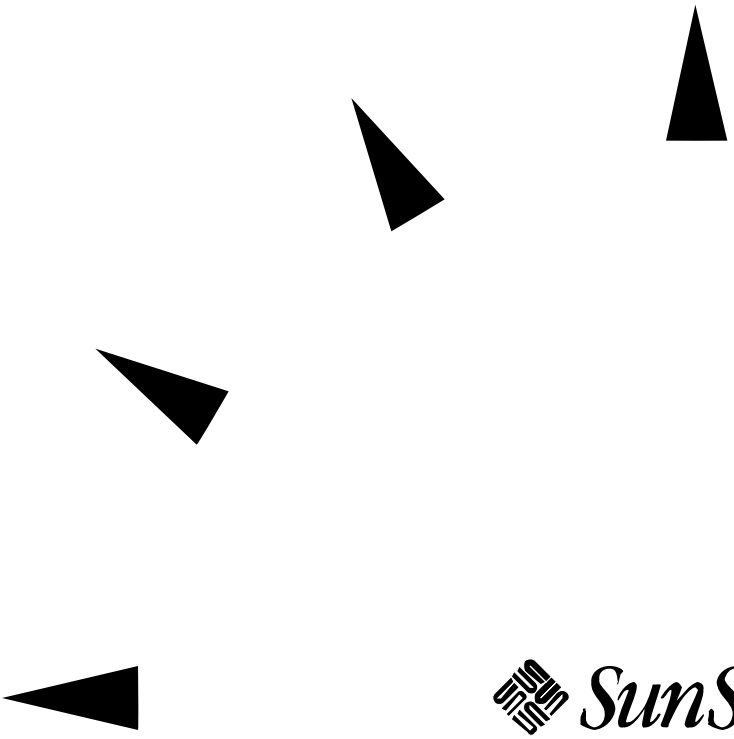
SunOS Reference Manual



Sun Microsystems, Inc.
2550 Garcia Avenue
Mountain View, CA 94043
U.S.A.

SunSoft
A Sun Microsystems, Inc. Business

2550 Garcia Avenue, Mountain View, California 94043-1100 U.S.A.

Preface

OVERVIEW

A man page is provided for both the naive user, and sophisticated user who is familiar with the SunOS operating system and is in need of on-line information. A man page is intended to answer concisely the question “What does it do?” The man pages in general comprise a reference manual. They are not intended to be a tutorial.

The following contains a brief description of each section in the man pages and the information it references:

- Section 1 describes, in alphabetical order, commands available with the operating system.

- Section 1M describes, in alphabetical order, commands that are used chiefly for system maintenance and administration purposes.

- Section 2 describes all of the system calls. Most of these calls have one or more error returns. An error condition is indicated by an otherwise impossible returned value.

- Section 3 describes functions found in various libraries, other than those functions that directly invoke UNIX system primitives, which are described in Section 2 of this volume.

- Section 4 outlines the formats of various files. The C structure declarations for the file formats are given where applicable.

- Section 5 contains miscellaneous documentation such as character set tables, etc.

- Section 7 describes various special files that refer to specific hardware peripherals, and device drivers. STREAMS software drivers, modules and the STREAMS-generic set of system calls are also described.

- Section 9 provides reference information needed to write device drivers in the kernel operating systems environment. It describes two device driver interface specifications: the Device Driver Interface (DDI) and the Driver–Kernel Interface (DKI).

- Section 9E describes the DDI/DKI, DDI-only, and DKI-only entry-point routines a developer may include in a device driver.

- Section 9F describes the kernel functions available for use by device drivers.

- Section 9S describes the data structures used by drivers to share information between the driver and the kernel.

Below is a generic format for man pages. The man pages of each manual section generally follow this order, but include only needed headings. For example, if there are no bugs to report, there is no BUGS section. See the intro pages for more information and detail about each section, and **man**(1) for more information about man pages in general.

NAME

This section gives the names of the commands or functions documented, followed by a brief description of what they do.

SYNOPSIS

This section shows the syntax of commands or functions. When a command or file does not exist in the standard path, its full pathname is shown. Literal characters (commands and options) are in **bold** font and variables (arguments, parameters and substitution characters) are in *italic* font. Options and arguments are alphabetized, with single letter arguments first, and options with arguments next, unless a different argument order is required.

The following special characters are used in this section:

[ ] The option or argument enclosed in these brackets is optional. If the brackets are omitted, the argument *must* be specified.

... Ellipses. Several values may be provided for the previous argument, or the previous argument can be specified multiple times, for example, '*filename* ...'.

| Separator. Only one of the arguments separated by this character can be specified at time.

PROTOCOL

This section occurs only in subsection 3R to indicate the protocol description file. The protocol specification pathname is always listed in **bold** font.

AVAILABILITY

This section briefly states any limitations on the availabilty of the command. These limitations could be hardware or software specific.

A specification of a class of hardware platform, such as **x86** or **SPARC**, denotes that the command or interface is applicable for the hardware platform specified.

In Section 1 and Section 1M, **AVAILABILITY** indicates which package contains the command being described on the manual page. In order to use the command, the specified package must have been installed with the operating system. If the package was not installed, see **pkgadd**(1) for information on how to upgrade.

MT-LEVEL

This section lists the **MT-LEVEL** of the library functions described in the Section 3 manual pages. The **MT-LEVEL** defines the libraries' ability to support threads. See **Intro**(3) for more information.

DESCRIPTION

This section defines the functionality and behavior of the service. Thus it describes concisely what the command does. It does not discuss OPTIONS or cite EXAMPLES. Interactive commands, subcommands, requests, macros, functions and such, are described under USAGE.

IOCTLS

This section appears on pages in Section 7 only. Only the device class which supplies appropriate parameters to the **ioctls**(2) system call is called **ioctls** and generates its own heading. IOCTLS for a specific device are listed alphabetically (on the man page for that specific device). IOCTLS are used for a particular class of devices all which have an **io** ending, such as **mtio**(7).

OPTIONS

This lists the command options with a concise summary of what each option does. The options are listed literally and in the order they appear in the SYNOPSIS section. Possible arguments to options are discussed under the option, and where appropriate, default values are supplied.

RETURN VALUES

If the man page documents functions that return values, this section lists these values and describes the conditions under which they are returned. If a function can return only constant values, such as 0 or –1, these values are listed in tagged paragraphs. Otherwise, a single paragraph describes the return values of each function. Functions declared as **void** do not return values, so they are not discussed in RETURN VALUES.

ERRORS

On failure, most functions place an error code in the global variable **errno** indicating why they failed. This section lists alphabetically all error codes a function can generate and describes the conditions that cause each error. When more than one condition can cause the same error, each condition is described in a separate paragraph under the error code.

USAGE

This section is provided as a *guidance* on use. This section lists special rules, features and commands that require in-depth explanations. The subsections listed below are used to explain built-in functionality:

Commands
Modifiers
Variables
Expressions
Input Grammar

EXAMPLES

This section provides examples of usage or of how to use a command or function. Wherever possible a complete example including command line entry and machine response is shown. Whenever an example is given, the prompt is shown as

example%

or if the user must be super-user,

example#

Examples are followed by explanations, variable substitution rules, or returned values. Most examples illustrate concepts from the SYNOPSIS, DESCRIPTION, OPTIONS and USAGE sections.

ENVIRONMENT

This section lists any environment variables that the command or function affects, followed by a brief description of the effect.

FILES

This section lists all filenames referred to by the man page, files of interest, and files created or required by commands. Each is followed by a descriptive summary or explanation.

SEE ALSO

This section lists references to other man pages, in-house documentation and outside publications.

DIAGNOSTICS

This section lists diagnostic messages with a brief explanation of the condition causing the error. Messages appear in **bold** font with the exception of variables, which are in *italic* font.

WARNINGS

This section lists warnings about special conditions which could seriously affect your working conditions — this is not a list of diagnostics.

NOTES

This section lists additional information that does not belong anywhere else on the page. It takes the form of an *aside* to the user, covering points of special interest. Critical information is never covered here.

BUGS

This section describes known bugs and wherever possible suggests workarounds.

NAME

Intro, intro – introduction to special files

DESCRIPTION

This section describes various special files that refer to specific hardware peripherals, and device drivers. STREAMS (see **intro**(2)) software drivers, modules and the STREAMS-generic set of **ioctl**(2) system calls are also described. The system provides drivers for a variety of hardware devices, such as disk, magnetic tapes, serial communication lines, mice and frame buffers, as well as virtual devices such as pseudo-terminals and windows.

For hardware related files, the names of the entries are generally derived from names for the hardware, as opposed to the names of the special files themselves. Characteristics of both the hardware device and the corresponding device driver are discussed where applicable.

Disk device file names are in the following format:

/dev/{r}dsk/c#t#d#s#

where **r** indicates a raw interface to the disk, the **c#** indicates the controller number, **#t** indicates the SCSI target id, **d#** indicates the device attached to the controller and **s#** indicates the section number of the partitioned device.

Protocols and Protocol Families

SunOS supports both socket-based and STREAMS-based network communications. The Internet protocol family, described in **inet**(7), is the primary protocol family primary supported by SunOS, although the system can support a number of others. The raw interface provides low-level services, such as packet fragmentation and reassembly, routing, addressing, and basic transport for socket-based implementations. Facilities for communicating using an Internet-family protocol are generally accessed by specifying the **AF_INET** address family when binding a socket; see **socket**(3N) for details.

Major protocols in the Internet family include:

- The Internet Protocol (IP) itself, which supports the universal datagram format, as described in **ip**(7). This is the default protocol for SOCK_RAW type sockets within the **AF_INET** domain.
- The Transmission Control Protocol (TCP); see **tcp**(7). This is the default protocol for SOCK_STREAM type sockets.
- The Address Resolution Protocol (ARP); see **arp**(7).
- The Internet Control Message Protocol (ICMP); see **icmp**(7).

SEE ALSO

intro(2), **ioctl**(2), **socket**(3N), **arp**(7), **icmp**(7), **inet**(7), **ip**(7), **tcp**(7)

File System Administration

Name	Appears on Page	Description
aha	**aha**(7)	low-level module for Adaptec 154x ISA host bus adapters
ARP	**arp**(7)	Address Resolution Protocol
arp	**arp**(7)	Address Resolution Protocol
asy	**asy**(7)	asynchronous serial port driver
ata	**ata**(7)	AT attachment disk driver
audio	**audio**(7)	generic audio device interface
audioamd	**audioamd**(7)	telephone quality audio device
audiocs	**audiocs**(7)	Crystal Semiconductor 4231 audio Interface
bd	**bd**(7)	SunButtons and SunDials STREAMS module
be	**be**(7)	BigMAC Fast Ethernet device driver
bpp	**bpp**(7)	bi-directional parallel port driver
bufmod	**bufmod**(7)	STREAMS Buffer Module
bwtwo	**bwtwo**(7)	black and white memory frame buffer
cdio	**cdio**(7)	CD-ROM control operations
cgeight	**cgeight**(7)	24-bit color memory frame buffer
cgfour	**cgfour**(7)	P4-bus 8-bit color memory frame buffer
cgfourteen	**cgfourteen**(7)	24-bit color graphics device
cgsix	**cgsix**(7)	accelerated 8-bit color frame buffer
cgthree	**cgthree**(7)	8-bit color memory frame buffer
cgtwelve	**cgtwelve**(7)	24-bit SBus color memory frame buffer and graphics accelerator
cgtwo	**cgtwo**(7)	color graphics interface
cmdk	**cmdk**(7)	common disk driver
cmtp	**cmtp**(7)	common tape driver
connld	**connld**(7)	line discipline for unique stream connections
console	**console**(7)	STREAMS-based console interface
dbri	**dbri**(7)	Dual Basic Rate ISDN and audio Interface
display	**display**(7)	system console display
dkio	**dkio**(7)	disk control operations
dlpi	**dlpi**(7)	Data Link Provider Interface
dpt	**dpt**(7)	DPT 2011, 2021, 2012 and 2022 low-level controller modules
dsa	**dsa**(7)	low-level module for Dell SCSI Array Controller (DSA)
eha	**eha**(7)	low-level module for Adaptec 174x EISA host bus adapter
el	**el**(7)	3COM 3C503 Ethernet device driver
elink	**elink**(7)	3COM 3C507 Ethernet device driver
elx	**elx**(7)	3COM EtherLink III Ethernet device driver
envm	**envm**(7)	EISA NVRAM support
esp	**esp**(7)	ESP SCSI Host Bus Adapter Driver
fbio	**fbio**(7)	frame buffer control operations

fd	**fd**(7)	drivers for floppy disks and floppy disk controllers
fdc	**fd**(7)	drivers for floppy disks and floppy disk controllers
fdio	**fdio**(7)	floppy disk control operations
gt	**gt**(7)	double buffered 24-bit SBus color frame buffer and graphics accelerator
hdio	**hdio**(7)	SMD and IPI disk control operations
hsfs	**hsfs**(7)	High Sierra & ISO 9660 CD-ROM filesystem
ICMP	**icmp**(7)	Internet Control Message Protocol
icmp	**icmp**(7)	Internet Control Message Protocol
id	**ipi**(7)	IPI driver
ie	**ie**(7)	Intel 82586 Ethernet device driver
iee	**iee**(7)	Intel EtherExpress 16 Ethernet device driver
if	**if_tcp**(7)	general properties of Internet Protocol network interfaces
if_tcp	**if_tcp**(7)	general properties of Internet Protocol network interfaces
inet	**inet**(7)	Internet protocol family
IP	**ip**(7)	Internet Protocol
ip	**ip**(7)	Internet Protocol
ipd	**ppp**(7)	STREAMS modules and drivers for the Point-to-Point Protocol
ipdcm	**ppp**(7)	STREAMS modules and drivers for the Point-to-Point Protocol
ipdptp	**ppp**(7)	STREAMS modules and drivers for the Point-to-Point Protocol
ipi3sc	**ipi**(7)	IPI driver
ipi	**ipi**(7)	IPI driver
is	**ipi**(7)	IPI driver
isdnio	**isdnio**(7)	ISDN interfaces
isp	**isp**(7)	ISP SCSI Host Bus Adapter Driver
kb	**kb**(7)	keyboard STREAMS module
kdmouse	**kdmouse**(7)	built-in mouse device interface
keyboard	**keyboard**(7)	system console keyboard
kmem	**mem**(7)	physical or virtual memory
kstat	**kstat**(7)	kernel statistics driver
ksyms	**ksyms**(7)	kernel symbols
ldterm	**ldterm**(7)	standard STREAMS terminal line discipline module
le	**le**(7)	Am7990 (LANCE) Ethernet device driver
lebuffer	**le**(7)	Am7990 (LANCE) Ethernet device driver
ledma	**le**(7)	Am7990 (LANCE) Ethernet device driver
leo	**leo**(7)	double-buffered 24-bit SBus color frame buffer and graphics accelerator
llc1	**llc1**(7)	Logical Link Control Protocol Class 1 Driver
lofs	**lofs**(7)	loopback virtual file system
log	**log**(7)	interface to STREAMS error logging and event tracing

logi	**logi**(7)	LOGITECH Bus Mouse device interface
lp	**lp**(7)	driver for parallel port
mcis	**mcis**(7)	low-level module for IBM MicroChannel host bus adapter
mcpp	**mcpp**(7)	ALM-2 Parallel Printer port driver
mcpzsa	**mcpzsa**(7)	ALM-2 Zilog 8530 SCC serial communications driver
mem	**mem**(7)	physical or virtual memory
mlx	**mlx**(7)	low-level module for Mylex DAC960 EISA host bus adapter series
msm	**msm**(7)	Microsoft Bus Mouse device interface
mt	**mt**(7)	tape interface
mtio	**mtio**(7)	general magnetic tape interface
null	**null**(7)	the null file
openprom	**openprom**(7)	PROM monitor configuration interface
PCFS	**pcfs**(7)	DOS formatted file system
pcfs	**pcfs**(7)	DOS formatted file system
pckt	**pckt**(7)	STREAMS Packet Mode module
pe	**pe**(7)	Xircom Pocket Ethernet device driver
pfmod	**pfmod**(7)	STREAMS Packet Filter Module
pipemod	**pipemod**(7)	STREAMS pipe flushing module
pn	**ipi**(7)	IPI driver
ppp	**ppp**(7)	STREAMS modules and drivers for the Point-to-Point Protocol
ppp_diag	**ppp**(7)	STREAMS modules and drivers for the Point-to-Point Protocol
ptem	**ptem**(7)	STREAMS Pseudo Terminal Emulation module
ptm	**ptm**(7)	STREAMS pseudo-tty master driver
pts	**pts**(7)	STREAMS pseudo-tty slave driver
qe	**qe**(7)	QEC / MACE Ethernet device driver
qec	**qec**(7)	QEC bus nexus device driver
quotactl	**quotactl**(7)	manipulate disk quotas
sad	**sad**(7)	STREAMS Administrative Driver
sbpro	**sbpro**(7)	Sound Blaster Pro audio device
sd	**sd**(7)	driver for SCSI disk and CD-ROM devices
smc	**smc**(7)	SMC 8003 / 8013 / 8216 Ethernet device driver
smce	**smce**(7)	SMC 3032 / EISA dual-channel Ethernet device driver
sockio	**sockio**(7)	ioctls that operate directly on sockets
st	**st**(7)	driver for SCSI tape devices
stc	**stc**(7)	Serial Parallel Communications driver for SBus
streamio	**streamio**(7)	STREAMS ioctl commands
TCP	**tcp**(7)	Internet Transmission Control Protocol
tcp	**tcp**(7)	Internet Transmission Control Protocol
tcx	**tcx**(7)	24-bit SBus color memory frame buffer
termio	**termio**(7)	general terminal interface
termiox	**termiox**(7)	extended general terminal interface

ticlts	**ticlts**(7)	loopback transport providers
ticots	**ticlts**(7)	loopback transport providers
ticotsord	**ticlts**(7)	loopback transport providers
timod	**timod**(7)	Transport Interface cooperating STREAMS module
tirdwr	**tirdwr**(7)	Transport Interface read / write interface STREAMS module
tmpfs	**tmpfs**(7)	memory based filesystem
tr	**tr**(7)	IBM 16 / 4 Token Ring Network Adapter device driver
ttcompat	**ttcompat**(7)	V7, 4BSD and XENIX STREAMS compatibility module
tty	**tty**(7)	controlling terminal interface
UDP	**udp**(7)	Internet User Datagram Protocol
udp	**udp**(7)	Internet User Datagram Protocol
visual_io	**visual_io**(7)	Solaris VISUAL I / O control operations
volfs	**volfs**(7)	Volume Management file system
vuid2ps2	**vuidmice**(7)	converts mouse protocol to Firm Events
vuid3ps2	**vuidmice**(7)	converts mouse protocol to Firm Events
vuidm3p	**vuidmice**(7)	converts mouse protocol to Firm Events
vuidm4p	**vuidmice**(7)	converts mouse protocol to Firm Events
vuidm5p	**vuidmice**(7)	converts mouse protocol to Firm Events
vuidmice	**vuidmice**(7)	converts mouse protocol to Firm Events
wscons	**wscons**(7)	workstation console
xd	**xd**(7)	disk driver for Xylogics 7053 SMD Disk Controller
xdc	**xd**(7)	disk driver for Xylogics 7053 SMD Disk Controller
xt	**xt**(7)	driver for Xylogics 472 1 / 2 inch tape controller
xy	**xy**(7)	disk driver for Xylogics 450 and 451 SMD Disk Controllers
xyc	**xy**(7)	disk driver for Xylogics 450 and 451 SMD Disk Controllers
zero	**zero**(7)	source of zeroes
zs	**zs**(7)	Zilog 8530 SCC serial communications driver
zsh	**zsh**(7)	On-board serial HDLC / SDLC interface

NAME

aha – low-level module for Adaptec 154x ISA host bus adapters

AVAILABILITY

x86

DESCRIPTION

The **aha** module provides low-level interface routines between the common disk / tape I / O subsystem and the Adaptec ISA bus master 154x SCSI (Small Computer System Interface) controllers. The **aha** module can be configured for disk and streaming tape support for one or more host adapter boards, each of which must be the sole initiator on a SCSI bus. Auto configuration code determines if the adapter is present at the configured address and what types of devices are attached to it.

Board Configuration and Auto Configuration

The driver attempts to initialize itself in accordance with the information found in the configuration file, **/kernel/drv/aha.conf**. The relevant user configurable items in this file are:

io port reg=0x330,0,0 ioaddr=0x330 ,
dma channel dmachan=6 ,
dma speed dmaspeed=0 ,
bus on time buson=5 , and
bus off time busoff=9 .

The I / O port is the ISA bus I / O address used for communication with the adapter. The direct memory access (DMA) channel should be set to the manufacturer's default of 5 for the primary adapter. The DMA speed, bus on time, and bus off times may be set for optimum performance with each ISA motherboard. Refer to the *Adaptec AHA-1540/1542 User's Manual* for instructions. All jumpers on the board should be set (or verified) to conform the the configuration file.

The 154xC and the 154xCF should be set to default values. Specifically, disable BIOS support for drives with more than 1024 cylinders and more than two BIOS drives. Make sure that the DMA transfer speed does not exceed the capabilities of the motherboard: most can not be run faster than the default 5.7.

The default configurations described in the *Adaptec AHA-1540/1542 User's Manual* should be used for standard configurations of the system. If more than one board is to be used in a single system, each must at least occupy a different set of address ranges and use a different DMA channel. Use of a different interrupt level for each board is required.

The default listing of the configuration file is as follows:

```
#
# primary controller [Settings for CD-ROM
#
name="aha" class="sysbus" reg=0x330,0,0
        ioaddr=0x330 dmachan=6 dmaspeed=0 buson=5 busoff=9;
```

```
#
# another controller example
#
name="aha" class="sysbus" reg=0x234,0,0
        ioaddr=0x234 dmachan=6 dmaspeed=0 buson=5 busoff=9;
```

After installation, 154x controllers may be jumpered for any of the I/O address, IRQ, and DMA channel combinations supported by the hardware, provided that this is reflected in the configuration file and that the parameters do not conflict with other devices on the system.

NAME

arp, ARP – Address Resolution Protocol

SYNOPSIS

```
#include <sys/socket.h>
#include <net/if_arp.h>
#include <netinet/in.h>

s = socket(AF_INET, SOCK_DGRAM, 0);

d = open ("/dev/arp", O_RDWR);
```

DESCRIPTION

ARP is a protocol used to map dynamically between Internet Protocol (IP) and 10Mb/s Ethernet addresses. It is used by all the 10Mb/s Ethernet datalink providers (interface drivers) and it can be used by other datalink providers that support broadcast (such as FDDI and Token Ring). ARP is not specific to the Internet Protocol but this implementation supports only that network layer protocol. The STREAMS device **/dev/arp** is not a Transport Level Interface (TLI) transport provider and may not be used with the TLI interface.

ARP caches IP-to-Ethernet address mappings. When an interface requests a mapping for an address not in the cache, ARP queues the message that requires the mapping and broadcasts a message on the associated network requesting the address mapping. If a response is provided, the new mapping is cached and any pending message is transmitted. ARP will queue at most four packets while waiting for a mapping request to be responded to; only the four most recently transmitted packets are kept.

To facilitate communications with systems which do not use ARP, **ioctl( )** requests are provided to enter and delete entries in the IP-to-Ethernet tables.

USAGE

```
#include <sys/sockio.h>
#include <sys/socket.h>
#include <net/if.h>
#include <net/if_arp.h>
struct arpreq arpreq;
ioctl(s, SIOCSARP, (caddr_t)&arpreq);
ioctl(s, SIOCGARP, (caddr_t)&arpreq);
ioctl(s, SIOCDARP, (caddr_t)&arpreq);
```

Each **ioctl( )** request takes the same structure as an argument. **SIOCSARP** sets an ARP entry, **SIOCGARP** gets an ARP entry, and **SIOCDARP** deletes an ARP entry. These **ioctl( )** requests may be applied to any Internet family socket descriptor *s*, or to a descriptor for the ARP device, but only by the privileged user.

The **arpreq** structure contains:

```
/*
* ARP ioctl request
*/
struct arpreq {
        struct sockaddr arp_pa;         /* protocol address */
        struct sockaddr arp_ha;         /* hardware address */
        int     arp_flags;              /* flags */
};

        /*  arp_flags field values */
#define ATF_COM             0x2  /* completed entry (arp_ha valid) */
#define ATF_PERM            0x4  /* permanent entry */
#define ATF_PUBL            0x8  /* publish (respond for other host) */
#define ATF_USETRAILERS     0x10 /* send trailer packets to host */
```

The address family for the **arp_pa sockaddr** must be **AF_INET**; for the **arp_ha sockaddr** it must be **AF_UNSPEC**. The only flag bits that may be written are **ATF_PUBL** and **ATF_USETRAILERS**. **ATF_PERM** makes the entry permanent if the **ioctl( )** request succeeds. The peculiar nature of the ARP tables may cause the **ioctl( )** request to fail if too many permanent IP addresses hash to the same slot. **ATF_PUBL** specifies that the ARP code should respond to ARP requests for the indicated host coming from other machines. This allows a host to act as an "ARP server", which may be useful in convincing an ARP-only machine to talk to a non-ARP machine.

ARP is also used to negotiate the use of trailer IP encapsulations; trailers are an alternate encapsulation used to allow efficient packet alignment for large packets despite variable-sized headers. Hosts that wish to receive trailer encapsulations so indicate by sending gratuitous ARP translation replies along with replies to IP requests; they are also sent in reply to IP translation replies. The negotiation is thus fully symmetrical, in that either or both hosts may request trailers. The **ATF_USETRAILERS** flag is used to record the receipt of such a reply, and enables the transmission of trailer packets to that host.

ARP watches passively for hosts impersonating the local host (that is, a host which responds to an ARP mapping request for the local host's address).

SEE ALSO

arp(1M), **ifconfig**(1M), **if_tcp**(7), **inet**(7)

Plummer, Dave, ''*An Ethernet Address Resolution Protocol -or- Converting Network Protocol Addresses to 48.bit Ethernet Addresses for Transmission on Ethernet Hardware*,'' RFC 826, Network Information Center, SRI International, Menlo Park, Calif., November 1982.

Leffler, Sam, and Michael Karels, ''*Trailer Encapsulations*,'' RFC 893, Network Information Center, SRI International, Menlo Park, Calif., April 1984.

NAME

asy – asynchronous serial port driver

SYNOPSIS

#include <fcntl.h>
#include <sys/termios.h>
open("/dev/tty*nn***", mode);**
open("/dev/ttyd*n***", mode);**
open("/dev/cua*n***", mode);**

AVAILABILITY

x86

DESCRIPTION

The **asy** module is a loadable STREAMS driver that provides basic support for the standard UARTS that use Intel-8250, National Semiconductor-16450 / 16550 hardware, together with basic asynchronous communication support. The driver supports those **termio**(7) device control functions specified by flags in the **c_cflag** word of the **termios** structure and by the **IGNBRK**, **IGNPAR**, **PARMRK**, or **INPCK** flags in the **c_iflag** word of the **termios** structure. All other **termio**(7) functions must be performed by STREAMS modules pushed atop the driver. When a device is opened, the **ldterm**(7) and **ttcompat**(7) STREAMS modules are automatically pushed on top of the stream, providing the standard **termio**(7) interface.

The character-special devices **/dev/tty00** and **/dev/tty01** are used to access the two standard serial ports (COM1 and COM2) on an x86 system. The **asy** driver supports up to four serial ports, including the standard ports. These **tty***nn* devices have minor device numbers in the range 00-03.

By convention these same devices may be given names of the form **/dev/ttyd***n*, where *n* denotes which line is to be accessed. Such device names are typically used to provide a logical access point for a *dial-in* line being used with a modem.

To allow a single tty line to be connected to a modem and used for both incoming and outgoing calls, a special feature, controlled by the minor device number, is available. By accessing character-special devices with names of the form **/dev/cua***n* it is possible to open a port without the Carrier Detect signal being asserted, either through hardware or an equivalent software mechanism. These devices are commonly known as *dial-out* lines.

Once a **/dev/cua***n* line is opened, the corresponding tty, or ttyd line cannot be opened until the **/dev/cua***n* line is closed; a blocking open will wait until the **/dev/cua***n* line is closed (which will drop Data Terminal Ready, after which Carrier Detect will usually drop as well) and carrier is detected again, and a non-blocking open will return an error. Also, if the **/dev/ttyd***n* line has been opened successfully (usually only when carrier is recognized on the modem) the corresponding **/dev/cua***n* line can not be opened. This allows a modem to be attached to, for example, **/dev/ttyd0** (renamed from **/dev/tty00**) and used for dial-in (by enabling the line for login in **/etc/inittab**) and also used for dial-out (by **tip**(1) or **uucp**(1C)) as **/dev/cua0** when no one is logged in on the line.

IOCTLS

The standard set of **termio ioctl( )** calls are supported by **asy**.

Breaks can be generated by the **TCSBRK**, **TIOCSBRK**, and **TIOCCBRK ioctl( )** calls.

The input and output line speeds may be set to any of the speeds supported by **termio**. The speeds cannot be set independently; when the output speed is set to the same speed.

ERRORS

An **open( )** will fail if:

ENXIO	The unit being opened does not exist.
EBUSY	The dial-out device is being opened and the dial-in device is already open, or the dial-in device is being opened with a no-delay open and the dial-out device is already open.
EBUSY	The unit has been marked as exclusive-use by another process with a **TIOCEXCL ioctl( )** call.
EINTR	The open was interrupted by the delivery of a signal.

FILES

/dev/tty[00-03]	hardwired tty lines
/dev/ttyd[0-3]	dial-in tty lines
/dev/cua[0-3]	dial-out tty lines

SEE ALSO

tip(1), **uucp**(1C), **ldterm**(7), **termio**(7), **ttcompat**(7)

DIAGNOSTICS

asy*n* **: silo overflow.**
The hardware overrun occurred before the input character could be serviced.

asy*n* **: ring buffer overflow.**
The driver's character input ring buffer overflowed before it could be serviced.

NAME

ata – AT attachment disk driver

AVAILABILITY

x86

DESCRIPTION

The **ata** driver supports disk interfaces conforming to the AT Attachment specification. This includes IDE and ESDI interfaces. It excludes the MFM, RLL, ST506, and ST412 interfaces. The driver initializes itself in accordance with the information found in the configuration file (see below). The only user configurable items in this file are:

drive0_block_factor
drive1_block_factor

ATA controllers support some amount of buffering (blocking). The purpose is to interrupt the host when an entire buffer full of data has been read or written instead of using an interrupt for each sector. This reduces interrupt overhead and significantly increases throughput. The driver interrogates the controller to find the buffer size. Some controllers hang when buffering is used, so the values in the configuration file are used by the driver to reduce the effect of buffering (blocking). The values presented may be chosen from:

0x1, 0x2, 0x4, 0x8 and 0x10.

The values as shipped are set to 0x1, and they can be tuned to increase performance.

NOTE: If your controller hangs when attempting to use higher block factors, you may be unable to reboot the system. We recommend that the tuning be carried out using a duplicate of the **/kernel** subtree. This will ensure that a bootable kernel subtree exists in the event of a failed test.

max_transfer

This value controls the size of individual requests for consecutive disk sectors. The value may range from 0x1 to 0x100. Higher values yield higher throughput. The system is shipped with a value of 0x100, which probably should not be changed.

```
#
# primary controller
#
# for higher performance - set block factor to 16
name="ata" class="sysbus" intr=5,14 reg=0x1f0,0,0
        ioaddr1=0x1f0 ioaddr2=0x3f0
        drive0_block_factor=0x1 drive1_block_factor=0x1
        max_transfer=0x100
        flow_control="dmult" queue="qsort" disk="dadk" ;
```

```
#
# secondary controller
#
name="ata" class="sysbus" intr=5,15 reg=0x170,0,0
        ioaddr1=0x170 ioaddr2=0x370
        drive0_block_factor=0x1 drive1_block_factor=0x1
        max_transfer=0x100
        flow_control="dmult" queue="qsort" disk="dadk" ;
!
```

FILES

/kernel/drv/ata	the driver
/kernel/drv/ata.conf	the configuration file

SEE ALSO

aha(7), **cmdk**(7), **dpt**(7), **eha**(7)

NAME

audio – generic audio device interface

OVERVIEW

The audio interface described below is an uncommitted interface and may be replaced in the future.

An audio device is used to play and/or record a stream of audio data. Since a specific audio device may not support all of the functionality described below, refer to the device-specific manual pages for a complete description of each hardware device. An application can use the **AUDIO_GETDEV ioctl**(2) to determine the current audio hardware associated with **/dev/audio**.

AUDIO FORMATS

Digital audio data represents a quantized approximation of an analog audio signal waveform. In the simplest case, these quantized numbers represent the amplitude of the input waveform at particular sampling intervals. In order to achieve the best approximation of an input signal, the highest possible sampling frequency and precision should be used. However, increased accuracy comes at a cost of increased data storage requirements. For instance, one minute of monaural audio recorded in µ-law format at 8 KHz requires nearly 0.5 megabytes of storage, while the standard Compact Disc audio format (stereo 16-bit linear PCM data sampled at 44.1 KHz) requires approximately 10 megabytes per minute.

Audio data may be represented in several different formats. An audio device's current audio data format can be determined by using the **AUDIO_GETINFO ioctl** described below.

An audio data format is characterized in the audio driver by four parameters: Sample Rate, Encoding, Precision, and Channels. Refer to the device-specific manual pages for a list of the audio formats that each device supports. In addition to the formats that the audio device supports directly, other formats provide higher data compression. Applications may convert audio data to and from these formats when recording or playing.

Sample Rate

Sample rate is a number that represents the sampling frequency (in samples per second) of the audio data.

Encodings

An encoding parameter specifies the audio data representation. µ-law encoding (pronounced mew-law) corresponds to CCITT G.711, and is the standard for voice data used by telephone companies in the United States, Canada, and Japan. A-law encoding is also part of G.711, and is the standard encoding for telephony elsewhere in the world. A-law and µ-law audio data are sampled at a rate of 8000 samples per second with 12-bit precision, with the data compressed to 8-bit samples. The resulting audio data quality is equivalent to that of standard analog telephone service.

Linear Pulse Code Modulation (PCM) is an uncompressed audio format in which sample values are directly proportional to audio signal voltages. Each sample is a 2's complement number that represents a positive or negative amplitude.

Precision

Precision indicates the number of bits used to store each audio sample. For instance, μ-law and A-law data are stored with 8-bit precision. PCM data may be stored at various precisions, though 16-bit PCM is most common.

Channels

Multiple channels of audio may be interleaved at sample boundaries. A sample frame consists of a single sample from each active channel. For example, a sample frame of stereo 16-bit PCM data consists of 2 16-bit samples, corresponding to the left and right channel data.

DESCRIPTION

The device **/dev/audio** is a device driver that dispatches audio requests to the appropriate underlying audio device driver. The audio driver is implemented as a STREAMS driver. In order to record audio input, applications **open**(2) the **/dev/audio** device and read data from it using the **read**(2) system call. Similarly, sound data is queued to the audio output port by using the **write**(2) system call. Device configuration is performed using the **ioctl**(2) interface.

As some systems may contain more than one audio device, application writers are encouraged to query the **AUDIODEV** environment variable. If this variable is present in the environment, its value should identify the path name of the default audio device.

Opening the Audio Device

The audio device is treated as an exclusive resource – only one process can open the device at a time. However, two processes may simultaneously access the device: if one opens it read-only, then another may open it write-only.

When a process cannot open **/dev/audio** because the requested access mode is busy:

- if either the **O_NDELAY** or **O_NONBLOCK** flag are set in the **open()** *oflag* argument, then –1 is immediately returned, with *errno* set to EBUSY.
- if neither the **O_NDELAY** nor the **O_NONBLOCK** flag are set, then **open()** hangs until the device is available or a signal is delivered to the process, in which case a –1 is returned with *errno* set to EINTR. This allows a process to block in the **open** call, while waiting for the audio device to become available.

Upon the initial **open()** of the audio device, the driver will reset the data format of the device to the default state of 8-bit, 8Khz, mono μ-law data. If the device is already open and a different audio format has been set, this will not be possible. Audio applications should explicitly set the encoding characteristics to match the audio data requirements, rather than depend on the default configuration.

Since the audio device grants exclusive read or write access to a single process at a time, long-lived audio applications may choose to close the device when they enter an idle state and reopen it when required. The *play.waiting* and *record.waiting* flags in the audio information structure (see below) provide an indication that another process has requested access to the device. For instance, a background audio output process may choose to relinquish the audio device whenever another process requests write access.

Recording Audio Data

The **read()** system call copies data from the system buffers to the application. Ordinarily, **read()** blocks until the user buffer is filled. The **I_NREAD ioctl** (see **streamio**(7)) may be used to determine the amount of data that may be read without blocking. The device may alternatively be set to a non-blocking mode, in which case **read()** completes

immediately, but may return fewer bytes than requested. Refer to the **read**(2) manual page for a complete description of this behavior.

When the audio device is opened with read access, the device driver immediately starts buffering audio input data. Since this consumes system resources, processes that do not record audio data should open the device write-only (**O_WRONLY**).

The transfer of input data to STREAMS buffers may be paused (or resumed) by using the **AUDIO_SETINFO ioctl** to set (or clear) the *record.pause* flag in the audio information structure (see below). All unread input data in the STREAMS queue may be discarded by using the **I_FLUSH** STREAMS **ioctl** (see **streamio**(7)). When changing record parameters, the input stream should be paused and flushed before the change, and resumed afterward. Otherwise, subsequent reads may return samples in the old format followed by samples in the new format. This is particularly important when new parameters result in a changed sample size.

Input data can accumulate in STREAMS buffers very quickly. At a minimum, it will accumulate at 8000 bytes per second for 8-bit, 8 KHz, mono, μ-law data. If the device is configured for 16-bit linear or higher sample rates, it will accumulate even faster. If the application that consumes the data cannot keep up with this data rate, the STREAMS queue may become full. When this occurs, the *record.error* flag is set in the audio information structure and input sampling ceases until there is room in the input queue for additional data. In such cases, the input data stream contains a discontinuity. For this reason, audio recording applications should open the audio device when they are prepared to begin reading data, rather than at the start of extensive initialization.

Playing Audio Data

The **write( )** system call copies data from an applications buffer to the STREAMS output queue. Ordinarily, **write( )** blocks until the entire user buffer is transferred. The device may alternatively be set to a non-blocking mode, in which case **write( )** completes immediately, but may have transferred fewer bytes than requested (see **write**(2)).

Although **write( )** returns when the data is successfully queued, the actual completion of audio output may take considerably longer. The **AUDIO_DRAIN ioctl** may be issued to allow an application to block until all of the queued output data has been played. Alternatively, a process may request asynchronous notification of output completion by writing a zero-length buffer (end-of-file record) to the output stream. When such a buffer has been processed, the *play.eof* flag in the audio information structure (see below) is incremented.

The final **close**(2) of the file descriptor hangs until audio output has drained. If a signal interrupts the **close( ),** or if the process exits without closing the device, any remaining data queued for audio output is flushed and the device is closed immediately.

The conversion of output data may be paused (or resumed) by using the **AUDIO_SETINFO ioctl** to set (or clear) the *play.pause* flag in the audio information structure. Queued output data may be discarded by using the **I_FLUSH** STREAMS **ioctl**.

Output data will be played from the STREAMS buffers at a rate of at least 8000 bytes per second for μ-law or A-law data (faster for 16-bit linear data or higher sampling rates). If the output queue becomes empty, the *play.error* flag is set in the audio information

structure and output is stopped until additional data is written. If an application attempts to write a number of bytes that is not a multiple of the current sample frame size, an error will be generated and the device will need to be closed before any future writes will succeed.

Asynchronous I/O

The **I_SETSIG** STREAMS **ioctl** enables asynchronous notification, through the **SIGPOLL** signal, of input and output ready conditions. The **O_NONBLOCK** flag may be set using the **F_SETFL fcntl**(2) to enable non-blocking **read()** and **write()** requests. This is normally sufficient for applications to maintain an audio stream in the background.

Audio Control Pseudo-Device

It is sometimes convenient to have an application, such as a volume control panel, modify certain characteristics of the audio device while it is being used by an unrelated process. The **/dev/audioctl** pseudo-device is provided for this purpose. Any number of processes may open **/dev/audioctl** simultaneously. However, **read()** and **write()** system calls are ignored by **/dev/audioctl**. The **AUDIO_GETINFO** and **AUDIO_SETINFO ioctl** commands may be issued to **/dev/audioctl** to determine the status or alter the behavior of **/dev/audio**. Note: In general, the audio control device name is constructed by appending the letters "**ctl**" to the path name of the audio device.

Audio Status Change Notification

Applications that open the audio control pseudo-device may request asynchronous notification of changes in the state of the audio device by setting the **S_MSG** flag in an **I_SETSIG** STREAMS **ioctl**. Such processes receive a **SIGPOLL** signal when any of the following events occur:

- An **AUDIO_SETINFO ioctl** has altered the device state.
- An input overflow or output underflow has occurred.
- An end-of-file record (zero-length buffer) has been processed on output.
- An **open()** or **close()** of **/dev/audio** has altered the device state.
- An external event (such as speakerbox volume control) has altered the device state.

IOCTLS

Audio Information Structure

The state of the audio device may be polled or modified using the **AUDIO_GETINFO** and **AUDIO_SETINFO ioctl** commands. These commands operate on the **audio_info** structure as defined, in **<sys/audioio.h>**, as follows:

```
/* This structure contains state information for audio device
   IO streams */
struct audio_prinfo {
        /* The following values describe the audio data encoding */
    uint_t  sample_rate;    /* samples per second */
    uint_t  channels;       /* number of interleaved channels */
    uint_t  precision;      /* number of bits per sample */
    uint_t  encoding;       /* data encoding method */
/* The following values control audio device configuration */
    uint_t  gain;           /* volume level */
    uint_t  port;           /* selected I/O port */
    uint_t  buffer_size;    /* I/O buffer size */

/* The following values describe the current device state */
```

```
        uint_t    samples;        /* number of samples converted */
        uint_t    eof;            /* End Of File counter (play only) */
        uchar_t   pause;          /* non-zero if paused, zero to resume */
        uchar_t   error;          /* non-zero if overflow/underflow */
        uchar_t   waiting;        /* non-zero if a process wants access */
        uchar_t   balance;        /* stereo channel balance */

        /* The following values are read-only device state flags */
        uchar_t   open;           /* non-zero if open access granted */
        uchar_t   active;         /* non-zero if I/O active */
        uint_t    avail_ports;    /* available I/O ports */
} audio_prinfo_t;

/* This structure is used in AUDIO_GETINFO and AUDIO_SETINFO ioctl
   commands */
typedef struct audio_info {
        audio_prinfo_t  record;         /* input status information */
        audio_prinfo_t  play;           /* output status information */
        uint_t          monitor_gain;   /* input to output mix */
        uchar_t         output_muted;   /* non-zero if output muted */
} audio_info_t;

/* Audio encoding types */
#define AUDIO_ENCODING_ULAW     (1)     /* u-law encoding */
#define AUDIO_ENCODING_ALAW     (2)     /* A-law encoding  */
#define AUDIO_ENCODING_LINEAR   (3)     /* Linear PCM encoding */

/* These ranges apply to record, play, and monitor gain values */
#define AUDIO_MIN_GAIN          (0)     /* minimum gain value */
#define AUDIO_MAX_GAIN          (255)   /* maximum gain value */

/* These values apply to the balance field to adjust channel gain values */
#define AUDIO_LEFT_BALANCE      (0)     /* left channel only */
#define AUDIO_MID_BALANCE       (32)    /* equal left/right balance */
#define AUDIO_RIGHT_BALANCE     (64)    /* right channel only */

/* Define some convenient audio port names (for port and avail_ports) */

/* output ports (several might be enabled at once) */
#define AUDIO_SPEAKER           (0x01)  /* output to built-in speaker */
#define AUDIO_HEADPHONE         (0x02)  /* output to headphone jack */
#define AUDIO_LINE_OUT          (0x04)  /* output to line out */

/* input ports (usually only one may be enabled at a time) */
#define AUDIO_MICROPHONE        (0x01)  /* input from microphone */
#define AUDIO_LINE_IN           (0x02)  /* input from line in */

#define                         MAX_AUDIO_DEV_LEN(16)

/* Parameter for the AUDIO_GETDEV ioctl */
typedef struct audio_device {
        char  name[MAX_AUDIO_DEV_LEN];
        char  version[MAX_AUDIO_DEV_LEN];
        char  config[MAX_AUDIO_DEV_LEN];
} audio_device_t;
```

The *play.gain* and *record.gain* fields specify the output and input volume levels. A value of **AUDIO_MAX_GAIN** indicates maximum volume. Audio output may also be temporarily muted by setting a non-zero value in the *output_muted* field. Clearing this field restores

audio output to the normal state. Most audio devices allow input data to be monitored by mixing audio input onto the output channel. The *monitor_gain* field controls the level of this feedback path.

The *play.port* field controls the output path for the audio device. It can be set to either **AUDIO_SPEAKER** (built-in speaker), **AUDIO_HEADPHONE** (headphone jack), or **AUDIO_LINE_OUT** (line-out port). For some devices, it may be set to a combination of these ports. The *play.avail_ports* field returns the set of output ports that are currently accessible. The input ports can be either **AUDIO_MICROPHONE** or **AUDIO_LINE_IN**. The *record.avail_ports* field returns the set of input ports that are currently accessible.

The *play.balance* and *record.balance* fields are used to control the volume between the left and right channels when manipulating stereo data. When the value is set between **AUDIO_LEFT_BALANCE** and **AUDIO_MID_BALANCE**, the right channel volume will be reduced in proportion to the *balance* value. Conversely, when *balance* is set between **AUDIO_MID_BALANCE** and **AUDIO_RIGHT_BALANCE**, the left channel will be proportionally reduced.

The *play.pause* and *record.pause* flags may be used to pause and resume the transfer of data between the audio device and the STREAMS buffers. The *play.error* and *record.error* flags indicate that data underflow or overflow has occurred. The *play.active* and *record.active* flags indicate that data transfer is currently active in the corresponding direction.

The *play.open* and *record.open* flags indicate that the device is currently open with the corresponding access permission. The *play.waiting* and *record.waiting* flags provide an indication that a process may be waiting to access the device. These flags are set automatically when a process blocks on **open()**, though they may also be set using the **AUDIO_SETINFO ioctl** command. They are cleared only when a process relinquishes access by closing the device.

The *play.samples* and *record.samples* fields are initialized, at **open()**, to zero and increment each time a data sample is copied to or from the associated STREAMS queue. Some audio drivers may be limited to counting buffers of samples, instead of single samples for the *samples* accounting. For this reason, applications should not assume that the *samples* fields contain a perfectly accurate count. The *play.eof* field increments whenever a zero-length output buffer is synchronously processed. Applications may use this field to detect the completion of particular segments of audio output.

The *record.buffer_size* field controls the amount of input data that is buffered in the device driver during record operations. Applications that have particular requirements for low latency should set the value appropriately. Note however that smaller input buffer sizes may result in higher system overhead. The value of this field is specified in bytes and drivers will constrain it to be a multiple of the current sample frame size. Some drivers may place other requirements on the value of this field. Refer to the audio device-specific manual page for more details. If an application changes the format of the audio device and does not modify the *record.buffer_size* field, the device driver may use a default value to compensate for the new data rate. Therefore, if an application wishes to modify this field, it should modify it during or after the format change itself, not before. The

record.buffer_size field may be modified only on the **/dev/audio** device by processes that have it opened for reading. The *play.buffer_size* field is currently not supported.

The audio data format is indicated by the *sample_rate*, *channels*, *precision*, and *encoding* fields. The values of these fields correspond to the descriptions in the **AUDIO FORMATS** section above. Refer to the audio device-specific manual pages for a list of supported data format combinations.

The data format fields may be modified only on the **/dev/audio** device. The audio hardware will often constrain the input and output data formats to be identical. If this is the case, then the data format may not be changed if multiple processes have opened the audio device.

If the parameter changes requested by an **AUDIO_SETINFO ioctl** cannot all be accommodated, **ioctl( )** will return with *errno* set to EINVAL and no changes will be made to the device state.

Streamio IOCTLS

All of the **streamio**(7) **ioctl** commands may be issued for the **/dev/audio** device. Because the **/dev/audioctl** device has its own STREAMS queues, most of these commands neither modify nor report the state of **/dev/audio** if issued for the **/dev/audioctl** device. The **I_SETSIG ioctl** may be issued for **/dev/audioctl** to enable the notification of audio status changes, as described above.

Audio IOCTLS

The audio device additionally supports the following **ioctl** commands:

AUDIO_DRAIN

The argument is ignored. This command suspends the calling process until the output STREAMS queue is empty, or until a signal is delivered to the calling process. It may not be issued for the **/dev/audioctl** device. An implicit **AUDIO_DRAIN** is performed on the final **close( )** of **/dev/audio**.

AUDIO_GETDEV

The argument is a pointer to an **audio_device** structure. This command may be issued for either **/dev/audio** or **/dev/audioctl**. The returned value in the *name* field will be a string that will identify the current **/dev/audio** hardware device, the value in *version* will be a string indicating the current version of the hardware, and *config* will be a device-specific string identifying the properties of the audio stream associated with that file descriptor. Refer to the audio device-specific manual pages to determine the actual strings returned by the device driver.

AUDIO_GETINFO

The argument is a pointer to an **audio_info** structure. This command may be issued for either **/dev/audio** or **/dev/audioctl**. The current state of the **/dev/audio** device is returned in the structure.

AUDIO_SETINFO

The argument is a pointer to an **audio_info** structure. This command may be issued for either the **/dev/audio** or the **/dev/audioctl** device with some restrictions. This command configures the audio device according to the structure supplied and overwrites the structure with the new state of the device. Note: The *play.samples*, *record.samples*, *play.error*, *record.error*, and *play.eof* fields are modified to reflect the state of the device when the **AUDIO_SETINFO** was issued. This allows programs to automatically modify these fields while retrieving the previous value.

Certain fields in the information structure, such as the *pause* flags are treated as read-only when **/dev/audio** is not open with the corresponding access permission. Other fields, such as the gain levels and encoding information, may have a restricted set of acceptable values. Applications that attempt to modify such fields should check the returned values to be sure that the corresponding change took effect. The *sample_rate*, *channels*, *precision*, and *encoding* fields treated as read-only for **/dev/audioctl**, so that applications can be guaranteed that the existing audio format will stay in place until they relinquish the audio device. **AUDIO_SETINFO** will return EINVAL when the desired configuration is not possible, or EBUSY when another process has control of the audio device.

Once set, the following values persist through subsequent **open()** and **close()** calls of the device: *play.gain*, *record.gain*, *play.balance*, *record.balance*, *output_muted*, *monitor_gain*, *play.port*, and *record.port*. However, an automatic device driver unload will reset these parameters to their default values on the next load. All other state is reset when the corresponding I/O stream of **/dev/audio** is closed.

The **audio_info** structure may be initialized through the use of the **AUDIO_INITINFO** macro. This macro sets all fields in the structure to values that are ignored by the **AUDIO_SETINFO** command. For instance, the following code switches the output port from the built-in speaker to the headphone jack without modifying any other audio parameters:

```
audio_info_tinfo;

AUDIO_INITINFO(&info);
info.play.port = AUDIO_HEADPHONE;
err = ioctl(audio_fd, AUDIO_SETINFO, &info);
```

This technique eliminates problems associated with using a sequence of **AUDIO_GETINFO** followed by **AUDIO_SETINFO**.

ERRORS

An **open()** will fail if:

EBUSY The requested play or record access is busy and either the **O_NDELAY** or **O_NONBLOCK** flag was set in the **open()** request.

EINTR The requested play or record access is busy and a signal interrupted the **open()** request.

An **ioctl()** will fail if:

EINVAL The parameter changes requested in the **AUDIO_SETINFO ioctl** are invalid or are not supported by the device.

EBUSY The parameter changes requested in the **AUDIO_SETINFO ioctl** could not be made because another process has the device open and is using a different format.

FILES

The physcial audio device names are system dependent and are rarely used by programmers. The programmer should use the generic device names listed below.

/dev/audio	symbolic link to the system's primary audio device
/dev/audioctl	symbolic link to the control device for **/dev/audio**
/dev/sound/0	first audio device in the system
/dev/sound/0ctl	audio control device for **/dev/sound/0**

SEE ALSO

open(2), **close**(2), **read**(2), **write**(2), **ioctl**(2), **fcntl**(2), **poll**(2), **audioamd**(7), **audiocs**(7), **dbri**(7), **sbpro**(7), **streamio**(7)

BUGS

Due to a *feature* of the STREAMS implementation, programs that are terminated or exit without closing the **audio** device may hang for a short period while audio output drains. In general, programs that produce audio output should catch the **SIGINT** signal and flush the output stream before exiting.

FUTURE DIRECTIONS

Future workstation audio resources will be managed by an audio foundation library. For the time being, we encourage you to write your programs in a modular fashion, isolating the audio device-specific functions, so that they may be easily ported to such an environment.

The **AUDIO_GETDEV ioctl** is provided for the future implementation of an audio device capability database. In general, applications may use the *play.avail_ports* and *record.avail_ports* fields of the **audio_info** structure to determine the audio device capabilities.

NAME

audioamd – telephone quality audio device

AVAILABILITY

SPARC

SPARCstation 1 and 2, IPC, IPX, SLC, ELC, LC, and SPARCserver 6xx systems.

Desktop SPARCsystems include a built-in speaker for audio output. The audio cable provides connectors for a microphone and external headset. The headset output level is adequate to power most headphones, but may be too low for some external speakers. Powered speakers or an external amplifier may be used. SPARCserver 6xx systems do not have an internal speaker, but support an external microphone and speaker connected through the audio cable.

The Sun Microphone is recommended for normal desktop audio recording. It contains a battery that must be replaced after 210 hours of use. Other microphones may be used, but a pre-amplifier circuit may be required to achieve a sufficient input signal. Other audio sources may be recorded by connecting one channel of the line output to the audio cable microphone input. If the input signal is distorted, external attenuation may be required (audio sources may also be connected from their headphone output with the volume turned down).

DESCRIPTION

The **audioamd** device uses the AM79C30A Digital Subscriber Controller chip to implement the audio device interface. This interface is described fully in the **audio**(7) manual page.

Applications that open **/dev/audio** may use the **AUDIO_GETDEV** ioctl to determine which audio device is being used. The audioamd driver will return "**SUNW,am79c30**" in the *name* field of the **audio_device** structure. The *version* field will contain "**a**" and the *config* field will be set to "**onboard1**" .

The **AUDIO_SETINFO ioctl** controls device configuration parameters. When an application modifies the *record.buffer_size* field using the **AUDIO_SETINFO** ioctl, the driver will constrain it to be greater than zero and less than or equal to 8000 bytes or one second of audio data. Applications are warned that setting this field too low or too high may cause system performance problems and should therefore set this field with caution.

Audio Data Formats

The **audioamd** device supports the audio formats listed in the following table. When the device is open for simultaneous play and record, the input and output data formats must match.

Supported Audio Data Formats			
Sample Rate	Encoding	Precision	Channels
8000 Hz	μ-law	8	1
8000 Hz	A-law	8	1

Since **audioamd** supports only single-channel (monaural) audio, the *play.balance* and *record.balance* fields of the **audio_info** structure are ignored.

Audio Ports

The *record.avail_ports* and *play.avail_ports* fields of the **audio_info** structure report the available input and output ports. The **audioamd** device supports one input port, selected by setting the *record.port* field to **AUDIO_MICROPHONE**. The *play.port* field may be set to either **AUDIO_SPEAKER** or **AUDIO_HEADPHONE**, to direct audio output to the built-in speaker or headphone jack, respectively. Note that **AUDIO_SPEAKER** cannot be enabled for systems that do not include a built-in speaker.

Sample Granularity

Since the **audioamd** device manipulates single samples of audio data, the reported input and output sample counts will be very close to the actual sample count. However, some other audio devices report sample counts that are approximate, due to buffering constraints. Programs should, in general, not rely on absolute accuracy of the sample count fields.

FILES

/dev/audio
/dev/audioctl
/dev/sound
/usr/demo/SOUND

SEE ALSO

ioctl(2), **audio**(7), **streamio**(7)

AMD data sheet for the AM79C30A Digital Subscriber Controller, Publication number 09893.

NAME

audiocs – Crystal Semiconductor 4231 audio Interface

AVAILABILITY

The AUDIOCS Multimedia codec is available on SPARCstation 5 systems.

This hardware may or may not be available on future systems from Sun Microsystems Computer Corporation.

Audio Interfaces

SPARCstation 5 systems have the Multimedia Codec integrated onto the CPU board of the machine. In the "onboard" Codec, there are microphone, line in, headphone, and line out ports located on the system back panel. In addition, the headphone and microphone ports do not have the input detection circuitry to determine whether or not there is currently headphones or a microphone plugged in. There is *no* interface on the SPARCstation 5 for the speakerbox to connect to.

The new Sun Microphone II is recommended for normal desktop audio recording. Other audio sources may be recorded by connecting their line output to the line input (audio sources may also be connected from their headphone output if the volume is adjusted properly).

Applications that open **/dev/audio** may use the **AUDIO_GETDEV** ioctl to determine which audio device is being used. The audiocs driver will return the string "**SUNW,CS4231**" in the **name** field of the **audio_device** structure. The **version** field will contain "**a**" and the **config** field will contain the following value: "**onboard1**" on a **/dev/audio** stream associated with the onboard Multimedia Codec.

The **AUDIO_SETINFO ioctl** controls device configuration parameters. When an application modifies the **record.buffer_size** field using the **AUDIO_SETINFO** ioctl, the driver will constrain it to be non-zero and up to a maximum of **8180** bytes.

Audio Data Formats for the Multimedia 4231 Codec

The **audiocs** device supports the audio formats listed in the following table. When the device is open for simultaneous play and record, the input and output data formats must match.

Supported Audio Data Formats

Sample Rate	Encoding	Precision	Channels
8000 Hz	μ-law or A-law	8	1
9600 Hz	μ-law or A-law	8	1
11025 Hz	μ-law or A-law	8	1
16000 Hz	μ-law or A-law	8	1
18900 Hz	μ-law or A-law	8	1
22050 Hz	μ-law or A-law	8	1
32000 Hz	μ-law or A-law	8	1
37800 Hz	μ-law or A-law	8	1
44100 Hz	μ-law or A-law	8	1
48000 Hz	μ-law or A-law	8	1
8000 Hz	linear	16	1 or 2
9600 Hz	linear	16	1 or 2
11025 Hz	linear	16	1 or 2
16000 Hz	linear	16	1 or 2
18900 Hz	linear	16	1 or 2

22050 Hz	linear	16	1 or 2
32000 Hz	linear	16	1 or 2
37800 Hz	linear	16	1 or 2
44100 Hz	linear	16	1 or 2
48000 Hz	linear	16	1 or 2

Audio Ports

The **record.avail_ports** and **play.avail_ports** fields of the **audio_info** structure report the available input and output ports. The **audiocs** device supports three input ports, selected by setting the **record.port** field to either **AUDIO_MICROPHONE**, **AUDIO_INTERNAL_CD_IN**, or **AUDIO_LINE_IN**. If you select the **AUDIO_INTERNAL_CD_IN** this will select input from the internal CD drive installed on an SPARCstation 5 platform. This will allow you to gather data off of the CD without using a line out of the headphone jack to the line in of the audio input. The **play.port** field may be set to any combination of **AUDIO_SPEAKER**, **AUDIO_HEADPHONE**, and **AUDIO_LINE_OUT** by OR'ing the desired port names together.

Sample Granularity

Since the **audiocs** device manipulates buffers of audio data, at any given time the reported input and output sample counts will vary from the actual sample count by no more than the size of the buffers it is transferring. Programs should, in general, not rely on absolute accuracy of the **play.samples** and **record.samples** fields of the **audio_info** structure.

Audio Status Change Notification

As described in **audio**(7), it is possible to request asynchronous notification of changes in the state of an audio device.

ERRORS

audiocs errors are defined in the **audio**(7), man pages.

FILES

The physical device names are very system dependent and are rarely used by programmers. For example:

/devices/iommu@f,e0000000/sbus@f,e0001000/SUNW,CS4231@2,c00000:sound,audio

The programmer should instead use the generic device names listed below:

/dev/audio	symbolic link to the system's primary audio device, not necessarily a **audiocs** based audio device
/dev/audioctl	control device for the above audio device
/dev/sound/0*	represents the first audio device on the system and is not necessarily based on **audiocs**
/dev/sound/0	first audio device in the system
/dev/sound/0ctl	audio control for above device
/usr/demo/SOUND	audio demonstration programs and other files

SEE ALSO

ioctl(2), **audio**(7), **streamio**(7)

Crystal Semiconductor, Inc., data sheet for the CS4231 16-Bit, 48 kHz, Multimedia Audio Codec Publication number DS111PP2.

NOTES: The **AUDIO_INTERNAL_CD_IN** is another new functionality addition. Because of this, **audiotool** will now have a new button appear in the record popup box that will allow the user of **audiotool** to switch to the internal CD on the SPARCstation 5 (if present).

NAME

bd – SunButtons and SunDials STREAMS module

SYNOPSIS

open("/dev/bd", O_RDWR)

DESCRIPTION

The **bd** STREAMS module processes the byte streams generated by the SunButtons buttonbox and SunDials dialbox. The buttonbox generates a stream of bytes that encode the identity and state transition of the buttons. The dialbox generates a stream of bytes that encode the identity of the dials and the amount by which they are turned. Both of these streams are merged together when a host has both a buttonbox and a dialbox in use at the same time.

SunButtons reports the button number and up / down status encoded into a one byte message. Byte values from 0xc0 to 0xdf indicate a transition to button down. To obtain the button number, subtract 0xc0 from the byte value. Byte values from 0xe0 to 0xff indicate a transition to button up. To obtain the button number, subtract 0xe0 from the byte value.

Each dial sample in the byte stream consists of three bytes. The first byte identifies which dial was turned and the next two bytes return the delta in signed binary format. When bound to an application using the window system, Virtual User Input Device events are generated. An event from a dial is constrained to lie between 0x80 and 0x87.

A stream with the **bd** pushed streams module configured in it can emit firm_events as specified by the protocol of a VUID. **bd** understands the VUIDSFORMAT and VUIDGFORMAT ioctls (see reference below), as defined in **/usr/include/sys/bdio.h** and **$OPENWINHOME/include/xview/win_event.h.** All other ioctl() requests are passed downstream.

The **bd** streams module sets the parameters of the serial port when it is first opened. No **termio**(7) **ioctl ( )** requests should be performed on a **bd** STREAMS module, as **bd** expects the device parameters to remain as it set them.

IOCTLS

VUIDSFORMAT
VUIDGFORMAT These are standard *Virtual User Input Device* ioctls.

BDIOBUTLITE The **bd** streams module implements this ioctl to enable processes to manipulate the lights on the buttonbox. The **BDIOBUTLITE** ioctl must be carried by an I_STR ioctl to the **bd** module. For an explanation of I_STR see **streamio**(7). The data for the BDIOBUTLITE ioctl is an unsigned integer in which each bit represents the lamp on one button. The macro LED_MAP in **<sys/bdio.h>** maps button numbers to appropriate bits. Source code for the demo program x_buttontest is provided with the buttons and dials package, and may be found in the directory **/usr/demo/BUTTONBOX**. Look at **x_buttontest.c** for an example of how to manipulate the lights on the buttonbox.

FILES

/usr/include/sys/bdio.h
/usr/include/sys/stropts.h
$OPENWINHOME/share/include/xview/win_event.h

SEE ALSO

bdconfig(1M), **ioctl**(2), **x_dialtest**(6), **x_buttontest**(6), **streamio**(7), **termio**(7)

SunDials Installation and Programmers Guide
SunButtons Installation and Programmers Guide

WARNINGS

The SunDials dial box must be used with a serial port.

NAME

be – BigMAC Fast Ethernet device driver

SYNOPSIS

```
#include <sys/bmac.h>
#include <sys/be.h>
#include <sys/qec.h>
#include <sys/dlpi.h>
```

DESCRIPTION

The 10 / 100 Mbit / s Fast Ethernet driver is a multi-threaded, loadable, clonable, STREAMS hardware device driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), over 10 / 100 Mbit / s 802.30 controller in the SBus Fast Ethernet card. There is no software limitation on the number of Fast Ethernet cards supported by the driver. The **be** driver provides basic support for the BigMAC hardware. Functions include chip initialization, frame transmit and receive, multicast and promiscuous support, and error recovery and reporting.

The cloning character-special device **/dev/be** is used to access the 10 / 100 Mbit / s device installed within the system.

be and DLPI

The **be** driver is a "style 2" Data Link Service provider; an explicit **DL_ATTACH_REQ** message by the user is required to associate the opened Stream with a particular device (**ppa**). The **ppa** ID is interpreted as an **unsigned long** and indicates the corresponding device instance (unit) number. An error (**DL_ERROR_ACK**) is returned by the driver if the **ppa** field value does not correspond to a valid device instance number for this system (see **prtconf**(1M)).

All **M_PROTO** and **M_PCPROTO** type messages are interpreted as **DLPI** primitives.

The device is initialized on first attach and de-initialized (stopped) on last detach.

The values returned by the driver in the **DL_INFO_ACK** primitive in response to the **DL_INFO_REQ** from the user are as follows:

- The max SDU (Service Data Unit) is **1500** (**ETHERMTU**).
- The min SDU (Service Data Unit) is **0**.
- The **dlsap** address length is **8**. The physical address component is 6 bytes followed immediately by a 2-byte **sap** component within the **DLSAP** address.
- The MAC type is **DL_ETHER**.
- The **sap** length value is **–2**, which means the physical address component is followed immediately by a 2-byte **sap** component within the **DLSAP** address.
- The service mode is **DL_CLDLS**.
- No optional quality of service (QOS) support is included at present so the QOS fields are **0**.
- The provider style is **DL_STYLE2**.
- The version is **DL_VERSION_2**.

- The broadcast address value is Ethernet / IEEE broadcast address (**0xFFFFFFFF**).

When in the **DL_ATTACHED** state, the user must send a **DL_BIND_REQ** to associate a particular SAP (Service Access Point) with the Stream. The **be** driver interprets the **sap** field within the **DL_BIND_REQ** as an Ethernet "type"; therefore, valid values for the **sap** field are in the [**0-0xFFFF**] range. Only one Ethernet type can be bound to the Stream at any time.

10 / 100 Mbit / s algorithm for auto-selection is to be determined.

If the user selects a **sap** with a value of **0**, the receiver will be in 802.3 mode. All frames received from the media having a "type" field in the range [**0-1500**] are assumed to be 802.3 frames and are routed up all open Streams which are bound to **sap** value **0**. If more than one Stream is in "802.3 mode" then the frame will be duplicated and routed up multiple Streams as **DL_UNITDATA_IND** messages.

In transmission, the driver checks the **sap** field of the **DL_BIND_REQ** if the **sap** value is **0**, and if the destination type field is in the range [**0-1500**]. If either is true, the driver computes the length of the message, not including initial **M_PROTO** mblk (message block), of all subsequent **DL_UNITDATA_REQ** messages and transmits 802.3 frames that have this value in the MAC frame header length field.

The driver also supports raw **M_DATA** mode. When the user sends a **DLIOCRAW ioctl**, the particular Stream is put in raw mode. A complete frame along with a proper ether header is expected as part of the data.

The **be** driver **DLSAP** address format consists of the 6-byte physical (Ethernet) address component followed immediately by the 2-byte **sap** (type) component producing an 8-byte **DLSAP** address. Applications should *not* hardcode to this particular implementation-specific **DLSAP** address format but use information returned by the **DL_INFO_ACK** primitive to compose and decompose **DLSAP** addresses. The **sap** length, full **DLSAP** length, and **sap** / physical ordering are included within the **DL_INFO_ACK**. The physical address length can be computed by subtracting the **sap** length from the full **DLSAP** address length or by issuing the **DL_PHYS_ADDR_REQ** to obtain the current physical address associated with the Stream.

When in the **DL_BOUND** state, the user may transmit frames on the Fast Ethernet by sending **DL_UNITDATA_REQ** messages to the **be** driver. The **be** driver routes received Fast Ethernet frames as **DL_UNITDATA_IND** messages up all the open and bound Streams that have **sap** matching the Fast Ethernet type. Received Fast Ethernet frames are duplicated and routed up multiple open Streams if necessary. The **DLSAP** address contained within the **DL_UNITDATA_REQ** and **DL_UNITDATA_IND** messages consists of both the **sap** (type) and physical (Fast Ethernet) components.

be Primitives

In addition to the mandatory connectionless **DLPI** message set the driver additionally supports the following primitives.

The **DL_ENABMULTI_REQ** and **DL_DISABMULTI_REQ** primitives enable / disable reception of individual multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis with these primitives. These primitives

are accepted by the driver in any state following **DL_ATTACHED**.

The **DL_PROMISCON_REQ** and **DL_PROMISCOFF_REQ** primitives with the **DL_PROMISC_PHYS** flag set in the **dl_level** field enables / disables reception of all ("promiscuous mode") frames on the media including frames generated by the local host. When used with the **DL_PROMISC_SAP** flag set this enables / disables reception of all **sap** (Fast Ethernet type) values. When used with the **DL_PROMISC_MULTI** flag set this enables / disables reception of all multicast group addresses. The effect of each is always on a per-stream basis and independent of the other **sap** and physical level configurations on this Stream or other Streams.

The **DL_PHYS_ADDR_REQ** primitive return the 6-octet Fast Ethernet address currently associated (attached) to the Stream in the **DL_PHYS_ADDR_ACK** primitive. This primitive is valid only in states following a successful **DL_ATTACH_REQ**.

The **DL_SET_PHYS_ADDR_REQ** primitive changes the 6-octet Fast Ethernet address currently associated (attached) to this Stream. The owner of the process which originally opened this Stream must be superuser or **EPERM** is returned in the **DL_ERROR_ACK**. This primitive is destructive in that it affects all other current and future Streams attached to this device. An **M_ERROR** is sent up all other Streams attached to this device when this primitive on this Stream is successful. Once changed, all Streams subsequently opened and attached to this device will obtain this new physical address. Once changed, the physical address will remain so until this primitive is used to change the physical address again or the system is rebooted, whichever comes first.

FILES

/dev/be **be** special character device.

SEE ALSO

prtconf(1M), **dlpi**(7), **ie**(7), **le**(7), **qe**(7)

NAME

bpp – bi-directional parallel port driver

SYNOPSIS

#include <sys/types.h>
#include <fcntl.h>
#include <sys/bpp_io.h>

fd = open("/dev/bpp*n***", flags);**

DESCRIPTION

The **bpp** driver provides a general-purpose bi-directional interface to parallel devices. It supports a variety of output (printer) and input (scanner) devices, using programmable timing relationships between the various handshake signals. The **bpp** driver is an *exclusive-use* device. If the device has already been opened, subsequent opens fail with **EBUSY.**

Default Operation

Each time the **bpp** device is opened, the default configuration is **BPP_ACK_BUSY_HS** for read handshake, **BPP_ACK_HS** for write handshake, 1 microsecond for all setup times and strobe widths, and 60 seconds for both timeouts. This configuration (in the write mode) drives many common personal computer parallel printers with Centronics-type interfaces. The application should use the **BPPIOC_SETPARMS ioctl( )** to configure the **bpp** for the particular device which is attached, if necessary.

Write Operation

If a failure or error condition occurs during a **write**(2), the number of bytes successfully written is returned (short write). Note that **errno** will not be set. The contents of certain status bits will be captured at the time of the error, and can be retrieved by the application program, using the **BPPIOC_GETERR ioctl( )** call. Subsequent **write**(2) calls may fail with the system error **ENXIO** if the error condition is not rectified. The captured status information will be overwritten each time an attempted transfer or a **BPPIOC_TESTIO ioctl( )** occurs.

Read/Write Operation

When the driver is opened for reading and writing, it is assumed that scanning will take place, as scanners are the only devices supported by this mode. Most scanners require that the **SLCT_IN** or **AFX** pin be set to tell the scanner the direction of the transfer. The **AFX** line is set when the **read_handshake** element of the **bpp_transfer_parms** structure is set to **BPP_HSCAN_HS**, otherwise the **SLCT_IN** pin is set. Normally, scanning starts by writing a command to the scanner, at which time the pin is set. When the scan data is read back, the pin is reset.

If a failure or error condition occurs during a **read**(2), the number of bytes successfully read is returned (short read). Note that **errno** will not be set. The contents of certain status bits will be captured at the time of the error, and can be retrieved by the application, using the **BPPIOC_GETERR ioctl( )** call. Subsequent **read**(2) calls may fail with **ENXIO** if the error condition is not rectified. The captured register information will be overwritten each time an attempted transfer or a **BPPIOC_TESTIO ioctl( )** occurs.

Read Operation

If a failure or error condition occurs during a **read**(2), the number of bytes successfully read is returned (short read). Note that **errno** will not be set. If **read_handshake** is set to **BPP_CLEAR_MEM** or **BPP_SET_MEM,** zeroes or ones, respectively, are written into the user buffer.

IOCTLS

The following **ioctl**(2) calls are supported:

BPPIOC_SETPARMS Set transfer parameters.
The argument is a pointer to a **struct bpp_transfer_parms**. See below for a description of the elements of this structure. If a parameter is out of range, **EINVAL** is returned.

BPPIOC_GETPARMS Get current transfer parameters.
The argument is a pointer to a **struct bpp_transfer_parms**. See below for a description of the elements of this structure. If no parameters have been configured since the device was opened, the contents of the struct will be the default conditions of the parameters (see **Default Operation** above).

Transfer Parameters Structure

This structure is defined in **<sys/bpp_io.h>**.

```
struct bpp_transfer_parms {
        enum    handshake_t
                read_handshake;     /* parallel port read handshake mode */
        int     read_setup_time;    /* DSS register - in nanoseconds */
        int     read_strobe_width;  /* DSW register - in nanoseconds */
        int     read_timeout;       /*
                                     * wait this many seconds
                                     * before aborting a transfer
                                     */
        enum    handshake_t
                write_handshake;    /* parallel port write handshake mode */
        int     write_setup_time;   /* DSS register - in nanoseconds */
        int     write_strobe_width; /* DSW register - in nanoseconds */
        int     write_timeout;      /*
                                     * wait this many seconds
                                     * before aborting a transfer
                                     */

};

/* Values for read_handshake and write_handshake fields */
enum    handshake_t {
        BPP_NO_HS,          /* no handshake pins */
        BPP_ACK_HS,         /* handshake controlled by ACK line */
```

```
        BPP_BUSY_HS,        /* handshake controlled by BSY line */
        BPP_ACK_BUSY_HS,    /*
                             * handshake controlled by ACK and BSY lines
                             * read_handshake only!
                             */
        BPP_XSCAN_HS,       /* xerox scanner mode, read_handshake only! */
        BPP_HSCAN_HS,       /*
                             * HP scanjet scanner mode
                             * read_handshake only!
                             */
        BPP_CLEAR_MEM,      /* write 0's to memory, read_handshake only! */
        BPP_SET_MEM,        /* write 1's to memory, read_handshake only! */
        /* The following handshakes are RESERVED. Do not use. */
        BPP_VPRINT_HS,      /* valid only in read/write mode */
        BPP_VPLOT_HS        /* valid only in read/write mode */
};
```

The **read_setup_time** field controls the time between dstrb falling edge to bsy rising edge if the **read_handshake** field is set to **BPP_NO_HS** or **BPP_ACK_HS**. It controls the time between dstrb falling edge to ack rising edge if the **read_handshake** field is set to **BPP_ACK_HS** or **BPP_ACK_BUSY_HS**. It controls the time between ack falling edge to dstrb rising edge if the **read_handshake** field is set to **BPP_XSCAN_HS**.

The **read_strobe_width** field controls the time between ack rising edge and ack falling edge if the **read_handshake** field is set to **BPP_NO_HS** or **BPP_ACK_BUSY_HS**. It controls the time between dstrb rising edge to dstrb falling edge if the **read_handshake** field is set to **BPP_XSCAN_HS**.

The values allowed for the **write_handshake** field are duplicates of the definitions for the **read_handshake** field. Note that some of these handshake definitions are only valid in one mode or the other.

The **write_setup_time** field controls the time between data valid to dstrb rising edge for all values of the **write_handshake** field.

The **write_strobe_width** field controls the time between dstrb rising edge and dstrb falling edge if the **write_handshake** field is not set to **BPP_VPRINT_HS** or **BPP_VPLOT_HS**. It controls the minimum time between dstrb rising edge to dstrb falling edge if the **write_handshake** field is set to **BPP_VPRINT_HS** or **BPP_VPLOT_HS**.

BPPIOC_SETOUTPINS Set output pin values.
The argument is a pointer to a **struct bpp_pins**. See below for a description of the elements of this structure. If a parameter is out of range, **EINVAL** is returned.

BPPIOC_GETOUTPINS Read output pin values.
The argument is a pointer to a **struct bpp_pins**. See below for a description of the elements of this structure.

Transfer Pins Structure

This structure is defined in **<sys/bpp_io.h>**.

```
struct   bpp_pins {
         u_char  output_reg_pins;       /* pins in P_OR register */
         u_char  input_reg_pins;        /* pins in P_IR register */
};

/* Values for output_reg_pins field */
#define BPP_SLCTIN_PIN      0x01    /* Select in pin */
#define BPP_AFX_PIN         0x02    /* Auto feed pin */
#define BPP_INIT_PIN        0x04    /* Initialize pin */
#define BPP_V1_PIN          0x08    /* reserved pin 1 */
#define BPP_V2_PIN          0x10    /* reserved pin 2 */
#define BPP_V3_PIN          0x20    /* reserved pin 3 */

#define BPP_ERR_PIN         0x01    /* Error pin */
#define BPP_SLCT_PIN        0x02    /* Select pin */
#define BPP_PE_PIN          0x04    /* Paper empty pin */
```

BPPIOC_GETERR

Get last error status.
The argument is a pointer to a **struct bpp_error_status**. See below for a description of the elements of this structure. This structure indicates the status of all the appropriate status bits at the time of the most recent error condition during a **read**(2) or **write**(2) call, or the status of the bits at the most recent **BPPIOC_TESTIO ioctl**(2) call. Note: The bits in the pin_status element indicate whether the associated pin is active, not the actual polarity. The application can check transfer readiness without attempting another transfer using the **BPPIOC_TESTIO ioctl( )**. Note: The **timeout_occurred** and **bus_error** fields will never be set by the **BPPIOC_TESTIO ioctl( )**, only by an actual failed transfer.

Error Pins Structure

This structure is defined in the include file **<sys/bpp_io.h>**.

```
struct   bpp_error_status {
         char    timeout_occurred;      /* 1 if a timeout occurred */
         char    bus_error;             /* 1 if an SBus bus error */
         u_char  pin_status;            /*
                                         * status of pins which could
                                         * cause an error
                                         */
};

/* Values for pin_status field */
```

```
#define BPP_ERR_ERR      0x01   /* Error pin active */
#define BPP_SLCT_ERR     0x02   /* Select pin active */
#define BPP_PE_ERR       0x04   /* Paper empty pin active */
#define BPP_SLCTIN_ERR   0x10   /* Select in pin active  */
#define BPP_BUSY_ERR     0x40   /* Busy pin active */
```

BPPIOC_TESTIO Test transfer readiness.
This command checks to see if a read or write transfer would succeed based on pin status, opened mode, and handshake selected. If a transfer would succeed, zero is returned. If a transfer would fail, -1 is returned, and **errno** is set to **EIO,** and the error status information is captured. The captured status can be retrieved using the **BPPIOC_GETERR ioctl( )** call. Note that the **timeout_occurred** and **bus_error** fields will never be set by this **ioctl( )**.

ERRORS

EBADF The device is opened for write-only access and a read is attempted, or the device is opened for read-only access and a write is attempted.

EBUSY The device has been opened and another open is attempted.
An attempt has been made to unload the driver while one of the units is open.

EINVAL A **BPPIOC_SETPARMS ioctl( )** is attempted with an out of range value in the **bpp_transfer_parms** structure.
A **BPPIOC_SETOUTPINS ioctl( )** is attempted with an invalid value in the pins structure.
An **ioctl( )** is attempted with an invalid value in the command argument. An invalid command argument is received from the vd driver (during **modload**(1M), **modunload**(1M).

EIO The driver encountered an SBus bus error when attempting an access.

A read or write does not complete properly, due to a peripheral error or a transfer timeout.

A **BPPIOC_TESTIO ioctl( )** call is attempted while a condition exists which would prevent a transfer (such as a peripheral error).

ENXIO The driver has received an open request for a unit for which the attach failed.
The driver has received a read or write request for a unit number greater than the number of units available.
The driver has received a write request for a unit which has an active peripheral error.

FILES

/dev/bpp? bi-directional parallel port devices

SEE ALSO

ioctl(2), **read**(2), **write**(2)

NAME

bufmod – STREAMS Buffer Module

SYNOPSIS

ioctl(fd, I_PUSH, "bufmod");

DESCRIPTION

bufmod is a STREAMS module that buffers incoming messages, reducing the number of system calls and the associated overhead required to read and process them. Although **bufmod** was originally designed to be used in conjunction with STREAMS-based networking device drivers, the version described here is general purpose so that it can be used anywhere STREAMS input buffering is required.

Read-side Behavior

bufmod's behavior depends on various parameters and flags that can be set and queried as described below under **IOCTLS**. **bufmod** collects incoming **M_DATA** messages into *chunks*, passing each chunk upstream when the chunk becomes full or the current read timeout expires. It optionally converts **M_PROTO** messages to **M_DATA** and adds them to chunks as well. It also optionally adds to each message a header containing a timestamp, and a cumulative count of messages dropped on the stream read side due to resource exhaustion or flow control. **bufmod**'s default settings allow it to drop messages when flow control sets in or resources are exhausted; disabling headers and explicitly requesting no drops makes **bufmod** pass all messages through. Finally, **bufmod** is capable of truncating upstream messages to a fixed, programmable length.

When a message arrives, **bufmod** processes it in several steps. The following paragraphs discuss each step in turn.

Upon receiving a message from below, if the **SB_NO_HEADER** flag is not set, **bufmod** immediately timestamps it and saves the current time value for later insertion in the header described below.

Next, if **SB_NO_PROTO_CVT** is not set, **bufmod** converts all leading **M_PROTO** blocks in the message to **M_DATA** blocks, altering only the message type field and leaving the contents alone.

It then truncates the message to the current *snapshot length*, which is set with the **SBIOCSSNAP ioctl** described below.

Afterwards, if **SB_NO_HEADER** is not set, **bufmod** prepends a header to the converted message. This header is defined as follows.

```
struct sb_hdr {
        u_int   sbh_origlen;
        u_int   sbh_msglen;
        u_int   sbh_totlen;
        u_int   sbh_drops;
        struct  timeval sbh_timestamp;
};
```

The **sbh_origlen** field gives the message's original length before truncation in bytes. The **sbh_msglen** field gives the length in bytes of the message after the truncation has been done. **sbh_totlen** gives the distance in bytes from the start of the truncated message in the current chunk (described below) to the start of the next message in the chunk; the

value reflects any padding necessary to insure correct data alignment for the host machine and includes the length of the header itself. **sbh_drops** reports the cumulative number of input messages that this instance of **bufmod** has dropped due to flow control or resource exhaustion. In the current implementation message dropping due to flow control can occur only if the **SB_NO_DROPS** flag is not set. (Note: this accounts only for events occurring within **bufmod**, and does not count messages dropped by downstream or by upstream modules.) The **sbh_timestamp** field contains the message arrival time expressed as a **struct timeval**.

After preparing a message, **bufmod** attempts to add it to the end of the current chunk, using the chunk size and timeout values to govern the addition. The chunk size and timeout values are set and inspected using the **ioctl( )** calls described below. If adding the new message would make the current chunk grow larger than the chunk size, **bufmod** closes off the current chunk, passing it up to the next module in line, and starts a new chunk. If adding the message would still make the new chunk overflow, the module passes it upward in an over-size chunk of its own. Otherwise, the module concatenates the message to the end of the current chunk.

To ensure that messages do not languish forever in an accumulating chunk, **bufmod** maintains a read timeout. Whenever this timeout expires, the module closes off the current chunk and passes it upward. The module restarts the timeout period when it receives a read side data message and a timeout is not currently active. These two rules insure that **bufmod** minimizes the number of chunks it produces during periods of intense message activity and that it periodically disposes of all messages during slack intervals, but avoids any timeout overhead when there is no activity.

bufmod handles other message types as follows. Upon receiving an **M_FLUSH** message specifying that the read queue be flushed, the module clears the currently accumulating chunk and passes the message on to the module or driver above. (Note: **bufmod** uses zero length **M_CTL** messages for internal synchronization and does not pass them through.) **bufmod** passes all other messages through unaltered to its upper neighbor, maintaining message order for non high priority messages by passing up any accumulated chunk first.

If the **SB_DEFER_CHUNK** flag is set, buffering does not begin until the second message is received within the timeout window.

If the **SB_SEND_ON_WRITE** flag is set, **bufmod** passes up the read side any buffered data when a message is received on the write side. **SB_SEND_ON_WRITE** and **SB_DEFER_CHUNK** are often used together.

Write-side Behavior

bufmod intercepts **M_IOCTL** messages for the **ioctl**s described below. The module passes all other messages through unaltered to its lower neighbor. If **SB_SEND_ON_WRITE** is set, message arrival on the writer side suffices to close and transmit the current read side chunk.

IOCTLS

bufmod responds to the following **ioctl**s.

SBIOCSTIME Set the read timeout value to the value referred to by the **struct timeval** pointer given as argument. Setting the timeout value to zero

has the side-effect of forcing the chunk size to zero as well, so that the module will pass all incoming messages upward immediately upon arrival. Negative values are rejected with an EINVAL error.

SBIOCGTIME Return the read timeout in the **struct timeval** pointed to by the argument. If the timeout has been cleared with the **SBIOCCTIME ioctl**, return with an ERANGE error.

SBIOCCTIME Clear the read timeout, effectively setting its value to infinity. This results in no timeouts being active and the chunk being delivered when it is full.

SBIOCSCHUNK Set the chunk size to the value referred to by the *u_int* pointer given as argument. See **NOTES** for description of effect on stream head high water mark.

SBIOCGCHUNK Return the chunk size in the *u_int* pointed to by the argument.

SBIOCSSNAP Set the current snapshot length to the value given in the **u_long** pointed to by the **ioctl**'s final argument. **bufmod** interprets a snapshot length value of zero as meaning infinity, so it will not alter the message. See **NOTES** for description of effect on stream head high water mark.

SBIOCGSNAP Returns the current snapshot length in the **u_long** pointed to by the **ioctl**'s final argument.

SBIOCSFLAGS Set the current flags to the value given in the **u_long** pointed to by the **ioctl**'s final argument. Possible values are a combination of the following.

- **SB_SEND_ON_WRITE** Transmit the read side chunk on arrival of a message on the write side.
- **SB_NO_HEADER** Do not add headers to read side messages.
- **SB_NO_DROPS** Do not drop messages due to flow control upstream.
- **SB_NO_PROTO_CVT** Do not convert **M_PROTO** messages into **M_DATA**.
- **SB_DEFER_CHUNK** Begin buffering on arrival of the second read side message in a timeout interval.

SBIOCGFLAGS Returns the current flags in the **u_long** pointed to by the **ioctl**'s final argument.

SEE ALSO

dlpi(7), **ie**(7), **le**(7), **pfmod**(7)

NOTES

Older versions of **bufmod** did not support the behavioral flexibility controlled by the **SBIOCSFLAGS ioctl**. Applications that wish to take advantage of this flexibility can guard themselves against old versions of the module by invoking the **SBIOCGFLAGS ioctl** and checking for an **EINVAL** error return.

When buffering is enabled by issuing an **SBIOCSCHUNK** ioctl to set the chunk size to a non zero value, **bufmod** sends a **SETOPTS** message to adjust the stream head high and low water marks to accommodate the chunked messages.

When buffering is disabled by setting the chunk size to zero, message truncation can have a significant influence on data traffic at the stream head and therefore the stream head high and low water marks are adjusted to new values appropriate for the smaller truncated message sizes.

BUGS

bufmod does not defend itself against allocation failures, so that it is possible, although very unlikely, for the stream head to use inappropriate high and low water marks after the chunk size or snapshot length have changed.

NAME

bwtwo – black and white memory frame buffer

SYNOPSIS

/dev/fbs/bwtwo

DESCRIPTION

The **bwtwo** interface provides access to monochrome memory frame buffers. It supports the ioctls described in **fbio**(7).

Reading or writing to the frame buffer is not allowed — you must use the **mmap**(2) system call to map the board into your address space.

FILES

/dev/fbs/bwtwo[0-9] device files

SEE ALSO

mmap(2), **cgfour**(7), **fbio**(7)

BUGS

Use of vertical-retrace interrupts is not supported.

NAME

cdio – CD-ROM control operations

SYNOPSIS

#include <sys/cdio.h>

DESCRIPTION

A SCSI driver **sd**(7) supports most of this set of **ioctl**(2) commands for audio operations and **CD-ROM** specific operations. Basic to these **cdio ioctl( )** requests are the definitions in **<sys/cdio.h>**.

Several **CD-ROM** specific commands can report addresses either in **LBA** (Logical Block Address) format or in **MSF** (Minute, Second, Frame) format. The **READ HEADER , READ SUBCHANNEL ,** and **READ TABLE OF CONTENTS** commands have this feature.

LBA format represents the logical block address for the **CD-ROM** absolute address field or for the offset from the beginning of the current track expressed as a number of logical blocks in a **CD-ROM** track relative address field. **MSF** format represents the physical address written on **CD-ROM** discs, expressed as a sector count relative to either the beginning of the medium or the beginning of the current track.

IOCTLS

The following I / O controls do not have any additional data passed into or received from them.

CDROMSTART This **ioctl( )** spins up the disc and seeks to the last address requested.

CDROMSTOP This **ioctl( )** spins down the disc.

CDROMPAUSE This **ioctl( )** pauses the current audio play operation.

CDROMRESUME This **ioctl( )** resumes the paused audio play operation.

CDROMEJECT This **ioctl( )** ejects the caddy with the disc.

The following I / O controls require a pointer to the structure for that **ioctl( )**, with data being passed into the **ioctl( )**.

CDROMPLAYMSF This **ioctl( )** command requests the drive to output the audio signals at the specified starting address and continue the audio play until the specified ending address is detected. The address is in **MSF** format. The third argument of this **ioctl( )** call is a pointer to the type **struct cdrom_msf**.

```
/*
 * definition of play audio msf structure
 */
struct cdrom_msf {
        unsigned char   cdmsf_min0;     /* starting minute */
        unsigned char   cdmsf_sec0;     /* starting second */
        unsigned char   cdmsf_frame0;   /* starting frame */
        unsigned char   cdmsf_min1;     /* ending minute */
        unsigned char   cdmsf_sec1;     /* ending second */
        unsigned char   cdmsf_frame1;   /* ending frame */
};
```

CDROMPLAYTRKIND

This **ioctl( )** command is similar to **CDROMPLAYMSF**. The starting and ending address is in track / index format. The third argument of the **ioctl( )** call is a pointer to the type **struct cdrom_ti**.

```
/*
 * definition of play audio track/index structure
 */
struct cdrom_ti {
        unsigned char   cdti_trk0;      /* starting track */
        unsigned char   cdti_ind0;      /* starting index */
        unsigned char   cdti_trk1;      /* ending track */
        unsigned char   cdti_ind1;      /* ending index */
};
```

CDROMVOLCTRL This **ioctl( )** command controls the audio output level. The SCSI command allows the control of up to four channels. The current implementation of the supported **CD-ROM** drive only uses channel 0 and channel 1. The valid values of volume control are between 0x00 and 0xFF, with a value of 0xFF indicating maximum volume. The third argument of the **ioctl( )** call is a pointer to **struct cdrom_volctrl** which contains the output volume values.

```
/*
 * definition of audio volume control structure
 */
struct cdrom_volctrl {
        unsigned char   channel0;
        unsigned char   channel1;
        unsigned char   channel2;
        unsigned char   channel3;
};
```

The following I / O controls take a pointer that will have data returned to the user program from the **CD-ROM** driver.

CDROMREADTOCHDR

This **ioctl( )** command returns the header of the table of contents (TOC). The header consists of the starting tracking number and the ending track number of the disc. These two numbers are returned through a pointer of **struct cdrom_tochdr**. While the disc can start at any number, all tracks between the first and last tracks are in contiguous ascending order.

```
/*
 * definition of read toc header structure
 */
struct cdrom_tochdr {
        unsigned char   cdth_trk0;      /* starting track */
        unsigned char   cdth_trk1;      /* ending track */
};
```

CDROMREADTOCENTRY

This **ioctl( )** command returns the information of a specified track. The third argument of the function call is a pointer to the type **struct cdrom_tocentry**. The caller needs to supply the track number and the address format. This command will return a 4-bit **adr** field, a 4-bit **ctrl** field, the starting address in **MSF** format or **LBA** format, and the data mode if the track is a data track. The **ctrl** field specifies whether the track is data or audio. To get information for the lead-out area, supply the **ioctl( )** command with the track field set to **CDROM_LEADOUT** (0xAA).

```
/*
 * definition of read toc entry structure
 */
struct cdrom_tocentry {
        unsigned char   cdte_track;
        unsigned char   cdte_adr        :4;
        unsigned char   cdte_ctrl       :4;
        unsigned char   cdte_format;
        union {
                struct {
                        unsigned char   minute;
                        unsigned char   second;
                        unsigned char   frame;
                } msf;
                int     lba;
        } cdte_addr;
        unsigned char   cdte_datamode;
};
```

To get the information from leadout track, the following value is appropriate for **cdte_track** the field:

CDROM_LEADOUT Leadout track

To get the information form data track, the following value is appropriate for **cdte_ctrl** the field:

CDROM_DATA_TRACK Data track

The following values are appropriate for the cdte_adr field:

CDROM_LBA **LBA** format

CDROM_MSF **MSF** format

CDROMSUBCHNL This **ioctl( )** command reads the Q sub-channel data of the current block. The subchannel data includes track number, index number, absolute **CD-ROM** address, track relative **CD-ROM** address, control data and audio status. All information is returned through a pointer to **struct cdrom_subchnl**. The caller needs to supply the address format for the returned address.

```
struct cdrom_subchnl {
        unsigned char   cdsc_format;
        unsigned char   cdsc_audiostatus;
        unsigned char   cdsc_adr:       4;
        unsigned char   cdsc_ctrl:      4;
        unsigned char   cdsc_trk;
        unsigned char   cdsc_ind;
        union {
                struct {
                        unsigned char   minute;
                        unsigned char   second;
                        unsigned char   frame;
                } msf;
                int     lba;
        } cdsc_absaddr;
        union {
                struct {
                        unsigned char   minute;
                        unsigned char   second;
                        unsigned char   frame;
                } msf;
                int     lba;
        } cdsc_reladdr;
};
```

The following values are valid for the audio status field returned from **READ SUBCHANNEL** command:

CDROM_AUDIO_INVALID	Audio status not supported
CDROM_AUDIO_PLAY	Audio play operation in progress
CDROM_AUDIO_PAUSED	Audio play operation paused
CDROM_AUDIO_COMPLETED	Audio play successfully completed
CDROM_AUDIO_ERROR	Audio play stopped due to error
CDROM_AUDIO_NO_STATUS	No current audio status to return

CDROMREADOFFSET

This **ioctl( )** command returns the absolute **CD-ROM** address of the first track in the last session of a Multi-Session **CD-ROM**. The third argument of the **ioctl( )** call is a pointer to an **int**.

CDROMCDDA

This **ioctl( )** command returns the **CD-DA** data or the subcode data. The third argument of the **ioctl( )** call is a pointer to the type **struct cdrom_cdda**. In addition to allocating memory and supplying its address, the caller needs to supply the starting address of the data, the transfer length, and the subcode options. The caller also needs to issue the **CDROMREADTOCENTRY ioctl( )** to find out which tracks contain **CD-DA** data before issuing this **ioctl( )**.

```
/*
 * Definition of CD-DA structure
 */
struct cdrom_cdda {
        unsigned int    cdda_addr;
        unsigned int    cdda_length;
        caddr_t         cdda_data;
        unsigned char   cdda_subcode;
};
```

To get the subcode information related to **CD-DA** data, the following values are appropriate for the **cdda_subcode** field:

CDROM_DA_NO_SUBCODE	**CD-DA** data with no subcode
CDROM_DA_SUBQ	**CD-DA** data with sub Q code
CDROM_DA_ALL_SUBCODE	**CD-DA** data with all subcode
CDROM_DA_SUBCODE_ONLY	All subcode only

To allocate the memory related to **CD-DA** and / or subcode data, the following values are appropriate for each data block transferred:

CD-DA data with no subcode	2352 bytes
CD-DA data with sub Q code	2368 bytes
CD-DA data with all subcode	2448 bytes
All subcode only	96 bytes

CDROMCDXA This **ioctl( )** command returns the **CD-ROM XA** (CD-ROM Extended Architecture) data according to **CD-ROM XA** format. The third argument of the **ioctl( )** call is a pointer to the type **struct cdrom_cdxa**. In addition to allocating memory and supplying its address, the caller needs to supply the starting address of the data, the transfer length, and the format. The caller also needs to issue the **CDROMREADTOCENTRY ioctl( )** to find out which tracks contain **CD-ROM XA** data before issuing this **ioctl( )**.

```
/*
 * Definition of CD-ROM XA structure
 */
struct cdrom_cdxa {
        unsigned int    cdxa_addr;
        unsigned int    cdxa_length;
        caddr_t         cdxa_data;
        unsigned char   cdxa_format;
};
```

To get the proper **CD-ROM XA** data, the following values are appropriate for the **cdxa_format** field:

CDROM_XA_DATA	**CD-ROM XA** data only
CDROM_XA_SECTOR_DATA	**CD-ROM XA** all sector data
CDROM_XA_DATA_W_ERROR	**CD-ROM XA** data with error flags data

To allocate the memory related to **CD-ROM XA** format, the following values are appropriate for each data block transferred:

CD-ROM XA data only	2048 bytes
CD-ROM XA all sector data	2352 bytes
CD-ROM XA data with error flags data	2646 bytes

CDROMSUBCODE This **ioctl( )** command returns raw subcode data (subcodes P ~ W are described in the "Red Book," see **SEE ALSO**) to the initiator while the target is playing audio. The third argument of the **ioctl( )** call is a pointer to the type **struct cdrom_subcode**. The caller needs to supply the transfer length and allocate memory for

subcode data. The memory allocated should be a multiple of 96 bytes depending on the transfer length.

```
/*
 * Definition of subcode structure
 */
struct cdrom_subcode {
        unsigned int    cdsc_length;
        caddr_t         cdsc_addr;
};
```

The next group of I/O controls get and set various **CD-ROM** drive parameters.

CDROMGBLKMODE This **ioctl( )** command returns the current block size used by the **CD-ROM** drive. The third argument of the **ioctl( )** call is a pointer to an integer.

CDROMSBLKMODE This **ioctl( )** command requests the **CD-ROM** drive to change from the current block size to the requested block size. The third argument of the **ioctl( )** call is an integer which contains the requested block size.

This **ioctl( )** command operates in exclusive-use mode only. The caller must ensure that no other processes can operate on the same **CD-ROM** device before issuing this **ioctl(). read**(2) behavior subsequent to this **ioctl( )** remains the same: the caller is still constrained to read the raw device on block boundaries and in block multiples.

To set the proper block size, the following values are appropriate:

CDROM_BLK_512	512 bytes
CDROM_BLK_1024	1024 bytes
CDROM_BLK_2048	2048 bytes
CDROM_BLK_2056	2056 bytes
CDROM_BLK_2336	2336 bytes
CDROM_BLK_2340	2340 bytes
CDROM_BLK_2352	2352 bytes
CDROM_BLK_2368	2368 bytes
CDROM_BLK_2448	2448 bytes
CDROM_BLK_2646	2646 bytes
CDROM_BLK_2647	2647 bytes

CDROMGDRVSPEED This **ioctl( )** command returns the current **CD-ROM** drive speed. The third argument of the **ioctl( )** call is a pointer to an integer.

CDROMSDRVSPEED This **ioctl( )** command requests the **CD-ROM** drive to change the current drive speed to the requested drive speed. This speed setting is only applicable when reading data areas. The third

argument of the **ioctl( )** is an integer which contains the requested drive speed.

To set the **CD-ROM** drive to the proper speed, the following values are appropriate:

CDROM_NORMAL_SPEED	150k / second
CDROM_DOUBLE_SPEED	330k / second
CDROM_MAXIMUM_SPEED	330k / second

Note that these numbers are only accurate when reading 2048 byte blocks. The **CD-ROM** drive will automatically switch to normal speed when playing audio tracks and will switch back to the speed setting when accessing data.

SEE ALSO

ioctl(2), **sd**(7)

N. V. Phillips and Sony Corporation, *System Description Compact Disc Digital Audio*, ("Red Book").

N. V. Phillips and Sony Corporation, *System Description of Compact Disc Read Only Memory*, ("Yellow Book").

N. V. Phillips, Microsoft, and Sony Corporation, *System Description CD-ROM XA*, 1991.

Volume and File Structure of CD-ROM for Information Interchange, ISO 9660:1988(E).

SCSI-2 Standard, document X3T9.2/86-109

NOTES

The **CDROMCDDA, CDROMCDXA, CDROMSUBCODE, CDROMGDRVSPEED, CDROMSDRVSPEED** and some of the block sizes in **CDROMSBLKMODE** are designed for new Sun-supported **CD-ROM** drives and might not work on some of the older **CD-ROM** drives.

The interface to this device is preliminary and subject to change in future releases. You are encouraged to write your programs in a modular fashion so that you can easily incorporate future changes.

NAME

cgeight – 24-bit color memory frame buffer

SYNOPSIS

/dev/fbs/cgeight

DESCRIPTION

The **cgeight** is a 24-bit color memory frame buffer with a monochrome overlay plane and an overlay enable plane implemented optionally on the Sun-4/110, Sun-4/150, Sun-4/260 and Sun-4/280 system models. It provides the standard frame buffer interface as defined in **fbio**(7).

In addition to the ioctls described under **fbio**(7)**,** the **cgeight** interface responds to two **cgeight**-specific colormap ioctls, **FBIOPUTCMAP** and **FBIOGETCMAP**. **FBIOPUTCMAP** returns no information other than success/failure using the ioctl return value. **FBIOGETCMAP** returns its information in the arrays pointed to by the red, green, and blue members of its **fbcmap** structure argument; **fbcmap** is defined in **<sys/fbio.h>** as:

```
struct fbcmap {
        int             index;          /* first element (0 origin) */
        int             count;          /* number of elements */
        unsigned char   *red;           /* red color map elements */
        unsigned char   *green;         /* green color map elements */
        unsigned char   *blue;          /* blue color map elements */
};
```

The driver uses color board vertical-retrace interrupts to load the colormap.

The systems have an overlay plane colormap, which is accessed by encoding the plane group into the index value with the **PIX_GROUP** macro (see **<sys/pr_planegroups.h**>).

When using the **mmap**(2) system call to map in the **cgeight** frame buffer. The device looks like:

```
DACBASE: 0x200000   -> Brooktree Ramdac      16 bytes
         0x202000   -> P4 Register            4 bytes
OVLBASE: 0x210000   -> Overlay Plane         1152x900x1
         0x230000   -> Overlay Enable Planea 1152x900x1
         0x250000   -> 24-bit Frame Buffera  1152x900x32
```

FILES

/dev/fbs/cgeight0
<sys/fbio.h>
<sys/pr_planegroups.h>

SEE ALSO

mmap(2), **fbio**(7)

NAME

cgfour – P4-bus 8-bit color memory frame buffer

SYNOPSIS

/dev/fbs/cgfour

DESCRIPTION

The **cgfour** is a color memory frame buffer with a monochrome overlay plane and an overlay enable plane. It provides the standard frame buffer interface as defined in **fbio**(7).

In addition to the ioctls described under **fbio**(7)**,** the **cgfour** interface responds to two **cgfour**-specific colormap ioctls, **FBIOPUTCMAP** and **FBIOGETCMAP**. **FBIOPUTCMAP** returns no information other than success / failure using the ioctl return value. **FBIOGETCMAP** returns its information in the arrays pointed to by the red, green, and blue members of its **fbcmap** structure argument; **fbcmap** is defined in **<sys/fbio.h>** as:

```
struct fbcmap {
        int             index;      /* first element (0 origin) */
        int             count;      /* number of elements */
        unsigned char   *red;       /* red color map elements */
        unsigned char   *green;     /* green color map elements */
        unsigned char   *blue;      /* blue color map elements */
};
```

The driver uses color board vertical-retrace interrupts to load the colormap.

The cgfour has an overlay plane colormap, which is accessed by encoding the plane group into the index value with the **PIX_GROUP** macro (see **<sys/pr_planegroups.h>**).

FILES

/dev/fbs/cgfour0

SEE ALSO

mmap(2), **fbio**(7)

NAME

cgfourteen – 24-bit color graphics device

SYNOPSIS

/dev/fbs/cgfourteen

DESCRIPTION

The **cgfourteen** device driver controls the video SIMM (VSIMM) component of the video and graphics subsystem of the Desktop SPARCsystems with SX graphics option. The VSIMM provides 24-bit truecolor visuals in a variety of screen resolutions and pixel depths.

The driver supports multi-threaded applications and has an interface accessible through **mmap**(2). The user must have an effective user ID of 0 to be able to write to the control space of the **cgfourteen** device.

There are eight distinct physical spaces the user may map, in addition to the control space. The mappings are set up by giving the desired offset to the **mmap**(2) call.

The **cgfourteen** device supports the standard frame buffer interface as defined in **fbio**(7).

The **cgfourteen** device can serve as a system console device.

See **/usr/include/sys/cg14io.h** for other device-specific information.

FILES

/kernel/drv/cgfourteen	**cgfourteen** device driver
/dev/fbs/cgfourteen[0-9]	Logical device name.
/usr/include/sys/cg14io.h	Header file that contains device specific information
/usr/include/sys/cg14reg.h	Header file that contains device specific information

SEE ALSO

mmap(2), **fbio**(7)

NAME

cgsix – accelerated 8-bit color frame buffer

SYNOPSIS

/dev/fbs/cgsix

DESCRIPTION

cgsix is a low-end graphics accelerator designed to enhance vector and polygon drawing performance. It has an 8-bit color frame buffer and provides the standard frame buffer interface as defined in **fbio**(7).

In addition, **cgsix** supports the following **cgsix**-specific **IOCTL**, defined in **<sys/fbio.h>**.

FBIOGXINFO Returns **cgsix**-specific information about the hardware. See the definition of **cg6_info** in **<sys/fbio.h>** for more information.

cgsix has registers and memory that may be mapped with **mmap**(2), using the offsets defined in **<sys/cg6reg.h>**.

FILES

/dev/fbs/cgsix0

SEE ALSO

mmap(2), **fbio**(7)

NAME

cgthree – 8-bit color memory frame buffer

SYNOPSIS

/dev/fbs/cgthree

DESCRIPTION

cgthree is a color memory frame buffer. It provides the standard frame buffer interface as defined in **fbio**(7).

FILES

/dev/fbs/cgthree[0-9]

SEE ALSO

mmap(2), **fbio**(7)

NAME

cgtwelve – 24-bit SBus color memory frame buffer and graphics accelerator

SYNOPSIS

/dev/fbs/cgtwelve

DESCRIPTION

cgtwelve is a 24-bit SBus-based color frame buffer and graphics accelerator, with 12-bit double buffering, 8-bit colormap, and overlay/enable planes. It provides the standard frame buffer interface defined in **fbio**(7), paired with microcode which can be downloaded using **gsconfig**(1M). Application acceleration is achieved using the SunPHIGS Application Programmer Interface (API).

The cgtwelve has registers and memory that may be mapped with **mmap**(2), using the offsets defined in **<sys/cg12reg.h>**.

When in double-buffer mode, each channel is dithered to 4 bits, yielding 12-bit double-buffering.

FILES

/dev/fbs/cgtwelve0	device special file
/dev/fb	default frame buffer
/usr/include/sys/cg12reg.h	device-specific definitions

SEE ALSO

gsconfig(1M), **mmap**(2), **fbio**(7)

NAME

cgtwo – color graphics interface

SYNOPSIS

/dev/cgtwo

DESCRIPTION

The **cgtwo** interface provides access to the color graphics controller board, which is normally supplied with a 19'' 66 Hz non-interlaced color monitor. It provides the standard frame buffer interface as defined in **fbio**(7).

The hardware consumes 4 megabytes of VME bus address space. The board starts at standard address 0x400000. The board must be configured for interrupt level 4.

FILES

/dev/cgtwo[0-9]

SEE ALSO

mmap(2), **fbio**(7)

NAME

cmdk – common disk driver

AVAILABILITY

x86

DESCRIPTION

The **cmdk** device driver is a common interface to various disk devices. The driver supports magnetic fixed disks, magnetic removable disks, and both 512-byte and 2K-byte CD-ROM drives.

The block-files access the disk using the system's normal buffering mechanism and are read and written without regard to physical disk records. There is also a "raw" interface that provides for direct transmission between the disk and the user's read or write buffer. A single read or write call usually results in one I/O operation; raw I/O is therefore considerably more efficient when many bytes are transmitted. The names of the block files are found in **/dev/dsk**; the names of the raw files are found in **/dev/rdsk**.

I/O requests to the magnetic disk must have an offset and transfer length that is a multiple of 512 bytes or the driver returns an EINVAL error. However, I/O requests to the 2K-byte CD-ROM drive must be a multiple of 2K bytes. Otherwise, the driver returns an EINVAL error, too.

Slice 0 is normally used for the root file system on a disk, slice 1 as a paging area (for example, swap), and slice 2 for backing up the entire Solaris fdisk partition. Other slices may be used for **usr** file systems or system reserved area.

Fdisk partition 0 is to access the entire disk and is generally used by the **fdisk**(1M) program.

FILES

/dev/dsk/c*n***t***n***d***n***[***s* | *p***]***n* block device

/dev/rdsk/c*n***t***n***d***n***[***s* | *p***]***n* raw device

where:

c*n*	controller *n*
t*n*	target id *n (0-6)*
d*n*	lun *n (0-7)*
s*n*	UNIX system slice *n (0-15)*
p*n*	fdisk partition (0)

SEE ALSO

fdisk(1M), **mount**(1M), **lseek**(2), **read**(2), **write**(2), **directory**(3C), **vfstab**(4), **dkio**(7)

NAME

cmtp – common tape driver

AVAILABILITY

x86

DESCRIPTION

The **cmtp** device driver is a common interface to various tape devices. (At the time of this release, only SCSI interface tape devices are supported.) The driver supports 1/4" cartridge devices, 4mm digital audio tapes (DAT), 1/2" reel tapes, and 8mm devices. See **mtio**(7) for details.

The driver can be opened with either the rewind or the no wind on close option. The driver supports a maximum of 128 tape devices. In addition, a maximum of four tape densities per device are supported. The tape density is specified using the different device name suffixes. See **mtio**(7) for details.

EOT Handling

Most of the tape drives have a logical end of tape (LEOT) before the physical end of tape (PEOT), to guarantee flushing the data onto the tape. The amount of storage between LEOT and PEOT varies from a megabyte to about 20 megabytes, depending on the tape device. Further writing is prohibited to prevent running off the end of the reel.

The first write that encounters EOT will return a short count or zero. The next write will return zero. Further writes to the tape will receive an ENOSPC error.

Reading past EOT is transparent to the user. Reading is only stopped by reading EOFs. For 1/2" reel devices, two consecutive file marks indicate the end of the recorded media.

Ioctls

The behavior of tape positioning ioctls is the same across all supporting devices. However, not all devices support every ioctl. The driver returns an ENOTTY error on unsupported ioctls.

SEE ALSO

cpio(1), **mt**(1), **tar**(1), **mtio**(7)

NAME

connld – line discipline for unique stream connections

SYNOPSIS

/ dev / connld

DESCRIPTION

connld is a STREAMS-based module that provides unique connections between server and client processes. It can only be pushed (see **streamio**(7)) onto one end of a STREAMS-based pipe that may subsequently be attached to a name in the file system name space with **fattach**(3C). After the pipe end is attached, a new pipe is created internally when an originating process attempts to **open**(2) or **creat**(2) the file system name. A file descriptor for one end of the new pipe is packaged into a message identical to that for the **ioctl I_SENDFD** (see **streamio**(7)) and is transmitted along the stream to the server process on the other end. The originating process is blocked until the server responds.

The server responds to the **I_SENDFD** request by accepting the file descriptor through the **I_RECVFD ioctl** message. When this happens, the file descriptor associated with the other end of the new pipe is transmitted to the originating process as the file descriptor returned from **open**(2) or **creat**(2).

If the server does not respond to the **I_SENDFD** request, the stream that the **connld** module is pushed on becomes uni-directional because the server will not be able to retrieve any data off the stream until the **I_RECVFD** request is issued. If the server process exits before issuing the **I_RECVFD** request, the **open**(2) or the **creat**(2) invocation will fail and return -1 to the originating process.

When the **connld** module is pushed onto a pipe, it ignores messages going back and forth through the pipe.

ERRORS

On success, an open of **connld** returns 0. On failure, **errno** is set to the following values:

EINVAL	A stream onto which **connld** is being pushed is not a pipe or the pipe does not have a write queue pointer pointing to a stream head read queue.
EINVAL	The other end of the pipe onto which **connld** is being pushed is linked under a multiplexor.
EPIPE	**connld** is being pushed onto a pipe end whose other end is no longer there.
ENOMEM	An internal pipe could not be created.
ENXIO	An **M_HANGUP** message is at the stream head of the pipe onto which **connld** is being pushed.
EAGAIN	Internal data structures could not be allocated.
ENFILE	A file table entry could not be allocated.

SEE ALSO

creat(2), **open**(2), **fattach**(3C), **streamio**(7)

STREAMS Programmer's Guide

NAME

console – STREAMS-based console interface

SYNOPSIS

/dev/console

DESCRIPTION

The file **/dev/console** refers to the system console device.

SPARC

The identity of this device depends on the EEPROM settings in effect at the most recent system reboot; by default, it is the ''workstation console'' device consisting of the workstation keyboard and frame buffer acting in concert to emulate an ASCII terminal (see **wscons**(7)).

x86

By default the device is the ''workstation console'' device consisting of the workstation keyboard and display (see **display**(7) and **keyboard**(7)) acting in concert to emulate an ASCII terminal (see **wscons**(7)).

In either architecture, regardless of the system configuration, the console device provides asynchronous serial driver semantics so that, in conjunction with the STREAMS line discipline module **ldterm**(7), it supports the **termio**(7) terminal interface.

SEE ALSO

termios(3), **ldterm**(7), **termio**(7), **wscons**(7)

x86 Only

display(7), **keyboard**(7)

NOTES

In contrast to pre-SunOS 5.0 releases, it is no longer possible to redirect I/O intended for **/dev/console** to some other device. Instead, redirection now applies to the workstation console device using a revised programming interface (see **wscons**(7)). Since the system console is normally configured to be the work station console, the overall effect is largely unchanged from previous releases.

See **wscons**(7) for detailed descriptions of control sequence syntax, ANSI control functions, control character functions and escape sequence functions.

NAME

dbri – Dual Basic Rate ISDN and audio Interface

AVAILABILITY

SPARC

The DBRI Multimedia Codec, and SpeakerBox are available on SPARCstation 10 and LX systems.

SPARCstation 10SX and SPARCstation 20 systems have the Multimedia Codec integrated onto the CPU board of the machine.

This hardware may or may not be available on future systems from Sun Microsystems Computer Corporation.

DESCRIPTION

The **dbri** device uses the T5900FC Dual Basic Rate ISDN Interface (DBRI) and Multimedia Codec chips to implement the audio device interface. This interface is described fully in the **audio**(7) manual page.

Applications that open **/dev/audio** may use the **AUDIO_GETDEV** ioctl to determine which audio device is being used. The dbri driver will return the string "**SUNW,dbri**" in the *name* field of the **audio_device** structure. The *version* field will contain "**e**" and the *config* field will contain one of the following values: "**isdn_b**" on an ISDN B channel stream, "**speakerbox**" on a **/dev/audio** stream associated with a SpeakerBox, and lastly "**onboard1**" on a **/dev/audio** stream associated with the onboard Multimedia Codec.

The **AUDIO_SETINFO** ioctl controls device configuration parameters. When an application modifies the *record.buffer_size* field using the **AUDIO_SETINFO** ioctl, the driver will constrain it to be non-zero and a multiple of 16 bytes, up to a maximum of 8176 bytes.

Audio Interfaces

The SpeakerBox audio peripheral is available for connection to the SpeakerBox Interface (SBI) port of most **dbri** equipped systems and provides an integral monaural speaker as well as stereo line out, stereo line in, stereo headphone, and monaural microphone connections. The headset output level is adequate to power most headphones, but may be too low for some external speakers. Powered speakers or an external amplifier may be used with both the headphone and line out ports.

SPARCstation LX systems have the Multimedia Codec integrated onto the CPU board of the machine thus giving users the option of using it or using a SpeakerBox plugged into the AUI/Audio port on the back panel. When using the "onboard" Codec, the microphone and headphone ports are located on the system back panel - there are no Line In or Line Out ports available for this configuration. In addition, the headphone and microphone ports do not have the input detection circuitry to determine whether or not there is currently headphones or a microphone plugged in. If a SpeakerBox is plugged in when the machine is first rebooted and reconfigured, or upon the first access of the audio device, it will be used, otherwise the onboard Codec will be used.

The Sun Microphone is recommended for normal desktop audio recording. When the Sun Microphone is used in conjunction with the SpeakerBox, the microphone battery is bypassed. Other audio sources may be recorded by connecting their line output to the SpeakerBox line input (audio sources may also be connected from their headphone output if the volume is adjusted properly).

ISDN Interfaces

The DBRI controller offers two Basic Rate ISDN (BRI) interfaces. One is a BRI Terminal Equipment (TE) interface and the other is a BRI Network Termination (NT) interface.

The NT connector is switched by a relay so that when system power is not available or when software is not accessing the NT port, the TE and NT connectors are electrically connected and devices plugged into the NT port will be on the same BRI passive bus.

Audio Data Formats for the Multimedia Codec/SpeakerBox

The **dbri** device supports the audio formats listed in the following table. When the device is open for simultaneous play and record, the input and output data formats must match.

Supported Audio Data Formats

Sample Rate	Encoding	Precision	Channels
8000 Hz	µ-law or A-law	8	1
9600 Hz	µ-law or A-law	8	1
11025 Hz	µ-law or A-law	8	1
16000 Hz	µ-law or A-law	8	1
18900 Hz	µ-law or A-law	8	1
22050 Hz	µ-law or A-law	8	1
32000 Hz	µ-law or A-law	8	1
37800 Hz	µ-law or A-law	8	1
44100 Hz	µ-law or A-law	8	1
48000 Hz	µ-law or A-law	8	1
8000 Hz	linear	16	1 or 2
9600 Hz	linear	16	1 or 2
11025 Hz	linear	16	1 or 2
16000 Hz	linear	16	1 or 2
18900 Hz	linear	16	1 or 2
22050 Hz	linear	16	1 or 2
32000 Hz	linear	16	1 or 2
37800 Hz	linear	16	1 or 2
44100 Hz	linear	16	1 or 2
48000 Hz	linear	16	1 or 2

Audio Data Formats for BRI Interfeces

ISDN channels implement a subset of audio semantics. The preferred ioctls for querying or setting the format of a BRI channel are ISDN_GET_FORMAT, ISDN_SET_FORMAT, and ISDN_SET_CHANNEL. In particular, there is no audio format described in **audio**(7) that covers HDLC or transparent data. The **dbri** driver maps HDLC and transparent data to AUDIO_ENCODING_NONE. ISDN D-channels are always configured for HDLC encoding of data. The programmer should interpret an *encoding* value of AUDIO_ENCODING_NONE as an indication that the *fd* is not being used to transfer audio data.

B-channels can be configured for µ-law, A-law, or HDLC encoding of data. The µ-law and A-law formats are always at 8000 Hz, 8-bit, mono. Although a BRI H-channel is actually 16 bits wide at the physical layer and the 16-bit sample occurs at 8 kHz, the HDLC encoding always presents the data in 8-bit quantities. Therefore, 56 bit-per-second (bps), 64 bps, and 128 bps formats are all presented to the programmer as 8-bit wide, mono, AUDIO_ENCODING_NONE format streams at different sample rates. A line rate of

56kbps results in a 8-bit sample rate of 7000 Hz. If the bit stuffing and un-stuffing of HDLC were taken into account, the data rate would be slightly less.

For the sake of compatibility, AUDIO_GETINFO will return one of the following on a ISDN channel:

BRI Audio Data Formats

Sample Rate	Encoding	Precision	Channels
8000 Hz	µ-law or A-law	8	1
-	AUDIO_ENCODING_NONE	-	-

ISDN_GET_FORMAT will return one of the following for an ISDN channel:

BRI Audio Data Formats

Mode	Sample Rate	Encoding	Precision	# Ch	Available on
HDLC	2000 Hz	NONE	8	1	D
HDLC	7000 Hz	NONE	8	1	B1,B2
HDLC	8000 Hz	NONE	8	1	B1,B2
HDLC	16000 Hz	NONE	8	1	B1,B2
TRANS	8000 Hz	µ-law	8	1	B1,B2
TRANS	8000 Hz	A-law	8	1	B1,B2
TRANS	8000 Hz	NONE	8	1	B1,B2
TRANS	8000 Hz	NONE	16	1	B1 only

In the previous table, HDLC = ISDN_MODE_HDLC, TRANS = ISDN_MODE_TRANSPARENT.

Audio Ports

Audio ports are not relevant to ISDN D or B channels.

The *record.avail_ports* and *play.avail_ports* fields of the **audio_info** structure report the available input and output ports. The **dbri** device supports two input ports, selected by setting the *record.port* field to either **AUDIO_MICROPHONE** or **AUDIO_LINE_IN**. The *play.port* field may be set to any combination of **AUDIO_SPEAKER**, **AUDIO_HEADPHONE**, and **AUDIO_LINE_OUT** by OR'ing the desired port names together. As noted above, when using the onboard Multimedia Codec on the SPARCstation LX, the Line In and Line Out ports are not available.

Sample Granularity

Since the **dbri** device manipulates buffers of audio data, at any given time the reported input and output sample counts will vary from the actual sample count by no more than the size of the buffers it is transferring. Programs should, in general, not rely on absolute accuracy of the *play.samples* and *record.samples* fields of the **audio_info** structure.

Audio Status Change Notification

As described in **audio**(7), it is possible to request asynchronous notification of changes in the state of an audio device. The DBRI driver extends this to the ISDN B-channels by sending the signal up the data channel instead of the control channel. Asynchronous notification of events on a B-channel only occurs when the channel is in a transparent data mode. When the channel is in HDLC mode, no such notification will take place.

ERRORS

In addition to the errors described in **audio**(7), an **open()** will fail if:

ENODEV The driver is unable to communicate with the SpeakerBox, possibly because it is currently not plugged in.

FILES

The physical device names are very system dependent and are rarely used by programmers. For example:

/devices/sbus@1,f8000000/SUNW,DBRIe@1,10000:te,b2.

The programmer should instead use the generic device names listed below:

/dev/audio	- symlink to the system's primary audio device, not necessarily a **dbri** based audio device
/dev/audioctl	- control device for the above audio device.
/dev/sound/0*	- represents the first audio device on the system and is not necessarily based on **dbri** or SpeakerBox.
/dev/sound/0	- first audio device in the system.
/dev/sound/0ctl	- audio control for above device
/dev/isdn/0/*	- represents the first ISDN device on the system and any associated interfaces. This device is not necessarily based on **dbri.**
/dev/isdn/0/te/mgt	- TE management device
/dev/isdn/0/te/d	- TE D-channel
/dev/isdn/0/te/b1	- TE B1-channel
/dev/isdn/0/te/b2	- TE B2-channel
/dev/isdn/0/nt/mgt	- NT management device
/dev/isdn/0/nt/d	- NT D-channel
/dev/isdn/0/nt/b1	- NT B1-channel
/dev/isdn/0/nt/b2	- NT B2-channel
/dev/isdn/0/aux/0	- SpeakerBox or onboard Multimedia Codec
/dev/isdn/0/aux/0ctl	- Control device for SpeakerBox or onboard Multimedia Codec
/usr/demo/SOUND	- audio demonstration programs and other files.

SEE ALSO

ioctl(2), **audio**(7), **isdnio**(7), **streamio**(7)

AT&T Microelectronics data sheet for the T5900FC Sun Dual Basic Rate ISDN Interface.

Crystal Semiconductor, Inc., data sheet for the CS4215 16-Bit, 48 kHz, Multimedia Audio Codec Publication number DS76PP5.

NOTES

Due to hardware restrictions, it is impossible to reduce the record gain to 0. A valid input signal is still received at the lowest gain setting the Multimedia Codec allows. For security reasons, the **dbri** driver disallows a record gain value of 0. This is to provide feedback to the user that such a setting is not possible and that a valid input signal is still being received. An attempt to set the record gain to 0 will result in the lowest possible non-zero gain. The **audio_info** structure will be updated with this value when the **AUDIO_SETINFO** ioctl returns.

BUGS

When a DBRI channel associated with the SpeakerBox Interface underruns, DBRI may not always repeat the last sample but instead could repeat more than one sample. This behavior can result in a tone being generated by an audio device connected to the SBI port.

Monitor STREAMs connected to a B1 channel on either the TE or NT interface do not work because of a DBRI hardware problem. The device driver disallows the creation of such monitors.

NAME

display – system console display

AVAILABILITY

x86

DESCRIPTION

display is a component of the **kd** driver, which is comprised of the **display** and **keyboard** drivers.

Solaris for x86 normally uses a windowed environment. The character-based display facilities offered by the display section of the **kd** driver are supposed to be used only until the windowing system takes over. Currently, any VGA adapter can be used to boot the system, but the windows server requires an SVGA or 8514 adapter.

See the supported hardware list in the *Solaris 2.4 x86 Hardware Compatibility List* for the full list of tested adapters.

FILES

/dev/console

SEE ALSO

console(7), **keyboard**(7)
Solaris 2.4 x86 Hardware Compatibility List

NAME

dkio – disk control operations

SYNOPSIS

```
#include <sys/dkio.h>
#include <sys/vtoc.h>
```

DESCRIPTION

Disk drivers support a set of **ioctl**(2) requests for disk controller, geometry, and partition information. Basic to these **ioctl( )** requests are the definitions in **<sys/dkio.h>**.

IOCTLS

The following **ioctl( )** requests set and / or retrieve the current disk controller, partitions, or geometry information:

DKIOCINFO The argument is a pointer to a **dk_cinfo** structure (described below). This structure tells the type of the controller and attributes about how bad-block processing is done on the controller.

```
/*
 * Structures and definitions for disk I/O control commands
 */

#define DK_DEVLEN    16    /* device name max length, */
                           /* including unit # and NULL */

/*
 * Used for controller info
 */

struct dk_cinfo {
        char     dki_cname[DK_DEVLEN];  /* controller name (no unit #)*/
        u_short  dki_ctype;             /* controller type */
        u_short  dki_flags;             /* flags */
        u_short  dki_cnum;              /* controller number */
        u_int    dki_addr;              /* controller address */
        u_int    dki_space;             /* controller bus type */
        u_int    dki_prio;              /* interrupt priority */
        u_int    dki_vec;               /* interrupt vector */
        char     dki_dname[DK_DEVLEN];  /* drive name (no unit #) */
        u_int    dki_unit;              /* unit number */
        u_int    dki_slave;             /* slave number */
        u_short  dki_partition;         /* partition number */
        u_short  dki_maxtransfer;       /* maximum transfer size */
                                        /* in DEV_BSIZE */
};

/*
 * Controller types
 */

#define DKC_UNKNOWN     0
#define DKC_CDROM       1               /* CD-ROM, SCSI or
                                           otherwise */
```

```
#define DKC_WDC2880     2
#define DKC_XXX_0       3               /* unassigned */
#define DKC_XXX_1       4               /* unassigned */
#define DKC_DSD5215     5
#define DKC_XY450       6
#define DKC_ACB4000     7
#define DKC_MD21        8
#define DKC_XXX_2       9               /* unassigned */
#define DKC_NCRFLOPPY   10
#define DKC_XD7053      11
#define DKC_SMSFLOPPY   12
#define DKC_SCSI_CCS    13              /* SCSI CCS compatible */
#define DKC_INTEL82072  14              /* native floppy chip */
#define DKC_PANTHER     15
#define DKC_SUN_IPI1    DKC_PANTHER     /* Sun Panther */
                                        /* VME/IPI controller */
#define DKC_MD          16              /* meta-disk (virtual-disk) */
                                        /* driver */
#define DKC_CDC_9057    17              /* CDC 9057-321 (CM-3) */
                                        /* IPI String Controller */
#define DKC_FJ_M1060    18              /* Fujitsu/Intellistor */
                                        /* IM1060 PI-3 SC */
#define DKC_INTEL82077  19              /* 82077 floppy disk */
                                        /* controller */
#define DKC_DIRECT      20              /* Intel direct attached */
                                        /* device (IDE) */

/*
 * Sun reserves up through 1023
 */

#define DKC_CUSTOMER_BASE       1024

/*
 * Flags
 */

#define DKI_BAD144      0x01    /* use DEC std 144 bad sector fwding */
#define DKI_MAPTRK      0x02    /* controller does track mapping */
#define DKI_FMTTRK      0x04    /* formats only full track at a time */
#define DKI_FMTVOL      0x08    /* formats only full volume at a time */
#define DKI_FMTCYL      0x10    /* formats only full cylinders at a time*/
#define DKI_HEXUNIT     0x20    /* unit number printed as 3 hex digits */
```

DKIOCGAPART The argument is a pointer to a **dk_allmap** structure (described below). This **ioctl( )** gets the controller's notion of the current partition table for disk drive.

DKIOCSAPART The argument is a pointer to a **dk_allmap** structure (described below). This **ioctl( )** sets the controller's notion of the partition table without changing the disk itself.

```
/*
 * Partition map (part of dk_label)
 */
struct dk_map {
        daddr_t dkl_cylno;      /* starting cylinder */
        daddr_t dkl_nblk;       /* number of blocks */
};
/*
 * Used for all partitions
 */
struct dk_allmap {
        struct dk_map     dka_map[NDKMAP];
};
```

DKIOCPARTINFO

x86: The argument is a pointer to a **part_info** structure (described below). This **ioctl( )** gets the driver's notion of the size and extent of the partition or slice indicated by the file descriptor argument.

```
/*
 * Used by applications to get partition or slice information
 */

struct part_info {
        daddr_t     p_start;
        int         p_length;
 };
```

DKIOCGGEOM The argument is a pointer to a **dk_geom** structure (described below). This **ioctl( )** gets the controller's notion of the current geometry of the disk drive.

DKIOCSGEOM The argument is a pointer to a **dk_geom** structure (described below). This **ioctl( )** sets the controller's notion of the geometry without changing the disk itself.

DKIOCG_PHYGEOM

x86: The argument is a pointer to a **dk_geom** structure (described below). This **ioctl( )** gets the driver's notion of the physical geometry of the disk drive. It is functionally identical to the **DKIOCGGEOM ioctl( )**.

DKIOCG_VIRTGEOM

x86: The argument is a pointer to a **dk_geom** structure (described below). This **ioctl( )** gets the controller's (and hence the driver's) notion of the virtual geometry of the disk drive. Virtual geometry is a view of

the disk geometry maintained by the firmware in a host bus adapter or disk controller.

```
/*
 * Definition of a disk's geometry
 */
struct dk_geom {
        unsigned short    dkg_ncyl;             /* # of data */
                                                /* cylinders */
        unsigned short    dkg_acyl;             /* # of alternate*/
                                                /* cylinders */
        unsigned short    dkg_bcyl;             /* cyl offset (for */
                                                /* fixed head area) */
        unsigned short    dkg_nhead;            /* # of heads */
        unsigned short    dkg_obs1;             /* obsolete */
        unsigned short    dkg_nsect;            /* # of sectors */
                                                /* per track */
        unsigned short    dkg_intrlv;           /* interleave factor */
        unsigned short    dkg_obs2;             /* obsolete */
        unsigned short    dkg_obs3;             /* obsolete */
        unsigned short    dkg_apc;              /* alternates per*/
                                                /* cyl (SCSI only) */
        unsigned short    dkg_rpm;              /* revolutions per min*/
        unsigned short    dkg_pcyl;             /* # of physical */
                                                /* cylinders */
        unsigned short    dkg_write_reinstruct; /* # sectors to */
                                                /* skip, writes */
        unsigned short    dkg_read_reinstruct;  /* # sectors to */
                                                /* skip, reads */
        unsigned short    dkg_extra[7];         /* for compatible*/
                                                /* expansion */
};
#define dkg_gap1    dkg_extra[0]    /* for application */
                                    /* compatibility */
#define dkg_gap2    dkg_extra[1]    /* for application */
                                    /* compatibility */
```

DKIOCGVTOC The argument is a pointer to a **vtoc** structure (described below). This **ioctl( )** returns the device's current VTOC (volume table of contents).

DKIOCSVTOC The argument is a pointer to a **vtoc** structure (described below). This **ioctl( )** changes the VTOC associated with the device.

```
struct partition {
        ushort    p_tag;     /* ID tag of partition */
        ushort    p_flag;    /* permission flags */
        daddr_t   p_start;   /* start sector of partition */
        long      p_size;    /* # of blocks in partition */
};
```

If **DKIOCSVTOC** is used with a floppy diskette, the **p_start** field must be the first sector of a cylinder. Multiply the number of heads by the number of sectors per track to compute the number of sectors per cylinder.

```
struct vtoc {
    unsigned long  v_bootinfo[3];                 /* info needed */
                                                  /* by mboot */
                                                  /* (unsupported) */
    unsigned long  v_sanity;                      /* to verify vtoc */
                                                  /* sanity */
    unsigned long  v_version;                     /* layout version */
    char           v_volume[LEN_DKL_VVOL];        /* volume name */
    ushort         v_sectorsz;                    /* sector size in */
                                                  /* bytes */
    ushort         v_nparts;                      /* number of */
                                                  /* partitions */
    unsigned long  v_reserved[10];                /* free space */
    struct partition  v_part[V_NUMPAR];           /* partition */
                                                  /* headers*/
    time_t         timestamp[V_NUMPAR];           /* partition */
                                                  /* timestamp */
                                                  /* (unsupported) */
    char           v_asciilabel[LEN_DKL_ASCII];   /* compatibility */
};

/*
 * Partition permission flags
 */
#define V_UNMNT     0x01    /* Unmountable partition */
#define V_RONLY     0x10    /* Read only */

/*
 * Partition identification tags
 */
#define V_UNASSIGNED    0x00    /* unassigned partition */
#define V_BOOT          0x01    /* Boot partition */
#define V_ROOT          0x02    /* Root filesystem */
#define V_SWAP          0x03    /* Swap filesystem */
```

```
#define V_USR       0x04    /* Usr filesystem */
#define V_BACKUP    0x05    /* full disk */
#define V_STAND     0x06    /* Stand partition */
#define V_VAR       0x07    /* Var partition */
#define V_HOME      0x08    /* Home partition */
#define V_ALTSCTR   0x09    /* Alternate sector partition */
```

DKIOCADDBAD

x86: This **ioctl()** forces the driver to re-examine the alternates slice and rebuild the internal bad block map accordingly. It should be used whenever the alternates slice is changed by any method other than the **addbadsec**(1M) utility.

DKIOCEJECT This **ioctl()** requests the disk drive to eject its disk, if that drive supports removable media.

DKIOCLOCK SPARC: This **ioctl()** requests the disk drive to lock the door, for those devices with removable media.

DKIOCUNLOCK

SPARC: This **ioctl()** requests the disk drive to unlock the door, for those devices with removable media.

DKIOCSTATE SPARC: This **ioctl()** blocks until the state of the drive, inserted or ejected, is changed. The argument is a pointer to a **dkio_state,** enum, whose possible enumerations are listed below. The initial value should be either the last reported state of the drive, or **DKIO_NONE .** Upon return, the enum pointed to by the argument is updated with the current state of the drive.

```
enum dkio_state {
        DKIO_NONE,      /* Return disk's current state */
        DKIO_EJECTED,   /* Disk state is 'ejected' */
        DKIO_INSERTED   /* Disk state is 'inserted' */
};
```

SEE ALSO **ioctl**(2), **cdio**(7), **fdio**(7)
SPARC Only **hdio**(7), **ipi**(7), **sd**(7), **xd**(7), **xy**(7)
x86 Only **cmdk**(7)

NAME

dlpi – Data Link Provider Interface

SYNOPSIS

#include <sys/dlpi.h>

DESCRIPTION

SunOS STREAMS-based device drivers wishing to support the STREAMS TCP / IP and other STREAMS-based networking protocol suite implementations support Version 2 of the Data Link Provider Interface (DLPI). DLPI V2 enables a data link service user to access and use any of a variety of conforming data link service providers without special knowledge of the provider's protocol. Specifically, the interface is intended to support Ethernet, X.25 LAPB, SDLC, ISDN LAPD, CSMA / CD, FDDI, token ring, token bus, Bisync, and other datalink-level protocols.

The interface specifies access to the data link service provider in the form of M_PROTO and M_PCPROTO type STREAMS messages and does not define a specific protocol implementation. The interface defines the syntax and semantics of primitives exchanged between the data link user and the data link provider to attach a physical device with physical-level address to a stream, bind a datalink-level address to the stream, get implementation-specific information from the data link provider, exchange data with a peer data link user in one of three communication modes (connection, connectionless, acknowledged connectionless), enable / disable multicast group and promiscuous mode reception of datalink frames, get and set the physical address associated with a stream, and several other operations.

For details on this interface refer to the **<sys/dlpi.h>** header and to the STREAMS DLPI Specification, 800-6915-01.

FILES

Files in or under **/dev**.

SEE ALSO

ie(7), **le**(7)

NAME

dpt – DPT 2011, 2021, 2012 and 2022 low-level controller modules

AVAILABILITY

x86

DESCRIPTION

The **dpt** module provides low-level interface routines between the common disk/tape I/O subsystem and the DPT ISA bus master 2011 and 2021 SCSI (Small Computer System Interface) and DPT EISA 2012 and 2022 SCSI controllers. The **dpt** module can be configured for disk and streaming tape support for one or more host adapter boards, each of which must be the sole initiator on a SCSI bus. Auto configuration code determines if the adapter is present at the configured address and what types of devices are attached to it. If a memory cache module is installed on the DPT board, this cache will be flushed to disk by the **dpt** driver module when the system is shut down by the system administrator.

Board Configuration and Auto Configuration

In order to boot from a 2011, 2021, 2012, or 2022 host adapter, it must first be configured correctly.

DPT 2011 and DPT 2021 ISA SCSI Bus Master Host Bus Adapters

The DPT 2011 and DPT 2021 are adapters that are configured using jumpers. Before installation of an operating system, the utility **dptfmt** must be run to prepare disk drives for use by the adapter. You will be required to enter emulation information as part of this procedure. There is information for two drives, and it should show ''disabled'' for both. Failure to perform this step will result in missing drives during the system boot process. The entry for drive types should be set to 0 for drives zero and one. This indicates ''no drives present'' and disables the emulation mode of the adapter, thus allowing correct operation of the native mode driver. The user configurable parameters in the **/kernel/drv/dpt.conf** file for the DPT 2011 and DPT 2021 are:

io port "reg=0x1f0,0,0" "ioaddr=0x1f0"
priority level (5) and IRQ (interrupt) 14 "intr=5,15"

The I/O port (**ioaddr**) is the ISA bus base I/O address used for communication with the adapter. The same base address should appear after **reg=***XXX* and **ioaddr=***XXX*. The first DPT 2011 or DPT 2021 should be set to 0x1f0, and the next to 0x170. Each 2011 or 2021 should have a unique direct memory access (DMA) channel. The first 2011 or 2021 should be on DMA channel 5. The **dpt** module reads the 2011 or 2021 DMA channel at auto configuration time, so no parameter is necessary in the configuration file. The interrupt priority level should always be 5. The boot adapter should be set to IRQ (interrupt) 15. Each 2011 or 2021 should have a unique I/O port and a unique DMA channel. Use of a different interrupt level for each board is required.

A complete entry in **/kernel/drv/dpt.conf** is:

```
name="dpt" class="sysbus" intr=5,14 reg=0x1f0,0,0
        ioaddr=0x1f0
        flow_control="dmult" queue="qsort" disk="scdk" tape="sctp" ;
```

DPT 2012 AND DPT 2022 EISA SCSI Host Bus Adapters

These are adapters that are configured using the EISA configuration utility supplied by the computer manufacturer in conjunction with a configuration file. You will be required to enter emulation information as part of the configuration process. There is information for two drives, and it should show ''disabled'' for both. When asked for drive types for drives zero and one, enter 0. This indicates ''no drives present'' and disables the WD1003 emulation mode of the adapter, allowing correct operation of the native mode driver. You will also be required to use a DPT format utility to configure hard drives prior to installation. The only relevant user configurable item in **dpt.conf** is:

io address "reg=0x1c88,0,0"
"ioaddr=0x1c88"

The I/O address is 0x1000 times the EISA slot number + 0xc88. Hence, slot 1 is address 0x1c88 and slot 10 is 0xac88. The same base address should appear after **reg=***XXX* and **ioaddr=***XXX*.

The first default EISA listing from the configuration file is:

```
#       eisa-type hba
name="dpt" class="sysbus" intr=5,14 reg=0x1c88,0,0
        ioaddr=0x1c88
        flow_control="dmult" queue="qsort" disk="scdk" tape="sctp" ;
```

To speed boot, parameters in the configuration file may be commented out with a "#" in the first column for controllers that are not installed.

NAME

dsa – low-level module for Dell SCSI Array Controller (DSA)

AVAILABILITY

x86

DESCRIPTION

The **dsa** module provides low-level interface routines between the common disk / tape I / O subsystem and the Dell EISA bus master controller. The **dsa** module can be configured for disk and raid disks on up to four host adapter boards. These disks are called composite disks in Dell configuration software. Auto configuration code determines if the adapter is present at the configured address and what devices are attached to it. Non composite drives attached to the bus of a DSA controller are accessed through Adaptec 1540 emulation. See the entry **aha**(7).

Board Configuration and Auto Configuration

The Dell EISA configuration utility must be run to properly initialize access to the controller. One controller should have the adapter bios enabled. If the DSA controller is used to read the Solaris CD disk for installation, Adaptec 1540A emulation should be enabled.

All hard drives accessible by the **dsa** driver must be configured by the Dell Array Manager software as composite drives. All raid levels supported by Dell are visible to the **dsa** driver. A controller can be in slots one through eight. If the DSA controller is used for Solaris x86 CD installation, the CD must be mapped at the proper target, which cannot be 0. The DSA controller is target 0 on the SCSI bus but should be set up to appear as target 7 in the emulation mappings.

The driver attempts to initialize itself in accordance with the information found in the configuration file, **/kernel/drv/dsa.conf**. There are no user configurable items in this file.

The default listing of the an item in the configuration file is as follows:

```
name="dsa" class="sysbus" interrupts=5,11,5,12,5,13,5,14,5,15
        reg=0x1c80,0,0 ioaddr=0x1c80
        flow_control="dmult" queue="qfifo" disk="dadk" ;
```

The driver determines the interrupt from the board at initialization time.

To speed boot, parameters in the configuration file may be commented out with a "#" in the first column of all three lines for controllers that are not installed. The first number in the "reg" and "ioaddr" addresses indicates the EISA slot number. Hence, "2c80" indicates the I / O address of the DSA controller in EISA slot 2.

FILES

/kernel/drv/dsa.conf configuration file for the **dsa** driver.

SEE ALSO

aha(7)

NOTES

Note that although the DSA controller is physically connected to SCSI devices, the interface to composite drives is that of a direct access disk "dadk." There is no way to send SCSI commands to composite drives on a DSA controller. Non composite devices (such as tape and CD) can not be accessed via the **dsa** driver.

NAME

eha – low-level module for Adaptec 174x EISA host bus adapter

AVAILABILITY

x86

DESCRIPTION

The **eha** module provides low-level interface routines between the common disk / tape io subsystem and the Adaptec EISA 174x SCSI (Small Computer System Interface) controllers. The **eha** module can be configured for disk and streaming tape support for one or more host adapter boards, each of which must be the sole initiator on a SCSI bus. Auto configuration code determines if the adapter is present at the configured address and what types of devices are attached to it.

Board Configuration and Auto Configuration

The driver attempts to initialize itself in accordance with the information found in the configuration file, **/kernel/drv/eha.conf.** The only relevant user configurable item in this file is:

io address "reg=0x1000,0,0"
"ioaddr=0x1000"

The I / O address is 0x1000 times the EISA slot number. Hence, slot 1 is address 0x1000 and slot 8 is 0x8000.

Prior to installation, the 174x controller must be put into enhanced mode with the EISA configuration utility run under MS-DOS.

The default listing of the configuration file is as follows:

```
#
# primary controller [Settings for CD-ROM installation]
#
name="eha" class="sysbus" reg=0x1000,0,0
        ioaddr=0x1000;

# another controller example
#
name="eha" class="sysbus" reg=0x2000,0,0
        ioaddr=0x2000;
#
```

To speed boot, parameters in the configuration file may be commented out with a "#" in the first column for controllers that are not installed.

NAME

el – 3COM 3C503 Ethernet device driver

SYNOPSIS

```
#include <sys/stropts.h>
#include <sys/ethernet.h>
#include <sys/dlpi.h>
```

AVAILABILITY

x86

DESCRIPTION

The **el** Ethernet driver is a multi-threaded, loadable, clonable, STREAMS hardware driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), over 3COM 3C503 EtherLink II and EtherLink II / 16 Ethernet controllers. Multiple EtherLink II controllers installed within the system are supported by the driver. The **el** driver provides basic support for the EtherLink II hardware. Functions include chip initialization, frame transmit and receive, multicast and "promiscuous" support, and error recovery and reporting.

The cloning, character-special device **/dev/el** is used to access all EtherLink II devices installed within the system.

The **el** driver is a "style 2" Data Link Service provider. All **M_PROTO** and **M_PCPROTO** type messages are interpreted as DLPI primitives. An explicit **DL_ATTACH_REQ** message by the user is required to associate the opened stream with a particular device (**ppa**). The **ppa** ID is interpreted as an unsigned long integer and indicates the corresponding device instance (unit) number. The unit numbers are assigned sequentially to each board found. The search order is determined by the order defined in the **el.conf** file. An error (**DL_ERROR_ACK**) is returned by the driver if the **ppa** field value does not correspond to a valid device instance number for this system. The device is initialized on first attach and de-initialized (stopped) on last detach.

The values returned by the driver in the **DL_INFO_ACK** primitive in response to the **DL_INFO_REQ** from the user are as follows:

The maximum SDU is 1500 (ETHERMTU).

The minimum SDU is 0. The driver will pad to the mandatory 60-octet minimum packet size.

The **dlsap** address length is 8.

The MAC type is **DL_ETHER.**

The **sap** length value is –2, meaning the physical address component is followed immediately by a 2-byte **sap** component within the DLSAP address.

The service mode is **DL_CLDLS.**

No optional quality of service (QOS) support is included at present, so the QOS fields are 0.

The provider style is **DL_STYLE2.**

The version is **DL_VERSION_2.**

The broadcast address value is Ethernet / IEEE broadcast address

(FF:FF:FF:FF:FF:FF).

Once in the **DL_ATTACHED** state, the user must send a **DL_BIND_REQ** to associate a particular Service Access Pointer (SAP) with the stream. The **el** driver interprets the **sap** field within the **DL_BIND_REQ** as an Ethernet "type;" therefore valid values for the **sap** field are in the [0-0xFFFF] range. Only one Ethernet type can be bound to the stream at any time.

In addition to Ethernet V2 service, an "802.3 mode" is also provided by the driver. In this mode, **sap** values in the range [0-1500] are treated as equivalent and represent a desire by the user for "802.3" mode. If the value of the **sap** field of the **DL_BIND_REQ** is within this range, then the driver expects that the destination DLSAP in a **DL_UNITDATA_REQ** will contain the *length* of the data rather than a **sap** value. All frames received from the media that have a "type" field in this range are assumed to be 802.3 frames, and they are routed up all open streams which are bound to any **sap** value within this range. If more than one stream is in "802.3 mode," then the frame will be duplicated and routed up multiple streams as **DL_UNITDATA_IND** messages.

The **el** driver DLSAP address format consists of the 6-byte physical (Ethernet) address component followed immediately by the 2-byte **sap** (type) component, producing an 8-byte DLSAP address. Applications should *not* hardcode to this particular implementation-specific DLSAP address format, but should instead use information returned in the **DL_INFO_ACK** primitive to compose and decompose DLSAP addresses. The **sap** length, full DLSAP length, and **sap** / physical ordering are included within the **DL_INFO_ACK.** The physical address length can be computed by subtracting the **sap** length from the full DLSAP address length or by issuing the **DL_PHYS_ADDR_REQ** to obtain the current physical address associated with the stream.

Once in the **DL_BOUND** state, the user may transmit frames on the Ethernet by sending **DL_UNITDATA_REQ** messages to the **el** driver. The **el** driver will route received Ethernet frames up all open and bound streams that have a **sap** which matches the Ethernet type as **DL_UNITDATA_IND** messages. Received Ethernet frames are duplicated and routed up multiple open streams if necessary. The DLSAP address contained within the **DL_UNITDATA_REQ** and **DL_UNITDATA_IND** messages consists of both the **sap** (type) and physical (Ethernet) components.

In addition to the mandatory connectionless DLPI message set, the driver also supports the following primitives:

The **DL_ENABMULTI_REQ** and **DL_DISABMULTI_REQ** primitives enable / disable reception of individual multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis using these primitives. These primitives are accepted by the driver in any state following **DL_ATTACHED.**

The **DL_PROMISCON_REQ** and **DL_PROMISCOFF_REQ** primitives with the **DL_PROMISC_PHYS** flag set in the **dl_level** field enables / disables reception of all "promiscuous mode" frames on the media including frames generated by the local host.

When used with the **DL_PROMISC_SAP** flag set, this enables/disables reception of all **sap** (Ethernet type) values. When used with the **DL_PROMISC_MULTI** flag set, this enables/disables reception of all multicast group addresses. The effect of each is always on a per-stream basis and independent of the other **sap** and physical level configurations on this stream or other streams.

The **DL_PHYS_ADDR_REQ** primitive returns the 6-octet Ethernet address currently associated (attached) to the stream in the **DL_PHYS_ADDR_ACK** primitive. This primitive is valid only in states following a successful **DL_ATTACH_REQ.**

The **DL_SET_PHYS_ADDR_REQ** primitive changes the 6-octet Ethernet address currently associated (attached) to this stream. The credentials of the process which originally opened this stream must be superuser or an **EPERM** error is returned in the **DL_ERROR_ACK.** This primitive is destructive in that it affects all other current and future streams attached to this device. An **M_ERROR** is sent up all other streams attached to this device when this primitive on this stream is successful. Once changed, all streams subsequently opened and attached to this device will obtain this new physical address. The new physical address will remain in effect until this primitive is used to change the physical address again or the system is rebooted, whichever comes first.

CONFIGURATION

The **/kernel/drv/el.conf** file supports the following options:

intr Specifies the IRQ level for the board.

media Specifies the media type. Defined values are:

- *"thick"* Use standard AUI interface.
- *"thin"* Use the BNC connector interface.
- *"tp"* Use the "twisted pair" interface.

reg Specifies the shared RAM the board is jumpered for.

It is important to ensure that there are no conflicts for the board's I/O port, shared RAM, or IRQ level.

FILES

/dev/el

SEE ALSO

dlpi(7)

NAME

elink – 3COM 3C507 Ethernet device driver

SYNOPSIS

```
#include <sys/stropts.h>
#include <sys/ethernet.h>
#include <sys/dlpi.h>
```

AVAILABILITY

x86

DESCRIPTION

The **elink** Ethernet driver is a multi-threaded, loadable, clonable, STREAMS hardware driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), over 3COM 3C507 EtherLink 16 Ethernet controllers. Multiple EtherLink 16 controllers installed within the system are supported by the driver. The **elink** driver provides basic support for the EtherLink 16 hardware. Functions include chip initialization, frame transmit and receive, multicast and "promiscuous" support, and error recovery and reporting.

The cloning, character-special device **/dev/elink** is used to access all EtherLink 16 devices installed within the system.

elink and DLPI

The **elink** driver is a "style 2" Data Link Service provider. All **M_PROTO** and **M_PCPROTO** type messages are interpreted as **DLPI** primitives. An explicit **DL_ATTACH_REQ** message by the user is required to associate the opened stream with a particular device (**ppa**). The **ppa** ID is interpreted as an unsigned long integer and indicates the corresponding device instance (unit) number. The unit numbers are assigned sequentially to each board found. The search order is determined by the order defined in the **/kernel/drv/elink.conf** file. An error (**DL_ERROR_ACK**) is returned by the driver if the **ppa** field value does not correspond to a valid device instance number for this system. The device is initialized on first attach and de-initialized (stopped) on last detach.

The values returned by the driver in the **DL_INFO_ACK** primitive in response to the **DL_INFO_REQ** from the user are as follows:

- The maximum SDU is **1500** (**ETHERMTU**).
- The minimum SDU is **0**. The driver will pad to the mandatory 60-octet minimum packet size.
- The **dlsap** address length is **8**.
- The MAC type is **DL_ETHER**.
- The **sap** length value is **–2**, meaning the physical address component is followed immediately by a 2-byte **sap** component within the **DLSAP** address.
- The service mode is **DL_CLDLS**.
- No optional quality of service (QOS) support is included at present, so the QOS fields are **0**.
- The provider style is **DL_STYLE2**.
- The version is **DL_VERSION_2**.
- The broadcast address value is Ethernet / IEEE broadcast address

(**FF:FF:FF:FF:FF:FF**).

Once in the **DL_ATTACHED** state, the user must send a **DL_BIND_REQ** to associate a particular Service Access Pointer (SAP) with the stream. The **elink** driver interprets the **sap** field within the **DL_BIND_REQ** as an Ethernet "type;" therefore valid values for the **sap** field are in the [**0-0xFFFF**] range. Only one Ethernet type can be bound to the stream at any time.

In addition to Ethernet V2 service, an "802.3 mode" is also provided by the driver. In this mode, **sap** values in the range [**0-1500**] are treated as equivalent and represent a desire by the user for "802.3" mode. If the value of the **sap** field of the **DL_BIND_REQ** is within this range, then the driver expects that the destination **DLSAP** in a **DL_UNITDATA_REQ** will contain the *length* of the data rather than a **sap** value. All frames received from the media that have a "type" field in this range are assumed to be 802.3 frames, and they are routed up all open streams which are bound to any **sap** value within this range. If more than one stream is in "802.3 mode," then the frame will be duplicated and routed up multiple streams as **DL_UNITDATA_IND** messages.

The **elink** driver **DLSAP** address format consists of the 6-byte physical (Ethernet) address component followed immediately by the 2-byte **sap** (type) component, producing an 8-byte **DLSAP** address. Applications should *not* hardcode to this particular implementation-specific **DLSAP** address format, but should instead use information returned in the **DL_INFO_ACK** primitive to compose and decompose **DLSAP** addresses. The **sap** length, full **DLSAP** length, and **sap** / physical ordering are included within the **DL_INFO_ACK**. The physical address length can be computed by subtracting the **sap** length from the full **DLSAP** address length or by issuing the **DL_PHYS_ADDR_REQ** to obtain the current physical address associated with the stream.

Once in the **DL_BOUND** state, the user may transmit frames on the Ethernet by sending **DL_UNITDATA_REQ** messages to the **elink** driver. The **elink** driver will route received Ethernet frames up all open and bound streams that have a **sap** which matches the Ethernet type as **DL_UNITDATA_IND** messages. Received Ethernet frames are duplicated and routed up multiple open streams if necessary. The **DLSAP** address contained within the **DL_UNITDATA_REQ** and **DL_UNITDATA_IND** messages consists of both the **sap** (type) and physical (Ethernet) components.

elink Primitives

In addition to the mandatory connectionless **DLPI** message set, the driver also supports the following primitives:

The **DL_ENABMULTI_REQ** and **DL_DISABMULTI_REQ** primitives enable / disable reception of individual multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis using these primitives. These primitives are accepted by the driver in any state following **DL_ATTACHED**.

The **DL_PROMISCON_REQ** and **DL_PROMISCOFF_REQ** primitives with the **DL_PROMISC_PHYS** flag set in the **dl_level** field enables / disables reception of all "promiscuous mode" frames on the media including frames generated by the local host.

When used with the **DL_PROMISC_SAP** flag set, this enables/disables reception of all **sap** (Ethernet type) values. When used with the **DL_PROMISC_MULTI** flag set, this enables/disables reception of all multicast group addresses. The effect of each is always on a per-stream basis and independent of the other **sap** and physical level configurations on this stream or other streams.

The **DL_PHYS_ADDR_REQ** primitive returns the 6-octet Ethernet address currently associated (attached) to the stream in the **DL_PHYS_ADDR_ACK** primitive. This primitive is valid only in states following a successful **DL_ATTACH_REQ**.

The **DL_SET_PHYS_ADDR_REQ** primitive changes the 6-octet Ethernet address currently associated (attached) to this stream. The credentials of the process which originally opened this stream must be superuser or an **EPERM** error is returned in the **DL_ERROR_ACK**. This primitive is destructive in that it affects all other current and future streams attached to this device. An **M_ERROR** is sent up all other streams attached to this device when this primitive on this stream is successful. Once changed, all streams subsequently opened and attached to this device will obtain this new physical address. The new physical address will remain in effect until this primitive is used to change the physical address again or the system is rebooted, whichever comes first.

CONFIGURATION

The **/kernel/drv/elink.conf** file supports the following options:

intr Specifies the IRQ level for the board.

reg Specifies the shared RAM the board is configured for.

It is important to ensure that there are no conflicts for the board's I/O port, shared RAM, or IRQ level.

FILES

/dev/elink	character special device
/kernel/drv/elink.conf	configuration file of **elink** driver

SEE ALSO

dlpi(7)

NAME

elx – 3COM EtherLink III Ethernet device driver

SYNOPSIS

```
#include <sys/stropts.h>
#include <sys/ethernet.h>
#include <sys/dlpi.h>
```

AVAILABILITY

x86

DESCRIPTION

The **elx** Ethernet driver is a multi-threaded, loadable, clonable, STREAMS hardware driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), over 3COM ETHERLINK III Ethernet controllers (3C509, 3C529 and 3C579). Multiple EtherLink III controllers installed within the system are supported by the driver. The **elx** driver provides basic support for the EtherLink III hardware. Functions include chip initialization, frame transmit and receive, multicast and "promiscuous" support, and error recovery and reporting.

The cloning, character-special device **/dev/elx** is used to access all EtherLink III devices installed within the system.

The **elx** driver is a "style 2" Data Link Service provider. All **M_PROTO** and **M_PCPROTO** type messages are interpreted as DLPI primitives. An explicit **DL_ATTACH_REQ** message by the user is required to associate the opened stream with a particular device (**ppa**). The **ppa** ID is interpreted as an unsigned long integer and indicates the corresponding device instance (unit) number. The unit numbers are assigned sequentially to each board found. The search order is determined by the order defined in the **elx.conf** file. An error (**DL_ERROR_ACK**) is returned by the driver if the **ppa** field value does not correspond to a valid device instance number for this system. The device is initialized on first attach and de-initialized (stopped) on last detach.

The values returned by the driver in the **DL_INFO_ACK** primitive in response to the **DL_INFO_REQ** from the user are as follows:

The maximum SDU is **1500** (**ETHERMTU**).

The minimum SDU is **0**. The driver will pad to the mandatory 60-octet minimum packet size.

The **dlsap** address length is **8**.

The MAC type is **DL_ETHER.**

The **sap** length value is **–2**, meaning the physical address component is followed immediately by a 2-byte **sap** component within the DLSAP address.

The service mode is **DL_CLDLS.**

No optional quality of service (QOS) support is included at present, so the QOS fields are **0**.

The provider style is **DL_STYLE2.**

The version is **DL_VERSION_2.**

The broadcast address value is Ethernet / IEEE broadcast address

(**FF:FF:FF:FF:FF:FF**).

Once in the **DL_ATTACHED** state, the user must send a **DL_BIND_REQ** to associate a particular Service Access Pointer (SAP) with the stream. The **elx** driver interprets the **sap** field within the **DL_BIND_RE** as an Ethernet "type;" therefore valid values for the **sap** field are in the [**0-0xFFFF**] range. Only one Ethernet type can be bound to the stream at any time.

In addition to Ethernet V2 service, an "802.3 mode" is provided by the driver and works as follows. **sap** values in the range [**0-1500**] are treated as equivalent and represent a desire by the user for "802.3" mode. If the value of the **sap** field of the **DL_BIND_REQ** is within this range, then the driver computs the length of the message, not including the initial **M_PROTO** mblk (message block), of all subsequent **DL_UNITDATA_REQ** messages and transmit 802.3 frames that have this value in the MAC frame header length field. All frames received from the media that have a "type" field in this range are assumed to be 802.3 frames, and they are routed up all open streams which are bound to any **sap** value within this range. If more than one stream is in "802.3 mode," then the frame will be duplicated and routed up multiple streams as **DL_UNITDATA_IND** messages.

The **elx** driver DLSAP address format consists of the 6-byte physical (Ethernet) address component followed immediately by the 2-byte **sap** (type) component, producing an 8-byte DLSAP address. Applications should *not* hardcode to this particular implementation-specific DLSAP address format, but should instead use information returned in the **DL_INFO_ACK** primitive to compose and decompose DLSAP addresses. The **sap** length, full DLSAP length, and **sap** / physical ordering are included within the **DL_INFO_ACK.** The physical address length can be computed by subtracting the **sap** length from the full DLSAP address length or by issuing the **DL_PHYS_ADDR_REQ** to obtain the current physical address associated with the stream.

Once in the **DL_BOUND** state, the user may transmit frames on the Ethernet by sending **DL_UNITDATA_REQ** messages to the **elx** driver. The **elx** driver will route received Ethernet frames up all open and bound streams that have a **sap** which matches the Ethernet type as **DL_UNITDATA_IND** messages. Received Ethernet frames are duplicated and routed up multiple open streams if necessary. The DLSAP address contained within the **DL_UNITDATA_REQ** and **DL_UNITDATA_IND** messages consists of both the **sap** (type) and physical (Ethernet) components.

elx Primitives

In addition to the mandatory connectionless DLPI message set, the driver also supports the following primitives:

The **DL_ENABMULTI_REQ** and **DL_DISABMULTI_REQ** primitives enable / disable reception of individual multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis using these primitives. These primitives are accepted by the driver in any state following **DL_ATTACHED.**

The **DL_PROMISCON_REQ** and **DL_PROMISCOFF_REQ** primitives with the **DL_PROMISC_PHYS** flag set in the **dl_level** field enables / disables reception of all "promiscuous mode" frames on the media including frames generated by the local host.

When used with the **DL_PROMISC_SAP** flag set, this enables/disables reception of all **sap** (Ethernet type) values. When used with the **DL_PROMISC_MULTI** flag set, this enables/disables reception of all multicast group addresses. The effect of each is always on a per-stream basis and independent of the other **sap** and physical level configurations on this stream or other streams.

The **DL_PHYS_ADDR_REQ** primitive returns the 6-octet Ethernet address currently associated (attached) to the stream in the **DL_PHYS_ADDR_ACK** primitive. This primitive is valid only in states following a successful **DL_ATTACH_REQ.**

The **DL_SET_PHYS_ADDR_REQ** primitive changes the 6-octet Ethernet address currently associated (attached) to this stream. The credentials of the process which originally opened this stream must be superuser or an **EPERM** error is returned in the **DL_ERROR_ACK.** This primitive is destructive in that it affects all other current and future streams attached to this device. An **M_ERROR** is sent up all other streams attached to this device when this primitive on this stream is successful. Once changed, all streams subsequently opened and attached to this device will obtain this new physical address. The new physical address will remain in effect until this primitive is used to change the physical address again or the system is rebooted, whichever comes first.

CONFIGURATION

The **/kernel/drv/elx.conf** file supports the following options:

intr Specifies the IRQ level for the board.

It is important to ensure that there are no conflicts for the board's I/O port or IRQ level.

FILES

/dev/elx	special character device.
/kernel/drv/elx.conf	configuration file for **elx** driver.

SEE ALSO

dlpi(7)

NAME

envm – EISA NVRAM support

AVAILABILITY

x86

DESCRIPTION

The EISA NVRAM is analogous to the CMOS RAM on an AT -type machine, but is much more complete. It describes the hardware environment in great detail on a slot-by-slot basis. The information is placed in the NVRAM by the EISA Configuration Utility supplied with the machine. EISA NVRAM support offers access to this data for drivers and user applications. User-level access is through the device **/dev/eisarom**. An application must open the device and issue *ioctl* calls to gather the required data. Drivers or other kernel code must call the driver routines directly to gather their data.

Determination of Bus Type for Drivers

For a driver to determine whether or not it is running on an EISA machine, it should do the following:

```
#include <sys/eisarom.h>
extern int envm_check ();/* Returns –1 if not an EISA machine. */

if (envm_check () != –1)
{
        /* It's an EISA machine. */
}
else
{
        /* It's not. */
}
```

Determination of Bus Type for Applications

For an application to determine whether or not it is running on an EISA machine, it should do the following:

```
#include <sys/fcntl.h>
extern int open();

if (open("/dev/eisarom", O_RDONLY) != –1) /* It's an EISA machine. */
{
        /* It's an EISA machine. */
}
else
{
        /* It's not. */
}
```

Data Gathering for Drivers

To read data from the NVRAM, a driver should use the following template. *eisa_nvm ()* returns the number of bytes placed in ‘‘data’’:

```
#include <sys/eisarom.h>
#include <sys/nvm.h>
extern int eisa_nvm ();

int
eisa_nvm (data, key_mask, [key1, key2, . . . key(n)])

char *data;
KEY_MASK key_mask;
{
}
```

Data Gathering for Applications

To read data from the NVRAM, an application should do the following:

```
#include <fcntl.h>
#include <sys/eisarom.h>
#include <sys/nvm.h>

char *data;
int length = (20*1024);
eisanvm nvm;/* See "eisarom.h". */
int fd;

/* The "ioctl" function will transform the arguments in "data" to a
stack frame that can be passed in to "eisa_nvm". */

if ((fd = open("/dev/eisarom", O_RDONLY)) != –1)
{
        /* We’re on an EISA machine. */

        data = (char *)malloc(length);

        nvm.data = data;

        /* This sets up the "key" arguments for the "ioctl" function. */

        *((int *)nvm.data)++ = key_mask;
        *((int *)nvm.data)++ = key1;
        *((int *)nvm.data)++ = key2;

        if (ioctl(fd, EISA_CMOS_QUERY, &nvm) != –1)
        {
        /* Call was successful. */
        /* If length is 0, no records matched all keys. */
        /* Length is in nvm.length. */
        /* Data is pointed to by nvm.data. */
        /* Data consists of 0 or more slot records, each */
        /* followed by 1 or more function records  */
```

```
        /* (see "nvm.h"). */
        }
        else
        {
        /* Fatal error. */
        }
}
else
{
        /* Not an EISA machine or no "envm" driver installed. */
}
```

Masks and Keys

This section deals with the values for the *key_mask* and *keys* fields in the call to *eisa_nvm ()*. The *key_mask* field determines which fields are checked during the search in *eisa_nvm ()*. The number of keys passed to *eisa_nvm ()* must be the same as the number of items specified in *key_mask*. The key arguments must be in the order shown below. See **nvm.h** for the slot and function record format. Arguments may be omitted, but the ordering must be maintained. The key argument ordering is:

slot function (board_id mask) revision checksum type sub-type

Correct values for the *key* fields may be obtained from the documentation accompanying the machine.

EXAMPLES

To copy all slot and function records into *buffer*:

```
bytes = eisa_nvm(buffer, 0);
```

To copy the record for slot 0 and all its function records into *buffer*:

```
bytes = eisa_nvm(buffer, SLOT, 0);
```

To copy any or all slot and function records that pertain to the board type *DISCO* into *buffer*:

```
bytes = eisa_nvm(buffer, TYPE, DISCO );
```

To copy any or all slot and function records that pertain to the board ID *xx40110e* and the type *COM* into *buffer*:

```
bytes = eisa_nvm(buffer, BOARD_ID | TYPE, 0x0140110e, 0xffffff, "COM");
```

To copy any or all slot and function records that pertain to the board ID *0140110e*, the checksum *0xABCD*, and the type *ASY* into *buffer*:

```
bytes = eisa_nvm(buffer, BOARD_ID | CHECKSUM | TYPE, 0x0140110e, 0xffffffff,
0xABCD, "ASY");
```

NAME

esp – ESP SCSI Host Bus Adapter Driver

SYNOPSIS

esp@*sbus-slot*,0x80000

AVAILABILITY

Limited to Sparc SBus-based systems with esp-based SCSI port, Sun4/330 with esp-based SCSI port, and SSHA, SBE/S, FSBE/S and DSBE/S SBus SCSI Host Adapter options.

DESCRIPTION

The **esp** Host Bus Adapter driver is a SCSA compliant nexus driver that supports the Emulex family of esp SCSI chips (esp100, esp100A, esp236, fas101, fas236).

The **esp** driver supports the standard functions provided by the SCSA interface. The driver supports tagged and untagged queueing, fast SCSI (on FAS esp's only), almost unlimited transfer size (using a moving DVMA window approach), auto request sense but does not support linked commands.

Driver Configuration

The esp driver can be configured by defining properties in **esp.conf** which override the global SCSI settings. Supported properties are **scsi-options, scsi-reset-delay, scsi-watchdog-tick, scsi-tag-age-limit, scsi-initiator-id**.

Refer to **scsi_hba_attach**(9F) for details.

EXAMPLE

Create a file **/kernel/drv/esp.conf** and add this line:

scsi-options=0x78;

This will disable tagged queueing, fast SCSI, and Wide mode for all esp instances. To disable an option for one specific esp (refer to **driver.conf**(4)):

name="esp" parent="/iommu@f,e0000000/sbus@f,e0001000/espdma@f,400000"
reg=0xf,0x00800000,00000040
scsi-options = 0x58 scsi-initiator-id = 6;

Note that the default initiator ID in OBP is 7 and that the change to ID 6 will occur at attach time. It may be preferable to change the initiator ID in OBP.

FILES

/kernel/drv/esp ELF Kernel Module
/kernel/drv/esp.conf Configuration file

SEE ALSO

prtconf(1M), **driver.conf**(4), **scsi_hba_attach**(9F), **scsi_abort**(9F), **scsi_ifgetcap**(9F), **scsi_ifsetcap**(9F), **scsi_reset**(9F), **scsi_sync_pkt**(9F), **scsi_transport**(9F), **scsi_device**(9S), **scsi_extended_sense**(9S), **scsi_inquiry**(9S), **scsi_pkt**(9S),

Writing Device Drivers

ANSI Small Computer System Interface-2 (SCSI-2)

ESP Technical Manuals, QLogic Corp.

DIAGNOSTICS

The messages described below are some that may appear on the system console, as well as being logged.

This first four messages may be displayed while the **esp** driver is trying to attach. All of these messages mean that the **esp** driver was unable to attach. These messages are preceded by "esp%d", where "%d" is the instance number of the esp controller.

Device in slave-only slot, unused
The SBus device has been placed in a slave-only slot and will not be accessible; move to non-slave-only SBus slot.

Device is using a hilevel intr, unused
The device was configured with a interrupt level that cannot be used with this **esp** driver. Check the SBus device.

Unable to map registers;
Driver was unable to map device registers; check for bad hardware. Driver did not attach to device, SCSI devices will be inaccessible.

Cannot find dma controller
Driver was unable to locate a dma controller. This is an auto-configuration error.

Disabled TQ since disconnects are disabled
Tagged Queueing was disabled because disconnects were disabled in scsi-options.

Bad clock frequency- setting 20mhz, asynchronous mode
Check for bad hardware.

Sync pkt failed.
Syncing a scsi packet failed. Refer to **scsi_sync_pkt**(9F).

All tags in use!
The driver could not allocate another tag number. The target devices do not properly support Tagged Queueing.

Cannot alloc tag queue
The driver could not allocate space for tag queue.

Gross error in esp status.
The driver experienced severe SCSI bus problems. Check cables and terminator.

Spurious interrupt
The driver received an interrupt while the hardware was not interrupting.

Lost state in phasemanage
The driver is confused about the state of the SCSI bus.

Unrecoverable DMA error during selection
The DMA controller experienced host SBus problems. Check for bad hardware.

Bad sequence step (0x%x) in selection
The esp hardware reported a bad sequence step. Check for bad hardware.

Undetermined selection failure
The selection of a target failed unexpectedly. Check for bad hardware.

>2 reselection IDs on the bus
Two targets selected simultaneously which is illegal. Check for bad hardware.

Reconnect: unexpected bus free
A reconnect by a target failed. Check for bad hardware.

timeout on receiving tag msg.
Suspect target f/w failure in Tagged Queueing handling.

Parity error in tag msg
A parity error was detected in a tag message. Suspect SCSI bus problems.

Botched tag
The target supplied bad tag messages. Suspect target f/w failure in Tagged Queueing handling.

Parity error in reconnect msg's
The reconnect failed because of parity errors.

Target <n> didn't disconnect after sending <message>
The target unexpectedly didnot disconnect after sending <message>.

No support for multiple segs
The esp driver can only transfer contiguous data.

No dma window?
Moving the DVMA window failed unexpectedly.

No dma window on <type> operation
Moving the DVMA window failed unexpectedly.

Cannot set new dma window
Moving the DVMA window failed unexpectedly.

Unable to set new window at <address> for <type> operation
Moving the DVMA window failed unexpectedly.

Illegal dma boundary?
An attempt was made to cross a boundary that the driver could not handle.

Unwanted data out/in for Target <n>
The target went into an unexpected phase.

Spurious <name> phase from target <n>
The target went into an unexpected phase.

SCSI bus DATA IN phase parity error
The driver detected parity errors on the SCSI bus.

SCSI bus MESSAGE IN phase parity error
The driver detected parity errors on the SCSI bus.

SCSI bus STATUS phase parity error
The driver detected parity errors on the SCSI bus.

Premature end of extended message
An extended SCSI bus message did not complete. Suspect a target f/w problem.

Premature end of input message
A multibyte input message was truncated. Suspect a target f/w problem.

Input message botch

The driver is confused about messages coming from the target.

Extended message <n> is too long
The extended message send by the target is longer than expected.

<name> message <n> from Target <m> garbled
Target <m> send message <name> of value <n> which the driver did not understand.

Target <n> rejects our message <name>
Target <n> rejected a message send by the driver.

Rejecting message <name> from Target <n>
The driver rejected a message received from target <n>

Cmd dma error
The driver was unable to send out command bytes.

Target <n> refused message resend
The target did not accept a message resend.

Two byte message <name> <value> rejected
The driver does not accept this two byte message.

Unexpected Selection Attempt
An attempt was made to select this host adapter by another initiator.

Polled cmd failed (target busy)
A polled cmd failed because the target did not complete outstanding commands within a reasonable time.

Polled cmd failed
A polled command failed because of timeouts or bus errors.

Disconnected command timeout for Target <id>.<lun>
A timeout occurred while target/lun was disconnected. This is usually a target f/w problem. For tagged queueing targets, <n> commands were outstanding when the timeout was detected.

Disconnected tagged cmds (<n>) timeout for Target <id>.<lun>
A timeout occurred while target/lun was disconnected. This is usually a target f/w problem. For tagged queueing targets, <n> commands were outstanding when the timeout was detected.

Connected command timeout for Target <id>.<lun>.
This is usually a SCSI bus problem. Check cables and termination.

Target <id>.<lun> reverting to async. mode
A data transfer hang was detected. The driver attempts to eliminate this problem by reducing the data transfer rate.

Target <id>.<lun> reducing sync. transfer rate
A data transfer hang was detected. The driver attempts to eliminate this problem by reducing the data transfer rate.

Reverting to slow SCSI cable mode
A data transfer hang was detected. The driver attempts to eliminate this problem

by reducing the data transfer rate.

Reset scsi bus failed
An attempt to reset the SCSI bus failed.

External SCSI bus reset
Another initiator reset the SCSI bus.

WARNINGS

The **esp** hardware does not support Wide SCSI mode. Only FAS-type esp's support fast SCSI (10 MB / sec).

NOTES

The **esp** driver exports properties indicating per target the negotiated transfer speed **(target<n>-sync-speed)** and whether tagged queueing has been enabled **(target<n>-TQ).** The sync-speed property value is the data transfer rate in KB / sec. The target-TQ property has no value. The existence of the property indicates that tagged queueing has been enabled. Refer to **prtconf**(1M) (verbose option) for viewing the **esp** properties.

```
dma, instance #3
   Register Specifications:
      Bus Type=0x2, Address=0x81000, Size=10
   esp, instance #3
      Driver software properties:
         name <target3-TQ> length <0> -- <no value>.
         name <target3-sync-speed> length <4>
            value <0x00002710>.
         name <scsi-options> length <4>
            value <0x000003f8>.
         name <scsi-watchdog-tick> length <4>
            value <0x0000000a>.
         name <scsi-tag-age-limit> length <4>
            value <0x00000008>.
         name <scsi-reset-delay> length <4>
            value <0x00000bb8>.
```

NAME

fbio – frame buffer control operations

DESCRIPTION

The frame buffers provided with this release support the same general interface that is defined by **<sys/fbio.h>**. Each responds to an **FBIOGTYPE ioctl**(2) request which returns information in a **fbtype** structure.

Each device has an **FBTYPE** which is used by higher-level software to determine how to perform graphics functions. Each device is used by opening it, doing an **FBIOGTYPE ioctl( )** to see which frame buffer type is present, and thereby selecting the appropriate device-management routines.

FBIOGINFO returns information specific to the GS accelerator.

FBIOSVIDEO and **FBIOGVIDEO** are general-purpose **ioctl( )** requests for controlling possible video features of frame buffers. These **ioctl( )** requests either set or return the value of a flags integer. At this point, only the **FBVIDEO_ON** option is available, controlled by **FBIOSVIDEO**. **FBIOGVIDEO** returns the current video state.

The **FBIOSATTR** and **FBIOGATTR ioctl( )** requests allow access to special features of newer frame buffers. They use the **fbsattr** and **fbgattr** structures.

Some color frame buffers support the **FBIOPUTCMAP** and **FBIOGETCMAP ioctl( )** requests, which provide access to the colormap. They use the **fbcmap** structure.

Also, some framebuffers with multiple colormaps will either encode the colormap identifier in the high-order bits of the "index" field in the fbcmap structure, or use the **FBIOPUTCMAPI** and **FBIOGETCMAPI ioctl( )** requests.

FBIOVERTICAL is used to wait for the start of the next vertical retrace period.

FBIOVRTOFFSET Returns the offset to a read-only *vertical retrace page* for those framebuffers that support it. This vertical retrace page may be mapped into user space with **mmap**(2). The first word of the vertical retrace page (type unsigned int) is a counter that is incremented every time there is a vertical retrace. The user process can use this counter in a variety of ways.

FBIOMONINFO returns a mon_info structure which contains information about the monitor attached to the framebuffer, if available.

FBIOSCURSOR, FBIOGCURSOR, FBIOSCURPOS and **FBIOGCURPOS** are used to control the hardware cursor for those framebuffers that have this feature. **FBIOGCURMAX** returns the maximum sized cursor supported by the framebuffer. Attempts to create a cursor larger than this will fail.

Finally **FBIOSDEVINFO** and **FBIOGDEVINFO** are used to transfer variable-length, device-specific information into and out of framebuffers.

SEE ALSO

gsconfig(1M), **ioctl**(2), **mmap**(2), **bwtwo**(7), **cgeight**(7), **cgfour**(7), **cgsix**(7), **cgthree**(7), **cgtwelve**(7), **cgtwo**(7)

BUGS

The **FBIOSATTR** and **FBIOGATTR ioctl( )** requests are only supported by frame buffers which emulate older frame buffer types. For example, **cgfour**(7) frame buffers emulate **bwtwo**(7) frame buffers. If a frame buffer is emulating another frame buffer, **FBIOGTYPE** returns the emulated type. To get the real type, use **FBIOGATTR**.

The **FBIOGCURPOS** ioctl was incorrectly defined in previous operating systems, and older code running in binary compatibility mode may get incorrect results.

NAME

fd, fdc – drivers for floppy disks and floppy disk controllers

CONFIG

x86

```
name="fd" parent="fdc" unit=0;
name="fd" parent="fdc" unit=1;
```

DESCRIPTION

The **fd** driver provides the interfaces to the floppy disks using the Intel 82072 on SUN4c systems and the Intel 82077 on SUN4m systems.

The **fd** and **fdc** drivers provide the interfaces to floppy disks using the Intel 8272, Intel 82077, NEC 765, or compatible disk controllers on x86 systems.

The default partitions for the floppy driver are

- **a** All cylinders except the last
- **b** Only the last cylinder
- **c** Entire diskette

The **fd** driver autosenses the density of the diskette.

When the floppy is first opened the driver looks for a SunOS label in logical block 0 of the diskette. If attempts to read the SunOS label fail, the open will fail. If block 0 is read successfully but a SunOS label is not found, auto-sensed geometry and default partitioning are assumed.

The **fd** driver supports both block and raw interfaces. The block files access the diskette using the system's normal buffering mechanism and may be read and written without regard to physical diskette records. There is also a "raw" interface that provides for direct transmission between the diskette and the user's read or write buffer. A single **read**(2) or **write**(2) call usually results in one I/O operation; therefore raw I/O is considerably more efficient when many words are transmitted.

3.5" Diskettes

For 3.5" double-sided diskettes, the following densities are supported:

SPARC

high density
80 cylinders, 18 sectors per track, 1.44 Mbyte capacity
double density
80 cylinders, 9 sectors per track, 720 Kbyte capacity
medium density
77 cylinders, 8 sectors per track, 1.2 Mbyte capacity (SUN4m only)

x86

extended density
80 cylinders, 36 sectors per track, 2.88 Mbyte capacity
high density
80 cylinders, 18 sectors per track, 1.44 Mbyte capacity
double density
80 cylinders, 9 sectors per track, 760 Kbyte capacity

5.25" Diskettes

For 5.25" double-sided diskettes, the following densities are supported:

SPARC

5.25" diskettes are not supported.

x86

high density
80 cylinders, 15 sectors per track, 1.2 Mbyte capacity
double density
40 cylinders, 9 sectors per track, 360 Kbyte capacity
double density
40 cylinders, 8 sectors per track, 320 Kbyte capacity
quad density
80 cylinders, 9 sectors per track, 720 Kbyte capacity
double density
40 cylinders, 16 sectors per track (256 bytes per sector), 320 Kbyte capacity
double density
40 cylinders, 4 sectors per track (1024 bytes per sector), 320 Kbyte capacity

ERRORS

EBUSY During opening, the partition has been opened for exclusive access and another process wants to open the partition. Once open, this error is returned if the floppy disk driver attempted to pass a command to the floppy disk controller when the controller was busy handling another command. In this case, the application should try the operation again.

EFAULT An invalid address was specified in an ioctl command (see **fdio**(7)).

EINVAL The number of bytes read or written is not a multiple of the diskette's sector size. This error is also returned when an unsupported command is specified using the **FDIOCMD** ioctl command (see **fdio**(7)).

EIO During opening, the diskette does not have a label or there is no diskette in the drive. Once open, this error is returned if the requested I/O transfer could not be completed.

ENOSPC An attempt was made to write past the end of the diskette.

ENOTTY The floppy disk driver does not support the requested ioctl functions (see **fdio**(7)).

ENXIO The floppy disk device does not exist or the device is not ready.

EROFS The floppy disk device is opened for write access and the diskette in the drive is write protected.

x86 Only

ENOSYS The floppy disk device does not support the requested ioctl function (**FDEJECT**).

FILES

SPARC

/kernel/drv/fd driver module

/usr/include/sys/fdreg.h
structs and definitions for Intel 82072 and 82077 controllers

/usr/include/sys/fdvar.h
structs and definitions for floppy drivers

/dev/diskette device file
/dev/diskette0 device file
/dev/rdiskette raw device file
/dev/rdiskette0 raw device file

For ucb compatibility:

/dev/fd0[a-c] block file
/dev/rfd0[a-c] raw file

/vol/dev/diskette0 directory containing volume management character device file
/bol/dev/rdiskette0 directory containing the volume management raw character device file

/vol/dev/aliases/floppy0
symbolic link to the entry in **/vol/dev/rdiskette0**

x86

/kernel/drv/fd driver module
/kernel/drv/fd.conf configuration file for floppy driver
/kernel/drv/fdc floppy-controller driver module
/kernel/drv/fdc.conf configuration file for the floppy-controller

/usr/include/sys/fdc.h
structs and definitions for x86 floppy devices

/usr/include/sys/fdmedia.h
structs and definitions for x86 floppy media

First Drive:

/dev/diskette device file
/dev/diskette0 device file
/dev/rdiskette raw device file
/dev/rdiskette0 raw device file

For ucb compatibility:

/dev/fd0[a-c] block file
/dev/rfd0[a-c] raw file

/vol/dev/diskette0 directory containing volume management character device file
/bol/dev/rdiskette0 directory containing the volume management raw character device file

/vol/dev/aliases/floppy0
symbolic link to the entry in **/vol/dev/rdiskette0**

Second Drive:

/dev/diskette1 device file
/dev/rdiskette1 raw device file

For ucb compatibility:

/dev/fd1[a-c] block file
/dev/rfd1[a-c] raw file

/vol/dev/diskette1 directory containing volume management character device file
/bol/dev/rdiskette1 directory containing the volume management raw character device file
/vol/dev/aliases/floppy1
symbolic link to the entry in **/vol/dev/rdiskette1**

SEE ALSO

fdformat(1), **dd**(1M), **drvconfig**(1M), **vold**(1M), **read**(2), **write**(2), **driver.conf**(4), **dkio**(7), **fdio**(7)

DIAGNOSTICS

fd<n>: <command name> failed (<sr1> <sr2> <sr3>)
The <command name> failed after several retries on drive <n>. The three hex values in parenthesis are the contents of status register 0, status register 1, and status register 2 of the Intel 8272, the Intel 82072, and the Intel 82077 Floppy Disk Controller on completion of the command as documented in the data sheet for that part. This error message is usually followed by one of the following, interpreting the bits of the status register:

fd<n>: not writable
fd<n>: crc error blk <block number>
There was a data error on <block number>.
fd<n>: bad format
fd<n>: timeout
fd<n>: drive not ready
fd<n>: unformatted diskette or no diskette in drive
fd<n>: block <block number> is past the end! (nblk=<total number of blocks>)
The operation tried to access a block number that is greater than the total number of blocks.
fd<n>: b_bcount 0x<op_size> not % 0x<sect_size>
The size of an operation is not a multiple of the sector size.
fd<n>: overrun/underrun

SPARC

Overrun/underrun errors occur when accessing a diskette while the system is heavily loaded. These errors are caused by a hardware limitation and cannot be fixed in the software.

NOTES

3.5" high density diskettes have 18 sectors per track and 5.25" high density diskettes have 15 sectors per track. They can cross a track (though not a cylinder) boundary without losing data, so when using **dd**(1M) to or from a diskette, you should specify **bs=18k** or

multiples thereof for 3.5" diskettes, and **bs=15k** or multiples thereof for 5.25" diskettes.

The SPARC **fd** driver is *not* an unloadable module.

Under Solaris for x86, the configuration of the floppy drives is specified in CMOS configuration memory. Use the BIOS setup program or an EISA or MicroChannel configuration program for the system to define the diskette size and density / capacity for each installed drive. Note that MS-DOS may operate the floppy drives correctly, even though the CMOS configuration may be in error. Solaris for x86 relies on the CMOS configuration to be accurate.

NAME

fdio – floppy disk control operations

SYNOPSIS

#include <sys/fdio.h>

DESCRIPTION

The Solaris floppy driver supports a set of **ioctl**(2) requests for getting and setting the floppy drive characteristics. Basic to these **ioctl( )** requests are the definitions in **<sys/fdio.h>**.

IOCTLS

The following **ioctl( )** requests are available only on the Solaris floppy driver.

FDDEFGEOCHAR

x86: This **ioctl( )** forces the floppy driver to restore the diskette and drive characteristics and geometry, and partition information to default values based on the device configuration.

FDGETCHANGE

The argument is a pointer to an **int.** This **ioctl( )** returns the status of the diskette-changed signal from the floppy interface. The following defines are provided for cohesion.

Note that for x86 systems, **FDGC_DETECTED** (which is available only on x86) should be used instead of **FDGC_HISTORY**.

```
/*
 * Used by FDGETCHANGE, returned state of the sense disk change bit.
 */
#define FDGC_HISTORY      0x01    /* disk has changed since last call */
#define FDGC_CURRENT      0x02    /* current state of disk change */
#define FDGC_CURWPROT     0x10    /* current state of write protect */
#define FDGC_DETECTED     0x20    /* previous state of DISK CHANGE */
```

FDIOGCHAR The argument is a pointer to an **fd_char** structure (described below). This **ioctl( )** gets the characteristics of the floppy diskette from the floppy controller.

FDIOSCHAR The argument is a pointer to an **fd_char** structure (described below). This **ioctl( )** sets the characteristics of the floppy diskette for the floppy controller.

```
/*
 * Floppy characteristics
 */
struct fd_char {
        u_char  fdc_medium;         /* medium type (scsi floppy only) */
        int     fdc_transfer_rate;  /* transfer rate */
        int     fdc_ncyl;           /* number of cylinders */
        int     fdc_nhead;          /* number of heads */
        int     fdc_sec_size;       /* sector size */
        int     fdc_secptrack;      /* sectors per track */
        int     fdc_steps;          /* number of steps per */
};
```

FDGETDRIVECHAR

The argument to this **ioctl( )** is a pointer to an **fd_drive** structure (described below). This **ioctl( )** gets the characteristics of the floppy drive from the floppy controller.

FDSETDRIVECHAR

x86: The argument to this **ioctl( )** is a pointer to an **fd_drive** structure (described below). This **ioctl( )** sets the characteristics of the floppy drive for the floppy controller. Only **fdd_steprate**, **fdd_headsettle**, **fdd_motoron**, and **fdd_motoroff** are actually used by the floppy disk driver.

```
/*
 * Floppy Drive characteristics
 */
struct fd_drive {
        int     fdd_ejectable;      /* does the drive support eject? */
        int     fdd_maxsearch;      /* size of per-unit search table */
        int     fdd_writeprecomp;   /* cyl to start write prcompensation */
        int     fdd_writereduce;    /* cyl to start recucing write current */
        int     fdd_stepwidth;      /* width of step pulse in 1 us units */
        int     fdd_steprate;       /* step rate in 100 us units */
        int     fdd_headsettle;     /* delay, in 100 us units */
        int     fdd_headload;       /* delay, in 100 us units */
        int     fdd_headunload;     /* delay, in 100 us units */
        int     fdd_motoron;        /* delay, in 100 ms units */
        int     fdd_motoroff;       /* delay, in 100 ms units */
        int     fdd_precomplevel;   /* bit shift, in nano-secs */
        int     fdd_pins;           /* defines meaning of pin 1, 2, 4 and 34 */
        int     fdd_flags;          /* TRUE READY, Starting Sector #, & Motor On */
};
```

FDGETSEARCH Not available.

FDSETSEARCH Not available.

FDEJECT SPARC: This **ioctl()** requests the floppy drive to eject the diskette.

FDIOCMD The argument is a pointer to an **fd_cmd** structure (described below). This **ioctl( )** allows access to the floppy diskette using the floppy device driver. Only the **FDCMD_WRITE**, **FDCMD_READ**, and **FDCMD_FORMAT_TR** commands are currently available.

```
struct fd_cmd {
        u_short   fdc_cmd;      /* command to be executed */
        int       fdc_flags;    /* execution flags */
        daddr_t   fdc_blkno;    /* disk address for command */
        int       fdc_secnt;    /* sector count for command */
        caddr_t   fdc_bufaddr;  /* user's buffer address */
        u_int     fdc_buflen;   /* size of user's buffer */
};

/*
 * Floppy commands
 */
#define   FDCMD_WRITE           1
#define   FDCMD_READ            2
#define   FDCMD_SEEK            3
#define   FDCMD_REZERO          4
#define   FDCMD_FORMAT_UNIT     5
#define   FDCMD_FORMAT_TRACK    6
```

FDRAW

The argument is a pointer to an **fd_raw** structure (described below). This **ioctl( )** allows direct control of the floppy drive using the floppy controller. Refer to the appropriate floppy-controller data sheet for full details on required command bytes and returned result bytes.

```
/*
 * Used by FDRAW
 */
struct fd_raw {
        char      fdr_cmd[10];  /* user-supplied command bytes */
        short     fdr_cnum;     /* number of command bytes */
        char      fdr_result[10]; /* controller-supplied result bytes */
        short     fdr_nbytes;   /* number to transfer if read/write command */
        char      *fdr_addr;    /* where to transfer if read/write command */
};
```

SEE ALSO **ioctl**(2), **dkio**(7), **hdio**(7)

x86 only **fd**(7)

NAME

gt – double buffered 24-bit SBus color frame buffer and graphics accelerator

DESCRIPTION

gt is a 24-bit SBus-based color frame buffer and graphics accelerator. The frame buffer consists of 108 video memory planes of 1280×1024 pixels including 24-bit double buffering, 16 alpha/overlay planes, 24 z-buffer planes, 10 window ID planes, 8 fast clear planes, and 2 cursor planes. It provides the standard frame buffer interface defined in **fbio**(7), paired with microcode that can be downloaded using **gtconfig**(1M). Application acceleration is achieved via the XGL native 3D graphics library.

FILES

/dev/fbs/gt0	device special file
/dev/fb	default frame buffer

SEE ALSO

gtconfig(1M), **mmap**(2), **fbio**(7)

NAME

hdio – SMD and IPI disk control operations

SYNOPSIS

#include <sys/hdio.h>

DESCRIPTION

The SMD and IPI disk drivers supplied with this release support a set of **ioctl**(2) requests for diagnostics and bad sector information. Basic to these **ioctl( )** requests are the definitions in **<sys/hdio.h>.**

IOCTLS

HDKIOCGTYPE The argument is a pointer to a **hdk_type** structure (described below). This **ioctl( )** gets specific information from the hard disk.

HDKIOCSTYPE The argument is a pointer to a **hdk_type** structure (described below). This **ioctl( )** sets specific information about the hard disk.

```
/*
 * Used for drive info
 */
struct hdk_type {
        u_short     hdkt_hsect;      /* hard sector count (read only) */
        u_short     hdkt_promrev;    /* prom revision (read only) */
        u_char      hdkt_drtype;     /* drive type (ctlr specific) */
        u_char      hdkt_drstat;     /* drive status (ctlr specific, ro) */
};
```

HDKIOCGBAD The argument is a pointer to a **hdk_badmap** structure (described below). This **ioctl( )** is used to get the bad sector map from the disk.

HDKIOCSBAD The argument is a pointer to a **hdk_badmap** structure (described below). This **ioctl( )** is used to set the bad sector map on the disk.

```
/*
 * Used for bad sector map
 */
struct hdk_badmap {
        caddr_t     hdkb_bufaddr;    /* address of user's map buffer */
};
```

HDKIOCGDIAG

The argument is a pointer to a **hdk_diag** structure (described below). This **ioctl( )** gets the most recent command that failed along with the sector and error number from the hard disk.

```
/*
 * Used for disk diagnostics
 */
struct hdk_diag {
        u_short     hdkd_errcmd;      /* most recent command in error */
        daddr_t     hdkd_errsect;     /* most recent sector in error */
        u_char      hdkd_errno;       /* most recent error number */
        u_char      hdkd_severe;      /* severity of most recent error */
};
```

SEE ALSO **ioctl**(2), **dkio**(7), **ipi**(7), **xd**(7), **xy**(7)

NAME

hsfs – High Sierra & ISO 9660 CD-ROM filesystem

DESCRIPTION

HSFS is a filesystem type that allows users access to files on High Sierra or ISO 9660 format CD-ROM disks from within the SunOS operating system. Once mounted, a HSFS filesystem provides standard SunOS read-only file system operations and semantics. That is, users can read files and list files in a directory on a High Sierra or ISO 9660 CD-ROM, and applications can use standard UNIX system calls on these files and directories.

This filesystem also contains support for the Rock Ridge Extensions. If the extensions are contained on the CD-ROM, then the filesystem will provide all of the filesystem semantics and file types of UFS, except for writability and hard links.

HSFS filesystems are mounted either with the command:

mount –F hsfs –o ro *device-special directory-name*

or

mount /hsfs

if a line similar to

/dev/dsk/c0t6d0s0 – /hsfs hsfs – no ro

is in your **/etc/vfstab** file (and **/hsfs** exists).

Normally, if Rock Ridge extensions exist on the CD-ROM, the filesystem will automatically use those extensions. If you do not want to use the Rock Ridge extensions, use the ''nrr'' (No Rock Ridge) mount option. The mount command would then be:

mount –F hsfs –o ro,nrr *device-special directory-name*

Files on a High Sierra or ISO 9660 CD-ROM disk have names of the form *filename.ext;version*, where *filename* and the optional *ext* consist of a sequence of uppercase alphanumeric characters (including ''_''), while the *version* consists of a sequence of digits, representing the version number of the file. HSFS converts all the uppercase characters in a file name to lowercase, and truncates the '';'' and version information. If more than one version of a file is present on the CD-ROM, only the file with the highest version number is accessible.

Conversion of uppercase to lowercase characters may be disabled by using the **–o nomaplcase** option to **mount**(1M). (See **mount_hsfs**(1M)).

If the CD-ROM contains Rock Ridge extensions, the file names and directory names may contain any character supported under UFS. The names may also be upper and/or lower case and will be case sensitive. File name lengths can be as long as those of UFS.

Files accessed through HSFS have mode 555 (owner, group and world readable and executable), uid 0 and gid 3. If a directory on the CD-ROM has read permission, HSFS grants execute permission to the directory, allowing it to be searched.

With Rock Ridge extensions, files and directories can have any permissions that are supported on a UFS filesystem; however, despite any write permissions, the file system is read-only, with EROFS returned to any write operations.

High Sierra and ISO 9660 CD-ROMs only support regular files and directories, thus HSFS only supports these file types. A Rock Ridge CD-ROM can support regular files, directories and symbolic links, as well as device nodes, such as block, character and FIFO.

EXAMPLES

If there is a file

BIG.BAR

on a High Sierra or ISO 9660 format CD-ROM it will show up as

big.bar

when listed on a HSFS filesystem.

If there are three files

BAR.BAZ;1

BAR.BAZ;2

BAR.BAZ;3

on a High Sierra or ISO 9660 format CD-ROM, only the file **BAR.BAZ;3** will be accessible; it will be listed as

bar.baz

SEE ALSO

mount(1M), **mount_hsfs**(1M), **vfstab**(4)

N. V. Phillips and Sony Corporation, *System Description Compact Disc Digital Audio*, ("Red Book").

N. V. Phillips and Sony Corporation, *System Description of Compact Disc Read Only Memory*, ("Yellow Book").

IR "Volume and File Structure of CD-ROM for Information Interchange" , ISO 9660:1988(E).

DIAGNOSTICS

hsfs: Unknown CD-ROM structure format

You are attempting to mount a CD-ROM with an unknown format. Perhaps it is UFS format.

hsfs: hsnode table full, %d nodes allocated

There are not enough HSFS internal data structure elements to handle all the files currently open. This problem may be overcome by adding a line of the form

set hsfs:nhsnode=*number*

to the **/etc/system** system configuration file and rebooting. See **system**(4).

WARNINGS

Do not physically eject a CD-ROM while the device is still mounted as a HSFS filesystem.

Under MS-DOS (for which CD-ROMs are frequently targeted), files with no extension may be represented either as *filename.* or *filename* (that is, with or without a trailing period).

These names are not equivalent under UNIX systems. For example, the names

BAR.

and

BAR

are not names for the same file under the UNIX system. This may cause confusion if you are consulting documentation for CD-ROMs originally intended for MS-DOS systems.

Use of the **–o notraildot** option to **mount**(1M) makes it optional to specify the trailing dot. (See **mount_hsfs**(1M)).

NOTES

No translation of any sort is done on the contents of High Sierra or ISO 9660 format CD-ROMs; only directory and file names are subject to interpretation by HSFS.

NAME

icmp, ICMP – Internet Control Message Protocol

SYNOPSIS

#include <sys/socket.h>

#include <netinet/in.h>

#include <netinet/ip_icmp.h>

s = socket(AF_INET, SOCK_RAW, *proto***);**

t = t_open("/dev/icmp", O_RDWR);

DESCRIPTION

ICMP is the error and control message protocol used by the Internet protocol family. It is used by the kernel to handle and report errors in protocol processing. It may also be accessed by programs using the socket interface or the Transport Level Interface (TLI) for network monitoring and diagnostic functions. When used with the socket interface, a "raw socket" type is used. The protocol number for ICMP, used in the *proto* parameter to the socket call, can be obtained from **getprotobyname**(3N). ICMP file descriptors and sockets are connectionless, and are normally used with the **t_sndudata** / **t_rcvudata** and the **sendto( )** / **recvfrom( )** calls.

Outgoing packets automatically have an Internet Protocol (IP) header prepended to them. Incoming packets are provided to the user with the IP header and options intact.

ICMP is an datagram protocol layered above IP. It is used internally by the protcol code for various purposes including routing, fault isolation, and congestion control. Receipt of an ICMP "redirect" message will add a new entry in the routing table, or modify an existing one. ICMP messages are routinely sent by the protocol code. Received ICMP messages may be reflected back to users of higher-level protocols such as TCP or UDP as error returns from system calls. A copy of all ICMP message received by the system is provided to every holder of an open ICMP socket or TLI descriptor.

SEE ALSO

getprotobyname(3N), **recv**(3N), **send**(3N), **t_rcvudata**(3N), **t_sndudata**(3N), **routing**(4), **inet**(7), **ip**(7)

Postel, Jon, *Internet Control Message Protocol — DARPA Internet Program Protocol Specification*, RFC 792, Network Information Center, SRI International, Menlo Park, Calif., September 1981.

DIAGNOSTICS

A socket operation may fail with one of the following errors returned:

EISCONN An attempt was made to establish a connection on a socket which already has one, or when trying to send a datagram with the destination address specified and the socket is already connected.

ENOTCONN An attempt was made to send a datagram, but no destination address is specified, and the socket has not been connected.

ENOBUFS The system ran out of memory for an internal data structure.

EADDRNOTAVAIL An attempt was made to create a socket with a network address for which no network interface exists.

NOTES

Replies to ICMP “echo” messages which are source routed are not sent back using inverted source routes, but rather go back through the normal routing mechanisms.

NAME

ie – Intel 82586 Ethernet device driver

SYNOPSIS

```
#include <sys/stropts.h>
#include <sys/ethernet.h>
#include <sys/dlpi.h>

open("/dev/ie", mode);
```

DESCRIPTION

The Intel 82586 ethernet driver is a multithreaded, loadable, clonable, STREAMS hardware driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), over Intel 82586 ethernet controller. Two device implementations are supported by this driver — the onboard (**ie0**) 82586 for those systems which include this chip on the motherboard and the **3/E** VME Ethernet / SCSI card. The older Multibus I Ethernet card in a Multibus-to-VME adaptor is not supported. Multiple 82586 controllers installed within the system are supported by the driver. The **ie** driver provides basic support for the 82586 hardware. Functions include chip initialization, frame transmit and receive, multicast and promiscuous support, and error recovery and reporting.

The cloning character-special device **/dev/ie** is used to access all 82586 controllers installed within the system.

The **ie** driver is a “style 2” Data Link Service provider. All M_PROTO and M_PCPROTO type messages are interpreted as DLPI primitives. An explicit DL_ATTACH_REQ message by the user is required to associate the opened stream with a particular device (**ppa**). The **ppa** ID is interpreted as an unsigned long and indicates the corresponding device instance (unit) number. An error (DL_ERROR_ACK) is returned by the driver if the **ppa** field value does not correspond to a valid device instance number for this system. The device is initialized on first attach and de-initialized (stopped) on last detach.

The values returned by the driver in the DL_INFO_ACK primitive in response to the DL_INFO_REQ from the user are as follows:

- The max SDU is 1500 (ETHERMTU).
- The min SDU is 0.
- The **dlsap** address length is 8.
- The MAC type is DL_ETHER.
- The **sap** length value is -2 meaning the physical address component is followed immediately by a 2 byte **sap** component within the DLSAP address.
- The service mode is DL_CLDLS.
- No optional quality of service (QOS) support is included at present so the QOS fields are 0.
- The provider style is DL_STYLE2.
- The version is DL_VERSION_2.
- The broadcast address value is Ethernet / IEEE broadcast address (0xFFFFFF).

Once in the DL_ATTACHED state, the user must send a DL_BIND_REQ to associate a particular SAP (Service Access Pointer) with the stream. The **ie** driver interprets the **sap** field within the DL_BIND_REQ as an Ethernet "type" therefore valid values for the **sap** field are in the [0-0xFFFF] range. Only one Ethernet type can be bound to the stream at any time.

In addition to Ethernet V2 service, an "802.3 mode" is provided by the driver and works as follows. **sap** values in the range [0-1500] are treated as equivalent and represent a desire by the user for "802.3" mode. If the value of the **sap** field of the DL_BIND_REQ is within this range, then the driver computes the length of the message, not including initial M_PROTO mblk, of all subsequent DL_UNITDATA_REQ messages and transmits 802.3 frames having this value in the MAC frame header length field. All frames received from the media having a "type" field in this range are assumed to be 802.3 frames and are routed up all open streams which are bound to any **sap** value within this range. If more than one stream is in "802.3 mode" then the frame will be duplicated and routed up multiple streams as DL_UNITDATA_IND messages.

The **ie** driver DLSAP address format consists of the 6 byte physical (Ethernet) address component followed immediately by the 2 byte **sap** (type) component producing an 8 byte DLSAP address. Applications should *not* hardcode to this particular implementation-specific DLSAP address format but use information returned in the DL_INFO_ACK primitive to compose and decompose DLSAP addresses. The **sap** length, full DLSAP length, and **sap** / physical ordering are included within the DL_INFO_ACK. The physical address length can be computed by subtracting the **sap** length from the full DLSAP address length or by issuing the DL_PHYS_ADDR_REQ to obtain the current physical address associated with the stream.

Once in the DL_BOUND state, the user may transmit frames on the Ethernet by sending DL_UNITDATA_REQ messages to the **ie** driver. The **ie** driver will route received Ethernet frames up all those open and bound streams having a **sap** which matches the Ethernet type as DL_UNITDATA_IND messages. Received Ethernet frames are duplicated and routed up multiple open streams if necessary. The DLSAP address contained within the DL_UNITDATA_REQ and DL_UNITDATA_IND messages consists of both the **sap** (type) and physical (Ethernet) components.

In addition to the mandatory connectionless DLPI message set the driver additionally supports the following primitives.

The DL_ENABMULTI_REQ and DL_DISABMULTI_REQ primitives enable / disable reception of individual multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis using these primitives. These primitives are accepted by the driver in any state following DL_ATTACHED.

The DL_PROMISCON_REQ and DL_PROMISCOFF_REQ primitives with the DL_PROMISC_PHYS flag set in the **dl_level** field enables / disables reception of all ("promiscuous mode") frames on the media including frames generated by the local host. When used with the DL_PROMISC_SAP flag set this enables / disables reception of all **sap** (Ethernet type) values. When used with the DL_PROMISC_MULTI flag set this enables / disables reception of all multicast group addresses.

The effect of each is always on a per-stream basis and independent of the other **sap** and physical level configurations on this stream or other streams.

The DL_PHYS_ADDR_REQ primitive return the 6 octet Ethernet address currently associated (attached) to the stream in the DL_PHYS_ADDR_ACK primitive. This primitive is valid only in states following a successful DL_ATTACH_REQ.

The DL_SET_PHYS_ADDR_REQ primitive changes the 6 octet Ethernet address currently associated (attached) to this stream. The credentials of the process which originally opened this stream must be superuser or EPERM is returned in the DL_ERROR_ACK. This primitive is destructive in that it affects all other current and future streams attached to this device. An M_ERROR is sent up all other streams attached to this device when this primitive on this stream is successful. Once changed, all streams subsequently opened and attached to this device will obtain this new physical address. The physical address will remain so until this primitive is used to change the physical address again or the system is rebooted, whichever comes first.

FILES

/dev/ie

SEE ALSO

netstat(1M), **dlpi**(7), **le**(7)

NOTES

netstat –**i** command (see **netstat**(1M)) will display the number of collisions of a packet transmission before a packet is successfully transmitted.

NAME

iee – Intel EtherExpress 16 Ethernet device driver

SYNOPSIS

```
#include <sys/stropts.h>
#include <sys/ethernet.h>
#include <sys/dlpi.h>
```

AVAILABILITY

x86

DESCRIPTION

The **iee** Ethernet driver is a multi-threaded, loadable, clonable, STREAMS hardware driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), over Intel EtherExpress 16 Ethernet controllers. Multiple EtherLink 16 controllers installed within the system are supported by the driver. The **iee** driver provides basic support for the EtherLink 16 hardware. Functions include chip initialization, frame transmit and receive, multicast and "promiscuous" support, and error recovery and reporting.

The cloning, character-special device **/dev/iee** is used to access all EtherLink 16 devices installed within the system.

iee and DLPI

The **iee** driver is a "style 2" Data Link Service provider. All **M_PROTO** and **M_PCPROTO** type messages are interpreted as **DLPI** primitives. An explicit **DL_ATTACH_REQ** message by the user is required to associate the opened stream with a particular device (**ppa**). The **ppa** ID is interpreted as an unsigned long integer and indicates the corresponding device instance (unit) number. The unit numbers are assigned sequentially to each board found. The search order is determined by the order defined in the **/kernel/drv/iee.conf** file. An error (**DL_ERROR_ACK**) is returned by the driver if the **ppa** field value does not correspond to a valid device instance number for this system. The device is initialized on first attach and de-initialized (stopped) on last detach.

The values returned by the driver in the **DL_INFO_ACK** primitive in response to the **DL_INFO_REQ** from the user are as follows:

- The maximum SDU is **1500** (**ETHERMTU**).
- The minimum SDU is **0**. The driver will pad to the mandatory 60-octet minimum packet size.
- The **dlsap** address length is **8**.
- The MAC type is **DL_ETHER**.
- The **sap** length value is **–2**, meaning the physical address component is followed immediately by a 2-byte **sap** component within the **DLSAP** address.
- The service mode is **DL_CLDLS**.
- No optional quality of service (QOS) support is included at present, so the QOS fields are **0**.
- The provider style is **DL_STYLE2**.
- The version is **DL_VERSION_2**.
- The broadcast address value is Ethernet / IEEE broadcast address

(FF:FF:FF:FF:FF:FF).

Once in the **DL_ATTACHED** state, the user must send a **DL_BIND_REQ** to associate a particular Service Access Pointer (SAP) with the stream. The **iee** driver interprets the **sap** field within the **DL_BIND_REQ** as an Ethernet "type;" therefore valid values for the **sap** field are in the [**0-0xFFFF**] range. Only one Ethernet type can be bound to the stream at any time.

In addition to Ethernet V2 service, an "802.3 mode" is also provided by the driver. In this mode, **sap** values in the range [**0-1500**] are treated as equivalent and represent a desire by the user for "802.3" mode. If the value of the **sap** field of the **DL_BIND_REQ** is within this range, then the driver expects that the destination **DLSAP** in a **DL_UNITDATA_REQ** will contain the *length* of the data rather than a **sap** value. All frames received from the media that have a "type" field in this range are assumed to be 802.3 frames, and they are routed up all open streams which are bound to any **sap** value within this range. If more than one stream is in "802.3 mode," then the frame will be duplicated and routed up multiple streams as **DL_UNITDATA_IND** messages.

The **iee** driver **DLSAP** address format consists of the 6-byte physical (Ethernet) address component followed immediately by the 2-byte **sap** (type) component, producing an 8-byte **DLSAP** address. Applications should *not* hardcode to this particular implementation-specific **DLSAP** address format, but should instead use information returned in the **DL_INFO_ACK** primitive to compose and decompose **DLSAP** addresses. The **sap** length, full **DLSAP** length, and **sap** / physical ordering are included within the **DL_INFO_ACK**. The physical address length can be computed by subtracting the **sap** length from the full **DLSAP** address length or by issuing the **DL_PHYS_ADDR_REQ** to obtain the current physical address associated with the stream.

Once in the **DL_BOUND** state, the user may transmit frames on the Ethernet by sending **DL_UNITDATA_REQ** messages to the **iee** driver. The **iee** driver will route received Ethernet frames up all open and bound streams that have a **sap** which matches the Ethernet type as **DL_UNITDATA_IND** messages. Received Ethernet frames are duplicated and routed up multiple open streams if necessary. The **DLSAP** address contained within the **DL_UNITDATA_REQ** and **DL_UNITDATA_IND** messages consists of both the **sap** (type) and physical (Ethernet) components.

iee Primitives

In addition to the mandatory connectionless **DLPI** message set, the driver also supports the following primitives:

The **DL_ENABMULTI_REQ** and **DL_DISABMULTI_REQ** primitives enable / disable reception of individual multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis using these primitives. These primitives are accepted by the driver in any state following **DL_ATTACHED**.

The **DL_PROMISCON_REQ** and **DL_PROMISCOFF_REQ** primitives with the **DL_PROMISC_PHYS** flag set in the **dl_level** field enables / disables reception of all "promiscuous mode" frames on the media including frames generated by the local host.

When used with the **DL_PROMISC_SAP** flag set, this enables/disables reception of all **sap** (Ethernet type) values. When used with the **DL_PROMISC_MULTI** flag set, this enables/disables reception of all multicast group addresses. The effect of each is always on a per-stream basis and independent of the other **sap** and physical level configurations on this stream or other streams.

The **DL_PHYS_ADDR_REQ** primitive returns the 6-octet Ethernet address currently associated (attached) to the stream in the **DL_PHYS_ADDR_ACK** primitive. This primitive is valid only in states following a successful **DL_ATTACH_REQ**.

The **DL_SET_PHYS_ADDR_REQ** primitive changes the 6-octet Ethernet address currently associated (attached) to this stream. The credentials of the process which originally opened this stream must be superuser or an **EPERM** error is returned in the **DL_ERROR_ACK**. This primitive is destructive in that it affects all other current and future streams attached to this device. An **M_ERROR** is sent up all other streams attached to this device when this primitive on this stream is successful. Once changed, all streams subsequently opened and attached to this device will obtain this new physical address. The new physical address will remain in effect until this primitive is used to change the physical address again or the system is rebooted, whichever comes first.

CONFIGURATION

The **/kernel/drv/iee.conf** file supports the following options:

intr Specifies the IRQ level for the board.

The iee driver does not support the use of shared RAM on the board. Auto-detect of the media type is also not supported and the board has to be explicitly configured for which media connector it is using. It is important to ensure that there are no conflicts for the board's I/O port, shared RAM, or IRQ level.

FILES

/dev/iee	**iee** character special device
/kernel/drv/iee.conf	configuration file of **iee** driver

SEE ALSO

dlpi(7)

NAME

if_tcp, if – general properties of Internet Protocol network interfaces

DESCRIPTION

A network interface is a device for sending and receiving packets on a network. A network interface is usually a hardware device, although one may be implemented in software. Network interfaces used by the Internet Protocol (IP) must be STREAMS devices conforming to the Datalink Provider Interface (DLPI).

An interface becomes available to IP when it is opened and the IP module is pushed onto the stream with the **I_PUSH ioctl( )** call. This may be initiated by the kernel at boot time or by a user program some time after the system is running. Each interface must be assigned an IP address with the **SIOCSIFADDR ioctl( )** before it can be used. On interfaces where the network-to-link layer address mapping is static, only the network number is taken from the **ioctl( )** request; the remainder is found in a hardware specific manner. On interfaces which provide dynamic network-to-link layer address mapping facilities (for example, 10Mb / s Ethernets using **arp**(7)), the entire address specified in the **ioctl( )** is used. A routing table entry for destinations on the network of the interface is installed automatically when an interface's address is set.

IOCTLS

The following **ioctl( )** calls may be used to manipulate IP network interfaces. Unless specified otherwise, the request takes an **ifreq** structure as its parameter. This structure has the form:

```
/* Interface request structure used for socket ioctl's.  All */
/* interface ioctl's must have parameter definitions which */
/* begin with ifr_name.  The remainder may be interface specific. */

struct ifreq {
#define  IFNAMSIZ     16
    char     ifr_name[IFNAMSIZ];                /* if name, for example */
                                                /* "emd1" */
    union {
        struct sockaddr   ifru_addr;
        struct sockaddr   ifru_dstaddr;
        char              ifru_oname[IFNAMSIZ];  /* other if name */
        struct sockaddr   ifru_broadaddr;
        short             ifru_flags;
        int               ifru_metric;
        char              ifru_data[1];          /* interface dependent data */
        char              ifru_enaddr[6];
        int               if_muxid[2];           /* mux id's for arp and ip */
    } ifr_ifru;
#define  ifr_addr       ifr_ifru.ifru_addr      /* address */
#define  ifr_dstaddr    ifr_ifru.ifru_dstaddr   /* other end of p-to-p
                                                   link */
#define  ifr_oname      ifr_ifru.ifru_oname     /* other if name */
#define  ifr_broadaddr  ifr_ifru.ifru_broadaddr /* broadcast address */
#define  ifr_flags      ifr_ifru.ifru_flags
```

```
                                                    /* flags */
#define  ifr_metric      ifr_ifru.ifru_metric       /* metric */
#define  ifr_data        ifr_ifru.ifru_data         /* for use by interface */
#define  ifr_enaddr      ifr_ifru.ifru_enaddr       /* ethernet address */
};
```

SIOCSIFADDR Set interface address. Following the address assignment, the "initialization" routine for the interface is called.

SIOCGIFADDR Get interface address.

SIOCSIFDSTADDR Set point to point address for interface.

SIOCGIFDSTADDR Get point to point address for interface.

SIOCSIFFLAGS Set interface flags field. If the interface is marked down, any processes currently routing packets through the interface are notified.

SIOCGIFFLAGS Get interface flags.

SIOCGIFCONF Get interface configuration list. This request takes an **ifconf** structure (see below) as a value-result parameter. The **ifc_len** field should be initially set to the size of the buffer pointed to by **ifc_buf**. On return it will contain the length, in bytes, of the configuration list.

SIOGIFNUM Get number of interfaces. This request returns an integer which is the number of interface descriptions (struct ifreq) that will be returned by the **SIOCGIFCONF** ioctl; that is it gives an indication of how large **ifc_len** has to be.

SIOCSIFMTU Set the maximum transmission unit size for interface. Place the result of this request in **ifru_metric** field. The mtu has to be smaller than physical mtu limitation (which is reported in the DLPI info ack message).

SIOCGIFMTU Get the maximum transmission unit size for interface. Place the result of this request in **ifru_metric** field.

SIOCSIFMETRIC Set the metric associated with the interface. The metric is used by routine daemons such as **in.routed**(1M).

SIOCGIFMETRIC Get the metric associated with the interface.

SIOCGIFMUXID Get the ip and arp muxid associated with the interface.

SIOCSIFMUXID Set the ip and arp muxid associated with the interface.

The **ifconf** structure has the form:

```
/*
 * Structure used in SIOCGIFCONF request.
 * Used to retrieve interface configuration
 * for machine (useful for programs which
 * must know all networks accessible).
 */
struct ifconf {
    int ifc_len;                            /* size of associated buffer */
    union {
        caddr_t         ifcu_buf;
        struct ifreq    *ifcu_req;
    } ifc_ifcu;
#define    ifc_buf      ifc_ifcu.ifcu_buf       /* buffer address */
#define    ifc_req      ifc_ifcu.ifcu_req       /* array of structures returned */
};
```

SEE ALSO **ifconfig**(1M), **in.routed**(1M), **arp**(7), **ip**(7)

NAME

inet – Internet protocol family

SYNOPSIS

```
#include <sys/types.h>
#include <netinet/in.h>
```

DESCRIPTION

The Internet protocol family implements a collection of protocols which are centered around the *Internet Protocol* (IP) and which share a common address format. The Internet family protocols can be accessed using the socket interface, where they support the **SOCK_STREAM**, **SOCK_DGRAM**, and **SOCK_RAW** socket types, or the Transport Level Interface (TLI), where they support the connectionless (**T_CLTS**) and connection oriented (**T_COTS_ORD**) service types.

PROTOCOLS

The Internet protocol family comprises the Internet Protocol (IP), the Address Resolution Protocol (ARP), the Internet Control Message Protocol (ICMP), the Transmission Control Protocol (TCP), and the User Datagram Protocol (UDP).

TCP supports the socket interface's **SOCK_STREAM** abstraction and TLI's **T_COTS_ORD** service type. UDP supports the **SOCK_DGRAM** socket abstraction and the TLI **T_CLTS** service type. See **tcp**(7) and **udp**(7). A direct interface to IP is available using both TLI and the socket interface; See **ip**(7). ICMP is used by the kernel to handle and report errors in protocol processing. It is also accessible to user programs; see **icmp**(7). ARP is used to translate 32-bit IP addresses into 48-bit Ethernet addresses; see **arp**(7).

The 32-bit IP address is divided into network number and host number parts. It is frequency-encoded; The most-significant bit is zero in Class A addresses, in which the high-order 8 bits represent the network number. Class B addresses have their high order two bits set to 10 and use the high-order 16 bits as the network number field. Class C addresses have a 24-bit network number part of which the high order three bits are 110. Sites with a cluster of IP networks may chose to use a single network number for the cluster; This is done by using subnet addressing. The host number portion of the address is further subdivided into subnet number and host number parts. Within a subnet, each subnet appears to be an individual network; Externally, the entire cluster appears to be a single, uniform network requiring only a single routing entry. Subnet addressing is enabled and examined by the following **ioctl**(2) commands; They have the same form as the **SIOCSIFADDR** command

SIOCSIFNETMASK Set interface network mask. The network mask defines the network part of the address; If it contains more of the address than the address type would indicate, then subnets are in use.

SIOCGIFNETMASK Get interface network mask.

ADDRESSING

IP addresses are four byte quantities, stored in network byte order. IP addresses should be manipulated using the byte order conversion routines (see **byteorder**(3N)).

Addresses in the Internet protocol family use the **sockaddr_in** structure, which has that following members:

```
short       sin_family;
u_short     sin_port;
struct      in_addr     sin_addr;
char        sin_zero[8];
```

Library routines are provided to manipulate structures of this form; See **inet**(3N).

The **sin_addr** field of the **sockaddr_in** structure specifies a local or remote IP address. Each network interface has its own unique IP address. The special value **INADDR_ANY** may be used in this field to effect "wildcard" matching. Given in a **bind**(3N) call, this value leaves the local IP address of the socket unspecified, so that the socket will receive connections or messages directed at any of the valid IP addresses of the system. This can prove useful when a process neither knows nor cares what the local IP address is or when a process wishes to receive requests using all of its network interfaces. The **sockaddr_in** structure given in the **bind**(3N) call must specify an **in_addr** value of either **IPADDR_ANY** or one of the system's valid IP addresses. Requests to bind any other address will elicit the error **EADDRNOTAVAI**. When a **connect**(3N) call is made for a socket that has a wildcard local address, the system sets the **sin_addr** field of the socket to the IP address of the network interface that the packets for that connection are routed via.

The **sin_port** field of the **sockaddr_in** structure specifies a port number used by TCP or UDP. The local port address specified in a **bind**(3N) call is restricted to be greater than **IPPORT_RESERVED** (defined in **<netinet/in.h>**) unless the creating process is running as the super-user, providing a space of protected port numbers. In addition, the local port address must not be in use by any socket of same address family and type. Requests to bind sockets to port numbers being used by other sockets return the error **EADDRINUSE**. If the local port address is specified as 0, then the system picks a unique port address greater than **IPPORT_RESERVED**. A unique local port address is also picked when a socket which is not bound is used in a **connect**(3N) or **sendto** (see **send**(3N)) call. This allows programs which do not care which local port number is used to set up TCP connections by simply calling **socket**(3N) and then **connect**(3N), and to send UDP datagrams with a **socket**(3N) call followed by a **sendto( )** call.

Although this implementation restricts sockets to unique local port numbers, TCP allows multiple simultaneous connections involving the same local port number so long as the remote IP addresses or port numbers are different for each connection. Programs may explicitly override the socket restriction by setting the **SO_REUSEADDR** socket option with **setsockopt** (see **getsockopt**(3N)).

TLI applies somewhat different semantics to the binding of local port numbers. These semantics apply when Internet family protocols are used using the TLI.

SEE ALSO

ioctl(2), **bind**(3N), **byteorder**(3N), **connect**(3N), **gethostbyname**(3N), **getnetbyname**(3N), **getprotobyname**(3N), **getservbyname**(3N), **getsockopt**(3N), **send**(3N), **socket**(3N), **arp**(7), **icmp**(7), **ip**(7), **tcp**(7), **udp**(7)

Network Information Center, *DDN Protocol Handbook* (3 vols.), Network Information Center, SRI International, Menlo Park, Calif., 1985.

NOTES

The Internet protocol support is subject to change as the Internet protocols develop. Users should not depend on details of the current implementation, but rather the services exported.

NAME

ip, IP – Internet Protocol

SYNOPSIS

```
#include <sys/socket.h>
#include <netinet/in.h>

s = socket(AF_INET, SOCK_RAW, proto);

t = t_open ("/dev/rawip", O_RDWR);
```

DESCRIPTION

IP is the internetwork datagram delivery protocol that is central to the Internet protocol family. Programs may use IP through higher-level protocols such as the Transmission Control Protocol (TCP) or the User Datagram Protocol (UDP), or may interface directly to IP. See **tcp**(7) and **udp**(7). Direct access may be via the socket interface (using a "raw socket") or the Transport Level Interface (TLI). The protocol options defined in the IP specification may be set in outgoing datagrams.

The STREAMS driver **/dev/rawip** is the TLI transport provider that provides raw access to IP.

Raw IP sockets are connectionless and are normally used with the **sendto( )** and **recvfrom( )** calls, ((see **send**(3N) and **recv**(3N)) although the **connect**(3N) call may also be used to fix the destination for future datagrams (in which case the **read**(2) or **recv**(3N) and **write**(2) or **send**(3N) calls may be used). If **proto** is **IPPROTO_RAW**, or **IPPROTO_IGMP** the application is expected to include a complete IP header when sending. Otherwise, that protocol number will be set in outgoing datagrams and used to filter incoming datagrams and an IP header will be generated and prepended to each outgoing datagram. In either case received datagrams are returned with the IP header and options intact.

The socket options supported at the IP level are:

IP_OPTIONS IP options for outgoing datagrams. This socket option may be used to set IP options to be included in each outgoing datagram. IP options to be sent are set with **setsockopt( )** (see **getsockopt**(3N)). The **getsockopt**(3N) call returns the IP options set in the last **setsockopt( )** call. IP options on received datagrams are visible to user programs only using raw IP sockets. The format of IP options given in **setsockopt( )** matches those defined in the IP specification with one exception: the list of addresses for the source routing options must include the first-hop gateway at the beginning of the list of gateways. The first-hop gateway address will be extracted from the option list and the size adjusted accordingly before use. IP options may be used with any socket type in the Internet family.

IP_ADD_MEMBERSHIP Join a multicast group.

IP_DROP_MEMBERSHIP Leave a multicast group.

These options take a **struct ip_mreq** as the parameter. The structure contains a multicast address which has to be set to the **CLASS-D** IP multicast address, and an interface address. Normally the interface address is set to **INADDR_ANY** which causes the kernel to choose the interface to join on.

IP_MULTICAST_IF The outgoing interface for multicast packets. This option takes a **struct in_addr** as an argument and it selects that interface for outgoing IP multicast packets. If the address specified is **INADDR_ANY** it will use the unicast routing table to select the outgoing interface (which is the default behavior.)

IP_MULTICAST_TTL Time to live for multicast datagrams. This option takes an unsigned character as an argument. Its value is the TTL that IP will use on outgoing multicast datagrams. The default is 1.

IP_MULTICAST_LOOP Loopback for multicast datagrams. Normally multicast datagrams are delivered to members on the sending host. Setting the unsigned character argument to 0 will cause the opposite behavior.

The multicast socket options can be used with any datagram socket type in the Internet family.

At the socket level, the socket option **SO_DONTROUTE** may be applied. This option forces datagrams being sent to bypass routing and forwarding by forcing the IP Time To Live field to 1 (meaning that the packet will not be forwarded bu routers).

Raw IP datagrams can also be sent and received using the TLI connectionless primitives.

Datagrams flow through the IP layer in two directions: from the network *up* to user processes and from user processes *down* to the network. Using this orientation, IP is layered *above* the network interface drivers and *below* the transport protocols such as UDP and TCP. The Internet Control Message Protocol (ICMP) is logically a part of IP. See **icmp**(7).

IP provides for a checksum of the header part, but not the data part of the datagram. The checksum value is computed and set in the process of sending datagrams and checked when receiving datagrams.

IP options in received datagrams are processed in the IP layer according to the protocol specification. Currently recognized IP options include: security, loose source and record route (LSRR), strict source and record route (SSRR), record route, and internet timestamp.

The IP layer will normally act as a router (forwarding datagrams that are not addressed to it etc) when the machine has two or more interfaces that are up. This behavior can be overridden by using **ndd**(1M) to to set the **/dev/ip** variable **ip_forwarding**. The value 0 means do not forward, 1 means forward and 2 gives you the default behavior of forwarding when there are two or more "up" interfaces.

The IP layer will send an ICMP message back to the source host in many cases when it receives a datagram that can not be handled. A "time exceeded" ICMP message will be sent if the "time to live" field in the IP header drops to zero in the process of forwarding a datagram. A "destination unreachable" message will be sent if a datagram can not be forwarded because there is no route to the final destination, or if it can not be fragmented. If the datagram is addressed to the local host but is destined for a protocol that is not supported or a port that is not in use, a destination unreachable message will also be sent. The IP layer may send an ICMP "source quench" message if it is receiving datagrams too quickly. ICMP messages are only sent for the first fragment of a fragmented datagram and are never returned in response to errors in other ICMP messages.

The IP layer supports fragmentation and reassembly. Datagrams are fragmented on output if the datagram is larger than the maximum transmission unit (MTU) of the network interface. Fragments of received datagrams are dropped from the reassembly queues if the complete datagram is not reconstructed within a short time period.

Errors in sending discovered at the network interface driver layer are passed by IP back up to the user process.

SEE ALSO

ndd(1M), **read**(2), **write**(2), **connect**(3N), **getsockopt**(3N), **recv**(3N), **send**(3N), **routing**(4), **icmp**(7), **if_tcp**(7), **inet**(7) **tcp**(7), **udp**(7)

Postel, Jon, *Internet Protocol - DARPA Internet Program Protocol Specification*, RFC 791, Network Information Center, SRI International, Menlo Park, Calif., September 1981.

DIAGNOSTICS

A socket operation may fail with one of the following errors returned:

EACCES A IP broadcast destination address was specified and the caller was not the privileged user.

EISCONN An attempt was made to establish a connection on a socket which already had one, or to send a datagram with the destination address specified and the socket was already connected.

EMSGSIZE An attempt was made to send a datagram that was too large for an interface, but was not allowed to be fragmented (such as broadcasts).

ENETUNREACH An attempt was made to establish a connection or send a datagram, where there was no matching entry in the routing table, or if an ICMP "destination unreachable" message was received.

ENOTCONN A datagrem was sent, but no destination address was specified, and the socket had not been connected.

ENOBUFS The system ran out of memory for fragmentation buffers or other internal data structure.

EADDRNOTAVAIL An attempt was made to create a socket with a local address that did not match any network interface, or an IP broadcast destination address was specified and the network interface does not support broadcast.

ERRORS

The following errors may occur when setting or getting IP options:

EINVAL An unknown socket option name was given.

EINVAL The IP option field was improperly formed; an option field was shorter than the minimum value or longer than the option buffer provided.

NOTES

Raw sockets should receive ICMP error packets relating to the protocol; currently such packets are simply discarded.

Users of higher-level protocols such as TCP and UDP should be able to see received IP options.

NAME

ipi, id, is, pn, ipi3sc – IPI driver

SYNOPSIS

pn@4d,0x1080000/ipi3sc@*board-num***,0/id@***facility***,0:***partition*

AVAILABILITY

SPARC

Only available on Sun-4/370, Sun-4/400, and SPARCsystem 600MP series systems.

DESCRIPTION

The driver for IPI disk devices consists of several components: an IPI controller driver (**pn** and **ipi3sc**), and a facility driver (**id**). Each of these driver modules may have an associated configuration file, which lives in the same directory as the driver module. See **driver.conf**(4) and **vme**(4) for the interpretation of the contents of these files.

The block files access the disk using the system's normal buffering mechanism and may be read and written without regard to physical disk records. There is also a *raw* interface that provides for direct transmission between the disk and the user's read or write buffer. A single read or write call usually results in one I/O operation; therefore raw I/O is considerably more efficient when many words are transmitted. The physical names for the raw files conventionally have '**,raw'** appended to them. The logical names for the raw files live in the **/dev/rdsk** directory, as usual.

In raw I/O, counts should be a multiple of 512 bytes (a disk sector). Likewise **directory**(3C) calls should specify a multiple of 512 bytes. Depending on the channel adaptor, the buffer for raw reads or writes may be required to be on a 2-byte or 4-byte boundary.

Partition **0** is normally used for the root file system on a disk, partition **1** as a paging area (for example, **swap**), and partition **2** for backing up the entire disk. Partition **2** normally maps the entire disk and may also be used as the mount point for secondary disks in the system. The rest of the disk is normally partition **6**. For the primary disk, the user file system is located here.

The **ioctl()** interfaces described in **dkio**(7) and **hdio**(7) are supported by this driver. The HDKIOCSCMD ioctl can be used to issue certain IPI commands to the drive. The argument structure is:

```
struct hdk_cmd {
        u_short     hdkc_cmd;      /* command to be executed */
        int         hdkc_flags;    /* execution flags */
        daddr_t     hdkc_blkno;    /* disk address for command */
        int         hdkc_secnt;    /* sector count for command */
        caddr_t     hdkc_bufaddr;  /* user's buffer address */
        u_int       hdkc_buflen;   /* size of user's buffer */
};
```

The lower 8-bits of the **hdkc_cmd** field indicate one of the supported commands listed below. The upper 8-bits indicate the IPI Opcode modifier. These commands are defined in **<sys/ipi3sc.h>**. Block numbers are not remapped by the partition map when these commands are used.

The supported commands are:

IP_READ
IP_WRITE Read or write data. The addressing is always by logical block (ignoring [**a-h**] logical partition information); the Opcode modifier is ignored.

IP_READ_DEFLIST
IP_WRITE_DEFLIST Read or write one of the defect lists. The defect list is selected by the Opcode modifier in bits <15:8> of the **hdkc_cmd**.

IP_FORMAT Format a range of cylinders. For this command, the block number and sector count fields must both be a multiple of the number of blocks per cylinder. The **hdk_buflen** field must be zero for this command.

IP_REALLOC Reallocate a block. The controller attempts to recover the data from the old block being reallocated. If the old data cannot be recovered, a conditional success status is presented and a message may be printed. The **hdk_buflen** field must be zero for this command.

DISK SUPPORT

This driver handles all supported IPI drives by reading controller attributes and a label from sector 0 of the drive which describes the disk geometry and partitioning.

FILES

/kernel/drv/pn	kernel module
/kernel/drv/ipi3sc	kernel module
/kernel/drv/id	kernel module
/kernel/drv/pn.conf	driver configuration file
/kernel/drv/ipi3sc.conf	driver configuration file
/kernel/drv/id.conf	driver configuration file
/dev/dsk/c*X***t***Y***d0s***Z***	block files, controller *X*, facility *Y*, slice *Z*
/dev/rdsk/c*X***t***Y***d0s***Z***	raw files, controller *X*, facility *Y*, slice *Z*

SEE ALSO

format(1M), **mount**(1M), **directory**(3C), **driver.conf**(4), **vfstab**(4), **vme**(4), **dkio**(7), **hdio**(7)

NOTES

The **pn.conf** and **ipi3sc.conf** files are only required on Sun-4/370 and Sun-4/490 systems.

NAME

isdnio – ISDN interfaces

SYNOPSIS

#include <sun/audioio.h>
#include <sun/isdnio.h>

int ioctl (int *fd***, int** command**, /*** *arg* ***/ ...);**

DESCRIPTION

ISDN ioctl commands are a subset of **ioctl**(2) commands that perform a variety of control functions on Integrated Services Digital Network (ISDN) STREAMS devices. The arguments *command* and *arg* are passed to the file designated by *fd* and are interpreted by the ISDN device driver.

fd is an open file descriptor that refers to a stream. *command* determines the control function to be performed as described in the IOCTLS section of this document. *arg* represents additional information that is needed by *command*. The type of *arg* depends upon the command, but generally it is an integer or a pointer to a *command*-specific data structure.

Since these ISDN commands are a subset of *ioctl* and **streamio**(7), they are subject to errors as described in those interface descriptions.

This set of generic ISDN **ioctl** commands is meant to control various types of ISDN STREAMS device drivers. The following paragraphs give some background on various types of ISDN hardware interfaces and data formats, and other device characteristics.

Controllers, Interfaces, and Channels

This manual page discusses operations on, and facilities provided by ISDN controllers, interfaces and channels. A controller is usually a hardware peripheral device that provides one or more ISDN interfaces and zero or more auxiliary interfaces. In this context, the term interface is synonymous with the term “port”. Each interface can provide one or more channels.

Time Division Multiplexed Serial Interfaces

ISDN BRI-TE, BRI-NT, and PRI interfaces are all examples of Time Division Multiplexed Serial Interfaces. As an example, a Basic Rate ISDN (BRI) Terminal Equipment (TE) interface provides one D-channel and two B-channels on the same set of signal wires. The BRI interface, at the S reference point, operates at a bit rate of 192,000 bits per second. The bits are encoded using a pseudoternary coding system that encodes a logic one as zero volts, and a logic zero as a positive or negative voltage. Encoding rules state that adjacent logic zeros must be encoded with opposite voltages. Violations of this rule are used to indicate framing information such that there are 4000 frames per second, each containing 48 bits. These 48 bits are divided into channels. Not including framing and synchronization bits, the frame is divided into 8 bits for the B1-channel, 1 bit for the D-channel, 8 bits for B2, 1 bit for D, 8 bits for B1, 1 bit for D, and 8 bits for B2. This results in a 64,000 bps B1-channel, a 64,000 bps B2-channel, and a 16,000 bps D-channel, all on the same serial interface.

Basic Rate ISDN

A Basic Rate ISDN (BRI) interface consists of a 16000 bit per second Delta Channel (D-channel) for signaling and X.25 packet transmission, and two 64000 bit per second Bearer Channels (B-channels) for transmission of voice or data.

The CCITT recommendations on ISDN Basic Rate interfaces, I.430, identify several “reference points” for standardization. From (Stallings89);

> “Reference point T (terminal) corresponds to a minimal ISDN network termination at the customer’s premises. It separates the network provider’s equipment from the user’s equipment. Reference point S (system) corresponds to the interface of individual ISDN terminals. It separates user terminal equipment from network-related communications functions. Reference point R (rate) provides a non-ISDN interface between user equipment that is not ISDN-compatible and adaptor equipment. . . . The final reference point . . . is reference point U (user). This interface describes the full-duplex data signal on the subscriber line.”

Some older technology components of some ISDN networks occasionally steal the low order bit of an ISDN B-channel octet in order to transmit in-band signaling information between switches or other components of the network. Even when out-of-band signaling has been implemented in these networks, and the in-band signaling is no longer needed, the bit-robbing mechanism may still be present. This bit robbing behavior does not appreciably affect a voice call, but it will limit the usable bandwidth of a data call to 56000 bits per second instead of 64000 bits per second. These older network components only seem to exist in the United States of America, Canada and Japan. ISDN B-channel data calls that have one end point in the United States, Canada or Japan may be limited to 56000 bps usable bandwidth instead of the normal 64000 bps. Sometimes the ISDN service provider may be able to supply 56kbps for some calls and 64kbps for other calls. On an international call, the local ISDN service provider may advertise the call as 64kbps even though only 56kbps are reliably delivered because of bit-robbing in the foreign ISDN that is not reported to the local switch.

A Basic Rate Interface implements either a Terminal Equipment (TE) interface or a Network Termination (NT) interface. TE’s can be ISDN telephones, a Group 4 fax, or other ISDN terminal equipment. A TE connects to an NT in order to gain access to a public or private ISDN network. A private ISDN network, such as provided by a Private Branch Exchange (PBX), usually provides access to the public network.

If multi-point configurations are allowed by an NT, it may be possible to connect up to eight TE’s to a single NT interface. All of the TE’s in a multipoint configuration share the same D and B-channels. Contention for B-Channels by multiple TEs is resolved by the ISDN switch (NT) through signaling protocols on the D-channel.

Contention for access to the D-channel is managed by a collision detection and priority mechanism. D-channel call control messages have higher priority than other packets. This media access function is managed at the physical layer.

A BRI-TE interface may implement a “Q-channel”, the Q-channel is a slow speed, 800 bps, data path from a TE to an NT. Although the structure of the Q-channel is defined in the I.430 specification, the use of the Q-channel is for further study.

A BRI-NT interface may implement an “S-channel”, the S-channel is a slow speed, 4000 bps, data path from a NT to an TE. The use of the S-channel is for further study.

Primary Rate ISDN

Primary Rate ISDN (PRI) interfaces are either 1.544Mbps (T1 rate) or 2.048Mbps (E1 rate) and are typically organized as 23 B-channels and one D-Channel (23B+D) for T1 rates, and 30 B-Channels and one D-Channel (30B+D) for E1 rates. The D-channels on a PRI interface operate at 64000 bits per second. T1 rate PRI interface is the standard in the United States, Canada and Japan while E1 rate PRI interface is the standard in European countries. Some E1 rate PRI interface implementations allow access to channel zero which is used for framing.

Channel Types

ISDN channels fall into several categories; D-channels, bearer channels, and management pseudo channels. Each channel has a corresponding device name somewhere under the directory **/dev/isdn/** as documented in the appropriate hardware specific manual page.

D-channels There is at most one D-channel per ISDN interface. The D-channel carries signaling information for the management of ISDN calls and can also carry X.25 packet data. In the case of a PRI interface, there may actually be no D-channel if Non-Facility Associated Signaling is used. D-channels carry data packets that are framed and checked for transmission errors according to the LAP-D protocol. LAP-D uses framing and error checking identical to the High Speed Data Link (HDLC) protocol.

B-channels BRI interfaces have two B-channels, B1 and B2. On a BRI interface, the only other type of channel is an H-channel which is a concatenation of the B1 and B2 channels. An H-channel is accessed by opening the “base” channel, B1 in this case, and using the **ISDN_SET_FORMAT** ioctl to change the configuration of the B-channel from 8-bit, 8 kHz to 16-bit, 8kHz.

On a primary rate interface, B channels are numbered from 0 to 31 in Europe and 1 to 23 in the United States, Canada and Japan.

H-Channels A BRI or PRI interface can offer multiple B-channels concatenated into a single, higher bandwidth channel. These concatenated B-channels are referred to as an “H-channels” on a BRI interface. The PRI interface version of an H-channel is referred to as an H*n*-channels where *n* is a number indicating how the B-channels have been aggregated into a single channel.

- A PRI interface H0 channel is 384 kbps allowing 3H0+D on a T1 rate PRI interface and 4H0+D channels on an E1 rate PRI interface.
- A T1 PRI interface H11 channel is 1536 kbps (24×64000bps). This will consume the channel normally reserved for the D-channel, so signaling must be done with Non-Facility Associated Signaling (NFAS) from another PRI interface.
- An E1 PRI interface H12 channel is 1920 kbps (30×64000bps). An H12-channel leaves room for the framing-channel as well as the D-channel.

Auxiliary channels

Auxiliary channels are non-ISDN hardware interfaces that are closely tied to the ISDN interfaces. An example would be a video or audio coder / decoder (codec). The existence of an auxiliary channel usually implies that one or more B-channels can be "connected" to an auxiliary interface in hardware.

Management pseudo-channels

A management pseudo-channel is used for the management of a controller, interface, or hardware channel. Management channels allow for out-of-band control of hardware interfaces and for out-of-band notification of status changes. There is at least one management device per hardware interface.

There are three different types of management channels implemented by ISDN hardware drivers:

- A controller management device handles all ioctls that simultaneously affect hardware channels on different interfaces. Examples include resetting a controller, µ-code downloading of a controller, or the connection of an ISDN B-channel to an auxiliary channel that represents an audio coder / decoder (codec). The latter case would be accomplished using the **ISDN_SET_CHANNEL** ioctl.
- An interface management device handles all ioctls that affect multiple channels on the same interface. Messages associated with the activation and deactivation of an interface arrive on the management device associated with the D channel of an ISDN interface.
- Auxiliary interfaces may also have management devices. See the hardware specific man pages for operations on auxiliary devices.

Trace pseudo-channels

A device driver may choose to implement a trace device for a data or management channel. Trace channels receive a special **M_PROTO** header with the original channel's original **M_PROTO** or **M_DATA** message appended to the special header. The header is described by:

```
typedef struct {
        uint_t    seq;          /* Sequence number */
        int       type;         /* device dependent */
        struct timeval timestamp;
        char      _f[8];        /* filler */
} audtrace_hdr_t;
```

ISDN Channel types

The **isdn_chan_t** type enumerates the channels available on ISDN interfaces. If a particular controller implements any auxiliary channels then those auxiliary channels will be described in a controller specific manual page. The defined channels are described by the **isdn_chan_t** type as shown below:

```
/* ISDN channels */
typedef enum {
        ISDN_CHAN_NONE = 0x0,     /* No channel given */
        ISDN_CHAN_SELF,           /* The channel performing the ioctl */
```

```
        ISDN_CHAN_HOST,             /* Unix STREAM */

        ISDN_CHAN_CTRL_MGT,         /* Controller management */

        /* TE channel defines */
        ISDN_CHAN_TE_MGT,           /* Receives activation/deactivation */
        ISDN_CHAN_TE_D_TRACE,       /* Trace device for protocol analysis apps */
        ISDN_CHAN_TE_D,
        ISDN_CHAN_TE_B1,
        ISDN_CHAN_TE_B2,

        /* NT channel defines */
        ISDN_CHAN_NT_MGT,           /* Receives activation/deactivation */
        ISDN_CHAN_NT_D_TRACE,       /* Trace device for protocol analysis apps */
        ISDN_CHAN_NT_D,
        ISDN_CHAN_NT_B1,
        ISDN_CHAN_NT_B2,

        /* Primary rate ISDN */
        ISDN_CHAN_PRI_MGT,
        ISDN_CHAN_PRI_D,
        ISDN_CHAN_PRI_B0, ISDN_CHAN_PRI_B1,
        ISDN_CHAN_PRI_B2, ISDN_CHAN_PRI_B3,
        ISDN_CHAN_PRI_B4, ISDN_CHAN_PRI_B5,
        ISDN_CHAN_PRI_B6, ISDN_CHAN_PRI_B7,
        ISDN_CHAN_PRI_B8, ISDN_CHAN_PRI_B9,
        ISDN_CHAN_PRI_B10, ISDN_CHAN_PRI_B11,
        ISDN_CHAN_PRI_B12, ISDN_CHAN_PRI_B13,
        ISDN_CHAN_PRI_B14, ISDN_CHAN_PRI_B15,
        ISDN_CHAN_PRI_B16, ISDN_CHAN_PRI_B17,
        ISDN_CHAN_PRI_B18, ISDN_CHAN_PRI_B19,
        ISDN_CHAN_PRI_B20, ISDN_CHAN_PRI_B21,
        ISDN_CHAN_PRI_B22, ISDN_CHAN_PRI_B23,
        ISDN_CHAN_PRI_B24, ISDN_CHAN_PRI_B25,
        ISDN_CHAN_PRI_B26, ISDN_CHAN_PRI_B27,
        ISDN_CHAN_PRI_B28, ISDN_CHAN_PRI_B29,
        ISDN_CHAN_PRI_B30, ISDN_CHAN_PRI_B31,

        /* Auxiliary channel defines */
        ISDN_CHAN_AUX0, ISDN_CHAN_AUX1, ISDN_CHAN_AUX2, ISDN_CHAN_AUX3,
        ISDN_CHAN_AUX4, ISDN_CHAN_AUX5, ISDN_CHAN_AUX6, ISDN_CHAN_AUX7
} isdn_chan_t;
```

ISDN Interface types

The **isdn_interface_t** type enumerates the interfaces available on ISDN controllers. The defined interfaces are described by the **isdn_interface_t** type as shown below:

```
        /* ISDN interfaces */
        typedef enum {
              ISDN_TYPE_UNKNOWN = -1,  /* Not known or applicable */
              ISDN_TYPE_SELF = 0,      /*
                                        * For queries, application may
                                        * put this value into "type" to
                                        * query the state of the file
                                        * descriptor used in an ioctl.
```

```
                                        */
        ISDN_TYPE_OTHER,                /* Not an ISDN interface */
        ISDN_TYPE_TE,
        ISDN_TYPE_NT,
        ISDN_TYPE_PRI,
} isdn_interface_t;
```

Activation and Deactivation of ISDN Interfaces

The management device associated with an ISDN D-channel is used to request activation, deactivation and receive information about the activation state of the interface. See the descriptions of the **ISDN_PH_ACTIVATE_REQ** and **ISDN_MPH_DEACTIVATE_REQ** ioctls. Changes in the activation state of an interface are communicated to the D-channel application through **M_PROTO** messages sent up-stream on the management device associated with the D-channel. If the D-channel protocol stack is implemented as a user process, the user process can retrieve the **M_PROTO** messages using the **getmsg**(2) system call.

These **M_PROTO** messages have the following format:

```
typedef struct isdn_message {
        unsigned int            magic;      /* set to ISDN_PROTO_MAGIC */
        isdn_interface_t        type;       /* Interface type */
        isdn_message_type_t     message;    /* CCITT or vendor Primitive */
        unsigned int            vendor[5];  /* Vendor specific content */
} isdn_message_t;

typedef enum isdn_message_type {
        ISDN_VPH_VENDOR = 0,                /* Vendor specific messages */

        ISDN_PH_AI,                         /* Physical: Activation Ind */
        ISDN_PH_DI,                         /* Physical: Deactivation Ind */

        ISDN_MPH_AI,                        /* Management: Activation Ind */
        ISDN_MPH_DI,                        /* Management: Deactivation Ind */
        ISDN_MPH_EI1,                       /* Management: Error 1 Indication */
        ISDN_MPH_EI2,                       /* Management: Error 2 Indication */
        ISDN_MPH_II_C,                      /* Management: Info Ind, connection */
        ISDN_MPH_II_D                       /* Management: Info Ind, disconn. */
} isdn_message_type_t;
```

IOCTLS

STREAMS IOCTLS

All of the **streamio**(7) **ioctl** commands may be issued for a device conforming to the the **isdnio** interface.

ISDN interfaces that allow access to audio data should implement a reasonable subset of the **audio**(7) interface.

ISDN ioctls

ISDN_PH_ACTIVATE_REQ

Request ISDN physical layer activation. This *command* is valid for both TE and NT interfaces. *fd* must be a D-channel file descriptor. *arg* is ignored.

TE activation will occur without use of the **ISDN_PH_ACTIVATE_REQ** ioctl if the device corresponding to the TE D-channel is open, “on”, and the ISDN switch is requesting activation.

ISDN_MPH_DEACTIVATE_REQ

fd must be a NT D-channel file descriptor. *arg* is ignored.

This *command* requests ISDN physical layer de-activation. This is not valid for TE interfaces. A TE interace may be turned off by use of the **ISDN_PARAM_POWER** command or by **close**(2) on the associated *fd*.

ISDN_ACTIVATION_STATUS

fd is the file descriptor for a D-channel, the management device associated with an ISDN interface, or the management device associated with the controller. *arg* is a pointer to an **isdn_activation_status_t** structure. Although it is possible for applications to determine the current activation state with this ioctl, a D-channel protocol stack should instead process messages from the management pseudo channel associated with the D-channel.

```
typedef struct isdn_activation_status {
        isdn_interface_t                type;
        enum isdn_activation_state      activation;
} isdn_activation_status_t;

typedef enum isdn_activation_state {
        ISDN_OFF = 0,                   /* Interface is powered down */
        ISDN_UNPLUGGED,                 /* Power but no-physical connection */
        ISDN_DEACTIVATED_REQ            /* Pending Deactivation, NT Only */
        ISDN_DEACTIVATED,               /* Activation is permitted */
        ISDN_ACTIVATE_REQ,              /* Attempting to activate */
        ISDN_ACTIVATED,                 /* Interface is activated */
} isdn_activation_state_t;
```

The **type** field should be set to **ISDN_TYPE_SELF**. The device specific interface type will be returned in the type field.

The **isdn_activation_status_t** structure contains the interface type and the current activation state. **type** is the interface type and should be set by the caller to **ISDN_TYPE_SELF**.

ISDN_INTERFACE_STATUS

The **ISDN_INTERFACE_STATUS** ioctl retrieves the status and statistics of an ISDN interface. The requesting channel must own the interface whose status is being requested or the ioctl will fail. *fd* is the file descriptor for an ISDN interface management device. *arg* is a pointer to a **struct isdn_interface_info**. If the **interface** field is set to **ISDN_TYPE_SELF**, it will be changed in the returned structure to reflect the proper device-specific interface of the requesting *fd* .

```
typedef struct isdn_interface_info {
        isdn_interface_t                        interface;

        enum isdn_activation_state              activation;

        unsigned int        ph_ai;              /* Physical: Activation Ind */
        unsigned int        ph_di;              /* Physical: Deactivation Ind */
        unsigned int        mph_ai;             /* Management: Activation Ind */
        unsigned int        mph_di;             /* Management: Deactivation Ind */
        unsigned int        mph_ei1;            /* Management: Error 1 Indication */
```

```
        unsigned int        mph_ei2;        /* Management: Error 2 Indication */
        unsigned int        mph_ii_c;       /* Management: Info Ind, connection */
        unsigned int        mph_ii_d;       /* Management: Info Ind, disconn. */
} isdn_interface_info_t;
```

ISDN_CHANNEL_STATUS

The **ISDN_CHANNEL_STATUS** ioctl retrieves the status and statistics of an ISDN channel. The requesting channel must own the channel whose status is being requested or the ioctl will fail. *fd* is any file descriptor. *arg* is a pointer to a **struct isdn_channel_info**. If the **interface** field is set to **ISDN_CHAN_SELF**, it will be changed in the returned structure to reflect the proper device-specific channel of the requesting *fd* .

```
typedef struct isdn_channel_info {
        isdn_chan_t         channel;

        enum isdn_iostate   iostate;

        struct isdn_io_stats {
        ulong_t             packets;        /* packets transmitted or received */
        ulong_t             octets;         /* octets transmitted or received */
        ulong_t             errors;         /* errors packets transmitted or received */
        } transmit, receive;
} isdn_channel_info_t;
```

ISDN_SET_PARAM

fd is the file descriptor for a management device. *arg* is a pointer to a **struct isdn_param**. This *command* allows the setting of various ISDN physical layer parameters such as timers. This *command* uses the same arguments as the **ISDN_GET_PARAM** *command.*

ISDN_GET_PARAM

fd is the file descriptor for a management device. *arg* is a pointer to a **struct isdn_param** This *command* provides for querying the value of a particular ISDN physical layer parameter.

```
typedef enum {
        ISDN_PARAM_NONE = 0,
        ISDN_PARAM_NT_T101,             /* NT Timer, 5-30 s, in milliseconds */
        ISDN_PARAM_NT_T102,             /* NT Timer, 25-100 ms, in milliseconds */
        ISDN_PARAM_TE_T103,             /* TE Timer, 5-30 s, in milliseconds */
        ISDN_PARAM_TE_T104,             /* TE Timer, 500-1000 ms, in milliseconds */
        ISDN_PARAM_MAINT,               /* Manage the TE Maintenance Channel */
        ISDN_PARAM_ASMB,                /* Modify Activation State Machine */
                                        /* Behavior */
        ISDN_PARAM_POWER,               /* Take the interface online or offline */
        ISDN_PARAM_PAUSE,               /* Paused if == 1, else not paused == 0 */
} isdn_param_tag_t;

enum isdn_param_asmb {
        ISDN_PARAM_TE_ASMB_CCITT88,             /* 1988 bluebook */
        ISDN_PARAM_TE_ASMB_CTS2,                /* Conformance Test Suite 2 */
};
```

```
typedef struct isdn_param {
        isdn_param_tag_t        tag;
        union {
                unsigned int                    us;             /* micro seconds */
                unsigned int                    ms;             /* Timer value in ms */
                unsigned int                    flag;           /* Boolean */
                enum isdn_param_asmb            asmb;
                enum isdn_param_maint           maint;
                struct {
                        isdn_chan_t             channel;        /* Channel to Pause */
                        int                     paused;         /* TRUE or FALSE */
                } pause;
                unsigned int                    reserved[2];    /* reserved, set to zero */
        } value;
} isdn_param_t;
```

ISDN_PARAM_POWER

If an implementation provides power on and off functions, then power should be on by default. If **flag** is **ISDN_PARAM_POWER_OFF** then a TE interface is forced into state F0, NT interfaces are forced into state G0. If **flag** is **ISDN_PARAM_POWER_ON** then a TE interface will immediately transition to state F3 when the TE D-channel is opened. If **flag** is one, an NT interface will transition to state G1 when the NT D-channel is opened.

Implementations that do not provide **ISDN_POWER** return failure with errno set to **ENXIO**.

ISDN_POWER is different from **ISDN_PH_ACTIVATE_REQ** since CCITT specification requires that if a BRI-TE interface device has power, then it permits activation.

ISDN_PARAM_NT_T101

This parameter accesses the NT timer value T1. The CCITT recommendations specify that timer T1 has a value from 5 to 30 seconds. Other standards may differ.

ISDN_PARAM_NT_T102

This parameter accesses the NT timer value T2. The CCITT recommendations specify that timer T2 has a value from 25 to 100 milliseconds. Other standards may differ.

ISDN_PARAM_TE_T103

This parameter accesses the TE timer value T3. The CCITT recommendations specify that timer T3 has a value from 5 to 30 seconds. Other standards may differ.

ISDN_PARAM_TE_T104

This parameter accesses the TE timer value T4. The CTS2 specifies that timer T4 is either not used or has a value from 500 to 1000 milliseconds. Other standards may differ. CTS2 requires that timer T309 be implemented if T4 is not available.

ISDN_PARAM_MAINT

This parameter sets the multi-framing mode of a BRI-TE interface. For normal

operation this parameter should be set to **ISDN_PARAM_MAINT_ECHO**. Other uses of this parameter are dependent on the definition and use of the BRI interface S and Q channels.

ISDN_PARAM_ASMB

There are a few differences in the BRI-TE interface activation state machine standards. This parameter allows the selection of the appropriate standard. At this time, only **ISDN_PARAM_TE_ASMB_CCITT88** and **ISDN_PARAM_TE_ASMB_CTS2** are available.

ISDN_PARAM_PAUSE

This parameter allows a management device to pause the IO on a B-channel. **pause.channel** is set to indicate which channel is to be paused or un-paused. **pause.paused** is set to zero to un-pause and one to pause. *fd* is associated with an ISDN interface management device. *arg* is a pointer to a **struct isdn_param**.

ISDN_SET_LOOPBACK

fd is the file descriptor for an ISDN interface's management device. *arg* is a pointer to an **isdn_loopback_request_t** structure.

```
typedef enum {
        ISDN_LOOPBACK_LOCAL,
        ISDN_LOOPBACK_REMOTE,
} isdn_loopback_type_t;

typedef enum {
        ISDN_LOOPBACK_B1 =          0x1,
        ISDN_LOOPBACK_B2 =          0x2,
        ISDN_LOOPBACK_D =           0x4,
        ISDN_LOOPBACK_E_ZERO =      0x8,
        ISDN_LOOPBACK_S =           0x10,
        ISDN_LOOPBACK_Q =           0x20,
} isdn_loopback_chan_t;

typedef struct isdn_loopback_request {
        isdn_loopback_type_t        type;
        int                         channels;
} isdn_loopback_request_t;
```

An application can receive D-channel data during D-Channel loopback but cannot transmit data. The field type is the bitwise OR of at least one of the following values:

```
ISDN_LOOPBACK_B1            (0x1)       /* loopback on B1-channel */
ISDN_LOOPBACK_B2            (0x2)       /* loopback on B2-channel */
ISDN_LOOPBACK_D             (0x4)       /* loopback on D-channel */
ISDN_LOOPBACK_E_ZERO        (0x8)       /* force E-channel to Zero if
                /* fd is for NT interface */
ISDN_LOOPBACK_S             (0x10)      /* loopback on S-channel */
ISDN_LOOPBACK_Q             (0x20)      /* loopback on Q-channel */
```

ISDN_RESET_LOOPBACK

arg is a pointer to an **isdn_loopback_request_t** structure. **ISDN_RESET_LOOPBACK** turns off the selected loopback modes.

ISDN data format

The **isdn_format_t** type is meant to be a complete description of the various data modes and rates available on an ISDN interface. Several macros are available for setting the format fields. The **isdn_format_t** structure is shown below:

```
/* ISDN channel data format */

typedef enum {
        ISDN_MODE_NOTSPEC,              /* Not specified */
        ISDN_MODE_HDLC,                 /* HDLC framing and error */
                                        /* checking */
        ISDN_MODE_TRANSPARENT           /* Transparent mode */
} isdn_mode_t;

/* Audio encoding types (from audioio.h) */
#define AUDIO_ENCODING_NONE     (0)     /* no encoding*/
#define AUDIO_ENCODING_ULAW     (1)     /* mu-law */
#define AUDIO_ENCODING_ALAW     (2)     /* A-law */
#define AUDIO_ENCODING_LINEAR   (3)     /* Linear PCM */

typedef struct isdn_format {
        isdn_mode_t     mode;
        unsigned int    sample_rate;    /* sample frames/sec*/
        unsigned int    channels;       /* # interleaved chans */
        unsigned int    precision;      /* bits per sample */
        unsigned int    encoding;       /* data encoding */
} isdn_format_t;

/*
 * These macros set the fields pointed
 * to by the macro argument (isdn_format_t*)fp in preparation
 * for the ISDN_SET_FORMAT ioctl.
 */
ISDN_SET_FORMAT_BRI_D(fp)               /* BRI D-channel */
ISDN_SET_FORMAT_PRI_D(fp)               /* PRI D-channel */
ISDN_SET_FORMAT_HDLC_B64(fp)            /* BRI B-ch @ 56kbps */
ISDN_SET_FORMAT_HDLC_B56(fp)            /* BRI B-ch @ 64kbps */
ISDN_SET_FORMAT_VOICE_ULAW(fp)          /* BRI B-ch voice */
ISDN_SET_FORMAT_VOICE_ALAW(fp)          /* BRI B-ch voice */
ISDN_SET_FORMAT_BRI_H(fp)               /* BRI H-channel */
```

ISDN Datapath Types

Every STREAMS stream that carries data to or from the ISDN serial interfaces is classified as a channel-stream datapath. A possible ISDN channel-stream datapath device name for a TE could be **/dev/isdn/0/te/b1**.

On some hardware implementations, it is possible to route the data from hardware channel to hardware channel completely within the chip or controller. This is classified as a channel-channel datapath. There does not need to be any open file descriptor for either channel in this configuration. Only when data enters the host and utilizes a STREAMS stream is this classified as an ISDN channel-stream datapath.

ISDN Management Stream

A management stream is a STREAMS stream that exists solely for control purposes and is not intended to carry data to or from the ISDN serial interfaces. A possible management device name for a TE could be **/dev/isdn/0/te/mgt**.

Channel Management IOCTLS

The following ioctls describe operations on individual channels and the connection of multiple channels.

ISDN_SET_FORMAT

fd is a data channel, the management pseudo-channel associated with the data channel, or the management channel associated with the data channel's interface or controller. *arg* is a pointer to a **struct isdn_format_req**. The **ISDN_SET_FORMAT** ioctl sets the format of an ISDN channel-stream datapath. It may be issued on both an open ISDN channel-stream datapath Stream or an ISDN Management Stream. Note that an **open**(2) call for a channel-stream datapath will fail if an **ISDN_SET_FORMAT** has never been issued after a reset, as the mode for all channel-stream datapaths is initially biased to **ISDN_MODE_NOTSPEC**. *arg* is a pointer to an ISDN format type (**isdn_format_req_t***).

```
typedef struct isdn_format_req {
        isdn_chan_t     channel;
        isdn_format_t   format;         /* data format */
        int             reserved[4];    /* future use - must be 0 */
} isdn_format_req_t;
```

If there is not an open channel-stream datapath for a requested channel, the default format of that channel will be set for a subsequent **open**(2).

To modify the format of an open STREAM, the driver will disconnect the hardware channel, flush the internal hardware queues, set the new default configuration, and finally reconnect the data path using the newly specified format. Upon taking effect, all state information will be reset to initial conditions, as if a channel was just opened. It is suggested that the user flush the interface as well as consult the hardware specific documentation to insure data integrity.

If a user desires to connect more than one B channel, such as an H-channel, the B-channel with the smallest offset should be specified, then the precision should be specified multiples of 8.

For an H-channel the precision value would be 16. The user should subsequently open the base B-channel. If any of the sequential B-channels are busy the open will fail, otherwise all of the B-channels that are to be used in conjunction will be marked as busy.

The returned failure codes and their descriptions are listed below:

```
EPERM       /* No permission for intented operation */
EINVAL      /* Invalid format request */
EIO         /* Set format attempt failed. */
```

ISDN_SET_CHANNEL

The **ISDN_SET_CHANNEL** ioctl sets up a data connection within an ISDN controller. The **ISDN_SET_CHANNEL ioctl** can only be issued from an ISDN management stream to establish or modify channel-channel datapaths. The ioctl

parameter *arg* is a pointer to an ISDN connection request (**isdn_conn_req_t***). Once a data path is established, data flow is started as soon as the path endpoints become active. Upon taking effect, all state information is reset to initial conditions, as if a channel was just opened.

The **isdn_conn_req_t** structure is shown below. The five fields include the receive and transmit ISDN channels, the number of directions of the data path, as well as the data format. The reserved field must always be set to zero.

```
/* Number of directions for data flow */
typedef enum {
        ISDN_PATH_NOCHANGE = 0,/* Invalid value */
        ISDN_PATH_DISCONNECT,  /* Disconnect data path */
        ISDN_PATH_ONEWAY,      /* One way data path */
        ISDN_PATH_TWOWAY,      /* Bi-directional data path */
} isdn_path_t;


typedef struct isdn_conn_req {
        isdn_chan_t     from;
        isdn_chan_t     to;
        isdn_path_t     dir;            /* uni/bi-directional or disconnect */
        isdn_format_t   format;         /* data format */
        int             reserved[4];    /* future use - must be 0 */
} isdn_conn_req_t;
```

To specify a read-only, write-only, or read-write path, or to disconnect a path, the **dir** field should be set to **ISDN_PATH_ONEWAY**, **ISDN_PATH_TWOWAY**, and **ISDN_PATH_DISCONNECT** respectively. To modify the format of a channel-channel datapath, a user must disconnect the channel and then reconnect with the desired format.

The returned failure codes and their descriptions are listed below:

```
EPERM           /* No permission for intented operation */
EBUSY           /* Connection in use */
EINVAL          /* Invalid connection request */
EIO             /* Connection attempt failed. */
```

ISDN_GET_FORMAT

The **ISDN_GET_FORMAT** ioctl gets the ISDN data format of the channel-stream datapath described by *fd*. *arg* is a pointer to an ISDN data format request type (**isdn_format_req_t***). **ISDN_GET_FORMAT** can be issued on any channel to retrieve the format of any channel it owns. For example, if issued on the TE management channel, the format of any other te channel can be retrieved.

ISDN_GETCONFIG

The **ISDN_GETCONFIG** ioctl is used to get the current connection status of all ISDN channels associated with a particular management STREAM. **ISDN_GETCONFIG** also retrieves a hardware identifier and the generic interface type. *arg* is an ISDN connection table pointer (**isdn_conn_tab_t***). The **isdn_conn_tab_t** structure is shown below:

```
typedef struct isdn_conn_tab {
    char            name[ISDN_ID_SIZE];  /* identification string */
    isdn_interface_t type;
    int             maxpaths;            /* size in entries of app's
                                            array */
    int             npaths;              /*
                                          * number of valid entries
                                          * returned by driver
                                          */
    isdn_conn_req_t *paths;              /* connection table in app's
                                            memory */
} isdn_conn_tab_t;
```

The table contains a string which is the interface's unique identification string. The second element of this table contains the ISDN transmit and receive connections and configuration for all possible data paths for each type of ISDN controller hardware. Entries that are not connected will have a value of **ISDN_NO_CHAN** in the **from** and **to** fields. The number of entries will always be **ISDN_MAX_CHANS**, and can be referenced in the hardware specific implementation documentation. An **isdn_conn_tab_t** structure is allocated on a per controller basis.

SEE ALSO

ioctl(2), **poll**(2), **read**(2), **write**(2), **audio**(7), **dbri**(7), **streamio**(7)

"ISDN, An Introduction", by William Stallings, Macmillian Publishing Company, ISBN 0-02-415471-7

NAME

isp – ISP SCSI Host Bus Adapter Driver

SYNOPSIS

isp@*sbus-slot*,0x10000

AVAILABILITY

Limited to the SparcStation10 line, the SparcStation20 line and the SparcCenter line of systems.

DESCRIPTION

The **isp** Host Bus Adapter is a SCSA compliant nexus driver that supports the Qlogic ISP1000 SCSI chip. The ISP1000 SCSI is an intelligent SCSI host Bus Adapter chip that reduces the amount of CPU overhead used in a SCSI transfer.

The **isp** driver supports the standard functions provided by the SCSA interface. The driver supports tagged and untagged queueing, fast and wide SCSI, auto request sense but does not support linked commands.

Driver Configuration

The **isp** driver can be configured by defining properties in **isp.conf** which override the global SCSI settings. Supported properties are **scsi-options, scsi-reset-delay, scsi-watchdog-tick, scsi-tag-age-limit, scsi-initiator-id**.

Refer to **scsi_hba_attach**(9F) for details.

EXAMPLE

Create a file **/kernel/drv/isp.conf** and add this line:

scsi-options=0x78;

This will disable tagged queueing, fast SCSI, and Wide mode for all isp instances. To disable an option for one specific isp (refer to **driver.conf**(4)):

```
name="isp" parent="/io-unit@f,e1200000/sbi@0,0"
    reg=3, 0x10000, 0x450
     scsi-options = 0x58 scsi-initiator-id = 15;
```

Note that the default initiator ID in OBP is 7 and that the change to ID 15 will occur at attach time. It may be preferable to change the initiator ID in OBP.

FILES

/kernel/drv/isp	ELF Kernel Module
/kernel/drv/isp.conf	Configuration file

SEE ALSO

prtconf(1M), **driver.conf**(4), **scsi_hba_attach**(9F), **scsi_abort**(9F), **scsi_ifgetcap**(9F), **scsi_ifsetcap**(9F), **scsi_reset**(9F), **scsi_transport**(9F), **scsi_device**(9S), **scsi_extended_sense**(9S), **scsi_inquiry**(9S), **scsi_pkt**(9S)

Writing Device Drivers

ANSI Small Computer System Interface-2 (SCSI-2)

ISP1000 Firmware Interface Specification, QLogic Corp.

ISP1000 Technical Manual, QLogic Corp.

DIAGNOSTICS

The messages described below are some that may appear on the system console, as well as being logged.

This first set of messages may be displayed while the **isp** driver is first trying to attach. All of these messages mean that the **isp** driver was unable to attach. These messages are preceded by "isp%d", where "%d" is the instance number of the isp controller.

Device in slave-only slot, unused
The SBus device has been placed in a slave-only slot and will not be accessible; move to non-slave-only SBus slot.

Device is using a hilevel intr, unused
The device was configured with a interrupt level that cannot be used with this **isp** driver, check the SBus device.

Failed to alloc soft state
Driver was unable to allocate space for the internal state structure. Driver did not attach to device, SCSI devices will be inaccessible.

Bad soft state
Driver requested an invalid internal state structure. Driver did not attach to device, SCSI devices will be inaccessible.

Unable to map registers;
Driver was unable to map device registers; check for bad hardware. Driver did not attach to device, SCSI devices will be inaccessible.

Cannot add intr
Driver was not able to add the interrupt routine to the kernel. Driver did not attach to device, SCSI devices will be inaccessible.

Unable to attach
Driver was unable to attach to the hardware for some reason that may be printed. Driver did not attach to device, SCSI devices will be inaccessible.

This next set of messages can be displayed at any time, they will be printed with the full device pathname followed by the shorter form described above.

Firmware should be < 0x%x bytes
Firmware size exceeded allocated space; will not download firmware. This could mean that the firmware was corrupted somehow; check the **isp** driver.

Firmware checksum incorrect
Firmware has an invalid checksum and will not be downloaded.

Chip reset timeout
ISP1000 failed to reset in the time allocated, may be bad hardware.

Stop firmware failed
Stopping the firmware failed, may be bad hardware.

Load ram failed
Unable to download new firmware into the ISP1000 chip

DMA setup failed
The DMA setup failed in the host adapter driver on a **scsi_pkt;** this will return **TRAN_BADPKT** to a SCSA target driver.

Bad request pkt
The ISP Firmware rejected the packet as being setup incorrectly. This will cause the **isp** driver to call the target completion routine with the reason of **CMD_TRAN_ERR** set in the **scsi_pkt**. Check the target driver for correctly setting up the packet.

Bad request pkt header
The ISP Firmware rejected the packet as being setup incorrectly. This will cause the **isp** driver to call the target completion routine with the reason of **CMD_TRAN_ERR** set in the **scsi_pkt**. Check the target driver for correctly setting up the packet.

Polled command timeout on %d.%d
A polled command experienced a timeout; the target device, as noted by the target lun (%d.%d) info, may not be responding correctly to the command, or the ISP1000 chip may be hung. This will cause an error recovery to be initiated in the **isp** driver. This could mean a bad device or cabling.

Firmware error
The ISP1000 Chip encountered a firmware error of some kind. This error will cause the **isp** driver to do error recovery by resetting the chip.

Received unexpected SCSI Reset
The ISP1000 chip received an unexpected SCSI Reset and has initiated its own internal error recovery, which will return all the **scsi_pkt** with reason set to **CMD_RESET.**

Fatal timeout on target %d.%d
The **isp** driver found a command that had not completed in the correct amount of time; this will cause error recovery by the **isp** driver. The device that experienced the timeout was at target lun (%d.%d).

Fatal error, resetting interface
This is an indication that the **isp** driver is doing error recovery. This will cause all outstanding commands that have been transported to the **isp** driver to be completed via the **scsi_pkt** completion routine in the target driver with reason of **CMD_RESET** and status of **STAT_BUS_RESET** set in the **scsi_pkt.**

WARNINGS

The current release of the **isp** driver only supports FAST (10M/s) SCSI-2 disks. In the future, tapes and other devices will be supported.

NOTES

The **isp** driver exports properties indicating per target the negotiated transfer speed **(target<n>-sync-speed),** whether tagged queueing has been enabled **(target<n>-TQ),** and whether the wide data transfer has been negotiated **(target<n>-wide).** The sync-speed property value is the data transfer rate in KB/sec. The target-TQ and target-wide properties have no value. The existence of these properties indicate that tagged queueing or

wide transfer has been enabled. Refer to **prtconf**(1M) (verbose option) for viewing the **isp** properties.

```
QLGC,isp, instance #2
   Driver software properties:
      name <target0-TQ> length <0> -- <no value>.
      name <target0-wide> length <0> -- <no value>.
      name <target0-sync-speed> length <4>
         value <0x000028f5>.
      name <scsi-options> length <4>
         value <0x000003f8>.
      name <scsi-watchdog-tick> length <4>
         value <0x0000000a>.
      name <scsi-tag-age-limit> length <4>
         value <0x00000008>.
      name <scsi-reset-delay> length <4>
         value <0x00000bb8>.
```

NAME

kb – keyboard STREAMS module

SYNOPSIS

```
#include <sys/types.h>
#include <sys/stream.h>
#include <sys/stropts.h>
#include <sys/vuid_event.h>
#include <sys/kbio.h>
#include <sys/kbd.h>

ioctl(fd, I_PUSH, "kb");
```

AVAILABILITY

SPARC

DESCRIPTION

The **kb** STREAMS module processes byte streams generated by keyboard attached to a CPU serial port. Definitions for altering keyboard translation, and reading events from the keyboard, are in **<sys/kbio.h>** and **<sys/kbd.h>**.

kb recognizes which keys have been typed using a set of tables for each known type of keyboard. Each translation table is an array of 128 16-bit words (**unsigned short**s). If an entry in the table is less than 0x100, it is treated as an ISO 8859/1 character. Higher values indicate special characters that invoke more complicated actions.

Keyboard Translation Mode

The keyboard can be in one of the following translation modes:

TR_NONE	Keyboard translation is turned off and up/down key codes are reported.
TR_ASCII	ISO 8859/1 codes are reported.
TR_EVENT	**firm_events** are reported.
TR_UNTRANS_EVENT	**firm_events** containing unencoded keystation codes are reported for all input events within the window system.

Keyboard Translation-Table Entries

All instances of the **kb** module share seven translation tables used to convert raw keystation codes to event values. The tables are:

Unshifted	Used when a key is depressed and no shifts are in effect.
Shifted	Used when a key is depressed and a Shift key is being held down.
Caps Lock	Used when a key is depressed and Caps Lock is in effect.
Alt Graph	Used when a key is depressed and the Alt Graph key is being held down.
Num Lock	Used when a key is depressed and Num Lock is in effect.

Controlled	Used when a key is depressed and the Control key is being held down (regardless of whether a Shift key or the Alt Graph is being held down, or whether Caps Lock or Num Lock is in effect).
Key Up	Used when a key is released.

Each key on the keyboard has a "key station" code which is a number from 0 to 127. This number is used as an index into the translation table that is currently in effect. If the corresponding entry in that translation table is a value from 0 to 255, this value is treated as an ISO 8859/1 character, and that character is the result of the translation.

If the entry is a value above 255, it is a "special" entry. Special entry values are classified according to the value of the high-order bits. The high-order value for each class is defined as a constant, as shown in the list below. The value of the low-order bits, when added to this constant, distinguishes between keys within each class:

SHIFTKEYS 0x100 — A shift key. The value of the particular shift key is added to determine which shift mask to apply:

CAPSLOCK 0	"Caps Lock" key.
SHIFTLOCK 1	"Shift Lock" key.
LEFTSHIFT 2	Left-hand "Shift" key.
RIGHTSHIFT 3	Right-hand "Shift" key.
LEFTCTRL 4	Left-hand (or only) "Control" key.
RIGHTCTRL 5	Right-hand "Control" key.
ALTGRAPH 9	"Alt Graph" key.
ALT 10	"Alternate" or "Alt" key.
NUMLOCK 11	"Num Lock" key.

BUCKYBITS 0x200 — Used to toggle mode-key-up/down status without altering the value of an accompanying ISO 8859/1 character. The actual bit-position value, minus 7, is added.

METABIT 0	The "Meta" key was pressed along with the key. This is the only user-accessible bucky bit. It is ORed in as the 0x80 bit; since this bit is a legitimate bit in a character, the only way to distinguish between, for example, 0xA0 as META+0x20 and 0xA0 as an 8-bit character is to watch for "META key up" and "META key down" events and keep track of whether the META key was down.
SYSTEMBIT 1	The "System" key was pressed. This is a place holder to indicate which key is the system-abort key.

FUNNY 0x300 — Performs various functions depending on the value of the low 4 bits:

NOP 0x300	Does nothing.
OOPS 0x301	Exists, but is undefined.
HOLE 0x302	There is no key in this position on the keyboard, and the position-code should not be used.
RESET 0x306	Keyboard reset.
ERROR 0x307	The keyboard driver detected an internal error.
IDLE 0x308	The keyboard is idle (no keys down).
COMPOSE 0x309	This key is the COMPOSE key; the next two keys should comprise a two-character "COMPOSE key" sequence.
NONL 0x30A	Used only in the Num Lock table; indicates that this key is not affected by the Num Lock state, so that the translation table to use to translate this key should be the one that would have been used had Num Lock not been in effect.
0x30B — 0x30F	Reserved for nonparameterized functions.

FA_CLASS 0x400 — This key is a "floating accent" or "dead" key. When this key is pressed, the next key generates an event for an accented character; for example, "floating accent grave" followed by the "a" key generates an event with the ISO 8859/1 code for the "a with grave accent" character. The low-order bits indicate which accent; the codes for the individual "floating accents" are as follows:

FA_UMLAUT 0x400	umlaut
FA_CFLEX 0x401	circumflex
FA_TILDE 0x402	tilde
FA_CEDILLA 0x403	cedilla
FA_ACUTE 0x404	acute accent
FA_GRAVE 0x405	grave accent

STRING 0x500 — The low-order bits index a table of strings. When a key with a **STRING** entry is depressed, the characters in the null-terminated string for that key are sent, character by character. The maximum length is defined as:

KTAB_STRLEN 10

Individual string numbers are defined as:

HOMEARROW 0x00
UPARROW 0x01
DOWNARROW 0x02
LEFTARROW 0x03
RIGHTARROW 0x04

String numbers 0x05 — 0x0F are available for custom entries.

FUNCKEYS 0x600 Function keys. The next-to-lowest 4 bits indicate the group of function keys:

LEFTFUNC 0x600
RIGHTFUNC 0x610
TOPFUNC 0x620
BOTTOMFUNC 0x630

The low 4 bits indicate the function key number within the group:

LF(*n*)	(LEFTFUNC+(*n*)-1)
RF(*n*)	(RIGHTFUNC+(*n*)-1)
TF(*n*)	(TOPFUNC+(*n*)-1)
BF(*n*)	(BOTTOMFUNC+(*n*)-1)

There are 64 keys reserved for function keys. The actual positions may not be on left / right / top / bottom of the keyboard, although they usually are.

PADKEYS 0x700

This key is a “numeric keypad key.” These entries should appear only in the Num Lock translation table; when Num Lock is in effect, these events will be generated by pressing keys on the right-hand keypad. The low-order bits indicate which key; the codes for the individual keys are as follows:

PADEQUAL 0x700	“=” key
PADSLASH 0x701	“ / ” key
PADSTAR 0x702	“*” key
PADMINUS 0x703	“-” key
PADSEP 0x704	“,” key
PAD7 0x705	“7” key
PAD8 0x706	“8” key
PAD9 0x707	“9” key
PADPLUS 0x708	“+” key
PAD4 0x709	“4” key
PAD5 0x70A	“5” key
PAD6 0x70B	“6” key
PAD1 0x70C	“1” key
PAD2 0x70D	“2” key

PAD3 0x70E "3" key

PAD0 0x70F "0" key

PADDOT 0x710 "." key

PADENTER 0x711 "Enter" key

In **TR_ASCII** mode, when a function key is pressed, the following escape sequence is sent:

ESC[0 . . . 9z

where ESC is a single escape character and "0 . . 9" indicates the decimal representation of the function-key value. For example, function key **R1** sends the sequence:

ESC[208z

because the decimal value of RF(1) is 208. In **TR_EVENT** mode, if there is a VUID event code for the function key in question, an event with that event code is generated; otherwise, individual events for the characters of the escape sequence are generated.

Keyboard Compatibility Mode

kb is in "compatibility mode" when it starts up. In this mode, when the keyboard is in the **TR_EVENT** translation mode, ISO 8859/1 characters from the "upper half" of the character set (that is, characters with the 8th bit set) are presented as events with codes in the **ISO_FIRST** range (as defined in **<sys/vuid_event.h>**). The event code is **ISO_FIRST** plus the character value. This is for backwards compatibility with older versions of the keyboard driver. If compatibility mode is turned off, ISO 8859/1 characters are presented as events with codes equal to the character code.

IOCTLS

The following **ioctl( )** requests set and retrieve the current translation mode of a keyboard:

KIOCTRANS The argument is a pointer to an **int**. The translation mode is set to the value in the **int** pointed to by the argument.

KIOCGTRANS The argument is a pointer to an **int**. The current translation mode is stored in the **int** pointed to by the argument.

ioctl( ) requests for changing and retrieving entries from the keyboard translation table use the **kiockeymap** structure:

```
struct kiockeymap {
    int     kio_tablemask;  /* Translation table (one of: 0, CAPSMASK,
                             * SHIFTMASK, CTRLMASK, UPMASK,
                             * ALTGRAPHMASK, NUMLOCKMASK)
                             */
#define KIOCABORT1 -1       /* Special "mask": abort1 keystation */
#define KIOCABORT2 -2       /* Special "mask": abort2 keystation */
    u_char  kio_station;    /* Physical keyboard key station (0-127) */
    u_short kio_entry;      /* Translation table station's entry */
    char    kio_string[10]; /* Value for STRING entries (null terminated) */
};
```

KIOCSKEY The argument is a pointer to a **kiockeymap** structure. The translation table entry referred to by the values in that structure is changed.

kio_tablemask specifies which of the five translation tables contains the

entry to be modified:

UPMASK 0x0080 "Key Up" translation table.

NUMLOCKMASK 0x0800
"Num Lock" translation table.

CTRLMASK 0x0030 "Controlled" translation table.

ALTGRAPHMASK 0x0200
"Alt Graph" translation table.

SHIFTMASK 0x000E "Shifted" translation table.

CAPSMASK 0x0001 "Caps Lock" translation table.

(No shift keys pressed or locked)
"Unshifted" translation table.

kio_station specifies the keystation code for the entry to be modified. The value of **kio_entry** is stored in the entry in question. If **kio_entry** is between STRING and STRING+15, the string contained in **kio_string** is copied to the appropriate string table entry. This call may return **-EINVAL** if there are invalid arguments.

There are a couple special values of **kio_tablemask** that affect the two step "break to the PROM monitor" sequence. The usual sequence is **L1**–**a** or **Stop**–**a .** If **kio_tablemask** is **KIOCABORT1** then the value of **kio_station** is set to be the first keystation in the sequence. If **kio_tablemask** is **KIOCABORT2** then the value of **kio_station** is set to be the second keystation in the sequence.

KIOCGKEY The argument is a pointer to a **kiockeymap** structure. The current value of the keyboard translation table entry specified by **kio_tablemask** and **kio_station** is stored in the structure pointed to by the argument. This call may return **EINVAL** if there are invalid arguments.

KIOCTYPE The argument is a pointer to an **int**. A code indicating the type of the keyboard is stored in the **int** pointed to by the argument:

KB_SUN3 Sun Type 3 keyboard
KB_SUN4 Sun Type 4 keyboard
KB_ASCII ASCII terminal masquerading as keyboard

KB_DEFAULT is stored in the **int** pointed to by the argument, if the keyboard type is unknown. In case of error, -1 is stored in the **int** pointed to by the argument.

KIOCLAYOUT The argument is a pointer to an **int**. On a Sun Type 4 keyboard, the layout code specified by the keyboard's DIP switches is stored in the **int** pointed to by the argument.

KIOCCMD The argument is a pointer to an **int**. The command specified by the value of the **int** pointed to by the argument is sent to the keyboard. The commands that can be sent are:

Commands to the Sun Type 3 and Sun Type 4 keyboards:

KBD_CMD_RESET Reset keyboard as if power-up.
KBD_CMD_BELL Turn on the bell.
KBD_CMD_NOBELL Turn off the bell.
KBD_CMD_CLICK Turn on the click annunciator.
KBD_CMD_NOCLICK Turn off the click annunciator.

Commands to the Sun Type 4 keyboard:

KBD_CMD_SETLED Set keyboard LEDs.
KBD_CMD_GETLAYOUT Request that keyboard indicate layout.

Inappropriate commands for particular keyboard types are ignored. Since there is no reliable way to get the state of the bell or click (because we cannot query the keyboard, and also because a process could do writes to the appropriate serial driver — thus going around this **ioctl()** request) we do not provide an equivalent **ioctl()** to query its state.

KIOCSLED The argument is a pointer to an **char**. On the Sun Type 4 keyboard, the LEDs are set to the value specified in that **char**. The values for the four LEDs are:

LED_CAPS_LOCK "Caps Lock" light.
LED_COMPOSE "Compose" light.
LED_SCROLL_LOCK "Scroll Lock" light.
LED_NUM_LOCK "Num Lock" light.

On some of the Japanese layouts, the value for the fifth LED is:

LED_KANA "Kana" light.

KIOCGLED The argument is a pointer to a **char**. The current state of the LEDs is stored in the **char** pointed to by the argument.

KIOCSCOMPAT The argument is a pointer to an **int**. "Compatibility mode" is turned on if the **int** has a value of 1, and is turned off if the **int** has a value of 0.

KIOCGCOMPAT The argument is a pointer to an **int**. The current state of "compatibility mode" is stored in the **int** pointed to by the argument.

These **ioctl( )** requests are supported for compatibility with the system keyboard device **/dev/kbd**.

KIOCSDIRECT Has no effect.

KIOCGDIRECT Always returns 1.

SEE ALSO

loadkeys(1), **keytables**(4), **termio**(7)

NOTES

Many of the keyboards released after Sun Type 4 keyboard also report themselves as Sun Type 4 keyboard.

NAME

kdmouse – built-in mouse device interface

AVAILABILITY

x86

DESCRIPTION

The **kdmouse** driver supports Micro Channel architecture mice and compatibles (such as the IBM PS/2 mouse) on machines with built-in mouse interfaces such as the 20e and the model 80. It allows applications to obtain information about the mouse's movements and the status of its buttons.

Programs are able to read directly from the device. The data returned corresponds to the byte sequences as defined in the *IBM PS/2 Technical Reference Manual*.

FILES

/dev/kdmouse

NOTES

After the mouse has been disconnected, when you plug it back in, you see the following message on the system console:

WARNING: kdmouse: detected mouse connection

and the system will continue to operate normally. If the message does not applear within 1 second of plugging the mouse back in, disconnect the mouse and plug it in again.

NAME

keyboard – system console keyboard

AVAILABILITY

x86

DESCRIPTION

keyboard is a component of the **kd** driver, which is comprised of the **display** and **keyboard** drivers.

The Solaris for x86 keyboard may be either an 84- or a 101-key standard PC keyboard. When the system is booting, keyboard services are provided by the keyboard section of the **kd** driver.

Developers are not encouraged to write programs that communicate directly with the keyboard; they should make use of the environment provided by the windows server.

FILES

/dev/console

SEE ALSO

console(7), **display**(7)

NAME

kstat – kernel statistics driver

DESCRIPTION

The **kstat** driver is the mechanism used by the **kstat**(3K) library to extract kernel statistics. This is NOT a public interface.

FILES

/dev/kstat
kernel statistics driver

SEE ALSO

kstat(3K), **kstat**(9S)

NAME

ksyms – kernel symbols

SYNOPSIS

/dev/ksyms

DESCRIPTION

The file **/dev/ksyms** is a character special file that allows read-only access to an ELF format image containing two sections: a symbol table and a corresponding string table. The contents of the symbol table reflect the symbol state of the currently running kernel. You can determine the size of the image with the **fstat**( ) system call. The recommended method for accessing the **/dev/ksyms** file is by using the ELF access library. See **elf**(3E) for details. If you are unfamiliar with the ELF format, consult the **a.out**(4) manual page.

/dev/ksyms is an executable for the processor on which you are accessing it. It contains ELF program headers which describe the text and data segment(s) in kernel memory. Since **/dev/ksyms** has no text or data, the fields specific to file attributes are initialized to NULL. The remaining fields describe the text or data segment(s) in kernel memory.

Symbol table The SYMTAB section contains the symbol table entries present in the currently running kernel. This section is ordered as defined by the ELF definition with locally-defined symbols first, followed by globally-defined symbols. Within symbol type, the symbols are ordered by kernel module load time. For example, the kernel file (**/kernel/unix**) symbols are first, followed by the first module's symbols, and so on, ending with the symbols from the last module loaded.

The section header index (st_shndx) field of each symbol entry in the symbol table is set to SHN_ABS, because any necessary symbol relocations are performed by the kernel link editor at module load time.

String table The STRTAB section contains the symbol name strings that the symbol table entries reference.

FILES

/kernel/unix system namelist

SEE ALSO

mmap(2), **stat**(2), **elf**(3E), **kvm_open**(3K), **a.out**(4), **mem**(7)

WARNINGS

The kernel is dynamically configured. It loads kernel modules when necessary. Because of this aspect of the system, the symbol information present in the running system can vary from time to time, as kernel modules are loaded and unloaded.

When you open the **/dev/ksyms** file, you have access to an ELF image which represents a snapshot of the state of the kernel symbol information at that instant in time. While the **/dev/ksyms** file remains open, kernel module autounloading is disabled, so that you are protected from the possibility of acquiring stale symbol data. Note that new modules can still be loaded, however. If kernel modules are loaded while you have the **/dev/ksyms** file open, the snapshot held by you will not be updated. In order to have access to the symbol information of the newly loaded modules, you must first close and then reopen the **/dev/ksyms** file. Be aware that the size of the **/dev/ksyms** file will have changed. You will need to use the **fstat( )** function (see **stat**(2)) to determine the new size of the file.

Avoid keeping the **/dev/ksyms** file open for extended periods of time, either by using **kvm_open**(3K) of the default namelist file or with a direct open. There are two reasons why you should not hold **/dev/ksyms** open. First, the system's ability to dynamic configure itself is partially disabled by the locking down of loaded modules. Second, the snapshot of symbol information held by you will not reflect the symbol information of modules loaded after your initial open of **/dev/ksyms**.

Note that the **ksyms** driver is a loadable module, and that the kernel driver modules are only loaded during an open system call. Thus it is possible to run **stat**(2) on the **/dev/ksyms** file without causing the **ksyms** driver to be loaded. In this case, the file size will appear to be zero. A workaround for this behavior is to first open the **/dev/ksyms** file, causing the **ksyms** driver to be loaded (if necessary). You can then use the file descriptor from this open in a **fstat**( ) system call to get the file's size.

NOTES

The kernel virtual memory access library (**libkvm**) routines use **/dev/ksyms** as the default namelist file. See **kvm_open**(3K) for more details.

The **/dev/ksyms** ELF image can be mapped into a process's address space. See **mmap**(2) for details.

NAME

ldterm – standard STREAMS terminal line discipline module

SYNOPSIS

#include <sys/stream.h>
#include <sys/termios.h>

int ioctl(*fd,* **I_PUSH**, "**ldterm**" **);**

DESCRIPTION

ldterm is a STREAMS module that provides most of the **termio**(7) terminal interface. This module does not perform the low-level device control functions specified by flags in the **c_cflag** word of the **termio/termios** structure or by the **IGNBRK, IGNPAR, PARMRK**, or **INPCK** flags in the **c_iflag** word of the **termio/termios** structure; those functions must be performed by the driver or by modules pushed below the **ldterm** module. **ldterm** performs all other **termio/termios** functions; some of them, however, require the cooperation of the driver or modules pushed below **ldterm** and may not be performed in some cases. These include the **IXOFF** flag in the **c_iflag** word and the delays specified in the **c_oflag** word.

ldterm also handles Extended Unix Code (EUC) and multi-byte characters.

The remainder of this section describes the processing of various STREAMS messages on the read- and write-side.

Read-side Behavior

Various types of STREAMS messages are processed as follows:

M_BREAK

When this message is received, depending on the state of the **BRKINT** flag, either an interrupt signal is generated or the message is treated as if it were an **M_DATA** message containing a single ASCII NUL character.

M_DATA

This message is normally processed using the standard **termio** input processing. If the **ICANON** flag is set, a single input record (''line'') is accumulated in an internal buffer and sent upstream when a line-terminating character is received. If the **ICANON** flag is not set, other input processing is performed and the processed data are passed upstream.

If output is to be stopped or started as a result of the arrival of characters (usually **CNTRL-Q** and **CNTRL-S**), **M_STOP** and **M_START** messages are sent downstream. If the **IXOFF** flag is set and input is to be stopped or started as a result of flow-control considerations, **M_STOPI** and **M_STARTI** messages are sent downstream.

M_DATA messages are sent downstream, as necessary, to perform echoing.

If a signal is to be generated, an **M_FLUSH** message with a flag byte of **FLUSHR** is placed on the read queue. If the signal is also to flush output, an **M_FLUSH** message with a flag byte of **FLUSHW** is sent downstream.

M_CTL

If the size of the data buffer associated with the message is the size of **struct iocblk, ldterm** will perform functional negotiation to determine where the

termio(7) processing is to be done. If the command field of the **iocblk** structure (**ioc_cmd**) is set to **MC_NO_CANON**, the input canonical processing normally performed on **M_DATA** messages is disabled and those messages are passed upstream unmodified; this is for the use of modules or drivers that perform their own input processing, such as a pseudo-terminal in **TIOCREMOTE** mode connected to a program that performs this processing. If the command is **MC_DO_CANON**, all input processing is enabled. If the command is **MC_PART_CANON**, then an **M_DATA** message containing a **termios** structure is expected to be attached to the original **M_CTL** message. The **ldterm** module will examine the **iflag, oflag**, and **lflag** fields of the **termios** structure and from then on will process only those flags which have not been turned ON. If none of the above commands are found, the message is ignored; in any case, the message is passed upstream.

M_FLUSH

The read queue of the module is flushed of all its data messages and all data in the record being accumulated are also flushed. The message is passed upstream.

M_IOCACK

The data contained within the message, which is to be returned to the process, are augmented if necessary, and the message is passed upstream.

All other messages are passed upstream unchanged.

Write-side Behavior

Various types of STREAMS messages are processed as follows:

M_FLUSH

The write queue of the module is flushed of all its data messages and the message is passed downstream.

M_IOCTL

The function of this **ioctl** is performed and the message is passed downstream in most cases. The **TCFLSH** and **TCXONC ioctl**s can be performed entirely in the **ldterm** module, so the reply is sent upstream and the message is not passed downstream.

M_DATA

If the **OPOST** flag is set, or both the **XCASE** and **ICANON** flags are set, output processing is performed and the processed message is passed downstream along with any **M_DELAY** messages generated. Otherwise, the message is passed downstream without change.

All other messages are passed downstream unchanged.

IOCTLS

ldterm processes the following **TRANSPARENT ioctl**s. All others are passed downstream.

TCGETS/TCGETA

The message is passed downstream; if an acknowledgment is seen, the data provided by the driver and modules downstream are augmented and the acknowledgement is passed upstream.

TCSETS/TCSETSW/TCSETSF/TCSETA/TCSETAW/TCSETAF
The parameters that control the behavior of the **ldterm** module are changed. If a mode change requires options at the stream head to be changed, an **M_SETOPTS** message is sent upstream. If the **ICANON** flag is turned on or off, the read mode at the stream head is changed to message-nondiscard or byte-stream mode, respectively. If the **TOSTOP** flag is turned on or off, the tostop mode at the stream head is turned on or off, respectively. In any case, **ldterm** passes the ioctl on downstream for possible additional processing.

TCFLSH
If the argument is 0, an **M_FLUSH** message with a flag byte of **FLUSHR** is sent downstream and placed on the read queue. If the argument is 1, the write queue is flushed of all its data messages and an **M_FLUSH** message with a flag byte of **FLUSHW** is sent upstream and downstream. If the argument is 2, the write queue is flushed of all its data messages and an **M_FLUSH** message with a flag byte of **FLUSHRW** is sent downstream and placed on the read queue.

TCXONC
If the argument is 0 and output is not already stopped, an **M_STOP** message is sent downstream. If the argument is 1 and output is stopped, an **M_START** message is sent downstream. If the argument is 2 and input is not already stopped, an **M_STOPI** message is sent downstream. If the argument is 3 and input is stopped, an **M_STARTI** message is sent downstream.

TCSBRK
The message is passed downstream, so the driver has a chance to drain the data and then send and an **M_IOCACK** message upstream.

EUC_WSET
This call takes a pointer to an **eucioc** structure, and uses it to set the EUC line discipline's local definition for the code set widths to be used for subsequent operations. Within the stream, the line discipline may optionally notify other modules of this setting using **M_CTL** messages.

EUC_WGET
This call takes a pointer to an **eucioc** structure, and returns in it the EUC code set widths currently in use by the EUC line discipline.

SEE ALSO

termios(3), **console**(7), **termio**(7)

STREAMS Programmer's Guide

NAME

le, lebuffer, ledma – Am7990 (LANCE) Ethernet device driver

SYNOPSIS

```
#include <sys/lance.h>
#include <sys/le.h>
#include <sys/dlpi.h>
```

DESCRIPTION

The Am7990 (LANCE) Ethernet driver is a multi-threaded, loadable, clonable, STREAMS hardware driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), over a LANCE Ethernet controller. The motherboard and add-in SBus LANCE controllers of several varieties are supported. Multiple LANCE controllers installed within the system are supported by the driver. The **le** driver provides basic support for the LANCE hardware. Functions include chip initialization, frame transmit and receive, multicast and promiscuous support, and error recovery and reporting.

The cloning character-special device **/dev/le** is used to access all LANCE controllers installed within the system.

The **lebuffer** and **ledma** device drivers are bus nexus drivers which cooperate with the **le** leaf driver in supporting the LANCE hardware functions over several distinct slave-only and DVMA LANCE-based Ethernet controllers. The **lebuffer** and **ledma** bus nexi drivers are not directly accessible to the user.

le and DLPI

The **le** driver is a "style 2" Data Link Service provider. All **M_PROTO** and **M_PCPROTO** type msgs are interpreted as **DLPI** primitives. An explicit **DL_ATTACH_REQ** message by the user is required to associate the opened stream with a particular device (**ppa**). The **ppa** ID is interpreted as an unsigned long and indicates the corresponding device instance (unit) number. An error (**DL_ERROR_ACK**) is returned by the driver if the **ppa** field value does not correspond to a valid device instance number for this system. The device is initialized on first attach and de-initialized (stopped) on last detach.

The values returned by the driver in the **DL_INFO_ACK** primitive in response to the **DL_INFO_REQ** from the user are as follows:

- The max SDU is **1500** (**ETHERMTU**).
- The min SDU is **0**.
- The **dlsap** address length is **8**.
- The MAC type is **DL_ETHER**.
- The **sap** length value is **–2** meaning the physical address component is followed immediately by a 2 byte **sap** component within the **DLSAP** address.
- The service mode is **DL_CLDLS**.
- No optional quality of service (QOS) support is included at present so the QOS fields are **0**.
- The provider style is **DL_STYLE2**.
- The version is **DL_VERSION_2**.
- The broadcast address value is Ethernet / IEEE broadcast address (**0xFFFFFF**).

Once in the **DL_ATTACHED** state, the user must send a **DL_BIND_REQ** to associate a particular SAP (Service Access Pointer) with the stream. The **le** driver interprets the **sap** field within the **DL_BIND_REQ** as an Ethernet "type" therefore valid values for the **sap** field are in the [**0-0xFFFF**] range. Only one Ethernet type can be bound to the stream at any time.

If the user selects a **sap** with a value of **0**, the receiver will be in 802.3 mode. All frames received from the media having a "type" field in the range [**0-1500**] are assumed to be 802.3 frames and are routed up all open Streams which are bound to **sap** value **0**. If more than one Stream is in "802.3 mode" then the frame will be duplicated and routed up multiple Streams as **DL_UNITDATA_IND** messages.

In transmission, the driver checks the **sap** field of the **DL_BIND_REQ** if the **sap** value is **0**, and if the destination type field is in the range [**0-1500**]. If either is true, the driver computes the length of the message, not including initial **M_PROTO** mblk (message block), of all subsequent **DL_UNITDATA_REQ** messages and transmits 802.3 frames that have this value in the MAC frame header length field.

The **le** driver **DLSAP** address format consists of the 6 byte physical (Ethernet) address component followed immediately by the 2 byte **sap** (type) component producing an 8 byte **DLSAP** address. Applications should *not* hardcode to this particular implementation-specific **DLSAP** address format but use information returned in the **DL_INFO_ACK** primitive to compose and decompose **DLSAP** addresses. The **sap** length, full **DLSAP** length, and **sap** / physical ordering are included within the **DL_INFO_ACK**. The physical address length can be computed by subtracting the **sap** length from the full **DLSAP** address length or by issuing the **DL_PHYS_ADDR_REQ** to obtain the current physical address associated with the stream.

Once in the **DL_BOUND** state, the user may transmit frames on the Ethernet by sending **DL_UNITDATA_REQ** messages to the **le** driver. The **le** driver will route received Ethernet frames up all those open and bound streams having a **sap** which matches the Ethernet type as **DL_UNITDATA_IND** messages. Received Ethernet frames are duplicated and routed up multiple open streams if necessary. The **DLSAP** address contained within the **DL_UNITDATA_REQ** and **DL_UNITDATA_IND** messages consists of both the **sap** (type) and physical (Ethernet) components.

In addition to the mandatory connectionless **DLPI** message set the driver additionally supports the following primitives.

le Primitives

The **DL_ENABMULTI_REQ** and **DL_DISABMULTI_REQ** primitives enable / disable reception of individual multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis using these primitives. These primitives are accepted by the driver in any state following **DL_ATTACHED**.

The **DL_PROMISCON_REQ** and **DL_PROMISCOFF_REQ** primitives with the **DL_PROMISC_PHYS** flag set in the **dl_level** field enables / disables reception of all ("promiscuous mode") frames on the media including frames generated by the local host.

When used with the **DL_PROMISC_SAP** flag set this enables / disables reception of all **sap** (Ethernet type) values. When used with the **DL_PROMISC_MULTI** flag set this enables / disables reception of all multicast group addresses. The effect of each is always on a per-stream basis and independent of the other **sap** and physical level configurations on this stream or other streams.

The **DL_PHYS_ADDR_REQ** primitive return the 6 octet Ethernet address currently associated (attached) to the stream in the **DL_PHYS_ADDR_ACK** primitive. This primitive is valid only in states following a successful **DL_ATTACH_REQ**.

The **DL_SET_PHYS_ADDR_REQ** primitive changes the 6 octet Ethernet address currently associated (attached) to this stream. The credentials of the process which originally opened this stream must be superuser or **EPERM** is returned in the **DL_ERROR_ACK**. This primitive is destructive in that it affects all other current and future streams attached to this device. An **M_ERROR** is sent up all other streams attached to this device when this primitive on this stream is successful. Once changed, all streams subsequently opened and attached to this device will obtain this new physical address. Once changed, the physical address will remain so until this primitive is used to change the physical address again or the system is rebooted, whichever comes first.

FILES

/dev/le	**le** special character device.
/kernel/drv/options.conf	System wide default device driver properties

SEE ALSO

driver.conf(4), **dlpi**(7), **ie**(7)

SPARCstation 10 Twisted-Pair Ethernet Link Test

Twisted-Pair Ethernet Link Test

NOTES

If you are using twisted pair Ethernet (TPE), you need to be aware of the link test feature. The IEEE 10Base-T specification states that the link test should always be enabled at the host and the hub. Complications may arise because:

1. Some older hubs do not provide link pulses
2. Some hubs are configured to not send link pulses

Under either of these two conditions the host translates the lack of link pulses into a link failure unless it is programmed to ignore link pulses. To program your system to ignore link pulses (also known as disabling the link test) do the following at the OpenBoot PROM prompt:

```
<#0> ok setenv tpe-link-test? false
tpe-link-test? = false
```

The above command will work for **SPARCstation-10, SPARCstation-20** and **SPARCclassic** systems that come with built in twisted pair Ethernet ports. For other systems and for add-on boards with twisted pair Ethernet refer to the documentation that came with the system or board for information on disabling the link test.

SPARCstation-10, SPARCstation-20 and **SPARCclassic** systems come with a choice of built in **AUI** (using an adapter cable) and **TPE** ports. From Solaris 2.2 onward an auto-selection scheme was implemented in the **le** driver that will switch between **AUI** and **TPE** depending on which interface is active. Auto-selection uses the presence or absence of the link test on the **TPE** interface as one indication of whether that interface is active. In the special case where you wish to use **TPE** with the link-test disabled you should manually override auto-selection so that the system will use only the twisted pair port.

This override can be performed by defining the *cable-selection* property in the file **/kernel/drv/options.conf** to force the system to use **TPE** or **AUI** as appropriate. The example below sets the cable selection to **TPE**.

```
example# cd /kernel/drv
example# echo 'cable-selection="tpe";' >> options.conf
```

Note that the standard **options.conf** file contains important information; the only change to the file should be the addition of the *cable-selection* property. Be careful to type this line *exactly* as shown above, ensuring that you append to the existing file, and include the terminating semi-colon. Alternatively you can use a text editor to append the line

```
cable-selection="tpe";
```

to the end of the file.

Please refer to the *SPARCstation 10 Twisted-Pair Ethernet Link Test* (801-2481-10), *Twisted-Pair Ethernet Link Test* (801-6184-10) and the **driver.conf**(4) man page for details of the syntax of driver configuration files.

NAME

leo – double-buffered 24-bit SBus color frame buffer and graphics accelerator

DESCRIPTION

leo (ZX) is a 24-bit SBus-based color frame buffer and graphics accelerator. The frame buffer consists of 96 video memory planes of 1280 × 1024 pixels, including 24-bit double-buffering, 8 overlay planes, 24 z-buffer planes, 10 window ID planes, and 6 fast clear planes. Leo provides the standard frame buffer interface as defined in **fbio**(7). Application acceleration is achieved via the XGL native 3D graphics library.

FILES

/dev/fbs/leo0 device special file

SEE ALSO

leoconfig(1M) **mmap**(2), **fbio**(7),

NAME

llc1 – Logical Link Control Protocol Class 1 Driver

SYNOPSIS

```
#include <sys/stropts.h>
#include <sys/ethernet.h>
#include <sys/dlpi.h>
#include <sys/llc1.h>
```

AVAILABILITY

x86

DESCRIPTION

The **llc1** driver is a multi-threaded, loadable, clonable, STREAMS multiplexing driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), implementing IEEE 802.2 Logical Link Control Protocol Class 1 over a STREAM to a MAC level driver. Multiple MAC level interfaces installed within the system can be supported by the driver. The **llc1** driver provides basic support for the LLC1 protocol. Functions provided include frame transmit and receive, XID, and TEST, multicast support, and error recovery and reporting.

The cloning, character-special device, **/dev/llc1**, is used to access all LLC1 controllers configured under **llc1**.

The **llc1** driver is a "Style 2" Data Link Service provider. All messages of types **M_PROTO** and **M_PCPROTO** are interpreted as DLPI primitives. An explicit **DL_ATTACH_REQ** message by the user is required to associate the opened stream with a particular device (**ppa**). The **ppa** ID is interpreted as an unsigned long and indicates the corresponding device instance (unit) number. An error (**DL_ERROR_ACK**) is returned by the driver if the **ppa** field value does not correspond to a valid device instance number for this system.

The values returned by the driver in the **DL_INFO_ACK** primitive in response to the **DL_INFO_REQ** from the user are as follows:

The maximum Service Data UNIT (SDU) is derived from the MAC layer linked below the driver. In the case of an Ethernet driver, the SDU will be 1497.

The minimum SDU is 0.

The **dlsap** address length is 7.

The MAC type is **DL_CSMACD** or **DL_TPR** as determined by the driver linked under **llc1.** If the driver reports that it is **DL_ETHER,** it will be changed to **DL_CSMACD;** otherwise the type is the same as the MAC type.

The **sap** length value is –1, meaning the physical address component is followed immediately by a 1-octet **sap** component within the DLSAP address.

The service mode is **DL_CLDLS.**

No optional quality of service (QOS) support is included at present, so the QOS fields should be initialized to 0.

The provider style is **DL_STYLE2.**

The DLPI version is **DL_VERSION_2.**

The broadcast address value is the broadcast address returned from the lower level driver.

Once in the **DL_ATTACHED** state, the user must send a **DL_BIND_REQ** to associate a particular Service Access Point (SAP) with the stream. The **llc1** driver interprets the **sap** field within the **DL_BIND_REQ** as an IEEE 802.2 "SAP," therefore valid values for the **sap** field are in the [0-0xFF] range with only even values being legal.

The **llc1** driver DLSAP address format consists of the 6-octet physical (e.g., Ethernet) address component followed immediately by the 1-octet **sap** (type) component producing a 7-octet DLSAP address. Applications should *not* hard-code to this particular implementation-specific DLSAP address format, but use information returned in the **DL_INFO_ACK** primitive to compose and decompose DLSAP addresses. The **sap** length, full DLSAP length, and **sap** / physical ordering are included within the **DL_INFO_ACK.** The physical address length can be computed by subtracting the absolute value of the **sap** length from the full DLSAP address length or by issuing the **DL_PHYS_ADDR_REQ** to obtain the current physical address associated with the stream.

Once in the **DL_BOUND** state, the user may transmit frames on the LAN by sending **DL_UNITDATA_REQ** messages to the **llc1** driver. The **llc1** driver will route received frames up all open and bound streams having a **sap** which matches the IEEE 802.2 DSAP as **DL_UNITDATA_IND** messages. Received frames are duplicated and routed up multiple open streams if necessary. The DLSAP address contained within the **DL_UNITDATA_REQ** and **DL_UNITDATA_IND** messages consists of both the **sap** (type) and physical (Ethernet) components.

In addition to the mandatory, connectionless DLPI message set, the driver additionally supports the following primitives:

The **DL_ENABMULTI_REQ** and **DL_DISABMULTI_REQ** primitives enable / disable reception of specific multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis using these primitives. These primitives are accepted by the driver in any driver state that is valid while still being attached to the **ppa**.

The **DL_PHYS_ADDR_REQ** primitive returns the 6-octet physical address currently associated (attached) to the stream in the **DL_PHYS_ADDR_ACK** primitive. This primitive is valid only in states following a successful **DL_ATTACH_REQ.**

The **DL_SET_PHYS_ADDR_REQ** primitive changes the 6-octet physical address currently associated (attached) to this stream. Once changed, all streams subsequently opened and attached to this device will obtain this new physical address. Once changed, the physical address will remain set until this primitive is used to change the physical address again or the system is rebooted, whichever occurs first.

The **DL_XID_REQ/DL_TEST_REQ** primitives provide the means for a user to issue an **LLC XID** or **TEST** request message. A response to one of these messages will be in the form of a **DL_XID_CON/DL_TEST_CON** message.

The **DL_XID_RES/DL_TEST_RES** primitives provide a way for the user to respond to the receipt of an **XID** or **TEST** message that was received as a **DL_XID_IND/DL_TEST_IND** message.

XID and **TEST** will be automatically processed by **llc1** if the **DL_AUTO_XID/DL_AUTO_TEST** bits are set in the **DL_BIND_REQ.**

FILES

/dev/llc1

SEE ALSO

dlpi(7)

NAME

lofs – loopback virtual file system

SYNOPSIS

#include <sys/param.h>
#include <sys/mount.h>

int mount(const char **dir***, const char** **virtual***, int** *mflag***, lofs , NULL , 0);**

DESCRIPTION

The loopback file system device allows new, virtual file systems to be created, which provide access to existing files using alternate pathnames. Once the virtual file system is created, other file systems can be mounted within it, without affecting the original file system. However, file systems which are subsequently mounted onto the original file system *are* visible to the virtual file system, unless or until the corresponding mount point in the virtual file system is covered by a file system mounted there.

virtual is the mount point for the virtual file system. *dir* is the pathname of the existing file system. *mflag* specifies the mount options; the **MS_DATA** bit in *mflag* must be set. If the **MS_RDONLY** bit in *mflag* is not set, accesses to the loop back file system are the same as for the underlying file system. Otherwise, all accesses in the loop back file system will be read-only. All other **mount**(2) options are inherited from the underlying file systems.

A loopback mount of '/' onto **/tmp/newroot** allows the entire file system hierarchy to appear as if it were duplicated under **/tmp/newroot**, including any file systems mounted from remote NFS servers. All files would then be accessible either from a pathname relative to '/' or from a pathname relative to **/tmp/newroot** until such time as a file system is mounted in **/tmp/newroot**, or any of its subdirectories.

Loopback mounts of '/' can be performed in conjunction with the **chroot**(2) system call, to provide a complete virtual file system to a process or family of processes.

Recursive traversal of loopback mount points is not allowed; after the loopback mount of **/tmp/newroot**, the file **/tmp/newroot/tmp/newroot** does not contain yet another file system hierarchy; rather, it appears just as **/tmp/newroot** did before the loopback mount was performed (for example, as an empty directory).

SEE ALSO

mount(1M), **chroot**(2), **mount**(2), **sysfs**(2), **vfstab**(4)

WARNINGS

Loopback mounts must be used with care; the potential for confusing users and applications is enormous. A loopback mount entry in **/etc/vfstab** must be placed after the mount points of both directories it depends on. This is most easily accomplished by making the loopback mount entry the last in **/etc/vfstab**.

BUGS

Because only directories can be mounted or mounted on, the structure of a virtual file system can only be modified at directories.

NAME

log – interface to STREAMS error logging and event tracing

SYNOPSIS

```
#include <sys/strlog.h>
#include <sys/log.h>
```

DESCRIPTION

log is a STREAMS software device driver that provides an interface for console logging and for the STREAMS error logging and event tracing processes (see **strerr**(1M), and **strace**(1M)). **log** presents two separate interfaces: a function call interface in the kernel through which STREAMS drivers and modules submit **log** messages; and a set of **ioctl**(2) requests and STREAMS messages for interaction with a user level console logger, an error logger, a trace logger, or processes that need to submit their own **log** messages.

Kernel Interface

log messages are generated within the kernel by calls to the function **strlog( )**:

strlog(short *mid***, short** *sid***, char** *level***, ushort** *flags***, char** ∗*fmt***, unsigned** *arg1* **...);**

Required definitions are contained in **<sys/strlog.h>**, **<sys/log.h>**, and **<sys/syslog.h>**. *mid* is the STREAMS module id number for the module or driver submitting the **log** message. *sid* is an internal sub-id number usually used to identify a particular minor device of a driver. *level* is a tracing level that allows for selective screening out of low priority messages from the tracer. *flags* are any combination of **SL_ERROR** (the message is for the error logger), **SL_TRACE** (the message is for the tracer), **SL_CONSOLE** (the message is for the console logger), **SL_FATAL** (advisory notification of a fatal error), and **SL_NOTIFY** (request that a copy of the message be mailed to the system administrator). *fmt* is a **printf**(3S) style format string, except that **%s**, **%e**, **%E**, **%g**, and **%G** conversion specifications are not handled. Up to **NLOGARGS** (in this release, three) numeric or character arguments can be provided.

User Interface

log is opened through the **/dev/log** instance of the **clone** driver. Each open of **/dev/log** obtains a separate stream to **log**. In order to receive **log** messages, a process must first notify **log** whether it is an error logger, trace logger, or console logger using a STREAMS **I_STR ioctl** call (see below). For the console logger, the **I_STR ioctl** has an **ic_cmd** field of **I_CONSLOG**, with no accompanying data. For the error logger, the **I_STR ioctl** has an **ic_cmd** field of **I_ERRLOG**, with no accompanying data. For the trace logger, the **ioctl** has an **ic_cmd** field of **I_TRCLOG**, and must be accompanied by a data buffer containing an array of one or more struct **trace_ids** elements.

```
struct trace_ids {
        short ti_mid;
        short ti_sid;
        char  ti_level;
};
```

Each **trace_ids** structure specifies a *mid*, *sid*, and *level* from which messages will be accepted. **strlog( )** will accept messages whose *mid* and *sid* exactly match those in the **trace_ids** structure, and whose level is less than or equal to the level given in the **trace_ids** structure. A value of –1 in any of the fields of the **trace_ids** structure indicates that any value is accepted for that field.

Once the logger process has identified itself using the **ioctl** call, **log** will begin sending up messages subject to the restrictions noted above. These messages are obtained using the **getmsg**(2) function. The control part of this message contains a **log_ctl** structure, which specifies the *mid*, *sid*, *level*, *flags*, time in ticks since boot that the message was submitted, the corresponding time in seconds since Jan. 1, 1970, a sequence number, and a priority. The time in seconds since 1970 is provided so that the date and time of the message can be easily computed, and the time in ticks since boot is provided so that the relative timing of **log** messages can be determined.

```
struct log_ctl {
        short    mid;
        short    sid;
        char     level;        /* level of message for tracing */
        short    flags;        /* message disposition */
        clock_t  ltime;        /* time in machine ticks since boot */
        time_t   time;         /* time in seconds since 1970 */
        long     seq_no;       /* sequence number */
        int      pri;          /* priority = (facility|level) */
};
```

The priority consists of a priority code and a facility code, found in **<sys/syslog.h>**. If **SL_CONSOLE** is set in *flags*, the priority code is set as follows: If **SL_WARN** is set, the priority code is set to **LOG_WARNING**; If **SL_FATAL** is set, the priority code is set to **LOG_CRIT**; If **SL_ERROR** is set, the priority code is set to **LOG_ERR**; If **SL_NOTE** is set, the priority code is set to **LOG_NOTICE**; If **SL_TRACE** is set, the priority code is set to **LOG_DEBUG**; If only **SL_CONSOLE** is set, the priority code is set to **LOG_INFO**. Messages originating from the kernel have the facility code set to **LOG_KERN**. Most messages originating from user processes will have the facility code set to **LOG_USER**.

Different sequence numbers are maintained for the error and trace logging streams, and are provided so that gaps in the sequence of messages can be determined (during times of high message traffic some messages may not be delivered by the logger to avoid hogging system resources). The data part of the message contains the unexpanded text of the format string (null terminated), followed by **NLOGARGS** words for the arguments to the format string, aligned on the first word boundary following the format string.

A process may also send a message of the same structure to **log**, even if it is not an error or trace logger. The only fields of the **log_ctl** structure in the control part of the message that are accepted are the *level*, *flags*, and *pri* fields; all other fields are filled in by **log** before being forwarded to the appropriate logger. The data portion must contain a null terminated format string, and any arguments (up to **NLOGARGS**) must be packed, one word each, on the next word boundary following the end of the format string.

ENXIO is returned for **I_TRCLOG** ioctls without any **trace_ids** structures, or for any unrecognized **ioctl** calls. The driver silently ignores incorrectly formatted **log** messages sent to the driver by a user process (no error results).

Processes that wish to write a message to the console logger may direct their output to **/dev/conslog**, using either **write**(2) or **putmsg**(2).

EXAMPLES

Example of **I_ERRLOG** registration:

```
struct strioctl ioc;

ioc.ic_cmd = I_ERRLOG;
ioc.ic_timout = 0;              /* default timeout (15 secs.) */
ioc.ic_len = 0;
ioc.ic_dp = NULL;

ioctl(log, I_STR, &ioc);
```

Example of I_TRCLOG registration:

```
struct trace_ids tid[2];

tid[0].ti_mid = 2;
tid[0].ti_sid = 0;
tid[0].ti_level = 1;

tid[1].ti_mid = 1002;
tid[1].ti_sid = –1;             /* any sub-id will be allowed */
tid[1].ti_level = –1;           /* any level will be allowed */

ioc.ic_cmd = I_TRCLOG;
ioc.ic_timout = 0;
ioc.ic_len = 2 * sizeof(struct trace_ids);
ioc.ic_dp = (char *)tid;

ioctl(log, I_STR, &ioc);
```

Example of submitting a **log** message (no arguments):

```
struct strbuf ctl, dat;
struct log_ctl lc;
char *message = "Don't forget to pick up some milk
        on the way home";

ctl.len = ctl.maxlen = sizeof(lc);
ctl.buf = (char *)&lc;

dat.len = dat.maxlen = strlen(message);
```

```
dat.buf = message;

lc.level = 0;
lc.flags = SL_ERROR | SL_NOTIFY;

putmsg(log, &ctl, &dat, 0);
```

FILES

/dev/log
/dev/conslog

SEE ALSO

strace(1M), **strerr**(1M), **intro**(2), **getmsg**(2), **putmsg**(2), **write**(2), *STREAMS Programmer's Guide*

NAME

logi – LOGITECH Bus Mouse device interface

SYNOPSIS

/dev/logi

AVAILABILITY

x86

DESCRIPTION

The **logi** driver supports the LOGITECH Bus Mouse. It allows applications to obtain information about the mouse's movements and the status of its buttons. The data is read in the Five Byte Packed Binary Format, also called MSC format.

FILES

/dev/logi

NAME

lp – driver for parallel port

SYNOPSIS

include <sys/bpp_io.h>

fd = open("/dev/lp*n*", *flags***);**

name=lp
class=sysbus
ioaddr=0x378 interrupts=3,7;

name=lp
class=sysbus
ioaddr=0x278 interrupts=3,5;

AVAILABILITY

x86

DESCRIPTION

The **lp** driver provides the interface to the parallel ports used by printers for x86 systems. The **lp** driver is implemented as a STREAMS device. Up to three parallel ports can be accessed by the driver. The **lp** driver accesses the **/kernel/drv/lp.conf** file for specifications about these parallel ports. The specifications include:

name

class

ioaddr The I/O port base address for this port.

interrupts The IRQ level of the port. **interrupts** is analogous to **intr**.

For more information about **lp.conf**, refer to **sysbus**(4).

IOCTLS

BPPIOC_TESTIO Test transfer readiness. This command checks to see if a read or write transfer would succeed based on pin status. If a transfer would succeed, **0** is returned. If a transfer would fail, **–1** is returned, and **errno** is set to **EIO**. The error status can be retrieved using the **BPPIOC_GETERR ioctl( )** call.

BPPIOC_GETERR Get last error status. The argument is a pointer to a **struct bpp_error_status**. See below for a description of the elements of this structure. This structure indicates the status of all the appropriate status bits at the time of the most recent error condition during a **read**(2) or **write**(2) call, or the status of the bits at the most recent **BPPIOC_TESTIO ioctl**(2) call. The application can check transfer readiness without attempting another transfer using the **BPPIOC_TESTIO ioctl( )**.

Error Pins Structure

This structure and symbols are defined in the include file **<sys/bpp_io.h>**:

```
struct bpp_error_status {
        char    timeout_occurred;       /* Not use */
        char    bus_error;              /* Not use */
        u_char  pin_status;             /* Status of pins which could
                                         * cause an error */
};

/* Values for pin_status field */
#define     BPP_ERR_ERR     0x01    /* Error pin active */
#define     BPP_SLCT_ERR    0x02    /* Select pin active */
#define     BPP_PE_ERR      0x04    /* Paper empty pin active */
```

Note: Other pin statuses are defined in **<sys/bpp_io.h>**, but **BPP_ERR_ERR**, **BPP_SLCT_ERR** and **BPP_PE_ERR** are the only ones valid for the x86 **lp** driver.

ERRORS

EIO A **BPPIOC_TESTIO ioctl( )** call is attempted while a condition exists that would prevent a transfer (such as a peripheral error).

EINVAL An **ioctl( )** is attempted with an invalid value in the command argument.

FILES

/kernel/drv/lp.conf
configuration file for **lp** driver. For a description of each field, refer to **sysbus**(4).

SEE ALSO

sysbus(4), **streamio**(7)

DIAGNOSTICS

"**lp_attach**: **cannot add intr.**"
An invalid **intr=** or **interrupts=** property has been specified in the **/kernel/drv/lp.conf** file.

NOTES

A read operation on a bi-directional parallel port is not supported.

NAME

mcis – low-level module for IBM MicroChannel host bus adapter

AVAILABILITY

x86

DESCRIPTION

The **mcis** module provides low-level interface routines between the common disk / tape I / O subsystem and the IBM MicroChannel bus master SCSI (Small Computer System Interface) controllers. The **mcis** module can be configured for disk and streaming tape support for one or more host adapter boards, each of which must be the sole initiator on a SCSI bus. Auto confi- guration code determines if the adapter is present at the configured address and what types of devices are attached to it.

Board Configuration and Auto Configuration

The driver attempts to initialize itself in accordance with the information found in the configuration file, **/kernel/drv/mcis.conf**. The relevant user configurable items in this file are:

io port ’reg=0x3540,0,0’ ’ioaddr=0x3540’,
hardware cache ’hwcache="on"’.

The first host bus adapter is at address **0x3540**. If there is a second or third adapter (up to four are permitted on a PS / 2 Model 95), uncomment the appropriate line(s) in the configuration file.

The **hwcache** property controls the cache on the host bus adapter. Enabling the cache can increase file system performance.

Note that the IBM boot disk must be configured at target 6 lun 0.

FILES

/kernel/drv/mcis.conf configuration file for **mcis**.

NAME

mcpp – ALM-2 Parallel Printer port driver

SYNOPSIS

#include <fcntl.h>
#include <sys/mcpio.h>
open("/dev/mcpp*n", mode***);**

DESCRIPTION (PARALLEL PORT)

The parallel port is Centronics-compatible and is suitable for most common parallel printers. Devices attached to this interface are normally handled by the line printer spooling system and should not be accessed directly by the user.

The printer devices reside on a separate major device number from the serial devices. Minor device numbers in the range 0 – 7 access the printer, and the recommended naming is **/dev/mcpp[0-7]**.

IOCTLS

Various control flags and status bits may be fetched and set on an ALM-2 printer port. The following flags and status bits are supported; they are defined in **sys/mcpio.h**:

MCPRIGNSLCT	0x02	set if interface ignoring SLCT– on open
MCPRDIAG	0x04	set if printer port is in self-test mode
MCPRVMEINT	0x08	set if VME bus interrupts are enabled
MCPRINTPE	0x10	print message when out of paper
MCPRINTSLCT	0x20	print message when printer offline
MCPRPE	0x40	set if device ready, cleared if device out of paper
MCPRSLCT	0x80	set if device online (Centronics SLCT asserted)

The flags **MCPRINTSLCT, MCPRINTPE,** and **MCPRDIAG** may be changed; the other bits are status bits and may not be changed.

The **ioctl( )** calls supported by ALM-2 printer ports are listed below.

MCPIOGPR The argument is a pointer to an **unsigned char**. The printer flags and status bits are stored in the **unsigned char** pointed to by the argument.

MCPIOSPR The argument is a pointer to an **unsigned char**. The printer flags are set from the **unsigned char** pointed to by the argument.

ERRORS

Normally, the interface only reports the status of the device when attempting an **open**(2) call. An **open( )** on a **/dev/mcpp**∗ device will fail if:

ENODEV The unit being opened does not exist.

ENXIO The device is offline or out of paper.

Bit 17 of the configuration **flags** may be specified to say that the interface should ignore Centronics SLCT– and RDY / PE– when attempting to open the device, but this is normally useful only for configuration and troubleshooting: if the SLCT– and RDY lines are not asserted during an actual data transfer (as with a **write**(2) call), no data is transferred.

FILES

/dev/mcpp[0-7] parallel printer port

SEE ALSO

open(2), **write**(2)

DIAGNOSTICS

Printer on mcpp*n* is out of paper

Printer on mcpp*n* paper ok

Assorted printer diagnostics, if enabled as discussed above.

NAME

mcpzsa – ALM-2 Zilog 8530 SCC serial communications driver

SYNOPSIS

#include <fcntl.h>
#include <sys/termios.h>
open("/dev/term/*n***",** *mode***);**
open("/dev/cua/*n***",** *mode***);**

DESCRIPTION

The ALM-2 board provides 16 serial input / output channels that are capable of supporting a variety of communication protocols. A typical system uses these devices to implement essential functions, including RS-423 ports (which also support most RS-232 equipment).

The **mcpzsa** module is a loadable STREAMS driver that provides basic support for the 8530 hardware, together with basic asynchronous communication support. The driver supports those **termio**(7) device control functions specified by flags in the **c_cflag** word of the **termios** structure and by the **IGNBRK**, **IGNPAR**, **PARMRK**, or **INPCK** flags in the **c_iflag** word of the **termios** structure. All other **termio**(7) functions must be performed by STREAMS modules pushed atop the driver. When a device is opened, the **ldterm**(7) and **ttcompat**(7) STREAMS modules are automatically pushed on top of the stream, providing the standard **termio**(7) interface.

The character-special devices **/dev/term/[0-15]** are used to access the serial ports on the first ALM-2 board.

Subsequent instances of the ALM-2 board will use the next 16 numbers in sequence. These **term/***n* devices have minor device numbers in the range 0 – 127.

To allow a single tty line to be connected to a modem and used for both incoming and outgoing calls, a special feature, controlled by the minor device number, is available. By accessing character-special devices with names of the form **/dev/cua/***n*, it is possible to open a port without the Carrier Detect signal being asserted, either through hardware or an equivalent software mechanism. These devices are commonly known as **dial-out** lines and have minor numbers 256 greater than their corresponding dial-in lines.

Once a **/dev/cua/***n* line is opened, the corresponding term line cannot be opened until the **/dev/cua/***n* line is closed; a blocking open will wait until the **/dev/cua/***n* line is closed (which will drop Data Terminal Ready, after which Carrier Detect will usually drop as well) and carrier is detected again, and a non-blocking open will return an error. Also, if the **/dev/term/***n* line has been opened successfully (usually only when carrier is recognized by the modem) the corresponding **/dev/cua/***n* line can not be opened. This allows a modem to be attached to, for example, **/dev/term/0** and used for dial-in (by enabling the line for login in **/etc/inittab**) and also used for dial-out (by **tip**(1) or **uucp**(1C)) as **/dev/cua/0** when no one is logged in on the line.

IOCTLS

The standard set of **termio ioctl( )** calls are supported by **mcpzsa**.

If the **CRTSCTS** flag in the **c_cflag** is set, output will be generated only if CTS is high; if CTS is low, output will be frozen. If the **CRTSCTS** flag is clear, the state of CTS has no effect. Breaks can be generated by the **TCSBRK**, **TIOCSBRK**, and **TIOCCBRK ioctl( )** calls. The modem control lines **TIOCM_CAR**, **TIOCM_CTS**, **TIOCM_RTS**, and **TIOCM_DTR** are provided.

The input and output line speeds may be set to any of the speeds supported by **termio**. The speeds cannot be set independently; when the output speed is set, the input speed is set to the same speed.

ERRORS

An **open( )** will fail if:

ENODEV	The unit being opened does not exist.
EPROTO	An unsupported or non-serial protocol has been requested.
EBUSY	The dial-out device is being opened and the dial-in device is already open, or the dial-in device is being opened with a no-delay open and the dial-out device is already open.
EBUSY	The unit has been marked as exclusive-use by another process with a **TIOCEXCL ioctl( )** call.
EINTR	The open was interrupted by the delivery of a signal.

FILES

/dev/term/[0-127]	hardwired tty lines
/dev/cua/[0-127]	dial-out tty lines

SEE ALSO

tip(1), **uucp**(1C), **ldterm**(7), **termio**(7), **ttcompat**(7), **zs**(7)

DIAGNOSTICS

mcpzsa*n c* **: parity error ignored.**
A parity error was detected and disregarded due to the **IGNPAR** flag being set.

mcpzsa*n c* **: SCC silo overflow.**
The 8530 character input silo overflowed before it could be serviced.

mcpzsa*n c* **: input ring overflow.**
The driver's character input ring buffer overflowed before it could be serviced.

NOTES

The character-special device names may not always be aligned on multiples of 16 if other serial port devices, such as SPIF devices are present on the system.

NAME

mem, kmem – physical or virtual memory

SYNOPSIS

/dev/mem
/dev/kmem

DESCRIPTION

The file **/dev/mem** is a special file that is an image of the *physical memory* of the computer. The file **/dev/kmem** is a special file that is an image of the *kernel virtual memory* of the computer. Either may be used, for example, to examine, and even patch the system.

Byte addresses in **/dev/mem** are interpreted as physical memory addresses. Byte addresses in **/dev/kmem** are interpreted as kernel virtual memory addresses. References to non-existent locations cause errors to be returned (see **ERRORS** below).

The file **/dev/kmem** accesses up to 4GB of kernel virtual memory. The file **/dev/mem** accesses physical memory; the size of the file is equal to the amount of physical memory in the computer. This can be larger than 4GB; in which case, memory beyond 4GB can be accessed using a series of **read**(2) and **write**(2) commands or a combination of **llseek**(2) and **read**(2) and **write**(2).

ERRORS

EFAULT Bad address. This error can occur when trying to: **write**(2) a read-only location, **read**(2) a write-only location, or **read**(2) or **write**(2) a non-existent or unimplemented location.

ENXIO This error results from attempting to **mmap**(2) a non-existent physical (**mem**) or virtual (**kmem**) memory address.

FILES

/dev/mem File containing image of physical memory of computer.
/dev/kmem File containing image of kernel virtual memory of computer.

SEE ALSO

llseek(2), **mmap**(2), **read**(2), **write**(2)

NOTES

Some of **/dev/kmem** cannot be read because of write-only addresses or unequipped memory addresses.

NAME

mlx – low-level module for Mylex DAC960 EISA host bus adapter series

SYNOPSIS

/kernel/drv/mlx

AVAILABILITY

x86

DESCRIPTION

The **mlx** module provides low-level interface routines between the common disk / tape I / O subsystem and the Mylex DAC960 controllers. The **mlx** module can be configured for disk, CD-ROM, and streaming tape support for one or more host adapter boards.

Auto-configuration code determines whether the adapter is present at the configured address and what types of devices are attached to it. The Mylex DAC960 is primarily used as a disk array (system drive) controller. In order to configure the attached disk arrays, the controller must first be configured prior to Solaris boot using the configuration utilities provided by the hardware manufacturer. With these utilities, the user can set different levels of redundant arrays of independent disks (RAID), striping parameters, caching mechanisms, etc. For more information, refer to the user's manual supplied with your hardware.

EISA Configuration Tips

The Mylex DAC960 BIOS can handle multiple cards. Therefore, if more than one Mylex DAC960 adapter is installed in a system only the BIOS of the one in the lowest slot should be enabled and the BIOS of the rest should be disabled.

Enable tag queueing only for the SCSI disk drives which are officially tested and approved by Mylex Corp. Otherwise, it is strongly recommended to disable tag queueing to avoid serious problems.

Board Configuration and Auto Configuration

The driver attempts to initialize itself in accordance with the information found in the configuration file **/kernel/drv/mlx.conf**. If the Mylex DAC960 SCSI host adapter has *N* channels, the **mlx.conf** file should have *N+1* entries for that slot. The section of the file for that slot will contain *N* entries, one per physical channel, numbered from **0** to **N-1** , and one entry dedicated to all the System Drives on that adapter, **virtual channel number 255** (**0xFF**). The entry for the virtual channel (**0xFF**) has to be the *first* one for each slot.

In general, if the Mylex DAC960 SCSI host adapter is installed in slot S, the syntax of the entry for its virtual channel is:

```
name="mlx" parent="eisa"
        interrupts=5,9,5,10,5,11,5,12,5,13,5,14,5,15 reg=0xS0FF,0,0
        ioaddr=0xS0FF flow_control="dmult" queue="qsort" disk="dadk";
```

And the entry for its XX-th physical channel (XX in hex) is:

```
name="mlx" parent="eisa"
        interrupts=5,9,5,10,5,11,5,12,5,13,5,14,5,15 reg=0xS0XX,0,0
        ioaddr=0xS0XX flow_control="dsngl" queue="qsort" disk="scdk"
        tape="sctp" tag_fctrl="adapt" tag_queue="qtag";
```

The *ioaddr* (I/O address) is **0x1000** times the EISA slot number plus the channel number in hex. Hence, channel **2** on slot **1** is at address **0x1002** and the virtual channel on slot **10** is at **0xa0ff**.

The SCSI id of the devices on each channel may not be equal or greater than the value of the maximum number of targets allowed per channel (**MAX_TGT**), otherwise it cannot even be configured.

For the best start-up performance on a particular host, keep only the entries that correspond to the installed slots and comment out the other entries in the configuration file **/kernel/drv/mlx.conf**.

EXAMPLES

In the following example, the controller is installed in slot 2, and the lines starting with '#' are comments.

```
#
# Slot 2:
#
# Virtual Channel 0xFF:
        name="mlx" parent="eisa"
                interrupts=5,9,5,10,5,11,5,12,5,13,5,14,5,15 reg=0x20FF,0,0
                ioaddr=0x20FF flow_control="dmult" queue="qsort" disk="dadk";
# Channel 0:
        name="mlx" parent="eisa"
                interrupts=5,9,5,10,5,11,5,12,5,13,5,14,5,15 reg=0x2000,0,0
                ioaddr=0x2000 flow_control="dsngl" queue="qsort" disk="scdk"
                tape="sctp" tag_fctrl="adapt" tag_queue="qtag";
# Channel 1:
        name="mlx" parent="eisa"
                interrupts=5,9,5,10,5,11,5,12,5,13,5,14,5,15 reg=0x2001,0,0
                ioaddr=0x2001 flow_control="dsngl" queue="qsort" disk="scdk"
                tape="sctp" tag_fctrl="adapt" tag_queue="qtag";
# Channel 2:
        name="mlx" parent="eisa"
                interrupts=5,9,5,10,5,11,5,12,5,13,5,14,5,15 reg=0x2002,0,0
                ioaddr=0x2002 flow_control="dsngl" queue="qsort" disk="scdk"
                tape="sctp" tag_fctrl="adapt" tag_queue="qtag";
# Channel 3:
        name="mlx" parent="eisa"
                interrupts=5,9,5,10,5,11,5,12,5,13,5,14,5,15 reg=0x2003,0,0
                ioaddr=0x2003 flow_control="dsngl" queue="qsort" disk="scdk"
                tape="sctp" tag_fctrl="adapt" tag_queue="qtag";
```

 # Channel 4:

```
name="mlx" parent="eisa"
        interrupts=5,9,5,10,5,11,5,12,5,13,5,14,5,15 reg=0x2004,0,0
        ioaddr=0x2004 flow_control="dsngl" queue="qsort" disk="scdk"
        tape="sctp" tag_fctrl="adapt" tag_queue="qtag";
```

FILES

/kernel/drv/mlx.conf **mlx** configuration file.

WARNINGS

Tag Queueing

Enable tag queueing only for the SCSI disk drives which are officially tested and approved by Mylex Corp. Otherwise, it is strongly recommended to disable tag queueing to avoid serious problems.

Standby Drives

If a SCSI disk drive is not defined to be part of any physical pack within a system drive, it is automatically labeled as a *standby* drive. If any SCSI disk drive within a system drive fails, *data on a standby drive may be lost due to the standby replacement procedure*. This procedure will overwrite the standby drive if the failed disk drive is configured with any level of redundancy (RAID levels 1, 5, and 6) *and* its size is identical to the size of the available standby drive.

Therefore, inspite of the fact that the standby drives are physically connected, the system denies any kind of access to them, so that there would be no chance of accidental loss of valuable data.

Hot Plugging

Other than the ‘‘hot replacement’’ of disk drives, which is described in the manufacturer’s user’s guide, the Mylex DAC960 series do not support ‘‘hot-plugging’’ (adding or removing devices while the system is running) unless the firmware version of the adapter is **1.22** or **1.23 .** Otherwise, in order to add or remove devices you must shut down the system, add or remove devices, reconfigure the host bus adapter using the configuration utility provided by the manufacturer, and then reboot your system.

SCSI Target IDs

When setting up the device SCSI target IDs, note that there is a limitation on the choice of target ID numbers. Assuming the maximum number of targets per channel on the particular model of Mylex host bus adapter is **MAX_TGT** (see the manufacturer’s user’s manual), the SCSI target IDs on a given channel should range from **0** to (**MAX_TGT** – **1**). Note that target SCSI IDs on one channel can be repeated on other channels.

Example 1:

Mylex DAC960-5 model supports a maximum of four targets per channel, i.e., **MAX_TGT** = **4**. Therefore, the SCSI target IDs on a given channel should range from **0** to **3**.

Example 2:

Mylex DAC960-3 model supports a maximum of seven targets per channel, i.e., **MAX_TGT** = **7**. Therefore, the SCSI target IDs on a given channel should range from **0** to **6**.

NAME

msm – Microsoft Bus Mouse device interface

AVAILABILITY

x86

DESCRIPTION

The **msm** driver supports the Microsoft Bus Mouse. It allows applications to obtain information about the mouse's movements and the status of its buttons. The data is read in the Five Byte Packed Binary Format, also called MSC format.

FILES

/dev/msm

NAME

mt – tape interface

DESCRIPTION

The files **rmt/*** refer to tape controllers and associated tape drives.

The **labelit**(1M) command requires these magnetic tape file names to work correctly with the tape controllers. No other tape controller commands require these file names.

FILES

/dev/rmt/*

SEE ALSO

labelit(1M)

NAME

mtio – general magnetic tape interface

SYNOPSIS

```
#include <sys/types.h>
#include <sys/ioctl.h>
#include <sys/mtio.h>
```

DESCRIPTION

1/2", 1/4", 4mm, and 8 mm magnetic tape drives all share the same general character device interface.

There are two types of tape records: data records and end-of-file (EOF) records. EOF records are also known as tape marks and file marks. A record is separated by inter-record (or tape) gaps on a tape.

End-of-recorded-media (EOM) is indicated by two EOF marks on 1/2" tape; by one on 1/4" and 8 mm cartridge tapes.

1/2" Reel Tape

Data bytes are recorded in parallel onto the 9-track tape. Since it is a variable-length tap device, the number of bytes in a physical record may vary.

The recording formats available (check specific tape drive) are 800 BPI, 1600 BPI, 6250 BPI, and data compression. Actual storage capacity is a function of the recording format and the length of the tape reel. For example, using a 2400 foot tape, 20 Mbyte can be stored using 800 BPI, 40 Mbyte using 1600 BPI, 140 Mbyte using 6250 BPI, or up to 700 Mbyte using data compression.

1/4" Cartridge Tape

Data is recorded serially onto 1/4" cartridge tape. The number of bytes per record is determined by the physical record size of the device. The I/O request size must be a multiple of the physical record size of the device. For QIC-11, QIC-24, and QIC-150 tape drives, the block size is 512 bytes.

The records are recorded on tracks in a serpentine motion. As one track is completed, the drive switches to the next and begins writing in the opposite direction, eliminating the wasted motion of rewinding. Each file, including the last, ends with one file mark.

Storage capacity is based on the number of tracks the drive is capable of recording. For example, 4-track drives can only record 20 Mbyte of data on a 450 foot tape; 9-track drives can record up to 45 Mbyte of data on a tape of the same length. QIC-11 is the only tape format available for 4-track tape drives. In contrast, 9-track tape drives can use either QIC-24 or QIC-11. Storage capacity is not appreciably affected by using either format. QIC-24 is preferable to QIC-11 because it records a reference signal to mark the position of the first track on the tape, and each block has a unique block number.

The QIC-150 tape drives require DC-6150 (or equivalent) tape cartridges for writing. However, they can read other tape cartridges in QIC-11, QIC-24, or QIC-120 tape formats.

8 mm Cartridge Tape

Data is recorded serially onto 8 mm helical scan cartridge tape. Since it is a variable-length tape device, the number of bytes in a physical record may vary. The recording formats available (check specific tape drive) are standard 2Gbyte, 5Gbyte, and compressed format.

4 mm DAT Tape

Data is recorded either in Digital Data Storage (DDS) tape format or in Digital Data Storage, Data Compressed (DDS-DC) tape format. Since it is a variable-length tape device, the number of bytes in a physical record may vary. The recording formats available are standard 2Gbyte and compressed format.

Read Operation

read(2) reads the next record on the tape. The record size is passed back as the number of bytes read, provided it is no greater than the number requested. When a tape mark or end of data is read, a zero byte count is returned; another read will return an error. This is different from the the older BSD behavior where another read will fetch the first record of the next tape file. If this behavior is required, device names containing the letter **b** (for BSD behavior) in the final component should be used.

Two successive reads returning zero byte counts indicate the EOM. No further reading should be performed past the EOM.

Fixed-length I/O tape devices require the number of bytes read to be a multiple of the physical record size. For example, 1/4" cartridge tape devices only read multiples of 512 bytes. If the blocking factor is greater than 64512 bytes (minphys limit), fixed-length I/O tape devices read multiple records.

Tape devices which support variable-length I/O operations, such as 1/2" and 8 mm tape, may read a range of 1 to 65535 bytes. If the record size exceeds 65535 bytes, the driver reads multiple records to satisfy the request. These multiple records are limited to 65534 bytes.

Depending on the type of tape drive, some tape drivers may relax the above limitation and allow applications to read record sizes larger than 65534. Refer to the specific tape driver man page for details.

Reading past logical EOT is transparent to the user. A read operation should never hit physical EOT.

Read requests that are lesser than a physical tape record are not allowed. Appropriate error is returned.

Write Operation

write(2) writes the next record on the tape. The record has the same length as the given buffer.

Writing is allowed on 1/4" tape at either the beginning of tape or after the last written file on the tape.

Writing is not so restricted on 1/2" and 8 mm cartridge tape. Care should be used when appending files onto 1/2" reel tape devices, since an extra file mark is appended after the last file to mark the EOM. This extra file mark must be overwritten to prevent the creation of a null file. To facilitate write append operations, a space to the EOM ioctl is provided. Care should be taken when overwriting records; the erase head is just forward of the write head and any following records will also be erased.

Fixed-length I/O tape devices require the number of bytes written to be a multiple of the physical record size. For example, 1/4" cartridge tape devices only write multiples of 512 bytes.

On SPARC systems, fixed-length I / O tape devices write multiple records if the blocking factor is greater than 64,512 bytes (minphys limit). These multiple writes are limited to 64,512 bytes. For example, if a write request is issued for 65,536 bytes using a 1 / 4" cartridge tape, two writes are issued; the first for 64,512 bytes and the second for 1024 bytes.

On x86 systems, fixed-length I / O tape devices write multiple records if the blocking factor is greater than 131,072 bytes (minphys limit). These multiple writes are limited to 131,072 bytes. For example, if a write request is issued for 132096 bytes using a 1 / 4" cartridge tape, two writes are issued; the first for 131,072 bytes and the second for 1024 bytes.

Tape devices which support variable-length I / O operations, such as 1 / 2" and 8 mm tape, may write a range of 1 to 65,535 bytes. If the record size exceeds 65,535 bytes, the driver writes multiple records to satisfy the request. These multiple records are limited to 65534 bytes. As an example, if a write request for 65540 bytes is issued using 1 / 2" reel tape, two records are written; one for 65,534 bytes followed by one for 6 byte.

Depending on the type of tape drive, some tape drivers may relax the above limitation and allow applications to write record sizes larger than 65,534. Refer to the specific tape driver man page for details.

On SPARC systems, when logical EOT is encountered, a zero byte count is returned. The next write will complete successfully and the full byte count is returned. Another write will return a zero byte count. This allows the flushing of buffers. However, it is strongly recommended to terminate the writing and close the file as soon as possible.

On x86 systems, when logical EOT is encountered, the number of bytes that have been written will be returned. Another write will return a zero byte count. The next write will receive an error code of **ENOSPC**.

Seeks are ignored in tape I / O.

Close Operation

Magnetic tapes are rewound when closed, except when the "no-rewind" devices have been specified. The names of no-rewind device files use the letter **n** as the end of the final component. The no-rewind version of **/dev/rmt/0l** is **/dev/0ln**. In case of error for a no-rewind device, the next open rewinds the device.

If the driver was opened for reading and a no-rewind device has been specified, the close advances the tape past the next filemark (unless the current file position is at EOM) leaving the tape correctly positioned to read the first record of the next file. However, if the tape is at the first record of a file it doesn't advance again to the first record of the next file. These semantics are different from the older BSD behavior. If BSD behavior is required where no implicit space operation is executed on close, the non-rewind device name containing the letter **b** (for BSD behavior) in the final component should be specified.

If data was written, a file mark is automatically written by the driver upon close. If the rewinding device was specified, the tape will be rewound after the file mark is written. If the user wrote a file mark prior to closing, then no file mark is written upon close. If a file positioning ioctl, like rewind, is issued after writing, a file mark is written before repositioning the tape.

All buffers are flushed on closing a tape device. Hence, one should check the value returned by the close operation.

Note that for 1/2" reel tape devices, two file marks are written to mark the EOM before rewinding or performing a file positioning ioctl. If the user wrote a file mark before closing a 1/2" reel tape device, the driver will always write a file mark before closing to insure that the end of recorded media is marked properly. If the non-rewinding device was specified, two file marks are written and the tape is left positioned between the two so that the second one is overwritten on a subsequent **open**(2) and **write**(2).

If no data was written and the driver was opened for WRITE-ONLY access, one or two file marks are written, thus creating a null file.

Ioctls

Not all devices support all ioctls. The driver returns an **ENOTTY** error on unsupported ioctls.

The following structure definitions for magnetic tape ioctl commands are from **<sys/mtio.h>**:

The minor device byte structure looks as follows:

15 7	6	5	4	3	2	1 0
Unit # Bits 7-15	BSD behavior	Reserved	Density Select	Density Select	No rewind on Close	Unit # Bits 0-1

```
/*
 * Layout of minor device byte:
 */
#define MTUNIT(dev)          (((minor(dev) & 0xff80) >> 5) +(minor(dev) & 0x3))
#define MT_NOREWIND          (1 <<2)
#define MT_DENSITY_MASK      (3 <<3)
#define MT_DENSITY1          (0 <<3)          /* Lowest density/format */
#define MT_DENSITY2          (1 <<3)
#define MT_DENSITY3          (2 <<3)
#define MT_DENSITY4          (3 <<3)          /* Highest density/format */
#define MTMINOR(unit)        (((unit & 0x7fc) << 5) + (unit & 0x3))
#define MT_BSD               (1 <<6)          /* BSD behavior on close */
/* structure for MTIOCTOP – magnetic tape operation command */
struct    mtop {
          short              mt_op;           /* operation */
          daddr_t            mt_count;        /* number of operations */
};
```

The following operations of **MTIOCTOP** ioctl are supported:

MTWEOF	write an end-of-file record
MTFSF	forward space over file mark

MTBSF	backward space over file mark (1/2", 8 mm only)
MTFSR	forward space to inter-record gap
MTBSR	backward space to inter-record gap
MTREW	rewind
MTOFFL	rewind and take the drive off-line
MTNOP	no operation, sets status only
MTRETEN	retension the tape (cartridge tape only)
MTERASE	erase the entire tape and rewind
MTEOM	position to EOM
MTNBSF	backward space file to beginning of file
MTSRSZ	set record size
MTGRSZ	get record size

```
/* structure for MTIOCGET – magnetic tape get status command */
struct    mtget {
          short          mt_type;       /* type of magtape device */

/* the following two registers are device dependent */
          short          mt_dsreg;      /* "drive status" register */
          short          mt_erreg;      /* "error" register */

/* optional error info. */
          daddr_t        mt_resid;      /* residual count */
          daddr_t        mt_fileno;     /* file number of current position */
          daddr_t        mt_blkno;      /* block number of current position */
          u_short        mt_flags;
          short          mt_bf;         /* optimum blocking factor */
};
```

When spacing forward over a record (either data or EOF), the tape head is positioned in the tape gap between the record just skipped and the next record. When spacing forward over file marks (EOF records), the tape head is positioned in the tape gap between the next EOF record and the record that follows it.

When spacing backward over a record (either data or EOF), the tape head is positioned in the tape gap immediately preceding the tape record where the tape head is currently positioned. When spacing backward over file marks (EOF records), the tape head is positioned in the tape gap preceding the EOF. Thus the next read would fetch the EOF.

Record skipping does not go past a file mark; file skipping does not go past the EOM. After an **MTFSR** <huge number> command the driver leaves the tape logically positioned *before* the EOF. A related feature is that EOFs remain pending until the tape is closed. For example, a program which first reads all the records of a file up to and including the EOF and then performs an MTFSF command will leave the tape positioned just after that same EOF, rather than skipping the next file.

The **MTNBSF** and **MTFSF** operations are inverses. Thus, an "**MTFSF** –1" is equivalent to an "**MTNBSF** 1". An "**MTNBSF** 0" is the same as "**MTFSF** 0"; both position the tape device at the beginning of the current file.

MTBSF moves the tape backwards by file marks. The tape position will end on the beginning of tape side of the desired file mark.

MTBSR and **MTFSR** operations perform much like space file operations, except that they move by records instead of files. Variable-length I/O devices (1/2" reel, for example) space actual records; fixed-length I/O devices space physical records (blocks). 1/4" cartridge tape, for example, spaces 512 byte physical records. The status ioctl residual count contains the number of files or records not skipped.

MTOFFL rewinds and, if appropriate, takes the device off-line by unloading the tape. The tape must be inserted before the tape device can be used again.

The **MTRETEN** retension ioctl applies only to 1/4" cartridge tape devices. It is used to restore tape tension, improving the tape's soft error rate after extensive start-stop operations or long-term storage.

MTERASE rewinds the tape, erases it completely, and returns to the beginning of tape.

MTEOM positions the tape at a location just after the last file written on the tape. For 1/4" cartridge and 8 mm tape, this is after the last file mark on the tape. For 1/2" reel tape, this is just after the first file mark but before the second (and last) file mark on the tape. Additional files can then be appended onto the tape from that point.

Note the difference between **MTBSF** (backspace over file mark) and **MTNBSF** (backspace file to beginning of file). The former moves the tape backward until it crosses an EOF mark, leaving the tape positioned *before* the file mark. The latter leaves the tape positioned *after* the file mark. Hence, "**MTNBSF** n" is equivalent to "**MTBSF** (n+1)" followed by "**MTFSF** 1". The 1/4 " cartridge tape devices do not support **MTBSF.**

MTSRSZ and **MTGRSZ** are used to set and get fixed record lengths. The **MTSRSZ** ioctl allows variable length and fixed length tape drives that support multiple record sizes to set the record length. The **mt_count** field of the **mtop** struct is used to pass the record size to/from the **st** driver. A value of **0** indicates variable record size. The **MTSRSZ** ioctl makes a variable-length tape device behave like a fixed-length tape device. Refer to the specific tape driver man page for details.

The **MTIOCGET** get status ioctl call returns the drive ID (*mt_type*), sense key error (*mt_erreg*), file number (*mt_fileno*), optimum blocking factor (*mt_bf*) and record number (*mt_blkno*) of the last error. The residual count (*mt_resid*) is set to the number of bytes not transferred or files/records not spaced. The flags word (*mt_flags*) contains information such as whether the device is SCSI, whether it is a reel device and whether the device supports absolute file positioning.

EXAMPLES

Suppose you have written three files to the non-rewinding 1/2" tape device, **/dev/rmt/0ln,** and that you want to go back and **dd**(1M) the second file off the tape. The commands to do this are:

```
mt –f /dev/rmt/0ln bsf 3
mt –f /dev/rmt/0ln fsf 1
dd if=/dev/rmt/0ln
```

To accomplish the same tape positioning in a C program, followed by a get status ioctl:

```
struct mtop mt_command;
struct mtget mt_status;

mt_command.mt_op = MTBSF;
mt_command.mt_count = 3;
ioctl(fd, MTIOCTOP, &mt_command);
mt_command.mt_op = MTFSF;
mt_command.mt_count = 1;
ioctl(fd, MTIOCTOP, &mt_command);
ioctl(fd, MTIOCGET, (char *)&mt_status);
```

or

```
mt_command.mt_op = MTNBSF;
mt_command.mt_count = 2;
ioctl(fd, MTIOCTOP, &mt_command);
ioctl(fd, MTIOCGET, (char *)&mt_status);
```

FILES

/dev/rmt/<*unit number*><*density*>[<*BSD behavior*>][<*no rewind*>]

density	**l, m, h, u/c** (low, medium, high, ultra / compressed, respectively)
BSD behavior (optional)	**b**
no rewind (optional)	**n**

For example, **/dev/rmt/0hbn** specifies unit 0, high density, BSD behavior and no rewind.

SEE ALSO

mt(1), **tar**(1), **dd**(1M), **read**(2), **write**(2), **ar**(4),

SPARC only **st**(7)

x86 only **cmtp**(7)

1/4 Inch Tape Drive Tutorial

NAME

null – the null file

SYNOPSIS

/dev/null

DESCRIPTION

Data written on the null special file, **/dev/null**, is discarded.
Reads from a null special file always return 0 bytes.

FILES

/dev/null

NAME

openprom – PROM monitor configuration interface

SYNOPSIS

```
#include <sys/fcntl.h>
#include <sys/types.h>
#include <sundev/openpromio.h>

open("/dev/openprom", mode);
```

DESCRIPTION

The internal encoding of the configuration information stored in EEPROM or NVRAM varies from model to model, and on some systems the encoding is "hidden" by the firmware. The **openprom** driver provides a consistent interface that allows a user or program to inspect and modify that configuration, using **ioctl**(2) requests. These requests are defined in **<sys/openpromio.h>**:

```
struct openpromio {
        u_int   oprom_size;                     /* real size of following array */
        char    oprom_array[1];                 /* For property names and values */
                                                /* NB: Adjacent, Null terminated */
};
#define OPROMMAXPARAM   32768           /* max size of array */

/*
 * Note that all OPROM ioctl codes are type void. Since the amount
 * of data copied in/out may (and does) vary, the openprom driver
 * handles the copyin/copyout itself.
 */
#define OIOC                    ('O'<<8)
#define OPROMGETOPT             (OIOC | 1)
#define OPROMSETOPT             (OIOC | 2)
#define OPROMNXTOPT             (OIOC | 3)
#define OPROMSETOPT2            (OIOC | 4)      /* preferred OPROMSETOPT */
#define OPROMNEXT               (OIOC | 5)      /* interface to raw config_ops */
#define OPROMCHILD              (OIOC | 6)      /* interface to raw config_ops */
#define OPROMGETPROP            (OIOC | 7)      /* interface to raw config_ops */
#define OPROMNXTPROP            (OIOC | 8)      /* interface to raw config_ops */
```

For all **ioctl**(2) requests, the third parameter is a pointer to a '**struct openpromio**'. All property names and values are null-terminated strings; the value of a numeric option is its ASCII representation.

IOCTLS

The **OPROMGETOPT** ioctl takes the null-terminated name of a property in the *oprom_array* and returns its null-terminated value (overlaying its name). *oprom_size* should be set to the size of *oprom_array*; on return it will contain the size of the returned value. If the named property does not exist, or if there is not enough space to hold its value, then *oprom_size* will be set to zero. See BUGS below.

The **OPROMSETOPT** ioctl takes two adjacent strings in *oprom_array*; the null-terminated property name followed by the null-terminated value.

The **OPROMNXTOPT** ioctl is used to retrieve properties sequentially. The null-terminated name of a property is placed into *oprom_array* and on return it is replaced with the null-terminated name of the next property in the sequence, with *oprom_size* set to its length. A null string on input means return the name of the first property; an *oprom_size* of zero on output means there are no more properties.

The **OPROMNXT, OPROMCHILD, OPROMGETPROP,** and **OPROMNXTPROP** ioctls provide an interface to the raw *config_ops* operations in the PROM monitor. One can use them to traverse the system device tree; see **prtconf**(1M).

ERRORS

EAGAIN	There are too many opens of the **/dev/openprom** device.
EFAULT	A bad address has been passed to an **ioctl**(2) routine.
EINVAL	The size value was invalid, or (for **OPROMSETOPT**) the property does not exist, or and invalid ioctl is being issued.
ENOMEM	The kernel could not allocate space to copy the user's structure.
EPERM	Attempts have been made to write to a read-only entity, or read from a write only entity.
ENXIO	Attempting to open a non-existent device.

FILES

/dev/openprom	PROM monitor configuration interface

SEE ALSO

eeprom(1M), **monitor**(1M), **prtconf**(1M), **mem**(7)

BUGS

There should be separate return values for non-existent properties as opposed to not enough space for the value.

An attempt to set a property to an illegal value results in the PROM setting it to some legal value, with no error being returned. An **OPROMGETOPT** should be performed after an **OPROMSETOPT** to verify that the set worked.

The driver should be more consistent in its treatment of errors and edge conditions.

NAME

pcfs, PCFS – DOS formatted file system

DESCRIPTION

PCFS is a file system type that allows users direct access to files on DOS formatted disks from within the SunOS operating system. Once mounted, a PCFS file system provides standard SunOS file operations and semantics. That is, users can create, delete, read, and write files on an DOS formatted disk. They can also create and delete directories and list files in a directory.

Mounting File Systems

PCFS file systems are mounted from diskette with the command:

mount –F pcfs *device-special directory-name*

or you can use:

mount *directory-name*

if the following line is in your **/etc/vfstab** file:

device-special – directory-name **pcfs – no rw**

x86: PCFS file systems are mounted from the hard disk with the command:

mount –F pcfs *device-special*:*logical-drive* **directory-name**

or you can use:

mount *directory-name*

if the following line is in your **/etc/vfstab** file:

device-special:*logical_drive – directory-name* **pcfs – no rw**

device-special specifies the special block device file for the diskette (**/dev/diskette***n*) or the entire hard disk (**/dev/dsk/c***n***t***n***d***n***p0**).

On x86 systems, *logical-drive* specifies either the DOS logical drive letter (c through z) or a drive number (1 through 24). Drive letter c is equivalent to drive number 1 and represents the Primary DOS partition on the disk; drive letters d through z are equivalent to drive numbers 2 through 24, and represent DOS logical drives within the Extended DOS partition. Note that *device-special* and *logical-drive* must be separated by a colon.

directory-name specifies the location where the file system is mounted.

For example, on x86, to mount the Primary DOS partition from a hard disk, use:

mount –F pcfs /dev/dsk/c*n***t***n***d***n***p0:c /pcfs/c**

On x86, to mount the first logical drive in the Extended DOS partition from the hard disk, use:

mount –F pcfs /dev/dsk/c*n***t***n***d***n***p0:d /pcfs/d**

To mount a DOS diskette in the first floppy drive, use:

mount –F pcfs /dev/diskette /pcfs/a

Conventions

Files and directories created through PCFS have to comply with the DOS file name convention, which is of the form *filename*[.*ext*], where *filename* consists of from one to eight upper-case characters, while the optional *ext* consists of from one to three upper-case

characters. PCFS converts all the lower-case characters in a file name to upper-case, and chops off any extra characters in *filename* or *ext*. When displaying file names, PCFS only shows them in lower-case.

One can use either the DOS **FORMAT** command, or the command:

fdformat –d

in the SunOS system to format a diskette in DOS format.

EXAMPLES

If you copy a file:

financial.data

from a UNIX file system to a PCFS file system, it will show up as:

FINANCIA.DAT

on the DOS disk.

The following file names:

.login

test.sh.orig

data+

are considered illegal in DOS, and therefore cannot be created through **PCFS**.

FILES

/usr/lib/fs/pcfs/mount

SEE ALSO

eject(1), **mount**(1M), **vfstab**(4)

x86 Only

fdisk(1M)

NOTES

The following are all the legal characters that are allowed in file names or extensions in PCFS:

0-9, a-z, A-Z, and $#&@!%()-{}<>‘_\˜|’

Since SunOS and DOS operating systems use different character sets, and have different requirements for the text file format, one can use

dos2unix

or

unix2dos

command to convert files between them.

PCFS offers a convenient transportation vehicle for files between Sun Workstations and PC’s. Since the DOS disk format was designed for use under DOS, it is quite inefficient to operate under the SunOS system. Therefore, it should not be used as the format for a regular local storage. You should use **ufs** for local storage within the SunOS system.

WARNINGS

It is not recommended to physically eject an DOS floppy while the device is still mounted as a PCFS file system.

x86: When mounting a **pcfs** file system on a hard disk, the first block on that device must contain a valid **fdisk** partition table.

Since PCFS truncates any extra characters in file names and extensions just as DOS, does, be careful when copying files from a UNIX file system to a PCFS file system. For instance, the following two files:

test.data1 test.data2

in a UNIX file system will get copied to the same file:

TEST.DAT

in PCFS.

BUGS

PCFS should handle the disk change condition in the same way that DOS, does, so that the user does not need to unmount the file system to change floppies. PCFS is currently not NFS mountable. Trying to mount a PCFS file system through NFS will fail with an **EACCES** error.

NAME

pckt – STREAMS Packet Mode module

SYNOPSIS

int ioctl(*fd,* **I_PUSH**, "**pckt**");

DESCRIPTION

pckt is a STREAMS module that may be used with a pseudo terminal to packetize certain messages. The **pckt** module should be pushed (see **I_PUSH** on **streamio**(7)) onto the master side of a pseudo terminal.

Packetizing is performed by prefixing a message with an **M_PROTO** message. The original message type is stored in the 1 byte data portion of the **M_PROTO** message.

On the read-side, only the **M_PROTO, M_PCPROTO, M_STOP, M_START, M_STOPI, M_STARTI, M_IOCTL, M_DATA, M_FLUSH**, and **M_READ** messages are packetized. All other message types are passed upstream unmodified.

Since all unread state information is held in the master's stream head read queue, flushing of this queue is disabled.

On the write-side, all messages are sent down unmodified.

With this module in place, all reads from the master side of the pseudo terminal should be performed with the **getmsg**(2) or **getpmsg**() function. The control part of the message contains the message type. The data part contains the actual data associated with that message type. The onus is on the application to separate the data into its component parts.

SEE ALSO

getmsg(2), **ioctl**(2), **ldterm**(7), **ptem**(7), **streamio**(7), **termio**(7)

STREAMS Programmer's Guide

NAME

pe – Xircom Pocket Ethernet device driver

SYNOPSIS

```
#include <sys/stropts.h>
#include <sys/ethernet.h>
#include <sys/dlpi.h>
```

AVAILABILITY

x86

DESCRIPTION

The Xircom Pocket Ethernet driver (pe) is a multi-threaded, loadable, clonable, STREAMS hardware driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), with a Xircom Pocket Ethernet Adapter III (PE3). Multiple PE3 controllers installed within the system are supported by the driver.

PE and DLPI

The **pe** driver provides basic support for the PE3 hardware. Functions include chip initialization, frame transmission and reception, multicast and "promiscuous" support, and error recovery and reporting.

The **pe** driver supports both bi-directional and unidirectional parallel ports. The Port and Adapter type is automatically detected and set when the driver initializes.

It is important not to attempt to use any other driver that may also use the same port when the **pe** driver is operational. This may interfere with network traffic that is currently being sent or received by the PE3 adapter.

The cloning, character-special device **/dev/pe** is used to access all PE3 controllers installed within the system.

The **pe** driver is a “style 2” Data Link Service provider. All M_PROTO and M_PCPROTO type messages are interpreted as DLPI primitives. An explicit DL_ATTACH_REQ message is required by the user to associate the opened stream with a particular device (**ppa**). The **ppa** ID is interpreted as an unsigned long and indicates the corresponding device instance (unit) number. The unit numbers are assigned sequentially to each adapter found. The search order is determined by the order defined in the **pe.conf** file. An error (DL_ERROR_ACK) is returned by the driver if the **ppa** field value does not correspond to a valid device instance number for this system. The device is initialized on the first attach and de-initialized (stopped) on the last detach.

The values returned by the driver in the DL_INFO_ACK primitive in response to the DL_INFO_REQ from the user are as follows:

- The max SDU is 1500 (ETHERMTU).
- The min SDU is 0.
- The **dlsap** address length is 8.
- The MAC type is DL_ETHER or DL_CSMACD.
- The **sap** length value is –2, meaning the physical address component is followed immediately by a 2-byte **sap** component within the DLSAP address.
- The service mode is DL_CLDLS.

- No optional quality of service (QOS) support is included at present, so the QOS fields are 0.
- The provider style is DL_STYLE2.
- The version is DL_VERSION_2.
- The broadcast address value is Ethernet/IEEE broadcast address (FF:FF:FF:FF:FF:FF).

Once in the DL_ATTACHED state, the user must send a DL_BIND_REQ to associate a particular SAP (Service Access Pointer) with the stream. The **pe** driver interprets the **sap** field within the DL_BIND_REQ as an Ethernet "type," therefore valid values for the **sap** field are in the [0-0xFFFF] range. Only one Ethernet type can be bound to the stream at any time.

In addition to Ethernet V2 service, an "802.3 mode" is provided by the driver and works as follows. **sap** values in the range [0-1500] are treated as equivalent and represent a desire by the user for "802.3" mode. If the value of the **sap** field of the DL_BIND_REQ is within this range, then the driver computes the length, not including initial M_PROTO mblk, of all subsequent DL_UNITDATA_REQ messages and transmits 802.3 frames having this value in the MAC frame header length field. All frames received from the media having a "type" field in this range are assumed to be 802.3 frames and are routed up all open streams that are bound to any **sap** value within this range. If more than one stream is in "802.3 mode," then the frame will be duplicated and routed up multiple streams as DL_UNITDATA_IND messages.

The **pe** driver DLSAP address format consists of the 6-byte physical (Ethernet) address component followed immediately by the 2-byte **sap** (type) component producing an 8-byte DLSAP address. Applications should *not* hardcode to this particular implementation-specific DLSAP address format but use information returned in the DL_INFO_ACK primitive to compose and decompose DLSAP addresses. The **sap** length, full DLSAP length, and **sap**/physical ordering are included within the DL_INFO_ACK. The physical address length can be computed by subtracting the **sap** length from the full DLSAP address length or by issuing the DL_PHYS_ADDR_REQ to obtain the current physical address associated with the stream.

Once in the DL_BOUND state, the user may transmit frames on the Ethernet by sending DL_UNITDATA_REQ messages to the **pe** driver. The **pe** driver will route received Ethernet frames up all those open and bound streams having a **sap** which matches the Ethernet type as DL_UNITDATA_IND messages. Received Ethernet frames are duplicated and routed up multiple open streams if necessary. The DLSAP address contained within the DL_UNITDATA_REQ and DL_UNITDATA_IND messages consists of both the **sap** (type) and physical (Ethernet) components.

PE Primitives

In addition to the mandatory connectionless DLPI message set, the driver additionally supports the primitives discussed below.

The DL_ENABMULTI_REQ and DL_DISABMULTI_REQ primitives enable/disable reception of individual multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis using these primitives. These

primitives are accepted by the driver in any state following DL_ATTACHED.

The DL_PROMISCON_REQ and DL_PROMISCOFF_REQ primitives with the DL_PROMISC_PHYS flag set in the **dl_level** field enables/disables reception of all ("promiscuous mode") frames on the media including frames generated by the local host.

When used with the DL_PROMISC_SAP flag set, this enables/disables reception of all **sap** (Ethernet type) values. When used with the DL_PROMISC_MULTI flag set, this enables/disables reception of all multicast group addresses. The effect of each is always on a per-stream basis and independent of the other **sap** and physical level configurations on this stream or other streams.

The DL_PHYS_ADDR_REQ primitive returns the 6-octet Ethernet address currently associated (attached) to the stream in the DL_PHYS_ADDR_ACK primitive. This primitive is valid only in states following a successful DL_ATTACH_REQ.

The DL_SET_PHYS_ADDR_REQ primitive changes the 6-octet Ethernet address currently associated (attached) to this stream. The credentials of the process that originally opened this stream must be superuser or EPERM is returned in the DL_ERROR_ACK. This primitive is destructive in that it affects all other current and future streams attached to this device. An M_ERROR is sent up all other streams attached to this device when this primitive on this stream is successful. Once changed, all streams subsequently opened and attached to this device will obtain this new physical address. Once changed, the physical address will remain in effect until this primitive is used to change the physical address again or the system is rebooted, whichever comes first.

CONFIGURATION

The **/kernel/drv/pe.conf** file supports the following options:

intr	Specifies the IRQ level for the parallel port that the Xircom Adapter is connected to.
ioaddr	Specifies the I/O address for the parallel port that the Xircom Adapter is connected to.

It is important to ensure that there are no conflicts for the adapter's I/O port or IRQ level.

FILES

/dev/pe

SEE ALSO

dlpi(7)

NAME

pfmod – STREAMS Packet Filter Module

SYNOPSIS

#include <sys/pfmod.h>

ioctl(*fd,* **I_PUSH**, "**pfmod**");

DESCRIPTION

pfmod is a STREAMS module that subjects messages arriving on its read queue to a packet filter and passes only those messages that the filter accepts on to its upstream neighbor. Such filtering can be very useful for user-level protocol implementations and for networking monitoring programs that wish to view only specific types of events.

Read-side Behavior

pfmod applies the current packet filter to all **M_DATA** and **M_PROTO** messages arriving on its read queue. The module prepares these messages for examination by first skipping over all leading **M_PROTO** message blocks to arrive at the beginning of the message's data portion. If there is no data portion, **pfmod** accepts the message and passes it along to its upstream neighbor. Otherwise, the module ensures that the part of the message's data that the packet filter might examine lies in contiguous memory, calling the **pullupmsg**(9F) utility routine if necessary to force contiguity. (Note: this action destroys any sharing relationships that the subject message might have had with other messages.) Finally, it applies the packet filter to the message's data, passing the entire message upstream to the next module if the filter accepts, and discarding the message otherwise. See PACKET FILTERS below for details on how the filter works.

If there is no packet filter yet in effect, the module acts as if the filter exists but does nothing, implying that all incoming messages are accepted. IOCTLS below describes how to associate a packet filter with an instance of **pfmod**.

pfmod passes all other messages through unaltered to its upper neighbor.

Write-side Behavior

pfmod intercepts **M_IOCTL** messages for the *ioctl* described below. The module passes all other messages through unaltered to its lower neighbor.

IOCTLS

pfmod responds to the following *ioctl*.

PFIOCSETF This *ioctl* directs the module to replace its current packet filter, if any, with the filter specified by the **struct packetfilt** pointer named by its final argument. This structure is defined in **<sys/pfmod.h>** as:

```
struct packetfilt {
        u_char  Pf_Priority;                    /* priority of filter */
        u_char  Pf_FilterLen;                   /* length of filter cmd list */
        u_short Pf_Filter[ENMAXFILTERS];        /* filter command list */
};
```

The **Pf_Priority** field is included only for compatibility with other packet filter implementations and is otherwise ignored. The packet filter itself is specified in the **Pf_Filter** array as a sequence of two-byte commands, with the **Pf_FilterLen** field giving the number of commands in the sequence. This implementation restricts the maximum number of commands in a filter (**ENMAXFILTERS**) to 255. The next section describes the available

commands and their semantics.

PACKET FILTERS

A packet filter consists of the filter command list length (in units of **u_short**s), and the filter command list itself. (The priority field mentioned above is ignored in this implementation.) Each filter command list specifies a sequence of actions that operate on an internal stack of **u_short**s ("shortwords"). Each shortword of the command list specifies one of the actions ENF_PUSHLIT, ENF_PUSHZERO, ENF_PUSHONE, ENF_PUSHFFFF, ENF_PUSHFF00, ENF_PUSH00FF, or ENF_PUSHWORD+*n*, which respectively push the next shortword of the command list, zero, one, 0xFFFF, 0xFF00, 0x00FF, or shortword *n* of the subject message on the stack, and a binary operator from the set {ENF_EQ, ENF_NEQ, ENF_LT, ENF_LE, ENF_GT, ENF_GE, ENF_AND, ENF_OR, ENF_XOR} which then operates on the top two elements of the stack and replaces them with its result. When both an action and operator are specified in the same shortword, the action is performed followed by the operation.

The binary operator can also be from the set {ENF_COR, ENF_CAND, ENF_CNOR, ENF_CNAND}. These are "short-circuit" operators, in that they terminate the execution of the filter immediately if the condition they are checking for is found, and continue otherwise. All pop two elements from the stack and compare them for equality; ENF_CAND returns false if the result is false; ENF_COR returns true if the result is true; ENF_CNAND returns true if the result is false; ENF_CNOR returns false if the result is true. Unlike the other binary operators, these four do not leave a result on the stack, even if they continue.

The short-circuit operators should be used when possible, to reduce the amount of time spent evaluating filters. When they are used, you should also arrange the order of the tests so that the filter will succeed or fail as soon as possible; for example, checking the IP destination field of a UDP packet is more likely to indicate failure than the packet type field.

The special action ENF_NOPUSH and the special operator ENF_NOP can be used to only perform the binary operation or to only push a value on the stack. Since both are (conveniently) defined to be zero, indicating only an action actually specifies the action followed by ENF_NOP, and indicating only an operation actually specifies ENF_NOPUSH followed by the operation.

After executing the filter command list, a non-zero value (true) left on top of the stack (or an empty stack) causes the incoming packet to be accepted and a zero value (false) causes the packet to be rejected. (If the filter exits as the result of a short-circuit operator, the top-of-stack value is ignored.) Specifying an undefined operation or action in the command list or performing an illegal operation or action (such as pushing a shortword offset past the end of the packet or executing a binary operator with fewer than two shortwords on the stack) causes a filter to reject the packet.

EXAMPLES

The packet filter module is not dependent on any particular device driver or module but is commonly used with datalink drivers such as the Ethernet driver. If the underlying datalink driver supports the Data Link Provider Interface (DLPI) message set, the appropriate STREAMS DLPI messages must be issued to attach the stream to a particular hardware device and bind a datalink address to the stream before the underlying driver

will route received packets upstream. Refer to the DLPI Version 2 specification for details on this interface.

The reverse ARP daemon program may use code similar to the following fragment to construct a filter that rejects all but RARP packets. That is, is accepts only packets whose Ethernet type field has the value ETHERTYPE_REVARP.

```
struct ether_header eh;          /* used only for offset values */
struct packetfilt pf;
register u_short *fwp = pf.Pf_Filter;
u_short offset;
int     fd;

/*
 * Push packet filter streams module.
 */
if (ioctl(fd, I_PUSH, "pfmod") < 0)
        syserr("pfmod");

/*
 * Set up filter.  Offset is the displacement of the Ethernet
 * type field from the beginning of the packet in units of
 * u_shorts.
 */
offset = ((u_int) &eh.ether_type - (u_int) &eh.ether_dhost) /
        sizeof (u_short);
*fwp++ = ENF_PUSHWORD + offset;
*fwp++ = ENF_PUSHLIT;
*fwp++ = htons(ETHERTYPE_REVARP);
*fwp++ = ENF_EQ;
pf.Pf_FilterLen = fwp - &pf.Pf_Filter[0];
```

This filter can be abbreviated by taking advantage of the ability to combine actions and operations:

```
*fwp++ = ENF_PUSHWORD + offset;
*fwp++ = ENF_PUSHLIT | ENF_EQ;
*fwp++ = htons(ETHERTYPE_REVARP);
```

SEE ALSO **bufmod**(7), **dlpi**(7), **ie**(7), **le**(7), **pullupmsg**(9F)

NAME

pipemod – STREAMS pipe flushing module

DESCRIPTION

The typical stream is composed of a stream head connected to modules and terminated by a driver. Some stream configurations such as pipes and **FIFOs** do not have a driver and hence certain features commonly supported by the driver need to be provided by other means. Flushing is one such feature, and it is provided by the **pipemod** module.

Pipes and **FIFOs** in their simplest configurations only have stream heads. A write side is connected to a read side. This remains true when modules are pushed. The twist occurs at a point known as the mid-point. When an **M_FLUSH** message is passed from a write queue to a read queue the **FLUSHR** and / or **FLUSHW** bits have to be switched. The mid-point of a pipe is not always easily detectable, especially if there are numerous modules pushed on either end of the pipe. In that case there needs to be a mechanism to intercept all message passing through the stream. If the message is an **M_FLUSH** message and it is at the mid-point, the flush bits need to be switched. This bit switching is handled by the **pipemod** module.

pipemod should be pushed onto a pipe or **FIFO** where flushing of any kind will take place. The **pipemod** module can be pushed on either end of the pipe. The only requirement is that it is pushed onto an end that previously did not have modules on it. That is, pipemod must be the first module pushed onto a pipe so that it is at the mid-point of the pipe itself.

The **pipemod** module handles only **M_FLUSH** messages. All other messages are passed on to the next module using the **putnext( )** utility routine. If an **M_FLUSH** message is passed to **pipemod** and the **FLUSHR** and **FLUSHW** bits are set, the message is not processed but is passed to the next module using the **putnext( )** routine. If only the **FLUSHR** bit is set, the **FLUSHR** bit is turned off and the **FLUSHW** bit is set. The message is then passed on to the next module using **putnext( )**. Similarly, if the **FLUSHW** bit is the only bit set in the **M_FLUSH** message, the **FLUSHW** bit is turned off and the **FLUSHR** bit is turned on. The message is then passed to the next module on the stream.

The **pipemod** module can be pushed on any stream that desires the bit switching. It must be pushed onto a pipe or **FIFO** if any form of flushing must take place.

SEE ALSO

STREAMS Programmer's Guide

NAME

ppp, ppp_diag, ipd, ipdptp, ipdcm – STREAMS modules and drivers for the Point-to-Point Protocol

AVAILABILITY

SUNWpppk

DESCRIPTION

ppp is a STREAMS module which implements the *Point to Point Protocol* (PPP). PPP is a datalink protocol which provides a method for transmitting datagrams over serial point-to-point links. PPP allows for various options to be negotiated between the two hosts of a point-to-point link; these options provide things such as peer authentication, header compression, link quality monitoring, and mapping of control characters. The PPP specifications are described in RFC 1331 *The Point-to-Point Protocol (PPP) for the Transmission of Multi-protocol Datagrams over Point-to-Point Links* and RFC 1332 *The PPP Internet Protocol Control Protocol (IPCP).*

The pseudo device drivers **/dev/ipd**, **/dev/ipdptp**, and **/dev/ipdcm** form the IP-dialup layer. This layer provides IP network interfaces for dialup (connect on demand) point-to-point links. The **ipd** and **ipdptp** devices are the IP-dialup network interfaces. The **ipd** device provides a point-to-multipoint interface, and the **ipdptp** device provides a point-to-point interface. The **ipdcm** device supplies an interface between the **ipd** or **ipdptp** device and a link manager.

The **ppp** module and IP-dialup layer work together to provide IP connectivity over serial point-to-point links. A "link manager" daemon is responsible for setting up and tearing down these dialup connections. Connections are established when an IP packet needs to be sent to the remote host, or the remote host has indicated its desire to establish a PPP connection.

The **ppp_diag** module captures PPP layer packets and parses the contents for debugging purposes. Usually, the parsed output is sent to the **strlog** facility from which it is retrieved by the link manager. This module is pushed between the serial device and the **ppp** module by the link manager when debugging is enabled.

Operation

When a packet is routed to an IP-dialup point-to-point interface which is not currently connected to the remote host, the **ipdcm** driver sends a message to the link manager to establish the connection. The link manager opens a communications channel and pushes the **ppp** module onto the corresponding serial device. The **ppp** module negotiates with the remote host on which options will be used for the link. When both hosts have agreed on a set of options, the link manager links the **ppp** module and serial device underneath the **ipd** or **ipdptp** interface which is providing the IP interface to the remote host.

Similarly, a remote host may initiate a connection on an enabled communications port. In this case the link manager receives the request and pushes the **ppp** module onto the corresponding device. Once the ppp module has successfully negotiated on the set of options for the link with its peer, the link manager links the **ppp** module and serial device underneath the **ipd** or **ipdptp** interface which is providing the IP-dialup interface.

When the **ppp** module and serial device have been linked underneath the IP-dialup interface, IP packets are sent and received over the point-to-point link in PPP frames.

FILES

/dev/ipd	pseudo device driver that provides point-to-ipoint interface.
/dev/ipdptp	pseudo device driver that provides point-to-multipoint interface.
/dev/ipdcm	pseudo device driver that provides interface between **ipd** and **ipdptp** and link manager.

SEE ALSO

aspppd(1M)

NAME

ptem – STREAMS Pseudo Terminal Emulation module

SYNOPSIS

int ioctl(*fd,* **I_PUSH**, "**ptem**"**);**

DESCRIPTION

ptem is a STREAMS module that, when used in conjunction with a line discipline and pseudo terminal driver, emulates a terminal.

The **ptem** module must be pushed (see **I_PUSH**, **streamio**(7)) onto the slave side of a pseudo terminal STREAM, before the **ldterm**(7) module is pushed.

On the write-side, the **TCSETA**, **TCSETAF**, **TCSETAW**, **TCGETA**, **TCSETS**, **TCSETSW**, **TCSETSF**, **TCGETS**, **TCSBRK**, **JWINSIZE**, **TIOCGWINSZ**, and **TIOCSWINSZ termio ioctl**(2) messages are processed and acknowledged. If remote mode is not in effect, ptem handles the **TIOCSTI** ioctl by copying the argument bytes into an **M_DATA** message and passing it back up the read side. Regardless of the remote mode setting, ptem acknowledges the ioctl and passes a copy of it downstream for possible further processing. A hang up (that is, **stty 0**) is converted to a zero length **M_DATA** message and passed downstream. Termio **cflags** and window row and column information are stored locally one per stream. **M_DELAY** messages are discarded. All other messages are passed downstream unmodified.

On the read-side all messages are passed upstream unmodified with the following exceptions. All **M_READ** and **M_DELAY** messages are freed in both directions. A **TCSBRK ioctl** is converted to an **M_BREAK** message and passed upstream and an acknowledgement is returned downstream. An **TIOCSIGNAL ioctl** is converted into an **M_PCSIG** message, and passed upstream and an acknowledgement is returned downstream. Finally an **ioctl TIOCREMOTE** is converted into an **M_CTL** message, acknowledged, and passed upstream; the resulting mode is retained for use in subsequent **TIOCSTI** parsing.

FILES

<sys/ptem.h>

SEE ALSO

stty(1), **ioctl**(2), **ldterm**(7), **pckt**(7), **streamio**(7), **termio**(7)

STREAMS Programmer's Guide

NAME

ptm – STREAMS pseudo-tty master driver

DESCRIPTION

The pseudo-tty subsystem simulates a terminal connection, where the master side represents the terminal and the slave represents the user process's special device end point. In order to use the pseudo-tty subsystem, a node for the master side driver **/dev/ptmx** and **N** number of nodes for the slave driver must be installed. See **pts**(7). The master device is set up as a cloned device where its major device number is the major for the clone device and its minor device number is the major for the **ptm** driver. There are no nodes in the file system for master devices. The master pseudo driver is opened using the **open**(2) system call with **/dev/ptmx** as the device parameter. The clone open finds the next available minor device for the **ptm** major device.

A master device is available only if it and its corresponding slave device are not already open. When the master device is opened, the corresponding slave device is automatically locked out. Only one open is allowed on a master device. Multiple opens are allowed on the slave device. After both the master and slave have been opened, the user has two file descriptors which are the end points of a full duplex connection composed of two streams which are automatically connected at the master and slave drivers. The user may then push modules onto either side of the stream pair.

The master and slave drivers pass all messages to their adjacent queues. Only the **M_FLUSH** needs some processing. Because the read queue of one side is connected to the write queue of the other, the **FLUSHR** flag is changed to the **FLUSHW** flag and vice versa. When the master device is closed an **M_HANGUP** message is sent to the slave device which will render the device unusable. The process on the slave side gets the errno **ENXIO** when attempting to write on that stream but it will be able to read any data remaining on the stream head read queue. When all the data has been read, **read( )** returns 0 indicating that the stream can no longer be used. On the last close of the slave device, a 0-length message is sent to the master device. When the application on the master side issues a **read( )** or **getmsg( )** and 0 is returned, the user of the master device decides whether to issue a **close( )** that dismantles the pseudo-terminal subsystem. If the master device is not closed, the pseudo-tty subsystem will be available to another user to open the slave device.

If **O_NONBLOCK** or **O_NDELAY** is set, read on the master side returns –1 with errno set to **EAGAIN** if no data is available, and write returns –1 with errno set to **EAGAIN** if there is internal flow control.

IOCTLS

The master driver supports the **ISPTM** and **UNLKPT** ioctls that are used by the functions **grantpt**(3C), **unlockpt**(3C) and **ptsname**(3C). The ioctl **ISPTM** determines whether the file descriptor is that of an open master device. On success, it returns the major / minor number of the master device which can be used to determine the name of the corresponding slave device. The ioctl **UNLKPT** unlocks the master and slave devices. It returns 0 on success. On failure, the errno is set to **EINVAL** indicating that the master device is not open.

FILES

/dev/ptmx	master clone device
/dev/pts/M	slave devices (M = 0 -> N-1)

SEE ALSO

grantpt(3C), **ptsname**(3C), **unlockpt**(3C), **pckt**(7), **pts**(7)

STREAMS Programmer's Guide

NAME

pts – STREAMS pseudo-tty slave driver

DESCRIPTION

The pseudo-tty subsystem simulates a terminal connection, where the master side represents the terminal and the slave represents the user process's special device end point. In order to use the pseudo-tty subsystem, a node for the master side driver **/dev/ptmx** and N nodes for the slave driver (N is determined at installation time) must be installed. The names of the slave devices are **/dev/pts/M** where **M** has the values 0 through N-1. When the master device is opened, the corresponding slave device is automatically locked out. No user may open that slave device until its permissions are adjusted and the device unlocked by calling functions **grantpt**(3C) and **unlockpt**(3C). The user can then invoke the open system call with the name that is returned by the **ptsname**(3C) function. See the example below.

Only one open is allowed on a master device. Multiple opens are allowed on the slave device. After both the master and slave have been opened, the user has two file descriptors which are end points of a full duplex connection composed of two streams automatically connected at the master and slave drivers. The user may then push modules onto either side of the stream pair. The user needs to push the **ptem**(7) and **ldterm**(7) modules onto the slave side of the pseudo-terminal subsystem to get terminal semantics.

The master and slave drivers pass all messages to their adjacent queues. Only the **M_FLUSH** needs some processing. Because the read queue of one side is connected to the write queue of the other, the **FLUSHR** flag is changed to the **FLUSHW** flag and vice versa. When the master device is closed an **M_HANGUP** message is sent to the slave device which will render the device unusable. The process on the slave side gets the errno **ENXIO** when attempting to write on that stream but it will be able to read any data remaining on the stream head read queue. When all the data has been read, read returns 0 indicating that the stream can no longer be used. On the last close of the slave device, a 0-length message is sent to the master device. When the application on the master side issues a **read( )** or **getmsg( )** and 0 is returned, the user of the master device decides whether to issue a **close( )** that dismantles the pseudo-terminal subsystem. If the master device is not closed, the pseudo-tty subsystem will be available to another user to open the slave device. Since 0-length messages are used to indicate that the process on the slave side has closed and should be interpreted that way by the process on the master side, applications on the slave side should not write 0-length messages. If that occurs, the write returns 0, and the 0-length message is discarded by the **ptem** module.

The standard STREAMS system calls can access the pseudo-tty devices. The slave devices support the **O_NDELAY** and **O_NONBLOCK** flags.

EXAMPLES

```
int fdm fds;
char *slavename;
extern char *ptsname();

fdm = open("/dev/ptmx", O_RDWR);  /* open master */
grantpt(fdm);                     /* change permission ofslave */
unlockpt(fdm);                    /* unlock slave */
```

```
slavename = ptsname(fdm);          /* get name of slave */
fds = open(slavename, O_RDWR);     /* open slave */
ioctl(fds, I_PUSH, "ptem");        /* push ptem */
ioctl(fds, I_PUSH, "ldterm");      /* push ldterm */
```

FILES

/dev/ptmx	master clone device
/dev/pts/M	slave devices (M = 0 -> N-1)

SEE ALSO

grantpt(3C), **ptsname**(3C), **unlockpt**(3C), **ldterm**(7), **ptm**(7), **ptem**(7)

STREAMS Programmer's Guide

NAME

qe – QEC / MACE Ethernet device driver

SYNOPSIS

```
#include <mace.h>
#include <qe.h>
#include <qec.h>
#include <dlpi.h>
```

DESCRIPTION

qe is a multi-threaded, loadable, clonable, STREAMS hardware device driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), over Am79C940 (MACE) Ethernet controllers in the SBus QED card. **qec**(7) is its parent in the Open Boot Prom device tree. There is no fixed limitation on the number of QED cards supported by the driver. The **qe** driver provides basic support for the MACE and QEC hardware. Functions include chip initialization, frame transmit and receive, multicast and promiscuous support, and error recovery and reporting.

The cloning character-special device **/dev/qe** is used to access all MACE controllers installed within the system.

qe and DLPI

The **qe** driver is a "style 2" Data Link Service provider. All **M_PROTO** and **M_PCPROTO** type msgs are interpreted as DLPI primitives. An explicit **DL_ATTACH_REQ** message by the user is required to associate the opened stream with a particular device (**ppa**). The **ppa** ID is interpreted as an **unsigned long** and indicates the corresponding device instance (unit) number. An error (**DL_ERROR_ACK**) is returned by the driver if the **ppa** field value does not correspond to a valid device instance number for this system. The device is initialized on first attach and de-initialized (stopped) on last detach.

The values returned by the driver in the **DL_INFO_ACK** primitive in response to the **DL_INFO_REQ** from the user are as follows:

- The max SDU is **1500** (**ETHERMTU**).
- The min SDU is **0**.
- The **dlsap** address length is **8**.
- The MAC type is **DL_ETHER**.
- The **sap** length value is **–2** meaning the physical address component is followed immediately by a 2 byte **sap** component within the **DLSAP** address.
- The service mode is **DL_CLDLS**.
- No optional quality of service (QOS) support is included at present so the QOS fields are **0**.
- The provider style is **DL_STYLE2**.
- The version is **DL_VERSION_2**.
- The broadcast address value is Ethernet / IEEE broadcast address (**0xFFFFFF**).

Once in the **DL_ATTACHED** state, the user must send a **DL_BIND_REQ** to associate a particular SAP (Service Access Pointer) with the stream. The **qe** driver interprets the **sap** field within the **DL_BIND_REQ** as an Ethernet "type" therefore valid values for the **sap** field are in the [**0-0xFFFF**] range. Only one Ethernet type can be bound to the stream at any time.

If the user selects a **sap** with a value of **0**, the receiver will be in 802.3 mode. All frames received from the media having a "type" field in the range [**0-1500**] are assumed to be 802.3 frames and are routed up all open Streams which are bound to **sap** value **0**. If more than one Stream is in "802.3 mode" then the frame will be duplicated and routed up multiple Streams as **DL_UNITDATA_IND** messages.

In transmission, the driver checks the **sap** field of the **DL_BIND_REQ** if the **sap** value is **0**, and if the destination type field is in the range [**0-1500**]. If either is true, the driver computes the length of the message, not including initial **M_PROTO** mblk (message block), of all subsequent **DL_UNITDATA_REQ** messages and transmits 802.3 frames that have this value in the MAC frame header length field.

The driver also supports raw **M_DATA** mode. When the user sends a **DLIOCRAW ioctl**, the particular Stream is put in raw mode. A complete frame along with a proper ether header is expected as part of the data.

The **qe** driver **DLSAP** address format consists of the 6 byte physical (Ethernet) address component followed immediately by the 2 byte **sap** (type) component producing an 8 byte **DLSAP** address. Applications should *not* hardcode to this particular implementation-specific **DLSAP** address format but use information returned in the **DL_INFO_ACK** primitive to compose and decompose **DLSAP** addresses. The **sap** length, full **DLSAP** length, and **sap** / physical ordering are included within the **DL_INFO_ACK**. The physical address length can be computed by subtracting the **sap** length from the full **DLSAP** address length or by issuing the **DL_PHYS_ADDR_REQ** to obtain the current physical address associated with the stream.

Once in the **DL_BOUND** state, the user may transmit frames on the Ethernet by sending **DL_UNITDATA_REQ** messages to the **qe** driver. The **qe** driver will route received Ethernet frames up all those open and bound streams having a **sap** which matches the Ethernet type as **DL_UNITDATA_IND** messages. Received Ethernet frames are duplicated and routed up multiple open streams if necessary. The **DLSAP** address contained within the **DL_UNITDATA_REQ** and **DL_UNITDATA_IND** messages consists of both the **sap** (type) and physical (Ethernet) components.

qe Primitives

In addition to the mandatory connectionless **DLPI** message set the driver additionally supports the following primitives.

The **DL_ENABMULTI_REQ** and **DL_DISABMULTI_REQ** primitives enable / disable reception of individual multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis using these primitives. These primitives are accepted by the driver in any state following **DL_ATTACHED**.

The **DL_PROMISCON_REQ** and **DL_PROMISCOFF_REQ** primitives with the **DL_PROMISC_PHYS** flag set in the **dl_level** field enables/disables reception of all ("promiscuous mode") frames on the media including frames generated by the local host. When used with the **DL_PROMISC_SAP** flag set this enables/disables reception of all **sap** (Ethernet type) values. When used with the **DL_PROMISC_MULTI** flag set this enables/disables reception of all multicast group addresses. The effect of each is always on a per-stream basis and independent of the other **sap** and physical level configurations on this stream or other streams.

The **DL_PHYS_ADDR_REQ** primitive return the 6 octet Ethernet address currently associated (attached) to the stream in the **DL_PHYS_ADDR_ACK** primitive. This primitive is valid only in states following a successful **DL_ATTACH_REQ**.

The **DL_SET_PHYS_ADDR_REQ** primitive changes the 6 octet Ethernet address currently associated (attached) to this stream. The credentials of the process which originally opened this stream must be superuser or **EPERM** is returned in the **DL_ERROR_ACK**. This primitive is destructive in that it affects all other current and future streams attached to this device. An **M_ERROR** is sent up all other streams attached to this device when this primitive on this stream is successful. Once changed, all streams subsequently opened and attached to this device will obtain this new physical address. Once changed, the physical address will remain so until this primitive is used to change the physical address again or the system is rebooted, whichever comes first.

FILES

/dev/qe special character device.

SEE ALSO

dlpi(7), **ie**(7), **le**(7), **qec**(7)

NAME

qec – QEC bus nexus device driver

DESCRIPTION

The **qec** device driver is a bus nexus driver which provides basic support for the QEC hardware. It is the parent of the **qe**(7) leaf driver. The driver supports multiple **QED** SBus cards installed within the system. It is not directly accessible to the user.

SEE ALSO

qe(7)

NAME

quotactl – manipulate disk quotas

SYNOPSIS

#include <sys/fs/ufs_quota.h>

int ioctl(int *fd,* **Q_QUOTACTL, struct quotactl** ∗*qp***)**

DESCRIPTION

This **ioctl( )** call manipulates disk quotas. *fd* is the file descriptor returned by the **open( )** system call after opening the **quotas** file (located in the root directory of the filesystem running quotas.) **Q_QUOTACTL** is defined in **/usr/include/sys/fs/ufs_quota.h**. *qp* is the address of the **quotctl** structure which is defined as

```
struct quotctl {
        int op;
        uid_t uid;
        caddr_t addr;
};
```

op indicates an operation to be applied to the user ID *uid*. (See below.) *addr* is the address of an optional, command specific, data structure which is copied in or out of the system. The interpretation of *addr* is given with each value of *op* below.

Q_QUOTAON Turn on quotas for a file system. *addr* points to the full pathname of the **quotas** file. *uid* is ignored. It is recommended that *uid* have the value of **0**. This call is restricted to the super-user.

Q_QUOTAOFF Turn off quotas for a file system. *addr* and *uid* are ignored. It is recommended that *addr* have the value of **NULL** and *uid* have the value of **0**. This call is restricted to the super-user.

Q_GETQUOTA Get disk quota limits and current usage for user *uid*. *addr* is a pointer to a **dqblk** structure (defined in **<sys/fs/ufs_quota.h>**). Only the super-user may get the quotas of a user other than himself.

Q_SETQUOTA Set disk quota limits and current usage for user *uid*. *addr* is a pointer to a **dqblk** structure (defined in **sys/fs/ufs_quota.h**). This call is restricted to the super-user.

Q_SETQLIM Set disk quota limits for user *uid*. *addr* is a pointer to a **dqblk** structure (defined in **sys/fs/ufs_quota.h**). This call is restricted to the super-user.

Q_SYNC Update the on-disk copy of quota usages for this file system. *addr* and *uid* are ignored.

Q_ALLSYNC Update the on-disk copy of quota usages for all file systems with active quotas. *addr* and *uid* are ignored.

RETURN VALUES

This **ioctl( )** returns:

0 on success.

–1 on failure and sets **errno** to indicate the error.

ERRORS

EFAULT	*addr* is invalid.
EINVAL	The kernel has not been compiled with the **QUOTA** option. *op* is invalid.
ENOENT	The **quotas** file specified by *addr* does not exist.
EPERM	The call is privileged and the caller was not the super-user.
ESRCH	No disk quota is found for the indicated user. Quotas have not been turned on for this file system.
EUSERS	The quota table is full.

If *op* is **Q_QUOTAON**, **ioctl**() may set **errno** to:

EACCES	The quota file pointed to by *addr* exists but is not a regular file. The quota file pointed to by *addr* exists but is not on the file system pointed to by *special*.
EIO	Internal I/O error while attempting to read the **quotas** file pointed to by *addr*.

FILES

/usr/include/sys/fs/ufs_quota.h
quota-related structure/function definitions and defines

SEE ALSO

quota(1M), **getrlimit**(2), **mount**(2), **quotacheck**(1M), **quotaon**(1M)

BUGS

There should be some way to integrate this call with the resource limit interface provided by **setrlimit( )** and **getrlimit**(2).

This call is incompatible with Melbourne quotas.

NAME

sad – STREAMS Administrative Driver

SYNOPSIS

```
#include <sys/types.h>
#include <sys/conf.h>
#include <sys/sad.h>
#include <sys/stropts.h>

int ioctl ( int fildes, int command, int arg);
```

DESCRIPTION

The STREAMS Administrative Driver provides an interface for applications to perform administrative operations on STREAMS modules and drivers. The interface is provided through **ioctl**(2) commands. Privileged operations may access the **sad** driver using **/dev/sad/admin**. Unprivileged operations may access the **sad** driver using **/dev/sad/user**.

fildes is an open file descriptor that refers to the **sad** driver. *command* determines the control function to be performed as described below. *arg* represents additional information that is needed by this command. The type of *arg* depends upon the command, but it is generally an integer or a pointer to a *command*-specific data structure.

COMMAND FUNCTIONS

The autopush facility (see **autopush**(1M)) allows one to configure a list of modules to be automatically pushed on a stream when a driver is first opened. Autopush is controlled by the following commands:

SAD_SAP Allows the administrator to configure the given device's autopush information. *arg* points to a **strapush** structure, which contains the following members:

```
uint   sap_cmd;
long   sap_major;
long   sap_minor;
long   sap_lastminor;
long   sap_npush;
uint   sap_list [MAXAPUSH] [FMNAMESZ + 1];
```

The **sap_cmd** field indicates the type of configuration being done. It may take on one of the following values:

SAP_ONE	Configure one minor device of a driver.
SAP_RANGE	Configure a range of minor devices of a driver.
SAP_ALL	Configure all minor devices of a driver.
SAP_CLEAR	Undo configuration information for a driver.

The **sap_major** field is the major device number of the device to be configured. The **sap_minor** field is the minor device number of the device to be configured. The **sap_lastminor** field is used only with the **SAP_RANGE** command, which configures a range of minor devices between **sap_minor** and **sap_lastminor**, inclusive. The minor fields have no meaning for the **SAP_ALL** command. The **sap_npush** field indicates the number of modules to

be automatically pushed when the device is opened. It must be less than or equal to **MAXAPUSH** , defined in **sad.h**. It must also be less than or equal to **NSTRPUSH**, the maximum number of modules that can be pushed on a stream, defined in the kernel master file. The field **sap_list** is an array of NULL-terminated module names to be pushed in the order in which they appear in the list.

When using the **SAP_CLEAR** command, the user sets only **sap_major** and **sap_minor**. This will undo the configuration information for any of the other commands. If a previous entry was configured as **SAP_ALL**, **sap_minor** should be set to zero. If a previous entry was configured as **SAP_RANGE** , **sap_minor** should be set to the lowest minor device number in the range configured.

On failure, **errno** is set to the following value:

EFAULT *arg* points outside the allocated address space.

EINVAL The major device number is invalid, the number of modules is invalid, or the list of module names is invalid.

ENOSTR The major device number does not represent a STREAMS driver.

EEXIST The major-minor device pair is already configured.

ERANGE The command is **SAP_RANGE** and **sap_lastminor** is not greater than **sap_minor**, or the command is **SAP_CLEAR** and **sap_minor** is not equal to the first minor in the range.

ENODEV The command is **SAP_CLEAR** and the device is not configured for autopush.

ENOSR An internal autopush data structure cannot be allocated.

SAD_GAP Allows any user to query the **sad** driver to get the autopush configuration information for a given device. *arg* points to a **strapush** structure as described in the previous command.

The user should set the **sap_major** and **sap_minor** fields of the **strapush** structure to the major and minor device numbers, respectively, of the device in question. On return, the **strapush** structure will be filled in with the entire information used to configure the device. Unused entries in the module list will be zero-filled.

On failure, **errno** is set to one of the following values:

EFAULT *arg* points outside the allocated address space.

EINVAL The major device number is invalid.

ENOSTR The major device number does not represent a STREAMS driver.

ENODEV The device is not configured for autopush.

SAD_VML Allows any user to validate a list of modules (that is, to see if they are

installed on the system). *arg* is a pointer to a **str_list** structure with the following members:

```
int                 sl_nmods;
struct str_mlist    *sl_modlist;
```

The **str_mlist** structure has the following member:

```
char                l_name[FMNAMESZ+1];
```

sl_nmods indicates the number of entries the user has allocated in the array and **sl_modlist** points to the array of module names. The return value is 0 if the list is valid, 1 if the list contains an invalid module name, or –1 on failure. On failure, **errno** is set to one of the following values:

EFAULT *arg* points outside the allocated address space.

EINVAL The **sl_nmods** field of the **str_list** structure is less than or equal to zero.

SEE ALSO

intro(2), **ioctl**(2), **open**(2)

STREAMS Programmer's Guide

DIAGNOSTICS

Unless otherwise specified, the return value from **ioctl** is 0 upon success and –1 upon failure with **errno** set as indicated.

NAME

sbpro – Sound Blaster Pro audio device

SYNOPSIS

/dev/sbpro
/dev/sbproctl

AVAILABILITY

x86

DESCRIPTION

The **sbpro** device plays and records one or two channels of sound using the Creative Labs Sound Blaster Pro audio card. Digital audio data is sampled at rates from 4000 to 44,100 samples per second with 8-bit precision. By default, the data is converted to use *u*–law encoding, for compatibility with SPARC systems.

The **sbpro** driver is implemented as a STREAMS device. In order to record audio input, applications **open**(2) the **/dev/sbpro** device and read data from it using the **read**(2) system call. (Note that for compatibility with SPARC systems, **/dev/sbpro** will typically be linked to **/dev/audio**). Similarly, sound data is queued to the audio output port by using the **write**(2) system call.

Opening the Sound Blaster Pro Device

The **sbpro** device is treated as an exclusive resource: only one process may typically open the device at a time. However, two processes may simultaneously access the device if one opens it read-only and the other opens it write-only.

When a process cannot open **/dev/sbpro** because the requested access mode is busy:

- If the **O_NDELAY** flag is set in the **open( )** *flags* argument, then **open( )** returns –1 immediately, with **errno** set to **EBUSY**.
- If **O_NDELAY** is not set, then **open( )** hangs until the device is available or a signal is delivered to the process, in which case **open( )** returns –1 with **errno** set to **EINTR**.

Since the **sbpro** device grants exclusive read or write access to a single process at a time, long-lived audio applications may choose to close the device when they enter an idle state, reopening it when required. The *play.waiting* and *record.waiting* flags in the audio information structure (see below) provide an indication that another process has requested access to the device. This information is advisory only; background audio output processes, for example, may choose to relinquish the **sbpro** device whenever another process requests write access.

Recording Audio Data

The **read( )** system call copies data from the system buffers to the application. Ordinarily, **read( )** blocks until the user buffer is filled. The **FIONREAD** ioctl may be used to determine the amount of data that may be read without blocking. The device may alternatively be set to a non-blocking mode, in which case **read( )** completes immediately, but may return fewer bytes than requested. Refer to the **read**(2) manual page for a complete description of this behavior.

When the **sbpro** device is opened with read access, the device driver immediately starts buffering audio input data. Since this consumes system resources, processes that do not record audio data should open the device write-only (**O_WRONLY**).

The transfer of input data to STREAMS buffers may be paused (or resumed) by using the **AUDIO_SETINFO** ioctl to set (or clear) the *record.pause* flag in the audio information structure (see below). All unread input data in the STREAMS queue may be discarded by using the **I_FLUSH** STREAMS ioctl (see **streamio**(7)).

Input data accumulates in STREAMS buffers at a rate equivalent to the sampling rate times the number of channels (the default is 8000 bytes per second for 8kHz monophonic samples). If the application that consumes the data cannot keep up with this data rate, the STREAMS queue may become full. When this occurs, the *record.error* flag is set in the audio information structure and input sampling ceases until there is room in the input queue for additional data. In such cases, the input data stream contains a discontinuity. For this reason, audio recording applications should open the **sbpro** device when they are prepared to begin reading data, rather than at the start of extensive initialization.

Playing Audio Data

The **write( )** system call copies data from an applications buffer to the STREAMS output queue. Ordinarily, **write( )** blocks until the entire user buffer is transferred. The device may alternatively be set to a non-blocking mode, in which case **write( )** completes immediately, but may have transferred fewer bytes than requested (see **write**(2)).

Although **write( )** returns when the data is successfully queued, the actual completion of audio output may take considerably longer. The **AUDIO_DRAIN** ioctl may be issued to allow an application to block until all of the queued output data has been played. Alternatively, a process may request asynchronous notification of output completion by writing a zero-length buffer (end-of-file record) to the output stream. When such a buffer has been processed, the *play.eof* flag in the audio information structure (see below) is incremented.

The final **close( )** of the file descriptor hangs until audio output has drained. If a signal interrupts the **close( )**, or if the process exits without closing the device, any remaining data queued for audio output is flushed and the device is closed immediately.

The conversion of output data may be paused (or resumed) by using the **AUDIO_SETINFO** ioctl to set (or clear) the *play.pause* flag in the audio information structure. Queued output data may be discarded by using the **I_FLUSH** STREAMS ioctl.

Output data is played from the STREAMS buffers at the specified sampling rate. If the output queue becomes empty, the *play.error* flag is set in the audio information structure and output ceases until additional data is written.

Asynchronous I/O

The **I_SETSIG** STREAMS ioctl may be used to enable asynchronous notification, via the **SIGPOLL** signal, of input and output ready conditions. This, in conjunction with non-blocking **read( )** and **write( )** requests, is normally sufficient for applications to maintain an audio stream in the background. Alternatively, asynchronous reads and writes may be initiated using the **aioread**(3) functions.

Audio Data Encoding

The data samples processed by the **sbpro** device are encoded in 8 bits. The high-order bit is a sign bit; 1 represents positive data and 0 represents negative data. The low-order 7 bits represent signal magnitude and are inverted (1's complement). The magnitude is encoded according to a *u*-law transfer function; such an encoding provides an improved signal-to-noise ratio at low amplitude levels. In order to achieve the best results, the audio recording gain should be set so that typical amplitude levels lie within approximately three-fourths of the full dynamic range.

Audio Control Pseudo-Device

It is sometimes convenient to have an application, such as a volume control panel, modify certain characteristics of the **sbpro** device while it is being used by an unrelated process. The **/dev/sbproctl** minor device is provided for this purpose. (Note that for compatibility with SPARC systems, **/dev/sbproctl** will typically be linked to **/dev/audioctl**). Any number of processes may open **/dev/sbproctl** simultaneously. However, **read( )** and **write( )** system calls are ignored by **/dev/sbproctl**. The **AUDIO_GETINFO** and **AUDIO_SETINFO** ioctl commands may be issued to **/dev/sbproctl** in order to determine the status or alter the behavior of **/dev/sbpro**.

Audio Status Change Notification

Applications that open the audio control pseudo-device may request asynchronous notification of changes in the state of the **sbpro** device by setting the **S_MSG** flag in an **I_SETSIG** STREAMS ioctl. Such processes receive a **SIGPOLL** signal when any of the following events occur:

- An **AUDIO_SETINFO** ioctl has altered the device state.
- An input overflow or output underflow has occurred.
- An end-of-file record (zero-length buffer) has been processed on output.
- An **open( )** or **close( )** of **/dev/sbpro** has altered the device state.

Audio Information Structure

The state of the **sbpro** device may be polled or modified using the **AUDIO_GETINFO** and **AUDIO_SETINFO** ioctl commands. These commands operate on the **audio_info** structure, defined in **<sys/audioio.h>** as follows:

```
/* Data encoding values, used below in the encoding field */
#define AUDIO_ENCODING_ULAW     (1)     /* u-law encoding */
#define AUDIO_ENCODING_ALAW     (2)     /* A-law encoding */
#define AUDIO_ENCODING_LINEAR   (3)     /* linear (8-bit signed data) encoding */

/* These ranges apply to record, play, and monitor gain values */
#define AUDIO_MIN_GAIN          (0)     /* minimum gain value */
#define AUDIO_MAX_GAIN          (255)   /* maximum gain value */

/* Audio I/O channel status, used below in the audio_info structure */
struct audio_prinfo {
        /* The following values describe the audio data encoding */
        unsigned        sample_rate;    /* samples per second */
        unsigned        channels;       /* number of interleaved channels */
        unsigned        precision;      /* number of bits per sample */
        unsigned        encoding;       /* data encoding method */
```

```
        /* The following values control audio device configuration */
        unsigned            gain;               /* gain level */
        unsigned            port;               /* selected I/O port */

        /* The following values describe the current device state */
        unsigned            samples;            /* number of samples converted */
        unsigned            eof;                /* End Of File counter (play only) */
        unsigned char       pause;              /* non-zero if paused, zero to resume */
        unsigned char       error;              /* non-zero if overflow/underflow */
        unsigned char       waiting;            /* non-zero if a process wants access */

        /* The following values are read-only device state flags */
        unsigned char       open;               /* non-zero if open access granted */
        unsigned char       active;             /* non-zero if I/O active */
};

        /* This structure is used in AUDIO_GETINFO and AUDIO_SETINFO
        ioctl commands */
typedef struct audio_info {
        struct audio_prinfo record;             /* input status information */
        struct audio_prinfo play;               /* output status information */
        unsigned            monitor_gain;       /* input to output mix */
} audio_info_t;


#define                     MAX_AUDIO_DEV_LEN(16)
/* Parameter for the AUDIO_GETDEV ioctl */
typedef struct audio_device {
        char                name[MAX_AUDIO_DEV_LEN];
        char                version[MAX_AUDIO_DEV_LEN];
        char                config[MAX_AUDIO_DEV_LEN];
} audio_device_t;
```

The *play.gain* and *record.gain* fields specify the output and input volume levels. A value of **AUDIO_MAX_GAIN** indicates maximum gain. The device also allows input data to be monitored by mixing audio input onto the output channel. The *monitor_gain* field controls the level of this feedback path.

The Sound Blaster hardware does not support multiple output devices, so the *play.port* field is provided for compatibility purposes only. On SPARC systems, it controls the output path for the audio device, and may be set to either **AUDIO_SPEAKER** or **AUDIO_HEADPHONE** to direct output to the built-in speaker or the headphone jack, respectively. The *record.port* field allows selecting which audio source is used for recording, and may be set to one of **AUDIO_MICROPHONE , AUDIO_LINE_IN ,** or **AUDIO_CD** to select input from the microphone jack, line-level input jack, or internal CD input, respectively.

The *play.pause* and *record.pause* flags may be used to pause and resume the transfer of data between the **sbpro** device and the STREAMS buffers. The *play.error* and *record.error* flags indicate that data underflow or overflow has occurred. The *play.active* and *record.active* flags indicate that data transfer is currently active in the corresponding direction.

The *play.open* and *record.open* flags indicate that the device is currently open with the corresponding access permission. The *play.waiting* and *record.waiting* flags provide an indication that a process may be waiting to access the device. These flags are set automatically when a process blocks on **open( )**, though they may also be set using the **AUDIO_SETINFO** ioctl command. They are cleared only when a process relinquishes access by closing the device.

The *play.samples* and *record.samples* fields are initialized, at **open( )**, to zero and increment each time a data sample is copied to or from the associated STREAMS queue. Applications that keep track of the number of samples read or written may use these fields to determine exactly how many samples remain in the STREAMS buffers. The *play.eof* field increments whenever a zero-length output buffer is synchronously processed. Applications may use this field to detect the completion of particular segments of audio output.

The *sample_rate*, *channels*, *precision*, and *encoding* fields report the audio data format in use by the device. Unlike the SPARC systems, these values may be modified and the **sbpro** driver will use valid values. The *sample_rate* field can be set to any value between 4000 and 44100. *channels* can be set to 1 for monophonic and 2 for stereophonic samples, and *encoding* may be set to **AUDIO_ENCODING_ULAW** or **AUDIO_ENCODING_LINEAR ,** for SPARC-compatible *u*–law encoding or PC-compatible linear 8-bit signed data, respectively.

Filio and STREAMS IOCTLS

All of the **streamio**(7) ioctl commands may be issued for the **/dev/sbpro** device. Because the **/dev/sbproctl** device has its own STREAMS queues, most of these commands neither modify nor report the state of **/dev/sbpro** if issued for the **/dev/sbproctl** device. The **I_SETSIG** ioctl may be issued for **/dev/sbproctl** to enable the notification of audio status changes, as described above.

Audio IOCTLS

The **sbpro** device additionally supports the following ioctl commands:

AUDIO_DRAIN

The argument is ignored. This command suspends the calling process until the output STREAMS queue is empty, or until a signal is delivered to the calling process. It may only be issued for the **/dev/sbpro** device. An implicit **AUDIO_DRAIN** is performed on the final **close( )** of **/dev/sbpro**.

AUDIO_GETINFO

The argument is a pointer to an **audio_info** structure. This command may be issued for either **/dev/sbpro** or **/dev/sbproctl**. The current state of the **/dev/sbpro** device is returned in the structure.

AUDIO_SETINFO

The argument is a pointer to an **audio_info** structure. This command may be issued for either **/dev/sbpro** or **/dev/sbproctl**. This command configures the **sbpro** device according to the structure supplied and overwrites the structure with the new state of the device. Note: The *play.samples*, *record.samples*, *play.error*, *record.error*, and *play.eof* fields are modified to reflect the state of the device when the **AUDIO_SETINFO** was issued. This allows programs to atomically modify these fields while retrieving the previous value.

Certain fields in the information structure, such as the *pause* flags, are treated as read-only when **/dev/sbpro** is not open with the corresponding access permission. Other fields, such as the gain levels and encoding information, may have a restricted set of acceptable values. Applications that attempt to modify such fields should check the returned values to be sure that the corresponding change took effect.

Once set, the following values persist through subsequent **open( )** and **close( )** calls of the device: *play.gain*, *record.gain*, *monitor_gain*, *play.port*, and *record.port*. All other state is reset when the corresponding I/O stream of **/dev/sbpro** is closed.

The **audio_info** structure may be initialized through the use of the **AUDIO_INITINFO** macro. This macro sets all fields in the structure to values that are ignored by the **AUDIO_SETINFO** command. For instance, the following code switches the input port from the microphone port to the line-level input jack without modifying any other audio parameters:

```
audio_info_t        info;

AUDIO_INITINFO(&info);
info.record.port = AUDIO_LINE_IN;
err = ioctl(audio_fd, AUDIO_SETINFO, &info);
```

This technique is preferred over using a sequence of **AUDIO_GETINFO** followed by **AUDIO_SETINFO**.

AUDIO_GETDEV

The argument is a pointer to an **audio_device** structure. This command may be issued for either **/dev/sbpro** or **/dev/sbproctl**. The returned value in the *name* field will be a string that will identify the current hardware device, the value in *version* will be a string indicating the current version of the hardware, and *config* will be a device-specific string identifying the properties of the audio stream associated with that file descriptor. The **sbpro** driver will return "**SUNW,sbpro**" in the *name* field of the **audio_device** structure. The *version* field will contain the version number of the device driver, and the *config* field will be set to "**config**" .

Unsupported Device Features

The Sound Blaster Pro card also supports FM synthesis and MIDI device control, although neither is supported in this version of the driver.

FILES

/dev/sbpro
/dev/sbproctl
/dev/audio linked to **/dev/sbpro**
/dev/audioctl linked to **/dev/sbproctl**
/usr/demo/SOUND

SEE ALSO

ioctl(2), **read**(2), **write**(2), **aioread**(3), **streamio**(7)

Creative Labs, Inc. *Sound Blaster Pro User Reference Manual*

BUGS

Due to a feature of the STREAMS implementation, programs that are terminated or exit without closing the **audio** device may hang for a short period while audio output drains. In general, programs that produce audio output should catch the **SIGINT** signal and flush the output stream before exiting.

The current driver implementation does not support the A-law encoding mode. Future implementations may permit the **AUDIO_SETINFO** ioctl to modify the *play.encoding* and *record.encoding* fields of the device information structure to enable this mode.

NAME

sd – driver for SCSI disk and CD-ROM devices

SYNOPSIS

sd@*target***,***lun*:*partition*

DESCRIPTION

This driver handles embedded SCSI-2 and CCS-compatible SCSI disk drives, CD-ROM drives, and the Emulex MD21 disk controller for ESDI drives.

The type of disk drive is determined using the SCSI inquiry command and reading the volume label stored on block 0 of the drive. The volume label describes the disk geometry and partitioning; it must be present or the disk cannot be mounted by the system.

The block-files access the disk using the system's normal buffering mechanism and are read and written without regard to physical disk records. There is also a "raw" interface that provides for direct transmission between the disk and the user's read or write buffer. A single read or write call usually results in one I/O operation; raw I/O is therefore considerably more efficient when many bytes are transmitted. The names of the block files are found in **/dev/dsk**; the names of the raw files are found in **/dev/rdsk**.

I/O requests (such as **lseek**(2)) to the SCSI disk must have an offset that is a multiple of 512 bytes (DEV_BSIZE), or the driver returns an EINVAL error. If the transfer length is not a multiple of 512 bytes, the transfer count is rounded up by the driver.

Partition **0** is normally used for the root file system on a disk, partition **1** as a paging area (for example, **swap**), and partition **2** for backing up the entire disk. Partition **2** normally maps the entire disk and may also be used as the mount point for secondary disks in the system. The rest of the disk is normally partition **6**. For the primary disk, the user file system is located here.

CD-ROM Drive Support

CD-ROM is a removable read-only direct-access device. **CD-ROM** drives are designed to work with any disk that meets the Sony-Philips "red-book" or "yellow-book" documents. These drives can read **CD-ROM** data disks, digital audio disks (Audio CD's) or combined-mode disks, with a mix of audio and data tracks. This driver supports the SONY CDU-8012 **CD-ROM** drive controller and other **CD-ROM** drives which have the same SCSI command set as the SONY CDU-8012. The type of **CD-ROM** drive is determined using the SCSI inquiry command.

A **CD-ROM** disk is singled sided containing approximately 540 mega-bytes of data or 74 minutes of audio.

When the device is first opened, the **CD-ROM** drive's eject button will be disabled, preventing the manual removal of the disk) until the last **close**(2) is called.

There is no volume label stored on the **CD-ROM** . The disk geometry and partitioning information is always the same. If the **CD-ROM** is in ISO 9660 or **High Sierra Disk** format, it can be mounted as a file system.

Ioctls

Refer to **dkio**(7).

ERRORS

EACCES	Permission denied.
EBUSY	The partition was opened exclusively by another thread.
EFAULT	The argument was a bad address.
EINVAL	Invalid argument.
EIO	An I/O error occurred.
ENOTTY	This indicates that the device does not support the requested ioctl function.
ENXIO	During opening, the device did not exist.
EROFS	The device is a read-only device.

FILES

sd.conf	driver configuration file
/dev/dsk/c*n***t***n***d***n***s***n*	block files
/dev/rdsk/c*n***t***n***d***n***s***n*	raw files

where:

c*n*	controller *n*
t*n*	SCSI target id *n* (0-6)
d*n*	SCSI LUN *n* (0-7)
s*n*	partition *n* (0-7)

SEE ALSO

format(1M), **ioctl**(2), **lseek**(2), **read**(2), **write**(2), **driver.conf**(4), **cdio**(7), **dkio**(7), **esp**(7), **isp**(7)

ANSI Small Computer System Interface-2 (SCSI-2)

Emulex MD21 Disk Controller Programmer Reference Manual

DIAGNOSTICS

Error for command '<command name>'Error Level: Fatal
Requested Block <n>, Error Block: <m>
Sense Key: <sense key name>
Vendor '<vendor name>': ASC = 0x<a> (<ASC name>), ASCQ = 0x<b>, FRU = 0x<c>
The command indicated by <command name> failed. The Requested Block is the block where the transfer started and the Error Block is the block that caused the error. Sense Key, ASC, and ASCQ information is returned by the target in response to a request sense command.

Caddy not inserted in drive
The drive is not ready because no caddy has been inserted.

Check Condition on REQUEST SENSE
A REQUEST SENSE cmd completed with a check condition. The original command will be retried a number of times.

Label says <m> blocks Drive says <n> blocks
There is a discrepancy between the label and what the drive returned on the READ CAPACITY command.

Not enough sense information
The request sense data was less than expected.

Request Sense couldn't get sense data
The REQUEST SENSE cmd did not transfer any data.

Reservation Conflict
The drive was reserved by another initiator.

SCSI transport failed: reason 'xxxx' : {retrying | giving up}
The host adapter has failed to transport a command to the target for the reason stated. The driver will either retry the command or, ultimately, give up.

Unhandled Sense Key <n>
The REQUEST SENSE data included an invalid sense key.

Unit not Ready. Additional sense code 0x<n>
The drive is not ready.

can't do switch back to mode 1
A failure to switch back to read mode 1.

corrupt label - bad geometry
The disk label is corrupted.

corrupt label - label checksum failed
The disk label is corrupted.

corrupt label - wrong magic number
The disk label is corrupted.

device busy too long
The drive returned busy during a number of retries.

disk not responding to selection
The drive was probably powered down or died.

failed to handle UA
A retry on a Unit Attention condition failed.

i/o to invalid geometry
The geometry of the drive could not be established.

incomplete read/write - retrying/giving up
There was a residue after the command completed normally.

logical block size <n> not supported
Illegal blocksize.

logical unit not ready
The drive is not ready.

no bp for disk label
A bp with consistent memory could not be allocated.

no mem for property
Free memory pool exhausted.

no memory for disk label
Free memory pool exhausted.

no resources for dumping
A packet could not be allocated during dumping.

offline
Drive went offline; probably powered down.

requeue of command fails <n>
Driver attempted to retry a command and experienced a transport error.

sdrestart transport failed (<n>)
Driver attempted to retry a command and experienced a transport error.

transfer length not modulo <n>
Illegal request size.

transport of request sense fails (<n>)
Driver attempted to submit a request sense command and failed.

transport rejected (<n>)
Host adapter driver was unable to accept a command.

unable to read label
Failure to read disk label.

unit does not respond to selection
Drive went offline; probably powered down.

NAME

smc – SMC 8003 / 8013 / 8216 Ethernet device driver

SYNOPSIS

```
#include <sys/stropts.h>
#include <sys/ethernet.h>
#include <sys/dlpi.h>
```

AVAILABILITY

x86

DESCRIPTION

The SMC 8003 / 8013 / 8216 Ethernet driver is a multi-threaded, loadable, clonable, STREAMS hardware driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), over an SMC 80*X*3 / 8216 Ethernet controller. Multiple SMC controllers installed within the system are supported by the driver. The **smc** driver provides basic support for the SMC hardware. Functions include chip initialization, frame transmit and receive, multicast and "promiscuous" support, and error recovery and reporting.

The cloning character-special device **/dev/smc** is used to access all SMC controllers installed within the system.

The **smc** driver is a “style 2” Data Link Service provider. All **M_PROTO** and **M_PCPROTO** type messages are interpreted as **DLPI** primitives. An explicit **DL_ATTACH_REQ** message by the user is required to associate the opened stream with a particular device (**ppa**). The **ppa** ID is interpreted as an unsigned long and indicates the corresponding device instance (unit) number. The unit numbers are assigned sequentially to each board found. The search order is determined by the order defined in the **/kernel/drv/smc.conf** file. An error (**DL_ERROR_ACK**) is returned by the driver if the **ppa** field value does not correspond to a valid device instance number for this system. The device is initialized on first attach and de-initialized (stopped) on last detach.

The values returned by the driver in the **DL_INFO_ACK** primitive in response to the **DL_INFO_REQ** from the user are as follows:

- The max SDU is **1500** (**ETHERMTU**).
- The min SDU is **0**.
- The **dlsap** address length is **8**.
- The MAC type is **DL_ETHER** or **DL_CSMACD**.
- The **sap** length value is **–2**, meaning the physical address component is followed immediately by a 2-byte **sap** component within the **DLSAP** address.
- The service mode is **DL_CLDLS**.
- No optional quality of service (QOS) support is included at present, so the QOS fields are **0**.
- The provider style is **DL_STYLE2**.
- The version is **DL_VERSION_2**.
- The broadcast address value is Ethernet / IEEE broadcast address (FF:FF:FF:FF:FF:FF).

Once in the **DL_ATTACHED** state, the user must send a **DL_BIND_REQ** to associate a particular SAP (Service Access Pointer) with the stream. The **smc** driver interprets the **sap** field within the **DL_BIND_REQ** as an Ethernet "type," therefore valid values for the **sap** field are in the **[0-0xFFFF]** range. Only one Ethernet type can be bound to the stream at any time.

In addition to Ethernet V2 service, an "802.3 mode" is provided by the driver and works as follows. **sap** values in the range **[0-1500]** are treated as equivalent and represent a desire by the user for "802.3" mode. If the value of the **sap** field of the **DL_BIND_REQ** is within this range, then the driver computes the length, not including initial **M_PROTO** mblk, of all subsequent **DL_UNITDATA_REQ** messages and transmits 802.3 frames having this value in the MAC frame header length field. All frames received from the media having a "type" field in this range are assumed to be 802.3 frames and are routed up all open streams that are bound to any **sap** value within this range. If more than one stream is in "802.3 mode," then the frame will be duplicated and routed up multiple streams as **DL_UNITDATA_IND** messages.

The **smc** driver **DLSAP** address format consists of the 6-byte physical (Ethernet) address component followed immediately by the 2-byte **sap** (type) component producing an 8-byte **DLSAP** address. Applications should *not* hardcode to this particular implementation-specific **DLSAP** address format but use information returned by the **DL_INFO_ACK** primitive to compose and decompose **DLSAP** addresses. The **sap** length, full **DLSAP** length, and **sap** / physical ordering are included within the **DL_INFO_ACK**. The physical address length can be computed by subtracting the **sap** length from the full **DLSAP** address length or by issuing the **DL_PHYS_ADDR_REQ** to obtain the current physical address associated with the stream.

Once in the **DL_BOUND** state, the user may transmit frames on the Ethernet by sending **DL_UNITDATA_REQ** messages to the **smc** driver. The **smc** driver will route received Ethernet frames up all those open and bound streams having a **sap** which matches the Ethernet type as **DL_UNITDATA_IND** messages. Received Ethernet frames are duplicated and routed up multiple open streams if necessary. The **DLSAP** address contained within the **DL_UNITDATA_REQ** and **DL_UNITDATA_IND** messages consists of both the **sap** (type) and physical (Ethernet) components.

smc Primitives

In addition to the mandatory connectionless **DLPI** message set, the driver additionally supports the following primitives.

The **DL_ENABMULTI_REQ** and **DL_DISABMULTI_REQ** primitives enable / disable reception of individual multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis using these primitives. These primitives are accepted by the driver in any state following **DL_ATTACHED**.

The **DL_PROMISCON_REQ** and **DL_PROMISCOFF_REQ** primitives with the **DL_PROMISC_PHYS** flag set in the **dl_level** field enables / disables reception of all ("promiscuous mode") frames on the media including frames generated by the local host.

When used with the **DL_PROMISC_SAP** flag set, this enables / disables reception of all **sap** (Ethernet type) values. When used with the **DL_PROMISC_MULTI** flag set, this enables / disables reception of all multicast group addresses. The effect of each is always on a per-stream basis and independent of the other **sap** and physical level configurations on this stream or other streams.

The **DL_PHYS_ADDR_REQ** primitive returns the 6-octet Ethernet address currently associated (attached) to the stream in the **DL_PHYS_ADDR_ACK** primitive. This primitive is valid only in states following a successful **DL_ATTACH_REQ**.

The **DL_SET_PHYS_ADDR_REQ** primitive changes the 6-octet Ethernet address currently associated (attached) to this stream. The credentials of the process that originally opened this stream must be superuser or **EPERM** is returned in the **DL_ERROR_ACK**. This primitive is destructive in that it affects all other current and future streams attached to this device. An **M_ERROR** is sent up all other streams attached to this device when this primitive on this stream is successful. Once changed, all streams subsequently opened and attached to this device will obtain this new physical address. Once changed, the physical address will remain in effect until this primitive is used to change the physical address again or the system is rebooted, whichever comes first.

CONFIGURATION

The **/kernel/drv/smc.conf** file supports the following options:

intr Specifies the IRQ level for the board.

reg Specifies the shared RAM the board is jumpered for.

It is important to ensure that there are no conflicts for the board's I / O port, shared RAM, or IRQ level.

FILES

/dev/smc

/kernel/drv/smc.conf **smc** configuration file.

SEE ALSO

dlpi(7)

NAME

smce – SMC 3032 / EISA dual-channel Ethernet device driver

SYNOPSIS

```
#include <sys/stropts.h>
#include <sys/ethernet.h>
#include <sys/dlpi.h>
```

AVAILABILITY

x86

DESCRIPTION

The **smce** Ethernet driver is a multi-threaded, loadable, clonable, STREAMS hardware driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), over the SMC 3032 / EISA dual-channel Ethernet controllers. Each dual-channel 3032 / EISA controller can support two subnetworks. Multiple 3032 / EISA controllers installed within the system are supported by the driver. The **smce** driver provides basic support for the 3032 / EISA hardware. Functions include chip initialization, frame transmit and receive, multicast and "promiscuous" support, and error recovery and reporting on both channels.

The cloning, character-special device **/dev/smce** is used to access all 3032 / EISA devices installed within the system.

The **smce** driver is a "style 2" Data Link Service provider. All **M_PROTO** and **M_PCPROTO** type messages are interpreted as **DLPI** primitives. An explicit **DL_ATTACH_REQ** message by the user is required to associate the opened stream with a particular device (**ppa**). The **ppa** ID is interpreted as an unsigned long integer and indicates the corresponding device instance (unit) number. The unit numbers are assigned sequentially to each board found. For the dual-channel 3032 / EISA controller, a pair of **ppa** IDs is associated with each controller. The lower (even) numbered **ppa** corresponds to port A of the controller while the higher (odd) numbered **ppa** corresponds to port B. The search order is determined by the order defined in the **/kernel/drv/smce.conf** file. If the **ppa** field value does not correspond to a valid device instance number for this system, the driver will return an error (**DL_ERROR_ACK**). The device is initialized on first attach and de-initialized (stopped) on last detach.

The values returned by the driver in the **DL_INFO_ACK** primitive in response to the **DL_INFO_REQ** from the user are as follows:

- The maximum SDU is **1500** (**ETHERMTU**).
- The minimum SDU is **0**. The driver will pad to the mandatory 60-octet minimum packet size.
- The **dlsap** address length is **8**.
- The MAC type is **DL_ETHER**.
- The **sap** length value is **–2**, meaning the physical address component is followed immediately by a 2-byte **sap** component within the **DLSAP** address.
- The service mode is **DL_CLDLS**.
- No optional quality of service (**QOS**) support is included at present, so the **QOS** fields are **0**.

- The provider style is **DL_STYLE2**.
- The version is **DL_VERSION_2**.
- The broadcast address value is Ethernet / IEEE broadcast address (FF:FF:FF:FF:FF:FF).

Once in the **DL_ATTACHED** state, the user must send a **DL_BIND_REQ** to associate a particular Service Access Pointer (SAP) with the stream. The **smce** driver interprets the **sap** field within the **DL_BIND_REQ** as an Ethernet "type;" therefore valid values for the **sap** field are in the **[0-0xFFFF]** range. Only one Ethernet type can be bound to the stream at any time.

In addition to Ethernet V2 service, an "802.3 mode" is also provided by the driver. In this mode, **sap** values in the range **[0-1500]** are treated as equivalent and represent a desire by the user for "802.3" mode. If the value of the **sap** field of the **DL_BIND_REQ** message is within this range, then the driver expects that the destination **DLSAP** in a **DL_UNITDATA_REQ** will contain the *length* of the data rather than a **sap** value. All frames received from the media that have a "type" field in this range are assumed to be 802.3 frames, and they are routed up all open streams which are bound to any **sap** value within this range. If more than one stream is in "802.3 mode," then the frame will be duplicated and routed up multiple streams as **DL_UNITDATA_IND** messages.

The **smce** driver **DLSAP** address format consists of the 6-byte physical (Ethernet) address component followed immediately by the 2-byte **sap** (type) component, producing an 8-byte address. Applications should *not* hardcode to this particular implementation-specific **DLSAP** address format, but should instead use information returned in the **DL_INFO_ACK** primitive to compose and decompose **DLSAP** addresses. The **sap** length, full **DLSAP** length, and **sap** / physical ordering are included within the **DL_INFO_ACK**. The physical address length can be computed by subtracting the **sap** length from the full **DLSAP** address length or by issuing the **DL_PHYS_ADDR_REQ** to obtain the current physical address associated with the stream.

Once in the **DL_BOUND** state, the user may transmit frames on the Ethernet by sending **DL_UNITDATA_REQ** messages to the **smce** driver. The **smce** driver will route received Ethernet frames up all open and bound streams that have a **sap** which matches the Ethernet type as **DL_UNITDATA_IND** messages. Received Ethernet frames are duplicated and routed up multiple open streams if necessary. The **DLSAP** address contained within the **DL_UNITDATA_REQ** and **DL_UNITDATA_IND** messages consists of both the **sap** (type) and physical (Ethernet) components.

smce Primitives

In addition to the mandatory connectionless **DLPI** message set, the driver also supports the following primitives:

The **DL_ENABMULTI_REQ** and **DL_DISABMULTI_REQ** primitives enable / disable reception of individual multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis using these primitives. These primitives are accepted by the driver in any state following **DL_ATTACHED**.

The **DL_PROMISCON_REQ** and **DL_PROMISCOFF_REQ** primitives with the **DL_PROMISC_PHYS** flag set in the **dl_level** field enables / disables reception of all "promiscuous mode" frames on the media including frames generated by the local host.

When used with the **DL_PROMISC_SAP** flag set, this enables / disables reception of all **sap** (Ethernet type) values. When used with the **DL_PROMISC_MULTI** flag set, this enables / disables reception of all multicast group addresses. The effect of each is always on a per-stream basis and independent of the other **sap** and physical level configurations on this stream or other streams.

The **DL_PHYS_ADDR_REQ** primitive returns the 6-octet Ethernet address currently associated (attached) to the stream in the **DL_PHYS_ADDR_ACK** primitive. This primitive is valid only in states following a successful **DL_ATTACH_REQ**. When the system starts up, both channels on the 3032 / EISA controller uses the same Ethernet address obtained from the on-board EEPROM.

The **DL_SET_PHYS_ADDR_REQ** primitive changes the 6-octet Ethernet address currently associated (attached) to this stream. The credentials of the process which originally opened this stream must be superuser or an **EPERM** error is returned in the **DL_ERROR_ACK**. This primitive is destructive in that it affects all other current and future streams attached to this device. An **M_ERROR** is sent up all other streams attached to this device when this primitive on this stream is successful. Once changed, all streams subsequently opened and attached to this device will obtain this new physical address. The new physical address will remain in effect until this primitive is used to change the physical address again or the system is rebooted, whichever comes first.

CONFIGURATION

The **/kernel/drv/smce.conf** file supports the following options:

intr	Specifies the IRQ level for the board.
reg	Specifies the shared RAM the board is jumpered for.

It is important to ensure that there are no conflicts for the board's I / O port, shared RAM, or IRQ level.

FILES

/dev/smce	
/kernel/drv/smce.conf	**smce** configuration file.

SEE ALSO

dlpi(7)

NAME

sockio – ioctls that operate directly on sockets

SYNOPSIS

#include <sys/sockio.h>

DESCRIPTION

The IOCTLs listed in this manual page apply directly to sockets, independent of any underlying protocol. The **setsockopt**() call (see **getsockopt**(3N)) is the primary method for operating on sockets, rather than on the underlying protocol or network interface. **ioctl**s for a specific network interface or protocol are documented in the manual page for that interface or protocol.

SIOCSPGRP The argument is a pointer to an **int**. Set the process-group ID that will subsequently receive **SIGIO** or **SIGURG** signals for the socket referred to by the descriptor passed to **ioctl** to the value of that **int**.

SIOCGPGRP The argument is a pointer to an **int**. Set the value of that **int** to the process-group ID that is receiving **SIGIO** or **SIGURG** signals for the socket referred to by the descriptor passed to **ioctl**.

SIOCCATMARK The argument is a pointer to an **int**. Set the value of that **int** to 1 if the read pointer for the socket referred to by the descriptor passed to **ioctl** points to a mark in the data stream for an out-of-band message. Set the value of that **int** to 0 if the read pointer for the socket referred to by the descriptor passed to **ioctl** does not point to a mark in the data stream for an out-of-band message.

SEE ALSO

ioctl(2), **getsockopt**(3N)

NAME

st – driver for SCSI tape devices

SYNOPSIS

st@*target,lun:[l,m,h,c,u][b][n]*

DESCRIPTION

The **st** device driver is an interface to various SCSI tape devices. Supported tape devices include 1/4" Archive Viper QIC-150 streaming tape drive, 1/4" Emulex MT-02 tape controller, HP-88780 1/2" tape drive, Exabyte EXB-8200/8500 8mm cartridge tape, and the Archive Python 4 mm DAT tape subsystem. **st** provides a standard interface to these various devices; see **mtio**(7) for details.

The driver can be opened with either rewind on close or no rewind on close options. A maximum of four tape formats per device are supported (see **FILES** below). The tape format is specified using the device name. Often tape format is also referred to as tape density.

Read Operation

If the driver is opened for reading in a different format than the tape is written in, the driver overrides the user selected format. For example, if a 1/4" cartridge tape is written in QIC-24 format and opened for reading in QIC-150, the driver will detect a read failure on the first read and automatically switch to QIC-24 to read the data.

Note that if the low density format is used, no indication is given that the driver has overridden the user selected format. Other formats issue a warning message to inform the user of an overridden format selection. Some devices automatically perform this function and do not require driver support (1/2" reel tape drive, for example).

Write Operation

Writing from the beginning of tape is performed in the user-specified format. The original tape format is used for appending onto previously written tapes.

Tape Configuration

The **st** tape driver has a built-in configuration table for all Sun supported tape drives. In order to support the addition of third party tape devices or to override a built-in configuration, drive information can be supplied in **/kernel/drv/st.conf** as global properties that apply to each node, or as properties that are applicable to one node only. The **st** driver looks for the property called "tape-config-list". The value of this property is a list of triplets, where each triplet consists of three strings.

The formal syntax is:

```
        tape-config-list = <triplet> [, <triplet> *];
where
        <triplet> := <vid+pid>, <pretty print>, <data-property-name>
and
        <data-property-name> = <version>, <type>, <bsize>,
                <options>, <number of densities>,
                <density> [, <density>*], <default-density>;
```

<vid+pid> is the string that is returned by the tape device on a SCSI inquiry command. This string may contain any character in the range 0x20-0x7e. Characters such as " " " (double quote) or " ' " (single quote), which are not permitted in property value strings,

are represented by their octal equivalent (for example, \042 and \047). Trailing spaces may be truncated.

<pretty print> is used to report the device on the console. This string may have zero length, in which case the **<vid+pid>** will be used to report the device.

<data-property-name> is the name of the property which contains all the tape configuration values (such as **<type>**, **<bsize>**, etc.) corresponding for the tape drive for the specified **<vid+pid>**.

<version> is a version number and should be 1. In the future, higher version numbers may be used to allow for changes in the syntax of the **<data-property-name>** value list.

<type> is a type field. Valid types are defined in **/usr/include/sys/mtio.h.** For third party tape configuration, the following generic types are recommended:

MT_ISQIC	0x32
MT_ISREEL	0x33
MT_ISDAT	0x34
MT_IS8MM	0x35
MT_ISOTHER	0x36

<bsize> is the preferred block size of the tape device. The value should be 0 for variable block size drives.

<options> is a bit pattern representing the drive options, as defined in **/usr/include/sys/scsi/targets/stdef.h**. Valid flags for tape configuration are:

ST_VARIABLE	0x0001
ST_REEL	0x0004
ST_BSF	0x0008
ST_BSR	0x0010
ST_LONG_ERASE	0x0020
ST_KNOWS_EOD	0x0200
ST_IQIC	0x0002
ST_UNLOADABLE	0x0400
ST_LONG_TIMEOUTS	0x1000
ST_BUFFERED_WRITES	0x4000
ST_NO_RECSIZE_LIMIT	0x8000

<number of densities> is the number of densities specified. Each tape drive can support up to four densities. The value entered should therefore be between 1 and 4; if less than 4, the remaining densities will be assigned a value of 0x0.

<density> is a single byte hexadecimal number. It can either be found in the drive specification manual or be obtained from the drive vendor.

<default-density> has a value between 0 and (<number of densities> - 1).

Example of a global tape-config-list property:

```
#
# Copyright (c) 1992, by Sun Microsystems, Inc."
#
#ident  "@(#)st.conf    1.6     93/05/03 SMI"

tape-config-list =
      "Magic   DAT", "Magic 4mm Helical Scan", "magic-data";

magic-data    = 1,0x34,1024,0x1639,4,0,0x8c,0x8c,0x8c,3;

name="st" class="scsi"
          target=0 lun=0;
name="st" class="scsi"
          target=1 lun=0;
name="st" class="scsi"
          target=2 lun=0;
          .
          .
          .
name="st" class="scsi"
          target=6 lun=0;
```

Example of a tape-config-list property applicable to target 2 only:

```
#
# Copyright (c) 1992, by Sun Microsystems, Inc.
#
#ident  "@(#)st.conf    1.6     93/05/03 SMI"

name="st" class="scsi"
          target=0 lun=0;
name="st" class="scsi"
          target=1 lun=0;
name="st" class="scsi"
          target=2 lun=0;
          tape-config-list =
   "Magic   DAT", "Magic 4mm Helical Scan", "magic-data"
          magic-data = 1,0x34,1024,0x1639,4,0,0x8c,0x8c,0x8c,3;
name="st" class="scsi"
          target=3 lun=0;
          .
          .
          .
name="st" class="scsi"
          target=6 lun=0;
```

Large Record Sizes

To support applications such as seismic programs that require large record sizes, flag **ST_NO_RECSIZE_LIMIT** must be set in drive option in the configuration entry. A SCSI tape drive that needs to transfer large records should OR this flag with other flags in the 'options' field in **/kernel/drv/st.conf**. Refer to **Tape Configuration**. By default, this flag is set for the built-in config entries of Archive DAT and Exabyte drives.

If this flag is set, the **st** driver issues a SCSI-2 **READ BLOCK LIMITS** command to the device to determine the maximum record size allowed by it. If the command fails, **st** continues to use the maximum record sizes mentioned in the **mtio**(7) man page.

If the command succeeds, **st** restricts the maximum transfer size of a variable-length device to the minimum of that record size and the maximum DMA size that the host adapter can handle. Fixed-length devices are bound by the maximum DMA size allocated by the machine. Note that tapes created with a large record size may not be readable by earlier releases or on other platforms.

EOT Handling

The Emulex drives have only a physical end of tape (PEOT); thus it is not possible to write past EOT. All other drives have a logical end of tape (LEOT) before PEOT to guarantee flushing the data onto the tape. The amount of storage between LEOT and PEOT varies from less than 1 Mbyte to about 20 Mbyte, depending on the tape drive.

If EOT is encountered while writing an Emulex, no error is reported but the number of bytes transferred is zero and no further writing is allowed. On all other drives, the first write that encounters EOT will return a short count or zero. If a short count is returned, then the next write will return zero. After a zero count is returned, the next write returns a full count or short count. A following write returns zero again. It is important that the number and size of trailer records be kept as small as possible to prevent data loss. Therefore, writing after EOT is not recommended.

Reading past EOT is transparent to the user. Reading is stopped only by reading EOF's. For 1/2" reel devices, it is possible to read off the end of the reel if one reads past the two file marks which mark the end of recorded media.

Write Data Buffering

Tape drives with data compression require a much higher data rate in order to stream the tape. Write data buffering in the driver improves streaming to the drive without changing the application and augments the buffering in the tape drive itself. If write data buffering is enabled, data is buffered in the driver and the request is immediately acknowledged by the driver before it has been written to the tape drive. This enables the driver to submit the next request as soon as the previous request completes and the application to prepare the next request while the current request is in progress. A SCSI tape drive that allows buffering requires ORing the flag **ST_BUFFERED_WRITES** with other flags in the 'options' field in **/kernel/drv/st.conf**. Refer to **Tape Configuration**. By default, this option is set for the built-in config entries of the Archive DAT and Exabyte drives.

In order for write buffering to work properly, sufficient space after LEOT must be available to empty the write buffers. Older tape devices usually do not have sufficient space after LEOT.

To turn on tape buffering, a property in **st.conf** called "tape-driver-buffering" should be added. The value assigned to this property is the maximum number of buffered write requests allowed. For example, **0** indicates no write request buffering allowed, while **2** indicates buffer up to 2 write requests. If this property is not specified in **st.conf**, the driver defaults to a value of **0**. The maximum size of write request that can be buffered is specified through a property in **st.conf** called "tape-driver-buf-max-size". If this property is not specified in **st.conf,** the driver defaults the buffer size to a value of 1 Mbye.

An example of **/kernel/drv/st.conf**, where the maximum number of write requests buffered is 4 and maximum size of write request buffered is 2 Mbyte, is given below. This applies to all nodes in this **conf** file.

```
# # Copyright (c) 1992, by Sun Microsystems, Inc. # #ident "@(#)st.conf 1.6 93/05/03 SMI"

tape-driver-buffering = 4; tape-driver-buf-max-size = 0x200000;

name="st" class="scsi"
     target=0 lun=0;

name="st" class="scsi"
     target=1 lun=0;

name="st" class="scsi"
     target=2 lun=0;

...
```

In the case of a SCSI bus reset, a medium error, or any other fatal transport error on a buffered request, the driver returns an error on subsequent write requests and allows no more writes. If no further write requests occur, an error is returned on close.

Since some applications may perceive write buffering as a potential data integrity problem, this feature is disabled by default and needs to be explicitly enabled in the config entry and turned on by means of the property in **st.conf**. Furthermore, some fault tolerant backup servers make assumptions about the data buffering in the tape drive itself. These assumptions may not be valid if write buffering has been enabled.

Write buffering may be superseded by other performance enhancements in a future release.

Ioctls

The behavior of SCSI tape positioning ioctls is the same across all devices which support them. Refer to **mtio**(7). However, not all devices support all ioctls. The driver returns an **ENOTTY** error on unsupported ioctls.

The retension ioctl only applies to 1/4" cartridge tape devices. It is used to restore tape tension, thus improving the tape's soft error rate after extensive start-stop operations or long-term storage.

In order to increase performance of variable-length tape devices (particularly when they are used to read / write small record sizes), two operations in the **MTIOCTOP** ioctl, **MTSRSZ** and **MTGRSZ**, can be used to set and get fixed record lengths. The ioctl also works with fixed-length tape drives which allow multiple record sizes. The min / max limits of record size allowed on a driver are found by using a SCSI-2 **READ BLOCK LIMITS** command to the drive. If this command fails, the default min / max record sizes allowed are 1 byte and 63k bytes. An application that needs to use a different record size opens the device, sets the size with the **MTSRSZ** ioctl and then continues with I / O. The scope of the change in record size remains until the device is closed. The next open to the device resets the record size to the default record size (retrieved from **st.conf**).

Note that the error status is reset by the **MTIOCGET** get status ioctl call or by the next read, write, or other ioctl operation. If no error has occurred (sense key is zero), the current file and record position is returned.

ERRORS

EACCES The driver is opened for write access and the tape is write protected.

EBUSY The tape drive is in use by another process. Only one process can use the tape drive at a time. The driver will allow a grace period for the other process to finish before reporting this error.

EINVAL The number of bytes read or written is not a multiple of the physical record size (fixed-length tape devices only).

EIO During opening, the tape device is not ready because either no tape is in the drive, or the drive is not on-line. Once open, this error is returned if the requested I / O transfer could not be completed.

ENOTTY This indicates that the tape device does not support the requested ioctl function.

ENXIO During opening, the tape device does not exist.

FILES

/kernel/drv/st.conf
driver configuration file

/usr/include/sys/mtio.h
structures and definitions for mag tape io control commands

/usr/include/sys/scsi/targets/stdef.h
definitions for SCSI tape drives

/dev/rmt/[0– 127][l,m,h,u,c][b][n]
where **l,m,h,u,c** specifies the density (low, medium, high, ultra / compressed), **b** the optional BSD behavior (see **mtio**(7)), and **n** the optional no rewind behavior. For example, **/dev/rmt/0lbn** specifies unit 0, low density, BSD behavior, and no rewind.

For 1 / 2" reel tape devices (HP-88780), the densities are:

l	800 BPI density
m	1600 BPI density
h	6250 BPI density

c	data compression (not supported on all modules)

For helical-scan tape devices (Exabyte 8200 / 8500 / 8500c / 8505):

l	Standard 2 Gbyte format
m	5 Gbyte format (8500 only)
h,c	data compression (8500c, 8505 only)

For 4mm DAT tape devices (Archive Python):

l	Standard format
m,h,c	data compression

For QIC-150 tape devices (Archive Viper):

l	QIC-150 Format
m	QIC-150 Format
h	QIC-150 Format
c	QIC-150 Format

For QIC-24 tape devices (Emulex MT–02):

l	QIC-11 Format
m	QIC-24 Format
h	QIC-24 Format
c	QIC-24 Format

SEE ALSO

read(2), **write**(2), **driver.conf**(4), **esp**(7), **isp**(7), **mtio**(7), **ioctl**(9E)

DIAGNOSTICS

Error for command '<command name>'Error Level: Fatal
Requested Block <n>, Error Block: <m>
Sense Key: <sense key name>
Vendor '<name>': ASC = 0x<a> (<extended sense code name>),
ASCQ = 0x<b>, FRU = 0x<c>

The command indicated by <command name> failed. The Requested Block is the block where the transfer started and the Error Block is the block that caused the error. Sense Key, ASC, ASCQ and FRU information is returned by the target in response to a request sense command.

write/read: not modulo <n> block size

The request size for fixed record size devices must be a multiple of the specified block size.

recovery by resets failed

After a transport error, the driver attempted to recover with device and bus reset. This recovery failed.

Periodic head cleaning required

The driver reported that periodic head cleaning is now required.

Soft error rate (<n>%) during writing/reading was too high
The soft error rate has exceeded the threshold specified by the vendor.

SCSI transport failed: reason 'xxxx': {retrying | giving up}
The host adapter has failed to transport a command to the target for the reason stated. The driver will either retry the command or, ultimately, give up.

BUGS

Tape devices that do not return a BUSY status during tape loading prevent user commands from being held until the device is ready. The user must delay issuing any tape operations until the tape device is ready. This is not a problem for Sun Microsystem Computer Corporation supplied tape devices.

Tape devices that do not report a blank check error at the end of recorded media may cause file positioning operations to fail. Some tape drives for example, mistakenly report media error instead of blank check error.

NAME

stc – Serial Parallel Communications driver for SBus

DESCRIPTION

The **SPC/S** SBus communications board consists of eight asynchronous serial ports and one *IBM PS/2-compatible* parallel port. The *stc* driver supports up to 8 **SPC/S** boards in an SBus system. Each serial port has full modem control: the **CD**, **DTR**, **DSR**, **RTS** and **CTS** modem control lines are provided, plus flow control is supported in hardware for either **RTS/CTS** hardware flow control or **DC1/DC3** software flow control. The parallel port is unidirectional with support for the **ACK**, **STROBE**, **BUSY**, **PAPER OUT**, **SELECT** and **ERROR** interface signals. Both the serial and parallel ports support those **termio**(7) device control functions specified by flags in the **c_cflag** word of the **termios**(3) structure; in addition, the serial ports support the **IGNPAR**, **PARMRK**, **INPCK**, **IXON**, **IXANY** and **IXOFF** flags in the **c_iflag** word of the **termios**(3) structure. The latter **c_iflag** functions are performed by the *stc* driver for the serial ports. Since the parallel port is a unidirectional, output-only port, no input **termios**(3) (**c_iflag**) parameters apply to it. Trying to execute a nonsensical **ioctl( )** on the parallel port is not recommended. All other **termios**(3) functions are performed by STREAMS modules pushed atop the driver. When an *stc* device is opened, the **ldterm**(7) and **ttcompat**(7) STREAMS modules are automatically pushed on top of the stream if they are specified in the **/etc/iu.ap** file (the default condition), providing the standard **termio**(7) interface.

The device names of the form **/dev/term/***n* or **/dev/ttyy***n* specify the serial I/O ports provided on the **SPC/S** board, conventionally as incoming lines. The device names of the form **/dev/cua/***n* or **/dev/ttyz***n* specify the serial I/O ports provided on the **SPC/S** board, conventionally as outgoing lines. The device names of the form **/dev/printers/***n* or **/dev/stclp***n* specify the parallel port, and the device name of the form **/dev/stc***n* specify a special control port per board.

To allow a single tty line to be connected to a modem and used for both incoming and outgoing calls, a special feature, controlled by the minor device number, has been added. Minor device numbers in the range *128-191* correspond to the same physical lines as those in the range *0-63* (that is, the same line as the minor device number minus *128*).

A dial-in line has a minor device in the range *0-63* and is conventionally named **/dev/term/***n***,** where *n* is a number indicating which dial-in line it is (so that **/dev/term/0** is the first dial-in line), and the dial-out line corresponding to that dial-in line has a minor device number *128* greater than the minor device number of the dial-in line and is conventionally named **/dev/cua/***n***,** where *n* is the number of the dial-in line. These devices will also have the compatibility names **/dev/ttyz***n***.**

The **/dev/cua/***n* lines are special in that they can be opened even when there is no carrier on the line. Once a **/dev/cua/***n* line is opened, the corresponding **/dev/term/***n* line cannot be opened until the **/dev/cua/***n* line is closed; a blocking open will wait until the **/dev/cua/***n* line is closed (which will drop **DTR**, after which **DCD** will usually drop as well) and carrier is detected again, and a non-blocking open will return an error. Also, if the **/dev/term/***n* line has been opened successfully (usually only when carrier is recognized on the modem) the corresponding **/dev/cua/***n* line can not be opened. This allows a modem to be attached to **/dev/term/0**, for example, and used for dial-in (by enabling the

line for login (using **pmadm**(1M)) and also used for dial-out (by **tip**(1) or **uucp**(1C)) as **/dev/cua/0** when no one is logged in on the line.

The parallel port is given the name **/dev/stclp***n***,** where *n* is the **SPC/S** unit number (see **Minor Numbers**, below).

The control port, named **/dev/stc***n***,** where *n* is the *SPC/S*, is available. And **ioctl( )** is provided for this special file which allow the collection of statistics maintained on serial port performance.

Minor Numbers

o p u u | u l l l – these correspond to bits in the minor number

- *o* set if this device is an outgoing serial line
- *p* set if this is a parallel port device
- *u* device unit number
- *l* device line number if this is the parallel port line, *'p'* should be 1 and *'lll'* should be all 0's if this is the control line, both *'p'* and *'lll'* should be set to all 1's

IOCTLS

The standard set of **termio ioctl( )** calls are supported by the *stc* driver on both the serial and parallel ports.

If the **CRTSCTS** flag in the **c_cflag** is set and if **CTS** is high, output will be transmitted; if **CTS** is low, output will be frozen. If the **CRTSCTS** flag is clear, the state of **CTS** has no effect. Breaks can be generated by the **TCSBRK**, **TIOCSBRK** and **TIOCCBRK ioctl( )** calls. The modem control lines **TIOCM_CAR**, **TIOCM_CTS**, **TIOCM_RTS**, **TIOCM_DSR** and **TIOCM_DTR** are provided for the serial ports, although the **TIOCMGET ioctl( )** call will not return the state of the **TIOCM_RTS** or **TIOCM_DSR** lines, which are *output-only* signals.

The serial port input and output line speeds may be set to any of the speeds supported by **termio**(7).

DEVICE-SPECIFIC IOCTLS

The following additional **ioctl( )**'s are supported by the *stc* driver.

STC_SPPC(struct ppc_params_t *)
set parallel port parameters (valid until changed or **close( )**)

STC_GPPC(struct ppc_params_t *)
get parallel port parameters (valid until changed or **close( )**)

```
struct ppc_params_t {
        u_int   flags;          /* driver status flag */
        u_int   state;          /* status of the printer interface */
        u_int   strobe_w;       /* strobe width, in microseconds */
        u_int   data_setup;     /* data setup time, in microseconds */
        u_int   ack_timeout;    /* ACK timeout in secs */
        u_int   error_timeout;  /* PAPER OUT, etc... timeout in secs */
        u_int   busy_timeout;   /* BUSY timeout in seconds */
};
```

The possible values for *flags*, defined in **/usr/include/sys/stcio.h,** are:

PP_PAPER_OUT honor PAPER OUT from port; returned HIGH means PAPER OUT.

PP_ERROR honor ERROR from port; returned HIGH means ERROR.

PP_BUSY honor BUSY from port; returned HIGH means BUSY.

PP_SELECT honor SELECT from port; returned HIGH means OFFLINE.

PP_MSG print console message on every error scan.

PP_SIGNAL send a PP_SIGTYPE (SIGURG) to the process if printer error.

The *state* field contains the current status of the printer interface. It is analogous to the bit order of *flags*, but contains the status the driver maintains, masked by the flags that are set. The result of shifting *state PP_SHIFT* bits to the left is the actual state of the hardware.

The **STC_SPPC** and **STC_GPPC** ioctl calls are understood only by the parallel port.

STC_GSTATS(struct stc_stats_t *)

get or reset driver performance statistics on serial ports

```
struct stc_stats_t {
        u_int   cmd;            /* command */
        u_int   qpunt;          /* punting in stc_drainsilo() */
        u_int   drain_timer;    /* posted a timer in stc_drainsilo() */
        u_int   no_canput;      /* canput() failed in stc_drainsilo() */
        u_int   no_rcv_drain;   /* can't call stc_drainsilo() in stc_rcv() */
        u_int   stc_drain;      /* STC_DRAIN flag set on this line */
        u_int   stc_break;      /* BREAK requested on XMIT via stc_ioctl() */
        u_int   stc_sbreak;     /* start BREAK requested via stc_ioctl() */
        u_int   stc_ebreak;     /* end BREAK requested via stc_ioctl() */
        u_int   set_modem;      /* set modem control lines in stc_ioctl() */
        u_int   get_modem;      /* get modem control lines in stc_ioctl() */
        u_int   ioc_error;      /* bad ioctl() */
        u_int   set_params;     /* call to stc_param() */
        u_int   no_start;       /* can't run in stc_start(); already there */
        u_int   xmit_int;       /* transmit interrupts */
        u_int   rcv_int;        /* receive interrupts */
        u_int   rcvex_int;      /* receive exception interrupts */
        u_int   modem_int;      /* modem change interrupts */
        u_int   xmit_cc;        /* characters transmitted */
        u_int   rcv_cc;         /* characters received */
        u_int   break_cnt;      /* BREAKs received */
        u_int   bufcall;        /* times we couldn't get STREAMS buffer */
        u_int   canwait;        /* stc_drainsilo() called w/pending timer */
        u_int   reserved;       /* this field is meaningless */
};
```

The possible *cmd* values, defined in **/usr/include/sys/stcio.h**, are

STAT_CLEAR clear the line statistics

STAT_GET get the line statistics

The **STC_GSTATS** ioctl works only on the **SPC/S** control port.

SOFTCAR, DTR and CTS/RTS FLOW CONTROL

Several methods may be used to enable or disable *soft carrier* on a particular serial line. The non-programmatic method is to edit the **/kernel/drv/stc.conf** file. For this change to take effect, the machine must be rebooted. See the next section, **SETTING DEFAULT LINE PARAMETERS**, for more information on this method. From within an application program, you can enable or disable the recognition of carrier on a particular line by issuing the **TIOCGSOFTCAR ioctl( )** to the driver.

The default mode of operation for the **DTR** signal is to assert it on the first **open( )** of a serial line and, if *HUPCL* is set, to de-assert it on the last **close( )**. To change the operation of this feature, issue the set on the **/kernel/drv/stc.conf** parameter *flags* field bit **DTR_ASSERT**.

SETTING DEFAULT LINE PARAMETERS

Many default parameters of the serial and parallel ports can be changed using the **/kernel/drv/stc.conf** file. The format of a line in the **stc.conf** file is:

*device_tag***=***token***[=***value***][:***token***[=***value***]]**

For serial ports, the *device_tag* is stc_*n*, where *n* is between 0 and the maximum number of serial ports used by the driver. The token and parameters that follow it apply to both the **/dev/term/***n* entries and **/dev/cua/***n* entries.

For parallel ports, the *device_tag* is stc_p*n*, where *n* is between 0 and the number of parallel ports driven by **stc**.

The *token***[=***value***]** specifies a *token*, and if the *token* takes a *value*, the *value* to assigned. Tokens that don't take a value are considered boolean. If boolean tokens don't appear in the **stc.conf** file, they will be cleared by the driver. If these tokens appear in the **stc.conf** file, they will be set by the driver.

Tokens that take parameters must have a parameter specified in the *token=value* couplet in the **stc.conf** file. If no parameter or an invalid parameter is specified, the driver will ignore the token and revert to using the driver's default value.

Tokens for Serial Ports

Valid boolean tokens for serial ports are:

soft_carrier- enables the soft carrier on the specified line. When the soft carrier is set, transitions on the carrier detect line will be ignored.

dtr_assert- causes the **DTR** to be asserted on the next open of the port.

dtr_force- causes **DTR** to be continuously asserted. it overrides any other **DTR** operations and ioctl calls.

dtr_close- use alternate semantics when dealing with **DTR** in close. If this is clear, **DTR** will drop on the close of the port. If this is set, **DTR** will not drop on **close( )** if TS_SOFTCAR (see **termiox**(7)) is set in the *t_flags*.

cflow_flush- flush any data being held off by remote flow control on **close()**.

cflow_msg- display a message on the console if data transmission is stalled due to remote flow control blocking the transfer in **close()**.

instantflow- if transmission is stopped by software flow control and the flow control is disabled via an **ioctl()** call, the transmitter will be enabled immediately.

display- displays all serial port parameters.

Valid tokens requiring values are:

drain_size- The size of STREAMS buffers allocated when passing data from the receive interrupt handler upstream

hiwater, lowwater- The high water and low water thresholds in the receive interrupt handler 1024 byte buffer

rtpr- The inter-character receive timer

rxfifo- The UART receive fifo threshold.

For the value-carrying tokens for serial ports:

token	default value	min value
hiwater	1010 bytes	2 bytes
lowwater	512 bytes	2 bytes
drain_size	64 bytes	4 bytes
rtpr	18 millisecs	1 millisecs
rxfifo	4 bytes	1 bytes

Tokens for Parallel Ports

Valid boolean tokens for parallel ports are

paper_out- If set, the PAPER OUT signal from the port is monitored. If clear, the signal is ignored.

error- Monitor the ERROR signal from the port. Ignore the signal if clear.

busy- Monitor the BUSY signal from the port. Ignore the signal if clear.

select- Monitor the SELECT, or ON LINE, signal from the port. Ignore the signal if clear.

pp_message- If this token is clear, a console message will be printed when any of the above four enabled conditions are detected, and another when the condition is cleared. If set, a console message will be printed every 60 seconds until the condition is cleared.

pp_signal- If this token is set, the parallel port's controlling process will get a PP_SIGTYPE signal whenever one of the above four conditions is detected. PP_SIGTYPE is defined in **stcio.h**, which is available to the user.

Valid tokens requiring parameters for the parallel ports are

ack_timeout- The amount of time in seconds to wait for an ACK from the port after asserting STROBE and transferring a byte of data.

error_timeout- Amount of time in seconds to wait for an error to go away.

busy_timeout- The amount of time in seconds to wait for a BUSY signal to clear, or zero for an infinite BUSY timeout.

data_setup- The amount of time in microseconds between placing data ont the parallel lines and asserting the STROBE.

strobe_width- width of the STROBE pulse, in microseconds.

For value-carrying tokens for parallel ports:

token	**default value**	**min value**
strobe_width	2 microsecs	1 microsecs
data_setup	2 microsecs	0 microsecs
ack_timeout	60 seconds	5 seconds
errror_timeout	5 seconds	1 seconds
busy_timeout	10 seconds	0 seconds

PARALLEL PORT PARAMETERS

The default values of certain parallel port parameters that govern data transfer between the **SPC/S** board and the device attached to the parallel port will usually work well with most devices; however, some devices don't strictly adhere to the *IBM PS/2-compatible (Centronics-compatible)* data transfer and device control / status protocol, and may require modification of one or more of the default parallel port parameters. Some printers, for example, have non-standard timing on their **SELECT** line, which manifests itself if you start sending data to the printer and then take it off line; when you put it back on line, the printer will not assert it's **SELECT** line until after the next character is sent to the printer. Since the *stc* driver will not send data to the device if it's **SELECT** line is de-asserted, a deadlock condition occurs. To remedy this situation, you can change the default signal list that the *stc* driver monitors on the parallel port by removing the **SELECT** signal from the list. This can be done either through the **/kernel/drv/stc.conf** configuration file or programmatically through the **STC_SPPC ioctl( )** call.

LOADABLE ISSUES

If you try to unload the driver, and one or more of the ports on one or more of the **SPC/S** boards is in use (i.e. **open( )**) by a process, the driver will not be unloaded, and all lines on all **SPC/S** boards, **with the exception of the control ports,** will be marked with an *open inhibit* flag to prevent further opens until the driver is sucessfully unloaded.

ERRORS

An **open( )** will fail with **errno** set to:

ENXIO The unit being opened does not exist.

EBUSY The dial-out device is being opened and the dial-in device is already open, the dial-in device is being opened with a no-delay open and the dial-out device is already open or the unit has been marked as exclusive-use by another process with a **TIOCEXCL ioctl( )** call.

EINTR The open was interrupted by the delivery of a signal.

EPERM The control port for the board was opened by a process whose *uid* was not **root**.

An **ioctl()** will fail with **errno** set to:

ENOSR A STREAMS data block couldn't be allocated to return data to the caller.

EINVAL An invalid value was passed as the data argument to the **ioctl()** call or an invalid argument or *op-field* was passed in one of the driver-specific **ioctl()**'s.

EPERM An **STC_GSTATS ioctl()** was requested by a process whose *uid* was not **root**.

ENOTTY An unrecognized **ioctl()** command was received.

FILES

/dev/term/[00-3f]	
/dev/ttyy[00-3f]	hardwired and dial-in tty lines
/dev/cua/[00-3f]	
/dev/ttyz[00-3f]	dial-out tty lines
/dev/printers/[0-7]	
/dev/stclp[0-7]	parallel port lines
/dev/stc[0-7]	control port
/usr/include/sys/stcio.h	header file with **ioctl()**'s supported by this driver

SEE ALSO

tip(1), **uucp**(1C), **pmadm**(1M), **termios**(3), **mcpp**(7), **termio**(7), **termiox**(7), **ldterm**(7), **ttcompat**(7), **allocb**(9F), **bufcall**(9F)

DIAGNOSTICS

All diagnostic messages from the driver appear on the system console. There are three severity levels of messages displayed:

FATAL - the device driver does not get loaded and any **SPC/S** boards installed in the system are inaccessible (usually occurs during the process of **modload**'ing the driver).

ERROR - some condition has caused the normal operation of the board and/or device driver to be disrupted; data loss may or may not occur; this class of message might indicate an impending hardware failure.

ADVISORY - the device driver has detected a condition that may be of interest to the user of the system; usually this is a transient condition that clears itself.

Messages During Initialization Of Driver/Board:

stc_attach: can't allocate memory for unit structs
FATAL. **kmem_zalloc()** failed to allocate memory for the driver's internal data structures.

stc_attach: board revision undeterminable
FATAL. The driver did not get a hardware revision level from the board's onboard FCode PROM.

stc_attach: board revision 0x%x not supported by driver.
FATAL. This revision of the board is not supported by the driver.

stc_attach: oscillator revision undeterminable
FATAL. The driver did not get an oscillator revision level from the board's onboard FCode PROM.

stc_attach: wierd oscillator revision (0x%x), assuming 10Mhz
ADVISORY. The board's onboard FCode PROM returned an unanticipated baud-rate oscillator value, so the driver assumes that a 10Mhz oscillator is installed.

stc_attach: error initializing stc%d
FATAL. An error occured while trying to initialize the board; perhaps a memory access failed.

stc_attach: bad number of interrupts: %d
FATAL. An incorrect number of interrupts was read from the board's onboard FCode PROM.

stc_attach: bad number of register sets: %d
FATAL. An incorrect number of register sets was read from the board's onboard FCode PROM.

stc_init: stc%d GIVR was not 0x0ff, was: 0x%x
FATAL. The *cd-180* 8-channel UART failed to initialize properly, or a memory fault occured while trying to access the chip.

cd180_init: stc%d GIVR was not 0x0ff, was: 0x%x
FATAL. The *cd-180* 8-channel UART failed to initialize properly, or a memory fault occured while trying to access the chip.

stc%d: board revision: 0x%x should be updated
ADVISORY. Two versions of the FCode PROM on the **SPC/S** card have been released; V1.0 (0x4) and V1.1 (0x5). The V1.1 PROM fixes some incompatabilities between the V1.0 FCode PROM (on the **SPC/S**) and the V2.0 *OpenBOOT* PROM (on your system) and is required on an **SPC/S** card to be used in a system running Solaris 2.X.

stc%d: system boot PROM revision V%d.%d should be updated
ADVISORY. Your system's BOOT PROM should be updated to at least V1.3 because prior versions of the BOOT PROM did not map the SBus interrupt levels that the **SPC/S** uses correctly.

Messages Related To The Serial Port:

SET_CCR: CCR timeout
ERROR. the *cd-180*'s **CCR** register did not return to zero within the specified timeout period after it was issued a command

PUTSILO: unit %d line %d soft silo overflow
ERROR. The driver's internal receive data silo for the enunciated line has overflowed because the system has not gotten around to pulling data out of the silo; check that you are using the correct flow control; all data in the silo is

flushed; *this message may also frequently appear due to a hardware crosstalk problem that was fixed in later releases of the board*.

stc_rcvex: unit %d line %d receiver overrun, char: 0x%x
ERROR. The driver could not get around to service the *cd-180* receive data interrupt before the *cd-180*'s receive data fifo filled up; *this message may also frequently appear due to a hardware crosstalk problem that was fixed in later releases of the board*.

stc_drainsilo: unit %d line %d can't allocate streams buffer
ERROR. The driver could not get a STREAMS message buffer from **bufcall**(9F); all data in the driver's receive data silo is flushed.

stc_drainsilo: unit %d line %d punting put retries
ERROR. After trying several times to send data down the stream from the driver to the application and finding the path blocked, the driver gives up; all data in the driver's receive data silo is flushed.

stc_modem: unit %d line %d interesting modem control
ADVISORY. The *cd-180* posted a modem control line change interrupt, but upon examination by the driver, no modem control lines had changed state since the last time a scan was conducted; if you see this problem frequently, it is likely that your data cables are either too long or picking up induced noise.

Messages Related To The Parallel Port:

ppc_stat: unit %d PAPER OUT
ADVISORY. The device connected to the parallel port on the enumerated BOARD has signalled that it's out of paper (**PAPER OUT** line asserted).

ppc_stat: unit %d PAPER OUT condition cleared
ADVISORY. The previously-detected paper out condition has been cleared by the device connected to the parallel port on the enumerated board (**PAPER OUT** line de-asserted)

ppc_stat: unit %d OFFLINE
ADVISORY. The device connected to the parallel port on the enumerated board has signalled that it is off-line (**SLCT** line de-asserted).

ppc_stat: unit %d OFFLINE condition cleared
ADVISORY. The previously-detected off line condition has been cleared by the device connected to the parallel port on the enumerated board (**SLCT** line asserted).

ppc_stat: unit %d ERROR
ADVISORY. The device connected to the parallel port on the enumerated board has signalled that it has encountered an error of some sort (**ERROR** line asserted).

ppc_stat: unit %d ERROR condition cleared
ADVISORY. The previously-detected error condition has been cleared by the device connected to the parallel port on the enumerated board (**ERROR** line de-asserted).

ppc_acktimeout: unit %d ACK timeout
ERROR. The **ACK** line from the device connected to the parallel port did not assert itself within the configurable timeout period; check to be sure that the device is connected and powered on.

ppc_acktimeout: unit %d BUSY timeout
ERROR. The **BUSY** line from the device connected to the parallel port did not de-assert itself within the configurable timeout period; check to be sure that the device is connected and powered on.

ppc_int: unit %d stray interrupt
ADVISORY. The parallel port controller (**ppc**) chip generated an interrupt while the device was closed; this was unexpected and if you see it frequently, your parallel cable might be picking up induced noise causing the **ppc** to generate an unwanted interrupt, or this could indicate that the **ppc** might have an internal problem.

ppc_acktimeout: unit %d can't get pointer to read q
ERROR. Somehow the driver's internal **ppc** data structure became corrupted; this should not happen.

ppc_acktimeout: unit %d can't send M_ERROR message
ERROR. The driver can't send an **M_ERROR** STREAMS message to the application; this should not happen either.

ppc_signal: unit %d can't get pointer to read q
ERROR. Somehow the driver's internal **ppc** data structure became corrupted; this should also not happen.

ppc_signal: unit %d can't send M_PCSIG(PP_SIGTYPE 0x%x) message
ERROR. The driver can't send an **M_PCSIG** STREAMS message to the application (which could cause a signal to be posted); this should also not happen either.

Messages Related To STREAMS Processing:

stc_wput: unit %d trying to M_STARTI on ppc or control device
ADVISORY. An **M_STARTI** STREAMS message was sent to the parallel port or the board control device; this should only happen if an application explictly sends this message.

stc_wput: unit %d line %d unknown message: 0x%x
ADVISORY. An unknown STREAMS message was sent to the driver; check your application coding.

stc_start: unit %d line %d unknown message: 0x%x
ADVISORY. An unknown STREAMS message was sent to the driver; check your application coding.

Messages Related To Serial Port Control:

stc_ioctl: unit %d line %d can't allocate streams buffer for ioctl
ERROR. The driver could not get a STREAMS message buffer from **bufcall( )** for the requested ioctl; the ioctl will not be executed

stc_ioctl: unit %d line %d can't allocate STC_DCONTROL block
ERROR. The driver could not allocate a data block from **allocb**(9F) for the **STC_DCONTROL** return value; the ioctl does not get executed.

stc_ioctl: unit %d line %d can't allocate STC_GPPC block
ERROR. The driver could not allocate a data block from **allocb()** for the **STC_GPPC** return value; the ioctl does not get executed

stc_ioctl: unit %d line %d can't allocate TIOCMGET block
ERROR. The driver could not allocate a data block from **allocb()** for the **TIOCMGET** return value; the ioctl does not get executed

stc_vdcmd: unit %d cd-180 firmware revision: 0x%x
ADVISORY. The firmware revision level of the *cd-180*, displayed when the driver is first loaded.

NAME

streamio – STREAMS ioctl commands

SYNOPSIS

```
#include <sys/types.h>
#include <stropts.h>
#include <sys/conf.h>

int ioctl ( int fildes, int command, ... /* arg */);
```

DESCRIPTION

STREAMS (see **intro**(2)) **ioctl** commands are a subset of the **ioctl**(2) commands, and perform a variety of control functions on streams.

fildes is an open file descriptor that refers to a stream. *command* determines the control function to be performed as described below. *arg* represents additional information that is needed by this command. The type of *arg* depends upon the command, but it is generally an integer or a pointer to a *command*-specific data structure. *command* and *arg* are interpreted by the stream head. Certain combinations of these arguments may be passed to a module or driver in the stream.

Since these STREAMS commands **ioctl**s, they are subject to the errors described in **ioctl**(2). In addition to those errors, the call will fail with **errno** set to **EINVAL,** without processing a control function, if the stream referenced by *fildes* is linked below a multiplexor, or if *command* is not a valid value for a stream.

Also, as described in **ioctl**(2), STREAMS modules and drivers can detect errors. In this case, the module or driver sends an error message to the stream head containing an error value. This causes subsequent calls to fail with **errno** set to this value.

COMMAND FUNCTIONS

The following **ioctl** commands, with error values indicated, are applicable to all STREAMS files:

I_PUSH Pushes the module whose name is pointed to by *arg* onto the top of the current stream, just below the stream head. If the stream is a pipe, the module will be inserted between the stream heads of both ends of the pipe. It then calls the open routine of the newly-pushed module. On failure, **errno** is set to one of the following values:

EINVAL	Invalid module name.
EFAULT	*arg* points outside the allocated address space.
ENXIO	Open routine of new module failed.
ENXIO	Hangup received on *fildes*.

I_POP Removes the module just below the stream head of the stream pointed to by *fildes*. To remove a module from a pipe requires that the module was pushed on the side it is being removed from. *arg* should be 0 in an **I_POP** request. On failure, **errno** is set to one of the following values:

EINVAL	No module present in the stream.
ENXIO	Hangup received on *fildes*.

I_LOOK Retrieves the name of the module just below the stream head of the stream pointed to by *fildes*, and places it in a null terminated character string pointed at by *arg*. The buffer pointed to by *arg* should be at least **FMNAMESZ**+1 bytes long. This requires the declaration **#include <sys/conf.h>)**. On failure, **errno** is set to one of the following values:

EFAULT	*arg* points outside the allocated address space.
EINVAL	No module present in stream.

I_FLUSH This request flushes all input and / or output queues, depending on the value of *arg*. Legal *arg* values are:

FLUSHR	Flush read queues.
FLUSHW	Flush write queues.
FLUSHRW	Flush read and write queues.

If a pipe or FIFO does not have any modules pushed, the read queue of the stream head on either end is flushed depending on the value of *arg*.

If **FLUSHR** is set and *fildes* is a pipe, the read queue for that end of the pipe is flushed and the write queue for the other end is flushed. If *fildes* is a FIFO, both queues are flushed.

If **FLUSHW** is set and *fildes* is a pipe and the other end of the pipe exists, the read queue for the other end of the pipe is flushed and the write queue for this end is flushed. If *fildes* is a FIFO, both queues of the FIFO are flushed.

If **FLUSHRW** is set, all read queues are flushed, that is, the read queue for the FIFO and the read queue on both ends of the pipe are flushed.

Correct flush handling of a pipe or FIFO with modules pushed is achieved via the **pipemod** module. This module should be the first module pushed onto a pipe so that it is at the midpoint of the pipe itself.

On failure, **errno** is set to one of the following values:

ENOSR	Unable to allocate buffers for flush message due to insufficient STREAMS memory resources.
EINVAL	Invalid *arg* value.
ENXIO	Hangup received on *fildes*.

I_FLUSHBAND

Flushes a particular band of messages. *arg* points to a **bandinfo** structure that has the following members:

```
unsigned char    bi_pri;
int              bi_flag;
```

The **bi_flag** field may be one of **FLUSHR**, **FLUSHW**, or **FLUSHRW** as described earlier.

I_SETSIG Informs the stream head that the user wishes the kernel to issue the **SIGPOLL** signal (see **signal**(3C)) when a particular event has occurred on the stream associated with *fildes*. **I_SETSIG** supports an asynchronous processing capability in STREAMS. The value of *arg* is a bitmask that specifies the events for which the user should be signaled. It is the bitwise OR of any combination of the following constants:

S_INPUT	Any message other than an **M_PCPROTO** has arrived on a stream head read queue. This event is maintained for compatibility with previous releases. This event is triggered even if the message is of zero length.
S_RDNORM	An ordinary (non-priority) message has arrived on a stream head read queue. This event is triggered even if the message is of zero length.
S_RDBAND	A priority band message (band > 0) has arrived on a stream head read queue. This event is triggered even if the message is of zero length.
S_HIPRI	A high priority message is present on the stream head read queue. This event is triggered even if the message is of zero length.
S_OUTPUT	The write queue just below the stream head is no longer full. This notifies the user that there is room on the queue for sending (or writing) data downstream.
S_WRNORM	This event is the same as **S_OUTPUT**.
S_WRBAND	A priority band greater than 0 of a queue downstream exists and is writable. This notifies the user that there is room on the queue for sending (or writing) priority data downstream.
S_MSG	A STREAMS signal message that contains the **SIGPOLL** signal has reached the front of the stream head read queue.
S_ERROR	An **M_ERROR** message has reached the stream head.
S_HANGUP	An **M_HANGUP** message has reached the stream head.
S_BANDURG	When used in conjunction with **S_RDBAND**,**SIGURG** is generated instead of **SIGPOLL** when a priority message reaches the front of the stream head read queue.

A user process may choose to be signaled only of high priority messages by setting the *arg* bitmask to the value **S_HIPRI**.

Processes that wish to receive **SIGPOLL** signals must explicitly register to receive them using **I_SETSIG**. If several processes register to receive this signal for the same event on the same stream, each process will be signaled when the event occurs.

If the value of *arg* is zero, the calling process will be unregistered and will not receive further **SIGPOLL** signals. On failure, **errno** is set to one of the following values:

EINVAL *arg* value is invalid or *arg* is zero and process is not registered to receive the **SIGPOLL** signal.

EAGAIN Allocation of a data structure to store the signal request failed.

I_GETSIG Returns the events for which the calling process is currently registered to be sent a **SIGPOLL** signal. The events are returned as a bitmask pointed to by *arg*, where the events are those specified in the description of **I_SETSIG** above. On failure, **errno** is set to one of the following values:

EINVAL Process not registered to receive the **SIGPOLL** signal.

EFAULT *arg* points outside the allocated address space.

I_FIND Compares the names of all modules currently present in the stream to the name pointed to by *arg*, and returns 1 if the named module is present in the stream. It returns 0 if the named module is not present. On failure, **errno** is set to one of the following values:

EFAULT *arg* points outside the allocated address space.

EINVAL *arg* does not contain a valid module name.

I_PEEK Allows a user to retrieve the information in the first message on the stream head read queue without taking the message off the queue. **I_PEEK** is analogous to **getmsg**(2) except that it does not remove the message from the queue. *arg* points to a **strpeek** structure, which contains the following members:

```
struct strbuf   ctlbuf;
struct strbuf   databuf;
long            flags;
```

The **maxlen** field in the **ctlbuf** and **databuf strbuf** structures (see **getmsg**(2)) must be set to the number of bytes of control information and / or data information, respectively, to retrieve. **flags** may be set to **RS_HIPRI** or 0. If **RS_HIPRI** is set, **I_PEEK** will look for a high priority message on the stream head read queue. Otherwise, **I_PEEK** will look for the first message on the stream head read queue.

I_PEEK returns 1 if a message was retrieved, and returns 0 if no message was found on the stream head read queue. It does not wait for a message to arrive. On return, **ctlbuf** specifies information in the control buffer, **databuf** specifies information in the data buffer, and **flags** contains the value **RS_HIPRI** or 0. On failure, **errno** is set to the following value:

EFAULT *arg* points, or the buffer area specified in **ctlbuf** or **databuf** is, outside the allocated address space.

EBADMSG Queued message to be read is not valid for **I_PEEK**.

EINVAL Illegal value for **flags**.

I_SRDOPT Sets the read mode (see **read**(2)) using the value of the argument *arg*. Legal *arg* values are:

RNORM Byte-stream mode, the default.

RMSGD Message-discard mode.

RMSGN Message-nondiscard mode.

In addition, the stream head's treatment of control messages may be changed by setting the following flags in *arg*:

RPROTNORM Reject **read**()**with EBADMSG** if a control message is at the front of the stream head read queue.

RPROTDAT Deliver the control portion of a message as data when a user issues **read**(). This is the default behavior.

RPROTDIS Discard the control portion of a message, delivering any data portion, when a user issues a **read**().

On failure, **errno** is set to the following value:

EINVAL *arg* is not one of the above legal values.

I_GRDOPT Returns the current read mode setting in an **int** pointed to by the argument *arg*. Read modes are described in **read**( ). On failure, **errno** is set to the following value:

EFAULT *arg* points outside the allocated address space.

I_NREAD Counts the number of data bytes in data blocks in the first message on the stream head read queue, and places this value in the location pointed to by *arg*. The return value for the command is the number of messages on the stream head read queue. For example, if zero is returned in *arg*, but the **ioctl** return value is greater than zero, this indicates that a zero-length message is next on the queue. On failure, **errno** is set to the following value:

EFAULT *arg* points outside the allocated address space.

I_FDINSERT Creates a message from user specified buffer(s), adds information about another stream and sends the message downstream. The message contains a control part and an optional data part. The data and control parts to be sent are distinguished by placement in separate buffers, as described below.

arg points to a **strfdinsert** structure, which contains the following members:

```
struct strbuf   ctlbuf;
struct strbuf   databuf;
long            flags;
int             fildes;
int             offset;
```

The **len** field in the **ctlbuf strbuf** structure (see **putmsg**(2)) must be set to the size of a pointer plus the number of bytes of control information to be sent with the message. *fildes* in the **strfdinsert** structure specifies the file descriptor of the other stream. **offset**, which must be word-aligned, specifies the number of bytes beyond the beginning of the control buffer where **I_FDINSERT** will store a pointer. This pointer will be the address of the read queue structure of the driver for the stream corresponding to **fildes** in the **strfdinsert** structure. The **len** field in the **databuf strbuf** structure must be set to the number of bytes of data information to be sent with the message or zero if no data part is to be sent.

flags specifies the type of message to be created. An ordinary (non-priority) message is created if **flags** is set to 0, a high priority message is created if **flags** is set to **RS_HIPRI**. For normal messages, **I_FDINSERT** will block if the stream write queue is full due to internal flow control conditions. For high priority messages, **I_FDINSERT** does not block on this condition. For normal messages, **I_FDINSERT** does not block when the write queue is full and **O_NDELAY** or **O_NONBLOCK** is set. Instead, it fails and sets **errno** to **EAGAIN**.

I_FDINSERT also blocks, unless prevented by lack of internal resources, waiting for the availability of message blocks, regardless of priority or whether **O_NDELAY** or **O_NONBLOCK** has been specified. No partial message is sent. On failure, **errno** is set to one of the following values:

EAGAIN A non-priority message was specified, the **O_NDELAY** or **O_NONBLOCK** flag is set, and the stream write queue is full due to internal flow control conditions.

ENOSR Buffers could not be allocated for the message that was to be created due to insufficient STREAMS memory resources.

EFAULT *arg* points, or the buffer area specified in **ctlbuf** or **databuf** is, outside the allocated address space.

EINVAL One of the following: **fildes** in the **strfdinsert** structure is not a valid, open stream file descriptor; the size of a pointer plus **offset** is greater than the **len** field for the buffer specified through **ctlptr**; **offset** does not specify a properly-aligned location in the data buffer; an undefined value is stored in **flags**.

ENXIO Hangup received on **fildes** of the **ioctl** call or **fildes** in the **strfdinsert** structure.

ERANGE The **len** field for the buffer specified through **databuf** does not fall within the range specified by the maximum and minimum packet sizes of the topmost stream module, or the **len** field for the buffer specified through **databuf** is larger than the maximum configured size of the data part of a message, or the **len** field for the buffer specified through **ctlbuf** is larger than the maximum configured size of the control part of a message.

I_FDINSERT can also fail if an error message was received by the stream head of the stream corresponding to **fildes** in the **strfdinsert** structure. In this case, **errno** will be set to the value in the message.

I_STR Constructs an internal STREAMS ioctl message from the data pointed to by *arg*, and sends that message downstream.

This mechanism is provided to send user **ioctl** requests to downstream modules and drivers. It allows information to be sent with the **ioctl**, and will return to the user any information sent upstream by the downstream recipient. **I_STR** blocks until the system responds with either a positive or negative acknowledgement message, or until the request "times out" after some period of time. If the request times out, it fails with **errno** set to **ETIME**.

At most one **I_STR** can be active on a stream. Further **I_STR** calls will block until the active **I_STR** completes at the stream head. The default timeout interval for these requests is 15 seconds. The **O_NDELAY** and **O_NONBLOCK** (see **open**(2)) flags have no effect on this call.

To send requests downstream, *arg* must point to a **strioctl** structure which contains the following members:

```
int     ic_cmd;
int     ic_timout;
int     ic_len;
char    *ic_dp;
```

ic_cmd is the internal **ioctl** command intended for a downstream module or driver and **ic_timout** is the number of seconds (-1 = infinite, 0 = use default, >0 = as specified) an **I_STR** request will wait for acknowledgement before timing out. **ic_len** is the number of bytes in the data argument and **ic_dp** is a pointer to the data argument. The **ic_len** field has two uses: on input, it contains the length of the data argument passed in, and on return from the command, it contains the number of bytes being returned to the user (the buffer pointed to by **ic_dp** should be large enough to contain the maximum amount of data that any module or the driver in the stream can return).

The stream head will convert the information pointed to by the **strioctl** structure to an internal **ioctl** command message and send it downstream. On failure, **errno** is set to one of the following values:

ENOSR Unable to allocate buffers for the **ioctl** message due to insufficient STREAMS memory resources.

EFAULT Either *arg* points outside the allocated address space, or the buffer area specified by **ic_dp** and **ic_len** (separately for data sent and data returned) is outside the allocated address space.

EINVAL **ic_len** is less than 0 or **ic_len** is larger than the maximum configured size of the data part of a message or **ic_timout** is less than -1.

ENXIO Hangup received on *fildes*.

ETIME A downstream **ioctl** timed out before acknowledgement was received.

An **I_STR** can also fail while waiting for an acknowledgement if a message indicating an error or a hangup is received at the stream head. In addition, an error code can be returned in the positive or negative acknowledgement message, in the event the ioctl command sent downstream fails. For these cases, **I_STR** will fail with **errno** set to the value in the message.

I_SWROPT Sets the write mode using the value of the argument *arg*. Legal bit settings for *arg* are:

SNDZERO Send a zero-length message downstream when a write of 0 bytes occurs.

To not send a zero-length message when a write of 0 bytes occurs, this bit must not be set in *arg*.

On failure, **errno** may be set to the following value:

EINVAL *arg* is not the above legal value.

I_GWROPT Returns the current write mode setting, as described above, in the **int** that is pointed to by the argument *arg*.

I_SENDFD Requests the stream associated with *fildes* to send a message, containing a file pointer, to the stream head at the other end of a stream pipe. The file pointer corresponds to *arg*, which must be an open file descriptor.

I_SENDFD converts *arg* into the corresponding system file pointer. It allocates a message block and inserts the file pointer in the block. The user id and group id associated with the sending process are also inserted. This message is placed directly on the read queue (see **intro**(2)) of the stream head at the other end of the stream pipe to which it is connected. On failure, **errno** is set to one of the following values:

EAGAIN The sending stream is unable to allocate a message block to contain the file pointer.

EAGAIN The read queue of the receiving stream head is full and cannot accept the message sent by **I_SENDFD**.

EBADF *arg* is not a valid, open file descriptor.

EINVAL *fildes* is not connected to a stream pipe.

ENXIO Hangup received on *fildes*.

I_RECVFD Retrieves the file descriptor associated with the message sent by an **I_SENDFD ioctl** over a stream pipe. *arg* is a pointer to a data buffer large enough to hold an **strrecvfd** data structure containing the following members:

```
int     fd;
uid_t   uid;
gid_t   gid;
```

fd is an integer file descriptor. **uid** and **gid** are the user id and group id, respectively, of the sending stream.

If **O_NDELAY** and **O_NONBLOCK** are clear (see **open**(2)), **I_RECVFD** will block until a message is present at the stream head. If **O_NDELAY** or **O_NONBLOCK** is set, **I_RECVFD** will fail with **errno** set to **EAGAIN** if no message is present at the stream head.

If the message at the stream head is a message sent by an **I_SENDFD**, a new user file descriptor is allocated for the file pointer contained in the message. The new file descriptor is placed in the **fd** field of the **strrecvfd** structure. The structure is copied into the user data buffer pointed to by *arg*. On failure, **errno** is set to one of the following values:

EAGAIN	A message is not present at the stream head read queue, and the **O_NDELAY** or **O_NONBLOCK** flag is set.
EBADMSG	The message at the stream head read queue is not a message containing a passed file descriptor.
EFAULT	*arg* points outside the allocated address space.
EMFILE	**NOFILES** file descriptors are currently open.
ENXIO	Hangup received on *fildes*.
EOVERFLOW	*uid* or *gid* is too large to be stored in the structure pointed to by *arg*.

I_LIST Allows the user to list all the module names on the stream, up to and including the topmost driver name. If *arg* is **NULL**, the return value is the number of modules, including the driver, that are on the stream pointed to by *fildes*. This allows the user to allocate enough space for the module names. If *arg* is non-**NULL**, it should point to an **str_list** structure that has the following members:

```
int          sl_nmods;
struct       str_mlist*sl_modlist;
```

The **str_mlist** structure has the following member:

```
char         l_name[FMNAMESZ+1];
```

sl_nmods indicates the number of entries the user has allocated in the array and on return, **sl_modlist** contains the list of module names. The return value indicates the number of entries that have been filled in. On failure, **errno** may be set to one of the following values:

EINVAL	The **sl_nmods** member is less than 1.
EAGAIN	Unable to allocate buffers

I_ATMARK Allows the user to see if the current message on the stream head read queue is ''marked'' by some module downstream. *arg* determines how the checking is done when there may be multiple marked messages on the stream head read queue. It may take the following values:

ANYMARK	Check if the message is marked.
LASTMARK	Check if the message is the last one marked on the queue.

The return value is 1 if the mark condition is satisfied and 0 otherwise. On failure, **errno** is set to the following value:

EINVAL Invalid *arg* value.

I_CKBAND Check if the message of a given priority band exists on the stream head read queue. This returns 1 if a message of a given priority exists, 0 if not, or -1 on error. *arg* should be an integer containing the value of the priority band in question. On failure, **errno** is set to the following value:

EINVAL Invalid *arg* value.

I_GETBAND Returns the priority band of the first message on the stream head read queue in the integer referenced by *arg*. On failure, **errno** is set to the following value:

ENODATA No message on the stream head read queue.

I_CANPUT Check if a certain band is writable. *arg* is set to the priority band in question. The return value is 0 if the priority band *arg* is flow controlled, 1 if the band is writable, or -1 on error. On failure, **errno** is set to the following value:

EINVAL Invalid *arg* value.

I_SETCLTIME Allows the user to set the time the stream head will delay when a stream is closing and there are data on the write queues. Before closing each module and driver, the stream head will delay for the specified amount of time to allow the data to drain. Note, however, that the module or driver may itself delay in its close routine; this delay is independent of the stream head's delay and is not settable. If, after the delay, data are still present, data will be flushed. *arg* is the number of milliseconds to delay, rounded up to the nearest legal value on the system. The default is fifteen seconds. On failure, **errno** is set to the following value:

EINVAL Invalid *arg* value.

I_GETCLTIME Returns the close time delay in the integer pointed by *arg*.

The following four commands are used for connecting and disconnecting multiplexed STREAMS configurations.

I_LINK Connects two streams, where *fildes* is the file descriptor of the stream connected to the multiplexing driver, and *arg* is the file descriptor of the stream connected to another driver. The stream designated by *arg* gets connected below the multiplexing driver. **I_LINK** requires the multiplexing driver to send an acknowledgement message to the stream head regarding the linking operation. This call returns a multiplexor ID number (an identifier used to disconnect the multiplexor, see **I_UNLINK**) on success, and -1 on failure. On failure, **errno** is set to one of the following values:

ENXIO Hangup received on *fildes*.

ETIME	Time out before acknowledgement message was received at stream head.
EAGAIN	Temporarily unable to allocate storage to perform the **I_LINK**.
ENOSR	Unable to allocate storage to perform the **I_LINK** due to insufficient STREAMS memory resources.
EBADF	*arg* is not a valid, open file descriptor.
EINVAL	*fildes* stream does not support multiplexing.
EINVAL	*arg* is not a stream, or is already linked under a multiplexor.
EINVAL	The specified link operation would cause a ''cycle'' in the resulting configuration; that is, a driver would be linked into the multiplexing configuration in more than one place.
EINVAL	*fildes* is the file descriptor of a pipe or FIFO.

An **I_LINK** can also fail while waiting for the multiplexing driver to acknowledge the link request, if a message indicating an error or a hangup is received at the stream head of *fildes*. In addition, an error code can be returned in the positive or negative acknowledgement message. For these cases, **I_LINK** will fail with **errno** set to the value in the message.

I_UNLINK Disconnects the two streams specified by *fildes* and *arg*. *fildes* is the file descriptor of the stream connected to the multiplexing driver. *arg* is the multiplexor ID number that was returned by the **I_LINK**. If *arg* is -1, then all streams that were linked to *fildes* are disconnected. As in **I_LINK**, this command requires the multiplexing driver to acknowledge the unlink. On failure, **errno** is set to one of the following values:

ENXIO	Hangup received on *fildes*.
ETIME	Time out before acknowledgement message was received at stream head.
ENOSR	Unable to allocate storage to perform the **I_UNLINK** due to insufficient STREAMS memory resources.
EINVAL	*arg* is an invalid multiplexor ID number or *fildes* is not the stream on which the **I_LINK** that returned *arg* was performed.
EINVAL	*fildes* is the file descriptor of a pipe or FIFO.

An **I_UNLINK** can also fail while waiting for the multiplexing driver to acknowledge the link request, if a message indicating an error or a hangup is received at the stream head of *fildes.* In addition, an error code can be returned in the positive or negative acknowledgement message. For these cases, **I_UNLINK** will fail with **errno** set to the value in the message.

I_PLINK Connects two streams, where *fildes* is the file descriptor of the stream connected to the multiplexing driver, and *arg* is the file descriptor of the stream connected to another driver. The stream designated by *arg* gets connected via a persistent link below the multiplexing driver. **I_PLINK** requires the multiplexing driver to send an acknowledgement message to the stream head regarding the linking operation. This call creates a persistent link that continues to exist even if the file descriptor *fildes* associated with the upper stream to the multiplexing driver is closed. This call returns a multiplexor ID number (an identifier that may be used to disconnect the multiplexor, see **I_PUNLINK**) on success, and -1 on failure. On failure, **errno** is set to one of the following values:

ENXIO	Hangup received on *fildes.*
ETIME	Time out before acknowledgement message was received at the stream head.
EAGAIN	Unable to allocate STREAMS storage to perform the **I_PLINK**.
EBADF	*arg* is not a valid, open file descriptor.
EINVAL	*fildes* does not support multiplexing.
EINVAL	*arg* is not a stream or is already linked under a multiplexor.
EINVAL	The specified link operation would cause a ‘‘cycle’’ in the resulting configuration; that is, if a driver would be linked into the multiplexing configuration in more than one place.
EINVAL	*fildes* is the file descriptor of a pipe or FIFO.

An **I_PLINK** can also fail while waiting for the multiplexing driver to acknowledge the link request, if a message indicating an error on a hangup is received at the stream head of *fildes*. In addition, an error code can be returned in the positive or negative acknowledgement message. For these cases, **I_PLINK** will fail with **errno** set to the value in the message.

I_PUNLINK Disconnects the two streams specified by *fildes* and *arg* that are connected with a persistent link. *fildes* is the file descriptor of the stream connected to the multiplexing driver. *arg* is the multiplexor ID number that was returned by **I_PLINK** when a stream was linked below the multiplexing driver. If *arg* is **MUXID_ALL** then all streams that are persistent links to *fildes* are disconnected. As in **I_PLINK**, this command requires the multiplexing driver to acknowledge the unlink. On failure, **errno** is set to one of the following values:

ENXIO	Hangup received on *fildes*.
ETIME	Time out before acknowledgement message was received at the stream head.
EAGAIN	Unable to allocate buffers for the acknowledgement message.
EINVAL	Invalid multiplexor ID number.
EINVAL	*fildes* is the file descriptor of a pipe or FIFO.

An **I_PUNLINK** can also fail while waiting for the multiplexing driver to acknowledge the link request if a message indicating an error or a hangup is received at the stream head of *fildes*. In addition, an error code can be returned in the positive or negative acknowledgement message. For these cases, **I_PUNLINK** will fail with **errno** set to the value in the message.

SEE ALSO

intro(2), **close**(2), **fcntl**(2), **getmsg**(2), **ioctl**(2), **open**(2), **poll**(2), **putmsg**(2), **read**(2), **write**(2), **signal**(3C), **signal**(5)

STREAMS Programmer's Guide

DIAGNOSTICS

Unless specified otherwise above, the return value from **ioctl** is 0 upon success and -1 upon failure with **errno** set as indicated.

NAME

tcp, TCP – Internet Transmission Control Protocol

SYNOPSIS

```
#include <sys/socket.h>
#include <netinet/in.h>
s = socket(AF_INET, SOCK_STREAM, 0);
t = t_open("/dev/tcp", O_RDWR);
```

DESCRIPTION

TCP is the virtual circuit protocol of the Internet protocol family. It provides reliable, flow-controlled, in order, two-way transmission of data. It is a byte-stream protocol layered above the Internet Protocol (IP), the Internet protocol family's internetwork datagram delivery protocol.

Programs can access TCP using the socket interface as a **SOCK_STREAM** socket type, or using the Transport Level Interface (TLI) where it supports the connection-oriented (**T_COTS_ORD**) service type.

TCP uses IP's host-level addressing and adds its own per-host collection of "port addresses." The endpoints of a TCP connection are identified by the combination of an IP address and a TCP port number. Although other protocols, such as the User Datagram Protocol (UDP), may use the same host and port address format, the port space of these protocols is distinct. See **inet**(7) for details on the common aspects of addressing in the Internet protocol family.

Sockets utilizing TCP are either "active" or "passive". Active sockets initiate connections to passive sockets. Both types of sockets must have their local IP address and TCP port number bound with the **bind**(3N) system call after the socket is created. By default, TCP sockets are active. A passive socket is created by calling the **listen**(3N) system call after binding the socket with **bind( )**. This establishes a queueing parameter for the passive socket. After this, connections to the passive socket can be received with the **accept**(3N) system call. Active sockets use the **connect**(3N) call after binding to initiate connections.

By using the special value **INADDR_ANY**, the local IP address can be left unspecified in the **bind( )** call by either active or passive TCP sockets. This feature is usually used if the local address is either unknown or irrelevant. If left unspecified, the local IP address will be bound at connection time to the address of the network interface used to service the connection.

Once a connection has been established, data can be exchanged using the **read**(2) and **write**(2) system calls.

TCP supports one socket option which is set with **setsockopt( )** and tested with **getsockopt**(3N). Under most circumstances, TCP sends data when it is presented. When outstanding data has not yet been acknowledged, it gathers small amounts of output to be sent in a single packet once an acknowledgement is received. For a small number of clients, such as window systems that send a stream of mouse events which receive no replies, this packetization may cause significant delays.

Therefore, TCP provides a boolean option, **TCP_NODELAY** (defined in **<netinet/tcp.h>**), to defeat this algorithm. The option level for the **setsockopt( )** call is the protocol number for TCP, available from **getprotobyname**(3N).

Options at the IP level may be used with TCP. See **ip**(7).

TCP provides an urgent data mechanism, which may be invoked using the out-of-band provisions of **send**(3N). The caller may mark one byte as "urgent" with the **MSG_OOB** flag to **send**(3N). This sets an "urgent pointer" pointing to this byte in the TCP stream. The receiver on the other side of the stream is notified of the urgent data by a **SIGURG** signal. The **SIOCATMARK ioctl( )** request returns a value indicating whether the stream is at the urgent mark. Because the system never returns data across the urgent mark in a single **read**(2) call, it is possible to advance to the urgent data in a simple loop which reads data, testing the socket with the **SIOCATMARK ioctl( )** request, until it reaches the mark.

Incoming connection requests that include an IP source route option are noted, and the reverse source route is used in responding.

A checksum over all data helps TCP implement reliability. Using a window-based flow control mechanism that makes use of positive acknowledgements, sequence numbers, and a retransmission strategy, TCP can usually recover when datagrams are damaged, delayed, duplicated or delivered out of order by the underlying communication medium.

If the local TCP receives no acknowledgements from its peer for a period of time, as would be the case if the remote machine crashed, the connection is closed and an error is returned to the user. If the remote machine reboots or otherwise loses state information about a TCP connection, the connection is aborted and an error is returned to the user.

SEE ALSO

read(2), **write**(2), **accept**(3N), **bind**(3N), **connect**(3N), **getprotobyname**(3N), **getsockopt**(3N), **listen**(3N), **send**(3N), **inet**(7), **ip**(7)

Postel, Jon, *Transmission Control Protocol - DARPA Internet Program Protocol Specification*, RFC 793, Network Information Center, SRI International, Menlo Park, Calif., September 1981.

DIAGNOSTICS

A socket operation may fail if:

EISCONN	A **connect( )** operation was attempted on a socket on which a **connect( )** operation had already been performed.
ETIMEDOUT	A connection was dropped due to excessive retransmissions.
ECONNRESET	The remote peer forced the connection to be closed (usually because the remote machine has lost state information about the connection due to a crash).
ECONNREFUSED	The remote peer actively refused connection establishment (usually because no process is listening to the port).
EADDRINUSE	A **bind( )** operation was attempted on a socket with a network address / port pair that has already been bound to another socket.

EADDRNOTAVAIL	A **bind( )** operation was attempted on a socket with a network address for which no network interface exists.
EACCES	A **bind( )** operation was attempted with a “reserved” port number and the effective user ID of the process was not the privileged user.
ENOBUFS	The system ran out of memory for internal data structures.

NAME

tcx – 24-bit SBus color memory frame buffer

SYNOPSIS

/dev/fbs/tcx

DESCRIPTION

tcx is a 8 / 24-bit color frame buffer and graphics accelerator, with 8-bit colormap, and overlay / enable planes. It provides the standard frame buffer interface defined in **fbio**(7).

tcx has two control planes which define how the underlying pixel is displayed. The display modes are 8-bit (8 bits taken from low-order 8 bits of pixel) through a colormap; 24-bit through a gamma-correction table; 24-bit through the colormap; or 24-bit direct. The colormap is shared by both 24-bit and 8-bit modes.

The tcx has registers and memory that may be mapped with **mmap**(2), using the offsets defined in **<sys/tcxreg.h>**.

There is an 8-bit only version of **tcx** which operates the same as the 24-bit version, except that the 24-bit-related mappings can not be made.

tcx accepts the following ioctls, defined in **<sys/fbio.h>** and **<sys/visual_io.h>**, and implemented as described in **fbio**(7).

FBIOGATTR	**FBIOGCURSOR**
FBIOGTYPE	**FBIOSCURPOS**
FBIOPUTCMAP	**FBIOGCURPOS**
FBIOGETCMAP	**FBIOGCURMAX**
FBIOSATTR	**FBIOGXINFO**
FBIOSVIDEO	**FBIOMONINFO**
FBIOGVIDEO	**FBIOVRTOFFSET**
FBIOVERTICAL	**VIS_GETIDENTIFIER**
FBIOSCURSOR	

The value returned by **VIS_GETIDENTIFIER** is "SUNW,tcx".

Emulation mode (**FBIOGATTR**, **FBIOSATTR**) may be either none, **FBTYPE_SUN3COLOR**, or **FBTYPE_MEMCOLOR**.

FBIOPUTCMAP returns immediately, although the actual colormap update may be delayed until the next vertical retrace. If vertical retrace is currently in progress, the new colormap takes effect immediately.

FBIOGETCMAP returns immediately with the currently-loaded colormap, unless a colormap write is pending (see above), in which case it waits until the colormap is updated before returning. This may be used to synchronize software with colormap updates.

The size and linebytes values returned by **FBIOGATTR**, **FBIOGTYPE** and **FBIOGXINFO** are the sizes of the 8-bit framebuffer. The proper way to compute the size of a framebuffer mapping is

size=linebytes∗height∗bytes_per_pixel

FILES

/dev/fbs/tcx	device special file
/dev/fb	default frame buffer
/usr/include/sys/tcxreg.h	device-specific definitions

SEE ALSO **mmap**(2), **fbio**(7)

NAME

termio – general terminal interface

SYNOPSIS

#include <termio.h>

ioctl(int *fildes,* **int** *request,* **struct termio** **arg***);**

ioctl(int *fildes,* **int** *request,* **int** *arg***);**

#include <termios.h>

ioctl(int *fildes,* **int** *request,* **struct termios** **arg***);**

DESCRIPTION

This release supports a general interface for asynchronous communications ports that is hardware-independent. The user interface to this functionality is using function calls (the preferred interface) described in **termios**(3) or **ioctl** commands described in this section. This section also discusses the common features of the terminal subsystem which are relevant with both user interfaces.

When a terminal file is opened, it normally causes the process to wait until a connection is established. In practice, users' programs seldom open terminal files; they are opened by the system and become a user's standard input, output, and error files. The first terminal file opened by the session leader that is not already associated with a session becomes the controlling terminal for that session. The controlling terminal plays a special role in handling quit and interrupt signals, as discussed below. The controlling terminal is inherited by a child process during a **fork**(2). A process can break this association by changing its session using **setsid( )** (see **getsid**(2)).

A terminal associated with one of these files ordinarily operates in full-duplex mode. Characters may be typed at any time, even while output is occurring, and are only lost when the character input buffers of the system become completely full, which is rare (for example, if the number of characters in the line discipline buffer exceeds **{MAX_CANON}** and **IMAXBEL** (see below) is not set), or when the user has accumulated {**MAX_INPUT**} number of input characters that have not yet been read by some program. When the input limit is reached, all the characters saved in the buffer up to that point are thrown away without notice.

Session management (Job Control)

A control terminal will distinguish one of the process groups in the session associated with it to be the foreground process group. All other process groups in the session are designated as background process groups. This foreground process group plays a special role in handling signal-generating input characters, as discussed below. By default, when a controlling terminal is allocated, the controlling process's process group is assigned as foreground process group.

Background process groups in the controlling process's session are subject to a job control line discipline when they attempt to access their controlling terminal. Process groups can be sent signals that will cause them to stop, unless they have made other arrangements. An exception is made for members of orphaned process groups.

The operating system will not normally send **SIGTSTP, SIGTTIN,** or **SIGTTOU.** signals to a process that is a member of an orphaned process group.

These are process groups which do not have a member with a parent in another process group that is in the same session and therefore shares the same controlling terminal. When a member's orphaned process group attempts to access its controlling terminal, errors will be returned. since there is no process to continue it if it should stop.

If a member of a background process group attempts to read its controlling terminal, its process group will be sent a **SIGTTIN** signal, which will normally cause the members of that process group to stop. If, however, the process is ignoring or holding **SIGTTIN**, or is a member of an orphaned process group, the read will fail with **errno** set to **EIO**, and no signal will be sent.

If a member of a background process group attempts to write its controlling terminal and the **TOSTOP** bit is set in the **c_lflag** field, its process group will be sent a **SIGTTOU** signal, which will normally cause the members of that process group to stop. If, however, the process is ignoring or holding **SIGTTOU**, the write will succeed. If the process is not ignoring or holding **SIGTTOU** and is a member of an orphaned process group, the write will fail with **errno** set to **EIO**, and no signal will be sent.

If **TOSTOP** is set and a member of a background process group attempts to **ioctl** its controlling terminal, and that **ioctl** will modify terminal parameters (for example, **TCSETA**, **TCSETAW, TCSETAF,** or **TIOCSPGRP**), its process group will be sent a **SIGTTOU** signal, which will normally cause the members of that process group to stop. If, however, the process is ignoring or holding **SIGTTOU**, the ioctl will succeed. If the process is not ignoring or holding **SIGTTOU** and is a member of an orphaned process group, the write will fail with **errno** set to **EIO**, and no signal will be sent.

Canonical mode input processing

Normally, terminal input is processed in units of lines. A line is delimited by a newline (ASCII LF) character, an end-of-file (ASCII EOT) character, or an end-of-line character. This means that a program attempting to read will be suspended until an entire line has been typed. Also, no matter how many characters are requested in the read call, at most one line will be returned. It is not necessary, however, to read a whole line at once; any number of characters may be requested in a read, even one, without losing information.

During input, erase and kill processing is normally done. The ERASE character (by default, the character DEL) erases the last character typed. The WERASE character (the character control-W) erases the last ''word'' typed in the current input line (but not any preceding spaces or tabs). A ''word'' is defined as a sequence of non-blank characters, with tabs counted as blanks. Neither ERASE nor WERASE will erase beyond the beginning of the line. The KILL character (by default, the character NAK) kills (deletes) the entire input line, and optionally outputs a newline character. All these characters operate on a key stroke basis, independent of any backspacing or tabbing that may have been done. The **REPRINT** character (the character control-R) prints a newline followed by all characters that have not been read. Reprinting also occurs automatically if characters that would normally be erased from the screen are fouled by program output. The characters are reprinted as if they were being echoed; consequencely, if **ECHO** is not set, they are not printed.

The ERASE and KILL characters may be entered literally by preceding them with the escape character (\ ). In this case, the escape character is not read. The erase and kill characters may be changed.

Non-canonical mode input processing

In non-canonical mode input processing, input characters are not assembled into lines, and erase and kill processing does not occur. The **MIN** and **TIME** values are used to determine how to process the characters received.

MIN represents the minimum number of characters that should be received when the read is satisfied (that is, when the characters are returned to the user). **TIME** is a timer of 0.10-second granularity that is used to timeout bursty and short-term data transmissions. The four possible values for **MIN** and **TIME** and their interactions are described below.

Case A: **MIN** > 0, **TIME** > 0

In this case, **TIME** serves as an intercharacter timer and is activated after the first character is received. Since it is an intercharacter timer, it is reset after a character is received. The interaction between **MIN** and **TIME** is as follows: as soon as one character is received, the intercharacter timer is started. If **MIN** characters are received before the intercharacter timer expires (note that the timer is reset upon receipt of each character), the read is satisfied. If the timer expires before **MIN** characters are received, the characters received to that point are returned to the user. Note that if **TIME** expires, at least one character will be returned because the timer would not have been enabled unless a character was received. In this case (**MIN** > 0, **TIME** > 0), the read sleeps until the **MIN** and **TIME** mechanisms are activated by the receipt of the first character. If the number of characters read is less than the number of characters available, the timer is not reactivated and the subsequent read is satisfied immediately.

Case B: **MIN** > 0, **TIME** = 0

In this case, since the value of **TIME** is zero, the timer plays no role and only **MIN** is significant. A pending read is not satisfied until **MIN** characters are received (the pending read sleeps until **MIN** characters are received). A program that uses this case to read record based terminal I/O may block indefinitely in the read operation.

Case C: **MIN** = 0, **TIME** > 0

In this case, since **MIN** = 0, **TIME** no longer represents an intercharacter timer: it now serves as a read timer that is activated as soon as a **read** is done. A read is satisfied as soon as a single character is received or the read timer expires. Note that, in this case, if the timer expires, no character is returned. If the timer does not expire, the only way the read can be satisfied is if a character is received. In this case, the read will not block indefinitely waiting for a character; if no character is received within **TIME***.10 seconds after the read is initiated, the read returns with zero characters.

Case D: **MIN** = 0, **TIME** = 0

In this case, return is immediate. The minimum of either the number of characters requested or the number of characters currently available is returned without waiting for more characters to be input.

Comparison of the different cases of MIN, TIME interaction

Some points to note about **MIN** and **TIME**:

1. In the following explanations, note that the interactions of **MIN** and **TIME** are not symmetric. For example, when **MIN** > 0 and **TIME** = 0, **TIME** has no effect. However, in the opposite case, where **MIN** = 0 and **TIME** > 0, both **MIN** and **TIME** play a role in that **MIN** is satisfied with the receipt of a single character.
2. Also note that in case A (**MIN** > 0, **TIME** > 0), **TIME** represents an intercharacter timer, whereas in case C (**MIN** = 0, **TIME** > 0), **TIME** represents a read timer.

These two points highlight the dual purpose of the **MIN/TIME** feature. Cases A and B, where **MIN** > 0, exist to handle burst mode activity (for example, file transfer programs), where a program would like to process at least **MIN** characters at a time. In case A, the intercharacter timer is activated by a user as a safety measure; in case B, the timer is turned off.

Cases C and D exist to handle single character, timed transfers. These cases are readily adaptable to screen-based applications that need to know if a character is present in the input queue before refreshing the screen. In case C, the read is timed, whereas in case D, it is not.

Another important note is that **MIN** is always just a minimum. It does not denote a record length. For example, if a program does a read of 20 bytes, **MIN** is 10, and 25 characters are present, then 20 characters will be returned to the user.

Writing characters

When one or more characters are written, they are transmitted to the terminal as soon as previously written characters have finished typing. Input characters are echoed as they are typed if echoing has been enabled. If a process produces characters more rapidly than they can be typed, it will be suspended when its output queue exceeds some limit. When the queue is drained down to some threshold, the program is resumed.

Special Characters

Certain characters have special functions on input. These functions and their default character values are summarized as follows:

INTR (CTRL-C or ASCII ETX) generates a SIGINT signal. SIGINT is sent to all frequent processes associated with the controlling terminal. Normally, each such process is forced to terminate, but arrangements may be made either to ignore the signal or to receive a trap to an agreed upon location. (See **signal**(5)).

QUIT (CTRL-\ or ASCII FS) generates a SIGQUIT signal. Its treatment is identical to the interrupt signal except that, unless a receiving process has made other arrangements, it will not only be terminated but a core image file (called **core**) will be created in the current working directory.

ERASE (DEL) erases the preceding character. It does not erase beyond the start of a line, as delimited by a NL, EOF, EOL, or EOL2 character.

WERASE (CTRL-W or ASCII ETX) erases the preceding ''word''. It does not erase beyond the start of a line, as delimited by a NL, EOF, EOL, or EOL2 character.

KILL (CTRL-U or ASCII NAK) deletes the entire line, as delimited by a NL, EOF,

EOL, or EOL2 character.

REPRINT (CTRL-R or ASCII DC2) reprints all characters, preceded by a newline, that have not been read.

EOF (CTRL-D or ASCII EOT) may be used to generate an end-of-file from a terminal. When received, all the characters waiting to be read are immediately passed to the program, without waiting for a newline, and the EOF is discarded. Thus, if no characters are waiting (that is, the EOF occurred at the beginning of a line) zero characters are passed back, which is the standard end-of-file indication. Unless escaped, the EOF character is not echoed. Because EOT is the default EOF character, this prevents terminals that respond to EOT from hanging up.

NL (ASCII LF) is the normal line delimiter. It cannot be changed or escaped.

EOL (ASCII NULL) is an additional line delimiter, like NL. It is not normally used.

EOL2 is another additional line delimiter.

SWTCH (CTRL-Z or ASCII EM) is used only when **shl** layers is invoked.

SUSP (CTRL-Z or ASCII SUB) generates a SIGTSTP signal. SIGTSTP stops all processes in the foreground process group for that terminal.

DSUSP (CTRL-Y or ASCII EM) It generates a SIGTSTP signal as SUSP does, but the signal is sent when a process in the foreground process group attempts to read the DSUSP character, rather than when it is typed.

STOP (CTRL-S or ASCII DC3) can be used to suspend output temporarily. It is useful with CRT terminals to prevent output from disappearing before it can be read. While output is suspended, STOP characters are ignored and not read.

START (CTRL-Q or ASCII DC1) is used to resume output. Output has been suspended by a STOP character. While output is not suspended, START characters are ignored and not read.

DISCARD (CTRL-O or ASCII SI) causes subsequent output to be discarded. Output is discarded until another DISCARD character is typed, more input arrives, or the condition is cleared by a program.

LNEXT (CTRL-V or ASCII SYN) causes the special meaning of the next character to be ignored. This works for all the special characters mentioned above. It allows characters to be input that would otherwise be interpreted by the system (for example KILL, QUIT).

The character values for INTR, QUIT, ERASE, WERASE, KILL, REPRINT, EOF, EOL, EOL2, SWTCH, SUSP, DSUSP, STOP, START, DISCARD, and LNEXT may be changed to suit individual tastes. If the value of a special control character is _POSIX_VDISABLE (0), the function of that special control character is disabled. The ERASE, KILL, and EOF characters may be escaped by a preceding \ character, in which case no special function is done. Any of the special characters may be preceded by the LNEXT character, in which case no

special function is done.

Modem disconnect

When a modem disconnect is detected, a **SIGHUP** signal is sent to the terminal's controlling process. Unless other arrangements have been made, these signals cause the process to terminate. If **SIGHUP** is ignored or caught, any subsequent read returns with an end-of-file indication until the terminal is closed.

If the controlling process is not in the foreground process group of the terminal, a **SIGTSTP** is sent to the terminal's foreground process group. Unless other arrangements have been made, these signals cause the processes to stop.

Processes in background process groups that attempt to access the controlling terminal after modem disconnect while the terminal is still allocated to the session will receive appropriate **SIGTTOU** and **SIGTTIN** signals. Unless other arrangements have been made, this signal causes the processes to stop.

The controlling terminal will remain in this state until it is reinitialized with a successful open by the controlling process, or deallocated by the controlling process.

Terminal parameters

The parameters that control the behavior of devices and modules providing the **termios** interface are specified by the **termios** structure defined by **<termios.h>**. Several **ioctl**(2) system calls that fetch or change these parameters use this structure that contains the following members:

```
tcflag_t    c_iflag;     /* input modes */
tcflag_t    c_oflag;     /* output modes */
tcflag_t    c_cflag;     /* control modes */
tcflag_t    c_lflag;     /* local modes */
cc_t        c_cc[NCCS];  /* control chars */
```

The special control characters are defined by the array **c_cc**. The symbolic name **NCCS** is the size of the control-character array and is also defined by **<termios.h>**. The relative positions, subscript names, and typical default values for each function are as follows:

0	**VINTR**	ETX
1	**VQUIT**	FS
2	**VERASE**	DEL
3	**VKILL**	NAK
4	**VEOF**	EOT
5	**VEOL**	NUL
6	**VEOL2**	NUL
7	**VSWTCH**	NUL
8	**VSTART**	DC1
9	**VSTOP**	DC3
10	**VSUSP**	SUB
11	**VDSUSP**	EM
12	**VREPRINT**	DC2
13	**VDISCARD**	SI
14	**VWERASE**	ETB
15	**VLNEXT**	SYN

16-19 reserved

Input modes

The **c_iflag** field describes the basic terminal input control:

IGNBRK	Ignore break condition.
BRKINT	Signal interrupt on break.
IGNPAR	Ignore characters with parity errors.
PARMRK	Mark parity errors.
INPCK	Enable input parity check.
ISTRIP	Strip character.
INLCR	Map NL to CR on input.
IGNCR	Ignore CR.
ICRNL	Map CR to NL on input.
IUCLC	Map upper-case to lower-case on input.
IXON	Enable start/stop output control.
IXANY	Enable any character to restart output.
IXOFF	Enable start/stop input control.
IMAXBEL	Echo BEL on input line too long.

If **IGNBRK** is set, a break condition (a character framing error with data all zeros) detected on input is ignored, that is, not put on the input queue and therefore not read by any process. If **IGNBRK** is not set and **BRKINT** is set, the break condition shall flush the input and output queues and if the terminal is the controlling terminal of a foreground process group, the break condition generates a single **SIGINT** signal to that foreground process group. If neither **IGNBRK** nor **BRKINT** is set, a break condition is read as a single ASCII NULL character (´\0´), or if **PARMRK** is set, as ´\377´, ´\0´, ´\0´.

If **IGNPAR** is set, a byte with framing or parity errors (other than break) is ignored.

If **PARMRK** is set, and **IGNPAR** is not set, a byte with a framing or parity error (other than break) is given to the application as the three-character sequence: ´\377´, ´\0´, *X*, where X is the data of the byte received in error. To avoid ambiguity in this case, if **ISTRIP** is not set, a valid character of ´\377´ is given to the application as ´\377´, ´\377´. If neither **IGNPAR** nor **PARMRK** is set, a framing or parity error (other than break) is given to the application as a single ASCII NULL character (´\0´).

If **INPCK** is set, input parity checking is enabled. If I**NPCK** is not set, input parity checking is disabled. This allows output parity generation without input parity errors. Note that whether input parity checking is enabled or disabled is independent of whether parity detection is enabled or disabled. If parity detection is enabled but input parity checking is disabled, the hardware to which the terminal is connected will recognize the parity bit, but the terminal special file will not check whether this is set correctly or not.

If **ISTRIP** is set, valid input characters are first stripped to seven bits, otherwise all eight bits are processed.

If **INLCR** is set, a received NL character is translated into a CR character. If **IGNCR** is set, a received CR character is ignored (not read). Otherwise, if **ICRNL** is set, a received CR character is translated into a NL character.

If **IUCLC** is set, a received upper case, alphabetic character is translated into the corresponding lower case character.

If **IXON** is set, start / stop output control is enabled. A received STOP character suspends output and a received START character restarts output. The STOP and START characters will not be read, but will merely perform flow control functions. If **IXANY** is set, any input character restarts output that has been suspended.

If **IXOFF** is set, the system transmits a STOP character when the input queue is nearly full, and a START character when enough input has been read so that the input queue is nearly empty again.

If **IMAXBEL** is set, the ASCII BEL character is echoed if the input stream overflows. Further input is not stored, but any input already present in the input stream is not disturbed. If **IMAXBEL** is not set, no BEL character is echoed, and all input present in the input queue is discarded if the input stream overflows.

Output modes

The **c_oflag** field specifies the system treatment of output:

OPOST	Post-process output.
OLCUC	Map lower case to upper on output.
ONLCR	Map NL to CR-NL on output.
OCRNL	Map CR to NL on output.
ONOCR	No CR output at column 0.
ONLRET	NL performs CR function.
OFILL	Use fill characters for delay.
OFDEL	Fill is DEL, else **NULL**.
NLDLY	Select newline delays:
NL0	
NL1	
CRDLY	Select carriage-return delays:
CR0	
CR1	
CR2	
CR3	
TABDLY	Select horizontal tab delays:
TAB0	or tab expansion:
TAB1	
TAB2	
TAB3	Expand tabs to spaces.
XTABS	Expand tabs to spaces.
BSDLY	Select backspace delays:
BS0	
BS1	
VTDLY	Select vertical tab delays:
VT0	
VT1	
FFDLY	Select form feed delays:

FF0
FF1

If **OPOST** is set, output characters are post-processed as indicated by the remaining flags; otherwise, characters are transmitted without change.

If **OLCUC** is set, a lower case alphabetic character is transmitted as the corresponding upper case character. This function is often used in conjunction with **IUCLC**.

If **ONLCR** is set, the NL character is transmitted as the CR-NL character pair. If **OCRNL** is set, the CR character is transmitted as the NL character. If **ONOCR** is set, no CR character is transmitted when at column 0 (first position). If **ONRET** is set, the NL character is assumed to do the carriage-return function; the column pointer is set to 0 and the delays specified for CR are used. Otherwise, the NL character is assumed to do just the line-feed function; the column pointer remains unchanged. The column pointer is also set to 0 if the CR character is actually transmitted.

The delay bits specify how long transmission stops to allow for mechanical or other movement when certain characters are sent to the terminal. In all cases, a value of 0 indicates no delay. If **OFILL** is set, fill characters are transmitted for delay instead of a timed delay. This is useful for high baud rate terminals that need only a minimal delay. If **OFDEL** is set, the fill character is DEL; otherwise it is **NULL**.

If a form-feed or vertical-tab delay is specified, it lasts for about 2 seconds.

Newline delay lasts about 0.10 seconds. If **ONLRET** is set, the carriage-return delays are used instead of the newline delays. If **OFILL** is set, two fill characters are transmitted.

Carriage-return delay type 1 is dependent on the current column position, type 2 is about 0.10 seconds, and type 3 is about 0.15 seconds. If **OFILL** is set, delay type 1 transmits two fill characters, and type 2 transmits four fill characters.

Horizontal-tab delay type 1 is dependent on the current column position. Type 2 is about 0.10 seconds. Type 3 specifies that tabs are to be expanded into spaces. If **OFILL** is set, two fill characters are transmitted for any delay.

Backspace delay lasts about 0.05 seconds. If **OFILL** is set, one fill character is transmitted.

The actual delays depend on line speed and system load.

Control Modes

The **c_cflag** field describes the hardware control of the terminal:

CBAUD	Baud rate:
B0	Hang up
B50	50 baud
B75	75 baud
B110	110 baud
B134	134 baud
B150	150 baud
B200	200 baud
B300	300 baud
B600	600 baud
B1200	1200 baud
B1800	1800 baud
B2400	2400 baud
B4800	4800 baud
B9600	9600 baud
B19200	19200 baud
EXTA	External A
B38400	38400 baud
EXTB	External B
CSIZE	Character size:
CS5	5 bits
CS6	6 bits
CS7	7 bits
CS8	8 bits
CSTOPB	Send two stop bits, else one
CREAD	Enable receiver
PARENB	Parity enable
PARODD	Odd parity, else even
HUPCL	Hang up on last close
CLOCAL	Local line, else dial-up
CIBAUD	Input baud rate, if different from output rate
PAREXT	Extended parity for mark and space parity

The **CBAUD** bits specify the baud rate. The zero baud rate, B0, is used to hang up the connection. If B0 is specified, the data-terminal-ready signal is not asserted. Normally, this disconnects the line. If the **CIBAUD** bits are not zero, they specify the input baud rate, with the **CBAUD** bits specifying the output baud rate; otherwise, the output and input baud rates are both specified by the **CBAUD** bits. The values for the **CIBAUD** bits are the same as the values for the **CBAUD** bits, shifted left **IBSHIFT** bits. For any particular hardware, impossible speed changes are ignored.

The **CSIZE** bits specify the character size in bits for both transmission and reception. This size does not include the parity bit, if any. If **CSTOPB** is set, two stop bits are used; otherwise, one stop bit is used. For example, at 110 baud, two stops bits are required.

If **PARENB** is set, parity generation and detection is enabled, and a parity bit is added to each character. If parity is enabled, the **PARODD** flag specifies odd parity if set; otherwise, even parity is used.

If **CREAD** is set, the receiver is enabled. Otherwise, no characters are received.

If **HUPCL** is set, the line is disconnected when the last process with the line open closes it or terminates. That is, the data-terminal-ready signal is not asserted.

If **CLOCAL** is set, the line is assumed to be a local, direct connection with no modem control; otherwise, modem control is assumed.

Local modes

The **c_lflag** field of the argument structure is used by the line discipline to control terminal functions. The basic line discipline provides the following:

ISIG	Enable signals.
ICANON	Canonical input (erase and kill processing).
XCASE	Canonical upper/lower presentation.
ECHO	Enable echo.
ECHOE	Echo erase character as BS-SP-BS.
ECHOK	Echo NL after kill character.
ECHONL	Echo NL.
NOFLSH	Disable flush after interrupt or quit.
TOSTOP	Send **SIGTTOU** for background output.
ECHOCTL	Echo control characters as ^*char*, delete as ^?.
ECHOPRT	Echo erase character as character erased.
ECHOKE	BS-SP-BS erase entire line on line kill.
FLUSHO	Output is being flushed.
PENDIN	Retype pending input at next read or input character.
IEXTEN	Enable extended (implementation-defined) functions.

If **ISIG** is set, each input character is checked against the special control characters INTR, QUIT, SWTCH, SUSP, STATUS, and DSUSP. If an input character matches one of these control characters, the function associated with that character is performed. If **ISIG** is not set, no checking is done. Thus, these special input functions are possible only if **ISIG** is set.

If **ICANON** is set, canonical processing is enabled. This enables the erase and kill edit functions, and the assembly of input characters into lines delimited by NL, EOF, EOL, and EOL2. If **ICANON** is not set, read requests are satisfied directly from the input queue. A read is not satisfied until at least **MIN** characters have been received or the timeout value **TIME** has expired between characters. This allows fast bursts of input to be read efficiently while still allowing single character input. The time value represents tenths of seconds.

If **XCASE** is set, and if **ICANON** is set, an upper case letter is accepted on input by preceding it with a \ character, and is output preceded by a \ character. In this mode, the following escape sequences are generated on output and accepted on input:

for:	**use**:
`	\´
|	\!
~	\^
{	\(
}	\)
\	\\

For example, **A** is input as **\a**, **\n** as **\\n**, and **\N** as **\\\n**.

If **ECHO** is set, characters are echoed as received.

When **ICANON** is set, the following echo functions are possible.

1. If **ECHO** and **ECHOE** are set, and **ECHOPRT** is not set, the ERASE and WERASE characters are echoed as one or more ASCII BS SP BS, which clears the last character(s) from a CRT screen.
2. If **ECHO**, **ECHOPRT**, and **IEXTEN** are set, the first ERASE and WERASE character in a sequence echoes as a backslash (\), followed by the characters being erased. Subsequent ERASE and WERASE characters echo the characters being erased, in reverse order. The next non-erase character causes a slash (/) to be typed before it is echoed. **ECHOPRT** should be used for hard copy terminals.
3. If **ECHOKE** and **IEXTEN** are set, the kill character is echoed by erasing each character on the line from the screen (using the mechanism selected by **ECHOE** and **ECHOPRT**).
4. If **ECHOK** is set, and **ECHOKE** is not set, the NL character is echoed after the kill character to emphasize that the line is deleted. Note that an escape character (\) or an LNEXT character preceding the erase or kill character removes any special function.
5. If **ECHONL** is set, the NL character is echoed even if **ECHO** is not set. This is useful for terminals set to local echo (so called half-duplex).

If **ECHOCTL** and **IEXTEN** are set, all control characters (characters with codes between 0 and 37 octal) other than ASCII TAB, ASCII NL, the START character, and the STOP character, ASCII CR, and ASCII BS are echoed as **^X**, where **X** is the character given by adding 100 octal to the code of the control character (so that the character with octal code 1 is echoed as **^A**), and the ASCII DEL character, with code 177 octal, is echoed as ^?.

If **NOFLSH** is set, the normal flush of the input and output queues associated with the INTR, QUIT, and SUSP characters is not done. This bit should be set when restarting system calls that read from or write to a terminal (see **sigaction**(2)).

If **TOSTOP** and **IEXTEN** are set, the signal **SIGTTOU** is sent to a process that tries to write to its controlling terminal if it is not in the foreground process group for that terminal. This signal normally stops the process. Otherwise, the output generated by that process is output to the current output stream. Processes that are blocking or ignoring

SIGTTOU signals are excepted and allowed to produce output, if any.

If **FLUSHO** and **IEXTEN** are set, data written to the terminal is discarded. This bit is set when the FLUSH character is typed. A program can cancel the effect of typing the FLUSH character by clearing **FLUSHO**.

If **PENDIN** and **IEXTEN** are set, any input that has not yet been read is reprinted when the next character arrives as input. **PENDIN** is then automatically cleared.

If **IEXTEN** is set, the following implementation-defined functions are enabled: special characters (**WERASE, REPRINT, DISCARD**, and **LNEXT**) and local flags (**TOSTOP, ECHOCTL, ECHOPRT, ECHOKE, FLUSHO**, and **PENDIN**).

Minimum and Timeout

The **MIN** and **TIME** values are described above under *Non-canonical mode input processing*. The initial value of **MIN** is 1, and the initial value of **TIME** is 0.

Terminal size

The number of lines and columns on the terminal's display is specified in the **winsize** structure defined by **<sys/termios.h>** and includes the following members:

```
unsigned  short  ws_row;     /* rows, in characters */
unsigned  short  ws_col;     /* columns, in characters */
unsigned  short  ws_xpixel;  /* horizontal size, in pixels */
unsigned  short  ws_ypixel;  /* vertical size, in pixels */
```

Termio structure

The SunOS / SVR4 **termio** structure is used by some **ioctl**s; it is defined by **<sys/termio.h>** and includes the following members:

```
unsigned  short  c_iflag;    /* input modes */
unsigned  short  c_oflag;    /* output modes */
unsigned  short  c_cflag;    /* control modes */
unsigned  short  c_lflag;    /* local modes */
char             c_line;     /* line discipline */
unsigned  char   c_cc[NCC];  /* control chars */
```

The special control characters are defined by the array **c_cc**. The symbolic name **NCC** is the size of the control-character array and is also defined by **<termio.h>**. The relative positions, subscript names, and typical default values for each function are as follows:

0	**VINTR**	EXT
1	**VQUIT**	FS
2	**VERASE**	DEL
3	**VKILL**	NAK
4	**VEOF**	EOT
5	**VEOL**	NUL
6	**VEOL2**	NUL
7	reserved	

The **MIN** values is stored in the **VMIN** element of the **c_cc** array; the **TIME** value is stored in the **VTIME** element of the **c_cc** array. The **VMIN** element is the same element as the **VEOF** element; the **VTIME** element is the same element as the **VEOL** element.

The calls that use the **termio** structure only affect the flags and control characters that can be stored in the **termio** structure; all other flags and control characters are unaffected.

Modem lines

On special files representing serial ports, the modem control lines supported by the hardware can be read, and the modem status lines supported by the hardware can be changed. The following modem control and status lines may be supported by a device; they are defined by **<sys/termios.h>**:

TIOCM_LE	line enable
TIOCM_DTR	data terminal ready
TIOCM_RTS	request to send
TIOCM_ST	secondary transmit
TIOCM_SR	secondary receive
TIOCM_CTS	clear to send
TIOCM_CAR	carrier detect
TIOCM_RNG	ring
TIOCM_DSR	data set ready

TIOCM_CD is a synonym for **TIOCM_CAR**, and **TIOCM_RI** is a synonym for **TIOCM_RNG**. Not all of these are necessarily supported by any particular device; check the manual page for the device in question.

Default values

The initial termios values upon driver open is configurable. This is accomplished by setting the "ttymodes" property in the file **/kernel/drv/options.conf**. Note: This property is assigned during system initialization, therefore any change to the "ttymodes" property will not take effect until the next reboot. The string value assigned to this property should be in the same format as the output of the stty command with the -g option. See **stty**(1).

If this property is undefined, the following termios modes are in effect. The initial input control value is **BRKINT**, **ICRNL**, **IXON**, **IMAXBEL**. The initial output control value is **OPOST**, **ONLCR**, **TAB3**. The initial hardware control value is **B9600**, **CS8**, **CREAD**. The initial line-discipline control value is **ISIG**, **ICANON**, **IEXTEN**, **ECHO**, **ECHOK**, **ECHOE**, **ECHOKE**, **ECHOCTL**.

IOCTLS

The **ioctl**s supported by devices and STREAMS modules providing the **termios** interface are listed below. Some calls may not be supported by all devices or modules. The functionality provided by these calls is also available through the preferred function call interface specified on **termios**(3).

TCGETS The argument is a pointer to a **termios** structure. The current terminal parameters are fetched and stored into that structure.

TCSETS The argument is a pointer to a **termios** structure. The current terminal parameters are set from the values stored in that structure. The change is immediate.

TCSETSW The argument is a pointer to a **termios** structure. The current terminal parameters are set from the values stored in that structure. The change occurs after all characters queued for output have been transmitted. This form should be used when changing parameters that affect output.

TCSETSF The argument is a pointer to a **termios** structure. The current terminal parameters are set from the values stored in that structure. The change occurs after all characters queued for output have been transmitted; all characters queued for input are discarded and then the change occurs.

TCGETA The argument is a pointer to a **termio** structure. The current terminal parameters are fetched, and those parameters that can be stored in a **termio** structure are stored into that structure.

TCSETA The argument is a pointer to a **termio** structure. Those terminal parameters that can be stored in a **termio** structure are set from the values stored in that structure. The change is immediate.

TCSETAW The argument is a pointer to a **termio** structure. Those terminal parameters that can be stored in a **termio** structure are set from the values stored in that structure. The change occurs after all characters queued for output have been transmitted. This form should be used when changing parameters that affect output.

TCSETAF The argument is a pointer to a **termio** structure. Those terminal parameters that can be stored in a **termio** structure are set from the values stored in that structure. The change occurs after all characters queued for output have been transmitted; all characters queued for input are discarded and then the change occurs.

TCSBRK The argument is an **int** value. Wait for the output to drain. If the argument is 0, then send a break (zero valued bits for 0.25 seconds).

TCXONC Start / stop control. The argument is an **int** value. If the argument is 0, suspend output; if 1, restart suspended output; if 2, suspend input; if 3, restart suspended input.

TCFLSH The argument is an **int** value. If the argument is 0, flush the input queue; if 1, flush the output queue; if 2, flush both the input and output queues.

TIOCGPGRP The argument is a pointer to a **pid_t**. Set the value of that **pid_t** to the process group ID of the foreground process group associated with the terminal. See **termios**(3) for a description or **TCGETPGRP**.

TIOCSPGRP The argument is a pointer to a **pid_t**. Associate the process group whose process group ID is specified by the value of that **pid_t** with the terminal. The new process group value must be in the range of valid process group ID values. Otherwise, the error **EPERM** is returned. See **termios**(3) for a description of **TCSETPGRP**.

TIOCGSID The argument is a pointer to a **pid_t**. The session ID of the terminal is fetched and stored in the **pid_t**.

TIOCGWINSZ The argument is a pointer to a **winsize** structure. The terminal driver's notion of the terminal size is stored into that structure.

TIOCSWINSZ The argument is a pointer to a **winsize** structure. The terminal driver's notion of the terminal size is set from the values specified in that structure. If the new sizes are different from the old sizes, a **SIGWINCH** signal is set to the process group of the terminal.

TIOCMBIS The argument is a pointer to an **int** whose value is a mask containing modem control lines to be turned on. The control lines whose bits are set in the argument are turned on; no other control lines are affected.

TIOCMBIC The argument is a pointer to an **int** whose value is a mask containing modem control lines to be turned off. The control lines whose bits are set in the argument are turned off; no other control lines are affected.

TIOCMGET The argument is a pointer to an **int**. The current state of the modem status lines is fetched and stored in the **int** pointed to by the argument.

TIOCMSET The argument is a pointer to an **int** containing a new set of modem control lines. The modem control lines are turned on or off, depending on whether the bit for that mode is set or clear.

FILES files in or under /**dev**

SEE ALSO **fork**(2), **getsid**(2), **ioctl**(2), **termios**(3), **signal**(3C), **streamio**(7)

NAME

termiox – extended general terminal interface

DESCRIPTION

The extended general terminal interface supplements the **termio**(7) general terminal interface by adding support for asynchronous hardware flow control, isochronous flow control and clock modes, and local implementations of additional asynchronous features. Some systems may not support all of these capabilities because of either hardware or software limitations. Other systems may not permit certain functions to be disabled. In these cases the appropriate bits will be ignored. See <**termiox.h**> for your system to find out which capabilities are supported.

Hardware Flow Control Modes

Hardware flow control supplements the **termio**(7) **IXON**, **IXOFF**, and **IXANY** character flow control. Character flow control occurs when one device controls the data transfer of another device by the insertion of control characters in the data stream between devices. Hardware flow control occurs when one device controls the data transfer of another device using electrical control signals on wires (circuits) of the asynchronous interface. Isochronous hardware flow control occurs when one device controls the data transfer of another device by asserting or removing the transmit clock signals of that device. Character flow control and hardware flow control may be simultaneously set.

In asynchronous, full duplex applications, the use of the Electronic Industries Association's EIA-232-D Request To Send (RTS) and Clear To Send (CTS) circuits is the preferred method of hardware flow control. An interface to other hardware flow control methods is included to provide a standard interface to these existing methods.

The EIA-232-D standard specified only uni-directional hardware flow control - the Data Circuit-terminating Equipment or Data Communications Equipment (DCE) indicates to the Data Terminal Equipment (DTE) to stop transmitting data. The **termiox** interface allows both uni-directional and bi-directional hardware flow control; when bi-directional flow control is enabled, either the DCE or DTE can indicate to each other to stop transmitting data across the interface. Note: It is assumed that the asynchronous port is configured as a DTE. If the connected device is also a DTE and not a DCE, then DTE to DTE (for example, terminal or printer connected to computer) hardware flow control is possible by using a null modem to interconnect the appropriate data and control circuits.

Clock Modes

Isochronous communication is a variation of asynchronous communication whereby two communicating devices may provide transmit and/or receive clock to each other. Incoming clock signals can be taken from the baud rate generator on the local isochronous port controller, from CCITT V.24 circuit 114, Transmitter Signal Element Timing - DCE source (EIA-232-D pin 15), or from CCITT V.24 circuit 115, Receiver Signal Element Timing - DCE source (EIA-232-D pin 17). Outgoing clock signals can be sent on CCITT V.24 circuit 113, Transmitter Signal Element Timing - DTE source (EIA-232-D pin 24), on CCITT V.24 circuit 128, Receiver Signal Element Timing - DTE source (no EIA-232-D pin), or not sent at all.

In terms of clock modes, traditional asynchronous communication is implemented simply by using the local baud rate generator as the incoming transmit and receive clock source and not outputting any clock signals.

Terminal Parameters

The parameters that control the behavior of devices providing the **termiox** interface are specified by the **termiox** structure, defined in the <**sys/termiox.h**> header. Several **ioctl**(2) system calls that fetch or change these parameters use this structure:

```
#define          NFF        5
struct termiox   {
        unsigned short   x_hflag;        /* hardware flow control modes */
        unsigned short   x_cflag;        /* clock modes */
        unsigned short   x_rflag[NFF];   /* reserved modes */
        unsigned short   x_sflag;        /* spare local modes */
};
```

The **x_hflag** field describes hardware flow control modes:

RTSXOFF	**0000001**	Enable RTS hardware flow control on input.
CTSXON	**0000002**	Enable CTS hardware flow control on output.
DTRXOFF	**0000004**	Enable DTR hardware flow control on input.
CDXON	**0000010**	Enable CD hardware flow control on output.
ISXOFF	**0000020**	Enable isochronous hardware flow control on input.

The EIA-232-D DTR and CD circuits are used to establish a connection between two systems. The RTS circuit is also used to establish a connection with a modem. Thus, both DTR and RTS are activated when an asynchronous port is opened. If DTR is used for hardware flow control, then RTS must be used for connectivity. If CD is used for hardware flow control, then CTS must be used for connectivity. Thus, RTS and DTR (or CTS and CD) cannot both be used for hardware flow control at the same time. Other mutual exclusions may apply, such as the simultaneous setting of the **termio**(7) **HUPCL** and the **termiox** DTRXOFF bits, which use the DTE ready line for different functions.

Variations of different hardware flow control methods may be selected by setting the the appropriate bits. For example, bi-directional RTS/CTS flow control is selected by setting both the **RTSXOFF** and **CTSXON** bits and bi-directional DTR/CTS flow control is selected by setting both the **DTRXOFF** and **CTSXON**. Modem control or uni-directional CTS hardware flow control is selected by setting only the **CTSXON** bit.

As previously mentioned, it is assumed that the local asynchronous port (for example, computer) is configured as a DTE. If the connected device (for example, printer) is also a DTE, it is assumed that the device is connected to the computer's asynchronous port using a null modem that swaps control circuits (typically RTS and CTS). The connected DTE drives RTS and the null modem swaps RTS and CTS so that the remote RTS is received as CTS by the local DTE. In the case that **CTSXON** is set for hardware flow control, printer's lowering of its RTS would cause CTS seen by the computer to be lowered. Output to the printer is suspended until the printer's raising of its RTS, which would cause CTS seen by the computer to be raised.

If **RTSXOFF** is set, the Request To Send (RTS) circuit (line) will be raised, and if the asynchronous port needs to have its input stopped, it will lower the Request To Send (RTS) line. If the RTS line is lowered, it is assumed that the connected device will stop its output until RTS is raised.

If **CTSXON** is set, output will occur only if the Clear To Send (CTS) circuit (line) is raised by the connected device. If the CTS line is lowered by the connected device, output is suspended until CTS is raised.

If **DTRXOFF** is set, the DTE Ready (DTR) circuit (line) will be raised, and if the asynchronous port needs to have its input stopped, it will lower the DTE Ready (DTR) line. If the DTR line is lowered, it is assumed that the connected device will stop its output until DTR is raised.

If **CDXON** is set, output will occur only if the Received Line Signal Detector (CD) circuit (line) is raised by the connected device. If the CD line is lowered by the connected device, output is suspended until CD is raised.

If **ISXOFF** is set, and if the isochronous port needs to have its input stopped, it will stop the outgoing clock signal. It is assumed that the connected device is using this clock signal to create its output. Transit and receive clock sources are programmed using the **x_cflag** fields. If the port is not programmed for external clock generation, **ISXOFF** is ignored. Output isochronous flow control is supported by appropriate clock source programming using the **x_cflag** field and enabled at the remote connected device.

The **x_cflag** field specifies the system treatment of clock modes.

XMTCLK	0000007	Transmit clock source:
XCIBRG	0000000	Get transmit clock from internal baud rate generator.
XCTSET	0000001	Get transmit clock from transmitter signal element timing (DCE source) lead, CCITT V.24 circuit 114, EIA-232-D pin 15.
XCRSET	0000002	Get transmit clock from receiver signal element timing (DCE source) lead, CCITT V.24 circuit 115, EIA-232-D pin 17.
RCVCLK	0000070	Receive clock source:
RCIBRG	0000000	Get receive clock from internal baud rate generator.
RCTSET	0000010	Get receive clock from transmitter signal element timing (DCE source) lead, CCITT V.24 circuit 114, EIA-232-D pin 15.
RCRSET	0000020	Get receive clock from receiver signal element timing (DCE source) lead, CCITT V.24 circuit 115, EIA-232-D pin 17.
TSETCLK	0000700	Transmitter signal element timing (DTE source) lead, CCITT V.24 circuit 113, EIA-232-D pin 24, clock source:
TSETCOFF	0000000	TSET clock not provided.
TSETCRBRG	0000100	Output receive baud rate generator on circuit 113.

TSETCTBRG	0000200	Output transmit baud rate generator on circuit 113.
TSETCTSET	0000300	Output transmitter signal element timing (DCE source) on circuit 113.
TSETCRSET	0000400	Output receiver signal element timing (DCE source) on circuit 113.
RSETCLK	0007000	Receiver signal element timing (DTE source) lead, CCITT V.24 circuit 128, no EIA-232-D pin, clock source:
RSETCOFF	0000000	RSET clock not provided.
RSETCRBRG	0001000	Output receive baud rate generator on circuit 128.
RSETCTBRG	0002000	Output transmit baud rate generator on circuit 128.
RSETCTSET	0003000	Output transmitter signal element timing (DCE source) on circuit 128.
RSETCRSET	0004000	Output receiver signal element timing (DCE) on circuit 128.

If the **XMTCLK** field has a value of **XCIBRG** the transmit clock is taken from the hardware internal baud rate generator, as in normal asynchronous transmission. If **XMTCLK** = **XCTSET** the transmit clock is taken from the Transmitter Signal Element Timing (DCE source) circuit. If **XMTCLK** = **XCRSET** the transmit clock is taken from the Receiver Signal Element Timing (DCE source) circuit.

If the **RCVCLK** field has a value of **RCIBRG** the receive clock is taken from the hardware Internal Baud Rate Generator, as in normal asynchronous transmission. If **RCVCLK** = **RCTSET** the receive clock is taken from the Transmitter Signal Element Timing (DCE source) circuit. If **RCVCLK** = **RCRSET** the receive clock is taken from the Receiver Signal Element Timing (DCE source) circuit.

If the **TSETCLK** field has a value of **TSETCOFF** the Transmitter Signal Element Timing (DTE source) circuit is not driven. If **TSETCLK** = **TSETCRBRG** the Transmitter Signal Element Timing (DTE source) circuit is driven by the Receive Baud Rate Generator. If **TSETCLK** = **TSETCTBRG** the Transmitter Signal Element Timing (DTE source) circuit is driven by the Transmit Baud Rate Generator. If **TSETCLK** = **TSETCTSET** the Transmitter Signal Element Timing (DTE source) circuit is driven by the Transmitter Signal Element Timing (DCE source). If **TSETCLK** = **TSETCRBRG** the Transmitter Signal Element Timing (DTE source) circuit is driven by the Receiver Signal Element Timing (DCE source).

If the **RSETCLK** field has a value of **RSETCOFF** the Receiver Signal Element Timing (DTE source) circuit is not driven. If **RSETCLK** = **RSETCRBRG** the Receiver Signal Element Timing (DTE source) circuit is driven by the Receive Baud Rate Generator. If **RSETCLK** = **RSETCTBRG** the Receiver Signal Element Timing (DTE source) circuit is driven by the Transmit Baud Rate Generator. If **RSETCLK** = **RSETCTSET** the Receiver Signal Element Timing (DTE source) circuit is driven by the Transmitter Signal Element Timing (DCE source). If **RSETCLK** = **RSETCRBRG** the Receiver Signal Element Timing (DTE source) circuit is driven by the Receiver Signal Element Timing (DCE source).

The **x_rflag** is reserved for future interface definitions and should not be used by any implementations. The **x_sflag** may be used by local implementations wishing to customize their terminal interface using the **termiox** ioctl system calls.

IOCTLS

The **ioctl**(2) system calls have the form:

ioctl (*fildes, command, arg*)
struct termiox **arg*;

The commands using this form are:

TCGETX
The argument is a pointer to a **termiox** structure. The current terminal parameters are fetched and stored into that structure.

TCSETX
The argument is a pointer to a **termiox** structure. The current terminal parameters are set from the values stored in that structure. The change is immediate.

TCSETXW
The argument is a pointer to a **termiox** structure. The current terminal parameters are set from the values stored in that structure. The change occurs after all characters queued for output have been transmitted. This form should be used when changing parameters that will affect output.

TCSETXF
The argument is a pointer to a **termiox** structure. The current terminal parameters are set from the values stored in that structure. The change occurs after all characters queued for output have been transmitted; all characters queued for input are discarded and then the change occurs.

FILES

/**dev**/*

SEE ALSO

stty(1), **ioctl**(2), **termio**(7)

NAME

ticlts, ticots, ticotsord – loopback transport providers

SYNOPSIS

```
#include <sys/ticlts.h>
#include <sys/ticots.h>
#include <sys/ticotsord.h>
```

DESCRIPTION

The devices known as **ticlts**, **ticots**, and **ticotsord** are ''loopback transport providers,'' that is, stand-alone networks at the transport level. Loopback transport providers are transport providers in every sense except one: only one host (the local machine) is ''connected to'' a loopback network. Loopback transports present a TPI (**STREAMS**-level) interface to application processes and are intended to be accessed via the TLI (application-level) interface. They are implemented as clone devices and support address spaces consisting of ''flex-addresses,'' that is, arbitrary sequences of octets, of length > 0, represented by a **netbuf** structure.

ticlts is a datagram-mode transport provider. It offers (connectionless) service of type **T_CLTS**. Its default address size is **TCL_DEFAULTADDRSZ**. **ticlts** prints the following error messages (see **t_rcvuderr**(3N)):

TCL_BADADDR	bad address specification
TCL_BADOPT	bad option specification
TCL_NOPEER	bound
TCL_PEERBADSTATE	peer in wrong state

ticots is a virtual circuit-mode transport provider. It offers (connection-oriented) service of type **T_COTS**. Its default address size is **TCO_DEFAULTADDRSZ**. **ticots** prints the following disconnect messages (see **t_rcvdis**(3N)):

TCO_NOPEER	no listener on destination address
TCO_PEERNOROOMONQ	peer has no room on connect queue
TCO_PEERBADSTATE	peer in wrong state
TCO_PEERINITIATED	peer-initiated disconnect
TCO_PROVIDERINITIATED	provider-initiated disconnect

ticotsord is a virtual circuit-mode transport provider, offering service of type **T_COTS_ORD** (connection-oriented service with orderly release). Its default address size is **TCOO_DEFAULTADDRSZ**. **ticotsord** prints the following disconnect messages (see **t_rcvdis**(3N)):

TCOO_NOPEER	no listener on destination address
TCOO_PEERNOROOMONQ	peer has no room on connect queue
TCOO_PEERBADSTATE	peer in wrong state
TCOO_PEERINITIATED	peer-initiated disconnect
TCOO_PROVIDERINITIATED	provider-initiated disconnect

USAGE

Loopback transports support a local IPC mechanism through the TLI interface. Applications implemented in a transport provider-independent manner on a client-server model using this IPC are transparently transportable to networked environments.

Transport provider-independent applications must not include the headers listed in the synopsis section above. In particular, the options are (like all transport provider options) provider dependent.

ticlts and **ticots** support the same service types (**T_CLTS** and **T_COTS**) supported by the OSI transport-level model.

ticotsord supports the same service type (**T_COTSORD**) supported by the TCP/IP model.

FILES

/dev/ticlts
/dev/ticots
/dev/ticotsord

SEE ALSO

t_rcvdis(3N), **t_rcvuderr**(3N)

NAME

timod – Transport Interface cooperating STREAMS module

SYNOPSIS

#include <sys/stropts.h>

ioctl(*fildes***, I_STR, &***my_strioctl***);**

DESCRIPTION

timod is a STREAMS module for use with the Transport Interface (TI) functions of the Network Services library. The **timod** module converts a set of **ioctl**(2) calls into STREAMS messages that may be consumed by a transport protocol provider that supports the Transport Interface. This allows a user to initiate certain TI functions as atomic operations.

The **timod** module must be pushed onto only a stream terminated by a transport protocol provider that supports the TI.

All STREAMS messages, with the exception of the message types generated from the **ioctl** commands described below, will be transparently passed to the neighboring module or driver. The messages generated from the following **ioctl** commands are recognized and processed by the **timod** module. The format of the **ioctl** call is:

```
#include <sys/stropts.h>
                -
                -
struct strioctl my_strioctl;
                -
                -
strioctl.ic_cmd = cmd;
strioctl.ic_timout = INFTIM;
strioctl.ic_len = size;
strioctl.ic_dp = (char *)buf
ioctl(fildes, I_STR, &my_strioctl);
```

On issuance, *size* is the size of the appropriate TI message to be sent to the transport provider and on return *size* is the size of the appropriate TI message from the transport provider in response to the issued TI message. *buf* is a pointer to a buffer large enough to hold the contents of the appropriate TI messages. The TI message types are defined in **<sys/tihdr.h>**. The possible values for the *cmd* field are:

TI_BIND Bind an address to the underlying transport protocol provider. The message issued to the **TI_BIND ioctl** is equivalent to the TI message type **T_BIND_REQ** and the message returned by the successful completion of the **ioctl** is equivalent to the TI message type **T_BIND_ACK**.

TI_UNBIND Unbind an address from the underlying transport protocol provider. The message issued to the **TI_UNBIND ioctl** is equivalent to the TI message type **T_UNBIND_REQ** and the message returned by the successful completion of the **ioctl** is equivalent to the TI message type **T_OK_ACK**.

TI_GETINFO Get the TI protocol specific information from the transport protocol provider. The message issued to the **TI_GETINFO ioctl** is equivalent to the TI message type **T_INFO_REQ** and the message returned by the

successful completion of the **ioctl** is equivalent to the TI message type **T_INFO_ACK**.

TI_OPTMGMT Get, set, or negotiate protocol specific options with the transport protocol provider. The message issued to the **TI_OPTMGMT ioctl** is equivalent to the TI message type **T_OPTMGMT_REQ** and the message returned by the successful completion of the **ioctl** is equivalent to the TI message type **T_OPTMGMT_ACK**.

FILES

<sys/timod.h>
<sys/tiuser.h>
<sys/tihdr.h>
<sys/errno.h>

SEE ALSO

intro(2), **tirdwr**(7)

STREAMS Programmer's Guide
Network Interfaces Programmer's Guide

DIAGNOSTICS

If the **ioctl** returns with a value greater than 0, the lower 8 bits of the return value will be one of the TI error codes as defined in **<sys/tiuser.h>**. If the TI error is of type **TSYSERR**, then the next 8 bits of the return value will contain an error as defined in **<sys/errno.h>** (see **intro**(2)).

NAME

tirdwr – Transport Interface read/write interface STREAMS module

SYNOPSIS

int ioctl(*fd,* **I_PUSH**, "**tirdwr**");

DESCRIPTION

tirdwr is a STREAMS module that provides an alternate interface to a transport provider which supports the Transport Interface (TI) functions of the Network Services library (see Section 3N). This alternate interface allows a user to communicate with the transport protocol provider using the **read**(2) and **write**(2) system calls. The **putmsg**(2) and **getmsg**(2) system calls may also be used. However, **putmsg** and **getmsg** can only transfer data messages between user and stream; control portions are disallowed.

The **tirdwr** module must only be pushed (see **I_PUSH** in **streamio**(7)) onto a stream terminated by a transport protocol provider which supports the TI. After the **tirdwr** module has been pushed onto a stream, none of the Transport Interface functions can be used. Subsequent calls to TI functions cause an error on the stream. Once the error is detected, subsequent system calls on the stream return an error with **errno** set to **EPROTO**.

The following are the actions taken by the **tirdwr** module when pushed on the stream, popped (see **I_POP** in **streamio**(7)) off the stream, or when data passes through it.

push When the module is pushed onto a stream, it checks any existing data destined for the user to ensure that only regular data messages are present. It ignores any messages on the stream that relate to process management, such as messages that generate signals to the user processes associated with the stream. If any other messages are present, the **I_PUSH** will return an error with **errno** set to **EPROTO**.

write The module takes the following actions on data that originated from a **write** system call:

All messages with the exception of messages that contain control portions (see the **putmsg** and **getmsg** system calls) are transparently passed onto the module's downstream neighbor.

Any zero length data messages are freed by the module and they will not be passed onto the module's downstream neighbor.

Any messages with control portions generate an error, and any further system calls associated with the stream fails with **errno** set to **EPROTO**.

read The module takes the following actions on data that originated from the transport protocol provider:

All messages with the exception of those that contain control portions (see the **putmsg** and **getmsg** system calls) are transparently passed onto the module's upstream neighbor.

The action taken on messages with control portions will be as follows:

Messages that represent expedited data generate an error. All further system calls associated with the stream fail with **errno** set to **EPROTO**.

Any data messages with control portions have the control portions removed from the message before to passing the message on to the upstream neighbor.

Messages that represent an orderly release indication from the transport provider generate a zero length data message, indicating the end of file, which will be sent to the reader of the stream. The orderly release message itself is freed by the module.

Messages that represent an abortive disconnect indication from the transport provider cause all further **write** and **putmsg** system calls to fail with **errno** set to **ENXIO**. All further **read** and **getmsg** system calls return zero length data (indicating end of file) once all previous data has been read.

With the exception of the above rules, all other messages with control portions generate an error and all further system calls associated with the stream will fail with **errno** set to **EPROTO**.

Any zero length data messages are freed by the module and they are not passed onto the module's upstream neighbor.

pop When the module is popped off the stream or the stream is closed, the module takes the following action:

If an orderly release indication has been previously received, then an orderly release request will be sent to the remote side of the transport connection.

SEE ALSO

intro(2), **getmsg**(2), **putmsg**(2), **read**(2), **write**(2), **intro**(3), **streamio**(7), **timod**(7)

STREAMS Programmer's Guide
Network Interfaces Programmer's Guide

NAME

tmpfs – memory based filesystem

SYNOPSIS

#include <sys/mount.h>
mount (*special***,** *directory***, MS_DATA, "tmpfs", NULL, 0);**

DESCRIPTION

tmpfs is a memory based filesystem which uses kernel resources relating to the VM system and page cache as a filesystem. Once mounted, a **tmpfs** filesystem provides standard file operations and semantics. **tmpfs** is so named because files and directories are not preserved across reboot or unmounts, all files residing on a **tmpfs** filesystem that is unmounted will be lost.

tmpfs filesystems can be mounted with the command:

mount –F tmpfs swap *directory*

Alternatively, to mount a **tmpfs** filesystem on **/tmp** at multi-user startup time (and maximizing possible performance improvements), add the following line to **/etc/vfstab**:

swap – /tmp tmpfs – yes –

tmpfs is designed as a performance enhancement which is achieved by caching the writes to files residing on a **tmpfs** filesystem. Performance improvements are most noticeable when a large number of short lived files are written and accessed on a **tmpfs** filesystem. Large compilations with **tmpfs** mounted on **/tmp** are a good example of this.

Users of **tmpfs** should be aware of some constraints involved in mounting a **tmpfs** filesystem. The resources used by **tmpfs** are the same as those used when commands are executed (for example, swap space allocation). This means that large sized **tmpfs** files can affect the amount of space left over for programs to execute. Likewise, programs requiring large amounts of memory use up the space available to **tmpfs**. Users running into this constraint (for example, running out of space on **tmpfs**) can allocate more swap space by using the **swap**(1M) command.

Another constraint is that the number of files available in a **tmpfs** filesystem is calculated based on the physical memory of the machine and not the size of the swap device / partition. If you have too many files, **tmpfs** will print a warning message and you will be unable to create new files. You cannot increase this limit by adding swap space.

Normal filesystem writes are scheduled to be written to a permanent storage medium along with all control information associated with the file (for example, modification time, file permissions). **tmpfs** control information resides only in memory and never needs to be written to permanent storage. File data remains in core until memory demands are sufficient to cause pages associated with **tmpfs** to be reused at which time they are copied out to swap.

An additional mount option can be specified to control the size of an individual **tmpfs** filesystem.

SEE ALSO

df(1M), **mount**(1M), **mount_tmpfs**(1M), **swap**(1M), **mmap**(2), **mount**(2), **umount**(2), **vfstab**(4)

File System Administration

DIAGNOSTICS

If **tmpfs** runs out of space, one of the following messages will be printed to the console.

directory: **File system full, swap space limit exceeded**
This message is printed because a page could not be allocated while writing to a file. This can occur if **tmpfs** is attempting to write more than it is allowed, or if currently executing programs are using a lot of memory. To make more space available, remove unnecessary files, exit from some programs, or allocate more swap space using **swap**(1M).

directory: **File system full, memory allocation failed.**
tmpfs ran out of physical memory while attempting to create a new file or directory. Remove unnecessary files or directories or install more physical memory.

WARNINGS

Files and directories on a **tmpfs** filesystem are not preserved across reboots or unmounts. Command scripts or programs which count on this will not work as expected.

NOTES

Compilers do not necessarily use **/tmp** to write intermediate files therefore missing some significant performance benefits. This can be remedied by setting the environment variable **TMPDIR** to **/tmp**. Compilers use the value in this environment variable as the name of the directory to store intermediate files.

swap to a **tmpfs** file is not supported.

df(1M) output is of limited accuracy since a **tmpfs** filesystem size is not static and the space available to **tmpfs** is dependent on the swap space demands of the entire system.

NAME

tr – IBM 16/4 Token Ring Network Adapter device driver

SYNOPSIS

```
#include <sys/stropts.h>
#include <sys/ethernet.h>
#include <sys/dlpi.h>
```

AVAILABILITY

x86

DESCRIPTION

The **tr** token ring driver is a multi-threaded, loadable, clonable, STREAMS hardware driver supporting the connectionless Data Link Provider Interface, **dlpi**(7), over IBM 16/4 Token Ring adapters. The driver supports installation of both a primary and secondary 16/4 Adapter within the system. The **tr** driver provides basic support for the IBM 16/4 Adapter hardware. Functions include chip initialization, frame transmit and receive, functional addresses, and "promiscuous" support, and error recovery and reporting.

The cloning, character-special device **/dev/tr** is used to access all 16/4 adapter devices installed within the system.

The **tr** driver is a "style 2" Data Link Service provider. All **M_PROTO** and **M_PCPROTO** type messages are interpreted as **DLPI** primitives. An explicit **DL_ATTACH_REQ** message by the user is required to associate the opened stream with a particular device (**ppa**). The **ppa** ID is interpreted as an unsigned long integer and indicates the corresponding device instance (unit) number. The unit numbers are assigned sequentially to each board found. The search order is determined by the order defined in the **/kernel/drv/tr.conf** file. An error (**DL_ERROR_ACK**) is returned by the driver if the **ppa** field value does not correspond to a valid device instance number for this system. The device is initialized on first attach and de-initialized (stopped) on last detach.

The values returned by the driver in the **DL_INFO_ACK** primitive in response to the **DL_INFO_REQ** from the user are as follows:

- The maximum SDU is **4084**.
- The minimum SDU is **0**.
- The **dlsap** address length is **7** or **8** bytes.
- The MAC type is **DL_TPR**.
- The **sap** length value is **–1** or **–2**, meaning the physical address component is followed immediately by a 1 or 2-byte **sap** component within the **DLSAP** address.
- The service mode is **DL_CLDLS**.
- No optional quality of service (QOS) support is included at present, so the QOS fields are **0**.
- The provider style is **DL_STYLE2**.
- The version is **DL_VERSION_2**.
- The broadcast address value is the IEEE broadcast address (FF:FF:FF:FF:FF:FF).

The token ring broadcast address (C0:00:FF:FF:FF:FF) is also supported.

Once in the **DL_ATTACHED** state, the user must send a **DL_BIND_REQ** to associate a particular Service Access Pointer (SAP) with the stream. The **tr** driver interprets the **sap** field within the **DL_BIND_REQ** as an IEEE 802.2 **sap**; therefore valid values for the **sap** field are in the **[0-0xFF]** range, of which only even values are legal.

In addition to 802.2 service, a "SNAP mode" is also provided by the driver. In this mode, **sap** values in the range **[0x5de-0xffff]** are used to indicate a request to use "SNAP" mode.

The **tr** driver **DLSAP** address format consists of the 6-byte physical token ring address component followed immediately by the 1 or 2-byte **sap** component, producing a 7 or 8-byte **DLSAP** address. Applications should *not* hardcode to this particular implementation-specific **DLSAP** address format, but should instead use information returned by the **DL_INFO_ACK** primitive to compose and decompose **DLSAP** addresses. The **sap** length, full **DLSAP** length, and **sap** / physical ordering are included within the **DL_INFO_ACK**. The physical address length can be computed by subtracting the **sap** length from the full **DLSAP** address length or by issuing the **DL_PHYS_ADDR_REQ** to obtain the current physical address associated with the stream.

Once in the **DL_BOUND** state, the user may transmit frames on the token ring by sending **DL_UNITDATA_REQ** messages to the **tr** driver. The **tr** driver will route received token ring frames up all open and bound streams that have a **sap** which matches the sap in the **DL_UNITDATA_IND** messages. Received token ring frames are duplicated and routed up multiple open streams if necessary. The **DLSAP** address contained within the **DL_UNITDATA_REQ** and **DL_UNITDATA_IND** messages consists of both the **sap** and physical (token ring) components.

tr Primitives

In addition to the mandatory connectionless **DLPI** message set, the driver also supports the following primitives:

The **DL_ENABMULTI_REQ** and **DL_DISABMULTI_REQ** primitives enable / disable reception of individual multicast group addresses. A set of multicast addresses may be iteratively created and modified on a per-stream basis using these primitives. These primitives are accepted by the driver in any state following **DL_ATTACHED**.

The **DL_PROMISCON_REQ** and **DL_PROMISCOFF_REQ** primitives with the **DL_PROMISC_PHYS** flag set in the **dl_level** field is currently unsupported for this driver.

When used with the **DL_PROMISC_SAP** flag set, this enables / disables reception of all **sap** values. When used with the **DL_PROMISC_MULTI** flag set, this enables / disables reception of all functional addresses. The effect of each is always on a per-stream basis and independent of the other **sap** and physical level configurations on this stream or other streams.

The **DL_PHYS_ADDR_REQ** primitive returns the 6-octet token ring address currently associated (attached) to the stream in the **DL_PHYS_ADDR_ACK** primitive. This primitive is valid only in states following a successful **DL_ATTACH_REQ**.

The **DL_SET_PHYS_ADDR_REQ** primitive changes the 6-octet token ring address currently associated (attached) to this stream. The credentials of the process which originally opened this stream must be superuser or an **EPERM** error is returned in the **DL_ERROR_ACK**. This primitive is destructive in that it affects all other current and future streams attached to this device. Once changed, all streams subsequently opened and attached to this device will obtain this new physical address. The new physical address will remain in effect until this primitive is used to change the physical address again or the system is rebooted, whichever comes first.

CONFIGURATION

The **/kernel/drv/tr.conf** file supports the following options:

intr Specifies the IRQ level for the board. Note that if the dip switches for the board are set to use the cascade interrupt, IRQ 2, the IRQ level specified in the configuration file should be IRQ 9.

ioaddr Specifies the beginning I/O port address occupied by the board.

reg The first register property specifies the location and size of the board's BIOS/MMIO area. The second register property specifies the location and size of the board's shared RAM.

It is important to ensure that there are no conflicts for the board's I/O port, shared RAM, or IRQ level.

FILES

/dev/tr

/kernel/drv/tr.conf **tr** configuration file.

SEE ALSO

dlpi(7)

NOTE

IBM 16/4 Token Ring Network Adapters and compatibles are not capable of fully supporting the **snoop**(1) program. This limitation is due to the hardware itself and not to a bug in the **tr** driver or the **snoop** program.

NAME

ttcompat – V7, 4BSD and XENIX STREAMS compatibility module

SYNOPSIS

```
#include <sys/stream.h>
#include <stropts.h> /*fixed by epg */
#include <sys/ttold.h>
#include <sys/ttcompat.h>

ioctl( fd, I_PUSH, "ttcompat");
```

DESCRIPTION

ttcompat is a STREAMS module that translates the **ioctl** calls supported by the older **Version 7, 4BSD,** and **XENIX** terminal drivers into the **ioctl** calls supported by the **termio** interface (see **termio**(7)). All other messages pass through this module unchanged; the behavior of **read** and **write** calls is unchanged, as is the behavior of **ioctl** calls other than the ones supported by **ttcompat**.

This module can be automatically pushed onto a stream using the **autopush** mechanism when a terminal device is opened; it does not have to be explicitly pushed onto a stream. This module requires that the **termios** interface be supported by the modules and the application can push the driver downstream. The **TCGETS, TCSETS,** and **TCSETSF ioctl** calls must be supported. If any information set or fetched by those **ioctl** calls is not supported by the modules and driver downstream, some of the **V7/4BSD/XENIX** functions may not be supported. For example, if the **CBAUD** bits in the **c_cflag** field are not supported, the functions provided by the **sg_ispeed** and **sg_ospeed** fields of the **sgttyb** structure (see below) will not be supported. If the **TCFLSH ioctl** is not supported, the function provided by the **TIOCFLUSH ioctl** will not be supported. If the **TCXONC ioctl** is not supported, the functions provided by the **TIOCSTOP** and **TIOCSTART ioctl** calls will not be supported. If the **TIOCMBIS** and **TIOCMBIC ioctl** calls are not supported, the functions provided by the **TIOCSDTR** and **TIOCCDTR ioctl** calls will not be supported.

The basic **ioctl** calls use the **sgttyb** structure defined by **<sys/ttold.h>**:

```
struct  sgttyb  {
        char    sg_ispeed;
        char    sg_ospeed;
        char    sg_erase;
        char    sg_kill;
        int     sg_flags;
};
```

The **sg_ispeed** and **sg_ospeed** fields describe the input and output speeds of the device, and reflect the values in the **c_cflag** field of the **termios** structure. The **sg_erase** and **sg_kill** fields of the argument structure specify the erase and kill characters respectively, and reflect the values in the **VERASE** and **VKILL** members of the **c_cc** field of the **termios** structure.

The **sg_flags** field of the argument structure contains several flags that determine the system's treatment of the terminal. They are mapped into flags in fields of the terminal state, represented by the **termios** structure.

Delay type **0** is always mapped into the equivalent delay type **0** in the **c_oflag** field of the **termios** structure. Other delay mappings are performed as follows:

sg_flags	c_oflag
BS1	**BS1**
FF1	**VT1**
CR1	**CR2**
CR2	**CR3**
CR3	not supported
TAB1	**TAB1**
TAB2	**TAB2**
XTABS	**TAB3**
NL1	**ONLRET|CR1**
NL2	**NL1**

If previous **TIOCLSET** or **TIOCLBIS ioctl** calls have not selected **LITOUT** or **PASS8** mode, and if **RAW** mode is not selected, then the **ISTRIP** flag is set in the **c_iflag** field of the **termios** structure, and the **EVENP** and **ODDP** flags control the parity of characters sent to the terminal and accepted from the terminal.

Parity is not to be generated on output or checked on input. The character size is set to **CS8** and the flag is cleared in the **c_cflag** field of the **termios** structure.

Even parity characters are to be generated on output and accepted on input. The flag is set in the **c_iflag** field of the **termios** structure, the character size is set to **CS7** and the flag is set in the **c_cflag** field of the **termios** structure.

Odd parity characters are to be generated on output and accepted on input. The flag is set in the **c_iflag** field, the character size is set to **CS7** and the flags are set in the **c_cflag** field of the **termios** structure.

Even parity characters are to be generated on output and characters of either parity are to be accepted on input. The flag is cleared in the **c_iflag** field, the character size is set to **CS7** and the flag is set in the **c_cflag** field of the **termios** structure.

The **RAW** flag disables all output processing (the **OPOST** flag in the **c_oflag** field, and the **XCASE** flag in the **c_lflag** field, are cleared in the **termios** structure) and input processing (all flags in the **c_iflag** field other than the **IXOFF** and **IXANY** flags are cleared in the **termios** structure). 8 bits of data, with no parity bit, are accepted on input and generated on output; the character size is set to **CS8** and the **PARENB** and **PARODD** flags are cleared in the **c_cflag** field of the **termios** structure. The signal-generating and line-editing control characters are disabled by clearing the **ISIG** and **ICANON** flags in the **c_lflag** field of the **termios** structure.

The **CRMOD** flag turns input RETURN characters into NEWLINE characters, and output and echoed NEWLINE characters to be output as a RETURN followed by a LINEFEED. The **ICRNL** flag in the **c_iflag** field, and the **OPOST** and **ONLCR** flags in the **c_oflag** field, are set in the **termios** structure.

The **LCASE** flag maps upper-case letters in the ASCII character set to their lower-case equivalents on input (the **IUCLC** flag is set in the **c_iflag** field), and maps lower-case letters in the ASCII character set to their upper-case equivalents on output (the **OLCUC** flag is set in the **c_oflag** field). Escape sequences are accepted on input, and generated on output, to handle certain ASCII characters not supported by older terminals (the **XCASE** flag is set in the **c_lflag** field).

Other flags are directly mapped to flags in the **termios** structure:

sg_flags	flags in **termios** structure
CBREAK	complement of **ICANON** in **c_lflag** field
ECHO	**ECHO** in **c_lflag** field
TANDEM	**IXOFF** in **c_iflag** field

Another structure associated with each terminal specifies characters that are special in both the old Version 7 and the newer **4BSD** terminal interfaces. The following structure is defined by **<sys/ttold.h>**:

```
struct   tchars  {
        char        t_intrc;        /* interrupt */
        char        t_quitc;        /* quit */
        char        t_startc;       /* start output */
        char        t_stopc;        /* stop output */
        char        t_eofc;         /* end-of-file */
        char        t_brkc;         /* input delimiter (like nl) */
};
```

XENIX defines the **tchar** structure as **tc**. The characters are mapped to members of the **c_cc** field of the **termios** structure as follows:

tchars	**c_cc** index
t_intrc	**VINTR**
t_quitc	**VQUIT**
t_startc	**VSTART**
t_stopc	**VSTOP**
t_eofc	**VEOF**
t_brkc	**VEOL**

Also associated with each terminal is a local flag word, specifying flags supported by the new **4BSD** terminal interface. Most of these flags are directly mapped to flags in the **termios** structure:

local flags	flags in **termios** structure
LCRTBS	not supported
LPRTERA	**ECHOPRT** in the **c_lflag** field
LCRTERA	**ECHOE** in the **c_lflag** field
LTILDE	not supported
LTOSTOP	**TOSTOP** in the **c_lflag** field
LFLUSHO	**FLUSHO** in the **c_lflag** field
LNOHANG	**CLOCAL** in the **c_cflag** field
LCRTKIL	**ECHOKE** in the **c_lflag** field
LCTLECH	**CTLECH** in the **c_lflag** field
LPENDIN	**PENDIN** in the **c_lflag** field
LDECCTQ	complement of **IXANY** in the **c_iflag** field
LNOFLSH	**NOFLSH** in the **c_lflag** field

Another structure associated with each terminal is the **ltchars** structure which defines control characters for the new **4BSD** terminal interface. Its structure is:

```
struct ltchars {
        char    t_suspc;    /* stop process signal */
        char    t_dsuspc;   /* delayed stop process signal */
        char    t_rprntc;   /* reprint line */
        char    t_flushc;   /* flush output (toggles) */
        char    t_werasc;   /* word erase */
        char    t_lnextc;   /* literal next character */
};
```

The characters are mapped to members of the **c_cc** field of the **termios** structure as follows:

ltchars	**c_cc** index
t_suspc	**VSUSP**
t_dsuspc	**VDSUSP**
t_rprntc	**VREPRINT**
t_flushc	**VDISCARD**
t_werasc	**VWERASE**
t_lnextc	**VLNEXT**

IOCTLS

ttcompat responds to the following **ioctl** calls. All others are passed to the module below.

TIOCGETP The argument is a pointer to an **sgttyb** structure. The current terminal state is fetched; the appropriate characters in the terminal state are stored in that structure, as are the input and output speeds. The values of the flags in the **sg_flags** field are derived from the flags in the terminal state and stored in the structure.

TIOCEXCL Set ''exclusive-use'' mode; no further opens are permitted until the file has been closed.

TIOCNXCL Turn off ''exclusive-use'' mode.

TIOCSETP The argument is a pointer to an **sgttyb** structure. The appropriate characters and input and output speeds in the terminal state are set from the values in that structure, and the flags in the terminal state are set to match the values of the flags in the **sg_flags** field of that structure. The state is changed with a **TCSETSF ioctl** so that the interface delays until output is quiescent, then throws away any unread characters, before changing the modes.

TIOCSETN The argument is a pointer to an **sgttyb** structure. The terminal state is changed as **TIOCSETP** would change it, but a **TCSETS ioctl** is used, so that the interface neither delays nor discards input.

TIOCHPCL The argument is ignored. The **HUPCL** flag is set in the **c_cflag** word of the terminal state.

TIOCFLUSH The argument is a pointer to an **int** variable. If its value is zero, all characters waiting in input or output queues are flushed. Otherwise, the value of the **int** is treated as the logical **OR** of the **FREAD** and **FWRITE** flags defined by **<sys/file.h>**. If the **FREAD** bit is set, all characters waiting in input queues are flushed, and if the **FWRITE** bit is set, all characters waiting in output queues are flushed.

TIOCBRK The argument is ignored. The break bit is set for the device.

TIOCCBRK The argument is ignored. The break bit is cleared for the device.

TIOCSDTR The argument is ignored. The Data Terminal Ready bit is set for the device.

TIOCCDTR The argument is ignored. The Data Terminal Ready bit is cleared for the device.

TIOCSTOP The argument is ignored. Output is stopped as if the STOP character had been typed.

TIOCSTART The argument is ignored. Output is restarted as if the START character had been typed.

TIOCGETC The argument is a pointer to a **tchars** structure. The current terminal state is fetched, and the appropriate characters in the terminal state are stored in that structure.

TIOCSETC The argument is a pointer to a **tchars** structure. The values of the appropriate characters in the terminal state are set from the characters in that structure.

TIOCLGET The argument is a pointer to an **int**. The current terminal state is fetched, and the values of the local flags are derived from the flags in the terminal state and stored in the **int** pointed to by the argument.

TIOCLBIS The argument is a pointer to an **int** whose value is a mask containing flags to be set in the local flags word. The current terminal state is fetched, and the values of the local flags are derived from the flags in the terminal state; the specified flags are set, and the flags in the terminal state are set to match the new value of the local flags word.

TIOCLBIC The argument is a pointer to an **int** whose value is a mask containing flags to be cleared in the local flags word. The current terminal state is fetched, and the values of the local flags are derived from the flags in the terminal state; the specified flags are cleared, and the flags in the terminal state are set to match the new value of the local flags word.

TIOCLSET The argument is a pointer to an **int** containing a new set of local flags. The flags in the terminal state are set to match the new value of the local flags word.

TIOCGLTC The argument is a pointer to an **ltchars** structure. The values of the appropriate characters in the terminal state are stored in that structure.

TIOCSLTC The argument is a pointer to an **ltchars** structure. The values of the appropriate characters in the terminal state are set from the characters in that structure.

FIORDCHK Returns the number of immediately readable characters. The argument is ignored.

FIONREAD Returns the number of immediately readable characters in the **int** pointed to by the argument.

LDSMAP Calls the function **emsetmap** (*tp*, *mp*) if the function is configured in the kernel.

LDGMAP Calls the function **emgetmap** (*tp*, *mp*) if the function is configured in the kernel.

LDNMAP Calls the function **emunmap** (*tp*, *mp*) if the function is configured in the kernel.

The following **ioctls** are returned as successful for the sake of compatibility. However, nothing significant is done (that is, the state of the terminal is not changed in any way).

TIOCSETD	**LDOPEN**
TIOCGETD	**LDCLOSE**
DIOCSETP	**LDCHG**
DIOCSETP	**LDSETT**
DIIOGETP	**LDGETT**

SEE ALSO

ioctl(2), **termios**(3), **ldterm**(7), **termio**(7)

NOTES

TIOCBRK and **TIOCCBRK** should be handled by the driver. **FIONREAD** and **FIORDCHK** are handled in the stream head.

NAME

tty – controlling terminal interface

DESCRIPTION

The file **/dev/tty** is, in each process, a synonym for the control terminal associated with the process group of that process, if any. It is useful for programs or shell sequences that wish to be sure of writing messages on the terminal no matter how output has been redirected. It can also be used for programs that demand the name of a file for output, when typed output is desired and it is tiresome to find out what terminal is currently in use.

FILES

/dev/tty
/dev/tty*

SEE ALSO

ports(1M), **console**(7)

NAME

udp, UDP – Internet User Datagram Protocol

SYNOPSIS

```
#include <sys/socket.h>
#include <netinet/in.h>
s = socket(AF_INET, SOCK_DGRAM, 0);
t = t_open("/dev/udp", O_RDWR);
```

DESCRIPTION

UDP is a simple datagram protocol which is layered directly above the Internet Protocol (IP). Programs may access UDP using the socket interface, where it supports the **SOCK_DGRAM** socket type, or using the Transport Level Interface (TLI), where it supports the connectionless (**T_CLTS**) service type.

Within the socket interface, UDP is normally used with the **sendto( )**, **sendmsg( )**, **recvfrom( )**, and **recvmsg( )** calls (see **send**(3N) and **recv**(3N)). If the **connect**(3N) call is used to fix the destination for future packets, then the **recv**(3N) or **read**(2) and **send**(3N) or **write**(2) calls may be used.

UDP address formats are identical to those used by the Transmission Control Protocol (TCP). Like TCP, UDP uses a port number along with an IP address to identify the endpoint of communication. The UDP port number space is separate from the TCP port number space (that is, a UDP port may not be "connected" to a TCP port). The **bind**(3N) call can be used to set the local address and port number of a UDP socket. The local IP address may be left unspecified in the **bind( )** call by using the special value **INADDR_ANY**. If the **bind( )** call is not done, a local IP address and port number will be assigned to the endpoint when the first packet is sent. Broadcast packets may be sent (assuming the underlying network supports this) by using a reserved "broadcast address"; This address is network interface dependent. Broadcasts may only be sent by the privileged user.

Options at the IP level may be used with UDP; see **ip**(7).

There are a variety of ways that a UDP packet can be lost or corrupted, including a failure of the underlying communication mechanism. UDP implements a checksum over the data portion of the packet. If the checksum of a received packet is in error, the packet will be dropped with no indication given to the user. A queue of received packets is provided for each UDP socket. This queue has a limited capacity. Arriving datagrams which will not fit within its *high-water* capacity are silently discarded.

UDP processes Internet Control Message Protocol (ICMP) error messages received in response to UDP packets it has sent. See **icmp**(7). ICMP "source quench" messages are ignored. ICMP "destination unreachable," "time exceeded" and "parameter problem" messages disconnect the socket from its peer so that subsequent attempts to send packets using that socket will return an error. UDP will not guarantee that packets are delivered in the order they were sent. As well, duplicate packets may be generated in the communication process.

SEE ALSO

read(2), **write**(2), **bind**(3N), **connect**(3N), **recv**(3N), **send**(3N), **icmp**(7), **inet**(7), **ip**(7), **tcp**(7)

Postel, Jon, *User Datagram Protocol*, RFC 768, Network Information Center, SRI International, Menlo Park, Calif., August 1980

DIAGNOSTICS

A socket operation may fail if:

EISCONN	A **connect()** operation was attempted on a socket on which a **connect()** operation had already been performed, and the socket could not be successfully disconnected before making the new connection.
EISCONN	A **sendto()** or **sendmsg()** operation specifying an address to which the message should be sent was attempted on a socket on which a **connect()** operation had already been performed.
ENOTCONN	A **send()** or **write()** operation, or a **sendto()** or **sendmsg()** operation not specifying an address to which the message should be sent, was attempted on a socket on which a **connect()** operation had not already been performed.
EADDRINUSE	A **bind()** operation was attempted on a socket with a network address/port pair that has already been bound to another socket.
EADDRNOTAVAIL	A **bind()** operation was attempted on a socket with a network address for which no network interface exists.
EINVAL	A **sendmsg()** operation with a non-NULL **msg_accrights** was attempted.
EACCES	A **bind()** operation was attempted with a "reserved" port number and the effective user ID of the process was not the privileged user.
ENOBUFS	The system ran out of memory for internal data structures.

NAME

visual_io – Solaris VISUAL I/O control operations

SYNOPSIS

#include <sys/visual_io.h>

DESCRIPTION

The Solaris VISUAL environment defines a small set of ioctls for controlling graphics and imaging devices.

One ioctl, **VIS_GETIDENTIFIER,** is mandatory, and must be implemented in device drivers for graphics devices using the Solaris VISUAL environment. The **VIS_GETIDENTIFIER,** ioctl is defined to return a device identifier from the device driver. This identifier must be a uniquely-defined string.

Another set of ioctls supports mouse tracking via hardware cursor operations. These are optional, but if a graphics device has hardware cursor support and implements these ioctls the mouse tracking performance will be improved.

IOCTLS

VIS_GETIDENTIFIER

This ioctl returns an identifier string to uniquely identify a device used in the Solaris VISUAL environment. This is a mandatory ioctl and must return a unique string. **VIS_GETIDENTIFIER** takes a **vis_identifier** structure as its parameter. This structure has the form:

```
#define VIS_MAXNAMELEN 128

struct vis_identifier {
        char name[VIS_MAXNAMELEN];
};
```

We suggest the name be formed as <*companysymbol*><*devicetype*>. For example, the cgsix driver returns **SUNWcg6 .**

VIS_GETCURSOR

VIS_SETCURSOR

These ioctls fetch and set various cursor attributes, using the **vis_cursor** structure.

```
struct vis_cursorpos {
    short       x;          /* cursor x coordinate */
    short       y;          /* cursor y coordinate */
};

struct vis_cursorcmap {
    int         version;    /* version */
    int         reserved;
    unsigned char *red;     /* red color map elements */
    unsigned char *green;   /* green color map elements */
    unsigned char *blue;    /* blue color map elements */
};
```

```
#define VIS_CURSOR_SETCURSOR        0x01    /* set cursor */
#define VIS_CURSOR_SETPOSITION      0x02    /* set cursor position */
#define VIS_CURSOR_SETHOTSPOT       0x04    /* set cursor hot spot */
#define VIS_CURSOR_SETCOLORMAP      0x08    /* set cursor colormap */
#define VIS_CURSOR_SETSHAPE         0x10    /* set cursor shape */

#define VIS_CURSOR_SETALL           (VIS_CURSOR_SETCURSOR | \
                                    VIS_CURSOR_SETPOSITION | \
                                    VIS_CURSOR_SETHOTSPOT | \
                                    VIS_CURSOR_SETCOLORMAP | \
                                    VIS_CURSOR_SETSHAPE)

struct vis_cursor {
        short                   set;        /* what to set */
        short                   enable;     /* cursor on/off */
        struct vis_cursorpos    pos;        /* cursor position */
        struct vis_cursorpos    hot;        /* cursor hot spot */
        struct vis_cursorcmap   cmap;       /* color map info */
        struct vis_cursorpos    size;       /* cursor bit map size */
        char                    *image;     /* cursor image bits */
        char                    *mask;      /* cursor mask bits */
};
```

The **vis_cursorcmap** structure should contain pointers to two elements, specifying the red, green, and blue values for foreground and background.

VIS_MOVECURSOR

VIS_SETCURSORPOS

These ioctls fetch and move the current cursor position, using the **vis_cursorpos** structure.

NAME

volfs – Volume Management file system

DESCRIPTION

volfs is the Volume Management file system rooted at *root_dir*. The default file system name is **/vol**. The Volume Management daemon, **vold**(1M), creates and maintains the **/vol** file system.

Media can be accessed in a logical manner (no association with a particular piece of hardware), or a physical manner (associated with a particular piece of hardware).

Logical names for media are referred to through **/vol/dsk** and **/vol/rdsk**. **/vol/dsk** provides block access to random access devices. **/vol/rdsk** provides character access to random access devices.

The **/vol/rdsk** and **/vol/dsk** directories are mirrors of one another. Any change to one is reflected in the other immediately. The **dev_t** for a volume will be the same for both the block and character device.

The default permissions for **/vol** are **mode=0555**, **owner=root**, **group=sys**. The default permissions for **/vol/dsk** and **/vol/rdsk** are **mode=01777**, **owner=root**, **group=sys**.

Physical references to media are obtained through **/vol/dev**. This hierarchy reflects the structure of the **/dev** name space. The default permissions for all directories in the **/vol/dev** hierarchy are **mode=0555**, **owner=root**, **group=sys**.

mkdir(2), **rmdir**(2), **unlink**(2) (**rm**), **symlink**(2) (**ln** –**s**), **link**(2) (**ln**), and **rename**(2) (**mv**) are supported, subject to normal file and directory permissions.

The following system calls are not supported in the **/vol** filesystem: **creat**(2), only when creating a file, and **mknod**(2).

If the media does not contain file systems that can be automatically mounted by **rmmount**(1M), users can gain access to the media through the following **/vol** locations.

Location	State of Media
/vol/dev/diskette0/unnamed_floppy	formatted unnamed floppy-block device access
/vol/dev/rdiskette0/unnamed_floppy	formatted unnamed floppy-raw device access
/vol/dev/diskette0/unlabeled	unlabeled floppy-block device access
/vol/dev/rdiskette0/unlabeled	unlabeled floppy-raw device access
/vol/dev/dsk/c0t6/unnamed_cdrom	CD-ROM-block device access
/vol/dev/rdsk/c0t6/unnamed_cdrom	CD-ROM-raw device access

For more information on the location of CD-ROM and floppy media, see *Peripherals Administration* or **rmmount**(1M).

Partitions

Some media supports the concept of a partition. If the label identifies partitions on the media, the name of the media will become a directory with partitions under it. Only valid partitions are represented. Partitions cannot be moved out of a directory.

Example: disk volume '**foo**' has 3 valid partitions: 0, 2, 5.
/vol/dsk/foo/s0, /vol/dsk/foo/s2, /vol/dsk/foo/s5,
/vol/rdsk/foo/s0, /vol/rdsk/foo/s2, /vol/rdsk/foo/s5

If a volume is relabeled to reflect different partitions, the name space changes to reflect the new partition layout.

A format program can check to see if there are others with the volume open and not allow the format to occur if it is. Volume Management, however, does not explicitly prevent the rewriting of a label while others have the volume open. If a partition of a volume is open, and the volume is relabeled to remove that partition, it will appear exactly as if the volume were missing. A notify event will be generated and the user may cancel the operation with **volcancel**(1), if desired.

SEE ALSO

volcancel(1), **volcheck**(1), **volmissing**(1) **rmmount**(1M), **vold**(1M), **rmmount.conf**(4), **vold.conf**(4),

File System Administration
Peripherals Administration

NAME

vuidmice, vuidm3p, vuidm4p, vuidm5p, vuid2ps2, vuid3ps2 – converts mouse protocol to Firm Events

SYNOPSIS

```
#include <sys/stream.h>
#include <sys/vuid_event.h>
int ioctl(fd, I_PUSH, vuidm3p);
int ioctl(fd, I_PUSH, vuidm4p);
int ioctl(fd, I_PUSH, vuidm5p);
int ioctl(fd, I_PUSH, vuid2ps2);
int ioctl(fd, I_PUSH, vuid3ps2);
```

AVAILABILITY

x86

DESCRIPTION

The STREAMS modules **vuidm3p**, **vuidm4p**, **vuidm5p**, **vuid2ps2**, and **vuid3ps2** convert mouse protocols to Firm events. The Firm event structure is described in **<sys/vuid_event.h>**. Pushing a STREAMS module does not automatically enable mouse protocol conversion to Firm events. The STREAMS module state is initially set to raw or **VUID_NATIVE** mode which performs *no* message processing. The user will need to change the state to **VUID_FIRM_EVENT** mode in order to initiate mouse protocol conversion to Firm events. This can be accomplished by the following code:

```
int format;

format = VUID_FIRM_EVENT;
ioctl(fd, VUIDSFORMAT, &format);
```

The user can also query the state of the STREAMS module by using the **VUIDGFORMAT** option.

```
int format;

int fd;  /* file descriptor */

ioctl(fd, VUIDGFORMAT, &format);

if ( format == VUID_NATIVE );
        /* The state of the module is in raw mode.
         * Message processing is not enabled.
         */

if ( format == VUID_FIRM_EVENT );
        /* Message processing is enabled.
         * Mouse protocol conversion to Firm events
         * are performed.
```

The remainder of this section describes the processing of STREAMS messages on the read- and write-side.

Read Side Behavior

M_DATA The messages coming in are queued and converted to Firm events.

M_FLUSH The read queue of the module is flushed of all its data messages and all data in the record being accumulated are also flushed. The message is passed upstream.

Write Side Behavior

M_IOCTL messages sent downstream as a result of an **ioctl**(2) system call. There are two valid **ioctl** options processed by the **vuidmice** modules **VUIDGFORMAT** and **VUIDSFORMAT**.

VUIDGFORMAT This option returns the current state of the STREAMS module. The state of the **vuidmice** STREAMS module may either be **VUID_NATIVE** (no message processing) or **VUID_FIRM_EVENT** (convert to Firm events).

VUIDSFORMAT This option sets the state of the STREAMS module to **VUID_FIRM_EVENT**. If the state of the STREAMS module is already in **VUID_FIRM_EVENT** then this option is non-operational.

It is not possible to set the state back to **VUID_NATIVE** once the state becomes **VUID_FIRM_EVENT**. To disable message processing, pop the STREAMS module out by calling **ioctl(fd, 1I_POP, vuid*)**.

M_FLUSH The write queue of the module is flushed of all its data messages and the message is passed downstream.

Mouse Configurations

Module	Protocol Type	Device
vuidm3p	3-Byte Protocol Microsoft 2 Button Serial Mouse	**/dev/tty***
vuidm4p	4-Byte Protocol Logitech 3 Button Mouseman	**/dev/tty***
vuidm5p	5-Byte Protocol Logitech 3 Button Bus Mouse Microsoft Bus Mouse	**/dev/logi** **/dev/msm**
vuid2ps2	PS/2 Protocol 2 Button PS/2 Compatible Mouse	**/dev/kdmouse**
vuid3ps2	PS/2 Protocol 3 Button PS/2 Compatible Mouse	**/dev/kdmouse**

SEE ALSO

STREAMS Programmer's Guide

NAME

wscons – workstation console

SYNOPSIS

#include <sys/strredir.h>

ioctl(*fd***, SRIOCSREDIR,** *target***);**
ioctl(*fd***, SRIOCISREDIR,** *target***);**

DESCRIPTION

The "workstation console" is a device consisting of the combination of the workstation keyboard and frame buffer, acting in concert to emulate an ASCII terminal. It includes a redirection facility that allows I/O issued to the workstation console to be diverted to some other STREAMS device, so that, for example, window systems can arrange to redirect output that would otherwise appear directly on the frame buffer, corrupting its appearance.

Redirection

The redirection facility maintains a list of devices that have been named as redirection targets, through the **SRIOCSREDIR** ioctl described below. All entries but the most recent are inactive; when the currently active entry is closed, the most recent remaining entry becomes active. The active entry acts as a proxy for the device being redirected; it handles all **read**(2), **write**(2), **ioctl**(2), and **poll**(2) calls issued against the redirectee.

The following two ioctls control the redirection facility. In both cases, *fd* is a descriptor for the device being redirected (that is, the workstation console) and *target* is a descriptor for a STREAMS device.

SRIOCSREDIR Make *target* be the source and destination of I/O ostensibly directed to the device denoted by *fd*.

SRIOCISREDIR Returns 1 if *target* names the device currently acting as proxy for the device denoted by *fd*, and 0 if it is not.

SPARC: ANSI STANDARD TERMINAL EMULATION

On SPARC systems, the PROM monitor emulates an ANSI X3.64 terminal.

Note: the VT100 also follows the ANSI X3.64 standard but both the Sun and the VT100 have nonstandard extensions to the ANSI X3.64 standard. The Sun terminal emulator and the VT100 are *not* compatible in any true sense.

The Sun console displays 34 lines of 80 ASCII characters per line, with scrolling, (*x*, *y*) cursor addressability, and a number of other control functions.

While the display size is usually 34 by 80, there are instances where it may be a different size.

- If the display device is not large enough to display 34 lines of text.
- If either screen-#rows or screen-#columns is set by the user to a value other than the default of 34 or 80 respectively. screen-#rows and screen-#columns are fields stored in NVRAM/EEPROM, see **eeprom**(1M).

The Sun console displays a cursor which marks the current line and character position on the screen. ASCII characters between 0x20 (space) and 0x7E (tilde) inclusive are printing characters — when one is written to the Sun console (and is not part of an escape sequence), it is displayed at the current cursor position and the cursor moves one position to the right on the current line.

Later PROM revisions have the full 8-bit ISO Latin-1 (ISO 8859-1) character set, not just ASCII. Earlier PROM revisions display characters in the range 0xA0 – 0xFE as spaces.

If the cursor is already at the right edge of the screen, it moves to the first character position on the next line. If the cursor is already at the right edge of the screen on the bottom line, the Line-feed function is performed (see CTRL-J below), which scrolls the screen up by one or more lines or wraps around, before moving the cursor to the first character position on the next line.

SPARC: Control Sequence Syntax

The Sun console defines a number of control sequences which may occur in its input. When such a sequence is written to the Sun console, it is not displayed on the screen, but effects some control function as described below, for example, moves the cursor or sets a display mode.

Some of the control sequences consist of a single character. The notation

CTRL-*X*

for some character *X*, represents a control character.

Other ANSI control sequences are of the form

ESC [*params*char

Spaces are included only for readability; these characters must occur in the given sequence without the intervening spaces.

ESC represents the ASCII escape character (ESC, CTRL-[, 0x1B).

[The next character is a left square bracket '[' (0x5B).

params are a sequence of zero or more decimal numbers made up of digits between 0 and 9, separated by semicolons.

char represents a function character, which is different for each control sequence.

Some examples of syntactically valid escape sequences are (again, ESC represent the single ASCII character 'Escape'):

ESC[m	select graphic rendition with default parameter
ESC[7m	select graphic rendition with reverse image
ESC[33;54H	set cursor position
ESC[123;456;0;;3;B	move cursor down

Syntactically valid ANSI escape sequences which are not currently interpreted by the Sun console are ignored. Control characters which are not currently interpreted by the Sun console are also ignored.

Each control function requires a specified number of parameters, as noted below. If fewer parameters are supplied, the remaining parameters default to 1, except as noted in the descriptions below.

If more than the required number of parameters is supplied, only the last *n* are used, where *n* is the number required by that particular command character. Also, parameters which are omitted or set to zero are reset to the default value of 1 (except as noted below).

Consider, for example, the command character M which requires one parameter. ESC[;M and ESC[0M and ESC[M and ESC[23;15;32;1M are all equivalent to ESC[1M and provide a parameter value of 1. Note: ESC[;5M (interpreted as 'ESC[5M') is *not* equivalent to ESC[5;M (interpreted as 'ESC[5;1M') which is ultimately interpreted as 'ESC[1M').

In the syntax descriptions below, parameters are represented as '**#**' or '**#1;#2**'.

SPARC: ANSI Control Functions

The following paragraphs specify the ANSI control functions implemented by the Sun console. Each description gives:

- the control sequence syntax
- the hex equivalent of control characters where applicable
- the control function name and ANSI or Sun abbreviation (if any).
- description of parameters required, if any
- description of the control function
- for functions which set a mode, the initial setting of the mode. The initial settings can be restored with the SUNRESET escape sequence.

SPARC: Control Character Functions

CTRL-G (0x7) Bell (BEL)
The Sun Workstation Model 100 and 100U is not equipped with an audible bell. It 'rings the bell' by flashing the entire screen. The window system flashes the window. The screen will also be flashed on current models if the Sun keyboard is not the console input device.

CTRL-H (0x8) Backspace (BS)
The cursor moves one position to the left on the current line. If it is already at the left edge of the screen, nothing happens.

CTRL-I (0x9) Tab (TAB)
The cursor moves right on the current line to the next tab stop. The tab stops are fixed at every multiple of 8 columns. If the cursor is already at the right edge of the screen, nothing happens; otherwise the cursor moves right a minimum of one and a maximum of eight character positions.

CTRL-J (0xA) Line-feed (LF)
The cursor moves down one line, remaining at the same character position on the line. If the cursor is already at the bottom line, the screen either scrolls up or ''wraps around'' depending on the setting of an internal variable *S* (initially 1) which can be changed by the ESC[r control sequence. If *S* is greater than zero, the entire screen (including the cursor) is scrolled up by *S* lines before executing the line-feed. The top *S* lines scroll off the screen and are lost.
S new blank lines scroll onto the bottom of the screen. After scrolling, the line-feed is executed by moving the cursor down one line.

If *S* is zero, 'wrap-around' mode is entered. 'ESC [1 r' exits back to scroll mode. If a line-feed occurs on the bottom line in wrap mode, the cursor goes to the same character position in the top line of the screen. When any line-feed occurs, the line that the cursor moves to is cleared. This means that no scrolling occurs. Wrap-around mode is not implemented in the window system.

The screen scrolls as fast as possible depending on how much data is backed up waiting to be printed. Whenever a scroll must take place and the console is in normal scroll mode ('ESC [1 r'), it scans the rest of the data awaiting printing to see how many line-feeds occur in it. This scan stops when any control character from the set {**VT**, **FF**, **SO**, **SI**, **DLE**, **DC1**, **DC2**, **DC3**, **DC4**, **NAK**, **SYN**, **ETB**, **CAN**, **EM**, **SUB**, **ESC**, **FS**, **GS**, **RS**, **US**} is found. At that point, the screen is scrolled by N lines ($N \geq 1$) and processing continues. The scanned text is still processed normally to fill in the newly created lines. This results in much faster scrolling with scrolling as long as no escape codes or other control characters are intermixed with the text.

See also the discussion of the 'Set scrolling' **(ESC[r)** control function below.

CTRL-K (0xB) Reverse Line-feed
The cursor moves up one line, remaining at the same character position on the line. If the cursor is already at the top line, nothing happens.

CTRL-L (0xC) Form-feed (FF)
The cursor is positioned to the Home position (upper-left corner) and the entire screen is cleared.

CTRL-M (0xD) Return (CR)
The cursor moves to the leftmost character position on the current line.

SPARC: Escape Sequence Functions

CTRL-[(0x1B) Escape (ESC)
This is the escape character. Escape initiates a multi-character control sequence.

ESC[#@ Insert Character (ICH)
Takes one parameter, # (default 1). Inserts # spaces at the current cursor position. The tail of the current line starting at the current cursor position inclusive is shifted to the right by # character positions to make room for the spaces. The rightmost # character positions shift off the line and are lost. The position of the cursor is unchanged.

ESC[#A Cursor Up (CUU)
Takes one parameter, # (default 1). Moves the cursor up # lines. If the cursor is fewer than # lines from the top of the screen, moves the cursor to the topmost line on the screen. The character position of the cursor on the line is unchanged.

ESC[#B Cursor Down (CUD)
Takes one parameter, # (default 1). Moves the cursor down # lines. If the cursor is fewer than # lines from the bottom of the screen, move the cursor to the last line on the screen. The character position of the cursor on the line is unchanged.

ESC[#C Cursor Forward (CUF)

Takes one parameter, # (default 1). Moves the cursor to the right by # character positions on the current line. If the cursor is fewer than # positions from the right edge of the screen, moves the cursor to the rightmost position on the current line.

ESC[#D Cursor Backward (CUB)
Takes one parameter, # (default 1). Moves the cursor to the left by # character positions on the current line. If the cursor is fewer than # positions from the left edge of the screen, moves the cursor to the leftmost position on the current line.

ESC[#E Cursor Next Line (CNL)
Takes one parameter, # (default 1). Positions the cursor at the leftmost character position on the #-th line below the current line. If the current line is less than # lines from the bottom of the screen, positions the cursor at the leftmost character position on the bottom line.

ESC[#1;#2f Horizontal And Vertical Position (HVP)
or
ESC[#1;#2H Cursor Position (CUP)
Takes two parameters, #1 and #2 (default 1, 1). Moves the cursor to the #2-th character position on the #1-th line. Character positions are numbered from 1 at the left edge of the screen; line positions are numbered from 1 at the top of the screen. Hence, if both parameters are omitted, the default action moves the cursor to the home position (upper left corner). If only one parameter is supplied, the cursor moves to column 1 of the specified line.

ESC[J Erase in Display (ED)
Takes no parameters. Erases from the current cursor position inclusive to the end of the screen. In other words, erases from the current cursor position inclusive to the end of the current line and all lines below the current line. The cursor position is unchanged.

ESC[K Erase in Line (EL)
Takes no parameters. Erases from the current cursor position inclusive to the end of the current line. The cursor position is unchanged.

ESC[#L Insert Line (IL)
Takes one parameter, # (default 1). Makes room for # new lines starting at the current line by scrolling down by # lines the portion of the screen from the current line inclusive to the bottom. The # new lines at the cursor are filled with spaces; the bottom # lines shift off the bottom of the screen and are lost. The position of the cursor on the screen is unchanged.

ESC[#M Delete Line (DL)
Takes one parameter, # (default 1). Deletes # lines beginning with the current line. The portion of the screen from the current line inclusive to the bottom is scrolled upward by # lines. The # new lines scrolling onto the bottom of the screen are filled with spaces; the # old lines beginning at the cursor line are deleted. The position of the cursor on the screen is unchanged.

ESC[#P Delete Character (DCH)
Takes one parameter, # (default 1). Deletes # characters starting with the current

cursor position. Shifts to the left by # character positions the tail of the current line from the current cursor position inclusive to the end of the line. Blanks are shifted into the rightmost # character positions. The position of the cursor on the screen is unchanged.

ESC[#m Select Graphic Rendition (SGR)

Takes one parameter, # (default 0). Note: unlike most escape sequences, the parameter defaults to zero if omitted. Invokes the graphic rendition specified by the parameter. All following printing characters in the data stream are rendered according to the parameter until the next occurrence of this escape sequence in the data stream. Currently only two graphic renditions are defined:

0 Normal rendition.

7 Negative (reverse) image.

Negative image displays characters as white-on-black if the screen mode is currently black-on white, and vice-versa. Any non-zero value of # is currently equivalent to 7 and selects the negative image rendition.

ESC[p Black On White (SUNBOW)

Takes no parameters. Sets the screen mode to black-on-white. If the screen mode is already black-on-white, has no effect. In this mode spaces display as solid white, other characters as black-on-white. The cursor is a solid black block. Characters displayed in negative image rendition (see 'Select Graphic Rendition' above) is white-on-black in this mode. This is the initial setting of the screen mode on reset.

ESC[q White On Black (SUNWOB)

Takes no parameters. Sets the screen mode to white-on-black. If the screen mode is already white-on-black, has no effect. In this mode spaces display as solid black, other characters as white-on-black. The cursor is a solid white block. Characters displayed in negative image rendition (see 'Select Graphic Rendition' above) is black-on-white in this mode. The initial setting of the screen mode on reset is the alternative mode, black on white.

ESC[#r Set scrolling (SUNSCRL)

Takes one parameter, # (default 0). Sets to # an internal register which determines how many lines the screen scrolls up when a line-feed function is performed with the cursor on the bottom line. A parameter of 2 or 3 introduces a small amount of ''jump'' when a scroll occurs. A parameter of 34 clears the screen rather than scrolling. The initial setting is 1 on reset.

A parameter of zero initiates ''wrap mode'' instead of scrolling. In wrap mode, if a linefeed occurs on the bottom line, the cursor goes to the same character position in the top line of the screen. When any linefeed occurs, the line that the cursor moves to is cleared. This means that no scrolling ever occurs. 'ESC [1 r' exits back to scroll mode.

For more information, see the description of the Line-feed (CTRL-J) control function above.

ESC[s Reset terminal emulator (SUNRESET)
Takes no parameters. Resets all modes to default, restores current font from PROM. Screen and cursor position are

RETURN VALUES

When there are no errors, the redirection ioctls have return values as described above. Otherwise, they return **–1** and set **errno** to indicate the error.

If the *target* stream is in an error state, **errno** is set accordingly.

ERRORS

EBADF	*target* does not denote an open file.
ENOSTR	*target* does not denote a STREAMS device.
EINVAL	(x86 only) *fd* does not denote **/dev/console**.

x86 FILES

/dev/systty	(x86 only)
/dev/syscon	(x86 only)
/dev/console	(x86 only) the device that must be opened for the **SRIOCSREDIR** and **SRIOCISREDIR** ioctls
/dev/wscons	the workstation console, accessed by way of the redirection facility

SEE ALSO

console(7)

WARNINGS

The redirection ioctls block while there is I/O outstanding on the device instance being redirected. Thus, attempting to redirect the workstation console while there is a read outstanding on it will hang until the read completes.

NAME

xd, xdc – disk driver for Xylogics 7053 SMD Disk Controller

SYNOPSIS

xdc@6d,ee80/xd@*slave***,0:***partition*
xdc@6d,ee90/xd@*slave***,0:***partition*
xdc@6d,eea0/xd@*slave***,0:***partition*
xdc@6d,eeb0/xd@*slave***,0:***partition*

AVAILABILITY

SPARC

Only available on Sun-4 / 200, Sun-4 / 300, and Sun-4 / 400 series systems.

DESCRIPTION

The driver for Xylogics 7053 devices consists of several components: a controller driver (**xdc**) and a slave device driver module (**xd**). Each driver module has an associated configuration file, which lives in the same directory as the driver module. See **driver.conf**(4) and **vme**(4) for the interpretation of the contents of these files.

The block files access the disk using the system's normal buffering mechanism and may be read and written without regard to physical disk records. There is also a *raw* interface that provides for direct transmission between the disk and the user's read or write buffer. A single read or write call usually results in only one I / O operation; therefore raw I / O is considerably more efficient when many words are transmitted. The physical names of the raw files conventionally have '**,raw**' appended to them. The logical names for the raw files live in the **/dev/rdsk** directory, as usual.

When using raw I / O, transfer counts should be multiples of 512 bytes (the size of a disk sector). Likewise, when using **lseek**(2) to specify block offsets from which to perform raw I / O, the logical offset should also be a multiple of 512 bytes.

Partition **0** is normally used for the root file system on a disk, partition **1** as a paging area (for example, **swap**), and partition **2** for backing up the entire disk. Partition **2** normally maps the entire disk and may also be used as the mount point for secondary disks in the system. The rest of the disk is normally partition **6**. For the primary disk, the user file system is located here.

DISK SUPPORT

This driver handles all SMD drives by reading a label from sector 0 of the drive which describes the disk geometry and partitioning.

FILES

/kernel/drv/xdc	driver module
/kernel/drv/xd	driver module
/kernel/drv/xdc.conf	driver configuration file
/kernel/drv/xd.conf	driver configuration file
/dev/dsk/c*X***t***Y***d0s***Z*	block devices, controller *X*, unit *Y*, slice *Z*
/dev/rdsk/c*X***t***Y***d0s***Z*	raw devices, controller *X*, unit *Y*, slice *Z*

SEE ALSO

lseek(2), **read**(2), **write**(2), **driver.conf**(4), **vme**(4), **dkio**(7), **hdio**(7)

NOTES

In raw I/O **read**(2) and **write**(2) truncate file offsets to 512-byte block boundaries, and **write**(2) scribbles on the tail of incomplete blocks. Thus, in programs that are likely to access raw devices, **read**(2), **write**(2), and **lseek**(2) should always deal in 512-byte multiples.

NAME

xt – driver for Xylogics 472 1/2 inch tape controller

SYNOPSIS

xt@2d,ee60:[l,m][b][n]
xt@2d,ee68:[l,m][b][n]

AVAILABILITY

Only available on Sun-4/200, Sun-4/300, and Sun-4/400 series systems.

DESCRIPTION

The Xylogics 472 tape controller controls Pertec-interface 1/2" tape drives such as the Fujitsu M2444 and the CDC Keystone III. The **xt** driver provides a standard tape interface to the device; see **mtio**(7) for details.

The **xt** driver supports the character device interface. The driver can be opened with either rewind on close or no rewind on close options. The tape format and options are specified using the device name (see FILES below).

EOT Handling

The user will be notified of end of tape (EOT) on write by a 0 byte count returned the first time this is attempted. This write must be retried by the user. Subsequent writes will be successful until the tape winds off the reel. Reading past EOT is transparent to the user.

IOCTL

See **mtio**(7) for a list of ioctls available for tape devices. However, not all devices support all ioctls. The driver returns an ENOTTY error on unsupported ioctls.

1/2" tape devices do not support the tape retension function.

ERRORS

EACCES The driver is opened for write access and the tape is write protected.

EBUSY The tape drive is in use by another process. Only one process can use the tape drive at a time.

EINVAL The requested number of bytes for a read operation is less than the actual record length on the tape.

EIO During opening, the tape device is not ready because either no tape is in the drive, or the drive is not on-line. Once open, this error is returned if the requested I/O transfer could not be completed.

ENOTTY This indicates that the tape device does not support the requested ioctl function.

ENXIO During opening, the tape device does not exist.

FILES

/kernel/drv/xt	driver module
/kernel/drv/xt.conf	driver configuration file
/dev/rmt/[0–1][l,m][b][n]	raw devices

For raw devices **l,m** specifies the density (low, medium), and **b** the optional BSD behavior (see **mtio**(7)) and **n** the optional no rewind behavior. For example **/dev/rmt/0lbn** specifies unit 0, low density, BSD behavior, and no rewind.

For 1/2" reel tape devices, the densities are:

l	typically 1600 BPI density
m	typically 6250 BPI density

SEE ALSO **ioctl**(2), **driver.conf**(4), **vme**(4), **mtio**(7)

BUGS Record sizes are restricted to an even number of bytes.

The EOT handling for write operation differs from the **mtio**(7) specification.

NAME

xy, xyc – disk driver for Xylogics 450 and 451 SMD Disk Controllers

SYNOPSIS

xyc@2d,ee40/xy@*slave***,0:***partition*
xyc@2d,ee48/xy@*slave***,0:***partition*

AVAILABILITY

SPARC

Only available on Sun-4 / 200, Sun-4 / 300, and Sun-4 / 400 series systems.

DESCRIPTION

The driver for Xylogics 450 / 451 devices consists of several components: a controller driver module (**xyc**) and a slave device driver module (**xy**). Each driver module has an associated configuration file, which lives in the same directory as the driver module. See **driver.conf**(4) and **vme**(4) for the interpretation of the contents of these files.

The block files access the disk using the system's normal buffering mechanism and may be read and written without regard to physical disk records. There is also a *raw* interface that provides for direct transmission between the disk and the user's read or write buffer. A single read or write call usually results in only one I / O operation; therefore raw I / O is considerably more efficient when many words are transmitted. The physical names of the raw files conventionally have '**,raw**' appended to them. The logical names for the raw files live in the **/dev/rdsk** directory, as usual.

When using raw I / O, transfer counts should be multiples of 512 bytes (the size of a disk sector). Likewise, when using **lseek**(2) to specify block offsets from which to perform raw I / O, the logical offset should also be a multiple of 512 bytes.

Partition **0** is normally used for the root file system on a disk, partition **1** as a paging area (for example, **swap**), and partition **2** for backing up the entire disk. Partition **2** normally maps the entire disk and may also be used as the mount point for secondary disks in the system. The rest of the disk is normally partition **6**. For the primary disk, the user file system is located here.

Due to word ordering differences between the disk controller and Sun computers, user buffers that are used for raw I / O must not begin on odd byte boundaries.

DISK SUPPORT

This driver handles all SMD drives by reading a label from sector 0 of the drive which describes the disk geometry and partitioning.

FILES

/kernel/drv/xyc	driver module
/kernel/drv/xy	driver module
/kernel/drv/xyc.conf	driver configuration file
/kernel/drv/xy.conf	driver configuration file
/dev/dsk/c*X***t***Y***d0s***Z*	block device, controller *X*, unit *Y*, slice *Z*
/dev/rdsk/c*X***t***Y***d0s***Z*	raw device, controller *X*, unit *Y*, slice *Z*

SEE ALSO

lseek(2), **read**(2), **write**(2), **driver.conf**(4), **vme**(4), **dkio**(7), **hdio**(7)

NOTES

In raw I/O **read**(2) and **write**(2) truncate file offsets to 512-byte block boundaries, and **write**(2) scribbles on the tail of incomplete blocks. Thus, in programs that are likely to access raw devices, **read**(2), **write**(2), and **lseek**(2) should always deal in 512-byte multiples.

NAME

zero – source of zeroes

DESCRIPTION

A zero special file is a source of zeroed unnamed memory.

Reads from a zero special file always return a buffer full of zeroes. The file is of infinite length.

Writes to a zero special file are always successful, but the data written is ignored.

Mapping a zero special file creates a zero-initialized unnamed memory object of a length equal to the length of the mapping and rounded up to the nearest page size as returned by **sysconf**. Multiple processes can share such a zero special file object provided a common ancestor mapped the object **MAP_SHARED**.

FILES

/dev/zero

SEE ALSO

fork(2), **mmap**(2), **sysconf**(3C)

NAME

zs – Zilog 8530 SCC serial communications driver

SYNOPSIS

#include <fcntl.h>
#include <sys/termios.h>

open("/dev/term/*n*", *mode***);**
open("/dev/tty*n*", *mode***);**
open("/dev/cua/*n*", *mode***);**

AVAILABILITY

SPARC

DESCRIPTION

The Zilog 8530 provides two serial input / output channels that are capable of supporting a variety of communication protocols. A typical system uses two or more of these devices to implement essential functions, including RS-423 ports (which also support most RS-232 equipment), and the console keyboard and mouse devices.

The **zs** module is a loadable STREAMS driver that provides basic support for the 8530 hardware, together with basic asynchronous communication support. The driver supports those **termio**(7) device control functions specified by flags in the **c_cflag** word of the **termios** structure and by the **IGNBRK**, **IGNPAR**, **PARMRK**, or **INPCK** flags in the **c_iflag** word of the **termios** structure. All other **termio**(7) functions must be performed by STREAMS modules pushed atop the driver. When a device is opened, the **ldterm**(7) and **ttcompat**(7) STREAMS modules are automatically pushed on top of the stream, providing the standard **termio**(7) interface.

The character-special devices **/dev/term/a** and **/dev/term/b** are used to access the two serial ports on the CPU board.

Note: **/dev/cua/**[**a-z**], **/dev/term/**[**a-z**] and **/dev/tty**[**a-z**] are valid name space entries. The number of entries used in this name space are machine dependent.

The **/dev/tty***n* device names only exist if the *binary compatibility package* is installed. The **/dev/tty***n* device names are created by the **ucblinks** command. This command is only available via the *binary compatibility package*.

To allow a single tty line to be connected to a modem and used for both incoming and outgoing calls, a special feature, controlled by the minor device number, is available. By accessing character-special devices with names of the form **/dev/cua/***n* it is possible to open a port without the Carrier Detect signal being asserted, either through hardware or an equivalent software mechanism. These devices are commonly known as dial-out lines.

Once a **/dev/cua/***n* line is opened, the corresponding tty line cannot be opened until the **/dev/cua/***n* line is closed; a blocking open will wait until the **/dev/cua/***n* line is closed (which will drop Data Terminal Ready, after which Carrier Detect will usually drop as well) and carrier is detected again, and a non-blocking open will return an error. Also, if the tty line has been opened successfully (usually only when carrier is recognized on the modem) the corresponding **/dev/cua/***n* line cannot be opened. This allows a modem to be attached to, for example, **/dev/term/***n* (renamed from **/dev/tty***n*) and used for dial-in (by enabling the line for login in **/etc/inittab**) and also used for dial-out (by **tip**(1) or

uucp(1C)) as **/dev/cua/***n* when no one is logged in on the line.

IOCTLS

The standard set of **termio ioctl**( ) calls are supported by **zs**.

If the **CRTSCTS** flag in the **c_cflag** field is set, output will be generated only if **CTS** is high; if **CTS** is low, output will be frozen. If the **CRTSCTS** flag is clear, the state of **CTS** has no effect.

Breaks can be generated by the **TCSBRK**, **TIOCSBRK**, and **TIOCCBRK ioctl**( ) calls.

The state of the **DCD**, **CTS**, **RTS**, and **DTR** interface signals may be queried through the use of the **TIOCM_CAR**, **TIOCM_CTS**, **TIOCM_RTS**, and **TIOCM_DTR** arguments to the **TIOCMGET** ioctl command, respectively. Due to hardware limitations, only the **RTS** and **DTR** signals may be set through their respective arguments to the **TIOCMSET**, **TIOCMBIS**, and **TIOCMBIC** ioctl commands.

The input and output line speeds may be set to any of the speeds supported by **termio**. The speeds cannot be set independently; when the output speed is set to the same speed.

ERRORS

An **open**( ) will fail if:

ENXIO The unit being opened does not exist.

EBUSY The dial-out device is being opened and the dial-in device is already open, or the dial-in device is being opened with a no-delay open and the dial-out device is already open.

EBUSY The port is in use by another serial protocol.

EBUSY The unit has been marked as exclusive-use by another process with a **TIOCEXCL ioctl**( ) call.

EINTR The open was interrupted by the delivery of a signal.

FILES

/dev/cua/[**a-z**]	dial-out tty lines
/dev/term/[**a-z**]	dial-in tty lines
/dev/tty[**a-z**]	binary compatibility package device names

SEE ALSO

cu(1C), **tip**(1), **ucblinks**(1B), **uucp**(1C), **ports**(1M), **ioctl**(2), **open**(2), **ldterm**(7), **termio**(7), **ttcompat**(7), **zsh**(7)

Solaris Binary Compatibility Guide

DIAGNOSTICS

zs*n* **: silo overflow.**
The 8530 character input silo overflowed before it could be serviced.

zs*n* **: ring buffer overflow.**
The driver's character input ring buffer overflowed before it could be serviced.

NAME

zsh – On-board serial HDLC / SDLC interface

SYNOPSIS

#include <fcntl.h>
open(/dev/zsh*n, mode* **);**
open(/dev/zsh, *mode* **);**

AVAILABILITY

SPARC

DESCRIPTION

The **zsh** module is a loadable STREAMS driver that implements the sending and receiving of data packets as **HDLC** frames over synchronous serial lines. The module is not a standalone driver, but instead depends upon the **zs** module for the hardware support required by all on-board serial devices. When loaded this module acts as an extension to the **zs** driver, providing access to an **HDLC** interface through character-special devices.

The **zsh***n* devices provide what is known as a **data path** which supports the transfer of data via **read**(2) and **write**(2) system calls, as well as **ioctl**(2) calls. Data path opens are exclusive in order to protect against injection or diversion of data by another process.

The **zsh** device provides a separate **control path** for use by programs that need to configure or monitor a connection independent of any exclusive access restrictions imposed by data path opens. Up to three control paths may be active on a particular serial channel at any one time. Control path accesses are restricted to **ioctl**(2) calls only; no data transfer is possible.

When used in synchronous modes, the **Z8530 SCC** supports several options for **clock sourcing** and **data encoding**. Both the transmit and receive clock sources can be set to be the external **T**ransmit **C**lock (**TRxC**), external **R**eceive **C**lock (**RTxC**), the internal **B**aud **R**ate **G**enerator (**BRG**), or the output of the **SCC**'s **D**igital **P**hase-**L**ock **L**oop (**DPLL**).

The **B**aud **R**ate **G**enerator is a programmable divisor that derives a clock frequency from the **PCLK** input signal to the **SCC**. A programmed baud rate is translated into a 16-bit **time constant** that is stored in the **SCC**. When using the **BRG** as a clock source the driver may answer a query of its current speed with a value different from the one specified. This is because baud rates translate into time constants in discrete steps, and reverse translation shows the change. If an exact baud rate is required that cannot be obtained with the **BRG**, an external clock source must be selected.

Use of the **DPLL** option requires the selection of **NRZI** data encoding and the setting of a non-zero value for the baud rate, because the **DPLL** uses the **BRG** as its reference clock source.

A **local loopback mode** is available, primarily for use by the **syncloop**(1M) utility for testing purposes, and should not be confused with **SDLC** loop mode, which is not supported on this interface. Also, an **auto-echo** feature may be selected that causes all incoming data to be routed to the transmit data line, allowing the port to act as the remote end of a digital loop. Neither of these options should be selected casually, or left in use when not needed.

The **zsh** driver keeps running totals of various hardware generated events for each channel. These include numbers of packets and characters sent and received, abort conditions detected by the receiver, receive **CRC** errors, transmit underruns, receive overruns, input errors and output errors, and message block allocation failures. Input errors are logged whenever an incoming message must be discarded, such as when an abort or **CRC** error is detected, a receive overrun occurs, or when no message block is available to store incoming data. Output errors are logged when the data must be discarded due to underruns, **CTS** drops during transmission, **CTS** timeouts, or excessive watchdog timeouts caused by a cable break.

IOCTLS

The **zsh** driver supports several **ioctl( )** commands, including:

S_IOCGETMODE Return a **struct scc_mode** containing parameters currently in use. These include the transmit and receive clock sources, boolean loopback and **NRZI** mode flags and the integer baud rate.

S_IOCSETMODE The argument is a **struct scc_mode** from which the **SCC** channel will be programmed.

S_IOCGETSTATS Return a **struct sl_stats** containing the current totals of hardware-generated events. These include numbers of packets and characters sent and received by the driver, aborts and **CRC** errors detected, transmit underruns, and receive overruns.

S_IOCCLRSTATS Clear the hardware statistics for this channel.

S_IOCGETSPEED Returns the currently set baud rate as an integer. This may not reflect the actual data transfer rate if external clocks are used.

S_IOCGETMCTL Returns the current state of the **CTS** and **DCD** incoming modem interface signals as an integer.

The following structures are used with **zsh ioctl( )** commands:

```
struct scc_mode {
        char    sm_txclock;     /* transmit clock sources */
        char    sm_rxclock;     /* receive clock sources */
        char    sm_iflags;      /* data and clock inversion flags (non-zsh) */
        u_char  sm_config;      /* boolean configuration options */
        int     sm_baudrate;    /* real baud rate */
        int     sm_retval;      /* reason codes for ioctl failures */
};

struct sl_stats {
        long    ipack;          /* input packets */
        long    opack;          /* output packets */
        long    ichar;          /* input bytes */
        long    ochar;          /* output bytes */
        long    abort;          /* abort received */
        long    crc;            /* CRC error */
```

```
        long    cts;            /* CTS timeouts */
        long    dcd;            /* Carrier drops */
        long    overrun;        /* receive overrun */
        long    underrun;       /* transmit underrun */
        long    ierror;         /* input error */
        long    oerror;         /* output error */
        long    nobuffers;      /* receive side memory allocation failure */
};
```

ERRORS

An **open( )** will fail if a **STREAMS** message block cannot be allocated, or:

ENXIO The unit being opened does not exist.

EBUSY The device is in use by another serial protocol.

An **ioctl( )** will fail if:

EINVAL An attempt was made to select an invalid clocking source.

EINVAL The baud rate specified for use with the baud rate generator would translate to a null time constant in the **SCC**'s registers.

FILES

/dev/zsh[0-1],/dev/zsh character-special devices

/usr/include/sys/ser_sync.h header file specifying synchronous serial communication definitions

SEE ALSO

syncinit(1M), **syncloop**(1M), **syncstat**(1M), **ioctl**(2), **open**(2), **read**(2), **write**(2), **zs**(7)

Refer to the *Zilog Z8530 SCC Serial Communications Controller* for details of the **SCC**'s operation and capabilities.

DIAGNOSTICS

zsh data open failed, no memory, rq=*nnn*

zsh clone open failed, no memory, rq=*nnn*
A kernel memory allocation failed for one of the private data structures. The value of *nnn* is the address of the read queue passed to **open**(2).

zsh_open: can't alloc message block
The open could not proceed because an initial STREAMS message block could not be made available for incoming data.

zsh: clone device *d* **must be attached before use!**
An operation was attempted through a control path before that path had been attached to a particular serial channel.

zsh*n***: invalid operation for clone dev.**
An inappropriate STREAMS message type was passed through a control path. Only **M_IOCTL** and **M_PROTO** message types are permitted.

zsh*n*: **not initialized, can't send message**

An **M_DATA** message was passed to the driver for a channel that had not been programmed at least once since the driver was loaded. The **SCC**'s registers were in an unknown state. The **S_IOCSETMODE** ioctl command performs the programming operation.

zsh*n*: **transmit hung**

The transmitter was not successfully restarted after the watchdog timer expired.

Index

E

F

G

K

L

M

N

O

P

Q

S

T

U

V

W

X

Z