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Customer Documentation

Programmer's Reference for the DG/UX™ System (Volume 3)

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PRODUCT LINE

Programmer's Reference for the DG/UX™ System (Volume 3)

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NOTICE

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Revision 1 – February 1992	DG/UX 5.4.1

NAME

`dirent` – file system independent directory entry

SYNOPSIS

```
#include <sys/dirent.h>
#include <sys/types.h>
```

DESCRIPTION

Different file system types may have different directory entries. The `dirent` structure defines a file system independent directory entry, which contains information common to directory entries in different file system types. A set of these structures is returned by the `getdents`(2) system call.

The `dirent` structure is defined below.

```
struct dirent {
                long            d_ino;
                off_t           d_off;
                unsigned short  d_reclen;
                char            d_name[1];
        };
```

The *d_ino* is a number which is unique for each file in the file system. The field *d_off* is the offset of that entry in the file system directory. The field *d_name* is the beginning of the character array giving the name of the directory entry. This name is null terminated and may have at most MAXNAMLEN characters. This results in file system independent directory entries being variable length entities. The value of *d_reclen* is the record length of this entry. This length is defined to be the number of bytes between the current entry and the next one, so that it will always result in the next entry being on a long boundary.

FILES

`/usr/include/sys/dirent.h`

SEE ALSO

`getdents`(2).

NAME

dumptab – tape table file for dump2

DESCRIPTION

/etc/dumptab is an ASCII file containing an entry describing media characteristics for each medium made available to dump2.

This table file contains lines in one of three formats:

a. comment lines (must start with a "#")

b. lines specifying the capacity of the medium:

medium-name buffer-size <capacity>

c. lines giving the density, tape length, and IRG for the medium:

medium-name buffer-size density tape-length <IRG>

Fields are separated by white space. The fields are desribed below:

medium-name
: descriptive label for the medium.

buffer-size
: size (in 1024-byte blocks) of the buffers written to the medium.

capacity
: formatted capacity of the medium (in bytes). The capacity can also be specified as a number followed by a upper or lowercase b, k, m, or g to indicate bytes, kilobytes, megabytes, or gigabytes, respectively.

density
: density at which data is written to the device (in bpi).

tape-length
: length of the tape (in feet).

IRG
: inter-record gap size used by the device (in tenths per inch).

SEE ALSO

dump2(1M).

NAME

ethers – Ethernet address to hostname database or YP domain

DESCRIPTION

The ethers file contains information regarding the known (48 bit) Ethernet addresses of hosts on the Internet. For each host on an Ethernet, a single line should be present with the following information:

ethernet_address official_hostname

Separate items by any number of blanks and/or TAB characters. A '#' indicates the beginning of a comment extending to the end of line.

The standard form for Ethernet addresses is "*x*:*x*:*x*:*x*:*x*:*x*" where *x* is a hexadecimal number between 0 and ff, representing one byte. The address bytes are always in network order. Host names may contain any printable character other than a space, tab, newline, or comment character. It is intended that hostnames in the ethers file correspond to the hostnames in the hosts(4) file.

The ether_line() routine from the Ethernet address manipulation library, ethers(3N) may be used to scan lines of the ethers file.

EXAMPLE

The following is a sample /etc/ethers file:

```
8:0:1b:0:a0:17     dg1
0:0:77:1a:0:6a     sales
8:0:20:0:a7:5d     sun1
```

If you use the domain name system, you should specify fully-qualified names in addition to official hostnames. Here is the same sample /etc/ethers file including fully-qualified names:

```
8:0:1b:0:a0:17     dg1
0:0:77:1a:0:6a     sales
8:0:20:0:a7:5d     sun1
8:0:1b:0:a0:17     dg1.tnt.acme.com
0:0:77:1a:0:6a     sales.tnt.acme.com
8:0:20:0:a7:5d     sun1.tnt.acme.com
```

For more information about the domain name system, see *Managing TCP/IP on the DG/UX™ System.*

FILES

/etc/ethers

SEE ALSO

ethers(3N), hosts(4)

NAME

exports, xtab – directories to export to NFS clients

SYNOPSIS

/etc/exports

/etc/xtab

DESCRIPTION

The /etc/exports file contains entries for directories that can be exported to NFS clients. This file is read automatically by the exportfs(1M) command. If you change this file, you must run exportfs(1M) for the changes to affect the mountd server's operation.

Only when this file is present at boot time does the rc.nfslockd script execute exportfs(1M). The rc.nfsserv script starts the NFS file-system server (daemon), nfsd(1M).

The /etc/xtab file contains entries for directories that are *currently* exported. This file should only be accessed by programs using getexportent (see exportent(3C)). (Use the -u option of exportfs to remove entries from this file).

An entry for a directory consists of a line of the following form:

directory *-option*[, *option*]...

directory is the pathname of a directory (or file).

option is one of

ro Export the directory read-only. If not specified, the directory is exported read-write.

rw=*hostnames*[:*hostname*] . . .
Export the directory read-mostly. Read-mostly means read-only to most machines, but read-write to those specified. If not specified, the directory is exported read-write to all.

anon=*uid*
If a request comes from an unknown user, use *uid* as the effective user ID. Note: root users (uid 0) are always considered unknown by the NFS server, unless they are included in the root option below. The default value for this option is -2. Setting anon to -1 disables anonymous access. Note: by default secure NFS will accept insecure requests as anonymous, and those wishing for extra security can disable this feature by setting anon to -1.

root=*hostnames*[:*hostname*] . . .
Give root access only to the root users from a specified *hostname*. The default is for no hosts to be granted root access.

access=*client*[:*client*] . . .
Give mount access to each *client* listed. A *client* can be either a hostname, or a netgroup (see netgroup(5)). Each *client* in the list is first checked for in the netgroup database, and then the hosts database. The default

value allows any machine to mount the given directory.

`secure`
Require clients to use a more secure protocol when accessing the directory.

A '#' (pound-sign) anywhere in the file indicates a comment that extends to the end of the line.

EXAMPLE

```
/usr       -access=clients          # export to my clients
/usr/local                          # export to the world
/usr2    -access=hermes:zip:tutorial # export to only these machines
/usr/dgux  -root=hermes:zip         # give root access only to these
/usr/new   -anon=0                  # give all machines root access
/usr/bin   -ro                      # export read-only to everyone
/usr/stuff -access=zip,anon=-3,ro  # several options on one line
```

FILES

```
/etc/exports
/etc/xtab
/etc/hosts
/etc/netgroup
```

SEE ALSO

`exportfs`(1M), `nfsd`(1M), `exportent`(3C), `hosts`(5), `netgroup`(5).

WARNINGS

You cannot export either a parent directory or a subdirectory of an exported directory that is *within the same filesystem*. It would be illegal, for instance, to export both `/usr` and `/usr/local` if both directories resided on the same disk partition.

NAME

filehdr – file header for common object files

SYNOPSIS

```
#include <filehdr.h>
```

DESCRIPTION

Every common object file begins with a 20-byte header. The following C `struct` declaration is used:

```
struct  filehdr  {
   unsigned short  f_magic ;   /* magic number */
   unsigned short  f_nscns ;   /* number of sections */
   long            f_timdat ;  /* time & date stamp */
   long            f_symptr ;  /* file ptr to symtab */
   long            f_nsyms ;   /* # symtab entries */
   unsigned short  f_opthdr ;  /* sizeof(opt hdr) */
   unsigned short  f_flags ;   /* flags */
} ;
```

F_symptr is the byte offset into the file at which the symbol table can be found. Its value can be used as the offset in `fseek`(3S) to position an I/O stream to the symbol table. The UNIX system optional header is 28-bytes. The magic number for the M88000 is:

```
#define MC88MAGIC 0540
```

The value in *f_timdat* is obtained from the `time`(2) system call. Flag bits currently defined are:

```
#define F_RELFLG  0000001 /* relocation entries stripped */
#define F_EXEC    0000002 /* file is executable */
#define F_LNNO    0000004 /* line numbers stripped */
#define F_LSYMS   0000010 /* local symbols stripped */
#define F_AR32W   0001000 /* non-DEC host */
#define F_BM32B   0020000 /* file contains WE 32100 code */
#define F_BM32MAU 0040000 /* file reqs MAU to execute */
```

SEE ALSO

`time`(2), `fseek`(3S), `a.out`(4).

NAME

fs – file system format

SYNOPSIS

```
#include <ufs/disk_format.h>
```

DESCRIPTION

There is a at most one filesystem for each logical disk. The basic components of a the file system are the File Manager Information Areas (FMIA's), Disk Allocation Regions (DAR's), and a table of entries containing information about each DAR called the DAR Information Area.

The FMIA

Two copies of the FMIA are maintained to reduce its vulnerability to corruption. The copies are placed in the first and last blocks of the file system. The FMIA in the first block (the Primary FMIA) is contained in the first DAR, but the FMIA contained in the last block of the logical disk (the Secondary FMIA) is not contained in the last DAR.

The following is the definition of a FMIA. This contains the per-filesystem information. When a filesystem is mounted, this structure is used to generate memory databases for the newly mounted entry.

```
typedef struct
    {
    df_self_id_type          self_id;
    df_fsid_type             fsid;
    uint32e_type             minor_device_number;
    uint32e_type             dar_size;
    uint32e_type             file_nodes_per_dar;
    boolean16e_type          fsck_required;
    uint16e_type             revision;
    byte8e_type              fname[DF_FS_LABEL_SIZE];
    byte8e_type              fpack[DF_FS_LABEL_SIZE];
    uint8e_type              default_des_exponent;
    uint8e_type              default_ies_exponent;
    uint8e_type              default_dir_des_exponent;
    uint8e_type              default_dir_ies_exponent;
    uint32e_type             first_anniversary;
    uint32e_type             second_anniversary;
    uint32e_type             fs_size;
    uint32e_type             space_used;
    uint32e_type             number_of_used_file_nodes;
    uint32e_type             first_log_lda;
    uint32e_type             second_log_lda;
    uint32e_type             log_size;
    boolean_field_type       shrink_operation_in_progress;
    boolean_field_type       grow_operation_in_progress;
    skip_type                reserved:14;
    byte8e_type              pad_to_block[DF_PADDING_PER_FMIA_BLOCK];
    }   df_fmia_block_type  ;
```

self_id is the self-identification information. The block kind is DF_FMIA_BLOCK. The block number is:

```
#define DF_PRIMARY_FMIA_ADDRESS   0
```

The file node number is:

```
#define DF_NODE_NUMBER_FOR_NON_FILES    012345670123
```

The following fields are assumed to be correct by `fsck`(1M).

fsid is the filesystem identifier unique among mounted file systems on a single host. It is kept on disk so that it will stay the same if possible from mount to mount. If it doesn't, NFS accesses using filehandles based on a previous mount will fail.

minor_device_number is the assigned extended minor device number. It is kept on disk so that it will stay the same if possible from mount to mount. If the value in this field on disk is not in the valid range for extended minor device numbers, it is file manager's responsibility to correct the problem at mount time.

dar_size is the size of a DAR in blocks. The minimum value for this field is:

```
#define DF_MIN_DAR_SIZE     4032
```

and the maximum value is:

```
#define DF_MAX_DAR_SIZE(fs_size)
```

`mkfs`(1M) defines the default for this field; for efficiency, it should be a multiple of:

```
#define DF_BITS_PER_BITMAP_BLOCK  4032
```

whenever possible; 4 to 12 MB (two to six bitmap blocks' worth) per DAR seems a reasonable default DAR size given current disk sizes. As disks grow by orders of magnitude in size, DAR sizes should likely grow linearly with the square root of the disk sizes.

file_nodes_per_dar is the number of file nodes for each DAR. This value must be a multiple of:

```
#define DF_FILE_NODE_MULTIPLE_REQUIREMENT      64
```

The minimum value for this field is

```
#define DF_MIN_FILE_NODES_PER_DAR 64
```

and the maximum value is:

```
#define DF_MAX_FILE_NODES_PER_DAR(dar_size)
```

`mkfs`(1M) defines this field's default, which is to have about one file node for each four user data blocks, similar to 4.2 BSD.

fsck_required indicates that `fsck`(1M) needs to be run. If this field is not zero (FALSE), the filesystem needs to be checked before it can be mounted.

revision is the revision number of the FMIA. Used to determine the type of filesystem that the FMIA resides on.

Preface

This is Volume 3 of the *Programmer's Reference for the DG/UX™ System*. The *Programmer's Reference* describes the programming features of the DG/UX system. It contains individual manual pages that describe commands, system calls, subroutines, file formats, and other useful topics, such as the ASCII table shown on **ascii**(5).

This manual is part of a five-volume reference set. The other manuals are the *System Manager's Reference for the DG/UX System* and the *User's Reference for the DG/UX System*. These manuals contain in printed (typeset) form the online entries released with the DG/UX System in **/usr/catman** for access by the **man** command.

The *Programmer's Reference* provides neither a general overview of the DG/UX system nor details of the implementation of the system. For more details about some of the most often used programming tools, see *Programmer's Guide: ANSI C and Programming Support Tools*, *Programmer's Guide: System Services and Application Packaging Tools*, and the Data General supplements to these two manuals. Other related manuals are listed under "Related Documents" at the end of this manual.

Man Pages

For historical reasons, each entry is called a "manual page" or "man page," though an entry may occupy more than one physical page and may contain more than one entry. If the man page contains more than one entry, it is alphabetized under its "primary" name; for example, the **utmp** manual page describes the **utmp** and **wtmp** files.

Manual pages are assigned to classes ranging from 0 through 8 for easy cross-reference. The class number appears in parentheses following the name; for example, in **accept**(1M) the "1" indicates that **accept** is a command, and the "M" indicates that the man page is in the *System Manager's Reference*.

A command followed by a (1) or (1G) usually means that it is described in the *User's Reference*. (Class 1 commands appropriate for use by programmers are located in the *Programmer's Reference*.) A man page name with a (1M), (4M), (7), or (8) following it means that the entry is in the *System Manager's Reference*. Names with (2) or (3*x*), (4), (5) [except **editread**(5)], or (6F) are in the *Programmer's Reference*. Occasionally, DG/UX man pages refer to other products' man pages, which are not part of the DG/UX documentation; these are so noted.

Manual Organization

Volume 1 contains two chapters:

Chapter 1: Commands (1)
This chapter describes commands that support C and other programming languages.

Chapter 2: System Calls (2) This chapter describes the access to services provided by the DG/UX kernel, including the C language interface and a description of returned error codes.

Volume 2 contains one chapter:

Chapter 3: Subroutines and Libraries (3) This chapter describes the available subroutines and subroutine libraries. Their binary versions reside in various system libraries in the directories **/lib** and **/usr/lib**. See **intro**(3) for descriptions of these libraries and the files in which they are stored. Although these man pages are alphabetized together, each has a letter associated with the number 3 indicating the pertinent library:

- 3C C Programming Language Libraries
- 3E ELF Library Routines
- 3G General Library Routines
- 3M Mathematical Library Routines
- 3N Networking Support Utilities
- 3R Remote Procedure Call Routines
- 3S Standard I/O Library Routines
- 3W Multinational Language Set (MNLS) Routines
- 3X Specialized Libraries

Volume 3 contains three chapters and one appendix:

Chapter 4: File Formats (4) This chapter documents the structure of particular kinds of files; for example, the format of the output of the link editor is given in **a.out**(4). Excluded are files used by only one command (for example, the assembler's intermediate files). In general, the C language structures corresponding to these formats can be found in the directories **/usr/include** and **/usr/include/sys**.

Chapter 5: Miscellaneous Features (5) This chapter contains a variety of facilities. Included are descriptions of character sets, macro packages, and other things.

Chapter 6: Communications Protocols (6) This chapter contains a description of the **unix_ipc** communications facility.

Appendix A: Contents and Permuted Index Man Pages
These manual pages contain information extracted from the DG/UX man pages in all five reference volumes.

Man Page Format

Each man page has at least some of the following sections:

NAME	gives the primary name (and secondary names, as the case may be) and briefly states its purpose.
SYNOPSIS	summarizes the usage of the program being described.
DESCRIPTION	discusses how to use these commands.
EXAMPLES	gives examples of usage, where appropriate.
FILES	contains the file names that are referenced by the program.
EXIT CODES	discusses values set when the command terminates. The value set is available in the shell environment variable "?" (see **sh**(1)).
DIAGNOSTICS	discusses the error messages that may be produced. Messages that are intended to be self-explanatory are not listed.
SEE ALSO	offers pointers to related information.
NOTES	gives information that may be helpful under the particular circumstances described.

Some man pages may contain other heads such as **ENVIRONMENT** and **CAVEATS**.

Man Page Notation Conventions

This manual uses certain symbols and styles of type to indicate different meanings in man pages. Those symbol and typeface conventions are defined in the following list. You should familiarize yourself with these conventions before reading the manual.

The description of convention meanings uses the terms "command line," "format line," and "syntax line." A command line is an example of a command string that you should type verbatim; it is preceded by a system prompt. A format line shows how to structure a command; it shows the variables that must be supplied and the available options. A syntax line is a fragment of program code that shows how to use a particular routine; some syntax lines contain variables.

Convention	Meaning
boldface	This font is used for section heads and subsection heads. It is also used to distinguish input from output in examples where the two are intermixed.
`constant width/ monospace`	In command formats and code syntax: This typeface indicates text (including punctuation) that you type verbatim from your keyboard. In text: This typeface is used for examples, code samples, pathnames, and the names of commands, files, directories, and manual pages. In all contexts: The following characters, which have special meanings explained below, do not have special meaning but simply represent themselves when they appear in constant-width font: `< > [ ] { } |`. In constant-width font they are are I/O redirection operators, brackets, braces, and the pipe symbol.
italic	In format lines: This font represents variables for which you supply values; for example, the names of your directories and files, your username and password, and possible arguments to commands.
[*optional*]	In format lines: Regular-font brackets surround an optional argument. Don't type the brackets; they only set off what is optional. These brackets should not be confused with constant-width brackets.
choice1|*choice2*	In format lines: The vertical bar indicates a choice between *choice1* and *choice2*.
...	In format lines and syntax lines: You can repeat the preceding argument as many times as desired.
{ }	In format lines: These regular-font braces surround either two or more choices or syntax elements that are repeatable as a group.
< >	In command lines and other examples: Angle brackets distinguish a command sequence or a keystroke (such as **<Ctrl-D>**, **<Esc>**, and **<3dw>**) from surrounding text. Note that these angle brackets are in regular type and that you do not type them; there are, however, constant-width versions of these symbols that you do type.
`$, %, #`	In command lines and other examples: These symbols represent the system command prompt symbols used for the Bourne and Korn shells, the C shell, and the superuser, respectively. Note that your system might use different symbols for the command prompts.

Contacting Data General

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Manuals

If you require additional manuals, please use the enclosed TIPS order form (United States only) or contact your local Data General sales representative. A list of related documents appears at the end of this manual with the TIPS order form.

For a complete list of AViiON® and DG/UX™ manuals, see the *Guide to AViiON® and DG/UX™ System Documentation* (069-701085). The on-line version of this manual found in **/usr/release/doc_guide** contains the most current list.

Telephone Assistance

If you are unable to solve a problem using any manual you received with your system, free telephone assistance is available with your hardware warranty and with most Data General software service options. If you are within the United States or Canada, contact the Data General Customer Support Center (CSC) by calling 1-800-DG-HELPS. Lines are open from 8:00 a.m. to 5:00 p.m., your time, Monday through Friday. The center will put you in touch with a member of Data General's telephone assistance staff who can answer your questions.

For telephone assistance outside the United States or Canada, ask your Data General sales representative for the appropriate telephone number.

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End of Preface

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Chapter 5 — Miscellaneous Features

Chapter 6 — Communications Protocols

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Related Documents

Tables

Chapter 4
File Formats

This chapter contains in printed form the online manual entries for DG/UX, TCP/IP, and NFS file formats. The entries are in alphabetical order except for **intro**(4), which is first.

For other file format manual pages (4M), see the *System Manager's Reference for the DG/UX System*.

Table 4-1 lists the TCP/IP man pages included in this chapter.

Table 4-1 Summary of TCP/IP File Format Manual Pages

Name	Description
aliases(4)	Addresses and aliases for **sendmail**
ethers(4)	Ethernet address to hostname database or NIS domain
hosts(4)	Host name database
networks(4)	Network name database
protocols(4)	Table of protocols
services(4)	Service name database for DG/UX system
svcorder(4)	File specifying name/address resolution order

Table 4-2 lists the ONC/NFS man pages included in this chapter.

Table 4-2 Summary of ONC/NFS File Format Manual Pages

Name	Description
bootparams(4)	Boot parameter database
exports(4)	Directories to export to NFS clients
netgroup(4)	List of network groups
publickey(4)	Public key database
rpc(4)	RPC program number database
statd(4)	**statd** directories and file structures
updaters(4)	Configuration file for updating
ypfiles(4)	The NIS database and directory structure

NAME

intro – introduction to file formats

DESCRIPTION

This section outlines the formats of various files. The C structure declarations for the file formats are given where applicable. Usually, the header files containing these structure declarations can be found in the directories `/usr/include` or `/usr/include/sys`. For inclusion in C language programs, however, the syntax `#include <`*filename.h*`>` or `#include <sys/`*filename.h*`>` should be used.

SEE ALSO

intro(4M).

NAME

`a.out` – assembler and link editor output

SYNOPSIS

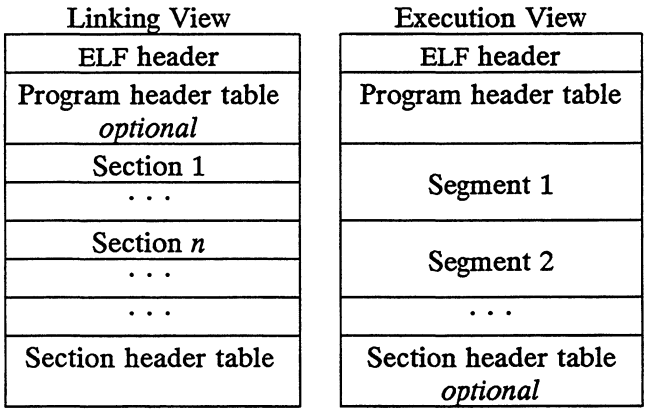
```
#include <elf.h>          /* for ELF executables*/
#include <a.out.h>/* for COFF executables */
```

DESCRIPTION

The filename `a.out` is the default output filename from the link editor `ld`(1). The link editor will make `a.out` executable if there were no errors in linking. The output file of the assembler, `as`(1), also follows the common object file format of the `a.out` file although the default filename is different.

ELF (Executable and Linking Format) Files

Programs that manipulate ELF files may use the library that `elf`(3E) describes. An overview of the file format follows. For more complete information, see the references given below.



An ELF header resides at the beginning and holds a "road map" describing the file's organization. Sections hold the bulk of object file information for the linking view: instructions, data, symbol table, relocation information, and so on. Segments hold the object file information for the program execution view. As shown, a segment may contain one or more sections.

A program header table, if present, tells the system how to create a process image. Files used to build a process image (execute a program) must have a program header table; relocatable files do not need one. A section header table contains information describing the file's sections. Every section has an entry in the table; each entry gives information such as the section name, the section size, etc. Files used during linking must have a section header table; other object files may or may not have one.

Although the figure shows the program header table immediately after the ELF header, and the section header table following the sections, actual files may differ. Moreover, sections and segments have no specified order. Only the ELF header has a fixed position in the file.

When an `a.out` file is loaded into memory for execution, three logical segments are set up: the text segment, the data segment (initialized data followed by uninitialized, the latter actually being initialized to all 0's), and a stack. The text segment is not writable by the program; if other processes are executing the same `a.out` file, the processes will share a single text segment.

The data segment starts at the next maximal page boundary past the last text address. (If the system supports more than one page size, the "maximal page" is the largest

supported size.) When the process image is created, the part of the file holding the end of text and the beginning of data may appear twice. The duplicated chunk of text that appears at the beginning of data is never executed; it is duplicated so that the operating system may bring in pieces of the file in multiples of the actual page size without having to realign the beginning of the data section to a page boundary. Therefore, the first data address is the sum of the next maximal page boundary past the end of text plus the remainder of the last text address divided by the maximal page size. If the last text address is a multiple of the maximal page size, no duplication is necessary. The stack is automatically extended as required. The data segment is extended as requested by the `brk`(2) system call.

COFF (Common Object File Format) Files

A common object file consists of a file header, a UNIX system header (if the file is link editor output), a table of section headers, relocation information, (optional) line numbers, a symbol table, and a string table. The order is given below:

File header.
UNIX system header.
Section 1 header.
...
Section n header.
Section 1 data.
...
Section n data.
Section 1 relocation.
...
Section n relocation.
Section 1 line numbers.
...
Section n line numbers.
Symbol table.
String table.

The last three parts of an object file (line numbers, symbol table and string table) may be missing if the program was linked with the `-s` option of `ld`(1) or if they were removed by `strip`(1). Also note that the relocation information will be absent after linking unless the `-r` option of `ld`(1) was used. The string table exists only if the symbol table contains symbols with names longer than eight characters.

The sizes of each section (contained in the header, discussed below) are in bytes.

When an `a.out` file is loaded into memory for execution, three logical segments are set up: the text segment, the data segment (initialized data followed by uninitialized, the latter actually being initialized to all 0's), and a stack. On the M88K computer the text segment typically starts at location 0x00010000 plus the byte offset in the a.out file of the text section data.

The first 16 bits of `a.out` files is the magic number. For non-executable `a.out` files and executables linked in the m88kbcs SDE, the magic number is 0555.For executables linked in the dgux SDE, the magic number is 0541. See `sde`(1). The optional header of an `a.out` file produced by `ld`(1) also has a magic number whose value is 0413. The headers (file header, optional header, and section headers) appear at the beginning of `a.out` files and determine the address of the text segment when it is loaded into memory. The first text address will equal 0x00010000 plus the size of the headers, and will vary depending upon the number of section headers in the `a.out`

file. In an `a.out` file with three sections (.text, .data, and .bss), the first text address is at 0x000100B8 on the M88K computer.The text segment is not writable by the program; if other processes are executing the same `a.out` file, the processes will share a single text segment.

On the M88K computer the stack begins at location 0xF000000 and grows toward lower addresses. The stack is automatically extended as required. The data segment is extended only as requested by the `brk`(2) system call.

For relocatable files the value of a word in the text or data portions that is not a reference to an undefined external symbol is exactly the value that will appear in memory when the file is executed. If a word in text or data involves a reference to an undefined external symbol, there will be a relocation entry for the word, the storage class of the symbol-table entry for the symbol will be marked as an "external symbol", and the value and section number of the symbol-table entry will be undefined. When the file is processed by the link editor and the external symbol becomes defined, the value of the symbol will be added to the word in the file.

The format of the `filehdr` header is

```
struct filehdr
{
    unsigned short   f_magic;    /* magic number */
    unsigned short   f_nscns;    /* number of sections */
    long             f_timdat;   /* time and date stamp */
    long             f_symptr;   /* file ptr to symtab */
    long             f_nsyms;    /* # symtab entries */
    unsigned short   f_opthdr;   /* sizeof(opt hdr) */
    unsigned short   f_flags;    /* flags */
};
```

The format of the optional header is

```
typedef struct aouthdr
{
    short    magic;        /* magic number */
    short    vstamp;       /* version stamp */
    long     tsize;        /* text size in bytes, padded */
    long     dsize;        /* initialized data (.data) */
    long     bsize;        /* uninitialized data (.bss) */
    long     entry;        /* entry point */
    long     text_start;   /* base of text used for this file */
    long     data_start;   /* base of data used for this file */
} AOUTHDR;
```

The format of the section header is

```
struct scnhdr
{
    char            s_name[8];  /* section name */
    long            s_paddr;    /* physical address */
    long            s_vaddr;    /* virtual address */
    long            s_size;     /* section size */
    long            s_scnptr;   /* file ptr to raw data */
    long            s_relptr;   /* file ptr to relocation */
    long            s_lnnoptr;  /* file ptr to line numbers */
    unsigned long   s_nreloc;   /* # reloc entries */
    unsigned long   s_nlnno;    /* # line number entries */
    long            s_flags;    /* flags */
};
```

Object files have one relocation entry for each relocatable reference in the text or data. If relocation information is present, it will be in the following format:

```
struct reloc
{
    long            r_vaddr;    /* (virtual) address of reference */
    long            r_symndx;   /* index into symbol table */
    unsigned short  r_type;     /* relocation type */
    unsigned short  r_offset;   /* high 16 bits of expression */
};
```

The start of the relocation information is *s_relptr* from the section header. If there is no relocation information, *s_relptr* is 0.

The format of each symbol in the symbol table is

```
#define  SYMNMLEN  8
#define  FILNMLEN  14
#define  DIMNUM    4

struct syment
{
    union                       /* all ways to get a symbol name */
    {
        char        _n_name[SYMNMLEN]; /* name of symbol */
        struct
        {
            long    _n_zeroes;  /* == 0L if in string table */
            long    _n_offset;  /* location in string table */
        } _n_n;
        char        *_n_nptr[2];  /* allows overlaying */
    } _n;
    long            n_value;    /* value of symbol */
    short           n_scnum;    /* section number */
    unsigned short  n_type;     /* type and derived type */
    char            n_sclass;   /* storage class */
    char            n_numaux;   /* number of aux entries */
    char            n_pad1;     /* pad to 4 byte multiple */
    char            n_pad2;     /* pad to 4 byte multiple */
};
```

```
#define  n_name    _n._n_name
#define  n_zeroes  _n._n_n._n_zeroes
#define  n_offset  _n._n_n._n_offset
#define  n_nptr    _n._n_nptr[1]
```

Some symbols require more information than a single entry; they are followed by *auxiliary entries* that are the same size as a symbol entry. The format follows:

```
union auxent {
     struct {
          long  x_tagndx;
          union {
               struct {
                    unsigned longx_lnno;
                    unsigned longx_size;
               } x_lnsz;
               long   x_fsize;
          } x_misc;
          union {
               struct {
                    long  x_lnnoptr;
                    long  x_endndx;
               }  x_fcn;
               struct {
                    unsigned shortx_dimen[4];
               } x_ary;
                      struct {
                              unsigned long   x_dimen1[2];
                   } x_ary1;



          } x_fcnary;
          unsigned short  x_tvndx;
          char x_pad1;
          char x_pad2;
     } x_sym;

        struct {
            unsigned long x_dimen2[5];
        } x_ary2;

        union {
          char  x_fname[FILNMLEN];
                struct {
                    long _x_zeroes;      /* 0 if name is in string table*/
                    long _x_offset;      /* offset into string table */
                } _x_x;
                char     *_x_xptr[2];    /* allows for overlaying */
        } x_file;
     } x_file;

     struct {
          long      x_scnlen;
```

```
        unsigned short  x_nreloc;
        unsigned short  x_nlinno;
    } x_scn;

    struct {
        long        x_tvfill;
        unsigned short    x_tvlen;
        unsigned short    x_tvran[2];
    } x_tv;
};
```

Indexes of symbol table entries begin at *zero*. The start of the symbol table is *f_symptr* (from the file header) bytes from the beginning of the file. If the symbol table is stripped, *f_symptr* is 0. The string table (if one exists) begins at *f_symptr* + (*f_nsyms* * SYMESZ) bytes from the beginning of the file.

SEE ALSO

as(1), att_dump(1), cc(1), ld(1), ld-coff(1), brk(2), elf(3E), filehdr(4), ldfcn(4), linenum(4), reloc(4), syms(4).

The "Object Files" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

NAME

acct – per-process accounting file format

SYNOPSIS

```
#include <sys/acct.h>
```

DESCRIPTION

Files produced as a result of calling acct(2) have records in the form defined by <sys/acct.h>, whose contents are:

```
typedef  ushort comp_t;  /* "floating point" */
                         /* 13-bit fraction, 3-bit exponent  */

struct  acct
{
   char     ac_flag;     /* Accounting flag */
   char     ac_stat;     /* Exit status */
   ushort   ac_uid;      /* Accounting user ID */
   ushort   ac_gid;      /* Accounting group ID */
   dev_t    ac_tty;      /* control typewriter */
   time_t   ac_btime;    /* Beginning time */
   comp_t   ac_utime;    /* acctng user time in clock ticks */
   comp_t   ac_stime;    /* acctng system time in clock ticks */
   comp_t   ac_etime;    /* acctng elapsed time in clock ticks */
   comp_t   ac_mem;      /* memory usage in kbytes */
   comp_t   ac_io;       /* chars trnsfrd by read/write */
   comp_t   ac_rw;       /* number of block reads/writes */
   char     ac_comm[8];  /* command name */
};
```

Also defined are the following symbolic names:

```
AFORK /* has executed fork, but no exec */ ASU   /* used super-
user privileges */ ACCTF /* record type: 00 = acct */
```

In *ac_flag*, the AFORK flag is turned on by each fork(2) and turned off by an exec(2). The *ac_comm* field is inherited from the parent process and is reset by any exec. Each time the system charges the process with a clock tick, it also adds to *ac_mem* the current process size, computed as follows:

(data size) + (text size) / (number of in-core processes using text)

The value of *ac_mem / (ac_stime + ac_utime)* can be viewed as an approximation to the mean process size, as modified by text-sharing.

The structure `tacct.h`, which resides with the source files of the accounting commands, represents the total accounting format used by the various accounting commands:

```
/*
 *  total accounting (for acct period), also for day
 */

struct tacct {
   uid_t           ta_uid;       /* userid */
   char            ta_name[8];   /* login name */
   float           ta_cpu[2];    /* cum. cpu time, p/np (mins) */
   float           ta_kcore[2];  /* cum kcore-minutes, p/np */
   float           ta_con[2];    /* cum. connect time, p/np, mins */
   float           ta_du;        /* cum. disk usage */
   long            ta_pc;        /* count of processes */
   unsigned short  ta_sc;        /* count of login sessions */
   unsigned short  ta_dc;        /* count of disk samples */
   unsigned short  ta_fee;       /* fee for special services */
};
```

SEE ALSO

acct(2), exec(2), fork(2).
acct(1M) in the *System Manager's Reference for the DG/UX System.*
acctcom(1) in the *User's Reference for the DG/UX System.*

NOTES

The *ac_mem* value for a short-lived command gives little information about the actual size of the command because *ac_mem* may be incremented while a different command (like the shell) is being executed by the process.

NAME

`aliases` – addresses and aliases for sendmail

DESCRIPTION

These files contain mail addresses or aliases, recognized by `sendmail`(1M), for the local host:

`/etc/passwd`	Mail addresses (usernames) of local users.
`/etc/aliases`	Aliases for the local host, in ASCII format. This file can be edited to add, update, or delete local mail aliases.
`/etc/aliases.{dir,pag}`	The aliasing information from `/etc/aliases`, in binary, dbm(3X) format for use by `sendmail`(1M). The program `newaliases` maintains these files.
`~/.forward`	Addresses to which a user's mail is forwarded.
`mail.aliases`	If you are running ONC/NFS, this Network Information Service (NIS) aliases map contains addresses and aliases available for use across the network.

As distributed, `sendmail`(1M) supports the following types of mail addresses:

- Local usernames. These are listed in the local host's `/etc/passwd` file.
- Local filenames. When mailed to an absolute pathname, a message can be appended to a file.
- Commands. If the first character of the address is a vertical bar, (|), `sendmail`(1M) pipes the message to the standard input of the command the bar precedes.
- Internet mail addresses of the form:

  name@domain

  If *domain* does not contain any '.' (dots), then it is interpreted as the name of a host in the current domain. Otherwise, the message is passed to a *mailhost* that determines how to get to the specified domain. Domains are divided into subdomains that are separated by dots, with the top-level domain on the right. Top-level domains include the following:

`.com`	Commercial organizations.
`.edu`	Educational organizations.
`.gov`	Government organizations.
`.mil`	Military groups.
`.org`	Other organizations.

  For example, the full address of K. Owen could be:

  `owen@cs.unc.edu`

  if he can be reached through the subdomain named "cs" at the University of North Carolina.

- uucp(1) addresses of the form:

  ... [*host*!]*host*!*username*

  Addresses such as these are sometimes referred to as "Usenet" addresses. uucp(1) provides links to numerous sites throughout the world for the remote copying of files.

Other site-specific forms of addressing can be added by customizing the `sendmail` configuration file. See the `sendmail`(1M) man page and "Configuring and Using sendmail" in *Managing TCP/IP on the DG/UX System* for details. Standard addresses are recommended.

The `/etc/aliases` file is formatted as a series of lines of the form

aliasname: *address*[, *address*]

aliasname is the name of the alias or alias group, and *address* is the address of a recipient in the group. Aliases can be nested. That is, an *address* can be the name of another alias group. Because of the way `sendmail` performs mapping from uppercase to lowercase, an *address* that is the name of another alias group must not contain any uppercase letters.

Lines beginning with white space are treated as continuation lines for the preceding alias. Lines beginning with `#` are comments.

Given an alias of the following form:

aliasname: *address*, *address*, *address*

an alias such as the following:

`owner-`*aliasname*: *erraddress*

directs error-messages resulting from mail to *aliasname* to *erraddress*, instead of back to the person who sent the message.

An alias of the form:

aliasname: `:include:`*pathname*

with colons as shown, adds the recipients listed in the file *pathname* to the *aliasname* alias. This allows a private list to be maintained separately from the aliases file.

When an alias (or address) is resolved to the name of a user on the local host, `sendmail` checks for a `.forward` file, owned by the intended recipient, in that user's home directory, and with universal read access. This file can contain one or more addresses or aliases as described above, each of which is sent a copy of the user's mail.

Care must be taken to avoid creating addressing loops in the `.forward` file. (See **"ONC/NFS-specific Information"** below for additional information specific to ONC/NFS.)

A backslash before a username in the `.forward` file inhibits further aliasing. Suppose user `owen` had the following `.forward` file:

```
Postmaster
\owen
```

Mail for `owen` will be redirected to `Postmaster`, but a copy also is sent to `owen`. The `sendmail` program will not alias a username following the backslash.

ONC/NFS-specific Information

If you are running ONC/NFS, the following information applies in addition to the `mail.aliases` file cited above:

Normally, the aliases file on the master NIS server is used for the `mail.aliases` NIS map, which can be made available to every NIS client. Thus, the `/etc/aliases*` files on the various hosts in a network will be largely used to provide host specific aliases. Domain-wide aliases should ultimately be resolved into user-names on specific hosts. For example, if the following were in the domain-wide alias file:

```
mlee:ml@mlmachine
```

then any NIS client could just mail to `mlee` and not have to remember the machine and username for Mike Lee.

When forwarding mail between machines, be sure that the destination machine does not return the mail to the sender through the operation of any NIS aliases. Otherwise, copies of the message may "bounce." Usually, the solution is to change the NIS alias to direct mail to the proper destination.

FILES

```
/etc/passwd
/etc/aliases
/etc/aliases.dir
/etc/aliases.pag
~/.forward
```

SEE ALSO

uucp(1), dbm(3X), sendmail(1M).

BUGS

Because of restrictions in dbm(3X) a single alias cannot contain more than about 1000 characters. Nested aliases can be used to circumvent this limit.

NAME

ar – DG/UX common archive file format

DESCRIPTION

The archive command `ar` is used to combine several files into one. Archives are used mainly as libraries to be searched by the link editor `ld`.

Each archive begins with the archive magic string.

```
#define  ARMAG   "!<arch>\n"   /* magic string */
#define  SARMAG  8             /* length of magic string */
```

Following the archive magic string are the archive file members. Each file member is preceded by a file member header which is of the following format:

```
#define  ARFMAG    "`\n"  /* header trailer string */

struct  ar_hdr            /* file member header */
{
    char    ar_name[16]; /* '/' terminated file member name */
    char    ar_date[12]; /* file member date */
    char    ar_uid[6];   /* file member user identification */
    char    ar_gid[6];   /* file member group identification */
    char    ar_mode[8];  /* file member mode (octal) */
    char    ar_size[10]; /* file member size */
    char    ar_fmag[2];  /* header trailer string */
};
```

All information in the file member headers is in printable ASCII. The numeric information contained in the headers is stored as decimal numbers (except for *ar_mode* which is in octal). Thus, if the archive contains printable files, the archive itself is printable.

If the file member name fits, the *ar_name* field contains the name directly, and is terminated by a slash (/) and padded with blanks on the right. If the member's name does not fit, *ar_name* contains a slash (/) followed by a decimal representation of the name's offset in the archive string table described below.

The *ar_date* field is the modification date of the file at the time of its insertion into the archive. Common format archives can be moved from system to system as long as the portable archive command `ar` is used.

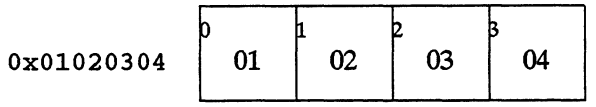
Each archive file member begins on an even byte boundary; a newline is inserted between files if necessary. Nevertheless, the size given reflects the actual size of the file exclusive of padding.

Notice there is no provision for empty areas in an archive file.

Each archive that contains object files [see `a.out`(4)] includes an archive symbol table. This symbol table is used by the link editor `ld` to determine which archive members must be loaded during the link edit process. The archive symbol table (if it exists) is always the first file in the archive (but is never listed) and is automatically created and/or updated by `ar`.

The archive symbol table has a zero length name (i.e., `ar_name[0]` is `'/'`), `ar_name[1]==' '`, etc.). All "words" in this symbol table have four bytes, using the machine-independent encoding shown below. (All machines use the encoding

described here for the symbol table, even if the machine's "natural" byte order is different.)



The contents of this "file" are as follows:

1. The number of symbols. Length: 4 bytes.
2. The array of offsets into the archive file. Length: 4 bytes * "the number of symbols".
3. The name string table. Length: *ar_size* − 4 bytes * ("the number of symbols" + 1).

As an example, the following symbol table defines 4 symbols. The archive member at file offset 114 defines `name` and `object`. The archive member at file offset 426 defines `function` and a second version of `name`.

Offset	+0	+1	+2	+3	
0	4				4 offset entries
4	114				name
8	114				object
12	426				function
16	426				name
20	n	a	m	e	
24	\0	o	b	j	
28	e	c	t	\0	
32	f	u	n	c	
36	t	i	o	n	
40	\0	n	a	m	
44	e	\0			

The number of symbols and the array of offsets are managed with `sgetl` and `sputl`. The string table contains exactly as many null terminated strings as there are elements in the offsets array. Each offset from the array is associated with the corresponding name from the string table (in order). The names in the string table are all the defined global symbols found in the common object files in the archive. Each offset is the location of the archive header for the associated symbol.

If some archive member's name is more than 15 bytes long, a special archive member contains a table of file names, each followed by a slash and a new-line. This string table member, if present, will precede all "normal" archive members. The special archive symbol table is not a "normal" member, and must be first if it exists. The *ar_name* entry of the string table's member header holds a zero length name `ar_name[0]=='/'`, followed by one trailing slash (`ar_name[1]=='/'`), followed by blanks (`ar_name[2]==' '`, etc.). Offsets into the string table begin at zero. Example *ar_name* values for short and long file names appear below.

Offset	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
0	f	i	l	e	_	n	a	m	e	_
10	s	a	m	p	l	e	/	\n	l	o
20	n	g	e	r	f	i	l	e	n	a
30	m	e	x	a	m	p	l	e	/	\n

Member Name	*ar_name*	Note
short-name	short-name/	Not in string table
file_name_sample	/0	Offset 0 in string table
longerfilenamexample	/18	Offset 18 in string table

SEE ALSO

ar(1), ld(1), strip(1), sputl(3X), a.out(4).

NOTES

strip will remove all archive symbol entries from the header. The archive symbol entries must be restored via the -ts options of the ar command before the archive can be used with the link editor ld.

NAME

bootparams – boot parameter data base

SYNOPSIS

/etc/bootparams

DESCRIPTION

The bootparams file contains the list of client entries that diskless clients use for booting. For each diskless client the entry should contain the following information:

name of client
a list of keys, names of servers, and pathnames.

The first item of each entry is the name of the diskless client. The subsequent item is a list of keys, names of servers, and pathnames.

Items are separated by TAB characters. A line-continuation character () can be used, but it must be preceded by TAB or SPACE characters (see EXAMPLE).

EXAMPLE

Here is an example of the /etc/bootparams file:

```
myclient     root=myserver:/srv/release/PRIMARY/root/myhost \
       swap=myserver:/srv/release/PRIMARY/swap/myhost \
       dump=myserver:/srv/release/PRIMARY/dump/myhost
```

Root specifies the pathname of the executable file to boot. This file must exist to boot the client. Swap gives the pathname of the swap area file. The swap file is a fixed-sized file that must be pre-allocated to an appropriate size. Dump specifies the pathname of the system dump file, where system information is written following a system crash. This file must exist to dump the system crash information. During a system crash, this entry is optional for DG/UX clients; however, non-DG/UX clients may require it. If there is no dump entry, an attempted dump will fail.

FILES

/etc/bootparams

SEE ALSO

bootparamd(1M).

NAME

checklist – list of file systems processed by fsck and ncheck

DESCRIPTION

Checklist may reside in directory /etc and contain a list of special file names. Each special file name is contained on a separate line and corresponds to a file system. Each file system will then be automatically processed by the fsck(1M) and ncheck(1M) commands. You have to create the checklist file yourself; the system does not create it for you.

If you have your special files in fstab, you do not need to create a checklist file to get fsck to process them.

SEE ALSO

fsck(1M) and ncheck(1M) in the *System Manager's Reference for the DG/UX System*.
fstab(4).

NAME

compver – compatible versions file

DESCRIPTION

compver is an ASCII file used to specify previous versions of the associated package which are upward compatible. It is created by a package developer.

Each line of the file specifies a previous version of the associated package with which the current version is backward compatible.

Since some packages may require installation of a specific version of another software package, compatibility information is extremely crucial. Consider, for example, a package called "A" which requires version "1.0" of application "B" as a prerequisite for installation. If the customer installing "A" has a newer version of "B" (version 1.3), the compver file for "B" must indicate that "1.3" is compatible with version "1.0" in order for the customer to install package "A".

NOTES

The comparison of the version string disregards white space and tabs. It is performed on a word-by-word basis. Thus "Version 1.3" and "Version 1.3" would be considered the same.

EXAMPLE

A sample compver file is shown below.

```
Version 1.3
Version 1.0
```

SEE ALSO

pkginfo(4).

NAME

`copyright` – copyright information file

DESCRIPTION

`copyright` is an ASCII file used to provide a copyright notice for a package. The text may be in any format. The full file contents (including comment lines) is displayed on the terminal at the time of package installation.

SEE ALSO

`pkginfo`(4).

NAME

core – format of core image file

DESCRIPTION

The system writes out a core image of a terminated process when any of several errors occur. See signal(2) for the list of reasons; the most common are memory violations, illegal instructions, and user-generated quit signals. The core image is called core and is written in the process's working directory (if possible; normal access controls apply). A process with an effective user id different from the real user id will not produce a core image.

The first section of the core image is a copy of the system's per-user data for the process, including the registers as they were at the time of the fault. The remainder represents the actual contents of the user's core area when the core image was written. The text segment is not dumped.

The format of the information in the first section is described by the *user* structure of the system, defined in /usr/include/sys/user.h.

SEE ALSO

sdb(1), dbx(1), setuid(2), signal(2).
crash(1M) in the *System Manager's Reference for the DG/UX System*.

NAME

cpio - format of cpio archive

DESCRIPTION

The header structure, when the -c option of cpio(1) is not used, is:

```
struct {
        short   h_magic,
                h_dev;
        ushort  h_ino,
                h_mode,
                h_uid,
                h_gid;
        short   h_nlink,
                h_rdev,
                h_mtime[2],
                h_namesize,
                h_filesize[2];
        char    h_name[h_namesize rounded to word];
} Hdr;
```

When the -c option is used, the header information is described by:

```
sscanf(Chdr,"%6o%6o%6o%6o%6o%6o%6o%6o%11lo%6o%11lo%s",
        &Hdr.h_magic, &Hdr.h_dev, &Hdr.h_ino, &Hdr.h_mode,
        &Hdr.h_uid, &Hdr.h_gid, &Hdr.h_nlink, &Hdr.h_rdev,
        &Longtime, &Hdr.h_namesize,&Longfile,Hdr.h_name);
```

Longtime and *Longfile* are equivalent to *Hdr.h_mtime* and *Hdr.h_filesize*, respectively. The contents of each file are recorded in an element of the array of varying length structures, *archive*, with other items describing the file. Every instance of *h_magic* contains the constant 070707 (octal). The items *h_dev* through *h_mtime* have meanings explained in stat(2). The length of the null-terminated path name *h_name*, including the null byte, is given by *h_namesize*.

The last record of the *archive* always contains the name TRAILER!!!. Special files, directories, and the trailer are recorded with *h_filesize* equal to zero.

SEE ALSO

stat(2).
cpio(1), find(1) in the *User's Reference for the DG/UX System*.

NAME

d_passwd – log-in programs and passwords for dial-up devices

SYNOPSIS

/etc/d_passwd

DESCRIPTION

This file contains an entry for programs (such as shells) that login(1) can invoke for users logging into the system via dial-up devices. Each entry includes the pathname of the shell program for which a dialup password is required and the encrypted password that the user must provide in order to invoke the program. You have to create a d_passwd file yourself; the system does not create one for you.

A dial-up device is any device that has an entry in the /etc/dialups file. See dialups(4). You have to create a dialups file yourself; the system does not create one for you.

When a user logs into a dial-up device, login searches the d_passwd file to see if it contains an entry for the shell program specified in the user's passwd entry. If such an entry is found, login requires that the user provide a second ("dial-up") password in addition to their personal password. The program name in the user's passwd entry and the program name in the d_passwd file must match exactly. E.g., /bin/csh and /usr/bin/csh will not be matched even though they reference the same file.

The program /usr/bin/sh is treated as a special case. If d_passwd contains an entry for /usr/bin/sh, the password for that entry will be used as the default dial-up password for all users whose passwd shell program doesn't match any of the other d_passwd entries. In the case where no matching entry is found for a user and no /usr/bin/sh entry exists, the user is not prompted for a dial-up password.

Here is a sample d_passwd entry:

```
/bin/csh:xxxxxx:
```

where xxxxxx is the encrypted password.

SEE ALSO

login(1), dialups(4).

NAME

depend – software dependencies files

DESCRIPTION

depend is an ASCII file used to specify information concerning software dependencies for a particular package. The file is created by a software developer.

Each entry in the depend file describes a single software package. The instance of the package is described after the entry line by giving the package architecture and/or version. The format of each entry and subsequent instance definition is:

type pkg name
(arch)version
(arch)version
...

The fields are:

type Defines the dependency type. Must be one of the following characters:

- P Indicates a prerequisite for installation, for example, the referenced package or versions must be installed.
- I Implies that the existence of the indicated package or version is incompatible.
- R Indicates a reverse dependency. Instead of defining the package's own dependencies, this designates that another package depends on this one. This type should be used only when an old package does not have a depend file but it relies on the newer package nonetheless. Therefore, the present package should not be removed if the designated old package is still on the system since, if it is removed, the old package will no longer work.

pkg Indicates the package abbreviation.

name Specifies the full package name.

(arch)version Specifies a particular instance of the software. A version name cannot begin with a left parenthesis. The instance specifications, both *arch* and *version*, are completely optional but must each begin on a new line that begins with white space. A null version set equates to any version of the indicated package.

EXAMPLE

Here is a sample depend file:

```
I msvr 3B2 Messaging Server
P ctc Cartridge Tape Utilities
P dfm Directory and File Management Utilities
P ed Editing Utilities
P ipc Inter-Process Communication Utilities
P lp Line Printer Spooling Utilities
P shell Shell Programming Utilities
P sys System Header Files
            Release 3.0
P sysadm System Administration Utilities
P term Terminal Filters Utilities
```

```
P terminfo Terminal Information Utilities
P usrenv User Environment Utilities
P uucp Basic Networking Utilities
P x25 X.25 Network Interface
            Issue 1 Version 1
            Issue 1 Version 2
P windowing AT&T Windowing Utilities
            (3B2)Version 1
R cms 3B2 Call Management System
```

SEE ALSO

pkginfo(4).

NAME

dialups – devices requiring a dial-up password.

SYNOPSIS

/etc/dialups

DESCRIPTION

This file contains the pathnames of devices that require an additional password, called a dial-up password, from users who attempt to log into it. An example entry might be /dev/tty16. For such devices, the login(1) command prompts the user for the dial-up password after the user has provided a valid log-in name and personal password.

Dial-up passwords must appear in the /etc/d_passwd file along with the programs (such as a shell) that login will execute after a succesful log-in at the given device.

You have to create the dialups and d_passwd files yourself; the system does not create them for you.

SEE ALSO

login(1), d_passwd(4).

`fsck`(1M) will attempt to correct the following fields if they are invalid:

fname is used by `statfs`(2), `fstatfs`(2), `labelit`(1M), `volcopy`(1M), `frec`(1M), Initialized to zeros, when used it is considered an ASCII string not necessarily terminated by a NULL byte.

fpack is used by `statfs`(2), `fstatfs`(2), `labelit`(1M), `volcopy`(1M), `frec`(1M), Initialized to zeros, when used it is considered an ASCII string not necessarily terminated by a NULL byte.

The following exponent fields pertain to the size of elements used to access user data blocks. Data elements are equal sized sets of contiguous blocks of a file. These data elements are either pointed to directly from the file node or indirectly through an index structure. Index elements are arrays of block numbers. The index structure is hierarchical; an index block number may point to another index element or, if the bottom is reached, point to a data element. The direct or indexed access of data elements depends on the size of the file and the block being accessed; blocks at the beginning of the file can be accessed through the direct access to provide faster access for smaller files since they are generally more common. The following fields control the sizes of these elements, allowing the user to choose values more suitable for the types of files that will typically fill the file system. For more information about data access from the inode, see `inode`(4).

default_des_exponent specifies the default data element size for non-directory files. The default data element size in blocks is 2 raised to the default_des_exponent power. The default value for this field is:

```
#define DF_DEFAULT_DEFAULT_DES_EXPONENT 4
```

The maximum value is:

```
#define DF_MAX_DES_EXPONENT 31
```

although it is also limited to the base 2 logarithm of the largest power of two that is less than or equal to:

```
#define DF_USER_BLOCKS_PER_DAR(dar_size, file_nodes_per_dar)
```

default_ies_exponent specifies the default index element size for non-directory files. The default index element size in blocks is 2 raised to the default_ies_exponent power. The default value for this field is:

```
#define DF_DEFAULT_DEFAULT_IES_EXPONENT 0
```

The maximum value is:

```
#define DF_MAX_IES_EXPONENT 15
```

although it is also limited to the base 2 logarithm of the largest power of two that is less than or equal to:

```
#define DF_USER_BLOCKS_PER_DAR(dar_size, file_nodes_per_dar)
```

default_dir_des_exponent specifies the default data element size for directories and CPDs. The default data element size in blocks is 2 raised to the default_dir_des_exponent power. The default value for this field is:

```
#define DF_DEFAULT_DEFAULT_DES_EXPONENT 4
```

The maximum value is:

```
#define DF_MAX_DES_EXPONENT 31
```

although it is also limited to the base 2 logarithm of the largest power of two that is less than or equal to

```
#define DF_USER_BLOCKS_PER_DAR(dar_size, file_nodes_per_dar)
```

default_dir_ies_exponent specifies the default index element size for directories and CPDs. The default index element size in blocks is 2 raised to the default_dir_ies_exponent power. The default value for this field is:

```
#define DF_DEFAULT_DEFAULT_IES_EXPONENT 0
```

The maximum value is:

```
#define DF_MAX_IES_EXPONENT 15
```

although it is also limited to the base 2 logarithm of the largest power of two that is less than or equal to:

```
#define DF_USER_BLOCKS_PER_DAR(dar_size, file_nodes_per_dar).
```

fs_size is the number of blocks in the filesystem. `fsck`(1M) will check this against the disk size as reported by the device driver.

space_used is the total (user and system) space used on this filesystem, including any space wasted at the end due to an incomplete DAR.

number_of_used_file_nodes is the number of file nodes used in the file system, not including the wasted file nodes with node numbers 0 and 1.

first_anniversary is the first anniversary of each file in blocks. When a file first consumes this much space, the filesystem should change the DAR from which it gets space for the file. The minimum value of this field is 2 raised to the default_des_exponent power; the default value is:

```
#define DF_DEFAULT_FIRST_ANNIVERSARY(dar_size)
```

second_anniversary the second anniversary of each file in blocks. A file should change the DAR from which the filesystem gets space each time its space utilization crosses a multiple of the second anniversary. The second anniversary must be greater than or equal to the first anniversary. The default value of this field is:

```
#define DF_DEFAULT_SECOND_ANNIVERSARY(dar_size)
```

first_log_lda and *second_log_lda* give the logical disk address of the two halves of the fast recovery log. They will be zero if the file system was not mounted for fast recovery when the filesystem was last mounted or if /f4fsck/fP has been run over the file system.

log_size is the size in 512-byte blocks of each half of the fast recovery log.

shrink_operation_in_progress is set if the filesystem is in the process of being shrunk.

grow_operation_in_progress is set if the filesystem is in the process of being grown.

The Disk Allocation Region (DAR)

The DAR is similar to the BSD cylinder group; however, the DAR is not necessarily associated with a physical disk cylinder as it is in BSD. The purpose of the DAR is to spread files throughout the filesystem while maintaining a locality between inodes and the data blocks associated with them.

The DAR consists of three parts: a bitmap, a file node table, and the data blocks allocated to files as they are needed.

The bitmap records the space allocation in the DAR. A bit in the bitmap represents a block in the DAR (this includes the blocks allocated for the bitmap and the file node table). If the bitmap value is 1, it is used; otherwise, it is free. The size of the bitmap is a function of the size of the DAR and is provided (in blocks) by:

```
#define DF_DAR_BITMAP_SIZE(dar_size)
```

The file node table contains entries for each file in the DAR. A file node entry (called an inode) contains information about the file. The first block of the table is after the bitmap. The number of file nodes in the DAR is a field in the FMIA. The number of blocks allocated to the table (in blocks) is:

```
#define DF_DAR_FILE_NODE_TABLE_SIZE(file_nodes_per_dar)
```

The file node table element (the inode) is discussed in `inode`(4).

The data blocks take up the remaining blocks of the DAR.

With the exception of the blocks of the DAR Information Area and the Secondary FMIA, all blocks in the file system are contained in DAR's. The number of DAR's in a file system is a function of the size of the file system, the size of each DAR, and the file nodes contained in each DAR. This is provided by:

```
#define DF_NUMBER_OF_DARS(fs_size, dar_size, nodes_per_dar)
```

The last DAR of the file system may be the smaller than the other DAR's. If the space before the DAR Information Area and the Secondary FMIA is large enough to contain the DAR's bitmap and file node table, then the DAR will be created; otherwise, the space between the end of the last DAR and the beginning of the DAR Information Area is wasted. Since the bitmap in the last DAR is the same size as the other DAR's, if the last DAR is smaller the bitmap will have bits indicating the allocation of data blocks that do not exist (in fact it is legal for no data blocks to exist in the last DAR). In this case, the non-existent blocks are marked as allocated. The following macros provide values associated with the space before the DAR Information Area:

```
#define DF_LAST_DAR_SIZE(fs_size, dar_size, nodes_per_dar)
```

```
#define DF_FS_WASTED_SPACE(fs_size, dar_size, nodes_per_dar)
```

The DAR Information Area

At the end of the file system, a table of entries exist for each DAR in the file system. It is located such that its last block of entries is before the last block of the file system containing the Secondary FMIA. This location is provided by:

```
#define DF_DARE_TABLE_ADDRESS(fs_size,dar_size,file_nodes_per_dar)
```

A definition for a DAR entry is:

```
typedef struct
    {
    uint32e_type              file_nodes_used;
    uint32e_type              space_used;
    uint32e_type              directories_used;
    df_file_node_number_type  free_file_node_number;
    byte8e_type               reserved[DF_RESERVED_BYTES_PER_DAR];
    } df_dar_entry_type;
```

file_nodes_used Number of file_nodes in use from the DAR the entry represents.

space_used is the number of data blocks in use from the DAR. This explicitly excludes DAR Information Area blocks, the block containing the Secondary FMIA, and blocks marked as allocated in the last DAR but do not exist. This field includes the following system blocks: the Primary FMIA for the first DAR only, the DAR's bitmap blocks and the DAR's file node blocks.

directories_used is the number of directories in the DAR.

free_file_node_number is the file node number of next free file node in the DAR. This functions as the head of the DAR's free file node list.

SEE ALSO

fstatfs(2), mount(2), statfs(2), inode(4). frec(1M), fsck(1M), labelit(1M), mkfs(1M), volcopy(1M) in the *System Manager's Reference for the DG/UX System*.

NAME

`fspec` – format specification in text files

DESCRIPTION

You many want to maintain text files on the DG/UX system with tabs that are not set at every eighth column. You must usually convert such files to a standard format, frequently by replacing all tabs with the appropriate number of spaces, before they can be processed by DG/UX system commands. A format specification in the first line of a text file specifies how tabs are to be expanded in the rest of the file.

A format specification consists of a sequence of parameters separated by blanks and surrounded by the brackets `<:` and `:>`. Each parameter consists of a keyletter, possibly followed immediately by a value. The following parameters are recognized:

`t`*tabs* The `t` parameter specifies the tab settings for the file. The value of *tabs* must be one of the following:

1. A list of column numbers separated by commas, indicating tabs set at the specified columns;
2. A `-` followed immediately by an integer *n*, indicating tabs at intervals of *n* columns;
3. A `-` followed by the name of a canned tab specification.

Standard tabs are specified by `t-8`, or equivalently, `t1,9,17,25`, etc. The canned tabs are defined by the `tabs`(1) command.

`s`*size* The `s` parameter specifies a maximum line size. The value of *size* must be an integer. Size is checked after tabs have been expanded, but before the margin is prepended.

`m`*margin* The `m` parameter specifies a number of spaces to be prepended to each line. The value of *margin* must be an integer.

`d` The `d` parameter takes no value. It indicates that the line containing the format specification is to be deleted from the converted file.

`e` The `e` parameter takes no value. It indicates that the current format is to prevail only until another format specification is encountered in the file.

Default values, which are assumed for parameters not supplied, are `t-8` and `m0`. If the `s` parameter is not specified, no size checking is performed. If the first line of a file does not contain a format specification, the above defaults are assumed for the entire file. The following is an example of a line containing a format specification:

```
* <:t5,10,15 s72:> *
```

For programming language source files, if you can disguise a format specification as a comment, you don't need to code the `d` parameter.

SEE ALSO

`ed`(1), `newform`(1), `tabs`(1) in the *User's Reference for the DG/UX System*.

NAME

`fstab` – static information about file systems

SYNOPSIS

```
#include <mntent.h>
```

DESCRIPTION

The file `/etc/fstab` describes the file systems and swapping areas used by the local machine. The system administrator can modify it with a text editor or by invoking the `sysadm`(1M) system administration utility. It is read by commands that mount, dump, restore, and check the consistency of file systems, as well as by the system in providing swap space. The file consists of a number of lines like this:

```
fsname dir type opts freq passno
```

for example:

```
/dev/dsk/usr  /usr  dg/ux  rw  1  1
```

would indicate a mount for a local file system, and

```
titan:/usr/titan  /usr/titan  nfs  rw,hard  0 0
```

would indicate an NFS file system mount.

A High Sierra CDROM would be indicated using the following line:

```
/dev/pdsk/4 /cdrom cdrom ro 0 0
```

A DOS floppy would be indicated using the following line:

```
/dev/pdsk/3 /pdd/floppy dos rw 0 0
```

A swap area could be indicated using the following line:

```
/dev/dsk/swap1 swap1_area swap sw 0 0
```

The `fstab` format was changed in order to support NFS file systems as well as local file systems. The old-style `fstab` entries are supported, but not recommended.

The entries from this file are accessed using the routines in `getmntent`(3C), which returns a structure of the following form:

```
struct mntent {
        char    *mnt_fsname;    /* file system name */
        char    *mnt_dir;       /* file system path prefix */
        char    *mnt_type;      /* dg/ux, nfs, swap, cdrom, or ignore */
        char    *mnt_opts;      /* rw, ro, hard, soft, bg, fg */
        int     mnt_freq;       /* highest dump level */
        int     mnt_passno;     /* pass number on parallel fsck */
};
```

Fields are separated by white space; a #, as the first non-white character, indicates a comment. The *mnt_type* field determines how the *mnt_fsname* and *mnt_opts* fields will be interpreted. The following is a list of the file system types currently supported, and the way each of them interprets these fields:

Type	*Field*	*Interpretation*
dg/ux	mnt_fsname	Must be a block special device unless this is a ramdisk, in which case, it is a symbolic link to the mounted memory file system.
	mnt_opts	Valid options are ro, rw, bg, and fg. If this has the ramdisk option, other options include use_wired_memory, max_file_space and max_file_count.
cdrom	mnt_fsname	Must be a block special device.
	mnt_opts	Valid options are ro, bg, fg.
dos	mnt_fsname	Must be a block special device.
	mnt_opts	Common options are ro, rw, bg, fg.
nfs	mnt_fsname	The hostname of the server and the pathname on the server of the directory to be served. A colon separates the pathname and hostname.
	mnt_opts	Valid options are ro, rw, hard, soft, bg, fg.
swap	mnt_fsname	Must be a block special device swap section.
	mnt_opts	Ignored.

If the *mnt_type* is specified as *ignore*, the entry is ignored. This is useful to show disks not currently used.

Entries identified as *swap* are made available as swap space by the *swapon(1M)* command at the end of the system reboot procedure.

When the *mnt_fsname* field is interpreted as a block special device, programs that require the corresponding character special device must construct the name by changing *dsk* to *rdsk* in the pathname.

If the *mnt_opts* field is a comma-separated list of options that includes `rw` or `ro`, the file system is mounted read-write or read-only. If this includes `hard` or `soft`, the NFS file system is mounted `hard` or `soft`. If the list includes `bg` or `fg`, and failed attempt to mount will cause `mount` to retry in the background or in the foreground. For more details on these options, see `mount`(1M).

The field *mnt_freq* indicates how often each file system should be dumped by the *dump2*(1M) command (and triggers that command's `w` option, which determines what file systems should be dumped). Most systems set the *mnt_freq* field to 1, indicating that file systems are dumped each day. Some programs, like *sysadm*, may use a different set of entries here.

The final field *mnt_passno* is used by the consistency checking program `fsck`(1M) to allow overlapped checking of file systems during a reboot. All file systems with a *mnt_passno* of 1 are checked first simultaneously, then all file systems with *mnt_passno* of 2 are checked, and so on. A value of 0 indicates that the file system will not be checked. The <*mnt_passno*> of the root file system should be 0, as the

root cannot be checked since it is already mounted.

Programs read the `/etc/fstab` file but never write to it. It is the duty of the system administrator to maintain this file. The order of records in `/etc/fstab` is important because *fsck* and *mount* process the file sequentially; file systems must appear after file systems they are mounted within. For example, if you have an entry for `/usr/spool`, it must appear after the entry for `/usr`.

FILES

/etc/fstab

SEE ALSO

`dump2`(1M), `fsck`(1M), `mount`(1M), `swapon`(1M), `sysadm`(1M), `getfsent`(3C), `getmntent`(3C).

NAME

group – group file

SYNOPSIS

/etc/group

DESCRIPTION

Group is an ASCII file containing a one-line entry for each group recognized by the system. The file format is as follows:

groupname:*password*:*gid*:*user-list*

where:

groupname	The name of the group.
password	An encrypted password.
gid	The group's numerical ID within the system; it must be unique.
user-list	A comma-separated list of users allowed in the group.

If the password field is empty, no password is demanded. Because of the encrypted passwords, the group file can and does have general read permission and can be used, for example, to map numerical group IDs to names.

Malformed entries cause routines that read this file to halt, in which case group assignments specified further along are never made. grpck can be used to verify entries in the group file. See pwck(1M) in the *System Manager's Reference for the DG/UX System*.

ONC/NFS Features

If you are using the DG/UX Open Network Computing/Network File System (ONC/NFS), a group file can have a line beginning with a plus sign (+), which means to incorporate an entry or entries from the Network Information Service (NIS). There are two styles of + entries. By itself, + means to insert the entire contents of the NIS group file at that point; +*groupname* means to insert the entry (if any) for *groupname*. If a + entry has a non-empty *password* or *user-list* field, the contents of that field override the corresponding field from the NIS. The *gid* field cannot be overridden in this way.

An entry can also begin with a minus (–); –*groupname* means to disallow *groupname*. All subsequent entries for the indicated *groupname*, whether originating from the NIS or the local group file, are ignored.

EXAMPLE

```
primary:q.mJzTnu8icF.:10:fred,mary
+myproject:::bill,steve
+:
```

If these entries appear at the end of a group file, then the group primary will have members fred and mary, and a group ID of 10. The group myproject will have members bill and steve, and the password and group ID of the NIS entry for the group myproject. All groups listed in the NIS are pulled in and placed after the entry for myproject.

FILES

/etc/group

SEE ALSO

setgroups(2), crypt(3C), crypt(3X), passwd(4), groups(1), newgrp(1), passwd(1), su(1), pwck(1M).

NOTES

The passwd(1) command won't change group passwords.

Normally, group-ids less than 100 are reserved for system-level use (DG/UX software).

NAME

hfm – high sierra file manager

DESCRIPTION

The DG/UX kernel provides configurable support for High Sierra and ISO 9660 formatted Compact Discs (CDs). The high sierra file manager lets the system administrator mount a CD into the UNIX file system hierarchy. A mounted CD will appear as a readonly UNIX file system. The mode of all files from the CD will be readonly and executable for user, group and other.

Filenames in High Sierra or ISO 9660 format are uppercase, but for convenience, they are translated to lowercase by the high sierra file manager. All input filenames are similarly translated to uppercase. High Sierra and ISO 9660 mounted file systems can be NFS exported in the same way as any normal DG/UX file system. The mount point must be added to `/etc/exports` and the `exportfs`(1M) command must be executed after the file system is mounted. This will be automatic if the mount of the CD is in your `/etc/fstab` file. Since most current CDs available in high sierra or ISO 9660 format are for PC's, the high sierra file manager will be most useful when used with a DOS emulator.

In order to use the high sierra file manager, you must configure the hfm() pseudo device into your kernel.

```
sd(insc(),*)
st(insc(),*)
inen()
loop()
pmt()
prf()
meter()
hfm()       # this is the line that must be added.
```

Once the kernel is built and running, you may use the `mount`(1M) command to add the high sierra or ISO 9660 file system to the UNIX file system hierarchy.

```
mount -t cdrom /dev/pdsk/4 /pdd/cdrom
```

The special device mentioned in the mount command is the block special representation of the CD device in `/dev/pdsk`. The type "cdrom" must be used with mount to route the mount request to the correct file manager.

You may add a line to the /etc/fstab file to have the mount occur when the system is brought up to init level 3.

```
/dev/pdsk/4 /pdd/cdrom  cdrom ro x 0
```

The `umount`(1M) command may be used to unmount the CD from the file system hierarchy

```
umount /pdd/cdrom
```

To export the file system on the CD, in lieu of adding it to `/etc/exports`:

```
exportfs -iv /pdd/cdrom
```

When the `mount`(1M) command is issued, the CD device will lock the CD platter into the unit until a successful `umount`(1M) is issued.

The high sierra file manager does not support the path table or the extended attribute record from files on the CD, as these are unnecessary to the UNIX file system implementation.

SEE ALSO

config(1M), exportfs(1M), mount(1M), umount(1M), fstab(4).

NAME

holidays – accounting information used to distinguish prime and non-prime days

SYNOPSIS

/usr/lib/acct/holidays

DESCRIPTION

The holidays file distinguishes between *prime* and *non-prime* time for the accounting system. It divides weekdays into two pieces, and it divides the year into prime and non-prime days. Weekends are always non-prime. Additional company holidays can be specified as non-prime.

Comment lines are denoted by an asterisk in column one.

The first non-comment line contains three fields, separated by white space. The first field is the four-digit current year. The second field is the start of prime time, specified as four digits in the form *hhmm* (for hour and minute). The third field is the start of non-prime time, specified in the same way. The hours must be between 0 and 23, inclusive, and the minutes must be between 0 and 59, inclusive.

Subsequent lines define up to 20 non-prime days. The first field is the day of year, where January 1 has the value 1. The second field is the calendar date. The third field is the holiday name.

EXAMPLE

```
* Prime/Nonprime Table for UNIX Accounting System
*
* Curr  Prime   Non-Prime
* Year  Start   Start
*
  1989  0830    1700
*
* Day of        Calendar        Company
* Year          Date            Holiday
*
    2           Jan 2           New Year's Day Observed
  149           May 29          Memorial Day
  184           Jul 3           Day Before Independence Day
  185           Jul 4           Independence Day
  247           Sep 4           Labor Day
  327           Nov 23          Thanksgiving
  328           Nov 24          Day After Thanksgiving
  359           Dec 25          Christmas Day
```

SEE ALSO

acctcon(1M), acctprc(1M).

NAME

`hosts` – hostname database

DESCRIPTION

The `hosts` file contains information about the known hosts on the network. For each host, a single line should be present with the following information:

Internet_address hostname [*aliases*] [# *comment*]

Items are delimited by any number of blanks and/or tab characters. A # character indicates the beginning of a comment; characters up to the end of the line are not interpreted by routines that search the file.

For ARPANET systems only: The `hosts` file is often created from the official host database maintained at the DARPA Network Information Center (NIC). However, local changes may be required to update the file for unofficial aliases and/or unknown hosts.

Network addresses are specified in conventional dot notation for use by the `inet_addr` routine from the Internet address manipulation library, `inet`(3N).

A *hostname* can be a domain name or a single component of a domain name; see `hostname`(5) for details. A component consists of up to 24 characters drawn from the lowercase alphabet (a-z), uppercase alphabet (A-Z), digits (0-9), and minus sign (-). Periods are only allowed when they serve to delimit components of domain names. No blank or space characters are permitted as part of a component. No distinction is made between upper and lower case. The first character of a component must be an alphabetic character. The last character can not be a minus sign or period. Single character names or nicknames are not allowed.

If your system is using either the Network Information Service (NIS) or the Domain Name System (DNS), host names and address mappings are handled differently. For details on NIS, see *Managing ONC™/NFS® and Its Facilities on the DG/UX™ System*. For details on DNS, see *Managing TCP/IP on the DG/UX™ System*. The `svcorder` file determines how name/address resolution is done on your system. See the `svcorder`(4) manual page for details.

EXAMPLES

```
85.0.0.31 hostB HOSTB #Comment
85.0.0.32 hostC HOSTC #Greg's Office
```

FILES

```
/etc/hosts
```

SEE ALSO

`gethostent`(3N), `svcorder`(4).

NAME

`idl` – interface description language

DESCRIPTION

`Idl` is a language for describing interfaces without respect to the display mechanism which is used to present the information. The interface is described in terms of the menus, screens, and queries that are presented to the user. The language contains statements which can be used to define the entire menu hierarchy.

`Idl` files are read by the interface description interpreter and compiler, `idi`(1) and `idc`(1).

Syntax

The language is free format, with whitespace separating tokens. Whitespace is one or more spaces, tabs, or newlines. The character `#` indicates that the remainder of a line is a comment.

The language is built up from several primitive token types: *name*s, *value*s, *number*s, and *keyword*s.

A *name* is a sequence of letters, digits, and underscores. A *value* is a sequence of characters other than double quote ("). If the *value* contains whitespace, it must be surrounded by double quotes. A *number* is a sequence of one or more digits (with an optional leading sign character) which is interpreted as a base 10 number.

The following *keyword*s are reserved, and may not be used otherwise:

```
add         boolquery    end          export
menu        operation    querygroup   rangequery
screen      selectquery  set          text
textquery   to
```

The syntax of the language is described below:

statement:

```
menu name [ menu-attributes ] ... end
operation name [ operation-attributes ] ... end
text name [ text-attributes ] ... end
screen name [ screen-attributes ] ... end
querygroup name [ querygroup-attributes ] ... end
textquery name [ textquery-attributes ] ... end
boolquery name [ boolquery-attributes ] ... end
selectquery name [ selectquery-attributes ] ... end
rangequery name [ rangequery-attributes ] ... end
set name = value
add name1 to name2
export name
```

These statements, except the `set`, `add`, and `export` statements, create an instance of a database class. For example, a `menu` statement creates an instance of the *menu* class; the instance is named *name* and has the attributes specified by *menu-attributes*.

Each of the attribute lists (*menu-attributes*, *operation-attributes*, and so on) are of the form:

attribute-list:

[*attribute-list*] *attribute-item*

attribute-item:

name = *value*

Below are the other "types" which the value of an attribute may take.

name-list:
name
"[*name-list*] *name*"

value-list:
value
"[*value-list*] *value*"

command:
value

A *command* is different from a *value* in that a *command* is a string which has meaning if passed to the shell (sh(1)) for execution.

boolean:
${YES}
${NO}

direction:
${HORIZONTAL}
${VERTICAL}

menu Class

Instances of the *menu* class are simple containers for *operations*. *Menus* are used to specify the hierarchy of *operations*. *Menus* are added to other *menus* with the add statement.

The following attributes are allowed for the *menu* class:

menu Attribute Set		
Name	**Type**	**Default**
access-groups	*name-list*	""
access-names	*name-list*	"*"
description	*value*	"No description"
help	*value*	"No help for this menu."
mnemonic	*value*	""
name	*value*	"Unnamed"
title	*value*	"Untitled"
visible	*boolean*	"${YES}"

The attributes have the following meanings:

access-groups
A whitespace-separated list of group names which are allowed access to this menu. A star ("*") means that all groups are allowed access.

access-names
A whitespace-separated list of user names which are allowed access to this menu. A star ("*") means that all users are allowed access.

description
A one-line description of the menu and what is contained under it. The description is displayed by the parent menu before this menu is selected, and may be displayed at the same time as the menu's name.

`help` A message to display if the user requests help on this menu.

`mnemonic`
A one-character abbreviation for the menu's *name*.

`name` A one or two word name for the menu. The `name` is displayed in the parent menu to identify this menu.

`title` A string, such as "Main Menu" which is used as the title for the menu. This string may be displayed above the items in the menu when this menu is selected.

`visible` A boolean indication of whether this menu will be displayed. If the value is `${NO}`, the menu will not be shown by `idi`(1).

operation Class

Instances of the *operation* class are the basic actions which can be performed by the user. *Operation*s may contain queries which must be answered before performing the action. *Operation*s are added to *menu*s with the `add` statement.

The following attributes are allowed for the *operation* class:

operation Attribute Set		
Name	**Type**	**Default**
access-groups	*name-list*	""
access-names	*name-list*	"*"
action	*command*	""
action-message	*command*	"Operation failed."
confirm	*value*	""
description	*value*	"No description"
entry-action	*command*	""
entry-action-message	*command*	"Entry action failed."
exit-action	*command*	""
exit-action-message	*command*	"Exit action failed."
help	*value*	"No help for this operation."
mnemonic	*value*	""
name	*value*	"Unnamed"
repeat	*value*	""
visible	*boolean*	"${YES}"

The attributes have the following meanings:

`access-groups`
A whitespace-separated list of group names which are allowed access to this operation. A star ("*") means that all groups are allowed access.

`access-names`
A whitespace-separated list of user names which are allowed access to this operation. A star ("*") means that all users are allowed access.

`action` A shell command line to execute when this operation is selected (after any queries for the operation are answered and confirmed). This command is not executed if the operation is canceled.

`action-message`
The error message to display if the `action` for the operation fails.

`confirm` A string to use as a confirmation prompt which must be answered before the operation is executed. If the value of this attribute is the empty string, no confirmation is performed.

`description`
A one-line description of the operation. The `description` is displayed by the parent menu before this operation is selected, and may be displayed at the same time as the operation's `name`.

`entry-action`
A shell command line to execute as soon as the operation is selected, before any screens or queries are presented. If the value of the `repeat` attribute is not empty, the `entry-action` is performed once for each iteration of the operation.

`entry-action-message`
The error message to display if the `entry-action` for the operation fails.

`exit-action`
A shell command line to execute after all processing of the operation has completed. This command is executed after the `action` command, and is executed even if the operation is canceled. If the value of the `repeat` attribute is not empty, the `exit-action` is performed after all iterations of the operation.

`exit-action-message`
The error message to display if the `exit-action` for the operation fails.

`help` A message to display if the user requests help on the operation.

`mnemonic`
A one-character abbreviation for the operation's *name*.

`name` A one or two word name for the operation. The `name` is displayed in the parent menu to identify this operation.

`repeat` A string to present before repeating the operation. If the value of this attribute is the empty string, the operation is performed only once. Otherwise, the string is presented, and the user is given the opportunity to repeat or cancel the operation.

`visible` A boolean indication of whether the operation will be made available. If the value is `${NO}`, the operation will appear in the parent menu but will not be available.

text Class

Instances of the *text* class are simple text holders. *Text* objects may be added to *querygroup*s with the `add` statement.

The following attributes are allowed for the *text* class:

text Attribute Set		
Name	**Type**	**Default**
value	*value*	""
visible	*boolean*	"${YES}"

The attributes have the following meanings:

`value` A text string to display.

`visible` A boolean indication of whether the text will be displayed.

screen Class

Instances of the *screen* class are holders for *querygroup*s. All of the *querygroup*s of a certain *screen* are guaranteed to be evaluated at the same time and before the *querygroup*s of any later *screen*s. The interface driver may also display *screen*s as separate windows. *Screen*s may be added to *operation*s with the `add` statement.

The following attributes are allowed for the *screen* class:

screen Attribute Set		
Name	**Type**	**Default**
entry-action	*command*	""
entry-action-message	*command*	"Entry action failed."
exit-action	*command*	""
exit-action-message	*command*	"Exit action failed."
title	*value*	"Untitled"
visible	*boolean*	"${YES}"

The attributes have the following meanings:

`entry-action`
A shell command line to execute when entering the screen.

`entry-action-message`
The error message to display if the `entry-action` fails.

`exit-action`
A shell command line to execute when leaving the screen. This is executed after all queries for the screen are validated, and is executed even if the user terminates the screen.

`exit-action-message`
The error message to display if the `exit-action` fails.

`title` A string such as "Add a User" which is used as a title for the screen. This string may be displayed above the queries and querygroups which compose the screen.

`visible` A boolean indication of whether the screen (and any querygroups below it) will be displayed. This attribute is evaluated after an operation is chosen, at the same time as all other screens for the operation, and before the `visible` attributes of the querygroups are evaluated.

querygroup Class

Instances of the *querygroup* class are used to group similar queries. The interface driver may use *querygroup* information to display related queries in a more attractive manner. *Querygroup*s may be added to *screen*s with the `add` statement.

The following attributes are allowed for the *querygroup* class:

querygroup Attribute Set		
Name	**Type**	**Default**
orientation	*direction*	"${VERTICAL}"
title	*value*	""
visible	*boolean*	"${YES}"

The attributes have the following meanings:

`orientation`
The preferred layout of queries within the querygroup. The value may be either `$VERTICAL` or `$HORIZONTAL`. The default is `$VERTICAL`. This attribute may be ignored by the display driver.

`title` A string describing the queries within the querygroup. This string may be displayed above the queries which compose the querygroup.

`visible` A boolean indication of whether the querygroup (and any queries below it) will be displayed. This attribute is evaluated after a screen is entered, and is evaluated at the same time as the `visible` attributes of all other querygroups for the screen.

Queries

The following attributes are allowed for all query types: *textquery*, *boolquery*, *selectquery*, and *rangequery*:

Query Attribute Set		
Name	**Type**	**Default**
confirm	*value*	""
confirm-value	*value*	""
default	*value*	""
help	*value*	"No help available."
preserve	*boolean*	"${NO}"
prompt	*value*	""
variable	*value*	""

The attributes have the following meanings:

`confirm` The string to use as a confirmation prompt which must be answered by the user before execution continues. Confirmation is performed if the value entered for the query matches the *confirm-value*.

`confirm-value`
An ed(1)-style regular expression. If the value entered for a query matches *confirm-value*, confirmation of the value is sought (using the *confirm* string as the prompt).

`default` The default value of the *variable*.

`help` The text string to display if the user requests help on the query.

`preserve`
An indication of whether the value of *variable* should be saved in a global variable. If the value of this attribute is `${YES}`, the *variable*'s value (after being validated and confirmed) is saved in a global `idl` variable

named *variable*. If the value of this attribute is `${NO}`, the *variable* is destroyed when the operation is complete.

`prompt` The text string to be displayed when the query is presented.

`variable`
The name of an `idl` variable that is set by the query. *variable*s may be referenced in other attribute strings by using the `$`*variable* notation.

textquery Class

Instances of the *textquery* class describe how to retrieve an arbitrary text entry from the user. *Textqueries* may be added to *querygroup*s or to *selectqueries* with the `add` statement.

The following attributes are allowed for the *textquery* class:

textquery Attribute Set		
Name	**Type**	**Default**
confirm	*value*	""
confirm-value	*value*	""
default	*value*	""
help	*value*	"No help available."
max-columns	*number*	"40"
max-lines	*number*	"1"
preserve	*boolean*	"${NO}"
prompt	*value*	"Enter text"
semantics	*command*	""
semantics-message	*value*	""
show-columns	*number*	"40"
show-lines	*number*	"1"
syntax	*command*	""
syntax-message	*value*	""
variable	*value*	"Text"

The `confirm`, `confirm-value`, `default`, `help`, `preserve`, `prompt`, and `variable` attributes are generic Query Attributes. The other attributes have the following meanings:

`max-columns`
The maximum number of columns of text accepted for the query.

`max-lines`
The maximum number of lines of text accepted for the query.

`semantics`
A command string to execute on the administered host to determine if the value entered for the query is semantically correct. The command must return zero if the value is correct, and return non-zero if the string is not correct. The command may be a builtin command.

`semantics-message`
The custom error message to display if the semantics check fails. If the value of this attribute is empty, the error message is generated by `idi` from the prompt and the entered value.

`show-columns`
The maximum number of columns to display at one time. The default

value for this attribute is the value of *max-columns*. This attribute may be ignored by the display driver.

`show-lines`
The maximum number of lines to display at one time. The default value for this attribute is the value of *max-lines*. This attribute may be ignored by the display driver.

`syntax` A command string to execute on the administering host to determine if the value entered for the query is syntactically correct. The command must return zero if the value is correct, and return non-zero if the value is not correct. The command may be a builtin command.

`syntax-message`
The custom error message to display if the syntax check fails. If the value of this attribute is empty, the error message is generated by `idi` from the prompt and the entered value.

boolquery Class

Instances of the *boolquery* class describe how to retrieve a positive or negative response from the user. *Boolqueries* may be added to *querygroup*s with the `add` statement.

The following attributes are allowed for the *boolquery* class:

boolquery Attribute Set		
Name	**Type**	**Default**
confirm	*value*	""
confirm-value	*value*	""
default	*boolean*	"${YES}"
help	*value*	"No help available."
preserve	*boolean*	"${NO}"
prompt	*value*	"Enter yes or no"
variable	*value*	"Bool"

The `confirm`, `confirm-value`, `default`, `help`, `preserve`, `prompt`, and `variable` attributes are generic Query Attributes.

selectquery Class

Instances of the *selectquery* class describe how to retrieve one or more choices from a list of choices. *Selectqueries* may be added to *querygroup*s with the `add` statement.

The following attributes are allowed for the *selectquery* class:

selectquery Attribute Set		
Name	**Type**	**Default**
abort-message	*value*	"No possible values."
assign-values	*value-list*	""
confirm	*value*	""
confirm-value	*value*	""
default	*value*	""
exclusive	*boolean*	"${YES}"
help	*value*	"No help available."
input-separator	*value*	", "
number	*boolean*	"${YES}"
output-separator	*value*	","
packed	*boolean*	"${YES}"
possible-values	*value-list*	""
preserve	*boolean*	"${NO}"
prompt	*value*	"Enter selection"
variable	*value*	"Selection"

The `confirm`, `confirm-value`, `default`, `help`, `preserve`, `prompt`, and `variable` attributes are generic Query Attributes. The other attributes have the following meanings:

`abort-message`
: The message to display if an operation must be aborted because the value of *possible-values* for this query is empty.

`assign-values`
: A newline-separated list of values which may be assigned to the *variable* when the user selects one of the *possible-values*. The value of this attribute may be a backquoted string which is executed to dynamically produce the list described.

`exclusive`
: If the value of this attribute is `${YES}`, only one of the *possible-values* for the query may be selected. If the value of this attribute is `${NO}`, more than one of the values may be selected.

`input-separator`
: The set of characters which may be used by the user to separate multiple selections when selecting more than one *possible-value*. This attribute is used only if the value of the *exclusive* attribute is `${NO}`.

`number`
: If the value of this attribute is `${YES}`, the *possible-values* of the query will be automatically numbered by the interface driver. If the value of this attribute is `${NO}`, the *possible-values* will not be numbered. This attribute should be set to `${NO}` when the *possible-values* are numbers so that there is no confusion between the *possible-values* and the automatically-generated numbers.

`output-separator`
: The character string which is used to separate multiple selections when assigning a value to the query's *variable*. This attribute is used only if the value of the *exclusive* attribute is `${NO}`.

`packed`
: If the value of this attribute is `${YES}`, the interface driver may conserve screen space when presenting the query. If the value is `${NO}`, screen

space may not be conserved.

`possible-values`
A newline-separated list of choices for the query. The value of this attribute may be a backquoted string which is executed to produce the list of values.

rangequery Class

Instances of the *rangequery* class describe how to retrieve a number within a given range from the user. *Rangequeries* may be added to *querygroups* with the `add` statement.

The following attributes are allowed for the *rangequery* class:

rangequery Attribute Set		
Name	**Type**	**Default**
confirm	*value*	""
confirm-value	*value*	""
default	*value*	"0"
help	*value*	"No help available"
preserve	*boolean*	"${NO}"
prompt	*value*	"Enter value"
range	*number-list*	"0 1"
semantics	*command*	""
semantics-message	*value*	""
syntax	*command*	""
syntax-message	*value*	""
variable	*value*	"Range"

The `confirm`, `confirm-value`, `default`, `help`, `preserve`, `prompt`, and `variable` attributes are generic Query Attributes. The other attributes have the following meanings:

`range` A whitespace-separated list of two numbers which are the minimum and maximum values for the query. The value of this attribute may be a backquoted string which is executed to produce the list of numbers.

`semantics`
A command string to execute on the administered host to determine if the value entered for the query is semantically correct. The command must return zero if the value is correct, and return non-zero if the value is not correct. The command may be a builtin command.

`semantics-message`
The custom error message to display if the semantics check fails. If the value of this attribute is empty, the error message is generated by `idi` from the prompt and the entered value.

`syntax` A command string to execute on the administering host to determine if the value entered for the query is syntactically correct. The command must return zero if the value is correct, and return non-zero if the value is not correct. The command may be a builtin command.

`syntax-message`
The custom error message to display if the syntax check fails. If the value of this attribute is empty, the error message is generated by `idi` from the prompt and the entered value.

set Statement

The `set` statement causes the `idl` variable named *name* to take on the value *value*. The *value* is available globally for the duration of the program.

add Statement

The `add` statement causes the database object named *name1* to be added as a sub-object of the database object named *name2*.

The following rules apply:

a. Both *name*s must be defined previously.

b. Any number of *menu*s or *operation*s may be added to a *menu*.

c. Any number of *screen*s may be added to an *operation*.

d. Any number of *querygroup*s may be added to a *screen*.

e. Any number of queries (*textquery*, *boolquery*, *selectquery*, or *rangequery*) may be added to a *querygroup*.

f. An number of *text*s may be added to a *querygroup*.

g. At most one *textquery* may be added to a *selectquery*.

export Statement

The `export` statement exports the `idl` variable named *name* (along with the variable's value) into the environment of all sub-shells. This is a function similar to the `export` command of the shell (`sh`(1)).

Compiler Directives

The following compiler directives can be used to alter the behavior of the compiler or interpreter.

`%dir` *name*
: Interpret subsequent `%include` lines relative to *name*. Such a line overrides any previous `%dir` directive.

`%include` *name*
: Read the contents of the file *name* as if the contents were present in the current file.

`%print [ object ]`
: If *object* is given, print debugging information about *object*. Otherwise, print information about all objects.

Variable Substitution

The `action`, `assign-values`, `confirm`, `default`, `help`, `possible-values`, `preserve`, `prompt`, `range`, `semantics`, and `syntax` attributes are processed so that `idl` variables may be used inside of the values for these attributes.

Variable expansion may be indicated by any of these forms:

`$`*var* or `${`*var*`}`
: If *var* is set, substitute the value of *var*. Otherwise, substitute an empty string.

`$#`*var* or `${#`*var*`}`
: Substitute the number of words found in the value of *var*. Words are separated by whitespace.

${*var*:-*val*}
If *var* is set and non-null, substitute the value of *var*. Otherwise, substitute *val*.

${*var*:+*val*}
If *var* is set and non-null, substitute *val*. Otherwise, substitute an empty string.

${*var*:?*val1*:*val2*}
If *var* is set and non-null, substitute *val1*. Otherwise, substitute *val2*.

${*var*:<*prefix*}
If *var* is set and non-null, substitute its value prefixed by *prefix*. Otherwise, substitute an empty string.

${*var*:=*text1*:*value1*;*text2*:*value2*;*textn*:*valuen*}
Compare the value of *var* with each of the *text*s, and substitute the *value* associated with the matching *text*. As many text and value pairs as are required may be included. An empty *text* may be specified to indicate a default case. If *var* matches none of the *text*s, substitute an empty string.

If the colon (:) is omitted from the above expressions, `idi` only checks whether *var* is set or not.

In all cases, *var* must be a sequence of alphanumeric characters and underscores, optionally followed by an index specification of the form

name[*index*]

where the *index* is used to select only some of the words or lines from the value of *name*. If the *index* begins with =, the *index*-th line is substituted; otherwise, the *index*-th word is substituted. Words are separated by one or more whitespace characters. The *index* is subjected to variable substitution and may consist of a single number or two numbers separated by a `-`. The first word or line of a variable's value is numbered `1`. If the first number of a range is omitted, it defaults to `1`. If the last member of a range is omitted, it defaults to `$#name`. The index `*` selects all words or lines.

If a *val* or *prefix* contains any of colon (:), semi-colon (;), or right brace (}), the character must be preceded by a backslash (\) to escape its special meaning.

Any variables found within double quotes (") are expanded. All characters between back quotes (‘) are expanded and passed to the shell (`sh`(1)) for execution, and the result of the shell execution is inserted in place of the back-quoted string. A backslash (\) preceding either $ or ‘ causes the character to lose its special meaning.

The *value* or *text* part of any of the above expressions may contain other variable references.

Pre-defined Variables

The following variables are used internally by `idi`(1) and should not be changed. These variables should be used in place of the strings they represent (for example, always use "${YES}" instead of "yes").

`YES` This is defined to be the affirmative string, `yes`.

`NO` This is defined to be the negative string, `no`.

`HORIZONTAL`
This is defined to be `horizontal`. This may be used as the value for the

`orientation` attribute of querygroups.

`VERTICAL`
: This is defined to be `vertical`. This may be used as the value for the `orientation` attribute of querygroups.

`NO_DEFAULT`
: This is defined to be `[ No default ]`. This may be used as the value for the `default` attribute of selectqueries. When this is used, the interface driver will leave the `default` for the selectquery empty if possible.

`SKILL_LEVELS`
: This is defined to be the list of possible skill levels: `Novice Intermediate Expert`. Note that this variable's value varies based on the current locale.

The following global variables are set by `idi` at run-time:

`Argc` The number of arguments passed to the `idi` process.

`Argv` The argument vector passed to the `idi` process. The first item of the vector is referenced as `$Argv[ 1 ]`.

`InterfaceName`
: The name of the chosen interface. This will be either `ascii` or `motif`. This is the only means for changing the behavior of the program based on the chosen interface.

`Locale` The locale string returned from `setlocale`(3C).

`OperationName`
: The value of the `name` attribute of the current operation. This may be used to generalize query prompts:

```
prompt = "Host Name to ${OperationName}"
```

The following global variables may be set by the `idl` programmer:

`SkillLevel`
: The chosen level of expertise. This must be one of the values from the ${SKILL_LEVELS} variable. The default is `Intermediate`.

`TitlePrefix`
: The string which precedes the actual title of windows and screens. The default is the empty string.

`TitleSuffix`
: The string which follows the actual title of windows and screens. The default is the empty string.

Builtin Commands

Several builtin commands are provided for use in values for the `action`, `semantics`, and `syntax` attributes. The builtin commands are the following:

`:Confirm` *confirmation-string*
: Present the *confirmation-string* to the user using the appropriate interface driver. Return zero if the string is confirmed; return non-zero if it is not confirmed.

`:DoOp` *operation-name* [*confirmation-string*]
: Perform the *operation-name* operation. If the *confirmation-string* is used,

ask for confirmation before the operation is performed. If the confirmation fails, exit with status 0; otherwise, exit with the exit status of the operation.

`:Echo` *message*
Echo the *message* to the display.

`:Error` *message*
Display the error *message* in a way appropriate for the interface driver.

`:Help` *help-text*
Present a help message to the user. The *help-text* is a `text` object containing the text of the help message.

`:Log` *message*
Append the *message* to the log file. The *message* is written regardless of the verbosity level chosen by the user.

`:Match` *regexp string*
Return zero if the *string* matches the given `egrep`(1)-style regular expression, *regexp*; otherwise, return non-zero. This command is useful in the `syntax` attribute of queries.

`:Numeric` *lower-bound upper-bound value*
Return zero if the integer *value* given is within the range specified by *lower-bound* and *upper-bound*. This command is useful in the `syntax` attribute of queries.

`:Quit` *exit-code*
Terminate the program with *exit-code* as the status code.

`:Restart` [*command-line*]
Restart the interface driver, optionally using the supplied *command-line*. If the *command-line* is not given, the current command line is used. This operation may be used to take into account new or changed description files.

`:Run` *command*
Execute an interactive *command* on the host system. The standard input, output, and error file descriptors are set appropriately.

`:Set` *variable value*
Set the global *variable* to *value*. The *variable* is then available for use by other queries. The *variable* is created if it does not exist, or modified if it does exist.

`:Show` Dump the values of all variables to stdout. This is useful for debugging.

`:Unimp` *message*
Display a *message* indicating that some feature is unimplemented. *message* should describe the feature not implemented.

`:Unset` *variable*
Remove the global *variable* and its value. This command should only be used for *variable*s which are set using the `:Set` builtin command.

`:Warning` *message*
Display the warning *message* in a way appropriate for the interface driver.

EXAMPLES

Below is a sample `idl` file which creates a single menu with several operations which could be used to manage the /etc/ethers database file.

```
        ######################################################################
        #
        #  Some patterns used here
        #
        ######################################################################

        set STD_HOST_NAME_PATTERN   = "^[a-zA-Z][-.a-zA-Z0-9]*\$"

        set STD_HOST_NAME_HELP =
        "Enter an Internet host name.  A host name may contain the characters:
                        a-z  A-Z  0-9  .  -
        It should begin with a letter (a-z or A-Z) and be no more
        than 32 characters in length.  It should not contain a . or -
        as the last character."

set STD_ETHER_ADDRESS_PATTERN                   =
"^[0-9a-fA-F]+:[0-9a-fA-F]+:[0-9a-fA-F]+:[0-9a-fA-F]+:[0-9a-fA-F]+:[0-9a-fA-F]+\$"

        set STD_ETHER_ADDRESS_HELP =
        "Enter an Ethernet address.  An Ethernet address has the form:
                        aa:bb:cc:dd:ee:ff
        where a, b, c, d, e, f are two-digit hexadecimal numbers 00 and ff.
        The numbers are separated by colons.  You must enter all 17 characters."

        set dg_EthersFile = "/etc/ethers"

        ######################################################################
        #
        #  Main menu
        #
        ######################################################################

        menu main
            name = "Main"
            title = "Main Menu"
            description = "Top level menu"
            help =
        "This is the first level menu.  It contains a sub-menu for
        manipulating the ethers database."
        end

        ######################################################################
        #
        #  Ether menu
        #
        ######################################################################

        menu dg_Ether
            name = "Ether"
            mnemonic = E
            title = "Ethers Menu"
            description = "Manipulate the ethers databases"
            help =
```

```
"This menu provides access to the ethers databases.  There are
operations for adding, deleting, modifying, and listing entries
from the database."
end

#####################################################################
#
#  Operations
#
#####################################################################

operation dg_EtherAdd
    name = Add
    mnemonic = A
    action = "admether -o add -a ${NetAddress}
    description = "Add an entry to the ethers database"
    help =
"The Add operation takes a host name and an Ethernet address and adds
an entry to the ethers database."
    exit-action = ":Unset DefaultString"
end

operation dg_EtherDelete
    name = Delete
    mnemonic = D
    action = "admether -odelete
    description = "Delete entry from the ethers database"
    confirm = "Delete ${HostName} from the ethers database?"
    help =
"The Delete operation takes one or more host names and
deletes the corresponding entry or entries from the
ethers database."
end

operation dg_EtherModify
    name = Modify
    mnemonic = M
    action =
"admether -o modify -n ${NewHostName} -a ${NetAddress}
    description = "Modify an entry in the ethers database"
    help =
"The Modify operation takes a host name and allows the user to modify
the corresponding entry in the ethers file.
The user may modify the host name and the Ethernet address."
    exit-action = ":Unset DefaultString"
end

operation dg_EtherList
    name = List
    mnemonic = L
    action = "admether -o list"
    description = "List entries from the ethers database"
    help =
```

```
      "The List operation displays the contents of the ethers database
      for one or more hosts."
      end

      ######################################################################
      #
      #  Screens, querygroups, and queries
      #
      ######################################################################

      screen dg_AddEtherScreen
          title = "Add an Ethers Entry"
          entry-action = ":Set DefaultString 00:00:00:00:00:00 NewName"
      end

      #
      #  This querygroup and its queries are used for entering a
      #  new ether entry.  The defaults are stored in the DefaultString
      #  variable, and should be set by the screen.
      #

      querygroup dg_NewEtherEntryQG
      end

      textquery dg_HostNameText
          prompt = "Host Name"
          variable = HostName
          syntax = ":Match ${STD_HOST_NAME_PATTERN} ${HostName}"
          help = "${STD_HOST_NAME_HELP}

      This is the name of the host as it should appear in the
      ethers database."
          #
          #  Do different checks based on whether we're adding or
          #  listing.
          #
semantics = "${OperationName=Add:test -z '`grep ${HostName} ${dg_EthersFile}`';\
:test -n '`grep ${HostName} ${dg_EthersFile}`'}"
          default = "${DefaultString[2]}"
      end

      textquery dg_EthernetText
          prompt = "Ethernet address"
          variable = NetAddress
          syntax = ":Match ${STD_ETHER_ADDRESS_PATTERN} ${NetAddress}"
          help = "${STD_ETHER_ADDRESS_HELP}

      This is the Ethernet address of the host as it should appear
      in the ethers database."
          default = "${DefaultString[1]}"
      end

      #
```

```
#  This screen, querygroup, and query are shared between Delete
#  and List, because both operations need to choose one or more
#  existing host names.
#

screen dg_HostNameListScreen
    title = "${OperationName} Ethers Entry(ies)"
end

querygroup dg_HostNameListQG
end

selectquery dg_HostName
    prompt = "Host Name(s)"
    possible-values = "all
`admether -o list -q | cut -f2 -d' '`"
    exclusive = "$NO"
    variable = HostName
    default = "${NO_DEFAULT}"
    help = "
This is the name of the host(s) to ${OperationName}."
end

#
#  This screen and its queries are used for getting a single
#  existing entry which will be modified.
#

screen dg_ModifyEtherScreen1
    title = "Modify an Ethers Entry"
end

querygroup dg_ModifyEtherQG1
end

screen dg_ModifyEtherScreen2
    title = "Modify an Ethers Entry"
    entry-action = ":Set DefaultString `admether -o list -q ${HostName}`"
end

selectquery dg_OldHostName
    prompt = "Old Host Name"
    possible-values = "`admether -o list -q | cut -f2 -d' '`"
    exclusive = "$YES"
    variable = HostName
    help = "
This is the name of the host whose database entry is to
be modified."
end

add dg_Ether to main
add dg_EtherAdd to dg_Ether
    add dg_AddEtherScreen to dg_EtherAdd
```

```
                    add dg_NewEtherEntryQG to dg_AddEtherScreen
                        add dg_HostNameText to dg_NewEtherEntryQG
                        add dg_EthernetText to dg_NewEtherEntryQG

        add dg_EtherDelete to dg_Ether
            add dg_HostNameListScreen to dg_EtherDelete
                        add dg_HostNameListQG to dg_HostNameListScreen
                            add dg_HostName to dg_HostNameListQG

        add dg_EtherModify to dg_Ether
            add dg_ModifyEtherScreen1 to dg_EtherModify
                        add dg_ModifyEtherQG1 to dg_ModifyEtherScreen1
                            add dg_OldHostName to dg_ModifyEtherQG1

            add dg_ModifyEtherScreen2 to dg_EtherModify
                        add dg_NewEtherEntryQG to dg_ModifyEtherScreen2

        add dg_EtherList to dg_Ether
            add dg_HostNameListScreen to dg_EtherList
```

SEE ALSO

ed(1), egrep(1), idi(1), idc(1), sh(1).

NAME

`inittab` – script for `init`

DESCRIPTION

The file `/etc/inittab` controls process dispatching by `init`. The processes most typically dispatched by `init` are servers.

The `inittab` file is composed of entries that are position dependent and have the following format:

id : *rstate* : *action* : *process*

Each entry is delimited by a newline, however, a backslash (\) preceding a newline indicates a continuation of the entry. Up to 512 characters per entry are permitted. Comments may be inserted in the *process* field using the convention for comments described in `sh`(1). There are no limits (other than maximum entry size) imposed on the number of entries in the `inittab` file. The entry fields are:

id This is one or two characters used to uniquely identify an entry.

rstate This defines the run level in which this entry is to be processed. Run-levels effectively correspond to a configuration of processes in the system. That is, each process spawned by `init` is assigned a run level or run levels in which it is allowed to exist. The run levels are represented by a number ranging from `0` through `6`. As an example, if the system is in run level `1`, only those entries having a `1` in the *rstate* field are processed. When `init` is requested to change run levels, all processes that do not have an entry in the *rstate* field for the target run level are sent the warning signal `SIGTERM` and allowed a 5-second grace period before being forcibly terminated by the kill signal `SIGKILL`. The *rstate* field can define multiple run levels for a process by selecting more than one run level in any combination from `0` through `6`. If no run level is specified, then the process is assumed to be valid at all run levels `0` through `6`. There are three other values, `a`, `b` and `c`, which can appear in the *rstate* field, even though they are not true run levels. Entries which have these characters in the *rstate* field are processed only when an `init` or `telinit` process requests them to be run (regardless of the current run level of the system). See `init`(1M). They differ from run levels in that `init` can never enter run level `a`, `b` or `c`. Also, a request for the execution of any of these processes does not change the current run level. Furthermore, a process started by an `a`, `b` or `c` command is not killed when `init` changes levels. They are killed only if their line in `inittab` is marked `off` in the *action* field, their line is deleted entirely from `inittab`, or `init` goes into single-user state.

action Key words in this field tell `init` how to treat the process specified in the *process* field. The actions recognized by `init` are as follows:

`respawn` If the process does not exist, then start the process; do not wait for its termination (continue scanning the `inittab` file), and when the process dies, restart the process. If the process currently exists, do nothing and continue scanning the `inittab` file.

`wait` When `init` enters the run level that matches the entry's *rstate*, start the process and wait for its termination. All subsequent reads of the `inittab` file while `init` is in the same run level cause `init` to ignore this entry.

`once` When `init` enters a run level that matches the entry's *rstate*, start the process, do not wait for its termination. When it dies, do not restart the process. If `init` enters a new run level and the process is still running from a previous run level change, the program is not restarted.

`boot` The entry is to be processed only at `init`'s boot-time read of the `inittab` file. `init` is to start the process, not wait for its termination; and when it dies, not restart the process. In order for this instruction to be meaningful, the *rstate* should be the default or it must match `init`'s run level at boot time. This action is useful for an initialization function following a hardware reboot of the system.

`bootwait` The entry is to be processed the first time `init` goes from single-user to multi-user state after the system is booted. (If `initdefault` is set to `2`, the process runs right after the boot.) `init` starts the process, waits for its termination and, when it dies, does not restart the process.

`powerfail` Execute the process associated with this entry only when `init` receives a power fail signal, `SIGPWR` [see `signal(2)`].

`powerwait` Execute the process associated with this entry only when `init` receives a power fail signal, `SIGPWR`, and wait until it terminates before continuing any processing of `inittab`.

`off` If the process associated with this entry is currently running, send the warning signal `SIGTERM` and wait 5 seconds before forcibly terminating the process with the kill signal `SIGKILL`. If the process is nonexistent, ignore the entry.

`ondemand` This instruction is really a synonym for the `respawn` action. It is functionally identical to `respawn` but is given a different keyword in order to divorce its association with run levels. This instruction is used only with the `a`, `b` or `c` values described in the *rstate* field.

`initdefault` An entry with this action is scanned only when `init` is initially invoked. `init` uses this entry, if it exists, to determine which run level to enter initially. It does this by taking the highest run level specified in the *rstate* field and using that as its initial state. If the *rstate* field is empty, this is interpreted as `0123456` and `init` therefore enters run level `6`. This will cause the system to loop, that is, it will go to firmware and reboot continuously. Additionally, if `init` does not find an `initdefault` entry in `inittab`, it requests an initial run level from the user at reboot time.

`sysinit` Entries of this type are executed before `init` tries to access the console (i.e., before the `Console Login:` prompt). It is expected that this entry will be only used to initialize devices on which `init` might try to ask the run level question. These entries are executed and waited for before continuing.

process This is a command to be executed. The entire `process` field is prefixed with `exec` and passed to a forked `sh` as `sh -c 'exec` *command*`'`. For this reason, any legal `sh` syntax can appear in the *process* field.

SEE ALSO

`init`(1M), `ttymon`(1M), `exec`(2), `open`(2), `signal`(2)

`sh`(1), `who`(1) in the *User's Reference Manual*

NAME

inode – file node structure

SYNOPSIS

```
#include <ufs/disk_format.h>
```

DESCRIPTION

The inode table for a file system is distributed across the disk: a table exists in each disk allocation region (DAR). For more information about the file system layout, refer to fs(4).

The file node's purpose is to provide access to data blocks associated with the file. The data blocks are allocated in chunks of contiguous physical blocks called data elements. In the case that the file is less than the data element size, the file is fragmented. In this case, the file has only one data element and its size is determined by the fragment exponent field. If the file grows, the fragmented data element is copied to a full sized element, and the allocation to the file will always be in data element sized chunks, causing the actual size of the file to be less than or equal to the blocks allocated to it.

Data elements are accessed directly or indirectly depending on the size of the file. The file node has an array of direct data elements, pointing to the first block of the data element. If the size of the file is greater than the number of direct data element pointers, then indirect access is used.

Indirect data element access is provided through indexing. An index structure consists of index blocks containing pointers to data elements. Depending on the depth of the index structure, index entries point to data elements or other index blocks. There are three index structures rooted in the file node; each of the three differs in the levels of indexing. If the file node represents a directory, only the first index level is used.

In the case of the first index structure, the pointer in the file node points to the first block containing the index entries (an index may span blocks); the entries at this level point to data elements. The second index structure points to the first block containing index entries. Each index entry at this level points to the first block of an index containing the same number of entries as the previous level. These index entries contain pointers to data elements. The third index structure is similar to the previous two but has another level of indexing before the index containing the data element pointers.

This expansion of index levels produces a tree, where the leaves of the tree are data elements. The number at each level multiplies itself by the number of index entries.

To access a data block, it must be determined if it is accessible directly or through indexing. If direct access is possible, the data element needs to be determined along with the particular block within the data element. If the block is deep enough in the file to require indexing, the level of indexing must be determined by finding what range of blocks each index covers. After the index structure is determined, the path of entries through the index structure is required.

The inode table in the DAR is made up of entries of the following structure:

```
typedef struct
    {
    boolean_field_type          is_allocated                : 1;
    boolean_field_type          is_fragmented               : 1;
    field_type                  fragment_size_exponent      : 3;
    field_type                  des_exponent                : 5;
    field_type                  ies_exponent                : 4;
    field_type                  pad_to_double_word          : 9;
    field_type                  partial_block_byte_count    : 9;
    uint32e_type                whole_block_count;
    uint32e_type                generation_number;
    uint32e_type                dar_index;
    df_file_node_number_type    space_parent;
    uint32e_type                maximum_space_usage;
    uint32e_type                current_space_usage;
    uint32e_type                maximum_file_node_usage;
    uint32e_type                current_file_node_usage;
    df_file_mode_type           mode;
    uint16e_type                user_id;
    uint16e_type                group_id;
    int16e_type                   link_count;
    df_time_type                time_last_accessed;
    df_time_type                time_last_modified;
    df_time_type                time_attributes_last_changed;
    union
        {
        struct
            {
            uint32e_type          data[DF_DIRECT_ELEMENT_COUNT];
            union
                {
                struct
                  {
                  uint32e_type index_array[DF_MAX_DIR_INDEX_LEVEL];
                  df_din_type  din;
                  } directory;
                struct
                  {
                  uint32_type   index_array[DF_MAX_INDEX_LEVEL];
                  } regular;
                } index;
            } element_addresses;
        struct
            {
            uint16e_type   major_device_number;
            uint16e_type   minor_device_number;
            byte8e_type    pad_to_union_size[48];
            } represented_device;
        } contents;
        byte8e_type reserved[DF_RESERVED_BYTES_PER_FILE_NODE];
    } df_file_node_type;
```

is_allocated indicates whether this is a free file node or not. If FALSE it is a free file

node; if TRUE, then this is a valid file node.

is_fragmented is TRUE when the first (and only) element of the file is reduced in size from the data element size to the fragment size specified by fragment_size_exponent; otherwise, all data elements (if any) are the full data element size and fragment_size_exponent is invalid.

fragment_size_exponent specifies, when valid, the size of the fragmented data element which contains the file's data. The size in blocks of the fragment is 2 raised to the fragment_size_exponent power. It must be large enough to fit the total size of the file in the fragment. Because all fragments must fit into a single file system buffer, the maximum fragment size is:

```
#define DF_MAX_FRAGMENT_SIZE      16
```

blocks, although the fragment_size_exponent field is large enough to support fragment sizes up to 128 (2 ^ 7) blocks.

des_exponent specifies the data element size. The data element size in blocks is 2 raised to the des_exponent power. The maximum data element size is therefore 2 ^ 31 blocks. The maximum value for this field is:

```
#define DF_MAX_DES_EXPONENT 31
```

although it is also limited to the base 2 logarithm of the largest power of 2 that is less than or equal to:

```
#define DF_USER_BLOCKS_PER_DAR(dar_size, file_nodes_per_dar)
```

ies_exponent specifies the index element size. The index element size in blocks is 2 raised to the ies_exponent power. The maximum index element size is therefore 2 ^ 15 blocks. The maximum value for this field is:

```
#define DF_MAX_IES_EXPONENT 15
```

although it is also limited to the base 2 logarithm of the largest power of 2 that is less than or equal to:

```
#define DF_USER_BLOCKS_PER_DAR(dar_size, file_nodes_per_dar)
```

partial_block_byte_count is the count of the number of bytes to the end of file following the last whole block. All possible values, i.e., 0 to 511, are legal.

whole_block_count is the number of 512 byte blocks logically in the file before EOF. The file size as reported by `stat`(2) is:

```
((whole_block_count * 512) + partial_block_byte_count).
```

generation_number is incremented each time an inode is freed and is kept valid on free nodes so that subsequent uses of the same file node number are guaranteed to have different UFID values.

dar_index is the current allocation hint (index of a DAR to use for data and file node

allocation). DAR indexes are zero based.

space_parent is the parent file node number. In the file node for the root of the filesystem, the value of space_parent is:

```
#define DF_ROOT_FILE_NODE_NUMBER 2
```

therefore, the filesystem root is its own space parent.

maximum_space_usage is the maximum usage limit in blocks for the file plus all its space descendants. It must be set to UINT32_MAX for non-CPD directories and other non-directory files, as well as for CPD's which have no allocation limit. On the root of each filesystem, this limit is not applied to the superuser.

current_space_usage is the current usage in blocks for the file plus all its space descendants, if any. If not a CPD, then it is the number of blocks actually used to store the file's contents on disk, including both index and data elements. For a CPD, it is that plus the current_space_allocation fields of all files which name this CPD as their space parent.

maximum_file_node_usage is the maximum file node usage limit for the file plus all its space descendants. Must be UINT32_MAX for non-CPD directories and other non-directory files, as well as for CPDs with no file node allocation limit. On the root of each filesystem, this limit is not applied to the superuser. On all other CPD's it is applied equally to all users.

current_file_node_usage is the current file node usage count for the file plus all its space descendants. It must be 1 for non-CPD directories and other non-directory files. For a CPD, it is 1 plus the current_file_node_usage fields of all files which name this CPD as their space parent.

mode is the file's mode. See `stat`(2).

user_id is user id of the file.

group_id is the group id of the file.

link_count is the number of links (directory entries) to the file. Must be greater than zero.

time_last_accessed is the time the file's contents were last accessed (i.e., read or executed).

time_last_modified is the time the file's contents were last modified (i.e., written or truncated).

time_attributes_last_changed is the time one of the file's attributes (mode, user_id, group_id, link_count, child_count, etc.) was last changed.

contents is a union containing represented_device for block-special or character-special files, and containing element_addresses for all other file types.

represented_device is the device numbers of the device represented by a character or

block special file. The padding bytes (pad_to_union_size) must be set to zero.

element_addresses are the disk addresses of the data elements and index elements of the file. The "data" field contains the addresses of the first:

```
#define DF_DIRECT_ELEMENT_COUNT      10
```

data elements in the file. The "index" field contains the addresses of the first index element of each level for regular files. For directory files, we only have 1 level of indexing, with the other two index fields being used to store the directory manager information.

Since all the file nodes in a DAR are not necessarily allocated, a list of free file nodes must be maintained. The head of the list is contained in each DAR entry. The DAR entry contains the file node number of a file node in the DAR, that file node should be unallocated and the following structure contains the fields for a free file node:

```
typedef struct
    {
    boolean_field_type       is_allocated : 1;
    df_file_node_number_type next_free_file_node_number;
    uint32e_type             generation_number;
    byte8e_type  pad_to_file_node_size[DF_FREE_FILE_NODE_PADDING];
    } df_free_file_node_type;
```

is_allocated is TRUE when this is a valid file_node. If FALSE, then this is a free file_node.

generation_number is kept valid on free nodes so that subsequent uses of the same file node number are guaranteed to have different UFID values.

next_free_file_node_number is the file node number of next free file_node on the DAR free file_node list.

SEE ALSO

stat(2), dg_stat(2), fs(4); fsck(1M), mkfs(1M) in the *System Manager's Reference for the DG/UX System*.

NAME

`issue` – issue identification file

DESCRIPTION

The file `/etc/issue` contains the *issue* or project identification to be printed as part of the login prompt. This is an ASCII file containing any text you choose and is read by program `getty` and then written to any terminal spawned or respawned from the `inittab`(4) file.

FILES

`/etc/issue`

SEE ALSO

`ttydefs`(4M)
`login`(1) in the *User's Reference for the DG/UX System*.

NAME

ldfcn – COFF executable file access routines

SYNOPSIS

```
#include <stdio.h>
#include <sys/types.h>
#include <filehdr.h>
#include <ldfcn.h>
```

DESCRIPTION

The executable file access routines are a collection of functions for reading a COFF executable file that is in DG/UX executable file format. Although the calling program must know the detailed structure of the parts of the executable file that it processes, the routines effectively insulate the calling program from knowledge of the overall structure of the executable file.

The interface between the calling program and the executable file access routines is based on LDFILE defined as struct ldfile, declared in the header file ldfcn.h. This structure provides uniform access to simple executable files and to executable files that are members of an archive file.

The function ldopen(3X) allocates and initializes the LDFILE structure and returns a pointer to the structure to the calling program. The fields of the LDFILE structure may be accessed individually through macros defined in ldfcn.h and contain the following information:

LDFILE	*ldptr;
TYPE(ldptr)	The file magic number, used to distinguish between archive members and simple executable files.
IOPTR(ldptr)	The file pointer returned by fopen(3S) and used by the standard input/output functions.
OFFSET(ldptr)	The file address of the beginning of the executable file; the offset is non-zero if the executable file is a member of an archive file.
HEADER(ldptr)	The file header structure of the executable file.

The executable file access functions may be divided into four categories:

(1) Functions that open or close an executable file

ldopen(3X) and ldaopen(3X) open an executable file
ldclose(3X) and ldaclose(3X) close an executable file

(2) Functions that read header or symbol table information.

ldahread(3X) reads the archive header of a member of an archive file
ldfhread(3X) reads the file header of an executable file
ldshread(3X) reads a section header of an executable file
ldsyshread(3X) reads the system header of an executable file
ldtbread(3X) reads a symbol table entry of an executable file
ldgetname(3X) retrieves a symbol name from a symbol table entry.

(3) Functions that position an executable file at (seek to) the start of a particular section.

Ldohseek(3X) seeks to the system header of an executable file
ldsseek(3X) seeks to a section of an executable file
ldtbseek(3X) seeks to the symbol table of an executable file

(4) The function ldtbindex(3X) returns the index of a particular executable file symbol table entry.

These functions are described in detail on their respective manual pages.

All the functions except ldaopen(3X), ldgetname(3X), ldopen(3X), and ldtbindex(3X) return either SUCCESS or FAILURE, both constants defined in ldfcn.h. Ldaopen(3X) and ldopen(3X) both return pointers to an LDFILE structure.

Additional access to an executable file is provided through a set of macros defined in ldfcn.h. These macros parallel the standard input/output file reading and manipulating functions, translating a reference of the LDFILE structure into a reference to its file descriptor field.

The following macros are provided:

```
GETC(ldptr)
FGETC(ldptr)
GETW(ldptr)
UNGETC(c, ldptr)
FGETS(s, n, ldptr)
FREAD(ptr, sizeof (*ptr), nitems, ldptr)
FSEEK(ldptr, offset, ptrname)
FTELL(ldptr)
REWIND(ldptr)
FEOF(ldptr)
FERROR(ldptr)
FILENO(ldptr)
SETBUF(ldptr, buf)
```

See the manual entries for the corresponding standard input/output library functions for details on these macros.

The program must be loaded with the executable file access routine library libld.a.

SEE ALSO

fseek(3S), ldahread(3X), ldclose(3X), ldfhread(3X), ldgetname(3X), ldohseek(3X), ldopen(3X), ldshread(3X), ldsseek(3X), ldtbindex(3X), ldtbread(3X), ldtbseek(3X), regexp(5), intro(5).

NOTES

The executable file format is used only for executable files (load modules), not for object files.

WARNINGS

The macro FSEEK defined in the header file ldfcn.h translates into a call to the standard input/output function fseek(3S). FSEEK should not be used to seek from the end of an archive file because the end of an archive file may not be the same as the end of one of its executable file members!

Note that <ldfcn.h> must not be included in a file where <regexp.h> is also included, as the macros defined in <ldfcn.h> conflict with the macros expected in <regexp.h>.

NAME

`limits` – header file for implementation-specific constants

SYNOPSIS

```
#include <limits.h>
```

DESCRIPTION

The header file `limits.h` is a list of minimal magnitude limitations imposed by a specific implementation of the operating system.

```
ARG_MAX     5120                    /* max length of arguments to exec */
CHAR_BIT    8                       /* max # of bits in a "char" */
CHAR_MAX    255                     /* max value of a "char" */
CHAR_MIN    0                       /* min value of a "char" */
CHILD_MAX   25                      /* max # of processes per user id */
EDMC??
CLK_TCK     _sysconf(3)             /* clock ticks per second */
DBL_DIG     15                      /* digits of precision of a "double" */
DBL_MAX     1.79769313486223179E+308/* max decimal value of a "double"*/
DBL_MIN     2.2250738585071991E-308 /* min decimal value of a "double"*/
FCHR_MAX    2147483647              /* max size of a file in bytes */
FLT_DIG     6                       /* digits of precision of a "float" */
FLT_MAX     3.40282347E+38F         /* max decimal value of a "float" */
FLT_MIN     1.17549435E-38F         /* min decimal value of a "float" */
HUGE_VAL    7.237005145973118E-75   /* error value returned by Math lib */
INT_MAX     2147483647              /* max value of an "int" */
INT_MIN     (-2147483647-1)         /* min value of an "int" */
LINK_MAX    1000                    /* max # of links to a single file */
LOGNAME_MAX8                        /* max # of characters in a login name */
LONG_BIT    32                      /* # of bits in a "long" */
LONG_MAX    2147483647              /* max value of a "long int" */
LONG_MIN    (-2147483647-1)         /* min value of a "long int" */
MAX_CANON   255                     /* max bytes in a line for canonical
                                    processing */
MAX_INPUT   512                     /* max size of a char input buffer */
MB_LEN_MAX  5                       /* max # of bytes in a multibyte
                                    character */
NAME_MAX    14                      /* max # of characters in a file name */
NGROUPS_MAX16                       /* max # of groups for a user */
NL_ARGMAX   9                       /* max value of "digit" in calls to the
                                    NLS printf() and scanf() */
NL_LANGMAX  14                      /* max # of bytes in a LANG name */
NL_MSGMAX   32767                   /* max message number */
NL_NMAX     1                       /* max # of bytes in N-to-1 mapping
                                    characters */
NL_SETMAX   255                     /* max set number */
NL_TEXTMAX  255                     /* max # of bytes in a message string */
NZERO       20                      /* default process priority */
OPEN_MAX    64                      /* max # of files a process can have
                                    open */
PASS_MAX    8                       /* max # of characters in a password */
```

```
PATH_MAX    1023                /* max # of characters in a path name */
PID_MAX     30000               /* max value for a process ID */
PIPE_BUF    8192                /* max # bytes atomic in write to a pipe */
PIPE_MAX    8192                /* max # bytes written to a pipe
                                in a write */
SCHAR_MAX   127                 /* max value of a "signed char" */
SCHAR_MIN   (-128)              /* min value of a "signed char" */
SHRT_MAX    32767               /* max value of a "short int" */
SHRT_MIN    (-32768)            /* min value of a "short int" */
STD_BLK     512                 /* # bytes in a physical I/O block */
SYS_NMLN    256                 /* 4.0 size of utsname elements */
                                /* also defined in sys/utsname.h */
SYSPID_MAX  1                   /* max pid of system processes */
TMP_MAX     17576               /* max # of unique names generated
                                by tmpnam */
UCHAR_MAX   255                 /* max value of an "unsigned char" */
UID_MAX     60000               /* max value for a user or group ID */
UINT_MAX    4294967295          /* max value of an "unsigned int" */
ULONG_MAX   4294967295          /* max value of an "unsigned long int" */
USHRT_MAX   65535               /* max value of an "unsigned short int" */
USI_MAX     4294967295          /* max decimal value of an "unsigned" */
WORD_BIT    32                  /* # of bits in a "word" or "int" */
```

The following POSIX definitions are the most restrictive values to be used by a POSIX conformant application. Conforming implementations shall provide values at least this large.

```
_POSIX_ARG_MAX          4096    /* max length of arguments to exec */
_POSIX_CHILD_MAX        6       /* max # of processes per user ID */
_POSIX_LINK_MAX         8       /* max # of links to a single file */
_POSIX_MAX_CANON        255     /* max # of bytes in a line of input */
_POSIX_MAX_INPUT        255     /* max # of bytes in terminal
                                input queue */
_POSIX_NAME_MAX         14      /* # of bytes in a filename */
_POSIX_NGROUPS_MAX       0      /* max # of groups in a process */
_POSIX_OPEN_MAX         16      /* max # of files a process can have open */
_POSIX_PATH_MAX         255     /* max # of characters in a pathname */
_POSIX_PIPE_BUF         512     /* max # of bytes atomic in write
                                to a pipe */
```

SEE ALSO

passwd(4).

NAME

`linenum` – line number entries in a common object file

SYNOPSIS

```
#include <linenum.h>
```

DESCRIPTION

When invoked with the `-g` option, the `cc` command generates an entry in the object file for each C source line on which a breakpoint is possible. debuggers such as `sdb`(1) and `dbx`(1) can then reference line numbers in the source. The structure of the line number entries appears below.

```
struct lineno
{
        union
        {
                long    l_symndx ;
                long    l_paddr ;
        }               l_addr ;
        union
        {
                struct
                {
                        unsigned short _l_lnno;
                        unsigned short _l_pad;
                }       _l_l;
                long    _l_lnno;
        }               _l;
} ;
```

Numbering starts with 1 for each function. The initial line number entry for a function has *l_lnno* equal to zero, and the symbol table index of the function's entry is in *l_symndx*. Otherwise, *l_lnno* is non-zero, and *l_paddr* is the physical address of the code for the referenced line. Thus the overall structure is the following:

l_addr	*l_lnno*
function symtab index	0
physical address	line
physical address	line
...	
function symtab index	0
physical address	line
physical address	line
...	

SEE ALSO

`cc`(1), `sdb`(1), `dbx`(1), `a.out`(4).

NAME

`master` – format of a master file

DESCRIPTION

Information about configurable kernel components is contained in a set of *master files* that are kept in the *master file directory* (by default, `/usr/etc/master.d`). This information is used by the `config`(1M) program to configure a kernel image. There are four types of configurable kernel components: device drivers, socket protocols, STREAMS modules, and tunable parameters.

Each layered kernel product available on the system has its own master file in the master file directory. For example, the TCP/IP product includes the master file `/usr/etc/master.d/tcpip`. The base DG/UX System itself uses `/usr/etc/master.d/dgux` as its master file. If you create your own device drivers or other configurable kernel compenents, you will need to create a new master file to supply information about the new components. Remember that every file found in the master file directory is examined when `config`(1M) is run, so backup or duplicate copies of master files should not be stored there, since they will cause errors when components are defined in more than one place. If you are not adding a new configurable component, you will probably only use the master files as reference when setting up your *system file* (see `system`(4)).

A *master file* can contain entries describing device drivers, socket protocols, STREAMS modules, tunable parameters, and aliases. Different types of information are grouped into their own sections with their own entry format. Each section is prefaced by a line containing a section name, whose first character is the dollar sign ($). A master file may have any number (including zero) of each type of section, and they may appear in any order. Six different types of sections are supported:

`$device`	Describes drivers for hardware devices and pseudo-devices.
`$protocol`	Describes protocols that can be supported by the `socket`(2) system call.
`$stream`	Describes STREAMS modules.
`$keyword`	Describes user-tunable system parameters.
`$alias`	Defines aliases for the keywords defined in any of the above types of sections. These aliases can them be used in a system file in place of the master file keywords.
`$local_alias`	Defines constants for use only within the master file.

Each entry in a section consists of a single line broken into a number of fields separated by blanks and/or tabs. Comments are preceded by a pound sign (#) and can begin at any position on a line. Blank lines and comments are ignored.

Device Entries

Entries in a `$device` section have three fields:

Field 1: Device name as specified in the system file. The kernel uses this name as a prefix to names for device driver routines in `conf.c`.

Field 2: Restriction flags on this device. Flags are:

- o Only one device of this type is allowed.
- r This device is required and will be automatically be configured into any kernels configured against this master file.

s This device is a DG/UX-style STREAMS device.

S This device is a System V-style STREAMS device.

N This STREAMS device uses the new (System V.4) style open/close interface.

z This device may be configured either explicitly or implicitly as part of a nested declaration of another device. For example, "st(insc(),4)" declares the device "insc()" implicitly.

n No restrictions.

Field 3: STREAMS Concurrency Set. The concurrency set name specifies the STREAMS set to which a given STREAMS module or STREAMS device driver belongs. STREAMS concurrency only occurs within each set: modules or drivers belonging to the same set are guaranteed never to run concurrently. A set may contain drivers, modules, or both. Two exceptional cases allow for more concurrency: the pseudo-set named `module` means that each instance of such a STREAMS device or module will have its own private set; and the pseudo-set named `stream` means that locking is granular to the individual STREAMS themselves. All other set name values specify a named set. The concurrency set name has no meaning for non-STREAMS devices, which by convention are assigned to the set named `default`.

Protocol Entries

Entries in a `$protocol` section have six fields:

Field 1: Name to be used in the system file to reference this protocol.

Field 2: The protocol's protocol number as defined in the `/etc/protocols` file.

Field 3: The protocol's domain number as defined in the `<sys/socket.h>` header file.

Field 4: The protocol's type as defined in the `<sys/socket.h>` header file.

Field 5: The *infix name*. The kernel will use this name to generate names for the protocol's control routines. You may use any name you want and then match this name with the names of your protocol control routines.

Field 6: Restriction flags on this protocol. Flags are:

r This protocol is required and will be automatically be configured into any kernels configured against this master file.

d This protocol will be the default protocol used for `socket`(2) calls of the listed Domain and Type.

u This protocol is a UNIX domain protocol.

n No restrictions.

STREAMS Module Entries

Entries in a `$stream` section have four fields:

Field 1: Name of the stream control module as given in the system file.

Field 2: The *infix name*. The kernel will use this name to generate names for the stream's control module routines. You may use any name you want and then match this name with the names of your stream control module routines.

Field 3: Restriction flags on this module. Flags are:

N This STREAMS module uses the new (System V.4) style open/close interface.

n No restrictions.

Field 4: STREAMS Concurrency Set. The concurrency set name specifies the STREAMS set to which a given STREAMS module or STREAMS device driver belongs. STREAMS concurrency only occurs within each set: modules or drivers belonging to the same set are guaranteed never to run concurrently. A set may contain drivers, modules, or both. Two exceptional cases allow for more concurrency: the pseudo-set named `module` means that each instance of such a STREAMS device or module will have its own private set; and the pseudo-set named `stream` means that locking is granular to the individual STREAMS themselves. All other set name values specify a named set.

Tunable Parameter Entries

Entries in a `$keyword` section have four fields, the last of which is optional:

Field 1: Name of kernel variable to be set.

Field 2: The default value that the variable will have, unless it is overridden in the system file.

Field 3: The kernel variable's data type. This must not be a type that requires use of any header file besides `/usr/src/uts/aviion/ext/c_generics.h`.

Field 4: The implied value for a variable that is listed in the system file without a value. This is useful for things like function pointers, whose value is represented by a string that would otherwise be inconvenient to type.

Alias Entries

Entries in an `$alias` section have two fields:

Field 1: Alias name.

Field 2: Name of master file entry being referenced.

Local Alias Entries

Entries in a `$local_alias` section have two fields:

Field 1: Alias name.

Field 2: The value which this alias name will have. This can be either a numeric or character string value.

SEE ALSO

`system`(4).
`config`(1M), `sysdef`(1M) in the *System Manager's Reference for the DG/UX System Installing the DG/UX System. Customizing the DG/UX System. Managing the DG/UX System.*

NAME

`mfs` – memory file system

DESCRIPTION

The DG/UX kernel provides support for memory file systems. These are file systems that live entirely in memory without any backing store on disk. Files in memory file systems do not persist between system instantiations. Memory file systems are faster than normal file systems and are ideal for temporary files and for putting common executables in them to avoid any disk I/O on execution. A memory file system has the same semantics as a normal DG/UX file system. Memory file systems can be NFS-exported just like regular DG/UX file systems.

A memory file system can be instantiated via the `mount`(1M) command:

```
mount -o ramdisk /dev/m1 /pdd/memory
```

The "ramdisk" option instructs the DG/UX file system to create a memory file system instead of trying to mount the device "/dev/m1" on the directory. The "/dev/m1" pseudo device must not exist at the time of the mount command. The pseudo device node will be created during the mount to reference the mounted on directory. Any naming convention can be used for this memory device with the exception that the name must reference a path in `/dev`. The example name "/pdd/memory" is the directory in the DG/UX file system hierarchy where the memory file system will be created. This may be any directory.

There are several options:

```
mount -o ramdisk,use_wired_memory /dev/m1 /pdd/memory
```

"use_wired_memory" is a boolean option that will instruct the file manager to use wired memory to hold data for the memory file system instead of unwired memory (the default is to use unwired memory). This is useful if you have lots of expansion memory for the file system, since data in the file system will always reside in memory and never be swapped out. (But see the CAUTIONS section below.)

```
mount -o ramdisk,max_file_space=20000 /dev/m1 /pdd/memory
```

"max_file_space=*n*" gives the number of blocks that can be allocated to the memory file system to hold data. No space is ever allocated up front, so using a high value will not lead to trouble. The amount of actual space that can be given to a memory file system is the minimum of the value assigned by this attribute and the total amount of the resource (wired or unwired memory) available on the system. If space is not available to allocate blocks to a memory file system, then the operation that requests space will return an ENOSPC result. The default amount of space allocated to a memory file system is 2048 blocks.

```
mount -o ramdisk,max_file_count=50000 /dev/m1 /pdd/memory
```

"max_file_count=*n*" gives the number file nodes that can be allocated in the memory file system. This is counted separately from the "max_file_space" attribute. The default number is 16384.

Memory file systems can be unmounted via the `umount`(1M) command:

```
umount /pdd/memory
```

The `umount` will not work until all the files have been removed from the file system. This is to protect against unintended data loss.

There is no limit to the number of memory file systems that may be created on a given system. Memory limitations, both wired and unwired, will ultimately govern how large they may grow.

SEE ALSO

`exportfs`(1M), `mount`(1M), `umount`(1M), `fstab`(4).

CAUTIONS

Do not over-commit the swap space available to the system. Because of the way DG/UX allocates memory, if you establish a large memory file system, start some very large application, then fill the memory file system, you might exhaust the swap space on the system. This will cause the system to thrash and to kill random processes in order to recover the swap space.

Do not mount a memory file system on `/tmp`, since the recovery mechanism of `ex`(1) and `vi`(1) depends on the persistence of temporary files in the `/tmp` directory.

Do not use the use_wired_memory option unless your system has enough expansion (physical) memory.

Use of the use_wired_memory option is also strongly discouraged on diskless workstations.

NAME

mnttab – mounted file system table

SYNOPSIS

```
#include <mntent.h>
```

DESCRIPTION

mnttab resides in the directory /etc and consists of a list of currently mounted file systems. The file contains a number of lines like this:

```
fsname dir type opts freq passno
```

for example:

```
/dev/dsk/usr  /usr  dg/ux  rw  1  1
```

would indicate a mount for a local filesystem, and

```
titan:/usr/titan  /usr/titan  nfs  rw,hard  0 0
```

would indicate an NFS filesystem mount. The entries from this file are accessed using the routines in getmntent(3C), which returns a structure of the following form:

```
struct  mntent  {
   char    *mnt_fsname;    /* filesystem name */
   char    *mnt_dir;       /* filesystem path prefix */
   char    *mnt_type;      /* dg/ux, nfs, swap, cdrom, or ignore */
   char    *mnt_opts;      /* rw, ro, hard, soft, fg, bg, memory */
   int     mnt_freq;       /* highest dump level */
   int     mnt_passno;     /* pass number on parallel fsck */
};
```

Fields are separated by white space; a #, as the first non-white character, indicates a comment. The *mnt_type* field determines how the *mnt_fsname* and *mnt_opts* fields will be interpreted. The following is a list of the filesystem types currently supported, and the way each of them interprets these fields:

Type	*Field*	*Interpretation*
dg/ux	mnt_fsname	Must be a block special device.
	mnt_opts	Valid options are ro, rw, bg, and fg. If this has the ramdisk option, other options include use_wired_memory, max_file_space and max_file_count.
cdrom	mnt_fsname	Must be a block special device.
nfs	mnt_fsname	The hostname of the server and the pathname on the server of the directory to be served. A colon separates the pathname and hostname.
	mnt_opts	Valid options are ro, rw, hard, soft.
swap	mnt_fsname	Must be a block special device swap section.
	mnt_opts	Ignored.

If the *mnt_type* is specified as `ignore` then the entry is ignored. This is useful to show disks not currently used.

Entries identified as `swap` are made available as swap space by the `swapon`(1M) command at the end of the system reboot procedure.

When the *mnt_fsname* field is interpreted as a block special device, programs that require the corresponding character special device must construct the name by changing `dsk` to `rdsk` in the pathname.

If the *mnt_opts* field is a comma-separated list of options that includes `ro` or `rw`, then the filesystem is mounted read-write or read-only. If this includes `hard` or `soft`, then the NFS filesystem is mounted `hard` or `soft`.

The field *mnt_freq* indicates how often each filesystem should be dumped by the `dump`(1M) command (and triggers that command's `w` option, which determines what filesystems should be dumped). Most systems set the *mnt_freq* field to 1, indicating that filesystems are dumped each day.

The final field *mnt_passno* is used by the consistency checking program `fsck`(1M) to allow overlapped checking of filesystems during a reboot. All filesystems with a *mnt_passno* of 1 are checked first simultaneously, then all filesystems with *mnt_passno* of 2 are checked, and so on. The *<mnt_passno>* of the root filesystem should be 0, as the root cannot be checked since it is already mounted.

The maximum number of entries in `mnttab` is based on the system parameter `NMOUNT` located in `/usr/src/uts/mv/cf/config.h`, which defines the number of allowable mounted special files.

SEE ALSO

`mount`(1M), `setmnt`(1M) in the *System Manager's Reference for the DG/UX System*.

NAME

`netconfig` – network configuration database

SYNOPSIS

```
#include <netconfig.h>
```

DESCRIPTION

The network configuration database, `/etc/netconfig`, is a system file used to store information about networks connected to the system and available for use. The `netconfig` database and the routines that access it [see `getnetconfig`(3N)] are part of the UNIX System V Network Selection component. The Network Selection component also includes the environment variable `NETPATH` and a group of routines that access the `netconfig` database using `NETPATH` components as links to the `netconfig` entries. `NETPATH` is described in `sh`(1); the `NETPATH` access routines are discussed in `getnetpath`(3N).

`netconfig` contains an entry for each network available on the system. Entries are separated by newlines. Fields are separated by whitespace and occur in the order in which they are described below. Whitespace can be embedded as "*blank*" or "*tab*". Backslashes may be embedded as "\\". Each field corresponds to an element in the `struct netconfig` structure. `struct netconfig` and the identifiers described on this manual page are defined in `/usr/include/netconfig.h`.

network ID

A string used to uniquely identify a network. *network ID* consists of non-null characters, and has a length of at least 1. No maximum length is specified. This namespace is locally significant and the local system administrator is the naming authority. All *network ID*s on a system must be unique.

semantics

The *semantics* field is a string identifing the "semantics" of the network, i.e., the set of services it supports, by identifying the service interface it provides. The *semantics* field is mandatory. The following semantics are recognized.

`tpi_clts` Transport Provider Interface, connectionless

`tpi_cots` Transport Provider Interface, connection oriented

`tpi_cots_ord`
Transport Provider Interface, connection oriented, supports orderly release.

flag The *flag* field records certain two-valued ("true" and "false") attributes of networks. *flag* is a string composed of a combination of characters, each of which indicates the value of the corresponding attribute. If the character is present, the attribute is "true." If the character is absent, the attribute is "false." "–" indicates that none of the attributes is present. Only one character is currently recognized:

`v` Visible ("default") network. Used when the environment variable `NETPATH` is unset.

protocol family

The *protocol family* and *protocol name* fields are provided for protocol-specific applications.

The *protocol family* field contains a string that identifies a protocol family. The *protocol family* identifier follows the same rules as those for *network ID*s, that is, the string consists of non-null characters; it has a length of at least `1`; and there is no maximum length specified. A "–" in the *protocol family* field

indicates that no protocol family identifier applies, that is, the network is experimental. The following are examples:

`loopback`	Loopback (local to host).
`inet`	Internetwork: UDP, TCP, etc.
`implink`	ARPANET imp addresses
`pup`	PUP protocols: e.g. BSP
`chaos`	MIT CHAOS protocols
`ns`	XEROX NS protocols
`nbs`	NBS protocols
`ecma`	European Computer Manufacturers Association
`datakit`	DATAKIT protocols
`ccitt`	CCITT protocols, X.25, etc.
`sna`	IBM SNA
`decnet`	DECNET
`dli`	Direct data link interface
`lat`	LAT
`hylink`	NSC Hyperchannel
`appletalk`	Apple Talk
`nit`	Network Interface Tap
`ieee802`	IEEE 802.2; also ISO 8802
`osi`	Umbrella for all families used by OSI (e.g., protosw lookup)
`x25`	CCITT X.25 in particular
`osinet`	AFI = 47, IDI = 4
`gosip`	U.S. Government OSI

protocol name

The *protocol name* field contains a string that identifies a protocol. The *protocol name* identifier follows the same rules as those for *network IDs*, that is, the string consists of non-NULL characters; it has a length of at least `1`; and there is no maximum length specified. The following protocol names are recognized. A "–" indicates that none of the names listed applies.

`tcp`	Transmission Control Protocol
`udp`	User Datagram Protocol
`icmp`	Internet Control Message Protocol

network device

The *network device* is the full pathname of the device used to connect to the transport provider. Typically, this device will be in the `/dev` directory. The *network device* must be specified.

directory lookup libraries

The *directory lookup libraries* support a "directory service" (a name-to-address mapping service) for the network. This service is implemented by the UNIX System V Name-to-Address Mapping feature. If a network is not provided with such a library, the *netdir* feature will not work. A "–" in this field indicates the absence of any lookup libraries, in which case name-to-address mapping for the network is non-functional. The directory lookup library field consists of a comma-separated list of full pathnames to dynamically linked libraries. Commas may be embedded as "\,"; backslashs as "\\".

Lines in `/etc/netconfig` that begin with a sharp sign (#) in column 1 are treated as comments.

The `struct netconfig` structure includes the following members corresponding to the fields in in the `netconfig` database entries:

`char * nc_netid`	Network ID, including NULL terminator
`unsigned long nc_semantics`	Semantics
`unsigned long nc_flag`	Flags
`char * nc_protofmly`	Protocol family
`char * nc_proto`	Protocol name
`char * nc_device`	Full pathname of the network device
`unsigned long nc_nlookups`	Number of directory lookup libraries
`char ** nc_lookups`	Full pathnames of the directory lookup libraries themselves
`unsigned long nc_unused[9]`	Reserved for future expansion (not advertised to user level)

The `nc_semantics` field takes the following values, corresponding to the semantics identified above:

```
NC_TPI_CLTS
NC_TPI_COTS
NC_TPI_COTS_ORD
```

The `nc_flag` field is a bitfield. The following bit, corresponding to the attribute identified above, is currently recognized. `NC_NOFLAG` indicates the absence of any attributes.

```
NC_VISIBLE
```

FILES

```
/etc/netconfig
/usr/include/netconfig.h
```

SEE ALSO

`netdir_getbyname(3N)`, `getnetconfig(3N)`, `getnetpath(3N)`, `netconfig(4)`
Network Programmer's Guide
System Administrator's Guide

NAME

netgroup – list of network groups

DESCRIPTION

netgroup defines network wide groups, used for permission checking when doing remote mounts, remote logins, and remote shells. For remote mounts, the information in netgroup is used to classify machines; for remote logins and remote shells, it is used to classify users. Each line of the netgroup file defines a group and has the format

groupname member1 member2 ....

where member*i* is either another group name, or a triple:

(*hostname*, *username*, *domainname*)

Any of these three fields can be empty, in which case it signifies a wild card. Thus

```
universal (,,)
```

defines a group to which everyone belongs.

A gateway machine should be listed under all possible hostnames by which it may be recognized:

```
wan (gateway,,) (gateway-ebb,,)
```

Field names that begin with something other than a letter, digit or underscore (such as '–') work in precisely the opposite fashion. For example, consider the following entries:

```
justmachines(analytica,-,dgux)
justpeople  (-,babbage,dgux)
```

The machine analytica belongs to the group justmachines in the domain dgux, but no users belong to it. Similarly, the user babbage belongs to the group justpeople in the domain dgux, but no machines belong to it.

The *domainname* field refers to the domain in which the triple is valid, not the name containing the trusted host.

FILES

/etc/netgroup

SEE ALSO

makedbm(1M), ypserv(1M), getnetgrent(3N), exports(4).

NAME

networks – network name database

DESCRIPTION

The networks file contains information on the networks known to your system. Each networks file should contain a single line for each network with the following information:

net_name net_number [*aliases*] [# *comment*]

Items are separated by any number of blanks and/or tab characters. A # indicates the beginning of a comment; characters up to the end of the line are not interpreted by routines that search the file. This file is normally created from the official network database maintained at the Network Information Center (NIC), though local changes may be required to update the file for unofficial aliases and/or unknown networks.

Network names may contain any printable character other than a field delimiter (blanks, tabs, CR, ESC), New Line, or comment character. Network numbers must be specified in four-part dot notation with trailing zeros omitted. For example, you would not specify 128.223 as 128.223.0.0.

If your system is using NIS, see *Managing ONC™/NFS® and Its Facilities on the DG/UX™ System* for details.

EXAMPLE

```
loop-net 127 loop # s/w test net
mfg-net 85 #mfg network
```

FILES

/etc/networks

SEE ALSO

getnetent(3N).

NAME

passwd – password file

SYNOPSIS

/etc/passwd

DESCRIPTION

The passwd file is an ASCII file containing basic information about each user's account. The file contains a one-line entry for each user allowed to log in to the system. Each entry has the following format:

username:*password*:*uid*:*gid*:*gcos-field*:*home-dir*:*login-shell*

where

username — User's login name. This field contains no uppercase characters, and must not be more than USR_NAME [see limits(4)] characters long.

password — The user's encrypted password. If this field is empty, login(1) does not request a password before logging the user in.

uid — The user's user identification number (UID) for the system. The UID must be unique; otherwise, users with the same UID will be able to access each other's files. *uid* is generally a value between 0 and 32767.

gid — The user's group identification number (GID) for the system. *gid* is generally a value between 0 an 32767.

gcos-field — The user's real name, along with information to pass along in a mail-message heading. Some system administrators use this field to contain the user's office, extension, home phone, and so on. It is called the GCOS field for historical reasons. An ampersand (&) in this field stands for the login name (in cases where the login name appears in a user's real name).

home-dir — The pathname of the directory to which the user is initially positioned when logging in.

login-shell — The user's initial shell program. If this field is empty, the default shell is /bin/sh unless you are running the Network File System (NFS); in that case the default is /usr/bin/sh.

Because the encrypted passwords on a secure system are kept in the passwd.adjunct file, /etc/passwd has general read permission on all systems, and can be used by routines that map UIDs to names.

The encrypted password consists of 13 characters chosen from a 64-character alphabet (. , / , 0-9 , A-Z , a-z), except when the password is null. In that case, the encrypted password is also null. Password aging is affected for a particular user if the user's encrypted password in the password file is followed by a comma and a non-null string of characters from the above alphabet (such a string must first be introduced by the superuser).

The first character of the age denotes the maximum number of weeks for which a password is valid. If you try to login after your password has expired, you must supply a new one. The next character denotes the minimum period in weeks that must elapse before the password may be changed. The remaining characters define the week (counted from the beginning of 1970) when the password was last changed (a

null string is equivalent to zero). The first and second characters have numerical values in the range 0-63 that correspond to the 64-character alphabet shown above (i.e., / = 1 week; z = 63 weeks). If both characters are equal to zero (derived from the string "." or ".."), you must change your password the next time you login. The age will disappear from your entry in the password file. If the second character is greater than the first (signified, e.g., by the string "./"), then only the superuser will be able to change the password.

ONC/NFS Features

If you are using DG/UX Open Network Computing/Network File System (ONC/NFS), additional features are available. The `passwd` file can also have lines beginning with a plus (+), which means to incorporate entries from the Network Information Service (NIS).

There are three styles of + entries: by itself, + means to insert the entire contents of the NIS password file at that point; *+name* means to insert the entry (if any) for *name* from NIS at that point; *+@netgroup* means to insert the entries for all members of the network group *netgroup* at that point. If a *+name* entry has a non-null *password*, *gcos-field*, *home-dir*, or *login-shell* field, they will override what is contained in NIS. The *uid* and *gid* fields cannot be overridden.

Entries beginning with a minus sign (-) are also allowed. They have two formats: *-name* and *-@name*. The meaning of these formats is the same as for *+name* and *+@name*, respectively, except that the action is reversed; all members matched are considered to be excluded from the password file, regardless of subsequent entries. Minus entries can be used to exclude specific entries from NIS.

Appropriate precautions must be taken to lock the `/etc/passwd` file against simultaneous changes if it is to be edited with a text editor; `vipw`(1M) does the necessary locking.

EXAMPLE

Here is a sample `/etc/passwd` file:

```
root:q.mJzTnu8icF.:0:10:God:/:/bin/csh
tut:6k/7KCFRPNVXg:508:10:Bill Tuthill:/usr/tut:/bin/csh
+john:
-@documentation:no-login:
+:::Guest
john::605:20:John Smith:/usr/john:
```

In this example, there are specific entries for users `root` and `tut`, in case NIS is not running. (See *Managing ONC/NFS and Its Facilities on the DG/UX System.*) The user `john` will have his password entry in NIS incorporated without change; anyone in the netgroup `documentation` will have their password field disabled, and anyone else will be able to login with their usual password, shell, and home directory, but with a GCOS field of `Guest`.

The second entry for `john` in this example will not be used if NIS is running; the first entry for a given user name will be used if multiple entries exist.

Appropriate precautions must be taken to lock the `/etc/passwd` file against simultaneous changes if it is to be edited with a text editor; `vipw`(1M) does the necessary locking. The password file can be scanned for inconsistencies using `pwck`(1M).

ONC/NFS Example

The following example relates to ONC/NFS and NIS:

```
root:q.mJzTnu8icF.:0:10:Super User:/:/bin/csh
fred:6k/7KCFRPNVXg:508:10:% Fredericks:/usr2/fred:/bin/csh
+john:
+@documentation:no-login:
+::::Guest
```

In this example, there are specific entries for users `root` and `fred`, to assure that they can log in even when the system is running standalone. The user `john` will have his password entry in the Network Information Service incorporated without change; anyone in the netgroup `documentation` will have their password field disabled, and anyone else will be able to log in with their usual password, shell, and home directory, but with a GCOS field of `Guest`.

FILES

`/etc/passwd`

SEE ALSO

`login`(1), `mail`(1), `passwd`(1), `pwck`(1M), `sendmail`(1M), `useradd`(1M), `vipw`(1M), `crypt`(3C), `crypt`(3X), `getpwent`(3C), `group`(4), `limits`(4).

BUGS

The `mail`(1) and `sendmail`(1M) programs use the GCOS field to compose the `From:` line for addressing mail messages, but these programs get confused by nested parentheses when composing replies. This problem can be avoided by using different types of brackets within the GCOS field; for example:

```
(& Fredricks [Podunk U <EE/CIS>] {818}-555-5555)
```

NAME

pkginfo – package characteristics file

DESCRIPTION

pkginfo is an ASCII file that describes the characteristics of the package along with information that helps control the flow of installation. It is created by the software package developer.

Each entry in the pkginfo file is a line that establishes the value of a parameter in the following form:

PARAM="value"

There is no required order in which the parameters must be specified within the file. Each parameter is described below. Only fields marked with an asterisk are mandatory.

*PKG** — Abbreviation for the package being installed, generally three characters in length (for example, dir or pkg). All characters in the abbreviation must be alphanumeric and the first may not be numeric. The abbreviation is limited to a maximum length of nine characters. install, new, and all are reserved abbreviations.

*NAME** — Text that specifies the package name (maximum length of 256 ASCII characters).

*ARCH** — A comma-separated list of alphanumeric tokens that indicate the architecture (for example, 3B2) associated with the package. The pkgmk tool may be used to create or modify this value when actually building the package. The maximum length of a token is 16 characters and it cannot include a comma.

*VERSION** — Text that specifies the current version associated with the software package. The maximum length is 256 ASCII characters and the first character cannot be a left parenthesis. The pkgmk tool may be used to create or modify this value when actually building the package.

*CATEGORY** — A comma-separated list of categories under which a package may be displayed. A package must at least belong to the system or application category. Categories are case-insensitive and may contain only alphanumerics. Each category is limited in length to 16 characters.

DESC — Text that describes the package (maximum length of 256 ASCII characters).

VENDOR — Used to identify the vendor that holds the software copyright (maximum length of 256 ASCII characters).

HOTLINE — Phone number and/or mailing address where further information may be received or bugs may be reported (maximum length of 256 ASCII characters).

EMAIL — An electronic address where further information is available or bugs may be reported (maximum length of 256 ASCII characters).

VSTOCK — The vendor stock number, if any, that identifies this product (maximum length of 256 ASCII characters).

CLASSES — A space-separated list of classes defined for a package. The order of the list determines the order in which the classes are installed. Classes listed first will be installed first (on a media by media basis).

This parameter may be modified by the request script.

ISTATES A list of allowable run states for package installation (for example, "S s 1").

RSTATES A list of allowable run states for package removal (for example, "S s 1").

BASEDIR The pathname to a default directory where "relocatable" files may be installed. If blank, the package is not relocatable and any files that have relative pathnames will not be installed. An administrator can override the default directory.

ULIMIT If set, this parameter is passed as an argument to the `ulimit` command, which establishes the maximum size of a file during installation.

ORDER A list of classes defining the order in which they should be put on the medium. Used by `pkgmk` in creating the package. Classes not defined in this field are placed on the medium using the standard ordering procedures.

MAXINST The maximum number of package instances that should be allowed on a machine at the same time. By default, only one instance of a package is allowed. This parameter must be set in order to have multiple instances of a package.

PSTAMP Production stamp used to mark the `pkgmap` file on the output volumes. Provides a means for distinguishing between production copies of a version if more than one is in use at a time. If `PSTAMP` is not defined, the default is used. The default consists of the UNIX system machine name followed by the string "*YYMMDDHHMM*" (year, month, date, hour, minutes).

INTONLY Indicates that the package should only be installed interactively when set to any non-NULL value.

PREDEPEND Used to maintain compatibility with pre-SVR4 package dependency checking. Pre-SVR4 dependency checks were based on whether or not the name file for the required package existed in the `/var/options` directory. This directory is not maintained for SVR4 packages since the `depend` file is used for checking dependencies. However, entries can be created in this directory to maintain compatibility. Setting the `PREDEPEND` parameter to `y` or `yes` creates a `/usr/option` entry for the package. (Packages that are new for SVR4 do not need to use this parameter.)

EXAMPLES

Here is a sample `pkginfo`:

```
PKG="oam"
NAME="OAM Installation Utilities"
VERSION="3"
VENDOR="AT&T"
HOTLINE="1-800-ATT-BUGS"
EMAIL="attunix!olsen"
VSTOCK="0122c3f5566"
CATEGORY="system.essential"
ISTATES="S 2"
RSTATES="S 2"
```

SEE ALSO

compver(4), copyright(4), depend(4), pkgmap(4).

NOTES

Developers may define their own installation parameters by adding a definition to this file. A developer-defined parameter must begin with a capital letter,

NAME

pkgmap – package contents description file

DESCRIPTION

pkgmap is an ASCII file that provides a complete listing of the package contents. It is automatically generated by pkgmk(1) using the information in the prototype file.

Each entry in pkgmap describes a single "deliverable object file." A deliverable object file includes shell scripts, executable objects, data files, directories, etc. The entry consists of several fields of information, each field separated by a space. The fields are described below and must appear in the order shown.

part An optional field designating the part number in which the object resides. A part is a collection of files, and is the atomic unit by which a package is processed. A developer can choose the criteria for grouping files into a part (e.g., based on class). If no value is defined in this field, part 1 is assumed.

ftype A one-character field that indicates the file type. Valid values are:

- f a standard executable or data file
- e a file to be edited upon installation or removal
- v volatile file (one whose contents are expected to change)
- d directory
- x an exclusive directory
- l linked file
- p named pipe
- c character special device
- b block special device
- i installation script or information file
- s symbolic link

class The installation class to which the file belongs. This name must contain only alphanumeric characters and be no longer than 12 characters. It is not specified if the ftype is i (information file).

pathname The pathname where the object will reside on the target machine, such as /usr/bin/mail. Relative pathnames (those that do not begin with a slash) indicate that the file is relocatable.

For linked files (ftype is either l or s), pathname must be in the form of *path1=path2*, with *path1* specifying the destination of the link and *path2* specifying the source of the link.

pathname may contain variables which support relocation of the file. A $*parameter* may be embedded in the pathname structure. $BASEDIR can be used to identify the parent directories of the path hierarchy, making the entire package easily relocatable. Default values for *parameter* and BASEDIR must be supplied in the pkginfo file and may be overridden at installation.

major The major device number. The field is only specified for block or character special devices.

minor The minor device number. The field is only specified for block or character special devices.

mode The octal mode of the file (for example, 0664). A question mark (?) indicates that the mode will be left unchanged, implying that the file already exists on the target machine. This field is not used for linked files,

packaging information files or non-installable files.

owner The owner of the file (for example, `bin` or `root`). The field is limited to 14 characters in length. A question mark (?) indicates that the owner will be left unchanged, implying that the file already exists on the target machine. This field is not used for linked files or non-installable files. It is used optionally with a package information file. If used, it indicates with what owner an installation script will be executed.

Can be a variable specification in the form of $[A-Z]. Will be resolved at installation time.

group The group to which the file belongs (for example, "bin" or "sys"). The field is limited to 14 characters in length. A question mark (?) indicates that the group will be left unchanged, implying that the file already exists on the target machine. This field is not used for linked files or non-installable files. It is used optionally with a package information file. If used, it indicates with what group an installation script will be executed.

Can be a variable assignment in the form of `$[A-Z]`. Will be resolved at installation time.

size The actual size of the file in bytes. This field is not specified for named pipes, special devices, directories or linked files.

cksum The checksum of the file contents. This field is not specified for named pipes, special devices, directories or linked files.

modtime The time of last modification, as reported by the `stat`(2) function call. This field is not specified for named pipes, special devices, directories or linked files.

Each `pkgmap` must have one line that provides information about the number and maximum size (in 512-byte blocks) of parts that make up the package. This line is in the following format:

:number_of_parts maximum_part_size

Lines that begin with "#" are comment lines and are ignored.

When files are saved during installation before they are overwritten, they are normally just copied to a temporary pathname. However, for files whose mode includes execute permission (but which are not editable), the existing version is linked to a temporary pathname and the original file is removed. This allows processes which are executing during installation to be overwritten.

EXAMPLES

The following is an example of a `pkgmap` file.

```
:2 500
1 i pkginfo 237 1179 541296672
1 b class1 /dev/diskette 17 134 0644 root other
1 c class1 /dev/rdiskette 17 134 0644 root other
1 d none bin 0755 root bin
1 f none bin/INSTALL 0755 root bin 11103 17954 541295535
1 f none bin/REMOVE 0755 root bin 3214 50237 541295541
1 l none bin/UNINSTALL=bin/REMOVE
1 f none bin/cmda 0755 root bin 3580 60325 541295567
1 f none bin/cmdb 0755 root bin 49107 51255 541438368
1 f class1 bin/cmdc 0755 root bin 45599 26048 541295599
```

```
1 f class1 bin/cmdd 0755 root bin 4648 8473 541461238
1 f none bin/cmde 0755 root bin 40501 1264 541295622
1 f class2 bin/cmdf 0755 root bin 2345 35889 541295574
1 f none bin/cmdg 0755 root bin 41185 47653 541461242
2 d class2 data 0755 root bin
2 p class1 data/apipe 0755 root other
2 d none log 0755 root bin
2 v none log/logfile 0755 root bin 41815 47563 541461333
2 d none save 0755 root bin
2 d none spool 0755 root bin
2 d none tmp 0755 root bin
```

SEE ALSO

pkginfo(4).

NOTES

The pkgmap file may contain only one entry per unique pathname.

NAME

`profile` – setting up an environment at login time

DESCRIPTION

If you are using the Bourne shell and your login directory contains a file named `.profile`, that file will be executed (via `exec .profile`) before your session begins; `.profiles` are handy for setting exported environment variables and terminal modes. If the file `/etc/profile` exists, it will be executed for every user before the `.profile`. The following example is typical (except for the comments):

```
#   Make some environment variables global
export MAIL PATH
#   Set file creation mask
umask 22
#   Tell me when new mail comes in
MAIL=/usr/mail/myname
#   Add my /bin directory to the shell search sequence
PATH=$PATH:$HOME/bin
```

FILES

`$HOME/.profile`
`/etc/profile`

SEE ALSO

`environ`(5), `term`(5).
`env`(1), `login`(1), `mail`(1), `sh`(1), `stty`(1), `su`(1) in the *User's Reference for the DG/UX System*.

NAME

protocols – protocol name database

DESCRIPTION

The protocols file contains information about the known protocols used in the networks. Each protocol should have a one-line entry in the protocols file with the following information:

```
official protocol name
protocol number
aliases (optional)
# comment (optional)
```

Items are separated by any number of blanks and/or tab characters. A # indicates the beginning of a comment; characters up to the end of the line are not interpreted by routines that search the file. Use only decimal numerals to specify protocol numbers.

Names in the protocols file may contain any printable character other than a field delimiter (blanks, tabs, CR, ESC), New Line, or comment character.

If your system is using the Network Information System (NIS), see Chapters 3 and 4 in *Managing ONC™/NFS® and Its Facilities on the DG/UX™ System* for information on how to update the protocols database.

EXAMPLES

```
tcp 6 TCP # transmission control protocol
```

FILES

/etc/protocols

SEE ALSO

getprotoent(3N).

NAME

`prototype` – package information file

DESCRIPTION

`prototype` is an ASCII file used to specify package information. Each entry in the file describes a single deliverable object. An object may be a data file, directory, source file, executable object, etc. This file is generated by the package developer.

Entries in a `prototype` file consist of several fields of information separated by white space. Comment lines begin with a "#" and are ignored. The fields are described below and must appear in the order shown.

part An optional field designating the part number in which the object resides. A part is a collection of files, and is the atomic unit by which a package is processed. A developer can choose criteria for groupig files into a part (e.g., based on class). If this field is not used, part 1 is assumed.

ftype A one-character field which indicates the file type. Valid values are:

- `f` a standard executable or data file
- `e` a file to be edited upon installation or removal
- `v` volatile file (one whose contents are expected to change)
- `d` directory
- `x` an exclusive directory
- `l` linked file
- `p` named pipe
- `c` character special device
- `b` block special device
- `i` installation script or information file
- `s` symbolic link

class The installation class to which the file belongs. This name must contain only alphanumeric characters and be no longer than 12 characters. The field is not specified for installation scripts. (`admin` and all classes beginning with capital letters are reserved class names.)

pathname The pathname where the file will reside on the target machine, e.g., `/usr/bin/mail` or `bin/ras_proc`. Relative pathnames (those that do not begin with a slash) indicate that the file is relocatable. The form

path1=path2

may be used for two purposes: to define a link and to define local pathnames.

For linked files, *path1* indicates the destination of the link and *path2* indicates the source file. (This format is mandatory for linked files.)

For local pathnames, *path1* indicates the pathname an object should have on the machine where the entry is to be installed and *path2* indicates either a relative or fixed pathname to a file on the host machine which contains the actual contents.

A pathname may contain a variable specification, which will be resolved at the time of installation. This specification should have the form $[A-Z].

major The major device number. The field is only specified for block or character special devices.

minor The minor device number. The field is only specified for block or character special devices.

mode The octal mode of the file (for example, 0664). A question mark (?) indicates that the mode will be left unchanged, implying that the file already exists on the target machine. This field is not used for linked files or packaging information files.

owner The owner of the file (for example, `bin` or `root`). The field is limited to 14 characters in length. A question mark (?) indicates that the owner will be left unchanged, implying that the file already exists on the target machine. This field is not used for linked files or packaging information files.

Can be a variable specification in the form of `$[A-Z]`. Will be resolved at installation time.

group The group to which the file belongs (for example, `bin` or `sys`). The field is limited to 14 characters in length. A question mark (?) indicates that the group will be left unchanged, implying that the file already exists on the target machine. This field is not used for linked files or packaging information files.

Can be a variable specification in the form of $[A-Z]. Will be resolved at installation time.

An exclamation point (!) at the beginning of a line indicates that the line contains a command. These commands are used to incorporate files in other directories, to locate objects on a host machine, and to set permanent defaults. The following commands are available:

`search` Specifies a list of directories (separated by white space) to search for when looking for file contents on the host machine. The basename of the *path* field is appended to each directory in the ordered list until the file is located.

`include` Specifies a pathname which points to another prototype file to include. Note that `search` requests do not span `include` files.

`default` Specifies a list of attributes (mode, owner, and group) to be used by default if attribute information is not provided for prototype entries which require the information. The defaults do not apply to entries in `include` prototype files.

param=value Places the indicated parameter in the current environment.

The above commands may have variable substitutions embedded within them, as demonstrated in the two example `prototype` files below.

Before files are overwritten during installation, they are copied to a temporary pathname. The exception to this rule is files whose mode includes execute permission, unless the file is editable (i.e, *ftype* is `e`). For files which meet this exception, the existing version is linked to a temporary pathname, and the original file is removed. This allows processes which are executing during installation to be overwritten.

EXAMPLES

Example 1:

```
!PROJDIR=/usr/proj
!BIN=$PROJDIR/bin
!CFG=$PROJDIR/cfg
!LIB=$PROJDIR/lib
!HDRS=$PROJDIR/hdrs
```

```
!search /usr/myname/usr/bin /usr/myname/src /usr/myname/hdrs
i pkginfo=/usr/myname/wrap/pkginfo
i depend=/usr/myname/wrap/depend
i version=/usr/myname/wrap/version
d none /usr/wrap 0755 root bin
d none /usr/wrap/usr/bin 0755 root bin
! search $BIN
f none /usr/wrap/bin/INSTALL 0755 root bin
f none /usr/wrap/bin/REMOVE 0755 root bin
f none /usr/wrap/bin/addpkg 0755 root bin
!default 755 root bin
f none /usr/wrap/bin/audit
f none /usr/wrap/bin/listpkg
f none /usr/wrap/bin/pkgmk
# the following file starts out zero length but grows
v none /usr/wrap/logfile=/dev/null 0644 root bin
# the following specifies a link (dest=src)
l none /usr/wrap/src/addpkg=/usr/wrap/bin/rmpkg
! search $SRC
!default 644 root other
f src /usr/wrap/src/INSTALL.sh
f src /usr/wrap/src/REMOVE.sh
f src /usr/wrap/src/addpkg.c
f src /usr/wrap/src/audit.c
f src /usr/wrap/src/listpkg.c
f src /usr/wrap/src/pkgmk.c
d none /usr/wrap/data 0755 root bin
d none /usr/wrap/save 0755 root bin
d none /usr/wrap/spool 0755 root bin
d none /usr/wrap/tmp 0755 root bin
d src /usr/wrap/src 0755 root bin
```

Example 2:

```
# this prototype is generated by 'pkgproto' to refer
# to all prototypes in my src directory
!PROJDIR=/usr/dew/projx
!include $PROJDIR/src/cmd/prototype
!include $PROJDIR/src/cmd/audmerg/protofile
!include $PROJDIR/src/lib/proto
```

SEE ALSO

pkginfo(4), pkgmk(1).

NOTES

Normally, if a file is defined in the `prototype` file but does not exist, that file is created at the time of package installation. However, if the file pathname includes a directory that does not exist, the file will not be created. For example, if the `prototype` file has the following entry:

```
f none /usr/dev/bin/command
```

and that file does not exist, it will be created if the directory `/usr/dev/bin` already exists or if the `prototype` also has an entry defining the directory:

```
d none /usr/dev/bin
```

NAME

publickey – public key database

SYNOPSIS

/etc/publickey

DESCRIPTION

NOTE: Secure RPC using DES Authentication is an additional feature that must be purchased separately from the DG/UX™ ONC™/NFS® package. You must have this feature to use the database described in this manual page.

/etc/publickey is the public key database used for secure networking. Each entry in the database consists of a network user name (which may either refer to a user or a hostname), followed by the user's public key (in hex notation), a colon, and then the user's secret key encrypted with its login password (also in hex notation).

This file is altered either by the user through the chkey(1) command or by the system administrator through the newkey(1M) command. The file /etc/publickey should only contain data on the Network Information Service master machine, where it is converted into the NIS database publickey.byname.

SEE ALSO

chkey(1), newkey(1M), ypupdated(1M), des_crypt(3R), publickey(3R), rpc(3N).

NAME

`rcsfile` – format of RCS file

DESCRIPTION

An RCS file's contents are described by the grammar below.

The text is free format: space, backspace, tab, newline, vertical tab, form feed, and carriage return (collectively, *white space*) have no significance except in strings. However, an RCS file must end in a newline character.

Strings are enclosed by @. If a string contains a @, it must be doubled; otherwise, strings may contain arbitrary binary data.

The meta syntax uses the following conventions: '|' (bar) separates alternatives; '{' and '}' enclose optional phrases; '{' and '}*' enclose phrases that may be repeated zero or more times; '{' and '}+' enclose phrases that must appear at least once and may be repeated; Terminal symbols are in `boldface`; nonterminal symbols are in *italics*.

rcstext ::= *admin* {*delta*}* *desc* {*deltatext*}*

admin ::= `head` {*num*}`;`
`{ branch` {*num*}`; }`
`access` {*id*}*`;`
`symbols` {*id* `:` *num*}*`;`
`locks` {*id* `:` *num*}*`;` {`strict ;`}
`{ comment` {*string*}`; }`
`{ expand` {*string*}`; }`
{ *newphrase* }*

delta ::= *num*
`date` *num*`;`
`author` *id*`;`
`state` {*id*}`;`
`branches` {*num*}*`;`
`next` {*num*}`;`
{ *newphrase* }*

desc ::= `desc` *string*

deltatext ::= *num*
`log` *string*
{ *newphrase* }*
`text` *string*

num ::= {*digit*{`.`}}+

digit ::= `0 | 1 | ... | 9`

id ::= *letter*{*idchar*}*

letter ::= any letter

idchar ::= any visible graphic character except *special*

special ::= `$ | , | . | : | ; | @`

string ::= @{any character, with @ doubled}*@

newphrase ::= *id word** `;`

word ::= *id* | *num* | *string* | `:`

Identifiers are case sensitive. Keywords are in lower case only. The sets of keywords and identifiers may overlap. In most environments RCS uses the ISO 8859/1 encoding: letters are octal codes 101–132, 141–172, 300–326, 330–366 and 370-377, visible graphic characters are codes 041–176 and 240–377, and white space characters are codes 010–015 and 040.

The *newphrase* productions in the grammar are reserved for future extensions to the format of RCS files. No *newphrase* will begin with any keyword already in use.

The *delta* nodes form a tree. All nodes whose numbers consist of a single pair (e.g., 2.3, 2.1, 1.3, etc.) are on the trunk, and are linked through the `next` field in order of decreasing numbers. The `head` field in the *admin* node points to the head of that sequence (i.e., contains the highest pair). The `branch` node in the admin node indicates the default branch (or revision) for most RCS operations. If empty, the default branch is the highest branch on the trunk.

All *delta* nodes whose numbers consist of $2n$ fields (n) (e.g., 3.1.1.1, 2.1.2.2, etc.) are linked as follows. All nodes whose first $2n-1$ number fields are identical are linked through the `next` field in order of increasing numbers. For each such sequence, the *delta* node whose number is identical to the first $2n-2$ number fields of the deltas on that sequence is called the branchpoint. The `branches` field of a node contains a list of the numbers of the first nodes of all sequences for which it is a branchpoint. This list is ordered in increasing numbers.

Example:

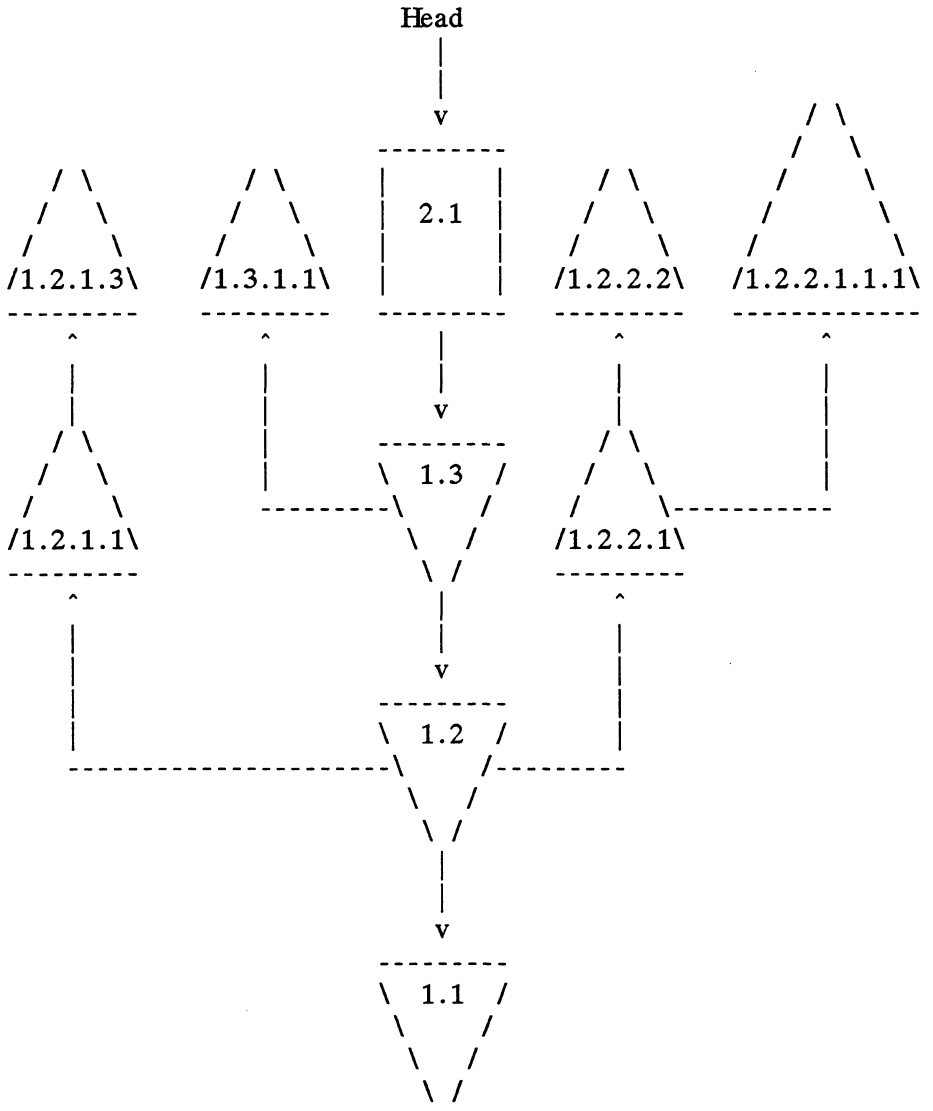


Fig. 1: A revision tree

IDENTIFICATION

Author: Walter F. Tichy, Purdue University, West Lafayette, IN, 47907.
Revision Number: 4.1.1.8; Release Date: 1992/01/07.

SEE ALSO

`ci`(1), `co`(1), `ident`(1), `rcs`(1), `rcsdiff`(1), `rcsmerge`(1), `rlog`(1), Walter F. Tichy, RCS—A System for Version Control, *Software—Practice & Experience* `15`, 7 (July 1985), 637-654.

NAME

reloc – relocation information for a common object file

SYNOPSIS

```
#include <reloc.h>
```

DESCRIPTION

Common object (COFF) files have one relocation entry for each relocatable reference in the text or data. If relocation information is present, it will be in the following format:

```
struct reloc
{
        long      r_vaddr ; /* (virtual) address of reference */
        long      r_symndx ;/* index into symbol table */
        ushort    r_type ;  /* relocation type */
        unsigned short r_offset;/* high 16 bits of expression*/
} ;

#define           R_ABS     0
#define           R_PCR16L  128
#define           R_PCR26L  129
#define           R_VRT16   130
#define           R_HVRT16  131
#define           R_LVRT16  132
#define           R_VRT32   133
```

As the link editor reads each input section and performs relocation, the relocation entries are read. They direct how references found within the input section are treated.

R_ABS The reference is absolute and no relocation is necessary. The entry will be ignored.

R_PCR16L A "PC-relative" 16-bit reference to the symbol's virtual address.

R_PCR26L A "PC-relative" 26-bit reference to the symbol's virtual address.

R_VRT16 Direct 16-bit reference to the symbol's virtual address.

R_HVRT16 Same as R_VRT16, except, only the high 16 bits are used in the relocation.

R_LVRT16 Same as R_VRT16, except, only the low 16 bits are used in the relocation.

R_VRT32 Direct 32-bit reference to the symbol's virtual address.

Relocation entries are generated automatically by the assembler and automatically used by the link editor. Link editor options exist for both preserving and removing the relocation entries from object files.

SEE ALSO

as(1), ld-coff(1), a.out(4), syms(4).

NAME

rpc – rpc program number data base

SYNOPSIS

/etc/rpc

DESCRIPTION

The rpc file contains user readable names that can be used in place of rpc program numbers. Each line has the following information:

name of server for the rpc program
rpc program number
aliases

Items are separated by any number of blanks and/or tab characters. A "#" indicates the beginning of a comment; characters up to the end of the line are not interpreted by routines which search the file.

Here is an example of a partial /etc/rpc file from the DG/UX System.

```
# $What: <@(#) rpc.4,v  4.1.1.7> $
portmapper      100000    portmap sunrpc
rstatd          100001    rstat rup perfmeter
rusersd         100002    rusers
nfs             100003    nfsprog
ypserv          100004    ypprog
mountd          100005    mount showmount
ypbind          100007
walld           100008    rwall shutdown
yppasswdd       100009    yppasswd
etherstatd      100010    etherstat
rquotad         100011    rquotaprog quota rquota
sprayd          100012    spray
3270_mapper     100013
rje_mapper      100014
selection_svc   100015    selnsvc
database_svc    100016
rexd            100017    rex
alis            100018
sched           100019
llockmgr        100020
nlockmgr        100021
x25.inr         100022
statmon         100023
status          100024
bootparam       100026
ypupdated       100028    ypupdate
keyserv         100029    keyserver
tfsd            100037
nsed            100038
```

FILES

/etc/rpc

SEE ALSO

getrpcent(3N), rpc(3N).

NAME

`sccsfile` – format of SCCS file

DESCRIPTION

An SCCS file is an ASCII file. It consists of six logical parts:

checksum

delta table information about each delta

user names
: login names and/or numerical group IDs of users who may add deltas

flags
: definitions of internal keywords

comments
: arbitrary descriptive information about the file

body
: the actual text lines intermixed with control lines

Throughout an SCCS file there are lines that begin with the `ASCII SOH` (start of heading) character (octal 001). We call this character *the control character*, and represent it graphically as @. Any line described below that does not begin with the control character is prevented from doing so.

Entries of the form `DDDDD` represent a five-digit string (a number between 00000 and 99999).

Each logical part of an SCCS file is described in detail below.

Checksum

The checksum is the first line of an SCCS file. The form of the line is:

```
@hDDDDD
```

The value of the checksum is the sum of all characters, except those of the first line. The `@h` provides a *magic number* of (octal) 064001.

Delta table

The delta table consists of a variable number of entries of the form:

```
@s DDDDD/DDDDD/DDDDD
@d type <SCCS ID> yr/mo/da hr:mi:se pgmr DDDDD DDDDD
@i DDDDD ...
@x DDDDD ...
@g DDDDD ...
@m <MR number>
  .
  .
  .
@c comments ...
  .
  .
  .
@e
```

The first line (`@s`) contains the number of lines inserted/deleted/unchanged. The second line (`@d`) contains the type of the delta (currently, normal: `D`, and removed: `R`); the SCCS ID of the delta; the date and time of creation of the delta; the login name corresponding to the real user ID at the time the delta was created; and the serial numbers of the delta and its predecessor

The @i, @x, and @g lines are optional; they contain the serial numbers of deltas included, excluded, and ignored, respectively.

The @m lines (optional) each contain one MR number associated with the delta; the @c lines contain comments associated with the delta.

The @e line ends the delta table entry.

User names

The list of login names and/or numerical group IDs of users who may add deltas to the file, separated by new-lines. The lines containing these login names and/or numerical group IDs are surrounded by the bracketing lines @u and @U. An empty list lets anyone to make a delta. Any line starting with a ! prohibits the succeeding group or user from making deltas.

Flags

Keywords used internally (see admin(1) for more information on their use). Each flag line takes the form:

@f *flag*<optional text>

The following flags are defined:

@f t <type of program>
@f v <program name>
@f i <keyword string>
@f b
@f m <module name>
@f f <floor>
@f c <ceiling>
@f d <default-sid>
@f n
@f j
@f l <lock-releases>
@f q <user defined>
@f z <reserved for use in interfaces>

The t flag defines the replacement for the %Y% identification keyword. The v flag controls prompting for MR numbers as well as comments; if the optional text is present it defines an MR number validity checking program.

The i flag controls the warning/error aspect of the No id keywords message. When the i flag is not present, this message is only a warning; when the i flag is present, this message will cause a fatal error; the file will not be gotten, or the delta will not be made.

When the b flag is present the -b keyletter may be used on the *get* command to cause a branch in the delta tree.

The m flag defines the first choice for the replacement text of the %M% identification keyword. The f flag defines the the release below which no deltas may be added (also known as the floor release).

The c flag defines the the release above which no deltas may be added (also known as the ceiling release).

The `d` flag defines the default SID to be used when none is specified on a *get* command.

The `n` flag causes *delta* to insert a null delta (a delta that applies *no* changes) in those releases that are skipped when a delta is made in a *new* release (e.g., when delta 5.1 is made after delta 2.7, releases 3 and 4 are skipped). The absence of the `n` flag causes skipped releases to be completely empty.

The `j` flag causes *get* to allow concurrent edits of the same base SID.

The `l` flag defines a *list* of releases that are *locked* against editing (`get`(1) with the `-e` keyletter).

The `q` flag defines the replacement for the `%Q%` identification keyword.

The `z` flag is used in certain specialized interface programs.

Comments

Arbitrary text is surrounded by the bracketing lines `@t` and `@T`. The comments section typically will contain a description of the file's purpose.

Body

The body consists of text lines and control lines. Text lines do not begin with the control character, control lines do. There are three kinds of control lines:

`@I DDDDD`	Insert
`@D DDDDD`	Delete
`@E DDDDD`	End

The digit string is the serial number corresponding to the delta for the control line.

SEE ALSO

`admin`(1), `delta`(1), `get`(1), `prs`(1) in the *User's Reference for the DG/UX System*.

NAME

scr_dump – format of curses screen image file

SYNOPSIS

scr_dump(*file*)

DESCRIPTION

The curses(3X) function scr_dump() copies the contents of the screen into a file. The format of the screen image is as described below.

The name of the tty is 20 characters long and the modification time (the *mtime* of the tty that this is an image of) is of the type *time_t*. All other numbers and characters are stored as chtype (see <curses.h>). No newlines are stored between fields.

<magic number: octal 0433>
<name of tty>
<mod time of tty>
columns <lines>
<line length> <chars in line> for each line on the screen
<line length> <chars in line>
.
.
.
<labels?> 1, if soft screen labels are present
<cursor row> <cursor column>

Only as many characters as are in a line will be listed. For example, if the *<line length>* is 0, there will be no characters following *<line length>*. If *<labels?>* is TRUE, following it will be

<number of labels>
<label width>
<chars in label 1>
<chars in label 2>
.
.
.

SEE ALSO

curses(3X).

NAME

sde-chooser - execute environment-sensitive tool

SYNOPSIS

sde-chooser [-e *sde-target*] *path* [*tool-args*]

DESCRIPTION

The action of a number of software development tools depends on the current software development environment [see sde(5)]. Such tools have different versions in each environment. Sde-chooser finds and executes the correct version of such a tool.

For example, when a command line such as "as foo.s" is executed, a small program named as in /usr/bin executes sde-chooser with the appropriate arguments. Sde-chooser in turn executes the correct version of as.

Sde-chooser is not normally invoked from a shell command line, but it can be with the following arguments:

-e *sde-target* Specifies a software development environment explicitly. If this option is not given, sde-chooser uses the current software development environment [see sde-target(1)].

path The path to the desired tool within an environment. Path is given as an absolute path but it is interpreted as being relative to /usr/sde/<*sde-target*>. For example, /usr/bin/as invokes /usr/sde/<*sde-target*>/usr/bin/as, where <*sde-target*> is a software development environment.

tool-args All remaining arguments to sde-chooser are passed to the selected tool as the argv array. The first of these arguments, argv[0], should be the command name.

For example, the command line

```
sde-chooser -e m88kdguxcoff /usr/bin/cc cc -V
```

will invoke the COFF version of cc with the -V option. The effect, in this example, is the same as issuing the command cc -V in the m88kdguxcoff software development environment.

SEE ALSO

sde-target(1), sde(5), elink(5).

NAME

sdetab – software development environment data base

DESCRIPTION

The sdetab file contains information used by certain software development tools to customize SDE targets. The actual file used is /usr/etc/sdetab, which is an elink to the appropriate file (see sde(5) and elink(5)).

Each entry in the sdetab file consists of a key followed by one or more attributes separated by a colon, :. Blank lines and comments (from the pound sign, #, to the end of the line) are ignored. The backslash, \, may be used to quote characters.

Currently, ld(1) uses the key fmagic to determine the magic number of the executable it produces.

FILES

/usr/etc/sdetab

SEE ALSO

sde-target(1), sde(5), elink(5).

NAME

`services` – service name database

DESCRIPTION

The `services` file contains information about the known services available in the DARPA Internet. For each service, a single line with the following information should be present:

name port/protocol [*aliases*] [# *comment*]

Items are separated by any number of blanks and/or tab characters. The *port* number and *protocol* name are considered a single item ; a slash (/) separates the *port* number and *protocol* name (e.g., `512/tcp`).

Use only decimal numbers to specify port numbers in `/etc/services`. Ports 1-1023 are reserved by DG/UX for system servers to listen for incoming connections from other machines. Other ports in the range 1024 to 2**16-1 are available for user-implemented services.

If you specify an *alias*, you may refer to the service by that name rather than the official service *name*. A # indicates the beginning of a comment; characters up to the end of the line are not interpreted by routines that search the file.

Names in the `services` file may contain any printable character other than a field delimiter (blanks, tabs, CR, ESC), New Line, or comment character.

If your system uses Network Information Service (NIS), see *Managing ONC™/NFS® and Its Facilities on the DG/UX™ System* for details.

EXAMPLES

```
ftp 21/tcp
telnet 23/tcp
```

FILES

`/etc/services`

SEE ALSO

`getservent(3N)`, `protocols(4)`.

NAME

space – disk space requirement file

DESCRIPTION

space is an ASCII file that gives information about disk space requirements for the target environment. It defines space needed beyond that which is used by objects defined in the prototype file—for example, files which will be installed with the installf command. It should define the maximum amount of additional space which a package will require.

The generic format of a line in this file is:

pathname blocks inodes

Definitions for the fields are as follows:

pathname Specifies a directory name which may or may not be the mount point for a filesystem. Names that do not begin with a slash (/) indicate relocatable directories.

blocks Defines the number of disk blocks required for installation of the files and directory entries contained in the pathname (using a 512-byte block size).

inodes Defines the number of inodes required for installation of the files and directory entries contained in the pathname.

EXAMPLE

```
# extra space required by config data which is
# dynamically loaded onto the system
data  500   1
```

SEE ALSO

installf(1M), prototype(4)

NAME

sm, sm.bak, state – statd directories and file structures

SYNOPSIS

/etc/sm /etc/sm.bak /etc/state

DESCRIPTION

/etc/sm and /etc/sm.bak are directories generated by statd. Each entry in /etc/sm represents the name of the machine to be monitored by the statd daemon. Each entry in /etc/sm.bak represents the name of the machine to be notified by the statd daemon upon the remote machine's recovery.

/etc/state is a file generated by statd to record its version number. This version number is incremented each time a crash or recovery takes place.

FILES

/etc/sm
/etc/sm.bak
/etc/state

SEE ALSO

lockd(1M), statd(1M).

NAME

`strftime` – language specific strings

DESCRIPTION

There can exist one printable file per locale to specify its date and time formatting information. These files must be kept in the directory `/usr/lib/locale/<`*locale*`>/LC_TIME`. The contents of these files are:

1. abbreviated month names (in order)
2. month names (in order)
3. abbreviated weekday names (in order)
4. weekday names (in order)
5. default strings that specify formats for locale time (`%X`) and locale date (`%x`).
6. default format for cftime, if the argument for cftime is zero or null.
7. AM (ante meridian) string
8. PM (post meridian) string

Each string is on a line by itself. All white space is significant. The order of the strings in the above list is the same order in which they must appear in the file.

EXAMPLE

`/usr/lib/locale/C/LC_TIME`

```
Jan
Feb
 ...
January
February
 ...
Sun
Mon
 ...
Sunday
Monday
 ...
%H:%M:%S
%m/%d/%y
%a %b %d %T %Z %Y
AM
PM
```

FILES

`/usr/lib/locale/<`*locale*`>/LC_TIME`

SEE ALSO

`ctime`(3C), `setlocale`(3C), `strftime`(3C).

NAME

svcorder – file that specifies name/address resolution order

DESCRIPTION

Use the file /etc/svcorder to configure the order and the means to perform name/address resolution. If the file /etc/svcorder exists, it contains one record made up of one or two fields.

The first field determines the order in which different address resolution methods are tried. This first field consists of any combination of a subset of the following values separated by a colon (:):

YP or yp for Network Information Services (NIS)
RES or res for the resolver
EHOSTS or ehosts for the /etc/hosts file

The second field is an optional comment. You separate the two fields with white space, and begin a comment with a # character.

EXAMPLE

The following line specifies that address resolution should be attempted by NIS first.

```
yp:ehosts:res
```

If NIS is running and cannot resolve the name/address pair, name/address resolution goes no farther. However, you can configure NIS so that it uses the domain name system (DNS) when it cannot resolve a name/address pair after consulting its own database. Note that DNS must be set up on your system before you can use it. See *Managing TCP/IP on the DG/UX System* for more information on DNS. You can configure NIS to use DNS in two ways. You can enter the following command line:

```
make INTERDOMAIN=-b hosts
```

You can also change the "INTERDOMAIN=" line in the /etc/yp/Makefile script to read "INTERDOMAIN=-b". In either case, make sure there is no space before or after the equals (=) sign. The latter method enables the domain name system automatically whenever a change is made in the hosts map. For more information, see Chapter 3 in *Managing ONC/NFS and Its Facilities on the DG/UX System*.

If NIS is not running, /etc/hosts is consulted for name address resolution. If /etc/hosts does not produce an answer, the domain name system is consulted.

If the /etc/svcorder file does not exist, the order in which different resolution methods are tried is as above.

FILES

/etc/svcorder

SEE ALSO

gethostbyname(3N), gethostbyaddr(3N), resolver(3C).

NAME

syms – common object file symbol table format

SYNOPSIS

```
#include <syms.h>
```

DESCRIPTION

Common object files contain information to support symbolic software testing [see sdb(1)]. Line number entries [see linenum(4)] and extensive symbolic information permit testing at the C *source* level. Every object file's symbol table is organized as shown below.

File name 1.
    Function 1.
        Local symbols for function 1.
    Function 2.
        Local symbols for function 2.
    ...
    Static externs for file 1.

File name 2.
    Function 1.
        Local symbols for function 1.
    Function 2.
        Local symbols for function 2.
    ...
    Static externs for file 2.
...

Defined global symbols.
Undefined global symbols.

The entry for a symbol is a fixed-length structure. The members of the structure hold the name (null padded), its value, and other information. The C structure is given below.

```
#define  SYMNMLEN   8
#define  FILNMLEN   14
#define  DIMNUM     4

struct  syment
{
    union                           /* all ways to get symbol name */
    {
        char        _n_name[SYMNMLEN]; /* symbol name */
        struct
        {
            long    _n_zeroes;      /* == 0L when in string table */
            long    _n_offset;      /* location of name in table */
        } _n_n;
        char        *_n_nptr[2];    /* allows overlaying */
    } _n;
    long            n_value;        /* value of symbol */
    short           n_scnum;        /* section number */
    unsigned short  n_type;         /* type and derived type */
    char            n_sclass;       /* storage class */
```

```
    char            n_numaux;     /* number of aux entries */
    char            n_pad1;       /* pad to 4 byte multiple */
    char            n_pad2;       /* pad to 4 byte multiple */
};
};
};

#define  n_name    _n._n_name
#define  n_zeroes  _n._n_n._n_zeroes
#define  n_offset  _n._n_n._n_offset
#define  n_nptr    _n._n_nptr[1]
```

Meaningful values and their explanations can be found in `syms.h`;. anyone who needs to interpret the entries should seek more information there. Some symbols require more information than a single entry; they are followed by *auxiliary entries* that are the same size as a symbol entry. The format follows:

```
union auxent
{
     struct
     {
          long        x_tagndx;
          union
          {
               struct
               {
                    unsigned shortx_lnno;
                    unsigned shortx_size;
               } x_lnsz;
               long   x_fsize;
          } x_misc;
          union
          {
               struct
               {
                    long  x_lnnoptr;
                    long  x_endndx;
               }     x_fcn;
               struct
               {
                    unsigned shortx_dimen[DIMNUM];
               }     x_ary;
          }          x_fcnary;
          unsigned short  x_tvndx;
          char  pad1;
          char  pad2;
     }    x_sym;
     struct
     {
          char  x_fname[FILNMLEN];
     }    x_file;
        struct
        {
                long    x_scnlen;
```

```
                unsigned short  x_nreloc;
                unsigned short  x_nlinno;
            }       x_scn;

        struct
        {
            long        x_tvfill;
            unsigned short    x_tvlen;
            unsigned short    x_tvran[2];
        }   x_tv;
    };
```

Indexes of symbol table entries begin at *zero*.

SEE ALSO

sdb(1), a.out(4), linenum(4).

CAUTION

Symbols declared as type `long` are recorded in the symbol table as type `int`.

NAME

`system` – format of a kernel description file

DESCRIPTION

The *system file* contains information about the hardware and system-dependent parameters found on your system. This information is used in conjunction with one or more *master files* as input into the `config`(1M) program. The `config`(1M) program is used to generate a `conf.c` file, which is then compiled and linked with kernel libraries to form a kernel image. A more complete description of the system file is found in *Managing the DG/UX System*.

Each line in a the system file is a separate entry. An entry contains one or more fields, separated by one or more space and/or tab characters. Any line with a number sign (#) in column 1 is treated as a comment and is ignored. Blank lines are also ignored. Each non-comment entry represents a device, STREAMS module, protocol, or tunable sysem parameter. Entries of any type may appear in any order.

Device Entries

An entry of the form:

devname(*parameters*)

or

devname@*devcode*(*parameters*)

specifies a device or pseudo-device to be configured into the kernel.

The device name *devname* must be listed in a `$device` section of one of the master files.

The *devcode* notation, if present, specifies that a non-default hardware device code will be used for that device. The device code must appear as a two-digit hexadecimal number.

The *parameters* string represents a specific unit or instantiation of the device; its interpretation is left to the specific device driver. If *parameters* is the null string, the driver's default parameter values will be used. Note that the *parameters* string may itself be a device specification, such as:

sd(insc(),*)

Protocol Entries

Each single-word entry that matches an entry in a master file's `$protocol` section specifies a socket protocol to be configured into the kernel.

STREAMS Module Entries

Each single-word entry that matches an entry in a master file's `$stream` section specifies a STREAMS module to be configured into the kernel.

Tunable Parameter Entries

Each one or two-word entry whose first word matches an entry in a master file's `$keyword` section specifies a tunable system parameter for which a non-default value should be configured into the kernel. The first word of the entry names the parameter that is to be tuned; the second word specifies its value. The value field may be omitted if an implied value is specified in the master file. Note that the implied value may be different from the default value.

SEE ALSO

`config`(1M), `sysdef`(1M), `master`(4).
Installing the DG/UX System, *Customizing the DG/UX System*, *Managing the DG/UX System*.

NAME

terminfo – terminal and printer capability database

DESCRIPTION

Terminfo is a compiled database of terminal and printer device capabilities. The capabilities of each type of device are described in a data file that has a name of the following form: /usr/lib/terminfo/?/*, where * stands for the device name and ? stands for the first character of the name. For example,

/usr/lib/terminfo/d/d215

is the terminfo entry for Data General's DASHER D215 terminal and terminals that behave like it.

Terminfo data files are obtained by compiling source descriptions with the tic(1M) command. Terminfo source descriptions describe, in special code, how basic operations are performed on a terminal or printer. They also describe padding requirements, initialization sequences, and so on. The section entitled "Preparing a Terminfo Description" explains how to build a terminfo source description. Applications such as vi(1) and curses(3X) refer to the compiled terminfo database so that they can work with a variety of terminals without changes to the program code.

Entries in a terminfo source file consist of a number of comma-separated fields. The white space after each comma is ignored. The first line names the device, and the remaining lines describe its capabilities.

Device Names

The first line of each device description in the terminfo source file gives the names by which terminfo knows the device. Each name is separated by bar (|) characters. The first name specifies the most common abbreviation for the device (this is the one to use for the environment variable TERM; see profile(4)). The last name should be a long name that fully identifies the device. All other names are synonyms for the device name. All names but the last should contain no blanks; the last, verbose name may contain blanks for readability.

Device names (except for the verbose entry) should be chosen using the following conventions. First, the particular vendor and model of the device should be specified in the root name, for example, att4425 for the AT&T 4425 terminal. Second, device modes or user preferences should be indicated by appending a hyphen and an indicator of the mode, for example, d410-w for the Data General DASHER D410 series in wide mode (more than 80 columns). See term(5) for examples and more information on choosing names and synonyms.

Device Capabilities

Lines after the first line of a device description describe the device's capabilities. Terminfo device capabilities are of three general types: boolean capabilities indicate that the device has some particular feature, numeric capabilities specify a numeric value associated with a particular feature, for example, the size of a terminal screen, and string capabilities give a sequence which can be used to perform particular device operations.

In the table below, the variable is the name by which a C programmer (at the terminfo level) accesses the capability. The capname is the short name for this variable used in the text of the database. It is used by a person updating the database and by the tput(1) command when asking what the value of the capability is for a particular device. **See Also** refers to the numbered subsection in "Terminfo Terminal Capabilities" or the lettered subsection in "Terminfo Printer Capabilities" where the capability is described in detail.

Capability names have no fixed length limit, but an informal limit of 5 characters has been adopted to keep them short. Most of the time, names are chosen to be the same as or similar to the ANSI X3.64-1979 standard. Semantics are also intended to match those of the description.

All string capabilities listed below may have padding described, with the exception of those used for input. Input capabilities, listed under the strings section in the table below, have names beginning with `key_`. The following indicators may appear at the end of the description for a variable.

(G) indicates that the string needs to be instantiated by `tparm()` with arguments (parms) as given ($\#_i$ as described below). `Tparm()` will substitute the arguments into the string to create a customized version. (See `curses`(3X) for more information on `tparm()` and the strings it creates.)

(*) indicates that padding may be based on the number of lines affected.

($\#_i$) indicates the i^{th} parameter.

Variable	Cap-name	See Also	Description
`Boolean Capabilities:`			
auto_left_margin	**bw**	1	`cubl` wraps back from column 0
auto_right_margin	**am**	1,13	Device has automatic margins
back_color_erase	**bce**	12	Screen erased with background color
can_change	**ccc**	12	Device can redefine existing color
ceol_standout_glitch	**xhp**	14	Standout not erased by overwriting (HP)
col_addr_glitch	**xhpa**	B	Only positive motion for `hpa`/`mhpa`
cpi_changes_res	**cpix**	A,G	Character pitch affects resolution
cr_cancels_micro_mode	**crxm**	B	Using `cr` disables micro mode
eat_newline_glitch	**xenl**	14	Newline ignored after 80 columns (Concept)
erase_overstrike	**eo**	6	Overstrikes are erased by blanks
generic_type	**gn**	13	Generic line type (e.g., dialup, switch)
hard_copy	**hc**	1	Hardcopy device
hard_cursor	**chts**	6	Cursor is hard to see
has_meta_key	**km**	13	Device can send meta-characters (e.g., key sets eighth bit)
has_print_wheel	**daisy**	E	Printer needs operator to change character sets
has_status_line	**hs**	10	Terminal has extra "status line"
hue_lightness_saturation	**hls**	12	Device uses only HLS color notation (Tektronix)
insert_null_glitch	**in**	5	Insert mode distinguishes nulls
lpi_changes_res	**lpix**	A,G	Line pitch affects resolution
memory_above	**da**	4	Display may be retained above screen
memory_below	**db**	4	Display may be retained below screen
move_insert_mode	**mir**	5	Safe to move in insert mode
move_standout_mode	**msgr**	6	Safe to move in standout modes

needs_xon_xoff	**nxon**	14	Padding won't work, XON/XOFF needed
no_esc_ctlc	**xsb**	14	Beehive (F1=<ESC>, F2=<Ctrl-C>)
non_rev_rmcup	**nrrmc**	6	smcup does not reverse rmcup
no_pad_char	**npc**	13	Pad character doesn't exist
over_strike	**os**	1,6	Device overstrikes (hardcopy device)
prtr_silent	**mc5i**	13	Printer won't echo on screen
row_addr_glitch	**xvpa**	B	Only positive motion for vpa/mvpa
semi_auto_right_margin	**sam**	B	Printing in last column causes cr
status_line_esc_ok	**eslok**	10	Escape sequences work on status line
dest_tabs_magic_smso	**xt**	13	Destructive tabs, magic smso character (t1061)
tilde_glitch	**hz**	14	Hazeltine; can't print tildes (~)
transparent_underline	**ul**	6	Underline character overstrikes
xon_xoff	**xon**	1,13	Device uses XON/XOFF handshaking

Numeric Capabilities:

buffer_capacity	**bufsz**	I	Bytes buffered before printing
columns	**cols**	1	Number of columns in a line
dot_vert_spacing	**spinv**	F	Vertical pin spacing (pins/inch)
dot_horz_spacing	**spinh**	F	Horizontal dot spacing (dots/inch)
init_tabs	**it**	8	Initial spacing of tab settings
label_height	**lh**	7	Number of rows in each soft label
label_width	**lw**	7	Number of columns in each soft label
lines	**lines**	1	Number of lines on screen or page
lines_of_memory	**lm**	13	Lines of memory; variable if 0
magic_cookie_glitch	**xmc**	6	Number of blanks left by smso/rmso
max_colors	**colors**	12	Maximum number of colors on-screen
max_micro_address	**maddr**	B	Maximum limit on micro_..._address
max_micro_jump	**mjump**	B	Maximum limit on parm_..._micro
max_pairs	**pairs**	12	Maximum number of color-pairs
micro_col_size	**mcs**	A	Horizontal step size in micro mode
micro_line_size	**mls**	A	Vertical step size in micro mode
no_color_video	**ncv**	12	Video attributes unusable with color
number_of_pins	**npins**	F	Number of pins in print head
num_labels	**nlab**	7	Number of soft labels available (starting from 1)
output_res_char	**orc**	A	Horizontal resolution (steps/column)
output_res_line	**orl**	A	Vertical resolution (steps/line)
output_res_horz_inch	**orhi**	A	Horizontal resolution (steps/inch)
output_res_vert_inch	**orvi**	A	Vertical resolution (steps/inch)
padding_baud_rate	**pb**	9	Lowest baud rate requiring padding
print_rate	**cps**	I	Average speed (characters/second)
virtual_terminal	**vt**	13	UNIX system virtual terminal number
wide_char_size	**widcs**	A	Character size in double wide mode
width_status_line	**wsl**	10	Number of columns in status line

String Capabilities:

acs_chars	**acsc**	11	Graphic character set pairs aAbBcC (vt100+)

back_tab	**cbt**	8	Back tab
bell	**bel**	1	Audible signal (bell)
carriage_return	**cr**	1,9	Carriage return (*)
change_char_pitch	**cpi**	A,G	Set pitch to #1 characters/inch (G)
change_line_pitch	**lpi**	A,G	Set pitch to #1 lines/inch (G)
change_res_horz	**chr**	A	Set horizontal resolution to #1 (G)
change_res_vert	**cvr**	A	Set vertical resolution to #1 (G)
change_scroll_region	**csr**	4	Scrolling area lines #1 through #2 (vt100) (G)
char_padding	**rmp**	5	Like `ip` but when in replace mode
char_set_names	**csnm**	E	Name of character set #1 (G)
clear_all_tabs	**tbc**	8	Clear all tab stops
clear_margins	**mgc**	8	Clear left and right soft margins
clear_screen	**clear**	1	Clear screen and home cursor (*)
clr_bol	**el1**	3	Clear to beginning of line
clr_eol	**el**	3,14	Clear to end of line
clr_eos	**ed**	3	Clear to end of display (*)
column_address	**hpa**	2	Horizontal position to column #1 (G)
command_character	**cmdch**	13	Prototype settable command character
cursor_address	**cup**	2	Move cursor to row #1, column #2 (G)
cursor_down	**cud1**	1	Move cursor down one line
cursor_home	**home**	2	Home cursor (especially if no `cup`)
cursor_invisible	**civis**	6	Make cursor invisible
cursor_left	**cub1**	1	Move cursor left one space
cursor_mem_address	**mrcup**	2	Like `cup` but memory relative (G)
cursor_normal	**cnorm**	6	Make cursor normal (undo `civis`/`cvvis`)
cursor_right	**cuf1**	1	Move cursor right one space (non-destructive)
cursor_to_ll	**ll**	2	Move cursor to column 0 of last line
cursor_up	**cuu1**	2	Move cursor up one line
cursor_visible	**cvvis**	6	Make cursor very visible
define_char	**defc**	E	Define character #1 with width #2 and descender #3 (G)
delete_character	**dch1**	5	Delete character (*)
delete_line	**dl1**	4	Delete line (*)
dis_status_line	**dsl**	10	Disable status line
down_half_line	**hd**	13	Move cursor down one half-line (forward 1/2 linefeed)
ena_acs	**enacs**	6	Initialize alternate character set
enter_alt_charset_mode	**smacs**	6	Enable alternate character set mode
enter_am_mode	**smam**	13	Enable automatic margins
enter_blink_mode	**blink**	6	Enable blinking mode
enter_bold_mode	**bold**	6	Enable bold (extra bright) mode
enter_ca_mode	**smcup**	6	String to send before using `cup`
enter_delete_mode	**smdc**	5	Begin delete mode
enter_dim_mode	**dim**	6	Enable half-bright mode
enter_doublewide_mode	**swidm**	D	Enable double wide printing
enter_draft_quality	**sdrfq**	G	Set draft quality printing
enter_insert_mode	**smir**	5	Begin insert mode

enter_italics_mode	**sitm**	D	Enable italics
enter_leftward_mode	**slm**	B	Enable leftward carriage motion
enter_micro_mode	**smicm**	B	Enable micro motion capabilities
enter_near_letter_quality	**snlq**	G	Set near-letter-quality printing
enter_normal_quality	**snrmq**	G	Set normal quality printing
enter_protected_mode	**prot**	6	Enable protected mode
enter_reverse_mode	**rev**	6	Enable reverse video mode
enter_secure_mode	**invis**	6	Enable blank mode (invisible text)
enter_shadow_mode	**sshm**	D	Enable shadow printing
enter_standout_mode	**smso**	6	Enable standout mode
enter_subscript_mode	**ssubm**	D	Enable subscript printing
enter_superscript_mode	**ssupm**	D	Enable superscript printing
enter_underline_mode	**smul**	6	Enable underscore mode
enter_upward_mode	**sum**	B	Enable upward carriage motion
enter_xon_mode	**smxon**	13	Enable XON/XOFF handshaking
erase_chars	**ech**	5	Erase #1 characters (G)
exit_alt_charset_mode	**rmacs**	6	Disable alternate character set mode
exit_am_mode	**rmam**	13	Disable automatic margins
exit_attribute_mode	**sgr0**	6	Disable all video attributes (G)
exit_ca_mode	**rmcup**	6	String to send when done with cup
exit_delete_mode	**rmdc**	5	End delete mode
exit_doublewide_mode	**rwidm**	D	Disable double wide printing
exit_insert_mode	**rmir**	5	End insert mode
exit_italics_mode	**ritm**	D	Disable italics
exit_leftward_mode	**rlm**	B	Enable rightward carriage motion (the normal state)
exit_micro_mode	**rmicm**	B	Disable micro motion capabilities
exit_shadow_mode	**rshm**	D	Disable shadow printing
exit_standout_mode	**rmso**	6	Disable standout mode
exit_subscript_mode	**rsubm**	D	Disable subscript printing
exit_superscript_mode	**rsupm**	D	Disable superscript printing
exit_underline_mode	**rmul**	6	Disable underscore mode
exit_upward_mode	**rum**	B	Enable downward carriage motion (the normal state)
exit_xon_mode	**rmxon**	13	Disable XON/XOFF handshaking
flash_screen	**flash**	6	Visible bell (must not move cursor)
form_feed	**ff**	13	Hardcopy device page eject (*)
from_status_line	**fsl**	10	Return from status line
init_1string	**is1**	8	Device initialization string 1
init_2string	**is2**	8	Device initialization string 2
init_3string	**is3**	8	Device initialization string 3
init_file	**if**	8	Name of initialization data file
init_prog	**iprog**	8	Path name of initialization program
initialize_color	**initc**	12	Define color #1 as RGB #2-#4 (G)
initialize_pair	**initp**	12	Define color-pair #1 as RGB #2-#7 (G)
insert_character	**ich1**	5	Insert new blank character
insert_line	**il1**	4	Add new blank line (*)
insert_padding	**ip**	5	Padding after character inserted (*)
key_a1	**ka1**	7	KEY_A1, Upper left of keypad

key_a3	**ka3**	7	KEY_A3, Upper right of keypad
key_b2	**kb2**	7	KEY_B2, Center of keypad
key_backspace	**kbs**	7	KEY_BACKSPACE, Sent by backspace key
key_beg	**kbeg**	7	KEY_BEG, Sent by beginning key (beg key)
key_btab	**kcbt**	7	KEY_BTAB, Sent by back-tab key
key_c1	**kc1**	7	KEY_C1, Lower left of keypad
key_c3	**kc3**	7	KEY_C3, Lower right of keypad
key_cancel	**kcan**	7	KEY_CANCEL, Sent by cancel key
key_catab	**ktbc**	7	KEY_CATAB, Sent by clear-all-tabs key
key_clear	**kclr**	7	KEY_CLEAR, Sent by clear-screen key (erase key)
key_close	**kclo**	7	KEY_CLOSE, Sent by close key
key_command	**kcmd**	7	KEY_COMMAND, Sent by command key (cmd key)
key_copy	**kcpy**	7	KEY_COPY, Sent by copy key
key_create	**kcrt**	7	KEY_CREATE, Sent by create key
key_ctab	**kctab**	7	KEY_CTAB, Sent by clear-tab key
key_dc	**kdch1**	7	KEY_DC, Sent by delete-character key
key_dl	**kdl1**	7	KEY_DL, Sent by delete-line key
key_down	**kcud1**	7	KEY_DOWN, Sent by cursor-down key (down-arrow key)
key_eic	**krmir**	7	KEY_EIC, Sent by end-insert-mode key
key_end	**kend**	7	KEY_END, Sent by end key
key_enter	**kent**	7	KEY_ENTER, Sent by enter/send key
key_eol	**kel**	7	KEY_EOL, Sent by clear-to-end-of-line key
key_eos	**ked**	7	KEY_EOS, Sent by clear-to-end-of-screen key
key_exit	**kext**	7	KEY_EXIT, Sent by exit key
key_f0	**kf0**	7	KEY_F(0), Sent by function key F0
key_f1	**kf1**	7	KEY_F(1), Sent by function key F1
key_f2	**kf2**	7	KEY_F(2), Sent by function key F2
key_f3	**kf3**	7	KEY_F(3), Sent by function key F3
key_f4	**kf4**	7	KEY_F(4), Sent by function key F4
key_f5	**kf5**	7	KEY_F(5), Sent by function key F5
key_f6	**kf6**	7	KEY_F(6), Sent by function key F6
key_f7	**kf7**	7	KEY_F(7), Sent by function key F7
key_f8	**kf8**	7	KEY_F(8), Sent by function key F8
key_f9	**kf9**	7	KEY_F(9), Sent by function key F9
key_f10	**kf10**	7	KEY_F(10), Sent by function key F10
key_f11	**kf11**	7	KEY_F(11), Sent by function key F11
key_f13	**kf13**	7	KEY_F(12), Sent by function key F12
key_f14	**kf14**	7	KEY_F(13), Sent by function key F13
key_f14	**kf14**	7	KEY_F(14), Sent by function key F14
key_f15	**kf15**	7	KEY_F(15), Sent by function key F15
key_f16	**kf16**	7	KEY_F(16), Sent by function key F16
key_f17	**kf17**	7	KEY_F(17), Sent by function key F17
key_f18	**kf18**	7	KEY_F(18), Sent by function key F18

key_f19	**kf19**	7	KEY_F(19), Sent by function key F19
key_f20	**kf20**	7	KEY_F(20), Sent by function key F20
key_f21	**kf21**	7	KEY_F(21), Sent by function key F21
key_f22	**kf22**	7	KEY_F(22), Sent by function key F22
key_f23	**kf23**	7	KEY_F(23), Sent by function key F23
key_f24	**kf24**	7	KEY_F(24), Sent by function key F24
key_f25	**kf25**	7	KEY_F(25), Sent by function key F25
key_f26	**kf26**	7	KEY_F(26), Sent by function key F26
key_f27	**kf27**	7	KEY_F(27), Sent by function key F27
key_f28	**kf28**	7	KEY_F(28), Sent by function key F28
key_f29	**kf29**	7	KEY_F(29), Sent by function key F29
key_f30	**kf30**	7	KEY_F(30), Sent by function key F30
key_f31	**kf31**	7	KEY_F(31), Sent by function key F31
key_f32	**kf32**	7	KEY_F(32), Sent by function key F32
key_f33	**kf33**	7	KEY_F(13), Sent by function key F33
key_f34	**kf34**	7	KEY_F(34), Sent by function key F34
key_f35	**kf35**	7	KEY_F(35), Sent by function key F35
key_f36	**kf36**	7	KEY_F(36), Sent by function key F36
key_f37	**kf37**	7	KEY_F(37), Sent by function key F37
key_f38	**kf38**	7	KEY_F(38), Sent by function key F38
key_f39	**kf39**	7	KEY_F(39), Sent by function key F39
key_f40	**kf40**	7	KEY_F(40), Sent by function key F40
key_f41	**kf41**	7	KEY_F(41), Sent by function key F41
key_f42	**kf42**	7	KEY_F(42), Sent by function key F42
key_f43	**kf43**	7	KEY_F(43), Sent by function key F43
key_f44	**kf44**	7	KEY_F(44), Sent by function key F44
key_f45	**kf45**	7	KEY_F(45), Sent by function key F45
key_f46	**kf46**	7	KEY_F(46), Sent by function key F46
key_f47	**kf47**	7	KEY_F(47), Sent by function key F47
key_f48	**kf48**	7	KEY_F(48), Sent by function key F48
key_f49	**kf49**	7	KEY_F(49), Sent by function key F49
key_f50	**kf50**	7	KEY_F(50), Sent by function key F50
key_f51	**kf51**	7	KEY_F(51), Sent by function key F51
key_f52	**kf52**	7	KEY_F(52), Sent by function key F52
key_f53	**kf53**	7	KEY_F(53), Sent by function key F53
key_f54	**kf54**	7	KEY_F(54), Sent by function key F54
key_f55	**kf55**	7	KEY_F(55), Sent by function key F55
key_f56	**kf56**	7	KEY_F(56), Sent by function key F56
key_f57	**kf57**	7	KEY_F(57), Sent by function key F57
key_f58	**kf58**	7	KEY_F(58), Sent by function key F58
key_f59	**kf59**	7	KEY_F(59), Sent by function key F59
key_f60	**kf60**	7	KEY_F(60), Sent by function key F60
key_f61	**kf61**	7	KEY_F(61), Sent by function key F61
key_f62	**kf62**	7	KEY_F(62), Sent by function key F62
key_f63	**kf63**	7	KEY_F(63), Sent by function key F63
key_find	**kfnd**	7	KEY_FIND, Sent by find key
key_help	**khlp**	7	KEY_HELP, Sent by help key
key_home	**khome**	7	KEY_HOME, Sent by home key
key_ic	**kich1**	7	KEY_IC, Sent by insert-character key

			(enter-insert-mode key)
key_il	**kil1**	7	KEY_IL, Sent by insert-line key
key_left	**kcub1**	7	KEY_LEFT, Sent by cursor-left key (left-arrow key)
key_ll	**kll**	7	KEY_LL, Sent by home-down key
key_mark	**kmrk**	7	KEY_MARK, Sent by mark key
key_message	**kmsg**	7	KEY_MESSAGE, Sent by message key
key_move	**kmov**	7	KEY_MOVE, Sent by move key
key_next	**knxt**	7	KEY_NEXT, Sent by next-object key
key_npage	**knp**	7	KEY_NPAGE, Sent by next-page key
key_open	**kopn**	7	KEY_OPEN, Sent by open key
key_options	**kopt**	7	KEY_OPTIONS, Sent by options key
key_ppage	**kpp**	7	KEY_PPAGE, Sent by previous-page key
key_previous	**kprv**	7	KEY_PREVIOUS, Sent by previous-object key
key_print	**kprt**	7	KEY_PRINT, Sent by print key (copy key)
key_redo	**krdo**	7	KEY_REDO, Sent by redo key
key_reference	**kref**	7	KEY_REFERENCE, Sent by reference key (ref key)
key_refresh	**krfr**	7	KEY_REFRESH, Sent by refresh key
key_replace	**krpl**	7	KEY_REPLACE, Sent by replace key
key_restart	**krst**	7	KEY_RESTART, Sent by restart key
key_resume	**kres**	7	KEY_RESUME, Sent by resume key
key_right	**kcuf1**	7	KEY_RIGHT, Sent by cursor-right key (right-arrow key)
key_save	**ksav**	7	KEY_SAVE, Sent by save key
key_sbeg	**kBEG**	7	KEY_SBEG, Sent by shifted beginning key
key_scancel	**kCAN**	7	KEY_SCANCEL, Sent by shifted cancel key
key_scommand	**kCMD**	7	KEY_SCOMMAND, Sent by shifted command key (cmd key)
key_scopy	**kCPY**	7	KEY_SCOPY, Sent by shifted copy key
key_screate	**kCRT**	7	KEY_SCREATE, Sent by shifted create key
key_sdc	**kDC**	7	KEY_SDC, Sent by shifted delete-character key
key_sdl	**kDL**	7	KEY_SDL, Sent by shifted delete-line key
key_select	**kslt**	7	KEY_SELECT, Sent by select key
key_send	**kEND**	7	KEY_SEND, Sent by shifted end key
key_seol	**kEOL**	7	KEY_SEOL, Sent by shifted clear-to-end-of-line key
key_sexit	**kEXT**	7	KEY_SEXIT, Sent by shifted exit key
key_sf	**kind**	7	KEY_SF, Sent by scroll-forward key (scroll-down key)
key_sfind	**kFND**	7	KEY_SFIND, Sent by shifted find key
key_shelp	**kHLP**	7	KEY_SHELP, Sent by shifted help key

key_shome	**kHOM**	7	KEY_SHOME, Sent by shifted home key
key_sic	**kIC**	7	KEY_SIC, Sent by shifted input key
key_sleft	**kLFT**	7	KEY_SLEFT, Sent by shifted cursor-left key (left-arrow key)
key_smessage	**kMSG**	7	KEY_SMESSAGE, Sent by shifted message key
key_smove	**kMOV**	7	KEY_SMOVE, Sent by shifted move key
key_snext	**kNXT**	7	KEY_SNEXT, Sent by shifted next key
key_soptions	**kOPT**	7	KEY_SOPTIONS, Sent by shifted options key
key_sprevious	**kPRV**	7	KEY_SPREVIOUS, Sent by shifted previous-object key
key_sprint	**kPRT**	7	KEY_SPRINT, Sent by shifted print key
key_sr	**kri**	7	KEY_SR, Sent by scroll-backward key (scroll-up key)
key_sredo	**kRDO**	7	KEY_SREDO, Sent by shifted redo key
key_sreplace	**kRPL**	7	KEY_SREPLACE, Sent by shifted replace key
key_sright	**kRIT**	7	KEY_SRIGHT, Sent by shifted cursor-right key (right-arrow key)
key_srsume	**kRES**	7	KEY_SRSUME, Sent by shifted resume key
key_ssave	**kSAV**	7	KEY_SSAVE, Sent by shifted save key
key_ssuspend	**kSPD**	7	KEY_SSUSPEND, Sent by shifted suspend key
key_stab	**khts**	7	KEY_STAB, Sent by set-tab key
key_sundo	**kUND**	7	KEY_SUNDO, Sent by shifted undo key
key_suspend	**kspd**	7	KEY_SUSPEND, Sent by suspend key
key_undo	**kund**	7	KEY_UNDO, Sent by undo key
key_up	**kcuu1**	7	KEY_UP, Sent by cursor-up key (up-arrow key)
keypad_local	**rmkx**	7	Disable "keypad-transmit" mode
keypad_xmit	**smkx**	7	Enable "keypad-transmit" mode
lab_f0	**lf0**	7	Label on function key F0 if not F0
lab_f1	**lf1**	7	Label on function key F1 if not F1
lab_f2	**lf2**	7	Label on function key F2 if not F2
lab_f3	**lf3**	7	Label on function key F3 if not F3
lab_f4	**lf4**	7	Label on function key F4 if not F4
lab_f5	**lf5**	7	Label on function key F5 if not F5
lab_f6	**lf6**	7	Label on function key F6 if not F6
lab_f7	**lf7**	7	Label on function key F7 if not F7
lab_f8	**lf8**	7	Label on function key F8 if not F8
lab_f9	**lf9**	7	Label on function key F9 if not F9
lab_f10	**lf10**	7	Label on function key F10 if not F10
label_off	**rmln**	7	Disable soft labels
label_on	**smln**	7	Enable soft labels
meta_off	**rmm**	13	Disable "meta mode"
meta_on	**smm**	13	Enable "meta mode" (eight-bit I/O)

micro_column_address	**mhpa**	B	Like `column_address` for micro adjustment (G)
micro_down	**mcud1**	B	Like `cursor_down` for micro adjustment
micro_left	**mcub1**	B	Like `cursor_left` for micro adjustment
micro_right	**mcuf1**	B	Like `cursor_right` for micro adjustment
micro_row_address	**mvpa**	B	Like `row_address` for micro adjustment (G)
micro_up	**mcuu1**	B	Like `cursor_up` for micro adjustment
newline	**nel**	1	Newline (like `CR` followed by `LF`)
order_of_pins	**porder**	F	Matches data bits to print head pins
orig_colors	**oc**	12	Set all color(-pair)s to defaults
orig_pair	**op**	12	Set color-pair to the default (G)
pad_char	**pad**	13	Pad character (rather than null)
parm_dch	**dch**	5	Delete #1 characters (G*)
parm_delete_line	**dl**	4	Delete #1 lines (G*)
parm_down_cursor	**cud**	1	Move cursor down #1 lines (G*)
parm_down_micro	**mcud**	B	Like `parm_down_cursor` for micro adjustment (G)
parm_ich	**ich**	4	Insert #1 blank characters (G*)
parm_index	**indn**	1	Scroll forward #1 lines (G)
parm_insert_line	**il**	4	Add #1 new blank lines (G*)
parm_left_cursor	**cub**	1	Move cursor left #1 spaces (G)
parm_left_micro	**mcub**	B	Like `parm_left_cursor` for micro adjustment (G)
parm_right_cursor	**cuf**	1	Move cursor right #1 spaces (G*)
parm_right_micro	**mcuf**	B	Like `parm_right_cursor` for micro adjustment (G)
parm_rindex	**rin**	1	Scroll backward #1 lines (G)
parm_up_cursor	**cuu**	1	Move cursor up #1 lines (G*)
parm_up_micro	**mcuu**	B	Like `parm_up_cursor` for micro adjustment (G)
pkey_key	**pfkey**	7	Program PFkey #1 to type #2 (G)
pkey_local	**pfloc**	7	Program PFkey #1 to execute #2 (G)
pkey_xmit	**pfx**	7	Program PFkey #1 to transmit #2 (G)
plab_norm	**pln**	7	Program soft label #1 to show #2 (G)
print_screen	**mc0**	13	Print contents of screen
prtr_non	**mc5p**	13	Enable printer for #1 bytes
prtr_off	**mc4**	13	Disable printer
prtr_on	**mc5**	13	Enable printer
repeat_char	**rep**	13	Repeat character #1 #2 times (G*)
req_for_input	**rfi**	13	Send next input character (for ptys)
reset_1string	**rs1**	8	Device full reset string 1
reset_2string	**rs2**	8	Device full reset string 2
reset_3string	**rs3**	8	Device full reset string 3
reset_file	**rf**	8	Name of file containing reset string
restore_cursor	**rc**	4,10	Move cursor to position of last `sc`

row_address	**vpa**	2	Vertical position to row #1 (G)
save_cursor	**sc**	4,10	Save cursor position for next `rc`
scroll_forward	**ind**	1	Scroll text up one line
scroll_reverse	**ri**	1	Scroll text down one line
select_char_set	**scs**	E	Select character set #1 (G)
set_attributes	**sgr**	6	Define video attributes #1-#9 (G)
set_background	**setb**	12	Set active background color to #1 (G)
set_bottom_margin	**smgb**	C	Set bottom margin at current line
set_bottom_margin_parm	**smgbp**	C	Set bottom margin at line #1 or #2 lines from bottom (G)
set_color_pair	**scp**	12	Set current color-pair to #1 (G)
set_foreground	**setf**	12	Set active foreground color to #1 (G)
set_left_margin	**smgl**	8	Set soft left margin
set_left_margin_parm	**smglp**	C	Set left margin at column #1 (right margin at #2) (G)
set_right_margin	**smgr**	8	Set soft right margin
set_right_margin_parm	**smgrp**	C	Set right margin at column #1 (G)
set_tab	**hts**	8	Set tab in all rows, current column
set_top_margin	**smgt**	C	Set top margin at current line
set_top_margin_parm	**smgtp**	C	Set top margin at line #1 (bottom margin at line #2) (G)
set_window	**wind**	4	Set current window to lines #1-#2, columns #3-#4 (G)
start_bit_image	**sbim**	F	Start printing bit image graphics, #1 dots wide (G)
start_char_set_def	**scsd**	E	Start defining character set #1, containing #2 characters (G)
stop_bit_image	**rbim**	F	End printing bit image graphics
stop_char_set_def	**rcsd**	E	End defining character set #1 (G)
subscript_characters	**subcs**	D	"Subscript-able" characters
superscript_characters	**supcs**	D	"Superscript-able" characters
tab	**ht**	8	Tab to next hardware tab stop
these_cause_cr	**docr**	B	Any of these characters causes `cr`
to_status_line	**tsl**	10	Go to status line, column #1 (G)
underline_char	**uc**	6	Underscore character and move past
up_half_line	**hu**	13	Move up one half-line (reverse 1/2 linefeed)
xoff_character	**xoffc**	13	XOFF character
xon_character	**xonc**	13	XON character
zero_motion	**zerom**	B	No motion for subsequent character

PREPARING A TERMINFO DESCRIPTION

At a mininum for a terminal, a `terminfo` source file should specify capabilities to do the following:

- Clear the screen
- Specify screen size
- Specify how to scroll the screen
- Specify how to move the cursor to any point on the screen
- Display whatever graphic embellishments are available (e.g., reverse video)
- Specify whether the cursor wraps around when it reaches the end of a line
- Specify a scrolling region, if possible
- Insert and delete lines and characters, if available

- Save and restore the cursor position, if possible
- Describe special keys, if any
- Specify how to handle special cases of terminal behavior, if any

The most effective way to prepare a new device description is by imitating the description of a similar device in `terminfo` and building up the new description gradually, testing whether `vi`(1) works with the compiled description. That is, first create a `terminfo` source file that includes what you have determined to be the minimum set of capabilities needed for the new device. Next, compile the source with the `tic`(1M) command. Use `vi`(1) and determine whether the device displays what it is supposed to display. Make alterations or add more advanced capabilities to the source file as appropriate, recompile the source, and repeat the test. Repeat this cycle until the description is complete and correct.

You can obtain the source description for a given device by using the `-I` option of `infocmp`(1M). You may copy and edit this description to accurately describe the device that you wish to enter into the `terminfo` database. Most reference manuals for terminals and printers list the codes that make the device perform specific operations. Use these codes to describe capabilities of the new device.

To test a new device description, set the environment variable `TERMINFO` to the pathname of a directory containing the compiled description. Programs will then search that directory for terminal information instead of `/usr/lib/terminfo`. To get the padding for insert-line correct on a terminal (if the manufacturer did not document it) a severe test is to comment out `xon`, edit a large file at 9600 baud with `vi`(1), delete 16 or so lines from the middle of the screen, then hit the `u` key several times quickly. If the display is corrupted, more padding is usually needed. An analagous test can be used for insert-character.

Be aware that a very unusual device may expose deficiencies in the ability of `terminfo` to describe it or the ability of programs such as `vi`(1) to work with that device.

Similar Devices

If there are two very similar devices, one can be defined as being just like the other with certain exceptions. The string capability `use` can be given with the name of the similar device. The capabilities given before `use` override those in the device type included by `use`.

More than one `use` capability may be specified. Statements that contain `use` exhibit left-to-right precedence. That is, the earliest `use` statement has priority when more than one statement defines the same capability.

A capability can be canceled by placing @ to the left of the capability definition. For example:

```
att4424-2|Teletype 4424 in display function group ii,
    rev@, sgr@, smul@, use=att4424,
```

defines an AT&T 4424 terminal that does not have the `rev`, `sgr`, and `smul` capabilities, and hence cannot do highlighting. This is useful for different modes of a device, or for different user preferences.

Parameterized Strings

Cursor addressing and other strings requiring parameters for the device are described by a parameterized string capability, with `printf`(3S)-like escapes (`%`*x*) in it. The parameter mechanism uses a stack and special `%` codes to manipulate it in the manner of a Reverse Polish Notation (postfix) calculator.

Typically a sequence pushes one of the parameters onto the stack and then prints it in some format. When a sequence pushes a value, the value is placed onto the top of the `terminfo` stack, leaving the source unchanged. The complement to a "push" is the "pop", which removes the topmost value from the `terminfo` stack, storing it elsewhere or using it in the current calculation.

Stack and Variable Manipulation

Parameterized strings can access arguments passed to `tparm()`. The arguments are referenced positionally, by number from `1` to `9`. `Terminfo` also provides 52 variables that parameterized strings can use. The variables are referenced by letter from `a` to `z` and from `A` to `Z`. The lowercase variable names represent automatic variables that do not retain their values between parameterized strings. The uppercase variable names represent static variables that do retain their values.

%p[1-9] Push the indicated parameter.
%'*c*' Push the character constant '*c*'.
%{*n*} Push the one or two digit decimal number constant *n*.
%P[a-zA-Z] Pop the stack into the indicated variable.
%g[a-zA-Z] Push the current contents of the indicated variable.

Printing Operations

The following escapes print a value in a specified format.

%% Print the '%' character.
%c Pop the stack and print the value without interpretation, that is, as a single character.
%[[:]*flags*][*width*[.*precision*]][doxXs]
Pop the stack and print the value as a formatted string, converting to decimal (`d`), octal (`o`), lowercase hexadecimal (`x`), uppercase hexadecimal (`X`), or character (`s`) data as indicated. For information on the *flags*, *width*, and *precision* fields, and more information on the conversions, consult `printf`(3S). (The *flags* supported are `-`, `+`, `#`, and the space character.)

NOTE: The `-` flag must be preceded by a colon (`:`) to differentiate the flag from the `%-` escape described below.

Arithmetic Operations

The following escapes pop one or two operands off the stack, perform some arithmetic operation, and then push the result onto the stack. Binary operations are in postfix form and expect the first operand to be on the top of the stack.

NOTE: Whether arithmetic is signed or unsigned is unspecified.

%+ Push the sum of the two topmost values on the stack.
%- Push the difference of the two topmost values on the stack.
%* Push the product of the two topmost values on the stack.
%/ Push the quotient of the two topmost values on the stack.
%m Push the modulus of the two topmost values on the stack.
%& Push the bitwise AND of the two topmost values on the stack.
%| Push the bitwise OR of the two topmost values on the stack.
%^ Push the bitwise exclusive OR of the two topmost values on the stack.
%~ Bitwise complement the topmost value on the stack.

Logical Operations

The following escapes are like arithmetic operations except that they return boolean values. They pop one or two operands off the stack, perform some logical operation,

and then push the result onto the stack. Possible results are 0 for FALSE, or 1 for TRUE.

NOTE: For logical operands, any nonzero value is considered TRUE.

%= Push TRUE if the two topmost operands are numerically equal.
%> Push TRUE if the second operand is greater than the topmost operand.
%< Push TRUE if the second operand is less than the topmost operand.
%A Push TRUE if the two topmost operands are both logically TRUE (AND).
%O Push TRUE if either of the two topmost operands are logically TRUE (OR).
%! Logically invert the topmost operand (NOT).

Miscellaneous Operations

%l Pop the stack, then push the length of the string indicated by that value. This escape is similar to strlen(3C).
%i Add one to the first two parameters passed to tparm(), or to the single parameter if just one was passed. This is useful for ANSI terminals, which number cursor positions starting from one instead of zero.
%?*expr*%t*then*%;
%?*expr*%t*then*%e*else*%;
"If-Then" and "If-Then-Else" (conditional) statements. *Expr*, *then*, and *else* are all parameterized substrings. In operation, terminfo evaluates *expr* and then pops the stack. If the popped value is logically TRUE, *then* is evaluated. Otherwise, if *else* was provided, *else* is evaluated. (*expr* typically calculates some logical expression, and *then* and *else* typically print corresponding strings.)

"If-Then-ElseIf" conditionals can be written as a string of "If-Then-Else" statements ala Algol 68, that is:

%? *c1* %t *b1* %e *c2* %t *b2* ... %e *cN* %t *bN* %e *E* %;

where *c*[*1-N*] are conditionals like *expr*, *b*[*1-N*] are bodies like *then*, and *E* is a body like *else*.

A Sample Entry

The following entry, which describes the Concept-100 terminal, is among the more complex entries in the terminfo file as of this writing. It is provided here to illustrate the form and content of a terminfo entry, and to provide a point of reference for the text that follows.

```
concept100|c100|concept|c104|c100-4p|concept 100,
    am, db, eo, in, mir, ul, xenl,
    cols#80, lines#24, pb#9600, vt#8,
    bel=^G, blank=\EH, blink=\EC, clear=^L$<2*>, cnorm=\Ew, cr=^M$9,
    cub1=^H, cud1=^J, cuf1=\E=, cup=\Ea%p1%' '%+%c%p2%' '%+%c,
    cuu1=\E;, cvvis=\EW, dch1=\E^A$<16*>, dim=\EE, dl1=\E^B$<3*>,
    ed=\E^C$<16*>, el=\E^U$16, flash=\Ek$<20>\EK, ht=\t$8, il1=\E^R$<3*>,
    .ind=^J$9, ind=^J, ip=$<16*>,
    is2=\EU\Ef\E7\E5\E8\El\ENH\EK\E\0\Eo&\0\Eo\47\E, kbs=^h, kcub1=\E>,
    kcud1=\E<, kcuf1=\E=, kcuu1=\E;, kf1=\E5, kf2=\E6, kf3=\E7, khome=\E?,
    prot=\EI, rep=\Er%p1%c%p2%' '%+%c$<.2*>, rev=\ED,
    rmcup=\Ev\s\s\s\s$<6>\Ep\r\n, rmir=\E\0, rmkx=\Ex, rmso=\Ed\Ee,
    rmul=\Eg, rmul=\Eg, sgr0=\EN\0, smcup=\EU\Ev\s\s8p\Ep\r, smir=\E^P,
    smkx=\EX, smso=\EE\ED, smul=\EG,
```

Entries may continue onto multiple lines by placing white space at the beginning of each line except the first. Lines beginning with "#" are interpreted as comments.

How to Describe Device Capabilities

In the example, the boolean capabilities appear in the second line. The numeric capabilities appear in the line that follows the booleans. The remainder of the entry consists of string capabilities.

The fact that a device has "automatic margins" (that is, an automatic return and linefeed when the end of a line is reached) is indicated by the boolean capability `am`. Thus, the device description simply gives `am`. Numeric capabilities are followed by the character '#' and then the value assigned. Thus `cols`, which indicates the number of columns the device has, specifies the value `80` for the Concept 100 as `cols#80`. The value may be specified in decimal, octal, or hexadecimal using normal C conventions. Finally, string-valued capabilities, such as `bel` (sound an audible alarm) are specified by the two- to five-character capability name, or capname for short, an '=', and then a string ending at the next following comma. The concept 100 responds to `<Ctrl-G>` by sounding its bell, so the description specifies `bel=^G`.

A delay in milliseconds may appear anywhere in a string capability, bracketed by `$<..>`, as in `el=\EK$<3>`. Padding characters are supplied by `tputs`() (see `curses`(3X)) to provide this delay. The delay can be either a number (for example, `20`); or a number followed by an '*' (for example, `3*`), a '/' (for example, `5/`), or both (for example, `10*/`). A '*' indicates that the padding required is proportional to the number of lines affected by the operation, and the amount given is the per-affected-unit padding required. (In the case of insert character, the factor is still the number of lines affected. This is always 1 unless the terminal has `in` defined and the software uses it.) When an '*' is specified, it is sometimes useful to give a delay of the form `3.5` to specify a delay per unit to tenths of milliseconds. (Only one decimal place is allowed.) A '/' indicates that the padding is mandatory. Otherwise, if the device has `xon` defined, the padding information is advisory and is only used for cost estimates or when the device is in raw mode. Mandatory padding is transmitted regardless of the setting of `xon`.

A number of escape sequences are provided in the string valued capabilities for easy encoding of characters there. Both `\E` and `\e` map to an ESCAPE character, `^`*x* maps to a `<Ctrl-`*x*`>` for any appropriate *x*, and the sequences `\n`, `\l`, `\r`, `\t`, `\b`, `\f`, and `\s` give a newline, linefeed, return, tab, backspace, formfeed, and space, respectively. Other escapes include: `\^` for caret (^); `\\` for backslash (\); `\,` for comma (,); `\:` for colon (:); and `\0` for null. (`\0` actually produces `\200`, which does not terminate a string but behaves as a null character on most devices.) Finally, characters may be given as three octal digits after a backslash (e.g., `\123`).

Sometimes individual capabilities must be commented out. To do this, put a period before the capability name. For example, see the first `ind` in the example above. Note that when capabilities are defined more than once, a prior definition overrides a later definition.

TERMINFO TERMINAL CAPABILITIES

The following subsections describe `terminfo` terminal capabilities in detail. Subsections are numbered for cross-reference to the table that appears earlier in this man page.

1. Basic Capabilities

The number of columns on each line for the terminal is given by the `cols` numeric capability. If the terminal has a screen, then the number of lines on the screen is given by the `lines` capability. If the terminal cursor wraps around to the beginning of the next line when it reaches the right margin, then the `am` capability should be given. If the terminal can clear its screen, leaving the cursor in the home position, then this is given by the `clear` string capability. If the terminal overstrikes (rather than clearing a position when a character is overwritten) then it should have the `os` capability. If the terminal is a printing terminal, with no soft copy unit, give it both `hc` and `os`. (`os` applies to storage scope terminals, such as the Tektronix 4010 series, as well as hardcopy and APL terminals.) If there is a code to move the cursor to the left edge of the current row, give this as `cr`. (Normally this is carriage return, `^M`.) If there is a code to produce an audible signal (bell, beep, etc) give this as `bel`. If the terminal uses the XON-XOFF flow control protocol, like most terminals, specify the boolean capability `xon`.

If there is a code to move the cursor one position to the left (such as backspace) that capability should be given as `cubl`. Similarly, codes to move to the right, up, and down should be given as `cufl`, `cuul`, and `cudl`. These local cursor motions should not alter the text they pass over; for example, you would not normally use `cufl=\s` because the space would erase the character moved over.

It is important to remember that the local cursor motions encoded in `terminfo` are undefined at the left and top edges of a screen terminal. Programs should never attempt to backspace around the left edge, unless `bw` is specified, and should never attempt to move the cursor up locally off the top.

To scroll text up, a program moves the cursor to the bottom left corner of the screen and sends the `ind` (index) string. To scroll text down, a program moves the cursor to the top left corner of the screen and sends the `ri` (reverse index) string. The strings `ind` and `ri` are undefined when the cursor is not on their respective corners of the screen.

Parameterized versions of the scrolling sequences are `indn` and `rin` which have the same semantics as `ind` and `ri` except that they take one parameter, and scroll that many lines. They are also undefined except at the appropriate corners of the screen.

The `am` capability tells whether the cursor sticks at the right edge of the screen when text is output, but this does not necessarily apply to a `cufl` from the last column. The only local motion which is defined from the left edge is if `bw` is given, then a `cubl` from the left edge moves to the right edge of the previous row. If `bw` is not given, the effect is undefined. `bw` is useful for drawing a box around the edge of the screen, for example. If the terminal has switch selectable automatic margins, the `terminfo` file usually assumes that this is on; i.e., `am`. If the terminal has a command which moves to the first column of the next line, that command can be given as `nel` (newline). It does not matter if the command clears the remainder of the current line, so if the terminal has no `CR` and `LF` it may still be possible to craft a working `nel` out of one or both of them.

These capabilities suffice to describe hardcopy and screen terminals. Thus the model 33 teletype is described as follows:

```
33|tty33|tty|model 33 teletype,
    bel=^G, cols#72, cr=^M, cudl=^J, hc, ind=^J, os,
```

The Lear Siegler ADM-3 is described as follows:

```
adm3|lsi adm3,
    am, bel=^G, clear=^Z, cols#80, cr=^M, cub1=^H,
    cud1=^J, ind=^J, lines#24,
```

2. Cursor Motions

If the terminal has a fast way to home the cursor (to the very upper left corner of the screen) then this can be given as `home`; similarly a fast way of getting to the lower left-hand corner can be given as `ll`; this may involve going up with `cuu1` from the home position, but a program should never do this itself (unless `ll` does) because it can make no assumption about the effect of moving up from the home position. Note that the home position is the same as addressing to (0,0): to the top left corner of the screen, not of memory. (Thus, the `\EH` sequence on Hewlett-Packard terminals cannot be used for `home` without losing some of the other features on the terminal.)

If the terminal has a way to move the cursor to any selected position on the screen, specify this with the `cup` string capability, which takes two parameters: the row and column of the new cursor position. (Rows and columns are numbered from zero and refer to the physical screen visible to the user, not to any unseen memory.) If the terminal has memory relative cursor addressing, that can be indicated by the string capability `mrcup`.

If the terminal has row or column absolute cursor addressing, these can be given as single parameter capabilities `hpa` (horizontal position absolute) and `vpa` (vertical position absolute). Sometimes these are shorter than the more general two-parameter sequence (as with the Hewlett-Packard 2645) and can be used in preference to `cup`. If there are parameterized local motions (e.g., move *n* spaces to the right) these can be given as `cud`, `cub`, `cuf`, and `cuu` with a single parameter indicating how many spaces to move. These are primarily useful if the terminal does not have `cup`, as with the Tektronix 4025.

3. Area Clears

If the terminal can clear from the current position to the end of the line, leaving the cursor where it is, this should be given as `el`. If the terminal can clear from the beginning of the line to the current position inclusive, leaving the cursor where it is, this should be given as `el1`. If the terminal can clear from the current position to the end of the display, then this should be given as `ed`. `ed` is only defined from the first column of a line. (Thus, it can be simulated by a request to delete a large number of lines, if a true `ed` is not available.)

4. Insert/delete line

If the terminal can open a new blank line before the line containing the cursor, this should be given as `il1`; this is done only from the first position of a line. The cursor must then appear on the newly blank line. If the terminal can delete the line which the cursor is on, then this should be given as `dl1`; this is done only from the first position on the line to be deleted. Versions of `il1` and `dl1` which take a single parameter and insert or delete that many lines can be given as `il` and `dl`.

If the terminal has a destructive programmable scrolling region (like the VT100), the command to set the region can be described with the `csr` string capability, which takes two parameters: the top and bottom lines of the scrolling region. It is possible to get the effect of insert or delete line using this command – the `sc` and `rc` (save and restore cursor) string capabilities are also useful. The cursor position is, alas, undefined after using this command. It must be reset using other terminfo capabilities such as `cup`, `home`, or `rc`. Inserting lines at the top or bottom of the screen can also be done using `ri` or `ind` on many terminals without a true insert/delete line, and is often faster even on terminals with those features.

To determine whether a terminal has destructive scrolling regions or non-destructive scrolling regions, create a scrolling region in the middle of the screen, place data on the bottom line of the scrolling region, move the cursor to the top line of the scrolling region, and do a reverse index (`ri`) followed by a delete line (`dl1`) or index (`ind`). If the data that was originally on the bottom line of the scrolling region was restored into the scrolling region by the `dl1` or `ind`, then the terminal has non-destructive scrolling regions. Otherwise, it has destructive scrolling regions. Do not specify `csr` if the terminal has non-destructive scrolling regions, unless `ind`, `ri`, `indn`, `rin`, `dl`, and `dl1` all simulate destructive scrolling.

If the terminal has the ability to define a window as part of memory, which all commands affect, it should be given as the parameterized string `wind`. The four parameters are the starting and ending lines in memory and the starting and ending columns in memory, in that order.

If the terminal can retain display memory above, then the `da` boolean capability should be given; if display memory can be retained below, then `db` should be given. These indicate that deleting a line or scrolling a full screen may bring non-blank lines up from below or that scrolling back with `ri` may bring down non-blank lines.

5. **Insert/Delete Character**

There are two basic kinds of intelligent terminals with respect to insert/delete character operations which can be described using `terminfo`. The most common insert/delete character operations affect only the characters on the current line and shift characters off the end of the line rigidly (i.e., all characters to the right of the insertion or deletion shift as a unit). Other terminals, such as the Concept-100 and the Perkin Elmer Owl, make a distinction between typed and untyped blanks on the screen, shifting upon an insert or delete only to an untyped blank on the screen which is either eliminated, or expanded to two untyped blanks.

You can determine the kind of terminal you have by clearing the screen and then typing text separated by cursor motions. Type "`abc def`" using local cursor motions (not spaces) between the `abc` and the `def`. Then position the cursor before the `abc` and put the terminal in insert mode. If typing characters causes the rest of the line to shift rigidly and characters to "fall off" the end, then your terminal does not distinguish between blanks and untyped positions. If the `abc` shifts over to the `def` which then move together around the end of the current line and onto the next as you insert, you have the second type of terminal, and thus you should define the boolean capability `in`, which stands for "insert null". While these are two logically separate attributes (one line versus multiline insert mode, and special treatment of untyped spaces), we have seen no terminals whose insert mode cannot be described with the single attribute.

`Terminfo` can describe both terminals which have an insert mode and terminals which send a simple sequence to open a blank position on the current line. Give as `smir` the sequence to get into insert mode. Give as `rmir` the sequence to leave insert mode. Now give as `ich1` any sequence needed to be sent just before sending the character to be inserted. Most terminals with a true insert mode do not specify `ich1`; terminals which send a sequence to open a screen position should specify it here. (If your terminal has both, insert mode is usually preferable to `ich1`. Do not give both unless the terminal actually requires both to be used in combination.)

If post-insert padding is needed, give this as a number of milliseconds padding in `ip` (a string capability). Any other sequence that may need to be sent after an insert of a single character may also be given in `ip`. If your terminal needs both to be placed into an 'insert mode' and a special code to precede each inserted character, then both

smir/rmir and ich1 can be given, and both are used.

The ich capability, with one parameter, *n*, repeats the effects of ich1 *n* times.

If padding is necessary between characters typed while not in insert mode, give this as a number of milliseconds padding in rmp.

It is occasionally necessary to move around while in insert mode to delete characters on the same line (e.g., if there is a tab after the insertion position). If your terminal allows motion while in insert mode you can give the capability mir to speed up inserting in this case. Omitting mir affects only speed. Some terminals (notably Datamedia's) must not have mir because of the way their insert mode works.

Finally, you can give dch1 to delete a single character, dch with one parameter, *n*, to delete *n* characters, and smdc and rmdc to enter and exit delete mode (any mode the terminal needs to be placed in for dch1 to work).

A command to erase *n* characters (equivalent to outputting *n* blanks without explicitly moving the cursor) can be given as ech with one parameter.

6. Highlighting, Underlining, and Visible Bells

If your terminal has one or more kinds of display attributes (graphic embellishments to text), these can be represented in a number of different ways. You should choose one display form as "standout mode" (see curses(3X)), representing a good, high contrast, easy-on-the-eyes format for highlighting error messages and other attention getters. (If you have a choice, reverse video plus half-bright is good, or reverse video alone; however, different users have different preferences on different terminals.) The sequences to enter and exit standout mode are given as smso and rmso, respectively. If the code to change into or out of standout mode leaves one or even two blank spaces on the screen, as on the TVI 912 and the Teleray 1061, then xmc should be given to tell how many spaces are left.

Codes to begin underlining and end underlining can be given as smul and rmul respectively. If the terminal has a code to underline the current character and move the cursor one space to the right, such as the Micro-Term MIME, this can be given as uc.

Other capabilities to enter various highlighting modes include blink (blinking), bold (bold or extra-bright), dim (dim or half-bright), invis (blanking or invisible text), prot (protected), rev (reverse video), sgr0 (turn off all attribute modes), smacs (enter alternate-character-set mode), and rmacs (exit alternate-character-set mode). Turning on any of these modes singly may or may not turn off other modes. If a command is necessary before alternate character set mode is entered, give the sequence in enacs (enable alternate-character-set mode).

If there is a sequence to set arbitrary combinations of modes, this should be given as sgr (set attributes), taking nine parameters. Each parameter is either zero or non-zero, as the corresponding attribute is on or off. The nine parameters are, in order: standout, underline, reverse, blink, dim, bold, invisible, protected, and alternate character set. Not all modes need be supported by sgr, only those for which corresponding separate attribute commands exist. (See the example at the end of this section.)

Terminals with the "magic cookie" glitch (xmc) deposit special "cookies" when they receive mode-setting sequences, rather than having extra attribute bits for each character. These "cookies" affect the display algorithm to provide video attributes, but also take up (blank) space on the screen.

Some terminals, such as the Hewlett-Packard 2621, automatically leave standout mode when the cursor is moved to a new line or is addressed. Programs using standout mode should exit standout mode before moving the cursor or sending a newline, unless the `msgr` capability, asserting that it is safe to move in standout mode, is present.

If the terminal has a way of flashing the screen to indicate an error quietly (a bell replacement), then this can be given as `flash`; it must not move the cursor. A good flash can be done by changing the screen into reverse video, padding for 200 ms, then returning the screen to normal video.

If the cursor needs to be made more visible than normal when it is not on the bottom line (to make, for example, a non-blinking underline into an easier to find block or blinking underline) give this sequence as `cvvis`. The boolean `chts` should also be given. If there is a way to make the cursor completely invisible, give that as `civis`. The capability `cnorm` should be given which undoes the effects of either of these modes.

If the terminal needs to be in a special mode when running a program that uses `terminfo` capabilities, the codes to enter and exit this mode can be given as `smcup` and `rmcup`. This arises, for example, from terminals like the Concept-100 with more than one page of memory. If the terminal has only memory relative cursor addressing and not screen relative cursor addressing, a window the size of the screen must be fixed into the terminal for cursor addressing to work properly. This is also used for the Tektronix 4025, where `smcup` sets the command character to the one used by `terminfo`. If the `smcup` sequence does not restore the screen after an `rmcup` sequence is output (to the state prior to outputting `rmcup`), specify the boolean capability `nrrmc`.

If your terminal generates underlined characters by using the underline character (with no special codes needed) even though it does not otherwise overstrike characters, then you should give the capability `ul`. For terminals where a character overstriking another leaves both characters on the screen, give the capability `os`. If overstrikes are erasable with a blank, then this should be indicated by giving `eo`.

Here is an example of highlighting: assume that a terminal needs the following escape sequences to turn on various modes.

tparm parameter	attribute	escape sequence
	none	\E[0m
p1	standout	\E[0;4;7m
p2	underline	\E[0;3m
p3	reverse	\E[0;4m
p4	blink	\E[0;5m
p5	dim	\E[0;7m
p6	bold	\E[0;3;4m
p7	invis	\E[0;8m
p8	protect	not available
p9	altcharset	^O (off) ^N(on)

Note that each escape sequence requires a `0` to turn off other modes before turning on its own mode. Combinations of attributes are allowed by appending a digit that represents each attribute, separated by a semicolon. For instance, underline + blink needs the sequence `\E[0;3;5m`. Note that, as suggested above, *standout* is set up to be the combination of *reverse* and *dim*. Also, since this terminal has no *bold* mode,

bold is set up as the combination of *reverse* and *underline*. The terminal doesn't have *protect* mode, either, but that cannot be simulated in any way, so *p8* is ignored. The *altcharset* mode is different in that it requires either `<Ctrl-O>` or `<Ctrl-N>` depending on whether it is to be turned off or on. If all modes were to be turned on, the sequence would be `\E[0;3;4;5;7;8m^N`.

Now look at the cases in which different sequences are output. For example, `;3` is output when either *p2* or *p6* is true, that is, if either *underline* or *bold* modes are turned on. Writing out the above sequences, along with their dependencies, gives the following:

sequence	when to output	terminfo translation
\E[0	always	\E[0
;3	if p2 or p6	%?%p2%p6%|%t;3%;
;4	if p1 or p3 or p6	%?%p1%p3%|%p6%|%t;4%;
;5	if p4	%?%p4%t;5%;
;7	if p1 or p5	%?%p1%p5%|%t;7%;
;8	if p7	%?%p7%t;8%;
m	always	m
^N or ^O	if p9 ^N, else ^O	%?%p9%t^N%e^O%;

Putting this all together into the `sgr` sequence gives:

```
sgr=\E[0%?%p2%p6%|%t;3%;%?%p1%p3%|%p6%|%t;4%;%?%p5%t;5%;
      %?%p1%p5%|%t;7%;%?%p7%t;8%;m%?%p9%t^N%e^O%;,
```

7. **Keypad**

If the terminal has a keypad that transmits codes when special keys are pressed, this information can be given. Note that it is not possible to handle terminals where the keypad only works in local mode (this applies, for example, to the unshifted Hewlett-Packard 2621 keys). If the keypad can be set to transmit or not transmit, give these codes as `smkx` and `rmkx`. Otherwise the keypad is assumed to always transmit.

The codes sent by the left arrow, right arrow, up arrow, down arrow, and home keys can be given as `kcub1`, `kcuf1`, `kcuu1`, `kcud1`, and `khome` respectively. If there are function keys such as F0, F1, ..., F63, the codes they send can be given as `kf0`, `kf1`, `...`, `kf63`. If the first 11 keys have labels other than the default F0 through F10, the labels can be given as `lf0`, `lf1`, `...`, `lf10`. The codes transmitted by certain other special keys can be given: `kll` (home down), `kbs` (backspace), `ktbc` (clear all tabs), `kctab` (clear the tab stop in this column), `kclr` (clear screen or erase), `kdch1` (delete character), `kdl1` (delete line), `krmir` (exit insert mode), `kel` (clear to end of line), `ked` (clear to end of screen), `kich1` (insert character or enter insert mode), `kil1` (insert line), `knp` (next page), `kpp` (previous page), `kind` (scroll forward/down), `kri` (scroll backward/up), `khts` (set a tab stop in this column). In addition, if the keypad has a 3 by 3 array of keys including the four arrow keys, the other five keys can be given as `ka1`, `ka3`, `kb2`, `kc1`, and `kc3`. These keys are useful when the effects of a 3 by 3 directional pad are needed. Further keys are defined above in the capabilities list.

Strings to program function keys can be given as `pfkey`, `pfloc`, and `pfx`. A string to program their soft screen labels can be given as `pln`. Each of these strings takes two parameters: the function key number to program (from 0 to 10) and the string to program it with. Function key numbers out of this range may program undefined keys in a terminal-dependent manner. The difference between the capabilities is that `pfkey` causes the given key to act as if the user had typed the given string; `pfloc` causes the string to be executed by the terminal in local mode; and `pfx` causes the

string to be transmitted to the computer. The capabilities `nlab`, `lw`, and `lh` define how many soft labels there are and how wide and high they are. If there are commands to turn the labels on and off, give them as `smln` and `rmln`. `smln` is normally output after one or more `pln` sequences to make sure that the change becomes visible.

8. Tabs and Initialization

If the terminal has hardware tabs, the command to advance to the next tab stop can be given as `ht` (usually *Ctrl-I*). A "backtab" command which moves leftward to the previous tab stop can be given as `cbt`. By convention, if the terminal driver modes indicate that tabs are being expanded by the computer rather than being sent to the terminal, programs should not use `ht` or `cbt` even if they are present, since the user may not have the tab stops properly set.

If the terminal has hardware tabs which are initially set every *n* spaces when the terminal is powered up, the numeric parameter `it` should be given, showing the number of spaces *n* to which the tabs are set. This is normally used by `tput init` (see `tput`(1)) to determine whether to set the mode for hardware tab expansion and whether to set the tab stops.

If the terminal has tab stops that can be saved in nonvolatile memory, the `terminfo` description can assume that they are properly set. If there are commands to set and clear tab stops, they can be given as `tbc` (clear all tab stops) and `hts` (set a tab stop in the current column of every row).

Other capabilities include: `is1`, `is2`, and `is3`, initialization strings for the terminal; `iprog`, the path name of a program to run to initialize the terminal; and `if`, the name of a file containing long initialization strings. These strings are expected to set the terminal into modes consistent with the rest of the `terminfo` description. They must be sent to the terminal each time the user logs in and be output in the following order: run the program `iprog`; output `is1`; output `is2`; set the margins using `mgc`, `smgl`, and `smgr`; set the tabs using `tbc` and `hts`; print the file `if`; and finally output `is3`. This is usually done using the `init` option of `tput`(1); see `profile`(4).

Most initialization is done with `is2`. Special terminal modes can be set up without duplicating strings by putting the common sequences in `is2` and special cases in `is1` and `is3`. Sequences that do a harder reset from a totally unknown state can be given as `rs1`, `rs2`, `rf`, and `rs3`, analogous to `is1`, `is2`, `if`, and `is3`. (The method using files, `if` and `rf`, is used for a few terminals, from `/usr/lib/tabset/*`; however, the recommended method is to use the initialization and reset strings.) These strings are output by `tput reset`, which is used when the terminal gets into a wedged state. Commands are normally placed in `rs1`, `rs2`, `rs3`, and `rf` only if they produce annoying effects on the screen and are not necessary when logging in. For example, the command to set a terminal into 80-column mode would normally be part of `is2`, but on some terminals it causes an annoying glitch on the screen and is not normally needed since the terminal is usually already in 80-column mode.

If a more complex sequence is needed to set the tabs than can be described by using `tbc` and `hts`, the sequence can be placed in `is2` or `if`.

If there are commands to set and clear margins, they can be given as `mgc` (clear all margins), `smgl` (set left margin), and `smgr` (set right margin).

9. Delays

Certain capabilities control padding in the terminal driver (see `termio`(7) and `ttcompat`(7)). These are primarily needed by hardcopy terminals, and are used by `tput init` to set terminal driver modes appropriately. Delays embedded in the capabilities `cr`, `ind`, `cubl`, `ff`, and `tab` can be used to set the appropriate delay bits in the terminal driver. If `pb` (padding baud rate) is given, these values can be ignored at baud rates below the value of `pb`.

10. Status Lines

If the terminal has an extra "status line" that is not normally used by software, this fact can be indicated. If the status line is viewed as an extra line below the bottom line, into which a program can cursor address normally (such as the Heathkit h19's 25th line, or the 24th line of a VT100 which is set to a 23-line scrolling region), the capability `hs` should be given. Special strings that go to a given column of the status line and return from the status line can be given as `tsl` and `fsl`. (`fsl` must leave the cursor position in the same place it was before `tsl`. If necessary, the `sc` and `rc` strings can be included in `tsl` and `fsl` to get this effect.) The capability `tsl` takes one parameter, which is the column number of the new cursor position in the status line.

If escape sequences and other special commands, such as tab, work while in the status line, the flag `eslok` can be given. A string which turns off the status line (or otherwise erases its contents) should be given as `dsl`. If the terminal has commands to save and restore the position of the cursor, give them as `sc` and `rc`. The status line is normally assumed to be the same width as the rest of the screen, e.g., `cols`. If the status line is a different width (possibly because the terminal does not allow an entire line to be loaded) the width, in columns, can be indicated with the numeric parameter `wsl`.

11. Line Graphics

If the terminal has a line drawing alternate character set, the mapping of glyph to character would be given in `acsc`. The definition of this string is based on the alternate character set used in the DEC VT100 terminal, extended slightly with some characters from the AT&T 4410v1 terminal.

glyph name	vt100+ character
arrow pointing right	+
arrow pointing left	,
arrow pointing down	.
solid square block	0
lantern symbol	I
arrow pointing up	–
diamond	‘
checker board (stipple)	a
degree symbol	f
plus/minus	g
board of squares	h
lower right corner	j
upper right corner	k

upper left corner	l
lower left corner	m
plus	n
scan line 1	o
horizontal line	q
scan line 9	s
left tee (├)	t
right tee (┤)	u
bottom tee (┴)	v
top tee	w
vertical line	x
bullet	~

The best way to describe a new terminal's line graphics set is to add a third column to the above table with the characters for the new terminal that produce the appropriate glyphs when the terminal is in the alternate character set mode. For example,

glyph name	vt100+ char	new tty char
upper left corner	l	R
lower left corner	m	F
upper right corner	k	T
lower right corner	j	G
horizontal line	q	,
vertical line	x	.

Now write down the characters left to right, as in `acsc=lRmFkTjGq\,x`.

12. Color Manipulation

Let us define two methods of color manipulation: the Tektronix method and the HP method. The Tektronix method uses a set of N predefined colors (usually 8) from which a program can select "current" foreground and background colors. Thus a terminal can support up to N colors mixed into N*N color-pairs to be displayed on the screen at the same time. When using an HP method the program cannot define the foreground independently of the background, or vice-versa. Instead, the program must define an entire color-pair at once. Up to M color-pairs, made from 2*M different colors, can be defined this way. Most existing color terminals belong to one of these two classes.

The numeric capabilities `colors` and `pairs` define the number of colors and color-pairs that can be displayed on the screen at the same time. If a terminal can change the definition of a color (for example, the Tektronix 4100 and 4200 series terminals), this should be specified with the boolean capability `ccc` (can change color). To change the definition of a color (Tektronix method), use the parameterized string capability `initc` (initialize color). It requires four parameters: color number (ranging from 0 to `colors`−1) and three RGB (red, green, and blue) values (ranging from 0 to 1000).

Tektronix 4100 series terminals use a type of color notation called HLS (Hue Lightness Saturation) instead of RGB color notation. For such terminals one must define a boolean capability `hls`. The last three parameters of the `initc` string would then be HLS values: H, ranging from 0 to 360; and L and S, ranging from 0 to 100.

To set the current foreground or background to a given color, use parameterized string capabilities `setf` (set foreground) and `setb` (set background). They each require one parameter: the number of the color. To initialize a color-pair (HP

method), use `initp` (initialize pair). It requires seven parameters: the number of a color-pair (ranging from 0 to `pairs`−1), and six RGB values: three for the foreground followed by three for the background. (When `initc` or `initp` is used, RGB or HLS arguments should be in the order "red, green, blue" or "hue, lightness, saturation", respectively.) To make a color-pair current, use the parameterized string capability `scp` (set color-pair). It takes one parameter, the number of a color-pair.

If a terminal can change the definitions of colors, but uses a color notation different from RGB and HLS, a mapping to either RGB or HLS must be developed and encoded in the `initc` and `initp` capabilities.

Some terminals (for example, most color terminal emulators for PCs) erase areas of the screen using the current background color. In such cases, the boolean capability `bce` (background color erase) should be defined. The string capability `op` (original pair) contains a sequence for setting the foreground and background colors to what they were at the terminal start-up time. Similarly, `oc` (original colors) contains a sequence for setting all colors (for the Tektronix method) or color-pairs (for the HP method) to the values they had at the terminal start-up time.

Some video attributes on some color terminals should not be combined with colors. For instance, some color terminals substitute color for video attributes, so each attribute can be displayed in only one color. Information about these video attributes should be packed into the numeric capability `ncv` (no color video). There is a one-to-one correspondence between the nine least significant bits of this capability and the video attributes. The following table depicts this correspondence.

Attribute	Bit Position	Decimal Value
A_STANDOUT	0	1
A_UNDERLINE	1	2
A_REVERSE	2	4
A_BLINK	3	8
A_DIM	4	16
A_BOLD	5	32
A_INVIS	6	64
A_PROTECT	7	128
A_ALTCHARSET	8	256

When a particular video attribute should not be used with colors, the corresponding `ncv` bit should be set to 1; otherwise it should be set to zero. To determine the information to pack into the `ncv` capability, you must add together the decimal values corresponding to those attributes that cannot coexist with colors. For example, if the terminal uses colors to simulate reverse video (bit number 2 and decimal value 4) and bold (bit number 5 and decimal value 32), the resulting value for `ncv` will be 36 (4 + 32).

13. Miscellaneous

If the terminal requires any character other than a null (zero) as a pad, then this can be given as `pad`. Only the first character of the `pad` string is used. If the terminal does not have a pad character, specify `npc`.

If the terminal can move up or down half a line, this can be indicated with `hu` (half-line up) and `hd` (half-line down). This is primarily useful for superscripts and subscripts on hardcopy terminals. If a hardcopy terminal can eject to the next page (form feed), give this as `ff` (usually `^L`).

If there is a command to repeat a given character a given number of times (to save time transmitting a large number of identical characters) this can be indicated with the parameterized string `rep`. The first parameter is the character to be repeated and the second is the number of times to repeat it. Thus, `tparm(repeat_char, 'x', 10)` produces the same effect as `xxxxxxxxxx`.

If the terminal has a programmable command character, such as the Tektronix 4025, this can be indicated with `cmdch`. A prototype command character is chosen which is used in all capabilities. This character is given in the `cmdch` capability to identify it. The following convention is supported on some UNIX systems: If the environment variable `CC` exists, all occurrences of the prototype character are replaced with the character in `CC`.

Terminal descriptions that do not represent a specific kind of known terminal, such as `switch`, `dialup`, `patch`, and `network`, should include the `gn` (generic) capability so that programs can complain that they do not know how to talk to the terminal. (This capability does not apply to `virtual` terminal descriptions for which the escape sequences are known.) If the terminal is one of those supported by the UNIX system virtual terminal protocol, the terminal number can be given as `vt`. A line-turn-around sequence to be transmitted before doing reads should be specified in `rfi`.

If the terminal uses XON/XOFF handshaking for flow control, define `xon`. Padding information should still be included so that routines can make better decisions about costs, but actual pad characters are not transmitted. Sequences to turn on and off XON/XOFF handshaking may be given in `smxon` and `rmxon`. If the characters used for handshaking are not `<Ctrl-S>` and *Ctrl-Q*, they may be specified with `xonc` and `xoffc`.

If the terminal has a "meta key" which acts as a shift key, setting the eighth bit of any character transmitted, this can be specified with the boolean capability `km`. Otherwise, software assumes that the eighth bit is parity and it is usually cleared. If strings exist to turn this "meta mode" on and off, they can be specified as `smm` and `rmm`.

If the terminal has more lines of memory than can fit on the screen at once, the number of lines of memory can be indicated with `lm`. A value of zero for `lm` indicates that the number of lines is not fixed, but that there is still more memory than fits on the screen.

If the terminal cursor can wrap around to the beginning of the next line when it reaches the right margin, this can be specified with the boolean capability `am`. If a string exists to enable this wrapping, specify it as `smam`. A string to make the cursor stick in the last column of a line is specified as `rmam`.

Media copy strings which control an auxiliary printer connected to the terminal can be given as `mc0`: print the contents of the screen, `mc4`: turn off the printer, and `mc5`: turn on the printer. When the printer is on, all text sent to the terminal is sent to the printer. A variation, `mc5p`, takes one parameter, and leaves the printer on for as many characters as the value of the parameter, then turns the printer off. The parameter should not exceed 255. If the text is not displayed on the terminal screen when the printer is on, specify `mc5i` (silent printer). All text, including `mc4`, is transparently passed to the printer while an `mc5p` is in effect.

14. Special Cases

The working model used by `terminfo` fits most terminals reasonably well. However, some terminals do not completely match that model, requiring special support by `terminfo`. These are not meant to be construed as deficiencies in the terminals;

they are just differences between the working model and the actual hardware. They may be unusual devices or, for some reason, do not have all the features of the `terminfo` model implemented.

Terminals which cannot display tilde (~) characters, such as certain Hazeltine terminals, should indicate `hz`.

Terminals which ignore a linefeed immediately after an `am` wrap, such as the Concept-100, should indicate `xenl`. Those terminals whose cursor remains on the rightmost column until another character has been received, rather than wrapping immediately upon receiving the rightmost character, such as the VT100, should also indicate `xenl`.

If `el` is required to get rid of standout mode (instead of writing normal text on top of it), `xhp` should be given.

Those Teleray terminals whose tabs overwrite blanks should indicate `xt` (destructive tabs). This capability is also taken to mean that it is not possible to position the cursor on top of a "magic cookie"; therefore, to erase standout mode, it is instead necessary to use delete and insert line.

Those Beehive Superbee terminals which do not transmit the `<ESC>` or `<Ctrl-C>` characters should specify `xsb`, indicating that the F1 key is to be used for `<ESC>` and the F2 key for *Ctrl-C*.

Most terminals can use padding as an alternative to XON-XOFF flow control. Some terminals, though, require XON-XOFF flow control. For these, specify the boolean capability `nxon`.

TERMINFO PRINTER CAPABILITIES

The `terminfo` database allows you to define capabilities of printers as well as terminals. To find out what capabilities are available for printers as well as for terminals, see the table in the "Device Capabilities" section. Most subsections below are lettered for cross-reference to that table.

Rounding Values

Because parameterized string capabilities work only with integer values, we recommend that `terminfo` designers create strings that expect numeric values that have been rounded. Application designers should note this and should always round values to the nearest integer before using them with a parameterized string capability.

Printer Resolution

A printer's resolution is defined to be the smallest spacing of characters it can achieve. In general printers have independent resolution horizontally and vertically. Thus the vertical resolution of a printer can be determined by measuring the smallest achievable distance between consecutive printing baselines, while the horizontal resolution can be determined by measuring the smallest achievable distance between the leftmost edges of consecutive printed, identical, characters. (The terms "smallest distance" and "smallest step" will be used later to refer to these smallest achievable distances.)

All printers are assumed to be capable of printing with a uniform horizontal and vertical resolution. The view of printing that `terminfo` currently presents is one of printing inside a uniform matrix: All characters are printed at fixed positions relative to each "cell" in the matrix; furthermore, each cell has the same size given by the smallest horizontal and vertical step sizes dictated by the resolution. (The cell size can be changed as will be seen later.)

Many printers are capable of "proportional printing," where the horizontal spacing depends on the size of the character last printed. `Terminfo` does not make use of this capability, although it does provide enough capability definitions to allow an application to simulate proportional printing.

A printer must not only be capable of printing characters as close together as the horizontal and vertical resolutions suggest, but also of "moving" to a position an integral multiple of the resolution from a previous position. Thus printed characters can be spaced apart a distance that is an integral multiple of the smallest distance, up to the length or width of a single page.

Some printers can have different resolutions depending on different "modes." In "normal mode," the existing `terminfo` capabilities are assumed to work on columns and lines, just like a video terminal. Thus the old `lines` capability would give the length of a page in lines, and the `cols` capability would give the width of a page in columns. In "micro mode," many `terminfo` capabilities work on increments of lines and columns. With some printers the micro mode may be concomitant with normal mode, so that all the capabilities work at the same time.

A. Specifying Printer Resolution

The printing resolution of a printer is given in several ways. Each specifies the resolution as the number of smallest steps per distance:

Numeric Capabilities for Specifying Characteristic Number of Smallest Steps	
orhi	Steps per inch horizontally
orvi	Steps per inch vertically
orc	Steps per column
orl	Steps per line

When printing in normal mode, each character printed causes movement to the next column, except in special cases described later; the distance moved is the same as the per-column resolution. Some printers cause an automatic movement to the next line when a character is printed in the rightmost position; the distance moved vertically is the same as the per-line resolution. When printing in micro mode, these distances can be different, and may be zero for some printers.

Numeric Capabilities for Specifying Automatic Motion after Printing	
Normal Mode:	
orc	Steps moved horizontally
orl	Steps moved vertically
Micro Mode:	
mcs	Steps moved horizontally
mls	Steps moved vertically

Some printers are capable of printing wide characters. The distance moved when a wide character is printed in normal mode may be different from when a regular width character is printed. The distance moved when a wide character is printed in micro mode may also be different from when a regular character is printed in micro mode, but the differences are assumed to be related: If the distance moved for a regular character is the same whether in normal mode or micro mode (**mcs=orc**), then the distance moved for a wide character is also the same whether in normal mode or micro mode. This doesn't mean the normal character distance is necessarily the same as the wide character distance, just that the distances don't change with a change in normal to micro mode. However, if the distance moved for a regular character is

different in micro mode from the distance moved in normal mode (**mcs<orc**), the micro mode distance is assumed to be the same for a wide character printed in micro mode, as the table below shows.

Numeric Capabilities for Specifying Automatic Motion after Printing Wide Character

Normal Mode or Micro Mode (`mcs = orc`*):*	
widcs	Steps moved horizontally
Micro Mode (`mcs < orc`*):*	
mcs	Steps moved horizontally

There may be control sequences to change the number of columns per inch (the character pitch) and to change the number of lines per inch (the line pitch). If these are used, the resolution of the printer changes, but the type of change depends on the printer:

String and Boolean Capabilities for Changing the Character/Line Pitches

cpi	Change character pitch
cpix	If set, `cpi` changes `orhi`, otherwise changes `orc`
lpi	Change line pitch
lpix	If set, `lpi` changes `orvi`, otherwise changes `orl`
chr	Change steps per column
cvr	Change steps per line

The `cpi` and `lpi` string capabilities each require a single parameter, the pitch in columns (or characters) and lines per inch, respectively. The `chr` and `cvr` string capabilities each require a single parameter, the number of steps per column and line, respectively.

Using any of the control sequences in these strings will imply a change in some of the values of `orc`, `orhi`, `orl`, and `orvi`. Also, the distance moved when a wide character is printed, `widcs`, changes in relation to `orc`. The distance moved when a character is printed in micro mode, `mcs`, changes similarly, with one exception: if the distance is 0 or 1, then no change is assumed (see items marked with † in the following table).

Programs that use `cpi`, `lpi`, `chr`, or `cvr` should recalculate the printer resolution (and should recalculate other values — see the topic "Effect of Changing Printing Resolution" in the section "Dot-Matrix Graphics").

Specification of Printer Resolution Effects of Changing the Character/Line Pitches

Before	*After*
Using `cpi` *with* `cpix` *clear:*	
`orhi '`	`orhi`
`orc '`	**orc**$=\frac{\textbf{orhi}}{V_{cpi}}$

Using `cpi` *with* `cpix` *set:*

`orhi '`	**orhi=orc**$\cdot V_{cpi}$
`orc '`	`orc`

Using `lpi` *with* `lpix` *clear:*

`orvi '`	`orvi`
`orl '`	$\textbf{orl}=\frac{\textbf{orvi}}{V_{lpi}}$

Using `lpi` *with* `lpix` *set:*

`orvi '`	**orvi=orl**$\cdot V_{lpi}$
`orl '`	`orl`

Using `chr`:

`orhi '`	`orhi`
`orc '`	V_{chr}

Using `cvr`:

`orvi '`	`orvi`
`orl '`	V_{cvr}

Using `cpi` *or* `chr`:

`widcs '`	$\textbf{widcs=widcs '}\frac{\textbf{orc}}{\textbf{orc '}}$
`mcs '`†	$\textbf{mcs=mcs '}\frac{\textbf{orc}}{\textbf{orc '}}$

V_{cpi}, V_{lpi}, V_{chr}, and V_{cvr} are the parameters required by `cpi`, `lpi`, `chr`, and `cvr`, respectively. The `'` mark indicates the old value.

B. Capabilities that Cause Movement

In the following descriptions, "movement" refers to the motion of the "current position." With video terminals this would be the cursor; with some printers this is the carriage position. Other printers have different equivalents. In general, the current position is where a character would be displayed if printed.

`Terminfo` has string capabilities for control sequences that cause movement a number of full columns or lines. It also has equivalent string capabilities for control sequences that cause movement a number of smallest steps.

String Capabilities for Specifying Single and Multiple Motions

mcub1	Move 1 step left
mcuf1	Move 1 step right
mcuu1	Move 1 step up
mcud1	Move 1 step down
mcub	Move *N* steps left
mcuf	Move *N* steps right
mcuu	Move *N* steps up
mcud	Move *N* steps down
mhpa	Move *N* steps from the left
mvpa	Move *N* steps from the top

The latter six strings each require a single parameter, *N*.

Some printers limit the motion to less than the width or length of a page. Also, some printers don't accept absolute motion to the left of the current position. `Terminfo` has capabilities for specifying these limits.

Numeric and Boolean Capabilities for Specifying Limits to Motion

mjump	Limit on use of `mcub1`, `mcuf1`, `mcuu1`, and `mcud1`
maddr	Limit on use of `mhpa` and `mvpa`
xhpa	If set, `hpa` and `mhpa` cannot move left
xvpa	If set, `vpa` and `mvpa` cannot move up

If a printer needs to be in a "micro mode" for the motion capabilities described above to work, there are string capabilities defined to enter and exit this mode. A boolean capability is available for those printers where using a carriage return causes an automatic return to normal mode.

String and Boolean Capabilities for Entering and Exiting Micro Mode

smicm	Enter micro mode
rmicm	Exit micro mode
crxm	If set, using `cr` exits micro mode

The movement made when a character is printed in the rightmost position varies among printers. Some make no movement, some move to the beginning of the next line, others move to the beginning of the same line. `Terminfo` has boolean capabilities for describing all three cases.

Boolean Capabilities for Specifying What Happens After Character Printed in Rightmost Position

sam	Automatic move to beginning of same line

Some printers can be put in a mode where the normal direction of motion is reversed. This mode can be especially useful when there are no capabilities for leftward or upward motion, because those capabilities can be built from the motion reversal capability and the rightward or downward motion capabilities. It is best to leave it up to an application to build the leftward or upward capabilities, though, and not enter them in the `terminfo` database. This allows several reverse motions to be

strung together without intervening wasted steps that leave and reenter reverse mode.

String Capabilities for Entering and Exiting Reverse Modes

slm	Reverse sense of horizontal motions
rlm	Restore sense of horizontal motions
sum	Reverse sense of vertical motions
rum	Restore sense of vertical motions

While sense of horizontal motions reversed:

mcub1	Move 1 step right
mcuf1	Move 1 step left
mcub	Move *N* steps right
mcuf	Move *N* steps left
cub1	Move 1 column right
cuf1	Move 1 column left
cub	Move *N* columns right
cuf	Move *N* columns left

While sense of vertical motions reversed:

mcuu1	Move 1 step down
mcud1	Move 1 step up
mcuu	Move *N* steps down
mcud	Move *N* steps up
cuu1	Move 1 line down
cud1	Move 1 line up
cuu	Move *N* lines down
cud	Move *N* lines up

The reverse motion modes should not affect the `mvpa` and `mhpa` absolute motion capabilities. The reverse vertical motion mode should, however, also reverse the action of the line "wrapping" that occurs when a character is printed in the rightmost position. Thus printers that have the standard `terminfo` capability `am` defined should experience motion to the beginning of the previous line when a character is printed in the rightmost position under reverse vertical motion mode.

The action when any other motion capabilities are used in reverse motion modes is not defined; thus, programs must exit reverse motion modes before using other motion capabilities.

Two miscellaneous capabilities complete the list of new motion capabilities. One of these is needed for printers that move the current position to the beginning of a line when certain control characters, such as "linefeed" or "formfeed," are used. The other is used for the capability of suspending the motion that normally occurs after printing a character.

String Capabilities for Specifying Miscellaneous Motion

docr	List of control characters causing `cr`
zerom	Prevent auto motion after printing next single character

C. Margins

`Terminfo` provides two strings for setting margins on terminals: one for the left margin and one for the right. Printers, however, have two additional margins, for the top and bottom of each page. Furthermore, instead of using motion strings to move the current position to a margin and then fixing the margin there, some printers require

the specification of where a margin should be regardless of the current position. Therefore `terminfo` offers six additional strings for defining margins with printers.

String Capabilities for Setting Margins

smgl	Set left margin at current column
smgr	Set right margin at current column
smgb	Set bottom margin at current line
smgt	Set top margin at current line
smgbp	Set bottom margin at line *N*
smglp	Set left margin at column *N*
smgrp	Set right margin at column *N*
smgtp	Set top margin at line *N*

The last four strings each require one or more parameters that give the position of the margin or margins to set. If both of `smglp` and `smgrp` are defined, each requires a single parameter, *N*, that gives the column number of the left and right margin, respectively. If both of `smgtp` and `smgbp` are defined, they are used to set the top and bottom margin, respectively: `smgtp` requires a single parameter, *N*, the line number of the top margin; however, `smgbp` requires two parameters, *N* and *M*, that each give the line number of the bottom margin, the first counting from the top of the page and the second counting from the bottom. This accommodates the two methods used by different manufacturers to specify the bottom margin. When coding a `terminfo` entry for a printer that has a settable bottom margin, only the first or second parameter should be used, depending on the printer. When writing an application that uses `smgbp` to set the bottom margin, both arguments must be given.

If only one of `smglp` and `smgrp` is defined, then it requires two parameters, the column numbers of the left and right margins, in that order. Likewise, if only one of `smgtp` and `smgbp` is set, then it requires two parameters that give the top and bottom margins, in that order, counting from the top of the page. Thus when coding a `terminfo` entry for a printer that requires setting both left and right or top and bottom margins simultaneously, only one of `smglp` and `smgrp`, or `smgtp` and `smgbp`, should be defined; the other capability of the pair should not be included in the entry. When writing an application that uses these string capabilities, each pair should first be checked to see if both members of the pair are defined or if only one is defined; the defined capabilities should then be instantiated accordingly.

In counting lines or columns, line zero is the top line and column zero is the leftmost column. A zero value for the second argument with `smgbp` means the bottom line of the page.

All margins can be cleared with `mgc`.

D. Shadows, Italics, Wide Characters, Superscripts, Subscripts

Five new sets of string capabilities are used to describe the methods printers have of enhancing printed text.

String Capabilities for Specifying Enhanced Printing

sshm	Enter shadow-printing mode
rshm	Exit shadow-printing mode

sitm	Enter italicizing mode
ritm	Exit italicizing mode
swidm	Enter wide character mode
rwidm	Exit wide character mode
ssupm	Enter superscript mode
rsupm	Exit superscript mode
supcs	List of characters available as superscripts
ssubm	Enter subscript mode
rsubm	Exit subscript mode
subcs	List of characters available as subscripts

If a printer requires the `sshm` control sequence before every character to be shadow-printed, the `rshm` string should be left undefined. Thus programs that find a control sequence in `sshm` but none in `rshm` should use the `sshm` control sequence before every character to be shadow-printed; otherwise, the `sshm` control sequence should be used once before the set of characters to be shadow-printed, followed by `rshm`. The same is also true of each of the `sitm/ritm`, `swidm/rwidm`, `ssupm/rsupm`, and `ssubm/rsubm` pairs.

Note that `terminfo` also has a capability for printing emboldened text (**bold**). While shadow printing and emboldened printing are similar in that they "darken" the text, many printers produce these two types of print in slightly different ways. Generally, emboldened printing is done by overstriking the same character one or more times. Shadow printing likewise usually involves overstriking, but with a slight movement up and/or to the side so that the character is "fatter."

`Terminfo` requires that enhanced printing modes be independent, so that it would be possible, for instance, to shadow print italicized subscripts.

As mentioned earlier, the amount of motion automatically made after printing a wide character should be given in the numeric capability `widcs`.

If only a subset of the printable ASCII characters can be printed as superscripts or subscripts, they should be listed in the `supcs` or `subcs` strings, respectively. If the `ssupm` (or `ssubm`) string contains control sequences, but the corresponding `supcs` (or `subcs`) string is undefined, a program can assume that all printable ASCII characters are available as superscripts (or subscripts).

Automatic motion made after printing a superscript or subscript must be the same as for regular characters. Thus, for example, printing any of the following two-character sequences will result in equivalent motion: `Bi` B_i B^i

Note that the existing `msgr` boolean capability describes whether motion control sequences can be used while in "standout mode." This capability has been extended to cover the enhanced printing modes added here. `msgr` should be set for those printers that accept any motion control sequences without affecting shadow, italicized, widened, superscript, or subscript printing. Conversely, if `msgr` is not set, a program should exit these modes before attempting any motion.

E. Alternate Character Sets

In addition to allowing you to define line graphics (described in the "Line Graphics" section), `terminfo` lets you define alternate character sets. The following capabilities cover printers and terminals with multiple selectable or definable character sets.

String and Boolean Capabilities for Specifying Alternate Character Sets

scs	Select character set *N*
scsd	Start definition of character set *N*, *M* characters
defc	Define character *A*, *B* dots wide, descender *D*
rcsd	End definition of character set *N*
csnm	List of character set names
daisy	If set, printer has manually changed print wheels

The `scs`, `rcsd`, and `csnm` strings each require a single parameter, *N*, a number from 0 to 63 that identifies the character set. The `scsd` string also requires the parameter *N* and another, *M*, that gives the number of characters in the set. The `defc` string requires three parameters: *A* gives the ASCII code representation for the character, *B* gives the width of the character in dots, and *D* is zero or one depending on whether the character is a "descender" or not. The `defc` string is also followed by a string of "image data" bytes that describe how the character looks (see below).

Character set 0 is the default character set present after the printer has been initialized. Not every printer has 64 character sets, of course; using `scs` with an argument that doesn't select an available character set should cause a null result from `tparm()`.

If a character set has to be defined before it can be used, the `scsd` control sequence must be used before defining the character set, and `rcsd` must be used after. They should also cause a null result from `tparm()` when used with an argument *N* that doesn't apply. If a character set still has to be selected after being defined, the `scs` control sequence must follow the `rcsd` control sequence. By examining the results of using each of the `scs`, `scsd`, and `rcsd` strings with a character set number in a call to `tparm()`, a program can determine which of the three are needed.

Between use of the `scsd` and `rcsd` strings, the `defc` string should be used to define each character. To print any character on printers covered by `terminfo`, the ASCII code is sent to the printer. This is true for characters in an alternate set as well as "normal" characters. Thus the definition of a character includes the ASCII code that represents it. In addition, the width of the character in dots is given, along with an indication of whether the character should descend below the print line (such as the lower case letter `g` in most character sets). The width of the character in dots also indicates the number of image data bytes that will follow the `defc` string. These image data bytes indicate where in a dot-matrix pattern ink should be applied to "draw" the character; the number of these bytes and their form are defined below in the "Dot-Matrix Graphics" section.

It's easiest for the creator of `terminfo` entries to refer to each character set by number; however, these numbers will be meaningless to the application developer. The `csnm` string alleviates this problem by providing names for each number.

When used with a character set number in a call to `tparm()`, the `csnm` string will produce the equivalent name. These names should be used as a reference only. No naming convention is specified, although anyone who creates a `terminfo` entry for a printer should use names consistent with the names found in user documents for the printer. Application developers should allow a user to specify a character set by number (leaving it up to the user to examine the `csnm` string to determine the correct number), or by name, where the application examines the `csnm` string to determine the corresponding character set number.

The boolean `daisy` indicates printers that have manually changed print wheels or font cartridges. However, the capabilities described above are likely to be used only with dot-matrix printers.

F. Dot-Matrix Graphics

Dot-matrix printers typically have the capability of reproducing "raster graphics" images. Three new numeric capabilities and three new string capabilities help a program draw raster graphics images independent of the type of dot-matrix printer or the number of pins or dots the printer can handle at one time.

Numeric and String Capabilities for Specifying Dot-Matrix Graphics

npins	Number of pins, *N*, in print head
spinv	Spacing of pins vertically in pins per inch
spinh	Spacing of dots horizontally in dots per inch
porder	Matches software bits to print head pins
sbim	Start printing bit image graphics, *B* bits wide
rbim	End printing bit image graphics

The `sbim` sring requires a single parameter, *B*, the width of the image in dots.

The model of dot-matrix or raster graphics that `terminfo` presents is similar to the technique used for most dot-matrix printers: Each pass of the printer's print head is assumed to produce a dot-matrix that is *N* dots high and *B* dots wide. This is typically a wide, squat, rectangle of dots. The height of this rectangle in dots will vary from one printer to the next; this is given in the `npins` numeric capability. The size of the rectangle in fractions of an inch will also vary; it can be deduced from the `spinv` and `spinh` numeric capabilities. With these three values an application can divide a complete raster graphics image into several horizontal strips, perhaps interpolating to account for different dot spacing vertically and horizontally.

The `sbim` and `rbim` strings start and end a dot-matrix image, respectively. The `sbim` string requires a single parameter that gives the width of the dot-matrix in dots. A sequence of "image data" bytes is sent to the printer after the `sbim` string and before the `rbim` string. The number of bytes is an integral multiple of the width of the dot-matrix; the multiple and the form of each byte are determined by the `porder` string as described below.

The `porder` string is a comma-separated list of pin numbers optionally followed by a numerical offset. The offset, if given, is separated from the list with a semicolon. The position of each pin number in the list corresponds to a bit in an eight-bit data byte. The pins are numbered consecutively from 1 to `npins`, with 1 being the top pin. Note that the term "pin" is used loosely here; "ink-jet" dot-matrix printers don't have pins, but can be considered to have an equivalent method of applying a single dot of ink to paper. The bit positions in `porder` are in groups of eight; the first position of each group is the most significant bit and the last position is the least significant bit. An application produces eight-bit bytes in the order of the groups in `porder`.

An application computes the "image data" bytes from its internal image, mapping vertical dot positions in each print head pass into eight-bit bytes, using a 1 bit where ink should be applied and 0 where no ink should be applied. This can be reversed (0 bit for ink, 1 bit for no ink) by giving a negative pin number in `porder`. If a position is skipped in `porder`, a 0 bit is used. If a position has a lower case 'x' instead of a pin number, a 1 bit is used in the skipped position. For consistency, a lower case 'o' can be used to represent a 0 filled (no-ink) bit. There must be a multiple of 8 bit

positions used or skipped in `porder`; if not, 0 bits are used to fill the last byte in the least significant bits. The offset, if given, is added to each data byte; the offset can be negative.

Some examples may help clarify the use of the `porder` string. The AT&T 470, AT&T 475 and C.Itoh 8510 printers provide eight pins for graphics. The pins are identified top to bottom by the 8 bits in a byte, from least significant to most. The `porder` strings for these printers would be `8,7,6,5,4,3,2,1`. The AT&T 478 and AT&T 479 printers also provide eight pins for graphics. However, the pins are identified in the reverse order. The `porder` strings for these printers would be `1,2,3,4,5,6,7,8`. The AT&T 5310, AT&T 5320, DEC LA100, and DEC LN03 printers provide six pins for graphics. The pins are identified top to bottom by the decimal values 1, 2, 4, 8, 16 and 32. These correspond to the low six bits in an 8-bit byte, although the decimal values are further offset by the value 63. The `porder` string for these printers would be `,,6,5,4,3,2,1;63`, or alternately `o,o,6,5,4,3,2,1;63`.

G. Effect of Changing Printing Resolution

If the control sequences to change the character pitch or the line pitch are used, the pin or dot spacing may change:

String and Boolean Capabilities for Changing the Character and Line Pitches

cpi	Change character pitch
cpix	If set, `cpi` changes `spinh`
lpi	Change line pitch
lpix	If set, `lpi` changes `spinv`

Programs that use `cpi` or `lpi` should recalculate the dot spacing:

Dot-Matrix Graphics
Effects of Changing the Character and Line Pitches

Before	*After*
Using `cpi` *with* `cpix` *clear:*	
`spinh '`	**spinh**
Using `cpi` *with* `cpix` *set:*	
`spinh '`	**spinh=spinh '$\cdot \frac{\textbf{orhi}}{\textbf{orhi}}$'**
Using `lpi` *with* `lpix` *clear:*	
`spinv '`	`spinv`
Using `lpi` *with* `lpix` *set:*	
`spinv '`	**spinv=spinv '$\cdot \frac{\textbf{orhi}}{\textbf{orhi}}$'**

Using `chr`:

```
spinh '                    spinh
```

Using `cvr`:

```
spinv '                    spinv
```

`orhi'` and `orhi` are the values of the horizontal resolution in steps per inch, before using `cpi` and after using `cpi`, respectively. Likewise, `orvi'` and `orvi` are the values of the vertical resolution in steps per inch, before using `lpi` and after using `lpi`, respectively. Thus, the changes in the dots per inch for dot-matrix graphics follow the changes in steps per inch for printer resolution.

H. Print Quality

Many dot-matrix printers can alter the dot spacing of printed text to produce "near-letter-quality" printing or "draft quality" printing. Usually it is important to be able to choose one or the other because the rate of printing generally falls off as the quality improves. There are three new string capabilities used to describe these print quality levels.

String Capabilities for Specifying Print Quality

snlq	Set near-letter-quality printing
snrmq	Set normal quality printing
sdrfq	Set draft quality printing

The capabilities are listed in decreasing levels of quality. If a printer doesn't have all three levels, one or two of the strings should be left undefined as appropriate.

I. Printing Rate and Buffer Size

Because there is no standard protocol that can be used to keep a program synchronized with a printer, and because modern printers can buffer data before printing it, a program generally cannot determine at any time what has been printed. However, two new numeric capabilities can help a program estimate what has been printed.

Numeric Capabilities for Specifying Print Rate and Buffer Size

cps	Nominal print rate in characters per second
bufsz	Buffer capacity in characters

`cps` is the nominal or average rate at which the printer prints characters; if this value is not given, the rate should be estimated at one-tenth the prevailing baud rate. `bufsz` is the maximum number of subsequent characters buffered before the guaranteed printing of an earlier character, assuming proper flow control has been used. If this value is not given it is assumed that the printer does not buffer characters, but prints them as they are received.

As an example, if a printer has a 1000-character buffer, then sending the letter `a` followed by 1000 additional characters is guaranteed to cause the letter `a` to print. If the same printer prints at the rate of 100 characters per second, then it should take 10 seconds to print all the characters in the buffer, less if the buffer is not full. By keeping track of the characters sent to a printer, and determining the print rate and buffer size, a program can synchronize itself with the printer.

Note that most printer manufacturers advertise the maximum print rate, not the nominal print rate. A good way to get a value for `cps` is to generate a few pages of text, count the number of printable characters, and then see how long it takes to print the text.

Applications that use these values should recognize the variability in print rate. Straight text, in short lines, with no embedded control sequences will probably print at close to the advertised print rate and probably faster than the rate in `cps`. Graphics data with a lot of control sequences, or very long lines of text, will print at well below the advertised rate and below the rate in `cps`. If the application is using `cps` to decide how long it should take a printer to print a block of text, the application should pad the estimate. If the application is using `cps` to decide how much text has already been printed, it should shrink the estimate. The application will thus err in favor of the user, who wants, above all, to see all the output in its correct place.

TERMINFO/TERMCAP CORRESPONDENCE

The table below presents the correspondence between `terminfo` and `termcap`(5) codes. The first two columns correspond to the first two columns in the previously presented table of `terminfo` capabilities. The last column shows the `Termcap Code`, which is the two-letter code that corresponds to the `termcap`(5) capability. The table is sorted alphabetically by `Capname`.

Variable	Cap-name	Termcap Code
acs_chars	**acsc**	ac
auto_right_margin	**am**	am
back_color_erase	**bce**	be
bell	**bel**	bl
enter_blink_mode	**blink**	mb
enter_bold_mode	**bold**	md
buffer_capacity	**bufsz**	Ya
auto_left_margin	**bw**	bw
back_tab	**cbt**	bt
can_change	**ccc**	cc
change_res_horz	**chr**	ZC
hard_cursor	**chts**	HC
cursor_invisible	**civis**	vi
clear_screen	**clear**	cl
command_character	**cmdch**	CC
cursor_normal	**cnorm**	ve
max_colors	**colors**	Co
columns	**cols**	co
change_char_pitch	**cpi**	ZA
cpi_changes_res	**cpix**	YF
print_rate	**cps**	Ym
carriage_return	**cr**	cr
cr_cancels_micro_mode	**crxm**	YB
char_set_names	**csnm**	Zy
change_scroll_region	**csr**	cs
parm_left_cursor	**cub**	LE
cursor_left	**cub1**	le
parm_down_cursor	**cud**	DO
cursor_down	**cud1**	do
parm_right_cursor	**cuf**	RI

cursor_right	**cuf1**	nd
cursor_address	**cup**	cm
parm_up_cursor	**cuu**	UP
cursor_up	**cuu1**	up
change_res_vert	**cvr**	ZD
cursor_visible	**cvvis**	vs
memory_above	**da**	da
has_print_wheel	**daisy**	YC
memory_below	**db**	db
parm_dch	**dch**	DC
delete_character	**dch1**	dc
define_char	**defc**	ZE
enter_dim_mode	**dim**	mh
parm_delete_line	**dl**	DL
delete_line	**dl1**	dl
these_cause_cr	**docr**	Zw
dis_status_line	**dsl**	ds
erase_chars	**ech**	ec
clr_eos	**ed**	cd
clr_eol	**el**	ce
clr_bol	**el1**	cb
ena_acs	**enacs**	eA
erase_overstrike	**eo**	eo
status_line_esc_ok	**eslok**	es
form_feed	**ff**	ff
flash_screen	**flash**	vb
from_status_line	**fsl**	fs
generic_type	**gn**	gn
hard_copy	**hc**	hc
down_half_line	**hd**	hd
hue_lightness_saturation	**hls**	hl
cursor_home	**home**	ho
column_address	**hpa**	ch
has_status_line	**hs**	hs
tab	**ht**	ta
set_tab	**hts**	st
up_half_line	**hu**	hu
tilde_glitch	**hz**	hz
parm_ich	**ich**	IC
insert_character	**ich1**	ic
init_file	**if**	if
parm_insert_line	**il**	AL
insert_line	**il1**	al
insert_null_glitch	**in**	in
scroll_forward	**ind**	sf
parm_index	**indn**	SF
initialize_color	**initc**	Ic
initialize_pair	**initp**	Ip
enter_secure_mode	**invis**	mk

insert_padding	**ip**	ip
init_prog	**iprog**	iP
init_1string	**is1**	i1
init_2string	**is2**	is
init_3string	**is3**	i3
init_tabs	**it**	it
key_sbeg	**kBEG**	&9
key_scancel	**kCAN**	&0
key_scommand	**kCMD**	*1
key_scopy	**kCPY**	*2
key_screate	**kCRT**	*3
key_sdc	**kDC**	*4
key_sdl	**kDL**	*5
key_send	**kEND**	*7
key_seol	**kEOL**	*8
key_sexit	**kEXT**	*9
key_sfind	**kFND**	*0
key_shelp	**kHLP**	#1
key_shome	**kHOM**	#2
key_sic	**kIC**	#3
key_sleft	**kLFT**	#4
key_smove	**kMOV**	%b
key_smessage	**kMSG**	%a
key_snext	**kNXT**	%c
key_soptions	**kOPT**	%d
key_sprint	**kPRT**	%f
key_sprevious	**kPRV**	%e
key_sredo	**kRDO**	%g
key_srsume	**kRES**	%j
key_sright	**kRIT**	%i
key_sreplace	**kRPL**	%h
key_ssave	**kSAV**	!1
key_ssuspend	**kSPD**	!2
key_sundo	**kUND**	!3
key_a1	**ka1**	K1
key_a3	**ka3**	K3
key_b2	**kb2**	K2
key_beg	**kbeg**	@1
key_backspace	**kbs**	kb
key_c1	**kc1**	K4
key_c3	**kc3**	K5
key_cancel	**kcan**	@2
key_btab	**kcbt**	kB
key_close	**kclo**	@3
key_clear	**kclr**	kC
key_command	**kcmd**	@4
key_copy	**kcpy**	@5
key_create	**kcrt**	@6
key_ctab	**kctab**	kt

key_left	**kcub1**	kl
key_down	**kcud1**	kd
key_right	**kcuf1**	kr
key_up	**kcuu1**	ku
key_dc	**kdch1**	kD
key_dl	**kdl1**	kL
key_eos	**ked**	kS
key_eol	**kel**	kE
key_end	**kend**	@7
key_enter	**kent**	@8
key_exit	**kext**	@9
key_f0	**kf0**	k0
key_f1	**kf1**	k1
key_f10	**kf10**	k;
key_f11	**kf11**	F1
key_f12	**kf12**	F2
key_f13	**kf13**	F3
key_f14	**kf14**	F4
key_f15	**kf15**	F5
key_f16	**kf16**	F6
key_f17	**kf17**	F7
key_f18	**kf18**	F8
key_f19	**kf19**	F9
key_f2	**kf2**	k2
key_f20	**kf20**	FA
key_f21	**kf21**	FB
key_f22	**kf22**	FC
key_f23	**kf23**	FD
key_f24	**kf24**	FE
key_f25	**kf25**	FF
key_f26	**kf26**	FG
key_f27	**kf27**	FH
key_f28	**kf28**	FI
key_f29	**kf29**	FJ
key_f3	**kf3**	k3
key_f30	**kf30**	FK
key_f31	**kf31**	FL
key_f32	**kf32**	FM
key_f33	**kf33**	FN
key_f34	**kf34**	FO
key_f35	**kf35**	FP
key_f36	**kf36**	FQ
key_f37	**kf37**	FR
key_f38	**kf38**	FS
key_f39	**kf39**	FT
key_f4	**kf4**	k4
key_f40	**kf40**	FU
key_f41	**kf41**	FV
key_f42	**kf42**	FW

key_f43	**kf43**	FX
key_f44	**kf44**	FY
key_f45	**kf45**	FZ
key_f46	**kf46**	Fa
key_f47	**kf47**	Fb
key_f48	**kf48**	Fc
key_f49	**kf49**	Fd
key_f5	**kf5**	k5
key_f50	**kf50**	Fe
key_f51	**kf51**	Ff
key_f52	**kf52**	Fg
key_f53	**kf53**	Fh
key_f54	**kf54**	Fi
key_f55	**kf55**	Fj
key_f56	**kf56**	Fk
key_f57	**kf57**	Fl
key_f58	**kf58**	Fm
key_f59	**kf59**	Fn
key_f6	**kf6**	k6
key_f60	**kf60**	Fo
key_f61	**kf61**	Fp
key_f62	**kf62**	Fq
key_f63	**kf63**	Fr
key_f7	**kf7**	k7
key_f8	**kf8**	k8
key_f9	**kf9**	k9
key_find	**kfnd**	@0
key_help	**khlp**	%1
key_home	**khome**	kh
key_stab	**khts**	kT
key_ic	**kich1**	kI
key_il	**kil1**	kA
key_sf	**kind**	kF
key_ll	**kll**	kH
has_meta_key	**km**	km
key_move	**kmov**	%4
key_mark	**kmrk**	%2
key_message	**kmsg**	%3
key_npage	**knp**	kN
key_next	**knxt**	%5
key_open	**kopn**	%6
key_options	**kopt**	%7
key_ppage	**kpp**	kP
key_print	**kprt**	%9
key_previous	**kprv**	%8
key_redo	**krdo**	%0
key_reference	**kref**	&1
key_resume	**kres**	&5
key_refresh	**krfr**	&2

key_sr	**kri**	kR
key_eic	**krmir**	kM
key_replace	**krpl**	&3
key_restart	**krst**	&4
key_save	**ksav**	&6
key_select	**kslt**	*6
key_suspend	**kspd**	&7
key_catab	**ktbc**	ka
key_undo	**kund**	&8
lab_f0	**lf0**	l0
lab_f1	**lf1**	l1
lab_f10	**lf10**	la
lab_f2	**lf2**	l2
lab_f3	**lf3**	l3
lab_f4	**lf4**	l4
lab_f5	**lf5**	l5
lab_f6	**lf6**	l6
lab_f7	**lf7**	l7
lab_f8	**lf8**	l8
lab_f9	**lf9**	l9
label_height	**lh**	lh
lines	**lines**	li
cursor_to_ll	**ll**	ll
lines_of_memory	**lm**	lm
change_line_pitch	**lpi**	ZB
lpi_changes_res	**lpix**	YG
label_width	**lw**	lw
max_micro_address	**maddr**	Yd
print_screen	**mc0**	ps
prtr_off	**mc4**	pf
prtr_on	**mc5**	po
prtr_silent	**mc5i**	5i
prtr_non	**mc5p**	pO
micro_col_size	**mcs**	Yf
parm_left_micro	**mcub**	Zg
micro_left	**mcub1**	Za
parm_down_micro	**mcud**	Zf
micro_down	**mcud1**	ZZ
parm_right_micro	**mcuf**	Zh
micro_right	**mcuf1**	Zb
parm_up_micro	**mcuu**	Zi
micro_up	**mcuu1**	Zd
clear_margins	**mgc**	MC
micro_column_address	**mhpa**	ZY
move_insert_mode	**mir**	mi
max_micro_jump	**mjump**	Ye
micro_line_size	**mls**	Yg
cursor_mem_address	**mrcup**	CM
move_standout_mode	**msgr**	ms

micro_row_address	**mvpa**	Zc
no_color_video	**ncv**	NC
newline	**nel**	nw
num_labels	**nlab**	Nl
no_pad_char	**npc**	NP
number_of_pins	**npins**	Yh
non_rev_rmcup	**nrrmc**	NR
needs_xon_xoff	**nxon**	nx
orig_colors	**oc**	oc
orig_pair	**op**	op
output_res_char	**orc**	Yi
output_res_horz_inch	**orhi**	Yk
output_res_line	**orl**	Yj
output_res_vert_inch	**orvi**	Yl
over_strike	**os**	os
pad_char	**pad**	pc
max_pairs	**pairs**	pa
padding_baud_rate	**pb**	pb
pkey_key	**pfkey**	pk
pkey_local	**pfloc**	pl
pkey_xmit	**pfx**	px
plab_norm	**pln**	pn
order_of_pins	**porder**	Ze
enter_protected_mode	**prot**	mp
stop_bit_image	**rbim**	Zs
restore_cursor	**rc**	rc
stop_char_set_def	**rcsd**	Zt
repeat_char	**rep**	rp
enter_reverse_mode	**rev**	mr
reset_file	**rf**	rf
req_for_input	**rfi**	RF
scroll_reverse	**ri**	sr
parm_rindex	**rin**	SR
exit_italics_mode	**ritm**	ZR
exit_leftward_mode	**rlm**	ZS
exit_alt_charset_mode	**rmacs**	ae
exit_am_mode	**rmam**	RA
exit_ca_mode	**rmcup**	te
exit_delete_mode	**rmdc**	ed
exit_micro_mode	**rmicm**	ZT
exit_insert_mode	**rmir**	ei
keypad_local	**rmkx**	ke
label_off	**rmln**	LF
meta_off	**rmm**	mo
char_padding	**rmp**	rP
exit_standout_mode	**rmso**	se
exit_underline_mode	**rmul**	ue
exit_xon_mode	**rmxon**	RX
reset_1string	**rs1**	r1

reset_2string	**rs2**	r2
reset_3string	**rs3**	r3
exit_shadow_mode	**rshm**	ZU
exit_subscript_mode	**rsubm**	ZV
exit_superscript_mode	**rsupm**	ZW
exit_upward_mode	**rum**	ZX
exit_doublewide_mode	**rwidm**	ZQ
semi_auto_right_margin	**sam**	YE
start_bit_image	**sbim**	Zq
save_cursor	**sc**	sc
set_color_pair	**scp**	sp
select_char_set	**scs**	Zj
start_char_set_def	**scsd**	Zr
enter_draft_quality	**sdrfq**	ZG
set_background	**setb**	Sb
set_foreground	**setf**	Sf
set_attributes	**sgr**	sa
exit_attribute_mode	**sgr0**	me
enter_italics_mode	**sitm**	ZH
enter_leftward_mode	**slm**	ZI
enter_alt_charset_mode	**smacs**	as
enter_am_mode	**smam**	SA
enter_ca_mode	**smcup**	ti
enter_delete_mode	**smdc**	dm
set_bottom_margin	**smgb**	Zk
set_bottom_margin_parm	**smgbp**	Zl
set_left_margin	**smgl**	ML
set_left_margin_parm	**smglp**	Zm
set_right_margin	**smgr**	MR
set_right_margin_parm	**smgrp**	Zn
set_top_margin	**smgt**	Zo
set_top_margin_parm	**smgtp**	Zp
enter_micro_mode	**smicm**	ZJ
enter_insert_mode	**smir**	im
keypad_xmit	**smkx**	ks
label_on	**smln**	LO
meta_on	**smm**	mm
enter_standout_mode	**smso**	so
enter_underline_mode	**smul**	us
enter_xon_mode	**smxon**	SX
enter_near_letter_quality	**snlq**	ZK
enter_normal_quality	**snrmq**	ZL
dot_horz_spacing	**spinh**	Yc
dot_vert_spacing	**spinv**	Yb
enter_shadow_mode	**sshm**	ZM
enter_subscript_mode	**ssubm**	ZN
enter_superscript_mode	**ssupm**	ZO
subscript_characters	**subcs**	Zu
enter_upward_mode	**sum**	ZP

superscript_characters	**supcs**	Zv
enter_doublewide_mode	**swidm**	ZF
clear_all_tabs	**tbc**	ct
to_status_line	**tsl**	ts
underline_char	**uc**	uc
transparent_underline	**ul**	ul
row_address	**vpa**	cv
virtual_terminal	**vt**	vt
wide_char_size	**widcs**	Yn
set_window	**wind**	wi
width_status_line	**wsl**	ws
eat_newline_glitch	**xenl**	xn
ceol_standout_glitch	**xhp**	xs
col_addr_glitch	**xhpa**	YA
magic_cookie_glitch	**xmc**	sg
xoff_character	**xoffc**	XF
xon_xoff	**xon**	xo
xon_character	**xonc**	XN
no_esc_ctlc	**xsb**	xb
dest_tabs_magic_smso	**xt**	xt
row_addr_glitch	**xvpa**	YD
zero_motion	**zerom**	Zx

FILES

`/usr/lib/terminfo/?/*`
: compiled device description database

`/usr/src/lib/libcurses/terminfo/*.ti`
: source device descriptions

`/usr/lib/tabset/*`
: tab settings for some devices, in a format appropriate to be output to the device (escape sequences that set margins and tabs)

SEE ALSO

`curses`(3X), `printf`(3S), `term`(5), `profile`(4), `termcap`(5).
`captoinfo`(1M), `infocmp`(1M), `tic`(1M), `termio`(7), `ttcompat`(7) in the *System Manager's Reference for the DG/UX System*.
`tput`(1) in the *User's Reference for the DG/UX System*.

CAUTIONS

As described in the "Tabs and Initialization" section above, a device's initialization strings, `is1`, `is2`, and `is3`, if defined, must be output before a `curses`(3X) program is run. An available mechanism for outputting such strings is `tput init` (see `tput`(1) and `profile`(4)).

If a null character (`\0`) is encountered in a string, the null and all characters after it are lost. Therefore it is not possible to code a null character (`\0`) in a string capability and send it to a device (either a terminal or a printer). The suggestion of sending `\0200` where `\0` (null) is needed can succeed only if the device ignores the eighth bit. For example, because all eight bits are used in the standard international ISO character set, devices that adhere to this standard will treat `\0200` differently from `\0`.

Tampering with entries in `/usr/lib/terminfo/?/*` (for example, changing or removing an entry) can affect programs such as `vi`(1) that expect the entry to be present and correct. In particular, removing the description for the `dumb` terminal causes unexpected problems.

NAME

timezone – set default system time zone and locale

SYNOPSIS

/etc/TIMEZONE, /etc/TIMEZONE.csh

DESCRIPTION

The files /etc/TIMEZONE and /etc/TIMEZONE.csh set and export the following environment variables:

TZ	time zone
NLSPATH	search path for message catalogs
LANG	local language

These files are included into other shell scripts (for example, /etc/profile and /etc/cshrc) to establish this localization information. /etc/TIMEZONE is also read by /etc/init to initialize the timezone and locale information for the system startup procedures.

To change the values of these environment variables, you may edit these files directly, or use admdate(1M) and admnls(1M), which can be invoked from sysadm(1M).

If /etc/TIMEZONE is missing, it is created at system startup by copying the file /etc/TIMEZONE.proto. If /etc/TIMEZONE.csh is missing, it is created at system startup by copying the file /etc/TIMEZONE.csh.proto.

NLSPATH and LANG are described in environ(5) and setlocale(3C). The default value of NLSPATH (in the proto files) is "/usr/lib/nls/msg/%L/%N". The default value of LANG is "C".

TZ can be either the name of a timezone database file found under the directory /usr/lib/locale/TZ, preceded by a colon (e.g. ":US/Eastern"), or else a string that describes the timezone rules. The syntax of such a rule string can be described as follows:

TZ → *zone*
| *zone signed_time*
| *zone signed_time zone*
| *zone signed_time zone dst*

zone → *letter letter letter*

signed_time → *sign time*
| *time*

time → *hour*
| *hour : minute*
| *hour : minute : second*

dst → *signed_time*
| *signed_time , dst_date , dst_date*
| *, dst_date , dst_date*

dst_date → *julian*
| *julian / time*

letter → *a* | *A* | *b* | *B* | ... | *z* | *Z*

hour → *00* | *01* | ... | *23*

minute → *00* | *01* | ... | *59*

second → *00* | *01* | ... | *59*

julian → *001* | *002* | ...| *366*

sign → − | +

EXAMPLES

The contents of the file `/etc/TIMEZONE` could be

```
# Time Zone
TZ=:US/Eastern
export TZ
# Message catalog search path
NLSPATH=/usr/lib/nls/msg/%L/%N
export NLSPATH
# Language
LANG=C
export C
```

A simple setting for `TZ` for New Jersey could be

```
TZ=EST5EDT
```

where `EST` is the abbreviation for the main time zone, `5` is the difference, in hours, between GMT (Greenwich Mean Time) and the main time zone, and `EDT` is the abbreviation for the alternate time zone.

The most complex representation of the same setting, for the year 1986, is

```
TZ="EST5:00:00EDT4:00:00,117/2:00:00,299/2:00:00"
```

where `EST` is the abbreviation for the main time zone, `5:00:00` is the difference, in hours, minutes, and seconds between GMT and the main time zone, `EDT` is the abbreviation for the alternate time zone, `4:00:00` is the difference, in hours, minutes, and seconds between GMT and the alternate time zone, `117` is the number of the day of the year (Julian day) when the alternate time zone will take effect, `2:00:00` is the number of hours, minutes, and seconds past midnight when the alternate time zone will take effect, `299` is the number of the day of the year when the alternate time zone will end, and `2:00:00` is the number of hours, minutes, and seconds past midnight when the alternate time zone will end.

A southern hemisphere setting such as the Cook Islands could be

```
TZ="KDT9:30KST10:00,64/5:00,303/20:00"
```

This setting means that `KDT` is the abbreviation for the main time zone, `KST` is the abbreviation for the alternate time zone, KST is `9` hours and `30` minutes later than GMT, KDT is `10` hours later than GMT, the starting date of KDT is the `64`th day at `5` AM, and the ending date of KDT is the `303`rd day at `8` PM.

Starting and ending times are relative to the alternate time zone. If the alternate time zone start and end dates and the time are not provided, the days for the United States that year will be used and the time will be 2 AM. If the start and end dates are provided but the time is not provided, the time will be midnight.

Note that in most installations, `TZ` is set to the correct value by default when the user logs on, via the local `/etc/profile` file (see `profile`(4)).

NOTES

When the longer format is used, the `TZ` variable must be surrounded by double quotes as shown.

The system administrator must change the Julian start and end days annually if the longer form of the `TZ` variable is used.

Setting the time during the interval of change from the main time zone to the alternate time zone or vice versa can produce unpredictable results.

SEE ALSO

zic(1M), ctime(3C), setlocale(3C), profile(4), environ(5).

NAME

updaters – configuration file for NIS updating

SYNOPSIS

/etc/yp/updaters

DESCRIPTION

The file /etc/yp/updaters is a makefile (see make(1)) which is used for updating NIS databases. Databases can only be updated in a secure network, that is, one that has a publickey(4) database. Each entry in the file is a make target for a particular NIS database. For example, if there is an NIS database named passwd.byname that can be updated, there should be a make target named passwd.byname in the updaters file with the command to update the file.

The information necessary to make the update is passed to the update command through standard input. The information passed is described below (all items are followed by a NEWLINE, except for bullets four and six, below):

- Network name of client wishing to make the update (a string)
- Kind of update (an integer)
- Number of bytes in key (an integer)
- Actual bytes of key
- Number of bytes in data (an integer)
- Actual bytes of data

After getting this information through standard input, the command to update the particular database should decide whether the user is allowed to make the change. If not, it should exit with the status YPERR_ACCESS. If the user is allowed to make the change, the command should make the change and exit with a status of zero. If there are any errors that may prevent the updater from making the change, it should exit with the status that matches a valid NIS error code described in <rpcsvc/ypclnt.h>.

FILES

/etc/yp/updaters

SEE ALSO

make(1), ypupdated(1M), ypupdate(3R).

NAME

utmp, wtmp – utmp and wtmp entry formats

SYNOPSIS

```
#include <sys/types.h>
#include <limits.h>
#include <utmp.h>
```

DESCRIPTION

These files, which hold user and accounting information for such commands as who(1), write(1), and login(1), have the following structure as defined by <utmp.h>:

```
#define UTMP_FILE "/etc/utmp"
#define WTMP_FILE "/etc/wtmp"
#define ut_name   ut_user

struct utmp {
  char    ut_user[USR_NAME]; /* User login name */
  char    ut_id[4];          /* /etc/inittab id (usually line #) */
  char    ut_line[12];       /* device name (console, lnxx) */
  short   ut_pid;            /* process id */
  short   ut_type;           /* type of entry */
  struct  exit_status {
    short   e_termination;   /* Process termination status */
    short   e_exit;          /* Process exit status */
  } ut_exit;                 /* The exit status of a process
                              * marked as DEAD_PROCESS. */
  time_t  ut_time;           /* time entry was made */
  char    ut_host[16];       /* hostname, if remote */
};

/*  Definitions for ut_type  */
#define EMPTY         0
#define RUN_LVL       1
#define BOOT_TIME     2
#define OLD_TIME      3
#define NEW_TIME      4
#define INIT_PROCESS  5  /* Process spawned by "init" */
#define LOGIN_PROCESS 6  /* A "getty" process waiting for login */
#define USER_PROCESS  7  /* A user process */
#define DEAD_PROCESS  8
#define ACCOUNTING    9
#define UTMAXTYPE     ACCOUNTING /* Largest legal value of ut_type */

/*  Special strings or formats used in the "ut_line" field when  */
/*  accounting for something other than a process  */
/*  No string for the ut_line field can be more than 11 chars +  */
/*  a NULL in length  */

#define RUNLVL_MSG  "run-level %c"
#define BOOT_MSG    "system boot"
#define OTIME_MSG   "old time"
#define NTIME_MSG   "new time"
```

FILES

/usr/include/utmp.h
/etc/utmp
/etc/wtmp

SEE ALSO

login(1), who(1), write(1), getut(3C), limits(4).

NAME

ypfiles – the Network Information Service database and directory structure

DESCRIPTION

The Network Information Service (NIS) network lookup service uses a distributed, replicated database of dbm files contained in the /etc/yp directory hierarchy on each NIS server. A dbm database consists of two files, created by calls to the ndbm(3C) library package. One has the filename extension .pag and the other has the filename extension .dir. For instance, the database named hosts.byname, is implemented by the pair of files hosts.byname.pag and hosts.byname.dir.

A dbm database served by the NIS is called an NIS *map*. An NIS *domain* is a sub-directory of /etc/yp containing a set of NIS maps. Any number of NIS domains can exist. Each may contain any number of maps.

No maps are required by the NIS lookup service itself, although they may be required for the normal operation of other parts of the system. There is no list of maps which NIS serves — if the map exists in a given domain, and a client asks about it, the NIS will serve it. For a map to be accessible consistently, it must exist on all NIS servers that serve the domain. To provide data consistency between the replicated maps, an entry to run ypxfr periodically should be made in the super-user's crontab file on each server. More information on this topic is in ypxfr(1M).

NIS maps should contain two distinguished key-value pairs. The first is the key YP_LAST_MODIFIED, having as a value a ten-character ASCII order number. The order number should be the system time in seconds when the map was built. The second key is YP_MASTER_NAME, with the name of the NIS master server as a value. makedbm(1M) generates both key-value pairs automatically. A map that does not contain both key-value pairs can be served by the YP, but the ypserv process will not be able to return values for "Get order number" or "Get master name" requests. See ypserv(1M). In addition, values of these two keys are used by ypxfr when it transfers a map from a master NIS server to a slave. If ypxfr cannot figure out where to get the map, or if it is unable to determine whether the local copy is more recent than the copy at the master, you must set extra command line switches when you run it.

NIS maps must be generated and modified only at the master server. They are copied to the slaves using ypxfr(1M) to avoid potential byte-ordering problems among NIS servers running on machines with different architectures, and to minimize the amount of disk space required for the dbm files. The NIS database can be initially set up for both masters and slaves by using ypinit(1M).

After the server databases are set up, it is probable that the contents of some maps will change. In general, some ASCII source version of the database exists on the master, and it is changed with a standard text editor. The update is incorporated into the NIS map and is propagated from the master to the slaves by running /etc/yp/Makefile. All maps supplied with this OS have entries in /etc/yp/Makefile; if you add an NIS map, edit this file to support the new map. The makefile uses makedbm(1M) to generate the NIS map on the master, and yppush(1M) to propagate the changed map to the slaves. yppush is a client of the map ypservers, which lists all the NIS servers. For more information on this topic, see yppush(1M).

FILES

/etc/yp
/etc/yp/Makefile

SEE ALSO

makedbm(1M), rpcinfo(1M), ypinit(1M), ypmake(1M), yppoll(1M), yppush(1M), ypserv(1M), ypxfr(1M), dbm(3X).

End of Chapter

Chapter 5
Miscellaneous Features

This chapter contains in printed form the online manual entries for miscellaneous features. The entries are in alphabetical order except for **intro**(5), which is first.

This chapter contains only DG/UX manual pages except for **hostname**(5), which is a TCP/IP man page.

NAME

intro – introduction to miscellany

DESCRIPTION

This section describes miscellaneous facilities, such as macro packages and character set tables.

NAME

ascii – map of ASCII character set

DESCRIPTION

ascii is a map of the ASCII character set, giving both octal and hexadecimal equivalents of each character, to be printed as needed. It contains:

```
|000 nul |001 soh |002 stx |003 etx |004 eot |005 enq |006 ack |007 bel |
|010 bs  |011 ht  |012 nl  |013 vt  |014 np  |015 cr  |016 so  |017 si  |
|020 dle |021 dc1 |022 dc2 |023 dc3 |024 dc4 |025 nak |026 syn |027 etb |
|030 can |031 em  |032 sub |033 esc |034 fs  |035 gs  |036 rs  |037 us  |
|040 sp  |041 !   |042 "   |043 #   |044 $   |045 %   |046 &   |047 ´   |
|050 (   |051 )   |052 *   |053 +   |054 ,   |055 -   |056 .   |057 /   |
|060 0   |061 1   |062 2   |063 3   |064 4   |065 5   |066 6   |067 7   |
|070 8   |071 9   |072 :   |073 ;   |074 <   |075 =   |076 >   |077 ?   |
|100 @   |101 A   |102 B   |103 C   |104 D   |105 E   |106 F   |107 G   |
|110 H   |111 I   |112 J   |113 K   |114 L   |115 M   |116 N   |117 O   |
|120 P   |121 Q   |122 R   |123 S   |124 T   |125 U   |126 V   |127 W   |
|130 X   |131 Y   |132 Z   |133 [   |134 \   |135 ]   |136 ^   |137 _   |
|140 `   |141 a   |142 b   |143 c   |144 d   |145 e   |146 f   |147 g   |
|150 h   |151 i   |152 j   |153 k   |154 l   |155 m   |156 n   |157 o   |
|160 p   |161 q   |162 r   |163 s   |164 t   |165 u   |166 v   |167 w   |
|170 x   |171 y   |172 z   |173 {   |174 |   |175 }   |176 ~   |177 del |
```

```
| 00 nul | 01 soh | 02 stx | 03 etx | 04 eot | 05 enq | 06 ack | 07 bel |
| 08 bs  | 09 ht  | 0a nl  | 0b vt  | 0c np  | 0d cr  | 0e so  | 0f si  |
| 10 dle | 11 dc1 | 12 dc2 | 13 dc3 | 14 dc4 | 15 nak | 16 syn | 17 etb |
| 18 can | 19 em  | 1a sub | 1b esc | 1c fs  | 1d gs  | 1e rs  | 1f us  |
| 20 sp  | 21 !   | 22 "   | 23 #   | 24 $   | 25 %   | 26 &   | 27 ´   |
| 28 (   | 29 )   | 2a *   | 2b +   | 2c ,   | 2d -   | 2e .   | 2f /   |
| 30 0   | 31 1   | 32 2   | 33 3   | 34 4   | 35 5   | 36 6   | 37 7   |
| 38 8   | 39 9   | 3a :   | 3b ;   | 3c <   | 3d =   | 3e >   | 3f ?   |
| 40 @   | 41 A   | 42 B   | 43 C   | 44 D   | 45 E   | 46 F   | 47 G   |
| 48 H   | 49 I   | 4a J   | 4b K   | 4c L   | 4d M   | 4e N   | 4f O   |
| 50 P   | 51 Q   | 52 R   | 53 S   | 54 T   | 55 U   | 56 V   | 57 W   |
| 58 X   | 59 Y   | 5a Z   | 5b [   | 5c \   | 5d ]   | 5e ^   | 5f _   |
| 60 `   | 61 a   | 62 b   | 63 c   | 64 d   | 65 e   | 66 f   | 67 g   |
| 68 h   | 69 i   | 6a j   | 6b k   | 6c l   | 6d m   | 6e n   | 6f o   |
| 70 p   | 71 q   | 72 r   | 73 s   | 74 t   | 75 u   | 76 v   | 77 w   |
| 78 x   | 79 y   | 7a z   | 7b {   | 7c |   | 7d }   | 7e ~   | 7f del |
```

SEE ALSO

terminfo(4).

NAME

dg_mknod – data returned by the dg_mknod system call

SYNOPSIS

```
#include <sys/types.h>
```

DESCRIPTION

The system call dg_mknod takes a parameter that is a pointer to the structure defined by this include file. This structure defines the node that is created.

```
struct  dg_mknod
{
   mode_t       extended_mode;
   dev_t        device_number;
   char *       symbolic_link_target;
   unsigned long      desired_data_element_blocks;
   unsigned long      data_element_blocks_limit;
   unsigned long      desired_index_element_blocks;
   unsigned long      index_element_blocks_limit;
};
```

The fields of this structure are defined as follows:

`extended_mode`
: The file type and access permissions of the file. The file type is available by AND-ing this field with DG_FILE_TYPE_MASK. The access bits are available by AND-ing this field with (~ DG_FILE_TYPE_MASK). The file type and access are encoded using the constants defined in stat.h and dg_stat.h

`device_number`
: The device specifier to be used if the file to be created is of type 'block-special' or 'character-special'. This field is ignored otherwise.

`symbolic_target_link`
: A null-terminated pathname which will be the target of the file to be created if that file is of type 'symbolic link'. This field is ignored otherwise.

`desired_data_element_blocks`
: The preferred size (in 512-byte blocks) of the data elements of the file to be created. If this size is 0, then the default data element size for the containing file system will be used.

`data_element_blocks_limit`
: The maximum size (in 512-byte blocks) of the data elements of the file to be created. Values in the range starting at the preferred size and working towards the limit are tried until a valid data element size is found.

`desired_index_element_blocks`
: The preferred size (in 512-byte blocks) of the index elements of the file to be created. If this size is 0, then the default data element size for the containing file system will be used.

`index_element_blocks_limit`
: The maximum size (in 512-byte blocks) of the index elements of the file to be created. Values in the range starting at the preferred size and working towards the limit are tried until a valid data element size is found.

FILES

/usr/include/sys/dg_mknod.h
/usr/include/sys/types.h

SEE ALSO

dg_mknod(2), dg_stat(5), types(5).

NAME

dg_stat – data returned by dg_stat and dg_fstat system call

SYNOPSIS

```
#include <sys/types.h>
#include <sys/stat.h>
#include <sys/dg_stat.h>
```

DESCRIPTION

The system calls dg_stat, and dg_fstat return data whose structure is defined by this include file.

```
struct  dg_stat
{
   dev_t        st_dev;
   ino_t        st_ino;
   mode_t       st_mode;
   nlink_t            st_nlink;
   uid_t        st_uid;
   gid_t        st_gid;
   dev_t        st_rdev;
   off_t        st_size;
   time_t       st_atime;
   unsigned long      st_ausec;
   time_t       st_mtime;
   unsigned long      st_musec;
   time_t       st_ctime;
   unsigned long      st_cusec;
   long            st_pad1[114];
   unsigned long      st_blocks;
   mode_t       extended_mode;
   unsigned long      data_element_blocks;
   unsigned long      index_element_blocks;
   unsigned long      max_cpd_blocks;
   unsigned long      max_cpd_file_nodes;
   unsigned long      cur_cpd_blocks;
   unsigned long      cur_cpd_file_nodes;
};
```

The fields of this structure are defined as follows:

st_dev
: An identifier of the flat file store containing the file. The meaning of this field is the same as that of the field of the same name in the stat structure.

st_ino
: An identifier of the per-file database within the flat file store. The meaning of this field is the same as that of the field of the same name in the stat structure.

st_mode
: The mode of the file, encoded using the constants defined in stat.h. The meaning of this field is the same as that of the field of the same name in the stat structure.

`st_nlink`
The number of links to the file. The meaning of this field is the same as that of the field of the same name in the stat structure.

`st_uid`
The user-id of the file. The meaning of this field is the same as that of the field of the same name in the stat structure.

`st_gid`
The group-id of the file. The meaning of this field is the same as that of the field of the same name in the stat structure.

`st_rdev`
The represented device, giving the major and minor device numbers of the device represented by a special file. This field is meaningful only if the file is of type 'block-special' or 'character-special'. The meaning of this field is the same as that of the field of the same name in the stat structure.

`st_size`
The size of the file in bytes. The meaning of this field is the same as that of the field of the same name in the stat structure.

`st_atime`
The last time the file was accessed. The meaning of this field is the same as that of the field of the same name in the stat structure.

`st_ausec`
The extended-precision portion of st_atime, in microseconds. If such precision is not available, this field will be zero.

`st_mtime`
The last time the file's contents were modified. The meaning of this field is the same as that of the field of the same name in the stat structure.

`st_musec`
The extended-precision portion of st_mtime, in microseconds. If such precision is not available, this field will be zero.

`st_ctime`
The last time the file's attributes were changed. The meaning of this field is the same as that of the field of the same name in the stat structure.

`st_cusec`
The extended-precision portion of st_ctime, in microseconds. If such precision is not available, this field will be zero.

`st_pad`
Reserved space.

`st_blocks`
The actual number of blocks allocated for the file.

`extended_mode`
The extended mode of the file, encoded using the constants defined below and in stat.h.

`data_element_blocks`
The number of 512-byte blocks used in each of the file's data elements.

`index_element_blocks`
The number of 512-byte blocks used in each of the file's index elements.

`max_cpd_blocks`
The maximum number of 512-byte blocks that can be allocated by this file and all of its space descendants. This field has meaning only if the file is a control-point directory. Otherwise, it will be zero. A node is a space descendant of a CPD if it is found in the directory tree descending from the CPD and if no file system mount point boundaries are crossed.

`max_cpd_file_nodes`
The maximum number of file nodes that can be allocated by this file and all of its space descendants. This field has meaning only if the file is a control-point directory. Otherwise, it will be zero.

`cur_cpd_blocks`
The current number of 512-byte blocks that have been allocated by this file and all of its space descendants. This field has meaning only if the file is a control-point directory. Otherwise, it will be zero.

`cur_cpd_file_nodes`
The current number of file nodes that have been allocated by this file and all of its space descendants. This field has meaning only if the file is a control-point directory. Otherwise, it will be zero.

#define DG_FILE_TYPE_MASK ((unsigned_long) 0xFFFFF000)

The bitmask used to extract the file's type from the *extended_mode* field. The result of AND-ing the file's *extended_mode* with this mask will be one of the following: DG_IFCPD, S_IFDIR, S_IFCHR, S_IFBLK, S_IFREG, S_IFLNK, S_IFIFO, S_IFSOCK. Logically, this field is equivalent to the S_IFMT mask defined in stat.h, except that DG_FILE_TYPE_MASK allows for detection of DG/UX-only extended file types, such as DG_IFCPD (see below).

#define DG_IFCPD ((unsigned long) 0x00010000)

Control-point directory file type.

#define DG_IFSTREAMS ((unsigned long) 0x00020000)

Streams special file type.

FILES

`/usr/include/sys/dg_stat.h`
`/usr/include/sys/types.h`

SEE ALSO

`dg_stat(2)`, `dg_fstat(2)`, `stat(5)`, `types(5)`.

NAME

elink - Environment variable sensitive file link

DESCRIPTION

An elink is the mechanism used to encode environment variable-sensitive references into symbolic links. This non-standard use of symbolic links is used by a number of software development tools such as cc to find files that pertain to a development environment selected with sde-target(1).

The elink mechanism is incorporated into a number of software development tools to support the generation of programs and libraries that conform to different standards on the same machine. It is implemented by inserting code into the error paths of special versions of some system library routines.

An elink is a symbolic link whose value conforms to the following grammar:

```
<elink>      ::= "elink:" <sp> <pathname> <sp> <comment>
<pathname>   ::= <pathname> <evref> <pathname>
                 | <pathchars>
                 |
<evref>      ::= "$" <evname>
                 | "${" <evname> "}"
                 | "${" <evname> ":-" <default> "}"
<evname>     ::= <id>
<default>    ::= <id>
<pathchars>  ::= <id>
                 | <pathchars> "/" <pathchars>
<comment>    ::= "#" <text>
                 |
```

<sp> is zero or more tab or space characters.
<id> is a sequence of identifier characters.
<text> is zero or more of any character except null.

This grammar is ambiguous in a number of ways that are not significant. For example, you can't tell how <evref> terminates if it is not the "${}" form and it is followed by an <id>.

Within one of the specially modified tools, when an operation such as open(2) is performed, nothing is done unless an error would be reported. In that case, the pathname argument is checked to see if it or any component is a symbolic link. If one is found, then the contents of the link are checked to see if they conform to the above grammar. If so, the <pathname> component is extracted, environment variable substitution is performed, and the operation is tried again, substituting the newly created pathname for the value of the symbolic link in the original argument. The previous steps are repeated until the operation succeeds or the argument does not resolve to a valid symbolic link (and an error is reported).

Environment variable substitution is defined as the replacement of all <evref> components in the <pathname> with the appropriate environment variable value. If a given environment variable is not defined, then the <default> value is used if it is supplied; otherwise "" is used.

For example, consider the following symbolic link:

```
/usr/lib/libc.a ->
elink:/usr/sde/${TARGET_BINARY_INTERFACE:-m88kdgux}/
      usr/lib/libc.a # See sde-target(1)
```

Links begin with "`elink:`" to give a visual cue that something is different about this symbolic link. The comment allows the insertion of other informational pointers.

This link makes reference to one environment variable although more could have been used. If the environment variable `TARGET_BINARY_INTERFACE` is not defined when a tool such as `ld`(1) attempts to open `/usr/lib/libc.a` then the tool will use the path `/usr/sde/m88kdgux/usr/lib/libc.a`. If `TARGET_BINARY_INTERFACE` is some value such as `m88kbcs`, the the path used to find `libc.a` will include the value of the variable such as `/usr/sde/m88kbcs/usr/lib/libc.a`.

It should be noted that the elink mechanism is incorporated only in a small set of tools. Other tools that attempt to use a pathname that contains an elink will get an error indicating that the file does not exist.

SEE ALSO

`sde-target`(1), `sde`(5).

NAME

environ – user environment

DESCRIPTION

When a process begins execution, exec routines make available an array of strings called the environment [see exec(2)]. By convention, these strings have the form *variable=value*, for example, PATH=/sbin:/usr/sbin. These environmental variables provide a way to make information about a program's environment available to programs. The following environmental variables can be used by applications and are expected to be set in the target run-time environment.

HOME The name of the user's login directory, set by login(1) from the password file (see passwd(4)).

LANG The string used to specify localization information that allows users to work with different national conventions. The setlocale(3C) function looks for the LANG environment variable when it is called with "" as the *locale* argument. LANG is used as the default locale if the corresponding environment variable for a particular category is unset.

For example, when setlocale() is invoked as

```
setlocale(LC_CTYPE, ""),
```

setlocale() will query the LC_CTYPE environment variable first to see if it is set and non-null. If LC_CTYPE is not set or null, then setlocale() will check the LANG environment variable to see if it is set and non-null. If both LANG and LC_CTYPE are unset or null, the default C locale will be used to set the LC_CTYPE category.

Most commands will invoke

```
setlocale(LC_ALL, "")
```

prior to any other processing. This allows the command to be used with different national conventions by setting the appropriate environment variables.

The system-wide default value for LANG can be changed with the sysadm(1M) command.

The following environment variables are supported to correspond with each category of setlocale(3C):

LC_COLLATE This category specifies the collation sequence being used. The information corresponding to this category is stored in a database created by the colltbl(1M) command. This environment variable affects strcoll(3C), strxfrm(3C) and the regular expression code (see regexpr(3C)).

LC_CTYPE This category specifies character classification, character conversion, and widths of multibyte characters. The information corresponding to this category is stored in a database created by the chrtbl(1M) command. The default C locale corresponds to the 7-bit ASCII character set. This environment variable is used by ctype(3C), mbchar(3C), and many commands; for example: cat(1), ed(1), ls(1), and vi(1).

LC_MESSAGES This category specifies the language of the AT&T-style message database being used. For example, an application may have one message database with French messages, and another database with German messages. Message databases are created by the mkmsgs(1M) command. This environment variable is used by exstr(1), gettxt(1), gettxt(3C), and srchtxt(1). The X/Open-style message facility does not use this variable.

LC_MONETARY This category specifies the monetary symbols and delimiters used for a particular locale. The information corresponding to this category is stored in a database created by the montbl(1M) command. This environment variable is used by localeconv(3C).

LC_NUMERIC This category specifies the decimal and thousands delimiters. The information corresponding to this category is stored in a database created by the chrtbl(1M) command. The default C locale corresponds to "." as the decimal delimiter and no thousands delimiter. This environment variable is used by localeconv(3C), printf(3C), and strtod(3C).

LC_TIME This category specifies date and time formats. The information corresponding to this category is stored in a database specified in strftime(4). The default C locale corresponds to U.S. date and time formats. This environment variable is used by many commands and functions; for example: at(1), calendar(1), date(1), strftime(3C), and getdate(3C).

MSGVERB Controls which standard format message components fmtmsg selects when messages are displayed to stderr [see fmtmsg(1) and fmtmsg(3C)].

SEV_LEVEL Define severity levels and associate and print strings with them in standard format error messages [see addseverity(3C), fmtmsg(1), and fmtmsg(3C)].

NETPATH A colon-separated list of network identifiers. A network identifier is a character string used by the Network Selection component of the system to provide application-specific default network search paths. A network identifier must consist of non-NULL characters and must have a length of at least 1. No maximum length is specified. Network identifiers are normally chosen by the system administrator. A network identifier is also the first field in any /etc/netconfig file entry. NETPATH thus provides a link into the /etc/netconfig file and the information about a network contained in that network's entry. /etc/netconfig is maintained by the system administrator. The library routines described in getnetpath(3N) access the NETPATH environment variable.

NLSPATH Contains a sequence of templates which the X/Open-style message facility uses when attempting to locate message catalogs (see catopen(3C)). The AT&T-style message facility does not use this variable. Each template consists of an optional prefix, one or more substitution fields, a

filename and an optional suffix.

For example:

```
NLSPATH="/usr/lib/nls/msg/%N.cat"
```

defines that `catopen()` should look for all message catalogs in the directory `/usr/lib/nls/msg`, where the catalog name should be constructed from the *name* parameter passed to `catopen()`, `%N`, with the suffix `.cat`.

Substitution fields consist of a `%` symbol, followed by a single-letter keyword. The following keywords are currently defined:

`%N`	The value of the *name* parameter passed to `catopen()`.
`%L`	The value of `LANG`.
`%l`	The language element from `LANG`.
`%t`	The territory element from `LANG`.
`%c`	The codeset element from `LANG`.
`%%`	A single `%` character.

An empty string is substituted if the specified value is not currently defined. The separators "_" and "." are not included in `%t` and `%c` substitutions.

Templates defined in `NLSPATH` are separated by colons (`:`). A leading colon or two adjacent colons (`::`) is equivalent to specifying `%N`.

For example:

```
NLSPATH=":%N.cat:/usr/lib/nls/msg/%L/%N.cat"
```

indicates to `catopen()` that it should look for the requested message catalog in *name*, *name*`.cat` and `/usr/lib/nls/msg/$LANG/`*name*`.cat`.

The system-wide default value for `NLSPATH` can be changed with the `sysadm`(1M) command.

`PATH` The sequence of directory prefixes that `sh`(1), `time`(1), `nice`(1), `nohup`(1), etc., apply in searching for a file known by an incomplete path name. The prefixes are separated by colons (`:`). `login`(1) sets `PATH=/usr/bin`. (For more detail, see `sh`(1).)

`TERM` The kind of terminal for which output is to be prepared. This information is used by commands, such as `vi`(1), which may exploit special capabilities of that terminal.

`CFTIME` Historically, the default format string to be used by the `date`(1) command and the `ascftime()` and `cftime()` routines (see `strftime`(3C)). If `CFTIME` is not set or is null, the default format string specified in the /lib/cftime/LANGUAGE file (if it exists) is used in its place (see `cftime`(4)). The use of `CFTIME` has generally been subsumed by `LANG` and `LC_TIME`.

`CHRCLASS` Historically, a value that corresponds to a file in `/lib/chrclass` containing character classification and conversion information. This information was used by commands (such as `cat`(1), `ed`(1), and `sort`(1)) to classify characters as alphabetic, printable, upper case, and so on,

and to convert characters to upper or lower case. The use of CHRCLASS has generally been subsumed by LANGF1 and LC_CTYPE. For more detail, see ctype(3C).

LANGUAGE Historically, a language for which a printable file by that name exists in /lib/cftime. This information was used by commands (such as date(1), ls(1), and sort(1)) to print date and time information in the language specified. The use of LANGUAGE has generally been subsumed by LANG and LC_TIME.

TZ Time zone information. The contents of the environment variable named TZ are used by the functions ctime(3C), localtime() (see ctime(3C)), strftime(3C) ascftime() (see strftime(3C)), cftime() (see strftime(3C)), and mktime(3C) to override the default timezone. The value of TZ has one of the two forms (spaces inserted for clarity):

:characters
or:

std offset dst offset, rule

If TZ is of the first format (i.e., if the first character is a colon), the string following the colon is the name of the timezone that will be loaded in from the /usr/lib/locale/TZ directory. For example, if TZ was set to :US/Eastern, it would load the /usr/lib/local/TZ/US/Eastern timezone definition file. The timezones under this directory are produced with the zic(1) command.

The expanded format (for all TZs whose value does not have a colon as the first character) is as follows:

std offset [*dst* [*offset*] , [*start* [*/time*] , *end* [*/time*]]]

Where:

std and *dst*
Three or more bytes that are the designation for the standard (*std*) and daylight savings time (*dst*) timezones. Only *std* is required, if *dst* is missing, then daylight savings time does not apply in this locale. Upper- and lower-case letters are allowed. Any characters except a leading colon (:), digits, a comma (,), a minus (-), a plus (+), or an ASCII NUL are allowed.

offset Indicates the value one must add to the local time to arrive at Coordinated Universal Time. The offset has the form:

hh [: *mm* [: *ss*]]

The minutes (*mm*) and seconds (*ss*) are optional. The hour (*hh*) is required and may be a single digit. The *offset* following *std* is required. If no *offset* follows *dst*, daylight savings time is assumed to be one hour ahead of standard time. One or more digits may be used; the value is always interpreted as a decimal number. The hour must be between 0 and 24, and the minutes (and seconds) if present between 0 and 59. Out of range values may cause unpredictable behavior. If preceded by a "-", the timezone is east of the Prime Meridian; otherwise it is west (which may be indicated by an optional preceding "+" sign).

rule Indicates when to change to and back from summer time. The *rule* has the form:

start/time, end/time

Which indicates when to change to and back from daylight savings time, where *start/time* describes when the change from standard time to daylight savings time occurs, and *end/time* describes when the change back happens. Each *time* field describes when, in current local time, the change is made.

The formats of *start* and *end* are one of the following:

`J`*n* The Julian day *n* ($1 \leq n \leq 365$). Leap days are not counted. That is, in all years, February 28 is day 59 and March 1 is day 60. It is impossible to refer to the occasional February 29.

n The zero-based Julian day ($0 \leq n \leq 365$). Leap days are counted, and it is possible to refer to February 29.

`M`*m.n.d* The d^{th} day, ($0 \leq d \leq 6$) of week *n* of month *m* of the year ($1 \leq n \leq 5$, $1 \leq m \leq 12$), where week 5 means "the last *d*-day in month *m*" which may occur in either the fourth or the fifth week). Week 1 is the first week in which the d^{th} day occurs. Day zero is Sunday.

The *time* has the same format as *offset* except that no leading sign ("−" or "+") is allowed. The default, if *time* is not given is 02:00:00.

Further names may be placed in the environment by the `export` command and *name=value* arguments in `sh`(1), or by `exec`(2). It is unwise to conflict with certain shell variables that are frequently exported by `.profile` files: `MAIL`, `PS1`, `PS2`, `IFS` (see `profile`(4)).

Whenever `ascftime`(), `cftime`(), `ctime`(), `localtime`(), `mktime`(), or `strftime`() is called, the time zone names contained in the external variable `tzname`() shall be set as if the `tzset`() function had been called.

Applications are explicitly allowed to change `TZ` and have the changed `TZ` apply to themselves.

The system-wide default value for `TZ` can be changed with the `sysadm`(1M) command.

NOTE:

There is an unfortunate potential for confusion with time zones identified by an offset from GMT. The `TZ` value *GMT+5*, according to the rules presented here, is equivalent to *EST5* — 5 hours West of GTM. There is also a timezone definition file that can be used by setting `TZ` to *:GMT+5*, but this file defines the time zone 5 hours *East* of GMT. Existing practice requires that both these notations be supported.

SEE ALSO

`chrtbl`(1M), `colltbl`(1M), `montbl`(1M), `netconfig`(4), `strftime`(4), `passwd`(4), `profile`(4) in the *System Manager's Reference*.

`exec`(2), `addseverity`(3C), `catopen`(3C), `ctime`(3C), `ctype`(3C), `fmtmsg`(3C), `getdate`(3C), `getenv`(3C), `gettxt`(3C), `localeconv`(3C), `mbchar`(3C), `mktime`(3C), `printf`(3C), `strcoll`(3C), `strftime`(3C), `strtod`(3C),

`strxfrm`(3C), `strftime`(4), `time`(4), `timezone`(4).

`cat`(1), `date`(1), `ed`(1), `gencat`(1), `fmtmsg`(1), `ls`(1), `login`(1), `mkmsgs`(1), `nice`(1), `nohup`(1), `sh`(1), `sort`(1), `time`(1), `vi`(1), `zic`(1) in the *User's Reference*.

`getnetpath`(3N), in the *Programmer's Guide: Networking Interfaces*.

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NAME

eucioctl – generic interface to EUC handling TTY drivers and modules

SYNOPSIS

```
#include <sys/eucioctl.h>

ioctl(int fd, I_STR, struct strioctl *sb);
```

DESCRIPTION

This interface is implemented in TTY drivers and pushable *STREAMS* modules that handle EUC codes. It is intended as a generic interface for EUC handling, to eliminate an explosion of "module specific" `ioctl` calls that would otherwise be necessary, and to provide uniformity in dealing with EUC codesets in the TTY subsystem.

Several calls are defined. The first two calls take an argument, which is expected to be a pointer to an `eucioc` structure, defined in the header file `<sys/eucioctl.h>`:

```
struct eucioc {
      unsigned char eucw[4];
      unsigned char scrw[4];
};
typedef struct eucioc   eucioc_t;
```

In all cases, these calls return non-zero on failure. Failure should be usually taken as an indication that the current driver, or line discipline module, does not support EUC in which case `errno` will be set to `EINVAL`. For the `EUC_WSET` and `EUC_WGET` calls `errno` will be set will be set to `EPROTO` if the `struct eucioc` argument is invalid.

`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 codeset widths to be used for subsequent operations. Within the *STREAM*, the line discipline may optionally notify other modules of this setting via `M_CTL` messages.

`EUC_WGET` This call takes a pointer to an `eucioc` structure, and returns in it the EUC codeset widths currently in use by the EUC line discipline. It need be recognized *only* by line discipline modules.

The following calls take no arguments. They should only fail if the driver (at the bottom of the TTY STREAM) does not recognize EUC codes. Drivers that support EUC, whether the STREAM contains modules that respond to the calls or not, will *recognize* the calls and acknowledge them. These calls are normally only *interpreted* by modules that have modes other than ASCII, and/or do some form of I/O conversion that normally prevents a program from receiving non-EUC characters in its byte stream. All of these calls, when received by modules, are passed down the TTY STREAM, to be ultimately acknowledged by the TTY driver.

`EUC_MSAVE` This call has no effect on modules that are currently in ASCII mode. Otherwise (i.e., for modules *not* in ASCII mode), the following actions are taken by all modules that recognize this call: (1) the current "mode" status is saved, (2) the mode is changed to ASCII mode immediately.

`EUC_MREST` If a mode was saved via a previous `EUC_MSAVE` call, the saved mode is restored, and the "saved state" flag is cleared. If the mode was not previously saved, this call has no effect. (The exact semantics are somewhat dependent on the module, since some

modules may respond to specific user-requests to switch modes, even while a mode is being saved via EUC_MSAVE.)

EUC_IXLOFF — If a module is currently in a state where "input conversion" is being performed on the incoming byte stream, then input conversion is turned off, and the module's "mode" status is saved. If no input conversion is being performed, there is no effect on the module. The purpose of this call is to provide a way of insuring a "pure" byte stream to the program. The byte stream while input conversion is off is, of course, not guaranteed to be a stream of EUC characters. Turning off input conversion is roughly equivalent to the old concept of "raw" mode, if used in conjunction with ICANON off. It should normally not be used by applications.

EUC_IXLON — If a module previously saved its state and turned off input conversion, then input conversion is restored (i.e., turned back on); otherwise, there is no effect.

EUC_OXLOFF — In a manner similar to EUC_IXLOFF, any "output conversion" is turned off, and the current mode status saved.

EUC_OXLON — In a manner similar to EUC_IXLON, any saved "output conversion" status is restored (i.e., output conversion is turned back on if previously turned off via EUC_OXLOFF).

Limitations

Drivers and modules that support EUC should all respond appropriately to these calls, depending on their type. Line disciplines must respond to EUC_WSET and EUC_WGET, changing their current codeset sizes to match EUC_WSET requests. All TTY STREAMS modules that do any input or output conversion should recognize the other calls; modules that do no codeset conversion are not required to recognize the calls, but *must* pass them through. Drivers that support EUC TTY STREAMS must all acknowledge the ON/OFF calls, whether the drivers themselves are affected or not, since these calls are purposely *not* acknowledged by modules which receive them; they are intended to be made available for affecting all modules in *the whole STREAM*.

FILES

/usr/include/sys/eucioctl.h

SEE ALSO

eucset(1).

NOTES

Adherence to this protocol for all EUC handling modules is strongly encouraged in order to increase portability and language-independence of applications. These calls are intended as a small set of primitives to help reduce an anticipated plethora of module- and language-dependent operations.

NAME

fcntl – file control options

SYNOPSIS

```
#include <fcntl.h>
```

DESCRIPTION

The `fcntl`(2) function helps you control open files. This include file describes *commands* and *arguments* to `fcntl` and `open`(2).

```
/* Flag values accessible to open(2) and fcntl(2) */
/* (The first three can only be set by open) */

#define O_RDONLY   0
#define O_WRONLY   1
#define O_RDWR     2
#define O_NDELAY   04   /* Non-blocking I/O */
#define O_APPEND   010  /* append (writes guaranteed at the end) */

/* Flag values accessible only to open(2) */
#define O_CREAT 00400   /* open with file create (uses 3rd open arg)*/
#define O_TRUNC 01000   /* open with truncation */
#define O_EXCL  02000   /* exclusive open */

/* fcntl(2) commands */
#define F_DUPFD   0     /* Duplicate fildes */
#define F_GETFD   1     /* Get the `close-on-exec' flag */
#define F_SETFD   2     /* Set the `close-on-exec' flag */
#define F_GETFL   3     /* Get file flags */
#define F_SETFL   4     /* Set file flags */
#define F_GETLK   5     /* Get record lock status */
#define F_SETLK   6     /* Set record lock or fail */
#define F_SETLKW  7     /* Set record lock or pend */
#define F_CHKFL   8     /* Check flags for validity */
#define F_FREESP  11    /* Free up file space */
#define F_GETOWN  65536 /* Get owner of fildes */
#define F_SETOWN  65537 /* Set owner of fildes */
```

SEE ALSO

`fcntl`(2), `open`(2).

NAME

hier – DG/UX file system hierarchy

DESCRIPTION

The following outline gives a quick tour through a representative directory hierarchy. The basis of the outline is the DG/UX operating system. It is not exhaustive.

/ root

/admin
typical home directory for sysadm

/bin a symbolic link to /usr/bin

/dev/ devices (7)

console	system console
dsk/*	logical disks
error	the error device, error(7)
kmem	logical kernel memory
lp	line printer, lp(7)
mem	physical memory
mt/*	magnetic tapes
null	the null device; i.e., the "bit bucket"
pdsk/*	physical disks
rdsk/*	raw logical disks
rmt/*	raw magnetic tapes
rpdsk/*	raw physical disks
tty[0-9]*	terminals, ttcompat(7)
ttyp[0-9]*	pseudo terminals
...	

/dgux the kernel binary (DG/UX System itself)

/etc/ essential data and maintenance utilities; section (1M)

cron.d	main cron directory also containing scheduler for at(1)
default	directory containing defaults for various programs
	cron file specifying actions for cron(1M) to take
	...
dumpdates	dump history, dump(1M)
erm/	directory containing error message files
	ermes file containing text of system error messages referenced by perror(3C)
	...
fstab	file system configuration table, fstab(4)
group	group file, group(4)
getty	initial part of login sequence, getty(1M)
hosts	host name to network address mapping file, hosts(4)
init.d	scripts for rc.d directories init(1M), rc(1M)
inittab	the init configuration table, inittab(4)
login.csh	global csh(1) startup script, csh(1)
mnttab	mounted file table, mnttab(4)
motd	message of the day, login(1)
networks	network name to network number mapping file, networks(4)
passwd	password file, passwd(4)
profile	global sh(1) startup script, sh(1)
protocols	protocol name to protocol number mapping file, protocols(4)
rc.init	shell program to enter init states (0, 1, ...), init(1M), rc(1M)

```
        rc[S0123456i].d
                    links to init.d scripts for actions in init states, init(1M),
                    rc(1M)
        services    network services definition file, services(4)
        ttydefs     terminal modes for getty, ttydefs(4)
        wtmp, utmp  login history, utmp(4)
        ...
/lib    a symbolic link to /usr/lib
/lost+found
        directory for connecting detached files for fsck(1M)
/sbin/
        basic utilities
        halt        stop the system processor, halt(1M)
        init        the parent of all processes, init(1M)
        mount       mount(1M)
        sh          Bourne shell, sh(1)
        ...
/srv/   server directory
        release     release directory
                    PRIMARY  directory for the primary release
                             root    directory containing root directories of
                                     diskless clients
        swap        directory containing swap space for diskless clients
        ...
/tmp/   temporary files, usually on a fast device, cf. /var/tmp/
        e*          used by ed(1)
        ctm*        used by cc(1)
        ...
/udd/   directory containing a local file system of user directories and possibly
        mounted file systems of remote user directories (name udd is optional)
        local       local directory containing user directories
                    wd       user's initial working directory, typically the user's
                             login name
                             .profile
                                      set environment for sh(1), environ(5)
                             .cshrc   startup file for csh(1)
                             .editreadrc
                                      startup file for Editread command-line
                                      editor
                             .exrc    startup file for ex(1)
                             .mailrc  startup file for mail(1)
                             .netrc   startup file for various network programs
                             calendar
                                      user's datebook for calendar(1)
        remote      mounted remote directory containing user directories
/usr/   system software directory, typically read-only
        bin/        utility programs
                    as       Data General macro assembler
                    cc       C compiler executive, cf. /usr/lib/ccomp,
                             /lib/cpp
                    csh      C shell, csh(1)
                    sh       Bourne shell, sh(1)
```

```
        ...
catman/     online manual pages for man(1)
            u_man/   User's Reference for the DG/UX System
                     man0/   general: contents, permuted index
                             contents.0.z
                             index.0.z
                     man1/   user commands and application programs
                             acctcom.1.z
                             alpq.1.z
                             ...
                     man5/   miscellaneous features
                             editread.5.z
                             ...
            a_man/   System Manager's Reference for the DG/UX System
                     man1/   system maintenance commands
                             accept.1m.z
                             acct.1m.z
                             ...
                     man4/   file formats for system maintenance com-
                             mands
                             dfm.4m.z
                             ...
                     man7/   special files
                             alp.7.z
                             ...
                     man8/   system maintenance procedures
                             crash.8.z
                             ...
            p_man/   Programmer's Reference for the DG/UX System
                     man1/   programmer commands
                             admin.1.z
                             ar.1.z
                             ...
                     man2/   system calls
                             accept.2.z
                             access.2.z
                             ...
                     man3/   runtime libraries
                             a64l.3c.z
                             ...
                     man4/   file formats
                             a.out.4.z
                             ...
                     man5/   miscellaneous features
                             ascii.5.z
                             ...
                     man6/   networking protocols
                             dot3.6.z
                             ...
include/    standard #include files
            a.out.h  object file layout, a.out(4)
            stdio.h  standard I/O, intro(3)
```

```
                    math.h   (3M)
                    net/     network header files
                    sys/     system-defined layouts
                    ...
          lib/      object libraries, etc.
                    acct/*   account programs and shell scripts
                    gcc      symbolic link to gcc-1
                    gcc-1    directory for GNU C preprocessor and compiler
                    libc.a   elink pointing to directory containing system calls,
                             standard I/O, etc. (2,3,3S)
                    locale   directory containing locale-specific information
                    ...
                    uucp/    programs and data for uucp(1)
                             L.sys    remote system names and numbers
                             uucico   the real copy program
                             ...
                    unittab  conversion tables for units(1)
          sbin/     utility programs
                    cron     the clock server, cron(1M)
                    dump     dump program, dump(1M)
                    restore  restore program, restore(1M)
                    ...
          sde/      software development environment directory
                    m88kdguxelf
                             Motorola 88000 ELF binary interface, elf(3E)
                             usr/bin  utiliy programs
                             usr/lib  libraries
                                      lint[12]  subprocesses for lint(1)
                                      llib-lc   dummy declarations for
                                                /lib/libc.a, used by lint(1)
                                      llib-lm   dummy declarations for
                                                /lib/libc.m
                                      ...
                             ...
                    ...
          tmp/      symbolic link to /var/tmp
                    stm*     used by sort(1)
/var/     directory to contain various writable directories
          adm/      administrative information
                    acct/*   system accounting data files
                    sulog    log of the invocations of the su(1) command
          mail/*    the directory where mail messages are stored
          news/*    the directory where news items are stored
          preserve/ editor temporaries preserved here after crashes/hangups
          spool/    delayed execution files
                    at/      used by at(1)
                    uucp/    work files and staging area for uucp(1)
                             LOGFILE  summary log
                             LOG.*    log file for one transaction
          tmp/      directory to avoid writing temporary files to /usr
```

SEE ALSO

find(1), grep(1), ls(1) in the *User's Reference for the DG/UX System*.

CAUTION

The position of files is subject to change without notice.

NAME

hostname – hostname resolution description

DESCRIPTION

Hostnames are expressed as domain names, where a domain name is a hierarchical, dot-separated list of labels; for example, the machine `abc`, in the `de` subdomain of the `COM` subdomain would be represented as `abc.de.COM` (with no trailing dot).

A label consists of up to 24 characters drawn from the lowercase alphabet (a-z), uppercase alphabet (A-Z), digits (0-9), and minus sign (-). You cannot include blank or space characters in a label. No distinction is made between upper and lower case.

Hostnames are often used with network client and server programs, which must generally translate the name to an address for use. (This translation is generally performed by the library routine `gethostbyname`(3N).) Hostnames are resolved by the domain name resolver in the following way.

If the hostname consists of a single component, that is, contains no dot, and if the environment variable `HOSTALIASES` is set to the name of a file, that file is searched for a string matching the hostname. The file should consist of lines made up of two strings separated by white space, the first of which is the hostname alias, and the second of which is the complete hostname to be substituted for that alias. If a case-sensitive match is found between the hostname to be resolved and the first field of a line in the file, the substituted name is looked up with no further processing.

If the input hostname ends with a trailing dot, the trailing dot is removed, and the remaining hostname is looked up with no further processing. A hostname that ends with a trailing dot is called a "fully-qualified" hostname.

If the input hostname does not end with a trailing dot, it is looked up in the local domain and its parent domains until either a match is found or fewer than two components of the local domain remain. For example, in the domain `tnt.acme.COM`, the name `spectre.bucky` will be checked first as `spectre.bucky.tnt.acme.COM`, then as `spectre.bucky.acme.COM`, then as `spectre.bucky.COM`, and then as `spectre.bucky`.

If you use the Domain Name System (DNS) you must either 1) set the default domain in `resolv.conf`(4) and use hostnames that consist of a single component or 2) consistently use fully-qualified hostnames.

SEE ALSO

`named`(1M), `gethostbyname`(3N), `resolv.conf`(4), RFC883.

NAME

`langinfo` – language information constants

SYNOPSIS

```
#include <langinfo.h>
```

DESCRIPTION

This header file contains the constants used to identify items of langinfo data. The mode of *items* is given in `nl_types`.

`DAY_1`	Locale's equivalent of 'sunday'
`DAY_2`	Locale's equivalent of 'monday'
`DAY_3`	Locale's equivalent of 'tuesday'
`DAY_4`	Locale's equivalent of 'wednesday'
`DAY_5`	Locale's equivalent of 'thursday'
`DAY_6`	Locale's equivalent of 'friday'
`DAY_7`	Locale's equivalent of 'saturday'
`ABDAY_1`	Locale's equivalent of 'sun'
`ABDAY_2`	Locale's equivalent of 'mon'
`ABDAY_3`	Locale's equivalent of 'tue'
`ABDAY_4`	Locale's equivalent of 'wed'
`ABDAY_5`	Locale's equivalent of 'thur'
`ABDAY_6`	Locale's equivalent of 'fri'
`ABDAY_7`	Locale's equivalent of 'sat'
`MON_1`	Locale's equivalent of 'january'
`MON_2`	Locale's equivalent of 'febuary'
`MON_3`	Locale's equivalent of 'march'
`MON_4`	Locale's equivalent of 'april'
`MON_5`	Locale's equivalent of 'may'
`MON_6`	Locale's equivalent of 'june'
`MON_7`	Locale's equivalent of 'july'
`MON_8`	Locale's equivalent of 'august'
`MON_9`	Locale's equivalent of 'september'
`MON_10`	Locale's equivalent of 'october'
`MON_11`	Locale's equivalent of 'november'
`MON_12`	Locale's equivalent of 'december'
`ABMON_1`	Locale's equivalent of 'jan'
`ABMON_2`	Locale's equivalent of 'feb'
`ABMON_3`	Locale's equivalent of 'mar'
`ABMON_4`	Locale's equivalent of 'apr'
`ABMON_5`	Locale's equivalent of 'may'

ABMON_6	Locale's equivalent of 'jun'
ABMON_7	Locale's equivalent of 'jul'
ABMON_8	Locale's equivalent of 'aug'
ABMON_9	Locale's equivalent of 'sep'
ABMON_10	Locale's equivalent of 'oct'
ABMON_11	Locale's equivalent of 'nov'
ABMON_12	Locale's equivalent of 'dec'
RADIXCHAR	Locale's equivalent of '.'
THOUSEP	Locale's equivalent of ','
YESSTR	Locale's equivalent of 'yes'
NOSTR	Locale's equivalent of 'no'
CRNCYSTR	Locale's currency symbol
D_T_FMT	Locale's default format for date and time
D_FMT	Locale's default format for the date
T_FMT	Locale's default format for the time
AM_STR	Locale's equivalent of 'AM'
PM_STR	Locale's equivalent of 'PM'

This information is retrived by `nl_langinfo`.

The items `CRNCYSTR`, `RADIXCHAR` and `THOUSEP` are extracted from the fields `currency_symbol`, `decimal_point` and `thousands_sep` in the structure returned by `localeconv`.

The items `T_FMT`, `D_FMT`, `D_T_FMT`, `YESSTR` and `NOSTR` are retrived from a special message catalog named `Xopen_info` which should be generated for each locale supported and installed in the appropriate directory [see `gettxt`(3C) and `mkmsgs`(1)]. This catalog should have the messages in the order `T_FMT`, `D_FMT`, `D_T_FMT`, `YESSTR` and `NOSTR`.

All other items are as returned by `strftime`.

SEE ALSO

`chrtbl`(1M), `mkmsgs`(1), `gettxt`(3C), `localeconv`(3C), `nl_langinfo`(3C), `strftime`(3C), `strftime`(4), `nl_types`(5).

NAME

`legend` – Debugging information technology

DESCRIPTION

Legend debugging information (or legends for short) is used by the `sdb`(1) and `dbx`(1) debuggers when debugging an ELF executable and always used by the `mxdb`(1) debugger. It is created during compilation typically by `as`(1) which calls the `ctl`(1) translator.

Traditional UNIX compilation systems control debugging information by the use of a `-g` option. If the `-g` option is present on the compiler command line (e.g. "cc -g") then debugging information is generated. Legend technology provides a number of options that can't be coded into a single yes or no option but many existing applications have makefiles and shell scripts that users don't want to modify. The legend options, therefore, are controlled by an environment variable called LEGENDS.

OPTIONS

The following values can be placed in the LEGENDS environment variable, separated by blanks, to control the generation of legends.

`-external`
: Store the legend data in a separate file. If the target file is named "prog.o", then the legend will be stored in a file named "prog.lg". This reduces the size of object files, libraries and executables, significantly saving link time as well as disk space.

`-no-external`
: Store legend data in the object file. This is the default.

`-compress`
: Legends come in two forms that allow you to make a speed/space trade-off. If present, this option requests that legends be generated in a compressed form. You can mix compressed and uncompressed legends into the same application.

`-no-compress`
: Don't compress the legend. This is the default.

`-keep-std`
: This option only makes sense when creating a COFF object file. If present, it directs the legend translator to preserve the COFF information in addition to generating a legend. This allows the use of COFF debuggers in addition to `mxdb`(1) on resulting executables. By default the COFF information is deleted.

`-no-keep-std`
: Don't preserve COFF information. This is the default.

`-v` Print the version of ctl to stderr.

`-warn` Print warning messages. They are suppressed by default.

SEE ALSO

`ctl`(1), `cc`(1), `gcc`(1), `ghcc`(1), `ghf77`(1), `ghpc`(1), `as`(1), `mxdb`(1), `sdb`(1), `dbx`(1)

NAME

math – math functions and constants

SYNOPSIS

```
#include <math.h>
```

DESCRIPTION

This file contains declarations of all the functions in the Math Library (described in Section 3M), as well as various functions in the C Library (Section 3C) that return floating-point values.

It defines the structure and constants used by the matherr(3M) error-handling mechanisms, including the following constant used as a error-return value:

HUGE	The maximum value of a single-precision floating-point number.

The following mathematical constants are defined for user convenience:

M_E	The base of natural logarithms (e).
M_LOG2E	The base-2 logarithm of e.
M_LOG10E	The base-10 logarithm of e.
M_LN2	The natural logarithm of 2.
M_LN10	The natural logarithm of 10.
M_PI	π, the ratio of the circumference of a circle to its diameter.
M_PI_2	$\pi/2$.
M_PI_4	$\pi/4$.
M_1_PI	$1/\pi$.
M_2_PI	$2/\pi$.
M_2_SQRTPI	$2/\sqrt{\pi}$.
M_SQRT2	The positive square root of 2.
M_SQRT1_2	The positive square root of 1/2.

The following mathematical constants are also defined in this header file:

MAXFLOAT	The maximum value of a non-infinite single-precision floating point number.
HUGE_VAL	positive infinity.

For the definitions of various machine-dependent constants, see values(5).

SEE ALSO

intro(3), matherr(3M), values(5).

NAME

`misalign` – handle misaligned memory access faults

DESCRIPTION

The Motorola M88000 microprocessor family, on which the Data General AViiON computers are based, requires that data be aligned in memory to their lengths. If the address of a datum is not an integral multiple of the datum's length, a reference to the datum will cause a misaligned access fault. For example, if a program attempts to fetch a 16-bit value from an odd address, a misaligned access fault occurs. A misaligned access fault results in the delivery of a SIGBUS signal to the application. If the application has not defined a SIGBUS signal handler, the application terminates with a "Bus error" message.

A program can use the facilities defined herein to repair misaligned access faults that it incurs. These facilities can be useful in porting applications that were written for computers that don't impose alignment restrictions as strict as those of the M88000 family. The facilities are offered in three forms, for generality and convenience:

- functions to repair misaligned access faults with which you can construct your own SIGBUS signal handler
- predefined SIGBUS signal handlers that are built from the repair functions mentioned above
- a link-time mechanism to have one of the predefined SIGBUS signal handlers installed automatically when your program runs

To use these facilities in any of the three forms you must specify the misalignment handling library, `libmisalign.a`, to the linker. To do this you can simply include `-lmisalign` on the `cc` or `ld` command line. If you use the `ld` command, be sure to specify the misalignment handling library before specifying `libc`, as with `-lc`.

If your program does not care to handle SIGBUS signals other than those representing misaligned access faults, you can simply specify `-u misalign.auto_install` to the linker before specifying the misalignment handling library. With such a specification, a SIGBUS handler that catches SIGBUS signals and repairs misaligned access faults will be installed automatically when your program runs. You do not need to modify your original program to use misalignment handling in this way.

If your program does not care to handle SIGBUS signals other than those representing misaligned access faults but does want to establish signal handlers explicitly, you can use the predefined signal handlers `misalignment_sigbus_handler_ocs1` and `misalignment_sigbus_handler_abi1`. These signal handlers catch SIGBUS signals and repair misaligned access faults in the same way; they differ only in the target environments for which they are appropriate. If you establish the signal handler in a COFF environment (such as `m88kbcs`, `m88kocs`, or `m88kdguxcoff`), use `misalignment_sigbus_handler_ocs1`. If you establish the signal handler in an ELF environment (such as `m88kdguxelf`), use `misalignment_sigbus_handler_abi1`.

If a predefined signal handler catches a SIGBUS signal that does not represent a misaligned access fault, or if it cannot repair a misaligned access fault for any reason, it aborts the program by sending a SIGBUS signal to its own process using the `kill()` function. This same failure response occurs when `-u misalign.auto_install` is used, because one of the predefined handlers is installed automatically in that case.

If the failure treatment of the predefined handlers is inappropriate for your program, or if you want to handle SIGBUS signals other than those representing misaligned access faults, you can use the functions `repair_misalignment_ocs1` and

`repair_misalignment_abi1`. These functions attempt to repair misaligned access faults and indicate their success or failure. You can call one of these functions from your program's SIGBUS signal handler, then take other appropriate action in the case of failure. The two functions act the same; they differ only in their argument lists and the target environments for which they are appropriate.
`repair_misalignment_ocs1` takes two arguments, the same arguments received by a signal handler that was established in a COFF environment.
`repair_misalignment_abi1` takes three arguments, the same arguments received by a signal handler that was established in an ELF environment by a call to `sigaction`(2) with the `SA_SIGINFO` flag set.

The repair functions return an integer whose value indicates whether the repair was successful. If the return value is negative, the repair failed; otherwise, it succeeded. Furthermore, if the return value is zero, the site of the misaligned access fault was patched so that future faults will not occur; if the return value is positive, patching was not possible.

The remainder of this description applies to repair of misaligned access faults by any of the three forms described above (automatic installation of predefined handler, explicit installation of predefined handler, or direct use of repair function). The common facilities are referred to collectively as "misalignment handling."

Misalignment handling can not only emulate the faulting memory access but also patch the faulting instruction so that future faults will not occur. Patching can greatly speed up an application that suffers misaligned access faults. Note, however, that patching renders your program's text area less sharable. Pages that contain faulting instructions that are patched become private to your process.

If a faulting instruction appears to be in a delay slot (that is, the instruction appears to follow a flow control instruction with delayed branching selected), it is assumed that the instruction is indeed in a delay slot, and instructions are generated to patch the flow control instruction as well as the faulting instruction. Patching an instruction in a delay slot requires more instructions. If the resulting performance of your program is inadequate due to a large number of misaligned access faults, you may wish to instruct the compiler not to perform delay slot optimization. For `gcc`, use the `-fno-delayed-branch` option. For `cc`, use the `-W0,-fno-delayed-branch` option. For Green Hills compilers, use the `-X307` option.

Three M88000 instructions can incur misaligned access faults: `ld`, `st`, and `xmem`. Misalignment handling handles all three instructions, but cannot maintain atomicity in most cases because the access must be done in pieces. The loss of atomicity is generally not important except for `xmem`, which is not typically generated by compilers.

You can control the behavior of misalignment handling by including an options file among the object files presented to the linker. The file `misalign-options.c` is provided as a prototype from which you can create your own version. The following table shows what behaviors the options file controls and what the defaults are when no options file is present. See the commentary in the prototype options file for complete information.

Behavior	Default
Whether to patch	yes
Whether to patch in delay slots	yes
What registers to treat as scratch	r26 through r29
How much bss area to preallocate	none
How to abort on failure	send SIGBUS signal to self

EXAMPLE

The following `gcc` command compiles a program for debugging with `mxdb`(1) and links it with misalignment handling.

```
gcc -g -mlegend -o example example.c -u misalign.auto_install -lmisalign
```

`Mxdb` can be used to determine where misaligned accesses occur. The following shell script produces a backtrace of the stack on each misaligned access. It then continues the program which allows misalignment handling to fix the access.

```
mxdb example <<EOF

  ,, Do a walkback on each SIGBUS.

  signal, catch bus,  \
          action  {  \
                  new-line;  \
                  write MISALIGNED ACCESS;  \
                  walkback, arg, locals;  \
                  continue  \
                  }

  continue          ,, Start the program.
  bye               ,, Quit when it is done.

EOF
```

The backslashes shown above are necessary.

If you use the above approach with patching enabled (the default), you should note two things. First, warnings of the following form may result but can be ignored:

```
Warning: instruction 00000000 not yet supported, ignored
```

Second, misaligned access faults can occur in the patch code sequences themselves. You need not worry about these faults, because in these cases the original faulting instruction is "repatched."

SEE ALSO

`mxdb`(1), `sigaction`(2), `kill`(2), `sde`(5),
Using the Multi-Extensible Debugger (Mxdb for DG/UX and 386/ix Systems),
88open Binary Compatibility Standard,
88open Object Compatibility Standard,
MC88100 RISC Microprocessor User's Manual.

NAME

nl_types – native language data types

SYNOPSIS

```
#include <nl_types.h>
```

DESCRIPTION

This header file contains the following definitions that relate to the X/open-sytle message facility:

nl_catd	used by the message catalog functions catopen, catgets and catclose to identify a catalogue
nl_item	used by nl_langinfo to identify items of langinfo data. Values for objects of type nl_item are defined in langinfo.h.
NL_SETD	used by gencat when no $set directive is specified in a message text source file. This constant can be used in subsequent calls to catgets as the value of the set identifier parameter.
NL_MGSMAX	maximum number of messages per set
NL_SETMAX	maximum number of sets per catalogue.
NL_TEXTMAX	maximum size of a message in bytes. " 41" counts as one byte; a multibyte character counts as more than one byte.
DEF_NLSPATH	the default search path for locating catalogues.

SEE ALSO

gencat(1M), catgets(3C), catopen(3C), nl_langinfo(3C), langinfo(5). mkmsgs(1), gettxt(3C) — AT&T-style message facilty.

NAME

printcap – printer capability data base

SYNOPSIS

/etc/printcap

DESCRIPTION

Printcap is a simplified version of the termcap(5) data base used to describe line printers. The spooling system accesses the printcap file every time it is used, allowing dynamic addition and deletion of printers. Each entry in the data base is used to describe one printer. This data base may not be substituted for, as is possible for termcap, because it may allow accounting to be bypassed.

The default printer is normally lp, though the environment variable PRINTER may be used to override this. Each spooling utility supports an option, -P*printer*, to allow explicit naming of a destination printer.

Capabilities

Refer to termcap(5) for a description of the file layout.

Name	Type	Default	Description
af	str	NULL	name of accounting file
br	num	none	if lp is a tty, set baud rate (ioctl call)
cf	str	NULL	cifplot data filter
df	str	NULL	tex data filter (DVI format)
fc	num	0	if lp is a tty, clear flag bits (sgtty.h)
ff	str	"\f"	string to send for a form feed
fo	bool	false	print a form feed when device is opened
fs	num	0	like "fc" but set bits
gf	str	NULL	graph data filter (plot (3X) format)
hl	bool	false	print the burst header page last
ic	bool	false	driver supports nonstandard ioctl to indent printout
if	str	NULL	name of text filter which does accounting
lf	str	"/dev/console"	error logging file name
lo	str	"lock"	name of lock file
lp	str	"/dev/lp"	device name to open for output
mx	num	1000	maximum file size (in BUFSIZ blocks), 0 = unlimited
nd	str	NULL	next directory for list of queues (unimplemented)
nf	str	NULL	ditroff data filter (device independent troff)
of	str	NULL	name of output filtering program
pc	num	200	price per foot or page in hundredths of cents
pl	num	66	page length (in lines)
pw	num	132	page width (in characters)
px	num	0	page width in pixels (horizontal)
py	num	0	page length in pixels (vertical)
rf	str	NULL	filter for printing FORTRAN style text files
rg	str	NULL	restricted group; only group members can access
rm	str	NULL	machine name for remote printer
rp	str	"lp"	remote printer name argument
rs	bool	false	restrict remote users to those with local accounts
rw	bool	false	open the printer device for reading and writing
sb	bool	false	short banner (one line only)
sc	bool	false	suppress multiple copies
sd	str	"/usr/spool/lpd"	spool directory
sf	bool	false	suppress form feeds

sh	bool	false	suppress printing of burst page header
st	str	"status"	status file name
tf	str	NULL	troff data filter (cat phototypesetter)
tr	str	NULL	trailer string to print when queue empties
vf	str	NULL	raster image filter
xc	num	0	if lp is a tty, clear local mode bits [tty(4)]
xs	num	0	like "xc" but set bits

If the local line printer driver supports indentation, the server must understand how to invoke it.

Filters

The `lpd`(1M) server creates a pipeline of *filters* to process files for various printer types. The filters selected depend on the flags passed to `lpr`(1). The pipeline set up is:

-p	pr | if	regular text + *pr*(1)
none	if	regular text

The `if` filter is invoked with arguments:

if [`-c`] `-w`width `-l`length `-i`indent `-n` login `-h` host acct-file

The `-c` flag is passed only if the `-l` flag (pass control characters literally) is specified to *lpr*. *Width* and *length* specify the page width and length (from `pw` and `pl` respectively) in characters. The `-n` and `-h` parameters specify the login name and host name of the owner of the job respectively. *Acct-file* is passed from the `af` *printcap* entry.

If no `if` is specified, `of` is used instead, with the distinction that `of` is opened only once, while `if` is opened for every individual job. Thus, `if` is better suited to performing accounting. The `of` is only given the *width* and *length* flags.

All other filters are called as:

filter `-x`*width* `-y`*length* `-n` *login* `-h` *host acct-file*

where *width* and *length* are represented in pixels, specified by the `px` and `py` entries respectively.

All filters take *stdin* as the file, *stdout* as the printer, may log either to *stderr* or using `syslog`(3), and must not ignore SIGINT.

Logging

Error messages generated by the line printer programs themselves (that is, the *lp** programs) are logged by `syslog`(3) using the *LPR* facility. Messages printed on *stderr* of one of the filters are sent to the corresponding `lf` file. The filters may, of course, use *syslog* themselves.

Error messages sent to the console have a carriage return and a line feed appended to them, rather than just a line feed.

SEE ALSO

`lpc`(1M), `lpd`(1M), `lpq`(1), `lpr`(1), `lprm`(1), `termcap`(5).

NAME

prof – profile within a function

SYNOPSIS

```
#define MARK
#include <prof.h>

void MARK (name);
```

DESCRIPTION

MARK introduces a mark called *name* that is treated the same as a function entry point. Execution of the mark adds to a counter for that mark, and program-counter time spent is accounted to the immediately preceding mark or to the function if there are no preceding marks within the active function.

name may be any combination of letters, numbers, or underscores. Each *name* in a single compilation must be unique, but may be the same as any ordinary program symbol.

For marks to be effective, the symbol MARK must be defined before the header file prof.h is included, either by a preprocessor directive as in the synopsis, or by a command line argument:

```
cc -p -DMARK foo.c
```

If MARK is not defined, the MARK(*name*) statements may be left in the source files containing them and are ignored. prof -g must be used to get information on all labels.

EXAMPLE

In this example, marks can be used to determine how much time is spent in each loop. Unless this example is compiled with MARK defined on the command line, the marks are ignored.

```
#include <prof.h>
foo( )
{
        int i, j;
        . . .
        MARK(loop1);
        for (i = 0; i < 2000; i++) {
                . . .
        }
        MARK(loop2);
        for (j = 0; j < 2000; j++) {
                . . .
        }
}
```

SEE ALSO

prof(1), profil(2), monitor(3C).

NAME

regexp: compile, step, advance – regular expression compile and match routines

SYNOPSIS

```
#define INIT declarations
#define GETC(void) getc code
#define PEEKC(void) peekc code
#define UNGETC(void) ungetc code
#define RETURN(ptr) return code
#define ERROR(val) error code

#include <regexp.h>

char *compile(char *instring, char *expbuf, char *endbuf, int eof);

int step(char *string, char *expbuf);

int advance(char *string, char *expbuf);

extern char *loc1, *loc2, *locs;
```

DESCRIPTION

These functions are general purpose regular expression matching routines to be used in programs that perform regular expression matching. These functions are defined by the `<regexp.h>` header file.

The functions `step` and `advance` do pattern matching given a character string and a compiled regular expression as input.

The function `compile` takes as input a regular expression as defined below and produces a compiled expression that can be used with `step` or `advance`.

A regular expression specifies a set of character strings. A member of this set of strings is said to be matched by the regular expression. Some characters have special meaning when used in a regular expression; other characters stand for themselves.

The regular expressions available for use with the regexp functions are constructed as follows:

Expression	*Meaning*
c	the character *c* where *c* is not a special character.
c	the character *c* where *c* is any character, except a digit in the range `1-9`.
^	the beginning of the line being compared.
$	the end of the line being compared.
.	any character in the input.
[*s*]	any character in the set *s*, where *s* is a sequence of characters and/or a range of characters, *e.g.*, `[c-c]`.
[^*s*]	any character not in the set *s*, where *s* is defined as above.
*r**	zero or more successive occurrences of the regular expression *r*. The longest leftmost match is chosen.
rx	the occurrence of regular expression *r* followed by the occurrence of regular expression *x*. (Concatenation)
r\{*m*,*n*\}	any number of *m* through *n* successive occurrences of the regular expression *r*. The regular expression *r*\{*m*\} matches exactly *m* occurrences;

r\{*m*,\} matches at least *m* occurrences.

\(*r*\) the regular expression *r*. When *n* (where *n* is a number greater than zero) appears in a constructed regular expression, it stands for the regular expression *x* where *x* is the n^{th} regular expression enclosed in \(and \) that appeared earlier in the constructed regular expression. For example, \(*r*\)*x*\(*y*\)*z*\2 is the concatenation of regular expressions *rxyzy*.

Characters that have special meaning except when they appear within square brackets ([ ]) or are preceded by \ are: ., *, [, \. Other special characters, such as $ have special meaning in more restricted contexts.

The character ^ at the beginning of an expression permits a successful match only immediately after a newline, and the character $ at the end of an expression requires a trailing newline.

Two characters have special meaning only when used within square brackets. The character - denotes a range, [*c*-*c*], unless it is just after the open bracket or before the closing bracket, [-*c*] or [*c*-] in which case it has no special meaning. When used within brackets, the character ^ has the meaning *complement of* if it immediately follows the open bracket (example: [^*c*]); elsewhere between brackets (example: [*c*^]) it stands for the ordinary character ^.

The special meaning of the \ operator can be escaped only by preceding it with another \, *e.g.* \\.

Programs must have the following five macros declared before the `#include <regexp.h>` statement. These macros are used by the `compile` routine. The macros `GETC`, `PEEKC`, and `UNGETC` operate on the regular expression given as input to `compile`. *NOTE:* If any of the macros below consist of more than 1 statement, then they should be surrounded with curly braces ({, }) or unexpected results will occur.

`GETC` This macro returns the value of the next character (byte) in the regular expression pattern. Successive calls to `GETC` should return successive characters of the regular expression.

`PEEKC` This macro returns the next character (byte) in the regular expression. Immediately successive calls to `PEEKC` should return the same character, which should also be the next character returned by `GETC`.

`UNGETC` This macro causes the argument `c` to be returned by the next call to `GETC` and `PEEKC`. No more than one character of pushback is ever needed and this character is guaranteed to be the last character read by `GETC`. The return value of the macro `UNGETC(c)` is always ignored.

`RETURN(`*ptr*`)` This macro is used on normal exit of the `compile` routine. The value of the argument *ptr* is a pointer to the character after the last character of the compiled regular expression. This is useful to programs which have memory allocation to manage.

`ERROR(`*val*`)` This macro is the abnormal return from the `compile` routine. The argument *val* is an error number [see ERRORS below for meanings]. This call should never return.

The syntax of the `compile` routine is as follows:

`compile(`*instring, expbuf, endbuf, eof*`)`

The first parameter, *instring*, is never used explicitly by the `compile` routine but is useful for programs that pass down different pointers to input characters. It is sometimes used in the `INIT` declaration (see below). Programs which call functions to input characters or have characters in an external array can pass down a value of `(char *)0` for this parameter.

The next parameter, *expbuf*, is a character pointer. It points to the place where the compiled regular expression will be placed.

The parameter *endbuf* is one more than the highest address where the compiled regular expression may be placed. If the compiled expression cannot fit in `(endbuf-expbuf)` bytes, a call to `ERROR(50)` is made.

The parameter *eof* is the character which marks the end of the regular expression. This character is usually a `/`.

Each program that includes the `<regexp.h>` header file must have a `#define` statement for `INIT`. It is used for dependent declarations and initializations. Most often it is used to set a register variable to point to the beginning of the regular expression so that this register variable can be used in the declarations for `GETC`, `PEEKC`, and `UNGETC`. Otherwise it can be used to declare external variables that might be used by `GETC`, `PEEKC` and `UNGETC`. [See EXAMPLE below.]

The first parameter to the `step` and `advance` functions is a pointer to a string of characters to be checked for a match. This string should be null terminated.

The second parameter, *expbuf*, is the compiled regular expression which was obtained by a call to the function `compile`.

The function `step` returns non-zero if some substring of *string* matches the regular expression in *expbuf* and zero if there is no match. If there is a match, two external character pointers are set as a side effect to the call to `step`. The variable `loc1` points to the first character that matched the regular expression; the variable `loc2` points to the character after the last character that matches the regular expression. Thus if the regular expression matches the entire input string, `loc1` will point to the first character of *string* and `loc2` will point to the null at the end of *string*.

The function `advance` returns non-zero if the initial substring of *string* matches the regular expression in *expbuf*. If there is a match, an external character pointer, `loc2`, is set as a side effect. The variable `loc2` points to the next character in *string* after the last character that matched.

When `advance` encounters a `*` or `\{ \}` sequence in the regular expression, it will advance its pointer to the string to be matched as far as possible and will recursively call itself trying to match the rest of the string to the rest of the regular expression. As long as there is no match, `advance` will back up along the string until it finds a match or reaches the point in the string that initially matched the `*` or `\{ \}`. It is sometimes desirable to stop this backing up before the initial point in the string is reached. If the external character pointer `locs` is equal to the point in the string at sometime during the backing up process, `advance` will break out of the loop that backs up and will return zero.

The external variables `circf`, `sed`, and `nbra` are reserved.

DIAGNOSTICS

The function `compile` uses the macro `RETURN` on success and the macro `ERROR` on failure (see above). The functions `step` and `advance` return non-zero on a successful match and zero if there is no match. Errors are:

11 range endpoint too large.

16 bad number.

25 \ *digit* out of range.

36 illegal or missing delimiter.

41 no remembered search string.

42 \(\) imbalance.

43 too many \(.

44 more than 2 numbers given in \{ \}.

45 } expected after \.

46 first number exceeds second in \{ \}.

49 [ ] imbalance.

50 regular expression overflow.

EXAMPLE

The following is an example of how the regular expression macros and calls might be defined by an application program:

```
#define INIT         register char *sp = instring;
#define GETC        (*sp++)
#define PEEKC       (*sp)
#define UNGETC(c)    (--sp)
#define RETURN(*c)    return;
#define ERROR(c)     regerr

#include <regexp.h>

 . . .
     (void) compile(*argv, expbuf, &expbuf[ESIZE],'\0');
 . . .
     if (step(linebuf, expbuf))
                       succeed;
```

SEE ALSO

regcmp(1), regcmp(3X).

NAME

sde – software development environment

DESCRIPTION

A *software development environment* (SDE) is a set of tools, libraries and system definitions that are specifically designed to work together to build an application that has certain qualities.

The environments provided in the DG/UX 5.4 release are:

`m88kdguxelf` Used to create ELF objects and executables that make use of full DG/UX 5.4 release features.

`m88kocs` Used for creating COFF objects and executables that can be linked and run on other vendors' 88open OCS- (and BCS-) conforming platforms.

`m88kbcs` Differs from the `m88kocs` because it allows the use of certain features (such as Berkeley signals) and optimizations (such as the macro implementation of `getc`) that are prohibited from the OCS environment. (This is unchanged from the DG/UX 4.3x release.)

`m88kdguxcoff` Used to create COFF objects and executables that make use of DG/UX 4.3x level features. This option is interesting to software developers who have COFF-dependent tools, such as third-party debuggers, that they want to use on the DG/UX 5.4 release. (This is the same as `m88kdgux` on 4.3x.)

`m88kdgux` The default for all past and future revisions. It refers to the largest feature set supported by the DG/UX system. In the DG/UX 5.4 release this is equal to `m88kdguxelf`.

The following table shows the domain of certain standards across the different environments. "Yes" means the environment conforms to that standard.

	BCS	OCS	POSIX	SVID/2	SVID/3	XPG/3	ANSI C
`m88kdguxelf`	No	No	Yes	No	Yes	Yes	Yes
`m88kocs`	Yes	Yes	Yes	Yes	No	No	Yes
`m88kbcs`	Yes	No	Yes	Yes	No	No	Yes
`m88kdguxcoff`	No	No	Yes	Yes	No	No	Yes

Support for multiple development environments is handled by the `sde-target`(1) mechanism. It allows you to specify the development environment that is appropriate for your needs, while other users (or you in another context) may be using a different development environment at the same time. You select your environment by setting the environment variable `TARGET_BINARY_INTERFACE` to one of the environment names listed above. The command `sde-target`(1) provides a convenient way to set that variable. (Note that the variable name has changed from `SDE_TARGET` in the DG/UX 4.3x release. The name was changed because additional variables that control the "sde target" in ways other than the binary interface are likely to be introduced in the future. The `sde-target` command will not change, but it might set multiple variables in the future.)

The environment variable set by `sde-target`(1) is used in two contexts. When you invoke a software development tool such as `/bin/cc` or `/bin/ld`, you are actually calling a small program that calls `sde-chooser`(1), which checks the environment variable and invokes the appropriate target-specific tool. Secondly, tools that read libraries, such as `ld`(1), use the `elink`(5) mechanism, which uses the environment

variable to find the appropriate system libraries.

The commands, libraries, and other files that support a specific environment are placed in the directory /usr/sde/<*s*>, where <*s*> is the value of the environment variable TARGET_BINARY_INTERFACE. If TARGET_BINARY_INTERFACE is not set, the default (m88kdgux) is used.

Different environments need different header information at compile time. The DG/UX system has one set of include files that are customized by the use of conditional preprocessing under the control of target-specific macro names. The C compiler commands cc(1), gcc(1), and ghcc(1) predefine the following macro names according to the value of TARGET_BINARY_INTERFACE. (If you use another C compiler, you will need to do this manually with a -D option.)

sde target	Target Macro Name
m88kdguxelf	_DGUX_TARGET
m88kocs	_M88KOCS_TARGET
m88kbcs	_M88KBCS_TARGET
m88kdguxcoff	_DGUXCOFF_TARGET

The above mechanism using sde-chooser and elinks was chosen over a more "traditional" method of using the PATH environment variable to find the right tools because many sources that people maintain, such as make files and shell scripts, contain fully specified path names. Such references would ignore the path specification and perhaps invoke the wrong tool or read the wrong library.

SEE ALSO

sde-target(1), sde-chooser(1), sdetab(4), elink(5).

NAME

siginfo – signal generation information

SYNOPSIS

```
#include <signal.h>
```

or

```
#include <sys/siginfo.h>
```

DESCRIPTION

When a process has caught a signal, it may have access to additional information describing why the system generated the signal. This information may be passed as an argument to the invoked signal handler, depending upon the system call that was used to establish the handler and current software development environment [see sde-target(1)].

There are two versions of the signal information structure, `struct siginfo`, which is defined in `signal.h` and `siginfo_t` which is defined in `sys/signal.h`.

If an application is compiled with the software development environment set to `m88kdgux` or `m88kdguxelf`, then the `siginfo_t` style of signal information may be reported to the signal handler. This information will be reported if `sigaction`(2) was used to establish the signal handler and the `SA_SIGINFO` bit is set in the signal action structure at the time the call was made [see `sigaction`(2)]. In this case, an object of type `siginfo_t` will be passed as the second argument to the invoking signal handler, and also an object of type `ucontext_t` will be sent as the third argument [see `sys/ucontext.h`]. The fields of the `siginfo_t` structure are discussed in more detail below.

If, however, an application is compiled with the software development environment set to `m88kbcs`, `m88kocs`, or `m88kcoff` then the first argument available to the handler will be the caught signal number and an object of type `struct siginfo` will always be available as the second argument.

In addition, if a process is monitoring its children, it may receive information that tells why a child changed state [see `waitid`(2)]. In either case, the system returns the information in a structure of type `siginfo_t`, which includes the following information:

```
int si_signo    /* signal number */
int si_errno    /* error number */
int si_code     /* signal code */
```

`si_signo` contains the system-generated signal number. (For the `waitid`(2) function, `si_signo` is always `SIGCHLD`.)

If `si_errno` is non-zero, it contains an error number associated with this signal, as defined in `errno.h`.

`si_code` contains a code identifying the cause of the signal. If the value of `si_code` is less than or equal to 0, then the signal was generated by a user process [see `kill`(2) and `sigsend`(2)] and the `siginfo` structure contains the following additional information:

```
pid_t si_pid    /* sending process ID */
uid_t si_uid    /* sending user ID */
```

Otherwise, `si_code` contains a signal-specific reason why the signal was generated, as follows:

Signal	Code	Reason
SIGILL	ILL_ILLOPC	illegal opcode
	ILL_ILLOPN	illegal operation number
	ILL_ILLADR	illegal address
	ILL_ILLTRP	illegal trap
	ILL_PRVOPC	privileged opcode
	ILL_PRVREG	privileged register
	ILL_COPROC	
	ILL_BADSTK	bad stack
SIGFPE	FPE_INTDIV	integer divide by zero
	FPE_INTOVF	integer overflow
	FPE_FLTDIV	floating point divide by zero
	FPE_FLTOVF	floating point overflow
	FPE_FLTUND	floating point underflow
	FPE_FLTRES	floating point inexact result
	FPE_FLTINV	invalid floating point operation
	FPE_FLTSUB	subscript out of range
SIGSEGV	SEGV_MAPERR	address not mapped to object
	SEGV_ACCERR	invalid permissions for mapped object
SIGBUS	BUS_ADRALN	invalid address alignment
	BUS_ADRERR	address error
	BUS_OBJERR	object error
SIGTRAP	TRAP_BRKPT	process breakpoint
	TRAP_TRACE	process trace trap
SIGCHLD	CLD_EXITED	child has exited
	CLD_KILLED	child was killed
	CLD_DUMPED	child terminated abnormally
	CLD_TRAPPED	traced child has trapped
	CLD_STOPPED	child has stopped
	CLD_CONTINUED	stopped child had continued
SIGPOLL	POLL_IN	data input available
	POLL_OUT	output buffers available
	POLL_MSG	input message available
	POLL_ERR	I/O error
	POLL_PRI	high priority input available
	POLL_HUP	device disconnected

In addition, the following signal-dependent information is available for kernel-generated signals:

Signal	Field	Value	Comment
SIGILL SIGFPE	caddr_t	si_addr	address of faulting instruction
SIGSEGV SIGBUS	caddr_t	si_addr	address of faulting memory reference
SIGCHLD	pid_t int	si_pid si_status	child process ID exit value or signal
SIGPOLL	long	si_band	band event for POLL_IN, POLL_OUT, or POLL_MSG

SEE ALSO

sde-target(1), sigaction(2), waitid(2), signal(5).

NOTES

For SIGCHLD signals, if si_code is equal to CLD_EXITED, then si_status is equal to the exit value of the process; otherwise, it is equal to the signal that caused the process to change state.

NAME

signal – base signals

SYNOPSIS

```
#include <signal.h>
```

DESCRIPTION

A signal is an asynchronous notification of an event. A signal is said to be generated for a process when the event associated with that signal first occurs. Examples of such events include hardware faults, timer expiration and terminal activity, as well as the invocation of the `kill`, `sigsend`, or `sigsendset` system calls. In some circumstances, the same event generates signals for multiple processes. A process may request a detailed notification of the source of the signal and the reason why it was generated [see `siginfo`(5)].

A signal is said to be delivered to a process when the appropriate action for the process and signal is taken. During the time between the generation of a signal and its delivery, the signal is said to be pending [see `sigpending`(2)]. Ordinarily, this interval cannot be detected by an application. However, a signal can be blocked from delivery to a process [see `signal`(2) and `sigprocmask`(2)]. If the action associated with a blocked signal is anything other than to ignore the signal, and if that signal is generated for the process, the signal remains pending until either it is unblocked or the signal's disposition requests that the signal be ignored. If the signal disposition of a blocked signal requests that the signal be ignored, and if that signal is generated for the process, the signal is discarded immediately upon generation.

Each process may specify a system action to be taken in response to each signal delivered to it, called the signal's disposition. The set of system signal actions for a process is initialized from that of its parent. Once an action is installed for a specific signal, it usually remains installed until another disposition is explicitly requested by a call to either `sigaction` or any of its associated calls or until the process execs [see `sigaction`(2) and `signal`(2)]. When a process execs, all signals whose dispositions have been set to catch the signal will be set to `SIG_DFL`. Alternatively, a process may request that the system automatically reset the disposition of a signal to `SIG_DFL` after it has been caught [see `sigaction`(2)].

Each process has a signal mask that defines the set of signals currently blocked from delivery to it [see `sigprocmask`(2)]. The signal mask for a process is initialized from that of its parent.

The determination of which action is taken in response to a signal is made at the time the signal is delivered, allowing for any changes since the time of generation. This determination is independent of the means by which the signal was originally generated.

For a list of the signals supported by DG/UX, see `<sys/signal.h>`.

SEE ALSO

`kill`(2), `pause`(2), `sigaction`(2), `sigset`(2), `sigaltstack`(2), `signal`(2), `sigprocmask`(2), `sigsend`(2), `sigsuspend`(2), `wait`(2), `psiginfo`(3C), `psignal`(3C), `sigsetops`(3C), `siginfo`(5), `ucontext`(5).

NAME

stat – data returned by stat system call

SYNOPSIS

```
#include <sys/types.h>
#include <sys/stat.h>
```

DESCRIPTION

The system calls `stat`, `fstat`, `lstat`, and `dg_mstat` return data whose structure is defined by this include file. The encoding of the field `st_mode` is also defined in this file.

```
/*
 * Structure of the result of stat
 */

struct  stat
{
     dev_t           st_dev;
     ino_t           st_ino;
     mode_t          st_mode;
     nlink_t         st_nlink;
     uid_t           st_uid;
     gid_t           st_gid;
     dev_t           st_rdev;
     off_t           st_size;
     time_t          st_atime;
     unsigned long   st_ausec;
     time_t          st_mtime;
     unsigned long   st_musec;
     time_t          st_ctime;
     unsigned long   st_cusec;
     timestruc_t     st_atim;
     timestruc_t     st_mtim;
     timestruc_t     st_ctim;
     long            st_blksize;
     long            st_blocks;
     char            st_fstype[16];
     char            st_pad5[408];
};

#define S_IFMT    0170000 /* type of file */
#define S_IFDIR   0040000 /* directory */
#define S_IFCHR   0020000 /* character special */
#define S_IFBLK   0060000 /* block special */
#define S_IFREG   0100000 /* regular */
#define S_IFLNK   0120000 /* symbolic link */
#define S_IFIFO   0010000 /* fifo */
#define S_IFSOCK  0140000 /* socket special file */
#define S_ISUID   04000   /* set user id on execution */
#define S_ISGID   02000   /* set group id on execution */
#define S_ISVTX   01000   /* save swapped text even after use */
#define S_IREAD   00400   /* read permission, owner */
#define S_IWRITE  00200   /* write permission, owner */
```

```
#define S_IEXEC   00100   /* execute/search permission, owner */
#define S_ENFMT   02000   /* record locking enforcement flag */
#define S_IRWXU   00700   /* read, write, execute search
                             permission, owner */
#define S_IRUSR   00400   /* read permission, owner */
#define S_IWUSR   00200   /* write permission, owner */
#define S_IXUSR   00100   /* execute/search permission, owner */
#define S_IRWXG   00070   /* read, write, execute/search
                             permission, group */
#define S_IRGRP   00040   /* read permission, group */
#define S_IWGRP   00020   /* write permission, group */
#define S_IXGRP   00010   /* execute/search permission, group */
#define S_IRWXO   00007   /* read, write, execute/search
                             permission, other */
#define S_IROTH   00004   /* read permission, other */
#define S_IWOTH   00002   /* write permission, other */
#define S_IXOTH   00001   /* execute/search permission, other */
```

FILES

/usr/include/sys/stat.h
/usr/include/sys/types.h

SEE ALSO

stat(2), types(5).

NAME

`statfs` – data returned by the statfs system call

DESCRIPTION

The system call `statfs` takes a parameter that is a pointer to the structure defined by this include file. This structure returns file system device statistics.

```
struct  statfs
{
   short        f_fstyp;
   long         f_bsize;
   long         f_frsize;
   long         f_blocks;
   long         f_bfree;
   long         f_bavail;
   long         f_files;
   long         f_ffree;
   char         f_fname [6];
   char         f_fpack [6];
   long         f_favail;
   long         fs_blocks;
   long         fs_bfree;
   long         fs_bavail;
   long         fs_files;
   long         fs_ffree;
   long         fs_favail;
};
```

The fields of this structure are defined as follows:

`f_fstyp` The type of the file system.

`f_bsize` The file system block size, in bytes.

`f_frsize` The file system fragment size, in bytes.

`f_blocks` The maximum number of blocks that may exist in the control-point directory containing the pathname passed to *statfs*, taking into account the block limits of all CPDs on the path. If the pathname is a CPD, its own block limit is also taken into account. If the pathname is the root of a file system, this field is the maximum that applies to superusers, so it is the same as *fs_blocks*. If the pathname is not a file system root, the maximum applies to both superusers and non-superusers.

`f_bfree` The number of free blocks in the control-point directory containing the pathname passed to *statfs*, taking into account the block limits of all CPDs on the path. If the pathname is a CPD, its own block limit is also taken into account. If the pathname is the root of a file system, this field is the number of blocks that can still be allocated by superusers, so it is the same as *fs_bfree*. If the pathname is not a file system root, the free count applies to both superusers and non-superusers.

`f_bavail` This field is the same as *f_bfree* unless the pathname is the root of a file system. In that case it gives the number of blocks that can still be allocated by non-superusers.

`f_files` The total number of files that may exist in the control-point directory containing the pathname passed to *statfs*, i.e. the number allocated plus

the number that still may be created, taking into account the file limits of all CPDs on the path. If the pathname is a CPD, its own file limit is also taken into account. If the pathname is the root of a file system, this field is the maximum that applies to superusers, so it is the same as *fs_files*. If the pathname is not a file system root, the maximum applies to both superusers and non-superusers.

`f_ffree` The number of files that still may be created in the control-point directory containing the pathname passed to *statfs*, taking into account the files limits of all CPDs on the path. If the pathname is a CPD, its own file limit is also taken into account. If the pathname is the root of a file system, this field is the number of files that can still be created by superusers, so it is the same as *fs_ffree*. If the pathname is not a file system root, the file count applies to both superusers and non-superusers.

`f_fname` The file system name. This field will be null unless a label has been added to the file system with *labelit*.

`f_fpack` The file system pack name. This field will be null unless a label has been added to the file system with *labelit*.

`f_favail` This field is the same as *f_ffree*.

`fs_blocks` The file system size, in blocks.

`fs_bfree` The total number of free blocks on the file system.

`fs_bavail` The number of free blocks on the file system available to non-superusers.

`fs_files` The total number of files that may exist on the file system, i.e. the number allocated plus the number that still may be created.

`fs_ffree` The number of files that still may be created on the file system.

`fs_favail` The number of files that still may be created on the file system by non-superusers.

FILES

`/usr/include/sys/statfs.h`

SEE ALSO

`statfs`(2).

NAME

stdarg – handle variable argument list

SYNOPSIS

```
#include <stdarg.h>

va_list pvar;

void va_start(va_list pvar, parmN);

type va_arg(va_list pvar, type);

void va_end(va_list pvar);
```

DESCRIPTION

This set of macros allows portable procedures that accept variable numbers of arguments of variable types to be written. Routines that have variable argument lists [such as `printf`] but do not use *stdarg* are inherently non-portable, as different machines use different argument-passing conventions.

`va_list` is a type defined for the variable used to traverse the list.

The `va_start()` macro is invoked before any access to the unnamed arguments and initializes `pvar` for subsequent use by `va_arg()` and `va_end()`. The parameter *parmN* is the identifier of the rightmost parameter in the variable parameter list in the function definition (the one just before the `, ...`). If this parameter is declared with the `register` storage class or with a function or array type, or with a type that is not compatible with the type that results after application of the default argument promotions, the behavior is undefined.

The `va_arg()` macro expands to an expression that has the type and value of the next argument in the call. The parameter `pvar` should have been previously initialized by `va_start()`. Each invocation of `va_arg()` modifies `pvar` so that the values of successive arguments are returned in turn. The parameter *type* is the type name of the next argument to be returned. The type name must be specified in such a way so that the type of a pointer to an object that has the specified type can be obtained simply by postfixing a `*` to *type*. If there is no actual next argument, or if *type* is not compatible with the type of the actual next argument (as promoted according to the default argument promotions), the behavior is undefined.

The `va_end()` macro is used to clean up.

Multiple traversals, each bracketed by `va_start` and `va_end`, are possible.

EXAMPLE

This example gathers into an array a list of arguments that are pointers to strings (but not more than MAXARGS arguments) with function f1, then passes the array as a single argument to function f2. The number of pointers is specified by the first argument to f1.

```
#include <stdarg.h>
#define MAXARGS   31

void f1(int n_ptrs, ...)
{
      va_list ap;
      char *array[MAXARGS];
      int ptr_no = 0;

      if (n_ptrs > MAXARGS)
            n_ptrs = MAXARGS;
      va_start(ap, n_ptrs);
      while (ptr_no < n_ptrs)
            array[ptr_no++] = va_arg(ap, char*);
      va_end(ap);
      f2(n_ptrs, array);
}
```

Each call to f1 shall have visible the definition of the function or a declaration such as

```
void f1(int, ...)
```

SEE ALSO

vprintf(3S).

NOTES

It is up to the calling routine to specify in some manner how many arguments there are, since it is not always possible to determine the number of arguments from the stack frame. For example, execl is passed a zero pointer to signal the end of the list. printf can tell how many arguments there are by the format. It is nonportable to specify a second argument of char, short, or float to va_arg, because arguments seen by the called function are not char, short, or float. C converts char and short arguments to int and converts float arguments to double before passing them to a function.

NAME

`syslog.conf` – configuration file for syslogd system log server

SYNOPSIS

`/etc/syslog.conf`

DESCRIPTION

The file `/etc/syslog.conf` contains information used by the system log server (daemon), `syslogd`(1M), to forward a system message to appropriate log files and/or users.

A configuration entry is composed of two TAB-separated fields:

selector *action*

The *selector* field contains a semicolon-separated list of priority specifications of the form:

facility.level[*;facility.level*]

where *facility* is a system facility, or comma-separated list of facilities, and *level* is an indication of the severity of the condition being logged. Recognized values for *facility* include:

`user`	Messages generated by user processes. This is the default priority for messages from programs or facilities not listed in this file.
`kern`	Messages generated by the kernel.
`mail`	Reserved for the `mail` system.
`daemon`	System servers, such as `ftpd`(1M).
`auth`	Reserved for the `auth` system; it does not currently use the `syslog` mechanism.
`lpr`	Messages generated by the `lpr/lpd` line printer spooling system.
`news`	Reserved for the USENET network news system.
`uucp`	Reserved for the UUCP system; it does not currently use the `syslog` mechanism.
`cron`	Reserved for the `cron` system; it does not currently use the `syslog` mechanism.
`local0-7`	Reserved for local use.
`mark`	For timestamp messages produced internally by `syslogd`.
`*`	An asterisk indicates all facilities except for the `mark` facility.

Recognized values for *level* are (in descending order of severity):

`emerg`	For panic conditions that would normally be broadcast to all users.
`alert`	For conditions that should be corrected immediately, such as a corrupted system database.
`crit`	For warnings about critical conditions, such as hard device errors.
`err`	For other errors.
`warning`	For warning messages.
`notice`	For conditions that are not error conditions, but may require special handling.

`info` Informational messages.

`debug` For messages that are normally used only when debugging a program.

`none` Do not send messages from the indicated *facility* to the selected file. For example, a *selector* of

```
*.debug;mail.none
```

will send all messages *except* mail messages to the selected file.

The *action* field indicates where to forward the message. Values for this field can have one of four forms:

- A filename, beginning with a leading slash, which indicates that messages specified by the *selector* are to be written to the specified file. The file will be opened in append mode.
- The name of a remote host, prefixed with an @, as with: @*server*, which indicates that messages specified by the *selector* are to be forwarded to the `syslogd` on the named host.
- A comma-separated list of usernames, which indicates that messages specified by the *selector* are to be written to the named users if they are logged in.
- An asterisk, which indicates that messages specified by the *selector* are to be written to all logged-in users.

Blank lines are ignored. Lines for which the first nonwhite character is a '#' are treated as comments.

EXAMPLE

With the following configuration file:

```
*.notice;mail.info      /usr/adm/notice
*.crit                  /usr/adm/critical
kern,mark.debug         /dev/console
kern.err                @server
*.emerg                 *
*.alert                 root,operator
*.alert;auth.warning    /usr/adm/auth
```

`syslogd` will log all mail system messages except `debug` messages and all `notice` (or higher) messages into a file named `/usr/adm/notice`. It logs all critical messages into `/usr/adm/critical`, and all kernel messages and 20-minute marks onto the system console.

Kernel messages of `err` (error) severity or higher are forwarded to the machine named *server*. Emergency messages are forwarded to all users. The users root and operator are informed of any `alert` messages. All messages from the authorization system of `warning` level or higher are logged in the file `/usr/adm/auth`.

SEE ALSO

`logger`(1), `syslogd`(1M), `syslog`(3C).

NAME

tar – tape archive file format

DESCRIPTION

tar (the tape archive command) dumps several files into one, in a medium suitable for transportation.

A "tar tape" or file is a series of blocks. Each block is of size TBLOCK. A file on the tape is represented by a header block which describes the file, followed by zero or more blocks which give the contents of the file. At the end of the tape are two blocks filled with binary zeros, as an end-of-file indicator.

The blocks are grouped for physical I/O operations. Each group of *n* blocks (where *n* is set by the b keyletter on the tar(1) command line — default is 32 blocks) is written with a single system call; on nine-track tapes, the result of this write is a single tape record. The last group is always written at the full size, so blocks after the two zero blocks contain random data. On reading, the specified or default group size is used for the first read, but if that read returns less than a full tape block, the reduced block size is used for further reads.

The header block looks like:

```
#define TBLOCK  512     /* length of tar header and data blocks */
#define TNAMLEN 100     /* maximum length for tar file names */
#define TMODLEN 8       /* length of mode field */
#define TUIDLEN 8       /* length of uid field */
#define TGIDLEN 8       /* length of gid field */
#define TSIZLEN 12      /* length of size field */
#define TTIMLEN 12      /* length of modification time field */
#define TCRCLEN 8       /* length of header checksum field */

union tblock {
        char dummy[TBLOCK];
        struct tar_hdr {
           char t_name[TNAMLEN],     /* name of file */
                t_mode[TMODLEN],     /* mode of file */
                t_uid[TUIDLEN],      /* uid of file */
                t_gid[TGIDLEN],      /* gid of file */
                t_size[TSIZLEN],     /* size of file in bytes */
                t_mtime[TTIMLEN],    /* modification time of file */
                t_cksum[TCRCLEN],    /* checksum of header */
                t_typeflag,
                t_linkname[TNAMLEN], /* file this file linked with */
                t_magic[TMAGLEN],
                t_version[TVERSLEN],
                t_uname[32],
                t_gname[32],
                t_devmajor[8],
                t_devminor[8],
                t_prefix[155];
        } tbuf;
} ;
```

The fields t_magic, t_uname, and t_gname are null-terminated strings. The fields t_name, t_linkname, and t_prefix are null-terminated except when all characters in the field, including the last character, are used for the name.

The t_name and t_prefix fields are used to construct the pathname of the file. If the t_prefix field contains non-null characters, a pathname is formed by concatenating the t_prefix field, a slash character, and the t_name field; otherwise, the pathname is formed using only the value in the t_name field.

T_mode is the file mode, with the top bit masked off.

Uid and *gid* are the user and group numbers for the file.

T_size is the size of the file in bytes (or the size of the current extension of the file if the file has been split over multiple volumes). Links, symbolic links, directories, and device files are dumped with this field specified as zero.

T_mtime is the modification time of the file at the time it was dumped.

T_chksum is an octal ASCII value which represents the sum of all the bytes in the header block. When calculating the checksum, the t_chksum field is treated as if it were all blanks.

T_typeflag is a one-character field which specifies the type of the file. The valid values for t_typeflag are:

```
null  Regular file (supplied for backward compatibility)
`0'   Regular file
`1'   Link
`2'   Symbolic link
`3'   Character special
`4'   Block special
`5'   Directory
`6'   FIFO special
`7'   Reserved
```

If typeflag is ASCII '1' (hard link) or ASCII '2' (symbolic link), the name linked-to, is in t_linkname, with a trailing null. The t_linkname field does not use the t_prefix; hence, linknames are limited to 99 characters.

T_magic indicates that the archive was output in this archive format. If the t_magic field contains the value TMAGIC (defined above), then the t_uname and t_gname fields contain the ASCII names of the owner and group, respectively, for the file. If necessary, the owner and group names will be truncated to fit in these fields.

T_version should contain the value TVERSION (defined above).

T_devmajor and T_devminor contain the major and minor device codes, respectively, for device files and are meaningful only if T_typeflag is ASCII '3' (character special) or ASCII '4' (block special).

The fields t_extno, extotal and efsize are used for files which are split over multiple volumes. The extensions (pieces) of the file are labeled separately on each volume and assigned sequential extension numbers. t_extno contains the extension number of the current extension and is null if the file is not split; t_extotal contains the total number of extensions for the file; and t_efsize contains the total size of the file.

Unused fields of the header are set to binary zeros and are included in the checksum.

The first time a given i-node number is dumped, it is dumped as a regular file. The second and subsequent times, it is dumped as a link instead. Upon retrieval, if a link entry is retrieved, but not the file it was linked to, an error message is printed and the tape must be manually re-scanned to retrieve the linked-to file.

The encoding of the header is designed to be portable across machines.

SEE ALSO

`tar`(1).

NOTE

Linknames longer than NAMSIZ produce error reports and cannot be dumped.

NAME

termcap – terminal capability data base

DESCRIPTION

Termcap is a data base of terminal descriptions used by the termcap(3X) library. All terminals are described in a file called /etc/termcap. Termcap entries describe, in special code, how basic operations are performed on a terminal. They also describe padding requirements, initialization sequences, and so on. The section entitled "Preparing a Termcap Description" that appears later explains how to build a termcap source description.

Entries in Termcap consist of a number of ':'-separated fields. The first line names the terminal, and the remaining lines describe its capabilities.

Terminal Names

The first line of for each terminal description gives the names that are known for the terminal, separated by vertical bar (|) characters. The first name is always two characters long for compatibility with older systems which store the terminal type in a 16-bit word in a system-wide data base. The second name is the most common abbreviation for the terminal, the last name should be a long name fully identifying the terminal, and all others are understood as synonyms for the terminal name. All names but the first and last should be in lower case and contain no blanks; the last name may well contain upper case letters and blanks for readability.

Terminal names (except for the last, verbose entry) should be chosen using the following conventions. First, the vendor and model of the terminal should be specified in the root name, for example, hp2621. This name should not contain hyphens. Terminal modes or user preferences should be indicated by appending a hyphen and an indicator of the mode. Therefore, a vt100 in 132-column mode would be vt100-w. The following suffixes should be used where possible:

Suffix	Meaning	Example
-w	Wide mode (more than 80 columns)	vt100-w
-am	With automatic margins (usually default)	vt100-am
-nam	Without automatic margins	vt100-nam
-*n*	Number of lines on the screen	aaa-60
-na	No arrow keys (leave them in local mode)	concept100-na
-*n*p	Number of pages of memory	concept100-4p
-rv	Reverse video	concept100-rv

Terminal Capabilties

Lines after the first line of a terminal description describe the terminal's capabilities. Capabilities in termcap are of three general types: Boolean capabilities, which indicate a terminal's particular features; numeric capabilities, which give the size of the display or other attributes; and string capabilities, which give character sequences that can be used to perform particular terminal operations.

The table below lists termcap capabilities alphabetically by name. The second field of the table indicates capability type. The characters in the Notes field in the table have the following meanings (more than one may apply to a capability):

N indicates numeric parameter(s)
P indicates that padding may be specified
* indicates that padding may be based on the number of lines affected
o indicates that the capability is obsolete

"Obsolete" capabilities have no `terminfo`(4) equivalents; either they were considered useless, or they have been subsumed by other capabilities. New software should not rely on them at all. The last field in the table gives a short description of the terminal capability.

Name	Type	Notes	Description
ae	str	(P)	End alternate character set mode
AL	str	(NP*)	Add *n* new blank lines
al	str	(P*)	Add one new blank line
am	bool		Terminal has automatic margins
as	str	(P)	Start alternate character set mode
bc	str	(o)	Backspace if not ^H
bl	str	(P)	Audible signal (bell)
bs	bool	(o)	Terminal can backspace with ^H
bt	str	(P)	Back tab
bw	bool		le (backspace) wraps from column 0 to last column
CC	str		Terminal settable command character in prototype
cd	str	(P*)	Clear to end of display
ce	str	(P)	Clear to end of line
ch	str	(NP)	Set cursor column (horizontal position)
cl	str	(P*)	Clear screen and home cursor
CM	str	(NP)	Memory-relative cursor addressing (motion)
cm	str	(NP)	Screen-relative cursor addressing (motion)
co	num		Number of columns in a line
cr	str	(P)	Carriage return
cs	str	(NP)	Change scrolling region (VT100)
ct	str	(P)	Clear all tab stops
cv	str	(NP)	Set cursor row (vertical position)
da	bool		Display may be retained above screen
dB	num	(o)	Milliseconds of bs delay needed (default 0)
db	bool		Display may be retained below screen
DC	str	(NP*)	Delete *n* characters
dC	num	(o)	Milliseconds of cr delay needed (default 0)
dc	str	(P*)	Delete one character
dF	num	(o)	Milliseconds of ff delay needed (default 0)
DL	str	(NP*)	Delete *n* lines
dl	str	(P*)	Delete one line
dm	str		Enter delete mode
dN	num	(o)	Milliseconds of nl delay needed (default 0)
DO	str	(NP*)	Move cursor down *n* lines
do	str		Move cursor down one line
ds	str		Disable status line
dT	num	(o)	Milliseconds of horizontal tab delay needed (default 0)
dV	num	(o)	Milliseconds of vertical tab delay needed (default 0)
ec	str	(NP)	Erase *n* characters
ed	str		End delete mode
ei	str		End insert mode
eo	bool		Terminal can erase overstrikes with a blank
EP	bool	(o)	Terminal uses even parity
es	bool		Escape sequences can be used on status line
ff	str	(P*)	Hardcopy terminal page eject
fs	str		Return from status line
gn	bool		Generic line type (*e.g.* dialup, switch)

hc	bool		Hardcopy terminal
HD	bool	(o)	Half-duplex
hd	str		Move a half-line down (forward 1/2 linefeed)
ho	str	(P)	Home cursor
hs	bool		Terminal has extra "status line"
hu	str		Move a half-line up (reverse 1/2 linefeed)
hz	bool		Terminal cannot print tildes (Hazeltine)
IC	str	(NP*)	Insert *n* blank characters
ic	str	(P*)	Insert one blank character
if	str		Name of file containing initialization string
im	str		Enter insert mode
in	bool		Insert mode distinguishes nulls
ip	str	(P*)	Insert padding after character inserted
is	str		Terminal initialization string
it	num		Tabs are initially every *n* positions
K1	str		Sent by keypad upper left key
K2	str		Sent by keypad upper right key
K3	str		Sent by keypad center key
K4	str		Sent by keypad lower left key
K5	str		Sent by keypad lower right key
k0-k9	str		Sent by function keys 0-9
kA	str		Sent by insert-line key
ka	str		Sent by clear-all-tabs key
kb	str		Sent by backspace key
kC	str		Sent by clear-screen or erase key
kD	str		Sent by delete-character key
kd	str		Sent by down-arrow key
kE	str		Sent by clear-to-end-of-line key
ke	str		Out of "keypad transmit" mode
kF	str		Sent by scroll-forward/down key
kH	str		Sent by home-down key
kh	str		Sent by home key
kI	str		Sent by insert-character or enter-insert-mode key
kL	str		Sent by delete-line key
kl	str		Sent by left-arrow key
kM	str		Sent by insert key while in insert mode
km	bool		Terminal has a "meta" key (sets eighth bit)
kN	str		Sent by next-page key
kn	num	(o)	Number of function (k0-k9) keys (default 0)
ko	str	(o)	Termcap entries for other non-function keys
kP	str		Sent by previous-page key
kR	str		Sent by scroll-backward/up key
kr	str		Sent by right-arrow key
kS	str		Sent by clear-to-end-of-screen key
ks	str		Put terminal in "keypad transmit" mode
kT	str		Sent by set-tab key
kt	str		Sent by clear-tab key
ku	str		Sent by up-arrow key
l0-l9	str		Labels on function keys if not "f*n*''
LC	bool	(o)	Terminal is lowercase only
LE	str	(NP)	Move cursor left *n* positions
le	str	(P)	Move cursor left one position
li	num		Number of lines on screen or page

ll	str		Move cursor to last line, first column
lm	num		Lines of memory if > li (0 means varies)
ma	str	(o)	Arrow key map
mb	str		Turn on blinking attribute
md	str		Turn on bold (extra bright) attribute
me	str		Turn off all attributes
mh	str		Turn on half-bright (dim) attribute
mi	bool		Safe to move while in insert mode
mk	str		Turn on blank attribute (characters invisible)
ml	str	(o)	Turn on memory lock above cursor
mm	str		Turn on "meta mode" (transmit eighth bit)
mo	str		Turn off "meta mode"
mp	str		Turn on protected attribute
mr	str		Turn on reverse-video attibute
ms	bool		Safe to move in standout modes
mu	str	(o)	Memory unlock (turn off memory lock)
nc	bool	(o)	No correctly-working cr (Datamedia 2500, Hazeltine 2000)
nd	str		Move cursor right one (non-destructive) space
NL	bool	(o)	\n is newline, not line feed
nl	str	(o)	Newline character if not \n
ns	bool	(o)	Terminal is a CRT but doesn't scroll
nw	str	(P)	Newline (behaves like cr followed by do)
OP	bool	(o)	Terminal uses odd parity
os	bool		Terminal overstrikes
pb	num		Lowest baud rate where delays are required
pc	str		Pad character (default NUL)
pf	str		Turn off printer
p0	str	(N)	Turn on printer for *n* bytes
po	str		Turn on printer
ps	str		Print contents of screen
pt	bool	(o)	Has hardware tabs (may need to be set with is)
rc	str	(P)	Restore cursor to position of last sc
rf	str		Name of file containing reset string
RI	str	(NP)	Move cursor right *n* positions
rp	str	(NP*)	Repeat character *c n* times
rs	str		Reset terminal completely to sane modes
sa	str	(NP)	Define video attributes
sc	str	(P)	Save cursor position
se	str		End standout mode
SF	str	(NP*)	Scroll forward (up) *n* lines
sf	str	(P)	Scroll forward (up) one line
sg	num		Number of garbage chars left by so or se (default 0)
so	str		Begin standout mode
SR	str	(NP*)	Scroll backward (down) *n* lines
sr	str	(P)	Scroll backward (down) one line
st	str		Set a tab in all rows, current column
ta	str	(P)	Tab to next hardware tab stop
tc	str		Entry of similar terminal – must be last entry
te	str		String to end programs that use termcap
ti	str		String to begin programs that use termcap
ts	str	(N)	Go to status line, column *n*
UC	bool	(o)	Terminal is uppercase only
uc	str		Underscore one character and move past it

ue	str		End underscore mode
ug	num		Number of garbage chars left by us or ue (default 0)
ul	bool		Underline character overstrikes
UP	str	(NP*)	Move cursor up *n* lines
up	str		Move cursor up one line
us	str		Start underscore mode
vb	str		Visible bell (must not move cursor)
ve	str		Make cursor appear normal (undo vs/vi)
vi	str		Make cursor invisible
vs	str		Make cursor very visible
vt	num		Virtual terminal number (not supported on all systems)
wi	str	(N)	Set current window
ws	num		Number of columns in status line
xb	bool		Beehive (f1=ESC, f2=^C)
xn	bool		Newline ignored after column 80 (Concept)
xo	bool		Terminal uses XOFF/XON (DC3/DC1) handshaking
xr	bool	(o)	Return acts like ce cr nl (Delta Data)
xs	bool		Standout not erased by overwriting (Hewlett-Packard)
xt	bool		Destructive tabs, magic so char (Teleray 1061)
xx	bool	(o)	Tektronix 4025 insert-line

PREPARING A TERMCAP DESCRIPTION

The most effective way to prepare a terminal description is by imitating the description of a similar terminal in termcap and building up your description gradually, using partial descriptions to check that they are correct.

To easily test a new terminal description, set the environment variable TERMCAP to the absolute pathname of a file containing the description you are working on and programs will look there rather than in /etc/termcap. TERMCAP can also be set to the termcap entry itself to avoid reading the file when starting up a program.

Be aware that a very unusual terminal may expose deficiencies in the ability of the termcap conventions to describe it.

Similar Terminals

If there are two very similar terminals, one can be defined as being just like the other with certain exceptions. The string capability tc can be given with the name of the similar terminal. This capability must be specified last, and the combined length of the entries must not exceed 1024 characters. The capabilities given before tc override those in the terminal type included by tc. A capability can be canceled by placing *xx*@ to the left of the tc invocation, where *xx* is the capability. For example, the entry

```
hn|2621-nl:ks@:ke@:tc=2621:
```

defines a "2621-nl" that does not have the ks or ke capabilities, and hence does not turn on the function key labels when in visual mode. This is useful for different modes of a terminal, or for different user preferences.

Parameterized Strings

Cursor addressing and other strings requiring parameters are described by a parameterized string capability, with printf(3S)-like escapes %x in it, while other characters are passed through unchanged. The % encodings have the following meanings:

%%	output %
%d	output value as in printf(%d)

%2	output value as in printf(%2d)
%3	output value as in printf(%3d)
%.	output value as in printf(%c)
%+*x*	add *x* to value, then do %.
%>*xy*	if value > *x* then add *y*, no output
%r	reverse order of two parameters, no output
%i	increment by one, no output
%n	exclusive-or all parameters with 0140 (Datamedia 2500), no output
%B	BCD (16*(value/10)) + (value%10), no output
%D	Reverse coding (value - 2*(value%16)), no output (Delta Data)

Consider the Hewlett-Packard 2645, which, to get to row 3 and column 12, needs to be sent \E&a12c03Y padded for 6 milliseconds. Note that the order of the row and column coordinates is reversed here and that the row and column are sent as two-digit integers. Thus its cm capability is cm=6\E&%r%2c%2Y.

The Microterm ACT-IV needs the current row and column sent simply encoded in binary preceded by a ^T, cm=^T%.%.. Note that terminals that use %. need to be able to backspace the cursor (le) and to move the cursor up one line on the screen (up). This is necessary because it is not always safe to transmit \n, ^D, ^H, and \r, as the system may change or discard them. (Programs using termcap must set terminal modes so that tabs are not expanded, so \t is safe to send. This turns out to be essential for the Ann Arbor 4080.)

A final example is the Lear Siegler ADM-3a, which offsets row and column by a blank character, thus cm=\E=%+ %+ .

A Sample Entry

The following entry, which describes the Concept-100, is among the more complex entries in the termcap file as of this writing. It is provided here to illustrate the form and content of a termcap entry, and to provide a point of reference for the text that follows.

```
ca|concept100|c100|concept|c104|concept100-4p|HDS Concept-100:\
  :al=3*\E^R:am:bl=^G:cd=16*\E^C:ce=16\E^U:cl=2*^L:cm=\Ea%+ %+ :\
  :co#80:.cr=9^M:db:dc=16\E^A:dl=3*\E^B:do=^J:ei=\E\200:eo:im=\E^P:in:\
  :ip=16*:is=\EU\Ef\E7\E5\E8\El\ENH\EK\E\200\Eo&\200\Eo\47\E:k1=\E5:\
  :k2=\E6:k3=\E7:kb=^h:kd=\E<:ke=\Ex:kh=\E?:kl=\E>:kr=\E=:ks=\EX:\
  :ku=\E;:le=^H:li#24:mb=\EC:me=\EN\200:mh=\EE:mi:mk=\EH:mp=\EI:\
  :mr=\ED:nd=\E=:pb#9600:rp=0.2*\Er%.%+ :se=\Ed\Ee:sf=^J:so=\EE\ED:\
  :.ta=8\t:te=\Ev     \200\200\200\200\200\200\Ep\r\n:\
  :ti=\EU\Ev  8p\Ep\r:ue=\Eg:ul:up=\E;:us=\EG:\
  :vb=\Ek\200\200\200\200\200\200\200\200\200\200\200\200\200\EK:\
  :ve=\Ew:vs=\EW:vt#8:xn:\
  :bs:cr=^M:dC#9:dT#8:nl=^J:ta=^I:pt:
```

Entries may continue onto multiple lines by giving a backslash (\) as the last character of a line, and empty fields may be included for readability (here between the last field on a line and the first field on the next). Comments may be included on lines beginning with pound sign (#).

How to Describe Terminal Capabilities in a Termcap Entry

All capabilities have two-letter codes. The fact that the Concept has automatic margins (that is, an automatic return and linefeed when the end of a line is reached) is indicated by the Boolean capability am. Hence the description of the Concept includes am on the second line.

Numeric capabilities are followed by a pound sign (#) and then the value. On the third line of the example above, `co`, which indicates the number of columns in the display, gives the value "80" for the Concept.

Finally, string-valued capabilities, such as `ce` (the sequence to clear-to-end-of-line), are given by the two-letter code, an equals sign (=), then a string ending at the next following colon (`:`). A delay in milliseconds may appear after the `=` in such a capability, and causes padding characters to be supplied by `tputs`(3X) to provide this delay after the remainder of the string is sent. The delay can be either a number, for example, `20`, or a number followed by an asterisk (`*`), for example, `3*`. An `*` indicates that the padding required is proportional to the number of lines affected by the operation, and the amount given is the per-affected-line padding required. (In the case of insert-character, the factor is still the number of lines affected; this is always 1 unless the terminal has `in` and the software uses it.) When an `*` is specified, it is sometimes useful to give a delay containing a decimal point, for example `3.5` to specify a delay per line to tenths of milliseconds. (Only one decimal place is allowed.)

A number of escape sequences are provided in the string-valued capabilities for easy encoding of control characters there. `\E` maps to an ESC character, `^X` maps to a control-*X* for any appropriate *X*, and the sequences **\n , \r , \t , \b ,** and `\f` map to linefeed, return, tab, backspace, and formfeed, respectively. Finally, characters may be given as three octal digits after a `\`, and the characters `^` and `\` may be given as `\^` and `\\`. If it is necessary to place a `:` in a capability it must be escaped in octal as `\072`. If it is necessary to place a NUL character in a string capability it must be encoded as `\200`. (The routines that deal with `termcap` use C strings and strip the eighth bit of the output very late, so that a `\200` comes out as a `\000` would.)

Sometimes individual capabilities must be commented out. To do this, put a period before the capability name. For example, see the first `cr` and `ta` in the preceeding example.

TERMCAP TERMINAL CAPABILITIES

The following subsections describe `termcap` capabilities in detail.

Basic Capabilities

The number of columns on each line of the display is given by the `co` numeric capability. If the display is a CRT, then the number of lines on the screen is given by the `li` capability. If the cursor wraps around to the beginning of the next line when it reaches the right margin, then it should have the `am` capability. If the terminal can clear its screen, the code to do this is given by the `cl` string capability. If the terminal overstrikes (rather than clearing the position when a character is overwritten), it should have the `os` capability. If the terminal is a printing terminal, with no soft copy unit, give it both `hc` and `os`. (`os` applies to storage scope terminals, such as the Tektronix 4010 series, as well as to hard copy and APL terminals.) If there is a code to move the cursor to the left edge of the current row, give this as `cr`. (Normally this will be carriage-return, `^M`.) If there is a code to produce an audible signal (bell, beep, for example), give this as `bl`.

If there is a code (such as backspace) to move the cursor one position to the left, that capability should be given as `le`. Similarly, codes to move to the right, up, and down should be given as `nd`, `up`, and `do`, respectively. These local cursor motions should not alter the text they pass over; for example, you would not normally give "nd= " unless the terminal has the `os` capability, because the space would erase the character moved over.

A very important point here is that the local cursor motions encoded in termcap have undefined behavior at the left and top edges of a display. Programs should never attempt to backspace around the left edge, unless bw is given, and never attempt to move the cursor up off the top line using local cursor motions.

In order to scroll text up, a program moves the cursor to the bottom left corner of the screen and sends the sf (index) string. To scroll text down, a program moves the cursor to the top left corner of the screen and sends the sr (reverse index) string. The strings sf and sr have undefined behavior when the cursor is not on their respective corners of the screen. Parameterized versions of the scrolling sequences are SF and SR, which have the same semantics as sf and sr except that they take one parameter and scroll that many lines. They also have undefined behavior except at the appropriate corners of the screen.

The am capability tells whether the cursor sticks at the right edge of the screen when text is output there, but this does not necessarily apply to nd from the last column. Leftward local motion is defined from the left edge only when bw is given; then an le from the left edge will move to the right edge of the previous row. This is useful for drawing a box around the edge of the screen, for example. If the terminal has switch-selectable automatic margins, the termcap description usually assumes that this feature is on, that is, am. If the terminal has a command that moves to the first column of the next line, that command can be given as nw (newline). It is permissible for this to clear the remainder of the current line, so if the terminal has no correctly-working CR and LF it may still be possible to craft a working nw out of one or both of them.

These capabilities suffice to describe hardcopy and "glass-tty" terminals. Thus the Teletype model 33 is described as

```
T3|tty33|33|tty|Teletype model 33:\
        :bl=^G:co#72:cr=^M:do=^J:hc:os:
```

and the Lear Siegler ADM-3 is described as

```
l3|adm3|3|LSI ADM-3:\
        :am:bl=^G:cl=^Z:co#80:cr=^M:do=^J:le=^H:li#24:sf=^J:
```

Cursor Motions

If the terminal has a fast way to home the cursor (to the very upper left corner of the screen), this can be given as ho. Similarly, a fast way of getting to the lower left-hand corner can be given as ll; this may involve going up with up from the home position, but a program should never do this itself (unless ll does), because it can make no assumption about the effect of moving up from the home position. Note that the home position is the same as cursor address (0,0): to the top left corner of the screen, not of memory. (Therefore, the "\EH" (memory home) sequence on Hewlett-Packard terminals cannot be used for ho.)

To address the cursor (move it to an absolute position), the cm capability is given. cm takes two parameters: the row and column to move the cursor to. (Rows and columns are numbered from zero and refer to the physical screen visible to the user, not to any unseen memory. If the terminal has memory-relative cursor addressing, that can be indicated by an analogous CM boolean capability.)

Row or column absolute cursor addressing can be given as single parameter capabilities ch (horizontal position absolute) and cv (vertical position absolute). Sometimes these are shorter than the more general two-parameter sequence (as with the Hewlett-Packard 2645) and can be used in preference to cm. If there are

parameterized local motions (for example, move *n* positions to the right) these can be given as `DO`, `LE`, `RI`, and `UP` with a single parameter indicating how many positions to move. These are primarily useful if the terminal does not have `cm`, as with the Tektronix 4025.

Area Clears

If the terminal can clear from the current cursor position to the end of the line, leaving the cursor where it is, this should be given as `ce`. If the terminal can clear from the current cursor position to the end of the display, this should be given as `cd`. Programs must output `cd` only from the first column of a line. (Therefore, it can be simulated by a request to delete a large number of lines, if a true `cd` is not available.)

Insert/Delete Line

If the terminal can open a new blank line before the line containing the cursor, this should be given as `al`; programs must output this only from the first position of a line. The cursor must then appear at the left of the newly blank line. If the terminal can delete the line that the cursor is on, this should be given as `dl`; programs must output this only from the first position on the line to be deleted. Versions of `al` and `dl` which take a single parameter and insert or delete that many lines can be given as `AL` and `DL`. If the terminal has a settable scrolling region (like the VT100), the command to set this can be described with the `cs` capability, which takes two parameters: the top and bottom lines of the scrolling region. The cursor position is undefined after using this command. The program must reset the cursor position using other `termcap` capabilities such as `cm` or `rc`. It is possible to get the effect of insert or delete line using this command — the `sc` and `rc` (save and restore cursor) commands are also useful. Inserting lines at the top or bottom of the screen can also be done using `sr` or `sf` on many terminals without a true insert/delete line, and is often faster even on terminals with those features.

If the terminal has the ability to define a window as part of memory which all commands affect, it should be given as the parameterized string `wi`. The four parameters are the starting and ending lines in memory and the starting and ending columns in memory, in that order.

If the terminal can retain display memory above the screen, then the `da` capability should be given; if display memory can be retained below, then `db` should be given. These indicate that deleting a line or scrolling may bring non-blank lines up from below, or that scrolling back with `sr` may bring down non-blank lines.

Insert/Delete Character

There are two basic kinds of intelligent terminals with respect to insert/delete character that can be described using `termcap`. The most common insert/delete character operations affect only the characters on the current line and shift characters off the end of the line rigidly. Other terminals, such as the Concept–100 and the Perkin Elmer Owl, make a distinction between typed and untyped blanks on the screen, shifting upon an insert or delete only to an untyped blank on the screen which is either eliminated or expanded to two untyped blanks. You can determine the kind of terminal you have by clearing the screen, and then typing text separated by cursor motions. Type `abc def` using local cursor motions (not spaces) between the `abc` and the `def`. Then position the cursor before the `abc` and put the terminal in insert mode. If typing characters causes the rest of the line to shift rigidly and characters to fall off the end, then your terminal does not distinguish between blanks and untyped positions. If the `abc` shifts over to the `def` which then move together around the end of the current line and onto the next as you insert, then you have the second type of terminal and should give the capability `in`, which stands for "insert null". While these are two logically separate attributes (one line versus multi-line

insert mode, and special treatment of untyped spaces), we have seen no terminals whose insert mode cannot be described with the single attribute.

`Termcap` can describe both terminals that have an insert mode and terminals that have a sequence to open a blank position on the current line. Give as `im` the sequence to get into insert mode. Give as `ei` the sequence to leave insert mode. Now give as `ic` any sequence that needs to be sent just before each character to be inserted. Most terminals with a true insert mode will not require `ic`; it is mainly intended for terminals that use a sequence to open a screen position. (If your terminal has both, insert mode is usually preferable to `ic`. Do not give both unless the terminal actually requires both to be used in combination.) If post-insert padding is needed, give this as a number of milliseconds in `ip` (a string capability). Any other sequence that may need to be sent after insertion of a single character can also be given in `ip`. The `IC` capability, with one parameter *n*, will repeat the effects of `ic` *n* times.

It is occasionally necessary to move the cursor around while in insert mode to delete characters on the same line (for example, if there is a tab after the insertion position). If your terminal allows motion while in insert mode, you can give the Boolean capability `mi` to speed up inserting in this case. Omitting `mi` will affect only speed. Some terminals (notably Datamedia) must not have `mi` because of the way their insert mode works.

Finally, you can specify `dc` to delete a single character, `DC` with one parameter *n* to delete *n* characters, and delete mode by giving `dm` and `ed` to enter and exit delete mode (which is any mode the terminal needs to be placed into for `dc` to work).

Highlighting, Underlining, and Visible Bells

If your terminal has one or more kinds of display attributes, these can be represented in a number of different ways. You should choose one display form as standout mode, representing a good, high-contrast, easy-on-the-eyes format for highlighting error messages and other attention getters. (If you have a choice, reverse video plus half-bright is good, or reverse video alone.) The sequences to enter and exit standout mode are given as `so` and `se`, respectively. If the code to change into or out of standout mode leaves one or even two blank spaces or garbage characters on the screen, as the TVI 912 and Teleray 1061 do, then the numeric capability `sg` should be given to tell how many characters are left.

Codes to begin and end underlining can be given as `us` and `ue`, respectively. If changing the underlining mode leaves blank spaces or garbage characters on the screen, specify `ug`, analagous to `sg`. If the terminal has a code to underline the current character and move the cursor one position to the right, such as the Microterm Mime, this can be given as `uc`.

Other capabilities to enter various highlighting modes include `mb` (blinking), `md` (bold or extra bright), `mh` (dim or half-bright), `mk` (blanking or invisible text), `mp` (protected), `mr` (reverse video), `me` (turn off all attribute modes), `as` (enter alternate character set mode), and `ae` (exit alternate character set mode). Turning on any of these modes singly may or may not turn off other modes.

If there is a sequence to set arbitrary combinations of attributes, this should be given as `sa` (set attributes), taking 9 parameters. Each parameter is either 0 or 1, as the corresponding attribute is on or off. The 9 parameters are, in order: standout, underline, reverse, blink, dim, bold, blank, protect, and alternate character set. Not all modes need be supported by `sa`, only those for which corresponding attribute commands exist.

Some terminals, such as the Hewlett-Packard 2621, automatically leave standout mode when the cursor is moved to a new line or is addressed. Programs should exit standout mode on such terminals before moving the cursor or sending a newline. On terminals where this is not a problem, the Boolean capability `ms` should be given to indicate that this overhead is unnecessary.

If the terminal has a way of flashing the screen to indicate an error quietly (a bell replacement), this can be given as `vb`; it must not move the cursor.

If the cursor needs to be made more visible than normal when it is not on the bottom line (to change, for example, a non-blinking underline into an easier-to-find block or blinking underline), give this sequence as `vs`. If there is a way to make the cursor completely invisible, give that as `vi`. The capability `ve`, which undoes the effects of both `vs` and `ve` should also be given.

If your terminal correctly displays underlined characters (with no special codes needed) even though it does not overstrike, then you should give the Boolean capability `ul`. If overstrikes are erasable with a blank, this should be indicated by giving the Boolean capability `eo`.

Keypad

If the terminal has a keypad that transmits codes when the keys are pressed, `termcap` can represent. Note that it is not possible to handle terminals where the keypad only works in local mode (this applies, for example, to the unshifted Hewlett-Packard 2621 keys). If the keypad can be set to transmit or not transmit, give these sequences as `ks` and `ke`. Otherwise the keypad is assumed to always transmit. The codes sent by the left-arrow, right-arrow, up-arrow, down-arrow, and home keys can be given as `kl`, `kr`, `ku`, `kd`, and `kh`, respectively. If there are function keys such as f0, f1, ..., f9, the codes they send can be given as `k0`, `k1`,..., `k9`. If these keys have labels other than the default f0 through f9, the labels can be given as `l0`, `l1`,..., `l9`. The codes transmitted by certain other special keys can be given: `kH` (home down), `kb` (backspace), `ka` (clear all tabs), `kt` (clear the tab stop in the current column), `kC` (clear screen or erase), `kD` (delete character), `kL` (delete line), `kM` (exit insert mode), `kE` (clear to end of line), `kS` (clear to end of screen), `kI` (insert character or enter insert mode), `kA` (insert line), `kN` (next page), `kP` (previous page), `kF` (scroll forward/down), `kR` (scroll backward/up), and `kT` (set a tab stop in the current column). In addition, if the keypad has a 3 by 3 array of keys including the four arrow keys, then the other five keys can be given as `K1`, `K2`, `K3`, `K4`, and `K5`. These keys are useful when the effects of a 3 by 3 directional pad are needed. The obsolete `ko` capability formerly used to describe "other" function keys has been completely supplanted by the above capabilities.

The `ma` entry is also used to indicate arrow keys that send single-character codes. This field is obsolete and redundant with `kl`, `kr`, `ku`, `kd`, and `kh`. It consists of groups of two characters. In each group, the first character is what an arrow key sends, and the second character is the corresponding cursor movement from `vi`(1). These commands are `h` for `kl`, `j` for `kd`, `k` for `ku`, `l` for `kr`, and `H` for `kh`. For example, the Mime would have `ma=^Hh^Kj^Zk^Xl` indicating arrow keys left (^H), down (^K), up (^Z), and right (^X). (There is no home key on the Mime.)

Tabs and Initialization

If the terminal needs to be in a special mode when running a program that uses *termcap* capabilities, the codes to enter and exit this mode can be given as `ti` and `te`. This is needed, for example, on terminals like the Concept with more than one page of memory. If the terminal has only memory-relative cursor addressing, a screen-sized window must be fixed into the display for cursor addressing to work

properly. This is also used for the Tektronix 4025, where `ti` sets the command character to be the one used by `termcap`.

Other capabilities include `is`, an initialization string for the terminal, and `if`, the name of a file containing long initialization strings. These strings are expected to set the terminal into modes consistent with the rest of the `termcap` description. They should be printed in the following order: `is`; setting tabs using `ct` and `st`; and finally `if`. A pair of sequences that does a harder reset from a totally unknown state can be analogously given as `rs` and `if`. Commands are normally placed in `rs` and `rf` only if they produce annoying effects on the screen and are usually unnecessary. For example, the command to set the VT100 into 80-column mode would normally be part of `is`, but it causes an annoying glitch of the screen and is not normally needed since the terminal is usually in 80-column mode already.

If the terminal has hardware tabs, the command to advance to the next tab stop can be given as `ta` (usually `^I`). A "backtab" command which moves leftward to the previous tab stop can be given as `bt`. By convention, if the terminal driver modes indicate that tab stops are being expanded by the computer rather than being sent to the terminal, programs should not use `ta` or `bt` even if they are present, since the user may not have the tab stops properly set. If the terminal has hardware tabs that are initially set every *n* positions when the terminal is powered up, then the numeric parameter `it` should be given, showing the number of positions between tab stops. If the terminal has tab stops that can be saved in nonvolatile memory, the `termcap` description can assume that they are properly set.

If there are commands to set and clear tab stops, they can be given as `ct` (clear all tab stops) and `st` (set a tab stop in the current column of every row). If a more complex sequence is needed to set the tabs than can be described by this, the sequence can be placed in `is` or `if`.

Delays

Certain capabilities control padding in the terminal driver. These are primarily needed by hardcopy terminals. The delays should be embedded as padding information in the `cr`, `sf`, `le`, `ff`, and `ta` capabilities. If the numeric capability `pb` (padding baud rate) is given, these values can be ignored at baud rates below the value of `pb`. The delays can also be given as (obsolete) numeric capabilities instead: `dC`, `dN`, `dB`, `dF`, and `dT`.

Miscellaneous

If the terminal requires other than a NUL (zero) character as padding, this can be given as `pc`. Only the first character of the `pc` string is used.

If the terminal has commands to save and restore the position of the cursor, give them as `sc` and `rc`.

If the terminal has an extra "status line" that is not normally used by software, this fact can be indicated. If the status line is viewed as an extra line below the bottom line, then the Boolean capability `hs` should be given. Special strings to go to a position in the status line and to return from the status line can be given as `ts` and `fs`. (`fs` must leave the cursor position in the same place that it was before `ts`. If necessary, the `sc` and `rc` strings can be included in `ts` and `fs` to get this effect.) The capability `ts` takes one parameter, which is the column number of the status line to which the cursor is to be moved. If escape sequences and other special commands such as tab work while in the status line, the flag `es` can be given. A string that turns off the status line (or otherwise erases its contents) should be given as `ds`. The status line is normally assumed to be the same width as the rest of the screen, that is, `co`. If the status line is a different width (possibly because the terminal does not

allow an entire line to be loaded), then its width in columns can be indicated with the numeric parameter `ws`.

If the terminal can move up or down half a line, this can be indicated with `hu` (half-line up) or `hd` (half-line down). This is primarily useful for superscripts and subscripts on hardcopy terminals. If a hardcopy terminal can eject to the next page (form feed), give this as `ff` (usually `^L`).

If there is a command to repeat a given character a given number of times (to save time transmitting a large number of identical characters), this can be indicated with the parameterized string `rp`. The first parameter is the character to be repeated and the second is the number of times to repeat it.

If the terminal has a settable command character, such as the Tektronix 4025, this can be indicated with `CC`. A prototype command character is chosen which is used in all capabilities. This character is given in the `CC` capability to identify it. The following convention is supported on some UNIX systems: The environment is searched for a **CC** variable, and if found, all occurrences of the prototype character are replaced by the character in the environment variable. This use of the **CC** environment variable is a very bad idea, however, because it conflicts with `make`(1).

Terminal descriptions that do not represent a specific kind of known terminal, such as *switch*, *dialup*, *patch*, and *network*, should include the `gn` (generic) Boolean capability so that programs can complain that they do not know how to work with that terminal. (This capability does not apply to virtual terminal descriptions for which the escape sequences are known.)

If the terminal uses XOFF/XON (DC3/DC1) handshaking for flow control, give `xo`. Padding information should still be included so that routines can make better decisions about costs, but actual pad characters will not be transmitted.

If the terminal has a "meta key" which acts as a shift key, setting the eighth bit of any character transmitted, then this fact can be indicated with `km`. Otherwise, software will assume that the eighth bit is parity and it will usually be cleared. If strings exist to turn this "meta mode" on and off, they can be given as `mm` and `mo`.

If the terminal has more lines of memory than will fit on the screen at once, the number of lines of memory can be indicated with `lm`. An explicit value of 0 indicates that the number of lines is not fixed, but that there is still more memory than fits on the screen.

If the terminal is one of those supported by the UNIX system virtual terminal protocol, the terminal number can be given as `vt`.

Media copy strings which control an auxiliary printer connected to the terminal can be given as `ps`: print the contents of the screen; `pf`: turn off the printer; and `po`: turn on the printer. When the printer is on, all text sent to the terminal will be sent to the printer. It is undefined whether the text is also displayed on the terminal screen when the printer is on. A variation `pO` takes one parameter and leaves the printer on for as many characters as the value of the parameter, then turns the printer off. The parameter should not exceed 255. All text, including `pf`, is transparently passed to the printer while `pO` is in effect.

Glitches and Braindamage

Hazeltine terminals, which do not allow tilde (~) characters to be displayed, should indicate `hz`.

The `nc` capability, now obsolete, formerly indicated Datamedia terminals, which echo **\r \n** for carriage return then ignore a following linefeed.

Terminals that ignore a linefeed immediately after an `am` wrap, such as the Concept, should indicate `xn`.

If `ce` is required to get rid of standout text (instead of merely writing normal text on top of it), `xs` should be given.

Teleray terminals, where tabs turn all characters moved over to blanks, should indicate `xt` (destructive tabs). This glitch is also taken to mean that it is not possible to position the cursor on top of a "magic cookie", and that to erase standout mode it is necessary to use delete and insert line.

The Beehive Superbee, which is unable to correctly transmit the `ESC` or `^C` characters, should specify `xb`, indicating that the "f1" key is used for `ESC` and "f2" for `^C`. (Only certain Superbees have this problem, depending on the ROM.)

You may correct other specific terminal problems by adding more capabilities of the form *xx*.

FILES

`/etc/termcap` file containing terminal descriptions

SEE ALSO

`make`(1) and `vi`(1) in the *User's Reference for the DG/UX System*.
`termcap`(3X), `curses`(3X), `printf`(3S), `term`(5), `terminfo`(4), in the *Programmer's Reference for the DG/UX System*.
`captoinfo`(1M) and `infocmp`(1M) in *System Manager's Reference for the DG/UX System*.

CAVEATS AND BUGS

`Note: termcap` is made obsolete by `terminfo`(4). The transition will be relatively painless if capabilities flagged as "obsolete" are avoided.

Lines and columns are now stored by the kernel as well as in the *termcap* entry.

The total length of a single entry (excluding only escaped newlines) may not exceed 1024 characters.

Not all programs support all entries.

NAME

types – primitive system data types

SYNOPSIS

```
#include <sys/types.h>
```

DESCRIPTION

The data types defined in the include file are used in DG/UX system code; some data of these types are accessible to user code:

```
typedef struct { int r[1]; } *physadr;
typedef long    clock_t;
typedef long    daddr_t;
typedef char *      caddr_t;
typedef unsigned char   unchar;
typedef unsigned short  ushort;
typedef unsigned int    uint;
typedef unsigned long   ulong;
typedef unsigned long   ino_t;
typedef int     pid_t;
typedef int     uid_t;
typedef int     gid_t;
typedef ulong   nlink_t;
typedef ulong   mode_t;
typedef short   cnt_t;
typedef long    time_t;
typedef int     label_t[10];
typedef ulong   dev_t;
typedef long    off_t;
typedef long    pid_t;
typedef long    paddr_t;
typedef int     key_t;
typedef unsigned char   use_t;
typedef short   sysid_t;
typedef short   index_t;
typedef short   lock_t;
typedef unsigned int    size_t;
```

The form *daddr_t* is used for disk addresses except in an i-node on disk; see `fs`(4). Times are encoded in seconds since 00:00:00 GMT, January 1, 1970. The major and minor parts of a device code specify kind and unit number of a device and are installation-dependent. Offsets are measured in bytes from the beginning of a file. The *label_t* variables are used to save the processor state while another process is running.

SEE ALSO

fs(4).

NAME

ucontext – user context

SYNOPSIS

```
#include <ucontext.h>
```

DESCRIPTION

The ucontext structure defines the context of a thread of control within an executing process.

The ucontext_t structure is defined in <sys/ucontext.h>.

SEE ALSO

getcontext(2), setcontext(2), sigaction(2), sigprocmask(2), sigaltstack(2),

NAME

ustat – data returned by the ustat system call

SYNOPSIS

```
#include <sys/types.h>
```

DESCRIPTION

The system call `ustat` takes a parameter that is a pointer to the structure defined by this include file. This structure returns file system device statistics.

```
struct  ustat
{
    daddr_t             f_tfree;
    ino_t         f_tinode;
    char          f_fname [6];
    char          f_fpack [6];
};
```

The fields of this structure are defined as follows:

`f_tfree`
: The number of blocks with a size of DEV_BSIZ bytes that are available for allocation on the file system.

`f_tinode`
: The number of additional files that can be created on the file system.

`f_fname`
: The file system name. This field will be null unless a label has been added to the file system with `labelit`.

`f_fpack`
: The file system pack name. This field will be null unless a label has been added to the file system with `labelit`.

FILES

`/usr/include/sys/ustat.h`
`/usr/include/sys/types.h`

SEE ALSO

`labelit`(1M), `ustat`(2), `types`(5).

NAME

`values` – machine-dependent values

SYNOPSIS

```
#include <values.h>
```

DESCRIPTION

This file contains a set of manifest constants, conditionally defined for particular processor architectures.

The model assumed for integers is binary representation (one's or two's complement), where the sign is represented by the value of the high-order bit.

`BITS(`*type*`)` The number of bits in a specified type (e.g., `int`).

`HIBITS` The value of a short integer with only the high-order bit set.

`HIBITL` The value of a long integer with only the high-order bit set.

`HIBITI` The value of a regular integer with only the high-order bit set.

`MAXSHORT` The maximum value of a signed short integer.

`MAXLONG` The maximum value of a signed long integer.

`MAXINT` The maximum value of a signed regular integer.

`MAXFLOAT, LN_MAXFLOAT`
The maximum value of a single-precision floating-point number, and its natural logarithm.

`MAXDOUBLE, LN_MAXDOUBLE`
The maximum value of a double-precision floating-point number, and its natural logarithm.

`MINFLOAT, LN_MINFLOAT`
The minimum positive value of a single-precision floating-point number, and its natural logarithm.

`MINDOUBLE, LN_MINDOUBLE`
The minimum positive value of a double-precision floating-point number, and its natural logarithm.

`FSIGNIF` The number of significant bits in the mantissa of a single-precision floating-point number.

`DSIGNIF` The number of significant bits in the mantissa of a double-precision floating-point number.

SEE ALSO

`intro`(3), `math`(5), `limits`(4).

NAME

varargs – handle variable argument list

SYNOPSIS

```
#include <varargs.h>

va_alist

va_dcl

va_list pvar;

void va_start(va_list pvar);

type va_arg(va_list pvar, type);

void va_end(va_list pvar);
```

DESCRIPTION

This set of macros allows portable procedures that accept variable argument lists to be written. Routines that have variable argument lists [such as `printf`(3S)] but do not use `varargs` are inherently non-portable, as different machines use different argument-passing conventions.

`va_alist` is used as the parameter list in a function header.

`va_dcl` is a declaration for `va_alist`. No semicolon should follow `va_dcl`.

`va_list` is a type defined for the variable used to traverse the list.

`va_start` is called to initialize `pvar` to the beginning of the list.

`va_arg` will return the next argument in the list pointed to by `pvar`. *type* is the type the argument is expected to be. Different types can be mixed, but it is up to the routine to know what type of argument is expected, as it cannot be determined at run-time.

`va_end` is used to clean up.

Multiple traversals, each bracketed by `va_start` and `va_end`, are possible.

EXAMPLE

This example is a possible implementation of `execl` [see `exec`(2)].

```
#include <unistd.h>
#include <varargs.h>
#define MAXARGS   100

/*    execl is called by
            execl(file, arg1, arg2, ..., (char *)0);
*/
execl(va_alist)
va_dcl
{
      va_list ap;
      char *file;
      char *args[MAXARGS];          /* assumed big enough*/
      int argno = 0;

      va_start(ap);
      file = va_arg(ap, char *);
      while ((args[argno++] = va_arg(ap, char *)) != 0)
            ;
```

```
        va_end(ap);
        return execv(file, args);
}
```

SEE ALSO

exec(2), printf(3S), vprintf(3S), stdarg(5).

NOTES

It is up to the calling routine to specify in some manner how many arguments there are, since it is not always possible to determine the number of arguments from the stack frame. For example, `execl` is passed a zero pointer to signal the end of the list. `printf` can tell how many arguments are there by the format.

It is non-portable to specify a second argument of `char`, `short`, or `float` to `va_arg`, since arguments seen by the called function are not `char`, `short`, or `float`. C converts `char` and `short` arguments to `int` and converts `float` arguments to `double` before passing them to a function.

`stdarg` is the preferred interface.

NAME

wstat – wait status

SYNOPSIS

```
#include <sys/wait.h>
```

DESCRIPTION

When a process waits for status from its children via either the `wait` or `waitpid` function, the status returned may be evaluated with macros, defined in `sys/wait.h`. These macros evaluate to integral expressions. The *stat* argument to these macros is the integer value returned from `wait` or `waitpid`.

See the `wait` man page for complete descriptions of these macros.

SEE ALSO

`exit`(2), `wait`(2), `waitpid`(3C).

End of Chapter

Chapter 6
Communications Protocols

This chapter contains in printed form the online manual entries for DG/UX, TCP/IP, and ONC/NFS communications protocols. Some entries in this chapter are generic to the DG/UX system; others relate specifically to TCP/IP or ONC/NFS.

Table 6-1 summarizes the man pages in this chapter:

Table 6-1 Summary of Communications Protocol Manual Pages

Product	Name	Description
DG/UX	**dot3**(6P)	Describes the IEEE 802.3 protocol
	snap(6P)	Describes the Subnetwork Access Protocol
	unix_ipc(6F)	Describes piping communications within a host
TCP/IP	**intro**(6)	Introduces the TCP/IP protocol family
	inet(6F)	Provides more detail about the TCP/IP protocol family
	ip(6)	Internet protocol
	tcp(6P)	Transport control protocol
	udp(6P)	User datagram protocol
ONC/NFS	**nfs**(6P)	Describes the Network File System protocol

NAME

intro – Communications Protocols introduction to networking facilities

SYNOPSIS

```
#include <netinet/tcp.h>
#include <netinet/udp.h>
#include <netinet/ip.h.
#include <netinet/ip_icmp.h>
#include <net/if.h>
```

DESCRIPTION

This section briefly describes the DG/UX system networking facilities. Documentation in this section covers three areas: the Internet protocol family, the available protocols, and the network interfaces. The Internet protocol family is described on the inet(6F) manual page, whereas entries describing the protocols are on manual pages marked *6P*. Network interfaces are described on manual pages marked *6*.

The Internet family includes the Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Internet Protocol (IP), and Internet Control Message Protocol (ICMP). These protocols are communications facilities implemented in the DG/UX system kernel that transfer information from user programs to the network and back. Programmers writing user-level programs can access TCP, IP, and UDP with the socket(2) family of system calls and the Transport Layer Interface (TLI) library orutines.

The Transmission Control Protocol (TCP) fits into the layered networking architecture just above IP. Application programs, such as remote terminal agents and file transfer agents, usually run on top of TCP, using its services.

TCP assures reliable end-to-end delivery of a data byte stream. TCP deals with user data copied to the protocol's buffers. It packages the data into segments and passes this information to IP, which then breaks the information into packets that can be easily transmitted across the network. IP then determines the next hop on a path through the network for the packet being transmitted and transfers the packet to the first host on the path. A gateway host would receive the packet and route it to the destination host. When packets arrive at the destination host, TCP reconstructs the entire message, checking to ensure that the data is complete and correctly ordered before sending it to application programs. If there is a problem, TCP requests that the message be retransmitted.

Like TCP, the User Datagram Protocol (UDP) fits into the layered networking architecture just above IP. It provides procedures for application programs to send messages to other programs with a minimum of protocol mechanism. UDP is a simple datagram protocol. Unlike TCP, it neither guarantees reliable delivery nor does it provide protection from duplicate messages.

The Internet Protocol (IP) is primarily concerned with getting a *datagram* to the next host on the route to the datagram's final destination. A datagram is a self contained package of data carrying sufficient information for hosts to deliver it to its destination. Since host availability changes, the packets that make up a complete message may have different routes and may end up at the destination out of their original order. The TCP layer is responsible for re-ordering the packets correctly. Some packets may be lost or garbled in transmission. IP frequently notifies higher level protocols when packets are lost or damaged, but sometimes does not.

The Internet Control Message Protocol (ICMP) is used to report errors in datagram processing. ICMP is an integral part of IP and must be implemented by every IP

module. ICMP messages are sent to report problems in the communication environment, not to make IP a reliable protocol.

Addressing

Associated with each protocol family is an address format. The following address formats are used by the system:

```
#define AF_UNIX 1   /* local to host (pipes) */
#define AF_INET 2   /* internetwork: UDP, TCP, etc. */
```

Interfaces

Each network interface in a system corresponds to a path through which messages may be sent and received. A network interface usually has a hardware device associated with it, though certain interfaces such as the loopback interface, `loop`(7), do not.

The following `ioctl` calls may be used to manipulate network interfaces. See *Programming with TCP/IP on the DG/UX™ System* for details.

`SIOCSIFADDR`
: Set interface address. Following the address assignment, the "initialization" routine for the interface is called.

`SIOCGIFADDR`
: Get interface address.

`SIOCSIFBRDADDR`
: Set interface broadcast address. This address is used to send IP broadcast packets on broadcast capbable interfaces.

`SIOCGIFBRDADDR`
: Get interface broadcast address.

`SIOCSIFDSTADDR`
: Set the destination address for point-to-point network interfaces.

`SIOCGIFDSTADDR`
: Get interface destination address.

`SIOCSIFMETRIC`
: Set the interface routing metric. This information is used by routing applications.

`SIOCGIFMETRIC`
: Get the interface routing metric.

`SIOCSIFNETMASK`
: Set the interface subnetwork mask.

`SIOCGIFNETMASK`
: Get the interface subnetwork mask.

`SIOCSIFFLAGS`
: Set interface flags field. If the interface is marked as down, any processes currently routing packets through the interface are notified.

`SIOCGIFFLAGS`
: Get interface flags.

`SIOCGIFCONF`
: Get interface configuration list.

SEE ALSO

`ioctl`(2), `socket`(2), *Programming with TCP/IP on the DG/UX System*.

NAME

dot3 – IEEE 802.3 carrier sense multiple access with collision detection

DESCRIPTION

IEEE project 802 has defined specifications for the lowest two layers of an OSI model network architecture, the physical layer and the data link layer. Project 802 focuses on the implementation of these layers for a local area network. It divides the data link layer into a logical link control (LLC) sublayer and a media access control (MAC) sublayer.

802.3 is a MAC sublayer that operates below the LLC sublayer. 802.3 is a standard for providing carrier sense multiple access with collision detection (CSMA/CD).

Data General's dot3 is a Streams module that sits on top of the Ethernet device driver to provide 802.3 functionality to upper-level protocols. This module, when used with the llc(7) multiplexor, allows the dgen, hken, or inen Ethernet device driver to be used to provide IEEE 802.3 functionality to one stream while providing Ethernet functionality to other streams.

Because of the fact that the 802.3 standard uses a length field instead of a type field in its header (as in Ethernet), it is not possible for more than one stream to the ethernet device to have the dot3 module in it. The reason for this is that it is not possible to demultiplex based on the length field of the 802.3 packet. The implication of this is that if a stream is open to the inen device that has llc and dot3 in the stream, another stream to the same inen device that tries to push the dot3 module on it will never receive packets upstream, until the first stream with the dot3 is closed.

SEE ALSO

netinit(1M), llc(7), dgen(7), hken(7), inen(7).

NAME

inet – Communications Protocol Internet protocol family

SYNOPSIS

```
#include <netinet/in.h>
```

DESCRIPTION

The Internet protocol family is a collection of protocols based on and including the Internet Protocol (IP), the Transmission Control Protocol (TCP), and the User Datagram Protocol (UDP). Each of these protocols uses the Internet address format.

Addressing

Internet addresses are four-byte quantities, stored in network standard format. The include file `netinet/in.h` defines this address as a discriminated union.

Sockets bound to the Internet protocol family utilize the following addressing structure:

```
struct sockaddr_in {
  short  sin_family;
  u_short      sin_port;
  struct in_addr   sin_addr;
  char   sin_zero[8];
};
```

Sockets may be created with the address INADDR_ANY to affect "wildcard" matching on incoming messages.

Protocols

The Internet protocol family consists of the Internet Protocol (IP), Internet Control Message Protocol (ICMP), Transmission Control Protocol (TCP), and User Datagram Protocol (UDP). TCP is used to support the SOCK_STREAM socket type, while UDP is used to support the SOCK_DGRAM socket type. A raw interface to IP is available by creating an Internet socket of type SOCK_RAW. The ICMP is not directly accessible.

SEE ALSO

ip(6P), tcp(6P), udp(6P).

NAME

IP – Communications Protocol Internet Protocol

INCLUDE FILES

```
#include <sys/socket.h>
#include <netinet/ip.h>
```

SYNOPSIS

This is an example of how you would create an endpoint for the IP connection.

```
s = socket(AF_INET, SOCK_RAW, 0);
```

DESCRIPTION

IP is the network/internetwork layer protocol used by the Internet protocol family. It may be accessed through a "raw socket" when developing special-purpose applications. A raw socket can be opened only by the superuser.

IP sockets are connectionless, and are normally used with the `sendto` and `recvfrom` calls, though the `connect`(2) call may also be used to fix the destination for future packets (in which case the `read`(2) or `recv`(2) and `write`(2) or `send`(2) system calls may be used).

Outgoing packets must have an IP header prepended to them.

OPTIONS

IPPROTO_IP level options recognized by IP:

IP_TX_OPTIONS	IP transmit options. When setting, the system will verify that the option string is well formed.
IP_RX_OPTIONS	IP receive options. When setting, the system will verify that the option string is well formed.
IP_TOS	IP Type Of Service.
IP_TTL	IP Time To Live. Number of routing hops a packet may make before reaching its destination.
IP_DONTFRAG	IP Dont Fragment flag. When non-zero, IP will try to send a packet without fragmenting. If a packet is too large to send without fragmenting, the packet is dropped.

SEE ALSO

`connect`(2), `recv`(2), `send`(2).
`intro`(6), `inet`(6F), *Programming with TCP/IP on the DG/UX System*.

NAME

nfs, NFS – network file system

CONFIG

```
options NFS
```

DESCRIPTION

The Network File System, or NFS, allows a client workstation to perform transparent file access over the network. Using it, a client workstation can operate on files that reside on a variety of servers, server architectures and across a variety of operating systems. Client file access calls are converted to NFS protocol requests, and are sent to the server system over the network. The server receives the request, performs the actual file system operation, and sends a response back to the client.

The Network File System operates in a stateless fashion using remote procedure (RPC) calls built on top of external data representation (XDR) protocol. These protocols are documented in *Managing ONC™/NFS® and Its Facilities on the DG/UX™ System*. The RPC protocol provides for version and authentication parameters to be exchanged for security over the network.

A server can grant access to a specific filesystem to certain clients by adding an entry for that filesystem to the server's `/etc/exports` file and executing the `exportfs -a` command.

A client gains access to that filesystem with the `mount`(2) system call, which requests a file handle for the filesystem itself. Once the filesystem is mounted by the client, the server issues a file handle to the client for each file (or directory) the client accesses. If the file is somehow removed on the server side, the file handle becomes stale (dissociated with a known file).

A server may also be a client with respect to filesystems it has mounted over the network, but its clients cannot gain access to those filesystems. Instead, the client must mount a filesystem directly from the server on which it resides.

The user ID and group ID mappings must be the same between client and server. However, the server maps uid 0 (the super-user) to uid 65534 before performing access checks for a client. This inhibits super-user privileges on remote filesystems. A server can, however, allow root access for specific clients by making an entry in the `/etc/exports` file.

DIAGNOSTICS

Generally physical disk I/O errors detected at the server are returned to the client for action. If the server is down or inaccessible, the client will see the console message:

```
NFS: file server not responding: still trying.
```

For hard-mounted file systems, the client resends the request until it receives an acknowledgement from the server. This means the server can crash or power down, and come back up, without any special action required by the client.

FILES

```
/etc/exports
```

SEE ALSO

`exportfs`(1M), `mount`(1M), `mountd`(1M), `nfsd`(1M), `mount`(2), `exports`(4), `fstab`(4).

NAME

snap - Subnetwork Access Protocol

DESCRIPTION

SNAP is part of the 802.1 layer. SNAP provides a way for protocols that run over Ethernet to run over 802.x media. The SNAP sub-layer contains a five byte header that can be used to specify additional information for upper layers. The first three bytes of the header represents an organizationally unique identifier (OUI) while the last two bytes are locally administered. This structure allows different vendors the flexibility to use the additional bytes of the header as they wish.

One use of SNAP that has been commonly agreed upon is to use an OUI of 0 to represent upper layer protocols that run over an Ethernet based media. The two bytes that are locally administered are then used to represent the two byte ether type field. In this manner, protocols that run over Ethernet are able to use the SNAP layer to run over 802.2 (LLC) and 802.x MAC layers. Data General provides the SNAP functionality in the form of the SNAP pseudo-driver.

SEE ALSO

ifconfig(1M), netinit(1M), dgen(7), hken(7), inen(7), llc(7).

NAME

TCP – Network Protocol Internet Transmission Control Protocol

SYNOPSIS

```
#include <sys/socket.h>
#include <netinet/tcp.h>
```

This is an example of how you would create an endpoint for the TCP connection:

```
s = socket(AF_INET, SOCK_STREAM, 0);
```

DESCRIPTION

Transmission Control Protocol (TCP) provides reliable, flow-controlled, two-way transmission of data. It is a byte-stream protocol used to support the SOCK_STREAM abstraction. TCP provides a per-host collection of port addresses on top of the standard Internet address format. Thus, each address is composed of an Internet address specifying the host and network, with a specific TCP port on the host identifying the peer entity.

Sockets utilizing the TCP are either "active" or "passive". Active sockets initiate connections to passive sockets. By default TCP sockets are created active; only active sockets may use the `connect`(2) call to initiate connections. To create a passive socket, the `listen`(2) system call must be used after binding the socket with the `bind`(2) system call. Only passive sockets may use the `accept`(2) call to accept incoming connections.

Passive sockets may "underspecify" their location to match incoming connection requests from multiple networks. This technique, termed "wildcard addressing", allows a single server to provide service to clients on multiple networks. To create a socket that listens on all networks, the Internet address INADDR_ANY must be bound to the socket. The TCP port may still be specified at this time; if the port is not specified, the system will assign one. Once a connection has been established, the socket's address is fixed by the peer entity's location. The address assigned to the socket is the address associated with the network interface through which packets are being transmitted and received.

OPTIONS

IPPROTO_TCP level options recognized by TCP:

TCP_NODELAY — When the option value is non-zero, the system does not delay sending data to coalesce small packets. When the option value is zero, the system may defer sending data to coalesce small packets to conserve network bandwidth.

TCP_MAXSEG — When set prior to a `connect`(2) call, TCP will use the option value to negotiate the maximum size of TCP packets sent and received during the life of the connection. Values for the TCP Maximum Segment Size are between 1 and 65,535. This option is only valid prior to establishing a connection. The result of segment size negotiation is less than or equal to the option value.

TCP_URGENT_INLINE — This option has no effect in the DG/UX system. Use the SO_OOBINLINE socket level option.

TCP_PEER_ADDRESS — Restricts the passive TCP endpoint to only accept connections

initiated by the address supplied in the option value. The option value must contain a pointer to a sockaddr_in structure.

TCP_ACCEPT_QUEUE_LENGTH
Sets the number of outstanding connections allowed at the TCP passive endpoint.

SEE ALSO

`intro`(6), `inet`(6F), *Programming with TCP/IP on the DG/UX System*.
`getsockopt`(2), `setsockopt`(2).

NAME

UDP – Communications Protocol Internet User Datagram Protocol

SYNOPSIS

```
#include <sys/socket.h>
#include <netinet/udp.h>
```

This is an example of how you would create an endpoint for the UDP connection:

```
s = socket(AF_INET, SOCK_DGRAM, 0);
```

DESCRIPTION

UDP is a simple, unreliable datagram protocol that is used to support the SOCK_DGRAM abstraction for the Internet protocol family.

UDP sockets are connectionless, and are normally used with the sendto(2) and recvfrom(2) calls. The connect(2) and bind(2) calls may also be used to fix the destination for future packets (in which case the recv(2) or read(2) and send(2) or write(2) system calls may be used). Listen(2) and accept(2) are not valid operations on datagram sockets.

SEE ALSO

send(2), recv(2), sendto(2), recvfrom(2).
intro(6), inet(6F), *Programming with TCP/IP on the DG/UX™ System.*

NAME

unix_ipc – piping communications within a host

SYNOPSIS

```
#include <sys/types.h>
#include sys/un.h
```

DESCRIPTION

The unix_ipc protocol is used for interprocess communications within a single host. It supports stream and datagram interfaces.

Addressing

Endpoints can be named by entries in the file system:

```
struct sockaddr_un {
        short sun_family;     /* AF_UNIX */
        char sun_path[SOCKADDR_UN_MAXLEN];  /* pathname */
};
```

SEE ALSO

bind(2), pipe(2).

NOTE

This implementation uses names in the file system; this is subject to change. See NOTES in bind(2).

End of Chapter

Appendix A
Contents and Permuted Index Man Pages

This is a printed copy of the table of contents and the permuted keyword in context index contained in the online **contents**(0) and **index**(0) manual pages. These man pages contain information extracted from the man pages in the DG/UX *Programmer's Reference* (Volumes 1 and 2), *System Manager's Reference*, and *User's Reference*.

The permuted index is a list of keywords, given in the second of three columns, together with the context in which the keyword is found. Keywords are either topical keywords or the names of manual entries. Entries are identified with their chapter numbers shown in parentheses. The right column lists the name of the manual page on which each keyword may be found. The left column contains useful information about the keyword.

TABLE OF CONTENTS

This manual page contains the following sections:

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2. System Calls
3. Subroutines and Libraries
4. File Formats
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6. Communications Protocols
7. System Special Files
8. System Maintenance Procedures

1. Commands and Application Programs

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PERMUTED INDEX

End of Chapter

Index

Note: Boldfaced page numbers (e.g., **1-5**) indicate definitions of terms or other key information.

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Related Documents

The following list of related manuals gives titles of Data General manuals followed by nine-digit numbers used for ordering. You can order any of these manuals via mail or telephone (see the TIPS Order Form in the back of this manual).

For a complete list of AViiON® and DG/UX™ manuals, see the *Guide to AViiON® and DG/UX™ Documentation* (069-701085). The on-line version of this manual found in **/usr/release/doc_guide** contains the most current list.

Data General Software Manuals

User's Manuals

User's Reference for the DG/UX™ System
Contains an alphabetical listing of DG/UX, TCP/IP, and ONC/NFS manual pages for commands relating to general system operation. Ordering Number — 093-701054

Using the DG/UX™ Editors
Describes the text editors **vi** and **ed**, the batch editor **sed**, and the command line editor **editread.** Ordering Number — 069-701036

Using the DG/UX™ System
Describes the DG/UX system and its major features, including the C and Bourne shells, typical user commands, the file system, and communications facilities such as **mailx**. Ordering Number — 069-701035

Installation and Administration Manuals

Managing ONC™/NFS® and Its Facilities on the DG/UX™ System
Explains how to manage and use the DG/UX ONC™/NFS® product. Contains information on the Network File System (NFS), the Network Information Service (NIS), Remote Procedure Calls (RPC), and External Data Representation (XDR). Ordering Number — 093-701049

System Manager's Reference for the DG/UX™ System
Contains an alphabetical listing of DG/UX, TCP/IP, and ONC/NFS manual pages for commands relating to system administration or operation. Ordering Number — 093-701050

Programming Manuals

Porting and Developing Applications on the DG/UX™ System
A compendium of useful information for experienced programmers developing or porting applications to the DG/UX™ system. It includes information on how to: set up your environment, use the software development tools, compile and link programs, port to the windowing environment, and build BCS applications. It also describes available debuggers and the various industry standards the DG/UX system supports. Ordering Number — 069-701059

Programmer's Guide: ANSI C and Programming Support Tools (UNIX System V Release 4)
Describes the standard tools of the UNIX program development environment including compiling, linking, debugging, and analysis and revision control. An accompanying supplement, *Supplement for Programmer's Guide: ANSI C and Programming Support Tools* (086-000180) describes the DG/UX system enhancements and differences. Ordering Number — 093-701104

Programmer's Guide: Systems Services and Application Packaging Tools (UNIX System V Release 4)
Describes standard programming procedures and interfaces available to the C application developer in the UNIX environment. Topics include interprocess communications, memory management, file and record locking and application packaging. **Note:** Chapters 5 and 9 of this Prentice Hall manual discuss topics that do not apply to the DG/UX system. Ordering Number — 093-701103

Programmer's Reference for the DG/UX™ System, (Volume 1)
Alphabetical listing of manual pages for DG/UX programming commands and system calls. This is part of a three-volume set. Ordering Number — 093-701055

Programmer's Reference for the DG/UX™ System, (Volume 2)
Alphabetical listing of manual pages for DG/UX and ONC/NFS subroutines and libraries. This is part of a three-volume set. Ordering Number — 093-701056

Programming with TCP/IP on the DG/UX™ System
Describes how to use the socket system calls and Transport Layer Interface (TLI library routines to access TCP, UDP, and IP protocol software. Ordering Number — 093-701024

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