1 Introduction
This manual describes how to write I/O driver routines for the WSIO interface on HP 9000 workstations (Series 700 and others) and servers (Series 800 and others). Except where noted, this manual is applicable to all workstations and servers using Release 11.0. The manual is organized as follows:

**Chapter 1: Introduction**
- How to use this manual and other references.

**Chapter 2: Overview of the Driver Environment**
- The I/O subsystem's structure and how drivers fit into this environment.

**Chapter 3: Understanding HP-UX I/O Subsystem Features**
- Features of the I/O subsystem, such as types of drivers, memory mapping, flow of I/O requests, data structures, and interrupt handling.

**Chapter 4: Multiprocessing**
- Multiprocessor issues.

**Chapter 5: Writing a Driver**
- A step-by-step strategy for writing drivers. It includes descriptions of routines used by device drivers, interface drivers, and combined drivers.

**Chapter 6: Installing Your Driver**
- Installing your driver in the kernel and configuring it to communicate with the hardware.

**Chapter 7: Creating Networking Device Drivers**
- Designing and writing networking device drivers.

**Chapter 8: Writing PCI Device Drivers**
- PCI bus driver routines.

**Chapter 9: Writing SCSI Device Drivers**
- SCSI bus driver routines.

**Chapter 10: Developing Dynamically Loadable Kernel Modules**
• Adding a kernel module to a running UNIX system without rebooting the system or rebuilding the kernel.

**Chapter 11: How To Make Pre 11.0 Drivers 64-Bit Safe**

• How to modify a Release 10.20 32-bit driver to run in a Release 11.0 32-bit or 64-bit environment.

**Appendix A: Example Drivers**

• Driver examples.

**Appendix B: Data Structures, Defines, Routines, Flags, and Code Examples**

• Networking related data structures, defines, routines, flags, and code examples.

**Appendix C: How to Design a Networking Trace/Log Subformatter and a Sample Subformatter**

• Generic subformatter code for networking drivers.

**Appendix D: Shared Library Examples for the lanadmin and lanscan Commands**

• Shared libraries and message catalogs that provide code examples to be used with network administration.
The Intended Audience

Porting an existing device driver is not a trivial task. Writing a device driver is even more complex. Using this manual to port or write a driver assumes that you know how to:

- Write programs in the C language.
- Understand the basic concepts of writing a driver.
- Understand the functionality of the hardware for which you are writing the driver.
- Read the HP-UX System Administration Tasks manual and perform system administration.
- Understand the virtual memory, I/O, and file system areas in the HP-UX and/or UNIX operating systems.

These assumptions are not meant to discourage anyone, but you should not plunge onward unless you know the HP-UX (UNIX) operating system, the C language, and the implications of writing drivers. The “Support/Compatibility Disclaimers” section describes the support provided by Hewlett-Packard Company.
Support/Compatibility Disclaimers

Since drivers function at the level of the kernel, Hewlett-Packard Company (HP) reminds you of the following:

- Adding your own driver to HP-UX requires relinking the driver into HP-UX. With each new release you should plan on recompiling your driver in order to reinstall it into the new HP-UX kernel. Many header files do not change. However, drivers typically use some header files that could change across releases (i.e., you can have some system dependencies).

- HP provides support services for HP products, including HP-UX. Products, including drivers, from non-HP parties receive no support, other than the support of those parts of a driver that rely on the documented behavior of supported HP products.

- Should difficulties arise during the development and test phases of writing a driver, HP may provide assistance in isolating problems to determine if:
  - HP hardware is not at fault; and
  - HP software (firmware) is not at fault by removing user-written kernel drivers.

- When HP hardware, software, and firmware are not at fault, you should seek help from the third party from whom you obtained software or hardware.
Using This Manual

How you read this manual depends on the tasks you need to perform. The steps you need to take will differ depending on whether you are writing a new kernel driver or porting an existing driver.

Chapter 5, “Writing a Driver,” describes general routines you will need to use regardless of the type of driver you are writing. These routines include the normal kernel driver entry points such as `driver_open`, `driver_close`, `driver_read`, and others. Tasks such as mapping of card registers, usage of DMA service routines, and linkage of interrupt service routines are usually bus-specific. For example, Chapter 8, “Writing PCI Device Drivers” contains the bus specific routines for PCI.

Chapter 11, “Developing Dynamically Loadable Kernel Modules”, describes the additional routines and tools you will need to use for a DLKM driver.

NOTE

This book contains many examples of C programs to help you design device drivers. Because of page width restrictions, some long lines of code exceed the space available and break in unintended places. Please treat these “broken” lines as one line. We recommend that you use the sample files included with this manual when possible, rather than retyping the examples.
Internet and E-mail Resources

Interface program and developer resource materials are available at the following locations:

- Interface Program at //www.hp.com/visualize/programs/netio/index.html
- Interface Program E-mail at interface@fc.hp.com
- Developer Resource at http://devresource.hp.com/
Reference Documentation

- Hewlett-Packard Company
  - HP-UX 10.20 Driver Development Reference, HP Part No. B2355-90067
  - HP-UX 11.0 Driver Development Reference, HP Part No. TBA
  - Dealer Configuration File Creation Guide, HP Part No. D2230-90001
  - EISA Configuration Guide for HP-UX, HP Part No. B2370-90000
  - HP-UX Managing Systems and Workgroups, HP Part No. B2355-90664
  - HP-UX Reference, HP Part No. B2355-90052
  - HP-UX System Administration Tasks, HP Part No. B2355-90079
  - HP C Programmer’s Guide, HP Part No. 92434-90002
  - Configuring HP-UX for Peripherals, HP Part No. B2355-90053
  - Installing and Updating HP-UX, HP Part No. B2355-90078
  - PA-RISC 1.1 Architecture and Instruction Set Reference Manual, HP Part No. 09740-90039
  - PA-RISC Procedure Calling Conventions Reference Manual, HP Part No. 09740-90015
  - Managing HP-UX Software with SD-UX, HP Part No. B2355-90044
J 2237-90005

- **Other References**
  - Edward Solari, *EISA Bus Design*, Annabooks
  - *EISA Specification Version 3.10 or later*, BCPR Services, Inc.
  - *PCI Local Bus Specification, Revision 2.1*, PCI Special Interest Group
  - *PCI System Design Guide, Revision 1.0*, PCI Special Interest Group
  - *Data Link Provider Interface Specifications*, Unix International