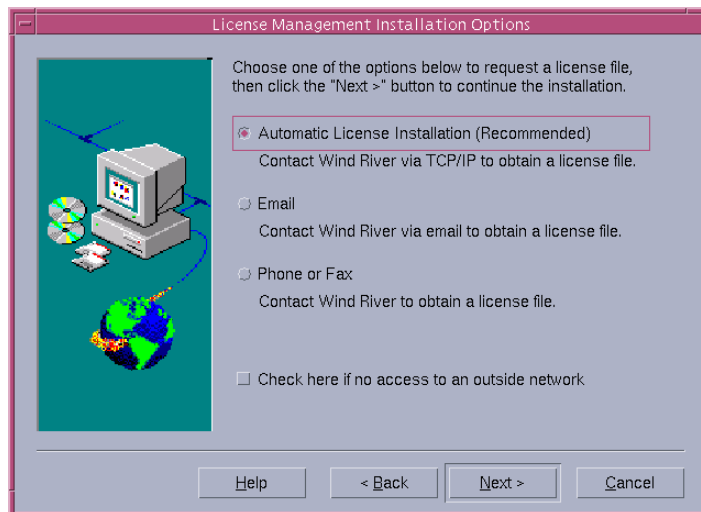
There is one more step to complete before you are done. See *4. Set Environment Variables*, p.26.

Obtaining a Node-Locked License

A node-locked license is a license reserved exclusively for a single Tornado 2.2 installation. The license is contained in a file stored locally during setup and Tornado 2.2 uses it exclusively thereafter. This section describes the steps to follow to reserve a node-locked license and to obtain the license file.

Choose a Method for Requesting the License File

In the License Management Installation Options dialog, select a method for **SETUP** to contact Wind River and request the license file.



Automatic License Installation

Recommended because it is the quickest and easiest method, and when you exit the **SETUP** program the license file is installed. This method requires an

active Internet connection. See *Automatic License Installation*, p.16, if you choose this method.

Manual License Installation

Choose one of the manual options (e-mail, phone, or fax) if the host is not connected to the Internet, or if you are located behind a firewall or a proxy server that prevents automatic installation from completing. When you request a license file using one of these methods, the file is sent to you through e-mail and you must install it manually. Click **Next** and see 3.*Select Node-Locked Licenses to Configure or Reload*, p.17 to continue.

If the host has no Internet access and cannot send e-mail, a final option for obtaining a license file is to visit the Wind River Web site using another computer that does have network access. Visit <http://www.windriver.com/ali> and follow the instructions there. Once you have the file, copy it to a diskette and transfer it to the install host, as described in 3.*Install the License File Manually*, p.20.

Automatic License Installation

This section describes the steps to follow when requesting a node-locked license using the Automatic License Installation option.

1. Query the License Database

In order to obtain the license file, **SETUP** automatically retrieves information from Wind River about the licenses you have purchased. In the Database Query Permission dialog, you give permission for **SETUP** to contact Wind River for this purpose. Your computer must have an active connection to the Internet to complete this step.

Yes, contact Wind River web site

Select this option to retrieve the information automatically. Before you click **Next**, review the information that will be transferred. **SETUP** transfers only the information necessary to configure a license, and no other data from your computer.

You may wish to use your disk serial number as your host ID instead of using your MAC address (the default). This option is recommended if you have a laptop with multiple NIC cards and you switch between the cards. For more information, see <http://www.windriver.com/corporate/support/license.html>. Click **Next** to continue.

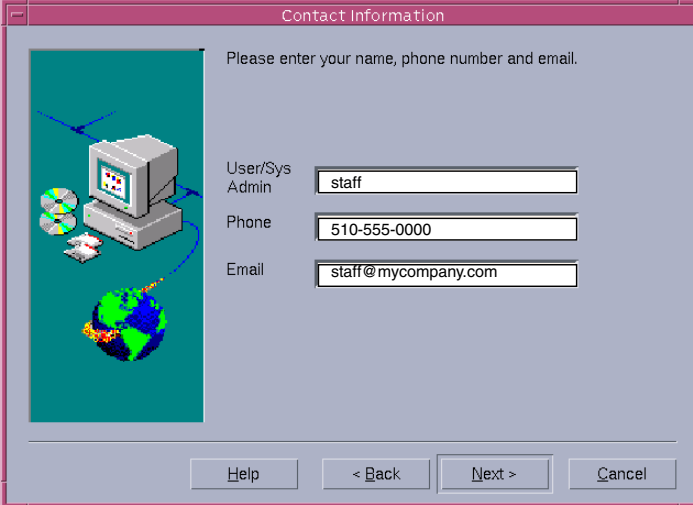
No, do not contact the Wind River Web Site

If you select this option, **SETUP** displays instructions for manually installing a license file (see 3.*Install the License File Manually*, p.20). If you wish, you can

return to the previous dialog, where you can choose one of the manual methods of requesting the license file instead. See *Choose a Method for Requesting the License File*, p.15.

2. Provide Contact Information/User Authorization

In the Contact Information/User Authorization dialog, enter contact information for the person who coordinates license configuration and management at your site. **SETUP** includes this information in the request for a license file.

A screenshot of a Windows-style dialog box titled "Contact Information". The dialog has a light blue background. On the left, there is a graphic showing a computer monitor, a tower unit, and a globe with a network of lines. To the right of the graphic, the text "Please enter your name, phone number and email." is displayed. Below this text are three text input fields. The first field is labeled "User/Sys Admin" and contains the text "staff". The second field is labeled "Phone" and contains the text "510-555-0000". The third field is labeled "Email" and contains the text "staff@mycompany.com". At the bottom of the dialog, there are four buttons: "Help", "< Back", "Next >", and "Cancel".

Authorization Code

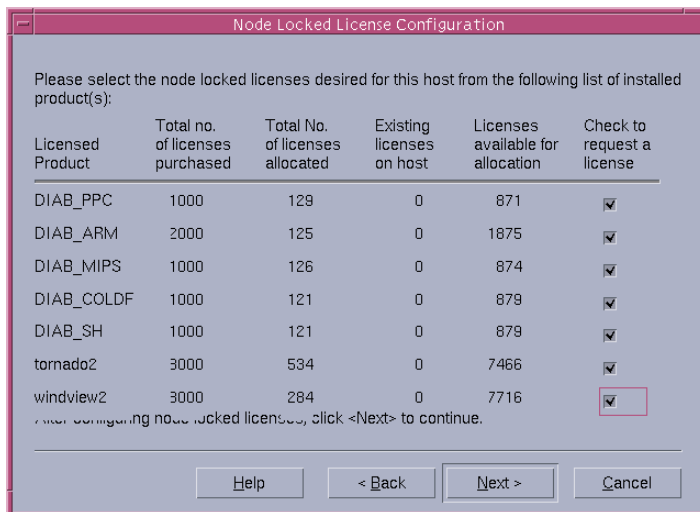
Your purchase agreement for Tornado 2.2 may have included a request for an authorization code, used to restrict access to licenses. If so, this dialog is labeled User Authorization and it includes a field for the code. You can find the code on the Installation Keys sheet. You must enter the code before you can request or reserve any licenses.

Click Next to continue.

3. Select Node-Locked Licenses to Configure or Reload

If you are requesting new licenses, the Node Locked License Configuration dialog displays the number of licenses still available out of the total purchased.

Select the licenses you want to reserve by checking the boxes next to the product name. Each node-locked license you reserve in this dialog reduces the number of licenses available for other Tornado 2.2 installations.



If you are reloading a license that was previously assigned to this host, the Reload Existing License dialog appears instead. This dialog displays information about the license(s) to be restored. You can review this information, but you cannot alter it.

When you have selected new licenses to reserve, or reviewed the licenses to be restored, click Next to continue and proceed with *4. Review License Management Summary*, p.20.

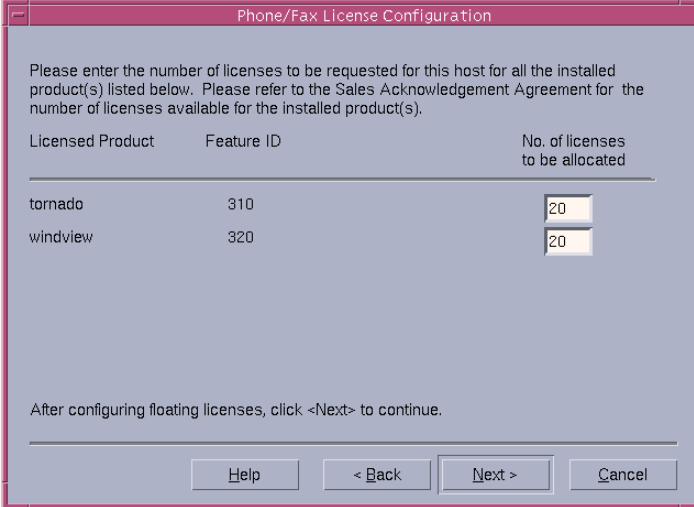
Manual License Installation

This section describes the steps to follow when requesting a node-locked license using one of the manual methods.

1. Select Products to License

The Email License Configuration dialog or the Phone/Fax License Configuration dialog appears, depending on the manual method you have chosen. The following image shows the Phone/Fax dialog, but the contents of the two dialogs are the same for both methods. The dialog displays the products you have installed and for which you can request a node-locked license. Select the

licenses you want to reserve by checking the appropriate boxes next to the product names.



Please enter the number of licenses to be requested for this host for all the installed product(s) listed below. Please refer to the Sales Acknowledgement Agreement for the number of licenses available for the installed product(s).

Licensed Product	Feature ID	No. of licenses to be allocated
tornado	310	<input type="text" value="20"/>
windview	320	<input type="text" value="20"/>

After configuring floating licenses, click <Next> to continue.

Click Next to continue.

2. Request the License

Next, you must provide information gathered by **SETUP** to Wind River. After Wind River has the information, you will receive the license file through e-mail.

▪ Request the License File by E-mail

To use this method, the host must have network access to a mail server.

- (a) **SETUP** inserts all the necessary information into an e-mail message that you can preview in the Email License dialog. When you have viewed the message, click **Next** to continue.
- (b) In the Mail Confirmation dialog, enter the e-mail address where you want the license file to be sent. Select a mail protocol and enter the name of the mail server to use.
- (c) Click **Send** in the Mail Confirmation dialog. The request is sent from the current host to **license@windriver.com**.
- (d) See *3. Install the License File Manually*, p.20.

▪ Request the License File by Phone

- (a) **SETUP** copies all the necessary information into a file that you can preview in the Contact Wind River dialog and print for your reference.
- (b) Call Wind River at the number listed on the dialog and give the information to the license representative.
- (c) Click on Finish to exit the **SETUP** program.
- (d) See 3. *Install the License File Manually*, p.20.

3. Install the License File Manually

When you receive the license file **WRSLicense.lic**, do not alter its contents or change the file name. Copy it to the directory *installDir*./**wind/license**, where *installDir* is the directory in which Tornado 2.2 is installed.

4. Review License Management Summary

The Summary dialog shows the license(s) or server(s) you have configured for this installation. If the information is correct, click **Next** to accept the results. To go back and change the configuration, click on **Back** or **Cancel**.

One final step is necessary for certain installations. On a UNIX host, you need to set some host environment variables. See 4. *Set Environment Variables*, p.26. Then, you are done installing Tornado 2.2 and configuring a license for it.

For an introductory tutorial on Tornado 2.2 usage, see 3. *Tornado Tutorial*.

2.4 Uninstalling Tornado 2.2



WARNING: Before uninstalling Tornado 2.2, make copies of any Tornado files you have modified. Uninstalling Tornado removes all files that were part of the original distribution list.

To remove Tornado 2.2, first stop the Tornado registry by killing the **wtxregd** process. Then type the following commands at the system prompt:

```
% cd installDir/setup
% UNINST installDir
```

The *installDir* directory is where Tornado 2.2 was installed.

If you plan to re-install Tornado 2.2 after uninstalling, remove the *installDir*./**wind** directory.

2.5 Administering License Management

2.5.1 Installing and Configuring a License Server

This section describes the steps for installing and configuring a license server using **SETUP**. If your site will use floating licenses, at least one license server must be in place before Tornado 2.2 floating seats and licensed optional products can be used. The license server manages a pool of floating licenses for use by Tornado 2.2 installations on other hosts on a shared network.

This section is relevant for system administrators who want to install the network license server, and not for typical end users of Tornado 2.2. It is not part of standard product installation, but must be completed before any licensed products can be used with floating licenses.



NOTE: A license server must be installed and available on a network before Tornado 2.2 can be used with the floating license option. Before users install Tornado 2.2 and attempt to obtain a floating license, ensure that a license server is installed.

Step 1: Run **SETUP**

The initial steps required for installing a license server are the same as 2.3 *Product Installation Procedure*, p.5. Follow *Step 1* through *Step 6* first. When the Installation Options dialog appears, select License Management Service Installation and click Next.



NOTE: To install only license management daemons and utilities files, you can invoke **SETUP** with the **-F** or **/F** option. If you use **-F** or **/F**, **SETUP** takes you directly to *Step 2*.

Step 2: Choose a Directory for License Management Utilities

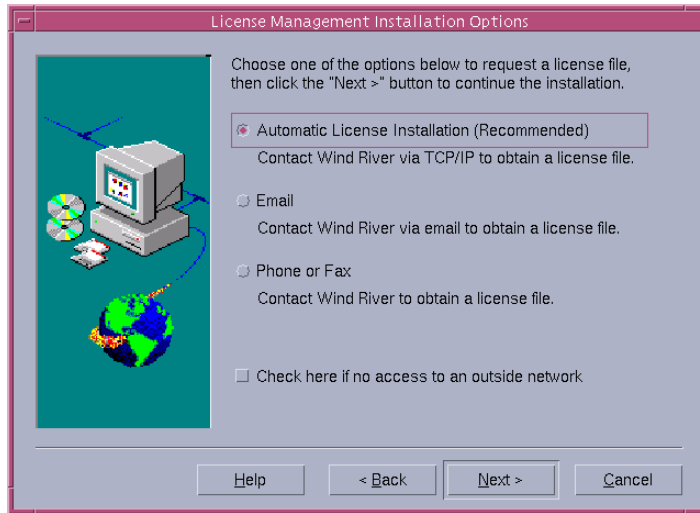
SETUP asks you to confirm that this is the correct host on which to install the license manager software before proceeding. If it is not, exit the program now. Choose a local directory for the license management files. Click **Next** to continue.

If you wish to reinstall your existing license file without adding licenses or making any other changes, check the box.

Step 3: Select Installation Method

The license manager requires a license file installed locally on the server machine. The file is generated upon request by Wind River. In the License Management

Installation Options dialog, select a method for contacting Wind River to request the license file.



Automatic License Installation

Recommended because it is the quickest and easiest method if you have an active connection to the Internet. When you exit the **SETUP** program, the license file is installed. If you choose this method, click **Next** and see *Automatic License File Installation*, p.23.

Email option or the Phone or Fax option

Choose one of these manual options, if the host is not connected to the Internet or if you are located behind a firewall. When you request a license file using one of these methods, the file is sent to you through e-mail and you must install it manually. Click **Next** and see *3.Install the WRSLicense.lic File Manually*, p.26 to continue.

If the host has no network access and cannot send e-mail, you can visit the Wind River Web site using another computer that does have network access. Visit **<http://www.windriver.com/ali>** and follow the instructions there. Once you have the file, copy it to a medium such as a diskette and transfer it to the install host, as described in *3.Install the WRSLicense.lic File Manually*, p.26.

Automatic License File Installation

This section describes the steps to follow when requesting a license file using the Automatic License Installation option.

1. Query the License Database

SETUP can automatically retrieve information from Wind River about the licenses you have purchased. If your computer has an active connection to the Internet, you can give permission for **SETUP** to contact Wind River for this purpose.

Yes, contact Wind River web site

Select this option to retrieve the information automatically, then click **Next**.

SETUP transfers only the information necessary to configure a license, and no other data, from your computer. Click **Next** to continue.

No, do not contact the Wind River Web Site

If you select this option, **SETUP** returns to the previous dialog, where you can choose one of the manual methods of requesting the license file instead.

2. Provide Contact Information/User Authorization

In the Contact Information/User Authorization dialog, enter contact information for the person who coordinates license configuration and management at your site. **SETUP** includes this information in the request for a license file.

Authorization Code

Your purchase agreement may have included a request for an Authorization Code: a number used to restrict access to licenses. If so, this dialog is labeled User Authorization and it includes a field for the code. You can find the code in the Installation Keys sheet. You must enter the code before you can request or reserve any licenses. Click **Next** to continue.

3. Choose a License Server Port

The license server receives requests for floating licenses on a dedicated port. Use the License Server Port dialog to select the port the server will use. You can accept the default of 27000, or choose an unused one numbered 1024 or higher. Click **Next** to continue.

4. Specify Floating Licenses to Manage

The Floating License Configuration dialog lists the products for which you have purchased licenses, the number of licenses (if any) that the current host is managing, and how many licenses are available to claim. Enter the number of

licenses for each product that you want the server to manage in its pool of licenses.

Floating License Configuration


Please enter the number of floating licenses for this host from the following list of installed product(s):

Licensed Product	Total no. of licenses purchased	Total No. of licenses allocated	Existing licenses on host	Licenses available for allocation	Additional licenses to allocate
DIAB_PPC	1000	644	0	356	<input type="text" value="0"/>
DIAB_ARM	1000	628	0	372	<input type="text" value="10"/>
DIAB_MIPS	1000	626	0	374	<input type="text" value="10"/>
DIAB_COLDf	1000	625	0	375	<input type="text" value="0"/>
DIAB_SH	1000	620	0	380	<input type="text" value="0"/>
tornado2	1000	661	0	339	<input type="text" value="10"/>
windview2	1000	660	0	340	<input type="text" value="10"/>

After configuring floating licenses, click <Next> to continue. NOTE: available licenses once allocated cannot be reconfigured on-line except through WRS license administrators.

If you are increasing the number of licenses for the server, then the numbers you enter will reserve *additional* licenses.

In either case, the number that remains for other servers to claim is reduced accordingly.



WARNING: If you install more floating seats than appear on your purchase order, Wind River will contact you to reconcile the difference. Please review your purchase order before installing, to be sure that you install only as many licenses as you have purchased or wish to purchase.

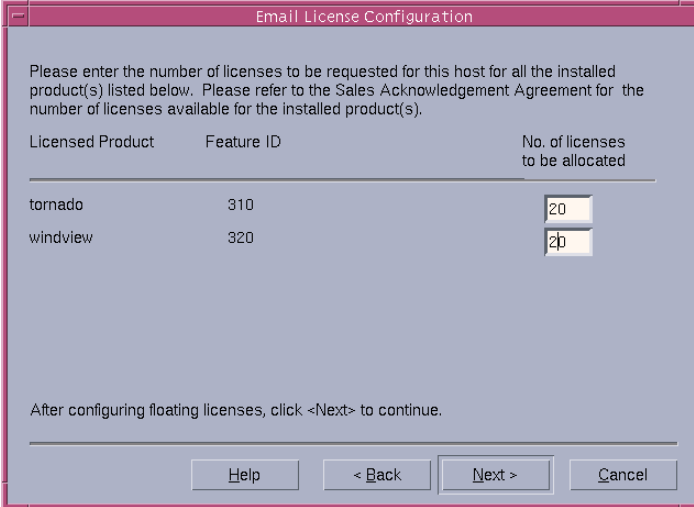
When you have made your selection, click Next to continue. The Summary: Floating License dialog shows the total number of licenses you have configured for the license server to manage. To accept the configuration, click OK. To go back and change the configuration, click Cancel.

You need to set system variables manually for UNIX hosts. See *4.Set Environment Variables*, p.26 to continue.

Manual License File Installation

This section describes the steps to follow when requesting the license file using one of the manual methods.

1. Select Products to License



The dialog box is titled "Email License Configuration". It contains a text area with the following text: "Please enter the number of licenses to be requested for this host for all the installed product(s) listed below. Please refer to the Sales Acknowledgement Agreement for the number of licenses available for the installed product(s)."

Licensed Product	Feature ID	No. of licenses to be allocated
tornado	310	20
windview	320	20

After configuring floating licenses, click <Next> to continue.

Buttons: Help, < Back, Next >, Cancel

The Email License Configuration dialog or the Phone/Fax License Configuration dialog appears, depending on the manual method you have chosen. The image shows the e-mail dialog, but the contents of the dialogs are the same for both methods. The dialog displays the products for which you can request a license file. Indicate the number of licenses you want to reserve in the fields next to the product names.

2. Manually Send the Request for a License File

To complete your request for the license file manually, you must provide the following information in your request. **SETUP** collects the information in an appropriate format for you to send to Wind River:

- host ID of the machine to be the license server
- host Name—the name of the license server host
- your customer license number
- number of licenses to be served for each licensed Wind River product (for example, five licenses for Tornado 2.2 and three for WindView).
- contact information (name, address, phone, e-mail address).



NOTE: The host ID is a number that the license manager software uses to uniquely identify the host machine. **SETUP** determines this number for you automatically, but you can also find it manually by issuing the command **Imutil Imhostid** from a host command line in the *installDir/SETUP/SUN4/SOLARIS2* directory.

- Request the License File by E-mail
 - (a) All the necessary information is put in an e-mail message. You can preview the message in the Email License dialog. Click **Next** to continue.
 - (b) In the Mail Confirmation dialog enter the e-mail address where you want the license file to be sent. Select a mail protocol and the ID of the mail server used by the host.
 - (c) Click **Send**. The request is sent from the current host to **license@windriver.com**, and an automated system receives it.
- Request the License File by Phone
 - (a) All the necessary information is copied to a file. You can preview the file in the Contact Wind River dialog and print it for your reference.
 - (b) When you call Wind River at the number listed on the dialog, have the information available to provide to the representative.
 - (c) Click on **Finish** to exit the **SETUP** program.
- 3. Install the **WRSLicense.lic** File Manually

When you receive the license file **WRSLicense.lic**, do not alter its contents in any way or change the file name. Copy it to the directory *installLic.wind/license*. The *installLic* directory is where license management software is installed.



CAUTION: In most cases you should not alter the file contents or its filename. If you do wish to rename the license file, relocate the file to a path other than *installLic.wind/license*, or combine the contents of the license file with other license files, please consult the user documentation from Globetrotter at <http://www.globetrotter.com>.

4. Set Environment Variables

After you have copied the license file to its location, you must set host environment variables. The **Finish** dialog displays instructions for the remaining configuration steps you must complete manually. Those steps are described here.

- Floating License

For Tornado 2.2 to use a floating license, the value of the environment variable **LM_LICENSE_FILE** must contain information about the floating license server(s) it uses. If **LM_LICENSE_FILE** already exists, then the information should be appended to its current value.

When the **SETUP** program completes installation of Tornado 2.2, the Finish dialog displays commands that you can use to set the variable to the appropriate value. These commands are also saved in the file **lmEnvVar.txt** in the installation directory.

Depending on the command shell you use, the command uses one of the following formats. Add the appropriate format to your startup script in, for example, **.cshrc**.

For csh:

```
setenv LM_LICENSE_FILE port@server
```

For bash, sh, or ksh:

```
LM_LICENSE_FILE=port@server  
export LM_LICENSE_FILE
```

In these examples, *server* is the name of the license server host, and *port* is the port number for the license server host. The port number is set by the system administrator.



NOTE: After you have updated your startup script, remember to **source** it again, or start a new session for the variable to take effect.

- License Server or Node-Locked License

A license server installation and a node-locked license installation of Tornado 2.2 both use the file **WRSLicense.lic**. The instructions for assigning system variables are the same for either type of installation.

The value of the environment variable **LM_LICENSE_FILE** must be set to the location of the **WRSLicense.lic** file. If **LM_LICENSE_FILE** already exists, then the information should be appended to the current value of the variable.

When the **SETUP** program completes the Tornado 2.2 installation, the Finish dialog displays commands that you can use to set the variable to the appropriate value. These commands are also saved in the file **lmEnvVar.txt** in the installation directory.

Depending on your command shell, add the appropriate command to your startup script in, for example, `.cshrc`. The default location of the file is `installDir/.wind/license`.

For csh:

```
setenv LM_LICENSE_FILE installDir/.wind/license/WRSLicense.lic
```

For bash, sh, or ksh:

```
LM_LICENSE_FILE=installDir/.wind/license/WRSLicense.lic  
export LM_LICENSE_FILE
```



NOTE: After you have updated your startup script, remember to **source** it again, or start a new session for the variable to take effect.

2.5.2 Managing Licenses

This section is intended for license administrators to get started using the license management software for Tornado 2.2.

Tornado 2.2 uses the FLEXlm license management system by Globetrotter Software. For detailed information about FLEXlm, including downloadable user documentation, visit <http://www.globetrotter.com>.

Summary of Floating License Management

The following is a summary of floating license management for Tornado 2.2:

- The license manager software runs on one or more hosts designated as floating license servers on your shared network.
- FLEXlm requires a license file installed on each server machine. This file is obtained from Wind River during installation of the license server.
- When a Tornado 2.2 installation on your shared network needs a floating license to run, it requests the license from a floating license server.
- The floating license server must be started in order to serve licenses to Tornado 2.2 installations.

Starting and Stopping the License Server

To make the floating licenses available to Tornado 2.2 installations on the shared network, the license manager must be started on the server.

To start up the license manager, do the following steps manually or add them to a system startup script so that the server is started automatically when the system is rebooted:

1. Change directory to the location where the license utilities are installed:

```
% cd installLic/host/sun4-solaris2/bin
```

2. Issue the startup command:

```
% lmgrd -c installLic/.wind/license/WRSLicense.lic -l  
installLic/.wind/license/lmgrd.log [-x lmdown]
```

In the above example, the optional switch **-l** directs output to a log file, **lmgrd.log**. The optional parameter **-x lmdown** prevents the shutdown of the license manager by the **lmdown** utility.

To stop a license manager process, do the following:

1. If you did not use **-x lmdown**, issue the shut down command:

```
% lmutil lmdown -c installLic/.wind/license/WRSLicense.lic
```

2. If you did use **-x lmdown**, determine the process ID (*pid*) of the license manager process:

```
% ps | grep lmgrd
```

3. Kill the process:

```
% kill pid
```


3

Tornado Tutorial

3.1 Introduction

This tutorial is designed to introduce you to key features of Tornado using the integrated VxWorks target simulator. It does not require any target hardware or special configuration of your host system. It is not a programming tutorial; the sample program was written to exercise Tornado in illustrative ways.

While simply reading the tutorial may be edifying, we encourage you to perform the steps described in this chapter so that you can experience Tornado first hand. In the course of the tutorial, you will:

- Use the project facility to create a workspace and project for a sample program.
- Build the program from the project facility GUI.
- Download the program to the VxWorks target simulator on your host system.
- Use the Tornado shell to run the sample program.
- Use the browser to observe memory usage on the target simulator.
- Use the WindView software logic analyzer to graphically display the execution flow of the sample program and to identify a problem with task prioritization.
- Use the debugger to identify a runtime application error.

Naturally, you will have several opportunities to modify the program to correct its runtime behavior, rebuild it, download it, and run it again.

The tutorial assumes minimal knowledge of multi-threaded programming in C, and basic UNIX usage.

You might approach the tutorial with the following scenario in mind:

A colleague has abruptly announced that he is going on vacation, and the VP of Engineering has handed you the delinquent's portion of The Project. You are alarmed. His code is typically cryptic, poorly documented, and full of run-time mischief. The thought of reading his source gives you a headache. And the target hardware seems to have gone on vacation with him. You decide to use Tornado's target simulator and analytical tools to see how the code behaves...



NOTE: This tutorial is intended for use with the integrated VxWorks target simulator. The results may differ if used otherwise (with target hardware, for example).

3.2 Set Tornado Environment Variables

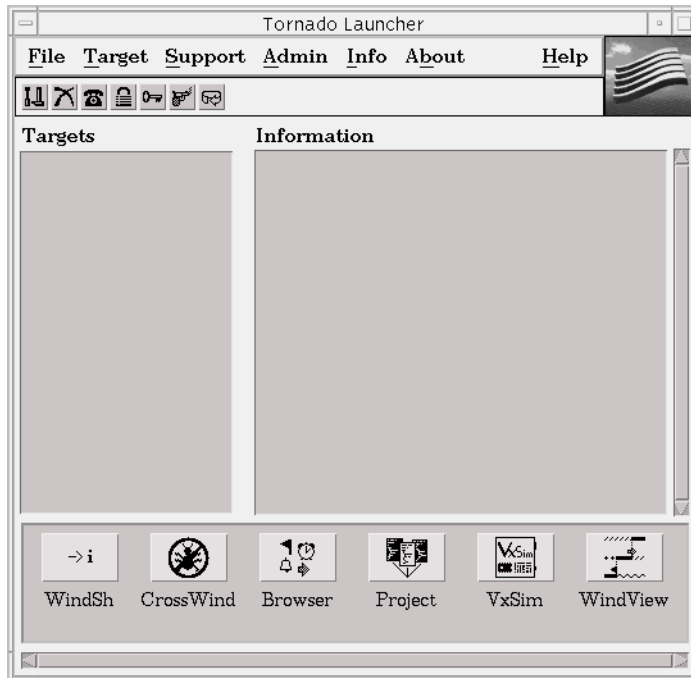
Before you run Tornado, you need to set several environment variables. You can do so most easily by changing directory to `installDir/host/sun4-solaris2/bin`, and then sourcing `torVars.csh` or `torVars.sh`—depending on the shell you use. If you use another shell, these scripts contain all the information you need to set the appropriate variables.

3.3 Start Tornado

To start Tornado, use the **launch** command:

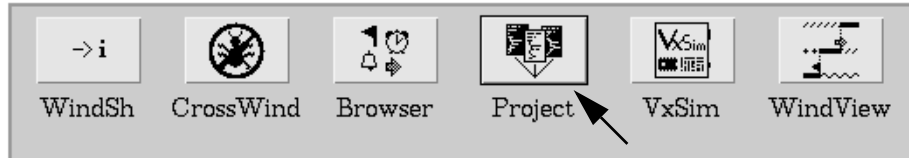
```
% launch &
```

If Tornado is unable to connect to a Tornado registry, you are prompted to start one.
The Tornado Launcher window appears:

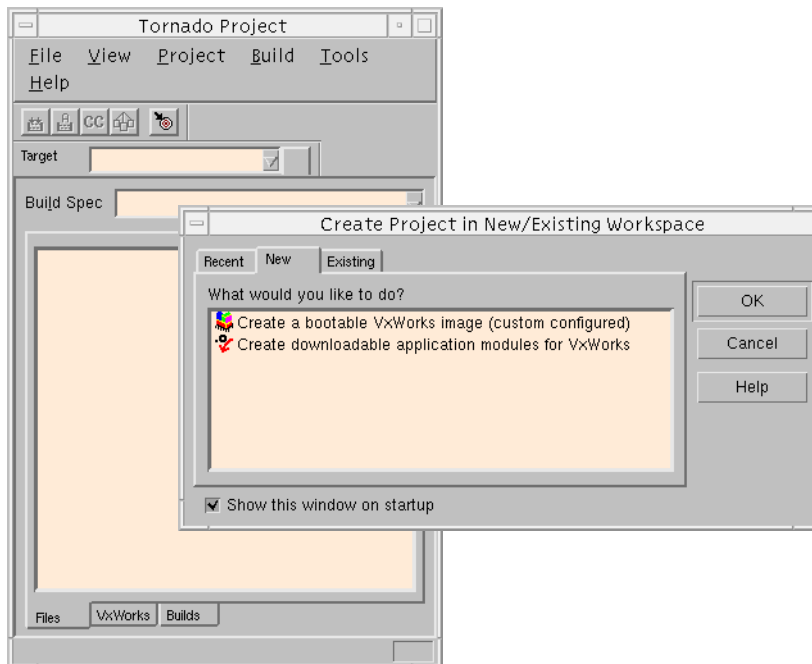


3.4 Create a Project

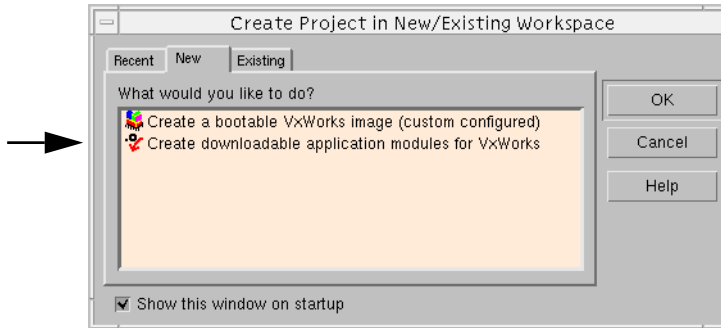
Use the Project button to display the Tornado Project window:



By default, the Tornado Project window and the Create Project dialog box open at the same time:



Select the option for a downloadable application:



Click OK to continue.

The Tornado application wizard appears. This wizard guides you through the steps of creating a new project. In the first step, the wizard prompts you for:

- A name for the project.
- The full path and name of the directory you want to use for the project files.
- An optional description of the project.
- The name and location of the workspace file, which contains information about the workspace, including which projects belong to it.

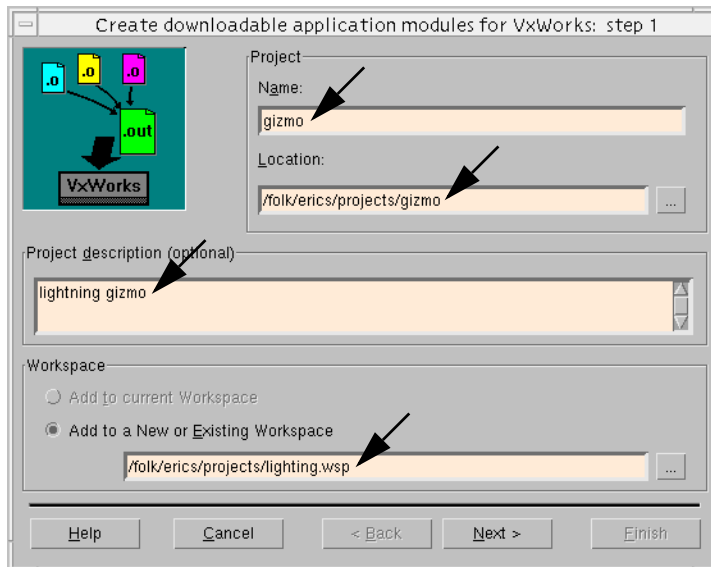
A *project* consists of the source code files, build settings, and binaries that are used to create an application.

A *workspace* is simply a grouping of one or more projects, which provides a useful means of working with related material, sharing code between projects, and associating related applications. Once a project and workspace have been created, a workspace window displays information about the projects that it contains.

You can accept the wizard's defaults for the project and workspace, but it is preferable to set them up outside of the Tornado installation tree. (If you do so, you won't have to untangle your work from the Tornado tree when you upgrade Tornado.)

In the wizard dialog displayed below:

- The project name is gizmo.
- The project directory is **/folk/erics/projects/gizmo**.
- The project description is lightning gizmo.
- The path and file name for the workspace are **/folk/erics/projects/lightning.wsp**.



NOTE: The directory path for the workspace must exist—or at least match the path (or an initial segment thereof) defined in the project Location field—for the wizard to complete project creation.

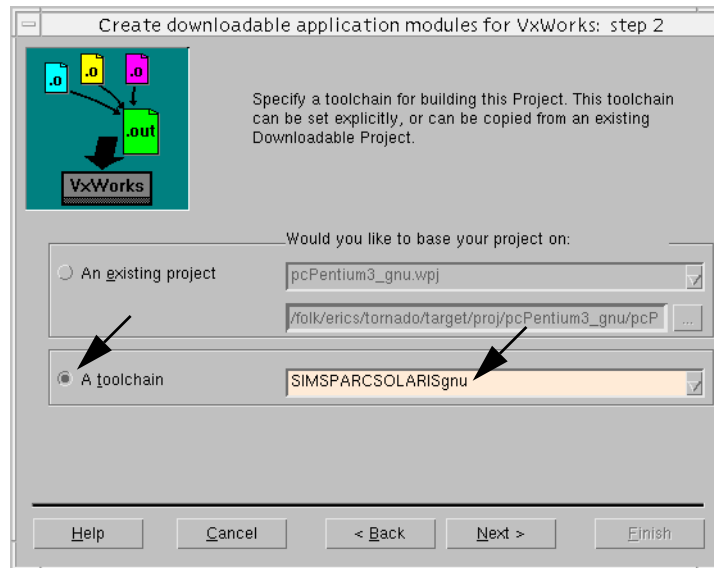
Click Next to continue.

In the second wizard dialog, you identify the toolchain with which the downloadable application will be built.

A *toolchain* is a set of cross-development tools used to build applications for a specific target processor (preprocessor, compiler, assembler, and linker).

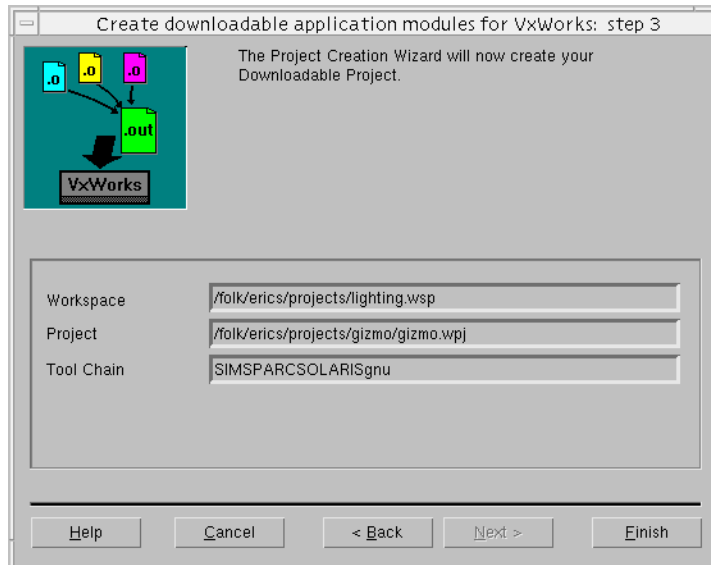
The default toolchain names for target simulators take the form *SIMhostOsgnu* (for example, *SIMSPARCSOLARISgnu*).

Select A toolchain and the option for the target simulator from the drop-down list, as illustrated in the following:



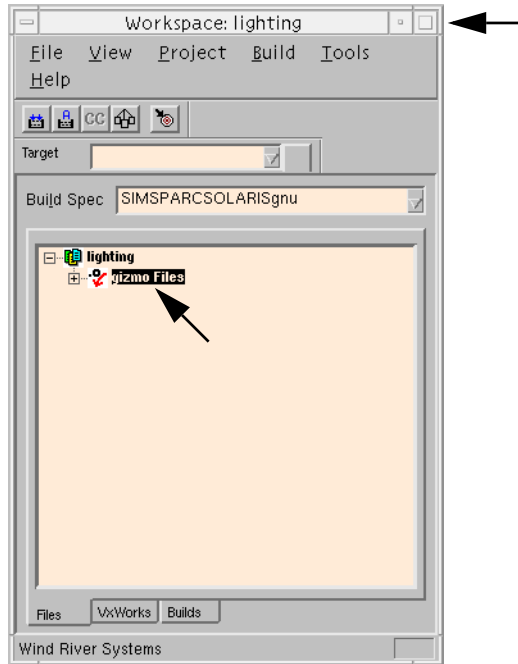
Click Next to continue.

The final wizard dialog confirms your selections:



Click Finish to continue.

The Workspace window appears. The workspace window title includes the name of the workspace, and the window itself includes a folder for the project:



NOTE: Context menus provide access to all commands that can be used with the objects displayed in, and the pages that make up, the Workspace window. Use the right mouse button to display an object's context menu.

3.5 Add the Sample Source File to the Project

The sample program for this tutorial is **cobble.c**. It is a simple multi-tasking application that simulates a data collection system that retrieves data from an external source (for example, a device that generates interrupts as data comes in). The four **cobble** tasks are:

- **tCosmos**, which simulates an interrupt service routine (ISR) and generates new data.
- **tSchlep**, which collects the data.
- **tCrunch**, which performs calculations on the data to obtain a result value.
- **tMonitor**, which monitors the results and prints a warning message if they are outside of the safety range.

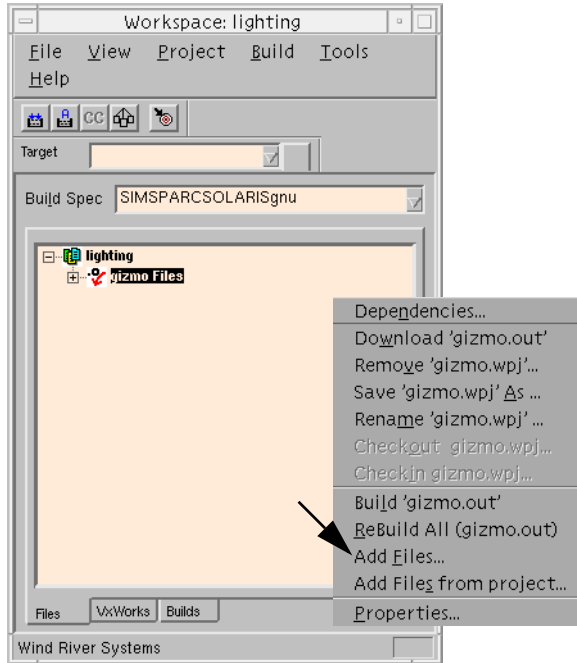
The **cobble** program also includes the **progStart()** and **progStop()** routines. Later in the tutorial, you will use these routines to start and stop the program.

Before you add the sample program to the project, copy it from the Tornado installation tree to another location, such as the project directory you have set up with the Tornado project wizard.

The sample file **cobble.c** is located in *installDir/target/src/demo/start* (where *installDir* is your base installation directory for Tornado).

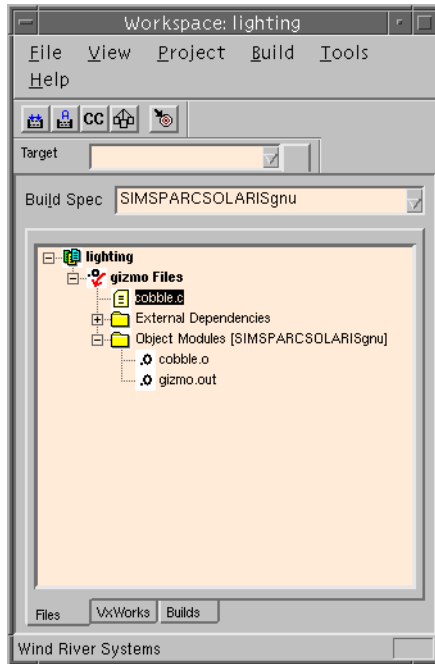
In the examples provided thus far in the tutorial, **/folk/erics/projects** has been used as the base directory for our project work, and subsequent examples are based on **cobble.c** being copied to that directory.

After you have copied **cobble.c** to another location, add it to the project. Select Add Files from the context menu in the Files view of the workspace:



Then use the file browser that appears to select **cobble.c**.

Open the Object Modules folder in the Files view to display the names of the object files that are built from the project:



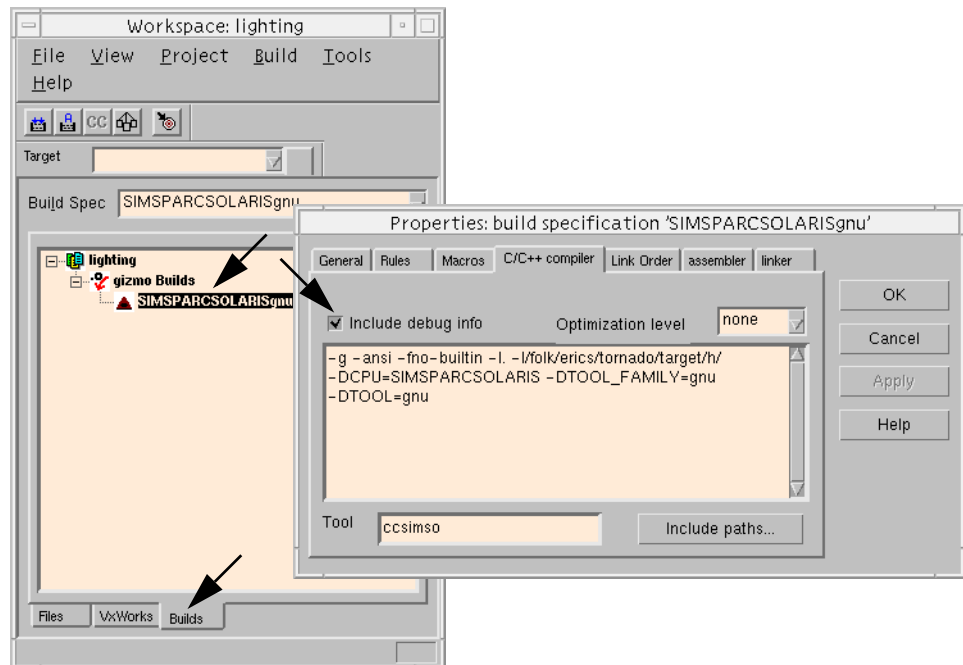
The Tornado project facility automatically creates the file *projectName.out* as a single, partially linked module when a project is built. It comprises all of the individual object modules in a downloadable application project, and provides for downloading them all to the target simultaneously.

3.6 Build the Project

To review the default build settings defined when you created the project, select the Builds tab on the Workspace window, open the gizmo Builds folder, and double-click on the default build name SIMSPARCSOLARISgnu.

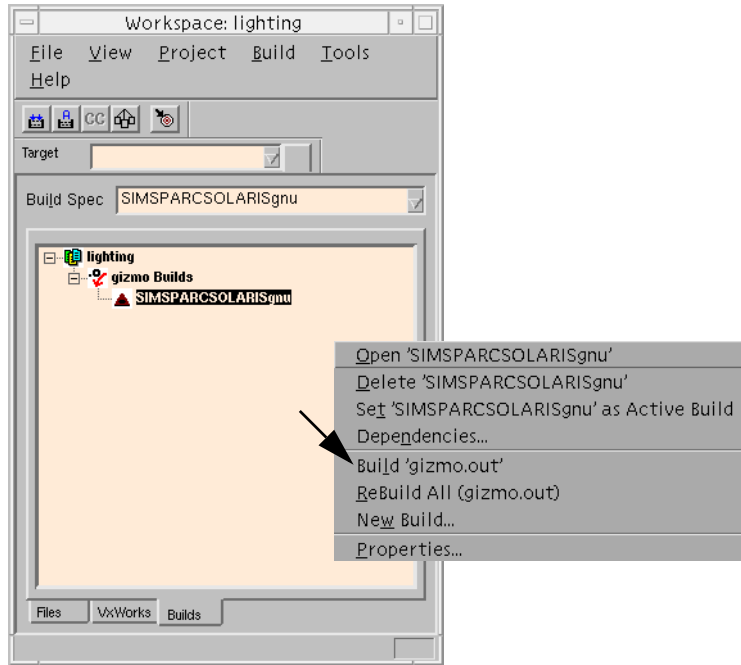
The properties sheet for the build appears, which you can use to review makefile rules and macros, as well as the compiler, assembler, and linker options used for the build.

When you display the C/C++ compiler page, you will note that the Include debug info checkbox is selected by default. This selection ensures that optimization is turned off when the project is compiled with debug information:



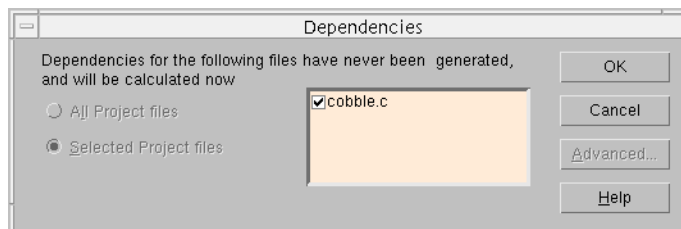
Close the property sheet by clicking on the Cancel button.

Build the project by selecting Build 'gizmo.out' from the context menu:



The option Build '*projectName.out*' builds all project modules as a single, partially linked module that is optimal for downloading to a target.

Before Tornado builds the project, the Dependencies dialog box warns you that makefile dependencies have not been calculated for **cobble.c**:



Click OK to continue.

Tornado calculates makefile dependencies and proceeds with building the project. If any external dependencies are found, they are automatically included in the project and listed in the External Dependencies folder in the Files view of the workspace.

The build output window displays any errors and warnings (in this case there are none):

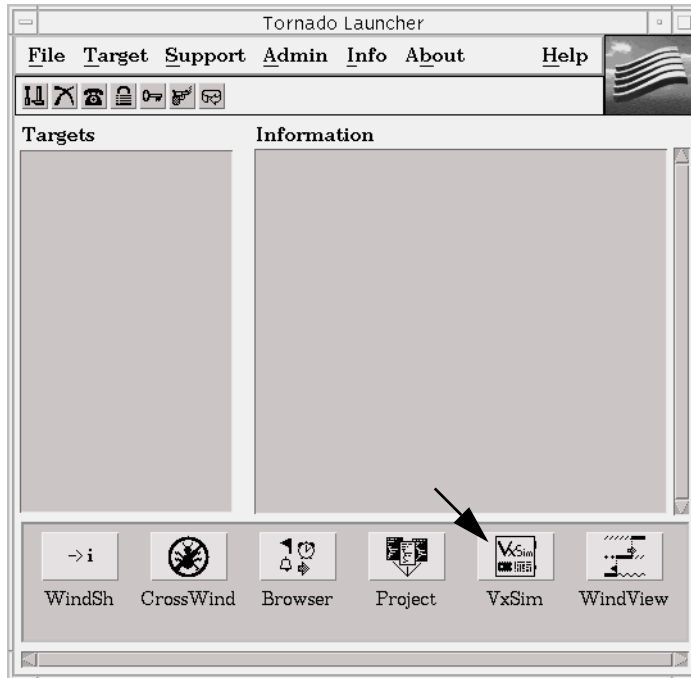


```
Build /folk/erics/projects/gizmo/gizmo.wpj gizmo.out
cd /folk/erics/projects/gizmo/SIMSPARCSOLARISgnu
make -f ../Makefile BUILD_SPEC=SIMSPARCSOLARISgnu gizmo.out
ccsimso -g -ansi -fno-builtin -I. -I/folk/erics/tornado/target/h/ -DCPU=SIMSPARC
SOLARIS -DTOOL_FAMILY=gnu -DTOOL=gnu -c ../../cobble.c
rm -f "" ../prjObjs.lst
Generating ../prjObjs.lst...
ldsimso -nostdlib -r @../prjObjs.lst -o partialImage.o
nmsimso partialImage.o @../prjObjs.lst | wtxtcl /folk/erics/tornado/host/src/hut
ils/munch.tcl -c simso > ctdt.c
ccsimso -c -fdollars-in-identifiers -g -ansi -fno-builtin -I. -I/folk/erics/torn
ado/target/h/ -DCPU=SIMSPARCSOLARIS -DTOOL_FAMILY=gnu -DTOOL=gnu ctdt.c -o ctdt.
o
ldsimso -nostdlib -r -T /folk/erics/tornado/target/h/tool/gnu/ldscripts/link.OUT
partialImage.o ctdt.o -o gizmo.out
hit ENTER to exit
□
```

Press **RETURN** to close the build output window.

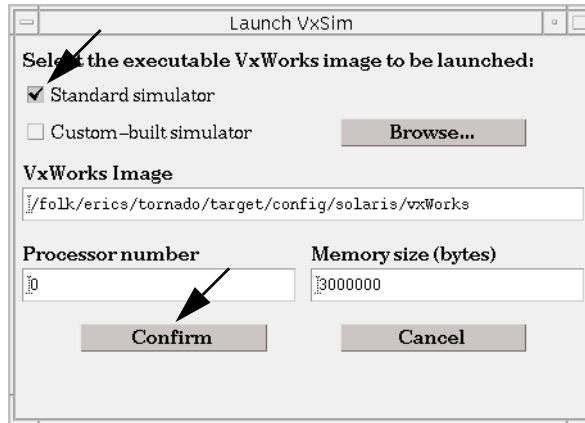
3.7 Start the VxWorks Target Simulator

To start the VxWorks target simulator, first click on the VxSim button in the Tornado Launcher window:



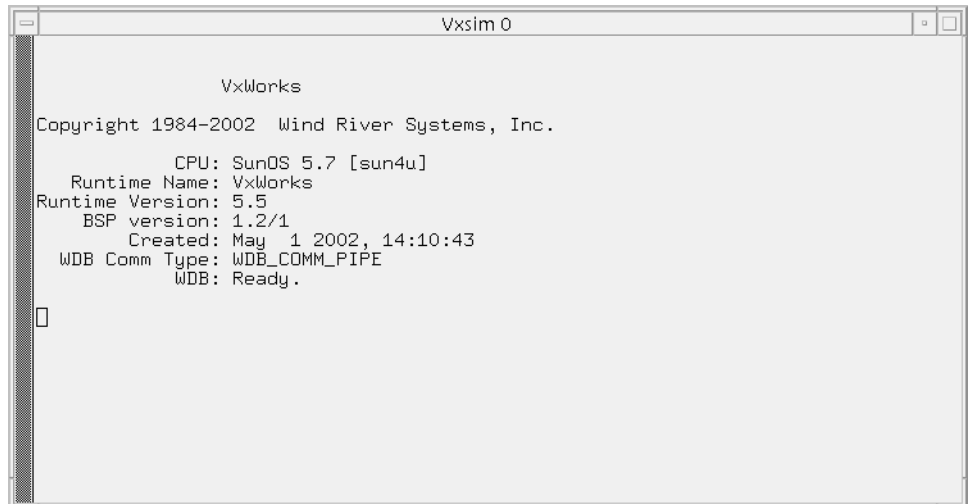
NOTE: Only one instance of the integrated VxWorks target simulator can be run at a time. To stop the simulator, close the simulator window.

The Launch VxSim dialog box appears:

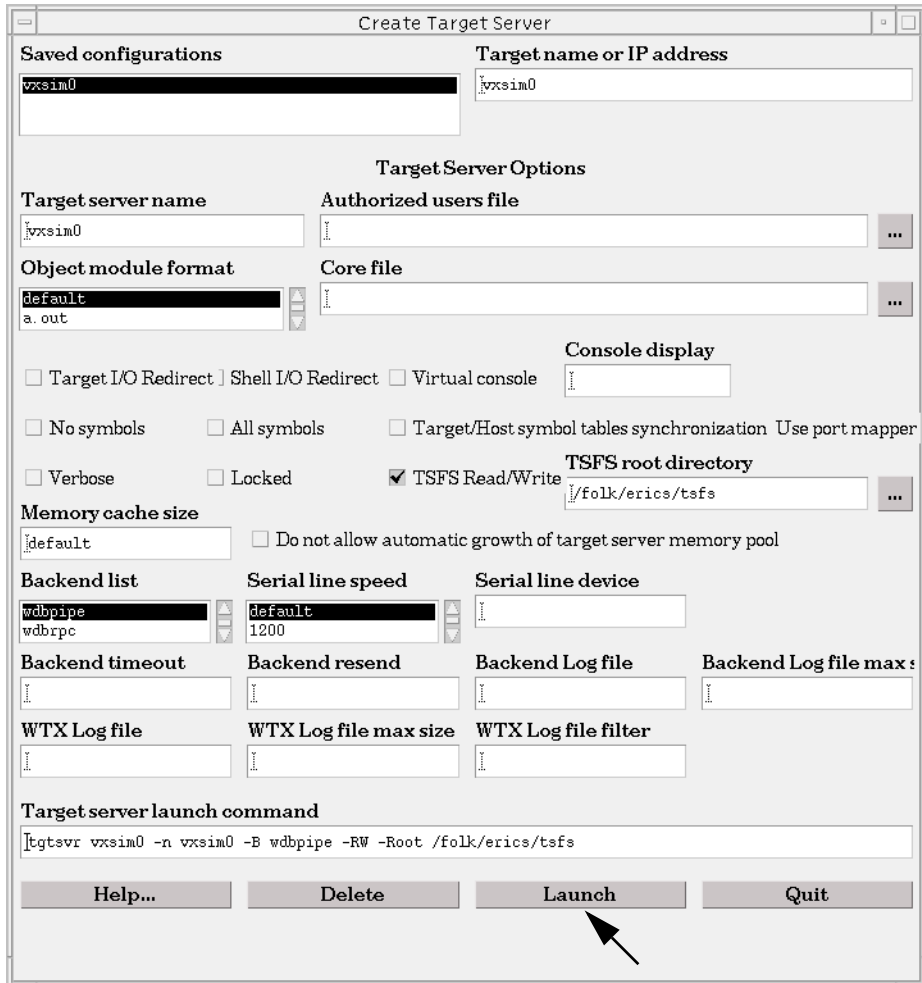


Leave Standard simulator selected, and click Confirm to continue. The target simulator window and the Create Target Server dialog box open.

The simulator window displays information about the operating system and the target:



Click Launch in the Create Target Server dialog to start a target server with the default configuration for the simulator (including wdbpipe in the Backend List field):



A target server manages all communication between Tornado host tools, such as the debugger, and the target. The convention for target server names is *targetName@hostName*. In this example, the name of the target is vxsim0 (the default for the integrated simulator), and the name of the host system is duna.

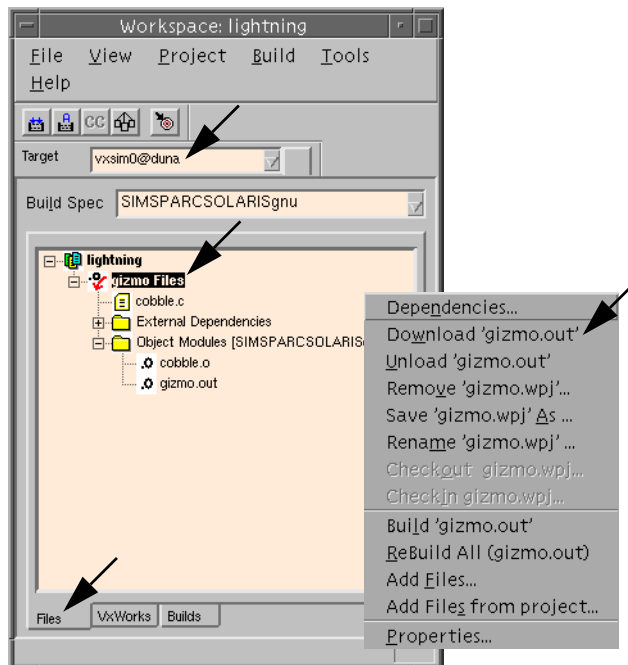
When the target server is launched, the target server name, as well as information about the target and host-target communications method are displayed in the Tornado Launcher:



NOTE: If you are using a Tornado registry with which other target servers have been registered, they will be listed in the Targets box as well. Select the target server for your simulator.

3.8 Download the Project to the VxWorks Target Simulator

To download the project to the simulator, first select the target server name for the simulator from the drop-down list in the workspace window. Then select the Files view of the workspace, select the project folder name with the right mouse button, and select the Download 'gizmo.out' option from the context menu:

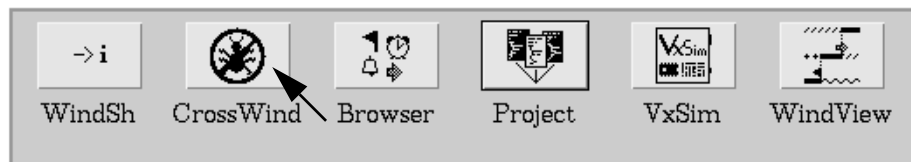


3.9 Run the Application from the Tornado Shell

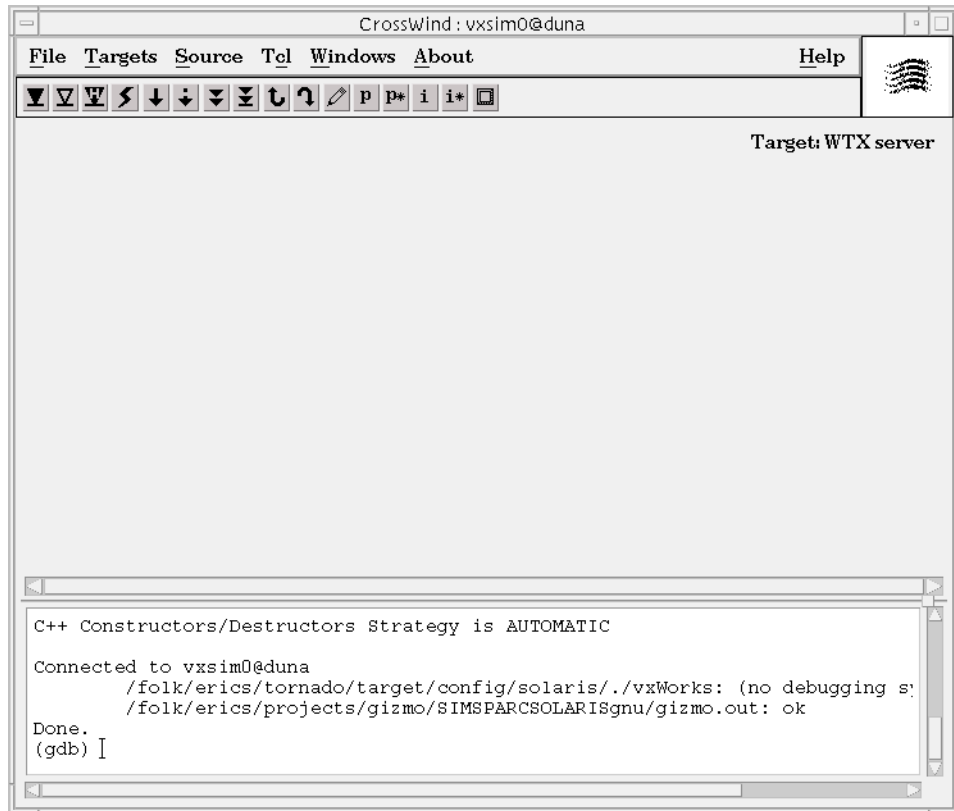
Before you run an application, it is often useful to configure and start the Tornado debugger, so that the debugger can respond to any program exception.

The Tornado debugger (also known as CrossWind) combines the best features of graphical and command-line debugging interfaces. The most common debugging activities, such as setting breakpoints and controlling program execution, are available through convenient point-and-click interfaces. Similarly, program listings and data-inspection windows provide an immediate visual context for the crucial portions of your application.

To start the debugger, click on the CrossWind button in the Tornado Launcher window:

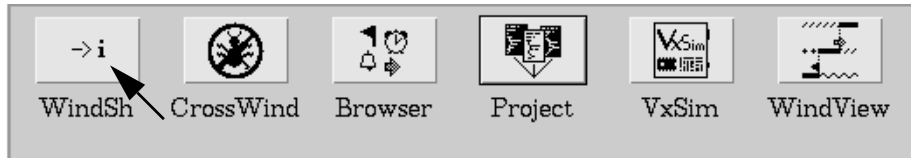


The CrossWind window appears:

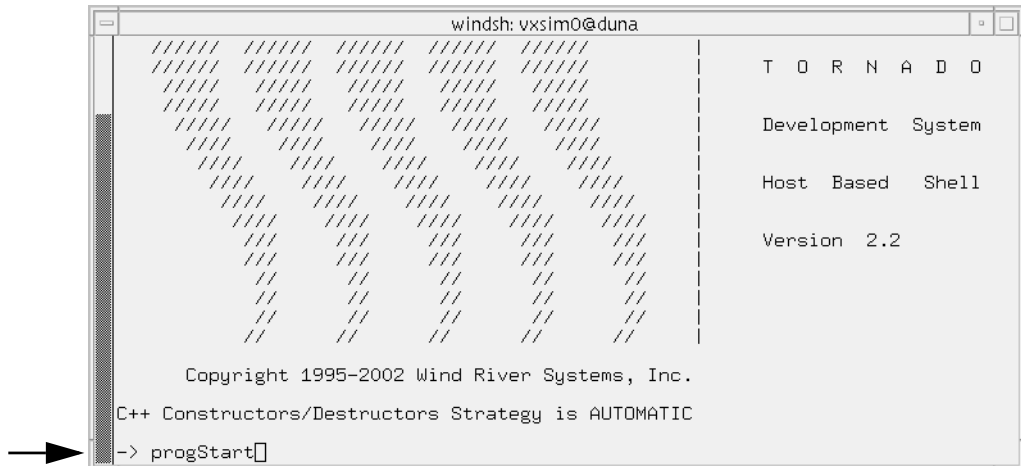


The Tornado shell (also known as WindSh) is a C-language command interpreter that allows you to invoke any routine from the shell command line that has been downloaded to the target. The shell also includes its own set of commands for managing tasks, accessing system information, debugging, and so on.

You can run the program from the shell command line. To start a shell, click the WindSh button in the Tornado Launcher window:



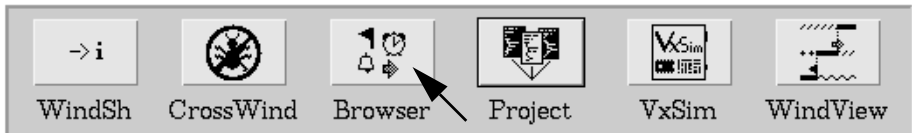
When the shell window opens, run the program by entering the name of the main routine, **progStart**, at the command line:



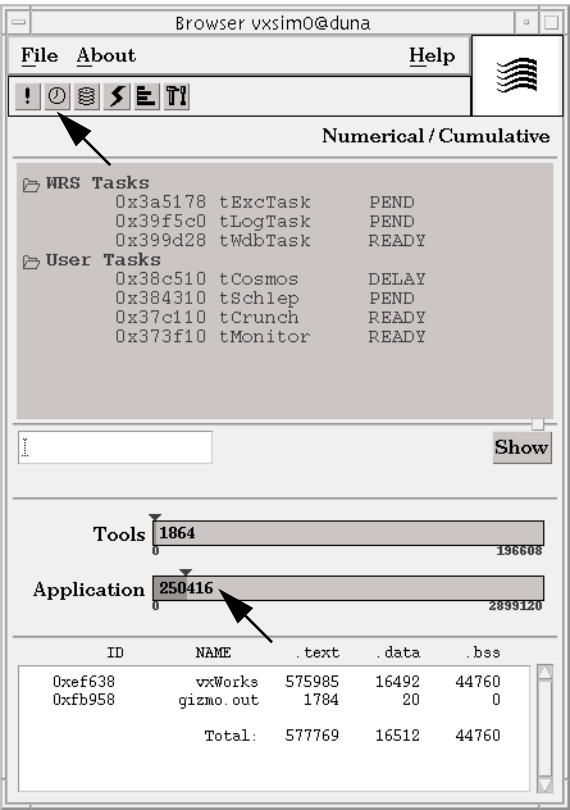
3.10 Examine Target Memory Consumption

The Tornado browser is a system-object viewer that is a graphical companion to the Tornado shell. The browser provides display facilities to monitor the state of the target system, including summaries of active tasks, memory allocation, and so on.

To start the browser, click the Browser button in the Tornado Launcher window:



When the browser appears, click the periodic refresh button . This updates the display every few seconds; notice **cobble.c** has a voracious appetite for memory:

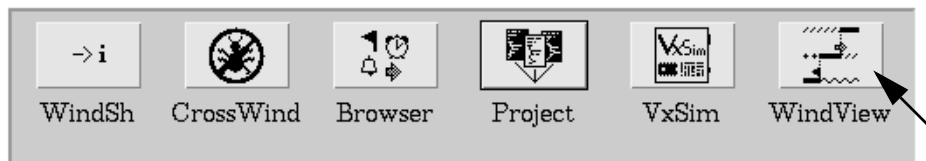


Stop the browser with the File>Quit menu option.

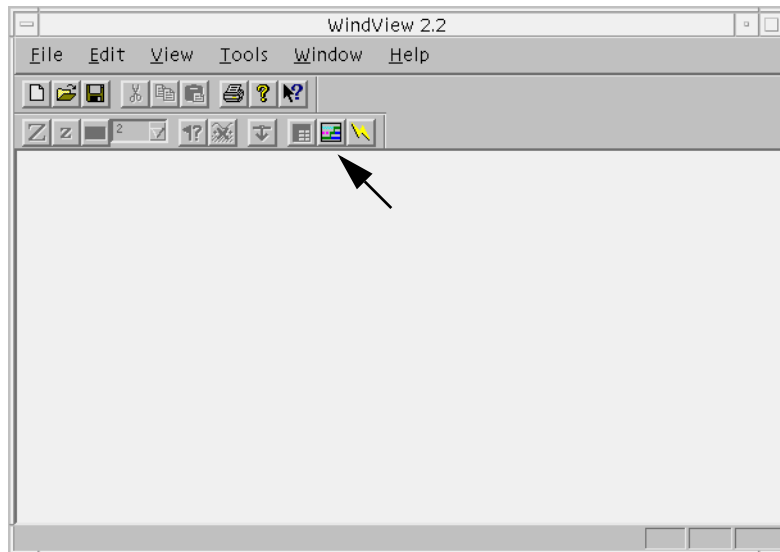
3.11 Examine Task Activity


WindView is the Tornado logic analyzer for real-time applications. It is a dynamic visualization tool that provides information about context switches, and the events that lead to them, as well as information about instrumented objects such as semaphores, message queues, and watchdog timers.

Start WindView by clicking on the WindView button in the Tornado Launcher window:

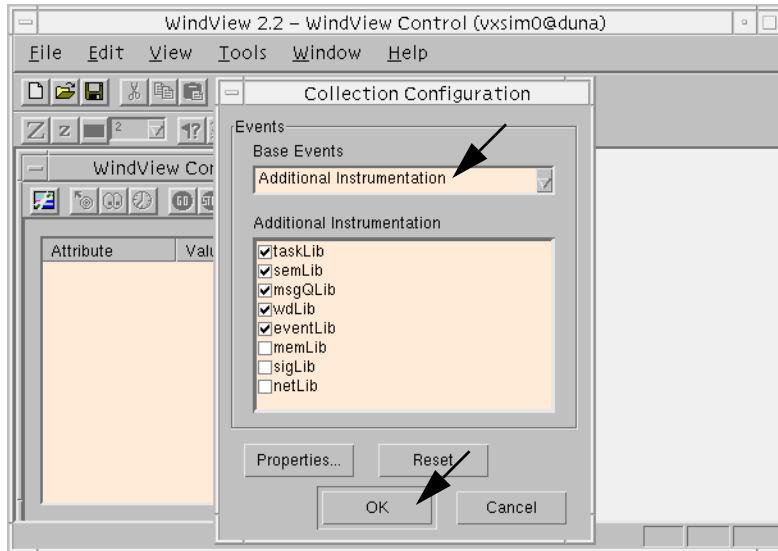



The main WindView window appears:



Click the WindView button  in the WindView window to display the WindView Control window and the WindView Collection Configuration dialog box.

Select Additional Instrumentation from the drop-down list in the dialog box and click OK:

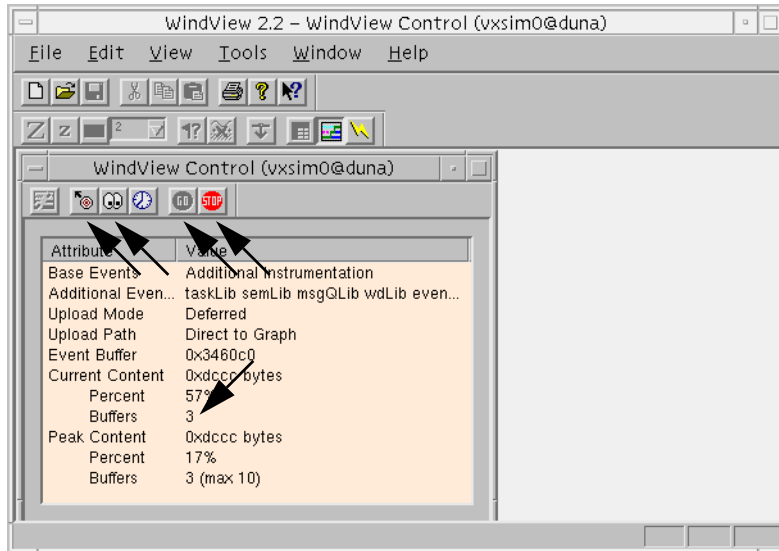



To begin data collection, click the GO button  in the WindView Control window.



NOTE: Except where otherwise specified, the default configuration of WindView is used for this exercise. If WindView settings have been changed during another session, the behavior may vary from the description below.

Wait a few seconds, and then click the update button  in the WindView Control window to update the status of data collection:



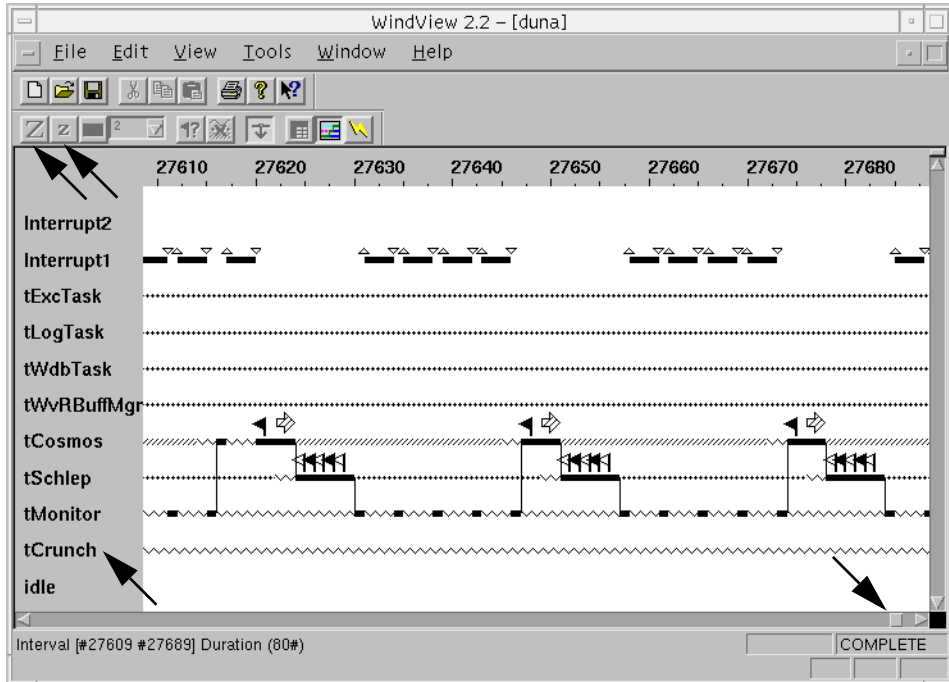
When the Buffers value listed under Current Content reaches at least two, click the Stop button  to end data collection.




Before you upload the WindView data from the simulator target to the host, stop the sample program by entering **progStop** at the shell command line.

Then use the upload button  to upload the data.

A view graph is displayed while the data is uploaded.

When the data upload is complete, maximize the view graph window control and adjust the size of the main WindView window. The data display should look something like the following:¹



You can use the zoom buttons   on the WindView toolbar to enlarge or decrease the scope of the display, and scroll bar at the bottom of the view graph to display the rest of the data. (The zoom 100% button  displays all of the data at once.) The flag-shaped icons indicate semaphore gives and takes. The horizontal lines indicate task states (executing, pending, ready, and so on). For information about the meaning of the WindView icons, select Help>Legend.

Note that **tCrunch**, the task that processes data—and removes nodes from a linked list—never runs.

Exit WindView with the menu option File>Exit, and click No in response to the dialog that prompts you to save the data with: Save changes to *hostName*?

1. The color of the view graph display can be changed with Tools>Options in the main WindView window.

3.12 Fix Task Priorities and Find the Next Bug

Open the source in your editor by double-clicking on **cobble.c** in the workspace Files view.²

Then find the **progStart()** routine, where you'll discover that **tCrunch** is assigned a lower priority than **tMonitor**, which never allows it to run. As a consequence, data is never processed, and nodes are never deleted from the linked list.

Edit the source file to reverse the priorities between the two tasks:

- Change the 240 argument in the **taskSpawn()** call for **tCrunch** to 230.
- Change the 230 argument in the **taskSpawn()** call for **tMonitor** to 240.

Then save the file.

Use the context menu in the Files view of the workspace, select the ReBuild All (gizmo.out) option to rebuild the project. When it is done, close the build output window.

Then download the project to the target with the Download 'gizmo.out' option from the context menu.

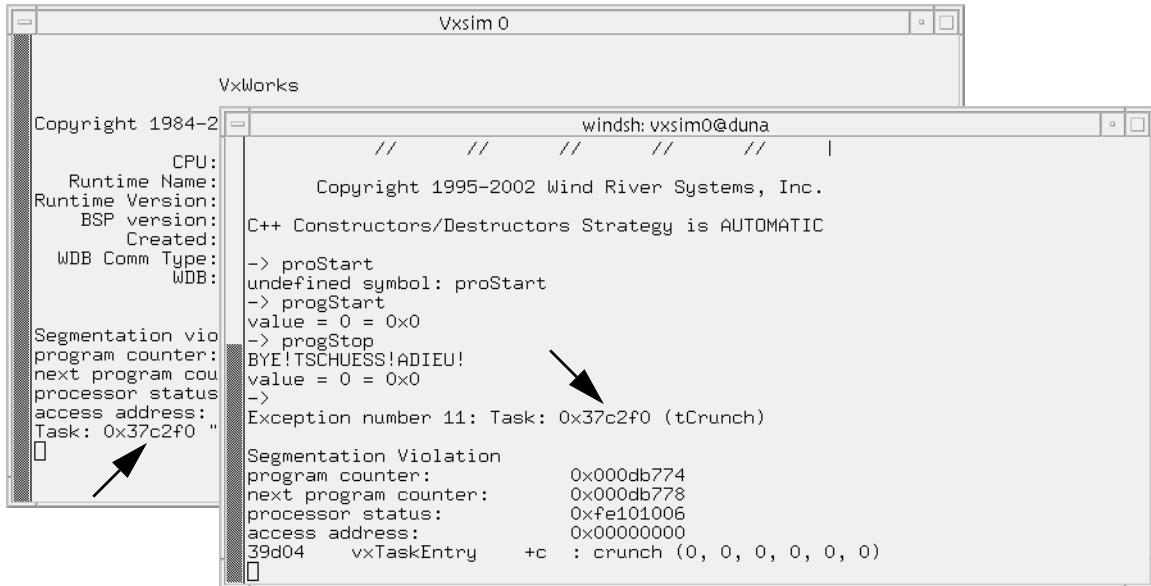


NOTE: Do not forget to download the new **gizmo.out** to the target! And if you have stopped the debugger, restart it by clicking on the CrossWind button in the Tornado Launcher window.

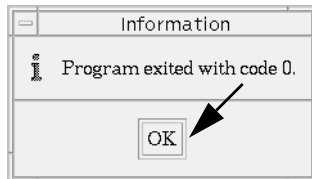
This time, start the program from the debugger with the command **run progStart**.

2. Tornado tools refer to the **EDITOR** environment variable to determine what program to run. The default is **vi**, if **EDITOR** is not defined.

Both the simulator and shell windows soon announce an exception, and the number of the task in which it occurred:



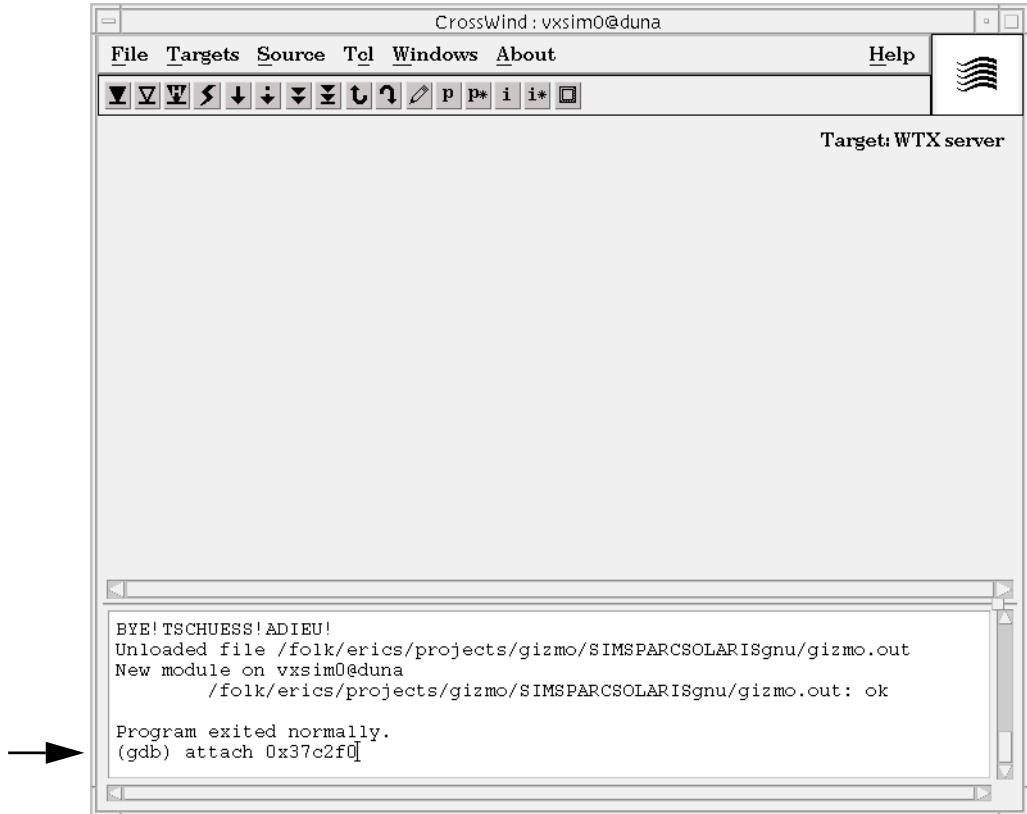
In the debugger Information dialog, click OK:



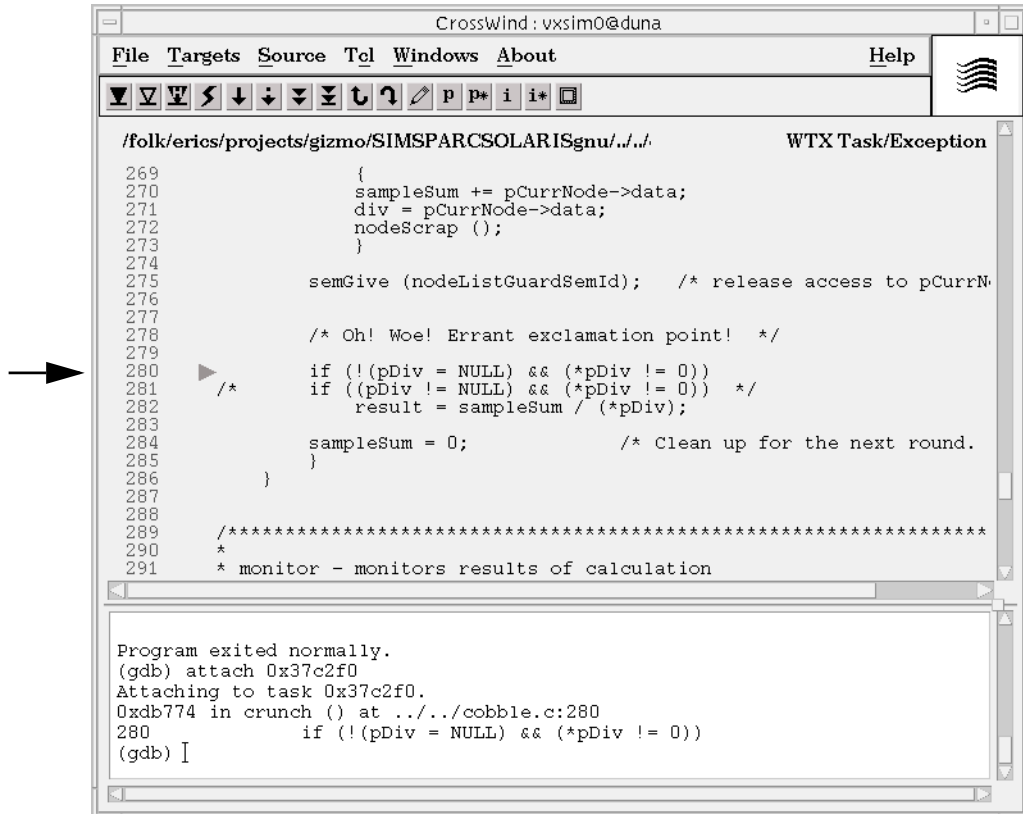
At the debugger command line enter the following:

attach *taskNumber*

where *taskNumber* is the number of the task in which the error occurred (in this example, it is 0x37c2f0):



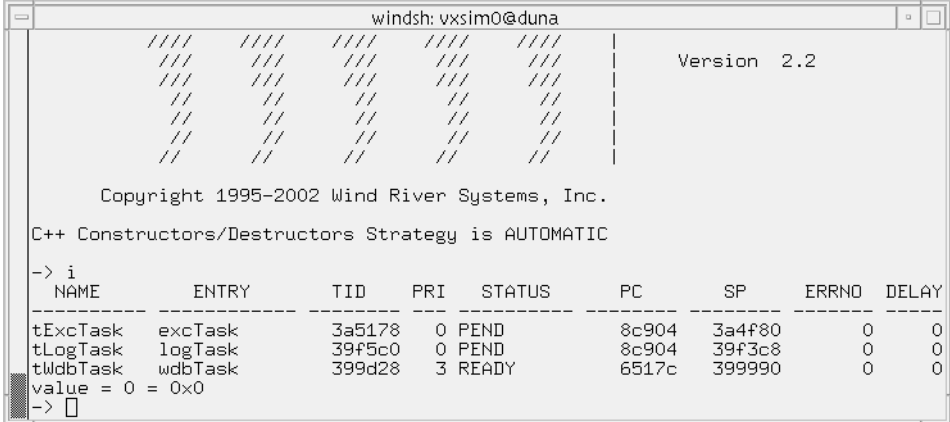
The debugger displays **cobble.c** source code, and a context pointer marking the position in the **crunch()** routine where the error was generated:



Before you proceed, detach the debugger and reboot the target simulator:

- At the debugger command line, enter **detach taskNumber**.
- In the shell window, press RETURN to display the prompt, and enter **reboot**.

If you use the **i** command in the shell window after you have rebooted the simulator, you see that only VxWorks system tasks are now running:



```

windsh: vxsim0@duna
Version 2.2

Copyright 1995-2002 Wind River Systems, Inc.
C++ Constructors/Destructors Strategy is AUTOMATIC

-> i
  NAME      ENTRY      TID      PRI  STATUS  PC      SP      ERRNO  DELAY
-----
tExcTask    excTask    3a5178   0  PEND    8c904   3a4f80   0      0
tLogTask    logTask    39f5c0   0  PEND    8c904   39f3c8   0      0
tWdbTask    wdbTask    399d28   3  READY   6517c   399990   0      0
value = 0 = 0x0
-> 

```

3.13 Fix the Last Bug and Take it for a Spin

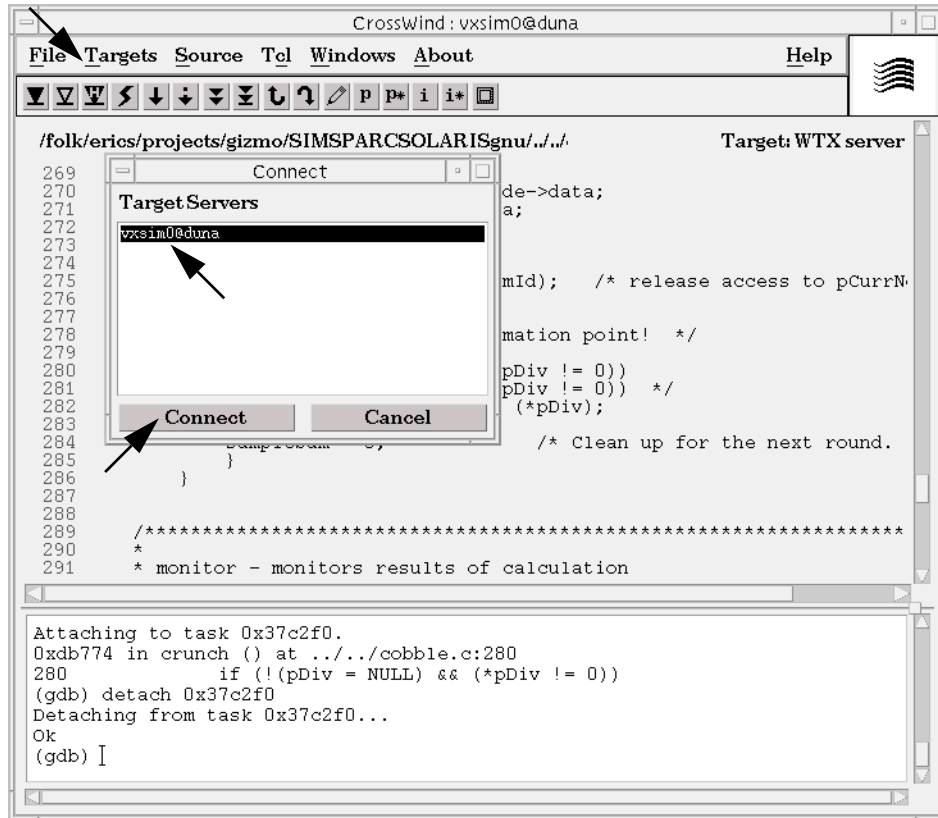
Open the **cobble.c** file in your editor by double-clicking on the file name in the Files view of the workspace window. Fix the source of the exception error in the **crunch()** routine by using the commented code immediately below it—or something more interesting. Save the file.

Then use the context menu in the Files view of the workspace to select the **ReBuild All (gizmo.out)** option. When the build is done, close the Build Output window.

Download the application to the target with the **Download 'gizmo.out'** option from the context menu.

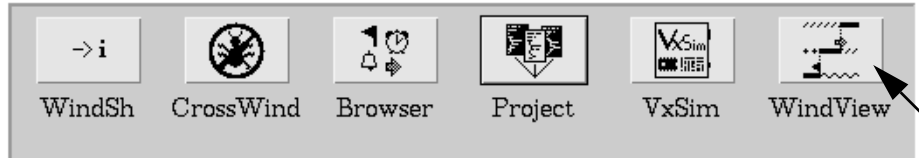
Reattach the debugger to the target by selecting **Targets>Connect Target Servers** from the CrossWind debugger menu. The Connect dialog box appears.


Select the name of the target server for the simulator from the list in the dialog and click Connect:




Start the program again from the Tornado shell with the command **progStart**.

Start WindView by clicking on the WindView button in the Tornado Launcher window:




Click the WindView button  in the WindView window to display the WindView Control window and the WindView Collection Configuration dialog box.

Select Additional Instrumentation from the drop-down list in the dialog box; click OK.

Then click the GO button  in the WindView Control window to begin data collection.

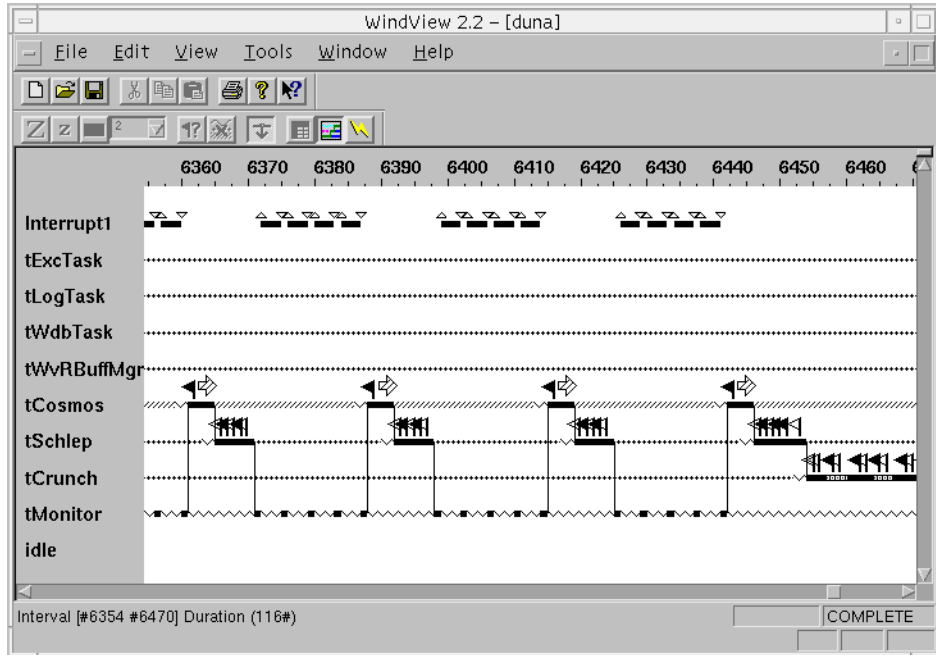
Wait a few seconds, and then click the update button  in the WindView Control window to update the status of data collection.



When the Buffers value listed under Current Content reaches at least two, click the Stop button  to end data collection.

Then use the upload button  to upload the data.

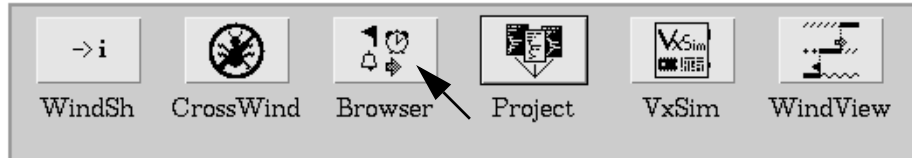
A view graph is displayed while the data is uploaded, and a message box announces completion of the upload. Click OK to continue.


Maximize the view graph window, adjust the window size, and scroll through the WindView data. You should find that all tasks, including **tCrunch**, are running in an orderly manner, and the view graph data should look like this:



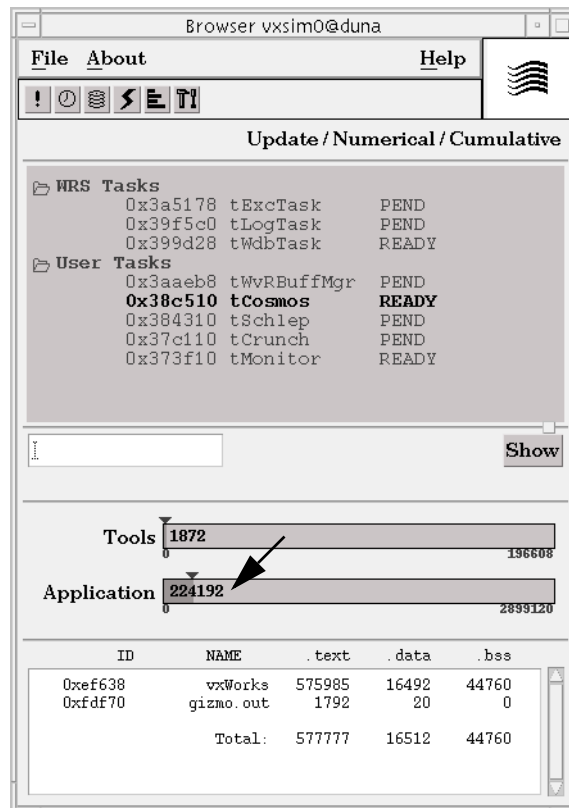
Remember that you can use the zoom buttons   on the WindView toolbar to enlarge or decrease the size of the scope of the display.

You can check memory consumption once again with the browser by clicking the the Browser button in the Tornado Launcher window:



When the browser appears, click the browser's periodic update button . Every few seconds the display will be updated.

You'll note that memory consumption fluctuates modestly within a constant range:



Moreover, output in the simulator window indicates that the program is humming along nicely, providing you with information about when it's hot and when it's not:

[illegible]

Stop the program by entering **progStop** at the shell command line.
Bye! Tschuess! Adieu!

3.14 What Next?

For detailed information about using features of Tornado such as the project facility, shell, browser, and debugger, see the *Tornado User's Guide*. The guide also provides information about setting up your Tornado development environment with target hardware.

For information about VxWorks itself, see the *VxWorks Programmer's Guide*, the *WindNet TCP/IP Programmer's Guide*, and the *VxWorks API Reference*.

The Tornado documentation set is available online in HTML format from the main Tornado launcher menu Help>Manuals contents, or directly from the top level HTML file `installDir\docs\books.html`.