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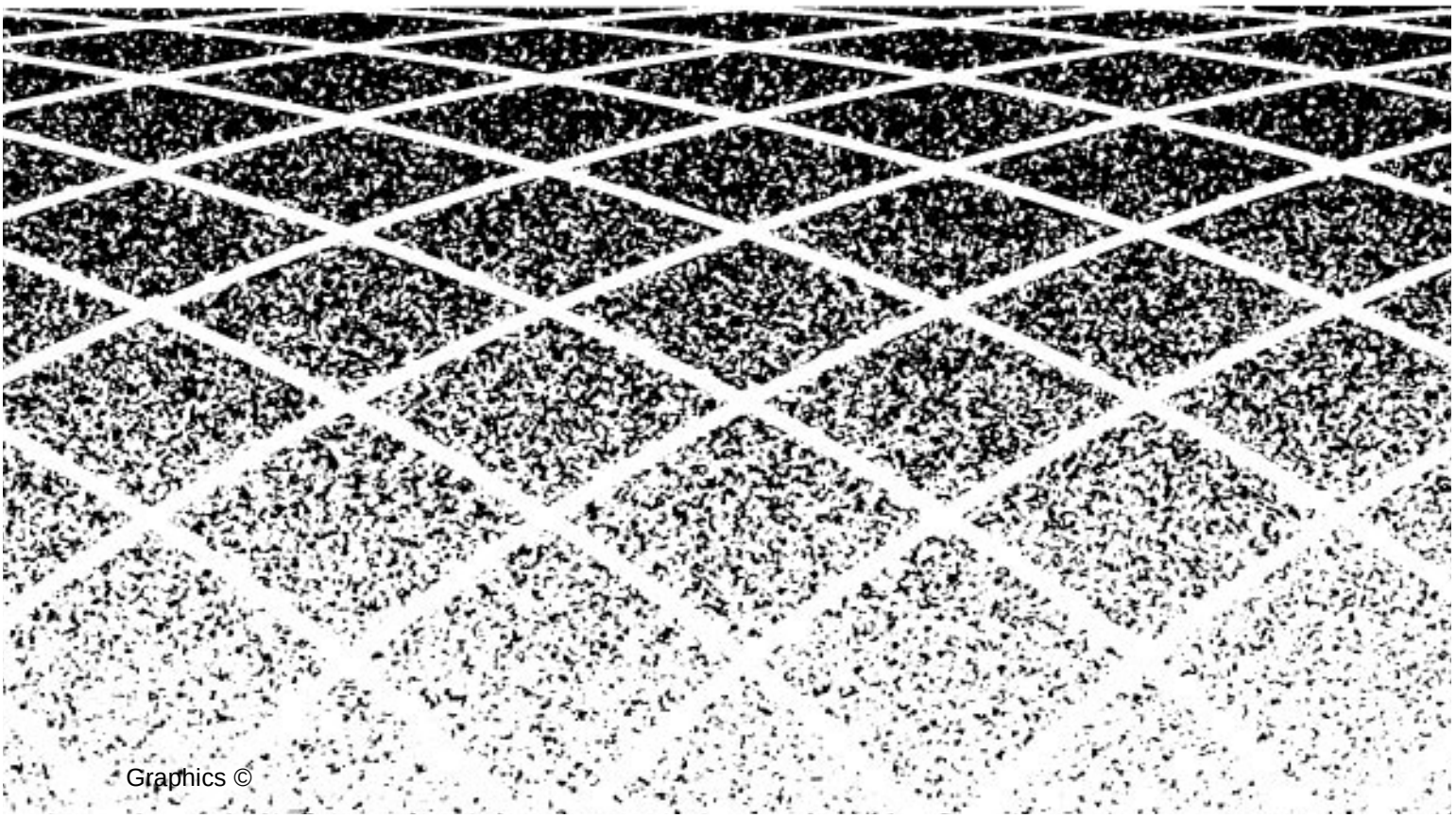
Conversant VIS
Application Development



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About This Book

Purpose

This book is a reference for people who develop applications for the VIS using the TSM script level language and/or C language. It provides information about designing software applications, processing speech, and writing programs that integrate the application software and generic software. Use this book by itself or in conjunction with the *CONVERSANT VIS Version 4.0 Script Builder User Guide,* 585-350-704.

How to Use This Book

The three activities you must complete for each application are:

- Design the application (Chapter 1, "Application Design", and Chapter 2, "Development Guidelines").
- Prepare the speech data that will be stored on disk (Chapter 3, "Speech Data").
- Write the application programs (Chapter 4, "Script Instructions", Chapter 5, "Data Interface Process", and Chapter 6, "Adding and Modifying System Messages"). Every application requires a “script.” The VIS uses a proprietary script language (described in Chapter 4, "Script Instructions") to specify this application control logic. In addition, a data interface process (DIP), described in Chapter 5, "Data Interface Process", allows the script to communicate with a C language process for host and/or database access.

Trademarks Used in this Book

- CONVERSANT® is a registered trademark of AT&T.
- UNIX® is a registered trademark of UNIX Systems Laboratories, Inc.
- i486™ is a trademark of the Microsoft Corporation.
- X Windows™ is a trademark of the Massachusetts Institute of Technology.
- Metro Link X® is a registered trademark of Metro Link Corporation.
- Auidio Works Station™ is a trademark of Bitworks® Inc.

How This Book is Organized

The following is a brief description of the contents of each chapter of this guide.

- Chapter 1, "Application Design", provides a general understanding of the human factors as well as the hardware factors you must consider when designing an application. Chapter 1 also lists the steps involved in designing an application before you begin to process the speech data and write the script instructions.
- Chapter 2, "Development Guidelines", provides an outline of the directory structure and naming conventions you should use when developing application programs.
- Chapter 3, "Speech Data", explains how to write a script, how to record speech, as well as, how the system processes recorded speech for disk storage, then digitizes and compacts the recorded speech with a coding algorithm.
- Chapter 4, "Script Instructions", explains the transaction state machine (TSM) process, the script conventions, the instructions used by a script, and the application-dependent functions that you can use in a script.
- Chapter 5, "Data Interface Process", explaining the data interface process (DIP) interfaces between the TSM and a host or local database. This chapter describes both hard-coded and dynamic DIPs.
- Chapter 6, "Adding and Modifying System Messages", describes how to add or change system messages and it associated explain text.
- Chapter 7, "Upgrade Considerations", describes the procedures to upgrade an existing VIS environment to the Version 3.1 environment to utilize logging capabilities.
- Chapter 8, "Using Speech Editing Systems", describes the use of third party Speech Editing Systems with applications running on the CONVERSANT Voice Information System Version 4.0.

- Chapter 9, "Application Example", provides a complete example of the application-dependent code and the files that an applications programmer must develop for any speech application.
- Appendix A, "Summary of Script Instructions", contains manual pages for each script instruction, including the syntax, arguments, and examples.
- Appendix B, "Voice System C-Library Functions", contains manual pages for the voice system C-library functions.

This book also includes a cross-referenced index.

Conventions Use in This Book

The following typographic conventions are used in this book:

- The word enter means to type a value and press (ENTER). For example, an instruction to type **y** and press (ENTER) is shown as

  Enter **y** to continue.

- The word select is used to mean the following: move to the desired menu item using the arrow keys and press (ENTER).
- Terminal keys are shown in rounded boxes. For example, an instruction to press the enter key is shown as

  Press (ENTER).

- Function keys (also known as “soft” keys) are shown in rounded boxes followed by the actual name of the key on the keyboard in parentheses. For example, an instruction to press the choices key is shown as

  Press (CHOICES) (F3).

- Two or three keys that you press at the same time (that is, you hold down the first key while pressing the second and/or third key) are shown as a series of rounded boxes. For example, an instruction to press and hold (ALT) while typing the letter d is shown as

  Press (ALT) (D).

- Information that is displayed on your terminal screen — including screen displays and error messages — is shown in typewriter-style constant-width type; `for example`

  Installation is in progress -- do not remove the floppy disk.

- Information that you enter from your terminal keyboard is shown in bold type, for example

  Enter **root** at the Console Login `prompt.`

- Command and file names and their parameters are shown in bold type. Variable parameters are shown in *bold italic* type when they are part of a user input and in *regular italic* type when they are not. All are illustrated in the following example:

  Use the **print** command to print your report. The command syntax is **print *reportname***, where *reportname* is the name of the report to be printed.

Related Resources

The following books should be used in conjunction with this book:

- *CONVERSANT VIS Version 4.0 Command Reference,* 585-350-209
- *CONVERSANT VIS Script Builder User Guide,* 585-350-704

A full description of the CONVERSANT VIS library is available in the *CONVERSANT VIS Documentation Guide,* 585-350-002.

How to Comment on This Book

A reader comment card is located behind the title page of this book. While we have tried to make this book fit your needs, we are interested in any suggestions for improving it and urge you to complete and return a reader comment card.

If the reader comment card has been removed from this book, please send your comments to:

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Application Design

1

What's in This Chapter

This chapter describes, in general terms, points to consider when developing an application. Specific procedures for developing application programs are covered later in Chapters 4 through 6.

The first part of this chapter discusses issues involving the capabilities and limitations of the user and the VIS. The second part of this chapter recommends steps for application development.

Designing a Successful Application

A successful application meets the following three criteria:

- The end user can easily access and use the service offered.
- The information provided for the end user is adequate.
- The connect time for each telephone call accessing the application is minimized.

To design an application to meet these criteria, you must consider the overall system including: the CONVERSANT Voice Information System (VIS), the end user, and the data source (which may be a separate host computer).

End User Capabilities

Consider the following when developing your application for the end user:

- Short-term human memory
- Information processing

Short-Term Human Memory

Study results of short-term memory indicate the following:

- Limit the number of items a person is to remember to four.

  Write the dialog so the user is given a maximum of four items to remember (for example, menu choices).

- Group items of more than four into "chunks" of four.

  For example, group the number string 464764 into two, three-digit items as 464 and 764. This makes it easier for the user to remember a total of six digits.

- Place actions as close to the end of a spoken instruction as possible. For example:

  Dial 431 to hear more about this special offer.
  To hear more about this special offer, dial 431.

  The first phrase is more difficult for a user to remember than the second, because the call to action is in the first part of the sentence. The second example is much easier to remember, because the call to action is at the end of the sentence.

Human short-term memory is susceptible to forgetfulness through interference. After an item, such as a menu number, is set in short-term memory, its likelihood of being forgotten increases as more auditory information is input.

Information Processing

The end user has a finite capacity to understand and to act on what is said by the VIS. When the end user is forced to spend more time trying to understand what is said, less information is remembered.

A well-designed transaction should have dialog that is intelligible to the user at the individual word level and at the phrase level.

Natural rhythm and intonation help user understanding of the concatenated speech produced by the system. During the recording of speech, it is important that the professional speaker maintains consistent rhythm and intonation throughout the recording session (details in Chapter 3, "Speech Data").

Make full use of the script instructions **tnum** and **tchar** to control the intonation of spoken numbers and letter/digit strings (described in Chapter 4, "Script Instructions"). Monitor the intelligibility of phrases as the application is developed.

Voice System Capabilities

The VIS is controlled by the transaction state machine (TSM) program (a UNIX system process) when it talks to end users and supplies the requested information. TSM reads the instructions written for a particular application (see Chapter 4, "Script Instructions").

The system capabilities that you must consider when designing an application are:

- Easily understood speech
- Recognition of touch-tone signals and spoken input

Easily Understood Speech

The end user hears speech as individual phrases that are spoken by the system. Processing speed eliminates any perceptible interval between the end of one phrase and the start of the next. As a result, individual phrases can be combined to form a complete sentence to be played to an end user. However, there are two problem areas to be aware of when combining phrases:

- Pitch and prosody (rhythm)
- Prosody

Pitch and Prosody

Even if the same speaker is used to record a set of phrases, if there is a wide variation in the average pitch among individual phrases, then the concatenated phrases are difficult for the end user to process and remember. Variation in prosody (rhythm and emphasis) between different phrases also disturbs the listener.

During recording of the phrases, make sure the speaker maintains a steady pitch and rhythm; otherwise, concatenated phrases, such as those used in constructing strings of digits like telephone numbers, will sound stilted and artificial (see Chapter 3, "Speech Data").

Prosody

Typically when “raw” phrase files are edited (see Chapter 3, "Speech Data"), silence is trimmed from the beginning and end of each phrase. When the resulting phrases are concatenated, the natural pause between the two is eliminated and

the combined phrases can sound unnatural at the juncture point. This effect can be remedied by inserting silences or pauses of various durations where needed between concatenated phrases.

Rhythm and prosody are of special concern when the Text-to-Speech (TTS) feature is used. For further information on TTS, refer to *CONVERSANT VIS Text-to-Speech,* 585-350-807.

Issues with Touch-Tone and Speech Recognition

As a receiver for the end user's input, the VIS accepts touch-tone input or speech. Touch-tone input is relatively straightforward: at a point in the transaction where the end user is to enter touch tones, the system listens (subject to time-out parameters described in Chapter 4, "Script Instructions") for a specified number of individual touch tones. The VIS can identify touch tones as accurately as the end user can input them.

Issues to consider include type-ahead or touch-tone flushing capabilities.

Speech input is more complicated. Examples of considerations with speech input are:

- How the application should detect and correct errors
- How to define informative prompts for speech recognition
- How to recognize normal speaking habits that may cause problems (for example, "1040" may be spoken "ten-forty")
- Whether to allow "barge-in" (interrupting the prompt with speech)
- How to avoid long strings that decrease the chance of correct speech recognition For more information on speech recognition, refer to *CONVERSANT VIS Whole Word Speech Recognition,* 585-350-813.

System Interface with Host

You may need to define the interface between the VIS and a host computer. The definitions made at this point are used in designing the application and the logic for the data interface process (DIP) code (see Chapter 5, "Data Interface Process"). Before defining the host interface, answer the following questions:

- Is communication with a host needed?
- Are "I-am-alive"/host-check messages needed?
- Is data to be sent to or from the host as a batch job or on an as-needed basis or both?
- What type of database information is needed and how often it is needed?

- Will the VIS respond to host inquiries/requests or will it only initiate communications?
- How should the VIS respond if the host does not respond?
- How are the VIS local databases initialized?
- What should the VIS communicate to the host (if anything) when a new call comes in (maybe send a startup message to the host)?
- What should the VIS do when it reboots?
- What should the VIS do when the host computer reboots?
- How much data is passed to/from the host computer at any time?

Determine Functional Data Requirements

The first step in writing the application is to determine the functional data that is to pass between the system and the end user. The second step is to determine the responses that the end user hears during the transaction.

To develop an application with efficient transactions, it is important to have a clear statement of the functional data that is to pass between the system and the end user and possibly a host computer. To ensure that the functional data requirements are complete and well-defined, this should be a joint effort between the developer, who knows the system capabilities, and the client, who knows the needs of the end user.

Requirements can be determined in many ways. One effective approach is to view the transaction as an exchange of information between the end user and the VIS. This approach facilitates integration of dialog with the overall application development.

Develop Dialog

For information on developing scripts and prompts, refer to "Tips for Writing A Script" section in Chapter 3, "Speech Data".

For each point in the dialog where a data transfer occurs, the dialog script must be expanded to account for all conceivable error states that might result. (The most time-consuming part of script development is trying to account for all error conditions, determine all potential causes, and then write dialog to cover these potential problems.)

Insert Hidden Housekeeping Routines

Housekeeping routines, such as counting, timing, etc, can be inserted as needed to count numbers of attempts made to access certain information objects, to record time required for database accesses, etc. These values may be stored in event memory (Chapter 4, "Script Instructions") and, at the termination of a call, are passed to the call data handler (CDH).

Test and Review Transaction

When the transaction program and its supporting routines have been written, the system should be tested, first with the client, and then with representative end users. There also should be a load test during which the maximum number of callers access the application simultaneously. The objectives of this testing include verifying the transaction's operation and evaluating end users' acceptance. You must be prepared to revise the script based on feedback from testing until the transaction is judged to be acceptable from the end user's point of view.

Development Guidelines

2

What's in This Chapter

This chapter discusses the guidelines for developing application programs for the CONVERSANT Voice Information System (VIS). The chapter provides a list of the basic tools that are available with the VIS, with guidelines to help you:

- Develop speech files and application programs
- Organize files
- Establish naming conventions for files
- Develop a coding style that is easy to maintain

Application Programs

After you have documented the functional data requirements and the system responses, you are ready to begin working on the application programs. This work may begin even before the speech has been processed for access by the script.

Two programs must be developed for each application as described below.

- Script

  A script functions as a set of instructions used by the transaction state machine process to run the application.

- Data Interface Process (DIP)

  A data interface process (DIP) performs operations not easily performed in script instructions, such as extensive calculations or interfacing to an asynchronous host. You must write a DIP module in C-language. This requires an understanding of the UNIX operating system as well as C-language. Refer to Chapter 5, "Data Interface Process", for more information on writing a DIP.

You can write a script using Script Builder or the script language described in Chapter 4, "Script Instructions". The Script Builder standard features are sufficient to support most applications.

If you find that you need capabilities not supported by Script Builder, you can write an external function using script language that is accessed by the Script Builder-generated application. For more information on writing external functions, refer to Chapter 10, “Using Advanced Features,” of *CONVERSANT VIS Version 4.0 Script Builder,* 585-350-704. If the external functions do not provide the capability required or if the application must access a database or perform complex calculations, you may write a DIP to perform these actions.

Application Development Tools

The standard set of tools available for the application developer include UNIX operating system tools, file processing programs tools, and debugging tools.

Using Application Development Tools — Scenario

Figure 2-1 illustrates the typical steps in developing an application, specifically what tools to use at each step.

Figure 2-1. Using Application Development Tools — Example

Application Development Tools — Description

These tools are described in detail in *CONVERSANT VIS Version 4.0 Command Reference,* 585-350-209. Some of these tools also are discussed in other chapters of this book or in other books. In these cases, the other sections or books are noted.

— The **audit** command verifies the format of the speech file systems.

— The **buildfs** command initializes an empty speech file system.

— The **3270_cfg** (3270 configuration) shell script translates an ASCII configuration file into the binary configuration file.

It then loads the executable program and binary configuration files onto one serial I/O board in the VIS. For more information, refer to Appendix D, “Information for Advanced Users,” of *CONVERSANT VIS Version 4.0 Operations,* 585-350-701.

— The **host_cfg** command translates the data in the appropriate ASCII configuration file into the format needed by the serial I/O board and writes the data to the appropriate binary configuration file. For more information, refer to Appendix D, “Information for Advanced Users,” of *CONVERSANT VIS Version 4.0 Operations,* 585-350-703.

— The **load_bin** — The host load command loads the executable program and binary configuration files onto one serial I/O board.

For more information, refer to Appendix D, “Information for Advanced Users,” of *CONVERSANT VIS Version 4.0 Operations,* 585-350-703.

— The **mkheader** command helps to define memory used by the TSM script (Chapter 4, "Script Instructions"). This program creates the **application_name_aloc.c** program and the **application_namedef.h** file.

— The **newscript** command updates changes to all currently assigned scripts. If you write an application using script language and use tas to assemble that script, you must use newscript to insure that the most recent version of the script is used. If you develop the application using Script Builder, it is not necessary to use newscript because Script Builder automatically executes this command.

— The **soft_szr** command starts a script on a channel independent of an incoming call. If the scriptname is given a null string, TSM starts the script that is assigned to the channel specified in the software seizure request.

— The transaction assembler (**tas**) program accepts a file in script source code and produces a TSM executable file (Chapter 4, "Script Instructions").

— The **vdf** utility displays the number of disk blocks remaining in each speech file system.

— The **virtual_szr** command starts a script on a virtual channel.

Application Tracing Tools

The **trace** command activates a “trace,” or monitor process, on specific DIPs and/or channels. In order for trace to be useful, however, you must place trace script instructions in the script and trace subroutines in the DIP.

The **trace** script instruction prints variables and status messages while the script is running and stores them in a buffer. The trace command displays this information.

From a DIP process, you can use four subroutines to trace either a DIP or a specific channel to determine if there are problems with the application and, if there are any, where the problems are located. These processes are provided in the system library (**/vs/lib/libspp.a**). The output of these subroutines can be viewed using the trace command. Refer to Chapter 5, "Data Interface Process", for additional information.

The four subroutines that enable tracing are:

— **db_init** (whoami) — Called once for set up. Whoami is the message origin name (for example, DIP0 and DIP2, which are defined in /mesg.h)

db_put (str) — An unconditional send of the character string.

— **db_pr** (format, a1, a2, a3, a4,a5, a6) — A conditional send used to pass information to the tracing file only for tracing the calling process.

— **db_ch** (chan, format, a1, a2, a3, a4, a5, a6) — Another conditional send used only if someone is tracing the identified channel.

For more information about the trace script instruction, refer to Appendix A, "Summary of Script Instructions".

File System Organization

Directory Structure

The standard VIS large capacity fixed disk is divided into common file systems called **root** and **usr**. An optional third file system, **usr2**, can be added during software installation.

Root has many directories, such as **/bin**, **/dev**, and **/etc**, that are created and populated by the UNIX system software. Other directories are created and used by the VIS software. Figure 2-2 shows all of the directories under root, as they might be delivered from AT&T or a Voice Processing Co-marketer (VPC). The UNIX system directories are described in detail in the *UNIX System V/386 Programmer's Guide*. The VIS-specific directories are listed and described immediately following Figure 2-2.

NOTE:
The **/usr/var** directory shown in Figure 2-2 is not supplied with the VIS software. However, it illustrates how a VPC might structure this directory.

Figure 2-2. VIS File System

Directory Usage Precautions

You should take the following precautions when using the directories:

1. Backup excess or repetitive files to floppy disks, then delete them from the root file system when root space becomes low. If root runs out of space, the software could malfunction.
2. Backup files periodically. This ensures that if the files are damaged, you can recover the data.
3. Remove temporary files or copy these files to diskettes to maintain or create free space within a directory that has run out of free space. Maintain or create free space within the directories with application software by periodically removing temporary files or copying these files to diskettes.

Conventions for Naming Files and Programs

To make files easy to identify and to meet the requirements of the C compiler, the VIS uses naming conventions for the files and programs. Most of the naming conventions consist of prefixes and suffixes that make the programs and files easy to classify into a group or type. The application name is often part of the name of the file or the program. All the following files and programs in bold are provided by the application developer.

File/Program	Description
name.c	This identifies a C-language source program. For example, **hostmeas.c** or **msg1hdlr.c**
name.o	This is a compiled C-program in which external references are not resolved. For example, **hostmeas.o** or **msg1hdlr.o**
name.h	This is a header file that contains structures and identifier definitions that do not require space allocation. This allows separately developed modules to use the same header files without repeating header file references in several places. For example, **et.h** or **hwrtype.h**
DIP*N*	Each DIP is referenced by the name DIP*N* where ***N*** is a number or a word. Refer to Chapter 5, "Data Interface Process", for more information on DIPs. For example, **DIP0** or **DIP_tes**t

File/Program	Description
application_name.t	This is the script source file for application_name. For example, **stock.t** .sp
application_name.T	This is a script that has been processed by using the tas command with *application_name*.t as an argument. For example, **stock.T**
application_namedef.h	This header file defines the application-dependent user memory for the TSM. The file is produced by running the associated executable version of *application_name*_aloc.c or by using the mkheader command. For example, **stockdef.h**
*application_name*_aloc.c	This application-dependent program allocates user memory for the database structures in the script. The script uses the structures as temporary work spaces and for communicating with the internal data processes. When the program is executed, it produces the header file *application*_name**def.h**. This header file defines the addresses of variables used by TSM. The **mkheader** command is used in creating and executing this program. For example, **stock_aloc.c**
application_name.D	This file contains descriptions of application variables that normally are used as event counters. For example, **stock.D**

File/Program	Description
infile.*application-name*	This file is created by the speech file developer. It lists each coded speech file and the associated ASCII phrase by which the files are identified by the script (when Script Builder is not used). For example, **infile.stock**
list.*application-name*	This file is created by the numasgn command (when Script Builder is not used). It consists of the infile.*application-name* file plus the talk file number, an application identifying string, and phrase numbers. The list.*application-name* is given as the argument of the script tfile( ) instruction (Chapter 4, "Script Instructions"). For example, **list.stock**
application_name.pl	This is the talkfile created by Script Builder.

Coding Style

Establishing a consistent coding style makes the programs and scripts readable by other developers and makes debugging and maintaining them easier and quicker. Recommendations are made here concerning define statements, labels, inline comments, and goto instructions.

Define Statements

Define statements used in naming addresses and numerical data make the program more understandable by explaining a value. For example, referring to the value -10 as MISTAKE is easier to interpret and understand:

```
#define MISTAKE ( -10) /* 1 of 15 values returned by getname */
.
.
.
jmp(r.3==im.MISTAKE, CORRECT)
```

Define statements can be put in the header files and included in the program by using C-language #include statements, which link the definitions to the program code during assembly or compilation. A define should be used only once for the same memory location. By convention, defines are in uppercase letters. They may have underscores (_) but no embedded spaces.

One file with a set of defines can be used for both the script and a DIP. This insures consistency within an application and makes it easier to change the defines.

NOTE:
If your script contains a large number of define statements, the transaction assembler (TAS) may report messages such as the following during compilation:

script.t: 1068: too much defining

where *script.t* is the script source file and *1068* is the line in which the define appears. The limit to the number of define statements that a script may have depends on the number of defined macros and their size. If this type of message appears, reduce the number of define statements in your script.

Script Labels

A label is a C-style identifier followed by a colon. It marks the instructions that follow it. By convention, labels for major blocks of code are in uppercase letters. Labels for subordinate blocks of code are in lowercase letters. In script source, a label must be on a line by itself; that is, no script statements should appear on the same line as the label.

Some examples of labels are:

```
GREET:
talk("hello")
rts( )

GET_ID:
/* COMMENTS */
jmp( r.3 == im.0, strt_idloop )
...

strt_idloop:
getdig(0, ch.DG, 9 )
...
rts( )
```

The uppercase labels *GREET* and *GET_ID* identify major blocks of code or subroutines. The lowercase label, *strt_idloop*, identifies a block of code under the main subroutine GET_ID.

Inline Comments

Inline comments either should precede or be to the right of those lines of code where an explanation would be useful. For example, an appropriate comment for a goto command or a subroutine call might be “cleanup routine” or “send voice response” to reflect the destination. Or, using the example given above for script labels, the comments for the GET_ID subroutine might be:

```
GET_ID:
/* This subroutine collects digits from the caller */
jmp( r.3 == im.0, strt_idloop )
...
```

Speech Data

3

What's in This Chapter

This chapter describes the procedures for processing speech data, from determining the transaction and planning the script to recording and encoding the speech. If you use the CONVERSANT Script Builder to generate your application, refer to Chapter 8, "Producing Speech," of *CONVERSANT VIS Version 4.0 Script Builder,* 585-350-704 for more information.

Defining Speech Data Processing

The purpose of speech data processing is to create a set of encoded speech files. The content of each speech file is a single phrase that is spoken at some point in an application dialog. A speech file, or phrase, may consist of a full sentence, a single word, a specified period of silence, or even a tone signal specific to an application. You determine the phrase content based on the application requirements.

During a call, the individual speech phrases specified by the script instructions are downloaded by the VIS to a tip/ring (T/R) card or signal processing (SP) card. The TR/SP synthesizes these individual phrases and concatenates them so that they sound human to the caller.

Speech Terminology

The following list defines similar terms used throughout this chapter. Please review this list of terms and their definitions before continuing.

- **Speech file** or **phrase** — Encoded speech stored on the hard disk in a special speech file system. This speech file system usually is designated as usr2, unmounted, and accessed as a raw slice. Each speech file contains one phrase.

  Speech files, or phrases, each have an assigned number. The phrase numbers 11000 are reserved for the standard speech included with each VIS. Any phrases you add are automatically assigned numbers beginning with 1001.

- **Talkfile** — Speech phrases stored in groups. Each talkfile may contain up to 65535 speech phrases. A system may have up to 16384 talkfiles. The talkfile number and speech phrase number together uniquely identify a speech phrase.

- **List file** — An ASCII file that maps phrase strings used in the scripts to actual speech phrase numbers.This file also identifies the talkfile. Normally, each script is associated with one list file.

Speech File System

The speech file system is organized in 16-Kbyte blocks. This organization allows for efficient and fast retrieval of speech files. However, you should keep in mind that each phrase requires at least one block. For small phrases, such as digits and letters, the disk storage is used somewhat inefficiently.

Supplying an application with a complete set of standard phrases can require up to five Mbytes or more of disk storage. Keep this in mind when you consider the disk requirements of an application.

Processing Recorded Speech

Processing recorded speech so that it can be stored on disk involves a number of steps. The following steps are recommended for processing speech data:

- Determine the transactions (refer to Chapter 1, "Application Design").
- Plan the script.
- Hire a professional speaker.
- Plan a recording session.
- Record spoken phrases on magnetic tape.

- Encode and digitize the phrases using Script Builder or send the recorded phrases to AT&T to be digitized. The recorded phrases are input from a reel-to-reel tape recorder, amplifier and microphone, or from a user over a telephone line. The encoded phrases are digitized, then stored as digital data. These digitized, encoded phrases are also called speech files. The system assigns a phrase number to each phrase.

Speech can be digitized in one of two ways: by using the Script Builder speech administration capability or by sending recorded phrases to AT&T. If you use Script Builder to record phrases, they are encoded automatically. For more information about Script Builder's speech administration capabilities, refer to Chapter 8, "Producing Speech," of *CONVERSANT VIS Version 4.0 Script Builder,* 585-350-704. For more information about sending speech to AT&T to be digitized, contact your AT&T account representative. Regardless of the method you use, the information about planning and recording the phrases included in this chapter is helpful.

The digitized phrases of compressed data are encoded using one of the following rates:

- Pulse Code Modulation (PCM) at 64 kbits per second (kps)
- SubBand Coding (SBC) at 16 kps
- SBC at 24 kps
- Adaptive Differential Pulse Code Modulation (ADPCM) at 16 kps
- ADPCM at 32 kps (the rate used in Script Builder)

Processing of speech data for an application may be done concurrent with application development. For example, one group of developers can write the script (refer to Chapter 4, "Script Instructions"), while another group writes the data interface process (Chapter 5, "Data Interface Process"). The only requirement is that the digitized speech must be loaded on the system before the script can be assembled.

Determining Transactions

Before recording can begin, transactions for the application should be designed. Transaction development is described in Chapter 1, "Application Design".

Planning the Script

Write a script, with the exact phrases to be recorded, based on the transactions. A professional speaker uses this script to record the phrases.

Write out every word that you expect to be spoken. Edit the script to change any poorly written or repetitive phrases.

Separate the phrases that will be used from the “frame” phrases. "Frame" phrases are used as a framework for certain words or numbers during recording. You can place quotation marks (“ ”) around all phrases that will be used that are not frame. Any frame words are outside the quotation marks. (Framing is described in detail later in this chapter.)

If script changes are made during recording, ensure that the changes are written into the script.

Track the contents of the script by using phrase numbers. Number each phrase in the written script.

You should follow these general guidelines when you are writing a script:

1. Make all commands short in duration and easy to understand. Users tend to remember only the ends of utterances, so place the call-to-action at the end of a phrase. For example:

   “At the tone, press one.”

2. Review your interactive script to see if the prompts and responses make sense.
3. Make prompts clear, but courteous. Remember to welcome users to your company and the system and to thank them at the end.
4. Try to use vocabulary that is literate, but not beyond the scope of your users. Do not use computer terminology unless it is familiar to all your users.
5. Two types of phrases should be used:
   a. Long phrases that stand alone:

      “Welcome to the CONVERSANT VIS order entry system.”

   b. Short phrases that you plan to concatenate:

      Today is “Wednesday.”

      Typically short phrases are days of the week, months of the year, and ordinal and cardinal numbers.

Tips for Writing A Script

Long phrases are easier to write for a recording because they stand alone. However, try to write in simple English that is not too specialized.

Avoid a long string of adjectives. For example, the following is a “bad” example:

“Check the right front brake drum pads.”

Short phrases that you plan to concatenate must be recorded carefully. You need to anticipate the environment in which these phrases will be used; that is, whether the phrase will be used at the beginning of a sentence, in the middle of the sentence, or at the end of a sentence. The following example shows two uses of the word “enter.”

“Enter the pound sign.”

“Please press enter.”

You may plan to use the word enter as one phrase, but, as you can see, you need two “takes,” or recordings, of this phrase (one phrase with initial emphasis and one with final emphasis).

In writing the script for your professional speaker, prepare a document that produces the best takes possible. Mark the target phrases in a way that is easy for the actor to recognize. Placing quotation marks around the important phrases is helpful. This is called *framing*.

For example, to get the right takes in the sentences above, you need to write your script as follows so the speaker concentrates on the word “enter:”

“Enter” the pound sign.

Please press “enter.”

The following is advice on writing frames:

1. If possible, use words preceding and following those important words or phrases. If you ask an actor to read a sentence that does not make sense, the emphasis on the words may be distorted.

   For example, if you want a good take on the word “and,” record the word in the following frame:

   Salt “and” pepper.

   Bread “and” butter.

The words that frame “and” can be removed later since they are not needed. These frame words are important, though, because they enable a speaker to speak the word “and” quickly which helps to concatenate it properly.

2. Remember that human speech is a continuous, uninterrupted signal. Therefore, do not assume that you can remove a word from one phrase and place that same word in another phrase that is being recorded for a different use. Consequently, individual words that you plan to concatenate must be carefully recorded with the proper intonations and sounds framing them.

3. As well as intonation, there are certain speech sounds that you need to consider when placing words together in a phrase. Words which end with the /r/ or /l/ sounds do not make good framing words because those sounds carry over to the next word.

   For example the following would be a bad frame to obtain a good take on the word “eight.”

   December “eight”

   “December” is bad because it ends in an /r/ sound (this affects the vowel quality of the “eight”).

   A better frame is:

   August “eight”

4. Voiceless stops or sounds preceding and following your target word also help you to make a good recording. In the example above, the final /t/ of “August” provides a silence that makes it easy to isolate “eight.” Voiceless stops are sounds like /p/, /t/, and /k/. Other voiceless sounds that might work to end or initiate a frame or space are /f/ or /s/.

   The following is a brief sample script:

   “Welcome to our telephone information service.”

   “To learn more about our investment opportunities, press the star sign.”

   “This amount represents” the total balance.

   “Please enter” two oh one.

   You have “a balance of” two hundred dollars.

   You can deposit “up to” five hundred dollars.

Notice that the information in quotation marks is the information that the professional speaker should focus on and the remaining information is the framework.

Hiring a Professional Speaker

Use these guidelines when choosing a speaker:

1. Hire a speaker with professional speaking experience (that is, actors, disc jockeys, and television announcers).
2. Before hiring a speaker, record and digitize the candidate's voice to ensure that the encoded quality is good. You may want to listen to several male and female voices to compare the digitized quality.
3. Use the same speaker for all speech associated with a specific application.
4. Make sure that the speaker is able to maintain a constant speaking rhythm and general intonation throughout the recording session. This ensures that phrases spoken early in the session result in normal-sounding speech when they are concatenated with phrases spoken later in the session.
5. The speaker should maintain a constant acceptable level of volume. Pronunciation should be clear.
6. The speaker should maintain a constant orientation and distance from the microphone.
7. Ensure that alpha and numeric characters that are recorded with rising, medial, and falling intonations are spoken with the appropriate intonation.

Planning a Recording Session

Environmental Conditions

A studio specifically designed for recording sessions is necessary. It should be noise-free and environmentally-controlled.

Arrange for the recording environment to be quiet and acoustically "dead." A carpeted room with soft walls (drapes, carpet, etc) usually is sufficient.

Recording Options

There are two ways to record speech:

- Record speech onto magnetic tape and convert to coded speech
- Record speech directly into the VIS using Script Builder The first option is discussed in detail here. The second option is discussed in Chapter 8, "Producing Speech," of *CONVERSANT VIS Version 4.0 Script Builder,* 585-350-704.

Equipment and Recording Parameters

The recommended equipment includes a reel-to-reel tape recorder or high quality cassette player and amplifier. The reel-to-reel tape should be recorded at 7-1/2 inches per second (19 centimeters per second). Post-processing such as filtering is not required. A VCR with a digital audio processor also produces a high-quality recording.

Equipment Specifications

The recording apparatus and medium should provide:

- Dynamic range of at least 50 decibels (db)
- Bandwidth from 100 to 8000 hertz (Hz)
- Flat frequency response in bandwidth
- Low noise insertion

Recording Spoken Phrases on Magnetic Tape

The speaker, the studio manager, and a coordinator usually are present at the recording session. The customer for whom the speech is recorded also may be present. During the recording session, these individuals can provide feedback about the necessary intonations for words and phrases and the overall quality of the speech.

The speaker uses the script to record entire sentences on tape so that speech sounds natural. For example, for a temperature service, the following sentence can be recorded, although only parts of this sentence will be used:

“The current temperature is” sixty-seven “degrees Fahrenheit.”

When the preceding sentence is encoded, the phrase “The current temperature is” can be encoded as one phrase and “degrees Fahrenheit” can be encoded as a second phrase. The speech “sixty-seven” should be removed because “sixty-seven” is a combination of two phrases that are recorded separately and concatenated later (numbers and alpha characters are recorded as separate phrases).

A stock service may use a sentence similar to the following:

“The Dow is at” “eighteen” “forty” “three,” “up” “7”

“at the close of trading.”

This entire sentence is recorded, but the sentence can be encoded as seven separate speech files that are concatenated later. The seven phrases which are encoded separately are shown in quotation marks (“ ”).

When recording sets of related words, such as the days of the week, ordinal numbers, or the months of the year, use a frame sentence in a typical context. A frame sentence for the days of the week might be:

The movie for “[the name of day]” is ____.

During speech editing, the frame words preceding and following the day of the week are deleted and only the phrase that is inserted in place of [the name of day] is saved as a phrase.

Record Alpha and Numeric Characters with Inflections

Record letters and numbers with frame words that separate instances of initial, medial, and final inflections for each letter and number:

- Initial — Phrase with a rising intonation
- Medial — Phrase with a steady intonation
- Final — Phrase with a falling intonation

For example, the frame word “and” can be used between the three instances of inflection with the letter “b” as follows:

b (initial) and b (medial) and b (final)

Be careful when choosing frame words. For example, “b” is a consonant, so you should not precede it with a frame word that ends in a strong consonant such as “t” or “r.” Be aware of how the frame word affects the clarity of the letter or digit.

NOTE:
Monitor the speaker during this phase of the recording session to insure that proper inflection is used and that volume and rhythm are constant.

Digitizing and Encoding Phrases

Once the speech is recorded, it must be digitized. Again, if you have recorded the speech using Script Builder, it is digitized automatically. If you want AT&T to digitize the speech, contact your AT&T account representative for information about where to send the recorded speech.

Installing Digitized Speech from AT&T

After you receive the digitized speech from AT&T, use the following procedure to install it on your VIS.

Insert the floppy disk into the drive, then type **sp_install name.pl** and press ENTER. The *name*.pl variable can be the name of the application or any other name.

Response: When the system prompt is displayed, the speech is loaded onto the hard disk and can be accessed by applications.

NOTE:
If you are adding speech to an existing application, be aware that the system overwrites any existing speech files that have the same name as a file being added.

Script Instructions

4

What's in This Chapter

The conventions used in writing a script are described in this chapter, along with all the instructions needed to develop the application script. The instructions for writing a script are grouped under the following headings:

- Voice output
- Data gathering
- Data manipulation
- String manipulation
- Flow control
- Equipment allocation
- Voice coding
- Network interface
- Miscellaneous

Overview of TSM Actions

The transaction state machine (TSM) software process is the focal point of the CONVERSANT Voice Information System (VIS). It manages the application software by reading a set of instructions called a script. With these instructions, the software written for each application controls its own unique sequence of events and the data and the equipment needed by the system for interacting with a caller.

The next few paragraphs discuss TSM actions at a lower level. If you do not need to know about this, turn to the "Call Progression" section. If you would like to know more about TSM actions, continue reading.

Based on the arguments in the script instructions, TSM sends messages to the system devices and other software processes that control the access to a local or a host database and hardware (refer to *CONVERSANT VIS Version 4.0 System Description,* 585-350-207, for additional information about the software architecture).

For example, when TSM receives a **tflush** instruction from the script after phrases have been specified with the **talk()** instruction, it sends an interprocess communication (IPC) message to the voice response unit output process (VROP). VROP uses the talk file and phrase numbers specified by the talk() instruction to tell the tip/ring (T/R)-T1 interface the phrases to play for a meaningful response to the caller. In the case of a database instruction to a host computer, TSM communicates with a data interface process (DIP). This process provides the interface between the generic host communication software and the application software by formatting the host messages between the two.

TSM communicates directly with the maintenance (MTC) and Logger/Alerter processes. In the case of a diagnostic initiated by the system or an operator, MTC notifies TSM to terminate the script immediately or at the end of the call.

The script's assembly language type instructions, running within the generic TSM software, are a sequence of library function calls that manage the low level interactions required to operate the system. There may be multiple invocations of the same script as well as the execution of several scripts concurrently within the TSM process. At any time a script can be assembled, using the transaction assembler (TAS), loaded, changed, or replaced without affecting the other scripts running on TSM. To insure that TSM downloads the revised script, the **newscript** command should be used (refer to the *CONVERSANT VIS Version 4.0 Command Reference*, 585-350-209 for more information about **newscript**).

A script begins to execute when a call is recognized by the system. TSM selects the appropriate script identified by the service assignment. The application's script maintains control of the system processes and equipment while the caller and the system are conversing. At the end of the call, control returns to the TSM process.

Both the script and TSM collect call information while a call is in progress. At the end of a call, TSM combines its data with the script's data and sends a call data record to the call data handler (CDH), which makes it available in reports to the host and the VIS.

Call Progression

A T/R or T1 card accepts a call made to the system by appropriate signaling to the central office or switch. The T/R then informs the tip/ring interface process (TRIP) or the T1 informs the T1 interface process (TWIP) that the call has been accepted. TRIP/TWIP passes control to the TSM process, which checks a service table to determine the script required for the call. At this point, TSM reads the script instructions and lets the script control the sequence of events during a call. When the call has ended, TSM takes control.

Starting Conditions

Before a script takes control, the following sequence of conditions must be met:

- A caller dials and reaches the VIS's incoming telephone facility.
- The software recognizes the ringing condition.
- TSM checks an internal table to determine what script to run for the call.
- All script memory is set to zero and the time-outs are set to their default values.

Script Control

At the point that all starting conditions have been met, the script takes control and typically executes the following functions during a transaction:

- Answers the incoming line (takes it off hook)
- Sends recorded voice messages to the caller
- Listens to touch-tone signals
- Accesses information from the host or from the disk
- Sends information to a host or a local database
- Records transaction events on disk
- Takes action when a caller does not respond
- Indicates its termination to TSM

TSM Control

When the script has ended, TSM takes control and performs the following functions:

- Puts the line on hook or terminates the script if one of the following conditions exists:
  - — The maintenance software provides commands to seize control of equipment at any time, thereby terminating transactions on one or more channels without notice.
  - — A program error causes a script to terminate. For example, it terminates if the last instruction, either a goto or a quit, is missing. It also terminates if TSM determines the script is in an infinite loop (that is, 1,000 loop executions). TSM terminates a script when there is a return from too many subroutine calls.
- Stops voice play on the TRIP
- Discards any pending messages from the host
- Sends the call data handler (CDH) a message about the transaction and a copy of the event memory
- Makes the channel available for the next call

Data Storage

The script has four areas where it temporarily stores data for each call it handles. TSM clears these areas at the beginning of a new call.

- User memory

  User memory is a work area for the script to store database information, global variables, and data sent to and from the host.

  The script writer is responsible for partitioning user space. This must be done carefully by assigning data addresses or by using the tool **mkheader**, discussed in Chapter 2, “Development Guidelines,” and *CONVERSANT Voice Information System Version 4.0 Command Reference,* 585-350-209.

  Each script is allocated 512 bytes for user space but automatic allocations insure up to 50,000 bytes if script data defines require additional space.

- Event memory

  The event memory contains a record of the events that occurred for each transaction. Event memory is one hundred 32-bit integers.

- Registers

  Eight registers, r.0 through r.7, provide a means for the script to manipulate data outside of user memory. Three of the registers perform special functions.

  r.0, and occasionally r.1 and r.2, is a return register which may be used to indicate the results of a specific instruction. For example, the **dbase** instruction (described under "Script Instructions" in this chapter) sets r.0 to a positive number on successful completion, which indicates the message contents. In general, a negative number indicates that the instruction failed. For example, if a database instruction that is supposed to receive data did not return any data, then r.0 is set to -2 after an instruction timeout period (45 seconds by default. See the **nwitime** instruction).

  Registers also may be used for indirect addressing.

  NOTE:
  Because most of the instructions store return values in r.0, it is recommended that this register not be used for general purposes.

  r.2 and r.3 are used to pass information to subroutines when a subroutine call is made with up to two arguments specified. The called subroutine reads the first field of information from r.3 and the second field from r.2.

- Stacks

  The contents of r.1 through r.7 are saved on a stack when a subroutine is called. Upon return from the subroutine, they are reloaded with the stack values.

Call Data Collection

Both the script and TSM collect call data during a transaction. The script may store application data in event memory. The data might be response time, user ID, request types, number of invalid selections, and an event counter.

TSM collects generic data such as the script name, channel number, start time, and stop time and stores it in a call data record.

At the end of a call, TSM copies the generic data it has collected and the contents of event memory into a call data record and sends it to CDH. Call data is stored in the ORACLE database.

The reports generated from the database are available to the systems operator (refer to the Appendix C, “Database Environment,” of *CONVERSANT VIS Version 4.0 Operations,* 585-350-703.

The .D File

The **.D** file is created by Script Builder when you specify call data parameters. It also may be created manually, if Script Builder is not used. The **.D** file provides descriptive labels for events when the events are displayed. The event counter array space may contain event counter integers, strings, or both. Records beginning with an integer between 099 are interpreted as a valid event specification record. You do not have to use a 0 or 1 as the first event counter.

The following is an example of the **.D** file syntax:

<event_number> [<WS> STR] [<WS> <label_string>]

where *WS* refers to a tab or blank space and *STR* refers to the literal string STR.

The following is an example of the **.D** file syntax:

1 STR User Name

where event memory 1 stores string data and displays it under the label User Name.

A sufficient amount of event memory space for storage of the strings should be allocated. This includes one byte for the null character at the end. In addition, the contents of one event counter should not overlap the contents of another event counter. You should also make sure the script copies the string starting at the event counter specified in the **.D** file.

Event data is reported only if it is specified in the service script and the file **/vs/trans/<script_name>.D** exists in the proper format. Place all **.D** files in the **/vs/trans** directory. It is important to place strings in the call event space properly. You must know the length of the string and map it correctly onto the 4-bit events of the event space.

Script Conventions

The following are rules that must be followed when writing scripts. They include the syntax, argument structure and types, and address mode and format for script instructions.

Script Syntax

The syntax used for a script is an instruction followed by any required and optional arguments enclosed in parentheses. There are some conventions that appear only in the documentation and are not part of an actual script. Brackets ([ ]) indicate an optional argument for an instruction and the less than or greater than symbols (< >) indicate a label instruction for a program segment.

The following characters are used in the script syntax:

Table 4-1. Script Syntax Characters

Character	Meaning	Example
( )	Encloses arguments in an instruction	load (ch.ONE ch.TWO)
,	Optional character that separates the arguments of an instruction	tchars (ch.ONE, 'F')
.	Required syntax character that separates an argument type and argument value	r.1.br (argument type is a register, register number is 1)
*	Preceding a type, signifies that the value is the number of a script register (r.0, r.1, r.2, or r.7) containing the user space address. A type without an asterisk signifies that the value is an address.	*ch.1.br (character string at address in register 1). spch.1024.br(character string at address 1024)

Arguments to Script Instructions

The argument type may be abbreviated as a few letters or even as one letter if it is unique. It even may be misspelled as long as the first few characters are recognizable by the TAS and there is no ambiguity. For example, the argument immediate could be abbreviated as immed, im, or even imt.

The format of an argument is:

type.#

Type signifies one of the arguments types listed in Table 4-2; # is replaced by a numerical value or a #define symbol. Refer to Chapter 2, "Development Guidelines", for additional information about define statements).

Destination and Source Arguments

If an instruction has both a destination address (*dst*) and a source address (*src*), the destination address is first. The address modes are represented by:

Table 4-2. Destination and Source Addresses

Address	Modes
type.dst	All types except immediate and time
type.src	All types
ctype.dst	Only types char and *char
ctype.src	Only types char and *char

Address Modes

The data types are summarized in Table 4-3. The values associated with character, short and integer types represent user space addresses defined in the script or in header files.

Most of the script instructions do not check data typing. Thus, in most instances, the outcome of using character, short, or integer typing has no effect on the outcome of the instruction. The instructions are sensitive, however, to the contents of the specified user space locations. If characters are required, a null terminated ASCII string must start at the specified address. Similarly, a short integer (2 bytes) or long integer (4 bytes) must start at the specified address if the instruction requires an integer value.

The subsequent instruction descriptions indicate when character values result or are required by the *ctype.dest* or *ctype.src* descriptions. *type.dest* or *type.src* require short or long integer values. Only the **atoi** and **itoa** instructions convert characters to integers and integers to characters.

Although most instructions allow character typing for integer values and integer typing for character values, this is a confusing practice that should be avoided. Integer types must be assigned to even user space byte addresses while character strings may begin at even or odd locations. The integer types are signed values ranging from -32768 to 32767 (short) and -2147483648 to 2147483647 (long).

Table 4-3. Argument Data Types

Argument	Field Width (Bytes)	Meaning	Example
immediate	-	Actual value, for example, a number,string, or string address	im.4
time	4	Operating system time value (a value following (.) is ignored)	time.0
register	4	Contents of script register	r.1
char	1	Character address in user memory	ch.VARIABLE
short	2	Short address in user memory	sh.SHORT
int	4	Integer address in user memory	int.NUMBER
event	4	Address in event memory	ev.1
*char	1	Register containing address of a character in user memory	*ch.1
*short	2	Register containing address of a short in user memory	*sh.1
*int	4	Register containing address of an integer in user memory	*int.1
*event	4	Register containing address in event memory	*ev.1
X	-	Data passed via the exec instruction. A value following (.) is ignored.See **exec** in Appendix A, "Summary of Script Instructions".	X.0

Script Instructions

The following sections detail the script instructions according to similiarities in functionality.

Voice Output Instructions

In this section, instructions that control speech output are described. These instructions send voice data to the TR, T1, and signal processing (SP) cards. Each description is followed by a brief example using that instruction. At the end of this section is an example which illustrates how the instructions described here might be used in a script.

- **tfile("listfile 1" ["listfile2" ...])**

  The **tfile** instruction indicates the speech database to use for the script. The first phrase listfile name, called *listfile 1* (see Chapter 2, "Development Guidelines"), is the name of the primary list file. Its talkfile number is the default talk file for speech referenced by phrases and is used for **tnum**, **tchar**, and **talk** instructions if the talk file portion of the phrase ID is 0 (unless the talk file number is changed later by a setalk instruction).

  Each phrase in the talk file is identified by a unique number and string in the phrase list file. Because **TAS** uses this information, the **tfile** instruction must be specified in the script before the first voice output instruction.

  The phrase list file usually is named *application_name*.**pl**. Phrases in the primary list file are not bound to the talk file when the script is compiled. They will be played from the talkfile currently in effect when the **talk** instruction is executed. However, any additional listfiles given in the file instruction have the talkfile and phrase number bound when the script is compiled. Phrases selected from these listfiles are not affected by changes in the talkfile that occur during script execution.

  The following is an example of the **tfile** instruction:

  ```
  tfile("list.stocks")
  ```

  This instruction tells the TAS to use the "list.stocks" speech database for the next transaction.

- **tchars(ctype.src[,'inflection'])**

  The **tchars** instruction puts its first argument into a queue for speaking. The first argument is a null terminated string of alphanumeric characters. This character string is spoken character-by-character, for example, letters and digits. The second argument, when specified, controls the speech inflection.

  Inflection is indicated as follows: (The default for the inflection is "m" for medial.)

Table 4-4. Speech Inflection Values

Inflection	One Phrase	Multiple Phrases
r	Rising	Rising on first; medial on others
m	Medial	Medial on all
f	Falling	Falling on last; medial on others
t	Falling	Rising on first; falling on last; medial on others

The following is an example of the **tchars** instruction:

tchars(char.INITIALS,'f')

This example instructs the script to speak the contents of char.INITIALS with a falling inflection on the last character and medial inflection on all other characters.

- **tnum(type.src [,'inflection'])**

The **tnum** instruction puts the phrases that speak the numeric value, specified by the first argument, in a queue. It interprets the numeric value of the first argument and selects recorded phrases that say the number in a natural way. For example, 202 is a number that is spoken as a single phrase — two-hundred-two. The second argument, when specified, controls the speech inflection.

NOTE:
The **tnum** instruction does not interpret numeric values in any language other than English. The reason for this is that the rules for concatenating numbers varies depending on the language. The standard speech package currently includes numbers 120, 30, 40, 50, 60, 70, 80, 90, 100, 1000, and 10000. This method forms numbers by combining these standard phrases which support English only.

The **tnum** instruction uses the same arguments for inflection as the **tchars** instruction.

The **tnum** instruction does not support speaking numbers in the billions and trillions because most of these numbers are too big to fit into an integer variable. However, the phrases "billion" and "trillion" are included in the standard speech package. If your script requires such large numbers, we

suggest that you start with an ASCII string, parse the string (getting the amounts of billions and trillions as substrings), then convert the three resulting substrings to integer values and speak them with the **tnum** instruction. Insert a **talk** instruction with the phrase for “trillion” or “billion,” where appropriate.

In the following example, the **tnum** instruction tells the script to speak the numeric value of int.FOUR with falling inflection on the last character and medial inflection on all other characters:

load(int.FOUR, im.4)
tnum(int.FOUR,’f’)

- talk("*phrase_ name*" ["*phrase_ name*"]...)

The **talk** instruction uses one or more *“phrase_name”* arguments. Each argument is a group of words enclosed in quotation marks. When the **talk** instruction is executed, each *“phrase_name”* argument is found in the list file designated by the previous tfile instruction and is queued for playing.

Two examples of the talk instruction are:

talk("Hello this is the CONVERSANT Voice Information System")
talk("Please enter your ID")

The *“phrase_name”* arguments must match a phrase in the *application_name*.**pl** file (see the **tfile** instruction). For example, the *application_name*.**pl** would also contain these matching phrases.

Hello this is the CONVERSANT Voice Information System
Please enter your ID

To simplify writing the **talk** instructions used in matching the phrases in the *application_name*.**pl** file with the *“phrase_name”* arguments in the **talk** instruction, the talk arguments may be abbreviated. In this process, except for the final period or question mark, punctuation is for reference only and is ignored. Each character or word must be separated by a space. Also, uppercase is converted to lowercase.

Two ways of writing the **talk** instruction for the first example are:

talk("Hello, CONVERSANT Voice Information System")
talk("h, c v s")

Words may be eliminated, but the words or abbreviations used must be written in the same order as in the *application_name*.**pl** file. They will match as long as the argument has enough of the key words in the desired phrase.

The following examples illustrate an abbreviated **talk** instruction.

talk("h v s")
talk("Hello Voice Information System")

Only the first letter of a word needs to be used in matching a phrase. Note in the following examples that although each phrase would match, a person reading these instructions would find it helpful to see more than just the first character.

talk("H C 1")
talk("H C 1 V")

Although only the first letter of each word must be specified, it is recommended that you spell the phrase to the extent that it is uniquely identifiable.

- **talk(*type.src*)**

  This is a version of the **talk** instruction that can be used where there is a variable phrase number. Instead of entering the *"phrase_name"* to identify the speech to be queued for the T/R and the SP card, the corresponding number found by the *"phrase_name"* in the *application_name*.pl file can be used.

  An example of the **talk** instruction is:

  #define PHRASE 40
  .
  .
  .
  talk(int.PHRASE) /*speaks the application_name.pl file*/
  /*phrase the number of which is found at*/
  /*address 40*/

- tflush([must _hear_flag][,wait_indicator][,remember_flag])

  The **tflush** instruction typically follows a **talk**, **tnum**, or **tchars** instruction to force queued phrases to be spoken that could otherwise be terminated by a touch-tone signal sent by the caller. Under normal operating conditions, a touch-tone signal terminates any speech activity (voice playback or voice coding) on that channel. (This feature usually is referred to as talk-off.) The **tflush** instruction takes only literals as arguments; do not use variables or registers.

  The **tflush** instruction also causes queued speech to be output as do the other wait instructions (see the **nwitime** instruction for a list of wait-causing instructions). Thus, **tflush** can be used to force speech to be spoken at appropriate points in the script.

  The three optional arguments to **tflush** can be set to the following values. If tflush is used without any arguments, the default value of 0 is used for all arguments.

Table 4-5. tflush Arguments

Argument	Value	Value Result
must_hear_flag	0	Touch tones entered during playback or voice coding cause playback or voice coding to stop (default)
	1	Touch tones entered during playback or voice coding do not cause playback or voice coding to stop
wait_indicator	0	Wait for the playback to complete before continuing script execution(default)
	1	Do not wait for the playback to complete. Continue script execution immediatelyafter queuing.
remember_flag	1	Remember phrases played by this instruction so they may be played againwith the talkresume instruction.
	0	Do not remember the speech.

The *must_hear_flag* option, when set to a non-zero value, disables talk-off so that speech activity (voice playback or voice coding) on the current channel is not stopped by touch tones. When using this option with speech playback-related instructions (**talk**, **tnum**, **tchars**), or **tflush(1)** should follow those instructions. When using **tflush** with voice coding (**vc**), **tflush(1)** should precede the **vc** instruction. The talk-off is enabled automatically by the next wait-causing instruction in the script (refer to the section on flow control instructions for a list of wait-causing instructions).

Note that if talk-off is disabled, speech leaving the TR/T1/SP card may interfere with incoming touch tones. Unless the **setttfl** instruction is used to enable the “type-ahead” feature, playing new speech causes any touch tones that have been typed up to that point to be deleted.

The *tflush wait_indicator* option, when set to a non-zero value, allows the script to start a playback, then continues script execution immediately without waiting for completion of the playback. By using a *wait_indicator* of 0, which is the default, the script does not start execution until a “playback complete” message is received.

The **tflush** instruction stores a return value in register 0. If the value is negative, an error has occurred. If the value is +1, the “playback complete” was caused by talk-off. If the value is 0, playback completed successfully.

The following are examples of the **tflush** instruction:

```
talk("You must hear this announcement before continuing")
tflush(1) /*does not end playback if caller enters a touch tone*/


tflush(1) /*do not end coding if user enters touch tones*/
vc('b',im.10,ADPCM32)
```

NOTE:
In the second example, any touch tones entered are encoded along with the speech.

- **talkresume(type.offset)**

  The **talkresume** instruction plays whatever phrases remain from the last tflush instruction starting at the point they were interrupted (that is, by talk-off) plus the given offset in seconds. If the offset is a positive number, speech is played from a point after the interruption. If the offset is a negative number, speech is played from a point before the interruption. If the offset is 0, play starts at the point where the interruption occurred. If VROP has played all of the phrases, only a negative offset has any effect. For example, this allows a developer to include a "fast forward" or "rewind" feature into speech playing.

  The **talkresume** instruction stores a return value in register 0. If the value is negative, an error has occurred. If the value is 0, playback completed successfully. If the value is +1, the "playback complete" was caused by talk-off. If the value is +2, there was no speech left to play (that is, **talkresume** was given with a non-negative offset when VROP had already played all the speech).

  For **talkresume** to work properly, the speech it affects must have been played originally with the **tflush** instruction with the optional *remember_flag* argument set to 1. This tells VROP to "remember" the speech that **tflush** tells it to play and to keep track of where that speech is interrupted. Subsequent calls to **talkresume** then have the desired effect on this speech. VROP remembers the speech it was playing until it receives another set of phrases to play by subsequent script instructions. Only one set of phrases can be remembered per channel at a time. If more speech is played with **tflush** with the *remember_flag* not set, any set of phrases remembered before are no longer remembered. (Here, a "set of phrases" constitutes whatever phrases were played by the previous **tflush** instruction.)

- **tstop()**

  The **tstop** instruction lets the script programmer stop any speech activity on the script's current channel.

The following is an example using the **tstop** instruction:

```
talk(int.MUSIC) /* Play music to the caller */
tflush(1,1) /* Do not let touch tones turn off music
and don't wait */
dbase(0, FUDB, ch.ACCOUNT_ID, 8, int.SELL_PRICE, 4)
 /* Get info from host */
tstop()
talk("Your account has now been credited with AT&T stock for the
price of")
tnum(int.SELL_PRICE)
```

In this example, the script wants the caller to hear music while it processes the transaction with the host computer. After this processing completes, the music is stopped, and the caller is informed of the results.

- background("phrase_name",type.src)

  background(type.src,type.src)

NOTE:
A time division multiplexor (TDM) bus and an SP card must be installed in the system for the **background** instruction to function properly.

The **background** script instruction starts and/or listens to background audio on the specified channel. The first argument is a phrase enclosed in quotation marks (" "). The phrase must match a phrase listed in the talk file specified by the currently active **tfile** instruction. The first argument can translate also to the index number of a phrase in the talk file; in this case, the argument must be expressed according to the conventions of *type.src*. This syntax is similar to the **talk()** instruction but it only supports one phrase rather than a phrase list.

If this phrase is not playing already in the VIS, it is started and its audio output added to the normal voice response prompts on the current channel. Other channels may execute the same **background** instructions; the audio then is added to those channels while still playing on the first channel. When the phrase has been played, it starts again at the beginning. The phrase continues to play as long as at least one channel requires it. The **background** audio stops when all channels requesting it have dropped it. Background speech lays at a volume level that is 33 percent of the foreground speech.

If the **background** instruction is successful, it returns a positive value in r.0. If the instruction is not successful, it returns a negative value in r.0.

The following are possible reasons the **background** instruction might fail:

- An attempt to add more than one background audio to a channel failed.
- The channel reached its limit for listen time slots (maximum seven per channel).
- No SP card is available.
- All TDM slots are busy.
- The system reached its limit on number of **backgrounds** (MAX-CHAN).
- A system call failure occurred.

NOTE:
On a T/R channel that is not using the TDM bus to play speech (for example, a channel set to “talk,” not “tdm”), foreground speech interrupts background speech. If the TDM bus is used, background speech is heard continuously.

Below is an example of how the **background** instruction might be used in a script.

```
#define ADD 1
#define DROP 0
tfile("/speech/talk/list.cabnt")
background("begin testing",im.ADD)
background(im.201,im.DROP)
```

Sample Script Using Voice Output Instructions

The following is a sample script using the voice output instructions.

```
MAIN:
#define VOLUME 0
#define INITIALS 4
--
--
--
tfile(“stocks.pl”)
talk(“Welcome to our stock quote system”)
talk(“A special announcement: our service will be offered 24-hours a day”)
tflush(1)
talk(“Please enter your account number”)
--
--
--
talk(“Your initials are”)
tchars(ch.INITIALS)
talk(“You currently own”)
tnum(int.VOLUME)
talk(“shares of Acme Incorporated.”)
--
--
--
```

In this example, the script tells TAS to use the “stocks.pl” speech database for this transaction, then welcomes the caller to the application. The script plays the special announcements, which cannot be interrupted by touch tones, because of the tflush instruction. The script asks for the caller’s account number and repeats for the caller what has been entered. The script tells the caller how many shares they own based on the value stored at address VOLUME.

Data Gathering Instructions

In this section, the data gathering instructions are described and examples are given. The data gathering instructions get information from a caller or from a stored database. At the end of this section, a sample script illustrates how these instructions might be used in an application.

- getdig(type, ctype.dst, number)

  The **getdig** instruction receives information entered by a calling party using touch tones or speech input. Touch tones include the full range of 12 keys on the telephone.

  Type 0 specifies no speech recognition. In this situation, the caller must use touch-tone input. However, touch-tone input is accepted for any type. Type 0 is the only valid type for VIS applications.

The *ctype.dst* argument specifies the script address (the offset) where the entered touch-tone digits will be stored.

The *number* argument specifies the maximum number of touch-tone digits to be received. The maximum value is 128. Received touch tones are stored as a null-terminated character string in a buffer specified by the destination argument. Possible characters are 0 through 9, *, and #.

The **getdig** instruction has a five second default wait time for touch-tone input. If the caller does not enter a touch tone or speak a word within the allotted time period, **getdig** returns the number of digits received before the timeout occurred. Use the **tttime** command to specify a desired wait time.

getdig is a wait-causing instruction. Therefore, it automatically forces any pending or unfinished announcements to be played from this channel.

When this instruction terminates, a return code is placed in r.0. The following list shows the return values for touch-tone input, where *N* represents the number of touch tones received:

N > 0	If the *number* argument is greater than N (fewer than the expected number of touch tones were received), an interdigit timeout occurred.
N = 0	An initial timeout occurred.
N < 0	A system error occurred.

The following is an example of the **getdig** instruction:

```
getdig(0, ch.ANS, 10) /*Get up to 10 touch tones and store
at address ANS*/
```

- tttime(type.firstdig, type.interdig)

  The **tttime** instruction allows a script to set the touch-tone time-out values. The *firstdig* argument specifies the maximum number of seconds the script should wait to receive the first touch-tone digit after executing a getdig instruction. The *interdig* argument specifies the maximum number of seconds to wait between two consecutive touch-tone digits.

  The **tttime** instruction has a two-second granularity; that is, if the specified time is 10 seconds, the timing is approximately 810 seconds. (Note that odd timeout values are rounded up one second. For example, if 11 is specified as the timeout value, the actual timing would be 1012 seconds.) There is no limit to the timeout values. The default values are 10 and 10.

  The **tttime** instruction is related to the **getdig** instruction. If the firstdig time is exceeded, r.0 is set to 0 and the **getdig** instruction terminates. If the interdig time is exceeded, r.0 is set to the number of digits that are received, transferred to the script buffer, and the **getdig** instruction terminates.

The following is an example of the **tttime** instruction:

tttime(im.10, im.2)

In this example, the script waits approximately ten seconds for the first touch tone and two seconds between touch tones.

- **setttfl(type.flg)**

  The **setttfl** instruction allows the script to change the way TSM handles the touch-tone buffer.

  Normally, TSM gets rid of any touch tones it has received for the script when the speech buffer is flushed and speech is played. The setttfl instruction disables the TSM action of clearing the touch-tone buffer whenever speech is played.

  If the *type.flg* argument is 1, touch-tone flushing is turned on. If the **setttfl** instruction is not used, the default condition is set to touch-tone flushing on.

  If *type.flg* is 0, touch-tone flushing is turned off and playing speech will not cause the touch-tone buffer to be cleared. Another effect of turning off touch-tone flushing is that any phrases that are queued in the phrase buffer are cleared if talk off is enabled on the channel instead of being played whenever an instruction that normally causes the phrases to be played is executed. This is done because phrases that are in the buffer are assumed to be part of the prompt that the talk-off touch tones affect. With talk-off enabled, phrases that are already queued are not heard. Instead, the script advances to the appropriate point based on the touch-tone input received.

- **ttclear()**

  The **ttclear** instruction clears the touch-tone buffer. This instruction is useful for applications in which you want to throw away all “typed ahead” input. The **ttclear** instruction removes any touch tones in the touch-tone buffer when the instruction is executed. The number of touch tones cleared is stored in r.0.

- **ttdelim(erase-char, erase-all, delim1, delim2)**

  The **ttdelim** instruction works with the **getdig** and **tttime** instructions. For example, after requesting five digits with a **getdig** instruction, normally r.0 is set to 5 and the actual digits received are stored at the destination. Any time the **ttdelim** instruction is used, the script also has to check the received digits to determine if delim1 or delim2 was used.

  The touch-tone buffer is scanned for the delimiters that are in effect when a **getdig** instruction is executed.

  The **ttdelim** instruction sets four control functions and the touch-tone keys used by the caller to perform those functions. The functions for the erase-char and erase-all arguments are defined by the system; the func-

tions for the delim1 and delim2 arguments are defined by the application developer. The developer defines the touch-tone keys used in performing all four functions.

The system-defined functions erase-char and erase-all do not terminate the collection of touch tones initiated by the getdig instruction and those characters are removed from the buffer; whereas, the developer-defined functions delim1 and delim2 terminate the collection of touch tones and those characters remain in the buffer.

The values for the ttdelim arguments are:

Table 4-6. ttdelim Arguments

Value	Meaning
-1	Function is not used (default)
0	Do not change value of current function
'c' or 'cc'	New value where c is
	0-9
	#
	*
	A-D (only on extended keyad, such as an operator console)

The following functions and characters might be specified for the instruction:

```
ttdelim('#1','#*','*1','*2')
```

Characters	Meaning
#1	Erase one character
#*	Erase all characters
*1	Get operator
*2	Play help message

Script routines written by the developer must check for *1 and *2 in the buffer. If the **ttdelim** instruction uses only one argument, then a default value must be entered for the other three arguments. An example of a ttde-

lim instruction using only the erase-all function is **ttdelim(-1,'#',-1,-1)**. Whenever *erase-char* and *erase-all* are used in a script, a *delim* argument will probably be used to allow a caller to end touch-tone entry. This argument is needed to indicate to the **getdig** instruction that although it may have received the maximum number of digits, a caller may make a mistake and may want to erase some digits and re-enter them.

To allow for the extra digits requested by a *delim1* or *delim2* argument, the **getdig** instruction should specify more digits than it needs. For instance, if a 5-digit entry is required, but it is anticipated that a caller might enter all incorrectly, and need to erase them, **getdig** would require a minimum of 7 digits to accommodate the two-digit delimiter for *erase-all*.

Based on the previous arguments for the sample ttdelim instruction shown earlier, the **getdig** instruction would have the results given by the following examples:

Table 4-7. getdig Results

Input	r.0	Destination	Script Action
12345	5	12345	Use 5 digits
123#*45678	5	45678	Use 5 digits
12*1	4	12*1	Transfer to operator
*1	2	*1	Transfer to operator
12*2	4	12*2	Play help message and reprompt for input

The time-outs for the two system defined functions, *erase-char* and *erase-all*, are the same. The **tttime** instruction only uses the *firstsec* argument once, but it repeatedly uses the interdig argument to wait the maximum amount of time specified for receiving the next digit. The script writer needs to write code to implement the functions. For example, *delim2* would need a talk instruction to play a help message.

- **dbase(dip, mcont_field, ctype.dst, mbyte, type.src, nbyte)**

  The **dbase** instruction passes information between the script and a host, a local database, or any other DIP. A maximum of 428 bytes can be sent at one time.

The *dip* argument specifies the data interface process (DIP) that is to receive the message. A DIP number or name may be used for *dip*. If dip is a name, it must be in the form *im."name"*. The *mcont_field* argument is a value sent to the DIP that the DIP uses to identify the message type and determine its next action. The *ctype.dst* argument specifies the destination script address for the data. The *mbyte* argument specifies its length. The *type.src* argument specifies the script address where data sent to the DIP is stored; the *nbyte* argument specifies its length. If *type.src* is a register, nbyte is ignored and four bytes are sent.

If the **dbase** call is successful and returns data to the script, r.0 is set to the mcont value of the DIP message. If the DIP is not running, r.0 is set to -1. After a response timeout (default value is 45 seconds), r.0 is set to -2. To change the default value for timeout, use the **nwitime** instruction described later in this chapter. If nbyte is zero (0), no information is transferred to the DIP. If *mbyte* is negative, no return data is expected from the DIP. r.0 is set to zero and script execution continues immediately after dbase is executed.

NOTE:
The *mbyte* and *nbyte* arguments must be #define variables or the actual value. These variables cannot be passed directly to an external function from the script.

The following is an example of the **dbase** instruction:

```
dbase(im."Bank-
dip",ACCOUNT_BAL,ch.INNO_FROM_HOST,55,ch.INFO_TO_H
OST,9)
```

This instruction tells the script to send ch.INFO_TO_HOST (nine bytes) to the host. The DIP “Bankdip” processes the information to the host based on the action defined by ACCOUNT_BAL and stores the result in ch.INFO_FROM_HOST (up to 55 bytes).

- **dipterm(type.dip)**

The **dipterm** instruction specifies to TSM that a DIP will receive a termination message when the script terminates. A DIP number or name may be used for *type.dip*. The **dipterm** instruction may be called repeatedly with different DIP numbers or names. The termination message will go to all DIPs specified.

The following is an example of a **dipterm** instruction:

```
dipterm(im.0)
```

This instruction tells TSM that DIP0 will receive a termination message when the script completes.

Sample Script Using Data Gathering Instructions

The following is a sample script illustrating how the data gathering instructions might be used in an application.

```
#include HOST_HEADER.h
#define PASSCODE 0
#define INFO_FROM HOST 4

MAIN:
 --
 --
 talk("Enter your 3-digit pass code.")
 getdig(0,ch.PASSCODE,3)
 --
 --
 --
 dbase(0,ACCOUNT_BAL,ch.INFO_FROM_HOST,55,ch.PASSCODE,3)
 --
 --
 --
```

In this example, the script instructs the VIS to prompt the caller for his or her pass-code. The script waits for the caller to enter three touch tones and stores them in ch.PASSCODE. The script then tells the VIS to send ch.PASSCODE (3 bytes) to the host. The host performs ACCOUNT_BAL processing, then returns up to 55 bytes of data. That data is stored in ch.INFO_FROM_HOST.

Data Manipulation Instructions

The data manipulation instructions perform arithmetic data functions and also change the contents of memory. Following the list of the instructions and descriptions of each are two sample scripts which illustrate how the instructions might be used in an application.

- **and(type.dst, type.src)**

  The **and** instruction implements bitwise AND operations on the *type.dst* and *type.src* arguments, allowing scripts to decode or encode bit flags stored in a single integer. The result is stored in *type.dst*.

- **atoi(type.dst,ctype.src)**

  The **atoi** instruction converts a null terminated character string at the source to an integer value and stores that value at the destination.

- **decr(type.dst, type.src)**

  The **decr** instruction decrements the destination value by the source value.

- **div(type.dst, type.src)**

  The **div** instruction divides the destination value by the source value. The integer quotient is stored in *type.dst*. The remainder is discarded. **Div** returns a value of 0 in r.0 if no error occurred. If division by 0 is done and a -1 value is returned in r.0, the result is set to the largest positive or negative integer, depending on whether *type.dst* was positive or negative originally.

- **dtitos(type.src, type.dst)**

  The **dtitos** instruction converts date and time data from internal UNIX system form to "tm" structure form. The *type.src* argument should contain a number representing the UNIX system internal representation of time (number of seconds since 00:00:00 GMT January 1, 1970). It is recommended that the *integer* type be used for this argument. The resulting "tm" structure (9-integer structure defined in CTIME(3C) in the *UNIX System V Programmer's Reference Manual*) is put in *type.dst* (that is, *type.dst* defines a starting address for the result).

  Dtitos() returns 0 in script r.0 if the conversion is successful. A -2 is returned in r.0 if TSM could not allocate enough space in script memory to store the result.

- **dtstoi(type.src, type.dst)**

  The **dtstoi** instruction converts date and time data from "tm" structure to internal UNIX system form. The "tm" structure is specified by the *type.src* argument. The result is placed in *type.dst*. It is recommended that the *type.dst* argument use type "integer" to guarantee that the correct value is received. This instruction is the complement to the **dtitos()** instruction.

  Dtstoi() returns 0 in script r.0 if the conversion is successful. A value of -1 is returned in r.0 if the "tm" structure indicated by *type.src* contains incorrect values or is at a location outside the script data area.

- **incr(type.dst, type.src)**

  The **incr** instruction increments the destination value by the source value.

- **itoa(ctype.dst, type.src)**

  The **itoa** instruction converts a numeric source value into a null terminated character string stored starting at the destination address.

- **load(type.dst, type.src)**

  load(ctype.dst, ctype.src)

  The **load** instruction sets the destination value equal to the source value.

- mul(type.dst, type.src)

  The **mul** instruction multiplies the destination value by the source value. The product is stored in *type.dst*. Overflow is not checked; multiplying large values may result in a negative number.

- **not(type.dst)**

  The **not** instruction performs a 1's complement operation on the *type.dst* argument, allowing scripts to decode or encode bit flags stored in a single integer.

- **or(type.dst, type.src)**

  The **or** instruction implements bitwise OR operations on the *type.dst* and *type.src* arguments, allowing scripts to decode or encode bit flags stored in a single integer. The result is stored in *type.dst*.

Sample Scripts Using Data Manipulation Instructions

The following are two sample scripts using the data manipulation instructions as they might be used in an application. The second example uses several instructions introduced later in this section.

Example 1:

```
MAIN:
 talk("Enter the number of widgets you wish to order")
 getdig(0,ch.QUANTITY,3)
 atoi(r.1,ch.QUANTITY)
 talk("You have ordered")
 tnum(r.1) /*spoken as a number, not a string of digits*/
 talk("widgets")
 talk("at a cost of $5 each for a total cost of")
 mul(r.1,im.5)
 tnum(r.1,'f')
 talk("dollars.")
```

In the above example, the script asks the caller to enter the number of widgets they wants to order, then waits for three touch tones and stores them in ch.QUANTITY. The script then converts the characters in ch.QUANTITY to an integer and stores it in r.1. The script tells the caller how many widgets they ordered based on the integer in r.1. Using the mul instruction and r.1, the script multiplies the integer in r.1 by 5 (im.5) to get the total cost of the order. The script then tells the caller the total cost of the order.

Example 2:

```
start:
load(r.1 im.0)
talk("Enter your password.")

validate:
getdig(0,ch.PASSWORD,4)
strcmp(ch.PASSWORD, ch.GOOD)
jmp(r.0 !=0,retry)
--
--
--

retry:
talk("I'm sorry, that was an invalid password")
incr(r.1,im.1)
jmp(r.1 == im.3,good-bye)
talk("Please re-enter your password.")
goto(validate)
```

In this example, the script sets the value of r.1 to 0, then asks the caller to enter their password. The script waits for four touch tones, stores them in ch.PASSWORD, then compares ch.PASSWORD with ch.GOOD. If they match, the script continues. If they do not match, as this example illustrates, the script jumps to the retry instructions where it tells the caller that the password is invalid. The script increments r.1 by 1. If r.1 equals 3, the script jumps to the "good-bye" subroutine. If r.1 is not equal to 3, the script asks the caller to re-enter the password. The script then goes back to the validate subroutine. In this example, the caller can enter an invalid password up to three times before the script terminates in good-bye.

String Instructions

The following script instructions recognize the use of the double-quote syntax to indicate a literal, null-terminated ASCII character string. Although the "talk" instruction also uses a double-quote syntax, the meaning is different; it implies a talk file search for phrases that match the string.

- **strcmp(ctype.src, ctype.src)**

  The **strcmp** instruction allows a script to compare two character strings. The *type.src* arguments can be either an address or a literal string. The results of the comparison are returned in r.0. The return value is interpreted as follows

If r.0 is:

=0	the strings are equal (exactly the same)
<0	the first string is lexicographically lessthan the second string
>0	the first string is lexicographically greater than the second string.

Below are two examples of the strcmp instruction.

strcmp(im.“abc”,im.“abx”)

In this example, the strcmp instruction returns a value less than 0 because “abc” is lexicographically less than “abx.” In other words, the string “abc” appears before the string “abx” in an alphabetical listing.

strcmp(im.“abx”,im.“abcd”)

In this example, the return value is greater than 0 because “abcd” appears before “abx” in an alphabetical listing even though “abcd” has more characters than “abx.”

NOTE:
Capital letters are always lexicographically less than lower case letters and numbers are always lexicographically less than letters.

- **strcpy(ctype.dst, ctype.src)**

  strcpy: instruction

  The **strcpy** instruction allows a script to copy a source string to a specified destination. The *type.dst* argument specifies the destination address to which the source string, specified by the second argument, is copied. The first argument must be an address. The second *type.src* argument specifies the source string to be copied. This argument may be a literal string of up to 300 characters (including the terminating null character) or the address at which the first character of the string is located.

  Below are examples of the **strcpy** instruction:

  strcpy(ch.COPY,ch.ORIGINAL)

  In this example, the string ch.ORIGINAL is copied to the destination ch.COPY.

  strcpy(ch.COPY,im.“Welcome”)

  In this example, the string im.“Welcome” is copied to the destination ch.COPY.

- **strlen(ctype.src)**

  The **strlen** instruction computes the length of the string specified by the *ctype.src* argument. The *type.src* argument can be a literal string or the location of a string. The length of the string (that is, the number of characters in the string) is returned in r.0.

  The following is an example of the **strlen** instruction:

  ```
  getdig(0,ch.SOCIAL_S_NUM,9)
  strlen(ch.SOCIAL_S_NUM)
  jmp(r.0< im.9,invalid_num)
  ```

  In this example, **getdig** looks for nine touch tones and stores them in ch.SOCIAL_S_NUM. The **strlen** instruction computes the length of the string stored in ch.SOCIAL_S_NUM and stores the value in r.0. Then the jmp instruction looks at the value in r.0 and if it is less than nine, goes to the code at invalid_num.

Flow Control Instructions

The flow control instructions determine the order in which the instructions are executed. Each instruction is listed below with a brief description. An example of a script using these instructions follows the descriptions.

- case(type.src,type.src,<subroutine_label><goto_label>)

  case(type.src,type.src,<subroutine_label()><goto_label>)

  case(type.src,type.src,<subroutine_label(type.src)><goto_label>)

  case(type.src,type.src,<subroutine_label(type.src,type.src)>
  <goto_label>)

  The two source values are compared. If they are equal, the subroutine is called, and on return, execution continues at the *goto_label* address. If they are not equal, the statement does nothing. If the *subroutine_label* is a negative number, no subroutine call is made and execution continued at the goto_label. If the *goto_label* is negative, execution continues with the next instruction.

  Subroutine calls invoked in a case statement behave like other subroutine calls (that is, with arguments allowed and register values saved on the stack).

- event(event_type[, subroutine_label])

  eventf4(event_type[, type.offset])

  The **event** instruction allows script execution to continue after certain events occur, such as when the caller hangs up or the script detects another external event. The **event()** script instruction causes a jump to the

subroutine_label given when events defined by the *event_type* argument occur. The event types are defined in the header file **/att/msgipc/tsm_dip.h**.

If valid arguments are passed, the **event()** instruction returns an integer offset in r.0. This offset is the value of the previous *subroutine_label* (if any) used for the event. It may be saved and used later as the *type.offset* argument to the **event()** instruction to reset the *subroutine_label* back to its previous value. (This is useful for external script functions which need to handle events and want to restore their disposition to whatever the calling script had set before returning.)

If *event_type* is not valid or *type.offset* is larger than the text space of the script, a value of -3 is returned by the event() instruction.

A negative value for *type.offset* may be used to set no subroutine label for an event, causing the default action to be taken when the event occurs (see below). If no *subroutine_label* or offset is given, the **event()** instruction returns in r.0 the value of the *subroutine_label* currently being used (or -1 if none) without changing the disposition for the event.

The event types are described briefly on the next page. Refer to Appendix A, "Summary of Script Instructions", for more information about the event instruction and event types.

- **EHANGUP** specifies a hangup event. This event is triggered when dial tone, no loop current, disconnect, or glare conditions are detected on the channel.
- **EDIALTONE** specifies a dial tone event. This is a special case of the EHANGUP event. Normally, EHANGUP is triggered when dial tone or stutter dial tone is detected (and the script is not expecting dial tone). EDIALTONE is used to treat dial tone detection separately from EHANGUP.
- **ESOFTDISC** specifies a soft disconnect event. This event is triggered by sending a SOFT_DISC message to TSM from a DIP.
- **EDIPINT** specifies a DIP interrupt event. This event may be triggered by sending a DIP_INT message from TSM to a DIP.
- **ETTREC** specifies a touch-tone received event. This event can be used to allow a **dbase()**, **sleep()**, or **tflush()** instruction to be interrupted if a touch tone is received while they are being executed.

NOTE:
The **tflush()** instruction is only interrupted if its first argument is 1 (“talk off” is disabled).

If an event subroutine is set, it receives the following values when the event occurs:

r.0 event type (ETTREC)

r.1 TT character that caused the interrupt

r.2 number of TTs received since last getdig() or ttclear()

r.3 instruction interrupted: 't' - tflush(), 's' - sleep(), 'd' - dbase()

If no event subroutine is set for ETTREC, the instructions are not interrupted by touch tones.

- **EANSSUP** specifies an answer supervision event. This event is triggered when answer supervision is detected for a T1 or Primary Rate Interface (PRI) channel.

- **exec(ctype.script[,type.data,type.nbytes][,exitval])**

  The **exec** instruction allows a script to execute another script.

  The *ctype.script* argument is the name of the script to be executed. The *type.data* and *type.nbytes* optional arguments are used to pass a block of data to the new script. The *type.data* argument specifies the location of the data and the *type.nbytes* argument specifies the size, in bytes, of that data. If *type.data* is a register or immediate type, *type.nbytes* is ignored and a size of an integer (4 bytes) is assumed. These two arguments work like the last two arguments of the **dbase()** instruction.

  The constant *exitval* argument is an optional exit value used when the "parent" script is terminated before the new "child" script is run. It is used in the same way as the argument to the **quit()** instruction and may be specified without using either *type.data* or *type.nbytes*. If no *exitval* is given, -1 is used by default. Refer to Appendix A, "Summary of Script Instructions", for more information on the **exec** instruction.

- **execu(ctype.script[,type.data,type.nbytes][,exitval])**

  The **execu()** instruction has the same format and functionality as **exec()**. Using **execu()** instead of **exec()**, however, causes the new script to inherit, intact, the data space of the "parent" script. Essentially, this feature allows a script to pass all its data to the new script. For this to be useful, however, the new script must have its data defined in the same way as the parent script (that is, structures, variables, etc. must be defined for the same locations). The data definition of the new script is used to overlay the actual data of the parent script.

- **goto(<label>)**

  The **goto** instruction is an unconditional jump to the instruction indicated by the *label*.

- **ibrl(type.dst, type.src, <label>)**

  The **ibrl** instruction, which means increment and branch if less, determines if another pass should be made through a loop. The **ibrl** instruction normally is placed at the end of the loop. The destination value is incremented by one and then compared to the source value. If the destination is less than the source value, a jump to the labeled instruction is executed and the loop is repeated. If the destination is greater than or equal to the source, the next instruction is executed.

- **jmp(type.src rel_op type.src, <label>)**

  The **jmp** instruction is a conditional jump to the labeled instruction. The *rel_op* argument compares the values of the two source operands. If the condition is true, a jump to the labeled instruction is executed; if false, the statement does nothing. The *rel_op* has six C-style operators:

== - equal	!= - not equal
<= - less than or equal to	< - less than
>= - greater than or equal to	> - greater than

- **<label>:**

  The **label** instruction assigns a label to a program segment. It is not the same as **label( )**, which is a subroutine call. Everything following label on the same line is ignored.

- **<label>([type.src] [,type.src]])**

  The **label( )** instruction is used to call a subroutine found at the address indicated by the *<label>:* of the segment. A return address and the values in r.1, r.2, and r.3 are saved on a subroutine stack. An optional first argument is stored in r.3 and an optional second argument is stored in r.2 for use by the called subroutine; otherwise, the registers are left unchanged.

- **nwitime(type.src)**

  The **nwitime** (next wait instruction time) instruction sets the maximum amount of time the script waits for the completion of the next instance of the following wait-causing instructions. The *type.src* argument specifies the number of seconds to wait.

  — dbase

  — phreserve

  — phremove

  — tic

- **quit( )**

  The **quit** instruction causes the voluntary termination of a script.

- **rts()**

  The **rts** instruction is the mechanism for returning from a subroutine call. An optional parameter is passed to a DIP specified in a **dipterm()** instruction. The saved values for r.1, r.2, and r.3 are restored.

- scrinst([ctype.script])

  The **scrinst** instruction enables an application script to find out how many instances of a script are running currently on the system. Based on the value returned by this instruction, the script may choose to prohibit execution of another instance of the script (via the **exec** instruction) or the script may quit if it is performing a check on itself and has exceeded the limit.

  The *ctype.script* optional argument is the script, or service, name. If no script name is given, the script executing the instruction is assumed. This instruction sets the value of r.0 to the number of instances of the given script at the time the instruction is invoked.

  There are several possible uses of scrinst based on the ways in which a script may be started:

  — Incoming call — It is suggested that the method of limiting the number of scripts started with an incoming call be left as it is. That is, do not assign a service to a number of channels greater than the desired limit. If the number of channels assigned to a script exceeds the limit, a script still may check the instance count as its first task and quit before answering the call if the instances exceed the limit.

  — **exec()** — The **exec** script instruction is the primary means by which an instance limit may be exceeded. Therefore, any application script concerned about running too many instances of another script should use **scrinst()** for that script before using **exec()**.

  In this case, it is important to avoid a wait condition in the interval between **scrinst** and **exec**. This could cause other scripts running simultaneously that are performing the same test to receive identical results from **scrins**t before any of them perform the **exec** instruction. Use **tflush** before **scrinst** to play any speech that is queued. If **tflush** is not used, the **exec** instruction causes the speech to play and the script waits for the play to complete before executing the **exec** instruction.

  — Soft seizure — Scripts started by a soft seizure request from a DIP may use **scrinst()** to check themselves against an instance limit as their first task, similar to the way **scrinst** may be used if the script is started by an incoming call. If the script determines that it cannot

continue, it may signal the DIP that started it by using the **dipterm()** instruction and calling **quit()** with a specific value that the DIP may check.

- **sleep(type.src)**

  The **sleep** instruction makes the script do nothing for the number of seconds specified by the argument. Currently, the only event that interrupts this sleep period is a hangup detection.

Sample Script Using Flow Control Instructions

The following is an example of a script using the flow control instructions:

```
#define DECIDE 0
#define COUNTER 2
INTRO:
talk("Welcome to our company")
load(r.1,im.0) /*initialize loop counter to 0*/

start:
talk("To speak to an operator, enter 1")
talk("To hear your account balance, enter 2")
getdig(0,ch.DECIDE,1)
case(ch.DECIDE,im.'1',OPERATOR,continue)
case(ch.DECIDE,im.'2',ACCT_BAL,continue)
--
--
--

OPERATOR:
talk("Please hold, an operator will be with you shortly")
--
--
(code to dial operator, transfer call)
--
--
(call returns)
rts()

ACCT_BAL:
nwitime(im.20) /*maximum seconds to wait for host confirmation*/
--
--
(query host)
--
--
talk("Your account balance is")
tnum(int.FIVE,'f')
```

```
rts()

continue:
ibrl(im.COUNTER,r.1,start)
talk("Thank you for calling")
quit()
```

In this example, the instructions first define DECIDE as 0 and COUNTER as 2. The script then welcomes the caller to the system and initializes r.1 as containing 0. The script asks the caller to enter 1 to talk to an operator and 2 to hear the account balance. The **getdig** instruction tells the script to wait for one touch tone and store it in ch.DECIDE. The **case** instructions tell the script that if the caller enters '1', to go to the OPERATOR subroutine, then to the continue code and if the caller enters '2', to go to the ACCT_AL subroutine, then to the continue code. Regardless of what the caller enters, script execution continues with the next instruction.

The OPERATOR subroutine would contain code telling the script to dial out to an operator and transfer the call (this code is omitted from this example to make it simpler). When the caller has finished talking to the operator, the script continues with the next instruction.

The ACCT_BAL subroutine tells the script to wait a maximum of 20 seconds for the host information requested (nwitime instruction). The call to the host is not included here to keep the example simple. After the host has returned the information, the script tells the caller what the account balance is based on the value in the tnum instruction. The script then continues with the next instruction.

The **ibrl** instruction tells the script to compare im.COUNTER (which was set at 2 at the beginning of the script) with the value in r.1. If r.1 is less than imm.COUNTER, the script returns to the start code. If r.1 is equal to imm.COUNTER, the script executes the next instruction. The script then thanks the caller for calling and quits, voluntarily ending the transaction.

Voice Coding Instructions

These instructions provide script facilities for adding or removing phrase numbers to or from a selected speech file. These instructions also store speech within these or previously-defined phrase allocations. These facilities may be used, with suitable script prompts, to record user voice or touch-tone messages.

The feature of ending the voice coding session by pressing a touch-tone key (referred to as talk-off) can be disabled using **tflush(1)** before the vc instruction. This allows the user to encode the touch tones as well as the speech. Refer to the section on voice output instructions for details about the tflush instruction.

The voice coding instructions are described below. Following these is an example of a script for voice coding and playback.

- **phreserve(type.phrase,type.talk,type.time,type.style)**

  The **phreserve** instruction creates an area in a talk file that is used to store a phrase. This phrase is later encoded by the vc instruction.

  This instruction differs from the **phcreate** instruction in that you can specify one of several coding types and rates.

  The arguments for the **phreserve** instruction are:

  — The *type.phrase* argument specifies the phrase id of the phrase to be created (valid range is 165,535).

  — The *type.talk* argument specifies the talk file id of the talk file where the phrase is stored (valid range is 116,383).

  — The *type.time* argument specifies the amount of space, or time (in seconds), to be reserved for a phrase in the talk file.

  — The *type.style* argument specifies the coding style and rate to be used. Valid coding styles and rates are defined in the header file **codestyle.h**, which is in the directory **/att/include**. This file should be included in the script by an **include** instruction. If the style specified is not valid, the instruction fails.

  Valid coding designations are:

Table 4-8. Coding Designations

ADPCM32	Adaptive Differential PCM at 32 kbps
ADPCM16	ADPCM at 16 kbps
SBC16	Sub Band Coding at 16 kbps
SBC24	Sub Band Coding at 24 kbps
PCM64	Pulse Code Modulation at 64 kbps

If *type.phrase* is -1, the system assigns a phrase id and returns this id in r.1. The phrase id can be used to reference the phrase (for example, in a **talk** instruction) once it has been coded and stored in the talk file by the **vc** instruction. If *type.talk* is -1, the system selects a default value (255) for the talk file and returns the id of the selected talk file in r.0.

NOTE:
If there are two **phreserve** instructions, there must be a vc instruction between them or the second **phreserve** instruction will fail.

When both *type.talk* and *type.phrase* are -1, both a phrase id and talk file id are chosen by the system and returned in r.1 and r.0 respectively. These selections start with the largest previously unassigned phrase number of talk file 255. Subsequent phrase selections fill unused phrases of file 255 toward phrase 0. Since r.0 and r.1 can be used implicitly to store talk file and/or phrase ids, the script writer must take care to save the contents of these registers before the **phreserve** command is executed.

If *type.phrase* matches the phrase id in the specified talk file, the existing phrase is replaced by the new phrase. The values 0 and -1 for the *type.time* argument indicate that the **phreserve** instruction should not allocate any space. If enough space is available to store the phrase when coding ends, the phrase will be stored. If there is not enough space, an error message will be issued from the vc instruction.

If the instruction is completed successfully, the return values are:

— r.0 = talk file id

— r.1 = phrase id

If the instruction is not completed successfully, the return value in r.0 is negative.

- **phremove(type.phrase,type.talk)**

  The **phremove** instruction removes the phrase specified by the *type.phrase* argument from the talk file specified by the *type.talk* argument. The valid values for type.phrase are 1-65,535. The valid values for *type.talk* are 1-16,383. *Type.phrase* must be a valid phrase id. *Type.talk* may have the value -1. If *type.talk* is -1, then the talk file id used is the current talk file.

  If the **phremove** instruction is successful, it returns the phrase id of the phrase removed in r.0. If the instruction is not successful, it returns a negative value in r.0.

- **setalk(type.talk)**

  Setalk is used to specify a new talk file for talk instructions. The *type.talk* argument is the id of the new talk file. After **setalk** is executed, the previous talk file id is returned in r.0 and can be saved for future use. The **setalk** instruction overrides the talk file number contained in the first list file specified in the tfile instruction.

- **vc(flag,type.time,type.rate)**

  The **vc** instruction codes speech into a phrase in a talk file.

  For the first argument, 'b' (for "begin coding") is accepted. Another character value, 'p' (for "prompt") may be used to play a short "beep" just before voice coding starts.

The *type.time* argument specifies the maximum duration, in seconds, of the coding session. A value 'n' for *type.time* specifies a coding session lasting up to 'n' seconds. A value of -1 or 0 for *type.time* specifies the default maximum duration of 45 seconds. Coding can be terminated at any time by entering a touch tone.

The *type.rate* argument specifies the coding rate in kilobits per second. If the value given for this argument is not a valid rate or type, the instruction fails.

The feature of ending the voice coding session by entering a touch tone (referred to as talk-off) can be disabled using **tflush(1)** before the vc instruction. This allows the user to encode the touch tones as well as the speech. Refer to the section on voice output instructions for details on the **tflush** instruction.

If the **vc** instruction is successfully completed, it returns the phrase id in r.0. If the **vc** instruction is not successfully completed, it returns -1 in r.0. If the vc instruction recorded nothing because the initial silence timeout was exceeded (see **vctime**), it returns -2 in r.0. r.1 contains the recorded message length in seconds (this should be 0 if r.0 is negative). r.2 is set to 1 if voice coding completed normally, 2 if coding was terminated by a touch tone (talk off), and 3 if coding was terminated due to silence detection, that is, the intermediate silence timeout was exceeded (see vctime).

- **vctime(type.src, type.src)**

  The **vctime** instruction allows the application developer to set silence timeouts. The first *type.src* argument contains the value for the initial silence timeout. The second *type.src* argument contains the value for the inter-word silence timeout. The maximum timeout is 30 seconds.

  The values for the *type.src* arguments and the effect on the timeout are given below:

Value	Effective Timeout Value
X > 0	X becomes the timeout value
X = 0	Timeout is turned off
X < 0	Timeout is set to default value (5 seconds)

  This instruction does not give a return value to indicate success or failure.

Sample Script Using Voice Coding Instructions

The following example illustrates how the script instructions used for voice coding work together. The example script is a code segment which:

— Prompts the caller for a talk file

— Creates phrase 200 in the talk file the caller specified

- — Codes the speech obtained from the caller
- — Plays back the phrase just coded
- — Removes the phrase from the talk file

```
#include "/att/include/codestyle.h"
tic('a') /*answer the phone*/
tfile("list.example")
talk("enter talk file")
getdig(0,ch.TALK,2) /*get talk file id*/
atoi (int.TFILE,ch.TALK) /*convert TT number to integer value*/
phreserve(im.200,int.TFILE,im.100,im.ADPCM32) /*create phrase 200*/
vctime(im.5,im.10) /*inital timeout 5 seconds*/
/*interword timeout 10 seconds*/
vc('b',im.100,im.ADPCM32) /*begin coding*/
talk("the new phrase is")
setalk(int.TALK) /*change talk files*/
load(ch.OLD,r.0) /*save old talk file id)*/
talk(int.200) /*play phrase just coded)*/
setalk(int.OLD) /*change back to old talk file*/
talk("now removing phrase")
phremove(im.200,int.200) /*remove phrase just created*/
quit()
```

Note that in this example, return codes from instructions such as **phreserve**, **vc**, and **phremove** are not checked by the script. These checks were not shown in order to make this example as simple as possible. Normally, all return codes should be examined so that errors can be detected. The discussion for each instruction describes the details pertinent to the return codes for that instruction.

Network Interface Instructions

tic

- tic('D', ctype.dialstr)
- tic('F')
- tic('O', ctype.dialstr)
- tic('W', type.rings)
- tic('a')
- tic('d', ctype.dialstr)
- tic('f')
- tic('h')
- tic('o', ctype.dialstr)
- tic('w', type.rings)

The **tic()** instruction provides the script with control functions for the telephone interface line (channel) that the script is currently using. The function that the **tic()** instruction performs depends on the value of its first argument. These argument values and their corresponding functions are listed below.

The **tic()** instruction uses script r.0 and r.1 to return a result. This result may differ according to whether the script is using a T/R, T1, or PRI channel. Where such variations exist, they are noted below.

- *D* — dial *ctype.dialstr*; wait for any call progress tone, then resume the script.
- *F* — flash; wait for any call progress tone, then resume the script.
- *O* — originate (go off-hook and dial *ctype.dialstr*); wait for any call progress tone, then resume the script
- *W* — turn on speech energy detection and wait for number of rings given in *type.rings* for "answer" (speech energy or ringing stopped) or "no answer"
- *a* — answer the line (go off-hook)
- *d* — dial *ctype.dialstr*, then resume the script
- *f* — flash the hook (transfer to another line), then resume the script
- *h* — hang up the line (go on-hook)
- *o* — originate (go off-hook and dial *ctype.dialstr*), then resume the script
- *w* — wait for the number of rings given in *type.rings* for "answer" (ringing stopped) or "no answer"

For more information about the tic instruction, refer to Appendix A, "Summary of Script Instructions".

The following is a portion of a script that uses the tic() instruction.

```
#define NUMBER 5


strcpy(ch.NUMBER, imm."9999")
tic('O', ch.NUMBER)
jmp(r.0 == imm.-1, end) /* hardware failure */
jmp(r.0 == imm.-2, end) /* timeout, no response */
jmp(r.0 == imm.'B', end) /* busy */
jmp(r.0 == imm.'R', ok) /* ring */
end:
quit()
ok:
tic('h')
rts()
```

In this example, the script copies “9999” into NUMBER, then originates a call to that number. Depending on what is returned, the script either jumps to the 'end' or 'ok' label.

Sample Scripts Using Network Interface Instructions

The following are examples of a script using the network interface instruction:

Example 1:

```
DIAL_OUT:
tic('F')
jmp(r.0!= 'D' End) /*No dial tone, error */
sleep(im.2)
tic('D',ch.PHONE_NUM)
sleep(im.3)
End:
quit()
```

NOTE:
If a dial tone is expected during a call, it is recommended that you use options 'D', 'F', and 'O' instead of 'd', 'f', and 'o'. This prevents the dial tone from being interpreted as a hangup signal.

In this example, the script directs the **tic** to use the flash hook function to transfer to another line. The script sleeps for the time set by the value of im.2. The **tic** then dials out on the current channel using the phone number stored in ch.PHONE_NUM. The script sleeps for the time specified in im.3, then quits.

Example 2:

```
#define INPUT 0
#define PHONE_NUM 5551234
.
.
.

start:
talk("to check your balance, enter your 5-digit account number")
talk("to speak to an attendant, press *")
talk"(to terminate your call, press #")
ttdelim(-1,-1,'*','#')
getdig(0,ch.INPUT,7)
decr(r.0,im.1)
incr(r.0,im.INPUT)
jmp(*ch.0==im.'*', attendant)
jmp(*ch.0==im.'#', BYE)
jmp(r.0==im.5, chk_acct)
goto(invalid_entry)

attendant:
talk("when you are finished speaking with the attendant")
talk("press one to return to this service")
tic('a') /*take line off hook*/
sleep(im.2) /*wait for dial tone*/
tic('d',ch.PHONE_NUM) /*dial attendant*/
tttime(180,0) /*script will sleep up to 3 minutes*/
getdig(0,ch.SLEEP,1)
jmp(ch.SLEEP==im.1, start)
jmp(ch.SLEEP==im.'#', BYE)
.
.
.
```

In this example, the script asks the caller to enter a 5-digit account number, press * to speak to an attendant, or press # to end the transaction. The script then defines the touch tones * and # using the **ttdelim** instruction. The script waits for seven touch tones and stores them in ch.INPUT. The script compares the contents *ch.0 with im.'*' and im.'#'. If *ch.0 is equal to imm.'*', the script goes to the attendant code. If *ch.0 is equal to im.'#', the script goes to the BYE subroutine.

Miscellaneous Instructions

- **chantype ()**

  This script instruction is used while implementing Converse Data Return to support the DEFINITY® *Call Vectoring* feature. The instruction enables scripts to determine the type of channel they are running on.

  As a response to this instruction, register r.0 will be populated by one of the following values:

  - 1: Channel type is tip/ring
  - 2: Channel type is T1
  - 3: Channel type is LST1
  - 4: Channel type is PRI
  - 5: Hardware or Software error.

  NOTE:
  The Converse vector step is not supported for PRI or T1 (E&M) channels.

  For example:

  ```
  /* get channel type */
  chantype()
  load(int.F_chantype, r.0)


  /* channel type must be TR or LST1 */
  jmp(int.F_chantype == imm.1,L__chan_OK)/* tip/ring? */
  jmp(int.F_chantype == imm.3,L__chan_OK)/* LST1? */
  ```

- **hbridge(type.src,type.src)**

  The **hbridge** script instruction directs the current channel to bridge partially to another channel. The result is that the audio coming in on the specified channel is heard or dropped by the calling party (current channel). The specified channel does not hear the calling party. The current channel does not hear voice responses or other background audio on the specified channel.

  The first *type.src* argument is a valid channel number. The second *type.src* argument is either 1 to add the specified channel or 0 (zero) to drop the channel. Values for the channel numbers and the add/drop flag follow the conventions for all *type.src* arguments.

  If the **hbridge** instruction is not successful, a negative value is returned to r.0. The following are conditions under which the **hbridge** instruction may fail:

- A **hbridge** attempt to a current channel failed.
- The channel reached limit for listen tie slots (7 maximum per channel).
- A system call failure occurred.

- **hundsec(type.dst)**

  The **hundsec()** instruction loads the integer *type.dst* with the system time in hundredths of a second.

  NOTE:
  Use the **sleep()** instruction, instead of **hundsec()**, to measure time greater than two seconds.

- **listenall(type.src, type.src)**

  The **listenall** script instruction listens to all audio input on a specified channel. Audio input includes normal voice responses to the network. The specified channel does not hear any audio from the current channel. This allows administrators to monitor the channel.

  The script with the call to **listenall** must be kept running until the caller is finished monitoring the audio input on the other channel. One way to accomplish this would be to add a call to sleep directly after **listenall** command.

  For example:

  listenall (imm.45, imm.ADD)
  sleep (45)

  These commands keep the monitor script running for 45 seconds after the script starts. You must determine how long the other channel will be monitored and use the appropriate sleep value.

  The first *type.src* argument is a valid channel number. The second *type.src* argument is either 1 to add the channel or 0 (zero) to drop it. These arguments must follow the conventions for *type.src* arguments discussed earlier in this chapter.

  If the **listenall** script instruction is successful, a positive value is returned to r.0. If the **listenall** instruction is not successful, a negative value is returned to r.0.

  The following are reasons the **listenall** instruction might fail:

  - An attempt to monitor current channel failed.
  - An attempt to monitor more than one channel failed.
  - The channel reached its limit for listen time-slots (maximum of 7 per channel).
  - A system call failure occurred.

NOTE:
If the **listenall** instruction hears a dialtone, it will hang up.

- **trace(type.src [,type.src])**

  The **trace** script instruction works with the trace line command to monitor the progress of scripts. This capability is useful in debugging and trouble-shooting scripts, either during the initial application development or if problems rise while the application is running. The **trace** instruction enables TSM to print messages to the shared memory area for trace messages. These messages can include the default trace messages for TSM or a specific channel.

  NOTE:
  If there are too many traces running simultaneous on a system, the buffer in which this information is stored may be filled and some data lost, with no notice of this in the trace output.

  The first argument is evaluated as a number and is used as a step identifier. The optional argument can be used to print a specific data value of interest. If the optional argument is of type *char*, *indirect char*, or *immediate*, the value is printed as a string (with null termination assumed). Therefore, whenever type *immediate* is used for the optional argument, the value should be in double quotes (“ ”). When other types are used, the value is assumed to be a number.

  In the following example, imm.25001 and int.F_TEMP are traced.

  trace (imm.25001, int.F_TEMP)

  When the example trace statement above is run, the statement appears as step 25001 in the trace.

Script Development

Transaction Control Header Files

Many parameters used in a script are defined in header files. The first two are defined already; the third and fourth parameters are defined by the script developer. The directories shown are only examples.

1. Defines generic messages to the DIP and their format

   /att/msgipc/tsm_dip.h

2. Defines speech codestyle messages to TSM

   /att/include/codestyle.h

3. Defines script variables and allocates user memory

   /usr/var/applN/trans/application-namedef.h
   or
   /att/trans/sb/application_name/application_namedef.h

4. Defines the application messages to the DIP and their format

   /usr/var/applN/dipN/tsmdipappl.h
   or
   /att/trans/sb/application_name/application_namedef.h

Defining User Memory

User memory is defined by the **mkheader** command (refer to *CONVERSANT VIS Version 4.0 Command Reference,* 585-350-209 for more information). The **mkheader** command allocates space for local, global, and database variables used by the script. The program is initiated by entering:

mkheader application-name

This command creates a header file called *application-name***def.h**.

Identification of Events

Once the information that is to be recorded during a transaction has been determined, then a number is assigned to each noteworthy event and a label is entered for that event.

When an event occurs during a transaction, the script can increment the event or load the appropriate integer into it. When the transaction is complete, the contents of event memory are passed automatically to CDH, which puts this data in the call data and call summary tables in the database.

Events are recorded in three ways:

- A count event increments an integer into event memory
- A store event loads an integer or string into event memory
- A time event loads the time into event memory

The following are examples for recording information about **getdig**:

```
getdig( SYNONLY, ch.YN, 1 )          /* Request Yes/No response */
incr( ev.1, im.1 )                   /* Record event 1
load(ev.2, int.NAME )                /* Record event 2 variable name */
load(ev.3, time.0)                   /* Record event 3 */
```

After getting a yes or no reply and storing it in a field called YN, the program increments event 1, which represents the number of attempts to get a yes/no answer; saves the integer in event 2; and saves the time of the response in event 3.

Source File

The script instructions are initially stored as an **application-name.t** source file in the **/att/trans/sb/application_name** directory. This file is given as the argument to the tas command to produce a machine readable ***application-name*.T** file which is stored in the **/vs/trans** directory and is used by the TSM process.

For more information on the **tas** command, see Chapter 2, “Development Guidelines,” and the *CONVERSANT VIS Version 4.0 Command Reference,* 585-350-209.

Script Instructions and Wait Conditions

The TSM program is responsible for running script programs that are produced with an editor or Script Builder and compiled with the TAS program. Once a script program is started on a particular channel, TSM continues to execute instructions until a wait condition occurs. Script execution then is suspended on that channel until the wait condition is satisfied by an external event or a timeout occurs.

Wait conditions fall into two general categories. Some script instructions cause a wait by flushing any speech that has been queued for playing by the script before the instructions are executed. These instructions are referred to here as speech-flushing instructions. Other script instructions cause a wait during their execution that is characteristic of their function. They make a request on behalf of the script that must be satisfied by a process external to TSM. These script instructions are referred to here as wait-causing instructions. Some instructions fall into both of these categories.

Speech-Flushing Instructions

Some instructions cause the script to wait by forcing any speech phrases or text that have been queued by the **talk()**, **tchar()**, **tnum()**, or **say()** instructions to play before the instruction itself is executed. Thus, the actual wait is done before the instruction is executed. These instructions are:

dbase()
exec()
execu()
getdig()
nwitime()
phremove()
phreserve()
quit()
setalk()
sleep()
sr_talkoff()
tfile()
tflush()
tic()

If any of these instructions are executed while there is speech queued for playing, the speech is played and the script waits for the play to complete before continuing on an executing the instruction. Playing speech also causes any touch tones that have been received by the script and not yet retrieved with **getdig()** to be thrown away unless the **setttfl()** instruction has been used to enable the “type_ahead” feature.

One exception, where a wait for speech is not caused, is when the **tflush()** instruction is used with its second argument set to 1. This causes any queued speech to be played and "spun off"; the script continues execution without waiting for the play to complete.

There is no timeout imposed by TSM on a wait for speech to finish playing. TSM depends on a message from VROP (or SPIP, in the case of Text-To-Speech [TTS]) to tell it when to resume script execution after the play has stopped.

There are other cases when a script waits for speech to play before continuing. One case is when the phrase buffer (or text buffer if using TTS) becomes full when no speech-flushing instruction has been executed. In this case, the next **talk()**, **tnum()**, or **tchar()** instruction (or **say()** instruction if using TTS) causes all speech in the buffer to be played and the script waits for the speech to finish playing before executing the instruction.

Another case is when a transition is being made between queuing coded speech (phrases) and text for TTS with no speech-flushing instruction between them. For example, executing the **talk()** instruction immediately after a **say()** instruction causes a wait while the text queued by **say()** is played before the **talk()** instruction is executed. A similar situation occurs when the order of the instructions is reversed (that is, **talk()** phrases are played before **say()** text is queued).

A **say()** instruction also waits if there are already two outstanding buffers of text that have been sent to the TTS SP card. (This can happen when "spinning off" text-to-speech with **tflush()**, see above.) When the SP is finished with one of the buffers, the script proceeds with the **say()** instruction.

Wait-Causing Instructions

Some instructions make a request of a process external to TSM and so cause the script to wait until that request is satisfied. In addition to causing a wait for a request to be satisfied, some of these instructions are also speech-flushing instructions (see above) and so may cause a wait for speech to finish playing before they are executed.

The wait-causing instructions are listed next. Refer to the descriptions of these instructions earlier in this chapter for more information.

- The **dbase()** instruction sends a message to a data interface process (DIP) and may wait for a return message. The **dbase()** instruction will not cause a wait if it is used to send a message to a DIP and not to receive one in return. (In this case, the number of bytes expected for the return message is set to a negative integer.) The timeout period for **dbase()** is 45 seconds by default. This may be changed with the **nwitime()** instruction.

- If the **getdig()** instruction is executed specifying a number of digits greater than that which has already been entered by the caller, the script will wait for the required number of digits to be entered. The **ttdelim()** instruction may be used to set delimiters which allow **getdig()** to accept variable length digit strings without waiting for a timeout. Two timeouts affect the **getdig()** instruction: an initial timeout and an interdigit timeout. Both of these timeouts are five seconds by default. The **tttime()** instruction may be used to change the default values.
- This **phremove()** instruction is used to remove a phrase from a talk file. The script waits for VROP to complete the request. The timeout period for **phremove()** is 45 seconds by default. This may be changed with the **nwitime()** instruction.
- The **phreserve()** instruction is used to reserve space in a talkfile for a phrase. The script waits for VROP to complete the request. The timeout period for **phreserve()** is 45 seconds by default. This may be changed with the **nwitime()** instruction.
- This **sleep()** instruction causes the script to wait for the specified number of seconds before continuing.
- This **talkresume()** instruction is used to play speech that is “remembered” for the channel by VROP (that is, played with the third flag of the **tflush()** instruction set to 1). As with **tflush()**, there is no timeout required for this instruction. VROP informs TSM when the playing has completed.
- The **tic()** instruction has several functions that constitute the interface between the script an the telephone network. Most **tic()** functions cause a wait condition while the function is being completed. The timeout period for **tic()** is 45 seconds by default. This may be changed with the **nwitime()** instruction or modified implicitly by some tic() functions (see tic() for more details).
- This **tstop()** instruction is used to stop all speech playing or coding activity on the channel. The script waits for a message indicating that such activity has stopped before continuing. The timeout period for **tstop()** is 45 seconds by default. This may be changed with the **nwitime()** instruction.
- This **vc()** instruction is used to do voice coding (recording speech from the caller). Two timeouts affect the **vc()** instruction: an initial silence timeout and an interword silence timeout. Both of these timeouts are five seconds by default. The **vctime()** instruction may be used to change the default values.

Avoiding Common Pitfalls with Wait Conditions

Once TSM is executing the instructions of a script, that execution proceeds uninterrupted until a wait condition occurs. Normally, at this point, script execution is suspended until the system function which required the wait is completed and the script resumes execution at the point where the wait occurred.

Several things can happen during a wait which may effect the script's execution after that point. When a script needs to wait, TSM returns to reading its message queue to process external events that effect the execution of all currently running scripts. The following is a list of some of the actions TSM may take:

- TSM may resume execution of a waiting script on another channel where the conditions of the wait have been satisfied or the wait has timed out.
- Instead of a wait condition being satisfied normally, TSM may receive another event for the channel, such as a caller disconnect, which will terminate the script.
- The MTC process may seize equipment being used by the channel causing the script to be terminated (if the seizure is done unconditionally).
- Touch tones typed by the caller are received by TSM and copied into the script's touch-tone buffer during a wait.
- Timing messages are received from the iCk process that decrement the timers of all running scripts. If a script's timer goes to 0 at this point, the wait is terminated with a timeout condition.
- Events that are handled by the **event()** script instruction may cause the current wait to be interrupted and script execution to be resumed with an interrupt subroutine (see the **event()** instruction for further details). When this is done, the script may return to the point of interruption (and resume the wait) if the interrupt routine has not caused a second wait condition. If the interrupt routine does cause a wait, the original wait condition will be disregarded and the script will continue at the next instruction after the point of interruption when the routine returns (using the **rts()** instruction).

NOTE:
One point of caution about using the **talk()**, **tnum()**, **tchar()**, or **say()** instructions in a script interrupt routine — these instructions queue up phrases or text in a buffer to be played when the next speech-flushing instruction is reached. TSM only has one such buffer that is shared among all channels. One buffer per channel isn't needed because the buffer is always flushed before the script does a wait. But if an interrupt routine puts phrases or text in this buffer *during* a wait and returns to resume the interrupted wait condition without flushing the speech, the speech will be played whenever any script — on any channel — executes a speech-flushing instruction. If it is necessary for an interrupt routine to play speech, a

tflush() should be completed before the interrupt routine returns to insure that the speech is played on the proper channel. To play speech without causing a wait in the interrupt routine use the second flag of **tflush()**, set to 1, to “spin off” the play before returning.

It is important to remember how timeout values apply to wait conditions. The **nwitime()** instruction may be used to change the general next wait instruction timeout (NWIT), which has a default of 45 seconds. This timeout value only applies to the next **dbase()**, **phremove()**, **phreserve()**, **tic()**, or **tstop()** instruction wait. It does not affect the timeouts of other wait-causing instructions that have their own specific timeout values (see "Wait-Causing Instructions" earlier in this chapter). Nor does it affect the wait for speech to finish playing, which has no practical timeout. The NWIT is reset to the 45 second default when the second instruction after **nwitime()** is executed.

Do not to let a wait condition separate a decision point in a script and its dependent action point if the decision is affected by what may happen in the system during the wait. An example of this is using the **scrinst()** instruction to take action based on the number of instances of a particular script running at a particular time. The **scrinst()** instruction returns the number of instances of a script at the time it is executed. If a wait condition is allowed between the **scrinst()** and the point in the script where action is taken based on the result of **scrinst()**, an unintended consequence may result because the number of scripts running may have changed during the wait. In this case, use **tflush()** before **scrinst()** to make sure that any wait for speech playing will not be done at a critical time and take care not to use any other wait-causing instructions in the critical interval. This is especially important when using the **exec()** instruction based on the result of **scrinst()** since exec() is a speech-flushing instruction. (see the description of **scrinst()** earlier in this chapter for an explanation).

Troubleshooting Scripts

This section contains information to help script writers make sure their scripts are working properly. Included are procedures for detecting problems in a script, possible problems found in scripts, and points to keep in mind when using specific instructions. The following points are discussed:

- Checking the status of talk instructions
- Erasing arguments in the ttdelim instruction
- Checking for string matching failures
- Losing touch-tones

Refer to *CONVERSANT VIS Version 4.0 Command Reference,* 585-350-209, for more information on the **trace** command.

Check the Status of talk Instructions

One or more talk instructions in a script cause a list of phrases to be played. If a failure occurs in the process of playing one or more phrases, the VIS software plays as many phrases as possible but returns an error code of -1 in r.0. When using the **tflush** instruction, the script writer can tell the script to check r.0 for the returned status.

When **talk** instructions are executed, the system queues phrases in a buffer, but the phrases are not immediately played. Phrases are played when:

- The script executes any wait-causing script instruction (the most common occurrence)
- The phrase buffer becomes full
- The **tflush** instruction flushes the buffer

In order to check the status of a list of phrases being queued, the script must examine r.0 immediately after one or more talk instructions have been executed. By entering the **tflush** instruction in the script, the status can be obtained immediately following one or more **talk** instructions. The **tflush** instruction, like other speech-flushing instructions, causes the phrases queued by the **talk** instructions to be played. But only **tflush** retains the returned status from playing phrases in r.0. The other instructions may overwrite r.0 with their own return status.

The following is an example of using tflush to examine the returned status of queued phrases:

```
talk (“Hello”)
talk (200)
talk (“Enter your ID”)
tflush()
jmp(r.0 < im.0,play_fail)
getdig(0, ch.ID, 4)
--
--
--
play_fail:
quit(3)
```

In this example, several phrases are queued as the result of the three talk instructions. The **tflush** instruction causes the phrases to be played. When the **tflush** instruction is completed, r.0 contains 0 if no errors occurred; otherwise, it contains -1. If no errors occur, the script collects touch tones by executing the **getdig** instruction. If there are errors in the playback, control jumps to the label play_fail.

It is recommended that the **tflush** instruction be used only after several talk instructions have executed, not after every talk instruction. Each time **tflush** is executed, two interprocess messages are sent: TSM sends a message to VROP which causes the phrases to be played and VROP returns a message to TSM which contains the status. These processes can delay playback of a script if **tflush** is used too often. A good rule to follow is to have one **tflush** instruction after every twelve consecutive **talk** instructions.

The **tflush** instruction is optional and does not have to be used. Its function is to allow the script writer to check the status when phrases are played.

Erase Arguments in the ttdelim Instruction

The following points must be kept in mind when using erase-character and/or erase-entry arguments in the **ttdelim** instruction.

1. If a **getdig** request asks for “x” touch tones and “x” are entered, neither this string nor the last character of this string can be erased using an erase-entry or erase-character, respectively. Once an input request for a specified number of touch tones has been satisfied, it is too late to perform an erase function. Hence erasing a string or the last character entered must be done before the last touch tone satisfying the input request has been entered.

For example, if a 5-digit string is requested, and a caller has entered 8275, it is possible at this point to erase the 5 in the string 8275. However, once another digit is entered, the result is immediately processed by the script. One exception arises and is explained as number 2 below.

2. If two touch tones are used as an erase character and/or erase-entry argument in the ttdelim instruction, the first touch tone of the argument should not be one that can be part of a “normal” input string.

   For example, suppose a script will accept a 5-digit ID as input. Normal input in this case consists of any 5-digit touch-tone string comprised solely of digits. Suppose that the following **ttdelim** instruction appears in the script:

ttdelim (’#’,’6#’,-1,-1)

Here, # is used to erase the last character and 6# is used to erase the last string entered.

Whenever the first character of a two-character erase argument is entered, the script always waits for another touch tone to be entered to determine if it is the second character of the two-character erase argument.

A problem arises with the preceding use of the **ttdelim** instruction. Assume that a caller enters 28136 in response to a request for five touch tones. The script will not immediately process these five touch tones. The system waits for a # to be entered because the 6 is the first of a 2-character erase argument. If the caller does not enter any more touch tones, the request for five touch tones “times out” and fails (that is, the **getdig** instruction fails). In this example, it is impossible to enter IDs that end with the digit 6.

To avoid this problem, use either single character erase arguments or, if 2-character erase arguments must be used, make sure that the first character cannot be part of a normal input string. The problem in this example can be solved by simply reversing the 6 and #. The new **ttdelim** instruction would be:

ttdelim (’#’,’#6’,-1,-1)

In this case, 28136 would be immediately processed by the script.

Speech String Matching Failures

Occasional speech string matching failures can occur when a “substituting” or abbreviated string in a **talk** instruction is searched in a list file when **tas** assembles a script. If the string fails to match, add one or more words to the string in the **talk** instruction until the string matches. The problem rarely occurs and is solved easily by adding one word or a few more words to the string.

Although the string matching algorithm has this small drawback, it is user-friendly in that it requires a minimum amount of effort on the part of the script writer to identify phrases in talk instructions. Rather than entire phrases in talk instructions, only a minimal substring that uniquely identifies the phrase in **talk** instructions is required.

Loss of Touch Tones

Script instructions can be grouped in two categories:

- Those that cause the touch-tone and phrase buffers to be flushed as a preliminary step before the instruction is executed. These instructions are the speech-flushing instructions listed earlier.
- Those that do not flush the touch-tone and phrase buffers

You also should be aware of two script instructions, **setttfl** and **ttclear**, that help to control touch-tone loss.

The decision to have certain instructions (those listed in the first category) flush the touch-tone and phrase buffers is based on the need to keep the caller and script “in sync.” Without flushing these buffers at certain points in the script (for example, after the speech-flushing instructions are executed), it is possible for the caller and script to get so far “out of sync” that the caller gets confused and must hangup and call again.

To illustrate this situation, consider the following example where touch tones are not flushed periodically.

A script prompts a caller to enter the following:

— A 4-digit id

— A 2-digit code to select from services described by the script

— A 1-digit code for additional information on a specific service

In response, the caller enters the following touch-tone sequence:

8225
31
6

These touch-tone sequences identify customer 8225 requesting service 31 and entering 6 to obtain various prices of this service. When callers become familiar with a script, they often enter touch tones before the script prompts for them. If all touch tones are retained and not flushed periodically, it is possible for the script to understand all the touch tones entered ahead of the script. However, when callers enter incorrect touch-tone sequences, it is difficult for both the script and the caller to take immediate corrective action. For example, suppose a caller enters the following touch-tone sequences before the script asks for them:

8225
37
6
14
2
88
5

If the entry 37 identifies a valid service but the caller meant to enter 31, then it is difficult for the script to recover from an error. If all touch tones are retained, they will be processed and the caller cannot stop the processing. Moreover, the caller may not realize there is an error and be confused by what the script plays back. The script and the caller become farther “out of sync.”

Situations like the one just described can be prevented by clearing the touch tone buffer periodically. Experience has shown that this is generally a more user-friendly approach. Although touch tones are occasionally lost if users enter them too far ahead, the only penalty is that users must re-enter a single response. However, the main advantage of periodically flushing the touch-tone buffer is that it makes writing scripts simpler. If all touch tones are retained, the variety of error-recovery situations that occur is large and nontrivial if it must be done in the script. If the touch tone buffers are flushed, the script writer is relieved of the addressing error-recovery situations in the script. The **setttfl** instruction can be used to prevent touch tones from being flushed. Refer to the description of this instruction earlier in this chapter.

Data Interface Process

5

What's in This Chapter

This chapter describes the standard interface between a data interface process (DIP) and the transaction state machine (TSM) scripts and the Logger/Alerter. It also details the pieces involved in writing DIPs, including the C-library functions and TSM script instructions.

This chapter assumes the following:

The C-development software is installed.

You are familiar with C-language programming in a UNIX operating system environment.

Introduction to the Data Interface Process

In any application, TSM scripts control how a call is handled. Decisions and actions such as answering the phone or collecting touch-tone digits are specified using the TSM assembly-like language. However, TSM scripts alone cannot handle a significant number of applications that need to access external data from files or a database or perform complex numerical calculations. A DIP provides these capabilities. In fact, DIPs provide all the resources of C-language programs and the UNIX operating system to scripts.

A process is a program that is currently running in the system. TSM, Logger, Alerter, and DIPs are examples of processes. Figure 5-1 shows typical interaction between a DIP and other processes in the voice system software

Figure 5-1. Data Interface Process Architecture

Generally, a DIP interacts with:

1. TSM scripts
2. Additional resources (for example, a database, or host computer)
3. The Logger

DIPs are usually message driven, meaning they sit and wait until a message arrives before taking any action. Once a request is received from a TSM script, for example, the DIP processes the message and returns the results to the corresponding TSM script.

The overlapping circles in Figure 5-1 indicate that a DIP can have multiple copies of itself running and reading from the same message queue to allow for faster servicing of requests.

Message Queues

DIPs talk to TSM scripts through UNIX system interprocess communication (IPC) messages queues. IPC message queues are similar to mailboxes behind the registration desk in a hotel.

The voice system acts as the hotel, the guests correspond to the DIPs, and the attendant at the desk is TSM. The DIPs have their own separate mailboxes (messages queues) for receiving messages sent by other guests or outsiders.

Data (messages) are passed between DIPs and TSM scripts through these mailboxes. DIPs leave messages to TSM scripts in TSM's pre-defined mailbox. TSM then reads, sorts, and distributes these messages to the appropriate script, just as the attendant distributes messages left for guests at the front desk of the hotel.

The voice system has a total number of 95 message queues (mailboxes) available, numbered from 1 through 95. These numbers, known as message queue keys (Qkeys), serve to uniquely identify individual message queues.

The voice system Qkeys are subdivided into:

- Voice system processes: 119
- Hardcoded DIPs: 2054
- Other processes: 5563
- Dynamic processes (including DIPs): 6495

Hardcoded and dynamic DIPs are discussed in the next portion of this chapter.

For More Information about Message Queues...

For additional information about UNIX System Message Queues, refer to the *UNIX System V/386 Release 3.2 Programmer's Guide Volume 1*. For additional information about UNIX programming features, refer to the *UNIX System V/386 Release 3.2 Programmer's Reference Manual*. You may order these books from:

AT&T Customer Information Center
Customer Service representative
P.O. Box 19901
Indianapolis, IN 46219
1-800-432-6600

Use the order number 307-074 to identify this book.

The following book may be purchased at a commercial bookstore:

Advanced UNIX Programming
Rochkind
Prentice-Hall ISBN 0-13-011800-1

Types of DIPs

There are two types of DIPs: hardcoded and dynamic. You may have both co-existent in your system. The only difference between these two types of DIPs is the manner in which they are assigned their message queue number. A hard-coded DIP has a pre-defined message queue, or DIP number, in its C-code. Going back to the hotel example, it is similar to selecting a mailbox without first checking at the registration desk to make sure no other guest is using that mail-box. DIPs reading from the same message queue will interfere with each other.

Dynamic DIPs (DynaDIPs) avoid this type of conflict by *asking* the voice system for an available message queue at run-time. That is, DynaDIPs do not know what message queue they will have until they are run each time on the voice system.

Each DynaDIP gives its DIP name and instance number to the system and a unique, unused Qkey is returned. DIPs using the same name receive the same Qkey from which to read, allowing for DIPs that are instances of each other. In this case, the DIPs intentionally read from the same Qkey because they are instances of one another. However, the case where two unrelated DIPs use the same name and then read from the same Qkey should be avoided. Using unique names instead of numbers (Qkeys 195) reduces the chances of clashes between two unrelated DIPs.

NOTE:
It is strongly recommended that you use DynaDIPs instead of hardcoded DIPs for the reason given on the previous page.

Message queue assignments remain in effect and are fixed as long as the voice system is running, despite DynaDIPs dying or respawning. Restarting the voice nystem removes these assignments, as the name "Dynamic" DIPs stresses the fact that their message queues are dynamically assigned and probably will change across restarts of the voice system.

The voice system allows up to 32 dynamic and 35 hardcoded DIPs. However, the following caveats apply:

1. The type of work DIPs and other processes do affect the performance of the system. Thus, the actual number of DIPs that can run with acceptable performance might be less than 32 dynamic and 35 hardcoded DIPs.

2. The voice system tunes the UNIX system for a maximum of 75 processes running at one time. You might need to increase this tunable parameter to fit all your DIPs and all the other processes in your specific system. (See Appendix D, "Information for Advanced Users," of *CONVERSANT VIS Version 4.0 Operations,* 585-350-703, for information about tuning your system.)

Bulletin Board

The bulletin board (BB) is an area of memory used for registering voice system processes and DIPs. Expanding again on the analogy of the voice system as a hotel for DIPs and other processes, the BB is like the registration book of this hotel. Before interfacing with any other process, DIPs start and register themselves by DIP name, instance, number, and assigned Qkey in the BB. Each DIP instance is assigned one of the fixed number of available slots. There are 111 slots: slots 179 are reserved for hardcoded processes and slots 80111 are for dynamic processes. Slots cannot be shared even if the DIPs share the same message queue.

DynaDIPs must register in the BB, as they can only receive a dynamically assigned message queue after "checking-in" at the front desk.

When the voice system starts, there is a typical influx of DIPs trying to register themselves at the same time. Registration is done in an orderly first-come first-served basis, as in a well-run hotel.

Besides getting an assigned, unused Qkey, there are two other advantages to posting a process in the BB:

- A process is protected from having duplicate copies of itself running. That is, only one process is allowed to run with a specified name and instance.
- Based on the rules supplied in the **iCk.rules** file (**/vs/data/etc/iCk.rules**), **iCk** checks all processes specified by the rules file to determine if they are “stuck” or not. Being “stuck” means that they have started processing a message and have not completed the process in the period of time specified by the rules file. If a process is stuck, **iCk** will respond in one of three ways, it will report the process to the logging system, report the process and kill it, or report the process and then excute a specified command to correct the issue.

Bulletin Board Slots

It is possible that, in time, the bulletin board may be filled with posted processes, preventing your process from being posted.

Use the **bbs** command to display the contents of the bulletin board and to determine if it is full. Remember that slots 80111 are for DynaDIPs. If the bulletin board

Slots are full, stop, then start the VIS usually frees some slots so that you can post your process.

Writing the DIP

A DIP must be able to send and receive messages to and from TSM. A DIP may send any errors or other information to the Logger. DynaDIPs send/receive messages using the method, format, and library function as hardcoded DIPs. Messages are sent to/received from the appropriate Qkey by specifying the corresponding Qkey. The Qkey must be known before any message can be sent or received.

Designing a DIP includes the following:

1. Write the C-code to define the data to be passed between the DIP and the TSM script.
2. Initialize the DIP to the voice system.
3. Write the C-code to send/receive/process messages.
4. Write the C-code to implement the application-specific processing.
5. Define and add Logger errors in the voice system.
6. Add error reporting C-code to notify the Logger of errors.
7. Add C-code trace messages.
8. Compile the DIP.
9. Execute the DIP.

Steps 13, and 79 are covered in detail in this chapter. Steps 5 and 6 are covered in Chapter 6, "Adding and Modifying System Messages". Step 4 is the responsibility of the application developer.

Examples provided here are used in the template for writing a DynaDIP. See the “DIP Sample” in Chapter 9, "Application Example".

Defining Data to be Passed Between DIP and Script

Before writing the actual DIP, you must first define the data that is to be passed between the DIP and the TSM script. First, the data to be sent is packaged or formatted as a message just like a letter is enclosed in an envelope. Once sent, the recipient gets the data by unpackaging the message, or opening the envelope.

Message Format

Messages are defined generally in two parts: the header and the application-specific data. Both of these parts are specified in C-language structure. The header contains information about the addressee or sender, the voice channel number associated with the message, and the message id, as shown in the following figure

Figure 5-2. Voice System Message Components

Header Components

In the message header file (**mesg.h**), the voice system defines the header structure of IPC messages for DIPs and voice system processes. The following figure displays the header structure for these IPC messages.

```
struct mbhdr {
long     mtype;   /* Message type */
long     mchan;  /* Channel number */
short    morig;   /* Sender's Qkey */
short    mcont;  /* Message id */
unsigned short mseqno /* Message sequence number */
};
```

Figure 5-3. Message Header Structure

The fields in the structure are as follows:

- The mtypef field allows more control over the destination of messages. This field is used only when sending messages from one DIP to another. Refer to the appendices of this book for additional information.

  NOTE:
  The mtype field must be a positive non-zero number. Set it to one if you do not plan to use it.

- The mchan field refers to the channel number that determines which TSM script is to receive the message. Messages sent from a DIP to TSM are routed to the TSM script running on the specified channel. This field originally is set by TSM and must be returned to TSM.

- The morig field specifies the Qkey of the sending or originating process. Remember that a DIP's Qkey is returned by **VSstartup** for DynaDIPs or is defined for a hardcoded DIP from the list in **mesg.h**. This must be used for returning a message to the sending process.

- The mcont field specifies what type of data is contained in the message, which allows the handling of messages with data of all shapes, sizes, and meanings. Without this message id, the recipient would not know what kind of the data is received.

  By convention, message ids are unique across all applications. A complete list of message ids used by the voice system is found in **/att/msgipc**. For each interface involving two processes (proc1, proc2) talking to one another, applications should define a header file with the following format:

  proc1_proc2.h

  where proc1 and proc2 are the names of two processes talking to each other.

- The mseqno field allows more control over the sequencing of messages. This field is not used often. Refer to the appendices of this book for additional information.

Data Components

The application-specific data part of the message follows the header. The application is free to shape and size the data in the way it chooses within system-imposed limits. For every different type of data sent and received, there is a corresponding structure and unique message id. A complete set of messages to be sent or received can be represented in C-language by a union of message structures as shown in the following figure. This figure uses an example from a stock application.

```
/* Define all message structures that can be received.
/
struct stockInfo {
struct mbhdrhd;
intstockid;
};
struct callerInfo {
struct mbhdrhd;
charcallerName [30];
intcallerId;
};
/* Define the union of all the possible message structures
* that can be received.
*/
union rcvMsg {
struct ms_univ u;/* standard message */
struct stockInfo stock;
struct callerInfo caller;
};
```

Figure 5-4. Message Structure Union Example

Figure 5-4 shows the union of received message (rcvMsg). Note that this message structure is as large as the largest message expected in the application, thus it can be used to hold any message read. Similarly, the set of messages to be sent can be defined in another union.

The union example contains the message structure **ms_univ**, defined in **mesg.h**, that consists of four long integers as shown in the following figure.

```
/* universal structure for passing a message */
struct ms_univ {
struct mbhdhd;
longarg[4];
};
```

Figure 5-5. Standard Message Structure

This type of message in Figure 5-5 is sent/received often in the voice system.

Initializing

When starting up, a DIP should:

1. Identify itself to the voice system by posting itself in the BB
2. Set up the tracing facility
3. Receive its assigned message queue, if it is a DynaDIP

Two C-library functions (**VSstartup** and **startup**) are available to perform the above activities. These two functions are identical, but **VSstartup** is used for DynaDIPs and **startup** for hardcoded DIPs.

DynaDIPs

VSstartup

VSstartup is called once to initialize a process to the VIS. VSstartup takes the DIP name, its instance, and a DIP flag. DIP Flag can take one of two values, constants DIP_PROC or NONDIP_PROC. Setting the flag to the constant DIP_PROC allows the DIP to send and receive messages to and from TSM scripts. If the flag is set to the constant NONDIP_PROC, messages sent by the DIP to TSM scripts are ignored by TSM. An assigned Qkey is returned if successful as in Figure 5-6. A negative value is returned if an error occurs.

Figure 5-6. VSstartup Input and Output

The DIP name should be a unique printable name of up to 15 characters.

The following figure displays the **VSstartup** synopsis in C-code for the dynamic DIP.

```
#include <sys/types.h>
#include "VS.h"

key_t VSstartup (dipName,instance,flag)
char *dipName;/* unique name associated with process */
short instance;/* process instance */
long flag;/* Will DIP talk to TSM scripts? */
```

Figure 5-7. VSstartup Synopsis

For additional information on **VSstartup**, refer to Appendix B, "Voice System C-Library Functions".

VStoqkey and VStoname

After posting themselves in the BB using **VSstartup**, DynaDIPs must retrieve the Qkeys of all other DIPs to which they send messages. The function **VStoqkey** converts DIP names to their assigned Qkeys and the function **VStoname** converts Qkeys to DIP names, as shown in Figures 5-8 and 5-9.

Figure 5-8. VStoqkey Input and Output

Figure 5-9. VStoname Input and Output

Figures 5-10 and 5-11 display the **VStoqkey** and **VStoname** synopsis in C-code for the dynamic DIP.

```
#include <sys/types.h>
#include "VS.h"

key_t VStoqkey (dipName)
char*dipName;/* unique name associated with process */
```

Figure 5-10. VStoqkey Synopsis

```
#include <sys/types.h>
#include "VS.h"

char *VStoname(Qkey)
key_tQkey;/* message queue key */
```

Figure 5-11. VStoname Synopsis

For additional information on **VStoqkey** and **VStoname**, refer to Appendix B, "Voice System C-Library Functions".

VSerror

VSstartup and **VStoqkey** may return one of a set of negative values when an error occurs. At this point, **VSerror** can be called to retrieve a text description of the error. **VSerror** is passed the negative error value and returns a character string describing the error so that a DIP can log or display the error. Figure 5-12 displays the **VSerror** synopsis written in C-code for the DIP.

```
#include <sys/types.h>
#include "VS.h"

char *VSerror (errid)
interrid;/* negative error value */
```

Figure 5-12. VSerror Synopsis

For additional information on **VSerror**, refer to Appendix B, "Voice System C-Library Functions".

Hardcoded DIPs

startup

The **startup** function is called once to post a hardcoded DIP to the BB. As shown in Figure 5-13, **startup** takes the Qkey and slot_offset.

```
#include "spp.h"

int startup (qkey,slot_offset)
intqkey; /* Message qkey of calling process */
intslot_offset; /* used to get slot for posting */
```

Figure 5-13. startup Synopsis

In **startup**, the DIP tells the voice system what Qkey should be assigned to it. Hardcoded DIP Qkeys range from DIP0 to DIP34 and, using one of these Qkeys, makes the DIP a message-sending DIP to TSM.

The *slot_offset* argument is used by **startup** to post the DIP in a specific slot in the BB. The *slot_offset* argument is the responsibility of the DIP writer, as it must be known what slots are available for posting hardcoded DIPs. With the increased use of hardcoded DIPs by the voice system, the chances of clashing with other DIPs is possible.

NOTE:
Be aware that other applications may utilize the same hardcoded DIPs causing a clash.

A list of current hardcoded DIPs that the voice system uses is included at the end of this chapter.

Startup computes the slot to post the DIP in from the *slot_offset* argument in the following manner:

slot = slot_offset + DIPSTART

DIPSTART is defined in the file **shmemtab.h** as 32. Slots reserved for hardcoded DIPs in the range 3266, so that the *slot_offset* given should range from 034 (the range of DIP numbers).

The voice system DIPs use the following convention to compute their corresponding *slot_offset*:

slot_offset = Qkey - DIP0 (where DIP0 is defined as 20 in **mesg.h**)

For additional information on **startup**, refer to Appendix B, "Voice System C-Library Functions".

Sending/Receiving Messages

The following sections describe how to send and receive data between DIPs and other processes.

mesgsnd

Once the data is packaged as a message, it can be sent using the C-library function **mesgsnd**. As shown in Figure 5-14, **mesgsnd** takes a pointer to the message msgp of size msgsz bytes and sends it to the message queue identified by the Qkey mdest.

```
#include "spp.h"

int mesgsnd (mdest,msgp,msgsz,msgflag)
intmdest;/* Message Qkey to send to */
union msgunion *msgp;/* message to send */
intmsgsz;/* size of message */
intmsgflag;/* flag for controlling send */
```

Figure 5-14. mesgsnd Synopsis

The *msgflag* argument is passed directly to the UNIX system call **msgsnd**, (see the *UNIX System V/386 Release 3.1 Programmer's Reference Manual*) and is used to determine the actions to take in case of an error. This flag is usually set to zero. For more information about the C-compiler, refer to the *UNIX System V/386 Release 3.1 Programmer's Reference Manual*.

The **mesgsnd** function returns a zero upon successful completion. Otherwise, a negative value is returned. For additional information on **mesgsnd**, refer to Appendix B, "Voice System C-Library Functions".

The **mesgsnd** function creates the message queue if necessary.

mesgrcv

The **mesgrcv** function reads the message from the message queue specified by Qkey (morig) into a buffer pointed to by mesgp of size msgsz bytes as shown in Figure 5-15. The **mesgrcv** function creates the message queue if necessary.

```
#include <sys/types.h>
#include <sys/msg.h>
#include <sys/ipc.h>
#include "mesg.h"
#include "spp.h"

int mesgrcv (morig,msgp,msgsz,msgtyp,msgflg,msgrtime)
intmorig;
char*msgp;/* message buffer */
intmsgtyp;/* type of message to read */
intmsgsz;/* size of message buffer */
intmsgflg;/* control flag */
long*msgrtime;/* message receive time */
```

Figure 5-15. mesgrcv Synopsis

Since the size of the message varies and is unknown before reading, the message must be read into a buffer that is large enough to accommodate the largest known message. This assures that all known messages are received properly without being truncated or discarded altogether.

The **mesgrcv** function also allows a DIP to read messages of a particular type (*msgtyp*). The type of message is defined in the field *mtype* in the header **mbhdr**. To read the first message on the queue regardless of its *mtype*, set the msgtyp field to 0.

The msgflag field represents a set of flags that control how **mesgrcv** reads the messages. By default **mesgrcv** waits indefinitely for a message of a specified type to arrived if none are on the queue. Many DIPs and voice system processes prefer this because they are message-driven. However, the msgflag field allows you specify that you do not wish **mesgrcv** to wait for a message to arrive. Currently, the flags are:

- IPC_NOWAIT — If on, **mesgrcv** returns immediately even if no message has arrived. If off (not specified, or 0), mesgrcv “sleeps” until a message arrives.
- MSG_NOERROR — If on, **mesgrcv** truncates the received message to msgsz bytes if necessary.
- IPC_GTIME — If on, **mesgrcv** returns the UNIX time in seconds when the message was read. The mesgrtime field must point to a long if IPC_GTIME is specified; otherwise, set it to NULL.

The msgflag field is formed by bit applying the Boolean "OR" operation (the C OR operator is |) to turn on all flags. For example, to wait for a message and obtain the time the message was read, compute and pass the following:

IPC_GTIME | IPC_NOWAIT.

IPC_GTIME is defined in **mesg.h** and IPC_NOWAIT is defined in **ipc.h**. If no flags are to be turned on, set msgflag to zero (0).

The **mesgrcv** function returns the number of bytes read upon successful completion. Otherwise, a negative value is returned. For additional information on **mesgrcv**, refer to the Appendix B, "Voice System C-Library Functions". For additional information on the UNIX system call **msgrcv**, refer to the *UNIX System V/386 Release 3.1 Programmer's Reference Manual*.

Talking to TSM Scripts

Usually, a TSM script initiates the interaction by sending a message to the DIP, which then responds with the information requested. Messages sent by TSM scripts have TSM as the sender and the channel number of the TSM script.

NOTE:
The channel number (mchan) must be saved by the DIP for responding to the appropriate TSM script later.

A DIP reads the message using **mesgrcv** and decides what action to take based on the message id (mcont). The message id is set by the TSM script through the instruction **dbase**. Typically, the DIP contains a switch statement on the message id with specific cases for all known message ids.

DIP Interrupt

Sometimes a DIP initiates the interaction between itself and a TSM script. This is done by sending the DIP interrupt message id defined in **tsm_dip.h**, which interrupts the TSM script instruction currently executing. See "Flow Control Instructions" in Chapter 4, "Script Instructions", for additional information.

TSM Scripts Talking to DIPs

TSM scripts send and receive messages to and from DIPs through TSM. TSM packages and unpackages the message for TSM scripts. That is, TSM scripts only work with the data part of the message while TSM takes care of either adding or removing the header part, depending on whether the message is sent or received by the script. When sending a message, TSM sends the data in the specified script memory area, and when receiving message, TSM places the data received from a DIP into the specified script memory area.

A TSM script is responsible for:

- Allocating script user memory for holding the largest data being sent or received. Typically, two separate buffers are allocated: one for receiving and the other for sending.

- Inserting the appropriate data into the buffer before sending it to a DIP
- Extracting and accessing the data from the buffer after receiving the data from a DIP

The four functions (**dbase**, **dipterm**, **dipname**, and **dipnum**), describe how a TSM script accomplishes these tasks.

dbase

Both the sending and receiving of data is done through the **dbase** instruction. **Dbase** first sends the data, then waits for a response from the specified DIP. Responses or messages from DIPs other than the specified DIP are thrown away by TSM.

The **dbase** instruction, when used in the case of DynaDIPs, allows the DIP argument to be the DIP name as well as the DIP number. The DIP name is specified using the TSM script language syntax for character strings.

For additional information on **dbase**, refer to Appendix A, "Summary of Script Instructions".

dipterm

As with the **dbase** instruction, **dipterm** allows the DIP argument to be the DIP name as well as the DIP number. **dipterm** instructs TSM to send a message to the specified DIPs when the TSM script terminates.

The **dipterm** message is defined as the C-structure **struct ms_univ** (see **mesg.h**). Figures 5-16 and 5-17 show the fields of the message and their values as set by TSM.

```
/* message structure for dipterm message */
struct ms_univ {
struct mbhdrhd;
longarg[4];
};
```

Figure 5-16. dipterm Synopsis

Figure 5-17. dipterm Message Structure

arg[0], as shown, displays why the script terminated. As defined in **tsm_dip.h**, there are several causes for a script to terminate.

NORMAL TERM	A quit instruction in the script was executed.
DISCONTERM	The call was disconnected.
SCRFAILTERM	An error occurred in the script code.
LOOPTERM	The script appears to be stuck in an infinite loop.
MTCTERM	The MTC process has seized the channel that the script is running on.
EXECTERM	The script exec'ed another script.

arg[1] is set to the value specified in the **quit** or **exec** instructions.

For additional information on **dipterm**, refer to Appendix A, "Summary of Script Instructions".

dipname

The **dipname** function takes a DIP number and converts it to the corresponding DIP name, as shown below:

dipname**(*ctype.dst,type.src*)**

The returned DIP name character string is stored in the specified destination address. The destination area should be 16 bytes: 15 characters for the DIP name plus 1 character for the null termination symbol.

dipname is primarily for converting the DIP number returned when a DIP interrupt occurs. This allows scripts working at the DIP-name level to continue by converting the DIP number of the DIP that interrupted them.

dipname returns a negative value if an error occurs during translation.

For additional information on **dipname**, refer to Appendix A, "Summary of Script Instructions".

dipnum

dipnum converts a DIP name to its corresponding DIP number, as shown below.

dipnum*(type.dst,ctype.src)fP*

dipnum returns a negative value if an error occurs during translation.

For additional information on **dipnum**, refer to Appendix A, "Summary of Script Instructions".

Tracing DIPs

DIPs can be traced by embedding debug information in the DIP and displaying it via the **trace** command. The debug information should be strategically placed in the DIP code, then when the DIP is running, issue the **trace** command from the shell command line to print debug information on your terminal as it is executed in the DIP code.

The trace Command

The **trace** command allows tracing of specified processes and channels. **Trace** displays the trace messages on standard out (stdout) that are executed by the specified processes after trace was invoked. For example to trace TSM, channels 0-5, and DIP frankenstein, enter the following at the command line:

trace tsm ch 0-5 frankenstein

Any number of processes and channels can be traced, but only one trace should be running at any one time. Having two trace commands running concurrently causes a sporadic and confusing display of trace messages.

See *CONVERSANT Voice Information System Version 4.0 Command Reference,* 585-350-209, for additional information on the **trace** command.

db_pr

The **db_pr** library function applies a variable number of arguments to the format string to form the output trace string as shown in the following figure.

```
#include <spp.h>

int db_pr (format, arg ...)
char*format;/* printf format string */
```

Figure 5-18. db_pr Synopsis

db_pr trace messages are written to the internal trace buffer and displayed only if tracing is turned on for the corresponding DIP or process. Otherwise, trace messages are ignored while the DIP executes. It is recommended that you use **db_pr** for trace messages because **db_pr** writes to the internal trace buffer only the messages of the processes that currently are being traced. Messages from other processes not being traced are discarded.

NOTE:
Although the **db_pr** structure is identical to the **printf** function, use **db_pr** for DIPs that have user interfaces instead of **printf** because it allows a more controlled method of output.

For additional information on **db_pr**, refer to Appendix B, "Voice System C-Library Functions".

db_put

The **db_put** library function applies a single string of of argument and displays it as shown in the following figure.

```
#include <spp.h>

int db_put (string)
char*string;/* string to write out */
```

Figure 5-19. db_put Synopsis

db_put trace messages are displayed when tracing is on, regardless of what processes are being traced.

For additional information on **db_put**, refer to Appendix B, "Voice System C-Library Functions".

Reporting Errors to the Logger/Alerter

Using the **logMsg**, **vlogMsg**, or **logSysError** library function, a DIP can report errors or log data to the voice system logging and alertering subsystem. The errors are displayed as part of the Message Log Report of the Voice System Administration menu.

```
#include <varargs.h>/* Required if vlogMsg() is used */

#include "prismDefs.h"
#include "log.h"
#include "systemLog.h"
#include "log{CLASS}.h"

char *logMsg (msgID,EL_FL,[args ...])
intmsgID;/* value of mnemonic #defined for error type */
 EL_FL;/* macro defining __FILE__,__LINE__ */
{type} {arg}/* variable # of arguments required by msg */
char *vlogMsg (msgID,EL_FL,argp)
intmsgID;       /* value of mnemonic #defined for error type */
 EL_FL;/* macro defining __FILE__,__LINE__ */
va_listargp;/* pointer to arguments */
char *logSysError (EL_FL,fmt,[args ...])
 EL_FL;/* macro defining __FILE__,__LINE__ */
char*fmt ;/* "printf()" format of supplemental information */
{type}{arg} ;“Any arguments required by "fmt" */
```

Figure 5-20. logMsg Synopsis

Refer to Chapter 6, "Adding and Modifying System Messages", for complete information on adding, deleting, and/or modifying Logger/Alerter messages for your DIP.

Message ids defined by the DIP are inserted in the header file **logAPPL.h** residing in the **/usr/spool/log/head** directory. A format for each message id error must be defined in the format file **APPLmsg** found in **/usr/spool/log/formats**.

The three routines above do one or more of the following things with the message. First they look up the assigned message priority and destinations in the shared memory constructed from the **msgDst.rules** file that is found in the **/usr/spool/log** directory. Then they format it for human consumption and return the formatted message to the calling routine and/or send it to the standard error output, or send it to the **logdaemon** processs. No acknowledgement or indication of failure or success is returned. **logdaemon** receives the error message and distributes it as required by the destination mask in the message.

Compiling a DIP

The DIP source program is compiled in a standard method using the C-compiler (cc) to include the voice system header files and to link the voice system library **libspp.a** residing in the directory **/vs/lib**. The voice system header files (**mesg.h, VS.h, shmemtab.h**) reside under **/att/include** and **/att/msgipc** and **/usr/spool/log/head.**

For example, to create the executable version of DIP bugsbunny.c, enter the following:

cc -I/att/include -I/att/msgipc -I/usr/spool/log/head -o bugsbunny bugs bunny.c /vs/lib/libspp.a /vs/lib/liblog.a /vs/lib/libprism.a

NOTE:
The backslash at the end of the first line indicates that this should appear entirely on one line in the file.

Once the executable version is created, you can start it manually from the shell command line or automatically through the **inittab** file.

For more information about the C-compiler, refer to the *UNIX System V/386 Release 3.1 Programmer's Reference Manual*.

Auto Startup Via inittab

A DIP can be started and managed automatically by the UNIX system process **init** if it appears in the **/etc/inittab** file. If you display the **inittab** file, entries for the Voice System processes like TSM, logdaemon, and iCK are shown. Typically, one entry is made for each process to run. An entry in the **inittab** files consists of fields separated by colons (:) that allow you to specify:

1. A unique label to identify the entry
2. The run-levels to run the program. Voice system processes and most DIPs use run-level 4.
3. Whether the program is to be run once only or re-run if it dies

The following is an example for a DIP called pinnochio that runs at run-level 4, is re-run if it dies, and is labeled PI1.

```
PI1:4:respawn:/local/bin/pinnochio > /dev/null 2>&1
```

The **start_vs** command rebuilds the modified **inittab** file by concatenating all the files in **/etc/conf/init.d**. In order for your entries to be permanent, place them in a file in the **/etc/conf/init.d** file, then restart the voice system.

Troubleshooting

This section provides some guidelines for detecting problems with your newly created DIP. Although not a thorough treatment, this information gets you started when processes within the Voice System appear to be stuck.

- Message queues

  Look for message queues that have unread messages. This may indicate a stuck process or DIP. Use the **ipcs** command to display the current status of the message queues. Refer to the *UNIX User and System Administrator Reference Manual* for more information about the **ipcs** command.

- Semaphores

  A semaphore can lock up the system if processes are waiting for its release that never happens. One semaphore is used for each posted process in the BB. Use the **ipcs** command to display the current status of the semaphores. Refer to the *UNIX User and System Administrator Reference Manual* for more information about the **ipcs** command.

- Bulletin board

  Use the **bbs** command to display the posted processes in the BB. See *CONVERSANT Voice Information System Version 4.0 Command Reference,* 585-350-209, for additional information.

- DIP and TSM scripts

  In **mesgsnd, mesgrcv**, or **dbase**, the sender and receiver may be reversed or the DIP may set the **mchan** value improperly in the return message to TSM. Use the **ipcs** command to display the current status of the DIP. Refer to the *UNIX User and System Administrator Reference Manual* for more information about the **ipcs** command.

- Number of processes

  If your trying to run a DIP and the system displays a message similar to:

  ```
  cannot fork: too many processes
  ```

  you may need to increase the maximum number of processes that are allowed. See the information earlier in this chapter on the "Types of DIPs" for details on how to tune your system to handle more processes.

Voice System Hardcoded DIPs

The following tables show the current hardcoded DIPs used in the voice system. The DIP name and number are listed, as are the software packages that interface with each DIP. The DynaDIPs are listed as “available,” meaning they are not used to interface solely with one software package. Also be aware that some of those marked available are actually called by other packages. If you do not have a certain package installed on your system, that hardcoded DIP will not be occupied. For example, DIP8 will be available if AUDIX Voice Power® is not installed on your system.

Table 5-1. Voice System Hardcoded DIPs 1 of 3

DIP Name	DIP #	Package
agdip3270	DIP0	Host
oraldb	DIP1	Local Database
vmdip	DIP2	AUDIX Voice Power
rptdip	DIP3	AUDIX Voice Power
Spadm DIP	DIP4	Speech Admin
sys_stat	DIP5	CVMS Interface
mtcxmtr	DIP6	CVMS Interface
asaihp	DIP7	ASAI
RADMDIP	DIP8	AUDIX Voice Power
ADMDIP	DIP9	AUDIX Voice Power
xferdip	DIP10	Call Bridge
agdiphelper	DIP11	Host

Table 5-2. Voice System Hardcoded DIPs, continued

DIP Name	DIP #	Package
	DIP12	available
	DIP13	available
	DIP14	available
	DIP15	available
	DIP16	available
	DIP17	available
	DIP18	MTC
	DIP19	VROP
	DIP20	available
mdp	DIP21	AUDIX Voice Power
	DIP22	available
	DIP23	available
swindcp	DIP24	AUDIX Voice Power
faxcng	DIP25	AUDIX Voice Power

Table 5-3. Voice System Hardcoded DIPs, continued

DIP Name	DIP #	Package
dc.sh	DIP26	Chan 0
		Data Collection
dc.sh	DIP27	Chan 1
		Data Collection
dc.sh	DIP28	Chan 2
		Data Collection
dc.sh	DIP29	Chan 3
		Data Collection
dc.sh	DIP30	Chan 4
		Data Collection
ocdip	DIP31	AUDIX Voice Power
	DIP32	Voice
		Workstation
	DIP33	available
	DIP34	available

Adding and Modifying System Messages

6

What's in This Chapter

This chapter contains:

- Logger environment overview
- Using logger messages in user DIPs
- Adding and changing system message explain text

Logger Overview

The following section details concepts of the CONVERSANT logger and procedures needed to add messages to the CONVERSANT logger.

Logger Road Map

The logger provides facilities which allow UNIX processes to log messages to predefined destinations with desired priorities (refer to Chapter 3, "Configuration Management," of *CONVERSANT VIS Version 4.0 Operations,* 585-350-703. Messages are logged from processes coded as C programs, for example, custom data interface processes (DIPs).

Logger messages are typically used to alert administrators or operators of errors encountered by the calling process as calls are processed. For example, a DIP may report an error to the logger if it got a message from a script that it does not understand. Logger messages can also be used to inform administrators and

operators of events completed by the calling process. For example, a DIP may report to the logger that is has successfully started and initialized itself.

There are several steps involved in coding logger messages in custom software. After points in the source code where logger messages are needed have been identified, the exact structure and wording of the message must be determined. This includes determination of what text should be "hard coded" in the messages and what text should be variable, that is, provided by the process at run time. Variable text might include such things as an error code, channel number, or a reason string, and may be a character string or integer.

System message format text appears in the ***{CLASS}*msg** files found in the **/usr/spool/log/formats** directory. Customer DIPs must use the **APPLmsg** format file.

CAUTION:
*No other **{CLASS}msg** files should be modified. Doing so could render the entire logging system inoperable or produce unintelligible messages in the log files.*

All messages in the logger system are organized internally by an indexing scheme. The logger header files found in **/usr/spool/log/head** provide the index of the logger message to the C program sending the message. Entries in the logger header files provide the internal index to the DIP. All definitions for customer DIPs must appear in the **logAPPL.h** header file. There must be a definition in **logAPPL.h** for each message used from the **APPLmsg**. These definitions must be sequential starting at 1 and the index in **logAPPL.h** must match the ***msgID*** in **APPLmsg**. It is important that no other logger header files in the system be modified in any way. However, DIPs are free to use the messages already defined in these files, if they apply to the situation or condition being reported.

Message Content/Format Specification

Message content and format is specified in the **APPLmsg** format file found in **/usr/spool/log/formats**. The following rules govern the parsing of this file:

- All blank lines are ignored.
- Comment lines are those with a '#' character in column 1.
- Each non-blank, non-commented line allocates one message.
- A message may span multiple lines using the '\' character at the end of the line to indicate continuation to the next line.

While tab ('\t') and newline ('\n') characters may be specified in the message text, it is not recommended since output message text formatting is handled by the **display messages** command.

The standard CONVERSANT VIS message text appears as follows:

{msgID} {FRU} {EQ} {EQ#} ({MNEMONIC}) {Message Text}

For the case of **APPLmsg**, *{msgID}* will be of the form APPLNNN where *NNN* is a number ranging from 001 to the number of message in the class. *NNN* must match the index for the message it is specifying in **logAPPL.h**. *{msgID}* must occupy 8 spaces; if *{msgID}* is less than 8 spaces it must be right filled with blanks. The **APPLmsg** file has been delivered with placeholders for APPL001 through APPL032. These placeholders may be used by the customer and more may be added if needed.

{FRU} is a two character field indicating field replaceable unit. Examples in the CONVERSANT environment include TR (Tip/Ring), SP (Signal Processing), etc. If it not necessary to specify a field replaceable unit, use -- as the value in this field.

{EQ} is a two character field indicating the type of resource to which the message applies (CH for channel, CA for card, or -- if not applicable).

{EQ#} is a three digit number to specify the particular card or channel (use --- as the value in this field, if not applicable).

({MNEMONIC}) is the #define symbol used in the **logAPPL.h** file to define this message. Note that the MNEMONIC has () (parenthesis) around it when the field is specified in **APPLmsg**.

{Message Text} is the text associated with the message. This text may contain many characters of free text optionally embedded with variable text parameters. The message text may span multiple lines by placing the \x11 character at the end of the line.

Message Text Parameters

Parameters are the variable text items provided by the calling process at run time. There are two types of parameters: character string, denoted %s and integer, denoted %d. The formatting rules for these parameters are the same as those defined for **printf(3S)** but should be limited to %s and %d.

These parameters specifications may appear anywhere within the {Message Text} area.

The *{FRU}*, *{EQ}*, and *{EQ#}* fields may also be specified as parameters in the **APPLmsg** file. If so, the following specifications should be used:

{FRU}%.2s
{EQ}%.2s
{EQ#}%.3d

It is not expected that most DIPs would make use of the *{FRU}, {EQ}* and *{EQ#}* fields. Therefore, these field would be usually specified as "--", "--", and "---" (without quotes) respectively.

Messages defined for CONVERSANT have included an optional <<{NAME},{TYPE}>> field following each parameter specification. This field may be omitted from messages defined in APPLmsg since these fields are only specified for future use.

Message Mnemonic Definition

The **logAPPL.h** header file, located in **/usr/spool/log/head**, must be modified to include the new messages specified in the file. New message definitions should be inserted in the file on the line preceding the last #endif statement in the file. See the example of **logAPPL.h** in Chapter 9, "Application Example", for placement of new messages.

In general, **logAPPL.h** entries should look as follows:

#define *{MNEMONIC}* logAPPL(*{N}*)

where *{MNEMONIC}* is a define symbol for the message. By convention, the form of the mnemonic is ***{CLASS}_{NAME}*** where *{CLASS}* would be APPL and *{NAME}* would be some descriptive word or abbreviation for the message. *{N}* is the message number within the APPL class of messages. It is important that logAPPL(1) correspond to the message defined for APPL001 and logAPPL(2) correspond to the message defined for APPL002, etc.

NOTE:
Not all messages allocated in need to have a corresponding mnemonic defined in **logAPPL.h**. In the delivered , many unused message IDs have been allocated. However, all messages which have message text defined for them must a corresponding mnemonic.

Compiling the Messages in the DIP

The following procedure assumes that the message text has already been added to the **APPLmsg** file and the mnemonic has already been added to **logAPPL.h**:

1. Include the following logger header files in DIP code.

   ```
   #include "/usr/spool/head/log.h"
   #include "/usr/spool/head/systemLog.h"
   #include "/usr/spool/head/logAPPL.h"
   ```

2. Place a call to **logInit(3x)** within the DIP to initialize the DIP/logger interface. **logInit(3x)** has the following format:

   logInit *(program_name)*

program_name is normally an all upper case representation of the name of the executable (for example, **"MYDIP"**).

Refer to the Appendix B, "Voice System C-Library Functions", for additional information on **logInit**.

3. Place calls to **logMsg(3x)** within DIP to send specified messages to the logger.

   logMsg (*MNEMONIC,EL_FL,arg1,arg2, . . .*)

   MNEMONIC is the message mnemonic for the system message, *EL_FL* is a macro that identifies the file name and line number in the code where the call was generated, and the *arg1,arg2,...* are the parameters to the message text.

   NOTE:
   By default, the message mnemonic does not appear in **display messages** output. Use **logCat** to display messages and their corresponding mnemonics. Use **logFmt** to enable and disable the appearance of the message mnemonic. Refer to *CONVERSANT Voice Information System Version 4.0 Command Reference,* 585-350-209, for additional information about **logCat**.

   Refer to the Appendix B, "Voice System C-Library Functions", for additional information on **logMsg**.

4. Rebuild the logger format and message indexing files and reinitialize the logger by executing the following commands at the system prompt:

   ```
   cd /usr/spool/log/formats
   make -f formats.mk install
   reinitLog
   ```

5. Compile DIP code by linking in the logger library files found in **/vs/lib/liblog.a** and **/vs/lib/libprism.a**.

6. Modify the new logger message priority, destination, and threshold using the System Message Administration procedures provided in Chapter 3, "Configuration Management," of *CONVERSANT Voice Information System Version 4.0 Operations,* 585-350-703.

Adding and Changing Explain Message Text

You may use the text editor or the command line to add and/or change explain message text.

Using the Text Editor

To add a new explain message text using the text editor:

1. Create the explanation text file in the proper directory. It must be in the directory **/gendb/data/explain/text.d/*<alphabetic_letter>*** whose letter matches the 1st letter of the explain message, that is, CGENnnnn must appear in the C directory, TSMnnnn must appear in the T directory, etc.
2. Add the name of the explain text file and any aliases to the **/gendb/data/explain/translateLst** file. The name of the file containing the explain text is the RIGHTMOST word on the line containing the error message define symbol. For example, the following lines appear in the current "translateLst":

NAME	ALIAS	
ADM001	ADM_SYSERR	
ADM002	ADM_MSGERR	
ALERT001	AL_LVL_CHG	
ALERT002	AL_RESET_STATS	AL_RESET_STA
ALERT003	AL_INVALID_THRESHOLD	AL_INVALID_T
ASAI001	A_LINKDOWN	
ASAI002	A_DSCRIPT_TERM	A_DSCRIPT_TE
ASAI003	A_LOGIN_FAIL	

3. Enter **:wq** to save the information and exit the file.

Using the Command Line

To add a new explain message text using the **addmsg** command:

1. Login to the system as **root**.
2. At the system prompt, type **addmsg**.

   Response: The system prompts you for the message id.
3. Type the message id, then press ENTER .

   Response: The system prompts you to type in the explain text, ending the text with a period (.) on a line by itself.

   If the message ID already exists, the response is:

   Message ID XXXX already exits. If you proceed you will overwrite the existing explain text. Type in the explain text.(End with '.' on a line by itself,or you may press the DELETE key if you wish to abort.)

4. Type in the explain text, ending the text with a period (.) on a line by itself.

Upgrade Considerations

7

What's in This Chapter

NOTE:
This chapter assumes a knowledge of the application development environment, the C language, and requires file editing, possible application source modification, and use of the provided conversion tools. Do *NOT* attempt upgrades unless you feel you meet these requirements.

This chapter details considerations for applications residing on previous CONVERSANT Voice Information System (VIS) generics that interfaced with the Error Tracker (ET) mechanism to upgrade to the Version 4.0 logging environment. However, if your application does not interface with ET (that is, if you have a data interface process [DIP] and it does not contain any **et_send ()** calls), the upgrade procedures provided in this chapter need not be performed.

Doing an Upgrade – What you Need to Know

These procedures also assume that you have followed the documented procedure for writing a DIP process, that is, you have placed your message number defines in a header file named **appl_et.h**, etc. If you have expanded upon or deviated from the recommended procedures, you will have to understand shell programming and perform additional steps to complete the upgrade procedure.

Saving Explain Text

The following procedure must be performed *prior* to upgrading a custom application if custom explain messages have been created for the application:

1. Before the Version 4.0 upgrade, enter the following command:

   > appl.explain
   while read errNum ; do explain $errNum >>appl.explain 2>&1 ; done
   {type each error number defined in "appl_et.h", that has explain text associated with it, 1 per line, end with <CNTL>D}

   This will produce the file **appl.explain**, which will have the form:

   The message for error code 101 is:
   A serious system error has occurred.
   Reboot the system.
   The message for error code 102 is:
   A fairly serious system error has occurred.
   If it happens again, reboot the system.
   The message for error code 103 is:
   This error is not serious at all. However, if it
   happens three times a week for more 10 consecutive weeks,
   reboot the system.

2. Save the **appl.explain** file that contains the explain messages on external media (for example, on a floppy disk). Also, save **appl_et.h** (or whatever header files contain the programming defines) for the application error numbers defined by your application.

Restoring Explain Text

1. After Version 3.1 has been installed, restore the **appl.explain** and **appl_et.h** files.

2. Create the following shell script:

   cat >/vs/upgrade/fmtExp <<!
   vName=\‘basename \$3\‘ ; echo ’<< ’\$vName’ >>’ ; echo ; cat \$3

   chmod +x /vs/upgrade/fmtExp

3. Enter the following command:

   /vs/upgrade/upgExp

   You will be prompted for the name of the file with your explanations in it and the name of the header file with the defines. If your names match the default file names (that is, **appl.explain** and **appl_et.h**), press ENTER. Otherwise, type the pathname for the requested file.

If all of your error number defines are less than or equal to 14 characters in length, **upgExp** will automatically convert each explanation into the form appropriate for Version 4.0. A session might look like:

```
/vs/upgrade/upgExp

Name of the file in which the output from the pre-3.1 explain
for the application DIP error numbers was saved: [appl.explain]
Name of the header file defining the error numbers: [appl_et.h]
Converting 109  APPL001 CORRUPT_DATA
Converting 110  APPL002 DATA_TOO_OLD
Converting 111  APPL003 NO_SERVER
```

If any of your define names are 15 or more characters in length, **upgExp** will suggest a “short” name, truncating after the 14th character. If you are satisfied with this “short” name, press ENTER This “short” name is the internal file name in which the explanation will be stored. The full “long” mnemonic is still an acceptable way to reference the explanation.

If an explanation is found in your explanation text file, **appl.explain**, but is not found in your header file, **appl_et.h**, **upgExp** will ask you for the mnemonic name associated with the error number.

You may rerun the **upgExp** command on the same set of explanations if you decided that you would like to change the actual explanation texts. First edit the explanation text file, **appl.explain**, changing *only* the text of the explanation itself (the lines of text between those beginning with “The message for error code...”). Once you have the explanations as you want them to appear, type **upgExp** again. The second and subsequent times, you will be asked if you want to overwrite each explanation. Press ENTER.

4. You have completed this procedure.

Upgrading an Application

When upgrading an application, two types of conversion processes are provided:

- A full conversion

  Of the two conversion processes, a full conversion is the recommended conversion. This process is the most efficient in terms of execution speed and provides the most features to application developers. It also produces logged messages which match the new logging message formats. Also, the user interface will provide the means to adjust message priorities, destinations, and thresholds (see Chapter 3, “Configuration Management,” of *CONVERSANT VIS Version 4.0 Operations* 585-350-703.

  This method removes all **et_send()** calls from C-source files of the application being converted. Consequently, when the application is executed, any log messages generated will be sent directly to the new logger process (**logdaemon**).

- A transparent conversion

  Use this type of conversion only when applications must work in pre-3.1 release environments as well as the current 3.1 release. Support for this transparent conversion will be discontinued in future releases.

  This method allows applications whose C-source files contain **et_send()** calls to continue to work and to log error messages without any changes.

Full Conversion

To complete a full conversion in an upgrade process, follow the steps below.

1. Copy to tape or diskette all of the application source code, headers, and **/gendb/data/errors** file which were saved before the older VIS version was removed.

   (See the tables in “Upgrade Checklists” in Chapter 1, “Upgrading the Software,” of *CONVERSANT VIS Version 4.0 Software Upgrade,* 585-350-110, which contain steps to insure this.)

2. After upgrading the machine to VIS V3.1, restore the application source code, headers, and **/gendb/data/errors** file to the VIS V3.1 machine.

3. Perform the following steps to create the file **/usr/spool/log/head/logAPPL.h** as this file should not exist prior to the upgrade procedure.

   ```
   cd /usr/spool/log/head
   if diff ORGlogAPPL.h logAPPL.h
   then rm logAPPL.h
   else echo You will need to manually combine o.logAPPL.h after upgrade.
   rm -f o.logAPPL.h
   mv logAPPL.h o.logAPPL.h
   fi
   ```

4. Remove all the comment lines up to the first "**#include**" at the top of file **/gendb/data/errors**.

5. If your error numbers are described in **/gendb/data/errors** file as they should be and if the name of your header file defining your error numbers is **/att/msgipc/etmsgs/appl_et.h**, enter the following command:

   ```
   /vs/upgrade/cvtAPPL
   ```

   This shell script will create two files, **/usr/spool/log/formats/APPLmsg** and **/usr/spool/log/head/logAPPL.h**. The former file contains the formats of each error number message. The latter file contains the mnemonic defines for each error number to be used by your application code. If you used a header by some other name, you must either temporarily rename it

appl_et.h so that you can use the **cvtAPPL** script, or you can manually execute the commands contained in **/vs/upgrade/cvtAPPL** with appropriate modifications to perform the necessary upgrade procedure.

6. Enter: **cd /usr/spool/log/formats**
7. Enter: **make -f formats.mk install**
8. Verify that:
   - **APPLmsg** exists and contains the message formats for your applications
   - The file **../head/logAPPL.h** exists and contains the define symbols identifying your logging messages
   - **cmpLogFmt**, **textLogFmt.Mne**, **textLogFmt.NoM** exist in **.** and **..**
   - **textLogFmt** exists in **..** and is linked to either **textLogFmt.NoM** or **textLogFmt.Mne**
   - **systemLog.h** exists in both **.** and **../head**
9. Enter **msgadm** as described in the *CONVERSANT VIS Version 4.0 Command Reference,* 958-350-209 or use the message administration screen to reestablish the priority of each APPL message and specify the destination as described in Chapter 3, “Configuration Management,” of *CONVERSANT VIS Version 4.0 Operations,* 585-350-703.

   NOTE:
   This step is optional if full pathnames were used in the previous step.

10. Enter: **cd *{src-directory}*** where *{src-directory}* is the directory in which your application code is located.
11. Create the file **/tmp/cvt.files**, containing a list of all compilable source code, ***.c**, ***.h**, and ***.pc** files, for any applications programs you want to recompile for the Version 3.1 environment.

    Each file name should appear on a line by itself. Pathnames should either be full pathnames (starting with ’/’) or relative to the directory in which you plan to run the **upgCode** program.

    NOTE:
    If you have not used **appl_et.h** as the name of your header file defining your error message numbers, you will need to amend the rules used to upgrade header files before proceding. Your header file should have been named something like **xxx_et.h**.

    Having already performed the header file upgrade in step 3, you should now have a new header file of the form, **logXXX.h**.

To amend the rules:

a. Edit the file **/vs/upgrade/incChgs**.

b. Add a line of the following form to the end of the list of rules:

xxx_et.hh'+.3i'logXXX.h

where "xxx" and "XXX" are the specific file name identifiers you used in your application.

12. Enter: **/vs/upgrade/upgCode**

13. Examine all files for which warning messages were created during the conversion process. The list of potential problems is in **/tmp/cvt.lst**.

Problems fall into three major classes:

a. Use of **#define** symbols or structure definitions from the header files **et_send.h** or **et_.h**

For example, references to **struct et_msg**, **ET_MSG**, and **ERRORS_ATT** will generate warnings. The complete list of items that will produce warnings is found in **/vs/upgrade/warningPats**. Manually change the code so that it no longer uses these symbols or structure elements.

b. Calls to **et_send (|)** which are expressed as a macro

For example:

#define ETSEND(msgID,arg,str)
et_send(chan,msgID,arg,0,0,0,str)

ETSEND(VMD_MMLUPD,5,"message text")

The conversion program cannot deal with such cases. To allow the conversion program to operate on the previous example, manually change it to the following form:

et_send(chan,VMD_MMLUPD,5,0,0,0,"message text")

c. Calls to **et_send(|)** which use a variable for the message ID

For example:

```
void func(id,arg0,arg1,str)
int id,arg0,arg1 ;
char *str ;
{
et_send(-1,id,arg0,arg1,0,0,str) ;
}
```

These are the most complicated to convert. Read the manual page for the **logMsg(|)** function in Appendix B, "Voice System C-Library Functions".

The **logMsg(|)** function replaces the **et_send(|)** function. Where **et_send(|)** had an invariant set of arguments in a fixed order, **logMsg(|)** has a variable list of arguments whose order and type depend on the message being logged.

To convert such references, you will have to understand the true intent of the underlying code. In the example above, the best solution would be to just replace the calls to **func(|)** with direct calls to **logMsg(|)** since this function does not do anything except log a message.

In more complicated cases, the solution will depend on the format of the messages that must be logged. Make changes to the code to resolve the problems if necessary.

14. Add a call of the form:

    logInit(*"{program-name}"*)

    to each executable.

    {program-name} is the name you want associated with messages logged by your application (for example, DBDIP). This name should match the bulletin board (BB) name provided to the **startup()** or **VSstartup()** routine.

    You should normally place this call in the **main()** routine. This call must appear prior to any attempt to log information via the **logMsg()**, **vlogMsg()**, or **logSysError()** functions.

15. Add the compiler option:

    -I/usr/spool/log/head

    so that headers files can be referenced from the "/usr/spool/log/head" directory.

    You may remove the compiler options

    -I /att/msgipc/etmsgs

    if you so desire, since header files from the old system will no longer be used after conversion.

16. Add the following libraries to the make rules file of the application to include them in the load option:

    /vs/lib/liblog.a
    /vs/lib/libprism.a

17. Recompile all modified applications.

18. You have completed this procedure.

Transparent Conversion

1. Restore **/gendb/data/errors** file which was saved earlier. Install this file in the same directory on Version 4.0.
2. Enter:

   /vs/bin/mkerr var

3. Verify the file **/vs/data/etStub.rules** was created.
4. Recomplie and install the application executables in the VIS V4.0 machine.

Using Speech Editing Systems

8

Overview

This chapter describes the use of third party Speech Editing systems with applications running on the CONVERSANT Voice Information System (4.0).

AT&T offers a Graphical Speech Editor feature as part of VIS 4.0, and it is recommended that this feature be used. However, the CONVERSANT system's open-architecture enables the use of third-party speech editing systems.

The emphasis of the chapter is on the prescribed format of speech-files to make using these third-party editing systems possible. Applicable speech-file formats are described, and the steps associated with facilitating file-transfer are separately discussed.

Using Audio Works Station with CONVERSANT VIS 4.0 has been provided as an example. This example clarifies the general use of VIS commands to facilitate the integration of speech-file formats.

Terminology

The following terminology is used in this chapter to describe the speech editing environment:

VIS system

The CONVERSANT Voice Information System (Version 4.0).

Phrase Tag

A string of up to 50 character that identifies the contents of a phrase used by an application script.

Speech Phrase

A continuous speech segment encoded into a digital string.

Speech File

A file containing an encoded speech phrase.

Speech File-System

A collection of several talkfiles. The file-system is organized into 16 Kbyte blocks for the efficient management and retrieval of talkfiles.
The CONVERSANT VIS speech file-system is not consistent with standard Unix file-systems, and can not be referenced with standard Unix commands such as **ls, cat** etc.

Talkfile

A collection of speech phrases organized and stored in groups. Each talkfile may contain up to 65535 speech phrases. The speech file-system itself may contain multiple talkfiles.

Listfile

An ASCII catalog that lists the contents of one or more talkfiles. Each application script is typically associated with a separate listfile. The listfile maps speech phrase strings used by application scripts into speech phrase numbers.

Editor System

A speech editing package provided by a third party vendor. This system enables speech phrases to be displayed and edited by the user.

Open Systems Interface

As part of the CONVERSANT VIS *open system architecture*, it is possible to use third party speech editors to edit CONVERSANT speech phrases.

It may be necessary to move speech between VIS and the editing system, and to convert files between the VIS and editing system supported formats for compatibility. The internal details of the speech formats supported by the VIS are presented later in this chapter. To use a third party graphical speech editing systems to edit VIS speech files, it is necessary to perform the following operations:

1. Extracting talkfiles from the VIS speech file system
2. Converting speech files from the VIS format to a format supported by the editor system
3. Moving talkfiles from VIS to third party editor system
4. Editing speech files within the editing system
5. Moving speech files back to the VIS system
6. Converting edited speech files to a format supported by the VIS system
7. Installing speech files in the VIS speech file system

These steps are described in the following sections as well as in the Audio Works Station example.

Speech File Formats

CONVERSANT VIS supports the following speech digitization formats:

- Pulse Code Modulation (PCM) at 64 kbits per second (kbps) in Mu-law encoding format.
- Adaptive Differential Pulse Code Modulation (ADPCM) at 16 kbps
- ADPCM at 32 kbps. This is the rate used in VIS Script Builder.
- Sub Band Coding (SBC) at 16 kbps
- SBC at 24 kbps.

Speech files are comprised of two parts:

1. A header section which is present at the beginning of the file and is also repeated at periodic intervals within the body of the file,
2. The encoded digital data representing speech. The header section has the format shown in Table 8-1 below.

Table 8-1. Header – section format

OxAA	OxFF	N	L

Where;

- 0xAA and 0xFF are the two bytes of data with bit patterns 01100110 11111111
- N is a unique identifier code representing the speech encoding format and is shown in the Table 8-2.
- L is a mandatory field which represents the length of a control field which follows the header bytes.

  The control field is optional, and if absent, L is set to 0x00 (also, see below). For PCM and ADPCM type VIS speech files, it is set to 0x00 (no control field is specified).

To encode N, values 0x40 or less are reserved for specific speech types. Values greater than 0x40 are user defined. If N is greater than 0x40, the length field L identifies the number of words (two bytes each) that follow which include user defined information.

Table 8-2. Identifier Codes in Speech Encoding

N	Value
PCM (Mu-law)	0 x 34
ADPCM 32	0 x 32
ADPCM 16	0 x 30
SBC 24	0 x 21
SBC 16	0 x 20
User defined	0 x 41, or greater

Header bytes are inserted into the speech file so that the header appears at least five times for every second of speech. The headers are aligned on even byte boundaries.

The digitally encoded speech is dependent on the type of speech format used. Since Sub Band Coding is not commonly used in VIS applications, it is not discussed further in this application note.

PCM Speech File Format

In a PCM speech file, speech is sampled at 8000 times a second. Each sample is digitally coded into an 8 bit pattern (allowing 256 levels), resulting in 64000 bits per second of speech. The header, which has the values 0xAA 0xFF 0x34 0x00, is repeated at least five times for every second of speech.

The speech data consists of contiguous 8 bit patterns representing sampled speech. Depending on the coding technique used, two types of PCM formats are possible, Linear and Mu-law.

- In the Linear PCM format, sound levels of successive digital encoding are equally spaced in the binary form. Some third party applications use the Linear PCM format.
- In the Mu-law PCM format, PCM coding uses predefined quasi-logarithmic steps for speech levels, encoding more steps when the speech level is low. VIS uses Mu-law encoding, and is assigned the identifier code N as 0x34.

If the bit pattern 0xAA 0xFF occurs anywhere within the speech portion of the file, it is changed to 0xAA 0xFE. This makes a small but imperceptible change to the speech data.

The format of an 8-bit, μ-law word is as follows:

$\overline{m0}\ \overline{m1}\ \overline{m2}\ \overline{m3}\ \overline{n0}\ \overline{n1}\ \overline{n2}\ s$

where;

the overline $\overline{\ }$ represents the compliment of a bit

This μ-law word represents the following number

$Y = (-1)^S * [(16.5 + M) * 2^N - 16.5]$

where:

M = m3 m2 m1 m0 (M is 0 to 15)

N = n2 n1 n0 (N is 0 to 7)

* = multiplication

S = sign bit (0 for positive, 1 for negative)

ADPCM Speech File Format

There are two types of ADPCM format speech files:

- ADPCM-32
- ADPCM-16

Both follow similar compression algorithms.ADPCM speech encoding is based on the principle that it is possible to reduce the amount of information needed to transmit speech between the sender and the receiver by using appropriate mathematical algorithms.

Given that the natural speech follows specific patterns (as opposed to random noise), in the ADPCM technique, the encoder (or the sender) predicts the speech level for the present instant by using a predefined algorithm and the past speech history. This predicted value is then compared to the actual speech level at the present instant and the difference is encoded into digital format. The difference between the actual and the predicted values can be made as small as possible by using suitably defined predictor algorithms.

Thus, it is possible to encode the difference between the predicted and the actual speech into digital samples of either 4 bits (16 levels) or 2 bits (4 levels). At the decoder (or the receiver) end the process is reversed. The decoder uses an equivalent algorithm to predict the present speech level from the past history, and makes the correction based on the received information from the sender to get the actual speech level. The accuracy and performance of the speech encoding and decoding depends on the type of algorithm used as well as the number of bits used for digital encoding of the difference between predicted and actual speech.

For further details of the encoding and decoding schemes, please see Reference 1 provided at the end of this chapter.

It should be noted that the ADPCM 32 and ADPCM 16 formats used in VIS use mathematical algorithms slightly different from those explained in Reference 1.

- In the ADPCM 32 speech file the header which has the values 0xAA 0xFF 0x32 0x00, is repeated at least five times for every second of speech data.
- In ADPCM 16 speech file the header which has the values 0xAA 0xFF 0x30 0x00, is repeated at least five times for every second of speech data.

If the bit pattern 0xAA 0xFF occurs anywhere within the speech portion of the file, it is changed to 0xAA 0xFE. This makes a small but imperceptible change to the speech data.

Format Conversion

To use the VIS speech file with a third party speech editing system, it may be necessary to convert speech files from one format to another.

To convert speech encoded in the Mu-law PCM format to ADPCM 32 or ADPCM 16 formats, two steps are required.

NOTE:
VIS utilities automatically convert VIS Mu-law files into VIS ADPCM formats.

In the first step, it is necessary to convert the speech file encoded in the Mu-law PCM format into a linear PCM format. The resulting speech file in linear PCM format is then converted to the ADPCM 32 format. To convert a speech file to either ADPCM 32 or ADPCM 16 to Mu-law PCM format, the reverse process is required. First, the speech needs to be converted into a linear PCM format from ADPCM, and then converted to the Mu-law format.

Depending on the speech editing system, the format supported by the system could be used as an interface between the VIS and this editing system.

NOTE:
VIS utilities do not facilitate A-law PCM conversion.

It should also be noted that a degradation in speech quality may occur whenever speech encoded in one format is converted to another format. Each time this conversion process is repeated, further degradation may occur.

Transferring Speech

In order to transfer a speech phrase from an editing system to the VIS, or vice versa, it may be necessary to move the speech file between the two systems. Depending on the user configuration, such transfer could be accomplished by one of several methods.

Speech could be moved between the two systems via an interconnected Local Area Network (LAN); by using modems; via serial communication transfers; or, by using magnetic media such as tapes or floppy disks.

The user will need to manage all speech phrases stored as Unix files and keep track of the applications to which the speech files belong. The user may also have to understand the format of phrase list files, which map system speech phrases to talkfiles, and phrase tags to phrase numbers and file names.

- In order to extract a speech phrase from the VIS speech file system to a UNIX file, the **gse_copy** command in the VIS can be used. This command has the format:

  gse_copy *talkfile-number phrase-number output-file*

  The *talkfile-number* and *phrase-number* parameters refer to the talkfile and phrase identifiers in the speech file system. This information could be obtained by the **list** command.

- In order to transfer a speech phrase from a UNIX file to the speech database, the **gse_add** command in the VIS can be used. This command has the format:

  gse_add *talkfile-number phrase-number codestyle input-file*

The *codestyle* parameter could be either **pcm64**, **adpcm32**, or **adpcm16**.

NOTE:
It is recommended that the **adpcm16** format not be used because it significantly degrades the speech quality.

- The **erase** command allows phrases to be deleted from the speech database
- The **list** command lists the directory entries for specific phrases.
- The user could also use the **gse_addpl** command to add multiple files from the Script Builder application *speech pool* to the speech file system. The syntax of the **gse_addpl** command is:

  gse_addpl *speech pool input-dir codestyle file1... fileN*

  (optional *file1... fileN* are located in the *Input-dir* unix directory. This defaults to all files in input-dir)

- The command **gse_copypl** allows the user to copy multiple speech phrases from a Script Builder application *speech pool*. The syntax is:

  gse_copypl *speech pool output-dir file1... fileN*

  The optional files *file1... fileN* will be created in the unix directory *output-dir*. File names correspond to those on the list file. The files created by **gse_copy** and **gse_copypl** have voice headers included in them. The command **striphdr voice** strips the voice header.

In addition, utilities are provided with the VIS system for transferring UNIX system files from/to MS-DOS formatted files.

- The **doscp** command allows the user to copy a UNIX file to a MS-DOS formatted file, with the command:

  doscp *UNIX-file a: /MSDOS-file*

- The **doscp** command also allows the user to copy a MS-DOS formatted file to a UNIX file system, with the command:

  doscp *a: /MSDOS-file UNIX-file*

Using *Audio Works Station*

Audio Works Station is a speech editing System offered by Bitworks Inc. It runs on the MS-DOS operating system platform. The product consists of an audio board which plugs into an IBM compatible personal computer system.

Audio Works Station software can be loaded by copying a set of files from the provided floppies to a subdirectory on the hard disk. The product accepts audio sources from either a microphone or an audio cassette tape. It can output audio to a audio receiver and a speaker. Audio Works Station can create speech files in digital format, supporting speech formats in 16 bit linear PCM, 8 bit Mu-law (64k PCM), 8 bit A (European standard) law, and 4 bit ADPCM. Audio Works Station accepts only 16 bit linear PCM files for editing.

The steps described below are required to add speech recorded on Audio Works Station into the VIS system. Before performing these steps, the **list** command may be used to identify the characteristics of the speech file

Following is the output of the **list talkfile** command which includes information on all phrases stored in the speech file system sorted by the respective talkfile number (Table 8-3):

- Talkfile number
- Phrase number
- Size in bytes
- Size in blocks
- Time
- Coding type
- Phrase-name

Table 8-3. *list talkfile* output

Talkfile Number	Phrase Number	Size (bytes)	Time	Coding Type	Phrase_Name
40	1085	1346	0.7	ADPCM 16	Hello
40	1086	2976	2.5	ADPCM 32	Welcome
101	1008	3451	2.8	ADPCM 32	Thank you
102	1003	2321	3.1	ADPCM 32	For using AT&T

Extracting Speech from VIS

The following commands can be used to extract a speech phrase in the 64K Mu-law PCM format from the VIS system to be edited on third-party editing systems. These commands must be used in the following sequence:

1. **gse_copy 101 1008 /tmp/myfile**

   Extracts the speech phrase to a unix file named **myfile** in **/tmp** directory which contains the speech.This file is converted from VIS ADPCM32 to VIS PCM64 automatically.

2. **cat /tmp/myfile | striphdr voice >/tmp/newfile**

   Removes the voice header and stores the Mu-law PCM speech in the unix ***file /tmp/newfile***.

   To transfer the /tmp/newfile to a DOS formatted floppy-disk, use the following command:

3. **doscp /tmp/newfile a:/dosfile**

   Copies the unix ***file /tmp/newfile*** to a file called dosfile in a dos formatted floppy disk located in the floppy disk drive.

Editing Speech in *Audio Works Station*

The Mu-law PCM speech stored in *dosfile* needs to be converted into a format supported by *Audio Works Station.* The VIS Mu-law PCM file format is described under the "Speech File Formats" section of this chapter.

After the file has been converted into an *Audio Works Station* compatible format, it can be edited. The modified speech needs to be stored in the VIS Mu-law PCM format in *file1* on a DOS formatted floppy-disk.

Transferring New Speech to VIS

To transfer the new speech phrase to the VIS system, the following steps need to be performed:

1. Insert the DOS floppy the VIS floppy disk drive and transfer its contents to the UNIX file system with the command:

   doscp a:/file1 /tmp/file1

   This copies the speech file to file1 in the UNIX /tmp directory.

2. Enter the following command:

   cat /tmp/file1 | addhdr voice > /tmp/file2

   This adds the voice header to the and stores the contents in a new file, ***/tmp/file2***.

3. After the voice header has been added, enter the following command:

   gse_add 101 1009 adpcm32 /tmp/file2

   This adds the speech created on Audio Works Station to the VIS speech filing system.

Related Documents

— Digital Coding of Waveforms — Principles and applications to Speech and Video, *N.S. Jayant and Peter Noll,* Prentice-Hall, 1984.

— *CONVERSANT VIS Version 4.0, Graphical Speech Editor,* 585-350-705.

— *CONVERSANT VIS Version 4.0, Script Builder,* 585-350-704

Application Example

9

What's in This Chapter

This chapter presents an example of an application. It includes:

- Two versions of the script.

  The first version shows the Script Builder action steps and the second shows the script instructions generated by the Script Builder software.
- A data interface process (DIP)
- An external function, **diptest**, that calls the DIP

This application is a very simple example of a banking application. The script prompts the caller for a social security number and a six-digit account number. The social security number and account number are passed to the DIP via the **dbase** instruction within the external function. In a real-life application, the DIP probably would use the social security and account numbers to access a local or remote database to retrieve information about that account.

For simplicity, the example DIP simply manipulates the social security number and returns the result (last four digits of social security number) as the account balance to the script. After the account balance is spoken to the caller, the caller is given the chance to enter another social security number and account number or to quit. You can use this sample application as a model in building other applications for the CONVERSANT Voice Information System (VIS).

Sample Script — Script Builder Action Steps

The following example shows the action steps defined in Script Builder.

start:
1. Answer Phone
2. Announce
Speak With Interrupt
Phrase: "Hello, this is the DIP test script"
entry_loop:
3. Set Field Value
Field: acct_balance = 0
4. Prompt & Collect
Prompt
Speak With Interrupt
Phrase: "Please enter your SSN"
Input
Caller Input Field: ssn
Min Number Of Digits: 09
Max Number Of Digits: 09
Checklist
Case: "Input Ok"
Continue
Case: "Initial Timeout"
Reprompt
Case: "Too Few Digits"
Reprompt
Case: "No More Tries"
Quit
End Prompt & Collect
5. Prompt & Collect
Prompt
Speak With Interrupt
Phrase: "Please enter your account number"

Input
Caller Input Field: acct_num
Min Number Of Digits: 06
Max Number Of Digits: 06
Checklist
Case: "Input Ok"
Continue
Case: "Initial Timeout"
Reprompt
Case: "Too Few Digits"

Reprompt
Case: "No More Tries"
Quit
End Prompt & Collect
6. External Function
Function Name: diptest
Use Arguments: ssn acct_num
Return Field: acct_balance
7. Evaluate
If acct_balance < 0
8. Announce
Speak With Interrupt
Phrase: "This is an error situation, the return value is"
Field: acct_balance As Nrmf
9. Quit
End Evaluate
10. Set Field Value
Field: acct_balance = acct_balance
11. Announce
Speak With Interrupt
Phrase: "Your account balance is"
Field: acct_balance As N$
12. Prompt & Collect
Prompt
Speak With Interrupt
Phrase: "Enter 1 to enter ssn again, 2 to quit"FONT1

Input
Caller Input Field: prompt
Max Number Of Digits: 01
Checklist
Case: "1"
Goto entry_loop
Case: "2"
Continue
Case: "Not On List"
Continue
Case: "Initial Timeout"
Reprompt
Case: "Too Few Digits"
Reprompt
Case: "No More Tries"
Quit
End Prompt & Collect
13. Announce
Speak With Interrupt

Phrase: "Thank you for calling the Dip Test Script"
14. Disconnect
15. Quit

Sample Script — Script Language

The following example shows the same script in the script language described in Chapter 4, "Script Instructions". This script was generated by Script Builder. The script labels used by Script Builder are not as descriptive as labels that a programmer would use.

```
/* TSM script application dipscript */

#include "dipscript.h"

tfile ("std_speech.pl" "dipscript.pl")
event(0,L__quit)
event(1,L__quit)
L_start:
trace(im.1)
tic('a')
trace(im.2)
talk("Hello, this is the DIP test script" )
L_entry_loop:
load(int.F_acct_balance, im.0)
trace(im.3, int.F_acct_balance)
/* get caller input */
ttdelim(-1, -1, -1, -1)
load(int.F__CI_TRIES_USED, im.0)
L_4: /* prompt */
talk("Please enter your SSN" )
L_5: /* try again */
tttime(5, 5)
incr(int.F__CI_TRIES_USED, im.1)
getdig(0, ch.F_ssn, im.09)
load(int.F__CI_NO_DIGS_GOT, r.0)/* save for user */
trace(im.4, ch.F_ssn)
jmp(r.0 == im.0, L_2)
jmp(int.F__CI_NO_DIGS_GOT < im.09, L_3)
goto(L_1)
L_2: /* Initial timeout */
jmp(int.F__CI_TRIES_USED == im.3, L__quit)
goto(L_4)
L_3: /* too few digits */
jmp(int.F__CI_TRIES_USED == im.3, L__quit)
goto(L_4)
```

```
L_1:
/* get caller input */
ttdelim(-1, -1, -1, -1)
load(int.F__CI_TRIES_USED, im.0)
L_9: /* prompt */
talk("Please enter your account number" )
L_10: /* try again */
tttime(5, 5)
incr(int.F__CI_TRIES_USED, im.1)
getdig(0, ch.F_acct_num, im.06)
load(int.F__CI_NO_DIGS_GOT, r.0)/* save for user */
trace(im.5, ch.F_acct_num)
jmp(r.0 == im.0, L_7)
jmp(int.F__CI_NO_DIGS_GOT < im.06, L_8)
goto(L_6)
L_7: /* Initial timeout */
jmp(int.F__CI_TRIES_USED == im.3, L__quit)
goto(L_9)
L_8: /* too few digits */
jmp(int.F__CI_TRIES_USED == im.3, L__quit)
goto(L_9)
L_6:
trace(im.6,ch.F_ssn)
trace(im.6,ch.F_acct_num)
L__diptest(im.F_ssn, im.F_acct_num)
load(int.F_acct_balance, r.0)
trace(im.6, r.0)
trace(im.7)
jmp(int.F_acct_balance >= im.0, L_11)
trace(im.8)
talk("This is an error situation, the return value is" )
tnum(int.F_acct_balance, 't')
trace(im.9)
goto(L__quit)
L_11:
load(int.F_acct_balance, int.F_acct_balance)
trace(im.10, int.F_acct_balance)
trace(im.11)
talk("Your account balance is" )
L__sp_dol(int.F_acct_balance)
/* get caller input */
ttdelim(-1, -1, -1, -1)
load(int.F__CI_TRIES_USED, im.0)
L_15: /* prompt */
talk("Enter 1 to enter ssn again, 2 to quit" )
```

```
L_16: /* try again */
tttime(5, 5)
incr(int.F__CI_TRIES_USED, im.1)
getdig(0, ch.F_prompt, im.01)
load(int.F__CI_NO_DIGS_GOT, r.0)/* save for user */
trace(im.12, ch.F_prompt)
jmp(r.0 == im.0, L_13)
jmp(ch.F_prompt == im.'1', L_entry_loop)
jmp(ch.F_prompt == im.'2', L_12)
goto(L_12)
L_13: /* Initial timeout */
jmp(int.F__CI_TRIES_USED == im.3, L__quit)
goto(L_15)
L_12:
trace(im.13)
talk("Thank you for calling the Dip Test Script" )
trace(im.14)
tic('h')
trace(im.15)
goto(L__quit)


L__quit:
quit()
L__save_events:
rts()

L__seasonal_greetings:/* play seasons greetings messages, if any*/
rts()
#include "/vs/bin/ag/lib/_sp_dol.t"
#include "diptest.t"
```

Sample External Function

The following is an example of an external function. This external function is called by the script included in this chapter. In this example, the external function is in the same directory as the script.

```
/*
* FUNCTION diptest - DIP test script sample external function
* INPUTS: None
* SSN - field with the SSN
* acct num - field with the account number
* RETURNS: account balance >= 0 , failure < 0
*/

DEFARG_COUNT(2)
DEFARG(ssn,char,in) /* r.3 */
DEFARG(acct_num,char,in) /* r.2 */

#define ACCT_REQ 8500 /* mcont for the DIP */
#define SZUV 17 /* length of ssn and acct num */
#define F__TEMP10 10 /* 10-byte offset into TEMP */

L__diptest:
strcpy(ch.F__TEMP, *ch.3) /* load ssn number */
strcpy(ch.F__TEMP10, *ch.2) /* load acct number */
dbase( im."bankMgrDip", ACCT_REQ, ch.F__TEMP, 5, ch.F__TEMP, SZUV )
trace (im.18001, r.0) /* mcont is returned into r.0 */
load ( r.0 int.F__TEMP)
trace (im.18006, r.0)
rts()
```

Sample DIP

The following is an example of a DIP. This is the same example used in Chapter 5 except that the DIP has been modicifed to manipulate the social security number as described in the introduction to this chapter.

```
#include <sys/types.h>
#include <sys/ipc.h>
#include"/usr/spool/log/head/log.h"
#include"/usr/spool/log/head/systemLog.h"
#include"/usr/spool/log/head/logAPPL.h"
#include "shmemtab.h"
#include "spp.h"
#include "mesg.h"
#include "VS.h"
```

```
/* Define all messages that can be received
* For example, caller_info_msg is a message that is sent by
* the TSM script giving the caller's social security number.
* Also define the message ids for each messages received.
* These message ids should be in a header file instead of
* here.
*/
#define ACCOUNT_REQUEST 8500
struct callerMsg {
struct mbhdr hd;
char socialSecurityNo[10];
char accountNo[7];
};


/* Define Message Receive structure
* Should be large enough to hold largest message.
* Add all received message structures in the following
* union.
*/
union rcvMsg {
struct ms_univ u; /* the standard message (mesg.h) */
struct callerMsg c; /* caller's info */
};

/* Define Message structures to be Sent.
* Also define the message id for each message.
* The message id should go in a header file but
* it's shown here for convenience.
* The message ids should all be unique across all applications.
* Only one message is sent in this example but usually you'll
* lots more.
*/
#define ACCOUNT_INFO 8090 /* message id */
struct accountMsg {
struct mbhdr hd;
int balance;
};

static char *Myname="bankMgrDip"; /* Name of this DIP */
static short Myinstance=1; /* Instance of DIP */

/* Names of other processes you talk to */
#define DBDIPPER "bankTellerDip"

main()
{
```

```
int myQkey;
int noBytesRead;
int accountBalance;
int retCode;
union rcvMsg rcvbuf;
struct accountMsg acctbuf;


/* initialize DIP */

/* Logger Initialization */

logInit(Myname);

/* Get your dynamically-assigned Qkey */
myQkey = VSstartup(Myname, Myinstance, DIP_PROC);
if (myQkey <= 0 ) {
db_put("%s: Can't get qkey: VSstartup: %s

VSerror(myQkey));
logMsg(APPL_INITFAIL,EL_FL,Myname,"Can't get qkey");
sleep(5); /* to slow down continuous respawning */
exit(1);
}

/* Clear out my message queue */
noBytesRead = mesgrcv(myQkey, &rcvbuf, sizeof(rcvbuf),
0, IPC_NOWAIT);
while (noBytesRead >= 0) {
noBytesRead = mesgrcv(myQkey, &rcvbuf, sizeof(rcvbuf),
0, IPC_NOWAIT);
}

/* Main processing Loop:
* Read and process message for ever
*/
while (1) {
/* wait for a message to arrive */
noBytesRead = mesgrcv(myQkey, &rcvbuf, sizeof(rcvbuf),
0, 0);

if (noBytesRead < 0) {
/* Something went wrong with the read
* Could be that the reading was interrupted (EINTR).
* There should be some error processing here but
* for brevity I'll just try to read again.
*/
continue;
```

```
}

/* Got a message! Get to work */
db_pr("%s: got message: chan =%d, id=%d, senderQkey=%d

Myname,rcvbuf.c.hd.mchan, rcvbuf.c.hd.mcont,
rcvbuf.c.hd.morig);

/* Typically, the DIP will have a case for each
* possible message id.
* In this example, we only have one possible message
* that can be received.
*/
switch (rcvbuf.c.hd.mcont) {
case ACCOUNT_REQUEST:
/* TSM script wants account balance info */
db_pr("%s: request for account info for SS#=%s
Myname, rcvbuf.c.socialSecurityNo);
db_pr("%s: and account#=%s

rcvbuf.c.accountNo);
/* Go out and get the account information
* and return it in accountBalance.
* This balance (for simplicity) is generated from
* the last 4 digits of the SSN
*/
accountBalance = atoi(rcvbuf.c.socialSecurityNo+5);
db_pr("%s: the balance = %d
accountBalance );

/* Now package and send respond back */
acctbuf.hd.mchan = rcvbuf.c.hd.mchan;
acctbuf.hd.mtype = 1;
acctbuf.hd.morig = myQkey;
acctbuf.hd.mcont = ACCOUNT_INFO;
acctbuf.hd.mseqno = 0;
acctbuf.balance = accountBalance;
retCode = mesgsnd(TSM, &acctbuf, sizeof(acctbuf), 0);
if (retCode < 0) {
/* Message send failed; log message
* Note that before this will work you
* must add your DIP errors into the logger system.
*/
logMsg(APPL_MSGSNDERR, EL_FL, acctbuf.hd.mchan, Myname);
}
break;
default:
/* Notify logget that an unknown message was
```

```
* received.
*/
logMsg(APPL_UNKNOWNMSG, EL_FL, rcvbuf.c.hd.mchan, Myname );
break;
} /* switch on message id */
} /* while loop that reads forever */
}
```

APPLmsg File

The following messages are samples in the **APPLmsg** file to be modified as required for your application. *DO NOT* add new messages unless all of the messages in this file have already been used. If you must extend the file, add a block of unused messages, so that you do not extend the file each time you add one new message.

APPL001 -- -- --- (APPL_INITFAIL) Application DIP '%s' failed to initialize. Reason: %s.

APPL002 -- -- %3d (APPL_MSGSNDERR) Application DIP '%s' failed to send message to script.

APPL003 -- -- %3d (APPL_UNKNOWNMSG) Application DIP '%s' received an unknown message.

APPL004 -- -- --- ({MNEMONIC}) %s
APPL005 -- -- --- ({MNEMONIC}) %s
APPL006 -- -- --- ({MNEMONIC}) %s
APPL007 -- -- --- ({MNEMONIC}) %s
APPL008 -- -- --- ({MNEMONIC}) %s
APPL009 -- -- --- ({MNEMONIC}) %s
APPL010 -- -- --- ({MNEMONIC}) %s
APPL011 -- -- --- ({MNEMONIC}) %s
APPL012 -- -- --- ({MNEMONIC}) %s
APPL013 -- -- --- ({MNEMONIC}) %s
APPL014 -- -- --- ({MNEMONIC}) %s
APPL015 -- -- --- ({MNEMONIC}) %s
APPL016 -- -- --- ({MNEMONIC}) %s
APPL017 -- -- --- ({MNEMONIC}) %s
APPL018 -- -- --- ({MNEMONIC}) %s
APPL019 -- -- --- ({MNEMONIC}) %s
APPL020 -- -- --- ({MNEMONIC}) %s
APPL021 -- -- --- ({MNEMONIC}) %s
APPL022 -- -- --- ({MNEMONIC}) %s
APPL023 -- -- --- ({MNEMONIC}) %s
APPL024 -- -- --- ({MNEMONIC}) %s
APPL025 -- -- --- ({MNEMONIC}) %s

```
APPL026 -- -- --- ({MNEMONIC}) %s
APPL027 -- -- --- ({MNEMONIC}) %s
APPL028 -- -- --- ({MNEMONIC}) %s
APPL029 -- -- --- ({MNEMONIC}) %s
APPL030 -- -- --- ({MNEMONIC}) %s
APPL031 -- -- --- ({MNEMONIC}) %s
APPL032 -- -- --- ({MNEMONIC}) %s
```

logAPPL.h File

The following is the code for the **logAPPL.h** file located in **/usr/spool/log/head**. There must be an definition in **logAPPL.h** for each message used from **APPLmsg**.

```
/*@(#)logAPPL.h8.1.1.2 16:54:41 6/28/93*/

#ifndef header_LOGAPPL_H
#defineheader_LOGAPPL_H

/*For compatibility with the old and new C++ define:*/

#ifdefc_plusplus
#ifndef__CCPLUSPLUS__
#define__CCPLUSPLUS__
#endif
#endif

#ifdef__cplusplus
#ifndef__CCPLUSPLUS__
#define__CCPLUSPLUS__
#endif
#ifndefCC_TYPE_SAFE
#defineCC_TYPE_SAFE
#endif
#endif

#ifdef_INSTALLABLE_APPL
#ifdef __CCPLUSPLUS__
CC_EXTERN( int Fcn_APPLMSG_START() ; )
inline int logAPPL(int xx){return (Fcn_APPLMSG_START()+(xx)-1); }
#else
extern int Fcn_APPLMSG_START() ;
#define logAPPL(xx)(Fcn_APPLMSG_START()+(xx)-1)
#endif

#else
```

```
#ifdef __CCPLUSPLUS__
inline int logAPPL(int xx){return (_APPLMSG_START+(xx)-1); }
#else
#define logAPPL(xx)(_APPLMSG_START+(xx)-1)
#endif

#endif

#define APPL_INITFAILlogAPPL(1)
#define APPL_MSGSNDERRlogAPPL(2)
#define APPL_UNKNOWNMSGlogAPPL(3)

#endif
```

Summary of Script Instructions

A

What's in This Appendix

This appendix contains information about the script instructions discussed in Chapter 4, "Script Instructions", and Chapter 5, "Data Interface Process", of this book. Typically, the information here is the same as in Chapters 4 and 5, but is presented in a different format.

The script instructions are listed in alphabetical order. Each script instruction is on a separate page, and for each instruction, the following is provided:

- Instruction name and syntax
- Purpose of the instruction
- Effects of using the instruction
- Examples of the instruction

Script Instruction Syntax

In presenting a script instruction's syntax, the following conventions are used:

- The script instructions are displayed in **bold** type.
- Associated options are displayed in ***bold italic*** type.
- Mandatory arguments or identifiers are displayed within parentheses — ( ).
- Optional arguments or identifiers are displayed within brackets — [ ].
- Lists of options for a single argument are divided by pipe symbols (a|b|c|d).

For more information about the conventions used in this book, refer to "Conventions Use in This Book" in the "About This Book" section.

and

Synopsis

This script instruction implements an AND operation on the specified arguments.

Command Format

***and*(*type.dst,type.src*)**

Description

The and instruction implements a bitwise AND operation on the arguments. The results are stored in type.dst

Example

The following example clears the bits set in FLAG in r.3.

and(r.3,im.FLAG)

atoi

Synopsis

This script instruction converts an ascii string to an integer.

Command Format

***atoi*(*type.dst,ctype.src*)**

Description

Atoi converts a null terminated character string at the ctype.src to an integer value and stores that value at the type.dst.

Example

The following example converts a null terminated character string found at the address labeled ISIZE to a numeric value and puts it in r.1.

atoi(r.1,ch.ISIZE)

background

Synopsis

This script instruction starts and/or listens to background audio on the specified channel.

Command Format

background(*"phrase_name",type.src*)
background(*type.src,type.src*)

Description

NOTE:
A time division multiplexor (TDM) bus and signal processor (SP) board must be installed in the system for the background instruction to function properly.

The background script instruction starts and/or listens to background audio on the specified channel. The first argument is a phrase enclosed in quotation marks (" "). The phrase must match a phrase listed in the talkfile specified by the currently active tfile instruction. The first argument can translate also to the index number of a phrase in the talkfile. In this case, the argument must be expressed according to the conventions of type.src. This syntax is similar to the talk() instruction but only supports one phrase rather than a phrase list.

If this phrase is not playing already in the VIS, it is started and its audio output added to the normal voice response prompts on the current channel. Other channels may execute the same background instructions. The audio then is added to those channels while it still is played on the first channel. When the phrase has been played, it starts again at the beginning. The phrase continues to play as along as at least one channel requires it. The background audio stops when all channels requesting it have dropped it. Background speech plays at a volume level that is 33 percent of foreground speech.

If the background instruction is successful, it returns a positive value in register 0. If the instruction is not successful, it returns a negative value in register 0.

The following are possible reasons the background instruction might fail:

- Attempt to add more than one background audio to a channel
- Channel reached the limit for listen time slots (maximum of 7 per channel)
- No SP available
- All TDM slots are busy
- Reached system limit on number of backgrounds (MAXCHAN)
- System call failure

NOTE:
On a TR channel that is not using the TDM bus to play speech (for example, the channel is set to "talk", not "tdm"), the foreground speech interrupts background speech. If the TDM bus is used, background speech will be heard continuously.

Example

```
#define ADD 1
#define DROP 0

tfile("/speech/talk/list.cabnt")
background("begin testing",imm.ADD)
background(imm.201,imm.DROP)
```

case

Synopsis

This script instruction calls a function if the values are equal.

Command Format

case(*type.src,type.src [,<subroutine_label>] [<goto_label>]*)
case(t*ype.src,type.src[,<subroutine_label> ()] [<goto_label>]*)
case(*type.src,type.src[,<subroutine_label>(type.src)] [<goto_label>]*)
case(*type.src,type.src[,<subroutine_label>] [type.src,type.src] [<goto_label>]*)

Description

Case provides a conditional subroutine call that compares two source values. If they are equal, the subroutine is called, and on return, execution continues at the goto_label address. If they are unequal, the statement is treated as a no-op instruction and execution continues. If the subroutine_label is -1, no subroutine call is made and execution continues at the goto_label. If the goto_label is -1, execution continues with the next instruction.

As is normal for subroutine calls, calling the specified subroutine results in the values of registers 1-3 being saved and register 3 will contain the first optional subroutine argument and register 2 will contain the second optional subroutine argument.

Example

```
case(int.FOLLOW_UP,im.F_ATD_A,CALL(im.APHONE),w4answ)
case(int.FOLLOW_UP,im.F_ATD_B,CALL(im.BPHONE),w4answ)
a.a.a.

w4answ:
a.a.a.

CALL: /* Call an attendant. Phone number is at address in r.3 */
tic('o', int.ATDTIC, *ch.3)
rts()
```

Based on the value of int.FOLLOW_UP, one of two phone numbers is dialed.

chantype

Synopsis

This script instruction enables scripts to determine the type of channel they are running on.

Command Format

chantype ()

Description

As a response to this instruction, register r.0 will be populated by one of the following values:

- 1: Channel type is tip/ring
- 2: Channel type is T1
- 3: Channel type is LST1
- 4: Channel type is PRI
- 5: Hardware or Software error

NOTE:
The Converse vector step is not supported for PRI or T1 (E&M) channels.

dbase

Synopsis

This script instruction sends a message to a data interface process (DIP).

Command Format

dbase(*type.dip,mcont_field,ctype.dst,mbyte,type.src,nbyte*)

Description

Dbase sends a message to a DIP and usually received data in return. It uses any DIP to interface with the host or local database. All the arguments must be specified for the dbase instruction to execute. The arguments are defined by the script writer. Refer to Chapter 5, "Data Interface Process", for more information.

A message is sent to a data interface process (DIP) specified by the first argument in the dbase instruction. The type.dip argument can be a DIP number (as for hardcoded DIPs) or name (as with Dynamic DIPs). The mcont_field is a DIP-specific code signifying the DIP action regarding the next instruction. The information returned by the DIP is stored at the destination address specified by ctype.dst; its length is specified by mbyte. If mbyte is negative, the dbase call will not wait for a response from the DIP. The information passed to the DIP from the TSM is read beginning from the address specified by type.src; its length is specified by nbyte. It is important that the DIP and TSM script agree on the structure and contents of the information passed. If the dbase call is successful and the DIP returns a message to the script, r.0 is set to the mcont value of the DIP message.

If type.src is a register, nbyte is ignored. If nbyte is zero, no information is passed to the DIP. If the DIP is not running, r.0 is set to -1. If the DIP does not respond within a reasonable time (the default value is approximately 45 seconds), r.0 is set to -2. To reset the default value for timeout, use the nwitime instruction.

NOTE:
The mbyte and nbyte arguments must be #define variables or the actual value. These variables cannot be passed directly to an external function from the script.

Example

In the following example, this instruction uses DIP "Bankdip" to retrieve information. The DIP action is defined by the second argument (LOGON). The retrieved information is stored in user memory beginning at CUSTRECS and has a length of SZCUSTREC bytes. CUSTRECS is found in the ***application-name*.def.h** header file. The argument LOGONS is also defined in the ***application-name*.def.h** header file and marks the starting address of the information passed to the DIP for retrieving the information. The LOGONS field is 5 bytes long.

```
dbase(im."Bankdip",LOGON,ch.CUSTRECS,SZCUSTREC,ch.LOGONS,5)
```

See Also

getdig

decr

Synopsis

This script instruction decreases a value.

Command Format

decr(type.dst,type.src)

Description

Decr decrements the type.dst value by the type.src value.

Example

The following example decreases r.3 by the value defined by NSTKS.

decr(r.3,im.NSTKS)

dipname

Synopsis

This script instruction translates a DIP number to a DIP name.

Command Format

dipname(ctype.dst, type.src)

Description

Dipname stores the DIP name in ctype.dst corresponding to the TSM DIP number specified in type.src. Ctype.dst should be least DBNAMELENG (as defined in shmemtab.h) bytes long. Dipnum stores a null string if the DIP number:

- is not between 1-34 or 44 to 75
- does not have an associated message queue already created
- maps to a message queue key that is not assigned to a DIP

Note that the contents of the registers if not affected by this instruction.

Dipname is used mostly for scripts that catch the DIP interrupt event and need to translate the DIP number of interrupting DIP to a DIP name.

Examples

```
/* Space for DIP name */
#define DIPNAME 30
dipname(ch.DIPNAME,r.1) /*DIP number in register 1 */
dipname(ch.DIPNAME,imm.0) /* DIP number 0 */

dipname(ch.DIPNAME,int12) /* DIP number in integer location 12 */
```

See Also

dipnum

dipnum

Synopsis

This script instruction translates a DIP name to a DIP number

Command Format

dipnum(type.dst, ctype.src)

Description

Dipnum stores the DIP number in type.dst corresponding to the TSM DIP name specified in ctype.src. Dipnum stores a -1 if the DIP name:

1. is invalid
2. does not have an associated message queue already created
3. maps to a message queue key that is not assigned to a DIP.

Note that the contents of the registers if not affected by this instruction.

Examples

```
/* Space for DIP name */
#define DIPNAME 30
#define dipnum 48
dipnum(r.1, ch.DIPNAME)

dipname(int.dipnum, imm."Dip")
```

See Also

dipname

dipterm

Synopsis

This script instruction specifies that a DIP receives a message when the script terminates.

Command Format

dipterm(type.dip)

Description

The dipterm instruction specifies to TSM which DIP receives a termination message when the script terminates. A DIP number or name may be used for type.dip. The dipterm instruction may be called repeatedly with different DIP numbers or names. The termination message will go to all DIPs specified.

The values of type.dip are:

Dip#Meaning

-1No message sent

OtherIdentifies DIP number or name

The **dipterm** message is defined as the C-structure **struct ms_univ** (see **mesg.h**). Figures A-1 and A-2 show the fields of the message and their values as set by TSM.

```
/* message structure for dipterm message */
struct ms_univ {
struct mbhdr hd;
long arg[4];
};
```

Figure A-1. dipterm Synopsis

Figure A-2. dipterm Message Structure

arg[0], as shown, displays why the script terminated. As defined in **tsm_dip.h**, there are several causes for a script to terminate.

NORMALTERMAquit instruction in the script was executed.
DISCONTERMThe call was disconnected.
SCRFAILTERMAn error in the script code.
LOOPTERMThe script appears to be stuck in an infinite loop.
MTCTERMThe MTC process has seized the channel that the script is running on.
EXECTERMThe script exec'ed another script.

arg[1] is set to the value specified in the **quit** or **exec** instructions.

Example

The following example causes DIP0 to receive a termination message when the script terminates.

dipterm(im.0)

The following example causes the DIP called "bankdip" to receive a termination message when the script terminates.

dipterm(im."bankdip")

div

Synopsis

This script instruction divides a value.

Command Format

div(type.dst,type.src)

Description

Div divides the type.dst value by the type.src value. The integer quotient is returned in type.dst. Div returns a value of 0 (zero) in Register 0 if no error occurred. If division by 0 is done and a -1 value is returned in Register 0, the result will be set to the largest positive or negative integer, depending on whether type.dst was positive or negative originally.

Example

The following example divides r.3 by the value defined by NSTKS.

div(r.3,im.NSTKS)

dtitos

Synopsis

This script instruction converts the date and time from an internal form to the "tm" structure form.

Command Format

dtitos(type.src, type.dst)

Description

Dtitos() converts the date and time from the internal UNIX system representation to "tm" structure form. The type.src argument should contain a number representing the UNIX system internal representation of time (number of seconds since 00:00:00 GMT, January 1, 1970). It is recommended that the integer type be used for this argument. The resulting "tm" structure (the 9-integer structure defined in CTIME(3C) in the UNIX System V Programmer's Reference Manual) will be put in type.dst (that is, type.dst defines a starting address for the result).

Dtitos() returns 0 in script register 0 (r.0) if the conversion is successful. A -2 is returned in r.0 if TSM could not allocate enough space in script memory to store the result.

Example

In the following example, the script plays the system date and time, then says "goodbye" and hangs up. Note that phrase numbers for the days of the week and month of the year in the stdspch.pl play file are offset from "sunday" and "january" by the values obtained in TM_WDAY and TM_MON, respectively.

```
#define TM  8
#define TM_SEC 8/* seconds after the minute (0-59) */
#define TM_MIN 12/* minutes after the hour (0-59) */
#define TM_HOUR  16/* hour since midnight (0-23) */
#define TM_MDAY  20/* day of the month (1-31) */
#define TM_MON  24/* months since January (0-11) */
#define TM_YEAR 28/* years since 1900 */
#define TM_WDAY 32/* days since Sunday (0-6) */
#define TM_YDAY  36/* days since January 1st (0-365) */
#define TM_ISDST 40/* flag for daylight savings time */
/* (non-zero if alt. timezone in effect) */
#define WKDAYPH 44
#define MONTHPH 48
```

```
tfile("stdspch.pl")
dtitos(time.0, ch.TM)
tic('a')
talk("date")
load(int.WKDAYPH, im."sunday?")
incr(int.WKDAYPH, int.TM_WDAY)
talk(int.WKDAYPH)
load(int.MONTHPH, im."january")
incr(int.MONTHPH, int.TM_MON)
talk(int.MONTHPH)
tnum(int.TM_MDAY)
tnum(imm.19)
tnum(int.TM_YEAR)
sleep(im.2)
talk("time")
tnum(int.TM_HOUR)
tnum(int.TM_MIN)
sleep(im.2)
talk("goodbye")
quit()
```

See Also

dtstoi()

dtstoi

Synopsis

This script instruction converts the date and time from the "tm" structure to a UNIX system internal form.

Command Format

dtstoi(type.src, type.dst)

Description

Dtstoi() converts the "tm" structure specified by the type.src argument and converts it to the internal UNIX system representation. The result is placed in type.dst. An integer type should be used for type.dst. This instruction is the complement to the dtitos() instruction.

Dtstoi() returns 0 in script register 0 (r.0) if the conversion was successful. A value of -1 is returned in r.0 if the "tm" structure indicated by type.src contains incorrect values or is at a location outside the script data area.

Example

In the following example, this script fragment gets the current system date and time, truncates the hour to midnight, and converts the result back to UNIX system time stored at location MIDNGT.

```
#define TM  8
#define TM_SEC 8/* seconds after the minute (0-59) */
#define TM_MIN 12/* minutes after the hour (0-59) */
#define TM_HOUR 16/* hour since midnight (0-23) */
#define TM_MDAY 20/* day of the month (1-31) */
#define TM_MON 24/* months since January (0-11) */
#define TM_YEAR 28/* years since 1900 */
#define TM_WDAY 32/* days since Sunday (0-6) */
#define TM_YDAY 36/* days since January 1st (0-365) */
#define TM_ISDST 40/* flag for daylight savings time */
/* (non-zero if alt. timezone in effect) */
#define MIDNGT 44

...

dtitos(time.0, ch.TM)
load(int.TM_HOUR, imm.0)
```

dtstoi(ch.TM, int.MIDNGT)

See Also

dtitos()

event

Synopsis

This script instruction causes a subroutine call when defined events occur.

Command Format

event(event_type[, subroutine_label])
event(event_type[, type.offset])

Description

The event() script instruction causes a jump to the subroutine_label given when events defined by the event_type argument occur. The event types are defined in the header file /att/msgipc/tsm_dip.h.

If valid arguments are passed, the event() instruction will return an integer offset in register 0 (r.0). This offset is the value of the previous subroutine_label (if any) used for the event. It may be saved and used later as the type.offset argument to the event() instruction to reset the subroutine_label back to its previous value. (This is useful for external script functions which need to handle events and want to restore their disposition to whatever the calling script had set before returning.)

If event_type is not valid or type.offset is larger than the text space of the script, a value of -3 will be returned by the event() instruction.

A negative value for type.offset may be used to set no subroutine label for an event, causing the default action to be taken when the event occurs (see below). If no subroutine_label or offset is given, the event() instruction returns in r.0 the value of the subroutine_label currently being used (or -1 if none) without changing the disposition for the event.

The event types are:

- **EHANGUP** — Hangup event. This event is triggered when dial tone, no loop current, disconnect, or glare conditions are detected on the channel. The register value passed to the event subroutine is EHANGUP for r.0. If no event subroutine is set for this event, the script exits as if the quit instruction was used.
- **EDIALTONE** — Dial tone event. This is a special case of the EHANGUP event. Normally, EHANGUP is triggered when dial tone or stutter dial tone is detected (and the script is not expecting dial tone). EDIALTONE is used

to treat dial tone detection separately from EHANGUP. If both EHANGUP and EDIALTONE are set with the event() instruction to call different interrupt routines, EDIALTONE must be set following EHANGUP.

The register value passed to the event subroutine is EDIALTONE for r.0. If no event subroutine is set for this event, the script exits as if the quit instruction was used.

- **ESOFTDISC** — Soft disconnect event. This event is triggered by sending a SOFT_DISC message to TSM from a DIP (see /att/msgipc/tsm_dip.h). This message is acknowledge with a SOFT_DPASS message before the event subroutine is called. Note that if the channel specified by the SOFT_DISC message is idle, a SOFT_DFAIL message is returned.

  Register values passed to the event subroutine are ESOFTDISC for r.0 and the number of the DIP that sent the SOFT_DISC message for r.3. If no event subroutine is set for this event, the script exits as if the quit instruction was used.

- **EDIPINT** — DIP interrupt event. This event may be triggered by sending a DIP_INT message from a DIP to TSM (see att/msgipc/tsm_dip.h). The DIP_INT message is not acknowledged.

  If an event subroutine is set, it will receive the following values when the event occurs:

  r.0 event type (EDIPINT)

  r.1 value from arg[1] of DIP_INT message

  r.2 value from arg[2] of DIP_INT message

  r.3 number of the DIP that sent the DIP_INT message

  If no event subroutine is set for EDIPINT, TSM ignores the DIP_INT message is ignored and the script continues to run.

- **ETTREC** — Touch tone received event. This event can be used to allow a dbase(), sleep(), tflush(), or tic() instruction to be interrupted if a touch tone is received while they are being executed. Note: The tflush() instruction is only interrupted if its first argument is 1 ("talk off" is disabled).

  If an event subroutine is set, it will receive the following values when the event occurs:

  r.0 event type (ETTREC)

  r.1 TT character that caused the interrupt

  r.2 number of TTs received since last getdig() or ttclear()

  r.3 instruction interrupted 't' - tflush(), 's' - sleep(), 'd' - dbase(), 'i' - tic()

If no event subroutine is set for ETTREC, the instructions will not be interrupted by touch tones.

- **EANSSUP** — Answer supervision event. This event is triggered when answer supervision is detected for a T1 or PRI channel.

  The register value passed to the event subroutine is EANSSUP for r.0. If no event subroutine is set for this event, the event is not triggered and the script continues to run.

The DIP number stored in r3 for ESOFTDISC and EDIPINT events is the same value used by the **dbase** and and **dipterm** instructions. It can be used directly by those instructions in the event subroutines, if desired.

Return from an event subroutine is handled the same for all events. If the event routine causes a wait condition, any previous wait condition will be forgotten. If the event routine sets r.0 to a negative value before returning (with the rts() instruction), any previous wait condition will be aborted. The wait causing instruction then returns immediately with r.0 still set to that negative value. In most cases, this simulates a failure condition for the interrupted instruction. If r.0 is not negative when the event routine returns, the script continues to wait for the expected condition before it continues. When the event routine returns, r.1, r.2, and r.3 are restored to the values they had before the event. Events of different types may be nested. A new event is ignored if an event of the same type is being handled already. The EDIALTONE event also is ignored while EHANGUP is being handled.

Examples

```
#define ATD_TIME 24

MAIN:
tfile("list.atd_mgmt")
event(EHANGUP, hangup)
...

hangup:
load(ev.ATD_TIME, time.0) /*Record time attendant becomes free*/
...
quit()
```

When a hangup is detected, the script calls the subroutine hangup which records the time in event data space and exits.

```
MAIN:
...
event(ETTREC, L_tkoff)
talk("something")
tflush(1)
/* tflush will return a -5 in r.0 if talkoff (# only) */
...
event(ETTREC, im.-1) /* reset event */

...

L_tkoff:
jmp(r.3 ! im.'t', L_notkoff) /* not tflush */
jmp(r.1 ! im.'#', L_notkoff) /* not # digit */
tstop()/* stop play */
load(r.0, im.-5) /* abort tflush() */
rts()
L_notkoff:
load(r.0, im.0)/* continue instruction wait */
rts()
```

When a touch tone is detected during the tflush(1) instruction, the script will stop the play only if the TT digit is a '#'. Note that any received digits are not removed from the script's TT buffer unless a getdig() or ttclear() instruction is done.

exec

Synopsis

This script instruction allows a script to start another script.

Command Format

exec(ctype.src[,type.data,type.nbytes][,exitval])

Description

The exec instruction allows a script to execute another script.

The ctype.src argument is the name of the script to be executed. The *type.data* and *type.nbytes* arguments are used to pass a block of data to the new script. The *type.data* argument specifies the location of the data and *type.nbytes* specifies the size in bytes of that data. If *type.data* is a register or immediate type, *type.nbytes* is ignored and the size of an integer (4 bytes) is assumed. These two optional arguments work like the last two arguments of the **dbase()** instruction. The constant exitval argument is an optional exit value that will be used when the "parent" script is terminated before the new "child" script is run. It is used in the same way as the argument to the **quit()** script instruction and may be specified without specifying the *type.data* and *type.nbytes* arguments. If no *exitval* is given, -1 is used by default.

The exec instruction only returns if the script name specified is invalid or the size of the data being passed exceeds the 1Kbyte default limit. In these cases, register 0 is set to -1. Otherwise, the script exits and the following actions are performed:

— If the *exitval* used is 0 or negative or if no *exitval* is given, a CALLDATA message is sent to CDH (as is done when the **quit()** instruction is called). However, if the *exitval* is greater than 0, the CALLDATA record is not written to CDH. In this case, the CALLDATA events and the start time of the call are preserved for the next script, which may send the record out when it executes another exec() or a quit().

— SCRIPTTERM messages are sent to all DIPs for which the **dipterm()** instruction was executed by the script. An array of four long integers is passed as data with the SCRIPTTERM message. The first of these is set to NORMALTERM in the case of quit() but will be set to EXECTERM in the case of exec() (see tsm_dip.h). The second integer in the array is set to whatever value is given to the quit() instruction or in the *exitval* argument to the exec() instruction. In each case, it is set to -1 if this value is not provided.

Normally, TSM sets all four script registers to zero (0) when a new script starts. When a script is run with exec(), however, the register values set by the old script, with the possible exception of Register 0, are preserved for the new script. If any speech has been queued with the talk(), tnum(), tchar(), or say() instruction, the exec() causes this speech to be played before the new script is executed. If speech is played, Register 0 will be modified to indicate the result of that play (see the tflush instruction). To pass some other value to the new script in Register 0, use tflush() to play any queued speech before setting Register 0 to the desired value and executing exec().

The System Monitor shows the transition when a new script is executed by displaying the new script name under the "Voice Service" heading for the channel. The number under the "Calls Today" heading is not incremented when a new script is started with exec() unless the new script executes a tic('a') instruction.

As was mentioned previously, the optional second and third arguments to exec() may be used to pass a block of data to the new script. This data is not stored in the user data space of the script because that space is usually freed and the new script's data space takes its place. This means that the new script cannot access the passed data directly as a script variable. Instead a new access code argument, "X.0", was introduced to reference this data and some existing instructions have been modified to support this code. The X.0 code may be used as the second argument to the strcpy() instruction to copy the exec() data into the script's data space. When this argument is used, strcpy() performs a block copy of the exec() data to the place specified by the first argument to strcpy(). Enough space should be set aside by the script to accommodate the data. Strcpy() uses the size that was passed by the exec() instruction in copying the data. It does not look for a null character at the end of the data, as is done normally.

The strcmp() and strlen() instructions also will accept X.0 for their arguments. In this case, strcmp() does a byte by byte comparison using the size of the exec() data as a limit (instead of looking for a null character termination) and returns in register 0 a value with the same meaning as strcmp() has had previously (i.e., a value less than, equal to, or greater than zero depending on whether the data indicated by the first argument is lexicographically less than, equal to, or greater than that indicated by the second argument). Strlen() simply returns in register 0 the size of the exec() data as it was passed to the exec() instruction.

The exec() data also may be passed directly to a DIP by using the X.0 code as the fifth argument to the dbase() instruction. The sixth argument indicating the size is ignored in this case since TSM will use the size originally passed to exec(). The exec() instruction similarly supports the X.0 code for its *type.data* argument. The *type.nbytes* argument also is ignored in this case.

These instructions are the only ones which have been modified to support the X.0 argument code. The TAS script compiler has been changed to do some checking of the arguments to the dbase() and strcpy() instructions to insure that X.0 will not be allowed for the first argument of strcpy() and the third argument to dbase().

There has been no effort made to do such checking for any other instruction; use of X.0 elsewhere may have unpredictable results.

Example

The following example quits the script with an exit value of 1 and starts executing the "test.script" script.

exec(im."test.script",1)

execu

Synopsis

This script instruction allows a script to start another script.

Command Format

execu(ctype.script[,type.data,type.nbytes][,exitval])

Description

The execu() instruction has the same format and functionality as exec(). Using execu() instead of exec(), however, causes the new script to inherit, intact, the data space of the "parent" script. Essentially, this feature allows a script to pass all its data to the new script. For this to be useful, however, the new script must have its data defined in the same way as the parent script (i.e., structures, variables, etc. must be defined for the same locations). The data definition of the new script will be used to overlay the actual data of the parent script.

Example

The following example quits the script with an exit value of 1 and starts executing the "test.script" script.

execu(im."test.script",1)

getdig

Synopsis

This script instruction receives touch-tone or spoken word data from a caller.

Command Format

getdig(type, ctype.dst, number)

Description

Getdig receives information entered by a calling party using touch tones or voice input. Touch tones include the full range of 12 keys on the telephone keypad. For information on using the getdip instruction for Speech Recognition, refer to *CONVERSANT VIS Speech Recognition*.

Type 0 specifies touch-tone input.

The number argument specifies the maximum number of touch-tone digits to be received. The maximum value is 128. Received touch tones are stored as a null terminated character string in a buffer specified by the destination argument. Possible characters are 0 through 9, *, and #.

Getdig has a 5-second default wait time for touch-tone input. If the caller does not enter a touch tone within the allotted time period, getdig returns the number of digits received before the timeout occurred. Use the **tttime** command to specify a desired wait time.

Getdig is a wait-causing instruction. Therefore, it automatically forces out any pending or unfinished announcements from this channel.

When this instruction terminates, a return code is placed in r.0. The following list shows the return values for touch tone input, where N represents the number of touch tones received:

N > 0	If the *number* argument is greater than N (fewer than the expected-number of touch tones were received), an interdigit time out occurred.
N = 0	An initial timeout occurred.
N < 0	A system error occurred.

Example

In the following example, the script waits for the caller to enter up to ten touch tones, then stores them in ch.ANS.

getdig(0, ch.ANS, 10)

See Also

ttclear
ttdelim
tflush
tttime

goto

Synopsis

This script instruction unconditionally branches to a label.

Command Format

goto(<label>)

Description

Goto is an unconditional jump to the instruction indicated by the label.

Example

In the following example, the goto instruction implements if-then logic to avoid the fall-through condition. As shown in the first block of code, the instruction would jump to no_value if true, but must avoid that block of code if false. A goto is also used as a direct path out of a block of code.

```
jmp(r.1 <= im.0, no_value)
talk("the value is positive")
goto(next_block)

no_value:
 talk("the value is not positive")
 ..........  ...................  ..............

next_block:
 ........  ...................
```

See Also

jmp
case

hbridge

Synopsis

This script instruction directs the current channel to bridge partially to another channel.

Command Format

hbridge(type.src,type.src)

Description

The hbridge script instruction directs the current channel to bridge partially to another channel. The result is that the audio coming in on the specified channel is heard or dropped by the calling party (current channel). The specified channel does not hear the calling party. The current channel does not hear voice responses or other background audio on the specified channel.

The first type.src argument is a valid channel number. The second type.src argument is either 1 to add the specified channel or 0 (zero) to drop the channel. Values for the channel numbers and the add/drop flag follow the conventions for all type.src arguments.

If the hbridge instruction is not successful, a negative value is returned to Register 0. The following are conditions under which the hbridge instruction may fail:

- Hbridge attempt to to current channel
- Channel reached limit for listen tie slots (7 maximum per channel)
- System call failure

Example

```
#define ADD 1
#define DROP 0
#define OTHCHAN17

hbridge (imm.OTHCHAN,imm.ADD)
hbridge(imm.OTHCHAN,imm.DROP)
```

hundsec

Synopsis

This script instruction gets the system time in hundredths of a second.

Command Format

hundsec(type.dst)

Description

Hundsec() loads the integer type.dst with the system time in hundredths of a second.

NOTE:
Use the sleep() instruction, instead of hundsec(), to measure time greater than two seconds.

Example

In the following examplek, HSEC2 contains the duration of the dbase() call in hundredths of a second.

```
#define HSEC1 10
#define HSEC2 14

...

hundsec(int.HSEC1)
dbase(DIP, GET_DATA, ch.SENDBUF, 20, ch.RCVBUF, 100)
hundsec(int.HSEC2)
decr(int.HSEC2, int.HSEC1)
```

ibrl

Synopsis

This script instruction increments a counter and branches to a label if one one is less than the other.

Command Format

ibrl(type.dst,type.src,<label>)

Description

Ibrl is intended for loop control by testing for equality of two variables. It determines whether to make another pass through a loop or to execute the next sequential instruction. The destination value is incremented by one, and then compared to the source value. If type.dst is less than type.src, then execution jumps to the labeled instruction.

Example

In the following example, ffter doing some other tasks, r.3 is increased by 1 and compared with r.1. If r.3 is less than r.1, the loop is repeated at the label SW1_CTRL; otherwise, the next instruction is executed which takes the program to end_loop.

SW1_CTRL:

```
..... ......... ...................
ibrl(r.3,r.1,SW1_CTRL)

end_loop:
```

incr

Synopsis

This script instruction increases a value.

Command Format

incr(type.dst,type.src)

Description

incr increments the type.dst value by the type.src value.

Example

The following example increases the event counter 2 by 1.

incr(ev.2,im.1)

itoa

Synopsis

This script instruction converts an integer to an ascii string.

Command Format

itoa(ctype.dst,type.src)

Description

Itoa converts a numeric type.src value to a null terminated character string stored starting at ctype.dst.

Example

In the following example, a numeric value in r.2 is written at the address labeled ISIZE as a null terminated character string.

itoa(ch.ISIZE,r.2)

jmp

Synopsis

This script instruction jumps to a label if the condition true.

Command Format

jmp(type.src rel_op type.src,<label>)

Description

Jmp is a conditional jump to the labeled instruction. The values of the two source operands are compared as specified by the relational operator.

Example

The following example directs the script to go to the attendant subroutine if ch.0 contains * and to go to the BYE subroutine if ch.0 contains #.

```
jmp(*ch.0==imm.'*',attendant)
jmp(*ch.0==imm.'#',BYE)
```

See Also

goto

label

Synopsis

This script instruction calls a subroutine.

Command Format

label([type.src] [,type.src])

Description

Label( ) is used to call a subroutine found at the address indicated by the label. A return address and the values in r.1, r.2, and r.3 are saved on a subroutine stack in the calling subroutine. The optional first and second arguments are stored in r.3 and r.2, respectively.

Example

```
load(in.FIRST,im.1)
load(in.SECOND,im.2)
ADDEM(in.FIRST,im.SECOND)
tnum(in.SUM)

ADDEM( )
 load(in.SUM,imm.0)
 incr(in.SUM,r.3)
 incr(in.SUM,r.2)
 rts ( )
```

The integer variables FIRST and SECOND are set equal to 1 and 2, respectively. The subroutine ADDEM is called with two arguments.

Within ADDEM, the variable SUM is set to zero. Then the value of SUM is incremented by r.3 (which has been assigned the value of FIRST from the calling routine) and incremented by r.2 (which has been assigned the value of SECOND from the calling routine.

The subroutine return (rts) returns control to the tnum instruction following the ADDEM subroutine call.

See Also

case

listenall

Synopsis

This script instruction listens to all audio input on a specified channel.

Command Format

listenall(type.src, type.src)

Description

The listenall script instruction listens to all audio input on a specified channel. Audio input includes normal voice responses to the network. The specified channel does not hear any audio from the current channel. This allows administrators to monitor the channel.

The script with the call to listenall must be kept running until the caller is finished monitoring the audio input on the other channel. One way to accomplish this would be to add a call to sleep directly after listenall command.

For example:

listenall (imm.45, imm.ADD)
sleep (45)

These commands will keep the monitor script running for 45 seconds after the script starts. You must determine how long the other channel will be monitored and use the appropriate sleep value.

The first type.src argument is a valid channel number. The second type.src argument is either 1 to add the channel or 0 (zero) to drop it. These arguments must follow the conventions for type.src arguments discussed in Chapter 4, "Script Instructions".

If the listenall script instruction is successful, a positive value is returned to Register 0. If the listenall instruction is not successful, a negative value is returned to Register 0.

The following are reasons the listenall instruction might fail:

- Attempt to monitor current channel
- Attempt to monitor more than one channel
- Channel reached limit for listen time slots (maximum of 7 per channel)
- System call failure

NOTE:
If the listenall instruction hears a dialtone, it will hang up.

Example

```
#define ADD 1
#define DROP0
#define OTHCHAN 17

listenall(imm.OTHCHAN,imm.ADD)
listenall(imm.OTHCHAN,imm.DROP)
```

load

Synopsis

This script instruction moves data.

Command Format

load(type.dst,type.src)
load(ctype.dst,ctype.src)

Description

Load sets the destination value equal to the source value.

Example

In the following example, the 4-byte value defined by the name NSTKS is put in r.1. The value 3 is written to r.2.

load(r.1,im.NSTKS) load(r.2,im.3)

mul

Synopsis

This script instruction multiples a value.

Command Format

mul(type.dst,type.src)

Description

Mul multiples the type.dst value by the type.src value.

Example

The following example multiplies the event counter 2 by 4.

mul(ev.2,im.4)

not

Synopsis

This script instruction implements a NOT operation on the argument.

Command Format

not(type.dst)

Description

The not instruction performs a 1's complement operation on the argument.

Example

In the following example, r.3 is changed to its 1's complement.

not(r.3)

In the following example, the bits set in FLAG are cleared in r.3.

```
load(r.2,im.FLAG)
not(r.2)
and(r.3,r.2)
```

nwitime

Synopsis

This script instruction specifies the amount of time to wait for the next wait-causing instruction.

Command Format

nwitime(type.src)

Description

The nwitime (next wait instruction time) instruction sets the maximum amount of time the script will wait for the completion of the next wait-causing instruction. The argument specifies the number of seconds to wait. Instructions that are affected by nwitime are: dbase, phremove, phreserve, and tic. Sleep also causes a wait, but nwitime will have no effect on it because sleep resets the wait time.

Example

In the following example, the nwitime instruction specifies the maximum number of seconds the script should wait for host confirmation before continuing.

```
ACCT_BAL:
 nwitime(imm.20)
 --
 --
 (query host - dbase())
 --
 --
 talk("Your account balance is")
 tnum(int.FIVE,'f')
 rts()
```

See Also

sleep

or

Synopsis

This script instruction implements an OR operation on the arguments.

Command Format

or(type.dst,type.src)

Description

The or instruction implements a bitwise OR operation on the arguments.

Example

In the following example, bits set in r.1 or FLAG are set to 3.

or(r.3,im.FLAG)

phremove

Synopsis

This script instruction removes a phrase from a talk file.

Command Format

phremove(type.phrase,type.talk)

Description

The phremove instruction removes the phrase specified by the type.phrase argument from the talk file specified by the type.talk argument. The valid values for type.phrase are 1-65,535. The valid values for type.talk are 1-16,383. Type.phrase must be a valid phrase id. Type.talk may have the value -1. If type.talk is -1, then the talk file id used will be the current talk file. Do not use a character data type as an argument.

If the phremove instruction is successful, it returns the phrase id of the phrase removed in register 0. If the instruction is not successful, it returns a negative value in register 0.

Example

In the following example, phrase 205 is removed from talk file 19.

```
load(sh.TALKID,im.19)
phremove(im.205,int.TALKID)
```

In the following example, phrase 117 is removed from talk file 10.

```
load(ch.TALKF,im.10)
load(int.PHR,im.117)
phremove(int.PHR,ch.TALKF)
```

phreserve

Synopsis

This script instruction creates space for a phrase in a talk file.

Command Format

phreserve(type.phrase,type.talk,type.time,type.style)

Description

Phreserve creates an area in a talk file that is used to store a phrase and specifies the coding style and rate to be used. This phrase is later encoded by the vc instruction. The arguments for the phreserve instruction are:

- type.phrase — specifies the phrase id of the phrase to be created (valid range is 1-65,535)
- type.talk — specifies the talk file id of the talk file where the phrase is stored (valid range is 1-255)
- type.time — specifies the amount of space, or time (in seconds), to be reserved for the phrase in the talk file.
- type.style — specifies the coding style and rate to be used. The coding styles and rates are defined in the header file codestyle.h. If the coding style and rate are invalid, the instruction fails. Do not use character data types for any of these arguments.

If type.phrase is -1, the system assigns a phrase id and returns this id in register 1. The phrase id can be used to reference the phrase (for example, in a talk instruction) once it has been coded and stored in the talk file by the vc instruction. If type.talk is -1, the system selects a default value (255) for the talk file and returns the id of the selected talk file in register 0.

NOTE:
If there are two phreserve instructions, there must be a vc instruction between them or the second phreserve instruction will fail.

When both type.talk and type.phrase are -1, both a phrase id and talk file id are chosen by the system and returned in registers 1 and 0 respectively. Since registers 0 and 1 can be used implicitly to store talk file and/or phrase ids, the script writer must take care to save the contents of these registers before the phreserve is executed.

If type.phrase matches the phrase id in the specified talk file, the existing phrase will be replaced by the new phrase. The value 0 or -1 for the type.time argument can be used to indicate that the phreserve instruction should not allocate any space. If enough space is available to store the phrase when coding ends, the phrase will be stored. If there is not enough space, an error message will be issued from the vc instruction.

If you add phrase 0 to any talk file, the phrase is added as phrase 65535 the first time. If the command is executed again, the phrase is added to the talk file as phrase 65534, then 65533, etc.

If the instruction is successfully completed, the return values are:

- Register 0 = talk file id
- Register 1 = phrase id

If the instruction is not successfully completed, the return value in register 0 is negative.

NOTE:
If the script terminates before **vc()** instruction is used, the space allocated to the phrase will be freed and the phrase number will be reused the next time a **phreserve** instruction is executed. A new phrase is not stored in the speech filesystem until a successful **vc()** is performed.

Example

In the following example, an area in talk file 15 is created to store the phrase. The id for the phrase is returned in register 1 and then loaded into location int.PHRASE. Since type.time is -1, the script writer relies on the system having enough space to store the phrase. The coding style for the phrase is ADPCM 32 kilobytes-per-second.

```
load(int.TALKID,im.15)
phreserve(im.-1,int.TALKID,im.-1,im.ADPCM32)
load(int.PHRASE,r.1)
```

In the following example, 10 seconds (using ADPCM 32kilobytes-per-second coding) of storage are allocated in talk file 23 for phrase 8.

```
load(ch.20,im.8)
phreserve(ch.20,im.23,im.10,im.ADPCM32)
```

quit

Synopsis

This script instruction terminates script instructions.

Command Format

quit([value])

Description

Quit is the voluntary termination of a script. A dipterm instruction may be defined before using quit, but it is not necessary for quit to execute. If dipterm is defined, an optional argument can be used. This optional argument is an integer defined by the script writer. It is sent to the DIP specified in dipterm and is usually used to notify the DIP why the script has quit.

Example

In the following example, TSM is instructed to send a termination message to DIP 0 when the script terminates. The script then executes the quit instruction, ending the script.

```
dipterm(im.0)
quit( )
```

See Also

dipterm
exec

rts

Synopsis

This script instructions returns from a script subroutine.

Command Format

rts()

Description

Rts is the mechanism for returning from a subroutine call. The saved values for r.1, r.2, and r.3 are restored. r.0 is left at whatever value it was before the rts instruction.

Example

In the following example, after speaking the character string in STKSYM with a falling inflection and then the phrase "has not opened," the script goes to dont_count. The rts() in dont_count causes the next instruction to be executed after the subroutine call in not_opened.

MAIN:

```
........  ..............  ..................
 SR_CALL( )
 ..............  ..............  ..................

SR_CALL:

 ..............  ..............  ..................

not_opened:
 tchars(ch.STKSYM,'f')
 talk("has not opened")
 goto dont_count()
..........  ...........  ..................

dont_count
 ...........  ..................  ..................
 rts()
```

scrinst

Synopsis

This script instruction determines the number of instances of a script currently running on the system.

Command Format

scrinst([ctype.script])

Description

The scrinst instructions enables an application script to find out how many instances of a script are running currently on the system. Based on the value returned by this instruction, the script may choose to prohibit execution of another instance of the script (via the exec instruction) or the script may quit if it is performing a check on itself and has exceeded the limit.

The ctype.script optional argument is the script, or service, name. If no script name is given, the script executing the instruction is assumed. This instruction sets the value of register 0 (r.0) to the number of instances of the given script at the time the instruction is invoked.

There are several possible uses of scrinst based on the ways in which a script may be started:

- Incoming call — It is suggested that the method of limiting the number of scripts started with an incoming call be left as it is. That is, do not assign a service to a number of channels greater than the desired limit. If the number of channels assigned to a script exceeds the limit, a script still may check the instance count as its first task and quit before answering the call if the instances exceed the limit.
- Exec() — The exec script instruction is the primary means by which an instance limit may be exceeded. Therefore, any application script that is concerned about running too many instances of another script should use scrinst() for that script before using exec().

  In this case, it is important to avoid a wait condition in the interval between scrinst and exec. This could cause other scripts running simultaneously that are performing the same test to get identical results from scrinst before any of them perform the exec instruction. Use tflush before scrinst to play any speech that is queued. Otherwise, the exec instruction will play the speech and the script will wait for the play to complete before performing the exec instruction.

— Soft seizure and virtual seizure — Scripts started by a soft seizure or virtual seizure request from a DIP may use scrinst() to check themselves against an instance limit as their first task, similar to the way scrinst may be used if the script is started by an incoming call. If the script determines that it cannot continue, it may signal the DIP that started it by using the dipterm() instruction and calling quit() with a specific value that the DIP may check.

Examples

In the first example, the script requests the number of instances of the script *riverbank* currently running on the system. In the second example, because no argument is given, the script requests the number of instances of itself running on the system.

scrinst(im."riverbank")
scrinst()

setalk

Synopsis

This script instruction specifies a new talk file.

Command Format

setalk(type.talk)

Description

Setalk is used to specify a new talk file. This instruction can be used without first using the tfile instruction. The argument, type.talk, is the id of the new talk file. Do not use a character data type as the type.talk argument.

After setalk is executed, the previous talk file id is returned in register 0 and can be saved for future use.

The setalk instruction overrides the talk file number that is contained in the first list file specified in the tfile instruction.

Example

In the following example, the new talk file is set to talk file 25. The previous talk file id is stored at location int.OLDTALK. The phrase number 210 spoken by the talk instruction refers to the speech phrase encoded in talkfile 25 and not to the speech phrase listed in list.cabnt.

```
tfile("/speech/talk/list.cabnt")
setalk(imm.25)
load(int.OLDTALK,r.0)
talk(imm.210)
```

setttfl

Synopsis

This script instruction sets touch-tone flushing.

Command Format

setttfl(type.flg)

Description

The setttfl instruction allows the script to change the way TSM handles the touch-tone buffer. Normally, TSM gets rid of any touch tones it has received for the script when the speech buffer is flushed and speech is played. The setttfl instruction disables the TSM action of clearing the touch-tone buffer whenever speech is played.

If the type.flg argument is 1, touch-tone flushing is turned on. If the setttfl instruction is not used, the default condition is to set touch-tone flushing to on.

If type.flg is 0, touch-tone flushing is turned off and playing speech will not cause the touch-tone buffer to be cleared. If touch-tone flushing is turned off and talkoff has been enabled on the channel (using the tflush instruction with the must_hear_flag set to 0), an instruction that normally plays the queued phrases now clears any phrases queued in the phrase buffer. This happens because phrases that are in the buffer are assumed to be part of the prompt that the talk off touch tones affect. With talk off enabled, phrases that are already queued will not be heard. Instead, the script advances to the appropriate point based on the touch-tone input received.

Example

setttfl(im.0) - turn off touch-tone flushing
setttfl(im.1) - turn on touch-tone flushing (default)

See Also

getdig
ttclear

sleep

Synopsis

Script instruction causes the script to sleep.

Command Format

sleep(type.src)

Description

The sleep instruction makes the script do nothing for the number of seconds specified by the argument. See the event instruction for TSM events that may interrupt the sleep instruction before the specified time has passed.

There is a two second granularity in the actual time the script will sleep. For example, executing sleep (im.5) will cause the script to sleep for a period of 4-6 seconds.

Example

In the following example, the script dials out on a channel, then waits 5 seconds for completion of the dial before continuing.

```
..... ..... .....
tic('d',int.PHONENBR)
sleep(im.5)
..... ..... .....
```

See Also

event

strcmp

Synopsis

This script instruction compares two character strings.

Command Format

strcmp(ctype.src,ctype.src)

Description

Strcmp compares two character strings and returns the result of the comparison in register 0 (i.e., r.0). The return value is interpreted as follows:

If r.0 is:

=0	the strings are equal
<0	the first string is lexicographically less than the second string
>0	the first string is lexicographically greater than the second string.

The type.src arguments can be either an address or a literal string.

Examples

In the following example, strcmp compares the literal string XYZ?:136 to the string in location char.20. If they are equal (exactly the same) the script jumps to the label equal.

strcmp (imm."XYZ?:136",char.20)
jmp(r.0 ==imm.0,equal)

In the following example, the string stored at location int.56 is compared to the string located at char.80. If the first string is greater or equal to the second (that is, would be listed after the string at char.80 in an alphabetical listing or is exactly the same as char.80), the script jumps to the label "greg."

strcmp(int.56,char.80)
jmp(r.0 >= imm.0,greg)

strcpy

Synopsis

This script instruction copies the source string to the destination.

Command Format

strcpy(ctype.dst,ctype.src)

Description

Strcpy copies a character string specified by the ctype.src argument to the address specified by the ctype.dst argument. The ctype.dst argument must be a string address. The ctype.src argument can be a literal string of up to 32 characters.

Examples

In the first example, the literal string ABCDEFGHI is copied into char.10. In the second example, the string stored in char.10 is copied to short.50.

f3strcpy(char.10,imm."ABCDEFGHI")

strcpy(sh.50,char.10)

In the first example, the literal string ABCDEFGHI is copied into char.10. In the second example, the string stored in char.10 is copied to short.50.

strlen

Synopsis

This script instruction computes the length of a string.

Command Format

strlen(ctype.src)

Description

Strlen computes the length of the string specified by the type.src argument. The type.src argument can be a literal string or the location of a string. The length of the string (i.e., number of characters in the string) is returned in register 0 (r.0).

Examples

In the following example, the length of the string is stored at location char.19. If the length of the string is less than 10 characters, the script jumps to the label Lab1.

```
strlen(char.19)
jmp(r.0 < imm.10,Lab1)
```

In the following example, the length of the literal string AB123,:=+ is computed (9 in this case) and stored in register 0. Since r.0 contains 9, the script will not jump to Lab2).

```
strlen(im."AB123,:=+")
jmp(r.0 !=im.9,Lab2)
```

talk

Synopsis

This script instruction speaks one or more phrases.

Command Format

talk("phrase_name" ["phrase_name"]...)
talk(type.src)

Description

The first format for the talk instruction uses one or more arguments, each being a phrase in double quotes. Each phrase must match a phrase listed in the *application-name* file specified by the tfile instruction. It must also match according to the rules explained in Chapter 4, "Script Instructions". The second format uses the assigned phrase number which appears in the *application-name*.pl file or list file.

NOTE:
Do not use character data types for arguments in either format.

When talk (as well as tchars and tnum) instructions are executed, the system queues phrases in a buffer, but the phrases are not immediately played. Phrases are played under either one of the following two conditions:

1. the script executes a speech-flushing instruction
2. the phrase buffer becomes full.

The first condition is the most common occurrence.

Example

In the following example, the GREET subroutine is called on to say two introductory phrases from the talk file specified in the tfile instruction. It then calls on a subroutine to speak the final phrase, "thank you."

```
MAIN:
 tfile("/speech/talk/application-name.pl")
 GREET( )
 ..... ..... .....
 BYE( )

GREET:
```

```
 talk("hello," "please enter your id")
 indirect_talk(im."thank you.")
..... ..... .....
 rts( )
indirect_talk:
 talk(r.3)
 rts( )
```

See Also

tchars
tnum

talkresume

Synopsis

This script instruction starts playing queued phrases at a specified point.

Command Format

talkresume(type.offset)

Description

The talkresume instruction plays whatever phrases remain from the last tflush instruction starting at the point they were interrupted (i.e., by talk off) plus the given offset in seconds. If the offset is a positive number, speech is played from a point after the interruption. If the offset is a negative number, speech is played from a point before the interruption. If the offset is 0, play starts at the point where the interruption occurred. If VROP has played all of the phrases, only a negative offset will have any effect.

The talkresume instruction stores a return value in register 0. If the value is negative, an error has occurred. If the value is 0, playback completed successfully. If the value is +1, the "playback complete" was caused by talk-off. If the value is +2, there was no speech left to play (i.e., talkresume was given with a non-negative offset when VROP had already played all the speech).

For talkresume to work properly, the speech it affects must have been played originally with the tflush instruction with the optional remember_flag argument set to 1. This tells VROP to "remember" the speech that tflush tells it to play and to keep track of where that speech is interrupted. Subsequent calls to talkresume then have the desired effect on this speech. VROP remembers the speech it was playing until it receives another set of phrases to play by subsequent script instructions. Only one set of phrases can be remembered per channel at a time. If more speech is played with tflush with the remember_flag not set, any set of phrases remembered before are no longer remembered.

Example

In the following example, the script is instructed to skip ahead four seconds, then resume talking.

talkresume(im.4)

tchars

Synopsis

This script instruction speaks phrases from a variable name.

Command Format

tchars(ctype.src[,'inflection'])

Description

Tchars puts the null terminated string of alphanumeric characters that are identified by the first argument into a queue for speaking. The second argument, when specified, controls the speech inflection. The three inflection parameters are r (rising), f (falling), and t (total). Total produces both a rising inflection on the first phrase and a falling inflection on the last phrase if there is more than one; it produces a falling inflection if there is only one phrase. It is important to note that "r", "f", and "t" work only if those types of phrases are in the talk file.

The tchars instruction speaks one character at a time, unlike the tnum instruction, which speaks the digits as one number. For example, the tchars instruction would speak the number 61 as "six-one" while the tnum instruction would speak "sixty-one." Also, tchars speaks the string "61A" as six-one-A."

Example

In the following example, the script asks the caller to enter his/her ID number. The script waits for three touch tones, which it stores in ch.ID. The script then repeats what the caller entered, reading the value in ch.ID.

```
talk("Please enter your ID number")
getdig(0,ch.ID,3)
talk("Your ID number is")
tchars(ch.ID)
tflush()
```

See Also

talk
tnum
tflush

tfile

Synopsis

This script instruction identifies a talk file.

Command Format

tfile(application-name.pl [talkfile 2...])

Description

The tfile instruction indicates the speech data base to use for the script. The first listfile name, called *application-name*.pl (see Chapter 2, "Development Guidelines"), is the name of the primary list file. Its talkfile number is used for the initial setalk and is used for tnum, tchar, and talk instructions if the tfile portion of the phrase ID is 0.

Each phrase in the talk file is identified by a unique number and string in the list file. Because the TAS uses this information, the tfile instruction must be specified in the script before the first voice output instruction.

Phrases in the primary list file are not bound to the talk file when the script is compiled. They will be played from the talkfile currently in effect when the talk instruction is executed. However, any additional listfiles given in the tfile instruction have the talkfile and phrase number bound when the script is compiled. Phrases selected from these listfiles are not affected by changes in the talkfile that occur during script execution.

Example

In the following example, the tfile instruction specifies the file of application phrases that are accessed by the voice output instructions, where the applN identifier in the file name represents the *application-name*.

```
MAIN:
 tfile("/speech/talk/STOCKS.pl")
 GREET( )
..... ..... .....
 BYE( )
```

See Also

talk
tchars
tnum
setalk

tflush

Synopsis

This script instruction outputs the speech buffer unconditionally.

Command Format

tflush([must_hear_flag][,wait_indicator][,remember_flag])

Description

Phrases specified by a script to be spoken with the talk, tchars, or tnum instruction are queued (i.e., not spoken) pending the encounter of a tflush instruction or a data gathering instruction.

The accepted values for the arguments are:

must_hear_flag	0	Touch tones entered during playback or voice coding cause playback or voicecoding to stop (default)
	1	Touch tones entered during playback or voice coding do not cause playback orvoice coding to stop
wait_indicator	0	Wait for the playback to complete before continuing script execution(default)
	1	Do not wait for the playback to complete. Continue script execution.
remember_flag	1	Remember phrases played by this instruction so they may be played againwith the **talkresume** instruction.
	0	Do not remember the speech

The must_hear_flag option, when set to a non-zero value, disables talk-off so that any speech activity (voice playback or voice coding) on the current channel will not be stopped by touch tones. When using this option with speech play-back-related instructions (talk, tnum, or tchars), tflush(1) should follow those instructions. When using this option with voice coding (vc), tflush(1) should pre-cede the vc instruction. The talk-off is enabled automatically by the next wait-causing instruction in the script.

Tflush returns a value in register 0. If that value is negative, an error occurred. If that value is +1, "playback complete" occurred because of talk-off. If the value is 0, playback has completed successfully.

Examples

In the following example, the script wants the caller to hear music while it processes the transaction with the host computer. After this processing completes, the music is stopped, and the caller is informed of the results and asked to continue entering commands. The tflush instruction does not remember the phrases played by the instruction.

```
..... .....
talk(int.MUSIC) /* Play music to the caller */
tflush(1,1,0) /* Do not let touch tones turn off music and don't wait*/
dbase(0,FUDB,ch.ACCOUNT_ID,8,int.SELL_PRICE, 4) /* Get info from host */
tstop()
talk("Your account has now been credited with AT&T stock for the price of")
tnum(int.SELL_PRICE)
talk("Enter your next instruction")
getdig(0,ch.DIG,2)
..... .....
```

In the following example, any touch tones entered are encoded along with the speech.

```
..... .....
tflush(1) /*do not end coding if user enters touch tones*/
vc('b',im.10,im.ADPCM32)
```

See Also

tstop
talk

tic

Synopsis

This script instruction controls an attendant line.

Command Format

tic('D', ctype.dialstr)
tic('F')
tic('O', ctype.dialstr)
tic('W', type.rings)
tic('a')
tic('d', ctype.dialstr)
tic('f')
tic('h')
tic('o', ctype.dialstr)
tic('w', type.rings)

Description

The tic() instruction provides the script with control functions for the telephone interface line (channel) that the script is currently using. The function that the tic() instruction performs depends on the value of its first argument. These argument values and their corresponding functions are listed below.

Tic() uses script registers 0 (r.0) and 1 (r.1) to return a result. This result may differ according to whether the script is using a Tip/Ring, T1, or PRI channel. Where such variations exist, they are noted below.

- D — Dial ctype.dialstr; wait for any call progress tone, then resume the script.
- F — Flash; wait for any call progress tone, then resume the script.
- O — Originate (go off-hook and dial ctype.dialstr); wait for any call progress tone, then resume the script.
- W — Turn on speech energy detection and wait for number of rings given in type.rings for "answer" (speech energy or ringing stopped) or "no answer".
- a — Answer the line (go off-hook).
- d — Dial ctype.dialstr, then resume the script.
- f — Flash the hook (transfer to another line), then resume the script.
- h — Hang up the line (go on-hook).

- o — Originate (go off-hook and dial ctype.dialstr), then resume the script.
- w — Wait for the number of rings given in type.rings for "answer" (ringing stopped) or "no answer".

Table A-1 lists the possible return values for the different forms of the tic() instruction. Note that the set of possible return values depends on the type of channel: TR , T1, or PRI.

Table A-1. Return Code Results for the tic() Instruction

Meaning	Return Values		For tic ()	Available On		
	r.0	r.1		TR	T1	PRI
Instruction Successfully Completed	0	•	'a','d','f*','h','o'	•	•	
Answer Detected(e.g. Voice Energy Detected or ringing stopped)	'A'	•	'W','w'†			
Answer Supervision from Switch	'P'	•	'D','O','W','w'	•	•	
Busy‡	'B'	•	'F'ud,'D','O','W','w'		•	
Fast Busy (Reorder Tone)*	'F'	•	'F'ud,'D','O','W','w'		•	
Ring No Answer	'N'	•	'W','w'			
Audible Ringing	'R'	•	'F','D','O'			
Dialtone Detected*	'D'	**	'F','D','O','W','w'	•		**.
Stutter Dialtone Detected	'S'	•	'F','D','O','W','w'			
ISDN Vacant Code.ad	'v'	**.	(any)			•
Provisioning or Protocol Error	'p'	**.	(any)			•
Internal hardware or software error or Dialing error	-1	•	(all)	•	•	
Timeout (no call progress tones detected within thetimeout period)	-2	•	(all except 'h')	•	•	
Illegal Dial String passed††	-3	**.	'D','O','d','o'	•	•	**.

*. A tic('F') or tic('f') instruction on a PRI channel will always fail (r.0 = -1).
†. A return value of 'A' in response to a tic ('W') means only that ringing has stopped before the given number of rings. The speech energy detector is turned on only when a tic ('W') is done.
‡. For PRI channels, the Voice System converts certain info provided by the switch into Busy, Fast Busy, or Dialtone call dispositions. It does not necessarily mean that an audible tone is actually present.
**. The disposition of calls on PRI channesl is based solely on info provided by the switch. This particular disposition is not provided by the switch on every call. However when it is provided more specific info (the ISDN cause value) is available in register 1 (r.1). See the PRI documentation for the list of ISDN Cause Values. The tic() instruction also will return a value in r.1 when the Full CCA feature is used. See the Full CCA feature documentation for a list of r.1 return values.
††. On a T1 channel, any dial string with a character other than 1,2,3,4,5,6,7,8,9,0,#,*,A,B,C, D,a,b,c, or d is illegal. PRI channesl allow all of the above characters except * and #. On Tip/Ring channels, any string with a character other than 1,2,3,4,5,6,7,8,9,0,#,*,A,B,C,D,a,b,c, d,(,), or – is illegal for touch-tone dialing. For dial pulse dialing on a T/R channel, any string with a character other than 1,2,3,4,5,6,7,8,9,0,#,*,A,B,C,D, a,b,c, d,(,), or – is illegal.

If your script will encounter a secondary dial tone, you may want to use a sequence of two tic() instructions, the first dialing the access number and waiting

for secondary dial tone, and the second dialing the remainder of the telephone number.

Due to the characteristics of most switches, you should not require the VIS to send a flash immediately after answer. The switch may not be prepared to recognize the flash so soon after it detects answer. If your application requires a flash (transfer) after answer, a delay of 1-2 seconds after answer is recommended before sending the flash signal. A short message could be played in this interval to make the delay less noticeable to callers.

Using a sleep() instruction after tic('f') or tic('F') causes the VIS to disconnect because it detects dial tone and assumes the caller has hung up. The event() instruction may be used by a script with the EHANGUP event type to catch this event and prevent disconnect.

If you use the tic('d') instruction to send touch tones between two scripts, the tones may be lost if one script sends tones before the other script turns on its DTMF receiver. To avoid this problem, insert a delay of more than 70 milliseconds (e.g., use 'talk(sil.100)') before the tic('d') instruction.

If the system encounters a "glare" condition (i.e., an incoming call is detected at almost the same moment the system is dialing out), the system drops the outgoing call and answers the incoming call. The termination of the script dialing out is treated as a hangup, meaning that if there is an EHANGUP event subroutine defined by the script (see the event() instruction), it will be executed before the script ends. This may mean that more than the usual number of rings are heard by the caller before the incoming call is answered.

For the tic('W') and tic('w') instructions, the type.rings argument specifies the timeout setting for the instruction, that is, how many rings the VIS should wait before determining that the call is not answered. TSM sets the timeout value based on the number of rings specified in this field. If the number of rings is greater than 6 and the script does not explicitly set the timeout value (see the nwitime() instruction), the timeout value is set in the following manner:

timeoutValue (in seconds) = ((nRingsToWait+1)*6) + 5

For example, if you set type.rings to 10, TSM will wait until after 10 rings have passed before timing out on the tic() instruction. If the number of rings is less than 6, the default of 45 seconds is used as the timeout value.

Example

The following example is a portion of a script that uses the tic() instruction. In this example, the script copies "9999" into NUMBER, then originates a call to that number. Depending on what is returned, the script either jumps to the *end* or *ok* label.

```
#define NUMBER 5

strcpy(ch.NUMBER, imm."9999")
tic('O', ch.NUMBER)
jmp(r.0 == imm.-1, end)/* hardware failure */
jmp(r.0 == imm.-2, end)/* timeout, no response */
jmp(r.0 == imm.'B', end)/* busy */
jmp(r.0 == imm.'R', ok)/* ring */
end:
quit()
ok:
tic('h')
rts()
```

tnum

Synopsis

This script instruction speaks a number with natural speech.

Command Format

tnum(type.src [,'inflection'])

Description

Tnum accepts the numeric value specified by the first argument, translates it into a string of phrases, and puts it in a queue for speaking. The second argument, when specified, controls the speech inflection.

The tnum instruction does not support speaking numbers in the billions and trillions because most of these numbers are too big to fit into an integer variable. However, the phrases "billion" and "trillion" are included in the standard speech package. If your script requires such large numbers, we suggest that you start with an ASCII string, parse the string (getting the amounts of billions and trillions as substrings), then convert the three resulting substrings to integer values and speak them with the tnum instruction. Insert a talk instruction with the phrase for "trillion" or "billion", where appropriate.

Example

In the following example, the program says it could not understand the caller. Then the system pauses for 500 milliseconds of silence, and asks if the number is the n-digit number that is stored in r.1 or the number "six-hundred-fourteen." The tnum instruction says the number to the caller in natural-sounding speech.

The atoi conversion instruction is needed since the getdig instruction returns information as a null terminated character string, but the tnum instruction uses integers.

Tnum is used when it is desired to hear the words hundred, thousand, thirty, etc. in the response. Tchars differs from tnum by only speaking the numbers individually.

GET_ID:

```
 getdig(0,ch.DG,9)
 atoi(r.1,ch.DG)
..... .....
 talk("i could not understand you" "sil.500" :"did you say")
 tnum(r.1)
 talk("or")
 tnum(im.614)
 ..... .....
```

trace

Synopsis

This script instruction works with the trace line instruction to monitor scripts.

Command Format

trace(type.src[,type.src])

Description

The trace script instruction works with the **trace** line command to display a message from the script if the trace command is run on the channel on which the script is running. These trace messages allow application developers to monitor the progress of a script. This capability is useful in debugging and troubleshooting scripts, either during the initial application development or if problems rise while the application is running. The trace instruction allows TSM to print messages to the shared memory area for trace messages. These messages can include the default trace messages for TSM or for a specific channel. The trace command is discussed in *CONVERSANT VIS V 4.0 Command Reference,* 585-350-209.

NOTE:
If there are too many traces running simultaneously on a system, the buffer in which this information is stored may be filled and some data lost, with no notice of this in the trace output.

The first argument is evaluated as a number and is used as a step identifier. The optional argument can be used to print a specific data value of interest. If the optional argument is of type *char*, *indirect char,* or *immediate*, the value will be printed as a string (with null termination assumed). Therefore, whenever type *immediate* is used for the optional argument, the value should be in double quotes (" "). When other types are used, the value is assumed to be a number.

Examples

The instruction

trace(im.1000)

in a script running on channel 2 produces the following line in the output of the trace command if it is being run for that channel.

```
CH002: <script>: STEP: 1000.
```

where *<script>* is the name of the script running on channel 2.

The instruction

trace(im.1000, im."Accessing Customer Database")

in a script running on channel 21 produces the following line in the output of the trace command if it is being run for that channel.

```
CH021: <script> STEP: 1000 VALUE: Accessing Customer Data-
base
```

See Also

tchar
talk
tflush

tstop

Synopsis

This script instruction stops playback on a conversation.

Command Format

tstop()

Description

The tstop instruction lets the script programmer stop any voice function (playing, coding, Text-to-speech) on the script's current playback conversation.

Return values of the stop instruction depend on what voice function has been stopped. If voice coding has been stopped, script register 0 (r.0) will contain the phrase number (a positive integer) of the coded phrase, register (r.1) will contain the phrase length, and register 2 (r.2) will be set to 1 (see the **vc** instruction). Otherwise, r.0 will be set to 0 and r.1 and r.2 will not be changed.

Example

In the following example, the script plays the phrase "music" while it processes the transaction with the host computer. After this processing completes, the music is stopped, and the caller is informed of the results.

```
.....   .....
talk(int.MUSIC) /* Play music to the caller */
tflush(1,1) /* Do not let touch tones turn off music and don't wait */
dbase(0,FUDB,ch.ACCOUNT_ID,8,int.SELL_PRICE,4) /* Get info from host */
tstop()
talk("Your account has now been credited with AT&T stock for the price of")
tnum(int.SELL_PRICE)
.....   .....
```

See Also

tflush

ttclear

Synopsis

This script instruction clears the touch-tone buffer.

Command Format

ttclear()

Description

The ttclear instruction clears the touch-tone buffer. This instruction is useful for applications in which you want to throw away all "typed ahead" input. Ttclear removes any touch tones in the touch-tone buffer when the instruction is executed. The number of touch tones cleared is stored in Register 0.

Example

ttclear()

ttdelim

Synopsis

This script instruction defines touch-tone key functions.

Command Format

ttdelim(erase-char,erase-all,delim1,delim2)

Description

The ttdelim instruction sets four control functions and the touch tone keys used by the caller to perform those functions. The functions for the erase-char and erase-all arguments are defined by the system; the functions for the delim1 and delim2 arguments are defined by the developer. The touch tone keys for performing all four functions are defined by the developer.

The system-defined functions erase-char and erase-all do not terminate the collection of touch tones initiated by the getdig instruction and those characters are removed from the buffer; whereas, the developer-defined functions delim1 and delim2 terminate the collection of touch tones and those characters remain in the buffer.

The touch-tone buffer is scanned for the delimiters currently in effect when a getdig instruction is executed rather than while the touch tones are entered.

The values for the ttdelim arguments are:

Value	Meaning
-1	Function is not used (default)
0	Do not change value of current function
'c'	New value where c is:
or	'cc' 0-9
	#
	*

The following functions and characters might be specified for the instruction:

ttdelim('#1','#*','*1','*2')

Characters	Meaning
#1	Erase one character
#*	Erase all characters
*1	Get operator
*2	Play help message

If a script does not use the ttdelim feature, then this instruction is not used. On the other hand, if it uses only one argument, then a default value must be entered for the other three arguments.

An example of a ttdelim instruction using only the erase-all function is:

ttdelim(-1,'#',-1,-1)

To allow for the extra digits requested by a delim1 or delim2 argument, the getdig instruction should specify more digits than it needs. For instance, if a 5-digit entry is required, but it is anticipated that a caller might enter all incorrectly, and need to erase them, getdig would require a minimum of seven digits.

The ttdelim instruction works with the getdig and tttime instructions. For example, after requesting 5 digits with a getdig instruction, normally r.0 is set to 5 and the actual digits received are stored at the destination. Whenever the ttdelim instruction is used, the getdig instruction has to check the values of r.0 and the received digits to determine if delim1 or delim2 was used.

Based on the previous arguments for the ttdelim instruction, the getdig instruction would have the results given by the following examples.

Input	r.0	Destination	Script Action
12345	5	12345	Use 5 digits
123#*45678	5	45678	Use 5 digits
12*1	4	12*1	Transfer to operator
*1	2	*1	Transfer to operator
12*2	4	12*2	Play help message and reprompt for input

The timeouts for the two system defined functions, erase-char and erase-all, are the same. The tttime instruction only uses the firstdig argument once, but it repeatedly uses the interdig argument to wait the maximum amount of time specified to receive the next digit.

The script writer needs to write code to implement the functions. For example, delim2 would need a talk instruction to play the help message.

Example

The following example causes the last digit to be erased when the #1-keys are pressed, the entire entry erased when the "#" key is repeated, and the entry terminated when the *-key is pressed. The value -1 indicates that the fourth argument is not used.

ttdelim('#1','##','*',-1)

NOTE:
Difficulty could arise with conflicting definitions (for example, # and #1). Since both a single character string and double character string are permitted, the system may respond when the first # key is pressed and never read the second key.

NOTE:
Any additional significance attached to the "*" key entry, other than entry termination, must be written into the script.

NOTE:
The digits entered at the delimiter must be accounted for in the getdig instruction. For example, if 8 digits plus a touch-tone terminator are expected, getdig must look for 8 digits plus the length of the touch-tone terminator.

tttime

Synopsis

This script instruction sets the time-out values for touch-tone input.

Command Format

tttime(type.firstdig,type.interdig)

Description

Tttime allows a script to set the touch-tone timeout values. Firstdig specifies the maximum seconds that the system should wait to receive the first touch-tone digit after executing a getdig instruction. Interdig specifies the maximum seconds to wait between two consecutive touch tone inputs. The default values are 10 seconds to wait for the first touch-tone digit and 10 seconds to wait between consecutive touch tones. There are no limits to timeout times.

The tttime instruction is related to the getdig instruction. If the firstdig time is exceeded, r.0 is set to 0 and the getdig instruction terminates. If the interdig time is exceeded, r.0 is set to the number of digits that are received, transferred to the script buffer, the getdig instruction terminates.

The tttime instruction has a two second granularity. That is, if the specified time is 10 seconds, the timing is approximately 8-10 seconds.

Example

In the following example, before asking a caller for a response, the tttime instruction sets the system to wait no more than 4 seconds for the caller's initial response and up to 2 seconds between digits before automatically returning from the data gathering instruction.

GET_IO_MODE:

```
tttime(im.4,im.2)
talk("enter your id now")
..............................  ............. ........
```

vc

Synopsis

This script instruction codes a phrase and stores it in a talk file.

Command Format

vc(flag,type.time,type.rate)

Description

The vc instruction codes speech into a phrase in a talk file. For the flag.type argument, 'b' (for "begin coding") is accepted. Another character value, 'p' (for "prompt") may be used to play a short "beep" just before voice coding starts.

The type.time argument specifies the maximum duration, in seconds, of the coding session. A value 'n' for type.time specifies a coding session lasting up to 'n' seconds. A value of -1 or 0 for type.time specifies the default maximum duration of 45 seconds. Coding can be terminated at any time by entering a touch tone.

The type.rate argument specifies the coding rate in kilobits per second. The valid coding types and rates are defined in the header file codestyle.h. If the value given for this argument is not a valid rate or type, the instruction fails.

If the vc instruction is successfully completed, it returns the phrase id in register 0. If the vc instruction is not successfully completed, it returns a negative value in register 0. A -1 in register 0 means coding failed, -2 means the initial silence timeout set by vctime was exceeded. Register 1 contains the recorded message length in seconds. Register 2 is set to 1 if coding completed normally, 2 if was coding terminated by touch tone, and 3 if the intermediate silence timeout set by vctime is exceeded.

Examples

In the following example, a beep will sound, then a phrase will be coded for a maximum of 100 seconds using ADPCM at a rate of 32kbps.

load (int.TIME,im.100)
vc ('p',int.TIME,im.ADPCM32)

In the following example, a phrase will be coded for a maximum of 120 seconds using sub-band coding at a rate of 16kbps. No beep will sound.

```
load(short.RATE,im.SBC16)
vc('b',im.120,short.RATE)
```

vctime

Synopsis

This script instruction sets the silence timeouts for voice coding.

Command Format

vctime([type.src] [type.src])

Description

The vctime instruction allows the script writer to set silence timeouts. The first type.src argument contains the value for the initial silence timeout. The second type.src argument contains the value for the inter-word silence timeout. The maximum timeout is 30 seconds.

The values for the type.src arguments and the effect on the timeout are given below:

Value	Effective Timeout Value
X > 0	X becomes the timeout value
X = 0	Timeout is turned off
X < 0	Timeout is set to default value (5 seconds)

A comma or place holder with a value of 0 is used when an argument is not inserted. This instruction does not give a return value to indicate success or failure.

Example

In the following example, initial silence timeout and inter-word silence timeout are set to three seconds.

vctime(im.3,im.3)

Voice System C-Library Functions

B

What's in This Appendix

This appendix contains summaries of the C-library functions discussed earlier in this book.

Table B-1 details the standard voice system library functions and the library in which they reside. The functions are listed in alphabetical order. Each function appears on a separate page and, for each function, the following is provided:

- Function name and syntax
- Purpose of the command
- Effects of using the library function
- Examples of the function

These library pages should be used to locate detailed information about each function.

Table B-1. C-Library Function Locations

Function	Library
arrays	libprism.a
BitMasks	libprism.a
CharBuffer	libprism.a
clock	libprism.a
db_init	/vs/lib/spp.h
db_pr	/vs/lib/spp.h
db_put	/vs/lib/spp.h
et_send	/vs/lib/spp.h
expand-Log:liblog.a	
ipc	libprism.a
logDstPri	liblog.a
logMsg	liblog.a
match	libprism.a
mesgrcv	/vs/lib/spp.h
mesgsnd	/vs/lib/spp.h
options	libprism.a
parseln	libprism.a
readLine	libprism.a
regex	libprism.a
startup	/vs/lib/spp.h
strmatch	libprism.a
threshold	libalerter.a
timeIncr	libprism.a
tmtotime	libprism.a
usage	libprism.a
VSerror	/vs/lib/spp.h

Function	Library
VSstartup	/vs/lib/spp.h
VStoname	/vs/lib/spp.h
VStoQkey	/vs/lib/spp.h

arrays

Synopsis

arrayOpen, arrayPut, arrayVPut, arrayDel, arrayClose, arrayDone, arrayDetach, arrayTransfer, arrayDesc, arrayPtr, arrayCnt, arrayChgIncr — Functions for managing dynamic arrays.

Command Format

```
#include <sys/types.h>
#include "prismdefs.h"
#include "arrays.h"

int arrayOpen(type,size)/* Open dynamic array */
int type ;/* primary or secondary */
unsigned size ;/* size of objects */

void *arrayPut(ardes,ptr)/* Constant length item array put */
int ardes ;/* Dynamic array descriptor */
caddr_t ptr ;/* Pointer to data to be stored */

void *arrayVPut(ardes,ptr,len)/* Variable length item array put */
int ardes ;/* Dynamic array descriptor */
caddr_t ptr ;/* Pointer to data to be stored */
unsigned len ;/* Length of variable length item */

int arrayDel(ardes,ptr)/* Delete item from array */
int ardes ;/* Dynamic array descriptor */
caddr_t ptr ;/* Pointer to item to be deleted */

int arrayClose(ardes)/* Close & release array */
int ardes ;/* Dynamic array descriptor */

void **arrayDone(ardes)/* Close array, BUT DO NOT release. */
int ardes ;/* Dynamic array descriptor */
void **arrayDetach(ardes)/* Detach array. Leave array open. */
int ardes ;/* Dynamic array descriptor */

int arrayTransfer(ardes)/* Transfer array contents. */
int ardes ;/* Dynamic array descriptor */

ARRAY *arrayDesc(ardes)/* Get array descriptor pointer */
int ardes ;/* Dynamic array descriptor */

void **arrayPtr(ardes)/* Get array data pointer */
```

```
int ardes ;/* Dynamic array descriptor */

int arrayCnt (ardes)/* Get count of items in array */
int ardes ;/* Dynamic array descriptor */

unsigned arrayChgIncr(ardes,incr)
int ardes ;/* Dynamic array descriptor */
unsigned incr ;/* New increment size for array */
```

Description

These functions can be used by programs to store data in dynamically allocated arrays. Arrays come in two types, *DA_PRIMARY* and *DA_SECONDARY.* A primary array is one in which the data is stored directly in the array. A secondary array is one in which the array contains a series of pointers to areas that contain the data. If you needed a dynamic array of longs, you would do:

If you wanted to build arrays of *field_item* structures such as those used in TABS, you would want a secondary array, where the array contained a series of pointers to the actual *field_item* structures as shwon in the following:

The arrays are dynamic in that as more items are stored in the array, the bigger the array gets. New space is allocated any time the current array area runs out of room. These functions are particularly useful when programmers want to avoid setting a predefined internal limit for data storage. Functions returning (void *) data type should have their return values cast to the appropriate data type pointer (See the Example section for this function).

By convention, DA_SECONDARY type arrays always have a NULL pointer at one past the end of the array. This can be used to indicate that the end of the array has been reached when scanning it pointer by pointer and it makes an array space of (char*) pointers, as created with **arrayVPut (|)**, appropriate as a target for **freeStrArray** (|) (See **freeStrArray (3X))** if it has been detached from its dynamic array with **arrayDone (|)** or **arrayDetach (|).**

arrayOpen (|) opens a dynamic array. It returns an array descriptor which is used with the other functions to reference the opened array. *Type* specifies whether the array directly contains the data items, that is, is a primary array, or contains pointers to the data items, that is, is a **secondary** array. *Size* is the number of bytes of each data item to be stored. *Size* may be 0 if the type of the array is secondary. This implies that the array is a variable-length-item array and data can only be placed in the array with the **arrayVPut** routine. **arrayOpen (|)** returns NULL upon error.

arrayPut (|) is used to add a data item to a dynamic array. *ardes* is an array descriptor obtained from **arrayOpen (|).** *ptr* is a pointer to the data to be stored. **arrayPut (|)** returns a pointer to the stored data if it succeeds or NULL upon error.

arrayPut (|) cannot be used to store data in a variable-length-item array. If *ptr* is NULL, a null object is inserted in the array at this point. This means that the pointer returned, points to an object that is all zeros.

arrayVPut (|) is used to add a variable length data item to a dynamic array. *ardes* is an array descriptor obtained from **arrayOpen (|)**. The array must be a secondary type array specifically opened with an object size of 0. *ptr* is a pointer to the data to be stored. *len* is the length of the item to be stored in the array. It must include NULL terminating bytes in cases where the items are NULL terminated strings. **arrayVPut (|)** returns a pointer to the stored data if it succeeds or NULL upon error. If *ptr* is NULL, a null object is inserted in the array at this point. This means that the pointer returned, points to an object that is all zeros.

arrayDel (|) is used to delete a data item from a dynamic array. *ardes* is an array descriptor obtained from **arrayOpen (|)**. *ptr* is a pointer to the array data to be deleted. It should be a value returned by an **arrayPut (|)**. If successful, this **arrayDel (|)** removes the data and moves all subsequent pointers in the array up. **arrayDel (|)** returns SUCCESS or FAILURE.

arrayClose (|) frees up all data items and their pointers in the dynamic array associated with *ardes*. **arrayClose (|)** returns SUCCESS or FAILURE.

arrayDone (|) is similar to **arrayClose (|)** in that it closes the array descriptor, *ardes*, BUT it does not release the array space itself, instead returning a pointer to the array. **arrayDone** is used in cases where there is a growing phase of the array and then a usage phase where the array does not grow. For example, in an application that was reading in arbitrary arrays of information initially, followed by use of those arrays, the application might not want to tie up an array descriptor indefinitely once the array was read. **arrayDone** basically disassociates the array from the array descriptor, closes the array descriptor, and returns a pointer to the array for the application to work with. Once an **arrayDone** is performed, the dynamic array module no longer maintains any information about the array and cannot be used to add or delete elements from the array. It is then the responsibility of the application to maintain the array and/or release it.

arrayDetach (|) is similar to **arrayDone (|)** in that it returns a pointer to the array space associated with the dynamic array specified by *ardes*. As with **arrayDone (|)**, this allocated array is no longer associated with a dynamic array and is the responsibility of the caller to manage. The difference between **arrayDetach (|)** and **arrayDone (|)** is that **arrayDetach (|)** leaves the dynamic array OPEN with its count of items and current array size set back to zero. This is useful if one routine wants to take over management of the array space created by another routine without causing the array descriptor to become invalid. This would be necessary if the originating routine had the array descriptor stored in a static, which was therefore inaccessible to any other routine to set to zero (indicating the array was not open.) Examples of this are the **parseInDA (|)** and **parseInEnhancedDA (|)**, both of which maintain their own internal and open dynamic arrays for parsing. The calling routine is expected to examine the array, but not close it. These routines

empty their arrays prior to each new parsing. The use of **arrayDetach (|)** allows a user of these routines to take control of the parsed information.

arrayTransfer (|) opens a new dynamic array, transfers the array associated with the original array descriptor, including the type, the increment size, and all other details, to the new dynamic array, and disassociates the array space from the original array, setting its count of items back to zero. **arrayTransfer (|)** can be used when two routines wish to cooperate in the management of a dynamic array, but want to maintain control of their own array descriptor. For example, if you want to use **parseInDA (|)** or **parseInEnhancedDA (|)** to create a dynamic array of words, but then want to perform further operations on the dynamic array, **array-Transfer (|)** would allow you to create your own dynamic array descriptor that contained the information created by one of the *parseIn* (|)* routines. If you did not use **arrayTransfer (|)**, the information in the array would be freed at the next call to the **parseIn* (|)** routines.

arrayDesc (|) is a macro which returns the pointer to the dynamic array descriptor structure (type: *"ARRAY *")*.

arrayPtr (|) is a macro which returns the pointer to the dynamic array itself.

arrayCnt (|) is a macro which returns the count of the number of items currently stored in the dynamic array.

arrayChgIncr (|) allows the user of an array to specify the granularity of the expansions of the array. The default array size is 10. Whenever growth is required, 10 more elements are added to the current array during reallocation. If a very large array was going to be used, specifying a larger granularity would increase efficiency, since reallocating space tends to be costly in terms of CPU time. **arrayChgIncr** returns the previous granularity and sets the granularity to *incr .*

Example

The following example illustrates the use of the above routines.

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

#include "prismdefs.h"
#include "arrays.h"

main(|)
{
int fiArdes,timeArdes ;
struct field_item field ;
FILE *fp ;
struct field_item **fipp ;
extern long time(|) ;
extern char *ctime(|) ;

/* Open two dynamic arrays, one for a secondary array of
* of field_item structures like TABS uses,
* and one for an array of times.
*/

fiArdes = arrayOpen(DA_SECONDARY,sizeof(struct field_item)) ;
timeArdes = arrayOpen(DA_PRIMARY,sizeof(time_t)) ;

fp = fopen("testForm","r") ;

while (readForm(fp,&field) == TRUE)
{

fipp = (struct field_item **)arrayPut(fiArdes,&field) ;
/* ... */
}

for (;;)
{
/* Display form */
Get_SI_List(arrayPtr(fiArdes),arrayCnt(fiArdes),0,FALSE,FALSE) ;
/* Save a time stamp each time through the form */
(void)arrayPut(timeArdes,time((long*)NULL)) ;
/* ... */
}
/* Print out the times and delete them as you go */

for (i=0; arrayCnt(timeArdes) > 0 ;i++)
{
fprintf(stdout,"%3d Time: %s",i,ctime(arrayPtr(timeArdes))) ;
```

```
/* This is not a particularly good example since the deletion
 * causes all the items above to be moved. A better example
 * would be where you wanted to remove random items from
 * somewhere in the interior of the array.
 */

arrayDel(timeArdes,arrayPtr(timeArdes)) ;
}
/* Free all space associated with this array */

arrayClose(fiArdes) ;
arrayClose(timeArdes) ;

exit(0);
}
```

Library

prismlib.a

See Also

malloc

parseln

bitMasks

Synopsis

mkBitMask, setBitMask, clrBitMask, complimentBitMask, tstBitMask, nextBitMask, mkCopyBitMask, orBitMasks, andBitMasks, andComplimentBitMasks, xorBitMasks, freeBitMask, setRangeBitMask, clrRangeBitMask, complimentRangeBitMask, tstRangeBitMask, zeroBitMask — Routines to create and manipulate dynamic extensible bit masks.

Command Format

```
“#include  prismdefs.h  “ “
“#include  bitMasks.h  “ “

“struct BitMask *mkBitMask” ( sz,incr )
“int sz” “;* Initial size of bit mask, normally 0 */
“int incr” “; /* Amount to increment bit mask by when expanding */

“struct BitMask *setBitMask” ( bmp,bitPos )
“struct BitMask *bmp” ;
“int bitPos” ;

“struct BitMask *clrBitMask” ( bmp,bitPos )
“struct BitMask *bmp” ;
“int bitPos” ;

“struct BitMask *complimentBitMask” ( bmp,bitPos )
“struct BitMask *bmp” ;
“int bitPos” ;

“int tstBitMask” ( bmp,bitPos )
“struct BitMask *bmp” ;
“int bitPos” ;

“int nextBitMask” ( bmp,startPos,clrFlag )
“struct BitMask *bmp” ;
“int startPos” ;
“int clrFlag” “; /* If TRUE, clear each bit as found */

struct BitMask *mkCopyBitMask ( srcbmp )
struct BitMask *bmp ;

struct BitMask *orBitMask ( bmp1,bmp2 )
struct BitMask *bmp1 ;
struct BitMask *bmp2 ;
```

```
struct BitMask *andBitMask ( bmp1,bmp2 )
struct BitMask *bmp1 ;
struct BitMask *bmp2 ;

struct BitMask *andComplimentBitMask ( bmp1,bmp2 )
struct BitMask *bmp1 ;
struct BitMask *bmp2 ;

struct BitMask *xorBitMask ( bmp1,bmp2 )
struct BitMask *bmp1 ;
struct BitMask *bmp2 ;

struct BitMask *freeBitMask ( bmp )
struct BitMask *bmp ;

struct BitMask *setRangeBitMask ( bmp,low,high )
struct BitMask *bmp ;
int low ;
int high ;

struct BitMask *clrRangeBitMask ( bmp,low,high )
struct BitMask *bmp ;
int low ;
int high ;

struct BitMask *complimentRangeBitMask ( bmp,low,high )
struct BitMask *bmp ;
int low ;
int high ;

int tstRangeBitMask ( bmp,low,high )
struct BitMask *bmp ;
int low ;
int high ;

void zeroBitMask ( bmp )
struct BitMask *bmp ;
```

Description

A BitMask structure is a dynamic object containing an indefinitely extensible bit mask. BitMask structures are created by any operation that attempts to add or delete bits from a bit mask, that is, **setBitMask (|), clrBitMask (|), compliment-BitMask (|), mkCopyBitMask (|), orBitMask (|), andBitMask (|), andCompli-mentBitMask (|), xorBitMask (|), setRangeBitMasks (|), clrRangeBitMasks (|), and complimentRangeBitMasks (|)**. In addition they can be created directly with **mkBitMask (|)**.

Using **mkBitMask (|)** to create a **BitMask**, *sz* is the initial size of the bit mask. It is perfectly reasonable to set this to 0. If so, no space will be allocated for the bit mask until an attempt is made to set a bit in the mask. *incr* is the size of each expansion of the bit mask. If 0 is specified, the default, which is 4, is used, meaning that each expansion of the bit mask will increase its size by four words.

setBitMask (|), clrBitMask (|), and complimentBitMask (|) respectively set, clear, and compliment the bit specified by bitPos in the bit mask. If bmp is NULL, the bit mask is first created before the operation is performed.

tstBitMask (|) returns TRUE if the bit specified by bitPos is set otherwise it returns FALSE. **nextBitMask (|)** finds the next set bit in the bit mask and returns its position. It starts its search at **startPos**. If clrFlag is set, it also clears each bit that it finds. FAILURE is returned if there are no more bits set between startPos and the top of the bit mask.

mkCopyBitMask (|) creates a copy of the specified bit mask.

orBitMasks (|), **andBitMask (|)**, **andComplimentBitMasks (|)**, and **xorBitMasks (|)** perform the specified operations between two bit masks. In all cases *bmp1* is the target bit mask and *bmp2* is the bit mask manipulated to affect *bmp1*. For example, with **andComplimentBitMasks (|)**, *bmp2* is complimented and its bits then ANDed with the bits in *bmp1* thereby producing a new *bmp1* missing those bits set in bmp2.

freeBitMask (|) frees the resources associated with the bit mask *bmp*.

setRangeBitMask (|) set all the bits from *low* through *high* bit positions. The bit mask is created and extended as necessary to perform the operation.

clrRangeBitMask (|) clears all the bits from *low* through *high* bit positions. The bit mask is created and extended as necessary to perform the operation.

complimentRangeBitMask (|) compliments all the bits from *low* through *high* bit positions. The bit mask is created and extended as necessary to perform the operation.

tstRangeBitMask (|) tests all the bits from *low* through *high* bit positions. TRUE is returned if any of the bits are set. FALSE is returned if the bit mask hasn't been created yet or does not span the specific range of bits.

zeroBitMask (|) zeros all the bits in the specified bit mask by releasingany allocated space associated with the bit mask and setting its length to zero.

It is not necessary that the bit masks being manipulated be of the same size when they are logically combined. It is always assumed that the shorter bit mask contains zero bits in all non-existant parts and so the affect on the larger bit mask is based on the operation being performed against 0 bits.

Examples

Create two bit masks for each person in an arbitrary database. One bit mask is those people who lives in Texas. The other bit mask is those people who are unemployed. AND them together to create a third bit mask containing the unemployed Texans:

```
int bitPos ;
struct BitMask *txBmp,*unemployedBmp,noJobsTxBmp ;
struct Record *rp ;
extern struct Record readRecord() ;
for (bitPos=0,noJobsTxBmp=txBmp=unemployedBmp=(struct BitMask *)NULL
; rp = readRecord() ;bitPos++)
{
if (strcmp(rp->state,"Texas") == 0)
txBmp = setBitMask(bmp,bitPos) ;
if (rp->job == NONE)
unemployedBmp = setBitMask(unemployedBmp,bitPos) ;
}
noJobsTxBmp = mkCopyBitMask(txBmp) ; /* Make copy so txBmp can be saved.
*/
noJobsTxBmp = andBitMasks(noJobsTxBmp,unemployedBmp) ;
```

Notice that all three bit masks start out as NULL pointers. If no records were detected for either one case or the other, the code still works properly with NULL bit mask pointers.

CharBuffer

Synopsis

mkCharBuffer, freeCharBuffer, detachCharBuffer, putCharBuffer, fputCharBuffer, putStrCharBuffer, removeLastCharBufferChar, resetCharBuffer, fullnessOfCharBuffer, sizeofCharBuffer, nullTerminateCharBuffer, fmtStr, vfmtStr, fmtCharBuf, vfmtCharBuf, maxFormatLength, vmaxFormatLength — Automatic resizing character buffer routines

Command Format

```
#include <stdio.h>
#include <varargs.h>
#include  prismdefs.h
#include  charBuffer.h

struct CharBuffer *mkCharBuffer ( incr ) /* Create CharBuffer */
int incr ;

void freeCharBuffer ( bp )
struct CharBuffer *bp ;

char *detachCharBuffer ( bp ) /* Return only buffer */
struct CharBuffer *bp ;

int putCharBuffer ( bp,chr ) /* Put character in buffer - MACRO */
struct CharBuffer *bp ;
char chr ;

int fputCharBuffer ( bp,chr ) /*Put character in buffer  */
struct CharBuffer *bp ;
char chr ;

char *expandCharBuffer ( bp )/* Expand buffer by 1 increment */
struct CharBuffer *bp ;

char *putStrCharBuffer ( bp,str ) /* Put string in buffer */
struct CharBuffer *bp ;
char *str ;

int removeLastCharBufferChar ( bp ) /* Remove & return last char */
struct CharBuffer *bp ;

void resetCharBuffer ( bp ) /* Empty buffer */
struct CharBuffer *bp ;
```

```
int fullnessOfCharBuffer ( bp ) /* Return # of chars in buffer */
struct CharBuffer *bp ;

void sizeofCharBuffer ( bp ) /* Return current buffer size */
struct CharBuffer *bp ;

char *charBufferAdr ( bp ) /* Return current ptr to buffer */
struct CharBuffer *bp ;

char *nullTerminateCharBuffer ( bp ) /* Insure '\0' char at end */
struct CharBuffer *bp ;

char *fmtStr ( fmt[,arg...] ) /* Create formatted string */
char *fmt ;

char *vfmtStr ( fmt,argp ) /* varargs version of  fmtStr  */
char *fmt ;
va_list *argp ;

int fmtCharBuffer ( bp,fmt[,arg...] ) /* Add formatted str to buffer */
struct CharBuffer *bp ;
char *fmt ;

int vfmtCharBuffer ( bp,fmt,argp ) /* varargs version of  fmtCharBuffer  */
struct CharBuffer *bp ;
char *fmt ;
va_list *argp ;

int maxFormatLength ( fmt[,arg...] ) /* Return max format buffer size */ char *fmt ;

int vmaxFormatLength ( fmt,argp ) /* varargs version of  maxFormatLength  */
char *fmt ;
va_list *argp ;
```

Description

These routines manipulate character buffers that are automatically expanded when they are found not to be large enough. They are adjuncts to the other automatic buffering routines found in PRISM TOOLS . See **readLine (3x)**, **readFile (3x)**, and **arrays (3x)**.

mkCharBuffer (|) creates the control structure to manage a character buffer. incr specifies the size of each increment to the character buffer when it needs expansion. The default, if incr is less than or equal to 0, is 0x80 bytes.

The control structure should be released via either the **freeCharBuffer (|)** routine, which releases both the control structure and any data in the character buffer, or the **detachCharBuffer (|)** routine, which releases only the control structure and returns the completed character buffer as its return value. When using detach-**CharBuffer (|)** it is the responsibility of the user to *free* (|) the character buffer if that should ever be appropriate.

putCharBuffer (|) adds a single character to the specified character buffer, expanding the buffer if necessary. **putCharBuffer (|)** is a macro. It returns the character stored or FAILURE if the buffer fails to expand when it should. It doesn't call the character buffering routines unless the buffer needs enlarging.

fputCharBuffer (|) performs the same job as **putCharBuffer (|)** but it is a function and so incurs the expense of a subroutine call each time it is called. It returns either the character stored or FAILURE if **bp** is not initialized or the buffer fails to expand when it should.

WARNING:

Be aware that a **CharBuffer** *filled via either the* **putCharBuffer (|)** *or* **fputCharBuffer (|)** *routines will not contain a '\0' character at the end of the buffer unless you explicitly store a '\0' character at the end or use* **nullTerminateCharBuffer (|)** *to insure that there is a '\0' character at the end of the buffer. Without this termination character, standard UNIX string operations will produce unpredictable results.*

putStrCharBuffer (|) adds an entire null terminated ASCII string to the specified character buffer. **putStrCharBuffer (|)** insures that the CharBuffer has a '\0' character after the last real character in the buffer. If str is NULL or points the the empty string, the only action is to insure this null termination. The '\0' character is not actually part of the buffer and will be overwritten by the next **putCharBuffer (|)** operation.

removeLastCharBufferChar (|) extracts the most recently added character from the specified buffer and removes it from the buffer. If the buffer is empty, **EOF** is returned. A side effect is that that buffer is guaranteed to be NULL terminated after a call if there was something to remove, since the removed character is converted to a '\0' character.

expandCharBuffer (|) is normally only called by macros or internally by the character buffer routines. It causes the character buffer to be expanded by one increment of size (default 0x80 bytes) each time it is called. It returns the new pointer to the character buffer.

resetCharBuffer (|) resets the pointer into **bp** so that future information is stored at the beginning of the CharBuffer . This effectively empties the buffer. **fullnes-sOfCharBuffer (|)** returns the number of characters currently stored in the **Char-Buffer** . This count DOES NOT include the trailing NULL character generated by

nullTerminateCharBuffer (|) or by any of the string appending operations. **sizeofCharBuffer (|)** returns the current size of the CharBuffer , (i.e. how many characters it can hold before it will be enlarged again). **charBufferAdr (|)** returns a pointer to the current buffer of characters associated with bp .

nullTerminateCharBuffer (|) is a macro call to *putStrCharBuffer* that insures that the specified buffer has a '\0' character after the last valid character in the buffer so that it can be manipulated by the standard ASCII string routines.

fmtStr (|) is a replacement for **sprintf (|)** in the standard I/O library. It returns a pointer to string containing the information specified by the format fmt and any required arguments. **vfmtStr (|)** is the varargs version, which takes a pointer to the required arguments rather than the arguments themselves. It replaces **vsprintf (|)**. Both **fmtStr (|)** and **vfmtStr (|)** use a single CharBuffer structure for all their formatting activities. Successive calls overwrite the previous values. If previous information must be retained, a copy must be made. (Use **mkcopy (|)**.)

fmtCharBuffer (|) and **vfmtCharBuffer (|)** perform formatting activities directly into a CharBuffer structure pointed to by bp . The formatted information is concatenated to any information already in the **CharBuffer** . **fmtCharBuffer (|)** takes its arguments directly. **vfmtCharBuffer (|)** takes its arguments indirectly via argp . Both routines return the number of characters added to the **CharBuffer** .

maxFormatLength (|) and **vmaxFormatLength (|)** return the approximate length required to format the specified *fmt* format string using the supplied arguments. **maxFormatLength (|)** takes its arguments directly, like **printf (|). vmaxFormatLength (|)** takes its arguments indirectly, via *argp*, like **vprintf (|)**. The length returned is guaranteed to be greater than or equal to the required length of the formatted material plus 1 addition byte for the '\0' character at the end.

See Also

readLine
readFile
arrays

Diagnostics

fputCharBuffer returns the character stored as an integer or FAILURE if the buffer pointer was not initialized or if the buffer failed to expand when it needed to. Both **putStrCharBuffer (|)**, and **expandCharBuffer (|)** return a pointer to the current buffer containing the characters stored to this point. **detachCharBuffer (|)** returns the pointer to the completed buffer. mkCharBuffer (|) returns (struct CharBuffer *)NULL if it is unable to allocated space.

Example

The following example copies a line of input from the user into a buffer and then insures that it is NULL terminated and prints it.

```
#include  prismdefs.h
#include  readInfo.h
#include  charBuffer.h
struct CharBuffer *getInputAndEcho(fp)
FILE *fp ;

struct CharBuffer *cbp ;
int chr ;
cbp = mkCharBuffer(0) ;
while ((chr = getc(fp)) != EOF && chr != '\n')
 putCharBuffer(cbp,chr) ;
putCharBuffer(cbp,'\n') ;
nullTerminateCharBuffer(cbp) ;/* Terminate ASCII string */
fputs(charBufferAdr(cbp),stdout) ;/* Print contents */
return(cbp) ;
}
```

The following little routine reads a file and stores its entire contents is a single character buffer and returns the buffer. It is up to the caller to free the buffer space at some later time.

```
char *getFile(fp)
FILE *fp ;
{
struct CharBuffer *cbp ;
char *ptr ;
cbp = mkCharBuffer(0) ;
while ((ptr = readLine(fp)) != EOF)
(void)putStrCharBuffer(cbp,ptr) ;
return(detachCharBuffer(cbp)) ;
}
```

The following example takes a series of format strings and associated arguments and formats them into a character buffer and returns the composite buffer.

```
struct FormatItem
{
char *fmt ;
va_list *argp ; /* Pointer to args for format */
} ;
char *formatter(fip)

struct FormatItem *fip ;
{
struct CharBuffer *cbp ;

if (fip == (struct FormatItem *)NULL)
return((char*)NULL) ;
cbp = mkCharBuffer(0) ;
for (; fip->fmt != (char*)NULL ;fip++)
(void)vfmtCharBuffer(cbp,fip->fmt,fip->argp) ;
return(detachCharBuffer(cbp)) ;
}
```

Caveats

Be aware that **resetCharBuffer (|)** does not destroy the current contents of the buffer. It only resets the pointer back to the beginning. The next operation that puts something into the buffer while overlay (and thereby destroy) the previous contents.

Also be aware that the **putCharBuffer (|)** operations do not insure NULL termination of the buffers contents. If you plan to perform any ASCII string operations on a buffer, be sure that either a **nullTerminateCharBuffer (|)** operation is performed as the last operation or that one of the string concantenating operations, **putStrCharBuffer (|)**, **fmtCharBuffer (|)**, or **vfmtCharBuffer (|)**, is the last operation performed on the buffer. These operations guarantee that the buffer is NULL terminated.

clock

Synopsis

clkinit, timeout, killtout, untimeout, sleep, setflag, suspendTimeouts, unsuspend-Timeouts — Routines to manage a queue of timeout requests similar to the clock queues in UNIX.

Command Format

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

int clkinit ( ncallouts )
int ncallouts ;

int timeout ( func,arg,ticks )
int (*func)() ;
"caddr_t arg ;
long ticks ;

long killtout ( func,arg )
int (*func)() ;
caddr_t arg ;

long untimeout ( id )
int id ;

unsigned sleep ( ticks )
unsigned int ticks ;

setflag ( flag )
int *flag ;

suspendTimeouts ()

unsuspendTimeouts ()
```

Description

clkinit (|) sets up the callout queues. *ncallouts* is the size of the queues. If clkinit (|) has not been called at the time the first **timeout (|)** call is made, the queues will be initialized at *DFL_CALLOUTS* , which is currently 20. **clkinit (|)** can also be used to resize the existing queues if necessary.

timeout (|) sets up a request on the callout queues that the specified *func* be called in *ticks* seconds with *arg* as its single argument. If it is desired to just be interrupted at as certain time in the future without having a routine called, for example, you want to attempt an **open (|)** for so many seconds and then quit if it doesn't succeed, timeout (|) may be called with func set to **NOACTION** . **timeout (|)** returns FAILURE if there is not room for another timeout request. When it succeeds it returns a unique ID number than can be used to kill the timeout request via untimeout (|).

killtout () removes a specific unexpired request from the callout queues. *func* and *arg* must match those specified in the **timeout ()** requeust. If two requests for the same function with the same argument were on the queues, only the first one would be removed. **killtout ()** returns the amount of time left on the request or FAILURE if it cannot find the request.

untimeout (|) performs that same job as **killtout (|)** except that it uses the unique ID returned by **timeout (|)** to identify the timeout structure of interest. Its advantage is that if there is more than one request with the same *func* and *arg* , you can still specifically remove the desired request. **killtout (|)** always removes the first matching request.

sleep (|) provides the same function as the UNIX C library sleep, but is compatible with timeout 's use of the *SIGALRM* signal. Processing is suspended for *ticks* seconds.

setflag (|) is provided as a function to be called by **timeout (|)** to set a flag to TRUE when a timer expires. It is set up by the following call:

"timeout(setflag,&flag,ticks)";

After *ticks* seconds, *flag* will be set to TRUE.

suspendTimeouts (|) causes all SIGALRM activity to be suspended. This routine should be used with care in those cases where critical code needs to be executed without interruption from **timeout (|)** or **alarm (|)** activity. All timeouts posted at the time the **suspendTimeouts (|)** call is performed, will be deferred until an **unsuspendTimeouts (|)** call is done. New **timeout (|)** activity can be generated after a suspend**Timeouts (|)** call is performed, thus allowing **sleep (|)** to work, but all **timeout (|)** activity prior to the **suspendTimeouts (|)** call is deferred. **suspendTimeouts (|)** can be called recursively up to the current maximum of 5 times. This is not recommended as the effect on deferred timeouts becomes hard to predict.

unsuspendTimeouts (|) reinstates **timeout (|)** activity previously deferred by **suspendTimeouts (|)** The timers are adjusted to account for the amount of time lost during the suspension, which might mean that one or more expired timers might go off as soon as **unsuspendTimeouts (|)** is executed.

See Also

list

Diagnostics

clkinit (|) will return FAILURE if it is unable to allocate callout queues. **timeout (|)** returns FAILURE if the callout queues are full. **killtout (|)** returns FAILURE if it cannot find the specified function on the callout queues. **suspendTimeouts (|)** returns the number of suspended timeouts if the call succeeds and FAILURE if the maximum number of suspensions has been reached. **unsuspendTimeouts (|)** returns the number of reinstated timeouts if the call succeeds and FAILURE if there is not suspension to reinstate.

Caveats

It is recommended that you do not use the UNIX **alarm (|)** call if you are using **timeout (|)** or **sleep (|),** since **timeout (|)** catches the SIGALRM signal and processes it. The clock routines attempt to avoid conflicts with other uses of **alarm (|)**, but should an alarm be set when **timeout (|)** or **sleep (|)** are invoked, processing of the alarm, should it expire during the **timeout (|)** or **sleep (|)** period will be deferred until the clock routines are finished using the SIGALRM signal.

All times given to the clock routines are in seconds and should be read as intervals of N-1 to N seconds in length. In other words, a time of 1 second is actually any amount of time from 01 seconds. It is strongly recommended that you never attempt a clock interval of less than 2 seconds for this reason.

The clock routines restore the original SIGALRM function whenever the callout table is empty and if there was an active **alarm (|)** when the clock routines took over SIGALRM , the **alarm (|)** is restarted minus the time that the clock routines used SIGALRM . If this means that the **alarm (|)** would have already expired, then processing is forced at this time.

sleep (|) uses l**ongjmp (|)** to avoid problems when setting up short sleeps, where the **alarm (|)** might expire before the **pause (|)** is done. The use of **longjmp (|)** is not avoidable in the current implementation of UNIX, but because of it, sleep (|) can delay other timeouts. In the worst cases, a **timeout (|)** might never be processed. The problem arises when two or more events are scheduled for the same clock tick. If one of the events is a **sleep (|)** and other events follow it, the events after the **sleep (|)** will not be executed until the next time SIGALRM is posted to

the clock routines. If there are no events following the **sleep (|)** event with non-zero times, then no future SIGALRM will be posted and those events might never be processed. It is recommended that you do not use **sleep (|)** in conjunction with other clock activity if possible. If you avoid 1 second waits, you can use ti**meout (|)** , a flag, **setflag (|)** and **pause (|)** to safely perform sleep activities. Any function called by the clock routines that performs a **longjmp (|)** runs the same risks that **sleep (|)** does.

db_init

Synopsis

db_init — Initialize and activate trace facility

Command Format

#include <spp.h>
int db_init *(qkey)*
int qkey; /* message queue key of process */

Description

Data interface processes (DIPs) call **db_init** once at the start to set up the trace mechanism provided by the VIS. The qkey is the message queue key assigned to the process.

From then on, processes can use **db_pr** and **db_put** to write out trace/debug messages. These trace messages then can be displayed on the command line by using the **trace** command. On behalf of the process, **VSstartup** and **startup** call **db_init** so this function does not have to be called directly.

See Also

db_pr
db_put
VSstartup
startup
trace

Diagnostics

No indication of success or failure is returned. If it fails, the **dp_put** message will appear on standard error (**stderr**) and **db_pr** messages will be ignored.

db_pr

Synopsis

db_pr — Conditionally output trace message

Command Format

#include <spp.h>
int db_pr *(format)*
char *format; /* printf(3S) format string */

Description

db_pr writes out the string formed using the same **printf** conventions to the trace buffer if the calling process now is being traced. (See the *UNIX System V/386 Release 3.1 Programmer's Reference Manual* for additional information on **printf**). If the process is not being traced, **db_pr** does nothing. If also does nothing if the trace facility was not initialized through **db_init**. **db_pr** calls **db_put** after forming the string to write out.

The **db_pr** messages can be displayed on the standard out (**stdout**) through the **trace** command.

Examples

db_pr("%s: Got Message on channel=%d\n, "Dip", 5);

See Also

db_put
db_init
trace
printf

Diagnostics

No indication of success or failure is returned.

Warning

db_pr can apply up to a maximum of nine arguments to the specified format string.

db_put

Synopsis

db_put — Unconditionally output string to trace buffer

Command Format

#include <spp.h>

int db_put (string)
char *string; /* string to write out */

Description

dp_put writes the string to the trace buffer regardless of whether the calling process now is being traced. It writes the string as it is to standard error if the trace facility was not initialized through **db_init**. Before writing to the trace buffer, it splits the output string into 78 character lines (if necessary) to fit in the buffer.

The **db_put** message can be displayed on standard out (**stdout**) through the trace command.

Examples

db_put ("DIP: Got a Message ");

See Also

db_init
trace

Diagnostics

No indication of success or failure is returned.

et_send

Synopsis

et_send — Send error message to ET (obsolete in the Version 3.1 Logger/Alerter environment)

Command Format

```
#include "spp.h"

int et_send (chan,msg_id,e_arg0,e_arg1,e_arg2,e_arg3,e_strarg)
int chan; /* channel in lower 2 bytes, board in upper 2 bytes*/
int msg_id; /* value of mnemonic #defined for error type */
int e_arg0; /* integer argument */
int e_arg1;/* integer argument */
int e_arg2; /* integer argument */
int e_arg3; /* integer argument */
char *e_strarg; /* string argument */
```

Description

et_send is used to notify ET of an error in the calling process. It sends an IPC message to ET with the specified arguments. Errors are identified by their error ids (*msg_id*) and should be unique across all errors known to ET. See the files under **/att/msgipc/etmsgs** for the errors currently known to ET.

ET generates the text description of the error by applying the arguments *e_arg0* through *e_arg3* and *e_strarg* to the rule associated with the given error (**msg_id**). The rule also tells ET what action to take; this usually translates to logging the error and text description. The error log can be displayed through the Event Log Report menu in the cvis_menu command.

Set the channel number to -1 if you are not sure of the channel and board number. This is important because if the channel and board number are incorrect, ET will reject the message. The advantage to specifying the channel and board number, if you know them, if that the message will identify the board and channel on which the error occurred. Set any of the integer arguments (*e_arg0* through *e_arg3*) to -1 and the *e_strarg* to the empty string ("") if they are not used.

Example

Assume that *msg_id*, DIP_FILE_ERR is known to ET and it substitutes the arguments to **et_send** using the following format string:

"database DIP:channel %chan: %st error (errno=%arg0)"

The actual chan, e_strarg, and e_arg0 arguments passed to **et_send** replace %chan, %st, and %arg0, respectively. The above format string would be used as part of the rule associated with DIP_FILE_ERR. The following example displays the code fragment for sending the DIP_FILE_ERR:

```
extern int errno: /* (see intro(2)). */
int fd;
int chan;
char but[32]
/* Assume working on channel 10 on board 1 but usually
* information would not be hardcoded as in this example.
* Instead, the channel number is extracted from an IPC
* message that is usually sent by a TSM script.
*/
chan = 10|(1>>16);
fd = open("customer"); /* customer records are kept here */
if (fd < 0) {
/* Assuming that errno is set to 13 (access denied),
* the following et_send message will be logged as
* "databaseDip: channel 10: OPEN error (errno=13)"
*/
et_send(chan, DIP_FILE_ERROR, errno, -1, -1, -1, "OPEN");
/* abort further processing with this file */
} else { /* open worked */
noBytes = read(fd, buf, 32);
if (noBytes < 0) {
/* Assuming that errno is set to 4 (interrupted call).
* The following et_send message will be logged as
* "databaseDIP: channel 10: READ error (errno=4)"
*/
et_send(chan, DIP_FILE_ERROR, errno, -1, -1, -1, "READ")"
/* abort further processing with this file */
}
}
```

Diagnostics

et_send does not return any indication of success or failure. If it fails to send the IPC message, **et_send** prints out a diagnostic on standard output (stdout).

Warning

et_send will truncate e_strarg to 64 (ET_MAXSTR-1) characters if necessary and will not print out a diagnostic when this happens.

expandLog

Synopsis

This function expands a compressed log string.

Command Format

```
char *expandLog ( cmpmsg )
char *cmpmsg ;

char *getExpandFmt ( index )
int index ;

void endExpandFmt ()

void setExpandFmt ( file )
char *file ;i

char *getExpansionFmt ()

void chgExpansionFmt ( fmt )
char *fmt ;

int getExpansionCutoff ()

int chgExpansionCutoff ( newcol )
int newcol ;

char *getContinuationPrefix ()

void chgContinuationPrefix ( fmt )
char *fmt ;

int getVisible ()

int setVisible ( newval )
int newval ()
```

Description

The **expandLog** function takes a compressed log message as produced by **log** and expands it to the human readable form using the **textLogFmt** file produced by **lComp**. It returns a pointer to a buffer containing the expanded message.

Its behavior is controlled by a number of additional routines. **setExpandFmt** changes the name of the expansion format file to *file*. **endExpandFmt** causes the current expansion format file to be closed. **getExpandFmt** causes the expansion format specified by *index* to be read in and a pointer to the expansion format is returned.

Message expansion is controlled by two different formats. There is a high-level format, which specifies what pieces of the message to print and how and a specific format for the information section of the message. The standard message consists of the following parts:

Priority	The priority of the message, which can be printed in one of two forms, a 2 character string or as a decimal digit. The default is a two character string.
Time	The time of day, which is normally printed in the same format the routine **ctime** produces minus the final \n. There is a great deal of flexibility in printing the time. All printing options supported by the **dateFONT?** command.
Name	The name of the process.
Source	The name of the source file where the message was generated.
Line	The line in the source file where the message was generated.
Message	The text of the message itself, whose text is the combination of the compressed data and the message format from the expansion text file.

The default format is:

%P %T %N %S:%L\n%M

The *%P and %T* specifiers can take arguments enclosed in ()s.

%P(%s) is the default and specifies that the priority be printed as a two character string. *%P(%d)* specifies that the priority be printed as a decimal digit.

%T() takes the standard **date** command options,

%m	The month of the year, 01-12
%d	The day of the month, 01-31
%y	The last 2 digits of the year, 00-99
%D	The date as mm/dd/yy
%H	The hour, 00-23
%M	The minutes, 00-59
%S	The seconds, 00-59
%T	The time of day as HH:MM:SS
%j	The day of the year, 001-366
%w	The day of the week, 0-6, with Sunday == 0
%a	The day of the week as a three letter abbreviation
%h	The month as a three letter abbreviation
%r	The time of day in HH:MM:SS AM/PM notation
%n	A newline character
%t	A tab character
%%	The '%' character

Any other characters appearing between the ()s to the *%T* specifier are printed as is.

getExpansionFmt gets a pointer to the current expansion format. **chgExpansionFmt** changes the current expansion format to that specified by *fmt*.

Normally, long lines are printed as is, but it is possible to request wrapping of long lines at a specific column and the continuation lines can be prepended with a specific prefix, if desired. **getExpansionCutoff** returns the current column at which wrapping takes place. If the value is 0, no wrapping is being performed. **chgExpansionCutoff** changes the column cutoff to *newcol*. **getContinuationPrefix** returns a pointer to the current continuation line prefix. The default is none. **chgContinuationPrefix** changes the continuation line prefix to that specified by *fmt*.

Normally all characters are printed as is. It is possible to request that control and non-printing characters be made visible. **getVisible** returns 0 if control and non-printing characters are not being made visible, which is the default. Currently any non-0 value indicates that the control and nonprinting characters are being converted to visible strings. **setVisible** sets the printing characteristics of control and non-printing characters to *newval*.

Enviroment Variables

The following environment variables are checked once, the first time **expandLog** is entered, if the parameter they specify has not already been set by the application developer.

LOGFORMAT	A string specifying the printing format to be used.
LOGCOLUMN	The column at which line wrapping should take place.
LOGCONTPREFIX	The string to be prepended to continuation lines.
LOGROOT	The directory in which **textLogFmt** is to be found if the expansion file is not specified otherwise.

Caveats

Expansion is performed into a single allocated buffer. If more than one expansion is done, it is the responsibility of the caller to copy the expanded message from the buffer if the previous expansion is to be retained while a new expansion is being done.

Line wrapping and making control characters visible are both performed after the basic message expansion. They require additional manipulations of the message buffer and cost machine cycles.

See Also

lComp
logCat

ipc

Synopsis

ipcInit, ipcOpen, ipcRecv, ipcSend, ipcClose, ipcRelease — Interprocess communication via named pipes

Command Format

```
#include <sys/types.h>
#include <fcntl.h>
#include  prismdefs.h
#include  ipcComm.h

int ipcInit ( name,createMode )

char *name ;
int  createMode ;

int ipcOpen ( queue,name,accessMode )
struct IpcQ *queue ;
char *name ;
int accessMode ;

int ipcRecv ( queue )
struct IpcQ *queue ;

ipcSend ( queue,msg )
struct IpcQ *queue ;
char *msg ;
```

Description

These routines allow processes to communicate with each other using named pipes as the communication pathway. The messages passed between processes are expected to be ASCII lines terminated by a \n.

ipcInit allows a process to create a named pipe for communication purposes if it does not exist and if it does exist, test for another reader of the pipe. There should only be one reader of any pipe used by these routines. *name* is the pathname of the named pipe. *createMode* is the modes to be used when creating the named pipe, for example 0622, which would allow the owner to read the pipe and anyone else to write it. If *createMode* is 0, the pipe will not be created if it doesn't exist, but the check for a reader will be carried out if the pipe exists. The check for a read is accomplished by setting a *timeout* (see **clock**) and then attempting to open the

pipe for writing. The open will not succeed if there isn't a reader of the pipe. **ipcInit** return FAILURE if the pipe exists and has a reader or it is unable to create the pipe. It returns SUCCESS if the pipe exists but has no reader or if it creates the pipe. SUCCESS means that it is legal to perform an **ipcOpen**. *errno* is always appropriately set either by UNIX or by **ipcInit** to indicate who returned FAILURE.

ipcOpen is a macro, which performs the opening of the named pipe *name* with access modes *accessMode* (see **fcntl (5)** & **open (2)**). The file description returned by the open is placed in the *queue* structure and returned as the return value.

ipcClose closes the named pipe associated with *queue*.

ipcRelease should be called if the *queue* structure for communication was a local variable. The buffer into which **ipcRecv** does its receives is allocated with **malloc** and needs to be returned if the *queue* structure will be destroyed by returning from the creating routine. It is recommended that *queue* structures be global or static to avoid the necessity of using **ipcRelease**.

ipcSend sends an ASCII *msg* through the named pipe associated with *queue*. *msg* should be terminated by a "\n\0" sequence. The message is transmitted with a 3 digit length appended to the beginning of the message. This implies that no message longer than 999 characters can be sent via these ipc mechanisms. **ipcRecv** strips this three digit length off the message before returning it. This 3 digit length allows transmission over the pipe to be atomic, with no chance of mixing of messages if there are multiple writers of the pipe. The message is always written as a single message, thereby guaranteed by UNIX to go onto the pipe as a single unit. It is read in two reads, first a 3 character read to get the length of the message that follows, and then a read of the **msg** itself.

ipcRecv reads the next message off its named pipe. It returns the length of the message as its return value. A return of 0 means the pipe is empty, which happens if the pipe was opened **NDELAY** , or if the pipe was in fact not a pipe, but instead a file or a tty and has reached **EOF** . A return of FAILURE indicates an interrupt or some problem.

The *queue* structure is as follows:

```
struct IpcQ
{
intiq_queue ; /* System queue (file descriptor) */
intiq_flag ;
intiq_len ; /* Length of message */
intiq_size ; /* Size of the buffer */
char *iq_buf ; /* Buffer in which to put message */
} ;
```

After performing an **ipcRecv**, *iq_buf* will point to the message and *ip_len* will be set to the length of the message.

Diagnostics

ipcInit returns FAILURE in the event of trouble or if the pipe is busy. In addition to standard UNIX errors when attempting to create the named pipe (see create (2)) it also sets errno.

ENOENT	The named pipe did not exist and **ipcInit** wasn't allowed to create it or wasn't able to create it.
EEXIST	Something other than a named pipe already existed with the name specified.
EBUSY	There already was a reader on the named pipe.

logDstPri

Synopsis

createLDParray, getLDPpriority, getLDPdsts, readDstPri, fmtLDPdsts, writeDstPri, freeLDPcontents, freeLDParray, indexLDPelement, deleteLDPelement, copyLDPcontents, insertLDPelement, replaceLDPelement — Routines to read, write, and manipulate the logging system's destination/priority assignment file.

Description

createLDParray (|) creates an initial dynamic array to hold the *LDPelement* structures. Normally it would not be called directly until a new file is being created from scratch. **readDstPri (|)** calls it when it reads in an existing rules file.

readDstPri (|) reads in a file containing the message priority and destination information. (See **msgRules (4x)** for details.) *name* is the name of the file containing the information. It is used only to report errors correctly. *fp* is an open standard I/O stream descriptor from which the information is read. *errp* is a pointer to an integer in which the number of errors detected during the reading process are returned. *checkFlag* causes any errors detected to produce an error message on the standard error stream in addition to an increment to the error count pointed to by *errp*.

writeDstPri (|) writes out the information in the dynamic array described by **dpDA.** The information written to the standard I/O stream *fpout*. A FAILURE (-1) is returned if nothing can be written otherwise the number of records written is returned.

freeLDParray (|) is the means to release the resources allocated by **readDstPri (|)** or the other routines can add things to the dynamic array of **LDPelement** structures. When it returns, the dynamic array is closed and all the resources returned to the system.

indexLDPelement (|) converts a **LDPelement** structure pointer into the index of the structure within the dynamic array of structures specified by **dpDA**. A FAILURE (-1) is returned if the array doesn't exist, *lp* does not point to a structure within the array of structures, or if *lp* does not point to the beginning of a structure within the array. This index value can be used with the **deleteLDPelement (|)** routine to delete structures.

deleteLDPelement (|) deletes the one specific **LDPelement** structure specified by *index* from the dynamic array of **LDPelement** structures specified by **dpDA**. All the resources associated with the structure are released and all structures above it are moved down one to fill in the hole.

insertLDPelement (|) inserts a new **LDPelement** structure into the dynamic array specified by **dpDA** at the location specified by *pos*. If *pos* is negative or greater than the current size of the dynamic array, the new structure is inserted at the end of the current array. If *pos* is greater than or equal to 0 and less than the size of the array, then the new structure is inserted at that location in the array. The information for the new structure is pointed to by *lp*. No assumptions are made about the data in the structure. All strings have new copies made, hence it is the responsibility of the calling routine to release any data storage associated with *lp* as new copies of all data are made during the insertion process.

replaceLDPelement (|) replaces the information in the **LDPelement** structure specified by *lpDst* with that pointed to by *lpSrc*. The original information used by *lpDst* is released before the replacement. As with **insertLDPelement (|)**, all data is copied. No pointers to data are reused, hence it is safe to release the data areas in *pSrc* once the **replaceLDPelement (|)** is complete.

copyLDPcontents (|) performs the same job as **replaceLDPelement (|)** except that it assumes that *lpDst* points to an uninitialized **LDPelement** structure. It first zeros the structure and then makes copies of the information found in *lpSrc*.

freeLDPcontents (|) releases all allocated strings used by the **LDPelement** structure pointed to by *lp*. Nothing is done with the structure itself.

getLDPpriority (|) converts the ASCII representation of the priority specified by *name* into a priority value. It understands the predefined list of names **E_NONE, E_MANUAL, E_MINOR, E_MAJOR, and E_CRITICAL** as well as the numbers 0-4. It can additional understand the values specified by a *$priorities* specification if **dpDA** is a dynamic array descriptor for an array of **LDPelement** structures and *priIndex* is the index of the *$priorities* specification to be used for the translation. A FAILURE (-1) is returned if the *name* is not understood, otherwise a value from 0-4 is returned.

The **getLDPdsts (|)** and **fmtLDPdsts (|)** functions require a *DstTranslator* structure to operate. This structure contains to parallel arrays of names and index values. The structure can be created one destination element at a time with **appendDstTranslator (|)**. *name* is the ASCII name of the destination, e.g "log" or "console". *index* is the index of the bit position (from 0-31) (and the index of entry describing this destination in *$LOGROOT/Config*). If *dtp* is NULL, a new **DstTranslator** structure is allocated and initialized. *name* and *index* are added to the appropriate arrays within this structure. The address of the **DstTranslator** structure is returned. NULL is returned if *name* does not point to a non-empty string or if index is not within the range 0-31. NULL is also returned if the allocation of a new **DstTranslator** structure fails. It is the responsibility of the caller to release the **DstTranslator** structure when it is no longer needed by calling **freeDstTranslator (|)**.

mkDstTranslator (|) makes a complete **DstTranslator** structure from the dynamic array of **LDPelement** structures specified by **dpDA**. This is the type array returned by **readDstPri (|)**.

getLDPdsts (|) converts an ASCII specification of destinations into a bit mask. The translation information needed to convert ASCII destination names into bits is supplied by the **DstTranslator** structure specified by *dtp*. **getLDPdsts (|)** returns **FALSE** if it is unable to convert the *spec* properly and **TRUE** if the translation was successful. The value of the translated mask is returned in the unsigned int pointed to by *dstp*. The matching of ASCII destination names to those supplied by the **DstTranslator** structure is via the shortest unique match, hence the destination names need not be completely spelled out as long as they are unique.

fmtLDPdsts (|) converts a bit mask into an ASCII representation of the legal destinations. *dst* is the bit mask of destinations. *dtp* is a pointer to a **DstTranslator** structure containing the mapping of bits to names. Each destination is separated by a '|' character and any bits not specified by the **DstTranslator** structure are printed as a decimal index of the bit (0-31).

See Also

expandLog(3x)
logCat(1x)
log(4x)
logMsg(3x)

logMsg

Synopsis

logMsg, vlogMsg, logSysError, logInit — Log messages using the dynamic destination/priority mechanism.

Command Format

```
#include <varargs.h>
#include "log.h"
#include "logDstPri.h"

int logInit(procName)
char *procName;/* Name of sending process */

char *logMsg(msgNum,EL_FL,...)
EL_FL/* Macro of __FILE__,__LINE__ */
int msgNum;/* Index number of loggin message */

char *vlogMsg(msgNum,El_FL,argPrt)
int msgNum;/* Index number of loggin message */
EL_FL/* Macro of __FILE__,__LINE__ */
va_list argPrt;/* Pointer to arguments for loggin message */

char *logSysError(EL_FL,fmt,...)
EL_FL/* Macro of __FILE__,__LINE__ */
char *fmt;
```

Description

logInit() is a simpler form of the **loginit()** function. It assumes that you will be using the **logMsg()**, **vlogMsg()**, or **logSysError()** routines and hence are not concerned with the values of the default priority or destination, what are arguments provided to **loginit()**. It only requires the name of the process as you want it to appear in the messages that are logged by the calling process. If specifies the default priority as **E_NONE** and the default destination as **MASTER_LOG**.

The routines **logMsg()**, **vlogMsg()**, and **logSysError()** provide a means to log messages with the PRISM logging system. Starting from the **msgID** supplied, a message priority and destination mask is looked up. This lookup information is stored in shared memory by the process **logDstPri**, which reads the file **msgDst.rules** from the directory **/usr/spool/log**, where the priority and destination masks are ultimately defined.

logMsg() log the message identified by **msgNum** to the logging system. The *EL_FL* macro identifies the place in the code where the call was generated. It is a macro expanding to *__FILE__,LINE__*. Any arguments required by a specific logging message format are provided after *EL_FL*.

vlogMsg() does the same job as **logMsg()**, but it takes any additional arguments from *argPrt*, which points to the arguments required by the specified message.

logSysError() generates an error message based on the current value of the global **errno**, which is set by the UNIX system whenever a system call fails.

See Also

fixLogFile
lComp
arrays
expandLog
log
logDstPri

match

Synopsis

match, exactMatch, matchNoCase, exactMatchNoCase — Searches a list of choices for the best match.

Command Format

```
#include  match.h


int match ( query,answers )
char *query ;
char **answers ;

int exactMatch ( query,answers )
char *query ;
char **answers ;

int matchNoCase ( query,answers )
char *query ;
char **answers ;

int exactMatchNoCase ( query,answers )
char *query ;
char **answers ;
```

Description

match (|) searches down the list of possible *answers* looking for the best fit to *query* . It returns the index of the best match from 1 to N. If it cannot find a match, it returns *NO_MATCH* . If the query is ambiguous, it returns *AMBIGUOUS* . If the array of *answers* is defective, such as having the same entry more than once, it returns *BAD_DATABASE*.

The *answers* array must contain a NULL pointer at the end to delimit the search.

exactMatch (|) is the little brother of **match (|)**. It will return *NO_MATCH* unless there is an exact match in the list of *answers* with the *query* string. If there is an exact match in the list, it returns an index of from 1 to N indicating which answer in the list matched.

matchNoCase (|) performs the same job as **match (|)** except that it ignores any upper/lower case information in determining whether things match or not.

exactMatchNoCase (|) performs the same job as **exactMatch (|)** except that it ignores any upper/lower case information in determining whether things match or not.

mesgrcv

Synopsis

mesgrcv — Get an IPC message

Command Format

```
#include <sys/types.h>
#include <sys/msg.h>
#include <sys/ipc.h>
#include "mesg.h"
#include "spp.h"

int mesgrcv (morig,msgp,msgsz,msgtyp,msgflag,msgrtime)
int morig
char *msgp; /* message buffer */
int msgtyp; /* type of message to read */
int msgsz; /* size of message buffer */
int msgflag; /* control flag */
long *msgrtime; /*message receive time */
```

Description

Mesgrcv is used by the voice system to read IPC messages off their message queues. It is the front-end to the UNIX system call, **msgrcv**.

Mesgrcv reads the next IPC message on the message queue (morig) and stores up to msgsz bytes in the buffer pointed to by msgp. The buffer should be as large as the largest message to be read. Otherwise, by default, **mesgrcv** will discard the message if its size is greater than msgsz. However, if (MSG_NOERROR & msgflag) is true, the message will truncated to fit in the buffer (see **msgop(2)** in the *UNIX Programmer's Reference Manual*).

Mesgrcv can read messages of a certain type selectively as specified by msgtyp. See msgop(2) for the possible values for msgtyp. Set **msgtyp** to zero to read the first message on the queue regardless of type.

By default **mesgrcv** waits indefinitely for a message to arrive on the queue if there is none currently to be read. However, if (msgflag & IPC_NOWAIT) is true, **mesgrcv** returns immediately with a -1 and errno is set to ENOMSG when no message is found on the queue.

Mesgrcv also returns (in msgrtime) the time the message was read and stored in the buffer (*msgp) if IPC_GTIME & msgflag is true.

Mesgrcv creates the IPC message queue for queue key morig if necessary.

Example

The following are examples of code fragments using **mesgrcv** to receive IPC messages. The examples assume that a TSM script is sending two types of messages. One contains the caller's personal information and the second contains the caller's order for a specified number of widgets.

```
/* Definition of the message structures and definitions
* used in the examples below.
*/
#include <sys/errno.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <stdio.h>
#include "spp.h"
#include "mesg.h"

typedef enum {VISA,AMEX} CREDIT_CARD_TYPE;

/* Define messages to receive */
struct callerinfoMsg {
struct mbhdr hd; /* see mesg.h */
CREDIT_CARD_TYPE creditCard; /*VISA, AMEX */
int creditCardNo; /* employee number */
};
#define CALLER_INFO 6910 /* message id */

struct orderMsg {
struct mbhdr hd; /* see mesg.h */
int noWidgetsOrdered; /* employee number */
};
#define ORDER_AMOUNT 6930 /* message id */


/* Actual area for receiving messages.
* Compose of all expected messages.
*/
union msgBuffer {
struct orderMsg order;
struct callerinfoMsg caller;
} MsgRcvArea;

union msgBuffer *Msgp = &MsgRcvArea;

extern int errno;
```

```
char *Myname = "WidgetDip";
int myQkey; /* my very own message queue */
int noBytesRead;
long Msgrtime;


/* Dummy function that contains the examples.

void
receiveExamples()
{
/*******Example I
* To read the first message on the queue and find out
* what message you got:
*/
int howMany;
CREDIT_CARD_TYPE cardType;
int cardNo;

noBytesRead = mesgrcv(MyQkey,Msgp,sizeof(union msgBuffer),
0,0,NULL);
if (noBytesRead > 0) { /* no error */
/* Time to unpackage the message and find out
* what message arrived.
*/
switch (Msgp->order.hd.mcont) {
case ORDER_AMOUNT:
howMany=Msgp->order.noWidgetsOrdered;
/* Process order */
break;
case CALLER_INFO:
cardType=Msgp->caller.creditCard;
cardNo=Msgp->caller.creditCardNo;
break;
default:
/* Unknown message received.
* Notify someone and probably go back
* and read something else.
*/
;/* null statement to make code compile for this example */
}
} else {
/* Could not read message for some reason.
* Depending on the error, might want to re-try reading.
* Check errno if noBytesRead==-1.
*/
}
```

```
/*******Example II
* To read message without waiting if there's none now.
* And to get the time the message was read:
*/
noBytesRead= mesgrcv(MyQkey,Msgp,sizeof(union msgBuffer),0,
IPC_NOWAIT, &Msgrtime);
if (noBytesRead == -1 && errno == ENOMSG) {
/* No message is on the message queue.
* Do some other work and then come back and re-read queue
*/
} else if (nobytesRead > 0) {
db_pr("%s: got message on %ld\n, MyName, Msgrtime);
/* process message */
} else {
/* some other error occurred */
; /* null statement to make code compile */
}
}
```

Diagnostics

Upon successful completion, mesgrcv returns the number of bytes

read, ranging from 1 to msgsz. Otherwise, one of the following negative values is returned:

-1 An error occurred in msgrcv and errno is set accordingly

-2 Can not create or get the message queue

-3 Destination qkey is not in the voice system range (195)

-4 Message was too big for the buffer and so it got discarded and (MSG_ERROR & msgflag) was false. No message was read. The size of the message buffer is too small.

See Also

msgop(2) (*UNIX Programmer's Reference Manual*)
msgsnd(2(2)) (*UNIX Programmer's Reference Manual*)

mesgsnd

Synopsis

mesgsnd — Send an IPC message

Command Format

```
#include "spp.h"

int mesgsnd (mdest, msgp, msgsz, msgflag)
int mdest; /* Message Qkey to send to */
union msgunion *msgp; /* message to send */
int msgsz; /* size of message */
int msgflag; /* flag for controlling send */
```

Description

Mesgsnd sends the IPC message pointed by msgp to qkey mdest. The number of bytes in the message is specified by msgsz. The message consists of the header and data parts. The header is defined as struct mbhdr in mesg.h. The size of message (msgsz) should include the header and data parts. **Mesgsnd** actually sends the message by calling the UNIX system call **msgsnd**. Msgflag is sent directly to the UNIX system call msgsnd.

Mesgsnd creates the IPC message queue for qkey mdest if necessary. When returning dbase messages to TSM, it is necessary to include the "channel number" value which originally came from TSM.

Example

The following is an example of a function that sends employee information to the TSM script running on the specified channel.

```
#include "spp.h"
#include "mesg.h"
/* Define message to send */
struct employeeMsg {
struct mbhdr hd; /* see mesg.h */
char ename[25];/* employee name */
int payrollNo; /* employee number */
};
#define EMPLOYEE_INFO#7890/* message id */
```

```
extern int MyQkey; /* sender's Qkey */

int
sendEmsg(chan, ename, enumber)
int chan;
char *ename;
int enumber;
{
Struct employeeMsg emsg;
int retcode;

/* Package Message */
emsg.hd.mchan = chan;
emsg.hd.mtype = 1;/* should be positive non-zero */
emsg.hd.morig = MyQkey;
emsg.hd.mcont = EMPLOYEE_INFO;
emsg.hd.mseqno = 0;/* set to zero for safety */
strcpy(emsg.ename, ename);
emsg.payrollNo = enumber;

retcode = mesgsnd(TSM, &emsg, sizeof(emsg), 0);
return(retcode);
}
```

See Also

msgop(2) (*UNIX Programmer's Reference Manual*)

Diagnostics

Upon successful completion, mesgsnd returns zero (the value returned by msgsnd system call). Otherwise, one of the following negative values is returned:

-1	An error occurred in msgsnd and errno is set accordingly
-2	Can not create or get the message queue
-3	Destination qkey (mdest) is not in the voice system range (195)
-4	The size of the message is too small (less than 4 bytes).

options

Synopsis

setDefaultOption, processOptionsFile, processOptions, setEnvVar, optStr, optInteger, optEnv, optBool, shellVariable, quotedShCmd, parseXeqY, setPrimaryOptionsFile, createStandardOptionsName, processProgramOptions, makeDfltOptionEnv, clearDfltOption — Routines for processing files containing "X=Y" pairs.

Command Option

```
"#include <stdio.h>
#include  prismdefs.h
#include  charBuffer.h
#include  arrays.h
#include  options.h

void setDefaultOption ( optPtr )
struct Option *optPtr ;

processOptionsFile ( file,optPtr )
char *file ;
struct Option *optPtr ;

processOptions ( linesPtr,optPtr )
char **linesPtr ;
struct Option *optPtr ;

void setEnvVar ( name,value )
char *name ;
char *value ;

void optStr ( op,name,value )
struct Option *op ;
char *name ;
char *value ;

void optInteger ( op,name,value )
struct Option *op ;
char *name ;
char *value ;

void optEnv ( op,name,value )
struct Option *op ;
char *name ;
```

```
char *value ;

void optBool ( op,name,value )
struct Option *op ;
char *name ;
char *value ;

char *shellVariable ( str )
char *str ;

char *quotedShCmd ( start,valuePtr )
char *start ;
char **valuePtr ;

int parseXeqY ( linePtr,xp,yp,remainderp )
char *linePtr ;
char **xp ;
char *yp ;
char *remainderp ;

void setPrimaryOptionsFile ( name )
char *name ;

char *createStandardOptionsName ( root,program )
char *root ;
char *program ;

void processProgramOptions ( program,optPtr )
char *program ;
struct Option *optPtr ;


void makeDfltOptionEnv ()


void clearDfltOption ()
```

Description

An **option** is something of the form **xxx=yyy**. The **option** is named **xxx** and has a value of **yyy**. The value portion can consist of ASCII characters, environment variables specified in normal shell syntax, quoted sections, and execution sections specified by the normal **"`cmd`"** shell syntax. For example, the following items are legal options:

```
UTMP=$PRISMROOT/etc/utmp
H=${HOME:-/}
DATE=‘date‘
```

How a specific option is used is specified by an option disposition structure of the form:

```
struct Option
{
char *o_name ;/* Name of option */
char *o_dflt ;/* Default value of option */
void (*o_hdlr)() ;/* Function to handle option */
POINTER o_adr ;/* Address used by handler */
} ;
```

For default behaviors, **o_name** is NULL. In all other cases, the name must exactly match that of the option. **o_dflt** , if specified, will be substituted for the value of the option, if the option has no value. **o_hdlr** is the name of a function which will process the option. Four of the most common handlers are provided, **optStr** , **optInteger** , **optEnv** , and **optBool** .

optStr will place a copy of the value of an option in the address specified by *o_adr* . It does not attempt to free the previous value, since it may be a static rather than allocated item. **optInteger** will place the integer represented by the string value in the address specified by *o_adr* . **optEnv** will place the name of the option in the environment and give it the value of the option. *o_adr* is not required for the **optEnv** handler. **optBool** sets the integer specified by the address *o_adr* to either TRUE (1) or FALSE (0) based on *value* . If *value* is any of the following: T, TRUE, Y, YES, ON, or SET, the integer is set to TRUE. If *value* is any of the following: F, FALSE, N, NO, OFF, or CLEAR, the integer is set to FALSE. Also if *value* is a numerical string, the integer is set to TRUE if the number is not equal to zero. If it is equal to zero, then the integer is set to FALSE. The non-numerical values are case-insensitive, in other words they can be upper or lower case.

How *o_adr* is used depends on the handler. For the Dialogue handler used by the **clipFld (3x)** routines, *o_adr* points to an array of structures that the handler uses to process options.

setDefaultOption allows you to specify the option to be used when an option is encountered for which there isn’t a specific option disposition. The two most likely things to do are to either ignore the option entirely or place the option into the environment. These behaviors can be produced by calling **clearDfltOption**, which causes options with no specific disposition to be ignored, and **makeDfltOptionEnv** , which causes options without specific dispositions to be placed in the environment. If other behaviors are desired, an appropriate **Option** structure must be passed to **setDefaultOption**.

processOptionsFile processes the specified *file* with the options list specified by optPtr and whatever the currently active default behavior is.

processOptions is used interally to process a set of options that have already been read into an array of character pointer specified by *linesPtr*.

setEnvVar is used by **optEnv** to place values into the environment. It takes *name* and *value* and generates a string of the form *name=value* and places it in the environment.

shellVariable processes *str* as if it was a shell string and returns the converted string. The string returned must be freed when the caller is finished using it, since it is a **malloc() 'ed** string. The allowable syntax for string passed to *shellVariable* are ASCII characters, environment variables of the forms: **$XXX** , **${XXX}** , **${XXX:-yyy}** , **${XXX:=yyy}** , **${XXX:?yyy}** , **${XXX:+yyy}** , **@logID** , and shell command substrings of the form: 'cmd....' . The strings can also include sections within ""s or "s and backslash quoting applies as well.

quotedShCmd handles shell commands within backquotes,i.e. 'cmd...'. *start* must be pointing at the opening backquote character. **quotedShCmd** takes all the material inside the backquotes, passes them to a shell via *popen()* . *valuePtr* is the address of a character pointer, where a pointer will be placed that points to the resulting output from the shell. This pointer returned from **quotedShCmd** must be released when the caller is finished with it via a *free()* call. **quoteShCmd** returns a pointer to the closing backquote character in the input.

parseXeqY this routine takes as its input, lines of the form X=[Y], pointed to by **linePtr** , and destructively parses them into the "X" portion to the left of the equal sign and the "Y" portion to the right of the equal sign. A pointer to the "X" portion is returned to the pointer pointed to by *xp* . A pointer to the "Y" portion is returned to the pointer pointed to by *yp* . Anything following the "Y" portion is pointed to by remainderp . TRUE is returned if the line has the form X=[Y]. FALSE is returned in other cases.

processProgramOptions processes one of two options files. If the user specified a primary options file, **via setPrimaryOptionsFile** and if that file exists, it is used. If it was not specified or does not exist, then **processProgramOptions** takes the name of the **program** and uses the base name portion (the portion to the right of the last '/' character, if any), and processes an option file with the name */etc/default/{basename}* . **createStandardOptionsName** generates a standard options file name based on a *root* directory and the *program* name. The generated name is of the form:

{root}/etc/default/{basename}

The returned value is an allocated string. Options which have a default value (an *o_dflt*) and which were not specified in the options file are set to their default values. This means that **processProgramOptions** guarantees that each value is either set to the default value or a value found in the options file.

See Also

clipboard
charBuffer
readLine
readFile
arrays

Diagnostics

processOptionsFile and **processOptions** return FALSE if they are given no options array (or the options file does not exist or cannot be opened.) They return TRUE in all causes where they are at least partially successful. *shellVariable* and *quotedShCmd* returns NULL if they aren't given a string to translate otherwise they returns an allocated character buffer containing the translated string. The caller is responsible for freeing the translation. *parseXeqY* returns FALSE if it isn't given a string to parse, if it isn't given the addresses of two character pointers into which to place the beginning of the X and Y portions of the answer, or if the string is not of the form "X=[Y]", where "Y" can be optional. Serious consideration should be given to security issues if some of the options that are setable via *processProgramOptions* might allow alteration of the behavior of the program to subvert security measures programmed into an application program. For example, it is an attractive idea to have an application determine its "root" directory based on an environment variable so that the same program can run in more than one program environment simply by setting an environment variable. If the primary program options file was also to be found based on this "root" directory (see **createStandardOptionsName**) it would then be possible for a user to provide an alternate "root" directory structure with options of their own choosing. If the options relate to access issues, then this could be an invitation to tampering. For example, if debug options were made dynamic, so that they could be turned on and off via an options file, they might allow a user to get around the normal checks built into a program. The point is that some options should only be compile time options or guarantees should be built into the end application so that unprivileged people cannot subvert security.

Example

The following example processes an option file for a program with the default behavior being that entries are inserted in the environment. Notice how **LIMIT** is specified. This demonstrates how a program can be compiled with a particular default behavior, which is still dynamically controllable at run time. Notice that instead of compiling this code with:

-DLIMIT=100

which would be the normal way if the option was only a compile time option, it must be defined as a string instead:

-DLIMIT=\~100\~

This allows the string to be placed in the Option structure and used to set the default value. This code will use at option file either from

/projectX/etc/default/{program}

or from

/etc/default/{program}

The code can be compiled with a different ROOTDBjust be specifying a different value: **-DROOTDIR**=\~...\~ on the compile line.

```
#include  prismdefs.h
#include  charBuffer.h
#include  arrays.h
#include  options.h

int debugLevel ;
char *mode ;
int limit ;
int indentFlag ;

#ifndef LIMIT
#define LIMIT "50"
#endif

#ifndef ROOTDIR
#define ROOTDB "/projectX"
#endif

struct Option progOpts[] =
{
{"DEBUG","0",optInteger,(POINTER)&debugLevel},
{"MODE",(char*)NULL,optStr,(POINTER)&mode},
{"LIMIT",LIMIT,optInteger,(POINTER)&limit},
```

```
{"INDENT","Y",optBool,(POINTER)&indentFlag},
{(char*)NULL,(char*)NULL,(void(*)())NULL,(POINTER)NULL}
} ;
main(argc,argv)

int argc ;
char **argv ;
{
char *progName ;

progName = *argv ;
setPrimaryOptionsFile(createStandardOptionsName(ROOT DIR,progName)) ;
makeDfltOptionEnv() ;
processProgramOptions(progName,&progOpts[0]) ;
...
}
```

If the option file specified contained:

```
HISTORY=American
NATIONALITY=Japanese
MODE=edit
DEBUG=0x443
USER=$LOGNAME
```

The result would be that **mode** would point to a string containing “edit,” **debugLevel** would be set to the integer 0x443, and the environment would contain HISTORY=American, NATIONALITY=Japanese, and USER={logname}. limit would be set to 50, assuming that **LIMIT** was not defined when the code was compiled to some other value because LIMIT did not appear in the option file. *indentFlag* would be set to TRUE since **INDENT** did not appear in the option file and the default for **INDENT** was **Y**.

parseln

Synopsis

parseln, parselnDA, localParselnDA, parselnEnhancedDA, localParselnEnhancedDA, sepln, & closeLocalParselnDA — Chop up strings into separate words

Command Format

```
#include  parseln.h

int parseln ( ln,words,size )
char *ln ;
char **words ;
int size ;

int parselnDA ( ln )
char *ln ;

int localParselnDA ( dadp,ln )
int *dadp ;
char *ln ;

parselnEnhancedDA ( ln,sepChrs,quoteChrs )
char *ln ;
char *sepChrs ;
char *quoteChrs ;

localParselnEnhancedDA ( dadp,ln,sepChrs,quoteChrs )
int *dadp ;
char *ln ;
char *sepChrs ;
char *quoteChrs ;

sepln ( ln,words,size,quoteChr )
char *ln ;
char **words ;
int size ;
int quoteChr ;

int closeLocalParselnDA ( da )
int da ;
```

Description

parseln (|) chops up the string pointed to by *ln* , separating each word with a NULL character. A word is either white space delimited or a string quoted with the ' ' or the '\" character. Within quoted words, the '\' character is the quote character, which can be used to quote ' ', '\", and '\' characters into the word. Pointers to the beginning of each word are placed in the *words* array. *size* specifies the size of the *words* array. **parseln (|)** returns the count of the number of words parsed from the *ln* string.

parselnDA (|) performs the same task as **parseln (|)** except that it puts the resultant pointers to the individual words into a dynamic array, hence the caller never needs to worry about how big to make the words array. **parselnDA (|)** returns a dynamic array descriptor to an array of character pointers. If ln was NULL or pointed to the empty string, then it returns 0. Do not perform either **arrayClose (|)** or **arrayDone (|)** on the array descriptor returned by **parselnDA (|)**. Management of the dynamic array is handled entirely by parselnDA (|). If it is desired to take over the array of character buffers associated with the returned array descriptor, use **arrayDetach (|)**. (**See arrays (3X)**)

parselnEnhancedDA (|) performs the same task as **parselnDA (|)** except that the caller is allowed full control of the set of characters to be treated as separators between words and quoting characters. The separator list is specified by **sepChrs**. If it is not supplied, \t\n is used. The list of quote characters pairs is specified by **quoteChrs** . It must be an even number of characters in length otherwise it will be ignored. Each pair of characters is treated as a starting quote character and an ending quote character. For example, " [|]<|> " means that quoted sections appear within either "[|]"s or "<|>"s. If a quoted section begins and ends with the same character, then the **quoteChrs** should have this character appear twice, that is, ~ means the quoted sections start with a double quote and end with a double quote. This is the default behavior provided by **parseln (|)**. If **quoteChrs is NULL** or of zero length, then there will be no quoted sections permitted within the input. As with **parselnDA (|)**, **parselnEnhancedDA (|)** returns a dynamic array descriptor to the parsed words array. **parselnEnhancedDA ("ln, \t\n , \~\~ ")** is equivalent to **parselnDA (ln)**.

sepln (|) performs the same function as **parseln (|)**, but specifies an alternate quoting character for quoted sections via **quoteChr . sepln (ln,words,size,' ')** has the same effect as **parseln (ln,words,size)**.

localParselnDA (|) and **localParselnEnhancedDA (|)** perform the same operations as **parselnDA (|)** and **parselnEnhancedDA (|)** except that the calling routine must provide a pointer to an initialize array descriptor, *dadp* , which is used by **localParselnDA (|)** in which to store the parsed word. By initialized, it is meant that *dadp* points to an integer set initially to 0 before the first of a series of calls. It need not be modified after being initialized to 0 prior to the first call or after a call to **closeLocalParselnDA (|)**. If **localParselnDA (|)** is used, it is also the responsi-

bility of the caller to call **closeLocalParseInDA (|)** with the array descriptor pointed to by *dadp* so that the array resources are released if the array descriptor is truly local to a routine as opposed to a *static* or *global* variable. The extra work in using **localParseInDA (|)** is balanced by the fact that a library function can use **localParseInDA (|)** without risking the fact that some other routine is already using it. If two routines attempt to use either **parseInDA (|)** or **parseInEnhancedDA (|)** at the same time (meaning that both routines are expecting the information in the dynamic array returned by the **parseIn * DA (|)** routine to remain available while other routines are called), chaos ensues when the single dynamic array is released by later users. Since each user of **localParseIn * DA (|)** are using locally managed dynamic array descriptors, the information returned remains available and unaffected until either another call is performed or **closeLocalParseInDA (|)** is called.

Caveats

The *ln* string is modified by **parseIn (|)**, **sepIn (|)**, **parseInEnhancedDA (|)**, and **parseInDA** . Quoted strings are forced to terminate at the end of a line, therefore it is not possible to have a \n in a word.

Each successive call to **parseInDA (|)** or **parseInEnhancedDA (|)** overwrites the dynamic array of information. Be sure to copy the information or detach it, via , before calling either routine a second time if the data must be retained.

Be aware that the separators are “soft,” not “hard.” In other words, adjacent separators are treated as a single separator, not as a series of zero length words. For example:

“,,,,5,10,,,,15,15,,”

would return three words, 5, 10, and 15, if ’,’ was the separator.

readline

Synopsis

readLine, readContLine, readQuotedLine, resetReadLine (saveReadLineState), setReadLine (restoreReadLineState), setReadLineModes — Routines to read lines in from standard I/O streams that don't rely on preallocated buffers and which also keep count of the lines read.

Command Format

```
#include <stdio.h>
#include  prismdefs.h
#include  readInfo.h

extern int inlineCnt ;
extern int virtLineCnt ;

char *readLine ( fp )
FILE *fp ;

char *readContLine ( fp )
FILE *fp ;

char *readQuotedLine ( fp )
FILE *fp ;

void resetReadLine | saveReadLineState ( rip )
struct ReadInfo *rip ;

void setReadLine | restoreReadLineState ( rip )
struct ReadInfo *rip ;

void setReadLineModes ( modes )
int modes ;
```

Description

readLine (|) reads a line from the stream specified by *fp*. It does the buffer management, unlike **fgets (|)**. For this reason the buffer is always large enough to hold whatever string is read. **readLine (|)** returns a pointer to the line read.

readContLine (|) is similar to **readLine (|)** except that it automatically concatenates continuation lines together into one long virtual line. A line is considered to be followed by a continuation line when it ends in \<*nl*> . **readContLine (|)** auto-

matically removes the backslash and newline characters, unless the RI_LEAVE_BACKSLASH flag is set in the modes, and continues reading the next line. Only upon encountering an unquoted newline character does **readContLine (|)** return.

readQuotedLine (|) is a further elaboration of **readContLine (|)**. It will concatenate lines ending in \<*nl*> , but will also read in quoted sections including the <nl> character as one virtual line. **readQuotedLine (|)** only terminates a line when it finds the *<nl>* character outside of a quoted section and not preceded by a \ character. A quoted section can be surrounded by double quote, **"**, single quote, **'**, or accent grave, **‘**.

readLine (|), **readContLine (|)**, and **readQuotedLine (|)** update the global counters **inlineCnt** and **virtLineCnt** . **inlineCnt** is the count of the number of physical lines read. It is useful when reporting line numbers within files. It must be reset to 0 when you open a new file and start reading from it via **resetReadLine (|)** or **setReadLine (|)** and you must only use **readLine (|)**, **readContLine (|)**, or **readQuotedLine (|)** for the count to remain valid. *virtLineCnt* is the number of virtual lines returned by **readLine (|)**, **readContLine (|)**, or **readQuotedLine (|)**. For **readLine (|)**, *inlineCnt* and *virtLineCnt* are one and the same. For **readContLine (|)** and **readQuotedLine (|)**, *virtLineCnt* is incremented once each time it returns a concatenated line, whereas *inlineCnt* is incremented each time a character is encountered after a newline character.

resetReadLine (|), also known as **saveReadLineState (|)**, resets the line counters for **readLine (|)**, **readContLine (|)**, and **readQuotedLine (|)**. It returns the previous values in the ReadInfo structure pointed to by **rip** , if **rip** is not **NULL**. It also saves the current working buffer being used by the **read * Line (|)** routines.

setReadLine (|), also known as **restoreReadLineState (|)**, sets the line counters and the modes to those specified by the **ReadInfo** structure **rip** and restores the working buffer to what it was when the last **resetReadLine (|)** call was performed. **resetReadLine (|)** and **setReadLine (|)** might be used if more than one file was being accessed at the same time or if there is nesting of **read * Line (|)** usage, such as library routines. Any library routine that wants to read a file using any of the **read * Line (|)** routines should bracket its operation with **resetReadLine (|)** and **setReadLine (|)** calls so that any other routine using them at higher levels will not suddenly find the buffer it was working with wiped out.

setReadLineModes (|) changes the modes being used by **readLine (|)** and **readContLine (|)** and returns the previous value. The default behavior of both routines is to retain the '\n' character at the end of each line. If the flag **RI_NO_NEWLINES** is set, the '\n' character is deleted from the end of each line as it is returned.

Diagnostics

readLine (|), readContLine (|), and **readQuotedLine (|)** return **NULL** if the end of file is encountered.

Caveats

readLine (|), readContLine (|), and **readQuotedLine (|)** use a single buffer. You must copy the contents of the buffer if you need to do successive reads while retaining the previous information returned by earlier reads. If you are nesting file operations, use **resetReadLine (|)** and **setReadLine (|)** to save and restore the state information and the current working buffer.

inlineCnt and *virtLineCnt* will only be correct if all input from a stream is done with either **readLine (|)**, **readContLine (|),** or **readQuotedLine (|)** and if only one stream is read at a time and no seeks are performed. If input from more than one stream is required and *inlineCnt* and/or *virtLineCnt* are to be meaningful, it is the responsibility of the user to save and restore the various line counts for each stream before using the read routines again.

regEx

Synopsis

regCmp, regPatSize, regularExp, regEx, startPatMatch, getSubString, getRE-name, regPrtPattern, regExprComputeLength, regExprCopy, regSubStringsCopy — Routines to compile regular expressions, execute them against ASCII strings, print the compiled patterns in C code style, and copy the associated structures.

Command Format

```
#include <stdio.h>
#include  prismdefs.h
#include  regularExp.h

char *regCmp ( re1[,...],(char *)NULL )
char *re1 ;

int regPatSize (|)

char *regularExp ( re,str,sspp )
char *re ; /* Compiled regular expression */
char *str ; /* ASCII input data */
struct SubStrings **sspp ; /* Where to return the substrings */

char *startPatMatch (|) /* Return start of match location. */

char *getSubString ( index,ssp )
int index ; /* Substring of interest */
struct SubStrings *ssp /* Description of substrings */

char *regEx ( re,str[,ss1,...] )
char *re ; /* Compiled regular expression */
char *str ; /* ASCII input data */
char *ss1 ; /* Pointer to 1st substring buffer */

char *getREname ( chr,symbolicFlag )
int chr ;
int symbolicFlag ;

int regPrtPattern ( fp,arrayName,re,symbolicFlag )
FILE *fp ;
char *arrayName ; /* Name of C code array */
char *re ; /* Compiled regular expression */
int symbolicFlag ; /* If TRUE, use symbolic names */
```

```
int regExprComputeLength ( rePtr )
char *rePtr ;

char *regExprCopy ( re ) ;
char *re ;

struct SubStrings *regSubStringsCopy ( ssp )
struct SubStrings *ssp ;
```

Description

regCmp (|) compiles a regular expression and returns a pointer to the compiled form of the expression. The compiled expression is placed in space allocated via the **malloc (|)** routine. It is the responsibility of the caller of **regCmp (|)** to free the regular expression when it is no longer needed. **regCmp (|)** returns **NULL** if there is some problem with the expression such that it cannot be compiled.

Should the size of the compiled pattern be needed, *getPatSize (|)* returns the size of the compiled pattern as long as **regCmp (|)** has not been called again before **getPatSize (|)** is called. If the size of a regular expression is needed and **regCmp ()** might have been called again or the pattern was precompiled, then use **regExprComputeLength ()**, which scans the compiled regular expression and computes the length by determining where the end of the pattern is. If the pattern is defective, -1 is returned.

regularExp (|) and **regEx (|)** execute a compiled regular expression against ASCII input. **regEx (|)** provides the original interface as described in the standard UNIX *Programmer's Reference Manual* . **regularExp (|)** has a different interface making it safer to use and more appropriate where the patterns to be executed are not specified at compilation time. **regEx (|)** arbitrarily returns substrings (see "(...)$n" below) detected by the compiled regular expression to the specified *ssN* buffer, where *N* is an index from 09. The size of each buffer is assumed to be large enough to hold however much must be returned. In a general case, where the pattern and perhaps the input, as well, are being specified at run time, knowing how big each buffer should be and how many substring buffers are required is impossible, so the program is always required to assume the worst case. **regularExp (|)** provides a more graceful interface for these situations as well as one further enhancement to the language of substring extraction. **regularExp (|)** returns substring information in a single allocated area (using **malloc (|)**) if the calling routine specifies the *sspp* argument. If the calling routine is not interested in the extracted substrings, then setting *sspp* to **"(struct SubStrings **)NULL"** causes the substring information to be discarded. As with the allocated space returned by **regCmp (|)**, the calling routine is responsible for freeing the allocated substring space with a **free ("(char*)ssp") ;** once the substring information is no longer needed. **regularExp (|)** also allows for support of "auto-indexed" substrings. This means that instead of specifying the index of the substring, the pattern assigns

the index as each occurrence of "(...)$+" in the input pattern is satisfied. This allows patterns of the form:

“(...(...)$+...)+”

to assign as many substrings as are required for each repetition of the parent group. For example:

“([a-z]+([0-9]+0$+!)+”

applied against the string:

“This is an odd sequence: bob59!ennifer80!steve13!”

would extract 59, 80, and 13 and place them in substrings 10, 11, and 12.

The allocated space returned to the **sspp** pointer is to a variable length space that starts out with a structure whose size is determined by the number of substring pointers required by the data. It has the following layout:

Definition of structureLayout in memory
struct SubStrings
{
int ss_cnt ;->count of substrings
char *ss_substrings[1] ;->pointer to 1st substring
} ;pointer to 2nd substring
. . .
[1] is actually an [ss_cnt],**pointer to n’th substring**
*since its size is determined***1st substring (including ’\0’)**
*by the number of substrings***.2nd substring**
. . .
n’th substring

getSubString (|) is a macro that, when given an *index* and a pointer to the sub-string area, *ssp*, returned by **regularExp (|)**, returns a pointer either to the specified substring or to an empty string, ~ . It always returns a valid pointer. If *ssp* is NULL or *index* is out of range or specifies a substring that hasn’t been set, you get the ~ string.

startPatMatch (|) returns the location in the input string where the match started if the previous call to **regEx (|)** or **regularExp (|)** succeeded.

To assist in code generation of static patterns, **regPrtPattern (|)** will print a compiled regular expression in one of two forms. If *symbolicFlag* is FALSE, the pattern is printed using hexidecimal values for opcode bytes of the pattern, meaning that the pattern that results does not require any headers to compile. If *symbolicFlag* is TRUE, the generated printing of the pattern uses the symbolic names described in **regularExp.h** and will require this header to compile. *fp* is the standard I/O stream on which the pattern is to be output, *arrayName* is the name of the C style array into which the printed pattern is to appear, and *re* is the compiled regular expres-

sion as returned by **regCmp (|)**. If *arrayName* is NULL, the pattern is printed without a name and the embracing "{...} ;" sequence.

getREname (|) is used internally by **regPrtPattern (|)**, but is made available to programs that may want to use it to print pattern contents. It will interpret one opcode byte specified by *chr* into either a hexidecimal byte if *symbolicFlag* is FALSE or into a regular expression symbolic name if *symbolicFlag* is TRUE.

Making copies of compiled regular expressions requires knowing the length, which is not obvious from simple inspection. Compiled expressions are not normal C-strings, i.e. a series of non-zero bytes terminated by a zero byte. Compiled expressions can contain zero bytes anywhere in the compiled expression. **regExprCopy ()** makes allocated copies of compiled regular expressions. As with **regCmp ()**, the caller is responsible for freeing the allocated space when appropriate. NULL is returned if the pattern is defective and hence cannot be copied.

regSubStringsCopy () makes allocated copies of the *SubStrings* structure returned by **regularExp ()**. As with **regularExp ()**, the caller is responsible for freeing the allocated space when appropriate.

The regular expression language is very similar to that used by **ed**, **sed**, and **vi**. There are a few differences. A description of the language follows:

[...] The list of characters within the braces specify the next valid input character. Each character may be listed explicitly or ranges may be specified, separated by the '-' character. The '-' character itself may only appear in the list at the beginning or the end so that it does not have its "range" meaning. Within range specification, the first character must come lexically before the second character, i.e. [a-z], not [z-a]. Example: "[-.;a-z]" means that the '-', '.', ';', and all lower case letters are acceptable.

[^...] If the first character within the braces is '^', then any character EXCEPT those listed will match. "[^.;a-z-]" will match any character that is not a '.', ';', '-', or a lower case letter.

^ If the first character of a regular expression is '^', it means the pattern must match from the beginning of the input (beginning of the line.) Anywhere else in the expression, except as the first character of a character range (inside [|]s), '^' is a normal character.

$	If the last character of an expression is '$', it means the pattern must match to the '\n' character at the end of the line. Anywhere except the end of the pattern, '$' is a normal character.
.	The '.' character matches any character expect '\n'.
*****	The '*' causes the immediately preceding character, character range, or group to match any number of times including 0. "a*[0-9]*" would match "aaaaaaaa", "aaaa12234343", "1342343232", or "".
+	The '+' character is the same as '*' except that the pattern it follows must match at least 1 time, hence "a+[a-9]+" would match "aaaa12234343", but none of the other examples in the previous description, since at least one 'a' and one digit is required.
****	This is the quoting character, causing the character following it to be treated as a normal character. This is necessary when attempting to search for characters with special meanings like '.'. \\x11 is required to search for the a \ itself. A '\' prior to a normal character, like 'a', is a no-op and is just discarded in the resulting pattern.
{m} {m,} {m,n}	Integer values enclosed in "{^ }" indicate the number of times the preceding character, character range, or group is to be repeated. m is the minimum number of matches required. n is the maximum number of matches required. If n is omitted, any number of matches greater than m is legal. If m appears without a ',' following it, then that number and only that number of matches is allowed, i.e. "matches exactly m times." "(...)+" is equivalent to "(...){1,}" and "(...)*" is equivalent to "(...){0,}"
(...)	Parentheses are used for grouping. The '*', '+', and "{m,n}" operations can be applied to patterns within parentheses, i.e. "a+(ab+){3}" , which says one or more 'a' characters followed by three groups of 'a' followed by one or more 'b' characters - aaaaabbbabbb.
(...)$n (...)$+	Parentheses followed by a '$' and either a digit, 0–9, or the '+' denote the substring extraction facility. Whatever portion of the input string that matches the description within the parentheses is copied to a sub-

string. Using regEx (|), only digits appearing after the '$' are meaningful and the substring is returned in the "n'th" ssN argument in the calling sequence. WARNING - the caller is totally responsible for ensuring that the "n'th" ssN buffer pointer has been supplied and is large enough to hold the extracted substring. Using regularExp (|), both the digit form and the '+' form is meaningful. If a digit is supplied, then the "n'th" substring will be set to the specified subpattern. If '+' is supplied, then regularExp (|) will automatically assign the next substring to the extracted string starting at 10 and auto-indexing upwards. For example, if

"(([a-z]+)$+boat[\t]+[a-z]+[\t]+)*"

is applied to

"the tugboat and sailboat on the river,"

then substring 10 would be "tug" and substring 11 would be "sail".

A successful pattern match returns a pointer to the location AFTER the successfully matched information. If the pattern fails to match the input, "**(char *)NULL**" is returned.

Examples

The following example is a small program that finds each occurrence of a pattern specified by the user in a file and prints the lines containing the pattern with ">>" and "<<" enclosing each matched region. Substrings, if specified in the pattern, are ignored.

```
#include <stdio.h>
#include  regularExp.h
#include  mkcopy.h
#include  readInfo.h
main(|)
{
char *pat,*re,*startp,*endp ;
char *input ;
char *file ;
FILE *fp ;
struct ReadInfo *ri ;
int cnt,i ;
```

```
for (;;)
 {
 printf( Pattern:  ) ;
 (void)setReadLineModes(RI_NO_NEWLINES) ;
 if ((pat = readLine(stdin)) == (char*)NULL)
continue ;
 if ((re = regCmp(pat,(char*)NULL)) == (char*)NULL)
 {
printf( %s — Pattern failed to compile.\n ,pat) ;
continue ;
 }
 pat = mkcopy(pat) ;
 printf( File:  ) ;
 if (file = readLine(stdin))
 {
file = mkcopy(file) ;
if ((fp = fopen(file, r )) == (FILE*)NULL)
 perror(file) ;
else
 {
 resetReadLine(&ri) ;
 (void)setReadLineModes(0) ;
 for (cnt=0; input = readLine(fp) ;)
 {
/*Test for first occurrence of pattern in the line.*/
if (endp = regularExp(re,input,
 (struct SubStrings **)NULL))
 {
 cnt++ ;
 printf( Line: %d -  ,inlineCnt) ;
/*Print out the line with >>{pat}<< around each matched section. */
 do
 {
startp = startPatMatch(|) ;
i = startp - input ;
printf( %.*s ,i,input) ;
fputs( >> ,stdout) ;
i = endp - startp ;
printf( %.*s ,i,startp) ;
fputs( << ,stdout) ;
input = endp ;
 }
 while (endp = regularExp(re,input,
(struct SubStrings **)NULL)) ;
/*Output the remainder of the line.*/
 fputs(input,stdout) ;
 }
 }
```

```
 printf( Lines matching pattern: %d\n ,cnt) ;
 fclose(fp) ;
 }
free(file) ;
 }
 free(re) ;/* Free compiled regular expression */
 free(pat) ;
 }
}
```

The following shorter example extracts the three parts of a phone number into substrings and prints them. Notice that the" "(^)" require '\'s preceding them and that it requires "\\" within a C program, since the C compiler also uses '\' as its quote character.

```
#include <stdio.h>
#include  regularExp.h
#include  mkcopy.h
#include  readInfo.h
main(argc,argv)
int argc ;
char **argv ;
{
char *re ;
char *input ;
FILE *fp ;
struct SubStrings *ssp ;
if (--argc != 1)
 {
 fprintf(stderr, Usage: findPhoneNos {file}\n ) ;
 return(1) ;
 }
if ((fp = fopen(*++argv,r)) == (FILE *)NULL)
 {
 perror(*argv) ;
 return(2) ;
 }
re = regCmp( \2-9][0-1][0-9])$0\\) ([0-9]{3})$1-([0-9]{4})$2 ,
 (char*)NULL) ;
while (input = readLine(fp))
 {
 if (regularExp(re,input,&ssp))
 {
printf( area code: %s exchange: %s line #: %s\n ,
 getSubString(0,ssp),
 getSubString(1,ssp),
 getSubString(2,ssp)) ;
freecopy(ssp) ;/* Free substring storage */
```

```
 }
 }
freecopy(re) ;
return(0) ;
}
```

See Also

malloc(3X), ed(1), lex(1), regCmp(1X)

Caveats

- Free allocated space
- It is important that the calling program free the compiled patterns returned by **regCmp (|)** and the substring area returned by **regularExp (|)** when they are finished with them.
- Repeated substring extractions
- Repeating groups which contain "(...)$n" substring extractions will not work properly. For example, when **"(([a-z]+)$0BOAT)+"** is applied against **"tug-BOATsailing"** will not have **"tug"** in substring 0, but will instead of "s" in $0. This results because the group was attempted a 2nd time, managed to find something that fit the class [a-z], but was unable to complete the pattern. (It took the whole word **"sailing"** and then backup character at a time hoping that **"BOAT"** was somehow buried in the material is had used to satisfy the "[a-z]+" portion of the pattern.) Unfortunately it also couldn't return to the previous successful state, since that had been wiped out. For cases like these, use the "auto-indexing" feature. Auto-indexed variable will not overwrite each other and the failed attempts are discarded so that "(([a-z]+)$+BOAT)+" is applied against "tugBOATsailing" would result in substring 10 being "tug" and that is all.
- Impossible patterns
- Some patterns cannot succeed even though they look as though they should. Two things must be kept in mind when writing patterns, 1) patterns always take as much input as they can, which is not what humans intuitively do and 2) patterns in which a part overlaps an immediately following part cannot be repeated more than once successfully. Such patterns will compile, but fail on some input. If the earlier part totally contains the following part as a subset, then the pattern will never succeed if more than one repetition is required regardless of the input. For example:

"([a-z]+boat){2}"

is such a pattern. You would think that applied against:

"tugboatsailboat"

that it should succeed since **"[a-z]+boat"** should match both **"tugboat"** and **"sailboat"** and the sum of them are two matches of the pattern. Unfortunately the word "boat" also matches the character class **"[a-z]"** . This means that the group matches **"tugboatsail"** as **"[a-z]+"** and only the final **"boat"** to the word **"boat"** , for one match. Then there is no more input and the pattern fails. The salient point to remember is that each subspecification matches as much as it can before it attempts more of the pattern. A .* , for example, will match the entire input. A pattern of **".*dog"** will work for a single match to the last word **dog** in the input, but any pattern requiring a minimum of two matches to the input will fail.

- Implementations differ
- This implementation of **regCmp (|)** and **regEx (|)**, while including what the standard version does, are not the same. They have been corrected for some subtle problems with recursive patterns which include substring extractions and the extention for auto-indexing was added. Also **malloc (|)** is used both for the compiler and the expression matcher.

startup

Synopsis

startup — Called once to initialize hardcoded processes to the Voice System

Command Format

#include spp.h

int startup (qkey, slot_offset)
int qkey; /* message qkey of calling process */
int slot_offset; /* used to get the slot for posting */

Description

Startup registers and initializes the calling process to the voice system. It should be called once at the onset and is used by hardcoded processes (that is, those that know beforehand what message queue they will use to receive IPC messages). **Startup** posts the process in a certain pre-defined slot in the Bulletin Board (BB). The calling process has some control over what slot is selected. The slot selected depends on the qkey and slot_offset specified.

NOTE:
It is recommended that user DIPs use VSstartup when possible. See the discussion of VSstartup later in this section.

It is important that processes choose a qkey and slot_offset that translates to a unique message queue and slot. The **bbs** command can be used to find out what processes are currently posted, to avoid interfering with another process. For DIPSs (identified by qkeys in the range from 2054), **startup** selects a slot using the following equation:

slot = 32 + *slot_offset*

The *slot_offset* for DIPs must be between 0 and 34 or the slot_offset is set to zero. DIPs can read from the same message queue by specifying the same qkey but different slot_offsets.

In addition, **startup** initializes the trace facility so that the process can write out trace message using the **db_pr** family of functions.

Startup is the old way of initializing hardcoded processes to the VIS and still is supported. New processes, however, should use **VSstartup** for initialization.

Specifically, **startup** does the following:

1. Calls the **db_init** library function to set up the trace facility for the calling process
2. Attaches the BB and initializes the global BB variables used by the rest of the interface functions
3. Posts the calling process in the BB base on its qkey and slot_offset
4. Acquires the process **semaphore** associated with the slot
5. Sets up the calling process to catch the **SIGTERM** and invoke the standard **exit** library function.

Examples

The following code fragment initializes a DIP with qkey DIP15 (as defined in mesg.h) and posts it in slot 47.

```
#include mesg.h
#include spp.h
/* No need to check the return code from startup since
* it is successful if it returns at all.
* DIP15-DIP0 is actually the DIP number for the DIP (15).
* Remember slot = 32 + DIP15-DIP0 = 32 + 15 = 47.
*/
(void) startup (DIP15, DIP15-DIP0);
```

See Also

db_pr
trace
VSstartup

Diagnostics

Upon successful completion, startup returns zero. It does not return if unsuccessful. **Startup** writes out a trace message and terminates the calling process if an error is encountered. Possible errors include:

a. Can not attach to the BB

b. Can not create the process semaphore

However, in one case **startup** does not terminates. If another process is already posted in the slot, **startup** waits indefinitely until the process can post itself in the slot that already contains a posted process.

strmatch

strmatch

Synopsis

strmatch — Compares a target string with a pattern

Command Format

```
#include  strmatch.h
int strmatch ( target,pattern )

char *target ;

char *pattern ;
```

Description

strmatch (|) compares the *target* string to the *pattern* string and returns TRUE if the target matches the pattern and FALSE if it does not. The *pattern* is of the "sh" variety, not the "regular expression" variety. The *pattern* must COMPLETELY match the *target*. It is useful if you need to determine if some ASCII string matches some particular template. **strmatch (|)** is NOT a partial matcher, where it looks for a pattern buried in a larger context and then tells you where that pattern is located in the larger context. For needs such as those, use the regular expression routines described in regcmp (3x) manual pages.

Meta-Characters

The following special sequences are supported by **strmatch (|)**:

*	matches any sequence of 0 or more characters,
?	matches any single character,
[xxx]	matches any of the characters denoted by the string "xxx",
[!xxx]	matches any character that is NOT one of the characters denoted by "xxx",
\n	the newline character,
\r	the carriage return character,

\b	the backspace character,
\f	the formfeed character,
\v	the vertical tab character,
\t	the horizontal tab character, and
\NNN	the ascii character denoted by the octal value of the string "NNN".

See Also

match
regcmp

Examples

Does "str" start with a digit and end in 'Z'?

"if (strmatch(str,"[0-9]*Z")) doSomething() ;"

Does "str" contain the name "John" somewhere in it?

"If (strmatch(str,"*John*")) doSomething();"
"If (strmatch(strmatch(str,"*a???e*")) do Something() ;"

Does "str" contain a five letter sequence starting with 'a' and ending with 'e'?

"If (strmatch(strmatch(str,"*a???e*")) do Something() ;"
"if (strmatch(str,"*a???e*")) doSomething() ;"

threshold

Synopsis

createMsgCarrier, freeMsgCarrier, ckMsgsOfThreshold, cleanThresholds, mkThreshold, freeThreshold, threshold, findThreshold, resetThreshold, print-Threshold, setThresholdCleanupInterval — Alerting message threshold management routines.

Command Format

```
 * decreased. */
 * information about threshold. */
```

Description

A **Threshold** structure is designed to keep track of a number of compressed logged messages with respect to a specified time period that terminates at the current time.

```
struct Threshold
{
struct Threshold *th_next ;
struct Threshold *th_prev ;

char *th_name ;/* ASCII name of this threshold */
int th_msgID ;/* Message ID of interest. If -1, then
 * any message is acceptable. */
int th_period ;/* # of seconds over which threshold is computed. */
int th_flags ;

#define TH_EDGE_TRIGGERED0x0000/* Respond when level exceeded */
#define TH_LEVEL_TRIGGERED0x0001/* Respond whenever above level */
#define TH_NO_REPORT0x0002/* Suppress threshold level changes \
 * messages. */

DownFunc th_downFunc ;/* Function to call when drops in levels
 * of activation. */
POINTER th_applPtr ;/* Pointer used by application to point to
 * information not contained in the
 * Threshold structure. It is assumed that
 * this pointer will always be type cast to
 * an appropriate type. */
int th_levelCnt ;/* Number of levels */
int *th_levels ;/* Array of levels */
```

```
int *th_curLvl ;/* Pointer to the current level */
int th_msgCnt ;/* # of messages currently in storage */
struct MsgCarrier *th_msgs ;/* Copies of messages currently
 * saved for this threshold. */
} ;
```

mkThreshold () is used to create a new **Threshold** structure and link it into the list of active thresholds. *msgID* is either -1, meaning that this threshold will take any message given to it, or the value of one specific message index that is to be accepted by this threshold. *name* points to an ASCII string, which is used to identify this threshold to the external world. It should be unique from all other threshold names. *period* is the number of seconds that a message will be retained by the threshold before it is discarded. *flags* is used to identify the characteristics of the threshold. In particular a threshold may be *edge* triggered, meaning it responds only when the number of stored messages crossed a boundary between activation levels, or it can be *level* triggered, meaning that whenever a message arrives and the number of messages is in excess of an activation level, there is a response. To clarify, consider a threshold that has activation levels of 3 and 6 messages. If it is edge triggered, it will only respond when the number of stored messages goes from 2 to 3 or from 5 to 6. If it is level triggered, it will respond with level 1 when messages 3, 4, and 5 arrive and with level 2 whenever the number of messages is 6 or more. By default, thresholds are edge triggered unless the **TH_LEVEL_TRIGGERED** flag is included in the *flags* word. In addition, it is possible to suppress reports of activation level changes by including the **TH_NO_REPORT** flag. Normally, whenever a threshold is crossed, a message is automatically generated reporting this fact. These messages are generated both on the way up and on the way down. When these messages are generated, examining the log files will tell you the activation level of each threshold. When messages age enough, they are removed from storage within the Threshold structure. If this causes a threshold to drop from one activation level to a lower activation level, a message will be generated if **TH_NO_REPORT** is *NOT* specified and, if not **NULL**, the function specified by **downFunc** will be called as

"(downFunc)(thp.previous);"

This function can handle any application specific activity that is appropriate as a threshold drops from a higher activation level to a lower level, such as turning off a light or alarm indicator. If there is additional information that needs to be stored with a threshold, it can be joined to the 3Threshold structure via the **applPtr**. The form and management of this data is entirely the responsibility of the application. The pointer is stored in the **Threshold**structure in the *th_applPtr* element. Each threshold has one or more activation levels. *cnt* specifies the number of different thresholds. Following *cnt* will be that number of threshold levels. They are assumed to be in ascending order. Each *level* is the number of messages that must be stored in the **Threshold** structure for the threshold to be at that specific activation level. At least one level must be specified and it may be 0. **mkThreshold ()** links the newly created **Threshold** structure into the list of active threshold specifications. If it is the first specification, a timer is started, which will continu-

ously clean up messages as they age. Also the address of the new **Threshold** structure is returned so that it can be used in calls to **threshold ()**.

A **Threshold** structure can be removed from the active list and its resources released via **freeThreshold ()**. If any cleanup is required for the *th_applPtr*, it is assumed to have been performed by the caller prior to the call to **freeThreshold ()**.

threshold () compares the index of the message described by *lmp* with the *th_msgID* element of the **Threshold** structure. If the *th_msgID* is -1 or if the index matches *th_msgID*, **threshold ()** stores the message in the **Threshold** structure. If the addition of a new message requires an action based on the type of threshold, **threshold ()** will return the current activation level of the threshold. If not action is required, **threshold ()** returns 0. It is the responsibility of the calling function to respond appropriately to a non-zero response by **threshold ()**.

lmp is a pointer to a parsed logging message, as returned by either **readParsedLogMsg ()** or **parseCmpLog ()**. (See **readLog (3x).)**

threshold () returns 0 whenever a new message is stored and the threshold still has not risen to its specified first level of activation, or for **EDGE** triggered thresholds, whenever the new message is not causing a level transition from a lower level of activation to a higher level of activation. Any real response to a change in activation levels of a threshold is the responsibility of the calling routine. Its response should be dictated by the activation level returned by **threshold ()**. The only response provided automatically by **threshold ()** is the generation of the "change of activation level" message, if not suppressed.

Any message that is retained in the threshold, either because *thp->th_msgID* was -1 or because the index of the message matched *thp->th_msgID*, is stored in an allocated *MsgCarrier* structure which has the following form:

```
struct MsgCarrier
{
struct MsgCarrier *mc_next ;
struct MsgCarrier *mc_prev ;
time_t mc_timeStamp ;/* Time stamp associated with msg */
int mc_msgID ;/* Extracted ID of msg */
char *mc_cmpMsgPtr ;/* Compressed msg */
} ;
```

These *MsgCarrier* structures are linked together in a circular list, from oldest to newest in terms of order of receipt. It is assumed that the messages arrive in time stamped order.

MsgCarrier structures are created and linked into the circular list associated with a **Threshold** structure using the **createMsgCarrier ()** routine. *headp* points to the current head of the circularly linked list. If it points to a NULL pointer, then the

newly created *MsgCarrier* structure becomes the head of the list. **freeMsgCarrier ()** removes a *MsgCarrier* from a circularly linked list and frees the associated storage. It is assumed that the message pointed to by *msgp* is one of the *MsgCarrier* structures associated with the list pointed to by *headp*.

ckMsgsOfThreshold () scans all the messages currently associated with the **Threshold** structure pointed to by *thp*, and removes and discards any that are older than the time period of the threshold. If this causes the threshold to drop one or more levels, then appropriate logging messages are generated unless the TH_NO_REPORT flag is set. **ckMsgsOfThreshold ()** is automatically called by **threshold ()** whenever it decides to store a new message. This insures that only messages within the current time period are on the threshold when the new message is stored.

cleanThresholds () is a timeout routine, arranged to be called by **threshold ()** once every 60 seconds or the value specified by **setThresholdCleanupInterval ()**. **cleanThresholds ()** scans all **Threshold** structures for messages that have gotten too old and removes them, logging appropriate level drops when appropriate. Once started, it automatically reschedules itself according to the current interval value. **setThresholdCleanupInterval ()** changes the cleanup interval to the number of seconds specified by *newValue*. The previous value is returned.

findThreshold () scans the list of active thresholds and returns the one whose name matches *name*. NULL is returned if the proper threshold cannot be found.

resetThreshold () causes all messages currently stored within a **Threshold** structure to be discarded. If *name* is NULL, all thresholds are reset otherwise only that threshold specified by *name* is reset. Resetting a threshold does result in an appropriate log message if the level of the threshold changes. FALSE is returned if the specified **Threshold** structure cannot be found.

printThreshold () causes all messages currently stored within a **Threshold** structure to be printed in addition to the parameters associated with the threshold. All printing is done to the standard I/O stream specified by *fp*. If *name* is NULL, all thresholds are printed otherwise only that threshold specified by *name* is printed. FALSE is returned if the specified **Threshold** structure cannot be found.

See Also

timeDesc (3x)
readLog (3x)

Caveats

It is strongly urged that you use the fast **malloc ()** routines found in **-lmalloc** due to the fact that a great deal of allocating and deallocating is performed by these routines.

timeIncr

Synopsis

timeIncr, fmtTimeIncr — Routine to convert an ASCII representation of a time increment into seconds and back.

Command Format

```
#include <sys/types.h>
#include <time.h>
#include  prismdefs.h
#include  timeDefs.h

long timeIncr ( str )
char *str ;

char *fmtTimeIncr ( incr,verbose )
unsigned long incr ;/* Time increment in seconds */
int verbose ;/* If TRUE, print in full English syntax */
```

Description

timeIncr (|) converts an ASCII string comprised of the following type elements into a number of seconds: **"NN weeks"**, **"NN days"**, **"NN hours"**, **"NN minutes"**, and **"NN seconds"**. The words may be abbreviated to any length, down to a single letter and the space between the number of the type identifier may be omitted, hence:

“2w 5d”

is an acceptable specification for 2 weeks 5 days. The order of objects is not relevent and any type of object can be omitted if not required to specify the time increment. No type of object can appear more than once in the specification and the entire object pointed to by *str* must correctly parse to be accepted. **BADDATE (-1)** is returned if parsing fails in any way.

fmtTimeIncr (|) converts a number of seconds into its ASCII equivalent. If *verbose* is FALSE, the string generated will use the following abbreviations:

w	weeks
d	days
h	hours
m	minutes
s	seconds

If *verbose* is not FALSE, then a full English form will be generated with commas and the word “and” included as is necessary. For example, if *incr* was 604801, the resulting string with *verbose* set to TRUE would be: " 1 week and 1 second ". If *incr* was 90002, the resulting string would be " 1 day, 1 hour, and 2 seconds ". Notice the plurals are also handled properly.

Library

prismlib.a

See Also

time(2)
ctime(3C)
tmtotime(3X)

Examples

spec	value or description
1s	1h 3601 seconds
2 weeks	14 days * 24 hours * 3600 seconds
5 min 30 sec	330 seconds
5m 3m	BADDATE — two minute specifications

Caveats

fmtTimeIncr (|) creates its answer in a static buffer. A copy must be made of the answer before a subsequent call to **fmtTimeIncr (|)** is made or the previous string will be lost.

Also note that the verbose form of output by **fmtTimeIncr (|)** is not proper input to the **timeIncr (|)** routine, while the terse form is. **timeIncr (|)** does not understand the commas or the word and" used by the verbose form.

tmtotime

Synopsis

datetotime, jdaytotime, getime, asciiToTime, cvtTimeDefToJDay, getDSTdates, cvtJulian — Routines to convert tm structures and ASCII time specifications to UNIX time specifications.

Command Format

```
#include <sys/types.h>
#include <time.h>
#include  prismdefs.h
#include  timeDefs.h
time_t jdaytotime ( tmPtr )
struct tm *tmPtr ;
time_t datetotime ( tmPtr )
struct tm *tmPtr ;
int cvtJulianDay ( tmPtr )
struct tm *tmPtr ;
int getDSTdates ( year,jStartp,jEndp )
int year ;/* Year of interest */
int jStartp ;/* Where julian start day goes */
int jEndp ;/* Where julian end day goes */
int cvtTimeDefToJDay ( year,tdp )
int year ;
struct TimeDef *tdp ;
time_t getime ( str,cntPtr,tmPtr )
char *str ;
int cntPtr ;/* How many chars used. */
struct tm *tmPtr ;
time_t asciiToTime ( asciip,tmPtr )
char *asciip ;/* ASCII description of date */
struct tm *tmPtr ;
```

Description

jdaytotime converts a partially filled structure of the the type *tm*, pointed to by *date*, into a long number of seconds equivalent to the system clock time (which is in GMT). It requires the element *tm_yday* be set. All other elements except the *tm_mon* and *tm_mday* can be optionally filled. If they are not set, they are set from the current date. It also completes filling in the day of the week, the month, day of the month, and setting the daylight savings time flag. The environment variable **TZ** is used to determine the time zone. If **TZ** is not available then Eastern Standard time is assumed.

jdaytotime returns a long which is equivalent to the system clock time OR in the cases of a bad conversion, BADDATE (-1). **datetotime** performs the same job as **jdaytotime** except that it requires the *tm_mon* and *tm_mday* to be set and not the *tm_yday*. The other elements may be optionally filled. It then completes the *tm* structure and returns a long with the equivalent UNIX system clock time or BADDATE.

cvtJulian generates only *tm_mon* and *tm_mday* from *tm_yday* in the *tm* structure pointed to by *tmPtr*.

getDSTdates determines the Julian day on which Daylight Savings Time begins and ends within the United States. The year of interest is specified by *year*. Account is taken of the Nixon years and the various changes in the law that has altered daylight savings time. *jStartp* points to the location where the starting Julian day is to be placed and *jEndp* points to the location where the ending Julian day is to be placed.

cvtTimeDefToJDay converts a *year* and a time of month specification, *tdp*, into a Julian day of the specified year. The time of month specification requires the index of the month (0-11), the week of the month (0 and up specify weeks from the start of the month, negative numbers specify from the end of the month), and the type of the week day of interest. BADDATE is returned if the specification cannot be satisfied otherwise the index of the Julian day is returned (0365).

getime scans a character string, *str*, which points to a location which is supposed to contain an ASCII date. If it is a date in one of the following formats:

[weekday] mmm dd[,] yy[yy] hh:mm[:ss] tz
[weekday] mm/dd[/yy[yy]hh:mm[:ss] tz
[weekday] dd-mmm-yy[yy]
[weekday] mmddhhmm[yy] [tz]

or some variation of the first three formats, a system time is produced. If the date is somehow bad, **BADDATE** " (" -1) is returned. The order of the elements of the date can come in any order with the following restrictions: month must be followed by a day in the first two formats, or the day followed by a month in the third format, and the hours must be followed by minutes, but all the pieces of the date are optionally as long as some piece appears. For example:

10:30 1982 apr 2
saturday 1982 est april 10,82

are legal dates. The day of the week is superfluous, but if it is specified, the date will be in error if it doesn't match the day of the week specified by the remainer of the date. *tz* is a timezone. Currently *getime* understands **GMT** , **AST** , **ADT** , **EST** , **EDT** , **CST** , **CDT** , **MST** , **MDT** , **PST** , **PDT** . The names of months, days of the week, and timezones can be any unique portion of the name, i.e. Ap is sufficient to identify April. All upper and lower case differences are ignored. The original string is not affected by the parsing performed by getime .

If the date is successfully parsed, **cntPtr* is set to the number of characters parsed through the trailing white space after the date. If the date is embedded, adding the count to *str* will give you a new pointer to the first word after the date.

If *tmPtr* is not NULL, it will be used to return a fully parsed structure of the type *tm*.

asciiToTime () is an enhancement of **getime ()**. It uses **getime ()** to parse strings of the forms supported by **getime ()**. If that is not successful, it attempts to convert dates of the form:

“{locant} {weekday} in {month}”

A "{locant}" must be one of the following phrases:

1st
or
first
2nd
or
second
3rd
or
third
4th
or
fourth
5th
or
fifth
last
or
“next to last”
“{1st|2nd|3rd|4th|5th} {to|from} last”
“{first|second|third|fourth|fifth} {to|from} last”

All upper case characters are mapped to lower case and hence are not important in the syntax. If the specification is correct in this form, it is used to produce a UNIX time, which is returned as the answer from **asciiToTime ()**, and a parsed *tm* structure is returned to the structure pointed to by *tmPtr.* If the ASCII representation cannot be parsed, **BADDATE** is returned. If a NULL pointer is provided for *tmPtr*, then the *tm* structure is not returned, but the routine operates properly and returns the UNIX time. The time returned will be relative to the current year if it is of the second form. The second form must have either four(4) or six(6) words in the phrase. Abbreviations are acceptable as long as they are unique. Periods(.) are ignored in the second form and so may be used as part of abbreviations.

The following date specifications are valid for **asciiToTime ()**:

"2nd Tues. in Aug."
"Third Friday in March"
"next to last Mon in May"

Library

prismlib.a

See Also

time(2)
ctime(3C)

Caveats

The integer pointed to by *cntPtr* will be advanced regardless of whether the date was good or bad. If the date was bad, this value should be ignored.

usage

Synopsis

usage — Writes out a standard usage message plus a variable string as a form of help.

Command Format

```
#include  usage.h

extern char *usageMsg[] ;

void usage ( fmt,vargs... )
char *fmt ;
{type} vargs ;

setUsageExitValue ( val )
int val ;

char **setUsageMsg ( msg )
char **msg ;
```

Description

usage writes out the NULL terminated array of strings normally found in **usageMsg** when it is called and then exits with a non-zero exit value, normally 1. This provides a standard way to exit and provide help when a program is executed with improper arguments. If **usage** is supplied with a non-zero *fmt*, which is not the NULL string, it is passed to *vfmtStr* along with the arguments following to be printed out preceding the usage message. This allows the user to enhance the usage message with specific comments about the problem, if desired. If the messages printed are longer than 22 lines and **stderr** is connected to a tty type device, *usage* provides *more* -like paging behavior so that the user can easily read the message without having it scroll off the screen.

setUsageExitValue allows the user to specify an exit value after the usage message is printed that is different from the default value, 1. It returns the previous exit value.

setUsageMsg allows the user to specify an alternate usage message to be printed in place of the specified by **usageMsg**. **usageMsg** must be supplied by the user, but if there might be more than one usage message, then the alternate messages could be substituted in place of the **usageMsg** version using **setUsageMsg**.

See Also

texToFmt(1x)
charBuffer(3x)

Diagnostics

usage does not return. After printing the messages, it exits with either 1 or the value last specified by **setUsageExitValue**.

setUsageExitValue returns the previous exit value.

setUsageMsg returns a pointer to the previous usage message.

Caveats

usageMsg must be provided by the application code. The easiest way to produce such a message is via the **texToFmt** tool, which will convert clear ASCII text into an appropriate array of character strings suitable for compiling with the C compiler.

VSerror

Synopsis

VSerror — Get text for voice system error messages

Command Format

```
#include <sys/types.h>
#include VS.h
char *VSerror (errid)
int errid: /* negative error value */
```

Description

VSerror returns a character string explaining what the specified error id means. Error ids equal to negative one (-1) are treated as UNIX system errors and the appropriate text in the UNIX error table (sys_errlist[]) is returned. Error ids defined in **VS.h** and UNIX system errors have text associated with them; all other errors are unknown to **VSerror** and result in a generic UNKNOWN message being returned.

Currently, the error return values from **VSstartup** and **VStoqkey** and from the underlying Bulletin Board interface functions are recognized by **VSerror**.

Examples

```
char *emsg;
key_t Qkey;
/* find the qkey of the speech recognition dip */
Qkey = VStoqkey(spRecog);
if (Qkey <= 0) {
emsg = VSerror(Qkey);
fprintf(stderr,VStoqkey failed; %s\n, emsg);
}
```

See Also

intro

VSstartup

Synopsis

VSstartup — Called once to initialize process to the voice system

Command Format

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

key_t VSstartup (procName, instance, flag)
char *procName; /* name associated with process */
short instance; /* process instance */
long flag; /* Is process a DIP? */
```

Description

VSstartup is called once to initialize a process to the VIS. **VSstartup** returns the DIP name, its instance, and a DIP flag. The DIP flag can take one of two values, constants DIP_PROC or NONDIP_PROC. Setting the flag to the constant DIP_PROC allows the DIP to send messages to and receive messages from TSM scripts. If the flag is set to the constant NONDIP_RPOC, messages sent by the IDP to TSM scripts are ignored by TSM.

Processes specifying the same *procName* and difference instance numbers will be assigned the same message queue key to read from, but will be posted in separate Bulletin Board (BB) slots.

The *instance* can be any arbitrary value in the range from 0 to 32767. However, the *instance* should be unique across processes using the same *procName*. A common use of the *instance* number is to differentiate between multiple copies of a process.

Specifically, **VSstartup** does the following:

1. Attach the BB and initialize the global BB variables used by the rest of the interface functions
2. Post the calling process in the BB and get its dynamically assigned Qkey
3. Acquire the process **semaphore** associated with the slot
4. Calls the **db_init** library functions to set up the trace facility for the calling process

Upon encountering an error, **VSstartup** will immediately return a pre-defined negative value.

Example

```
/* Post instance 0 of process xferdip as a DIP */
#define TRANSFER_DIP xferdip
key_t Qkey;
char *emsg;
Qkey = VSstartup(TRANSFER_DIP, 0, DIP_PROC);
if (Qkey <= 0) {
emsg = VSerror(Qkey);
fprintf(stderr,VStoqkey failed; %s\n, emsg);
sleep(20); /* sleep to avoid continuously respawning */
exit(1);
}
```

See Also

VSerror

Diagnostics

Upon successful completion, the assigned Qkey is returned. Errors in the **VSstartup** indicate failure in assigning a message queue key, in which case one of the following negative values is returned.

VS_EINVAL	*procName* argument cannot be NULL.
VS_ELEN	Length of *procName* is out of range.
VS_ERESV	*procName* is reserved for hardcoded processes.
VS_ENOPRT	Non-printable character found in *procName*.
VS_ENUM	*Instance* is negative or out of range.
VS_BADPROC	Another process with the same *procName* and *instance* is running already.
VS_ENOFREE	No BB slots available for posting process (see Troubleshooting information in Chapter 5, "Data Interface Process", for more information).
VS_ESHMAT	Can not attach the BB shared memory.

VStoname

Synopsis

VStoname — Find the **procName** of the given message queue key

Format

```
#include <sys/types.h>
#include <stdio.h>
#include VS.h

char *VStoname(Qkey)
key_t Qkey; /* message queue key */
```

Description

VStoname searches the voice system Bulletin Board (BB) and returns a pointer to the *procName* associated with the specified message queue key. **VStoname** will return the *procName* of hardcoded processes (processes not using dynamic Qkey numbers) as well as dynamic processes. If the message queue key is not found, **VStoname** will return a NULL. **VStoname** will also return a NULL if the BB is not attached using **BBattach**.

VStoname attaches the BB if not attached through **VSstartup**. Before returning it detaches the BB if it attached it to begin with.

See Also

VStoqkey

Warning

The returned **procName** pointer refers to a static area whose content is overwritten by each call to **VStoname**.

VStoqkey

Synopsis

VStoqkey — Find the message queue key of the given Process Name

Command Format

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

key_t VStoqkey(procName)
char *procName; /* unique name associated with process */
```

Description

VStoqkey searches the voice system Bulletin Board (BB) and returns the message queue key (Qkey) associated with the specified *procName*. If the *procName* is not found, **VStoqkey** will assign an unused Qkey and BB slot to the *procName*. The slot is then partially posted with the *procName* and Qkey. **VStoqkey** will return the Qkey of hardcoded processes (processes not using dynamically assigned Qkey numbers) as well as of dynamic processes.

VStoqkey waits to acquire the lock (process semaphore) on the BB before searching and writing, and releases the lock before returning to the calling routine.

VStoqkey attaches the BB if not attached through **VSstartup**. Before returning it detaches the BB if it attached it to begin with.

Examples

```
main () {
key_t DBDIPQKEY;
key_t VCTDIPQKEY;
key_t BRIDGEDIPQKEY;
key_t myQkey;
char *emsg;
int nbytesRead;
long rcvtime
struct ms_univ msg; /* see mesg.h */

/* Post myself in BB and init BB global variables */
myQkey = VSstartup(CallBridge, 0, DIP_PROC);
if (myQkey <= 0) {
```

```
emsg = VSerror(myQkey);
fprintf(stderr,VSstartup failed: %s\n, emsg);
sleep(20); /* sleep to avoid continuously respawning. */
exit(1);
}
DBDIPQKEY = VStoqkey(dbdip);
VCTDIPQKEY = VStoqkey(vctdip);
BRIDGEDIPQKEY = VStoqkey(bridgedip);
if (DBDIPQKEY < 0 || VCTDIPQKEY <0 ||
BRIDGEDIPQKEY < 0) {
/* Could not get Qkey */
/* Report the using VSerror, et_send error and cleanup */
sleep(10); /* to slow down continuous respawns. */
exit(1);
}
/* main processing loop */
while (1) {
/* read next message queue and switch on sender Qkey */
nbytesRead = mesgrcv(myQkey, &msg, sizeof(msg), 0, 0,
&rcvtime);
switch (msg.hd.morig) {
case DBDIPQKEY:
/* process message from Database DIP */
break;
case VCTDIPQKEY:
/* process message from Voice Coding DIP */
break;
case BRIDGEDIPQKEY:
/* process message from bridging DIP */
break;
default:
/* unknown sender */
break;
}
}
}
```

Diagnostics

Upon successful completion, the Qkey value is returned; otherwise one of the following errors is returned:

VS_EINVAL	*procName* argument cannot be NULL.
VS_ELEN	Length of *procName* is zero or greater than 15 characters in length.
VS_ERESV	*procName* is reserved for hardcoded processes and the specified *procName* is not posted already.
VS_ENOPRT	Non-printable character found in *procName*.
VS_ENOFREE	No BB slots available for posting process (see troubleshooting information in Chapter 5, "Data Interface Process", for more information).

Warning

Each call to **VStoqkey** involves a linear scan of the Bulletin Board. Therefore, it is recommended that a process call **VStoqkey** once for each **procName** it expects to reference and internally stored the returned Qkeys before entering its main processing loop. From then on, **VStoqkey** need not be invoked since the Qkeys are already available (see example for **VStoqkey**).

Also be aware that a process conceivably could use up all the VS message queues by repeatedly calling **VStoqkey** with non-existent **procNames**.

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