Programming with DOMAIN Advanced System Calls

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Preface

This manual describes newly released DOMAIN system calls. These calls are in addition to those released in the *DOMAIN System Call Reference*. This manual is intended to provide adequate documentation and syntax information for many existing system calls. This reference material is intended for programmers who have experience programming with DOMAIN system routines and insert files.

This manual is divided into two parts. Part I contains a general overview of a separate operating subsystem (e.g., the Command Line Handler, File and Tree Utility). Most chapters conclude with a sample program in Pascal demonstrating the calls.

Part II consists of reference information similar to the *DOMAIN System Call Reference*. Each subsystem has its own section, which contains the data types the subsystem uses, the syntax of its programming calls, and the error messages it generates.

Some calls described in this book belong to released subsystems (PM, PROC2, and RWS) that are described in the *DOMAIN System Call Reference* manual. To make it easy for you to incorporate this information, we repeated the entire sections, marking the new material with revision bars. This way, you can replace the entire section in your copy of the manual.

For easy organization, the sections in Part II are in *alphabetical order by subsystem name*. We numbered the pages of Part II by subsystem. For example, the third page in the CL section is page CL-3.

You should use this manual with the programming handbooks listed under Related Documents. These programming handbooks give detailed instructions about using these programming calls.

Audience

This manual is intended for advanced programmers who are writing application programs using DOMAIN system calls. Readers of this manual should be familiar with general DOMAIN system calls as described in *Programming with General System Calls*. They should also have experience with FORTRAN, Pascal, or C and the operating system as described in the *DOMAIN System User's Guide*. This manual is not intended as a tutorial document, but as a reference for programmers who need to use operating system calls.

Related Documents

The *Programming With General System Calls* handbook (005506), documents how to write programs that use standard DOMAIN system calls including the ACLM, CAL, EC2, ERROR, MTS, NAME, PAD, PBUFS, PFM, PGM, PM, PROC1, PROC2, RWS, SIO, STREAM, TIME, TONE, TPAD, and VFMT calls.

The *Programming With System Calls for Interprocess Communication* handbook (005696), documents how to write programs that use the DOMAIN interprocess facilities including the MBX, MS, IPC, MUTEX, and EC2 calls.

The *Programming With DOMAIN 2D Graphics Metafile Resource* handbook (005097), documents how to write programs that use the DOMAIN 2D Graphics Metafile Resource.

The *Programming With DOMAIN Graphic Primitives* handbook (005808), documents how to write graphics programs that use the DOMAIN Graphics Primitive Resource.

Documentation Conventions

Unless otherwise noted in the text, this manual uses the following symbolic conventions.

UPPERCASE	Uppercase words or characters in formats and command descriptions represent keywords that you must use literally.
lowercase	Lowercase words or characters in formats and command descriptions represent values that you must supply.
[ ]	Square brackets enclose optional items.
{ }	Braces enclose a list from which you must choose an item.
|	A vertical bar separates items in a list of choices.
< >	Angle brackets enclose the name of a key on the keyboard.
CTRL/Z	The notation CTRL/ followed by the name of a key indicates a control character sequence. Hold down <CTRL> while you type the character.
. . .	Horizontal ellipsis points indicate that you can repeat the preceding item one or more times.
.	Vertical ellipsis points mean that we have omitted irrelevant parts of a figure or example.

Problems, Questions, and Suggestions

We appreciate comments from the people who use our system. In order to make it easy for you to communicate with us, we provide the User Change Request (UCR) system for software-related comments, and the Reader's Response form for documentation comments. By using these formal channels, you make it easy for us to respond to your comments.

You can get more information about how to submit a UCR by consulting the *DOMAIN System Command Reference* manual. Refer to the CRUCR (Create User Change Request) Shell command description. You can view the same description on-line by typing:

$ HELP CRUCR <RETURN>

For documentation comments, a Reader's Response form is located at the back of each manual.

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Part I. Using the DOMAIN Advanced System Calls

Chapter 1
Parsing the Command Line

The Common Command Line Handler (CL) is a set of DOMAIN system routines that provides an easy and consistent way to read tokens from the command line. CL can perform the following:

- Expand wildcards to existing pathnames
- Handle derived names
- Handle names-file input when the user specifies the "*" operator
- Parse command lines from the keyboard or specified files.

Before reading this chapter, you should be familiar with the user-visible features of CL. These features are described in detail in the *DOMAIN System Command Reference* manual and the *DOMAIN System User's Guide*.

CL calls are often used in conjunction with File & Tree Utility (FU) calls. For more examples of the CL, you might want to refer to Chapter 2, Using the File and Tree Utility (FU).

1.1. System Calls, Insert Files, and Data Types

To use the CL manager, use the system calls with the CL prefix. This chapter describes how most of these calls work. For details on CL call syntax, data types, and error messages, see Part II of this manual.

When using CL system calls in your program, you must specify the appropriate insert file for the language your are using. The CL insert files are

/SYS/INS/CL.INS.C	for C.
/SYS/INS/CL.INS.FTN	for FORTRAN.
/SYS/INS/CL.INS.PAS	for Pascal.

1.2. Overview of the CL Manager

Before we describe how the CL manager works, we need to define a few terms that it uses.

A **token** is a text string that CL reads from the command line and parses according to the Shell parsing rules.

A **names-file** is a text file containing pathnames. CL reads the contents of a names-file as if it appeared on the command line. Tokens in a names-file can be delimited by spaces, or the NEWLINE character.

A **flag** is a token beginning with the hyphen, "-". Flags allow you to specify special actions so that the user can make optional choices on the command line.

While we refer to hyphenated words as flags, the *DOMAIN System Command Reference* manual refers to them as **options**. Also, some CL system calls refer to flags as **keywords**.

An **argument** is any token that is not a flag.

A **wildcard-name** is an argument that represents one or more existing pathnames. CL accepts wildcard characters as part of pathname arguments, and expands them to pathnames. These wildcard characters are listed in the *DOMAIN System Command Reference* manual.

A **derived name** is a name that is derived from another name. For example, Shell commands handle derived names with the = wildcard. The Shell command line **$ cpf name =.derived** copies the file "name" to "name.derived." For details on derived names, see the *DOMAIN System Command Reference* manual.

When the CL manager reads the command line, it places each token from the command line and any names-files into an individual **token record**. The token records form a linked list or **token list**, which resides in scratch space. Initially, the **token pointer** points to the head of the list. When using CL system calls to read tokens from the list, the token pointer keeps track of the most recent token read.

Figure 1-1 shows the structure of a token list.

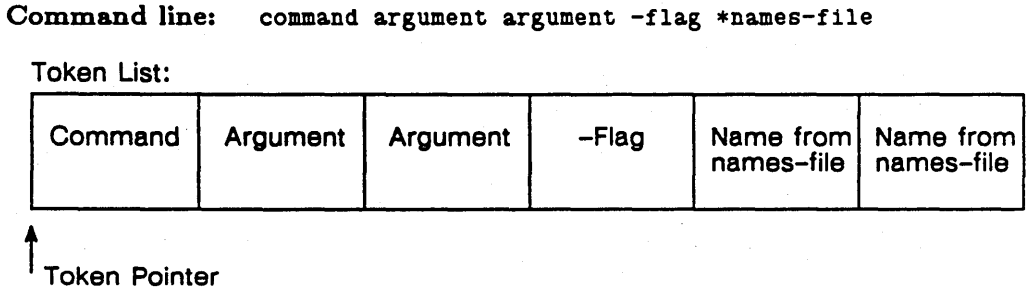


Figure 1-1. Structure of a Command Line Token List

Once you initialize the CL, you make other CL calls to read the flags and names from the command line. When making these calls, the CL refers to the token list, not the command line or names-files.

NOTE: **CL does not expand wildcards at initialization because it cannot determine which tokens represent names. Wildcard names and derived names are expanded later.**

When you make calls to get tokens, CL checks the token list for the token and marks it "used." Usually, once CL marks a token used, you cannot refer to it again. You can refer to a used token when handling derived names, or using any of the CL_$REREAD system calls. See Part II of this manual for details.

When using the CL manager to parse your command line, you usually perform the following steps:

1. Use CL_$INIT to initialize the token list on which all subsequent CL calls operate.

2. Use the appropriate GET_FLAG system call to read the token list for flags.

3. If flags require arguments, get the associated arguments using the appropriate call: CL_$GET_NAME for pathnames, CL_$GET_NUM for numbers, or CL_$GET_ARGS for character strings.

4. Check the token list for unclaimed flags with CL_$CHECK_UNCLAIMED.

5. Establish a loop to read the token list for arguments using the appropriate system call: CL_$GET_NAME for pathnames, CL_$GET_NUM for numbers, or CL_$GET_ARGS for character strings.

Figure 1-2 shows the basic model of for parsing the command line using CL calls. The next few sections describe these calls in detail.

```
. { List include files, CONST, VAR sections }
.
.

BEGIN { Main }

   cl_$init ( . . . );

{ Get specified flags. }

    IF cl_$get_flag ( . . . ) THEN . . .;

{ Get argument associated with flag. }

    IF cl_$get_flag ( . . . ) THEN BEGIN

        IF NOT  cl_$get_arg ( . . . )
             THEN  error_routine

             ELSE          { Convert to desired type, if necessary.
                             Handle arguments. }
        END; { if }

{ Check for any erroneous options that the user specified. }

    cl_$check_unclaimed;

{ Establish a loop to read names or other arguments. }

    WHILE  cl_$get_name ( . . . )

         DO BEGIN
            .
            .              { Do work here. }
            .
           END; { do begin }
END.   { Program }
```

Figure 1-2. Model for Parsing the Command Line

If an error occurs during a CL system call, CL prints an error message and performs a PGM_$EXIT and terminates your program. To prevent your program from terminating, you can set up a clean-up handler, as described in the *Programming with General System Calls* manual.

The next sections describe how to use specific CL calls to initialize the CL manager and get tokens from the token list.

1.3. Initializing the CL Manager

When using the CL manager to handle the command line, you must first initialize it by calling CL_$INIT or CL_$SETUP. CL_$INIT initializes CL and parses the command line according to the Shell parsing rules.

CL_$SETUP is like CL_$INIT in that it initializes CL manager, but it doesn't parse the command line. It allows you to supply a different source for the tokens, for example, from a file or interactively from the keyboard. You supply the additional CL parsing routines to perform the parsing. (For details, see Section 1.3.3.)

When you initialize CL, you can specify certain options to control how CL reads the tokens from the command line. These options affect how CL interacts with the user. For example, you can tell CL not to expand any wildcards, or to verify each pathname it reads with the user.

Table 1-1 lists the various CL calls that you can use to initialize CL and set up options. Sections 1.3.1 and 1.3.2 describe the options you can specify when initializing the CL manager. Section 1.3.3 is an example of initializing CL.

Table 1-1. System Calls to Initialize the CL Manager

System Call Name	Description
CL_$INIT	Initializes the command line handler, parsing the command line according to the Shell parsing rules.
CL_$SETUP	Initializes the command line handler, but does not load anything to parse. Use this call when the tokens come from a file or keyboard instead of the command line. You call one of the following CL parse calls to specify where the tokens are.
CL_$PARSE_LINE	Supplies the line for CL to parse. On subsequent calls, CL returns information from this line. It discards any previous arguments.
CL_$PARSE_INPUT	Reads a line from the specified stream ID and hands it to CL_$PARSE_LINE. Returns TRUE if successful, FALSE if it encounters the end-of-file character.

Table 1-1. System Calls to Initialize the CL Manager, Cont.

System Call Name	Description
CL_$PARSE_ARGS	Gets arguments from the keyboard. Use this after getting arguments with CL_$GET_ARG. This call disregards the first argument, because it assumes that it is the command name.
CL_$SET_WILD_OPTIONS	Defines the wildcard options for the wildcard manager.
CL_$SET_NAME_PREFIX	Defines a character string prefix to add before each name specified on the command line. For example, you might want to add the prefix /sys/print, to names on a print queue command.
CL_$SET_DERIVED_COUNT	Specifies the number of derived names allowed to follow each wildcard name. The default value is 1.
CL_$SET_OPTIONS	Adds specified options to the CL option set defined in the CL_$INIT or CL_$SETUP call.
CL_$RESET_OPTIONS	Replaces the previously defined CL option set with the specified CL option set.

1.3.1. Defining CL Options

You can control how the CL reads the command line by specifying CL options with the CL_$INIT or CL_$SETUP call. You can let CL define a set of these options automatically, by specifying the default empty brackets, []. Or, you can specify alternative CL options, by listing the CL options in the brackets.

Table 1-2 lists the default set of options, and their alternatives. Note that you can specify only one alternative per default option; the alternatives are mutually exclusive.

Table 1-2. CL Options

Default Option	Mutually-Exclusive Alternatives
CL_$WILDCARDS Causes CL_$GET_NAME to expand wildcards and return the expanded names.	CL_$NO_WILDCARDS Causes CL_$GET_NAME to return wildcard-names verbatim; it does not expand them.
CL_$NO_MATCH_WARNING Displays a warning message on error output when a wildcard does not match existing pathnames.	CL_$NO_MATCH_OK Displays no warning or error message when a wildcard does not match existing pathnames. CL_$NO_MATCH_ERROR Displays an error message on error output, and terminates the program when a wildcard does not match an existing pathname.
CL_$VERIFY_NONE CL_$GET_NAME does *not* verify any names with the by user.	CL_$VERIFY_WILD CL_$GET_NAME verifies only names expanded wildcards with the user. CL_$VERIFY_ALL CL_$GET_NAME verifies all names with the user.
CL_$STAR_NAMES Allows the user to specify names-files with the "*" operator.	CL_$NO_STAR_NAMES Does not allow users to specify names-files. Treats the "*" just like any other character.
CL_$KEYWORD_DELIM Prevents CL_$GET_ARG and CL_$GET_NAME from returning an "unused" flag as an argument. The calls return FALSE if they find a flag.	CL_$NO_KEYWORD_DELIM Causes no special treatment of unread flags by CL_$GET_ARG and CL_$GET_NAME. The procedures return the flags as if they were arguments.
CL_$DASH_NOP CL treats the hyphen "-" as a name. Normally, the hyphen is an identifier for the standard input stream.	CL_$DASH_NAMES CL reads names from standard input when it finds a hyphen.*

Table 1-2. CL Options, Cont.

Default Option	Mutually-Exclusive Alternatives
CL_$DASH_DFT_NOP Suppresses any special action when there are no arguments on the command line. CL_$NO_COMMENTS Causes no special treatment of characters enclosed in brackets.	CL_$NAME_DFT_STDIN Causes CL to read names from standard input if no arguments appear on the command line.* CL_$COMMENTS Causes CL to ignore all characters enclosed in brackets when reading a names-file. Do not use this in commands that accept derived names because you must use brackets to specify the tag expressions you want to use in a derived name.

* Made available to remain compatible with previous software releases. Obsolete for new software development.

You can add options to the current CL option set at another time during your program by using the CL_$SET_OPTIONS call. If you want to remove options from the current CL option set, you can specify an entirely new set of CL options with CL_$RESET_OPTIONS. CL_$RESET_OPTIONS replaces the previously defined CL option set with the option set specified in the call.

Example 1-1 shows how a program changes the set of CL options.

Initialize CL with specified CL options:

This CL options set contains CL_$NO_WILDCARDS, plus the default options: CL_$VERIFY_NONE, CL_$STAR_NAMES, CL_$KEYWORD_DELIM, CL_$DASH_NOP, CL_$DASH_DFT_NOP, CL_$NO_COMMENTS.

```
cl_$init ( [cl_$no_wildcards],     { Returns wildcards literally }
           program_name,           { Name of program }
           sizeof(program_name)); { Length of program name }
```

Add to the current set of CL options:

This CL options set adds CL_$VERIFY_ALL to the option set listed above:

```
cl_$set_options ([cl_$verify_all]);    { Verify all names }
```

Example 1-1. Redefining the CL Options Set

Replace the current list of options with a new set:

This CL options set contains the default set of options: CL_$WILDCARDS, CL_$VERIFY_NONE, CL_$STAR_NAMES, CL_$KEYWORD_DELIM, CL_$DASH_NOP, CL_$DASH_DFT_NOP, CL_$NO_COMMENTS.

```
cl_$reset_options ([]);
```

Example 1-1. Redefining the CL Options Set, Cont.

1.3.2. Defining Wildcard Options

When you initialize the CL manager, it defines a default set of wildcard options that determine how the wildcard manager expands wildcards. You can change how the CL wildcard manager expands wildcards by specifying other wildcard options with the CL_$SET_WILD_OPTIONS system call.

Table 1-3 lists the wildcard options available. You can list any combination of wildcard options with CL_$SET_WILD_OPTIONS. Note that you must specify all the wildcard options you want in effect, including the default options.

Table 1-3. Setting Wildcard Options

Default?	Wildcard Option	Wildcards match:
Yes	CL_$WILD_FILES	Names of files.
Yes	CL_$WILD_DIRS	Names of directories.
Yes	CL_$WILD_LINKS	Names of links.
No	CL_$WILD_EXCLUSIVE	Only the highest directory of a given wildcard. This is useful for commands that operate on entire directories such as COPY_TREE. Since it operates on all subdirectories, there's no need to match further.
No	CL_$WILD_CHASE_LINKS	Files and directories pointed to by links.
No	CL_$WILD_FIRST	Only the first name of a given wildcard rather than expanding all names.

1.3.3. Example of Initializing the CL Manager

Normally, you initialize the CL manager with CL_$INIT so that CL can parse the command line automatically. (See Example 1.7 for a sample program using CL_$INIT.) Examples in this section show how to initialize the CL manager with CL_$SETUP, and supply the lines to parse.

Example 1-2 is a program segment using CL_$SETUP to initialize the CL, and CL_$PARSE_LINE to supply the arguments for parsing. Instead of reading the command line for arguments, this program asks the user to supply a filename that contains the arguments to parse. It gets the file with STREAM calls, and then parses each line in the file with CL_$PARSE_LINE.

```
program cl_parse_line;


%nolist;
%include '/sys/ins/base.ins.pas';
%include '/sys/ins/streams.ins.pas';
%include '/sys/ins/cl.ins.pas';
%include '/sys/ins/vfmt.ins.pas';
%include '/sys/ins/pgm.ins.pas';
%include '/sys/ins/error.ins.pas';
%list;

CONST
  program_name = 'cl_parse_line';

VAR
  pathname   : name_$pname_t;
  name_len   : integer;
  buf        : name_$pname_t;
  ret_ptr    : ^name_$pname_t;
  ret_len    : integer32;
  seek_key   : stream_$sk_t;
  stream_id  : stream_$id_t;
  status     : status_$t;

PROCEDURE check_status; { Error handling procedure ================== }

BEGIN { Main ========================================================= }

{ Initialize CL with the default options, but don't parse the command line. }

    cl_$setup([], program_name, sizeof(program_name));


{ Set wildcard options. Note, if you want more than the default wildcard
  options,  you must specify all the wildcard options that you want. }

    cl_$set_wild_options ( [cl_$wild_files,
                            cl_$wild_dirs,
                            cl_$wild_links,
                            cl_$wild_first] );

{ Ask user for the file containing the lines. }

    writeln (' Enter the file containing the command line arguments.' );
```

Example 1-2. Initializing CL with CL_$SETUP and CL_$PARSE_LINE

```
    vfmt_$read2 ( '%""%eka%.', count, status, pathname, name_len);
    check_status;

{ Open file to parse and get lines. }

    stream_$open ( pathname, name_len, stream_$read, stream_$no_conc_write,
                   stream_id, status );
    check_status;

    WHILE (status.all = status_$ok ) DO BEGIN  { Read lines until end-of-file. }

        stream_$get_rec( stream_id, addr(buf), sizeof(buf), ret_ptr,
                         ret_len, seek_key, status );

        IF (status.code = stream_$end_of_file) AND
           (status.subsys = stream_$subs) THEN EXIT;
        check_status;

        { Parse the line before the NEWLINE character. }

        cl_$parse_line ( ret_ptr^,
                         ret_len -1 );

        .
        .
        .

    END;  { while }

    stream_$close ( stream_id, status );
    check_status;
END.
```

Example 1-2. Initializing CL with CL_$SETUP and CL_$PARSE_LINE, Cont.

While CL_$PARSE_LINE is useful for getting command line arguments from a file, CL_$PARSE_INPUT is useful for getting command line arguments interactively. The advantage of using CL_$PARSE_INPUT over CL_$PARSE_LINE is that it gets the line to parse and parses it in one step. (CL_$PARSE_LINE requires that you supply the line to parse.)

Example 1-3 is an example of initializing the CL with CL_$SETUP and CL_$PARSE_INPUT.

```
program cl_parse_input;

%nolist;
%include '/sys/ins/base.ins.pas';
%include '/sys/ins/streams.ins.pas';
%include '/sys/ins/cl.ins.pas';
%include '/sys/ins/vfmt.ins.pas';
%include '/sys/ins/pgm.ins.pas';
%include '/sys/ins/error.ins.pas';
%list;

CONST
  program_name = 'cl_parse_input';
```

Example 1-3. Initialising CL with CL_$SETUP and CL_$PARSE_INPUT

```
VAR
  ok            : boolean;
  null_line     : boolean;


BEGIN { Main }

{ Initialize the CL, but don't parse the command line. }

    cl_$setup ( [cl_$no_match_error],  { Terminate program when wildcards
                                         do not match any existing pathname. }
                program_name,          { Name of program }
                sizeof(program_name)); { Length of program name }


{ Get the line to parse from standard input. }

    writeln (' Enter a command option or NEWLINE.' );

    { Parse the input. }

    ok := cl_$parse_input ( stream_$stdin,
                            null_line  );

    IF null_line THEN
        writeln ('No input. Terminating program.');
    .
    .
    .
END.
```

Example 1-3. Initializing CL with CL_$SETUP and CL_$PARSE_INPUT, Cont.

1.4. Getting Flags

After initializing the CL manager, you usually check for any flags the user might have specified. The three CL calls that check for flags are the following:

CL_$GET_FLAG
: Checks for a specified flag, marks it used, and counts the number of tokens following it, up to the next flag or the end of the list.

CL_$CHECK_FLAG
: Checks for a specified flag, marks it used, and checks for correct number of tokens following it.

CL_$GET_ENUM_FLAG
: Scans the token list for one of several flags the caller might have specified. It counts the number of tokens following it, up to the next flag or the end of the list.

Your program can accept an abbreviated or full version of any flag by using brackets. For example, the string "-br[ief]" allows the user to specify either "-br" or "-brief." CL will return an error if the user specifies "-brie."

NOTE: You must use lowercase letters when defining flags with a GET_FLAG system call, CL will not recognize uppercase letters. However, the user can type either uppercase or lowercase letters.

Another way to get arguments associated with a flag is to specify CL_$NEXT as the first argument in the CL_$GET_ARGS or CL_$GET_NAME system calls. See Section 1.5 for details.

CL_$GET_FLAG and CL_$GET_ENUM_FLAG returns the number of tokens following the flag, up to the next flag. Note that these calls count the number of tokens on the command line only. The count does NOT include names expanded from wildcards.

Normally, you use the GET_FLAG calls to get the flags from the token list before getting the names. In this case, after you make the calls to get the flags, you call CL_$CHECK_UNCLAIMED. CL_$CHECK_UNCLAIMED checks for any invalid flags the user might have specified. CL prints an error message on error output and aborts the program if it finds any unclaimed flags.

There is one case where you might not want to call CL_$CHECK_UNCLAIMED: When you use the CL_$GET_FLAGGED_DERIVED_NAME call to associate a flag with a particular name, you cannot call CL_$CHECK_UNCLAIMED before getting the names. For more information on this call, see Section 1.5.

Sections 1.4.1 and 1.5.1 include Pascal examples of getting flags. Section 1.4.1 shows how to use the CL_$GET_ENUM_FLAG system call to define synonymous options that require the same program action. Section 1.5.1 shows how to get an argument associated with a specific flag. See Section 1.7 for a sample program using other GET_FLAG system calls.

1.4.1. Example of Handling Synonymous Flags with CL_$GET_ENUM_FLAG

Example 1-4 shows how to use the CL_$GET_ENUM_FLAG system call to define synonymous options that require the same program action. The CL_$GET_ENUM_FLAG allows you to specify an action if the user typed one of several flags. For example, the flags "-error" and "-fault" might both require the same action. Each time you call CL_$GET_ENUM_FLAG system call, CL looks for the specified flags on the token list. If it finds any flag specified, it returns the index of the flag in the list, and stops searching. If it does not find a specified flag, it returns a zero.

You can find out which flag the user actually typed in one of the the following ways: You can manipulate the index, since the CL_$GET_ENUM_FLAG call returns the index of the flag found. Or you can use the CL_$GET_FLAG_INFO system call to get the exact text that the user wrote. This example uses the CL_$GET_FLAG_INFO system call to see what the user actually typed.

```
PROGRAM cl_get_enum_flag;
%include  '/sys/ins/cl.ins.pas';

VAR
    report     : integer;
    number     : integer;
    flag_ptr   : ^string;
    flag_len   : integer;
   .
   .
   .
   { Report message if the user types the -mes[sage] or -rep[ort] flags. }

   report :=  cl_$get_enum_flag ( cl_$first, '-mes[sage] -rep[ort] X', number );

   { Check for any undefined flags that the user might have typed. }

   cl_$check_unclaimed;
   .
   .
   .
   IF report <> 0
       THEN BEGIN
           writeln ( ' This is the message you requested.');

           cl_$get_flag_info (flag_ptr,
                              flag_len);

           writeln ( 'You typed the option: ', flag_ptr^ : flag_len);

           END;
```

Example 1-4. Using CL_$GET_ENUM_FLAG

1.5. Reading Arguments

After you get the flags to handle the options that the user specified, you get the remaining arguments on the token list. To do so, call one of the following system calls:

CL_$GET_NUM
: Gets the next unused integer from the token list; converts it from a decimal to a 4-byte integer.

CL_$GET_NAME
: Gets the first or next unused name from the token list. It expands wildcards.

CL_$GET_ARG
: Gets the first or next unused argument from the token list, in character string format.

To get the arguments, you normally use the system call within a loop. This way, CL will continue to scan through the token list and return arguments until there are none left.

Where the CL_GET calls begin the search depends on whether you set the first argument of the call to CL_$FIRST or CL_$NEXT. If you specify CL_$FIRST, CL begins searching from the head of the list each time it scans the token list. If you specify CL_$NEXT, it begins the search at the token pointer, which is set to the last token read. Normally, you use CL_$NEXT when you want the argument adjacent to the last token read.

Sections 1.5.1 and 1.5.2 demonstrate ways to get arguments from the command line.

1.5.1. Getting Arguments Associated with Flags

You can get arguments associated with flags by using a either the CL_$GET_ARG, CL_$GET_NAME, or CL_$GET_NUM system call.

Use CL_$GET_NAME if you expect a pathname, and CL_$GET_NUM if you expect a decimal number. If you want to accept both names or numbers, you can use CL_$GET_ARG. Since CL_$GET_ARG returns arguments in character string format, it will accept any argument. You can then convert the argument to the desired type. (The system call VFMT_$DECODE2 allows you to convert variables to another type.)

Example 1-5 uses a CL_$GET_ARG, specifying CL_$NEXT as the first argument, so that CL_$GET_ARG will get the next argument after the "-copies" flag. Then it uses a VFMT_$DECODE system call to convert the string into a number. Note that we could have used CL_$GET_NUM to get the number directly, but CL_$GET_ARG assures that we get the token immediately following the flag.

```
PROGRAM cl_get_args;

.
.
.
%include  '/sys/ins/cl.ins.pas';

VAR
    num_args      : integer;
    copies_string : string;
    copies_len    : integer;
    copies_num : integer;
    hunoz         : integer;
    hucares       : integer;

BEGIN { Main }

        IF cl_$get_flag ( '-cop[ies]', num_args) THEN
            BEGIN
            IF NOT cl_$get_arg (cl_$next,
                                copies_string,
                                copies_len,
                                sizeof(copies_string))
                THEN BEGIN
                    writeln (' You must specify a number after "-copies."');
                    pgm_$set_severity (pgm_$error) ;
                    pgm_$exit
                    END;

            { Convert copies_string to a number. }
                  hunoz := vfmt_$decode2 ('%wd%.', { control string }
                                          copies_string, { To convert }
                                          copies_len,
                                          hucares,
                                          status,
                                          copies_num,  { Converted }
                                          0 );

            END;
```

Example 1-5. Getting Arguments Associated with Flags

1.5.2. Getting Derived Names

If your program expects derived names, you can retrieve them using one of the following GET_DERIVED_NAME calls:

CL_$GET_DERIVED_NAME
: Gets the next derived name associated with the last name returned from CL_$GET_NAME.

CL_$GET_FLAGGED_DERIVED_NAME
: Gets the next derived name associated with the specified flag, and the last name returned from CL_$GET_NAME.

The following example shows how to use the CL_$GET_NAME, CL_$GET_DERIVED_NAME, and CL_$GET_FLAGGED_DERIVED_NAME system calls. This program expects two arguments, the second name is a derived name from the first argument. If the user supplied the "-list" flag, it prints out the second name.

```
PROGRAM  cl_get_flagged_derived_names;
.
.
.
%include  '/sys/ins/cl.ins.pas';

VAR
    select      : cl_$arg_select_t;
    count       : integer;
    name        : array [1..2] of name_$pname_t;
    len         : array [1..2] of integer;
    num_args    : integer;

BEGIN { Main }
.   { Initialize the CL manager }
.
.   { Get flags except  '-l[ist]' }

{ Get first argument. }
    select := cl_$first;
    WHILE  cl_$get_name ( select,
                          name [1],
                          len [1],
                          sizeof(name [1]))
        DO BEGIN
            { Get second argument. Check to see if it is a derived
              name.  If it is, change name to derived name. }

            select := cl_$next;
            IF cl_$get_derived_name (name [2],
                                     len [2],
                                     sizeof(name [2]))
                THEN  { Use FU manager to copy file }
                .
                .
                .
            IF cl_$get_flagged_derived_name ('-l[ist]',
                                             cl_$required,
                                             name[2],
                                             len[2],
                                             sizeof(name[2]))
            THEN BEGIN
                IF len[2] = 0 THEN { Command line error }
                    writeln ('You can supply only one derived name per flag.')
                ELSE   { Write name }
                    vfmt_$write2 ( '%la%.',
                                   name[2],
                                   len[2] );
            END; { begin }
        END; { begin }
```

Example 1-6. Reading Arguments from the Token List

1.6. Using Miscellaneous CL Calls

The following is a list of miscellaneous CL calls that may be useful. The sample program in Section 1.7, as well as other examples in this chapter, shows how many of these calls work.

Table 1-4. Miscellaneous CL System Calls

System Call	Description
CL_$VERIFY	Verifies with the user that the program is supposed to operate on this name.
CL_$SET_VERB	Defines a verb for CL to display before each pathname when querying the user for names.
CL_$GET_FLAG_INFO	Returns the actual text of the previously returned flag.
CL_$GET_NAME_INFO	Returns information about the previously returned name. Determines whether the user supplied a full pathname or wildcard name on the command line.
CL_$MATCH	Compares a token against a specified string. Useful for cases where the command line logic is too complicated for CL to handle.
CL_$GET_SET	Creates a set to compare two character strings.
CL_$SET_STREAMS	Tells CL to use the specified streams as the default input and output channels.
CL_$REREAD	Marks the entire token list "unused" so the flags, names and arguments can be read again.
CL_$REREAD_NAMES	Marks all names "unused" so the names can be read again. The next CL_$GET_NAME call returns the first name on the list.
CL_$REREAD_FLAGS	Marks all the flags "unused" so the flags in the token list can be read again.

1.7. Sample Program Using CL System Calls

Example 1-7 uses CL system calls to parse the command line. It also uses File and Tree Utility (FU) system calls to copy a file. This program checks to see if the user specified a derived name, and copies the file to the new extension. For more information on FU system calls, see Chapter 2, Using the File and Tree Utility (FU).

```
PROGRAM cl_copy_file;

%nolist;
%include  '/sys/ins/ubase.ins.pas';
%include  '/sys/ins/vfmt.ins.pas';
%include  '/sys/ins/error.ins.pas';
%include  '/sys/ins/pgm.ins.pas';
%include  '/sys/ins/cl.ins.pas';
%include  '/sys/ins/fu.ins.pas';
%list;

CONST
    name_max = 32;
    program_name = 'copy_derived_names';

VAR
    select      : cl_$arg_select_t;
    count       : integer;
    name        : array [1..2] of name_$pname_t;
    len         : array [1..2] of integer;
    no_args     : integer;
    status      : status_t;

    fu_opts     : fu_$opt_set_t;
    fu_context  : fu_$context_t;


{ Internal Procedure -- Print_error  ============================== }

PROCEDURE print_error;

BEGIN
    pgm_$set_severity (pgm_$error );
    pgm_$exit;
END;

{ ****************************************************************  }

BEGIN { Main }

{ Initialize  CL with the default set of CL options. }

    cl_$init ( [],
               program_name,
               sizeof (program_name) );
    fu_$init;
```

Example 1-7. Sample Program Using CL System Calls

```
    fu_$set_prog_name ( program_name, sizeof (program_name) );
    fu_opts := ([ fu_$coe,
                  fu_$print_errors,
                  fu_$dacl,
                  fu_$subs ]);

{ Set verb for query in case user uses wildcards. }
    cl_$set_verb ('Copy', 4 );    { Verb, length of verb }

{ Allow the user to specify only 1 derived name after each wildcard name. }
    cl_$set_derived_count (1);

{ Set the verify option that the user specifies. }

  IF cl_$get_flag ('-qa[]', no_args) THEN  { Query all names }
      cl_$set_options ([cl_$verify_all]);
  IF cl_$get_flag ('-qw[]', no_args) THEN  { Query names expanded by wildcards }
      cl_$set_options ([cl_$verify_wild]);
  IF cl_$get_flag ('-nq[]', no_args) THEN  { No Query }
      cl_$set_options ([cl_$verify_none]);

{ Check for any invalid flags; exit if the user specified any. }
    cl_$check_unclaimed;

{ Get first name from the token list. }
    select := cl_$first;
    WHILE  cl_$get_name ( select,
                          name [1],
                          len [1],
                          sizeof(name [1]))
        DO BEGIN
            { Get second name. Copy the first name to the
              second name. }
            select := cl_$next;
            IF cl_$get_derived_name ( name [2],
                                      len [2],
                                      sizeof(name [2]))
                THEN BEGIN

                    fu_$copy_file ( name [1],
                                    len [1],
                                    name [2],
                                    len [2],
                                    fu_opts,
                                    fu_context,
                                    status );
                    IF status.all <> 0 THEN
                        BEGIN
                            print_error; {  FU error message }
                        END;
                    writeln ( name[2] :len[2], ' created.'); { Confirm }
                END; { then begin }
        END; { while }
END.  { Program }
```

Example 1-7. Sample Program Using CL System Calls, Cont.

Output

The following is a sample output from the above program.

```
$  cl_copy_file.bin existing_file create_existing_file
   create_existing_file created.
$ cl_copy_file.bin no_file no_file_2
   ?(copy_derived_names) "no_file" - name not found (OS/naming server)
$  cl_copy_file.bin test_derived =.chek
   test_derived.chek created.
$   cl_copy_file.bin test?* =.all -qa
   Verify wildcard "test?*":
   Copy "test2" ? y
   (file) "test2.all" deleted.     {* Replaced contents of existing file. *}
   TEST2.all created.
   Copy "test2.all" ? n            {* Queries file just created. *}
   Copy "test_fu.chek" ? y
   TEST_FU.CHEK.all created.
   Copy "test_tree" ? y
   ?(copy_derived_names) "test_tree" - object must be a leaf (US/file utility)
```

Example 1-7. Sample Program Using CL System Calls, Cont.

Chapter 2
Using the File and Tree Utility

The File and Tree Utility (FU) is a set of DOMAIN system routines that provides a consistent way to handle files and directories. By using FU system calls, your program can handle certain operations in the same way the Shell handles them so that you can provide your users with a consistent interface. FU allows you to perform the following operations:

- Copy files.
- Copy, merge, and replace files and directories.
- Delete files and directories.
- Compare directories.
- Move files.
- Make a unique pathname by appending today's date.

Most of these system calls correspond to individual Shell commands. For more information on these commands, see the *DOMAIN System Command Reference* manual.

This chapter provides an overview on using the FU subsystem and a sample program in Pascal. It concludes with system call syntax, data type, and error information.

Since FU calls are often used in conjunction the Command Line Handler (CL), you might want to see Chapter 1, Parsing the Command Line for more information on the CL.

2.1. System Calls, Insert Files, and Data Types

To use the File and Tree Utility, use the system calls with the FU prefix. This chapter describes how most of these calls work. For details on FU call syntax, data types, and error messages, see Part II of this manual.

When using FU system calls in your program, you must specify the appropriate insert file for the language your are using. The FU insert files are

/SYS/INS/FU.INS.C	for C.
/SYS/INS/FU.INS.FTN	for FORTRAN.
/SYS/INS/FU.INS.PAS	for Pascal.

2.2. Overview of the FU System Calls

The File and Tree Utility (FU) allows you to perform common operations on files and trees using DOMAIN system routines. When using FU, you often use the calls in the following order:

1. Initialize FU with FU_$INIT to allocate temporary storage space required to perform subsequent FU operations.

2. Identify your program name with FU_$SET_PROG_NAME so that FU can identify your program by name when reporting errors.

3. Use the various calls to operate on files and trees.

4. Release the storage space used by FU with FU_$RELEASE_STORAGE.

Table 2-1 lists the operations you can perform on files and trees. It also lists each call's corresponding Shell command.

Table 2-1. FU System Calls to Operate on Files and Trees

System Call	Corresponding Shell Command	Operation
FU_$CMP_TREE	CMT	Compares a source tree to a target tree.
FU_$COPY_FILE	CPF	Copies a file from the source pathname to the target pathname.
FU_$COPY_TREE	CPT	Copies, merges, and replaces files, directories, and links.
FU_$DELETE_FILE	DLF	Deletes a specified file.
FU_$DELETE_TREE	DLT	Deletes a tree and all its descendants.
FU_$MOVE_FILE	MVF	Moves a file to a different location in the naming tree.
FU_$RENAME_UNIQUE	CHN -U	Renames a pathname to create a unique name by appending today's date.

The FU system calls require that you specify the source and, where applicable, target pathnames and pathname lengths. In addition, most calls require that you set FU options. The options control how FU performs the operation. For example, you can set FU options to list files as they are operated, or to set the ACL of the target files.

2.2.1. Setting FU Options

By setting FU options, you can provide users with options similar to those on the standard Shell commands. To do so, use the CL_$GET_FLAG system call to check for the option; then set FU options by assigning the appropriate predefined values to the FU_OPTIONS variable. (See Example 2-1.)

Table 2-2 lists the predefined FU options and their corresponding Shell options.

Table 2-2. FU Options To Provide Shell Command Options

FU Option	Corresponding Shell Option	Operation
FU_$AFT_TIME	-AF DATE	Operates on only those objects whose dtm (date/time last modified) is after the given date and time.
FU_$BEF_TIME	-BE DATE	Operates on only those objects whose dtm (date/time last modified) is before the given date and time.
FU_$COE	*Not* specifying -AE (Abort on error)	If an error occurs while processing a file, continues to the next file. Most programs set this option.
FU_$DACL	-DACL	Assigns default ACL to target files. Target gets the same ACL as the parent (destination) directory.
FU_$DEL_WHEN_UNLKD	-DU	Deletes object when it becomes unlocked.
FU_$FORCE	None	Forces a copy in FU_$MOVE if the source and target files are not located on the same volume.
FU_$FORCE_DEL	-F	Forces deletion of a target during a replace operation if user has protect ("P") rights.
FU_$HELP	None	Displays detailed usage information. (This has no affect under AEGIS, but was added to provide help in a Boot Shell utility.)
FU_$LIST_DIRS	-LD	Lists directories operated on.
FU_$LIST_FILES	-LF	Lists files operated on.
FU_$LIST_LINKS	-LL	Lists links operated on.
FU_$LIST_D_DIRS	-LDL	Lists directories deleted as a result of a replace operation.

Table 2-2. FU Options To Provide Shell Command Options, Cont.

FU Option	Corresponding Shell Option	Operation
FU_$LIST_D_FILES	-LF	Lists files deleted as a result of a replace operation.
FU_$LIST_D_LINKS	-DLL -L	Lists links deleted as a result of a replace operation.
FU_$LIST_DEL	-LDL -L	Lists objects deleted as a result of a replace operation. This is obsolete for new development; use FU_$LIST_D_FILES, FU_$LIST_D_DIRS and FU_$LIST_D_LINKS instead.
FU_$MERGE	CPT -MS	Merges source and target if both are directories. For files and links with the same name in source and target, it deletes the target, and replaces it with a copy of the source.
FU_$MERGE_DST	CPT -MD	Merges source and target if both are directories. For files and links with the same name in source and target, the target remains unchanged.
FU_$PRESERVE_DT	-PDT	Preserves the source dtm (date/time last modified) and dtu (date/time last used).
FU_$PRINT_ERRORS	None	Prints errors on the error output stream. Use this to report FU errors.
FU_$QUIT	None	Terminates the program. (This has no affect under AEGIS, but was added to provide help in a Boot Shell utility.)
FU_$RENAME	-CHN	Changes the name of an existing object with the target pathname before creating a copy. If the target name exists, it appends today's date to the target pathname.
FU_$REPLACE	-R	Replaces target with a copy of the source.
FU_$SACL	-SACL	Assigns ACL of source file to target file. Target gets the same ACL as the source file.
FU_$SUBS	-SUBS	Retains the source ACL for objects that belong to protected subsystems.

Example 2-1 shows how to set FU options. After initializing FU, the program sets up a default set of FU options. It then uses the CL_$GET_FLAG system call to check for the options on the command line. If the user specified an option, it sets the appropriate FU option.

```
%include '/sys/ins/base.ins.pas';
%include '/sys/ins/cl.ins.pas';
%include '/sys/ins/fu.ins.pas';

CONST
  program_name = 'fu_handle_files';

VAR
  pathname     : name_$pname_t;
  pathname_len : integer;
  num_args     : integer;
  status       : status_$t;
  fu_opts      : fu_$opt_set_t;

BEGIN { Main }

. { Initialize the CL. }

{ Initialize FU.  Set the program name so that FU calls can
  identify the program name when reporting errors. }

   fu_$init;

   fu_$set_prog_name ( program_name,
                       sizeof(program_name) );

{ Set up default FU options. }

    fu_opts := ([ fu_$coe,           { Continue on error }
                  fu_$print_errors,  { Print FU errors }
                  fu_$dacl,      { Target gets ACL of destination directory }
                  fu_$subs ]);   { Retain source ACL for objects in protected
                                   subsytems }

{ Get options from command line and set FU options accordingly. }

    IF cl_$get_flag ('-r[]', num_args) THEN    { Replace target with copy }
          fu_opts := fu_opts + [fu_$replace]; { of source }
    IF cl_$get_flag ('-sacl[]', num_args) THEN
        BEGIN
           fu_opts := fu_opts - [fu_$dacl]; { Remove default option }
           fu_opts := fu_opts + [fu_$sacl]; { Target gets same ACL as source }
        END;
    IF cl_$get_flag ('-dacl[]', num_args) THEN
        fu_opts := fu_opts + [fu_$dacl]; { Target gets  ACL of dest directory }
    IF (( [fu_$dacl, fu_$sacl] * fu_opts) = [fu_$dacl, fu_$sacl]) THEN
        BEGIN
            writeln ('Invalid options: -dacl and -sacl are mutually exclusive.');
            error_routine;
        END;
```

Example 2-1. Setting FU Options

2.2.2. Releasing Storage with FU_$RELEASE_STORAGE

FU allocates read/write(RWS) storage space when copying files during the FU_$COPY_FILE, FU_$COPY_TREE and FU_$MOVE_FILE routines. (It needs this space for tables to keep track of ACLs.)

This storage gets released automatically when your program terminates. However, if your program performs numerous copy operations, we recommend that you call FU_$RELEASE_STORAGE to release the storage more often.

2.3. Sample Program Using the FU System Calls

Example 2-2 is a sample program that uses FU system calls to perform common operations on files and directories. It also uses Command Line Handler (CL) calls to parse the command line. For more information on CL system calls, see Chapter 1, Parsing the Command Line.

This program allows the user to perform various FU operations. It asks the user to specify which operation to perform, then it prompts the user for pathnames and options.

```
program fu_handling_files_trees;

%nolist;
%include '/sys/ins/base.ins.pas';
%include '/sys/ins/streams.ins.pas';
%include '/sys/ins/cl.ins.pas';
%include '/sys/ins/fu.ins.pas';
%include '/sys/ins/vfmt.ins.pas';
%include '/sys/ins/pgm.ins.pas';
%include '/sys/ins/error.ins.pas';
%include '/sys/ins/time.ins.pas';
%include '/sys/ins/cal.ins.pas';
%list;

CONST
  program_name = 'fu_handling_files_trees';

VAR
  select       : cl_$arg_select_t;
  pathname     : name_$pname_t;
  pathname_len : integer;
  num_args     : integer;
  status       : status_$t;
  command      : string;
  command_len  : integer;
  ok           : boolean;
  null_line    : boolean;
  fu_opts      : fu_$opt_set_t;
  fu_context   : fu_$context_t;
  fu_error     : name_$pname_t;
  fu_error_len : integer;
```

Example 2-2. Operating on Files and Trees with FU Calls

```
{ Internal Procedure -- Check_status ========================================== }

PROCEDURE check_status;

BEGIN

    IF status.all <> status_$ok THEN
        BEGIN
            error_$print (status);
            pgm_$set_severity (pgm_$error);
            pgm_$exit;
        END;

END; { check_status }

{ Internal Procedure -- Get_time ============================================== }

PROCEDURE get_time ( OUT int_clock : time_$clock_t  );

VAR
  readable_dt   : cal_$timedate_rec_t;
  date_string   : string;
  date_len      : integer;
  time_string   : string;
  time_len      : integer;

BEGIN

{ Convert command line date string to readable format.
  Date must be in year/month/day (85/09/15) format.    }

    ok := cl_$get_arg ( cl_$next, date_string, date_len, sizeof(date_string) );

    cal_$decode_ascii_date ( date_string, date_len, readable_dt.year,
                             readable_dt.month, readable_dt.day, status );
    check_status;

{ Convert command line time string to readable format.
   Time must be in hr/min/sec 24-hour format (17:33:55).  }

    ok := cl_$get_arg ( cl_$next, time_string, time_len, sizeof(time_string) );

    cal_$decode_ascii_time ( time_string, time_le  readable_dt.hour,
                             readable_dt.minute, readable_dt.second, status );
    check_status;

{ Convert readable date and time to internal time. }

    cal_$encode_time ( readable_dt, int_clock );
    cal_$remove_local_offset ( int_clock );

END; { get_time }
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

```
{ Internal Procedure -- Copy_file ========================================== }

{ Copies source pathname to target pathname. By default, the target gets
  the ACL of the destination directory, unless user specifies -SACL.
  User can also preserve source's dtm/dtu times by typing -PDT.              }

PROCEDURE copy_file;

VAR
  new_pathname     : name_$pname_t;
  new_pathname_len : integer;

BEGIN

{ Set wildcard options. }
    cl_$set_wild_options ( [cl_$wild_files] );

{ Reinitialize default FU options. }

    fu_opts := ([ fu_$coe,           { Continue on error }
                  fu_$print_errors,  { Print FU errors }
                  fu_$dacl,      { Target gets ACL of destination directory }
                  fu_$subs ]);  { Retain source ACL for objects in subsytems }


{  Get the filenames. }

    writeln;
    writeln (' Enter the name of the file you want to copy, then  ');
    writeln (' the name of the new file you want created. ');
    writeln;
    writeln;
    writeln (' Type "-r[eplace]" if you want to replace the target with  ');
    writeln ('       the source.  If target exists, it will be deleted. ');
    writeln ('       If it doesn''t exist, it will be created. ');
    writeln;
    writeln (' Type "-sacl" if you want the target file to have the    ');
    writeln ('       same ACL as the source file; otherwise the target ');
    writeln ('       file will have the same ACL as its parent directory. ');
    writeln;
    writeln (' Type "-pdt" if you want to preserve the source file''s ');
    writeln ('       modification and used times. ');
    writeln;

    ok := cl_$parse_input ( stream_$stdin, null_line  );

    IF null_line THEN
        writeln ('No input. Type CTRL/Q to quit.');

{ Get keywords, set appropriate FU options. Check for any invalid keywords;
  and exit if user specified any. }

    IF cl_$get_flag ('-r[eplace]', num_args) THEN
        fu_opts := fu_opts + [fu_$replace];  { Replace target with source }
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

```
    IF cl_$get_flag ('-sacl[]', num_args) THEN
        BEGIN
           fu_opts := fu_opts - [fu_$dacl]; { Remove default option }
           fu_opts := fu_opts + [fu_$sacl]; { Target gets same ACL as source }
        END;
    IF cl_$get_flag ('-pdt[]', num_args) THEN    { Preserve source's }
           fu_opts := fu_opts + [fu_$preserve_dt]; { modification and used times}

    cl_$check_unclaimed;

{ Get first argument. }

    select := cl_$first;

    WHILE  cl_$get_name ( select, pathname, pathname_len, sizeof(pathname) )
        DO BEGIN

            { Get second argument and copy the file. }

            select := cl_$next;

            IF cl_$get_derived_name ( new_pathname, new_pathname_len,
                                      sizeof(new_pathname) )
                THEN BEGIN
                    fu_$copy_file ( pathname,          { Source file }
                                    pathname_len,      { Length of source file }
                                    new_pathname,      { Target file }
                                    new_pathname_len,  { Length of target file }
                                    fu_opts,           { FU options in effect }
                                    fu_context,        { Error context }
                                    status );          { Completion status }
                    check_status;

                    IF status.all = status_$ok THEN

                        vfmt_$write2 ( 'Copied to file named,"%a" %.' ,
                                       new_pathname, new_pathname_len);

                END; { then begin }
        END; { while }

END;  { copy_file }

{ Internal Procedure -- Copy_tree ========================================== }

{ Copies source pathname to target pathname. }

PROCEDURE copy_tree;

VAR
  new_tree     : name_$pname_t;
  new_tree_len : integer;
  bef_time     : time_$clock_t;
  aft_time     : time_$clock_t;
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

```
BEGIN

{ Set verb for query in case user uses wildcards. }
    cl_$set_verb ('Copy', 4);  { Verb, length of verb }

{ Set wildcard options. }
    cl_$set_wild_options ([cl_$wild_files, cl_$wild_dirs, cl_$wild_exclusive]);

{ Reinitialize default FU options. }
    fu_opts := ([ fu_$coe,           { Continue on error }
                  fu_$print_errors,  { Print FU errors }
                  fu_$dacl,      { Target gets ACL of destination directory }
                  fu_$subs ]);  { Retain source ACL for objects in subsytems }

{  Get the filenames. }

    writeln (' Enter the name of the directory you want to copy, then  ');
    writeln (' the name of the new directory you want created. ');
    writeln;
    writeln (' Type "-ms[]" if you want to merge the source and target  ');
    writeln ('       if both are directories. ');
    writeln;
    writeln (' Type "-r[eplace]" if you want to replace the target with  ');
    writeln ('       the source.  If target exists, it will be deleted. ');
    writeln ('       If it doesn''t exist, it will be created. ');
    writeln;
    writeln (' Type "-bef date time" if you want to copy only those files  ');
    writeln ('       modified before a certain date and time. ');
    writeln;
    writeln (' Type "-aft date time" if you want to copy only those files  ');
    writeln ('       modified after a certain date. ');
    writeln;
    writeln (' Use this format for date time: yr/month/day hr:min:sec.  ');
    writeln ('   Example:  -bef 85/11/27 12:35:09  source target ');
    writeln;

    ok := cl_$parse_input ( stream_$stdin, null_line  );

    IF null_line THEN
        writeln ('No input. Type CTRL/Q to quit.');

{ Get keywords, set appropriate FU options, then check for any invalid
  keywords; exit if user specified any. }

{ Get flags and set appropriate FU options. }

    IF cl_$get_flag ('-ms[]', num_args) THEN   { Merge target and source
        fu_opts := fu_opts + [fu_$merge];        if they are directories }
    IF cl_$get_flag ('-r[eplace]', num_args) THEN
        fu_opts := fu_opts + [fu_$replace];    { Replace target with source }
    IF cl_$get_flag ('-bef[]', num_args) THEN
        BEGIN
            get_time ( bef_time );             { Operate on files modified
            fu_opts := fu_opts + [fu_$bf_time];  before date }
        END;
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

```
    IF cl_$get_flag ('-aft[]', num_args) THEN
        BEGIN
           get_time ( aft_time );              { Operate on files modified
           fu_opts := fu_opts + [fu_$af_time];   after date }
        END;
    cl_$check_unclaimed;

{ Get first argument. }

    select := cl_$first;

    WHILE  cl_$get_name ( select, pathname, pathname_len, sizeof(pathname) )
        DO BEGIN

            { Get second argument and copy the tree. }

            select := cl_$next;

            IF cl_$get_derived_name ( new_tree, new_tree_len, sizeof(new_tree ) )
                THEN BEGIN
                    fu_$copy_tree ( pathname,       { Source pathname }
                                    pathname_len,   { Source pathname length }
                                    new_tree,       { Target pathname }
                                    new_tree_len,   { Target pathname length }
                                    fu_opts,        { Options }
                                    bef_time.high,  { Before time }
                                    aft_time.high,  { After time }
                                    fu_error,       { Error pathname }
                                    fu_error_len,   { Error pathname length }
                                    status );       { Completion status }
                    check_status;

                    IF status.all = status_$ok THEN
                        vfmt_$write2 ( 'Copied to directory named,"%a" %.' ,
                                       new_tree, new_tree_len );

                END; { then begin }
        END; { while }

END;  { copy_tree }


{ Internal Procedure -- Delete_file ======================================== }

PROCEDURE delete_file;

{ Delete specified file. }

VAR
  force     : boolean;
  del_unlkd : boolean;
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

```
BEGIN

{ Set wildcard options. }
    cl_$set_wild_options ( [cl_$wild_files] );

{ Reinitialize default FU options. }
    fu_opts := ([ fu_$coe,           { Continue on error }
                  fu_$print_errors,  { Print FU errors }
                  fu_$dacl,      { Target gets ACL of destination directory }
                  fu_$subs ]);  { Retain source ACL for objects in subsytems }

{ Get the filename. }

    writeln (' Enter the name of the file(s) you want to delete. ');
    writeln (' Type -f[orce] if you want to force the delete. ');
    writeln (' Type -du if you want to delete a locked object. ');

    ok := cl_$parse_input ( stream_$stdin, null_line  );

    IF null_line THEN
        writeln ('No input. Terminating program.');

{ Get keywords and check for any invalid keywords;
  exit if user specified any. }

    force := cl_$get_flag ('-f[orce]', num_args);
    del_unlkd := cl_$get_flag ('-du[]', num_args);

    cl_$check_unclaimed;

{ Set verb for query in case user uses wildcards. }

    cl_$set_verb ('Delete', 6);  { Verb, length of verb }

{ Get first argument. }

    select := cl_$first;

    WHILE  cl_$get_name ( select, pathname, pathname_len, sizeof(pathname) )
        DO BEGIN
                    fu_$delete_file ( pathname,     { File to be deleted }
                                      pathname_len, { Length of file }
                                      force,        { If TRUE, deletes file
                                                      if user has owner rights,
                                                      but not delete rights. }
                                      del_unlkd,    { If TRUE, deletes file
                                                      even if it is locked. }
                                      status );
                    check_status;
                    IF status.all = status_$ok THEN
                        vfmt_$write2 ( 'Deleted file named,"%a" %.' ,
                                       pathname, pathname_len);
        END; { while }
END;  { delete_file }
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

```
{ Internal Procedure -- Delete_tree ========================================== }

PROCEDURE delete_tree;

{ Delete specified directory. }

BEGIN

{ Set verb for query in case user uses wildcards. }
    cl_$set_verb ('Delete', 6 );  { Verb, length of verb }

{ Set wildcard options. }
    cl_$set_wild_options ( [cl_$wild_files, cl_$wild_dirs, cl_$wild_exclusive]);

{ Reinitialize default FU options. }

    fu_opts := ([ fu_$coe,           { Continue on error }
                  fu_$print_errors,  { Print FU errors }
                  fu_$dacl,      { Target gets ACL of destination directory }
                  fu_$subs ]);  { Retain source ACL for objects in subsytems }

{  Get the filenames. }

    writeln;
    writeln (' Enter the name of the directory you want to delete. ');
    writeln (' Note that you will delete all the files, links and ');
    writeln (' subdirectories located in this directory. ');
    writeln;
    writeln (' Type "-l[ist]" if you want to list all the objects as  ');
    writeln ('       they are deleted. ');
    writeln;
    writeln (' Type "-lf" if you want to list only files as they are deleted.');
    writeln;

    ok := cl_$parse_input ( stream_$stdin, null_line  );

{ Get keywords, set appropriate FU options, then check for
  any invalid keywords; exit if user specified any. }

    IF null_line THEN
        writeln ('No input. Type CTRL/Q to quit.');
    IF cl_$get_flag ('-l[ist]', num_args) THEN
          fu_opts := fu_opts + [fu_$list_links,
                                fu_$list_dirs,
                                fu_$list_files];
    IF cl_$get_flag ('-lf[]', num_args) THEN
          fu_opts := fu_opts + [fu_$list_files];

    cl_$check_unclaimed;

{ Get first argument. }

    select := cl_$first;
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

```
    WHILE  cl_$get_name ( select, pathname, pathname_len, sizeof(pathname) )
        DO BEGIN
            fu_$delete_tree ( pathname,       { Source pathname }
                              pathname_len,   { Source pathname length }
                              fu_opts,        { Options }
                              fu_error,       { Error pathname }
                              fu_error_len,   { Error pathname length }
                              status );       { Completion status }
            check_status;

            IF status.all = status_$ok THEN
                vfmt_$write2 ( 'Delete directory named,"%a" %.' ,
                               pathname, pathname_len );

        END; { while }

END;  { delete_tree }

{ Internal Procedure -- Compare_tree ================================== }

{ Compare source tree to target tree. }

PROCEDURE compare_tree;

VAR
  tar_pathname     : name_$pname_t;
  tar_pathname_len : integer;

BEGIN

{ Set verb for query in case user uses wildcards. }

    cl_$set_verb ('Compare',  { Verb }
                  7 );        { Length of verb }

{ Set the wildcard options. }

    cl_$set_wild_options ( [cl_$wild_files, cl_$wild_dirs, cl_$wild_exclusive]);

{ Reinitialize default FU options. }

    fu_opts := ([ fu_$coe,           { Continue on error }
                  fu_$print_errors,  { Print FU errors }
                  fu_$dacl,      { Target gets ACL of destination directory }
                  fu_$subs ]);  { Retain source ACL for objects in subsytems }

{  Get the filenames. }

    writeln (' Enter the name of the two directories  you want to compare. ');
    writeln (' Type "-l or -list" if you want to compare all the directories  ');
    writeln ('       and files. ');
    writeln;
    writeln (' Type "-lf" if you want to compare all the files. ');
    writeln;
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

```
    ok := cl_$parse_input ( stream_$stdin, null_line  );

    IF null_line THEN
        writeln ('No input. Type CTRL/Q to quit.');

{ Get keywords, set appropriate FU options, then check for any invalid
  keywords; exit if user specified any. }

    IF cl_$get_flag ('-l[ist]', num_args) THEN
           fu_opts := fu_opts + [fu_$list_links,
                                 fu_$list_dirs,
                                 fu_$list_files];
    IF cl_$get_flag ('-lf[]', num_args) THEN
           fu_opts := fu_opts + [fu_$list_files];

    cl_$check_unclaimed;

{ Get first argument. }

    select := cl_$first;

    WHILE  cl_$get_name ( select, pathname, pathname_len, sizeof(pathname) )
        DO BEGIN

            { Get second argument and copy the tree. }

            select := cl_$next;

            IF NOT cl_$get_derived_name ( tar_pathname, tar_pathname_len,
                                          sizeof(tar_pathname ) )
                THEN BEGIN

                    vfmt_$write2 ( 'No pathname to compare with "%a" %. ',
                                   pathname,
                                   pathname_len );
                    pgm_$set_severity ( pgm_$error );
                    pgm_$exit
                    END;  { then begin }

                fu_$cmp_tree ( pathname,         { Source pathname }
                               pathname_len,     { Source pathname length }
                               tar_pathname,     { Target pathname }
                               tar_pathname_len, { Target pathname length }
                               fu_opts,          { Options }
                               fu_error,         { Error pathname }
                               fu_error_len,     { Error pathname length }
                               status );         { Completion status }
                check_status;

        END; { while }

END;  { compare_tree }
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

```
{ Internal Procedure -- Move_file ========================================== }

PROCEDURE move_file; { Move file to another location. }

VAR
  tar_pathname     : name_$pname_t;
  tar_pathname_len : integer;

BEGIN

{ Set verb for query in case user uses wildcards. }

    cl_$set_verb ('Move', 4 );    { Verb, length of verb }
    cl_$set_derived_count (1);

{ Set wildcard options. }
    cl_$set_wild_options ( [cl_$wild_files] );

{ Reinitialize default FU options }

    fu_opts := ([ fu_$coe,           { Continue on error }
                  fu_$print_errors,  { Print FU errors }
                  fu_$dacl,      { Target gets ACL of destination directory }
                  fu_$subs ]);  { Retain source ACL for objects in subsytems }

{  Get the filenames. }

    writeln (' Enter the name of the file you want to move, then ');
    writeln (' the pathname where you want to move it to. ');
    writeln;
    writeln (' Type "-l[ist]" if you want to list the files. ');
    writeln (' Type "-r[eplace]" to replace the target file with the ');
    writeln ('   source file if it exists. ');
    writeln (' Type "-chn" to change the name of the target file. ');
    writeln (' Type "-fdl" to delete the target file if it exists, ');
    writeln ('   if you have owner rights. ');
    writeln;

    ok := cl_$parse_input ( stream_$stdin, null_line  );

    IF null_line THEN
        writeln ('No input. Type CTRL/Q to quit.');

{ Get keywords, set appropriate FU options, then check for any invalid
  keywords; exit if user specified any. }

    IF cl_$get_flag ('-l[ist]', num_args) THEN
          fu_opts := fu_opts + [fu_$list_files];
    IF cl_$get_flag ('-r[eplace]', num_args) THEN
          fu_opts := fu_opts + [fu_$replace];
    IF cl_$get_flag ('-chn[]', num_args) THEN
          fu_opts := fu_opts + [fu_$rename];
    IF cl_$get_flag ('-fdl[]', num_args) THEN
          fu_opts := fu_opts + [fu_$force_del];
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

```
    cl_$check_unclaimed;

{ Get first argument. }

    select := cl_$first;

    WHILE  cl_$get_name ( select, pathname, pathname_len, sizeof(pathname) )
        DO
        BEGIN

            { Get second argument and copy the tree. }

            select := cl_$next;

            IF cl_$get_derived_name ( tar_pathname,tar_pathname_len,
                                      sizeof(tar_pathname ) )
                THEN
                BEGIN
                    fu_$move_file ( pathname,          { Source pathname }
                                    pathname_len,      { Source pathname length }
                                    tar_pathname,      { Target pathname }
                                    tar_pathname_len,  { Target pathname length }
                                    fu_opts,           { Options }
                                    fu_context,        { Error pathname }
                                    status );          { Completion status }
                    check_status;
                END; { then begin }
        END; { while }

END;  { move_file }


{ Internal Procedure -- Rename_file ======================================== }

{ Rename a pathname to create a unique pathname. }

PROCEDURE rename_file;

BEGIN

{ Reinitialize default FU options. }

    fu_opts := ([ fu_$coe,           { Continue on error }
                  fu_$print_errors,  { Print FU errors }
                  fu_$dacl,     { Target gets ACL of destination directory }
                  fu_$subs ]);  { Retain source ACL for objects in subsytems }

{ Get the filename. }

    writeln (' Enter the name of the file you want to make unique. It ');
    writeln (' will append a period and today''s date to the filename. ');
    writeln;
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

```
    ok := cl_$parse_input ( stream_$stdin, null_line  );

    IF null_line THEN
        writeln ('No input. Type CTRL/Q to quit.');

{ Get first argument. }

    select := cl_$first;

    WHILE  cl_$get_name ( select, pathname, pathname_len, sizeof(pathname) )
        DO BEGIN
            fu_$rename_unique ( pathname,     { Source pathname }
                                pathname_len, { Source pathname length }
                                fu_opts,      { Options }
                                status );     { Completion status }
            check_status;

        END; { while }

END;  { rename_file }


{ ========================================================================  }

BEGIN { Main }

{ Initialize the CL, but don't parse the command line. }

    cl_$setup ( [cl_$no_match_error,   { Terminate program when wildcards
                                         do not match any existing pathname. }
                 cl_$verify_all],      { Verify all names with user. }
                 program_name,         { Name of program }
                 sizeof(program_name)); { Length of program name }

{ Initialize FU, set the program name so that FU calls can
  identify the program name when reporting errors. }

   fu_$init;

   fu_$set_prog_name ( program_name,
                       sizeof(program_name) );

{ Set up default FU options. }

    fu_opts := ([ fu_$coe,           { Continue on error }
                  fu_$print_errors,  { Print FU errors }
                  fu_$dacl,      { Target gets ACL of destination directory }
                  fu_$subs ]);  { Retain source ACL for objects in subsytems }



{ Get the line to parse from standard input. }

    writeln;
    writeln ( 'This program allows you to handle files and trees. ');
    writeln;
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

```
REPEAT  { user types CTRL/Q }

    writeln ( 'Enter the option and files you want to operate on. ');

    writeln ( 'Type "cpf"  to copy a file. ');
    writeln ( 'Type "cpt"  to copy a tree. ');
    writeln ( 'Type "dlf"  to delete a file. ');
    writeln ( 'Type "dlt"  to  delete a tree. ');
    writeln ( 'Type "mvf"  to move a file. ');
    writeln ( 'Type "cmt"  to compare a tree. ');
    writeln ( 'Type "ren"  to rename a file. ');

    { Parse the input. }

    ok := cl_$parse_input ( stream_$stdin,
                            null_line  );

    IF null_line THEN
    BEGIN
        writeln ('No input. Terminating program.');
        pgm_$exit;
    END;

{ Get keywords, then check for any invalid   keywords;
  exit if user specified any. }

  IF cl_$get_arg (cl_$first, command, command_len, sizeof(command)) THEN
    BEGIN

        IF cl_$match ('cpf[]', command, command_len) THEN
            copy_file;
        IF cl_$match ('cpt[]', command, command_len) THEN
            copy_tree;
        IF cl_$match ('dlf[]', command, command_len) THEN
            delete_file;
        IF cl_$match ('dlt[]', command, command_len) THEN
            delete_tree;
        IF cl_$match ('mvf[]', command, command_len) THEN
            move_file;
        IF cl_$match ('cmt[]', command, command_len) THEN
            compare_tree;
        IF cl_$match ('ren[]', command, command_len) THEN
            rename_file;
    END;

   UNTIL FALSE; { User types CTRL/Q }
END.
```

Example 2-2. Operating on Files and Trees with FU Calls, Cont.

Chapter 3
Logging In and Changing the Registry

The LOGIN Manager is a set of DOMAIN system routines that allows you to tailor a log-in operation or change a user's registry ACCOUNT file. You might want to change a log-in operation to provide stricter log-in requirements. You can change a registry ACCOUNT file to change a user's password or home directory.

Before using the LOGIN system calls, you should be familiar with registry PERSON, PROJECT, ORGANIZATION (PPO) and ACCOUNT files. For more information, see the *Administering Your DOMAIN System* manual.

3.1. System Calls, Insert Files, and Data Types

To use the LOGIN manager, use the system calls with the prefix LOGIN. This chapter describes how most of these calls work. For details on LOGIN call syntax, data types, and error messages, see Part II of this manual.

When using LOGIN system calls in your program, you must specify the appropriate insert file for the language your are using. The LOGIN insert files are

/SYS/INS/LOGIN.INS.C	for C.
/SYS/INS/LOGIN.INS.FTN	for FORTRAN.
/SYS/INS/LOGIN.INS.PAS	for Pascal.

In addition, you might need to bind your program with the source file, NLOGIN.BIN because the entry points to most LOGIN system calls are not in a global library.

3.2. Overview of the LOGIN System Calls

The LOGIN subsystem contains system calls that allow you to write a tailored log-in procedure, or change a user's password or home directory.

To tailor a log-in operation, use the system call, LOGIN_$LOGIN.

To change a user's registry ACCOUNT file, use the LOGIN system calls:

- LOGIN_$OPEN
- LOGIN_$CHPASS
- LOGIN_$CHHDIR
- LOGIN_$CKPASS
- LOGIN_$CLOSE

Sections 3.3 and 3.4 describes the two log-in operations.

3.3. Tailoring a Log-In Operation

Use the LOGIN_$LOGIN system call to tailor a LOGIN operation. For example, you can require users to have different PPO identities to access a particular program. That is, the user DARLENE.MARKETING might need to log in as DARLENE.MARKETING.NEW_PRODUCTS.SPHINX to have full rights to an object.

To write your own LOGIN procedure using the LOGIN_$LOGIN system call, you supply LOGIN_$LOGIN with an open stream, and pointers to your own log-in I/O routines. Your program passes an open stream to LOGIN_$LOGIN, LOGIN_$LOGIN checks the password the user supplied against the registry's password for that PPO. If they match, the program logs the user in.

NOTE: Your program must be a protected subsystem in the LOGIN subsystem. (See the *DOMAIN System User's Guide* for more information on protected subsystems.)

Since LOGIN_$LOGIN is designed to be device-independent, you must supply your own input/output routines. LOGIN_$LOGIN requires four routines: a read, write, help, and an open log routine. LOGIN_$LOGIN uses these routines to get the user's input and display messages.

Example 3-1 shows how you declare pointers to your routines. The second parameter, LOGIN_$LOG_EVENTS, indicates that you are supplying an open log routine so that LOGIN_$LOGIN records any user's attempts to log in.

To get the addresses of these routines in Pascal, you must put the I/O routines in a module separate from your main log-in program. Bind the two binary files to execute your log-in program.

```
{ Get addresses of external I/O procedures for LOGIN_$LOGIN. }

    login_procedures.pread     := addr(my_read);
    login_procedures.pwrite    := addr(my_write);
    login_procedures.help      := addr(my_help);
    login_procedures.open_log  := addr(my_open_log);

    IF NOT login_$login ( stream_in,       { Stream ID where user will log in }
                          [login_$log_events],{ Logging events }
                          login_procedures,  { Address of your I/O routines }
                          status )           { Completion status }
       THEN
           IF (status.all = login_$err_shut) THEN
           BEGIN
               err_exit(status);
           END;
```

Example 3-1. Declaring External I/O Routines for LOGIN_$LOGIN

You are not restricted in how you write your I/O routines, except that each routine's parameters must correspond to those arguments that LOGIN_$LOGIN expects. The routines must also perform the operation that LOGIN_$LOGIN expects:

- MY_READ gets the PPO string and password for logging in. It also prompts for a new password if the user types "-P", or for a new home directory if the user types "-H." If MY_READ does not provide a way to get this information, LOGIN_$LOGIN prompts for it.

- MY_WRITE writes any error messages to output.

- MY_HELP provides a message for when a user types "-h[elp]" at the log-in prompt.

- MY_OPEN_LOG records all sucessful and unsuccessful log-in attempts if you specified the LOGIN_$LOG_EVENTS option when you called LOGIN_$LOGIN.

When you specify LOGIN_$LOG_EVENTS, LOGIN_$LOGIN calls your log event routine at each log-in attempt. It passes the name of its log file to your routine, opens the file, records the event, and closes the file. LOGIN_$LOGIN will record both sucessful and unsucessful log-in attempts in the file, 'NODE_DATA/SIOLOGIN_LOG. Your log-in routine can create its own log file simply by ignoring the file name that LOGIN_$LOGIN passed. However, note that LOGIN_$LOGIN will close your file after each log-in attempt.

Example 3-2 shows how to write the parameters for the I/O routines in Pascal.

```
{ Login read procedure ========================================== }

{ LOGIN_$LOGIN calls this procedure to get a PPO string and password. Also,
  if the user types a "-P" or "-H," it prompts for a new password or home
  directory respectively. This procedure can supply the prompt string that
  LOGIN_$LOGIN will use to prompt for PPO and password. }

FUNCTION my_read(
    IN stream      : stream_$id_t;          { Stream ID on which to log user
                                              in, usually stream_$stdin }
    OUT inbuf      : UNIV login_$string_t; { Returns string to supply to
                                              LOGIN_$LOGIN }
    IN inlen       : integer;               { Maximum length of string buffer }
    IN pstr        : UNIV login_$string_t; { Prompt string }
    IN plen        : integer;               { Length of "pstr" }
    IN echo        : boolean;               { Indicates whether to echo characters
                                              Used to prevent the DM from
                                               displaying a password.}
    IN fillbuf     : UNIV login_$string_t; { Not used, specific to the DM }
    IN fillbuflen  : integer                { Not used, specific to the DM }
):  integer;                                { Returns length of the PPO string }
EXTERN;

{ Login write procedure ========================================= }

PROCEDURE my_write(
    IN stream      : stream_$id_t;    { Stream ID on which to display user's
                                        output, usually stream_$stdout }
    IN pstr        : UNIV login_$string_t; { Message to write }
    plen           : integer               { Length of message }
);
EXTERN;
```

Example 3-2. Writing LOGIN External I/O Routines for LOGIN_$LOGIN

```
{ Login help procedure ========================================== }

{ LOGIN_$LOGIN calls this procedure when a user types h[elp] at the
  prompt. }

PROCEDURE my_help(
    IN stream      : stream_$id_t          { Stream ID on which to write
                                             help message }
EXTERN;

{ Login open log procedure ====================================== }

{ LOGIN_$LOGIN calls this procedure whenever a user attempts to log in,
  if the LOGIN_$LOG_EVENTS option was set. }

FUNCTION my_open_log(
    IN log_file    : UNIV login_$string_t; { Pathname of log file }
    IN log_flen    : integer;              { Length of "log_file" }
    OUT logstr     : stream_$id_t          { Returns stream ID of log file }
) : boolean;                               { Returns TRUE if successful }
EXTERN;
```

Example 3-2. Writing External I/O Routines for LOGIN_$LOGIN, Cont.

3.3.1. Sample Program Using LOGIN_$LOGIN

Examples 3-3 and 3-4 show how to use the LOGIN_$LOGIN system call in Pascal. The first example is a main procedure that performs a log-in operation. The second example is a module containing the input/output routines for LOGIN_$LOGIN.

The main program gets the addresses of the external I/O routines, and calls LOGIN_$LOGIN. Note that when calling LOGIN_$LOGIN, the LOGIN_$LOG_EVENTS option was specified, so that LOGIN_$LOGIN will record each log-in attempt.

LOGIN_$LOGIN calls MY_READ when it needs log-in information -- the login string and password, and, if the user typed a "-P," or "-H," the new password or home directory respectively. It calls MY_WRITE when it needs to write error messages. It calls MY_HELP when the user asked for help at the prompt. It calls MY_OPEN_LOG, (because we set the LOGIN_$LOG_EVENTS option), after each log-in attempt. When calling MY_OPEN_LOG, it records whether the attempt was successful or not, then closes the file.

Each call to MY_OPEN_LOG passes an open stream to LOGIN_$LOGIN.

The external procedures, located in MODULE LOGIN_PROCEDURES (Example 3-4), must be bound with LOGIN_LOGIN (Example 3-3) before the log-in program can be executed.

```
PROGRAM login_login;

%nolist;
%include  '/sys/ins/base.ins.pas';
%include  '/sys/ins/pfm.ins.pas';
%include  '/sys/ins/streams.ins.pas';
%include  '/sys/ins/vfmt.ins.pas';
%include  '/sys/ins/error.ins.pas';
%include  '/sys/ins/pgm.ins.pas';
%include  '/sys/ins/cl.ins.pas';
%include  '/sys/ins/login.ins.pas';
%list;

CONST
  prog_name  = 'login_login';

VAR
  cl_opts           : cl_$opt_set_t;
  inv_prog          : string;
  inv_prog_len      : integer;
  cleaner           : pfm_$cleanup_rec;
  status            : status_$t;
  login_procedures  : login_$proc_rec_t;
  stream_in         : stream_$id_t :=  stream_$stdin;
  connv             : pgm_$connv   := [stream_$stdin,
                                       stream_$stdout,
                                       stream_$errin,
                                       stream_$errout];
  handle            : pgm_$proc;

{ Login read procedure ========================================== }
{ LOGIN_$LOGIN gets input via this procedure. }

FUNCTION my_read(
    IN stream      : stream_$id_t;          { Stream ID where user logs in }
    OUT inbuf      : UNIV login_$string_t; { Login string to pass to LOGIN }
    IN inlen       : integer;               { Maximum length of string buffer }
    IN pstr        : UNIV login_$string_t; { Prompt string }
    IN plen        : integer;               { Length of prompt string }
    IN echo_mode   : boolean;               { Indicates whether to echo
                                              characters on input pad,
                                              used to prevent password echo }
    IN fillbuf     : UNIV login_$string_t; { Not used, specific to DM }
    IN fillbuflen  : integer                { Not used, specific to DM }
):  integer;
EXTERN;

{ Login write procedure ========================================= }
{ LOGIN_$LOGIN writes output via this procedure. }

PROCEDURE my_write(
    IN stream      : stream_$id_t;          { Stream ID for user's output }
    IN pstr        : UNIV login_$string_t; { Message to write to output }
    plen           : integer                { Length of message }
);
EXTERN;
```

Example 3-3. Performing a Log-In Operation with LOGIN_$LOGIN

```
{ Login help procedure ========================================== }
{ LOGIN_$LOGIN calls this procedure when a user unsucessfully attempts to
  log in. MY_HELP supplies the message by passing the stream ID of the
  help file to LOGIN_$LOGIN. }

PROCEDURE my_help(
    IN stream      : stream_$id_t          { Stream ID on which to write
                                             help message }
);
EXTERN;

{ Login open log procedure ====================================== }
{ LOGIN_$LOGIN calls this procedure whenever a user attempts to log in,
  if the LOGIN_$LOG_EVENTS option was set. }

FUNCTION my_open_log(
    IN log_file : UNIV login_$string_t; { Pathname of log file }
    IN log_flen : integer;       { Length of "log_file" }
    OUT logstr  : stream_$id_t   { Returns stream ID of log file }
) : boolean;                         { Returns TRUE if successful }
EXTERN;

{ Exit on error INTERNAL procedure ================================ }

PROCEDURE err_exit (IN status : UNIV status_$t);

VAR
  stat : status_$t;

BEGIN

    IF status.all <> status_$ok THEN
    BEGIN
        error_$std_format(status, '%$');
        pgm_$set_severity(pgm_$error);
        pfm_$rls_cleanup(cleaner, stat); {Reset cleanup handler}
        pgm_$exit;
    END;
END;  { err_exit }

BEGIN { Main ================================================== }

{ Set CL options and initialize the Command Line Handler. }

    cl_opts := [cl_$no_wildcards, cl_$no_keyword_delim];
    cl_$init (cl_opts, prog_name, sizeof(prog_name));
    status := pfm_$cleanup(cleaner);

    IF status.all <> pfm_$cleanup_set THEN
    BEGIN
        pgm_$set_severity(pgm_$error);
        pgm_$exit;
    END;
```

Example 3-3. Performing a Log-In Operation with LOGIN_$LOGIN, Cont.

```
    writeln;
    writeln ('  This program allows you to log in to a running process ');
    writeln ('  under a different SID. It will invoke a new process using ');
    writeln ('  the /com/sh command. ');
    writeln;
    writeln ('  Before logging you in, LOGIN_$LOGIN prompts for your ppo ');
    writeln ('  and password, and checks the password you supplied against  ');
    writeln ('  the password in the registry.');
    writeln;

{ Assign values to invoke shell program. }
    inv_prog     := '/com/sh';
    inv_prog_len := 7;

{ Get addresses of external I/O procedures for LOGIN_$LOGIN. }

    login_procedures.pread    := addr(my_read);
    login_procedures.pwrite   := addr(my_write);
    login_procedures.help     := addr(my_help);
    login_procedures.open_log := addr(my_open_log);

    IF NOT login_$login ( stream_in,          { Stream ID in which to log in }
                          [login_$log_events], { No log events file }
                          login_procedures,    { Address of my login procs }
                          status )             { Completion status }
       THEN
       BEGIN
           IF (status.all = login_$err_shut) THEN
           BEGIN
               err_exit(status);
           END;
       END;

    IF status.all = status_$ok THEN
    BEGIN
        writeln;
        writeln ('  Creating a new shell process:  ');
        writeln;
        writeln ('  Type CTRL/Z to terminate program. ');
        writeln;

        pgm_$invoke (inv_prog,        { Invoke program }
                     inv_prog_len,    { Number of characters of program }
                     0, 0,            { No arguments }
                     4,               { Number of streams }
                     connv,           { Pass standard streams }
                     [],              { New process in wait mode }
                     handle,          { Process handle }
                     status);         { Completion status }

        IF status.all <> status_$ok THEN
            err_exit(status);
    END;

END. { Main }
```

Example 3-3. Performing a Log-In Operation with LOGIN_$LOGIN, Cont.

```
MODULE login_procedures;

{ This contains I/O procedures for login.pas. }

%nolist;
%include  '/sys/ins/base.ins.pas';
%include  '/sys/ins/pfm.ins.pas';
%include  '/sys/ins/streams.ins.pas';
%include  '/sys/ins/vfmt.ins.pas';
%include  '/sys/ins/error.ins.pas';
%include  '/sys/ins/pgm.ins.pas';
%include  '/sys/ins/cl.ins.pas';
%include  '/sys/ins/pad.ins.pas';
%include  '/sys/ins/cal.ins.pas';
%include  '/sys/ins/time.ins.pas';
%include  '/sys/ins/login.ins.pas';
%list;

CONST
    newline       = chr(10);
    back_sp       = chr(8);
    car_ret       = chr(13);
    log_name      = 'login_log_file';
VAR
    stream_in     : stream_$id_t := stream_$stdin;
    stream_out    : stream_$id_t := stream_$stdout;
    status  : status_$t;

{ Login read function  ============================================== }

{ This procedure supplies LOGIN_$LOGIN with user input. }

FUNCTION my_read(
    IN stream     : stream_$id_t;
    OUT inbuf     : UNIV login_$string_t;
    IN inlen      : integer;
    IN pstr       : UNIV login_$string_t;
    IN plen       : integer;
    IN echo       : boolean;
    IN fillbuf    : UNIV login_$string_t;
    IN fillbuflen : integer
): integer;

VAR
    my_buffer     : array[1..4] of char;
    inptr         : ^string;
    size          : integer32;
    seek_key      : stream_$sk_t;
    i             : integer;
    status        : status_$t;

BEGIN { my_read }

    { Prompt }
    stream_$put_chr (stream_out, addr(pstr), plen, seek_key, status);
```

Example 3-4. Providing I/O Routines for LOGIN_$LOGIN

```
    { Turn off echo on user's input pad. }

    IF NOT echo THEN
    BEGIN

        pad_$raw (stream_in, status );     { Echo off }
        i := 1;

        REPEAT { Get input from user }
            stream_$get_rec(stream_in, addr(my_buffer), 1, inptr,
                            size, seek_key, status );

            IF status.all <> status_$ok THEN exit;
            IF inptr^[1] = back_sp THEN
            BEGIN
                IF i > 1 THEN i := i - 1;
                next;
            END;
            inbuf[i] := inptr^[1];
            IF (inbuf[i] = car_ret) OR
               (inbuf[i] = newline) THEN exit;
            i := i + 1;
        UNTIL FALSE;

        inbuf[i] := newline;
        my_read  := i;  { Count includes NEWLINE }

        { Allow pad to echo input again. }
        pad_$cooked(stream_in, status);

        { Write a NEWLINE after message. }

        stream_$put_rec(stream_out, addr(newline), 1, seek_key, status );
    END  { NOT echo_mode }
    ELSE BEGIN { echo_mode }
        { Get input from user }
        stream_$get_rec(stream_in,
                        addr(inbuf),
                        inlen,
                        inptr,
                        size,
                        seek_key,
                        status );
        IF status.all <> 0 THEN
            my_read := 0
        ELSE my_read := size;
    END; { echo_mode }

    return;

END; { my_read }
```

Example 3-4. Providing I/O Routines for LOGIN_$LOGIN, Cont.

```
{ Login write procedure ========================================== }
{ Writes output }

PROCEDURE my_write(
    IN stream      : stream_$id_t;
    IN pstr        : UNIV login_$string_t;
    IN plen        : integer );

VAR
    status   : status_$t;
    seek_key : stream_$sk_t;

BEGIN
    stream_$put_chr(stream_out, addr(pstr), plen, seek_key, status);
    stream_$put_rec(stream_out, addr(newline), 1, seek_key, status);
    return;
END; { my_write }

{ Login help procedure ========================================== }
{ This is the message that gets typed when user types h[elp] at the
  Login prompt. }

PROCEDURE my_help(
    IN stream      : stream_$id_t);

CONST
  helpline1 = '  This is the help message that';
  helpline2 = '  gets displayed when the user';
  helpline3 = '  types h[elp] at the prompt.';
  helplen1  = 31;
  helplen2  = 30;
  helplen3  = 28;

VAR
  status   : status_$t;
  seek_key : stream_$sk_t;

BEGIN
  my_write( stream_out, helpline1, helplen1);
  my_write( stream_out, helpline2, helplen2);
  my_write( stream_out, helpline3, helplen3);
END; { my_help }

{ Login open log procedure ========================================== }
{ Open the log file, write the date and time in it,and return the stream ID. }

FUNCTION my_open_log(
    IN log_file : UNIV login_$string_t;
    IN log_flen : integer;
    OUT logstr  : stream_$id_t
) : boolean ;

CONST
  my_log_file = 'LOGIN_log_file';
  my_log_flen =  14;
```

Example 3-4. Providing I/O Routines for LOGIN_$LOGIN, Cont.

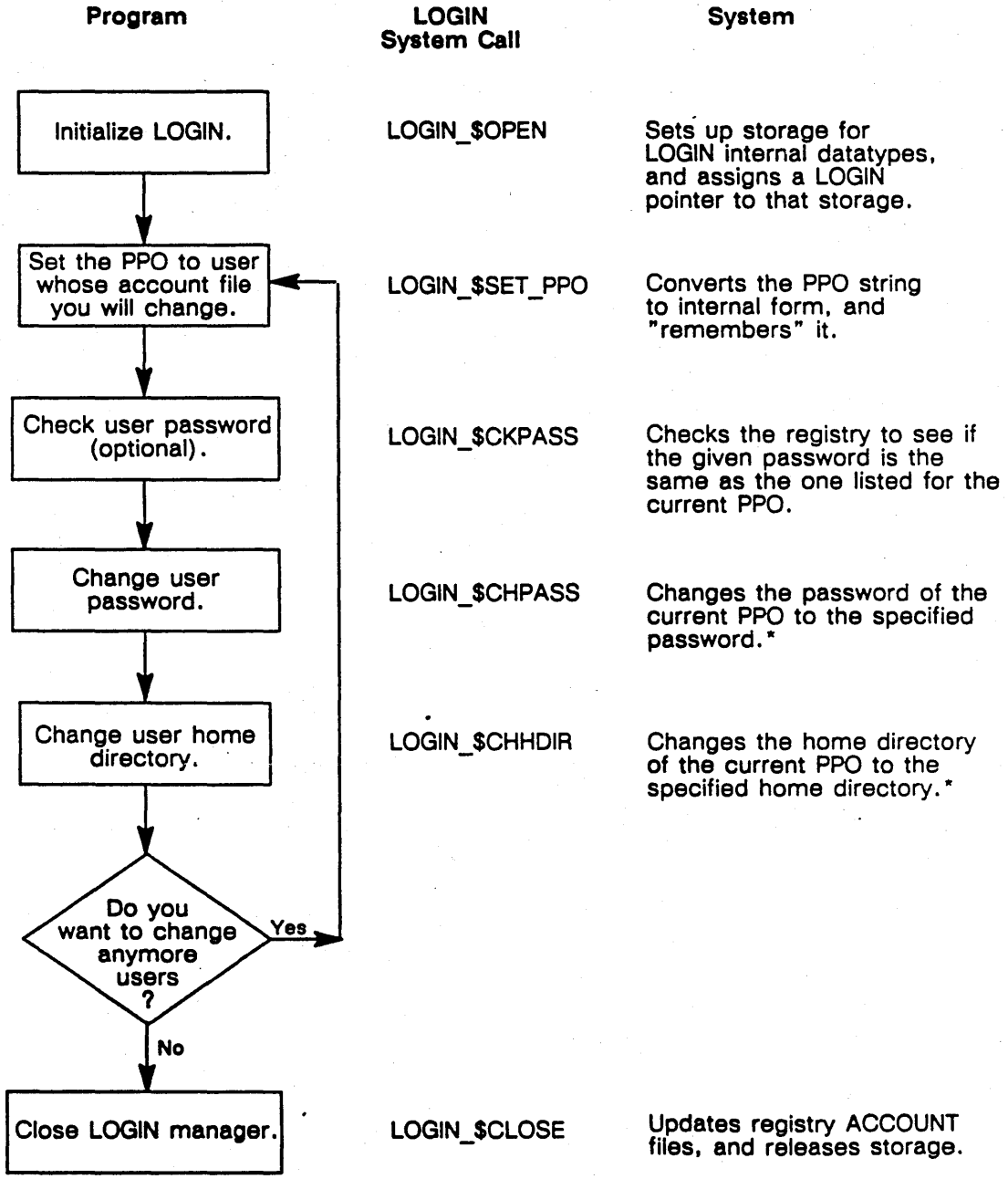
```
VAR
    td  :  cal_$timedate_rec_t ;
    da  :  ARRAY [1..10] OF char ;
    mon :  ARRAY [1..10] OF char ;
    d   :  cal_$weekday_t ;
    st  : status_$t;

BEGIN { My_open_log }

    my_open_log := FALSE;

    { Ignore the log file passed by LOGIN_$LOGIN, and open my own log
      file, return its stream ID to LOGIN_$LOGIN. (If I don't specify
      log_file,  LOGIN_$LOGIN writes to 'node_data/siologin_log.) }

    stream_$create(my_log_file,my_log_flen,stream_$append,
                   stream_$no_conc_write,logstr,st);
        IF st.all <> 0 THEN return;

    { Get decoded local time. }
    cal_$decode_local_time(td);    { Time stamp }

    WITH td DO BEGIN
        d := cal_$weekday (year, month, day);
        CASE d OF              { Determine day of week. }
            cal_$sun:  da := 'Sunday';
            cal_$mon:  da := 'Monday';
            cal_$tue:  da := 'Tuesday';
            cal_$wed:  da := 'Wednesday';
            cal_$thu:  da := 'Thursday';
            cal_$fri:  da := 'Friday';
            cal_$sat:  da := 'Saturday';
            OTHERWISE da := 'Doomsday';
            END; { case day }
        CASE month OF          { Determine month of year. }
            1:  mon := 'January';
            2:  mon := 'February';
            3:  mon := 'March';
            4:  mon := 'April';
            5:  mon := 'May';
            6:  mon := 'June';
            7:  mon := 'July';
            8:  mon := 'August';
            9:  mon := 'September';
            10: mon := 'October';
            11: mon := 'November';
            12: mon := 'December';
            END;  { case month }

        vfmt_$ws10(logstr,'%a, %a %wd, %wd  %wd:%2zwd:%2zwd%.',
              da, 10, mon, 10, day, year, hour, minute, second, 0);
        END;  { WITH td }
    my_open_log := TRUE;
END; { my_open_log }
```

Example 3-4. Providing I/O Routines for LOGIN_$LOGIN, Cont.

3.4. Changing User Account Files in the Network Registry

The LOGIN manager provides a set of LOGIN system calls that allow you to edit user account files in the network registry. Network account files associate usernames with log-in passwords and home directories. For details on the network registry, see the *Administering Your DOMAIN System* manual.

When using LOGIN system calls, you must follow a specific order. Figure 3-1 shows the sequence of using these calls.



** Note that changes are not finalized until LOGIN_$CLOSE closes successfully.*

Figure 3-1. Using LOGIN System Calls in Proper Sequence

When you initialize the LOGIN manager with LOGIN_$OPEN, it allocates heap storage for its private datatypes and returns a pointer value to that storage. Use the LOGIN pointer as an input parameter in subsequent LOGIN system calls.

When you open LOGIN, specify either of two modes: LOGIN_$READ, or LOGIN_$UPDATE. LOGIN_$READ allows you to read the user's password but you cannot change it. LOGIN_$UPDATE allows you to change a user's account file. Note that to change a user's account file, you must be a protected subsystem.

After initializing the LOGIN manager, set the PPO to the user whose account file you want to view or change with LOGIN_$SET_PPO. A user's PPO has four fields: the user's name, project name, organization name, and the hexadecimal ID of the user's node. The following are two examples of PPO's: WALLY_W.CURRENT.WRITERS.2713, ZACH.NONE.NONE.3541.

If you do not set the PPO with this call, the LOGIN manager will automatically set the PPO to the user who is currently logged in. Even if you want the current user, it's good programming practice to set the PPO explicitly with this call. You can specify the current user efficiently by specifying a null PPO and a PPO length of zero. LOGIN_$SET_PPO sets the PPO to the current user.

To check a user's password use LOGIN_$CKPASS, specify the LOGIN pointer (returned by LOGIN_$OPEN), the password you want to check, and its length. It returns the error message LOGIN_$BAD_PASSWD if the password check failed.

To change a user's password use LOGIN_$CHPASS, specifying the LOGIN pointer (returned by LOGIN_$OPEN), the new password, and its length.

To change a user's home directory, use LOGIN_$CHHDIR, specifying the LOGIN pointer (returned by LOGIN_$OPEN), the new home directory, and its length.

Use LOGIN_$CLOSE to close the LOGIN manager. At this time, The LOGIN manager updates the account files in the network registry. If a previous LOGIN system call had difficulty with an account file, a LOGIN_$CLOSE can fail, which means the registry will not be updated accurately. You will have to repeat the entire LOGIN sequence since you opened LOGIN with LOGIN_$LOGIN. Use LOGIN_$CLOSE even if LOGIN_$OPEN failed, because when LOGIN_$OPEN fails it can leave LOGIN partially opened.

3.4.1. Sample Program -- Changing the Registry ACCOUNT Files

Example 3-5 shows how to use the various LOGIN system calls to check and change a password and to change a home directory.

```
PROGRAM login_change_pass_dir;

%nolist;
%include  '/sys/ins/base.ins.pas';
%include  '/sys/ins/vfmt.ins.pas';
%include  '/sys/ins/error.ins.pas';
%include  '/sys/ins/pgm.ins.pas';
%include  '/sys/ins/cl.ins.pas';
%include  '/sys/ins/login.ins.pas';
%list;

CONST
  prog_name = 'LOGIN_chng_pass_dir';

VAR
  command       : string;
  command_len   : integer;
  ok            : boolean;
  null_line     : boolean;
  ppo           : string;
  ppo_len       : integer;
  verify        : boolean;
  num_args      : integer;
  login_ptr     : login_$ptr;
  bad_pname     : name_$pname_t;
  bad_pname_len : integer;
  errout        : stream_$id_t := stream_$errout;
  err_status    : status_$t;
  status        : status_$t;

{ ***************************************************************** }

PROCEDURE check_err ( IN status     : status_$t;
                      IN msg        : UNIV string );

BEGIN
        IF (status.code = 0 ) THEN
            RETURN;
        error_$std_format (status, msg );
        pgm_$set_severity (pgm_$error );
        pgm_$exit
END; { check_err }

{ ***************************************************************** }

PROCEDURE chn_pass;  { Go here if user specified chpass }

{ If the user specifies the -v[erify] option with a password, this
  procedure checks the specified password; otherwise, it changes the
  user's password to the specified password. }

VAR
    old_pass  : string;
    new_pass  : string;
    opass_len : integer;
    npass_len : integer;
```

Example 3-5. Using LOGIN Calls to Change ACCOUNT Files

```
BEGIN { chn_pass }

{ Get password. If user wants to verify current password, the next argument
  is the password to check.  If the user wants to change the password,
  the next argument is the new password. }

    IF verify THEN
        ok := cl_$get_arg (cl_$next, old_pass, opass_len, sizeof(old_pass))
    ELSE
        ok := cl_$get_arg (cl_$next, new_pass, npass_len, sizeof(new_pass));
    cl_$check_unclaimed;

{ If verifying old password, open LOGIN for read access, since you are
  not changing the registry. }

    IF verify THEN
    BEGIN
        login_$open (login_$read, { Open LOGIN manager for updates }
                     login_ptr,   { Pointer to LOGIN datatypes }
                     status);     { Completion status }
        check_err (status, '  Cannot perform LOGIN open. %$');

{ Set the PPO to operate on. }
        login_$set_ppo ( login_ptr,   { Pointer to LOGIN datatypes }
                         ppo,         { PPO file specified by user }
                         ppo_len,     { Length of PPO file }
                         status );    { Completion status }
        check_err (status, '  Cannot set user''s PPO. %$');
        { Check old password. }
        login_$ckpass (login_ptr,     { Pointer to LOGIN datatypes }
                       old_pass,      { Old password }
                       opass_len,     { Length of old password }
                       status);       { Completion status }

        IF status.all = login_$bad_passwd THEN BEGIN
            vfmt_$ws2(errout, 'Old password is incorrect.%.', 0, 0);
            pgm_$set_severity (pgm_$false);
            pgm_$exit;
            END
        ELSE vfmt_$write2(' Password verified.%.', 0, 0);
    END
    ELSE BEGIN   { Change current password to specified password. }

        login_$open ( login_$update, login_ptr, status);
        check_err (status, '  Cannot perform LOGIN open. %$');

{ Set the PPO to operate on. }
        login_$set_ppo ( login_ptr,   { Pointer to LOGIN datatypes }
                         ppo,         { PPO file specified by user }
                         ppo_len,     { Length of PPO file }
                         status );    { Completion status }
        check_err (status, '  Cannot set user''s PPO. %$');
        login_$chpass ( login_ptr,    { Pointer to LOGIN datatypes }
                        new_pass,     { New password }
                        npass_len,    { Length of new password }
                        status );     { Completion status }
```

Example 3-5. Using LOGIN Calls to Change ACCOUNT Files, Cont.

```
        IF status.all <> status_$ok THEN
        BEGIN
            login_$err_context ( login_ptr,     { Pointer to LOGIN datatypes }
                                 err_status,    { Returns error status }
                                 bad_pname,     { Pathname of user that failed }
                                 bad_pname_len, { Length of bad pathname }
                                 status );      { Completion status }
            vfmt_$ws2 (errout, '  Cannot change password for: ',
                       bad_pname, sizeof(bad_pname) );
        END;

    END;

    login_$close ( login_ptr, status );
    check_err (status, '  Cannot perform LOGIN close. %$');
END; { chn_pass }

PROCEDURE chn_dir; { ********************************************  }

{ This procedure changes the user's  home directory listed in
  the user's ACCOUNT file to the specified home directory. }

VAR
    new_dir    : string;
    dir_len    : integer;

BEGIN { chn_dir }

{ Get the new home directory. }

    ok := cl_$get_arg (cl_$next, new_dir, dir_len, sizeof(new_dir));
    cl_$check_unclaimed;

    login_$open (login_$update,  { Open LOGIN manager for updates }
                 login_ptr,      { Pointer to LOGIN datatypes }
                 status);        { Completion status }
    check_err (status, '  Cannot perform LOGIN open. %$');

{ Set the PPO to operate on. }

    login_$set_ppo ( login_ptr,  { Pointer to LOGIN internal data }
                     ppo,        { PPO }
                     ppo_len,    { Length of PPO }
                     status );   { Completion status }
    check_err (status, '  Cannot set user''s PPO. %$');
    login_$chhdir ( login_ptr,   { Pointer to LOGIN internal data }
                    new_dir,     { Name of new home directory }
                    dir_len,     { Length of new home directory }
                    status);     { Completion status }
    IF status.all <> status_$ok THEN
        BEGIN
            login_$err_context ( login_ptr,     { Pointer to LOGIN datatypes }
                                 err_status,    { Returns error status }
                                 bad_pname,     { Pathname of user that failed }
                                 bad_pname_len, { Length of bad pathname }
                                 status );      { Completion status }
```

Example 3-5. Using LOGIN Calls to Change ACCOUNT Files, Cont.

```
            vfmt_$ws2 (errout, '  Cannot home directory for: ',
                       bad_pname, sizeof(bad_pname) );
        END;

    login_$close ( login_ptr, status );

    check_err (status, '  Cannot perform LOGIN close. %$');

END; { chn_dir }


{ ************************************************************** }

BEGIN { Main }

{ Initialize the CL, but don't parse the command line. }

    cl_$setup ( [],                  { Default CL options in effect }
                prog_name,           { Name of program }
                sizeof(prog_name));  { Length of program name }

{ Get the line to parse from standard input. }

    writeln;
    writeln  ( '                *****                          ');
    writeln;
    writeln  ( '  This program allows you to change a user''s ');
    writeln  ( '  password or home directory. ');
    writeln;

REPEAT  { until user types CTRL/Q }

    writeln;
    writeln ( '  Enter the user''s PPO whose password or home ');
    writeln ( '  directory you want to change.');
    writeln;

{ Get the PPO. }
    ok := cl_$parse_input ( stream_$stdin, null_line  );
    ok:= cl_$get_arg (cl_$first, ppo, ppo_len, sizeof(ppo));

    writeln;
    writeln ( '  Type "chpass  -v[erify] ''password '' " if you want to check');
    writeln ( '  the current password.');
    writeln;
    writeln ( '  Type "chpass ''password'' "  to change the current password');
    writeln ( '     to the specified password.');
    writeln;
    writeln ( 'Type "chhdir ''dir'' " to change current home directory');
    writeln ( '     to the specified home directory.');
```

Example 3-5. Using LOGIN Calls to Change ACCOUNT Files, Cont.

```
{ Get the operation. }

    ok := cl_$parse_input ( stream_$stdin, null_line  );

{ Check if user supplied the verify option on the command line.
  Check for any invalid keywords; exit if user specified any.   }

    verify := cl_$get_flag ('-v[erify]', num_args);

    cl_$check_unclaimed;

{ Get the operations. }
  IF cl_$get_arg (cl_$first, command,command_len, sizeof(command)) THEN
    BEGIN

        IF cl_$match ('chpass[]', command, command_len) THEN
            chn_pass;
        IF cl_$match ('chhdir[]', command, command_len) THEN
            chn_dir;

    END;

   UNTIL FALSE; { User types CTRL/Q }

END. { Main }
```

Example 3-5. Using LOGIN Calls to Change ACCOUNT Files, Cont.

Chapter 4
More Process Manager System Calls

This chapter describes DOMAIN system calls for managing programs. These calls allow you to

- Load and call a program or library object n odule.
- Assign a name given its process UID.
- Set the priority given its process UID.

These system calls are part of the DOMAIN subsystems for managing programs. For details on other calls in these subsystems, see the chapter on managing programs in the *Programming with General System Calls* manual.

4.1. System Calls, Insert Files, and Data Types

To load and call object modules or libraries, use the LOADER manager. These calls are located in the LOADER insert file. Note that they have the PM prefix.

To assign a name to a given process UID, use PM_$SET_NAME, which is in the PM insert file.

To set the priority of a given process UID, use PROC2_$SET_PRIORITY, which is in the PROC2 insert file.

When using these system calls in your program, you must specify the appropriate insert file for the language your are using. Where prefix is the desired subsystem, the insert files are

/SYS/INS/prefix.INS.C	for C.
/SYS/INS/prefix.INS.FTN	for FORTRAN.
/SYS/INS/prefix.INS.PAS	for Pascal.

For details on the system call syntax, data types, and error messages, Part II of this manual. For details on other system calls in these subsystems, see the *DOMAIN System Call Reference* manual.

4.2. Loading and Calling a Program with LOADER System Calls

The two system calls in the LOADER manager allow you to load a program or library object module into memory so that it can be executed. PM_$LOAD converts a specified object module and returns its starting address. PM_$CALL invokes the loaded object module.

These calls work similarly to PGM_$INVOKE, except that PGM_$INVOKE performs some operations automatically. Table 4-1 highlights the differences between PGM_$INVOKE and the LOADER calls. The resources referred to in this table include read/write storage, mark release handlers, address space, and stream descriptors.

For details on using PGM_$INVOKE, see the *Programming with General System Calls* manual.

Table 4-1. Difference Between LOADER and PGM_$INVOKE System Calls

Condition	A Loads & Calls B (PM)	A Invokes B (PGM)
Program Level:	Not created.	Created.
Resources that B acquires:	Released when A terminates.*	Released when B terminates.
Storage unmapped:	When A terminates.	When B terminates.

* Note that if A continues to load programs that terminate abnormally, you can run out of resources (such as stream descriptors or address space) since they don't get released until A terminates.

PM_$LOAD and PM_$CALL are most commonly used to load libraries. You would also use them when you want to control how the object module gets loaded. For example, you can have PM_$LOAD make a writable copy of the object module so that you can set breakpoints without changing the original object module. Or you can have PM_$LOAD report an error if the object module contains any unresolved global variables.

When you use PM_$LOAD, you control how the object module gets loaded by setting the options of a variable in PM_$LOADER_OPTS format. Table 4-2 lists the options you can specify.

Table 4-2. PM_$LOAD Options

PM_$LOAD Option	Description
PM_$COPY_PROC	Copies the object module into read/write storage so that you can write to the object module without changing the original object module. If you do not specify this option, PM_$LOAD maps the object module directly.
PM_$INSTALL	Indicates that you are loading a library. PM_$LOAD makes all the global entry points, which were marked at binding, available to other programs. Specify this option when loading libraries.
PM_$INSTALL_SECTIONS	Indicates that you are loading a library containing global sections. PM_$LOAD makes these global sections, which were marked at binding, available to all programs. Specify this option when loading libraries.
PM_$LOAD_WRITABLE	Allows you to write to the object module. Specify this option when you want to write to the object module without making a copy of it first. The debugger provides this with its -NC option.
PM_$NO_UNRESOLVEDS	Returns an error message if the object module contains any unresolved global variables.

After you load the program with PM_$LOAD, use PM_$CALL to invoke it. When using PM_$CALL, you give it a pointer to the routine you want to call. This is the start address of the object module returned by PM_$LOAD, which is the first field in the predefined record, PM_$LOAD_INFO.

Section 4.2.1 is a sample program using PM_$LOAD and PM_$CALL to load and invoke a program.

Even though PM_$CALL is a function, you usually load a procedure, so the value it returns is meaningless. However, you can use PM_$CALL to return a value from the object module; PM_$CALL will pass a 32-bit integer value along to the main program as its return value. Note that you cannot pass any arguments to the routine you are invoking.

You can have PM_$CALL return data types other than a 32-bit integer, so long as the data fits in 32 bits or fewer. To do so, create a variant record with a 32-bit integer as one variant, and the actual data type returned by the target routine as another variant. Pad the second variant out to 32 bits. Assign the 32-bit integer value from PM_$CALL to the 32-bit integer variant, and take your desired data from the other variant. Example 4-1 shows how you would use PM_$CALL with a variant record.

```
{ This Pascal example uses PM_$CALL to call a function that returns a
  16-bit integer data item: }

VAR

  ret:   RECORD CASE INTEGER OF
               1: (long : integer32);
               2: (pad  : Integer;        { Filler }
               wanted_I  : Integer);      { Desired data }
       END;

  load_info : pm_$load_info;

BEGIN
     { Load my_integer16_function. }
     .
     .
     .
     { Call my_integer16_function using the start address returned by
       the PM_$LOAD_INFO data type in PM_$LOAD. }

     ret.long := pm_$call(load_info.start_addr);

    {Write out the returned value as a 16-bit integer. }

     writeln (ret.wanted_I);
```

Example 4-1. Returning a 16-Bit Value with PM_$CALL

4.2.1. Sample Programs Using LOADER System Calls

Example 4-2 is a sample program that loads and calls a second program (PM_LOAD_THIS.BIN) using PM_$LOAD and PM_$CALL. It gets the load options from the command line.

```
PROGRAM pm_load;

%nolist;
%include '/sys/ins/base.ins.pas';
%include '/sys/ins/streams.ins.pas';
%include '/sys/ins/cl.ins.pas';
%include '/sys/ins/loader.ins.pas';
%include '/sys/ins/vfmt.ins.pas';
%include '/sys/ins/pgm.ins.pas';
%include '/sys/ins/error.ins.pas';
%list;

CONST
  prog_name      = 'pm_load';
  prog_to_load   = 'pm_load_this.bin';

VAR
  name         : name_$pname_t;
  len          : integer;
  num_args     : integer;
  load_opts    : pm_$loader_opts;
  sec_info     : pm_$load_info;
  status       : status_$t;
  pm_status    : status_$t;
  ok           : boolean;
  null_line    : boolean;
  junk         : integer32;

{ ================================================================== }

PROCEDURE check_status;

BEGIN

    IF status.all <> status_$ok THEN
    BEGIN
        error_$print (status);
        pgm_$exit;
    END;
END; { check_status }

{ ================================================================== }
```

Example 4-2. Loading and Calling a Program

```
BEGIN { Main }

    cl_$setup  ( [],                  { Default CL options in effect }
                 prog_name,           { Name of program }
                 sizeof(prog_name)); { Length of program name }

    {Initialize empty set of loader options. }
    load_opts := [];


    writeln ( ' This program loads the object module, ',
              '   prog_name : sizeof(prog_name) );
    writeln;
    writeln ( ' You can specify the following options: ' );
    writeln;
    writeln ( ' -c[copy] to copy the object module so you can write to it. ');
    writeln ( ' -w[rite] to make the original object module writable. ');
    writeln ( ' -nr[esolveds] to terminate program with an error if ');
    writeln ( '    global variables are unresolved. ');
    writeln ( ' -lib[rary] to load a library. ');
    writeln;

    ok := cl_$parse_input ( stream_$stdin, null_line  );

{ Get keywords, then check for any invalid keywords;
  exit if user specified any. }

    IF cl_$get_flag ('-c[opy]', num_args)
        THEN  load_opts := [pm_$copy_proc];
    IF cl_$get_flag ('-w[rite]', num_args)
        THEN load_opts := [pm_$load_writable];
    IF cl_$get_flag ('-nr[esolveds]', num_args)
        THEN  load_opts := [pm_$no_unresolveds];
    IF cl_$get_flag ('-lib[rary]', num_args)
        THEN  load_opts := [pm_$install + pm_$install_sections];

    cl_$check_unclaimed;

    pm_$load ( prog_to_load,          { Name of program to load }
               sizeof(prog_to_load), { Length of program }
               load_opts,            { Load options }
               0,                    { Get start address only }
               sec_info,             { Returns start address of object module }
               status);              { Completion status }
    check_status;

    IF status.all = status_$ok THEN
    BEGIN
        writeln;
        writeln ('Program loaded sucessfully.');
        junk := pm_$call( sec_info.start_addr);
    END;
END. { pm_load }
```

Example 4-2. Loading and Calling a Program, Cont.

4.3. Setting a Process Priority

The **process priority** is an integer ranging from 1 (low) to 16 (high). When the operating system decides which process to run next, it chooses the process that currently has the highest priority.

The priority changes while a process executes. Its priority increases as the process waits for events, and decreases as it computes for long periods without waiting. To find out the priority range of a running process, use the PST (process_status) Shell comand.

By default, a process will have a priority range of 3 to 14. You can change this range by specifying different high and low values in the PROC2_$SET_PRIORITY system call. These values must be between of 1 to 16. The PPRI (process_priority) Shell command uses the PROC2_$SET_PRIORITY system call.

Note that the Display Manager (DM) process has a priority range of 16, 16. See Section 4.5 for an example of PROC2_$SET_PRIORITY in a program.

4.4. Assigning a Name to a Process

When the operating system creates a process, it assigns a number or **unique identifier** (UID) to the process. You might want to refer to the process by name rather than number so that you can identify it more easily. You do so with the PM_$SET_NAME system call. You supply the name, its length, and process UID; the call returns a completion status.

After assigning a name to a process with PM_$SET_NAME, Shell commands, such as PPRI (process_priority), PST (process_status), and SIGP (signal_process) refer to the process by its name.

Server programs such as "alarm_server" or "mail" use PM_$SET_NAME to name their server processes. Users can name a process they create by using the -N option with the Shell command CRP (create_a_process), and the DM commands, CP (create_process), CPO (create_process_only), and CPS (create_process_server).

NOTE: `A process can be assigned a name only once. You cannot rename or remove a name once it is assigned.`

If you try to name a process that already has a name, you will get the error, PM_$ALREADY_NAMED.

4.5. Sample Programs Using PM, PROC2 System Calls

Example 4-3 is a sample program using PM_$SET_NAME to assign a name to a process, and PROC2_$SET_PRIORITY to change its priority. The program first creates an unnamed process using PGM_$INVOKE, and then sets the name. Before it sets the name, it must first get its process UID using the PGM_$GET_PUID system call.

```
PROGRAM pm_proc2_set_name_priority;

%nolist;
%include '/sys/ins/base.ins.pas';
%include '/sys/ins/proc2.ins.pas';
%include '/sys/ins/pm.ins.pas';
%include '/sys/ins/streams.ins.pas';
%include '/sys/ins/error.ins.pas';
%include '/sys/ins/pgm.ins.pas';
%list;

CONST
  lo_bound  = 9;   { Low bound of process priority range }
  hi_bound  = 5;   { High bound of process priority range }

VAR
  uid       : uid_$t;         { Process UID }
  status    : status_$t;
  connv     : pgm_$connv;     { Connection vector }
  handle    : pgm_$proc;      { Process handle }
  prog_name : name_$name_t := 'invoke_clock';  { Name to give process }

PROCEDURE check_status;  { ============================================== }

BEGIN
    IF status.all <> status_$ok THEN
    BEGIN
        error_$print (status);
        pgm_$exit;
    END;
END; { check_status }

BEGIN   { Main ================================================================ }

    writeln;
    writeln ( '  This program invokes a process to run a digital clock,  ');
    writeln ( '  names the process, INVOKE_CLOCK, and sets its priority. ');
    writeln ( '  You can see the process listed by name by invoking the  ');
    writeln ( '  Shell command PST (process_status). ');
    writeln;

{ Load the standard streams to pass to the invoking program. }

    connv[0] := stream_$stdin;
    connv[1] := stream_$stdout;
    connv[2] := stream_$errin;
    connv[3] := stream_$errout;

{ Create an unnamed child process using PGM_$INVOKE. }
```

Example 4-3. Setting Name and Priority of a Process

```
    pgm_$invoke ( 'digclk.bin',  { Pathname of program to invoke }
                  10,            { Length of pathname }
                  0,             { Number of arguments to pass }
                  0,             { Argument vector }
                  4,             { Number of streams to pass }
                  connv,         { Array of stream IDs to pass }
                  [],            { Invoke program }
                  handle,        { Returns process handle for UID }
                  status );      { Completion status }
    check_status;

{ Get the UID of the child process. }

    pgm_$get_puid ( handle,      { Process handle }
                    uid,         { Returns UID }
                    status );    { Completion status }
    check_status;

{ Set name of the child process. }

    pm_$set_name ( prog_name,          { Name to give process }
                   sizeof(prog_name),  { Length of name }
                   uid,                { UID of the process }
                   status );           { Completion status }
    check_status;

    writeln;
    writeln (' The name of this process is: ',
              prog_name : sizeof(prog_name) );

{ Change the priority of the child process. }

    proc2_$set_priority ( uid,       { UID of current process }
                          lo_bound,  { Low bound of priority range }
                          hi_bound,  { High bound of priority range }
                          status );  { Completion status }
    check_status;

    writeln;
    writeln (' The new priority is: ',  lo_bound, hi_bound );

END.
```

Example 4-3. Setting Name and Priority of a Process

Chapter 5
Handling Dynamic Storage

The DOMAIN system contains two managers that allocate dynamic storage. The Read/Write Storage Manager (RWS) is a set of DOMAIN system routines that allocates dynamic storage. These system calls allow you to request a specific amount of storage during the execution of your program. Each call returns a pointer to the address of the new storage space.

The Basic Allocate/Free Heap Manager (BAF) allows you to create a heap and perform allocate and free operations on that heap. You would use the BAF manager when you want to specify where the storage comes from, or have a stricter control over allocating and releasing storage.

We describe both the RWS and BAF managers in this chapter.

5.1. System Calls, Insert Files, and Data Types

To use the RWS manager, use the system calls with the prefix RWS. To use the BAF manager, use the system calls with the prefix BAF. This chapter describes how most of these calls work. For details on system call syntax, data types, and error messages, see Part II of this manual. See also the *DOMAIN System Call Reference* manual for details on previously released RWS calls.

When using RWS or BAF system calls in your program, you must specify the appropriate insert file for the language your are using. Where prefix is the desired subsystem (RWS for read/write storage, BAF for basic allocate/free heap storage), the insert files are RWS insert files are

/SYS/INS/prefix.INS.C	for C.
/SYS/INS/prefix.INS.FTN	for FORTRAN.
/SYS/INS/prefix RWS.INS.PAS	for Pascal.

5.2. Overview of the RWS System Calls

RWS system calls provide a few different ways to allocate storage. Which method you should use depends on

- How long you want to keep the storage.
- How much system overhead you can afford.
- How you want to the storage to be accessed, for example, within the calling process or among all processes.

Table 5-1 lists the RWS system calls you can use to allocate storage dynamically. Details on each type of storage follow.

Table 5-1. RWS System Calls to Allocate Dynamic Storage

System Call	Description
RWS_$ALLOC	Allocates read/write storage for FORTRAN or Pascal programs.
RWS_$ALLOC_HEAP	Allocates heap* (releasable read/write) storage for programs.
RWS_$ALLOC_HEAP_POOL	Allocates heap* (releasable read/write) storage in a specified pool.
RWS_$ALLOC_RW	Allocates read/write storage for Pascal programs only.
RWS_$ALLOC_RW_POOL	Allocates read/write storage in a specified pool.
RWS_$RELEASE_HEAP	Releases the storage you allocated with RWS_$ALLOC_HEAP or RWS_$ALLOC_HEAP_POOL.

* When these calls allocate read/write storage, they provide you with pointers to storage that can be released when you no longer need it. To distinguish this from unreleasable read/write storage, we refer to this as heap storage. Note that this differs from a BAF heap described in Section 5.3.

You can use all the above systems calls in Pascal and C programs. However, in C programs, you might want to use the C Library routine, MALLOC. Note that due to FORTRAN calling conventions, the only RWS call you can use in FORTRAN programs is RWS_$ALLOC. This limitation will be corrected in a future AEGIS Software Release.

Whether you allocate read/write storage or heap storage depends on how long you want to keep the storage. Once you allocate **read/write storage**, the storage exists until the program terminates. However, you can explicitly release **heap storage** once you have finished using it.

The heap requires more system overhead initially. Currently, an allocation from the RWS heap requires between 4 to 16 bytes of overhead -- to keep track of the allocated storage. Note that the amount of overhead is subject to change, so your program should not depend on an exact amount of system overhead. The system requires no overhead to allocate read/write storage.

You usually want to allocate heap storage during your program if you need a substantial amount of storage for a limited period of time, or if you want to keep your working set as small as possible.

For example, the CL allocates heap storage to hold the tokens while parsing the command line. It frees the storage after parsing the line. The CL uses heap storage because it can tell when it no longer needs the storage. Also, if it doesn't free the storage, it would eventually run out.

You would allocate read/write storage if the amount of overhead for a heap is unacceptable, or if you do not need to release the storage before terminating the program.

If you want to control how the dynamic storage can be accessed, specify the appropriate option in the RWS_$POOL system calls. You can allocate both read/write storage and heap storage in these pools so that you can

- Limit storage to local access within the calling process. Specify the **standard pool** option (RWS_$STD_POOL) in most cases.

- Make storage accessible to all processe... Specify the **global pool** option (RWS_$GLOBAL_POOL) to share information among processes. For example, you might want to implement a global queue to pass messages between processes. Note that pointers are valid in *all* processes because all processes have a reserved *identical* portion of address space.

- Make storage accessible to the calling process and to an overlay process. Specify the **stream pool** option (RWS_$STREAM_TM_POOL) when your program needs to pass information to a program invoked with a UNIX EXEC system call. For example, the STREAM manager uses RWS_$STREAM_TM_POOL to pass an open stream to a program invoked with an EXEC call. It stores information about that stream in the stream pool.

Table 5-2 summarizes the aspects of each type of storage allocation.

Table 5-2. Summary of Types of Storage Allocation

	Read/Write Storage	Heap Storage
Standard Pool	Storage kept until program exits or until it invokes a program with a UNIX EXEC system call.	Storage kept until you release it with RWS_$RELEASE_HEAP, the program exits, or the program invokes a program with a UNIX EXEC call.
	No system overhead.	About 16 bytes of system overhead.
	Storage available to local process only.	
Global Pool	Storage kept until reboot.	Storage kept until you release it with RWS_$RELEASE_HEAP or reboot.
	About 4 bytes of system overhead.	About 4 bytes of system overhead.
	Storage available to all processes.	

Table 5-2. Summary of Types of Storage Allocation, Cont.

	Read/Write Storage	Heap Storage
Stream Pool	Storage kept until program exits.	Storage kept until you release it with RWS_$RELEASE_HEAP.
	No system overhead.	About 16 bytes of system overhead.
	Storage available to the local process or to a program invoked with a UNIX EXEC system call.	

NOTE: Do not depend on the exact amount of system overhead used in RWS system calls. The amount of overhead is subject to change.

5.3. Overview of the BAF System Calls

The basic allocate/free (BAF) heap manager allows you to create a heap to handle dynamic storage allocation yourself. The advantage to handling storage with the BAF manger is that you can specify from where BAF gets the storage. You also have tighter control over allocating and freeing the storage you use.

For example, you could allocate storage with BAF system calls to control the size of your working set by subdividing your heap into smaller heaps. Place storage referenced closer in time in the same heap.

To use the BAF manager, you follow this sequence:

1. Create a heap with BAF_$CREATE.
2. Allocate storage from the heap with BAF_$ALLOC.
3. Release the storage and return it to the heap with BAF_$FREE when your program is through using the storage.
4. Add storage space to the heap, if necessary, with BAF_$ADD_SPACE.

When creating the heap, you can specify the storage space in many ways, for example, declaring an array in a program, using an RWS_$ALLOC_RW or MS_$CRMAPL system call.

If the storage is shared, you must specify the BAF_$SHARED option in the first parameter of BAF_$CREATE. By setting the BAF_$SHARED option, subsequent calls to BAF_$ALLOC and BAF_$FREE will obtain locks before performing their operation. This is necessary to prevent two processes from corrupting the heap by using it at the same time.

Once you have created the heap, you can perform any number of allocate and free operations. Use BAF_$ALLOC to allocate storage from the heap. BAF_$ALLOC allocates a contiguous region of storage up to a maximum of 32K bytes. If you require more storage, you can make subsequent calls to BAF_$ALLOC.

BAF_$ALLOC could fail if there's not enough storage space left in the heap (it returns the error BAF_$NO_ROOM). You can add space to the heap with BAF_$ADD_SPACE.

BAF_$ALLOC and BAF_$FREE could fail if the heap overwrites the overhead information (pointers, size) which is located before each block. This can occur if your program refers to an array beyonds its bounds.

5.3.1. Improving Performance Under Current Implementation

This section describes some characteristics of the BAF manager that might help you improve performance. We reserve the right, however, to change details of this implementation in the future to improve efficiency.

The following implemenation details might help you use a BAF heap more efficiently:

- The current implementation of BAF manager uses a single tag before the block of storage to keep track of the block.
- BAF_$ALLOC combines adjacent free items while searching for the free list for a large enough block to perform the allocate operation.
- When you free items, BAF_$FREE puts the free blocks on a free list. Therefore, freeing is very efficient.
- Allocating and freeing blocks of the same size is very fast.
- The BAF manager tends to reuse recently freed blocks, so you get desirable working set behavior.

5.4. Sample Program Using RWS and BAF System Calls

The program in Example 5-1 shows how to use BAF system calls to allocate storage. It uses the MS_$CRMPL system call to create a temporary file to store the heap. (You might want to use a file to maintain storage at different program levels in a single process.) The program then performs allocates and frees from the file using BAF system calls.

```
PROGRAM manage_mapl_heap;

%include '/sys/ins/base.ins.pas';
%include '/sys/ins/baf.ins.pas';
%include '/sys/ins/cl.ins.pas';
%include '/sys/ins/pgm.ins.pas';
%include '/sys/ins/rws.ins.pas';
%include '/sys/ins/error.ins.pas';
%include '/sys/ins/vfmt.ins.pas';
%include '/sys/ins/ms.ins.pas';

CONST
  heap_chunk_size = 32 * 1024;
TYPE
  stack_pointer = ^stack_item;
  stack_item    = RECORD
    stack_data  : string;
    next_link   : stack_pointer;
    END; { record }

VAR
  stack          : univ_ptr;
  amount         : integer;
  command        : string;
  command_len    : integer;
  name           : string;
  new_name       : string;
  name_len       : integer;
  address        : stack_pointer := NIL;
  old_top        : stack_pointer;
  null_line      : boolean;
  stack_ptr      : stack_pointer := NIL;
  stack_address  : baf_$t;
  status         : status_$t;
  ok             : boolean;

{ Exit on error procedure  ========================================== }

PROCEDURE check_status (IN status : UNIV status_$t);

BEGIN

    IF status.all <> status_$ok THEN
    BEGIN
        error_$std_format(status,'%$');
        pgm_$set_severity(pgm_$error);
        pgm_$exit;
    END;
END;  { err_exit }
```

Example 5-1. Allocating Storage with BAF System Calls

```
{ Allocate storage for new top of stack ========================== }

PROCEDURE add_storage ( IN new_name : string;
                        IN OUT top : stack_pointer );
VAR
  temp_ptr : stack_pointer;

BEGIN  { add_storage }

    { Allocate enough storage for the new name. }
    temp_ptr := BAF_$ALLOC (stack_address,       { Address of heap from
                                                   which to get storage }
                            sizeof (stack_item), { Size of storage to allocate }
                            status );            { Completion status }
    check_status(status);

    IF temp_ptr = NIL THEN
    BEGIN
        { Create another temporary file to get more storage. }

        stack := MS_$CRMAPL ( ' ',              { Object to be mapped }
                              0,                { Length of object }
                              0,                { First byte to be mapped }
                              heap_chunk_size,  { Number of bytes to map }
                              ms_$nr_xor_1w,    { Allow 1 writer, any readers }
                              status );         { Completion status }
        check_status (status);

        BAF_$ADD_SPACE ( stack_address,     { Address of heap to which to add
                                              storage }
                         stack,             { Address of added storage }
                         heap_chunk_size,   { Amount of storage to add }
                         status );          { Completion status }
        check_status(status);

        temp_ptr := BAF_$ALLOC (stack_address,      { Address of heap from which
                                                      to get storage }
                                sizeof(stack_item),{ Size of storage to allocate}
                                status );           { Completion status }
        check_status(status);
    END;

    temp_ptr^.stack_data := new_name;   { Link  new name }
    temp_ptr^.next_link  := top;        { Connect to previous top }
    top := temp_ptr;                    { Redefine top of stack }

END; { add_storage }
```

Example 5-1. Allocating Storage with BAF System Calls, Cont.

```
{  Check for empty stack  ================================================== }

FUNCTION empty_stack (IN top : stack_pointer) : boolean;

BEGIN { empty_stack }

    empty_stack := top = NIL

END;  { empty_stack }

{ Pop name off stack and free storage  ================================== }

PROCEDURE free_storage ( OUT    del_name : string;
                         IN OUT top      : stack_pointer );
BEGIN  { free_storage }

    IF empty_stack(top) THEN
        writeln (' Cannot remove name from empty list. ')
    ELSE BEGIN
        del_name := top^.stack_data; { Get name to delete }
        old_top :=  top;             { Save old top of stack }
        top      := top^.next_link;  { Make next name top of stack }

        baf_$free ( stack_address,   { Address of storage from which to free
                                       block }
                    old_top,         { Address of block of storage to be freed }
                    status );        { Completion status }
        check_status(status);
    END;
END;  { free_storage }

{ Main procedure  ========================================================== }
BEGIN { Main }

    { Allocate file to hold stack info then create a heap to handle the stack.
      MS_$CRMAPL creates a temporary file and points to the first byte. }

    stack := MS_$CRMAPL ( ' ',              { Object to be mapped }
                          0,                { Length of object }
                          0,                { First byte to be mapped }
                          heap_chunk_size,  { Number of bytes to map }
                          ms_$nr_xor_1w,    { Allow 1 writer, any readers }
                          status );         { Completion status }
    check_status (status);

    IF stack <> NIL THEN
    BEGIN
        stack_address := BAF_$CREATE ( [],        { No options }
                                       stack,     { Address of storage to use }
                                       heap_chunk_size, { Maximum size of stack }
                                       status );        { Completion status }
        check_status(status);
    END;
```

Example 5-1. Allocating Storage with BAF System Calls, Cont.

```
    { Get the line to parse from standard input. }

    writeln;
    writeln ( 'This program allows you to add or free storage from the heap. ');
    writeln;

    REPEAT  { user types CTRL/Q }

        writeln ( 'Type "ADD name"  to the top of the list. ');
        writeln ( 'Type "FREE name" from the top of the list.');
        writeln ( 'Type "Q[uit]"  to quit. ');

        { Parse the input. }

        ok := cl_$parse_input ( stream_$stdin,
                                null_line  );

        IF null_line THEN
        BEGIN
            writeln ('No input. Terminating program.');
            pgm_$exit;
        END;

    { Get keywords, then check for any invalid keywords;
      exit if user specified any. }

      IF cl_$get_arg (cl_$first, command, command_len, sizeof(command)) THEN
      BEGIN

          IF cl_$match ('add[]', command, command_len) THEN
              IF cl_$get_arg (cl_$next, name, name_len, sizeof(name)) THEN
                  add_storage (name, address);

          IF cl_$match ('free[]', command, command_len) THEN
              IF cl_$get_arg (cl_$next, name, name_len, sizeof(name)) THEN
                  free_storage (name, address);

          IF cl_$match ('q[uit]', command, command_len) THEN
              pgm_$exit;
      END;

    UNTIL FALSE; { User types CTRL/Q }

END. { manage_mapl_heap }
```

Example 5-1. Allocating Storage with BAF System Calls, Cont.

Part II. DOMAIN Advanced System Call Reference

Introduction

This part of *Programming with DOMAIN Advanced System Calls* is the Reference Section. It describes the data types, call syntax, and error messages for the programming calls described in Part I of this book. For your convenience, we structured this part like the *DOMAIN System Call Reference* manual: The sections are divided by system manager, arranged **alphabetically** by system manager name.

If you prefer, you can insert these pages in the proper place within the reference manual. In cases where this book documents additional system calls to existing subsystems (for example, RWS) we duplicated the entire data types and error sections of the subsystem, marking the new material with change bars.

The rest of this introduction describes the DOMAIN system insert files and the format of the information found in the sections that follow.

DOMAIN Insert Files

The DOMAIN system provides insert files that define data types, constants, values, and routine declarations. The insert files also define the exact form of each system call or routine. (Even the FORTRAN version does this using comments, although the FORTRAN compiler doesn't check the forms that you use.)

To use system calls of a particular subsystem, you must specify the include file for that subsystem in your program. All insert files are located in the directory /SYS/INS/. For example, if you are using system error routines in a Pascal program, you include the insert file, /SYS/INS/ERROR.INS.PAS. Using the same routines in a FORTRAN program, you include /SYS/INS/ERROR.INS.FTN. All insert files are specified using the syntax

/SYS/INS/subsystem-prefix.INS.language-abbreviation

where the language abbreviation is PAS (Pascal), FTN (FORTRAN), or C (C). The listing on the next page shows all the available insert files.

In addition to including required subsystem insert files in a program, you must always include the BASE insert file for your programming language. These files contain some basic definitions that a number of subsystem routines use.

You specify BASE insert files using the syntax

/SYS/INS/BASE.INS.language-abbreviation

Summary of Insert Files

Insert File	Operating System Component
/SYS/INS/BASE.INS.lan	Base definitions -- must always be included
/SYS/INS/ACLM.INS.lan	Access Control List manager
/SYS/INS/BAF.INS.lan	Basic Allocate and Free manager
/SYS/INS/CAL.INS.lan	Calendar manager
/SYS/INS/CL.INS.lan	Command Line Handler
/SYS/INS/ERROR.INS.lan	Error reporting manager
/SYS/INS/EC2.INS.lan	Eventcount manager
/SYS/INS/FU.INS.lan	File and Tree Utility
/SYS/INS/GM.INS.lan	Graphics Metafile Resource
/SYS/INS/GMF.INS.lan	Graphics Map Files manager
/SYS/INS/GPR.INS.lan	Graphics Primitives manager
/SYS/INS/IPC.INS.lan	Interprocess Communications datagrams
/SYS/INS/KBD.INS.lan	[Useful constants for keyboard keys]
/SYS/INS/LOADER.INS.lan	Object module loader
/SYS/INS/LOGIN.INS.lan	Login manager
/SYS/INS/MBX.INS.lan	Mailbox manager
/SYS/INS/MS.INS.lan	Mapping server
/SYS/INS/MTS.INS.lan	Magtape/streams interface
/SYS/INS/MUTEX.INS.lan	Mutual exclusion lock manager
/SYS/INS/NAME.INS.lan	Naming server
/SYS/INS/PAD.INS.lan	Display manager
/SYS/INS/PBUFS.INS.lan	Paste buffer manager
/SYS/INS/PFM.INS.lan	Process fault manager
/SYS/INS/PGM.INS.lan	Program manager
/SYS/INS/PM.INS.lan	User process routines
/SYS/INS/PROC1.INS.PAS	Process manager (Pascal only)
/SYS/INS/PROC2.INS.lan	User process manager
/SYS/INS/RWS.INS.lan	Read/write storage manager
/SYS/INS/SIO.INS.lan	Serial I/O interface
/SYS/INS/SMDU.INS.lan	Display driver
/SYS/INS/STREAMS.INS.lan	Stream manager
/SYS/INS/TIME.INS.lan	Time manager
/SYS/INS/TONE.lan	Speaker manager
/SYS/INS/TPAD.INS.lan	Touchpad manager
/SYS/INS/VEC.INS.lan	Vector arithmetic routines
/SYS/INS/VFMT.INS.lan	Variable formatter

Organizational Information

This introductory section is followed by sections for each subsystem. The material for each subsystem is organized into the following three parts:

1. Detailed data type information (including illustrations of records for the use of FORTRAN programmers).

2. Full descriptions of each system call. Each call within a subsystem is ordered alphabetically.

3. List of possible error messages.

Data Type Sections

A subsystem's data type section precedes the subsystem's individual call descriptions. Each data type section describes the predefined constants and data types for a subsystem. These descriptions include an atomic data type translation (i.e., TIME_$REL_ABS_T = 4-byte integer) for use by FORTRAN programmers, as well as a brief description of the type's purpose. Where applicable, any predefined values associated with the type are listed and described. The following is an example of a data type description for the RWS_$POOL_T type.

DATA TYPES

RWS_$POOL_T

A 2-byte integer. Types of pools to allocate read/write or heap storage. One of the following pre-defined values:

RWS_$STD_POOL
Standard pool makes storage accessible to calling process only.

RWS_$STREAM_TM_POOL
Stream pool makes storage accessible to calling program and to a program invoked with the UNIX EXEC system call.

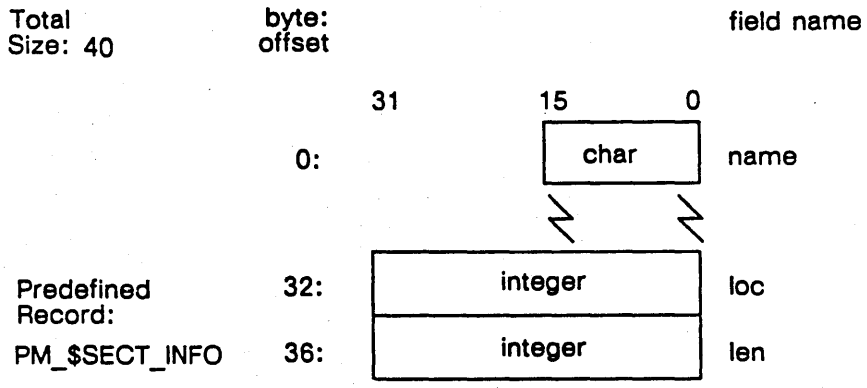
RWS_$GLOBAL_POOL
Global pool makes storage accessible to all processes.

In addition, the record data types are illustrated in detail. Primarily, we have geared these illustrations to FORTRAN programmers who need to construct record-like structures, but we've designed the illustrations to convey as much information as possible for all programmers.

Each record type illustration does the following:

- Clearly shows FORTRAN programmers the structure of the record that they must construct using standard FORTRAN data type statements. The illustrations show the size and type of each field.
- Describes the fields that make up the record.
- Lists the byte offsets for each field. These offsets are used to access fields individually.
- Indicates whether any fields of the record are, in turn, predefined records.

The following is the description and illustration of the PM_$SECT_INFO predefined record:



NAME
The name of the section, a character array of up to 32 elements.

LOC
A 4-byte integer. Location of section information.

LEN
A 4-byte integer. Length of section.

FORTRAN programmers, note that a Pascal variant record is a record structure that may be interpreted differently depending on usage. In the case of variant records, as many illustrations will appear as are necessary to show the number of interpretations.

System Call Descriptions

We have listed the system call descriptions alphabetically for quick reference. Each system call description contains:

- An abstract of the call's function.
- The order of call parameters.
- A brief description of each parameter.
- A description of the call's function and use.

These descriptions are standardized to make referencing the material as quick as possible.

Each parameter description begins with a phrase describing the parameter. If the parameter can be declared using a predefined data type, the descriptive phrase is followed by the phrase ",in XXX format" where XXX is the predefined data type. Pascal or C programmers, look for this phrase to determine how to declare a parameter.

FORTRAN programmers, use the second sentence of each parameter description for the same purpose. The second sentence describes the data type in atomic terms that you can use, such as "This is a 2-byte integer." In complex cases, FORTRAN programmers are referenced to the respective subsystem's data type section.

The rest of a parameter description describes the use of the parameter and the values it may hold.

The following is an example of a parameter description:

heap_ptr
Address of the created heap, in BAF_$T format. This is a 4-byte integer. A returned address of zero (NIL) means that BAF_$CREATE could not create a heap.

Error Sections

Each error section lists the status codes that may be returned by subsystem calls. The following information appears for each error:

- Predefined constant for the status code.
- Text associated with the error.

BAF

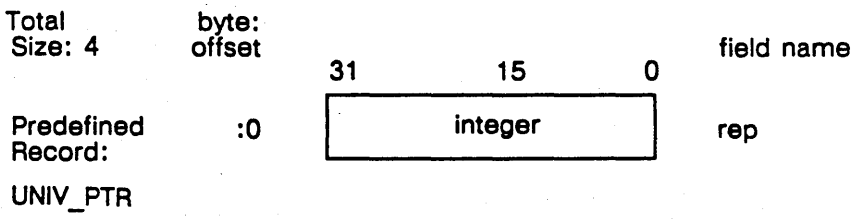
DATA TYPES

BAF_$OPTS_T

A 4-byte integer. A set of BAF_$SHARED types. Indicates that the storage supplied to BAF is shared.

BAF_$T

A record of UNIV pointers which point to internal data structures. The diagram below illustrates the BAF_$T data type:

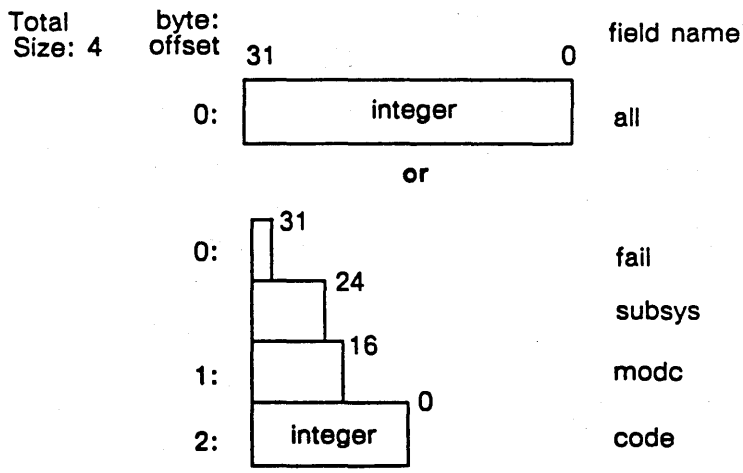


Field Description:

REP
Pointer to BAF internal data structures.

STATUS_$T

A status code. The diagram below illustrates the STATUS_$T data type:



Field Description:

ALL
All 32 bits in the status code.

FAIL
The fail bit. If this bit is set, the error was not

within the scope of the module invoked, but occurred within a lower-level module (bit 31).

SUBSYS
The subsystem that encountered the error (bits 24 - 30).

MODC
The module that encountered the error (bits 16 - 23).

CODE
A signed number that identifies the type of error that occurred (bits 0 - 15).

UNIV_PTR — A 4-byte integer. A pointer to allocated storage.

BAF_$ADD_SPACE

Adds more storage space to a basic allocate/free (BAF) heap that was previously created with BAF_$CREATE.

FORMAT

```
BAF_$ADD_SPACE (heap, area, size, status)
```

INPUT PARAMETERS

heap

The address of the heap to which the storage will be added, in BAF_$T format. This address is the return value of the function, BAF_$CREATE.

area

The address of the storage space to be added to the heap, in UNIV_PTR format. This is a 4-byte integer.

size

The amount of space to be added. This is a 4-byte integer. The maximum size you can add at one time is 32K bytes. If you want to add more than 32K bytes, add the space in a separate call to BAF_$ADD_SPACE.

OUTPUT PARAMETERS

status

Completion status, in STATUS_$T format. This data type is 4 bytes long. See the BAF Data Types for more information.

USAGE

Use this call to add storage to a basic alloc/free heap that you previously created with BAF_$CREATE. You can add up to 32K bytes per call. If you want to add more space to the heap, make another call to BAF_$ADD_SPACE.

BAF_$ALLOC

Allocates a contiguous region of storage from a basic allocate/free (BAF) heap.

FORMAT

```
pointer := BAF_$ALLOC (heap, size, status)
```

RETURN VALUE

pointer
Address of the allocated storage space, in UNIV_PTR format. This is a 4-byte integer. A returned address of zero (NIL) means that BAF_$ALLOC could not allocate the desired storage from the specified heap.

INPUT PARAMETERS

heap
Address of the heap from which storage will be allocated, in BAF_$T format. This address is the return value of the function, BAF_$CREATE.

size
Size of the new storage space to be allocated from the heap. This is a 4-byte integer. The maximum amount of space you can allocate at one time is 32K bytes.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the BAF Data Types section for more information. STATUS_$T will always return STATUS_$OK unless BAF_$ALLOC returns a value of NIL in the return parameter, "pointer."

USAGE

Use this call to allocate storage from the basic alloc/free heap that you created with BAF_$CREATE. This call allocates a contiguous region of storage of "size" bytes long. The storage space will be aligned on a 4-byte boundary. The overhead per allocation is currently 4 bytes long, but is subject to change.

BAF_$CREATE

Create a basic alloc/free heap.

FORMAT

```
heap_ptr := BAF_$CREATE (options, area, size, status)
```

RETURN VALUE

heap_ptr
Address of the created heap, in BAF_$T format. This is a 4-byte integer. A returned address of zero (NIL) means that BAF_$CREATE could not create a heap.

INPUT PARAMETERS

options
BAF options in BAF_$OPS_T format. This is a 4-byte integer. Specify the predefined value:

BAF_$SHARED

Indicates that the storage space you supply to BAF is shared. Therefore, BAF_$ALLOC and BAF_$FREE must obtain a lock during their operations to prevent another process from corrupting the heap. For greater efficiency, specify BAF_$SHARED only when the storage is shared.

area
Address of storage space that BAF_$CREATE will use to create a heap in UNIV_PTR format. This is a 4-byte integer.

size
Size of the heap. This is a 4-byte integer.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. STATUS_$T will always return STATUS_$OK unless BAF_$CREATE returns a value of NIL in the return parameter, "heap_ptr."

See the BAF Data Types section for more information.

USAGE

Use this call to create a basic alloc/free heap. You can use subsequent BAF system calls to allocate storage space from the heap (with BAF_$ALLOC), free storage space (with BAF_$FREE), and add more storage space to the heap (with BAF_$ADD_SPACE).

BAF_$FREE

Returns a region of storage to a basic allocate/free (BAF) heap that was previously allocated with BAF_$ALLOC.

FORMAT

```
BAF_$FREE (heap, block, status)
```

INPUT PARAMETERS

heap
The address of the heap from which storage will be freed, in BAF_$T format. This address is return value of the function BAF_$CREATE.

block
The address of the block of storage to be freed. This address is the return value of the function, BAF_$ALLOC. This is a 4-byte integer.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. See the BAF Data Types section for more information. This data type is 4 bytes long. STATUS_$T will always return STATUS_$OK unless the specified block is not located in the specified heap.

USAGE

Use this call to free storage from the basic alloc/free heap that you previously allocated with BAF_$ALLOC. This call fails if the block was not located in the heap, or if it was already free.

ERRORS

BAF_$FREED_TWICE
: BAF_$FREE returns this error if you attempted to free a block that was previously freed.

BAF_$NO_ROOM
: BAF_$ALLOC returns this error if there was not enough storage in the heap to allocate the blocks you specified.

BAF_$FORMAT_VIOLATED
: This error occurs if the block overhead gets overwritten. It gets overwritten when another process overflows the bounds of an array, because the overhead is located just before each block.

CL

DATA TYPES

CL_$OPT_T

A 2-byte integer. Set of options that control how the CL reads the command line. List some of the following predefined values. (Note that some of these options are mutually exclusive; see the CL call syntax for details.)

CL_$WILDCARDS
Causes CL_$GET_NAME to resolve wildcards and return the resolved names (default).

CL_$NO_WILDCARDS
Causes CL_$GET_NAME to return wildcard names verbatim, it does not resolve them.

CL_$VERIFY_NONE
CL_$GET_NAME does not verify any names with the user. (default).

CL_$VERIFY_ALL
CL_$GET_NAME verifies all names with the user.

CL_$VERIFY_WILD
CL_$GET_NAME verifies only names resolved by wildcards with the user.

CL_$DASH_NOP
Causes CL to treat the hyphen as a name. Normally, the hyphen is an identifier for the standard input stream (default).

CL_$DASH_NAMES
Causes CL to read names from standard input if no arguments appear on the command line. (Obsolete for new program development.)

CL_$DASH_DFT_NOP
Suppresses any special action when there are no arguments on the command line (default).

CL_$NAME_DFT_STDIN
Causes CL to read names from standard input if no arguments appear on the command line.

CL_$NO_MATCH_OK
Displays no warning or error message when a wildcard does not match existing pathnames.

CL_$NO_MATCH_WARNING
Displays a warning message on error output

when a wildcard does not match existing pathnames (default).

CL_$NO_MATCH_ERROR
Displays an error message on error output and terminates the program when a wildcard does not match an existing pathname.

CL_$KEYWORD_DELIM
Prevents CL_$GET_ARG and CL_$GET_NAME from returning an "unused" keyword as an argument. The calls return FALSE if they encounter a keyword. (default).

CL_$NO_KEYWORD_DELIM
Causes no special treatment of unread keywords by CL_$GET_ARG and CL_$GET_NAME. CL procedures return the keywords as if they were arguments.

CL_$COMMENTS
Causes CL to ignore all characters enclosed in brackets when reading a names-file. Do not use this option for commands that accept derived names.

CL_$NO_COMMENTS
Causes no special treatment of characters enclosed in brackets (default).

CL_$STAR_NAMES
Allows the user to specify names-files on the command line for CL to resolve (default).

CL_$NO_STAR_NAMES
Does not allow the user to specify names-files on the command line; CL treats the "*" like any other character.

CL_$OPT_SET_T

A 4-byte integer. A set of CL options in CL_$OPT_T format. For a list of options, see CL_$OPT_T above.

CL_$ARG_SELECT_T

A 2-byte integer. Determines whether CL begins a search at the current token pointer or at the top of the token list. One of the following pre-defined values:

CL_$FIRST
Search begins before the first unused token on the token list.

CL_$NEXT
Search begins at the current token pointer on the token list.

CL_$ANSWER_T

A 2-byte integer. The answer that the user supplies when CL performs a query. One of the following pre-defined values:

CL_$YES
User confirms pathname.

CL_$NO
User cancels pathname, so CL ignores it.

CL_$QUIT
User tells CL to verify any names.

CL_$GO
User tells CL to continue processing names without verifying them.

CL_$REQUIRED_T

A 2-byte integer. Determines whether the user needs to supply a derived name after a keyword in the CL_$GET_FLAGGED_DERIVED_NAME call. One of the following pre-defined values:

CL_$REQUIRED
Requires that the user supplies a derived name after the specified flag. If absent, the program terminates.

CL_$OPTIONAL
User has the option to specify a derived name after a specified keyword. If the user supplies a derived name, it returns TRUE, and the derived name. If the user does not supply a derived name, it returns TRUE, but with no name.

CL_$WILD_T

A 2-byte integer. Set of wildcard options that determine how the wildcard manager resolves wildcards. One of the following pre-defined values:

CL_$WILD_FILES
Returns the names of files.

CL_$WILD_DIRS
Returns the names of directories.

CL_$WILD_LINKS
Returns the names of links.

CL_$WILD_EXCLUSIVE
Traverses each branch of the naming tree as far as the first wildcard match. This is useful for commands that operate on entire directories, such as COPY_TREE, or WRITE_BACKUP.

CL_$WILD_CHASE_LINKS
Chases links that point to directories.

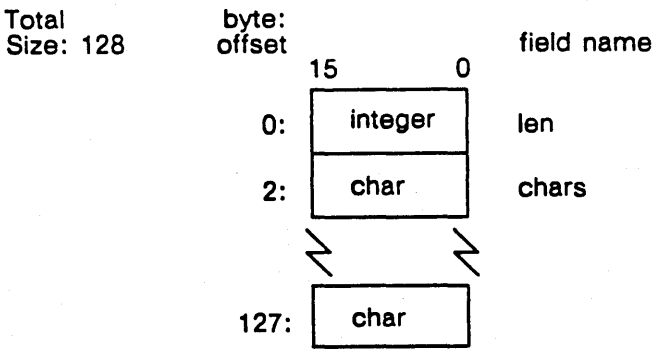
CL_$WILD_FIRST
Stops at the first match of a given wildcard, rather than resolving all names.

CL_$WILD_SET_T

A 2-byte integer. A set of wildcard options in CL_$WILD_T format. For a list of options see CL_$WILD_T above.

CL_$ARGV

An argument returned by CL_$PARSE_ARGS. The diagram below illustrates the CL_$ARV data type: The diagram below illustrates the CL_$ARGV data type:



Field Description:

LEN
Length of the argument.

CHARS
The text of the argument, a character array of up to 128 elements.

CL_$ATTR_SET_T

A 2-byte integer. An element set, 0..15, based on the contents of two character strings.

CL_$CHECK_FLAG

Checks the command line to see if the user specified a flag. It counts the number of tokens following it that are not flags.

FORMAT

```
found := CL_$CHECK_FLAG(flag_string, tokens_expected)
```

RETURN VALUE

found
Returns TRUE if flag_string is found; returns FALSE if not.

INPUT PARAMETERS

flag_string
The flag (a token preceded by a hyphen) you want the CL to search for. This is a lowercase character string in the UNIV character string format. You specify the flag in the form of "-required[optional]."

"-required" represents the characters of the flag that the user must type. "[optional]" represents those characters that are optional. If the user specifies any optional characters, they all must be specified.

If you do not specify any optional characters, you must supply an empty bracket, [].

For example, "-arg[uments]" matches "-arg" or "-arguments." "-ld[]" matches "-ld."

tokens_expected
The number of tokens that you expect to follow the specified flag. This is a 2-byte integer. If you supply a negative number, the CL assumes that you want at least that many arguments, but will accept more.

USAGE

Use this call to check if the user supplied the correct number of options.

The call searches the token list for a specified flag and returns a Boolean indicating whether the flag was found. It also tests for the expected number of arguments following the flag.

If the user does not supply the number of tokens expected, the CL returns an error and calls PGM_$EXIT to terminate the program. If it finds the flag, the CL marks it "used," and moves the token pointer to the flag. Otherwise, the token pointer remains unchanged.

Normally, you do not need to know whether the user typed the abbreviated or full flag. However, you can find out what the user typed with the CL_$GET_FLAG_INFO system call.

NOTE: Do not use this call if tokens can go anywhere on a command line because you might get unexpected results. In this case, use CL_$GET_FLAG.

CL_$CHECK_UNCLAIMED

Checks the token list for any unread flags. If it finds any, this call prints an error message and terminates the program.

FORMAT

```
CL_$CHECK_UNCLAIMED
```

USAGE

Use this call to check if the user specified any options that your program does not handle. If so, the program aborts.

Most programs use this call before calling CL_$GET_NAME. Do not use this call if you plan to use CL_$GET_FLAGGED_DERIVED_NAME.

CL_$GET_ARG

Gets the first or next unused argument from the token list.

FORMAT

```
found := CL_$GET_ARG(selector, arg, arg_len, max_len)
```

RETURN VALUE

found
Returns TRUE if it finds an argument; returns FALSE if not.

INPUT PARAMETERS

selector
Determines where the CL begins to scan the token list, in CL_$ARG_SELECT_T format. This is a 2-byte integer.

You must specify one of the following:

CL_$FIRST	Directs the CL to return to the first unused token on the token list to begin the search.
CL_$NEXT	Directs the CL to scan the token list beginning with the argument following the token pointer.

max_len
The maximum number of characters to place into "arg." This is a 2-byte integer. If the argument contains too many characters, the CL prints an error message and calls PGM_$EXIT to terminate the program.

OUTPUT PARAMETERS

arg
Returns the argument that CL finds on the token list, in character string format.

arg_len
Returns the actual length of the argument, as a 2-byte integer.

USAGE

Use this call to get arguments from the command line. You can then convert the character strings to the desired type. If you expect pathnames from the command line, use CL_$GET_NAME because CL_$GET_NAME resolves wildcards. If you expect numbers from the command line, use CL_$GET_NUM.

CL_$GET_ARG reads a token from the token list. If it finds an argument, the CL marks it used, and moves the token pointer to it. If it doesn't find any arguments, the CL sets the token pointer to top of the list, before the first token.

If the token is a flag and the default CL option CL_$KEYWORD_DELIM is in effect, the CL returns FALSE. If the token is a flag and you set the CL option CL_$NO_KEYWORD_DELIM the call returns TRUE, and the value of "arg." This is useful if you want to read tokens that begin with a hyphen but you don't want to treat them as flags.

CL_$GET_DERIVED_NAME

Gets the next derived name that applies to the name most recently read by CL_$GET_NAME.

FORMAT

```
found := CL_$GET_DERIVED_NAME(name, name_len, max_len)
```

RETURN VALUE

found
Returns TRUE if it finds a name; returns FALSE if not.

INPUT PARAMETERS

max_len
The maximum number of characters to place into "name." This is a 2-byte integer. If the name contains too many characters, the CL prints an error message and calls PGM_$EXIT to terminate the program.

OUTPUT PARAMETERS

name
Returns the name the CL found, in character string format. This is valid only if "found" is TRUE.

name_len
Returns the actual length of the name, as a 2-byte integer.

USAGE

Use this call after CL_$GET_NAME to get a derived name. Do not use in programs if you do not expect derived names.

Each time you call CL_$GET_NAME, the CL sets a "derived-name pointer" next to the token pointer. Each subsequent call to CL_$GET_DERIVED_NAME, advances the derived-name pointer to the next derived name, until there are none left.

A single derived name may be seen by a program a number of times. For example, the command line, **cpf ?*.pas =.05.31**, matches all instances in the working directory of files ending with the .pas extension. The program sees the derived name, not the token. For example, if it finds the pathname foo.pas, CL_$GET_DERIVED_NAME returns foo.pas.05.31.

CL_$GET_DERIVED_NAME does not change the token pointer. Once a token is used as a derived name, it is marked "used," and is not returned by CL_$GET_NAME or CL_$GET_ARG again.

CL_$GET_ENUM_FLAG

Scans the token list for any member of a list of flags that you supply. It counts the number of tokens following it which are not flags.

FORMAT

```
index := CL_$GET_ENUM_FLAG(selector, flag_list, token_count)
```

RETURN VALUE

index
Returns the index of the flag in the "flag_list," if found; returns zero if it does not find any of the specified flags.

INPUT PARAMETERS

selector
Determines where the CL begins to scan the token list, in CL_$ARG_SELECT_T format. This is a 2-byte integer.

You must specify one of the following:

CL_$FIRST — Directs the CL to return to the first unused token on the token list to begin the search.

CL_$NEXT — Directs the CL to scan the token list beginning with the argument following the token pointer.

flag_list
The flags you want the CL to search for. This is a lowercase character string, where each flag is in the form of "-required[optional]."

"-required" represents the characters of the flag that the user must type. "optional" represents those characters that are optional. If the user specifies any optional characters, they all must be specified.

If you do not specify any optional characters, you must supply an empty bracket, []. For example, "-arg[uments]" matches "-arg" or "-arguments." "-ld[]" matches "-ld".

You must separate each flag by spaces, and terminate the string with any non-space character other than a hyphen. For example, "-br[ief] -l[ist] X".

OUTPUT PARAMETERS

token_count
Returns the number of tokens that follow the flag up to the next flag. This 2-byte integer is valid only if "index" does not equal zero.

Note that this is the number of tokens listed on the command line only. It does not count the number of names resolved from a wildcard name.

USAGE

Use this call when the user can supply different options that require the same program action.

The call searches the token list for specified flags from the "flag_list." If the user specifies more than one flag that is on the list, the CL returns only the first one it matches.

If it finds the flag, the CL marks it "used," and moves the token pointer to the flag. Otherwise, the token pointer remains unchanged.

Normally, you do not need to know whether the user typed the abbreviated or full flag, However, you can find out what the user typed with the CL_$GET_FLAG_INFO call.

CL_$GET_FLAG

Checks the command line to see if the user specified a flag, which is a token preceded by a hyphen. It counts the number of tokens following it which are not flags.

FORMAT

```
found := CL_$GET_FLAG(flag_string, token_count)
```

RETURN VALUE

found
Returns TRUE if "flag_string" is found; returns FALSE if not.

INPUT PARAMETERS

flag_string
The flag you want the CL to search for. This is a lowercase character string in the form of "-required[optional]."

"-required" represents the characters of the flag that the user must type. "optional" represents those characters that are optional. If the user specifies any optional characters, they all must be specified.

If you do not specify any optional characters, you must supply an empty bracket, [].

For example, "-arg[uments]" matches "-arg" or "-arguments"; "-ld[]" matches "-ld".

OUTPUT PARAMETERS

token_count
Returns the number of tokens that follow the flag up to the next flag. This 2-byte integer is valid only if the call returns TRUE.

Note that this is the number of tokens listed on the command line only. It does not count the number of names resolved from a wildcard name.

USAGE

Use this call when you want to get any specific flag from the command line. This call searches the token list for the specified flag and returns a Boolean indicating whether the flag was found.

If it finds the flag, the CL marks it "used," and moves the token pointer to the flag. If not, the token pointer remains unchanged.

This is the most commonly used call for getting flags from the command line. See also CL_$CHECK_FLAG and CL_$GET_ENUM_FLAG for other ways of getting flags. You can use CL_$GET_INFO to see which flags the user provided.

CL_$GET_FLAGGED_DERIVED_NAME

Scans the token list for a specified flag followed by a derived name. If a derived name follows the flag, it returns the name found.

FORMAT

```
found := CL_$GET_FLAGGED_DERIVED_NAME(flag, required_name, name,
                                      name_len, max_len)
```

RETURN VALUE

found
Returns TRUE if it finds a name; returns FALSE if not.

INPUT PARAMETERS

flag
The flag you want the CL to search for. This is a lowercase character string in the form of "-required[optional]."

"-required" represents the characters of the flag that the user must type. "optional" represents those characters that are optional. If the user specifies any optional characters, they all must be specified.

If you do not specify any optional characters, you must supply an empty bracket, [].

For example, "-arg[uments]" matches "-arg" or "-arguments"; "-ld[]" matches "-ld".

required_name
Specifies whether a derived name must follow the flag, in CL_$REQUIRED_T format. This is a 2-byte integer.

If you supply CL_$REQUIRED, and a derived name does not follow the flag, the CL returns an error message and terminates the program. If you supply CL_$OPTIONAL, and a derived name does not follow the flag, the CL returns TRUE, but does not return a name.

max_len
The maximum number of characters to place into "name." This is a 2-byte integer. If the name contains too many characters, the CL prints an error message and calls PGM_$EXIT to terminate the program.

OUTPUT PARAMETERS

name
Returns the derived name the CL found, in character string format. This is valid only if "found" is TRUE.

name_len
Returns the actual length of the name. This is a 2-byte integer. If CL_$OPTIONAL is specified and a derived name does not follow the flag, "name_len" is set to zero.

USAGE

Use this call after CL_$GET_NAME to check for a specific flag followed by a derived name. You can call CL_$GET_FLAGGED_DERIVED_NAME either before or after calling CL_$GET_DERIVED_NAME.

A single derived name may be seen by a program a number of times. For example, the command line, **cmf {?*}.04.30 @1 -r @1.rpt** is handled by three calls: CL_$GET_NAME resolves the wildcard to match all instances of files in the working directory ending with the .04.30 extension. CL_$GET_DERIVED_NAME gets each derived name, which is the wildcard match without the extension. Then CL_$GET_FLAGGED_DERIVED_NAME adds the rpt extension.

CL_$GET_FLAGGED_DERIVED_NAME does not change the token pointer, or derived-name token pointer. Once a token is used as a derived name, the CL marks it "used," and does not return it to by CL_$GET_NAME or CL_$GET_ARG again.

NOTE: Do not search for this flag with CL_$GET_FLAG if you plan to use this call.

CL_$GET_FLAG_INFO

Returns a pointer to the text of the last flag found by CL_$GET_FLAG, CL_$CHECK_FLAG, CL_$GET_ENUM_FLAG.

FORMAT

```
CL_$GET_FLAG_INFO(flag_ptr, flag_len)
```

OUTPUT PARAMETERS

flag_ptr
Returns pointer to the character string containing the text of the flag. If the user did not specify a flag, it returns NIL.

flag_len
Number of characters in the character string pointed to by "flag_ptr." This is a 2-byte integer. This value is undefined if "flag_ptr" is NIL.

USAGE

Use this call to see which flag the user actually specified. You might want to return this text with an error message.

CL_$GET_NAME

Gets the first or next unused name from the token list.

FORMAT

```
found := CL_$GET_NAME(selector, name, name_len, max_len)
```

RETURN VALUE

found
Returns TRUE if it finds a name; returns FALSE if not.

INPUT PARAMETERS

selector
Determines where the CL begins to scan the token list, in CL_$ARG_SELECT_T format. This is a 2-byte integer.

You must specify one of the following:

CL_$FIRST — Directs the CL to return to the first unused token on the token list to begin search.

CL_$NEXT — Directs the CL to scan the token list beginning with the argument following the token pointer.

max_len
The maximum number of characters to place into "name." This is a 2-byte integer. If the name contains too many characters, the CL prints an error message and calls PGM_$EXIT to terminate the program.

OUTPUT PARAMETERS

name
Returns the name the CL found, in character string format. This is valid only if "found" is TRUE.

name_len
Returns the actual length of the name, as a 2-byte integer.

USAGE

Use this call to get names from the command line. If it finds a name, the CL marks it "used" and moves the token pointer to it. If it doesn't find any names, the CL moves the token pointer to top of the list, before the first token.

CL_$GET_NAME reads a token from the token list. If the token is a pathname, it returns the pathname verbatim. If it is a wildcard name and the default CL_$WILDCARD option is in effect, the CL resolves the wildcard and returns the first pathname that matches. Subsequent calls to CL_$GET_NAME return successive pathnames resulting from the wildcard.

If the token is a flag and the default CL_$KEYWORD_DELIM option is in effect, the call returns FALSE; therefore, preventing the call from returning an unused flag as a name.

If CL_$NO_KEYWORD_DELIM option is set and the token is a flag, the call returns TRUE, and the flag verbatim.

If you set one of the CL verify options VERIFY_$WILD or VERIFY_$ALL, this call queries the user for a yes/no approval. If the user answers "no," the CL ignores the name and processes the next name.

If the call does not find a match for a wildcard-name, CL consults the current state of the CL match option to determine whether it should terminate the program with a warning or error message, or should continue.

Normally, you do not need to know whether the token was a pathname or wildcard-name. However, you can find out exactlly what the user typed with the CL_$GET_INFO system call.

CL_$GET_NAME_INFO

Determines if the previous CL_$GET_NAME operated on a wildcard. If so, the call returns a pointer to the wildcard name.

FORMAT

```
CL_$GET_NAME_INFO(wild_ptr, wild_len)
```

OUTPUT PARAMETERS

wild_ptr
Returns a pointer to the character string containing the wildcard name. If the user did not specify a wildcard name, it returns NIL. This is a UNIV_PTR.

wild_len
Length of the character string pointed to by "wild_ptr." This is a 2-byte integer. This value is undefined if "wild_ptr" is NIL.

USAGE

Use this call to determine whether the user supplied a full pathname or a wildcard name on the command line.

CL_$GET_NUM

Checks the token list for a decimal numeric argument and converts it to a 4-byte integer.

FORMAT

```
found := CL_$GET_NUM(number)
```

RETURN VALUE

found
Returns TRUE if it finds a number; returns FALSE if not.

OUTPUT PARAMETERS

number
Returns a long integer (integer32) containing the decimal numeric argument. This is a 4-byte integer.

USAGE

Use this call to convert the argument following the token pointer to a long decimal. If the argument is not a decimal number, CL_$GET_NUM prints an error message and calls PGM_$EXIT to terminate the program.

If the CL finds a number, the CL marks it "used" and moves the token pointer to it. Otherwise, the token pointer remains unchanged.

CL_$GET_SET

Builds a 16-element set from a character string.

FORMAT

```
set :=CL_$GET_SET(char_string, string_len, token, token_len)
```

RETURN VALUE

set
Returns the set, in the CL_$ATTR_SET_T format. This is a 2-byte integer.

INPUT PARAMETERS

char_string
Character string that defines the allowable token characters and their order in the returned set. This is in UNIV string format. The first character corresponds to the returned set element "0", the second element, to element "1," and so on.

string_len
Number of characters in "char_string." This is a 2-byte integer.

token
Token, usually read from the token list, with which to build the set. This is a UNIV character string.

token_len
Number of characters in "token." This is a 2-byte integer.

USAGE

Use this call to build a set from a character string. For example, EDACL turns the character string "PGNDWRX" into a set for setting ACLs.

CL_$INIT

Initializes the command line handler that parses command lines. You must use this call before any other CL calls.

FORMAT

```
CL_$INIT([cl_option], program_name, program_len)
```

INPUT PARAMETERS

cl_option

Set of options, in CL_$OPT_SET_T format, that tells the CL how to read the command line. This is a 4-byte integer. The options control how the CL interacts with the user.

You can specify a default set of options with empty brackets, []. You need to specify only the options that are not default. The chart below lists the default CL options and their alternatives. Note that you can either take the default option, or specify one of its corresponding alternatives.

Default Option	Mutually-Exclusive Alternatives
CL_$WILDCARDS Causes CL_$GET_NAME to resolve wildcards and return the resolved names.	CL_$NO_WILDCARDS Causes CL_$GET_NAME to return wildcard-names verbatim; it does not resolve them.
CL_$NO_MATCH_WARNING Displays a warning message on error output when a wildcard does not match existing pathnames.	CL_$NO_MATCH_OK Displays no warning or error message when a wildcard does not match existing pathnames. CL_$NO_MATCH_ERROR Displays an error message on error output, and terminates the program when a wildcard does not match an existing pathname.
CL_$VERIFY_NONE CL_$GET_NAME does *not* verify any names with the user.	CL_$VERIFY_WILD CL_$GET_NAME verifies only names resolved by wildcards with the user. CL_$VERIFY_ALL CL_$GET_NAME verifies all names with the user.

Default Option	Mutually-Exclusive Alternatives
CL_$STAR_NAMES Allows user to specify names-files with the "*" operator.	CL_$NO_STAR_NAMES Does not allow user to specify names-files. Treats the "*" just like any other character.
CL_$KEYWORD_DELIM Prevents CL_$GET_ARG and CL_$GET_NAME from returning an "unused" flag as an argument. The calls return FALSE if they find a flag.	CL_$NO_KEYWORD_DELIM Causes no special treatment of unread flags by CL_$GET_ARG and CL_$GET_NAME. The procedures return the flags as if they were arguments.
CL_$DASH_NOP The CL treats the hyphen "-" as a name. Normally, the hyphen is an identifier for the standard input stream.	CL_$DASH_NAMES The CL reads names from standard input when it finds a hyphen.*
CL_$DASH_DFT_NOP Suppresses any special action when there are no arguments on the command line.	CL_$NAME_DFT_STDIN Causes the CL to read names from standard input if no arguments appear on the command line.*
CL_$NO_COMMENTS Causes no special treatment of characters enclosed in brackets.	CL_$COMMENTS Causes CL to ignore all characters enclosed in brackets when reading a names-file. Do not use this in commands that accept derived names because you must use brackets to specify the tag expressions you want to use in a derived name.

* Made available to remain compatible with previous software releases. Obsolete for new software development.

program_name
Name of program, in character string format. CL uses this name when reporting any errors.

program_len
Length of "program_name". This is a 2-byte integer.

USAGE

Use this call to initialize the CL. This call reads the command line and any names-files that the user supplies and builds an internal token list that contains these tokens. All subsequent CL calls refer to this token list, *not* the command line.

CL_$MATCH

Compares a token against a specified string and returns TRUE if they match.

FORMAT

```
match := CL_$MATCH(pattern, token, token_len)
```

RETURN VALUE

match
Returns TRUE if it finds a match; returns FALSE if not.

INPUT PARAMETERS

pattern
Pattern with which to compare the token. This is a lowercase UNIV character string in the form of "required[optional]."

"required" represents the characters of the flag that the user must type. "optional" represents those characters that are optional. If the user specifies any optional characters, they all must be specified.

If you do not specify any optional characters, you must supply an empty bracket, [].

For example, "q[uit]" matches "q" or "quit." "go[]" matches "go."

token
Character string to compare against the pattern. This is a lowercase character string in UNIV character string format.

token_len
The number of characters to place in "token." This is a 2-byte integer.

USAGE

Use this call to compare a string against a specification. For example, this allows you to perform an action as soon as the user types the command. The following example uses CL_$MATCH in an interactive parsing loop to exit the program as soon as the user types a response:

```
cl_$parse_line ( line, line_len );

{ Terminate program if user types a q[uit]. }

IF cl_$get_arg (cl_$first, token, token_len, sizeof(token_len) THEN

    IF cl_$match ('q[uit]', token, token_len  THEN
        pgm_$exit
    ELSE  IF cl_$match ( ...
```

CL_$PARSE_ARGS

Takes the specified argument vector, and makes it the current vector for the CL to parse. The CL discards any previous arguments. All subsequent CL calls operate on this argument list.

FORMAT

```
CL_$PARSE_ARGS(arg_count, arg_vector)
```

INPUT PARAMETERS

arg_count
Number of arguments in the argument vector. This is a 2-byte integer.

arg_vector
Address of the argument vector to parse, in CL_$ARGV format. This is a 4-byte integer. It is a UNIV array of pointers to arguments in a record.

USAGE

Use this call when you use PGM_$GET_ARGS to get arguments from the command line. Use CL_$SETUP to initialize the CL when you want to supply the lines to parse.

Note that this call disregards the first argument on the command line because it assumes it is the command name.

CL_$PARSE_INPUT

Parses a line of text from a specified stream and passes the line to CL_$PARSE_LINE.

FORMAT

```
ok := CL_$PARSE_INPUT(stream_id, null_line)
```

RETURN VALUE

ok

Returns TRUE if it reads the line from the stream successfully; returns FALSE if it encounters an end-of-file. If any other errors occur, the CL prints an error message, and calls PGM_$EXIT to terminate the program.

INPUT PARAMETERS

stream_id

Stream ID of the stream from which the line is read, in STREAM_$ID_T format.

OUTPUT PARAMETERS

null_line

Indicates whether the line is NULL (that is, the line contains only the NEWLINE character). This is a Boolean value.

The call returns TRUE if the line read is NULL; returns FALSE if the line is not NULL.

USAGE

You can use this call and CL_$PARSE_LINE so that you can use other CL calls to read tokens that the user inputs interactively.

Use CL_$SETUP to initialize the CL when you want to supply the lines to parse.

CL_$PARSE_LINE

Parses a line of text and creates a new token list. All subsequent CL calls operate on this line.

FORMAT

```
CL_$PARSE_LINE(text, null_line)
```

INPUT PARAMETERS

text
Character string to be parsed. This is in UNIV character string format.

text_len
Number of characters in "text." This is a 2-byte integer.

USAGE

Use this call if the lines of text you want to parse are contained in files. Use CL_$SETUP to initialize the CL when you want to supply the lines to parse.

CL_$REREAD

Marks the entire token list "unused," so that you can reread the entire token list.

FORMAT

```
CL_$REREAD
```

USAGE

Use this call to reread the entire command line. If you want to reread only the flags on the token list, use CL_$REREAD_FLAGS. If you want to reread only the names, use CL_$REREAD_NAMES.

CL_$REREAD_FLAGS

Locates all the "used" flags on the token list and marks them "unused." This allows you to reread all the flags.

FORMAT

```
CL_$REREAD_FLAGS
```

USAGE

Use this call to reread the flags on token list after having read them using CL_$GET_FLAG, CL_$CHECK_FLAG or CL_$GET_ENUM_FLAG.

To reread the entire token list, use CL_$REREAD.

CL_$REREAD_NAMES

Locates all the "used" names on the token list and marks them "unused." This allows you to reread all the names using CL_$GET_NAME.

FORMAT

```
CL_$REREAD_NAMES
```

USAGE

Use this call to reread the names on the token list after having read them with CL_$GET_NAME.

When you call CL_$GET_NAME after this call, it returns the first name on the token list.

To reread the entire token list, use CL_$REREAD.

CL_$RESET_OPTIONS

Replaces the previously defined CL option set with the set specified in this call.

FORMAT

```
CL_$RESET_OPTIONS([cl_option])
```

INPUT PARAMETERS

cl_option

Set of options, in CL_$OPT_SET_T format, that tells the CL how to read the command line. This is a 4-byte integer. These options control how the CL interacts with the user.

You must specify all the options you want in effect, except the default options.

The chart below lists the default CL options and their alternatives. Note that you can take either one of the default options, or specify one of the corresponding alternatives.

Default Option	Mutually-Exclusive Alternatives
CL_$WILDCARDS Causes CL_$GET_NAME to resolve wildcards and return the resolved names.	CL_$NO_WILDCARDS Causes CL_$GET_NAME to return wildcard-names verbatim; it does not resolve them.
CL_$NO_MATCH_WARNING Displays a warning message on error output when a wildcard does not match existing pathnames.	CL_$NO_MATCH_OK Displays no warning or error message when a wildcard does not match existing pathnames. CL_$NO_MATCH_ERROR Displays an error message on error output, and terminates the program when a wildcard does not match an existing pathname.
CL_$VERIFY_NONE CL_$GET_NAME does *not* verify any names with the user.	CL_$VERIFY_WILD CL_$GET_NAME verifies only names resolved by wildcards with the user. CL_$VERIFY_ALL CL_$GET_NAME verifies all names with the user.

Default Option	Mutually-Exclusive Alternatives
CL_$STAR_NAMES Allows user to specify names-files with the "*" operator.	CL_$NO_STAR_NAMES Does not allow user to specify names-files. Treats the "*" just like any other character.
CL_$KEYWORD_DELIM Prevents CL_$GET_ARG and CL_$GET_NAME from returning an "unused" flag as an argument. The calls return FALSE if they find a flag.	CL_$NO_KEYWORD_DELIM Causes no special treatment of unread flags by CL_$GET_ARG and CL_$GET_NAME. The procedures return the flags as if they were arguments.
CL_$DASH_NOP The CL treats the hyphen "-" as a name. Normally, the hyphen is an identifier for the standard input stream.	CL_$DASH_NAMES The CL reads names from standard input when it finds a hyphen.*
CL_$DASH_DFT_NOP Suppresses any special action when there are no arguments on the command line.	CL_$NAME_DFT_STDIN Causes the CL to read names from standard input if no arguments appear on the command line.*
CL_$NO_COMMENTS Causes no special treatment of characters enclosed in brackets.	CL_$COMMENTS Causes CL to ignore all characters enclosed in brackets when reading a names-file. Do not use this in commands that accept derived names because you must use brackets to specify the tag expressions you want to use in a derived name.

* Made available to remain compatible with previous software releases. Obsolete for new software development.

USAGE

Use this call to replace the set of CL options defined with the calls CL_$INIT, CL_$SETUP, or CL_$SET_OPTIONS. CL_$RESET_OPTIONS replaces the currently defined CL option set with the set specified in this call. If you want to simply add to the existing set of options, use CL_$SET_OPTIONS.

CL_$SETUP

Initializes the command line handler, but does not load anything to parse. Use this call instead of CL_$INIT when you want to use one of the CL parse routines.

You must use either this call or CL_$INIT before any other CL calls.

FORMAT

```
CL_$SETUP([cl_option], program_name, program_len)
```

INPUT PARAMETERS

cl_option

Set of options, in CL_$OPT_SET_T format, that tells the CL how to read the command line. This is a 4-byte integer. These options control how the CL interacts with the user.

You can specify a default set of options with empty brackets, []. You need to specify only the options that are not default. The chart below lists the default CL options and their mutually-exclusive alternatives.

Default Option	Mutually-Exclusive Alternatives
CL_$WILDCARDS Causes CL_$GET_NAME to resolve wildcards and return the resolved names.	CL_$NO_WILDCARDS Causes CL_$GET_NAME to return wildcard-names verbatim; it does not resolve them.
CL_$NO_MATCH_WARNING Displays a warning message on error output when a wildcard does not match existing pathnames.	CL_$NO_MATCH_OK Displays no warning or error message when a wildcard does not match existing pathnames. CL_$NO_MATCH_ERROR Displays an error message on error output, and terminates the program when a wildcard does not match an existing pathname.
CL_$VERIFY_NONE CL_$GET_NAME does *not* verify any names with the user.	CL_$VERIFY_WILD CL_$GET_NAME verifies only names resolved by wildcards with the user. CL_$VERIFY_ALL CL_$GET_NAME verifies all names with the user.

Default Option	Mutually-Exclusive Alternatives
CL_$STAR_NAMES Allows user to specify names-files with the "*" operator.	CL_$NO_STAR_NAMES Does not allow user to specify names-files. Treats the "*" just like any other character.
CL_$KEYWORD_DELIM Prevents CL_$GET_ARG and CL_$GET_NAME from returning an "unused" flag as an argument. The calls return FALSE if they find a flag.	CL_$NO_KEYWORD_DELIM Causes no special treatment of unread flags by CL_$GET_ARG and CL_$GET_NAME. The procedures return the flags as if they were arguments.
CL_$DASH_NOP The CL treats the hyphen "-" as a name. Normally, the hyphen is an identifier for the standard input stream.	CL_$DASH_NAMES The CL reads names from standard input when it finds a hyphen.*
CL_$DASH_DFT_NOP Suppresses any special action when there are no arguments on the command line.	CL_$NAME_DFT_STDIN Causes the CL to read names from standard input if no arguments appear on the command line.*
CL_$NO_COMMENTS Causes no special treatment of characters enclosed in brackets.	CL_$COMMENTS Causes CL to ignore all characters enclosed in brackets when reading a names-file. Do not use in commands that accept derived names; you must use brackets to specify tag expressions.

* Made available to remain compatible with previous software releases. Obsolete for new software development.

program_name
Name of program, in UNIV character string format. CL uses this name when reporting any errors.

program_len
Length of "program_name." This is a 2-byte integer.

USAGE

Use this call to initialize the CL when you want to provide the arguments to parse, rather than having the CL read arguments from the command line. You provide the CL with the arguments to parse by making subsequent calls to CL parse routines, CL_$PARSE_ARGS, CL_$PARSE_INPUT, or CL_$PARSE_LINE. You could use CL_$INIT to initialize the CL and then call a parsing routine, but this is a cleaner and faster method.

CL_$SET_DERIVED_COUNT

Tells the CL how many derived names follow each wildcard-name or pathname on the command line.

FORMAT

```
CL_$SET_DERIVED_COUNT(count)
```

INPUT PARAMETERS

count
Number of derived names that you expect to follow a wildcard-name or pathname. This is a 2-byte integer.

USAGE

Use this call when you expect derived names. Usually, you specify a "count" of one; but potentially, you can have several derived names from one source name.

This call is optional, but recommended.

CL_$SET_NAME_PREFIX

Defines a character string that the CL adds to the beginning of each name read from the token list.

FORMAT

```
CL_$SET_NAME_PREFIX(prefix, prefix_len)
```

INPUT PARAMETERS

prefix
Prefix to insert in front of the name read from the token list. This is a UNIV character string.

prefix_len
Number of characters in "prefix." This is a 2-byte integer.

USAGE

Use this call to add text before a name read by CL_$GET_NAME. For example, use this call to add "/sys/print" before a file to be queued. The CL adds this prefix to the beginning of each argument read by CL_$GET_NAME before it resolves wildcards.

CL_$SET_OPTIONS

Adds specified options to the set of CL options defined in the CL_$INIT or CL_$SETUP call.

FORMAT

```
CL_$SET_OPTIONS([cl_option])
```

INPUT PARAMETERS

cl_option

Set of options, in CL_$OPT_SET_T format, that tells the CL how to read the command line. This is a 4-byte integer. These options control how the CL interacts with the user.

You must specify all the options you want, except the default options.

The chart below lists the default CL options and their mutually-exclusive alternatives.

Default Option	Mutually-Exclusive Alternatives
CL_$WILDCARDS Causes CL_$GET_NAME to resolve wildcards and return the resolved names.	CL_$NO_WILDCARDS Causes CL_$GET_NAME to return wildcard-names verbatim; it does not resolve them.
CL_$NO_MATCH_WARNING Displays a warning message on error output when a wildcard does not match existing pathnames.	CL_$NO_MATCH_OK Displays no warning or error message when a wildcard does not match existing pathnames. CL_$NO_MATCH_ERROR Displays an error message on error output, and terminates the program when a wildcard does not match an existing pathname.
CL_$VERIFY_NONE CL_$GET_NAME does *not* verify any names with the user.	CL_$VERIFY_WILD CL_$GET_NAME verifies only names resolved by wildcards with the user. CL_$VERIFY_ALL CL_$GET_NAME verifies all names with the user.

Default Option	Mutually-Exclusive Alternatives
CL_$STAR_NAMES Allows user to specify names-files with the "**" operator.	CL_$NO_STAR_NAMES Does not allow user to specify names-files. Treats the "**" just like any other character.
CL_$KEYWORD_DELIM Prevents CL_$GET_ARG and CL_$GET_NAME from returning an "unused" flag as an argument. The calls return FALSE if they find a flag.	CL_$NO_KEYWORD_DELIM Causes no special treatment of unread flags by CL_$GET_ARG and CL_$GET_NAME. The procedures return the flags as if they were arguments.
CL_$DASH_NOP The CL treats the hyphen "-" as a name. Normally, the hyphen is an identifier for the standard input stream.	CL_$DASH_NAMES The CL reads names from standard input when it finds a hyphen.*
CL_$DASH_DFT_NOP Suppresses any special action when there are no arguments on the command line.	CL_$NAME_DFT_STDIN Causes the CL to read names from standard input if no arguments appear on the command line.*
CL_$NO_COMMENTS Causes no special treatment of characters enclosed in brackets.	CL_$COMMENTS Causes CL to ignore all characters enclosed in brackets when reading a names-file. Do not use this in commands that accept derived names because you must use brackets to specify the tag expressions you want to use in a derived name.

* Made available to remain compatible with previous software releases. Obsolete for new software development.

USAGE

Use this call to add options to the set of CL options that you defined when you initialized the CL with a call to CL_$INIT or CL_$SETUP. If you want to remove any options from the set, use CL_$RESET_OPTIONS.

CL_$SET_STREAMS

Tells the CL to use the specified names as the default input and output channels.

FORMAT

```
CL_$SET_STREAMS ( stream_in, error_in, stream_out, err_out)
```

INPUT PARAMETERS

stream_in
Name of stream used for standard input, in STREAM_$ID_T format. The default value is stream_$stdin (0).

error_in
Name of stream used for error input, in STREAM_$ID_T format. The default value is stream_$errin (2).

stream_out
Name of stream used for standard output, in STREAM_$ID_T format. The default value is stream_$stdout (1).

error_out
Name of stream used for error output, in STREAM_$ID_T format. The default value is stream_$errout (3).

USAGE

Use this call to redirect the default input and output channels to the specified streams. This allows the user to specify another file for input or output.

CL_$SET_VERB

Defines a verb that the CL displays before each query message.

FORMAT

```
CL_$VERB(verb, verb_len)
```

INPUT PARAMETERS

verb
Text that the CL prints before each pathname in user query messages. This is a UNIV character string.

verb_len
Number of characters in "verb." This is a 2-byte integer.

USAGE

Use this call to add text before a pathname read by CL_$GET_NAME when you are expecting the CL to query users. When the CL queries users, it will write the verb, the pathname, and then a question mark.

The CL verifies all pathnames when you specify the CL_$VERIFY_ALL CL option, or when you use the CL_$VERIFY system call. It verifies wildcard matches if you specify CL_$VERIFY_WILD.

CL_$SET_WILD_OPTIONS

Defines the wildcard options that tell the wildcard manager how to expand wildcards.

FORMAT

```
CL_$SET_WILD_OPTIONS([wild_option])
```

INPUT PARAMETERS

wild_option

Set of options, in CL_$WILD_SET_T format, that tells the CL wildcard manager how to expand wildcard options. This is a 2-byte integer.

If you want to change the default set of wildcard options that the CL established at initialization, you must specify the all the options you want to set.

The CL wildcard options are:

CL_$WILD_FILES
: Matches names of files (default).

CL_$WILD_DIRS
: Matches names of directories (default).

CL_$WILD_LINKS
: Matches names of links (default).

CL_$WILD_EXCLUSIVE
: Matches the highest directory of a given wildcard. This is useful for commands that operate on entire directories, such as COPY_TREE, or WRITE_BACKUP. Since they operates on all subdirectories, there's no need to match further.

CL_$WILD_CHASE_LINKS
: Chases links that point to directories or files.

CL_$WILD_FIRST
: Stops at the first match of a given wildcard; otherwise, subsequent calls to CL_$GET_NAME expand all names that match the wildcard.

USAGE

Use this call to change the default set of CL wildcard options.

CL_$VERIFY

Prompts the user for a yes/no response. This call adds a question mark after the specified prompt.

FORMAT

```
answer := CL_$VERIFY(name, name_len)
```

RETURN VALUE

answer
Returns the user's repsonse to the yes/no query in CL_$ANSWER_T format. This is a 2-byte integer.

The user's response can be either of the following values:

CL_$YES	Include this pathname on the token list.
CL_$NO	Ignore this pathname.
CL_$QUIT	Stop prompting user to verify pathnames.
CL_$GO	Include all the pathnames that you find on the token list without further query.

INPUT PARAMETERS

name
Name with which the user is prompted. This is a UNIV character string.

name_len
Number of characters in "name." This is a 2-byte integer.

USAGE

Use this call to prompt the user for a yes/no response. It writes the name followed by a question mark. You can call CL_$SET_VERB before this call to include a text string with the prompt.

ERRORS

CL_$ARG_TOO_LONG
: User supplied an argument that is longer than allowed. You specify the maximum length required at the time of the call.

CL_$DUPLICATE_SET_ELEMENT
: User supplied a duplicate character, detected by the CL_$GET_SET call.

CL_$INVALID_DECIMAL_NUMBER
: User supplied an invalid decimal number to be converted by the CL_$GET_NUM call.

CL_$INVALID_SET_ELEMENT
: User supplied an invalid character, detected by the CL_$GET_SET call.

CL_$MISSING_REQ_DERIVED_NAME
: User did not supply the required derived name after a keyword for the CL_$GET_FLAGGED_DERIVED_NAME call.

CL_$NO_MATCH_FOR_WILDCARD
: There are no pathnames in the user's working directory that match the wildcard specified.

CL_$NOT_ENOUGH_ARGUMENTS
: User did not supply enough arguments, detected by the CL_$CHECK_FLAG call.

CL_$TOO_MANY_ARGUMENTS
: User supplied more arguments than the program can handle, detected by the CL_$CHECK_FLAG call.

CL_$UNPARSED_KEYWORD
: User supplied a keyword that cannot be handled by program, detected by the CL_$CHECK_UNCLAIMED call.

FU

CONSTANTS

NAME_$PNAMLEN_MAX 256 Maximum length of a pathname.

DATA TYPES

NAME_$PNAME_T

An array of up to NAME_$PNAMLEN_MAX (256) characters.

FU_$CONTEXT_T

A 2-byte integer. Location of error returned by some FU calls. One of the following pre-defined values:

FU_$SRC
Error occurred in the source object or tree.

FU_$DST
Error occurred in the target object or tree.

FU_$UNK
Unknown whether the error occurred in the source or target object or tree.

FU_$OPT_T

A 2-byte integer. FU options passed to many FU calls. One of the following pre-defined values:

FU_$LIST_FILES
List files operated on.

FU_$LIST_DIRS
List directories operated on.

FU_$LIST_LINKS
List links operated on.

FU_$REPLACE
Replace target with a copy of the source.

FU_$MERGE
Merge source and target if both are directories. For files and links with the same name in source and target, it deletes the target and replaces it with a copy of the source.

FU_$COE
Continue to the next object if an error occurs while processing an object.

FU_$PRINT_ERRORS
Print errors on the error output stream.

FU_$LIST_DEL
List objects deleted as a result of a replace operation. Obsolete; use FU_$LIST_D_DIRS, FU_$LIST_D_FILES, FU_$LIST_D_LINKS instead.

FU_$HELP
Display detailed usage information. It has no meaning under AEGIS, used for a Boot Shell utility only.

FU_$QUIT
Has no meaning under AEGIS, used for a Boot Shell utility only.

FU_$BEF_TIME
For copy tree, copy only those objects whose dtm (date/time last modified) is before the given date and time.

FU_$AFT_TIME
For copy tree, copy only those objects whose dtm (date/time last modified) is after the given date and time.

FU_$FORCE_DEL
Force deletion of a target during a replace operation if user has owner "P" rights.

FU_$FORCE
Force a copy in FU_$MOVE if the source and target files are not located on the same volume.

FU_$DACL
Assign default ACL to target files. Target gets the default ACL of the parent (destination) directory.

FU_$SACL
Assign ACL of source object to target object. Target gets the same ACL as the source object.

FU_$RENAME
Change the name of existing object with the target pathname before creating copy. If target name is in use and cannot be deleted during a replace operation, it appends today's date to the target pathname.

FU_$LIST_D_FILES
List deleted files.

FU_$LIST_D_DIRS
List deleted directories.

FU_$LIST_D_LINKS
List deleted links.

FU_$MERGE_DST
Merge source and target if both are directories. For files and links with the same name in source and target, the target remains unchanged.

FU_$USE_PRESERVE
Reserved.

FU_$SUBS
Retain the source ACL for objects which belong to protected subsystems.

FU_$PRESERVE_DT
Preserve the source dtm (date/time last modified) and dtu (date/time last used).

FU_$SPARSE
Reserved.

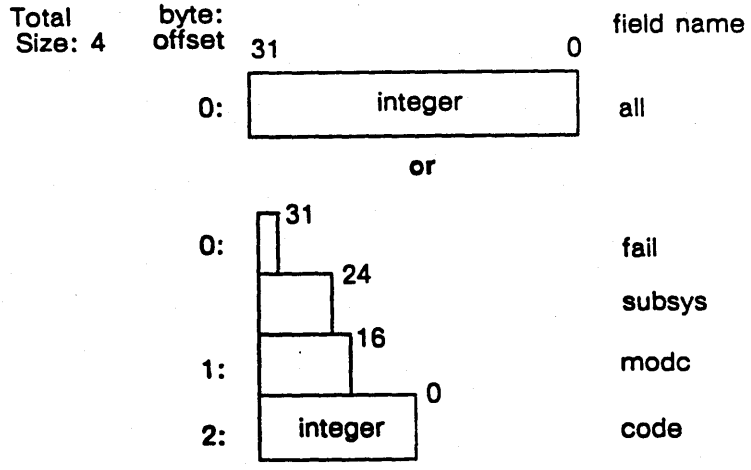
FU_$DEL_WHEN_UNLKD
Delete object when it becomes unlocked.

FU_$OPT_SET_T

A 2-byte integer. A set of FU options in FU_$OPT_T format. For a list of options, see FU_$OPT_T above.

STATUS_$T

A status code. The diagram below illustrates the STATUS_$T data type:



Field Description:

ALL
All 32 bits in the status code.

FAIL
The fail bit. If this bit is set, the error was not within the scope of the module invoked, but occurred within a lower-level module (bit 31).

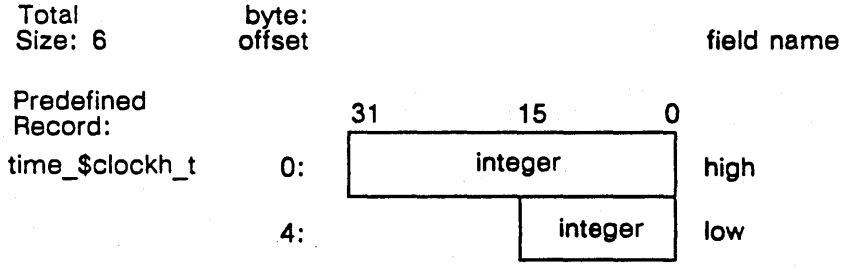
SUBSYS
The subsystem that encountered the error (bits 24 - 30).

MODC
The module that encountered the error (bits 16 - 23).

CODE
A signed number that identifies the type of error that occurred (bits 0 - 15).

TIME_$CLOCKH_T

Internal representation of time. The high 32 bits of the TIME_$CLOCK_T data type. The diagram below illustrates the TIME_$CLOCKH_T data type:



Field Description:

HIGH
High 32 bits of the clock.

LOW
Low 16 bits of the clock.

FU_$CMP_TREE

Compare a source tree to a target tree.

FORMAT

```
FU_$CMP_TREE(source_pathname, source_name_len, target_pathname, target_name_len,
             fu_options, error_pathname, error_pathname_len, status)
```

INPUT PARAMETERS

source_pathname
Pathname of the source file to be compared, in NAME_$PNAME_T format. This is an array of up to 256 characters.

The source file must be the same type of object as the target.

source_name_len
Number of characters in "source_pathname." This is a 2-byte integer.

target_pathname
Pathname of the target file to be compared,in NAME_$PNAME_T format. This is an array of up to 256 characters.

The target file must be the same type of object as the source.

target_name_len
Number of characters in "target_pathname." This is a 2-byte integer.

fu_options
FU compare options in FU_$OPT_SET_T format. This is a 2-byte integer. Specify any combination of the following predefined values:

FU_$COE Continues to the next file, if an error occurs while processing a file.

FU_$LIST_DIRS
Lists directories as they are compared.

FU_$LIST_FILES
Lists files as they are compared.

FU_$LIST_LINKS
Lists links as they are compared.

FU_$PRINT_ERRORS
Displays errors to the error output stream.

INPUT/OUTPUT PARAMETERS

error_pathname
Pathname of the file where an error occurred, if any, in NAME_$PNAME_T format. This is an array of up to 256 characters.

This is valid only if "status" does not equal zero.

error_pathname_len
Length of "error_pathname." This is a 2-byte integer.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the FU Data Types section for more information.

USAGE

Use this call to compare all the objects of a source tree against all objects in a target tree. This call reports any objects catalogued in the source that do not also appear in the target. However, it does not compare the target to the source, so it does not list objects that appear in the target that do not appear in the source.

FU_$CMP_TREE compares objects byte-by-byte. If it encounters a difference, it reports the difference, stops comparing that file and goes on to compare the next objects in the tree.

FU_$COPY_FILE

Copies a file from the source pathname to the target pathname.

FORMAT

```
FU_$COPY_FILE(source_pathname, source_name_len, target_pathname,
              target_name_len, fu_options, error_context, status)
```

INPUT PARAMETERS

source_pathname
Pathname of the source file to be copied, in NAME_$PNAME_T format. This is an array of up to 256 characters.

If the source name is a link name, it resolves the link, and copies the file to which the link refers.

source_name_len
Number of characters in "source_pathname." This is a 2-byte integer.

target_pathname
Pathname of the target file, in NAME_$PNAME_T format. This is an array of up to 256 characters.

If pathname is a directory, it copies the source to the target directory. You cannot specify a link as a target name.

target_name_len
Number of characters in "target_pathname." This is a 2-byte integer.

fu_options
FU copy options in FU_$OPT_SET_T format. This is a 2-byte integer. Specify any combination of the following predefined values:

FU_$COE — Continues to the next file, if an error occurs while processing a file.

FU_$DACL — Assigns the target file's ACL. The target file gets the default ACL of the parent (destination) directory. Invalid if FU_$SACL is set.

FU_$DEL_WHEN_UNLKD
Deletes object when it becomes unlocked as a result of a replace operation. (That is, if the user set the FU_$REPLACE option.)

FU_$FORCE_DEL
Forces deletion of a target during a replace operation if user has protect ("P") rights. (That is, if the user set the FU_$REPLACE option.)

FU_$LIST_D_FILES
Lists files deleted as a result of a replace operation. (That is, if the user set the FU_$REPLACE option.)

FU_$LIST_FILES
Lists files copied.

FU_$PRESERVE_DT
: Preserves the source file's dtm (date/time last modified) and dtu (date/time last used) if the user set the FU_$REPLACE option and the file was copied.

FU_$PRINT_ERRORS
: Displays errors to the error output stream.

FU_$RENAME
: Changes the name of existing object with the target pathname before making a copy. If target name is in use and cannot be deleted during a replace operation, it appends today's date to the target pathname.

FU_$REPLACE
: Replaces the target with a copy of the source.

FU_$SACL
: Assigns the target file's ACL. The target file gets the same ACL as the source file. Invalid if FU_$DACL is set.

FU_$SUBS
: Retains the source ACL for objects which belong to protected subsystems.

OUTPUT PARAMETERS

error_context
: Indicates where an error occurred, in FU_$CONTEXT_T format. This is a 2-byte integer. On error, the call can return any one of the following predefined values:

  FU_$SRC
  : Error occurred in the source object.

  FU_$DST
  : Error occurred in the target object.

  FU_$UNK
  : Error undefined.

  This is valid only if "status" does not equal zero.

status
: Completion status, in STATUS_$T format. This data type is 4 bytes long. See the FU Data Types for more information.

USAGE

Use this call to copy a source file to a target file. This call copies only files; use FU_$COPY_TREE to copy directories and their subordinate objects.

FU_$COPY_TREE

Copies, merges, and replaces files, directories, and links.

FORMAT

```
FU_$COPY_TREE(source_pathname, source_name_len, target_pathname,
              target_name_len, fu_options, before_time, after_time,
              error_pathname, error_pathname_len, status)
```

INPUT PARAMETERS

source_pathname
Pathname of the source file, link, or directory tree to be copied, in NAME_$PNAME_T format. This is an array of up to 256 characters.

source_name_len
Number of characters in "source_pathname." This is a 2-byte integer.

target_pathname
Pathname of the target file to be created, replaced, or merged, in NAME_$PNAME_T format. This is an array of up to 256 characters.

The target pathname can be derived from the source pathname. It cannot be a link, logical volume entry directory, or network root directory.

target_name_len
Number of characters in "target_pathname." This is a 2-byte integer.

fu_options
FU options, in FU_$OPT_SET_T format. This is a 2-byte integer. Specify any combination of the following predefined values:

FU_$AF_TIME Copies only those objects whose dtm (date/time last modified) is after the given date and time, in TIME_$CLOCKH_T format.

FU_$BF_TIME Copies only those objects whose dtm (date/time last modified) is before the given date and time, in TIME_$CLOCKH_T format.

FU_$COE Continues to the next file, if an error occurs while processing a file.

FU_$DACL Assigns the target directory's ACL. Each directory has its own ACL plus two default ACLs, one for its files and another for its subdirectories. Each subdirectory and file gets the target directory's default ACLs.

FU_$DEL_WHEN_UNLKD
Deletes the object when it becomes unlocked as a result of a replace operation. (That is, if the user set the FU_$REPLACE option.)

FU_$FORCE_DEL
Forces deletion of a target during a replace operation if user has protect ("P") rights. (That is, if the user set the FU_$REPLACE option.)

FU_$LIST_D_FILES
Lists files deleted as a result of a replace operation.

FU_$LIST_D_DIRS
: Lists directories deleted as a result of a replace operation.

FU_$LIST_D_LINKS
: Lists links deleted as a result of a replace operation.

FU_$LIST_DIRS
: Lists directories as they are copied.

FU_$LIST_FILES
: Lists files as they are copied.

FU_$LIST_LINKS
: Lists links as they are copied.

FU_$MERGE
: Merges the source and target if both are directories. If the target exists, it merges the source into the target, replacing files and links, and combining directories. If the target does not exist, FU_$COPY_TREE duplicates the source as the target.

  If both source and target are directories, FU_$COPY_TREE compares their contents, object by object. Objects that exist in the source but not in the target are created in the target. Objects that exist in the target but not in the source remain unchanged.

  If files and links have the same name in the source and target, FU_$COPY_TREE deletes the target and replaces it with a copy of the source. If directories have the same name in both source and target, it merges them.

  If the source and target are not both directories, FU_$COPY_TREE deletes the target and replaces it with the source.

FU_$MERGE_DST
: Merges source and target if both are directories. It works the same as FU_$MERGE except that files and links with the same name in both the source and target remain unchanged in the target.

FU_$PRESERVE_DT
: Preserves the source file's dtm (date/time last modified) and dtu (date/time last used) if the user set the FU_$REPLACE option and the file was copied.

FU_$PRINT_ERRORS
: Displays errors to the error output stream.

FU_$RENAME
: Changes the name of existing object with the target pathname before making a copy. If target name is in use and cannot be deleted during a replace operation, it appends today's date to the target pathname.

FU_$REPLACE
: Replaces the target with the source. It deletes the tree starting at the target pathname and copies the entire source tree in its place. If the target pathname does not exist, it creates one and duplicates the source.

FU_$SACL — Assigns the target directory's ACL. Each subdirectory and file gets the same ACL as the source directory.

FU_$SUBS — Retains the source ACL for objects which belong to protected subsystems.

before_time
Specified time, in TIME_$CLOCKH_T format. This data type is 4 bytes long.

Copies only those files whose dtm (date/time last modified) is before the given date and time.

afer_time
Specified time, in TIME_$CLOCKH_T format. This data type is 4 bytes long.

Copies only those files whose dtm (date/time last modified) is after the given date and time.

OUTPUT PARAMETERS

error_pathname
Returns the pathname of the file where an error occurred, in NAME_$PNAME_T format. This is an array of up to 256 characters.

This is valid only if "status" does not equal zero.

error_pathname_len
Length of "error_pathname." This is a 2-byte integer.

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the FU Data Types section for more information.

USAGE

Use this call to copy directories, subordinate objects, and links to a target directory. This is most useful in calls where you want to copy any pathname, and do not care whether the pathname is a file or tree.

If you want to copy files only, use FU_$COPY_FILE.

FU_$DELETE_FILE

Deletes a specified file.

FORMAT

```
FU_$DELETE_FILE(pathname, pathname_len, force, delete_when_unlocked, status)
```

INPUT PARAMETERS

pathname
Pathname of the source file to be deleted, in NAME_$PNAME_T format. This is an array of up to 256 characters.

pathname_len
Number of characters in "pathname." This is a 2-byte integer.

force
If TRUE, forces file deletion if user has owner rights, even if user does not have delete rights. This is a Boolean value.

delete_when_unlocked
If TRUE, it deletes delete the file when it becomes unlocked. This is a Boolean value.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the FU Data Types section for more information.

USAGE

Use this call to delete a file. It is similar to NAME_$DELETE_FILE except that it allows you to delete locked objects.

FU_$DELETE_TREE

Deletes a directory and all its descendants.

FORMAT

```
FU_$DELETE_TREE(pathname, pathname_len, fu_options,
                error_pathname, error_pathname_len, status)
```

INPUT PARAMETERS

pathname
Pathname of the directory to be deleted, in NAME_$PNAME_T format. This is an array of up to 256 characters.

If "pathname" is a directory, it deletes the directory and all subordinate objects (subdirectories, links, and files). If "pathname" is a link, it deletes the link, but has no effect on the files and directories named by the link.

pathname_len
Number of characters in "pathname." This is a 2-byte integer.

fu_options
FU delete options in FU_$OPT_SET_T format. This is a 2-byte integer. Specify any combination of the following predefined values:

FU_$COE — Continues to the next file, if an error occurs while processing a file.

FU_$DEL_WHEN_UNLKD
Deletes object when it becomes unlocked.

FU_$FORCE_DEL
Forces deletion if user has protect ("P") rights.

FU_$LIST_D_FILES
Lists files deleted.

FU_$LIST_D_DIRS
Lists directories deleted.

FU_$LIST_D_LINKS
Lists links deleted.

FU_$LIST_DIRS
Lists directories as they are copied.

FU_$LIST_DIRS
Lists directories as they are deleted.

FU_$LIST_FILES
Lists files as they are deleted.

FU_$LIST_LINKS
Lists links as they are deleted.

FU_$PRINT_ERRORS
Displays errors to the error output stream.

OUTPUT PARAMETERS

error_pathname
Returns the pathname of the file where an error occurred, in NAME_$PNAME_T format. This is an array of up to 256 characters.

This is valid only if "status" does not equal zero.

error_pathname_len
Length of "error_pathname." This is a 2-byte integer.

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the FU Data Types section for more information.

USAGE

Use this call to delete a directory, and all the files, links and subdirectories within it. This call is most useful when you want to delete a pathname, and you do not care if the pathname is a file or directory.

FU_$INIT

Initializes the file and tree utility (FU). You must use this call before any other FU calls.

FORMAT

```
FU_$INIT
```

USAGE

Use this call to initialize the FU. This call allocates read/write storage space for subsequent FU calls. You can release the storage with FU_$RELEASE_STORAGE before terminating your program.

FU_$MOVE_FILE

Moves a file to a different location in the naming tree.

FORMAT

```
FU_$MOVE_FILE(source_pathname, source_name_len, target_pathname,
              target_name_len, fu_options, error_context, status)
```

INPUT PARAMETERS

source_pathname
Pathname of the source file to be moved, in NAME_$PNAME_T format. This is an array of up to 256 characters.

source_name_len
Number of characters in "source_pathname." This is a 2-byte integer.

target_pathname
Pathname of the new file location, in NAME_$PNAME_T format. This is an array of up to 256 characters.

target_name_len
Number of characters in "target_pathname." This is a 2-byte integer.

fu_options
FU options in FU_$OPT_SET_T format. This is a 2-byte integer. Specify any combination of the following predefined values:

FU_$COE — Continues to the next file, if an error occurs while processing a file.

FU_$DACL — Assigns the target file's ACL. The target file gets the default ACL of its parent (destination) directory. Invalid if FU_$SACL is set.

FU_$DEL_WHEN_UNLKD
Deletes the object when it becomes unlocked as a result of a replace operation. (That is, if user set the FU_$REPLACE option.).

FU_$FORCE — Forces a copy of the target if the source and target are not located on the same volume.

FU_$LIST_D_FILES
Lists files deleted as a result of a replace operation.

FU_$LIST_D_DIRS
Lists directories deleted as a result of a replace operation.

FU_$LIST_D_LINKS
Lists links deleted as a result of a replace operation.

FU_$LIST_DIRS
Lists directories moved.

FU_$LIST_FILES
Lists files moved.

FU_$LIST_LINKS
: Lists links moved.

FU_$PRESERVE_DT
: Preserves the source file's dtm (date/time last modified) and dtu (date/time last used) if the user set the FU_$REPLACE option and the file was copied.

FU_$PRINT_ERRORS
: Displays errors to the error output stream.

FU_$RENAME
: Changes the name of existing object with the target pathname before making a copy. If the target object is in use and cannot be deleted during a replace operation, it appends today's date to the target pathname.

FU_$REPLACE
: Replaces the target with a copy of the source.

FU_$SACL
: Assigns the target file's ACL. The target file gets the same ACL as the source file. Invalid if FU_$DACL is set.

FU_$SUBS
: Retains the source ACL for objects that belong to protected subsystems.

OUTPUT PARAMETERS

error_context
: Indicates where an error occurred, in FU_$CONTEXT_T format. This is a 2-byte integer. On error, the call can return any one of the following predefined values:

  FU_$SRC
  : Error occurred in the source object.

  FU_$DST
  : Error occurred in the target object.

  FU_$UNK
  : Error undefined.

  This is valid only if "status" does not equal zero.

status
: Completion status, in STATUS_$T format. This data type is 4 bytes long. See the FU Data Types section for more information.

USAGE

Use this call to move a specified file to another location in the naming tree. You can also use FU_$MOVE_FILE to move a directory name, if the directory is located on the same volume.

FU_$RELEASE_STORAGE

Releases read/write storage used by FU calls.

FORMAT

```
FU_$RELEASE_STORAGE
```

USAGE

Use this call to release the read/write storage used by FU calls. FU allocates storage during copy operations, so you would usually use this call after your program performs numerous copy operations.

You can use this call any time after you initialize the FU with a FU_$INIT system call.

FU_$RENAME_UNIQUE

Renames a pathname to create a unique name by appending today's date to the pathname.

FORMAT

```
FU_$RENAME_UNIQUE(pathname, pathname_len, fu_options, status)
```

INPUT PARAMETERS

pathname
Pathname to be changed, in NAME_$PNAME_T format. This is an array of up to 256 characters.

pathname_len
Number of characters in "pathname." This is a 2-byte integer.

fu_options
FU options in FU_$OPT_SET_T format. This is a 2-byte integer. Specify any combination of the following predefined values:

FU_$COE — Continues to the next file, if an error occurs while processing a file.

FU_$LIST_DIRS
Lists directories operated on.

FU_$LIST_FILES
Lists files operated on.

FU_$LIST_LINKS
Lists links operated on.

FU_$PRINT_ERRORS
Displays errors to the error output stream.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the FU Data Types section for more information.

USAGE

Use this call to rename a file so it will have a unique pathname. The call appends a period and today's date and time to the specified pathname.

FU_$SET_PROG_NAME

Identifies the program name when the FU manager reports any errors.

FORMAT

```
FU_$SET_PROG_NAME(pathname, pathname_len)
```

INPUT PARAMETERS

pathname
Name of program, in NAME_$PNAME_T format. This is an array of up to 256 characters.

pathname_len
Number of characters in "pathname." This is a 2-byte integer.

USAGE

Use this call to identify your program. The FU manager returns this program name when reporting any errors that occur.

ERRORS

FU_$CANT_PROCESS
: Cannot delete or copy system directory.

FU_$COMPARE_FAILED
: Compare failed, detected by FU_$CMP_TREE.

FU_$DEST_IN_SOURCE
: Target file of FU_$COPY_TREE contained in source.

FU_$DIFF_VOLS
: Cannot move objects across volumes, detected by FU_$MOVE_FILE.

FU_$NOT_LEAF
: File is a directory, detected by FU_$COPY_FILE.

FU_$SAME_OBJECT
: Cannot copy source over itself.

FU_$UNREC_NSTYPE
: Naming server entry type is unknown.

FU_$UNREC_SYSTYPE
: Type of system object is unknown, detected by FU_$CMP_TREE.

LOADER

CONSTANTS

LOADER_TABLE_SIZE	2048	Maximum number of sections allowed in an array of the data type, PM_$SECT_INFO.
NAME_$PNAMLEN_MAX	256	Maximum length of a pathname.

DATA TYPES

NAME_$PNAME_T

An array of up to NAME_$PNAMLEN_MAX (256) characters.

PM_$OPTS

A 2-byte integer. Set of options that define how an object module gets loaded with PM_$LOAD. One of the following pre-defined values:

PM_$COPY_PROC
Causes PM_$LOAD to copy the object module into read/write storage so that you can write to the object module without changing the original.

PM_$INSTALL
Tells PM_$LOAD that it is loading a library containing global variables, not a program. PM_$LOAD makes all the global entry points that were marked at binding available to other programs.

PM_$NO_UNRESOLVEDS
Causes PM_$LOAD to report an error if there are any unresolved global variables.

PM_$LOAD_GLOBALS
Reserved.

PM_$INSTALL_SECTIONS
Tells PM_$LOAD that it's loading a library containing global sections. PM_$LOAD makes these global sections, which were marked at binding, available to all programs.

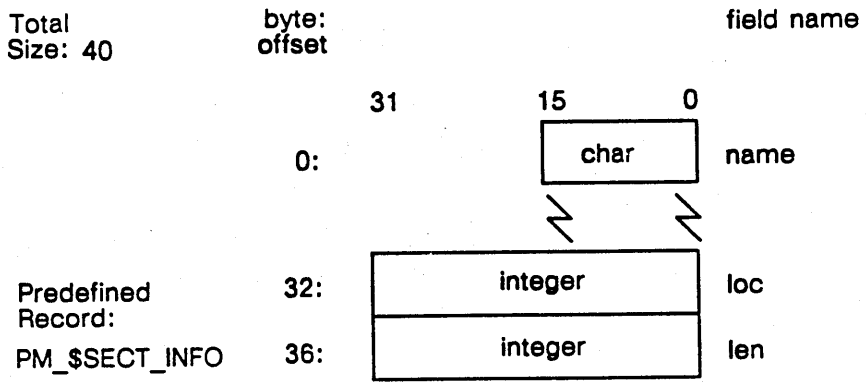
PM_$LOAD_WRITABLE
Causes PM_$LOAD to load the object module with read/write access. Normally, the object module has read/only access. Specify this option when you want to write to the object module without copying it first.

PM_$LOADER_OPTS

A 4-byte integer. A set of LOADER options in PM_$OPTS format. For a list of options, see PM_$OPTS above.

PM_$SECT_INFO

A record of information within the PM_$LOAD_INFO data type. The diagram below illustrates the PM_$SECT_INFO data type:



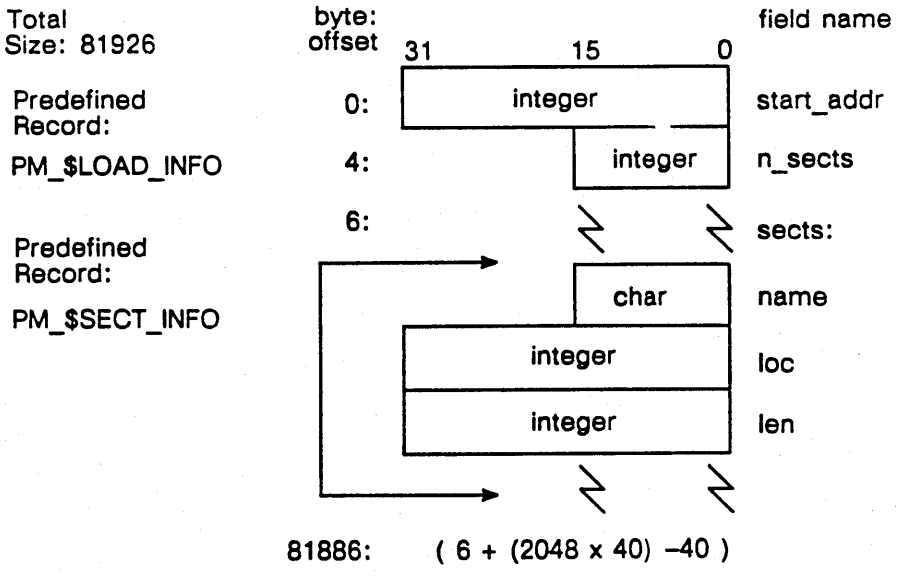
NAME
The name of the section, a character array of up to 32 elements.

LOC
A 4-byte integer. Location of section information.

LEN
A 4-byte integer. Length of section.

PM_$LOAD_INFO

An argument returned by PM_$LOAD. The diagram below illustrates the PM_$LOAD_INFO data type:



Field Description:

START_ADDRESS
A UNIV_PTR indicating the start address of the object module; i.e., the first instruction to execute. If the object is a library, the first instruction is the initialization point; if the object is a program, it is the main entry point.

N_SECTS
Number of sections contained in object module.

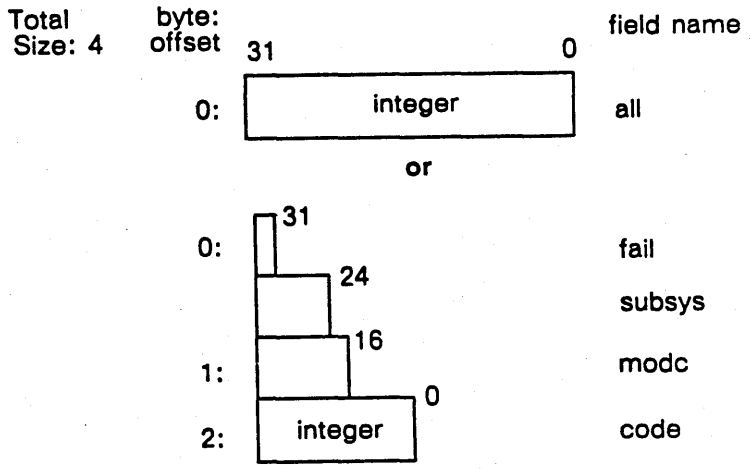
SECTS
Location of sections. An array of PM_$SECT_INFO records, up to LOADER_TABLE_SIZE (2048 bytes).

PM_$LOAD_INFO_PTR_T

A 4-byte integer. The address of a returned PM_$LOAD_INFO record.

STATUS_$T

A status code. The diagram below illustrates the STATUS_$T data type:



Field Description:

ALL
All 32 bits in the status code.

FAIL
The fail bit. If this bit is set, the error was not within the scope of the module invoked, but occurred within a lower-level module (bit 31).

SUBSYS
The subsystem that encountered the error (bits 24 - 30).

MODC
The module that encountered the error (bits 16 - 23).

CODE
A signed number that identifies the type of error that occurred (bits 0 - 15).

UNIV_PTR — A 4-byte integer. A pointer to allocated storage.

PM_$CALL

Invokes a program at the start address returned by PM_$LOAD.

FORMAT

```
long_int := PM_$CALL( start_address )
```

RETURN VALUE

long_int
Returns a 32-bit integer. This value has no meaning unless you expect a return value from the invoked program. For details, see the chapter on process manager system calls in Part I of this manual.

INPUT PARAMETERS

start_address
Starting address of the object module. This is a UNIV_PTR, which is the first field of the PM_$LOAD_INFO record, returned by PM_$LOAD.

USAGE

This call invokes a program at the current program level, at the start address returned by PM_$LOAD. The start address is the first field of the PM_$LOAD_INFO data type. For example, if you declare "sec_info" of the type PM_$LOAD_INFO, you would invoke the object module with the following statement:

```
pm_junk := pm_$call( sec_info.start_addr );
```

Before using this call, You must load the program with the PM_$LOAD system call. Using these two system calls is similar to using PGM_$INVOKE, except that PGM_$INVOKE creates a new program level and performs cleanup handling.

PM_$LOAD

Loads a specified object module or library at the current program level.

FORMAT

```
PM_$LOAD(program, program_len, loader_options, num_sects, load_info, status )
```

INPUT PARAMETERS

program
Name of the object to load, in NAME_$PNAME_T format. This is an array of up to 256 characters.

program_len
Number of characters in "name." This is a 2-byte integer.

loader_options
Loader options in PM_$LOADER_OPTS format. This is a 2-byte integer. Specify any combination of the following predefined values:

PM_$COPY_PROC
Causes PM_$LOAD to copy the object module procedure text to avoid changing the original object module. If you do not specify this option, PM_$LOAD maps the object module directly.

PM_$INSTALL Indicates that PM_$LOAD is loading a library containing global variables, not a program. The entries are marked at binding.

PM_$INSTALL_SECTIONS
Causes PM_$LOAD to define global sections so that you can share information among programs.

PM_$LOAD_WRITABLE
Causes PM_$LOAD to load the object module as writable, allowing you read/write access. Normally, the object module has read/only access.

PM_$NO_UNRESOLVEDS
Causes PM_$LOAD to report an error if there are any unresolved global variables.

num_sects
Number of sections. This is a 2-byte integer. If "num_sects" is greater than zero, it is the maximum number of sections that you want information on, which is returned in "load_info." If "num_sects" is zero, PM_$LOAD returns only the start address of the object module.

OUTPUT PARAMETERS

load_info
Returns the start address of the object module in PM_$LOAD_INFO format. If "num_sects" does not equal zero, it also returns the name and location of each section in the object module. For more information on this data type, see the LOADER Data Types section.

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the LOADER Data Types section for more information.

USAGE

Loads a library or program object module at the current program level. It converts the object module on the disk to executable form and returns the starting address of the module. You must invoke the program with the PM_$CALL system call.

Using these two system calls is similar to using PGM_$INVOKE, except that PGM_$INVOKE creates a new program level and performs cleanup handling.

ERRORS

KG_$NO_SPACE
: Not enough storage space for global entry points exported by this module for a read/write section.

LOADER_$BKPTS_IN_OBJ
: Leftover breakpoints exist in object module. This occurs when you set breakpoints in the original object module by using PM_$WRITABLE rather than making a copy with PM_$COPY_PROC. The breakpoints remain in the object module if it terminates abnorally.

LOADER_$DNx60_REQUIRED
: Attempted to execute an object that contains instructions specifically for the Dnx60 series on a non Dnx60 machine.

LOADER_$M020_REQUIRED
: Attempted to execute an object that contains instructions specifically for the M020 series on a non M020 machine.

LOADER_$M881_REQUIRED
: Attempted to execute an object that contains instructions specifically for the M881 series on a non M881 machine.

LOADER_$NO_COPY_SPACE
: Not enough read/write storage space to copy the object module, detected because the PM_$COPY_PROC option was set.

LOADER_$NO_PROC_SPACE
: Not enough address space to map the object module.

LOADER_$NO_RW_SPACE
: Not enough read/write storage space to load the object module.

LOADER_$NOT_A_PROGRAM
: The name you supplied is not an object module.

LOADER_$PEB_REQUIRED
: Attempted to execute an object that contains instructions specifically for the floating point performance enhancement board (PEB), on a machine that does not have the board.

LOADER_$TOO_MANY_SECTIONS
: Too many sections in object module.

LOADER_$TOO_MANY_UNDEFINED
: Too many undefined references in object module.

LOADER_$UNDEF_GLBL
: Made reference to an unresolved global at runtime.

LOADER_$UNDEF_GLBL_IN_LIB
: Library contains unresolved global variables, detected because the PM_$NO_UNRESOLVEDS option was set.

LOADER_$UNIX_INIT_REQUIRED
: C library initialization required; no C library is installed. /LIB/CLIB must always be present to run a C program. In practice, you should never see this error, since you cannot boot a node without installing CLIB.

LOADER_$WRONG_VERSION
: The LOADER could not understand the object module format because the version differed.

LOGIN

CONSTANTS

NAME_$PNAMLEN_MAX	256	Maximum length of a pathname.

DATA TYPES

NAME_$PNAME_T

An array of up to NAME_$PNAMLEN_MAX (256) characters.

LOGIN_$STRING_T

An array of up to 256 characters.

LOGIN_$OPT_T

A 2-byte integer. Options for LOGIN_$LOGIN system call. One of the following pre-defined values:

LOGIN_$LOCAL_CONN
Reserved.

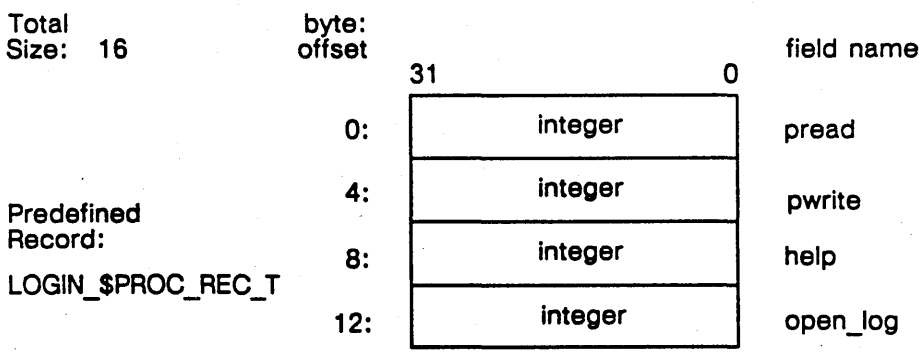
LOGIN_$LOG_EVENTS
Indicates that you are supplying a procedure to record user's attempts to log in.

LOGIN_$OPT_SET_T

A 4-byte integer. A set of LOGIN options in LOGIN_$OPT_T format. For a list of options, see LOGIN_$OPT_T above.

LOGIN_$PROC_REC_T

A record of pointers to LOGIN functions and procedures that you supply to LOGIN_$LOGIN. The diagram below illustrates the LOGIN_$PROC_REC_T data type:



Field Description:

PREAD
Pointer to read function that you supply to LOGIN_$LOGIN.

PWRITE
Pointer to write procedure that you supply to LOGIN_$LOGIN.

HELP
Pointer to help procedure that you supply to LOGIN_$LOGIN.

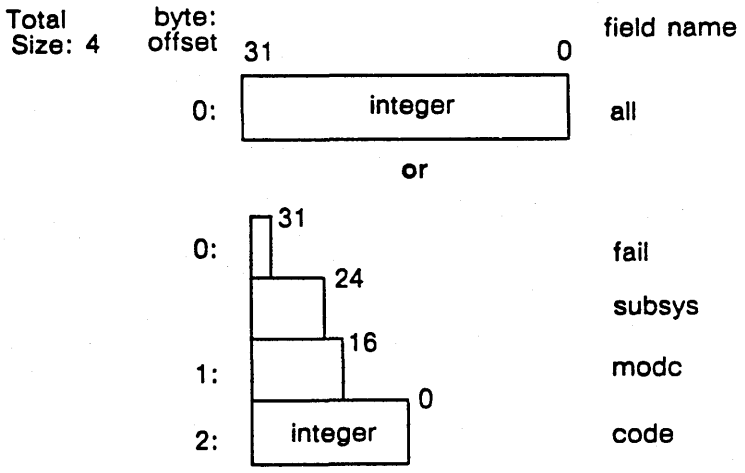
OPEN_LOG
Pointer to open log function that you supply to LOGIN_$LOGIN.

STREAM_$ID_T

A 2-byte integer. Open stream identifier.

STATUS_$T

A status code. The diagram below illustrates the STATUS_$T data type:



Field Description:

ALL
All 32 bits in the status code.

FAIL
The fail bit. If this bit is set, the error was not within the scope of the module invoked, but occurred within a lower-level module (bit 31).

SUBSYS
The subsystem that encountered the error (bits 24 - 30).

MODC
The module that encountered the error (bits 16 - 23).

CODE
A signed number that identifies the type of error that occurred (bits 0 - 15).

UNIV_PTR — A 4-byte integer. A pointer to allocated storage.

LOGIN_$CHHDIR

Changes the home directory that is listed in the registry ACCOUNT file.

FORMAT

```
LOGIN_$CHHDIR (login_ptr, home_dir, home_dir_len, status )
```

INPUT PARAMETERS

login_ptr
Pointer to internal LOGIN datatypes in LOGIN_$PTR format. This is a UNIV_PTR data type, and is 4 bytes long.

home_dir
Name of the supplied home directory. This is a UNIV character string.

home_dir_len
Number of characters in "home_dir." This is a 2-byte integer.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the LOGIN Data Types section for more information.

USAGE

Use this call to change a user's home directory listed in the network registry account file. Before using this call, you must use LOGIN_$OPEN to initialize the LOGIN manager, and LOGIN_$SET_PPO to set the PPO (person, project, organization) files to the user whose home directory you want to change. Use LOGIN_$LOGIN when you are finished changing registry ACCOUNT files.

LOGIN_$CHPASS

Change the password that is listed in the registry account file.

FORMAT

```
LOGIN_$CHPASS (login_ptr, password, pass_len, status )
```

INPUT PARAMETERS

login_ptr
Pointer to internal LOGIN datatypes in LOGIN_$PTR format. This is a UNIV_PTR data type, and is 4 bytes long.

password
Name of the supplied password. This is a UNIV character string.

pass_len
Number of characters in "password." This is a 2-byte integer.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the LOGIN Data Types section for more information.

USAGE

Use this call to change the user's password in the registry account file. Before using this call, you must use LOGIN_$OPEN to initialize the LOGIN manager, and LOGIN_$SET_PPO to set the PPO (person, project, organization) files to the user whose password you want to change. Use LOGIN_$LOGIN when you are finished changing registry ACCOUNT files.

LOGIN_$CKPASS

Checks the supplied password against the one listed in the registry ACCOUNT file.

FORMAT

```
LOGIN_$CKPASS (login_ptr, password, pass_len, status )
```

INPUT PARAMETERS

login_ptr
Pointer to internal LOGIN datatypes, in LOGIN_$PTR format. This is a UNIV_PTR data type, and is 4 bytes long.

password
Name of the supplied password. This is a UNIV character string.

pass_len
Number of characters in "password." This is a 2-byte integer.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the LOGIN Data Types section for more information.

USAGE

Use this call to check the supplied password against the password listed in the registry ACCOUNT file. Before using this call, you must use LOGIN_$OPEN to initialize the LOGIN manager, and LOGIN_$SET_PPO to set the PPO (PERSON, PRJECT, ORGANIZATION) files to the user whose password you want to check. Use LOGIN_$LOGIN when you are finished changing registry ACCOUNT files.

LOGIN_$CLOSE

Closes a LOGIN operation.

FORMAT

```
LOGIN_$CLOSE (login_ptr, status )
```

INPUT PARAMETERS

login_ptr
Pointer to internal LOGIN datatypes in LOGIN_$PTR format. This is a UNIV_PTR data type, and is 4 bytes long.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the LOGIN Data Types section for more information.

USAGE

Use this call to release the resources that the LOGIN manager used for LOGIN operations. The LOGIN manager updates the account files at this time. If a previous LOGIN call had difficulty with an account file, a LOGIN_$CLOSE can fail, which means that the registry will not be updated accurately. You will have to repeat the entire sequence since you opened LOGIN with LOGIN_$LOGIN. Call this routine even if the LOGIN_$OPEN fails.

LOGIN_$ERR_CONTEXT

Locates the file that failed during LOGIN operation.

FORMAT

```
LOGIN_$ERR_CONTEXT (login_ptr, err_status, bad_name, name_len, status )
```

INPUT PARAMETERS

login_ptr
Pointer to internal LOGIN datatypes, in LOGIN_$PTR format. This is a UNIV_PTR data type, and is 4 bytes long.

OUTPUT PARAMETERS

err_status
Error status, in STATUS_$T format. This data type is 4 bytes long. See the LOGIN Data Types section for more information.

bad_name
Pathname of the file that failed, in NAME_$PNAME_T format. This is an array of up to 256 characters.

name_len
Number of characters in "bad_name." This is a 2-byte integer.

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the LOGIN Data Types section for more information.

USAGE

Use this call to locate the pathname of the PPO file failed during a LOGIN operation.

LOGIN_$LOGIN

Allows a user to log in to a program.

FORMAT

```
ok := LOGIN_$LOGIN (stream, login_opt, login_procedures, status)
```

RETURN VALUE

ok
Returns TRUE if LOGIN_$LOGIN is successful, returns FALSE if not.

INPUT PARAMETERS

stream
Number of the stream where the user will log in, in STREAM_$ID_T format. This is a 2-byte integer.

login_opt
Option you can specify in your log in procedure, in LOGIN_$OPT_SET_T format. This is a 2-byte integer. Specify the predefined value:

LOGIN_$LOG_EVENTS
Tells LOGIN_$LOGIN that you are supplying a procedure to record log in events.

login_procedures
Pointers to input/output routines that you supply to LOGIN_$LOGIN, in LOGIN_$PROC_REC_T format.

The following are the procedures and functions you supply to LOGIN_$LOGIN with their input and output parameters.

NOTE: The INPUT parameters are the parameters that LOGIN_$LOGIN supplies to the routines. The OUTPUT parameters are the parameters that the routines pass to LOGIN_$LOGIN.

YOUR_READ Reads input line and passes it to LOGIN_$LOGIN.

Format

int := YOUR_READ(stream, inbuf, inlen, pstr, plen, echo, fillbuf, fillbuflen)

Return Value

int Returns an integer indicating the length of the message in "inbuf."

Input Parameters

stream Number of stream associated with input, in STREAM_$ID_T format. This is usually STREAM_$STDIN.

inlen Maximum length of "inbuf." This is a 2-byte integer.

pstr Prompt string in LOGIN_$STRING_T format. This is a UNIV character array of 256 characters.

plen Length of "pstr." This is a 2-byte integer.

echo Indicates whether the input should be echoed. LOGIN_$LOGIN returns TRUE when prompting for a PPO, FALSE when prompting for a password.

fillbuf Pre-fill buffer with string in LOGIN_$STRING_T format. This is a UNIV character array of 256 characters. Do not use this parameter, as it is specific to the Display Manager.

fillbuflen Length of "fillbuf." This is a 2-byte integer. Do not use this parameter, as it is specific to the Display Manager.

Output Parameters

inbuf
Login string that YOUR_READ passes to LOGIN_$LOGIN, in LOGIN_$STRING_T format. This is a UNIV character array of 256 characters.

YOUR_WRITE Writes error and help messages to output.

Format

YOUR_WRITE (stream, pstr, plen)

Input Parameters

stream Number of stream associated with output, in STREAM_$ID_T format. This is usually STREAM_$STDOUT.

pstr Message to output, in LOGIN_$STRING_T format. This is a UNIV character array of 256 characters.

plen Length of "pstr." This is a 2-byte integer.

YOUR_HELP Provides help message that LOGIN_$LOGIN supplies when user types h[elp] at the prompt.

Format

YOUR_HELP (stream)

Input Parameters

stream Number of stream on which to output help procedure, in STREAM_$ID_T format.

YOUR_OPEN_LOG
Records log in events in a log file.

Format

ok := YOUR_OPEN_LOG (log_file, log_file_len, log_stream)

Return Value

ok Returns TRUE if YOUR_OPEN_LOG opened successfully, returns FALSE if not.

Input Parameters

log_file Name of your log file, in LOGIN_$STRING_T format. This is a UNIV character array of 256 characters.

log_file_len Length of "log_file." This is a 2-byte integer.

Output Parameters

log_stream
Number of the stream associated with "log_file," in STREAM_$ID_T format.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the LOGIN Data Types section for more information.

USAGE

Use this call to write a log-in procedure that allows you to limit user's access to a specified program. LOGIN_$LOGIN does not handle input/output directly. Rather, you supply your own input/output routines so you can handle the special input/output needs of your application. The arguments of these routines must correspond to the parameters listed above.

To supply LOGIN_$LOGIN with the addresses of your input/output procedures, you must compile them in a separate module.

When the user supplies a PPO and password to LOGIN_$LOGIN, the system call checks the supplied password against the password listed in the registry. If the passwords match, LOGIN_$LOGIN will log the user in.

This system call corresponds to the Shell LOGIN command.

LOGIN_$OPEN

Initializes the LOGIN manager.

FORMAT

```
LOGIN_$OPEN (mode, login_ptr, status )
```

INPUT PARAMETERS

mode

Mode of LOGIN operation, in LOGIN_$MODE_T format. This is a 2-byte integer. Specify one of the following predefined values:

LOGIN_$READ Initializes LOGIN in read access mode only. Allows user to view registry account files only.

LOGIN_$UPDATE
Initializes LOGIN in read/write access mode. Allows user to view and change registry account files.

OUTPUT PARAMETERS

login_ptr

Pointer to internal LOGIN datatypes in LOGIN_$PTR format. This is a UNIV_PTR data type, and is 4 bytes long.

status

Completion status, in STATUS_$T format. This data type is 4 bytes long. See the LOGIN Data Types section for more information.

USAGE

LOGIN_$OPEN sets up storage for internal LOGIN datatypes. Use this call before using the following LOGIN system calls:

- LOGIN_$CHKPASS
- LOGIN_$CHPASS
- LOGIN_$CHHDIR

Even if LOGIN_$OPEN fails, you must also call LOGIN_$CLOSE.

LOGIN_$SET_PPO

Sets the PPO (person, project, organization) files of the user whose account file you want to check or change.

FORMAT

```
LOGIN_$SET_PPO (login_ptr, ppo, ppo_len, status )
```

INPUT PARAMETERS

login_ptr
Pointer to internal LOGIN datatypes, in LOGIN_$PTR format. This is a UNIV_PTR data type, and is 4 bytes long.

ppo
Name of user's PPO file. This is a UNIV character string.

ppo_len
Number of characters in "ppo." This is a 2-byte integer. If "ppo_len" is zero, LOGIN_$SET_PPO uses the PPO files of the user who is currently logged in.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the LOGIN Data Types section for more information.

USAGE

Use this call to set the PPO files before checking or making any changes to the registry. If you do not call this routine explicitly, the LOGIN manager automatically sets the PPO files to the user who is currently logged in.

ERRORS

LOGIN_$BAD_PASSWD
: User supplied an invalid password, detected by LOGIN_$CKPASS.

LOGIN_$ERR_EXIT
: User wants the call to exit.

LOGIN_$ERR_SHUT
: User wants the caller to shut down.

LOGIN_$NO_ROOM
: Not enough storage to initialize LOGIN's internal datatypes.

PM

CONSTANTS

NAME_$COMPLEN_MAX	32	Maximum length of a name.

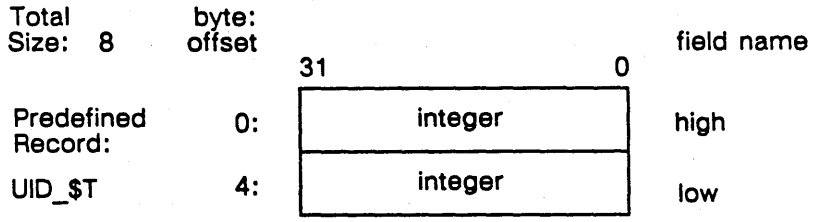
DATA TYPES

NAME_$NAME_T

An array of up to NAME_$COMPLEN_MAX (32) characters.

UID_$T

A process UID. The diagram below illustrates the UID_$T data type:



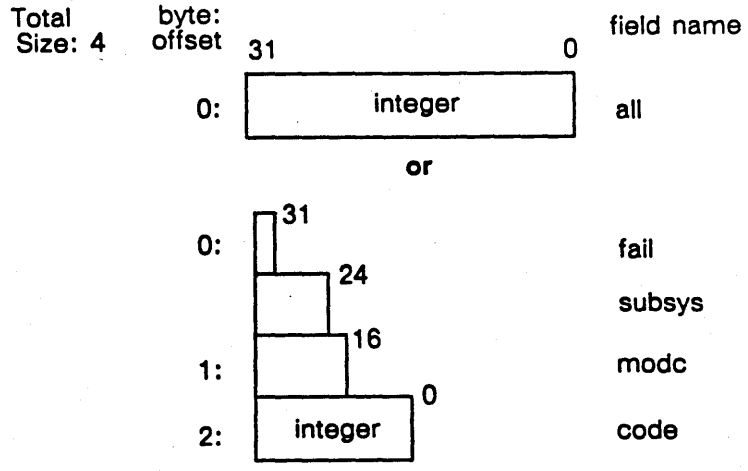
Field Description:

HIGH
The high four bytes of the UID.

LOW
The low four bytes of the UID.

STATUS_$T

A status code. The diagram below illustrates the STATUS_$T data type:



Field Description:

ALL
All 32 bits in the status code.

FAIL
The fail bit. If this bit is set, the error was not within the scope of the module invoked, but occurred within a lower-level module (bit 31).

SUBSYS
The subsystem that encountered the error (bits 24 - 30).

MODC
The module that encountered the error (bits 16 - 23).

CODE
A signed number that identifies the type of error that occurred (bits 0 - 15).

PM_$GET_HOME_TXT

Returns the home directory of the calling process as a string.

FORMAT

```
PM_$GET_HOME_TXT (maxlen, home, len)
```

INPUT PARAMETERS

maxlen
Maximum number of characters to be returned (at most, the size of the buffer you assign for home). This is a 2-byte positive integer. This parameter need not exceed 256.

OUTPUT PARAMETERS

home
Pathname of the home directory for the SID (log-in identifier) of this process. This is an array of up to 256 characters.

len
Number of characters returned in the home parameter. This is a 2-byte positive integer.

USAGE

The home directory is obtained from the network registry when you log in and is inherited by all your processes.

PM_$GET_SID_TXT

Returns the SID (log-in identifier) of the calling process as a string.

FORMAT

```
PM_$GET_SID_TXT (maxlen, sid, len)
```

INPUT PARAMETERS

maxlen
Maximum number of characters to be returned (at most, the size of the buffer you assign for home). This is a 2-byte positive integer. This parameter need not exceed 140.

OUTPUT PARAMETERS

sid
String containing the person, project, organization and node ID of the SID (log-in identifier) of this process, in the form:

```
person.group.project.nodeid
```

This is an array of up to 140 characters.

len
Number of characters returned in the log-in identifier. This is a 2-byte positive integer.

USAGE

Your SID is the full identifier obtained from the network registry when you log in and is inherited by all your processes.

PM_$SET_NAME

Assigns a name to a given process UID.

FORMAT

```
PM_$SET_NAME( name, length, process_uid, status)
```

INPUT PARAMETERS

name
The name you want to give to the process in NAME_$NAME_T format. This is an array of up to 32 characters.

length
Number of characters in "name." This is a 2-byte integer.

process_uid
The UID of the process that you want to name in UID_$T format. This data type is 8 bytes long. See the PM Data Types section for more information.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the PM Data Types for more information.

USAGE

Use this call to assign a name to a given process. Once a process has a name, you cannot rename or remove the name from the process.

ERRORS

PM_$ALREADY_NAMED

Attempted to assign a name to a process UID that was already named. You cannot change the name of a process already named by the Shell CRP command, or the DM commands, CP, CPO, or CPS.

PM_$NOT_FOUND

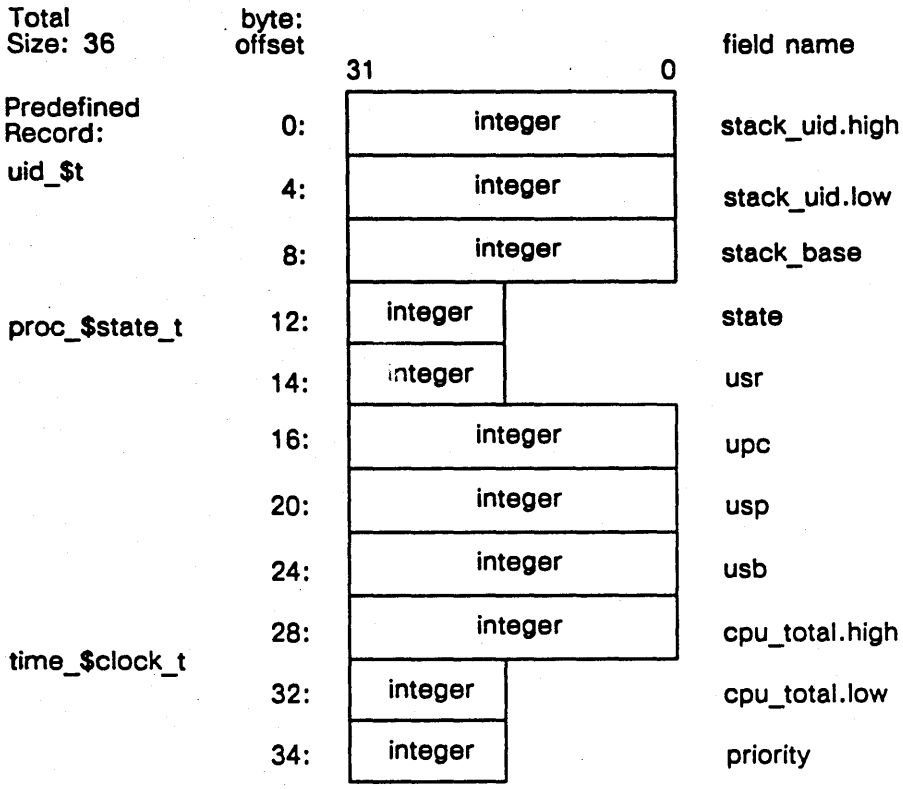
The process manager cannot find the process specified in the call.

PROC2

DATA TYPES

PROC2_$INFO_T

Process information record. The diagram below illustrates the PROC2_$INFO_T data type:



Field Description:

STACK_UID
UID of user stack.

STACK_BASE
Base address of user stack.

STATE
Process state - ready, waiting, etc.

USR
User status register.

UPC
User program counter.

USP
User stack pointer.

USB
User stack base pointer (A6).

CPU_TOTAL
Cumulative cpu time used by process.

PRIORITY
Process priority.

PROC2_$UID_LIST_T

An array of UIDs (in UID_$T format) of up to 24 elements.

PROC2_$STATE_T

A 2-byte integer. State of a user process. Any combination of the following pre-defined values:

PROC2_$WAITING
Process is waiting.

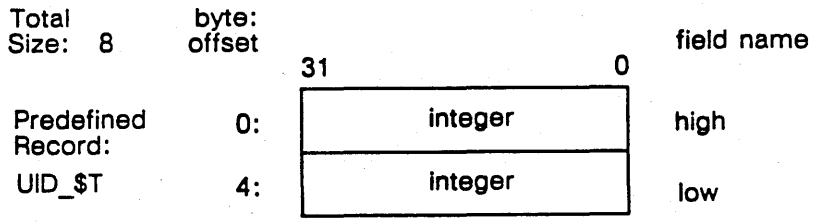
PROC2_$SUSPENDED
Process is suspended.

PROC2_$SUSP_PENDING
Process suspension is pending.

PROC2_$BOUND
Process is bound.

UID_$T

A type UID. The diagram below illustrates the UID_$T data type:



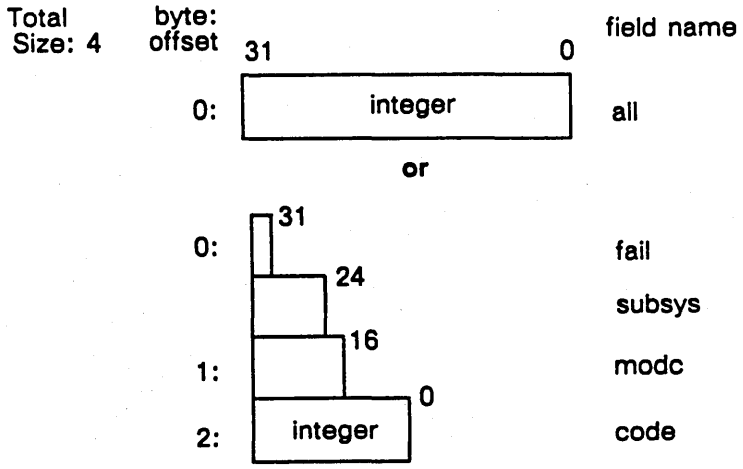
Field Description:

HIGH
The high four bytes of the UID.

LOW
The low four bytes of the UID.

STATUS_$T

A status code. The diagram below illustrates the STATUS_$T data type:



Field Description:

ALL
All 32 bits in the status code.

FAIL
The fail bit. If this bit is set, the error was not within the scope of the module invoked, but occurred within a lower-level module (bit 31).

SUBSYS
The subsystem that encountered the error (bits 24 - 30).

MODC
The module that encountered the error (bits 16 - 23).

CODE
A signed number that identifies the type of error that occurred (bits 0 - 15).

PROC2_$GET_INFO

Returns information about a process.

FORMAT

```
PROC2_$GET_INFO (process-uid, info, info-buf-length, status)
```

INPUT PARAMETERS

process-uid

The UID of the process for which you want information, in UID_$T format. This data type is 8 bytes long. See the PROC2 Data Types section for more information.

You can get process UIDs by calling PROC2_$WHO_AM_I and PROC2_$LIST.

If the process-uid in the call is the caller's own process, the only information returned is the stack UID and virtual address. If you want to find out the amount of CPU time used by the caller's process, use PROC1_$CPU_TIME.

info-buf-length

Length of the information buffer allotted for returned information, in bytes. This is normally 36 bytes.

OUTPUT PARAMETERS

info

Information about the process, in PROC2_$INFO_T format. This data type is 36 bytes long. See the PROC2 Data Types section for more information.

status

Completion status, in STATUS_$T format. This data type is 4 bytes long. See the PROC2 Data Types section for more information. Possible values are:

STATUS_$OK Completed successfully.

PROC2_$IS_CURRENT
Specified calling process UID (success).

PROC2_$UID_NOT_FOUND
Specified UID is not on node.

USAGE

GET_$INFO returns information about a process when supplied with a process UID. The information returned consists of the following:

- The program state (ready, waiting, suspended, SUSP_PENDING, bound).
- The User Status Register (USR).
- The User Program Counter (UPC).
- The user stack pointer (A7).
- The stack base pointer (A6).
- The amount of CPU time used.
- The CPU scheduling priority.

PROC2_$LIST

Returns a list of existing level 2 (user) processes on the caller's node.

FORMAT

```
PROC2_$LIST (uid-list, max-num-uids, number-uids)
```

OUTPUT PARAMETERS

uid-list
The UIDs of the active level 2 processes on the system, in PROC2_$UID_LIST_T format. This is a 24-element array of UIDs. Each UID is a 4-byte integer in UID_$T format.

INPUT PARAMETERS

max-num-uids
Maximum number of process UIDs to be returned. (At most, the size of the buffer you assign for "uid-list." This is a 2-byte integer.

OUTPUT PARAMETERS

number-uids
Number of active level 2 processes on the node, even if that number is greater than "max-num-uids." This is a 2-byte integer.

USAGE

The UIDs of all level 2 processes (user processes) on the caller's node, up to "max-num-uids," are returned.

PROC2_$SET_PRIORITY

Sets the priority of a pocess.

FORMAT

```
PROC2_$SET_PRIORITY( process_uid, low, high, status)
```

INPUT PARAMETERS

process_uid
The UID of the process that you want to change the priority level, in UID_$T format. This data type is 8 bytes long. See the PROC2 Data Types section for more information.

low
The lower boundary of the priority. This is a 2-byte integer within the range of 1 to 16. The default lower boundary is 3.

high
The higher boundary of the priority. This is a 2-byte integer within the range of 1 to 16. The default higher boundary is 14

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the PROC2 Data Types section for more information.

USAGE

Use this call to change the priority of a program. The process priority is an integer ranging from 1 (low) to 16 (high). The Display Manager runs at a priority of (16,16). When the operating system decides which process to run next, it chooses the process that currently has the highest priority.

The priority changes while a process executes. Its priority increases as the process waits for events, and decreases as it computes for long periods without waiting.

PROC2_$WHO_AM_I

Returns the UID of the calling process.

FORMAT

```
PROC2_$WHO_AM_I (my-uid)
```

OUTPUT PARAMETERS

my-uid
The UID of the calling process, in UID_$T format. This data type is 8 bytes long. See the PROC2 Data Types section for more information.

USAGE

You can use a UID obtained through this call to find out information about your process from the PROC2_$GET_INFO call.

ERRORS

PROC2_$BAD_STACK_BASE
: Bad stack base.

PROC2_$IS_CURRENT
: Request is for current process.

PROC2_$UID_NOT_FOUND
: UID of given process not found.

PROC2_$UID_NOT_LEVEL_2
: Not a level 2 process.

STATUS_$OK
: Successful completion.

RWS

DATA TYPES

RWS_$POOL_T

A 2-byte integer. Types of pools to allocate read/write or heap storage. One of the following pre-defined values:

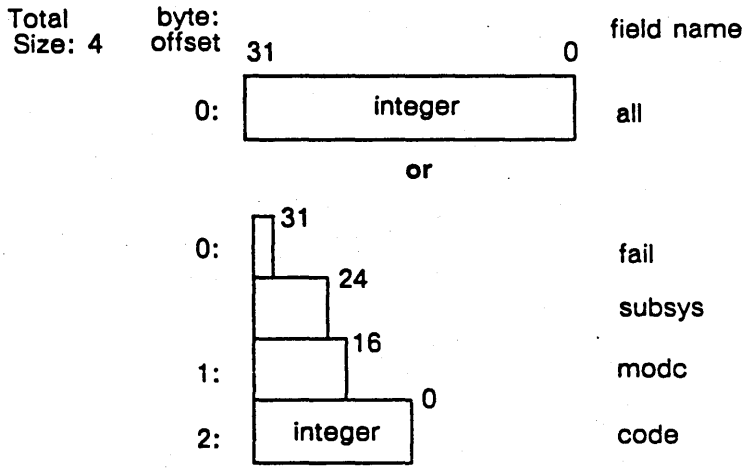
RWS_$STD_POOL
Standard pool makes storage accessible to calling process only.

RWS_$STREAM_TM_POOL
Stream pool makes storage accessible to calling program and to a program invoked with the UNIX EXEC system call.

RWS_$GLOBAL_POOL
Global pool makes storage accessible to all processes.

STATUS_$T

A status code. The diagram below illustrates the STATUS_$T data type:



Field Description:

ALL
All 32 bits in the status code.

FAIL
The fail bit. If this bit is set, the error was not within the scope of the module invoked, but occurred within a lower-level module (bit 31).

SUBSYS
The subsystem that encountered the error (bits 24 - 30).

MODC
The module that encountered the error (bits 16 - 23).

CODE
A signed number that identifies the type of error that occurred (bits 0 - 15).

UNIV_PTR — A 4-byte integer. A pointer to allocated storage.

RWS_$ALLOC

Allocates read/write storage for FORTRAN or Pascal programs.

FORMAT

```
RWS_$ALLOC (nbytes, pointer)
```

INPUT PARAMETERS

nbytes
The number of bytes of storage needed. This is a 4-byte integer.

OUTPUT PARAMETERS

pointer
The address of the new storage space, in UNIV_PTR format. This is a 4-byte integer. A returned address of zero means that RWS_$ALLOC could not allocate the desired storage.

USAGE

RWS_$ALLOC allocates the specified number of bytes of read/write storage to the calling process and returns the address of the storage area.

This routine is useful for allocating different quantities of dynamic storage, depending on a run-time factor.

RWS_$ALLOC_HEAP

Allocates heap storage for programs.

FORMAT

```
pointer = RWS_$ALLOC_HEAP (nbytes)
```

RETURN VALUE

pointer
The address of the new storage space, in UNIV_PTR format. This is a 4-byte integer. A returned address of zero means that RWS_$ALLOC_HEAP could not allocate the desired storage.

INPUT PARAMETERS

nbytes
The number of bytes of storage needed. This is a 4-byte integer.

USAGE

RWS_$ALLOC_HEAP allocates the specified number of bytes of read/write storage to the calling process and returns the address of the storage area.

This routine is useful for allocating different quantities of dynamic storage, depending on a run-time factor.

RWS_$ALLOC_HEAP_POOL

Allocates heap storage in a specified pool.

FORMAT

```
pointer  = RWS_$ALLOC_HEAP_POOL(alloc_pool, nbytes )
```

RETURN VALUE

pointer
The address of the new storage space, in UNIV_PTR format. This is a 4-byte integer. A returned address of zero (NIL) means that RWS_$ALLOC_HEAP_POOL could not allocate the desired storage.

INPUT PARAMETERS

alloc_pool
Pool where storage will be allocated, in RWS_$POOL_T format. This is a 2-byte integer. Specify one of the following following predefined values:

RWS_$GLOBAL_POOL
Global pool makes storage accessible to all processes.

RWS_$STD_POOL
Standard pool makes storage accessible to calling program only.

RWS_$STREAM_TM_POOL
Stream pool makes storage accessible to calling program and to a program invoked with a UNIX EXEC system call.

nbytes
Number of bytes of storage needed. This is a 4-byte integer.

USAGE

RWS_$ALLOC_HEAP_POOL allocates a specified number of bytes of heap storage to the calling process and returns the address of the storage area.

Use this call when you want to control storage access. You can specify that the storage be accessed by the calling process only, by the calling program and a program invoked with a UNIX EXEC system call, or by all programs.

Due to a current limitation, you cannot use this call in FORTRAN programs due to FORTRAN calling conventions. This will be corrected in the next AEGIS Software Release.

RWS_$ALLOC_RW

Allocates read/write storage for Pascal programs.

FORMAT

```
pointer = RWS_$ALLOC_RW (nbytes)
```

RETURN VALUE

pointer
The address of the new storage space, in UNIV_PTR format This is a 4-byte integer. A returned address of zero means that RWS_$ALLOC_RW could not allocate the desired storage.

INPUT PARAMETERS

nbytes
The number of bytes of storage needed. This is a 4-byte integer.

USAGE

RWS_$ALLOC_RW allocates the specified number of bytes of read/write storage to the calling process and returns the address of the storage area.

This routine is useful for allocating different quantities of dynamic storage, depending on a run-time factor.

RWS_$ALLOC_RW_POOL

Allocates read/write storage in a specified pool.

FORMAT

```
pointer  = RWS_$ALLOC_RW_POOL(alloc_pool, nbytes )
```

RETURN VALUE

pointer
The address of the new storage space, in UNIV_PTR format. This is a 4-byte integer. A returned address of zero (NIL) means that RWS_$ALLOC_RW_POOL could not allocate the desired storage.

INPUT PARAMETERS

alloc_pool
Pool where storage will be allocated, in RWS_$POOL_T format. This is a 2-byte integer. Specify one of the following following predefined values:

RWS_$GLOBAL_POOL
: Global pool makes storage accessible to all processes.

RWS_$STD_POOL
: Standard pool makes storage accessible to calling program only.

RWS_$STREAM_TM_POOL
: Stream pool makes storage accessible to calling program and to a program invoked with a UNIX EXEC system call.

nbytes
Number of bytes of storage needed. This is a 4-byte integer.

USAGE

RWS_$ALLOC_RW_POOL allocates a specified number of bytes of read/write storage to the calling process and returns the address of the storage area.

Use this call when you want to control storage access. You can specify that the storage be accessed by the calling process only, by the calling program and a program invoked with a UNIX EXEC system call, or by all programs.

Due to a current limitation, you cannot use this call in FORTRAN programs due to FORTRAN calling conventions. This will be corrected in the next AEGIS Software Release.

RWS_$RELEASE_HEAP

Releases storage allocated using the RWS_$ALLOC_HEAP call.

FORMAT

```
RWS_$RELEASE_HEAP
```

INPUT PARAMETERS

pointer
The address heap storage space, in UNIV_PTR format. This is a 4-byte integer.

This must be a pointer returned by a call to RWS_$ALLOC_HEAP.

OUTPUT PARAMETERS

status
Completion status, in STATUS_$T format. This data type is 4 bytes long. See the RWS Data Types section for more information.

USAGE

RWS_$RELEASE_HEAP is used in conjunction with the RWS_$ALLOC_HEAP call. RWS_$ALLOC_HEAP dynamically allocates storage for a program, returning a pointer to the new storage. When you no longer need the storage, you release it by passing the pointer to RWS_$RELEASE_HEAP.

ERRORS

RWS_$LEVEL_FAILURE
: User program wrote over the storage where the system stored the program level information.

RWS_$NOT_HEAP_ENTRY
: Argument to RWS_$RELEASE_HEAP did not refer to storage allocated with RWS_$ALLOC_HEAP.

RWS_$SCRIBBLED_OVER
: User program wrote over the storage where the system stored the heap's process information.

RWS_$WRONG_LEVEL
: Attempted to release storage that was allocated by a program at a superior (lower) program level. This error can occur when using RWS_$STD_POOL or RWS_$STREAM_TM_POOL.

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