DECnet/OSI for VMS

VAX WANDD Programming

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Preface

Manual Objectives

This manual explains how to use the programming interface to the VAX WAN device drivers.

Note that this manual describes WAN Device Driver functionality for Digital's ADVANTAGE-NETWORKS DECnet/OSI for VMS product; it does not refer to existing Phase IV products.

Audience

Some readers will have experience of the QIO interface available with previous versions of this product. All readers are expected to have some experience of an assembly language, such as VAX MACRO, or a high-level programming language, to understand the examples in the manual.

The Structure of the Manual

The manual is divided into two parts:

- Part I—Programming Tasks
- Part II—Reference Information

Part I consists of three chapters that explain how to carry out various programming tasks:

- Chapter 1 introduces the DECnet/OSI drivers.
- Chapter 2 tells you how to set up and use datalinks.
- Chapter 3 gives information that may be useful in solving problems with the programming interface.

Part II contains a single chapter that provides reference information that a programmer needs regularly. There are also five appendixes containing information that a programmer may need from time to time:

- Chapter 4 gives reference information about the programming interface.
- Appendix A gives information about DEC HDLC.
- Appendix B gives information necessary for writing datalink protocols.
- Appendix C provides example programs that use both the new pseudo-driver (WANDRIVER) and the programming interface available with previous versions of the VAX WAN Device Drivers.
- Appendix D describes the programming interface used for previous versions.
- Appendix E describes the differences between the DECnet/OSI drivers and previous versions, and gives information about managing the generic drivers.

Associated Manuals

Product Documentation

DECnet/OSI for VMS Installation and Configuration describes how to install and configure the VAX WAN Device Drivers. It also provides technical specifications of the individual devices and drivers.

DECnet/OSI for VMS Network Management provides information about setting up wide area connections.

VMS Documentation

- Overview of VMS Documentation
- VMS Master Index
- Extended Documentation Set:
  - System Management Subkit
  - Programming Subkit
- *VMS Install Utility Manual*
- *VMS System Messages and Recovery Procedures Reference Volume*

Conventions Used in This Manual

Convention	Meaning
[ ]	Brackets in QIO requests enclose optional arguments. For example: IO$_SETCHAR P1,[P2],P3,[P6].
...	Horizontal ellipses indicate that irrelevant characters or QIO arguments have been omitted. For example: This file defines most of the XF$... symbolic names described in this section.

.
.
.
	Vertical ellipses in coding examples indicate that irrelevant lines of code have been omitted. For example:
	`LOGNAM: .ASCID /SYS$INPUT/`
	`.`
	`.`
	`.`
	`;DETERMINE TERMINAL NAME`
	`$GETDVI_S -`
	`DEVNAME=LOGNAM, -`
	`ITMLST=DVILIST`

-	Hyphens in coding examples indicate that additional arguments in the QIO request are provided on the following line(s). See the code example above for an example of this.
italics	This indicates variable information.
`Special type`	Indicates a literal example of system output or user input.
Numbers	Unless otherwise noted, all numbers in the text are decimal. Nondecimal radixes (binary, octal, or hexadecimal) are explicitly indicated in the coding examples.
Return	Key names are shown enclosed to indicate that you must press a key on the keyboard.
Ctrl/*x*	This symbol indicates that you must press the CTRL key at the same time as you press another key. For example, Ctrl/C, Ctrl/Y, and so on.

Part I

Programming Tasks

This part of the programming manual explains the concepts introduced for the DECnet/OSI VAX WAN Device Drivers, and goes through the tasks involved in programming them.

Part I contains three chapters:

- Chapter 1 introduces the VAX WAN Device Drivers (in the context of DECnet/OSI networking), and outlines the differences between this version and previous versions of the VAX WAN Device Drivers.
- Chapter 2 outlines the programming tasks involved in using the interface to the VAX WAN Device Drivers.
- Chapter 3 indicates various sources of problem-solving information, explains the various loopback tests, and describes how to submit a Software Performance Report (SPR), if necessary.

1
Introduction to the DECnet/OSI Drivers

The programming interface enables you to write applications programs that use the VAX WAN Device Drivers directly by means of $QIO calls to the pseudo-driver WANDRIVER, which passes your instructions and data on to the network management entities. The network management entities are controlled using commands in the Network Control Language (NCL).

In addition, programs written for previous versions of the VAX WAN Device Drivers are still supported. However, Digital recommends that new programs should be written with the interface that uses WANDRIVER.

This chapter has sections that introduce:

- The director–entity management model (Section 1.1).
- Writing programs to use WANDRIVER (Section 1.2).

1.1 Understanding Modular Management

DECnet/OSI (which implements Phase V of the Digital Network Architecture) differs from DECnet Phase IV in a number of ways. In particular:

- Networks can contain many more nodes.
- DECnet/OSI integrates OSI architecture and protocols with DNA.
- There is a more powerful and modular network model.

Suitably privileged users can manage DECnet/OSI management modules by using the Network Command Language (NCL) (documented in the *DECnet/OSI for VMS Network Control Language Reference*).

Table 1–1 summarizes the ways that the DECnet/OSI drivers differ from the Phase IV drivers, and Figure 1–1 gives an overview of the difference.

Table 1–1 Differences Between DECnet/OSI and Phase IV Drivers

DECnet/OSI Feature	Phase IV Feature
Works with DECnet/OSI	Independent of DECnet
Management of drivers and data exchange separated	Management and data exchange intermixed

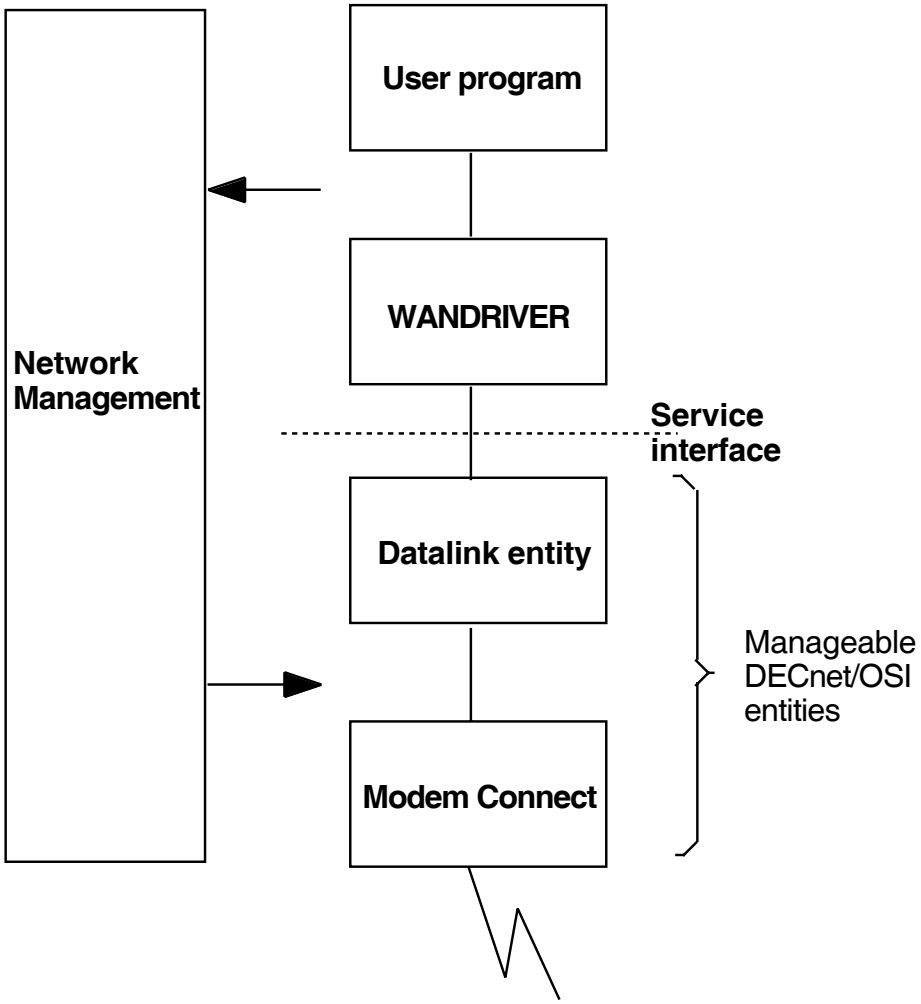
(continued on next page)

Table 1–1 (Cont.) Differences Between DECnet/OSI and Phase IV Drivers

DECnet/OSI Feature	Phase IV Feature
$QIO calls go to the pseudo-driver (WANDRIVER), which uses the services of the selected datalink layer entity to exchange data with the remote system. This manual refers to these calls as generic.	$QIO calls go to individual drivers
Improved problem solving through increased visibility of manageable parameters	Limited information about drivers available only through SENSEMODE calls
The Common Trace Facility (CTF)	No tracing facility

Figure 1–1 illustrates the relationship between the generic device drivers and DECnet/OSI.

Figure 1–1 The Generic Drivers and DECnet/OSI



1.2 Writing a Program for the VAX WAN Device Drivers

Before you use the DECnet/OSI VAX WAN Device Drivers, the necessary management entities need to be set up on the system or systems on which your program will run. These entities are:

- MODEM CONNECT.
- DEVICE (only if the datalink will use a device that has loadable firmware, such as the DSV11, DSB32, DSF32, DSW21, DSW41, or DSW42).
- The appropriate one or any combination of HDLC, DDCMP, and LAPB (the datalink layer entity or entities that your set up requires will depend on the communications hardware that you have installed).
- FRAME (only if you are using a protocol other than those provided by the generic VAX WAN Device Drivers).

These entities are set up during configuration both of the VAX WAN Device Drivers and of DECnet/OSI. Check that they exist by running NCL and issuing the commands:

```
SHOW NODE your-node DEVICE ALL ATTRIBUTES [1]
SHOW NODE your-node MODEM CONNECT ALL ATTRIBUTES
SHOW NODE your-node datalink-entity ALL ATTRIBUTES
```

where:

your-node	is the node that you want information about. You can omit NODE *your-node* if you issue the command from that node.
datalink-entity	is whichever of the DECnet/OSI datalink entities you are using.

1 Necessary only if the datalink uses the DSV11, DSB32, DSF32, DSW21, DSW41, or DSW42.

If the necessary entities are not running, see the relevant chapters in the *DECnet/OSI for VMS Network Control Language Reference* for information about creating and enabling them.

When your network is appropriately set up, you can then go on to set up and manage individual datalinks, and send and receive data over those datalinks using WANDRIVER. (See Chapter 2, which outlines the steps you have to take when you are setting up and using datalinks.)

Chapter 3 deals with problems you may meet in using the VAX WAN Device Drivers.

In some cases, you may want to use a program that was written for a previous version of the VAX WAN Device Drivers. Before doing so, see Appendix D.

1.2.1 Using the Obsolete Interface

The word “obsolete” is used throughout this book to refer to the interface available with previous versions of the VAX WAN Device Drivers, which is retained for compatibility with programs that are already in use. This interface is not obsolete in the sense of not being supported.

You cannot use the generic drivers and the obsolete interface at the same time on the same unit of a device. The obsolete QIOs cannot be issued to a VAX WAN Device Drivers unit if that unit is defined, at the time of the call, to be the COMMUNICATIONS PORT for a Modem Connect line child entity (COMMUNICATIONS PORT is a DECnet/OSI characteristic attribute). See Appendix D.

2
Setting Up and Using Datalinks

This chapter explains the tasks involved in making service interface calls to WANDRIVER. Part II gives the detailed reference information that you will need to perform these tasks.

2.1 Setting Up DECnet/OSI Modules

To use the VAX WAN Device Drivers, you need at least two DECnet/OSI management modules running on your system (three, if you are using a DSV11 or DSB32):

- MODEM CONNECT
- The appropriate datalink layer entity
- DEVICE (for DSV11, DSB32, DSF32, DSW21, DSW41, or DSW42)

The DECnet/OSI for VMS initialization procedure creates the Modem Connect module and the necessary datalink module or modules. If your hardware requires it, you create the Device module when the installation procedure for the VAX WAN Device Drivers runs the command file WANDD$STARTUP.COM (see *DECnet/OSI for VMS Installation and Configuration*).

You can create new modules, or reconfigure ones already created, by using NCL.

2.2 Using the Service Interface

To use a line, you use these QIOs:

- IO$_CREATE
- IO$_DELETE
- IO$_SETMODE
- IO$_SENSEMODE
- IO$_READLBLK
- IO$_WRITELBLK
- IO$_CLEAN

Section 2.2.1 explains how to use the QIOs to set up the V2.0 VAX WAN Device Drivers for data transfer. Section 2.2.2 explains how to use QIOs for reading and writing data. Full reference information about using the QIOs can be found in Chapter 4. For details of the obsolete QIO interface, see Appendix D.

2.2.1 Setting Up Datalinks

Before using a datalink to exchange data, you must:

1. Assign a channel to WANDRIVER (see Section 2.2.1.1)
2. (Optionally) enable an attention AST (see Section 2.2.1.3)
3. Open a port (see Section 2.2.1.2)
4. Start the protocol (also explained in Section 2.2.1.4)

At any time, you may flush both the read and write buffers (see Section 2.2.1.5). You can also get information about an open port (see Section 2.2.1.6)

To close the service interface, you must:

5. Enable an attention AST (see Section 2.2.1.3)
6. Shut down the protocol (see Section 2.2.1.7)
7. Close the port when the AST completes (see Section 2.2.1.8)
8. Deassign the channel

2.2.1.1 Assigning a Channel

To use WANDRIVER, you must first assign a channel to it by calling the $ASSIGN system service. Specify `WAN0` as the device name when assigning the channel.

$ASSIGN creates a new Unit Control Block (UCB), and allocates a channel to it. Use the channel number returned by $ASSIGN in all subsequent $QIO operations to this device.

2.2.1.2 Opening a Port

To open a port, you use the IO$_CREATE call.

2.2.1.3 Enabling an Attention AST

You enable an attention AST in order to get information about the progress of your program and the datalink it is using. Typical events that you would need your program to take into account would be:

- The link is up (and your program can continue to read and write).
- The link is down (in which case you would need further information about where and why the failure occurred).
- The datalink module is unavailable for some other reason.

To enable an attention AST, you use the IO$_SETMODE call with an IO$M_ ATTNAST modifier. Table 4–5 and Table 4–6 list possible return statuses and what they mean.

2.2.1.4 Starting the Protocol

To start a datalink protocol, you use the IO$_SETMODE call with an IO$M_ STARTUP modifier.

2.2.1.5 Clearing Buffers

If you are using the Frame module, you can choose to clear out either the write buffers or the read buffers or both. Do this at any time by issuing an IO$_CLEAN call, and use the modifiers to select which buffers you want cleared out.

2.2.1.6 Getting Information About the Port

To get information about an open port, you use the IO$_SENSEMODE call. The returns show you the characteristics for the port associated with the channel that you issue the QIO on.

2.2.1.7 Shutting Down the Protocol

To shut down a datalink protocol, you use the IO$_SETMODE call with an IOM_SHUTDOWN modifier.

2.2.1.8 Closing the Port

To close the port, you use the IO$_DELETE call.

2.2.2 Exchanging Data

You use the IO$_READLBLK call to receive a buffer of data. You use the IO$_WRITELBLK call to send a buffer of data.

2.2.2.1 Reading Data

To retrieve a message that has arrived in a read buffer, use the IO$_READLBLK call. Use the P1 and P2 parameters of the call to specify the address and length of the buffer.

If no received messages are available, the driver stores the receive request and returns it when a received message arrives from the datalink.

Use the IO$M_NOW qualifier to force the driver to return the receive request immediately. If there are no messages in the read buffer, the IO$READLBLK call returns with the status SS$_ENDOFFILE.

2.2.2.2 Writing Data

To put a message into a write buffer, use the IO$_WRITELBLK call. Use the P1 and P2 parameters of the call to specify the address and length of the message.

On a half-duplex line, if you are using the Frame module, use the IO$M_MORE qualifier to force the driver to keep the Request to Send (RTS) signal asserted after transmitting a message.

3
Programming Problems

3.1 Introduction to Problem Solving

Use these new facilities to help with problem solving:

1. The Common Trace Facility (CTF). This tool lets you trace protocol activities at various levels in your DECnet/OSI network by specifying the appropriate tracepoint or tracepoints. For details, see the *DECnet/OSI for VMS Common Trace Facility Use* manual.
2. Modular network management. Many things hidden in Phase IV are visible with DECnet/OSI management. This is particularly so in the case of modem signals. Whereas in Phase IV you could not find out what modem signals were being sent, the DECnet/OSI Modem Connect module gives you:
   - Read access to each of the interchange circuits
   - Information on the state of the physical interface

3.2 Loopback

The NCL commands STARTLOOP and STOPLOOP enable you to start and stop loopback tests on a line. A parameter to the STARTLOOP command enables you to specify any one of several types of loopback test. The loopback tests you can do are:

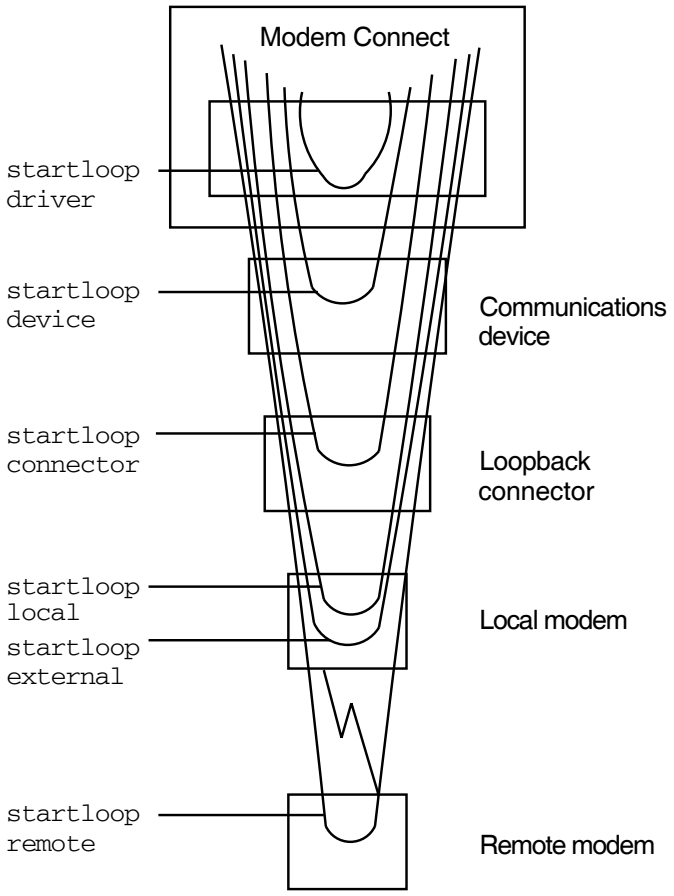
- STARTLOOP DRIVER
- STARTLOOP DEVICE
- STARTLOOP LOCAL
- STARTLOOP REMOTE
- STARTLOOP CONNECTOR
- STARTLOOP EXTERNAL

Figure 3–1 gives an overview of the different kinds of loopback test. Sections 3.2.1 to 3.2.6 give further details about using the different tests.

3.2.1 STARTLOOP DRIVER

In this test, the software simply turns transmit data into receive data. It does not exercise the device.

Figure 3–1 What the Loopback Tests Do



3.2.2 STARTLOOP DEVICE

In this test, the data loops back inside the device, as near as possible to the line's transmitters and receivers.

3.2.3 STARTLOOP CONNECTOR

This test tells the software that:

- The network manager has physically inserted a loopback connector (somewhere between the device and the local modem).
- The system under test will need to generate its own clock.

In this test the data loops back outside the distribution panel of the device and before the modem.

3.2.4 STARTLOOP LOCAL

In this test, the data loops back inside the local modem. This test requires a modem that recognizes and supports CCITT 141 ('local loopback').

3.2.5 STARTLOOP REMOTE

In this test, the data loops back inside the remote modem. This test requires two cooperating modems, with the local modem recognizing and supporting CCITT 140 ('remote loopback').

3.2.6 STARTLOOP EXTERNAL

This test tells the software that:

- The network manager has physically switched the modem so that it loops back.
- The system under test is receiving clock signals from some external source.

In this test the data loops back at the external device, which is in loopback mode.

3.3 Problems and System Failure

This section describes what to do if the system fails and you believe the failure is caused by the VAX WAN Device Drivers.

Collect the following information, and send it with a Software Performance Report (SPR) form to Digital at the address shown on the form. Explain your VAX WAN Device Drivers configuration, quoting the appropriate version number.

1. Clearly define the problem (one problem on each SPR form).

   State:

   - Whether or not the problem is consistently reproducible, and if so, how to reproduce the problem.
   - How frequently the problem occurs.
   - Whether there are any factors related to the problem, for example, heavy use of the system, low line-speed, or the use of particular communication devices.

2. Give the priority of the problem.

   - Priority 1

     Major loss of functions. For example, the VAX WAN Device Drivers consistently crashes the system.

   - Priority 2

     Some loss of functions. For example, performance degradation, data transfer rate falls by a considerable amount.

   - Priority 3

     Some impact on the user, manual intervention required. For example, an NCL command is required when there is a link or line failure, to turn the line off and back on again.

   - Priority 4

     Functions can run with no significant impact on the user, problem can easily be worked around. For example, you may only need to alter the order in which certain NCL commands are entered.

   - Priority 5

No system modifications needed to return to normal functions. For example, you have a suggestion, want some advice, or find a documentation error.

3. Please provide details of your software configuration:
   - A listing of the output from NCL SHOW commands for all the attributes of:
     - Each Modem Connect line you are using
     - Each LOGICAL LINK and LOGICAL STATION (if it exists) for each datalink you are using

     Example 3–1 gives examples.
   - The version number of any replacement components you may have.
4. Please provide details of your hardware configuration:
   - Details of CPU type.
   - Details of all the communication devices (revision levels and speeds) on the CPU.
   - CSR and vector addresses of the device you are using.

     You can find them out by issuing the command:

     ```
     SYSGEN> SHOW/CONFIGURATION
     ```
5. Please provide exact details of any event messages and error messages displayed.
6. If the problem occurs each time a particular user program is run, please submit the sources of the program on a floppy disk or magnetic tape.
7. If the problem concerns a line error or a protocol error at Level 1 or Level 2, use the Common Trace Facility to record line traffic, and submit the binary file obtained. If you have a Datascope, you can make problem resolution quicker and easier by also submitting a Datascope trace (either as a listing, or on a tape), giving details of the type of Datascope used.
8. If the system fails or you need to force a system crash, submit the system dump file with your SPR (not the analyzed output).

   For details of how to force a system crash, please refer to the Operating System documentation.

Example 3–1 Typical NCL SHOW Commands for a DEC HDLC Implementation

```
NCL> SHOW NODE FRED MODEM CONNECT LINE * ALL ATTRIBUTES
NCL> SHOW NODE FRED HDLC LINK * ALL ATTRIBUTES
NCL> SHOW NODE FRED HDLC LINK ACCOUNTS LOGICAL STATION * ALL ATTRIBUTES
```

3.3.1 Copying System Dump Files

You may use the System Dump Analyzer COPY command to copy the dump file to another location. Use the BACKUP utility to create a backup saveset containing the dump file and any additional information. To do this, use the commands:

```
BACKUP SYS$SYSTEM:[filenames]/IGNORE=BACKUP MUA0:name/SAVE/REWIND
BACKUP SYS$SYSTEM:[filenames]/IGNORE=BACKUP device:name/SAVE/INIT
```

where *filenames* is a list of the files containing any additional information that you are providing, and *name* is the name you give the saveset.

For more information on using BACKUP, refer to the *VMS Backup Utility Manual*.

Part II

Programming Reference Information

Part II gives only reference information. In order to program the VAX WAN Device Drivers you need to read Part I first, and then refer to Part II for detailed information.

Part II is divided between information that a programmer needs regularly and information needed only occasionally.

There is one chapter:

- Chapter 4 gives reference information about the $QIO interface.

There are five appendixes:

- Appendix A gives information about DEC HDLC.
- Appendix B gives information about writing your own datalink protocols.
- Appendix C gives sample programs, both for WANDRIVER and for the V1.2-like interface.
- Appendix D gives information on the obsolete (V1-like) interface.
- Appendix E gives information on management (particularly the Network Control Language—NCL)

4

I/O Function Codes and Status Returns

4.1 Overview of I/O Operations

4.1.1 WANDRIVER

WANDRIVER is the pseudo-driver that supports a QIO interface to the DECnet /OSI datalink service interfaces. In V2.0 of the VAX WAN Device Drivers, you make QIO calls to WANDRIVER which relays your instructions and I/O, through the datalink service interfaces, to the appropriate devices.

For compatibility with V1-style programs, the programming interfaces to drivers specific to individual devices are still supported (see Appendix D).

4.1.2 QIOs to WANDRIVER

In DECnet/OSI, the tasks of managing datalinks and using them for exchanging data are separated. You use QIO requests to the VAX WAN Device Drivers to do the following:

- Set up the service interfaces of datalinks managed by DECnet/OSI entities (see Section 4.2).
- Exchange user data (see Section 4.3).

Table 4–1 lists these QIO requests and their function codes.

Table 4–1 VAX WAN Device Drivers I/O Functions

Function Code	Arguments	Modifiers	Function
Managing Circuits			
IO$_CREATE	P1,P2	*none*	Open a port
IO$_DELETE	*none*	*none*	Close a port
IO$_SETMODE	[P1,[P2],P3]	IO$M_STARTUP IO$M_SHUTDOWN IO$M_ATTNAST	Set datalink characteristics and state for subsequent operations
IO$_ SENSEMODE	P2	*none*	Get information about an open port
IO$_CLEAN	*none*	IO$M_ READATTNAST IO$M_WRATTNAST	For HDLC, SDLC, and LAPB, stops outstanding reads and/or writes

(continued on next page)

Table 4–1 (Cont.) VAX WAN Device Drivers I/O Functions

Function Code	Arguments	Modifiers	Function
Exchanging Data			
IO$_READLBLK	P1,P2	IO$M_NOW	Read a logical block
IO$_ WRITELBLK	P1,P2	IO$M_MORE†	Write a logical block

†Only for half-duplex operation.

In Sections 4.2 and 4.3, there is a subsection for each call. In each subsection there is reference information broken down like this:

- Format
- Returns in R0
- Arguments
- Notes

In Sections 4.2 and 4.3, there is no information on the common argument *chan* that must be specified in all calls. The argument *chan* is the channel number that the $ASSIGN system service returned when you assigned to WANA0. It is passed by value.

Section 4.4 gives information about the Input/Output Status Block (IOSB).

4.2 Setting Up, Controlling, and Using Datalink Circuits

There are three stages in managing a circuit:

1. Setting up a datalink entity (usually, while you are configuring your network) via the network management interface.
2. Creating and specifying the characteristics of a particular datalink via the service interface.
3. Continuing to manage the datalink entity from day to day.

To manage the datalink itself (items 1 and 3), refer to the *DECnet/OSI for VMS Network Control Language Reference* manual. To set up, control, and use a particular datalink service interface (item 2), you use the $QIO calls detailed in:

- Section 4.2.1–Opening a port
- Section 4.2.2–Enabling an attention AST
- Section 4.2.3–Starting up the protocol
- Section 4.2.4–Shutting down the protocol
- Section 4.2.5–Getting port information
- Section 4.2.6–Clean/flushing the datalink
- Section 4.2.7–Closing the port
- Section 4.3.1–Receiving data
- Section 4.3.2–Transmitting data

4.2.1 Open a Port

The IO$_CREATE call creates a port to a datalink entity that has already been set up, either with NCL or with the programming calls used for management.

Format

SYS$QIO *chan*, IO$_CREATE, *[iosb]*, **P1, P2**

Returns

ss$_accvio	A QIO argument is not accessible to the user process.
ss$_illiofunc	Illegal I/O function code or modifiers specified.
ss$_insfarg	Required P1 parameter not specified.
ss$_ivlognam	P1 datalink name not in correct format.
ss$_insfmem	Driver failed to allocate a nonpaged pool buffer.
ss$_exquota	Could not allocate a nonpaged pool buffer because of quota limitations.
ss$_badparam	Unknown datalink entity name specified. *or* Illegal item in P2 itemlist
ss$_ivbuflen	The buffer size requested was too large.
ss$_ssfail	Your request to open a port has failed for some other reason. A code specifying the reason is given in the second longword of the IOSB. Possible reasons are given in Table 4–2.
ss$_nosuchobj	Could not connect to specified datalink entity.
ss$_devactive	Port is already open.
ss$_disconnect	The port was closed down while the open was being performed.

Notes

P2 is optional for DDCMP and FRAME ports.

P2 is not optional for LAPB and HDLC ports.

For LAPB you must at least specify the preferred buffer size item (dll$k_preferred_buffer_size) in the item list (see Table 4–4).

For HDLC you must at least specify the protocol ID item (dll$k_protocolID) in the item list (see Table 4–4).

Table 4–2 Reasons for SS$_SSFAIL on an IO$_CREATE Request

Code	Value	Reason
dll$_no_such_entity	8356	You have specified an entity that does not exist.
dll$_entity_in_use	10500	The entity specified in the Open Port call is in use.
dll$_ins_res	292	Your system has insufficient resources to meet the request.
dll$_unsup_profile (applicable only to LAPB ports)	268	The profile specified in your call is not supported.
dll$_inval_entity	10492	The entity specified in the request was not of the required type.
dll$_fatalerr	692	There has been an internal fatal error. Please submit an SPR.

Arguments

P1 The address of a quadword descriptor of the name (or logical name) of the datalink. The P1 parameter is mandatory. Datalink names are in this format:

ProtocolModule.LinkName[.StationName]

Replace *ProtocolModule* with either DDCMP, HDLC, LAPB or FRAME. You must specify a *LinkName*. You must specify *StationName* for all datalinks except FRAME and LAPB.

P2 If not zero, the address of a quadword descriptor of an item-list of parameters for a port on the specified datalink. For further details, see Section 4.2.1.1.

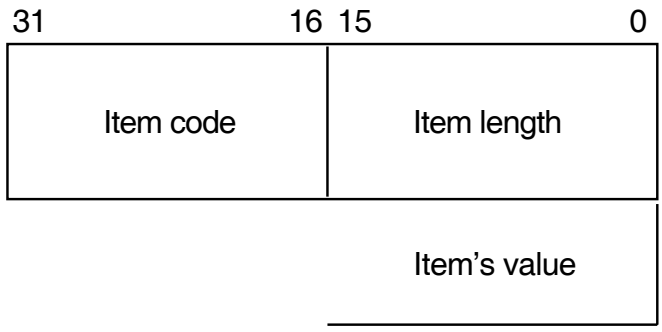
Notes

1. If P1 and P2 buffers are valid, the driver opens a port with the *LinkName* and (except in the FRAME or LAPB entity) *StationName* specified in the call.
2. IO$_CREATE takes no modifiers.

4.2.1.1 Item-Lists for the Attributes of Ports

The P2 parameter of an IO$_CREATE call is the address of a quadword descriptor that points to an item-list in which items have the format shown in Figure 4–1:

Figure 4–1 The Format of an Item



The item-list is a block of memory that is virtually contiguous. It contains one or more items, which consist of these fields:

- Item length
- Item code
- Item value

Item Length

The Item length includes both the length of the Item length and the length of the Item type, and is expressed in bytes. For example, an item whose value was a longword would have an Item Length of 8: that is, two bytes for the Item length, two bytes for the Item type, and four bytes for the longword value itself. So although the length always depends on the value, the length of the item is not equal to the length of the value (see Table 4–3).

Table 4–3 Sample Item Lengths

Length of Value	Length of Item
Byte	5
Word	6
Integer	6
Longword	8
String	length of string + 4
Local Entity Name	A Local Entity Name is itself an item-list.

Item Code

The Item code is any of the codes listed in Table 4–4 or Table 4–8.

Item Value

An Item value can itself be an item-list.

Table 4–4 Settable Open Port Items

Value	Item Code	Item Type	Description
100	`dll$k_auto_start`†	Byte	A boolean value that tells the datalink to try to start automatically, after the Open Port has completed successfully. This parameter does not affect whether the datalink attempts to restart itself following a link failure. If the setting of this parameter is TRUE, the client need not issue an Initialise Protocol function after opening a port. The default setting is TRUE.

† Not applicable to FRAME ports.

(continued on next page)

Table 4–4 (Cont.) Settable Open Port Items

Value	Item Code	Item Type	Description
101	dll$k_auto_restart†	Byte	A boolean value that tells the datalink that it should always attempt to restart the protocol itself after a link failure. The default setting is TRUE.
7	dll$k_preferred_ buffer_size [1,2,4]	Longword	The buffer size that the client would like to use. Where negotiation takes place, this value is used as the preferred maximum data size.
6	dll$k_minimum_ buffer_size[2,3]	Longword	The minimum buffer size that the client is prepared to accept. If the datalink performs negotiation of the buffer size, it should not allow negotiation below this value. This value should be greater than or equal to 262 if you are using DEC HDLC.
8	dll$k_protocolID[2]	Word	The protocol ID that must be exchanged with the remote station. The link is used only if both stations use the same ID.
9	dll$k_DECuserdata[2]	String	The user data to be transferred as part of the initialization sequence to the remote station, if possible.
10	dll$k_profile[3]	String	The datalink profile name that the client wants to use. The datalink checks that this matches the profile in use on this datalink. If the actual profile does not match the named profile, the datalink returns the error dll$_unsup_profile. This item is optional. If it is not specified, the datalink does no checking.
106	dll$k_buffer_limit	Byte	This is a boolean value that the datalink may pass to the device driver. If TRUE, the driver limits the receive buffer to its initial value. If FALSE, the driver uses the initial value as a minimum, and allocates more buffers whenever it sends full buffers to the user program. The default setting is FALSE.

[1]Applicable to FRAME Ports.

[2]Applicable to HDLC Ports.

[3]Applicable to LAPB Ports.

[4]Applicable to DDCMP Ports.

† Not applicable to FRAME ports.

4.2.2 Enable Attention AST

This function requests that an attention AST is delivered to the requesting process after one of the following events:

- The driver has set or cleared any of the status or error bits. See Table 4–5 and Table 4–6 for meanings of different settings of the status and error bits.
- Data has arrived and there is no read request outstanding.

The user is informed only once whenever either of these conditions occurs.

Format

SYS$QIO *chan*, IO$SETMODE!IO$M_ATTNAST, *[iosb]*,**P1,[P2],P3**

Returns

ss$_insfmem	Driver failed to allocate a nonpaged pool buffer.
ss$_exquota	Could not allocate a nonpaged pool buffer because of quota limitations.

Arguments

P1	The address of an AST service routine (or 0 to disable ASTs).
P2	User parameter for the AST routine.
P3	Access mode to deliver AST (0 to 3, corresponding to the VMS access mode chosen). If you specify a more privileged access mode than the current access mode of the calling process, the AST is delivered in the current access mode. Otherwise, the AST is delivered in the access mode you have specified.

Notes

1. You may use the Enable Attention AST function at any time, regardless of the condition of the driver and port status bits.
2. After an AST fires, it must be reenabled by another Enable Attention AST function before an AST can fire again.
3. The AST quota (ASTLM) for your process limits how many ASTs can be requested.
4. When the attention AST service is delivered, the top byte of the AST parameter is the byte specified in the P2 parameter that set up the attention AST. The lowest three bytes contain the status and error bits, listed in Tables 4–5 and 4–6.

Table 4–5 Meaning of Status Bits

Code	Value	Meaning When Set
dll$m_sts_active	1	The link is up.
dll$m_sts_receive_data_ready	2	There is received data waiting in the driver for the user to read.
dll$m_sts_physical_loopback	4	Data is looping back at the physical layer.

Table 4–6 Meaning of Error Bits

Code	Value	Meaning When Set
dll$m_err_remote_restart	256	The remote station is restarting.
dll$m_err_insuff_resources	512	There are insufficient system resources to provide the service called.
dll$m_err_physical_layer_down	1024	The physical layer is not available.
dll$m_err_negotiation_failure	2048	There has been a negotiation failure (DEC HDLC only).
dll$m_err_maintenance_mode	4096	The datalink has been set to maintenance mode.
dll$m_err_disabled	8192	The physical layer communications port is disabled.
dll$m_err_threshold_exceeded	16384	Datalink receive or transmit threshold exceeded.

4.2.3 Start Up Protocol

Starts up the datalink protocol.

Format

```
$QIO chan, IO$_SETMODE!IO$M_STARTUP [,iosb]
```

Returns

ss$_disconnect	The port was closed down while it was being started up.
ss$_devinact	The port has not yet opened, or has not successfully opened.
ss$_illiofunc	Illegal I/O function code or modifiers specified.
ss$_insfmem	Driver failed to allocate a nonpaged pool buffer.
ss$_exquota	Could not allocate a nonpaged pool buffer because of quota limitations.
ss$_nosuchdev	Port has not yet been opened.

Notes

1. IO$_SETMODE with the IO$M_STARTUP qualifier takes no parameters.

4.2.4 Shut Down Protocol

Shuts down the datalink protocol.

Format

```
$QIO chan, IO$_SETMODE!IO$M_SHUTDOWN [,iosb]
```

Returns

ss$_illiofunc	Illegal I/O function code or modifiers specified.
ss$_insfmem	Driver failed to allocate a nonpaged pool buffer.
ss$_exquota	Could not allocate a nonpaged pool buffer because of quota limitations.
ss$_nosuchdev	Port has not yet been opened.
ss$_disconnect	The port was closed down while it was being started up.
ss$_devinact	The port has not yet opened, or has not successfully opened.

Notes

1. IO$_SETMODE with the IO$M_SHUTDOWN qualifier takes no parameters.

4.2.5 Getting Port Information

To get information about an open port, you use the IO$_SENSEMODE call.

Format

SYS$QIO *chan*, IO$_SENSEMODE, *[iosb]*, ,**P2**

Returns

ss$_accvio	A QIO argument is not accessible to the user process.
ss$_illiofunc	Illegal I/O function code or modifiers specified.
ss$_insfarg	Required P2 parameter not specified.
ss$_bufferovf	Item-list is too large to fit into user's buffer.

Arguments

P2 The address of a quadword descriptor. The length field of the descriptor contains the length of the buffer pointed to by the address field of the descriptor.

The driver returns in the buffer described by this descriptor the following (in the item-list format discussed in Section 4.2.1.1):

- All the Open Port items (see Tables 4–4 and 4–7)
- All the items in the Link Up output item-list (for sequenced HDLC ports only—see Table 4–8)

The Link Up items will only be present if the link is up when the IO$_SENSEMODE request is received.

Table 4–7 Read-Only Open Port Items

Value	Item Code	Item Type	Description
1	dll$k_dl_entity	Local Entity Name	Local Entity Name of the datalink and/or logical station.
5	dll$k_port_entity	Local Entity Name	The name of the newly created datalink port entity.
2	dll$k_client	Local Entity Name	The local entity name of the client subentity.
11	dll$k_actual_buffer_size [1]	Integer	The negotiated buffer size for use over the link. In the case of HDLC, the datalink returns this value in the Link Up Item-List (Table 4–8).
106	dll$k_buffer_limit [1]	Byte	A boolean value that the datalink may pass to the driver. If the setting is TRUE, the driver limits its receive buffers to its initial number. If FALSE, the driver uses this number as a minimum, and allocates more buffers whenever it sends full buffers to the user program. The default setting is FALSE.

[1]Applicable to HDLC Ports.

Table 4–8 Link Up Item-List

Value	Item Code	Item Type	Description
11	dll$k_actual_ buffer_size	Integer	The negotiated buffer size for use over the link.
8	dll$k_protocolID	Word	The protocol ID proposed by the remote station, if supplied.
9	dll$k_DECuserdata	String	The user data received from the remote station, if supplied.

4.2.6 Clean

For the Frame datalink only, an IO$_CLEAN function can stop either outstanding write requests, or outstanding read requests, or both, depending on modifiers. By default, IO$_CLEAN stops outstanding Write requests only.

Format

```
$QIO chan, IO$_CLEAN[!IO$M_READATTN|IO$M_WRTATTN] [, iosb]
```

Returns

ss$_illiofunc	Illegal I/O function code or modifiers specified. *or* IO$_CLEAN not supported for this datalink.
ss$_insfmem	Driver failed to allocate a nonpaged pool buffer.
ss$_exquota	Could not allocate a nonpaged pool buffer because of quota limitations.
ss$_devinact	The port has not completed opening.
ss$_nosuchdev	The port has not been opened.
ss$_abort	Clean already in progress.

Notes

The modifiers work in this way:

- If you specify just one modifier, an IO$_CLEAN request stops either read requests or write requests.
- If you specify both modifiers, an IO$_CLEAN request stops both read requests and write requests.
- If you specify neither modifier, an IO$_CLEAN request stops only write requests

4.2.7 Close a Port

Closes a port.

Format

SYS$QIO *chan*, IO$_DELETE *[, iosb]*

Returns

ss$_illiofunc	Illegal I/O function code or modifiers specified.
ss$_devinact	Port has not been opened.

Notes

1. IO$_DELETE takes no function code modifier.

4.3 $QIOs for Exchanging User Data

The generic drivers do not differentiate between logical, virtual, and physical I/O functions.

4.3.1 Read

A Read function transfers incoming data into the buffer you specify.

Format

SYS$QIO *chan*, IO$_READLBLK[!IO$M_NOW] *[,iosb]*, **P1, P2**

Returns

ss$_accvio	A QIO argument is not accessible to the user process.
ss$_illiofunc	Illegal I/O function code or modifiers specified.
ss$_badparam	Receive request 0 length, or greater than maximum transmit buffer size.
ss$_bufferovf	Message was received successfully, but was too large to fit into user's buffer.
ss$_endoffile	IO$M_NOW modifier was specified on the read QIO, but no completed reads were available.
ss$_abort	QIO has been aborted.
ss$_nosuchdev	The port has not been opened.
ss$_devinact	The port has not completed opening.

Arguments

P1	The address of a buffer for a message that the driver receives.
P2	The length of the same buffer.

Notes

1. The status return SS$_ENDOFFILE (if the IO$M_NOW modifier is specified) indicates that there is no data to be read in the driver.

4.3.2 Write

Format

SYS$QIO *chan*, IO$_WRITELBLK[!IO$M_NOW], *[iosb]*, **P1, P2**

Returns

ss$_accvio	A QIO argument is not accessible to the user process.
ss$_illiofunc	Illegal I/O function code or modifiers specified.
ss$_badparam	Transmit request 0 length, or greater than the receive buffer size.
ss$_exquota	Could not allocate a nonpaged pool buffer due to quota limitations.
ss$_nosuchdev	Port has not been opened.
ss$_devinact	The port has not completed opening.
ss$_abort	QIO has been aborted.
ss$_ssfail	There has been some other error. Reasons are given in the second longword of the IOSB: see Table 4–9.

Table 4–9 Reasons for SS$_SSFAIL on a IO$_WRITELBLK Request

Code	Value	Meaning When Set
dll$m_sts_active	0	The datalink is not running.
dll$m_err_not_sent	32768	The buffer has not been sent because the datalink is unavailable. Try again.
dll$m_err_physical_layer_down	1024	The physical layer has failed.
dll$m_err_disabled	8192	The datalink port is being closed.
dll$m_err_fatalerr	65536	There has been an internal fatal error.

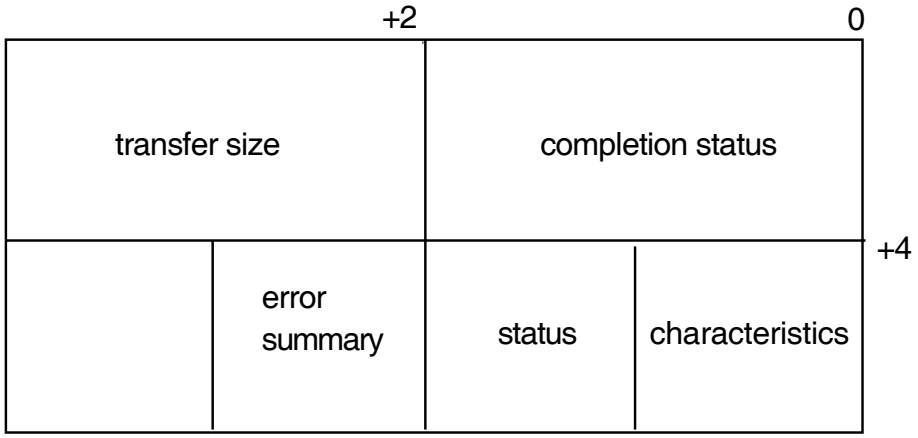
Arguments

P1	The address of a buffer that holds a message for the driver to send.
P2	The length of the same buffer.

Notes

1. The drivers put your data in a system buffer before transmitting it.
2. For the Frame datalink, on half-duplex lines, the write functions can take the modifier IO$M_MORE. This keeps Request To Send (RTS) asserted in half-duplex communications, after a message is transmitted. Without this modifier, the driver drops RTS.
3. If the link is unavailable, the driver does not attempt to pass data to the datalink. The driver holds the data in an internal queue until the datalink indicates that the link is available again.

Figure 4–2 The Format of the IOSB



4.4 Returns in the Input/Output Status Block (IOSB)

The format of the I/O Status Block (IOSB) is shown in Figure 4–2.

As well as the completion status, the first longword of the IOSB returns the size (in bytes) of the data transfer.

The second longword of the IOSB contains the DEVDEPEND longword. See Table 4–5 and Table 4–6 for meanings of different settings of the status and error bits.

4.5 Using the $CANCEL System Service

When you call the $CANCEL system service, outstanding attention ASTs are flushed and a close port operation is initiated. A close port operation flushes back all outstanding I/O, returns resources, and disconnects and shuts down the service interface into the datalink.

Note that using $CANCEL is slightly different than what happens when using the obsolete QIO interface. If you just want to abort outstanding I/O requests, you must use the Clean operation. See Section 4.2.6 for more information about the Clean operation.

A

DEC HDLC

This appendix gives reference details of DEC HDLC. A DEC HDLC module can exchange data only with another DEC HDLC module, or one that uses a compatible implementation of HDLC.

Section A.1 lists the optional functions provided for in *ISO 7809*. These are implementation options. Section A.1 also indicates which of them are either optional (for the user), required, or not implemented in DEC HDLC. Notes give further details of functions implemented in DEC HDLC.

Section A.2 lists which of the classes of procedure are available in DEC HDLC, and specifies the link type to which each class applies.

A.1 Optional Functions

Optional Procedure Number	Additional Function Provided	DEC HDLC Implementation Details
1	Ability to exchange identification and/or characteristics	Required[1]
2	Improved reporting of I frame sequence errors	Optional[2]
3	More efficient recovery from I frame sequence errors	No
4	Ability to exchange information fields (whether or not operational) without affecting I frame sequence numbers	Required[3]
5	Ability to initialize/request intialization	No
6	Ability to do unnumbered group and all-station polling	No[4]
7	Greater than single-octet addressing	No
8	Delete I responses (limits remote station to using I frames for commands)	No
9	Delete I commands (limits remote station to using I frames for responses)	No
10	Ability to use extended sequence numbering (modulo 128)	Optional[5]
11	One-way reset (for BAC only)	No
12	Ability to do basic datalink test	No
13	Ability to request logical disconnection	No
14	32-bit frame checking sequence (FCS)	Optional[6]

1. The Exchange Identification (XID) function lets Datalink Layer entities exchange parameters and chacteristics of operation before or during normal working. This function has three prime uses:

   - Exchanging information before setting up a logical data-link for Network Layer traffic.
   - Accommodating a limited amount of higher-layer information (for example, in security applications).
   - Indicating a local change in data-link parameter values (for example, because of congestion).

   Within DEC HDLC, the remote station must transmit an XID response using the general purpose XID information field identifier. The datalink parameters must be in accordance with International Standard *ISO 8885*, and the addresses in accordance with International Standard *ISO 8471*. The XID frame must itself contain a user data field in DEC HDLC format, with – at least—the HDLC protocol identifier and version.

2. The Improved Performance function allows for the reporting of I frames received out of sequence, by means of the REJ frame. A REJ frame requests transmission or retransmission of frames with a sequence number later than the last one successfully received.

   For DEC HDLC, if the option is denied, no REJ transmission will take place. Checkpointing will be necessary to recover from line errors.

3. The Unnumbered Information (UI) function allows for the sending of higher-layer information at any time with no impact on the ordering of I frames. On a highly reliable, error-free line, the exclusive use of UI frames may be the logical choice.

   A DEC HDLC link will not initialize if the UI support is denied. The remote station must also respond correctly to UI frames with the protocol identifier in the DEC HDLC format used by the Maintenance Operations Protocol.

4. It is possible to poll out of the running state, using DISC frames.

5. The Extended Sequence Numbering function defines the sequence numbering for I frames as modulo 128. The greater modulus value allows for larger send and receive windows. This function's prime use is over connections where there is a long propagation delay (for example, a satellite link).

   DEC HDLC selects this optional function according to the setting of the ACTUAL SEQUENCE MODULUS parameter for the datalink.

6. The 32-bit FCS function provides for a higher level of accuracy in error detection.

   DEC HDLC selects this optional function according to the PREFERRED CRC TYPE specified and the capacity of the device in use for the datalink. Note that in V2.0 of the VAX WAN Device Drivers only the DSF32 can support a 32-bit CRC.

A.2 Classes of Procedure

Class		Link Type	
Number	**Name**	**Number**	**Name**
1	Balanced ABM	**0**	Balanced[1]
2	Unbalanced NRM—primary	**1**	Primary[2]
3	Unbalanced NRM—secondary	**2**	Secondary[2]

[1]DEC HDLC supports Class 1 only on a full-duplex line.

[2]DEC HDLC supports Classes 2 and 3 only on a half-duplex line.

For further details of the HDLC protocol, see the International Standards *ISO 3309, ISO 4335* (with its *DAD*s), and *ISO 7809* (with its *DAD*s). Programmers who need to write their own datalink protocol should refer to Appendix B.

B

User-Written Datalink Protocols

If you want to write your own datalink protocol, you must make calls to the Frame module. The Frame module does only the framing for the type of line protocol being used.

See the *DECnet/OSI for VMS Network Control Language Reference* manual for information on manageable attributes of the frame datalink.

This appendix gives a brief description and provides usage notes for each of these framing routines:

- DDCMP
- HDLC
- BISYNC
- GENBYTE

B.1 The DDCMP Framing Routine

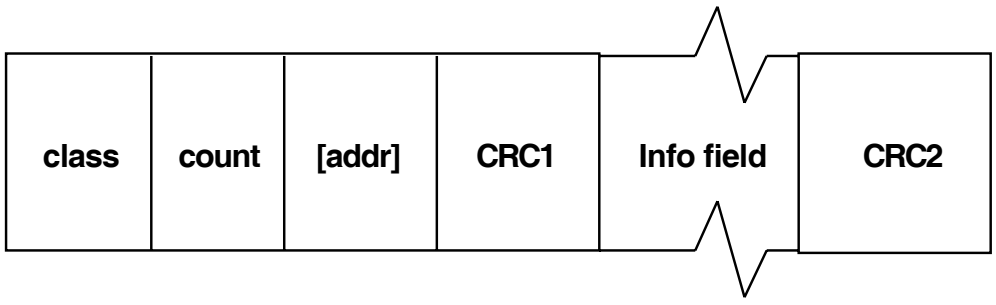
Note for DDCMP users

This section applies only to implementations of the DDCMP protocol that are not supplied by Digital.

DDCMP (Digital Data Communications Message Protocol) is a byte-oriented protocol that can be used on synchronous or asynchronous, half- or full-duplex, serial or parallel, and point-to-point or multi-point systems.

Figure B–1 shows the way a DDCMP frame is made up.

Figure B–1 A DDCMP Frame



Notes

DDCMP framing checks these fields only:

1. **CLASS**

   Eight bits. There are three classes of message: Data (81), Control (05), and Maintenance (90).

2. **COUNT**

   This 14-bit field is used in Data and Maintenance messages to indicate the number of characters that will follow the header, forming the information part of the message. In Control messages, the first eight bits indicate the kind of Control message it is.

   There are also two flag bits.

3. The DDCMP framing routine checks only that the two octets used by DDCMP for sequence and response are present.

4. **ADDRESS**

   Not checked by the framing routine.

5. **CRC1**

   This 16-bit field is a check just on the header information. In Control messages, the frame stops here.

6. **CRC2**

   A second check (also 16-bits), on the *Information* field.

DDCMP framing also checks that the length of the frame is valid.

B.2 The HDLC and SDLC Framing Routines

Note for HDLC users

This section applies only to implementations of HDLC protocols that are not supplied by Digital.

Notes

The HDLC framing routine checks these fields only:

1. **FLAGS**

   A bit pattern of `01111110` at the beginning and end of the frame.

2. **ADDRESS**

   An optional address check of the next 8 (or possibly 16) bits. (SDLC only)

3. **CRC**

   A frame check that is either CRC_CCITT (16 bits) or CRC_AUTODINII (32 bits). (HDLC only)

B.3 BISYNC

BISYNC is IBM's Binary Synchronous Communications Protocol. BISYNC is a character-oriented protocol, used for transmission between IBM computers and batch and video display terminals.

B.4 GENBYTE

Note

GENBYTE is not supported for calls to the WANDRIVER interface. It is available only to users of the obsolete interface, and is unchanged from the GENBYTE available with earlier versions of the VAX WAN Device Drivers.

The GENBYTE protocol is supported by the DMB32 and DMF32 device drivers. GENBYTE enables receive message framing to be tailored to suit a particular user-written protocol. This facility allows protocols not specifically supported by the driver, or by the device's firmware, to have their own rules for framing receive messages.

GENBYTE enables the users framing routine to become part of the driver's interrupt processing context. When GENBYTE is the line protocol, incoming data is passed, character by character, to the user's framing routine, which then decides whether the driver should:

- Ignore the character completely.
- Buffer the character as part of the frame being composed.
- Buffer the character and overwrite the previously buffered character.

The framing routine also tells the driver whether the latest incoming character terminates the frame in the desired protocol, and if the receive frame should be posted for I/O completion.

B.4.1 The Framing Routine

You must write your own framing routine and load it into nonpaged pool. Because it is in nonpaged pool, the framing routine must be written in position-independent code. You pass the address of your routine to the driver when you start the line.

The address of the framing routine is kept in the driver's database for the line. The driver also maintains for each GENBYTE line a context quadword, which is used by the framing interface for keeping state information while it is framing the receive message. The context quadword and the value of the incoming character constitute the total amount of information given to the framing routine. Thus, any protocol-specific context held by the framing routine must be kept in the context quadword since there is no other per-line data available to the framing routine.

The value of the context quadword at the start of the frame is defined in the SETMODE QIO P2 buffer. The framing routine can make use of the quadword in any way it wishes (for example, to hold counts and finite state machine states indicating which characters to expect next). At the end of each frame, the context quadword is reset to its initial value.

The driver calls your framing routine using a JSB instruction in the following manner:

IPL = Driver's fork IPL

R0 = Address of the framing routine context quadword for the line

R1 = Incoming character in the low byte

Your framing routine must preserve all the registers it uses (except R0 and R1). It may update the context quadword, but must not change any other system data structures.

On return to the driver, the framing routine holds the following parameters:

R1 = The incoming character

R0 = Indication of what the driver should do with the character

Bits set in R0 signify:

Bit 0 If clear, buffer the character in the next position. If set, use bit 1.

Bit 1 If clear, ignore the character. If set, buffer the character in the previous position (that is, overwrite the last character buffered).

Bit 2 If set, complete and return the framed buffer to the user. (Buffer character according to bits 0 and 1.) If clear, ignore.

So the following values of the least significant byte of R0 indicate:

0 = Buffer character in next position.

1 = Ignore character.

2 = Invalid code.

3 = Buffer character in previous position.

4 = Buffer character in the next position. Complete the frame.

5 = Ignore character. Complete the frame.

6 = Invalid code.

7 = Buffer character in previous position. Complete the frame.

Note that the framing routine should execute as few instructions as possible for each character, otherwise data may be lost. Ten instructions is a typical upper limit.

B.4.2 QIO Parameters Used in GENBYTE Operation

Select GENBYTE by setting the NMA$C_LINPR_PRO parameter in the SETMODE startup QIO to the value NMA$C_LINPR_BSY. (Since GENBYTE does not distinguish between line and circuit, the IO$M_CTRL subfunction modifier must always be specified in the startup QIO.)

Note that your process requires CMKRNL privilege to select GENBYTE mode, since access to system code in nonpaged pool is implied.

B.4.2.1 IO$_SETMODE P2 Parameter

Use any of the following parameters for the P2 argument to the SETMODE (controller) QIO function:

NMA$C_PCLI_PRO (with value = NMA$C_PRO_BSY)
NMA$C_PCLI_DUP
NMA$C_PCLI_BFN
NMA$C_PCLI_BUS
NMA$C_PCLI_CON

However, there are extra parameters for the P2 argument specifically for GENBYTE. See Table B–1 for details.

Table B–1 Extra P2 Parameters for GENBYTE

Parameter ID	Meaning
NMA$C_PCLI_SYC	The SYNC character used by the device. Defaults to 32 hex.
NMA$C_PCLI_NMS	The number of SYNC characters to precede a transmit. The default is 8.
NMA$C_PCLI_FRA	The address of your protocol framing routine in nonpaged system address space. This parameter must be specified.
NMA$C_PCLI_STI1 NMA$C_PCLI_STI2	These two parameters contain the initial value of the framing routine context quadword. The SETMODE startup QIO sets the context quadword to this initial value. When the framing routine signals end-of-frame to the driver, the context quadword is reset to this initial value.

B.4.2.2 IO$_WRITEBLK P4 Parameter

In GENBYTE mode, the IO$_WRITEBLK QIO function has an extra optional P4 parameter. If P4 is zero, the parameter is ignored; if P4 is nonzero, the parameter must point to an 8-byte buffer in your program. The contents of this buffer are immediately copied to the context quadword for the line. You can use this facility to indicate to the framing routine that a different type of frame is expected next. Note that the initial quadword value is always used to reset the context quadword at the end of each received frame.

B.4.3 Other Aspects of GENBYTE Operation

An IO$_CLEAN QIO stops all outstanding transmit and receive I/O operations.

The driver for a DMA device operates in a degraded mode when running in GENBYTE. This is because it has to examine repeatedly the contents of the receive buffer that is in progress to check whether there are new characters to be passed to the framing routine. Thus, the maximum line speed that the device driver supports in GENBYTE mode is less than that supported by other protocols used by the driver. An upper limit of 9.6K baud for GENBYTE is typical.

B.4.4 How to Use GENBYTE

Writing a framing routine for GENBYTE is relatively straightforward. Getting it loaded into system space, and providing the address of the framing routine, needs care. Remember that a GENBYTE framing routine effectively augments the VMS executive on line. Take great care to ensure that you have designed the GENBYTE interface correctly: an improperly designed interface can crash the system.

Example techniques you might use are as follows:

- The framing routine could be loaded as part of a pseudo-device driver, which can return the framing routine entry point address in response to some I/O request, such as IO$_INITIALIZE.
- Alternatively, use a suitably privileged process to allocate nonpaged pool, and copy the framing routine code into the nonpaged pool buffer. Ensure that the framing routine is written in position-independent code. This approach would enable the framing routine to be unloaded from nonpaged pool when it is no longer required and the line has been shut down.

Once the framing routine had been loaded into nonpaged pool and its entry point address has been identified, a CMKRNL-privileged process (the "starter-process") can issue an IO$_SETMODE QIO to start up the line into GENBYTE mode. If the starter-process is the only process that will perform data transfers over the line, then it can proceed to issue IO$_WRITELBLK and IO$_READLBLK QIOs. If other user-processes are required to transfer data over the line, then either they must have SHARE privilege, or else run images installed with SHARE privilege. SHARE privilege is required so that the process can assign to the line at the same time as the starter-process.

Section B.5 contains an example GENBYTE routine.

B.5 A Sample GENBYTE Macro-32 Framing Routine for a Subset of the IBM BISYNC Protocol

```
        .SBTTL  MACROS
;
; Macro to simplify CASE instructions
;
        .MACRO  SELECT  INDEX,VECLIST,TYPE=W,PREFIX1=<>,PREFIX2=<>,?DISPL0
;
; Inputs: Index   = Case index
;         Veclist = A list of pairs of values <<val,adr>,...,<val,adr>>
;                   which indicate the branch to take for various values
;                   of the index. If the index value does not appear in
;                   the list, control goes to immediately after the macro.
;         Prefix1 = An optional prefix that will precede the 'val' field
;                   in the 'veclist' pairs - used for abbreviating symbolic
;                   values in the list.
;         Prefix2 = An optional prefix that will precede the 'adr' field
;                   in the 'veclist' pairs - used for abbreviating symbolic
;                   values in the list.
;                   If the 'adr' field is null, then the address for this
;                   pair is taken as the concatenation of 'val' and 'prefix2'
;


        .MACRO  $$MAX   NUM,IGNORE
        .IIF    EQ $$MXSW, $$HIGH=NUM
        $$MXSW=1
        .IIF    LT $$HIGH-NUM, $$HIGH=NUM
        .ENDM   $$MAX

        .MACRO  $$MIN   NUM,IGNORE
        .IIF    EQ $$MNSW, $$LOW=NUM
        $$MNSW=1
        .IIF    GT  $$LOW-NUM, $$LOW=NUM
        .ENDM   $$MIN

        .MACRO  $$GENDISPL      VALUE,LABEL,PFIX1=<>,PFIX2=<>
        .IF     EQ  $$DISPL-PFIX1''VALUE
        .IIF NB <LABEL> , .SIGNED_WORD  PFIX2''LABEL-DISPL0
        .IIF B  <LABEL> , .SIGNED_WORD  PFIX2''VALUE-DISPL0
        .IIF    EQ  1-$$GENSW,  .ERROR  ; Duplicate occurrence of VALUE
        $$GENSW=1
        .ENDC
        .ENDM   $$GENDISPL

$$MXSW=0
$$MNSW=0
        .IRP    TUPLE,<VECLIST>
        $$MAX   PREFIX1''TUPLE
        $$MIN   PREFIX1''TUPLE
        .ENDR
$$BASE=$$LOW
$$LIMIT=$$HIGH-$$LOW
$$DISPL=$$BASE
        CASE'TYPE       INDEX,#$$BASE,#$$LIMIT
DISPL0:
        .REPT   $$LIMIT+1
        $$GENSW=0
        .IRP    TUPLE,<VECLIST>
        $$GENDISPL      TUPLE,PFIX1=<PREFIX1>,PFIX2=<PREFIX2>
        .ENDR
        .IIF    EQ  $$GENSW,    .WORD   2*<$$LIMIT+1>
        $$DISPL=$$DISPL+1
        .ENDR
        .ENDM   SELECT
```

```
;
; Macro to define EBCDIC constants.
;
        .MACRO  EBC$DEF
        EBC$_SPA        = 64
        EBC$_SOH        = 1
        EBC$_STX        = 2
        EBC$_ETX        = 3
        EBC$_ETB        = 38
        EBC$_EOT        = 55
        EBC$_DLE        = 16
        EBC$_NAK        = 61
        EBC$_ENQ        = 45
        EBC$_AK0        = 112
        EBC$_AK1        = 97
        EBC$_IGS        = 29
        EBC$_IRS        = 30
        EBC$_DC1        = 17
        EBC$_DC2        = 18
        EBC$_DC3        = 19
        EBC$_HT         = 5
        EBC$_ITB        = 31
        EBC$_NL         = 21
        EBC$_SYN        = 50
        EBC$_RVI        = 124
        EBC$_WACK       = 107
        EBC$_SLH        = 97
        EBC$_ESC        = 39
        EBC$_PAD        = 255
        .MACRO  EBC$DEF
        .ENDM   EBC$DEF
        .ENDM   EBC$DEF


;
; Macro to define BISYNC receive states.
;
        .MACRO ST_DEF
        ST_START        = 0
        ST_NTTX         = 1
        ST_STOP1        = 2
        ST_STOP         = 3
        ST_NTTX_ITB     = 4
        ST_NTTX_ITB1    = 5
        ST_XPR          = 6
        ST_XPR_DLE      = 7
        ST_XPR_SYN      = 8
        ST_XPR_ITB      = 9
        ST_XPR_ITB1     = 10
        ST_BINARY       = 11
        ST_DLE_FIRST    = 12
        ST_XPR_NEW      = 13
        ST_SLAVELOOP    = 14
        .MACRO  ST_DEF
        .ENDM   ST_DEF
        .ENDM   ST_DEF


;
; Genbyte framing return code status bits.
;
        GENB$M_BUFFER_CHAR        = 1@0
        GENB$M_BUFFER_IN_PREV_POS = 1@1
        GENB$M_COMPLETE_READ      = 1@2
```

```
;
; Set status for driver to buffer the character in R1 in the
; next position in the buffer.
;
        .MACRO  BUFFER_CURRENT
        CLRL    R0
        .ENDM   BUFFER_CURRENT


;
; Set status for driver to buffer character in R1 in previous position
; in buffer, overwriting previous character buffered.
;
        .MACRO  BUFFER_PREVIOUS
        MOVL    #GENB$M_BUFFER_CHAR!GENB$M_BUFFER_IN_PREV_POS,R0
        .ENDM   BUFFER_PREVIOUS


;
; Set status for driver to ignore the character.
;
        .MACRO  IGNORE_CHAR
        MOVL    #GENB$M_BUFFER_CHAR,R0
        .ENDM   IGNORE_CHAR



;
; Set status for driver to buffer character in current position,
; and then to complete the read.
;
        .MACRO  COMPLETE_FRAME
        MOVL    #GENB$M_COMPLETE_READ,R0
        .ENDM   COMPLETE_FRAME
;
        .SBTTL  FRAMING ROUTINE
;
        EBC$DEF                 ; EBCDIC character definitions
        ST_DEF                  ; Framing routine definitions
;
; NOTE: Framing routine assumes that the first byte of the
; state quadword is the BISYNC receive state.
;
        RCV$B_RCVSTATE  = 0     ; Receive state-machine state
        RCV$B_ITBCNT    = 1     ; ITB count in state quadword
        RCV$W_BIN_COUNT = 2     ; Byte count (when in binary state)


;
; Initial values of state quadword. Set up when the line is started.
; Reset when a frame completes.
;
        NY$C_INIT_STATE   = ST_START!<256*7>    ; START state. Max 7 ITBs
        NY$C_BINARY_STATE = ST_BINARY           ; Binary receive start state
        NY$C_SLAVE_STATE  = ST_SLAVELOOP        ; Slave receive start state
```

```
;
; ============================================================
; =             *** FRAMING ROUTINE FOR BISYNC ***             =
; ============================================================
;
FRAMING_ROUTINE::
;
; Select what to do next based on the current state of the
; BISYNC state-machine maintained by this framing routine.
;
        SELECT (R0),TYPE=B,-
               <START,-
                NTTX,-
                STOP1,-
                STOP,-
                NTTX_ITB,-
                NTTX_ITB1,-
                XPR,-
                XPR_DLE,-
                XPR_SYN,-
                XPR_ITB,-
                XPR_ITB1,-
                BINARY,-
                DLE_FIRST,-
                XPR_NEW,-
                SLAVELOOP,-
                >,PREFIX1=<ST_>,PREFIX2=<FRAME_>

;
; Start of frame
;
FRAME_START:
        CMPB    #EBC$_DLE,R1            ; Is it transparent text or a response?
        BNEQ    10$                     ; NEQ if no
        MOVB    #ST_DLE_FIRST,(R0)      ; Say first character was a DLE
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver
10$:    BBC     R1,RSPMASK,20$          ; 1 byte response (NAK,ENQ,EOT) ?
        BRW     FRAME_STOP              ; Complete receive with 1 byte response
20$:    MOVB    #ST_NTTX,(R0)           ; Non-transparent text state


;
; Non-transparent text
;
FRAME_NTTX:
        BBS     R1,CCHRMASK,FRAME_CTRL  ; BBS if control character
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver
FRAME_CTRL:
        CMPB    #EBC$_ITB,R1            ; Internal CRC next?
        BNEQ    10$                     ; NEQ if no
        MOVB    #ST_NTTX_ITB,(R0)       ; Signal first CRC byte next
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver
10$:    CMPB    #EBC$_SYN,R1            ; SYN in text?
        BNEQ    20$                     ; NEQ if no
        IGNORE_CHAR                     ; Say character is to be ignored
        RSB                             ; Return to driver
20$:    CMPB    #EBC$_ENQ,R1            ; Is it a forward abort?
        BEQL    FRAME_STOP              ; Go signal end of frame
        MOVB    #ST_STOP1,(R0)          ; CRC next
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver
```

```
;
; Second character of frame following DLE
;
FRAME_DLE_FIRST:
        CMPB    #EBC$_STX,R1            ; Is it a transparent text block
        BNEQ    10$                     ; NEQ if no
        MOVB    #ST_XPR,(R0)            ; Say we're in transparent text mode
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver
10$:    BRB     FRAME_STOP              ; Assume last character of response


;
; Transparent text
;
FRAME_XPR:
        CMPB    #EBC$_DLE,R1            ; Is it a DLE
        BEQL    10$                     ; EQL if yes
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver
10$:    MOVB    #ST_XPR_DLE,(R0)        ; DLE state next
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver


;
; Transparent text, DLE state
;
FRAME_XPR_DLE:
        CMPB    #EBC$_ITB,R1            ; Is it an internal CRC?
        BNEQ    10$                     ; NEQ if no
        MOVB    #ST_XPR_ITB,(R0)        ; Set transparent ITB state next
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver
10$:    CMPB    #EBC$_SYN,R1            ; Is it a SYN in text
        BNEQ    20$                     ; NEQ if no
        MOVB    #ST_XPR_SYN,(R0)        ; Set state to overwrite previous DLE
        IGNORE_CHAR                     ; Say ignore this character
        RSB                             ; Return to driver
20$:    BBS     R1,CCHRMASK,40$         ; Branch if control character
        CMPB    #EBC$_STX,R1            ; Is it an STX?
        BNEQ    30$                     ; NEQ if no
        MOVB    #ST_XPR,(R0)            ; Go back to transparent text state
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver
30$:    CMPB    #EBC$_DLE,R1            ; Is it a DLE
        BNEQ    FRAME_STOP              ; Abort receive for any other character
        MOVB    #ST_XPR,(R0)            ; Go back to transparent text state
        BUFFER_CURRENT                  ; Have second DLE buffered
        RSB                             ; Return to driver
40$:    MOVB    #ST_STOP1,(R0)          ; Say stop after two CRC bytes
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver
```

```
;
; Non-transparent first internal CRC byte state
;
FRAME_NTTX_ITB:
        MOVB    #ST_NTTX_ITB1,(R0)      ; Second CRC byte state next
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver
;
; Non transparent second internal CRC byte state
;
FRAME_NTTX_ITB1:
        MOVB    #ST_NTTX,(R0)           ; Non-transparent text state next
        BRB     FRAME_ITB_END           ; Do common end of ITB processing
;
; End of frame
;
FRAME_STOP:
        MOVQ    #NY$C_INIT_STATE,(R0)   ; Set next state to new frame
        COMPLETE_FRAME                  ; End of frame, buffer character
        RSB                             ; Return to driver


;
; Transparent first CRC byte state
;
FRAME_XPR_ITB:
        MOVB    #ST_XPR_ITB1,(R0)       ; Second CRC byte next
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver
;
; Transparent   second CRC byte state
;
FRAME_XPR_ITB1:
        MOVB    #ST_XPR_NEW,(R0)        ; New internal record state
FRAME_ITB_END:
        DECB    RCV$B_ITBCNT(R0)        ; One more internal record received
        BLEQ    FRAME_STOP              ; LEQ if more than 7 ITBs - give up
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver


;
; Transparent text, DLE SYN was received (DLE has been buffered)
;
FRAME_XPR_SYN:
        CMPB    #EBC$_DLE,R1            ; Is it a DLE
        BNEQ    10$                     ; NEQ if no
        MOVB    #ST_XPR_DLE,(R0)        ; Transparent DLE state next
        IGNORE_CHAR                     ; Ignore this DLE, one already buffered
        RSB                             ; Return to driver
10$:    MOVB    #ST_XPR,(R0)            ; Go back to normal transparent text
        BUFFER_PREVIOUS                 ; Buffer character, overwriting DLE
        RSB                             ; Return to driver
;
; First byte of final CRC state
;
FRAME_STOP1:
        MOVB    #ST_STOP,(R0)           ; Final byte next
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; Return to driver
```

```
;
; New record state
;
FRAME_XPR_NEW:
        CMPB    #EBC$_SYN,R1            ; Is it the leading SYN char
        BEQL    10$                     ; EQL if yes
        MOVB    #ST_XPR,(R0)            ; Go back to transparent text state
        BRW     FRAME_XPR               ; Go process the character
10$:    IGNORE_CHAR                     ; Ignore the SYN
        RSB                             ; Return to driver
;
; Binary read - used for diagnostic QIOs - Buffer till count runs out
;
FRAME_BINARY:
        DECW    RCV$W_BIN_COUNT(R0)     ; One more byte
        BEQL    FRAME_STOP              ; EQL if done - complete buffer & reset
                                        ; state to text
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; And return


;
; Slaveloop read - for diagnostic slave test - Buffer till PAD received
;
FRAME_SLAVELOOP:
        CMPB    #EBC$_PAD,R1            ; Is it end of frame?
        BEQL    10$                     ; EQL if yes
        BUFFER_CURRENT                  ; Buffer character in current position
        RSB                             ; And return
10$:                                    ; End of slaveloop frame
        MOVL    #GENB$M_BUFFER_CHAR!GENB$M_COMPLETE_READ,R0 ; End frame, ignore char
        RSB
;
        .SBTTL  Data Tables


;
; Macros to generate a table of 256 bits - all zeros
; except for the bits corresponding to the character
; codes specified in the parameter list.
;
        .MACRO  MASK_TABLE  TABLE,CHARLIST
        .IRP    CHAR,<CHARLIST>
                MASK_INCLUDE_CHAR  TABLE,\CHAR
        .ENDR
TABLE:
        M$ = 0
        .REPT   8
                MASK_LONGWORD  TABLE,\M$
                M$ = M$+1
        .ENDR
        .ENDM   MASK_TABLE

        .MACRO  MASK_LONGWORD  TABLE,INDEX
        .IIF  DF TABLE''INDEX ,  .LONG  TABLE''INDEX
        .IIF NDF TABLE''INDEX ,  .LONG  0
        .ENDM   MASK_LONGWORD

        .MACRO  MASK_INCLUDE_CHAR  TABLE,CHAR
        M$NUM = CHAR / 32
        M$BIT = CHAR - <M$NUM * 32>
        MASK_INCLUDE_BIT  TABLE,\M$NUM,\M$BIT
        .ENDM   MASK_INCLUDE_CHAR

        .MACRO  MASK_INCLUDE_BIT  TABLE,INDEX,BIT
        .IIF NDF TABLE''INDEX , TABLE''INDEX = 0
        TABLE''INDEX = TABLE''INDEX ! <1 @ BIT>
        .ENDM   MASK_INCLUDE_BIT


;
; Control character table (CCHRMASK)
;
        MASK_TABLE  CCHRMASK,-
                    <EBC$_ITB,EBC$_ETX,EBC$_EOT,EBC$_SYN,EBC$_ENQ,EBC$_ETB>
```

```
;
; 1 byte response table (RSPMASK)
;
        MASK_TABLE  RSPMASK,-
                    <EBC$_NAK,EBC$_EOT,EBC$_ENQ>

;
; End of Framing routine
;
FRAMING_ROUTINE_END::
;
; Length of framing routine area
;
FRAMING_ROUTINE_LENGTH == FRAMING_ROUTINE - FRAMING_ROUTINE_END
;
;
        .END
```

C
Example Programs

This appendix gives the listings of four programs written in C, divided between the WANDRIVER interface (Section C.1) and the obsolete interface (Section C.2).

Note that a number of example programs, written in C and Ada, are placed in the SYS$EXAMPLES directory when you install the VAX WAN Device Drivers. See the *DECnet/OSI for VMS Installation and Configuration* manual for a list of these files.

C.1 Programs That Use the WANDRIVER Interface

Section C.1.1 issues write requests to WANDRIVER; Section C.1.2 issues read requests to WANDRIVER.

C.1.1 WANDRIVER Program That Sends Data

```
/*
**
**  INCLUDE FILES
**
**/

#include  <stdio.h>
#include <starlet.h>
#include iodef
#include descrip
#include ssdef
#include "xmdef.h"
#include "nmadef.h"
#include "dl_external.h"
#include "dll_external.h"
```

```
/*
**++
**  FUNCTIONAL DESCRIPTION:
**
**  This program sends data to a device using the WANdriver interface
**  to the DECnet/OSI datalinks
**  The program requires the HDLC module with link name 'HDLCL1' and
**  logical station name 'LS2'.
**
**  FORMAL PARAMETERS:
**
**      none
**
**  IMPLICIT INPUTS:
**
**      none
**
**  IMPLICIT OUTPUTS:
**
**      none
**
**  COMPLETION CODES
**
**      Success/Fail codes
**
**
**  SIDE EFFECTS:
**
**      none
**--
**/

void ATT_AST(long status);      /* Function declaration  */

/*****************************************************************/

typedef struct                   /*  Definition of structure  */
         {                       /*  of io status block       */
         short cond_value;       /*  Word length condition value */
         short count;            /*  No of bytes of data transfered */
         int info;               /*  Device specific information   */
         } io_statblk;

/*****************************************************************/

typedef struct                  /* Definition of structure of item list */
         {
         short item_length;
         short item_code;
         int   item_value;
         } p2_param_item;

/*****************************************************************/

p2_param_item p2_list = {                   /* Initialising item list  */
                        6,
                        dll$K_PROTOCOLID,
                        0x0103
                        };
```

```
int p2_desc[2]  = {                 /* Definition of P2 */
                   6,               /* descriptor of item list      */
                   &p2_list
                  };
int status;
int message_no = 0;
int i = 0;                      /*  loop count for write   */
short assgnd_chan;
io_statblk   iosb,iosb2,iosb3,iosb4;
char secstr[12];

/***********************************************
 *           MAIN ROUTINE                      *
 ***********************************************/

main()
{

      $DESCRIPTOR (terminal, "wan0:");
      $DESCRIPTOR (datalink, "HDLC.HDLCL1.LS2");

/*************************************
 *    ASSIGN A CHANNEL FOR QIO       *
 *************************************/

      if (((status = SYS$ASSIGN(&terminal, &assgnd_chan, 0, 0)) & 1) != 1)
            LIB$STOP( status);

/*************************************
 *        OPEN A PORT                *
 *************************************/

      if (((status = SYS$QIOW( 0, assgnd_chan, (IO$_CREATE),
                     &iosb,0,0,&datalink,&p2_desc,0,0,0,0 )) & 1) != 1)
           LIB$STOP( status);

/*************************************
 *    START THE DATALINK PROTOCOL    *
 *************************************/

      if (((status = SYS$QIOW( 0, assgnd_chan, (IO$_SETMODE | IO$M_STARTUP),
                     &iosb2,0,0,0,0,0,0,0,0 )) & 1) != 1)
            LIB$STOP( status);

/*************************************
 *    ENABLE ATTENTION AST           *
 *************************************/

      if (((status = SYS$QIOW( 0, assgnd_chan, (IO$_SETMODE | IO$M_ATTNAST),
                     &iosb3,0,0,ATT_AST,200,0,0,0,0 )) & 1) != 1)
            LIB$STOP( status);

/*************************************
 *    WRITE DATA                     *
 *************************************/


      for (i = 0; i < 20; i++) {
           sprintf(secstr,"MESSAGE %03d",i);
           if (((status = SYS$QIOW(0, assgnd_chan, IO$_WRITEVBLK, &iosb4, 0,
                          0, secstr, sizeof(secstr)-1,0, 32,0, 0)) & 1) != 1)
                LIB$STOP( status);

           if (iosb4.cond_value != 1) {
               LIB$STOP (iosb4.cond_value);
               printf("Write not successful\n");
           }
      }
}
/*************** End of main *************************/
```

```
/*****************************************************************
 *   Attention Asynchronous System Trap routine                  *
 *****************************************************************/

void ATT_AST(long status)
/*
**++
**  FUNCTIONAL DESCRIPTION:
**
**      Attention Asynchronous System Trap routine called when an
**      attention AST is posted
**
**  FORMAL PARAMETERS:
**
**      none
**
**  IMPLICIT INPUTS:
**
**      none
**
**  IMPLICIT OUTPUTS:
**
**      none
**
**  COMPLETION CODES:
**
**      none
**
**  SIDE EFFECTS:
**
**      none
**
**--
**/
{
     if ((status && dll$m_sts_active) == 1 )
          printf("LINK IS UP\n");
     else
          printf("LINK IS DOWN");

     if ((status && dll$m_sts_receive_data_ready) == 0)
          printf("There is received data waiting to be read\n");
     else
          ;

     if ((status && dll$m_sts_physical_loopback) == 0)
          printf("Data is looping back at the physical layer\n");
     else
          ;

     if ((status && dll$m_err_remote_restart) == 0)
          printf("The remote station is restarting\n");
     else
          ;

     if ((status && dll$m_err_insuff_resources) == 0)
          printf("There are insufficient system resources to provide the
   service called\n");
     else
          ;

     if ((status && dll$m_err_physical_layer_down) == 0)
          printf("The DECnet/OSI physical layer is not available\n");
     else
          ;
```

```
     if ((status && dll$m_err_negotiation_failure) == 0)
          printf("There has been a negotiation failure\n");
     else
          ;
     if ((status && dll$m_err_maintenance_mode) == 0)
          printf("The modem has been set to maintenance mode\n");
     else
          ;
     if ((status && dll$m_err_disabled) == 0)
          printf("The device is disabled\n");
     else
          ;
     if ((status && dll$m_err_threshold_exceeded) == 0)
          printf("A system resource has been exceeded\n");
     else
          ;
/***************************************
 *    RE-ENABLE ATTENTION AST            *
 ***************************************/
      if (((status = SYS$QIOW( 0, assgnd_chan, (IO$_SETMODE | IO$M_ATTNAST),
                    &iosb3,0,0,ATT_AST,200,0,0,0,0 )) & 1) != 1)
            LIB$STOP( status);
}
/********** End of ATT_AST routine ****************************/

/*********************************************************************/
/*           END OF PROGRAMME                                        */
/*********************************************************************/
```

C.1.2 WANDRIVER Program That Receives Data

```
/*
**
**  INCLUDE FILES
**
**/

#include  <stdio.h>
#include  <starlet.h>
#include iodef
#include descrip
#include ssdef
#include "xmdef.h"
#include "nmadef.h"
#include "dl_external.h"
#include "dll_external.h"
```

```
/*
**++
**  FUNCTIONAL DESCRIPTION:
**
**  This program sends data to a device using the WANdriver interface
**  to the DECnet/OSI datalinks
**  The program requires the HDLC module with link name 'HDLCL1' and
**  logical station name 'LS2'.
**
**  FORMAL PARAMETERS:
**
**      none
**
**  IMPLICIT INPUTS:
**
**      none
**
**  IMPLICIT OUTPUTS:
**
**      none
**
**  COMPLETION CODES
**
**      Success/Fail codes
**
**
**  SIDE EFFECTS:
**
**      none
**--
**/

void ATT_AST(long status);      /* Function declarations  */
void ast(char *string);

/*****************************************************************************/

typedef struct                    /*  Definition of structure  */
         {                        /*  of io status block       */
         short cond_value;        /*  Word length condition value */
         short count;             /*  No of bytes of data transfered */
         int info;                /*  Device specific information   */
         } io_statblk;

typedef struct                    /* Definition of structure of item list */
         {
         short item_length;
         short item_code;
         int   item_value;
         } p2_param_item;

/*****************************************************************************/

p2_param_item p2_list = {
                        6,
                        dll$K_PROTOCOLID,
                        0x0103
                        };

int p2_desc[2]  = {                 /* Definition of P2 */
                    6,              /* descriptor of item list      */
                    &p2_list
                  };

int i = 0;
int status;
short assgnd_chan;
io_statblk   iosb,iosb2,iosb3,iosb4;
char secstr[12];
```

```
/***********************************************
 *           MAIN ROUTINE                      *
 ***********************************************/

main()
{

     $DESCRIPTOR (pseudo_driver, "wan0:");
     $DESCRIPTOR (datalink, "HDLC.HDLCL1.LS2");

/***************************************
 *    ASSIGN A CHANNEL FOR QIO         *
 ***************************************/

     if (((status = SYS$ASSIGN(&pseudo_driver, &assgnd_chan, 0, 0)) & 1) != 1)
          LIB$STOP( status);

/***************************************
 *        OPEN A PORT                  *
 ***************************************/

     if (((status = SYS$QIOW( 0, assgnd_chan, (IO$_CREATE),
                    &iosb2,0,0,&datalink,&p2_desc,0,0,0,0 )) & 1) != 1)
          LIB$STOP( status);

/***************************************
 *    START THE DATALINK PROTOCOL      *
 ***************************************/

     if (((status = SYS$QIOW( 0, assgnd_chan, (IO$_SETMODE | IO$M_STARTUP),
                    &iosb3,0,0,0,0,0,0,0,0 )) & 1) != 1)
          LIB$STOP( status);

/***************************************
 *    ENABLE ATTENTION AST             *
 ***************************************/

     if (((status = SYS$QIOW( 0, assgnd_chan, (IO$_SETMODE | IO$M_ATTNAST),
                    &iosb,0,0,ATT_AST,200,0,0,0,0 )) & 1) != 1)
          LIB$STOP( status);

/***************************************
 *    READ DATA                        *
 ***************************************/

     if (((status = SYS$QIO(0, assgnd_chan, IO$_READVBLK, &iosb4, ast, secstr,
                    secstr, sizeof(secstr)-1,0, 0,0, 0)) & 1) != 1)
          LIB$STOP( status);
    SYS$HIBER();
}

/********** End of MAIN ***********************************************/

/*********************************************************************
 *   Attention Asynchronous System Trap routine                      *
 *********************************************************************/
```

```
void ATT_AST(long status)
/*
**++
**  FUNCTIONAL DESCRIPTION:
**
**      Attention Asynchronous System Trap routine called when an
**      attention AST is posted
**
**  FORMAL PARAMETERS:
**
**      none
**
**  IMPLICIT INPUTS:
**
**      none
**
**  IMPLICIT OUTPUTS:
**
**      none
**
**  COMPLETION CODES:
**
**      none
**
**  SIDE EFFECTS:
**
**      none
**
**--
**/
{
     if ((status && dll$m_sts_active) == 1 )
          printf("LINK IS UP\n");
     else
          printf("LINK IS DOWN");

     if ((status && dll$m_sts_receive_data_ready) == 0)
          printf("There is received data waiting to be read\n");
     else
          ;

     if ((status && dll$m_sts_physical_loopback) ==  0)
          printf("Data is looping back at the physical layer\n");
     else
          ;

     if ((status && dll$m_err_remote_restart) == 0)
          printf("The remote station is restarting\n");
     else
          ;

     if ((status && dll$m_err_insuff_resources) == 0)
          printf("There are insufficient system resources to provide the
   service called\n");
     else
          ;

     if ((status && dll$m_err_physical_layer_down) == 0)
          printf("The DECnet/OSI physical layer is not available\n");
     else
          ;

     if ((status && dll$m_err_negotiation_failure) == 0)
          printf("There has been a negotiation failure\n");
     else
          ;
```

```
     if ((status && dll$m_err_maintenance_mode) == 0)
          printf("The modem has been set to maintenance mode\n");
     else
          ;
     if ((status && dll$m_err_disabled) == 0)
          printf("The device is disabled\n");
     else
          ;
     if ((status && dll$m_err_threshold_exceeded) == 0)
          printf("A system resource has been exceeded\n");
     else
          ;
/***************************************
 *    RE-ENABLE ATTENTION AST            *
 ***************************************/

      if (((status = SYS$QIOW( 0, assgnd_chan, (IO$_SETMODE | IO$M_ATTNAST),
                    &iosb3,0,0,ATT_AST,200,0,0,0,0 )) & 1) != 1)
            LIB$STOP( status);

}

/********** End of ATT_AST routine ****************************/

/*********************************************************************
 *   Asynchronous System Trap routine                                *
 *********************************************************************/

void ast(char *strng)
/*
**++
**  FUNCTIONAL DESCRIPTION:
**
**      Asynchronous System Trap routine called when an AST is posted
**
**  FORMAL PARAMETERS:
**
**      none
**
**  IMPLICIT INPUTS:
**
**      none
**
**  IMPLICIT OUTPUTS:
**
**      none
**
**  COMPLETION CODES:
**
**      none
**
**  SIDE EFFECTS:
**
**      none
**
**--
**/
{
    i++;
    printf("Received data is: %s\n",strng);
/***************************************
 *    RE-ISSUE READ                    *
 ***************************************/
```

```
    if (iosb4.cond_value != 1) {
        LIB$STOP (iosb4.cond_value);
        printf("Device write not successful\n");
    }
    if (((status = SYS$QIO(0, assgnd_chan, IO$_READVBLK, &iosb4, ast, secstr,
                  secstr, sizeof(secstr)-1,0, 0,0, 0)) & 1) != 1)
          LIB$STOP( status);
    if (i == 20) {
        SYS$WAKE();
        exit();
    }
}

/******************** End of AST routine ****************************/

/*****************************************************************/
/*            END OF PROGRAMME                                   */
/*****************************************************************/
```

C.2 Programs That Use the Obsolete Interface

Section C.2.1 issues write requests to the obsolete interface; Section C.2.2 issues read requests to the obsolete interface.

C.2.1 QIO Program That Sends Data

```
/*
**
**  INCLUDE FILES
**
**/

#include   <stdio.h>
#include    iodef
#include    descrip
#include    ssdef
#include   "xmdef.h"
#include   "nmadef.h"
#define    MAX_SIZE       1030
#define    DST32_DEVICE   0
#define    DMB32_DEVICE   1
#define    DMF32_DEVICE   2
#define    DSH32_DEVICE   3
#define    DSB32_DEVICE   4
#define    DSV11_DEVICE   5
#define    DSF32_DEVICE   6
#define    DSW_DEVICE   7
```

```
/*
**++
**  FUNCTIONAL DESCRIPTION:
**
**  This program sends data to a device using the QIO interface
**  It is an example of interfacing to the hdlc framing routine
**  and is not meant to provide a reliable datalink between two machines
**
**  FORMAL PARAMETERS:
**
**  Command line parameters: Program name set up as a symbol
**                           e.g prog :== $sys$sysroot:[sysmgr]prog.c
**                           Device name on which program is being run
**                           e.g SJA0:
**
**  IMPLICIT INPUTS:
**
**      none
**
**  IMPLICIT OUTPUTS:
**
**      none
**
**  COMPLETION CODES
**
**      Success/Fail codes
**
**
**  SIDE EFFECTS:
**
**      none
**--
**/

void get_device_name(void);     /*  Declaration of functions     */
void send_data(void);           /*                               */

/*****************************************************************/

typedef struct                    /* Definition of structure  */
              {                   /* of longword (6 bytes)    */
              short int device;
              unsigned char controller;
              unsigned char unit;
              }dev_name;
```

```
dev_name string_of_devices[7] = {           /* Initialisation of array */
                                'si',       /* of structures           */
                                10,
                                1,
    'xg',
    10,
    1,
    'zs',
    1,
    2,
    'sl',
    10,
    2,
    'sj',
    5,
    2,
    'sf',
    10,
    2,
    'zt',
    3,
    2
    };
/*********************************************************************/

typedef struct                  /*  Definition of structure  */
        {                       /*  of io status block       */
        short cond_value;       /*  Word length condition value */
        short count;            /*  No of bytes of data transfered */
        int info;               /*  Device specific information   */
        } io_statblk;


/*********************************************************************/

typedef struct                  /*  Definition of structure   */
        {                       /*  of parameter P1           */
        short not_used1;        /*  Un-used                   */
        short max_mess_size;    /*  Max message size          */
        short characteristics;  /*  Defines operational mode of driver */
        short not_used2;        /*  Un-used                   */
        } p1_param;

/*********************************************************************/

typedef struct                  /*  definition of structure   */
        {                       /*  of parameter P2           */
        short int pr_col_mode;  /*  Protocol identifier       */
        int pr_col_val;         /*  Protocol value            */
        short int dev_mode;     /*  Device mode               */
        int dev_value;          /*  Associated mode value     */
        short int cloc_gen;     /*  Internal clock mode       */
        int cloc_val;           /*  Associated clockvalue     */
        short int full_dup;     /*  Full-duplex mode          */
        int dup_val;            /*  Associated mode value     */
        short int buf_nums;     /*  No of receive buffers     */
        int buf_val;            /*  Associated number         */
        short int max_tr_rec;   /*  Max transmit $ Receive size  */
        int max_tr_rec_val;     /*  Value                        */
        short int num_synchar;  /*  Number of synch characters   */
        int synchar_val;        /*  Value                        */
        short int encod_tech;   /*  Encoding Technique           */
        int tech_val;           /*  Associated value             */
        short int clock_speed;  /*  Clock speed                  */
        int speed_val;          /*  Value                        */
        } p2_param;
```

```
/*****************************************************************/

p2_param     p2 = {                          /* initialisation of P2  */
                       NMA$C_PCLI_PRO, NMA$C_LINPR_LAPB, /* p2 buffer */
                       NMA$C_PCLI_CON, NMA$C_LINCN_NOR,
                       NMA$C_PCLI_CLO, NMA$C_LINCL_EXT,
                       NMA$C_PCLI_DUP, NMA$C_DPX_FUL,
                       NMA$C_PCLI_BFN, 4,
                       NMA$C_PCLI_BUS, MAX_SIZE,
                       NMA$C_PCLI_NMS, 6,
                       NMA$C_PCLI_NRZI, NMA$C_STATE_OFF,
                       NMA$C_PCLI_LNS, 19200
                  };

io_statblk   iosb,iosb2,iosb3;      /* I/O status blocks             */
int status;                         /* holds status return value     */
short assgnd_chan;                  /* Holds channel number returned  */
                                    /* from SYS$ASSIGN               */
char str1[2] = ":",str2[6],str3[9]; /* General purpose strings       */
int device_flag = -1;
int number_of_devices = 7;
short int *input_arg;               /* Number of command line arguments */
int unit,mat;
unsigned char type_of_device[2],contrl;
int c,l = 0,i = 0;
char message_1[1024] = "This is message 1";       /* Data to be sent  */
char message_2[1024] = "This is message 2";
char message_3[1024] = "This is message 3";
char message_4[1024] = "This is message 4";

struct dsc$descriptor_s p2_desc = {               /* Definition of P2 */
                                    sizeof(p2),   /* descriptor       */
                                    DSC$K_DTYPE_T,
                                    DSC$K_CLASS_S,
                                    &p2
                                  };

/***********************************************
 *           MAIN ROUTINE                      *
 ***********************************************/

main(int argc, char *argv[])
{

     $DESCRIPTOR (terminal, str3);                /*  Defines devic    */
     for ( i=1; i<1023; i++) message_1[i]=66;
     mat=sscanf(argv[1], "%2c%c%d", &type_of_device, &contrl, &unit);
     sprintf(str3,"%c%c%c%d:",type_of_device[0],type_of_device[1],
             contrl,unit);
     terminal.dsc$w_length = strlen(str3);

     get_device_name();    /*  Obtain name of device over which program */
                           /*  is to be run                             */

/***************************************
 *    ASSIGN A CHANNEL FOR QIO           *
 ***************************************/

     if (((status = SYS$ASSIGN(&terminal, &assgnd_chan, 0, 0)) & 1) != 1)
          LIB$STOP( status);

/***************************************
 *   SHUT DOWN OF CONTROLLER             *
 ***************************************/

     if (((status =
          SYS$QIOW(0,assgnd_chan,(IO$_SETMODE|IO$M_CTRL|IO$M_SHUTDOWN),
          &iosb,0,0,0,0,0,0,0,0 )) & 1) != 1)
          LIB$STOP( status);
```

```
     if (iosb.cond_value != 1) {
         printf("Shutdown not successful\n");
         LIB$STOP (iosb.cond_value);
     }

/****************************************
 *  START UP OF CONTROLLER                *
 ****************************************/

      if (((status =
            SYS$QIOW(0,assgnd_chan,(IO$_SETMODE|IO$M_CTRL|IO$M_STARTUP),
            &iosb,0,0,0,&p2_desc,4,0,0,0)) & 1) != 1)
            LIB$STOP( status);

      if (iosb.cond_value != 1) {               /* Check for success  */
          printf("Physical layer startup not successful\n");
          LIB$STOP (iosb.cond_value);
      }

      send_data();         /* Transmit data   */

}

/************** End of main *********************************/

/*************************************************************
 *         FUNCTION get_device_name                           *
 *************************************************************/

void get_device_name(void)

/*
**++
**  FUNCTIONAL DESCRIPTION:
**
**      This function obtains the name of the device and sets the
**       appropriate flag. It also rejects invalid inputs
**
**  FORMAL PARAMETERS:
**
**      none
**
**  IMPLICIT INPUTS:
**
**      none
**
**  IMPLICIT OUTPUTS:
**
**      sets variable 'device_flag'
**
**  COMPLETION CODES:
**
**      none
**
**  SIDE EFFECTS:
**
**      none
**
**--
**/
{

    input_arg = type_of_device;
```

```
    for (i = 0; i < number_of_devices; i++) {
         if (string_of_devices[i].device == *input_arg) {
             if ((contrl >= 'a') &&
       (contrl < ('a'+ string_of_devices[i].controller))) {
                  if ((unit >= 0) && (unit < string_of_devices[i].unit)) {
                       device_flag = i;
                       break;
                  }
                  else {
                       printf("Invalid device unit\n");
                       break;
                  }
             }
             else {
                  printf("Invalid device controller\n");
                  break;
             }
         }
         else if (i == (number_of_devices-1))
                  printf("Invalid device name\n");
    }

  if (device_flag >= 0) {
      switch(device_flag) {
             case 0: device_flag = DMB32_DEVICE;
                     break;
             case 1: device_flag = DMF32_DEVICE;
              break;
      case 2: device_flag = DST32_DEVICE;
              break;
            case 3: device_flag = DSB32_DEVICE;
              break;
      case 4: device_flag = DSV11_DEVICE;
              break;
      case 5: device_flag = DSF32_DEVICE;
              break;
      case 6: device_flag = DSW_DEVICE;
              break;
             }
         }
         else
             exit();

}

/*********** End of function get_device_name ***************/

/*********************************************************
 *                FUNCTION SEND_DATA                     *
 *********************************************************/

void send_data(void)
```

```
/*
**++
**  FUNCTIONAL DESCRIPTION:
**
**      This function writes data to a device
**
**  FORMAL PARAMETERS:
**
**      none
**
**  IMPLICIT INPUTS:
**
**      none
**
**  IMPLICIT OUTPUTS:
**
**      none
**
**  COMPLETION CODES:
**
**      Success/fail code
**
**  SIDE EFFECTS:
**
**      none
**
**--
**/
{

       printf("Sending data: \n");        /*   Send Data     */

       if (((status = SYS$QIOW(0,assgnd_chan,IO$_WRITEVBLK,&iosb3,0,0,
                      message_1,sizeof(message_1)-1,0,32,0,0))&1) != 1)
             LIB$STOP(status);

       if (((status = SYS$QIOW(0,assgnd_chan,IO$_WRITEVBLK,&iosb3,0,0,
                      message_2,sizeof(message_2)-1,0,32,0,0))&1) != 1)
             LIB$STOP(status);

       if (((status = SYS$QIOW(0,assgnd_chan,IO$_WRITEVBLK,&iosb3,0,0,
                      message_3,sizeof(message_3)-1,0,32,0,0))&1) != 1)
             LIB$STOP(status);

       if (((status = SYS$QIOW(0,assgnd_chan,IO$_WRITEVBLK,&iosb3,0,0,
                      message_4,sizeof(message_4)-1,0,32,0,0))&1) != 1)
             LIB$STOP(status);

}

/*************** End of function send_data ***********************/

/*****************************************************************
 *              END OF PROGRAM                                   *
 *****************************************************************/
```

C.2.2 QIO Program That Receives Data

```
/*
**
**  INCLUDE FILES
**
**/

#include   <stdio.h>
#include    iodef
#include    descrip
#include    ssdef
#include   "xmdef.h"
#include   "nmadef.h"
#define    MAX_SIZE       1030
#define    DST32_DEVICE   0
#define    DMB32_DEVICE   1
#define    DMF32_DEVICE   2
#define    DSH32_DEVICE   3
#define    DSB32_DEVICE   4
#define    DSV11_DEVICE   5
#define    DSF32_DEVICE   6
#define    DSW_DEVICE     7

/*
**++
**  FUNCTIONAL DESCRIPTION:
**
**  This program reads data from a device using the QIO interface
**  It is an example of interfacing to the hdlc framing routine
**  and is not meant to provide a reliable datalink between two machines
**
**  FORMAL PARAMETERS:
**
**  Command line parameters: Program name set up as a symbol
**                           e.g prog :== $sys$sysroot:[sysmgr]prog.c
**                           Device name on which program is being run
**                           e.g SJA0:
**
**  IMPLICIT INPUTS:
**
**      none
**
**  IMPLICIT OUTPUTS:
**
**      none
**
**  COMPLETION CODES
**
**      Success/Fail codes
**
**
**  SIDE EFFECTS:
**
**      none
**--
**/


void ast(char *);               /*                               */
void get_device_name(void);     /*  Declaration of functions     */
void send_data(void);           /*                               */
void read_data();               /*                               */

/*****************************************************************/
```

```
typedef struct                    /* Definition of structure  */
             {                    /* of longword (6 bytes)    */
             short int device;
             unsigned char controller;
             unsigned char unit;
             }dev_name;

dev_name string_of_devices[7] = {          /* Initialisation of array */
                                 'si',     /* of structures           */
                                 10,
                                 1,
    'xg',
    10,
    1,
    'zs',
    1,
    2,
    'sl',
    10,
    2,
    'sj',
    5,
    2,
    'sf',
    10,
    2,
    'zt',
    3,
    2
    };

/*********************************************************************/

typedef struct                    /*  Definition of structure  */
         {                        /*  of io status block       */
         short cond_value;        /*  Word length condition value */
         short count;             /*  No of bytes of data transfered */
         int info;                /*  Device specific information   */
         } io_statblk;


/*********************************************************************/

typedef struct                    /*  Definition of structure   */
         {                        /*  of parameter P1           */
         short not_used1;         /*  Un-used                   */
         short max_mess_size;     /*  Max message size          */
         short characteristics;   /*  Defines operational mode of driver */
         short not_used2;         /*  Un-used                   */
         } p1_param;

/*********************************************************************/
```

```
typedef struct                    /*  definition of structure   */
        {                         /*  of parameter P2           */
        short int pr_col_mode;    /*  Protocol identifier       */
        int pr_col_val;           /*  Protocol value            */
        short int dev_mode;       /*  Device mode               */
        int dev_value;            /*  Associated mode value     */
        short int cloc_gen;       /*  Internal clock mode       */
        int cloc_val;             /*  Associated clockvalue     */
        short int full_dup;       /*  Full-duplex mode          */
        int dup_val;              /*  Associated mode value     */
        short int buf_nums;       /*  No of receive buffers     */
        int buf_val;              /*  Associated number         */
        short int max_tr_rec;     /*  Max transmit $ Receive size  */
        int max_tr_rec_val;       /*  Value                     */
        short int num_synchar;    /*  Number of synch characters   */
        int synchar_val;          /*  Value                     */
        short int encod_tech;     /*  Encoding Technique        */
        int tech_val;             /*  Associated value          */
        short int clock_speed;    /*  Clock speed               */
        int speed_val;            /*  Value                     */
        } p2_param;

/*****************************************************************/

p2_param     p2 = {                          /* initialisation of P2  */
                     NMA$C_PCLI_PRO, NMA$C_LINPR_LAPB, /*  p2 buffer  */
                     NMA$C_PCLI_CON, NMA$C_LINCN_NOR,
                     NMA$C_PCLI_CLO, NMA$C_LINCL_EXT,
                     NMA$C_PCLI_DUP, NMA$C_DPX_FUL,
                     NMA$C_PCLI_BFN, 4,
                     NMA$C_PCLI_BUS, MAX_SIZE,
                     NMA$C_PCLI_NMS, 6,
                     NMA$C_PCLI_NRZI, NMA$C_STATE_OFF,
                     NMA$C_PCLI_LNS, 19200
                };

io_statblk   iosb,iosb2,iosb3;               /* I/O status blocks */
int status;                                  /* Holds status return value */
short assgnd_chan;                           /* Holds channel number      */
                                             /* returned from SYS$ASSIGN */
char str1[2] = ":",str2[6],str3[9],strng[150]; /* General purpose strings */
int device_flag = -1;
int number_of_devices = 7;
short int *input_arg;              /* Number of command line arguments  */
int unit,mat;
unsigned char type_of_device[2],contrl;
int c,l = 0,i = 0;

struct dsc$descriptor_s p2_desc = {              /* Definition of P2 */
                                   sizeof(p2),   /* descriptor       */
                                   DSC$K_DTYPE_T,
                                   DSC$K_CLASS_S,
                                   &p2
                                  };

/***********************************************
 *          MAIN ROUTINE                       *
 ***********************************************/

main(int argc, char *argv[])
{

     $DESCRIPTOR (terminal, str3);               /*  Defines device */
     mat=sscanf(argv[1], "%2c%c%d", &type_of_device, &contrl, &unit);
     sprintf(str3,"%c%c%c%d:",type_of_device[0],type_of_device[1],
             contrl,unit);
     terminal.dsc$w_length = strlen(str3);
```

```
    get_device_name();                /*  Obtain name of device over */
                                      /*  which program is to be run*/

/***************************************
 *    ASSIGN A CHANNEL FOR QIO           *
 ***************************************/

    if (((status = SYS$ASSIGN(&terminal, &assgnd_chan, 0, 0)) & 1) != 1)
         LIB$STOP( status);

/***************************************
 *   SHUT DOWN OF CONTROLER             *
 ***************************************/

    if (((status = SYS$QIOW( 0, assgnd_chan,
                            (IO$_SETMODE | IO$M_CTRL | IO$M_SHUTDOWN),
                            &iosb,0,0,0,0,0,0,0,0 )) & 1) != 1)
         LIB$STOP( status);

    if (iosb.cond_value != 1) {
        printf("Shutdown not successful\n");
        LIB$STOP (iosb.cond_value);
    }

/***************************************
 *  START UP OF CONTROLLER              *
 ***************************************/

     if (((status = SYS$QIOW(0, assgnd_chan,
                            (IO$_SETMODE|IO$M_CTRL|IO$M_STARTUP),
                            &iosb,0,0,0,&p2_desc,4,0,0,0)) & 1) != 1)
          LIB$STOP( status);

     if (iosb.cond_value != 1) {               /* Check for success */
         printf("Physical layer startup not successful\n");
         LIB$STOP (iosb.cond_value);
     }

     read_data();        /* Read data from device  */

}

/************ END OF MAIN **********************************/

/*********************************************************************
 *   Asynchronous System Trap routine                                 *
 *********************************************************************/
```

```
void ast(char *strng)
/*
**++
**  FUNCTIONAL DESCRIPTION:
**
**      Asynchronous System Trap routine called when an AST is posted
**
**  FORMAL PARAMETERS:
**
**      none
**
**  IMPLICIT INPUTS:
**
**      none
**
**  IMPLICIT OUTPUTS:
**
**      none
**
**  COMPLETION CODES:
**
**      none
**
**  SIDE EFFECTS:
**
**      none
**
**--
**/
{

    printf("Received data is: %s\n",strng);

}

/******************** End of AST routine ****************************/

/************************************************************
 *         FUNCTION get_device_name                         *
 ************************************************************/

void get_device_name(void)
```

```
/*
**++
**  FUNCTIONAL DESCRIPTION:
**
**      This function obtains the name of the device and sets the
**       appropriate flag. It also rejects invalid inputs
**
**  FORMAL PARAMETERS:
**
**      none
**
**  IMPLICIT INPUTS:
**
**      none
**
**  IMPLICIT OUTPUTS:
**
**      sets variable 'device_flag'
**
**  COMPLETION CODES:
**
**      none
**
**  SIDE EFFECTS:
**
**      none
**
**--
**/
{

    input_arg = type_of_device;

    for (i = 0; i < number_of_devices; i++) {
         if (string_of_devices[i].device == *input_arg) {
             if ((contrl >= 'a') &&
      (contrl < ('a'+ string_of_devices[i].controller))) {
                 if ((unit >= 0) && (unit < string_of_devices[i].unit)) {
                      device_flag = i;
                      break;
                 }
                 else {
                      printf("Invalid device unit\n");
                      break;
                 }
             }
             else {
                  printf("Invalid device controller\n");
                  break;
             }
         }
         else if (i == (number_of_devices-1))
                  printf("Invalid device name\n");
    }
```

```
  if (device_flag >= 0) {
      switch(device_flag) {
             case 0: device_flag = DMB32_DEVICE;
                     break;
             case 1: device_flag = DMF32_DEVICE;
              break;
      case 2: device_flag = DST32_DEVICE;
              break;
            case 3: device_flag = DSB32_DEVICE;
              break;
      case 4: device_flag = DSV11_DEVICE;
              break;
      case 5: device_flag = DSF32_DEVICE;
              break;
      case 6: device_flag = DSW_DEVICE;
              break;
             }
         }
         else
             exit();
}
/*********** End of function get_device_name ***************/

/*********************************************************
 *                FUNCTION READ_DATA                     *
 *********************************************************/
void read_data(void)
/*
**++
**  FUNCTIONAL DESCRIPTION:
**
**      This function reads data from a device
**
**  FORMAL PARAMETERS:
**
**      none
**
**  IMPLICIT INPUTS:
**
**      none
**
**  IMPLICIT OUTPUTS:
**
**      none
**
**  COMPLETION CODES:
**
**      Success/fail code
**
**  SIDE EFFECTS:
**
**      none
**
**--
**/
{
                /*   Read Data    */
      if (((status = SYS$QIOW(0,assgnd_chan,IO$_READVBLK,&iosb2,
                     ast,strng,strng,sizeof(strng)-1,0,0,0,0))&1) != 1)
            LIB$STOP(status);
```

```
      if (((status = SYS$QIOW(0,assgnd_chan,IO$_READVBLK,&iosb2,
                    ast,strng,strng,sizeof(strng)-1,0,0,0,0))&1) != 1)
            LIB$STOP(status);

      if (((status = SYS$QIOW(0,assgnd_chan,IO$_READVBLK,&iosb2,
                    ast,strng,strng,sizeof(strng)-1,0,0,0,0))&1) != 1)
            LIB$STOP(status);

      if (((status = SYS$QIOW(0,assgnd_chan,IO$_READVBLK,&iosb2,
                    ast,strng,strng,sizeof(strng)-1,0,0,0,0))&1) != 1)
            LIB$STOP(status);

}

/*************** End of function read_data ************************/

/*********************************************************************
 *              END OF PROGRAM                                       *
 *********************************************************************/
```

D

Obsolete Features of the $QIO Interface

If you choose not to use the programming calls designed for management together with the $QIO interface to WANDRIVER to set up and control datalinks, you can continue to use the QIO calls that were the only option for previous versions of the VAX WAN Device Drivers.

Section E.1.2.2 explains:

- How to use QIOs to start a device.
- How calls to the V1.1-like interface create DECnet/OSI entities.

Table D–1 lists the calls; Section D.3 and Section D.4 give further details.

The key to the values in the TYPE column is as follows:

L	Logical
V	Virtual
P	Physical
H	Only for half-duplex operation

Table D–1 Obsolete I/O Functions

Function Code and Arguments	Type	Modifiers	Function
IO$_READLBLK P1,P2	L	IO$M_NOW	Read logical block
IO$_READVBLK P1,P2	V	IO$M_NOW	Read virtual block
IO$_READPBLK P1,P2	P	IO$M_NOW	Read physical block
IO$_WRITELBLK P1,P2	L	IO$M_LASTBLOCK (H)	Write logical block
IO$_WRITEVBLK P1,P2	V	IO$M_LASTBLOCK (H)	Write virtual block
IO$_WRITEPBLK P1,P2	P	IO$M_LASTBLOCK (H)	Write physical block
IO$_SETMODE P1,[P2],P3	L	IO$M_CTRL IO$M_SHUTDOWN IO$M_STARTUP IO$M_ATTNAST	Set driver characteristics and state for subsequent operations

(continued on next page)

Table D–1 (Cont.) Obsolete I/O Functions

Function Code and Arguments	Type	Modifiers	Function
IO$_SETCHAR P1,[P2],P3	P	IO$M_CTRL IO$M_SHUTDOWN IO$M_STARTUP IO$M_ATTNAST	Set driver characteristics and state for subsequent operations
IO$_SENSEMODE P1,P2	L	IO$M_CTRL IO$M_RD_MODEM IO$M_CLR_COUNT IO$M_RD_COUNT	Sense driver characteristics and return them in specified buffer(s)
IO$_CLEAN	L	None	For HDLC and SDLC, stops all outstanding transmits. For BISYNC and GENBYTE, stops all outstanding I/O operations. Not to be used with DDCMP.

Generally, the drivers do not differentiate between logical, virtual, and physical I/O functions. However, you must have the required privilege to request a physical or logical function (for physical functions, PHY_IO privilege; for logical functions, LOG_IO privilege).

D.1 Read

A Read function transfers incoming data into the buffer you specify.

VAX/VMS provides three function codes:

- IO$_READLBLK—read logical block
- IO$_READVBLK—read virtual block
- IO$_READPBLK—read physical block

The drivers store data as they receive it, and copy it to the buffer you specify.

The parameters for the three function codes are:

- P1—The starting virtual address of the buffer to receive the data.
- P2—The size of the buffer in bytes. P2 must not be larger than the maximum Receive message size (set in a previous IO$SETMODE call). If a larger message is received, a status of SS$_BUFFEROVF is returned in the I/O status block (IOSB).

The Read functions can take the modifier IO$M_NOW. This completes the read operation immediately with a received message. If no message is available when IO$M_NOW is applied, a status of SS$_ENDOFFILE is returned in the IOSB.

D.2 Write

A Write function transfers data from the buffer you specify and transmits the data down the line.

VMS provides three function codes:

- IO$_WRITELBLK—write logical block
- IO$_WRITEVBLK—write virtual block

- IO$_WRITEPBLK—write physical block

The drivers put your data in a system buffer before transmitting it.

The parameters for the three function codes are:

- P1—The starting virtual address of the buffer holding your data.
- P2—The size (in bytes) of the buffer holding your data. P2 must not be larger than the maximum Send message size (set in a previous IO$SETMODE call).

On half-duplex lines, to turn the line at the end of a sequence of buffers, the Write functions use the modifier, IO$M_LASTBLOCK.

- IO$M_LASTBLOCK forces the driver to drop Request To Send (RTS) after the transmit is sent. Use IO$M_LASTBLOCK with your final IO$_WRITE call to indicate the final piece of data in a transmit sequence. If the IO$_WRITE call includes IO$M_LASTBLOCK, this data (but no subsequent data) will be sent to the device for transmission.

  The line direction is left indeterminate until there is an indication from the driver that Clear to Send (CTS) has been dropped and Carrier Detect (DCD) has been raised. The line direction is then set to RECEIVE and will remain so until DCD is dropped. However, if a transmit is queued before DCD is detected, the line direction is again set to TRANSMIT.

Note

IO$M_MORE is still supported to provide Phase IV compatibility for DMB32, DMF32, DUP11 and DPV11 devices.

To use IO$M_MORE on these devices, define the system-wide logical name VWDD$CUSTOM_PHASE4_*dev-c-u* to to be TRUE.

dev-c-u is defined as follows:

dev	Represents the device (DMB, DMF, DUP, or DPV)
c	Represents the controller number
u	Represents the unit number of the device

The following example shows the commands that define a DPV11 and DMB32:

```
$ DEFINE/SYSEM/EXECUTIVE_MODE VWDD$CUSTOM_PHASE4_DPV-0-0 TRUE
$ DEFINE/SYSEM/EXECUTIVE_MODE VWDD$CUSTOM_PHASE4_DMB-1-0 TRUE
```

IO$M_MORE forces the driver to keep Request To Send (RTS) asserted. Use IO$M_MORE on every block except the last. If the IO$_WRITE call includes IO$M_MORE, this data (and at least the next block of data written) will be sent to the device for transmission. If the IO$_WRITE call does not include the IO$M_MORE modifier, the RTS will be dropped on completion of the transmit.

To have the DMF32 operate as did the Phase IV driver in GENBYTE mode, you must set the logical name as previously discussed. For example:

```
$ DEFINE/SYSEM/EXECUTIVE_MODE VWDD$CUSTOM_PHASE4_DMF-0-0 TRUE
```

If this logical name is defined and if the DMF is operating in GENBYTE mode, the line will be turned at the end of **each** frame transmitted.

- You can issue several read QIOs one after the other. These will be accepted whatever the direction of the line at the time of issue and will not be aborted if the line changes to TRANSMIT.
- If there is no carrier from the receiving end, the first write QIO you issue will place the line into the TRANSMIT state. Hence, Request To Send (RTS) will be raised and, when Clear To Send (CTS) is raised, the data will be transmitted.
- Any transmits are queued until DCD is dropped. RTS is then raised and the transmits queued for transmission until a transmit either without IO$M_ MORE or with IO$M_LASTBLOCK comes through.

In summary, to prevent the line being turned:

- Use the IO$M_LASTBLOCK modifier on the last block only.
- Use the IO$M_MORE modifier on every block except the last (but **ONLY** when the logical name VWDD$CUSTOM_PHASE4_*dev-c-u* is defined).

D.3 Set Mode and Set Characteristics

The Set Mode and Set Characteristics functions control driver operations. Principally, the Set Mode and Set Characteristics functions are used to:

- Specify the protocol to be used
- Specify the line speed
- Specify full- or half-duplex operation
- Specify CRC type (where applicable)
- Allocate buffers
- Specify message size
- Request an attention AST
- Specify loopback mode
- Enable/disable the internal clock and set the clock speed

The functions that perform these and other tasks are described in the following sections.

VAX/VMS defines five types of Set Mode function:

- Set/Start Controller mode (see Section D.3.1)
- Set DDCMP mode (see Section D.3.2)
- Shut down controller (see Section D.3.3)
- Shut down DDCMP (see Section D.3.4)
- Enable attention AST (see Section D.3.5)

VAX/VMS provides two function codes:

- IO$_SETMODE—set mode
- IO$_SETCHAR—set characteristics (requires physical I/O privilege)

D.3.1 Set Controller Mode

This function sets and (optionally) starts the drivers. For DDCMP operation, both the drivers and the DDCMP protocol must be initialized and started. See Section D.3.2 for instructions on starting the DDCMP protocol.

VAX/VMS provides four combinations of function code and modifier:

- IO$_SETMODE!IO$M_CTRL—set driver characteristics
- IO$_SETCHAR!IO$M_CTRL—set driver characteristics
- IO$_SETMODE!IO$M_CTRL!IO$M_STARTUP—set driver characteristics and start the driver
- IO$_SETCHAR!IO$M_CTRL!IO$M_STARTUP—set driver characteristics and start the driver

If the modifier IO$M_STARTUP is specified, the driver is started and the modem is enabled. If IO$M_STARTUP is not specified, the driver characteristics are simply modified.

The parameters for the function codes are:

- P1—The virtual address of a quadword characteristics buffer. For further information, see Section D.3.1.1.
- P2—Optional. The address of a descriptor for an extended characteristics buffer. For further information, see Section D.3.1.2.
- P3—Number of Receive message blocks to allocate. For further information, see Section D.3.1.3.

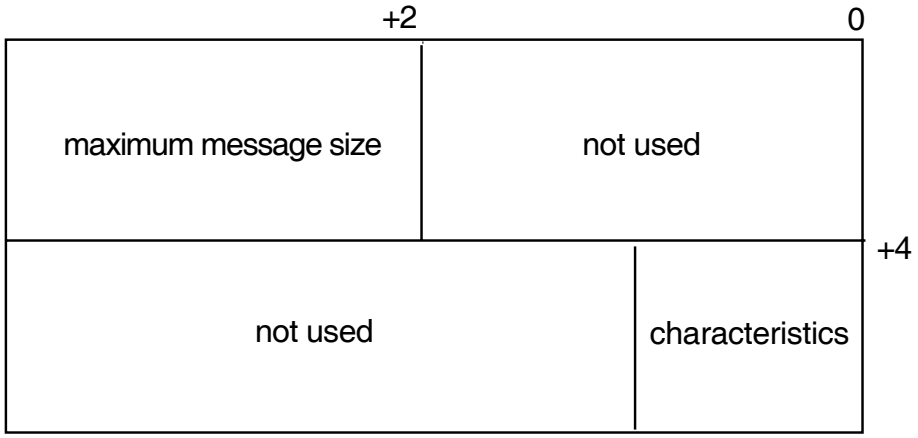
Note that if both the P1 and P2 parameters are specified, the P2 parameter values supersede the P1 parameter values. The P2 parameter NMA$C_PCLI_BFN (see Table D–3) also supersedes any P3 parameter.

Parameters P1, P2, and P3 are described in more detail in Section D.3.1.1, Section D.3.1.2, and Section D.3.1.3.

D.3.1.1 P1 Parameter

P1 is the virtual address of a quadword characteristics buffer. This parameter is used only for DDCMP. Figure D–1 shows the format of this buffer.

Figure D–1 P1 Characteristics Buffer (Set Controller)



The second word of the first longword ('maximum message size') holds the maximum length for transmitted and received messages.

The first word of the second longword ('characteristics') defines the operational mode of the driver.

Table D–2 lists the driver characteristics that can be set in the second longword. The $XMDEF macro defines these values.

Table D–2 Driver Characteristics

Characteristic	Meaning
XM$M_CHR_LOOPB	Sets loopback mode
XM$M_CHR_HDPLX	Sets half-duplex operation

D.3.1.2 P2 Parameter

P2 is optional. It is the address of a descriptor that defines an extended characteristics buffer.

The extended characteristics buffer that P2 points to consists of a series of 6-byte entries. The first word contains the parameter identifier (ID), and the longword that follows contains a value that can be associated with that parameter ID. Figure D–2 shows the format of this buffer.

Table D–3 shows the parameter IDs and possible values that can be specified in the P2 buffer (the notes referred to are at the end of the table). The $NMADEF macro defines these values.

Figure D–2 P2 Extended Characteristics Buffer

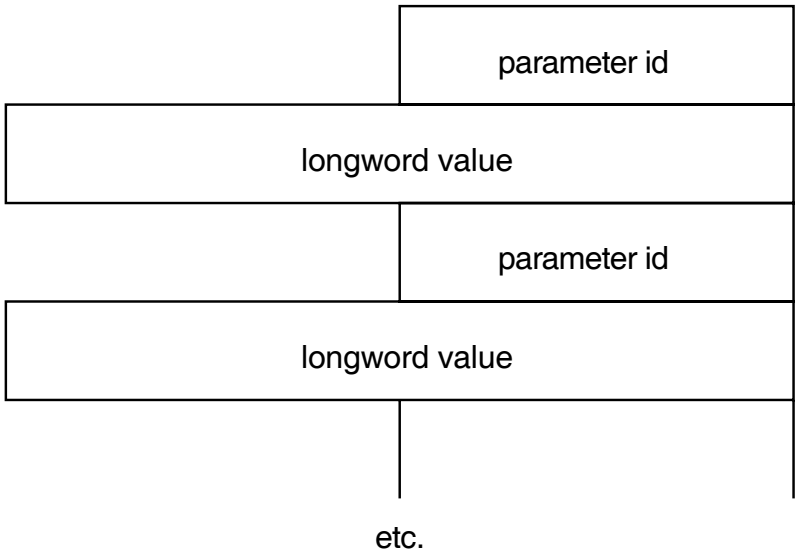


Table D–3 P2 Extended Characteristics Values

Parameter ID	Meaning	
NMA$C_PCLI_PRO	Protocol mode. The following values can be specified:	
	NMA$C_LINPR_POI	DDCMP point-to-point (default)
	NMA$C_LINPR_BISYNC	IBM bisynchronous protocol (see Note 1)
	NMA$C_LINPR_BSY	GENBYTE operation (see Note 2)
	NMA$C_LINPR_LAPB	HDLC operation (LAPB)
	NMA$C_LINPR_LAPBE	HDLC operation (LAPBE)
	NMA$C_LINPR_SDLC	SDLC bit stuff mode
	NMA$C_LINPR_SWIFT	SWIFT BISYNC variant - DSF32 only
	NMA$C_LINPR_CHIPS	CHIPS BISYNC variant - DSF32 only
NMA$C_PCLI_DUP	Duplex mode (see Note 3 for defaults). The following values can be specified:	
	NMA$C_DPX_FUL	Full-duplex
	NMA$C_DPX_HAL	Half-duplex (see Section D.2)
NMA$C_PCLI_CON	Device mode. The following values can be specified:	
	NMA$C_LINCN_NOR	Normal (default)
	NMA$C_LINCN_LOO	Loopback
NMA$C_PCLI_BFN	Number of Receive buffers to preallocate (minimum = 1; for defaults, see Note 5). May be provided here or as P3 argument (see Section D.3.1.3). If included, supersedes the P3 argument.	
NMA$C_PCLI_BUS	Maximum Transmit and Receive message length (for defaults and maximum values, see Note 6).	
NMA$C_PCLI_NMS	Number of sync characters to precede message. The number used is protocol-dependent (default = 8).	
NMA$C_PCLI_CODE	Character code used for IBM bisynchronous protocol. See Note 7.	
NMA$C_PCLI_CRC	Type of CRC. The following values can be specified:	
	0	CRC–CCITT preset to 1s
	1	CRC–CCITT preset to 0s
	2	LRC/VRC odd
	3	CRC–16
	4	VRC odd
	5	VRC even
	6	LRC/VRC even
	7	No error control
	For defaults and possible values, see Note 8.	

(continued on next page)

Table D–3 (Cont.) P2 Extended Characteristics Values

Parameter ID	Meaning
NMA$C_PCLI_NRZI	Data encoding technique. The following values can be specified: NMA$C_STATE_OFF NRZ encoding (default) NMA$C_STATE_ON NRZI encoding
NMA$C_PCLI_CLO	Controls generation of a clock signal. The following values can be specified (see Note 9): NMA$C_LINCL_EXT Clock signal disabled (default) NMA$C_LINCL_INT Clock signal enabled
NMA$C_PCLI_LNS	Controls the speed of the clock signal enabled by NMA$C_ PCLI_CLO. Values vary according to the device concerned (see Note 10).
NMA$C_PCLI_RTT	Retransmit timer for full-duplex point-to-point mode and selection timer for half-duplex point-to-point mode. DDCMP only. Specify time in milliseconds (default = 3000).
NMA$C_PCLI_TRI	Tributary mode address. Values in the range 0 to 255 are valid. Value 255 represents the multicast address and, when specified, will only allow reception of frames with an address of 255. If SDLC is operating, tributary mode is set automatically.

Notes:

1. BISYNC is supported by the DSV11, DPV11, DUP11, DMB32, DMF32, DSF32, DSH32, DST32, DSW21, DSW41, and DSW42.
2. GENBYTE is supported by the DMF32, DMB32, DPV, and DUP only.
3. The default duplex mode for each protocol is:

   DDCMP—Full-duplex
   HDLC—Full-duplex (no half-duplex mode with HDLC)
   SDLC—Half-duplex
   BISYNC—Half-duplex

4. Default number of buffers allocated:

   DDCMP—4
   HDLC—6
   SDLC—4
   BISYNC—2

5. Default message length (in bytes):

   DDCMP—576
   HDLC—128
   SDLC—280
   BISYNC—280

   Maximum message length (in bytes):

   DDCMP—4096
   HDLC—4106
   SDLC—4106
   BISYNC—4106

6. Indicate EBCDIC character coding for the DSV11 using the value NMA$C_CODE_EBCDIC. For the DUP11, the DPV11, the DMB32, the DMF32, and the DSF32, the following values can be specified:

Value	Meaning
NMA$C_CODE_ASCII	ASCII character code
NMA$C_CODE_EBCDIC	EBCDIC character code (default)

7. Default values and possible values for the CRC depend on the line protocol:

   DDCMP: CRC–16 only
   HDLC: CRC–CCITT preset to 1s only
   SDLC: CRC–CCITT preset to 1s only
   BISYNC: CRC–16 only
   GENBYTE: None

8. Digital recommends that NMA$C_PCLI_CLO be left at its default value. Set the line speed using the NMA$C_PCLI_LNS parameter only when NMA$_PCLI_CLO sets the internal clock. Setting the line speed with NMA$_PCLI_LNS when NMA$_PCLI_CLO sets an external clock has no effect on the line speed used by the device. Note that there is no method of obtaining the current value of the line speed parameter.

9. NMA$C_PCLI_LNS controls the speed of the clock signal enabled by NMA$C_PCLI_CLO. Table D–4 lists the values allowed.

Table D–4 Clock Speed Values (hertz)

DSB32 Values	DSH32 and DST32 Values	DSF32 Values	DSV11 Values	DSW21, DSW41, and DSW42 Values
0	0	0	0	0
600	600	–	–	–
1200	1200	1200	–	–
1800	–	–	–	–
2000	2000	2000	–	–
2400	2400	2400	–	–
4800	4800	4800	–	–
9600§	9600	9600	9600§	9600
14400	–	–	–	–
19200	19200	19200	19200	19200
–	38400	38400	38400	38400§
48000	–	–	–	–
56000	–	–	–	–
64000	–	–	–	–
–	–	–	72000	–

§Default clock speed

(continued on next page)

Table D–4 (Cont.) Clock Speed Values (hertz)

DSB32 Values	DSH32 and DST32 Values	DSF32 Values	DSV11 Values	DSW21, DSW41, and DSW42 Values
76800	–	–	–	–
96000	–	–	–	–
128000	–	–	128000	128000
–	–	–	256000	256000
–	-1	-1	–	-1

Key to Speeds:

0 - Clock is disabled

-1 - Highest clock speed consistent with selected protocol and cable configuration

D.3.1.3 P3 Parameter

P3 is the number of Receive message blocks you are allocating for incoming data. This parameter is used only for DDCMP.

D.3.2 Set DDCMP Mode

The Set DDCMP Mode function allows you to set and start the DDCMP protocol. Specifically, the information in this section explains how you set up DDCMP circuit parameters (hence, the parameter ID codes described contain the PCCI identifier).

Four combinations of function code and modifier are provided:

- IO$_SETMODE—modify DDCMP characteristics
- IO$_SETCHAR—modify DDCMP characteristics
- IO$_SETMODE!IO$M_STARTUP—start DDCMP protocol
- IO$_SETCHAR!IO$M_STARTUP—start DDCMP protocol

These codes take the following arguments:

- P1—The virtual address of a quadword characteristics buffer (optional). Figure D–3 shows the format of this buffer.
- P2—The address of a descriptor for an extended characteristics buffer (optional).

The following characteristic can be set in the second longword of the P1 Characteristics Buffer:

`XM$V_CHR_MOP`—set DDCMP to maintenance mode

The P2 buffer consists of a series of 6-byte entries. The first word contains the parameter identifier (ID), and the longword that follows contains one of the values that can be associated with the parameter ID. Figure D–2 shows the format for this buffer.

Figure D–3 P1 Characteristics Buffer (Set DDCMP)

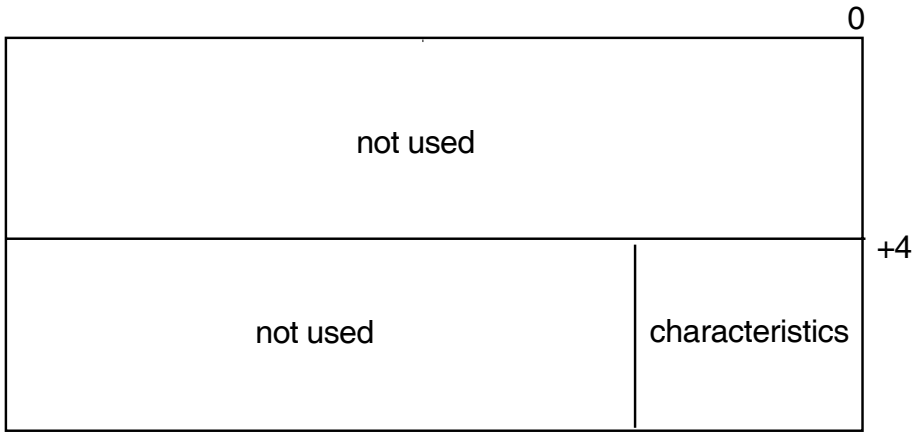


Table D–5 lists the parameter IDs and values that can be specified in the P2 buffer.

Table D–5 P2 Extended Characteristics Values

Parameter ID	Meaning
NMA$C_PCCI_MTR[1]	An integer value in the range 1-100, indicating the maximum number of data messages in a row transmitted before deselecting (default = 4)
NMA$C_PCCI_MST	Maintenance mode. The following values can be specified:

Value	Meaning
NMA$C_STATE_ON	DDCMP in maintenance mode
NMA$C_STATE_OFF	DDCMP not in maintenance mode (default)

NMA$C_PCLI_TRI	Tributary mode address. Values in the range 1 to 64 are valid (default = 1).

[1]Not implemented by the DSF32, DSH32, DST32, DSW21, DSW41, or DSW42.

If both P1 and P2 characteristics are specified, the P2 characteristics supersede the P1 characteristics.

On receipt of the QIO request for a device, the driver starts the protocol.

D.3.3 Shut Down Controller

This function ends driver operations and halts the protocol and the line. To restart the driver, issue a IO$_SETMODE!IO$M_CTRL!IO$M_STARTUP or IO$_SETCHAR!IO$M_CTRL!IO$M_STARTUP request (see Section D.3.1).

Note that the defaults are not reset on shutdown, but only on DEASSIGN. The VAX WAN Device Drivers use their previous settings on a restart after a shutdown. To change the settings after a shutdown, use the P2 parameter as described in Section D.3.1.2.

VAX/VMS provides two combinations of function code and modifier:

- IO$_SETMODE!IO$M_CTRL!IO$M_SHUTDOWN—shut down driver
- IO$_SETCHAR!IO$M_CTRL!IO$M_SHUTDOWN—shut down driver

D.3.4 Shut Down DDCMP

This function halts the DDCMP protocol. The attached device cannot be used until DDCMP is restarted.

VAX/VMS provides two combinations of function code and modifier:

- IO$_SETMODE!IO$M_SHUTDOWN—shut down DDCMP
- IO$_SETCHAR!IO$M_SHUTDOWN—shut down DDCMP

These codes take no arguments.

D.3.5 Enable Attention AST

This function requests that an attention AST is delivered to the requesting process after one of the following events:

- The driver has set or cleared an error summary bit.
- The driver has set or cleared any of the unit status bits (see Table D–6 and Table D–7).
- Data has arrived and there is no waiting IO$_READ request.

All outstanding attention ASTs are delivered after one of these events.

You may use the Enable Attention AST function at any time after the line is started, regardless of the condition of the driver and line status bits.

VAX/VMS provides two combinations of function code and modifier:

- IO$_SETMODE!IO$M_ATTNAST—enable attention AST
- IO$_SETCHAR!IO$M_ATTNAST—enable attention AST

The parameters for the two function codes are:

- P1—The address of an AST service routine (or 0 to disable ASTs).
- P2–User parameter for the AST routine.
- P3–Access mode to deliver AST (0 to 3, corresponding to the VMS access mode chosen). If you specify a more privileged access mode than the current access mode of the calling process, the AST is delivered at the current access mode. Otherwise, the AST is delivered at the access mode you have specified.

After an AST occurs, it must be reenabled by another Enable Attention AST function before an AST can occur again. Note that the AST quota (ASTLM) for your process limits how many ASTs can be requested.

D.3.5.1 Status Bits

The status bits show the status of the unit and the line. They can only be read.

Table D–6 lists the status values and their meanings. The values are defined by the $XMDEF macro.

Table D–6 Unit and Line Status

Status	Meaning
XM$M_STS_ACTIVE	Device and selected protocol are active (does not indicate establishment of a link to the remote device)
XM$M_STS_DISC	Modem disconnected. This bit will be returned in the field IRP$L_IOST2 if the driver has detected an incorrect modem status (returns a fatal error with DDCMP)
XM$M_STS_BUFFAIL	Receive buffer allocation failed
XM$M_STS_DCHK	Message received with CRC error (only returned in IOSB)

D.3.5.2 Error Summary Bits

The error summary bits are set when an error occurs. They are read-only bits. Errors (other than XM$M_ERR_LOST) cause shutdown of the DDCMP circuit. The circuit has to be restarted. Table D–7 lists the error values and their meanings.

Table D–7 Error Summary Bits

Error Summary Bit	Meaning
XM$M_ERR_MAINT	DDCMP maintenance message
XM$M_ERR_START	DDCMP start message received
XM$M_ERR_FATAL	Hardware or software error occurred on controller
XM$M_ERR_TRIB	Hardware or software error occurred on circuit
XM$M_ERR_LOST	Data lost when a message was received that was longer than the specified maximum message size
XM$M_ERR_THRESH	Receive, transmit, or select threshold errors

D.3.6 Using Non-DDCMP Protocols

The HDLC, SDLC, BISYNC and GENBYTE protocols do not have the concept of line and circuit. Therefore, only $QIO requests that include the function modifier IO$M_CTRL are allowed. VMS does not acknowledge the characteristics set in either P1 or P3 for this mode of operation.

Note that you must have CMKRNL privilege to run either the DMF32 or the DMB32 in GENBYTE mode.

D.3.6.1 BISYNC

You must construct and pass a complete BISYNC frame to the DMB32, DSV11, DPV11, DUP11, DSF32, DSH32, DST32, DSW21, DSW41, or DSW42 when using the driver in BISYNC mode. This frame must include all framing and control characters (for example, the DLE, STX, ETB, and ETX characters). You must also correctly position space in the frame to insert checksums (if you specify no NMA$C_PCLI_CRC parameter, the driver supplies CRC–16 by default). When allowing space in the buffer, note that DLE octets inserted to maintain transparency could as much as double the received message size: in accordance with the BISYNC specification, the DLE octets are not included in the blockcheck. Other control characters are included in the blockcheck.

The read buffer contains the data received from the line. In general, control characters and CRCs are included in the buffer, except those listed in Table D–8.

Table D–8 BISYNC Control Character Exceptions

Control Character	Format in Read Buffer	Comments
SYN	Stripped (in non-transparent mode; DLE SYN stripped in transparent mode)	
ENQ	Included	Frames terminated by ENQ do not have their CRC checked.

(continued on next page)

Table D–8 (Cont.) BISYNC Control Character Exceptions

Control Character	Format in Read Buffer	Comments
NAK	Included	Frames terminated by NAK do not have their CRC checked.
EVT	Included	Frames terminated by EVT do not have their CRC checked.
ACK	Included	Frames terminated by ACK do not have their CRC checked.
ACK0	Included	Frames terminated by ACK0 (DLE, 0) do not have their CRC checked.
ACK1	Included	Frames terminated by ACK1 (DLE, 1) do not have their CRC checked.
WACK	Included	Frames terminated by WACK (DLE, ;) do not have their CRC checked.
RVI	Included	Frames terminated by RVI (DLE, <) do not have their CRC checked.
ITB	Included	Frames with intermediate CRCs are reported as good only if all the CRCs are good.
DLE	Included (but DLE SYNs removed)	

If the CRC is reported by the device as bad, the read QIO is returned with SS$_DATACHK in the IOSB, and the XM$M_STS_DCHK error bit is set.

D.3.6.2 GENBYTE

The GENBYTE protocol allows protocols not specifically supported by the DMB32 or DMF32 firmware to have their own rules for framing receive messages.

In order to provide support for each protocol's special framing rules, the DMB32 and DMF32 drivers provide a special framing interface. You must write your own framing routine using the facilities provided by these drivers (as described in Section D.3.6.3) and load this routine into nonpaged pool. Because it is in nonpaged pool, your routine must be written in position-independent code. The address of your routine is passed to the driver on startup of the device.

The purpose of your framing routine is to tell the driver how to frame each byte of the received data message and when the received message is complete and ready to be posted.

The address of your routine is kept in the driver's UCB. The driver also maintains a quadword that is used by the framing interface for holding state information while it is framing the receive message. Your framing routine is called by the driver at FORK IPL through use of a JSB instruction. The input and the output to the framing interface are described in the Table D–9.

Table D–9 GENBYTE Framing Interface Description

Input	Contents	
R0	Address of quadword of state information (this register is free to be used during the operation of your routine).	
R1 (Bits 0-7)	Character to examine. The high-order bit of R1 is set if this is the first character of a new frame.	
Output	**Contents**	
R0	Status information for the driver. The following bits are defined:	
	XG$V_BUFFER_CHAR	If clear, buffer the character in the next position; if set, action depends on value of bit XG$V_BUFFER_IN_PREV_POS.
	XG$V_BUFFER_IN_PREV_POS	If XG$V_BUFFER_CHAR clear, then ignore this bit. If clear, ignore the character. If set, overwrite the last buffered character.
	XG$V_COMPLETE_READ	If clear, ignore. If set, return the framed buffer to the user (character is buffered or discarded according to the state of the previous two bits).

Note:

1. After the driver has completed a framed receive data message, the driver resets the quadword of state information to the value passed on startup. This means that the driver resets error information along with success information.
2. The bit XM$M_STS_DISC is set if the driver times out while waiting for the CTS signal to be present on the device. This bit is in the device-dependent status returned in the second longword of the IOSB.

While a user of the generic drivers need not be aware of which driver and device is responding to the $QIOs issued, a user of the obsolete interface will be aware of differences between different drivers. Two differences between the drivers follow:

1. Only DMB32, DMF32, DPV, and DUP support GENBYTE.
2. The framing routine for the DMB32, DMF32, DPV, and DUP is found in non-paged pool and non-privileged access is denied.

D.3.6.3 Parameters for GENBYTE Operation

In GENBYTE mode, use any of the following parameters for the P2 argument to the Set Controller function (as already described in Table D–3):

NMA$C_PCLI_PRO
NMA$C_PCLI_DUP
NMA$C_PCLI_BFN
NMA$C_PCLI_BUS
NMA$C_PCLI_CON

However, there are extra parameters for the P2 argument, specifically for the GENBYTE mode of operation. See Table D–10 for details.

Table D–10 GENBYTE Additional Parameters

Parameter ID	Meaning
NMA$C_PCLI_SYC	The sync character used by the device. Defaults to 32 hexadecimal.
NMA$C_PCLI_NMS	The number of sync characters to precede a transmit. The default is 8.
NMA$C_PCLI_BPC	The number of bits per character (5,6,7, or 8). The default is 8.
NMA$C_PCLI_FRA	The address of your protocol framing routine (in nonpaged system address space). This parameter must be specified.
NMA$C_PCLI_STI1 NMA$C_PCLI_STI2	These two parameters contain the initial value for the quadword of framing routine state information.
NMA$C_PCLI_TMO	Specifies the timeout (in seconds) when waiting for CTS during transmit operations.

D.4 Sense Mode

The Sense Mode function returns the driver characteristics (excluding the line speed characteristic) in the specified buffer(s).

VAX/VMS provides two function codes:

- IO$_SENSEMODE!IO$M_CTRL—read driver characteristics
- IO$_SENSEMODE!IO$M_CTRL!IO$M_RD_COUNTS—read counters

The parameters for the IO$_SENSEMODE!IO$M_CTRL function code are:

- P1—Optional. The address of a two-longword buffer for driver characteristics. See Figure D–1.
- P2—Optional. The address of a descriptor that defines a driver extended characteristics buffer. See Figure D–2.

If all the characteristics cannot be stored in the buffer you specify, the IOSB returns:

- SS$_BUFFEROVF in the first word
- The size (in bytes) of the extended characteristics buffer in the second word

Note that the size of the buffer returned may differ from the size of the buffer you specified. This happens when the sizes of the characteristics definitions do not fit exactly into the buffer. For example, if the driver has eight 6-byte characteristics to return (total 48 bytes) and the buffer is 20 bytes long, only 3 characteristics will be returned (total 18 bytes).

For a description of the IOSB, see Section D.7.

The parameters for the IO$_SENSEMODE!IO$M_CTRL!IO$M_RD_COUNTS function code are described in Part II of the *VMS I/O User's Reference Manual*, in the sections describing Sense Mode and Read Internal Counters.

D.4.1 The IO$_CLEAN Function

For HDLC and SDLC, an IO$_CLEAN function stops all outstanding Transmits. In both cases, the status return is SS$_ABORT. Use of IO$_CLEAN does not affect any modem signals.

D.5 Getting Information About the Drivers

To get information about DSB32, DSF32, DSH32, DST32, DSV11, DSW21, DSW41 and DSW42 characteristics, use the Get Device/Volume Information ($GETDVI) system service. For information on $GETDVI, see the *VMS System Services Volume*.

For the driver concerned, $GETDVI returns the following information:

- Driver device characteristics
- Driver device class
- Driver device type
- Maximum message size
- Driver status
- Line status

To get the driver's characteristics, call $GETDVI with item code DVI$_ DEVCHAR. Table D–11 lists these characteristics, which are defined by the $DEVDEF macro.

Table D–11 Device Characteristics

Static Bits (always set)	Meaning
DEV$M_AVL	Device available. Set when UCB (Unit Control Block) initialized
DEV$M_IDV	Input device
DEV$M_NET	Network device. Set for terminal port if it is a network device
DEV$M_ODV	Output device

To get the driver's device class, call $GETDVI with item code DVI$_DEVCLASS. The device class for DSB32, DSF32, DSH32, DST32, DSV11, DSW21, DSW41, and DSW42 drivers is DC$_SCOM.

To get the driver's device type, call $GETDVI with item code DVI$_DEVTYPE. The drivers' device types are:

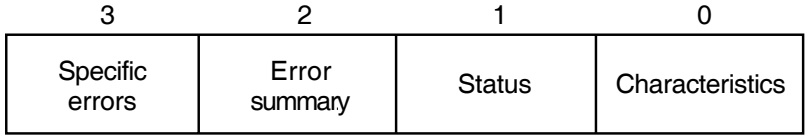
- DSB32—DT$_SL_DSB32
- DSF32—DT$_SF_DSF32
- DSH32—DT$_ZS_DSH32
- DST32—DT$_ZS_DST32
- DSV11—DT$_SJ_DSV11
- DSW21—DT$_ZT_DSW
- DSW41—DT$_ZT_DSW
- DSW42—DT$_ZT_DSW

The $DCDEF macro defines the device class and device type names.

To get the maximum message size, call $GETDVI with item code DVI$_DEVBUFSIZ. The maximum message size is the maximum Send- or Receive-message size you have defined for that driver. Note that, on modem-controlled lines, transmission errors increase as message size increases.

To get driver status and error information, call $GETDVI with item code DVI$_DEVDEPEND. $GETDVI returns a longword containing this information. The format of the longword is shown in Figure D–4.

Figure D–4 Longword Returned by $GETDVI



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The longword contains:

- Driver characteristics (byte 0)
- Driver and line status (byte 1)
- Driver error summary (byte 2)
- Driver specific error(s) (byte 3 - not used)

The contents of these fields are described in the following sections.

D.5.1 DSB32, DSF32, DSH32, DST32, DSV11, DSW21, DSW41, and DSW42 Driver Characteristics

The driver characteristic bits govern the DDCMP operating mode. These bits are defined by the $XMDEF macro and can be set using a Set Mode function or read by a Sense Mode function).

Table D–12 lists the values and meanings of the driver characteristics.

Table D–12 DSB32, DSF32, DSH32, DST32, DSV11, DSW21, DSW41, and DSW42 Driver Characteristics

Characteristic	Meaning
XM$M_CHR_HDPLX	Sets half-duplex operation
XM$M_CHR_LOOPB	Sets loopback mode
XM$M_CHR_MOP	DDCMP maintenance mode

D.5.2 DSB32, DSF32, DSH32, DST32, DSV11, DSW21, DSW41, and DSW42 Device and Line Status

These bits show the status of the driver and of the line. Set or clear these bits only when the driver and the circuit are inactive.

Table D–13 lists the status values and their meanings. The values are defined by the $XMDEF macro.

Table D–13 DSB32, DSF32, DSH32, DST32, DSV11, DSW21, DSW41, and DSW42 Device and Line Status

Status	Meaning
XM$M_STS_ACTIVE	Driver and selected protocol are active (indicates establishment of a link to the remote device only in full-duplex mode)
XM$M_STS_BUFFAIL	Receive buffer allocation failed
XM$M_STS_DISC	Modem disconnected. This bit is returned in the field IRP$L_ IOST2 if the driver has detected an incorrect modem status.
XM$M_STS_DCHK	Message received with CRC error (only returned in IOSB)

D.5.3 DSB32, DSF32, DSH32, DST32, DSV11, DSW21, DSW41, and DSW42 Error Summary

The driver error summary bits are set when an error occurs. They are read-only bits. Errors (other than XM$M_ERR_LOST) cause shutdown of the DDCMP circuit. The circuit needs to be restarted.

Table D–14 lists the error values and their meanings.

Table D–14 DSB32, DSF32, DSH32, DST32, DSV11, DSW21, DSW41 and DSW42 Error Summary

Error Summary Bit	Meaning
XM$M_ERR_FATAL	Hardware or software error occurred on the driver
XM$M_ERR_THRESH	Receive, Transmit, or Select threshold errors
XM$M_ERR_LOST	Data lost because longer message received than the specified maximum message size
XM$M_ERR_MAINT	DDCMP maintenance message received
XM$M_ERR_START	DDCMP start message received
XM$M_ERR_TRIB	Hardware or software error occurred on circuit

D.6 Reading the Modem Signals

This function reads the current modem status. VAX/VMS provides the following combination of function code and modifier:

- IO$_SENSEMODE!IO$M_CTRL!IO$M_RD_MODEM—read line unit modem status

This takes the following argument:

- P1—The address of a longword buffer which stores the modem status. One or more of the following bits can be set in the buffer:

Bit	Meaning
XM$V_MDM_CARRDET	Receiver is active (carrier sense)
XM$V_MDM_CTS	Data can be transmitted (CTS)
XM$V_MDM_DSR	Modem is in service (DSR)
XM$V_MDM_RTS	Request to send data from USART (RTS)
XM$V_MDM_DTR	Line unit is available and on line

D.7 The I/O Status Block

The format of the I/O status block (IOSB) for the obsolete interface is shown in Figure D–5. The format of an IOSB reporting an invalid SET MODE or SET CHAR parameter is shown in Figure D–6.

Figure D–5 IOSB Contents

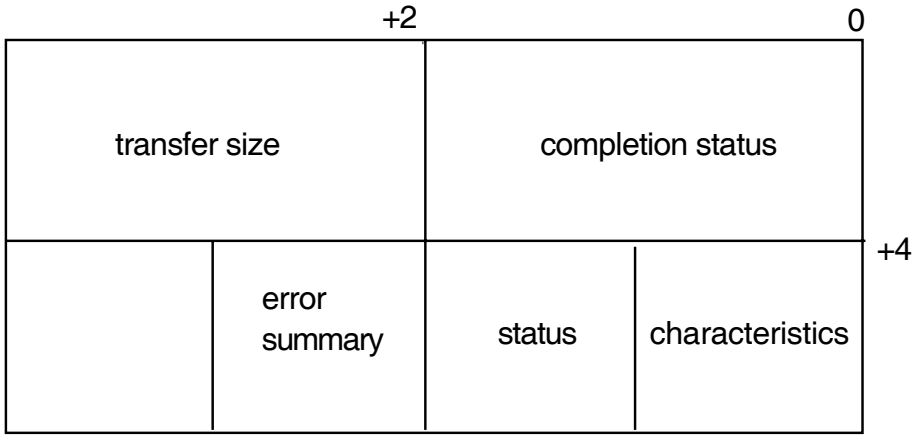


Table D–15 lists the completion status returns, and the *VMS System Messages and Recovery Procedures Reference Volume* provides explanations and suggested user actions for these returns.

Table D–15 Completion Status Returns

SS$_ABORT	SS$_ACCVIO	SS$_BADPARAM
SS$_BUFFEROVF	SS$_CONNECFAIL	SS$_DEVACTIVE
SS$_DEVICEFULL	SS$_DEVINACT	SS$_DEVOFFLINE
SS$_ENDOFFILE	SS$_EXQUOTA	SS$_INSFMEM
SS$_NOPRIV	SS$_NOSUCHDEV	SS$_NOSUCHOBJ

As well as the completion status, the first longword of the IOSB returns one of two values:

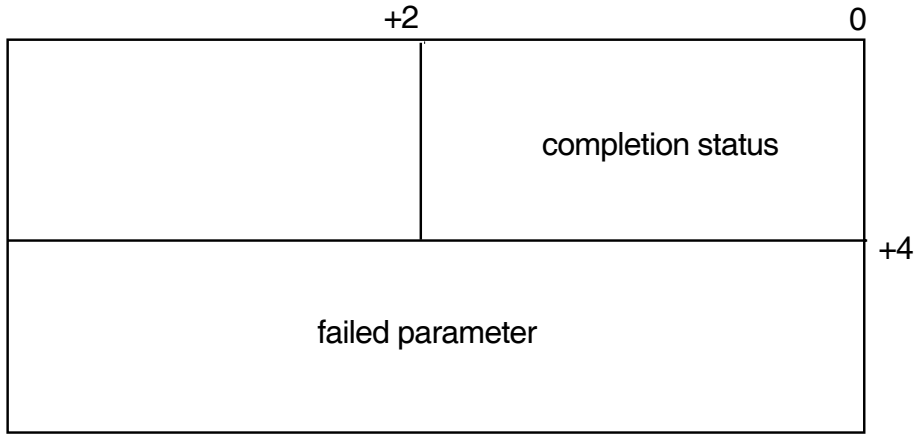
- The size (in bytes) of the data transfer
- The size (in bytes) of the extended characteristics buffer returned by a Sense Mode function

The second longword of the IOSB returns three values:

- The driver characteristics (see Table D–2)
- The driver and line status (see Table D–6)
- The driver error summary (see Table D–7)

When the IOSB reports an invalid SET MODE or SET CHAR parameter, the format of the IOSB is as shown in Figure D–6.

Figure D–6 IOSB Reporting Invalid Parameter



E

Management

E.1 Differences Between the V1.1 VAX WAN Device Drivers and the V2.0 VAX WAN Device Drivers

Many of the differences between previous versions of the VAX WAN Device Drivers and the generic VAX WAN Device Drivers are due to the differences between DECnet Phase IV (under which the VAX WAN Device Drivers could not be controlled by the network manager) and DECnet/OSI (under which they can).

DECnet/OSI separates management from service. The management modules are managed by NCL, and the service interfaces are used by either Digital products or specific user programs.

The generic drivers are all controlled by a pseudo-driver (WANDRIVER) which uses the service interface to the datalink entities. There is a $QIO interface to the pseudo-driver. WANDRIVER forwards your $QIO calls through the DECnet /OSI entities to whichever device driver is applicable. For more information about WANDRIVER, see Chapter 4.

E.1.1 Integration with DECnet

Previous versions of the VAX WAN Device Drivers were independent of DECnet: it was possible to run them without running DECnet. DECnet did not need to be involved with the drivers, although in many networks, DECnet ran over VAX WAN Device Drivers links provided by previous versions of the VAX WAN Device Drivers.

The generic VAX WAN Device Drivers are integrated with DECnet. For VAX WAN Device Drivers to run, you need only install and configure DECnet/OSI.

E.1.2 Managing the VAX WAN Device Drivers

E.1.2.1 Using WANDRIVER

NCL gives you much more control over your network than was possible with DECnet Phase IV. The characteristics, status, and counters relating to each entity and subentity can be individually seen, and characteristics can be changed.

Because the generic VAX WAN Device Drivers work closely with DECnet/OSI, solving operational problems with the drivers is different: NCL commands make information easier to inspect and easier to act on. In the case of modem signals, for example, in previous versions of the VAX WAN Device Drivers (with only the obsolete interface) there was no way of reading them. With DECnet/OSI, NCL SHOW commands make information about line usage visible to the user.

E.1.2.2 Using the Obsolete Interface

Using the obsolete interface, you can, as in earlier versions, use $QIO calls to start a device in DDCMP mode (both DDCMP framing and Level 2 protocol).

Alternatively, you can have framing *only* for any of the following:

BISYNC
HDLC
GENBYTE
SDLC

Starting a device creates or modifies the DECnet/OSI management entities, but this is invisible to the user. While the obsolete programming interface is in use, the network manager will be able to see (through NCL) these *temporary* entities:

- DDCMP and MODEM CONNECT (for DDCMP-mode calls)
- FRAME and MODEM CONNECT (for drivers using BISYNC, HDLC, GENBYTE or SDLC)

Note

Any attempt to manage these entities directly using NCL may lead to unpredictable failures.

E.2 NCL Commands

This section assumes that all the necessary entities (Modem Connect and any applicable datalink entity) already exist; they are created during initialization of your system. For further details about any of these commands, see the *DECnet /OSI for VMS Network Control Language Reference* manual.

Issuing NCL Commands for Modem Connect

To use the generic drivers by means of $QIO calls to WANDRIVER, first issue these NCL commands in order to CREATE, SET and ENABLE a Modem Connect LINE:

```
NCL> CREATE MODEM CONNECT LINE line-name COMMUNICATION PORT port-name
NCL> SET MODEM CONNECT LINE line-name MODEM CONTROL full|none
NCL> ENABLE MODEM CONNECT LINE line-name
```

Replace *line-name* with the name of your Modem Connect line and *port-name* with the name of the port that your datalink will use.

Issuing NCL Commands for DDCMP

If you are going to use the DDCMP module, you must then CREATE, SET and ENABLE a DDCMP link with a named station.

```
NCL> CREATE DDCMP LINK link-name PROTOCOL point|tributary
NCL> CREATE DDCMP LINK link-name LOGICAL STATION station-name
NCL> SET DDCMP LINK link-name PHYSICAL LINE MODEM CONNECT LINE line-name
NCL> ENABLE DDCMP LINK link-name LOGICAL STATION station-name
NCL> ENABLE DDCMP LINK link-name
```

Replace the variables like this:

link-name is the name you want to give to the DDCMP LINK

line-name	is the name of the Modem Connect LINE created with the CREATE MODEM CONNECT LINE command
station-name	is the name that you want to give to the LOGICAL STATION

Doing this sets up a port. Sections 2.2.1 and 2.2.2 show you how to use this port.

Issuing NCL Commands for HDLC

If you are going to use the HDLC module, you must then CREATE, SET and ENABLE a HDLC link with a named station.

```
NCL> CREATE HDLC LINK link-name LINK TYPE balanced|primary|secondary
NCL> CREATE HDLC LINK link-name LOGICAL STATION station-name
NCL> SET HDLC LINK link-name PHYSICAL LINE MODEM CONNECT LINE line-name,-
_NCL> PREFERRED LOCAL STATION ADDRESS address
NCL> ENABLE HDLC LINK link-name LOGICAL STATION station-name
NCL> ENABLE HDLC LINK link-name
```

Replace the variables like this:

link-name	is the name you want to give to the HDLC LINK
line-name	is the name of the Modem Connect LINE created with the CREATE MODEM CONNECT LINE command
address	is a number in the range 1-253
station-name	is the name you want to give to the LOGICAL STATION

Issuing NCL Commands for LAPB

If you are going to use the LAPB module, you must then CREATE, SET and ENABLE a LAPB link with a named station.

```
NCL> CREATE LAPB LINK link-name PROFILE profile-name
NCL> SET LAPB LINK link-name PHYSICAL LINE MODEM CONNECT LINE line-name
NCL> ENABLE LAPB LINK link-name
```

Replace the variables like this:

link-name	is the name you want to give to the LAPB LINK
profile-name	is the name of the PROFILE you want to use
line-name	is the name of the Modem Connect LINE created with the CREATE MODEM CONNECT LINE command

Issuing NCL Commands for FRAME

Even if you are using a specially written datalink protocol, you use the Frame module to integrate your datalink with DECnet/OSI.

```
NCL> CREATE FRAME LINK link-name PROTOCOL ddcmp|hdlc|sdlc|bisync|genbyte
NCL> SET FRAME LINK link-name PHYSICAL LINE MODEM CONNECT LINE line-name
NCL> ENABLE FRAME LINK link-name
```

Replace the variables like this:

link-name	is the name you want to give to the Frame LINK
line-name	is the name of the Modem Connect LINE created with the CREATE MODEM CONNECT LINE command

For further information on the Frame module, see Appendix B.

F

How to Program DSF32 Failover Sets

This section explains how to manage failover sets using the programmable interface to the SFDRIVER. The *DECnet/OSI for VMS Installation and Configuration* describes failover sets and failover set management.

F.1 The $QIO Interface

The SFDRIVER supports a $QIO interface to receive system management commands. This interface is used by the WANDD$FSM utility to create and modify failover set membership information. You can use this $QIO interface to implement your own failover set management utility.

To manage a failover set, your program must first perform a $ASSIGN to allocate a channel to the appropriate SF device (the *DECnet/OSI for VMS Installation and Configuration*) describes how you create SF devices). Your program can then issue $QIO function codes to control the failover set device.

F.2 Function Codes

The SFDRIVER supports the following $QIO function codes:

- IO$_CREATE
- IO$_DELETE
- IO$_MODIFY
- IO$_ACCESS

You send a $QIO function code to the SFDRIVER to:

- Describe the command you are issuing
- Provide the address of a buffer (in the P1 parameter) which contains further details of the action to be performed

When calling the IO$_CREATE, IO$_DELETE, and IO$_MODIFY function codes, the address in P1 must point to a quadword buffer. When calling the IO$_ACCESS function code, the address in P1 must point to a three longword buffer.

The function codes correspond to the following Failover Set Manager commands:

- IO$_CREATE for the ADD command
- IO$_DELETE for the REMOVE command
- IO$_MODIFY for the SET/CURRENT command
- IO$_ACCESS for the SHOW command

The content of the P1 argument depends on the function code you use and this content is described in the following sections. (Where entries are ignored, the diagrams are marked with Read As Zero (RAZ).)

The symbolic codes used are supplied on the WAN Device Driver's kit and after installation can be found in SYS$LIBRARY. The symbol files are:

- WANDD$FSMDEF.MLB for MACRO programs
- WANDD$FSMDEF.R32 for BLISS programs
- WANDD$FSMDEF.H for C programs

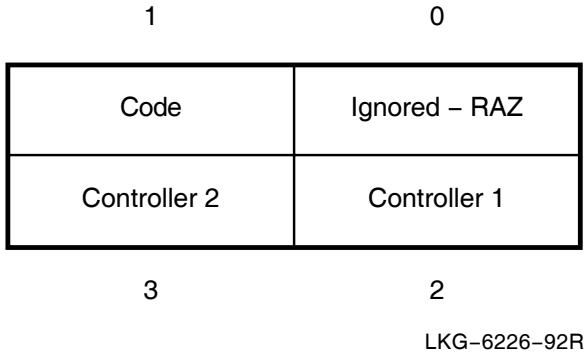
F.3 Using the Failover Set Commands

This section describes how you use the failover set commands when programming the DSF32.

F.3.1 The ADD Command

The ADD command allows you to add one or two physical controllers to a failover set. Your quadword buffer must contain one entry only, detailing which physical controllers to add. Figure F–1 shows the format of the quadword buffer.

Figure F–1 Format of Quadword Buffer



The Code byte takes the following values:

- DSF$K_ITEM_PC1 where only one device is being added to the failover set.
- DSF$K_ITEM_PC2 where two devices are being added to the failover set.

Use the Controller 1 and Controller 2 bytes to specify the physical controller you are adding to the failover set. When you are adding only one physical controller, the Controller 2 byte is ignored.

Use the following constants in the Controller 1 or the Controller 2 byte to specify the physical controller:

Constant	Controller
1	DSF$K_PC_SMB
2	DSF$K_PC_SMC
3	DSF$K_PC_SMD
4	DSF$K_PC_SME
6	DSF$K_PC_SMG
7	DSF$K_PC_SMH

Constant	Controller
8	DSF$K_PC_SMI
9	DSF$K_PC_SMJ

If the failover set is not empty, the SFDRIVER will ensure that only one physical controller can be added. If the failover set is already full, the SFDRIVER will reject your command. The SFDRIVER will return an invalid quadword buffer format error if any other values are found in the buffer.

F.3.2 The REMOVE Command

The REMOVE command allows you to remove one or two members from a failover set. The buffer must contain one entry, detailing which physical controllers you wish removed. The format of the quadword buffer is the same as shown in Figure F–1.

The Code byte takes the following values:

- DSF$K_ITEM_PC1 where only one device is being removed from the failover set. set.
- DSF$K_ITEM_PC2 where two devices are being removed from the failover set.

Use the Controller 1 and Controller 2 bytes to specify the physical controller you are removing from the failover set. When you are removing only one physical controller, the Controller 2 byte is ignored.

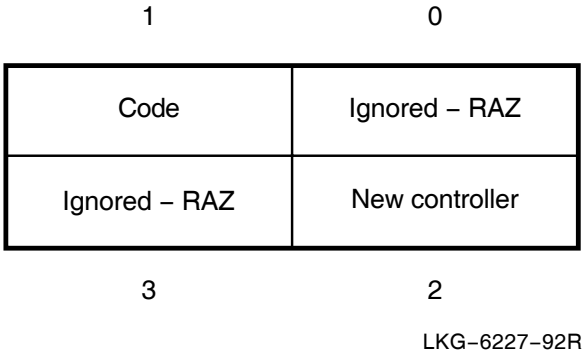
Use the following constants in the Controller 1 or the Controller 2 byte to specify the physical controller:

Constant	Controller
1	DSF$K_PC_SMB
2	DSF$K_PC_SMC
3	DSF$K_PC_SMD
4	DSF$K_PC_SME
6	DSF$K_PC_SMG
7	DSF$K_PC_SMH
8	DSF$K_PC_SMI
9	DSF$K_PC_SMJ

F.3.3 The SET/CURRENT Command

The SET/CURRENT command allows you to change which physical controller is currently active in a failover set. The SET/CURRENT command causes a manual failover of the failover set from one physical controller to the one specified in your buffer. Figure F–2 shows the format of the SET/CURRENT entry. Figure F–2 shows the format of the SET/CURRENT entry.

Figure F–2 Format of Individual SET/CURRENT Entry



The Code byte must contain the value DSF$K_ITEM_PC.

The New Controller byte must indicate a valid physical controller: that is, one made a member of the failover set by a previous ADD command. If the New Controller byte does not indicate a valid physical controller, the SFDRIVER returns an invalid buffer error.

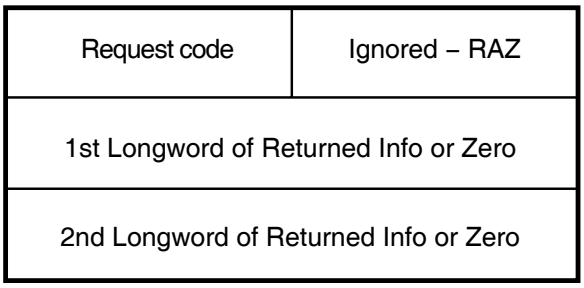
Use the following constants in the New Controller byte to specify the new physical controller of the failover set:

Constant	Controller
1	DSF$K_PC_SMB
2	DSF$K_PC_SMC
3	DSF$K_PC_SMD
4	DSF$K_PC_SME
6	DSF$K_PC_SMG
7	DSF$K_PC_SMH
8	DSF$K_PC_SMI
9	DSF$K_PC_SMJ

F.3.4 The SHOW Command

The SHOW command allows you to obtain information about the current state of the failover set. This command requires a three longword format item-list. The item-list consists of a series of information entries and is terminated by a longword set to zero. The format of each item-list entry is shown in Figure F–3. The programming libraries shipped on the kit supply the structure definitions you require to access the item-list.

Figure F–3 Format of Individual SHOW Entry



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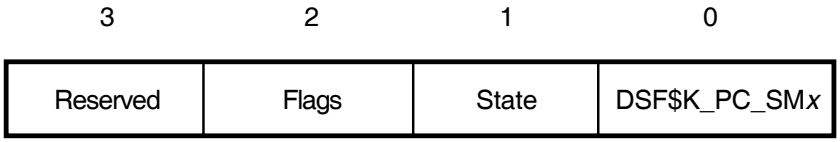
The request codes can have the following values:

- DSF$K_ITEM_PC which denotes a request for Failover Set State
- DSF$K_ITEM_CS which denotes a request for Cable State
- DSF$K_ITEM_FS which denotes a request for Failover Set Configuration State

F.3.4.1 Failover Set State

When you request Failover Set State, the driver returns zero, one, or two longwords of information. The number of nonzero longwords returned tells you the number of members currently in the failover set. The driver will clear any longwords not used, and will not assume they are supplied as zero. The format of each longword is shown in Figure F–4.

Figure F–4 Failover Set State Longword



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The low byte contains a constant identifying the physical device which is a member of this Failover Set. The state field contains the state of the physical unit. Possible values are listed below:

- DSF$K_STANDBY which means that the physical device is standing by
- DSF$K_CURRENT which means that the physical device is currently the active controller for this Failover Set
- DSF$K_FAILED which means that the physical device is broken

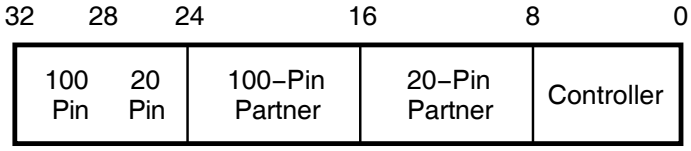
The flags field contains the following flags:

- DSF$M_INIT which means the physical device has completed its initialization successfully

F.3.4.2 Cable State

When Cable State is requested, the driver returns zero, one, or two longwords of information. One longword will be initialised for each current physical member of the failover set. The format of each longword is shown in Figure F–5.

Figure F–5 Cable State Longword



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The Controller byte contains a constant identifying the physical device to which the cable state information refers.

The 20-pin Partner and 100-pin Partner bytes contain constants identifying the physical devices connected through the 20-pin and 100 pin cables, respectively.

The top byte is split into two 4-bit fields: the 20-pin field and the 100-pin field. The values in these fields indicate the current state of the 20-pin and the 100-pin connections.

For the 20-pin connection, the values are as follows:

- DSF$K_20_GOOD—there is a good connection between the physical device and the partner at the other end of the 20-pin cable.
- DSF$K_20_NONE—there is no 20-pin cable connection (in this case, the 20-pin byte is set to 0).
- DSF$K_20_UNKNOWN—the state of the 20-pin connection is unknown (in this case, the 20-pin byte is set to 0).

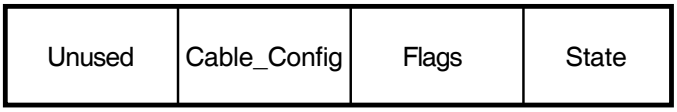
For the 100-pin connection, the values are as follows:

- DSF$K_100_GOOD—there is a good connection between the physical device and the partner at the other end of the 100-pin cable.
- DSF$K_100_NONE—there is no 100-pin cable connection (in this case, the 100-pin byte is set to 0).
- DSF$K_100_UNKNOWN—the state of the 100-pin connection is unknown (in this case, the 100-pin byte is set to 0).

F.3.4.3 Failover Set Configuration State

When Failset Configuration State is requested, the driver returns one longword of information in the second longword of the item-list. The format of this longword is shown in Figure F–6.

Figure F–6 Failover Set Configuration State Longword



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The state field describes the current state of the failover set. Possible values for this field are as follows:

- DSF$K_NULL which means that the failset is empty
- DSF$K_SINGLE which means that the failset contains one physical controller
- DSF$K_PARTNERED which means the failset contains two physical members in separate zones
- DSF$K_INVALID which means the failset state is invalid

The CABLE_CONFIG field describes the driver's perception of the validity of the physical cabling of the failover set. Possible values which may be returned are shown below:

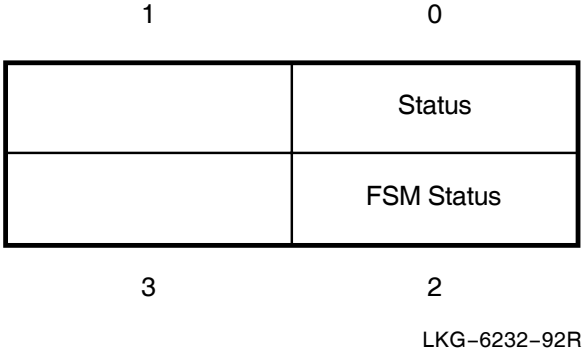
- DSF$K_GOOD which means the cable configuration is good
- DSF$K_BAD which means the cable configuration is bad
- DSF$K_UNKNOWN which means the cable setup cannot be determined (for example, if one zone is stopped the cable state can not be determined)

The *DECnet/OSI for VMS Installation and Configuration* describes the correct configuration of cables.

F.4 Returning Status

Figure F–7 shows the IOSB used by the driver to return its status.

Figure F–7 Status Return IOSB



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The driver returns a $QIO success (SS$_NORMAL) return status code with errors indicated in the IOSB, except for the SS$_NOOPER return, which is returned as a $QIO status.

The following status returns can be returned by the driver in the IOSB. The Status byte can return these values:

- SS$_ACCVIO which means an error has been returned for an inaccessible item-list entry, as determined by a PROBEW
- SS$_BADPARAM which means an error has been returned because there is a problem with the item-list format. An FSMCMD error should be returned for any error processing the item-list in the device-dependent field of the IOSB. The device dependent field of the IOSB should contain the byte offset into the item-list of the field, which is in error in the high word.
- SS$_NOOPER which means that the process does not have OPER privilege
- SS$_NORMAL which means successful completion of the command

If the Status byte contains SS$_BADPARAM, then the FSM Status byte contains one of these values:

- FSMCMD$K_ERR_BAD_ITEMLIST which means that the item-list is in the wrong state
- FSMCMD$K_ERR_BAD_LC which means invalid logical controller value
- FSMCMD$K_ERR_BAD_PC which means invalid physical controller value
- FSMCMD$K_ERR_DUPLICATE_INFO which means information has been requested twice in a SHOW item-list
- FSMCMD$K_ERR_EMPTY_FAILSET which means you cannot remove the device from the failover set because it is already empty
- FSMCMD$K_ERR_NO_LC which means that no logical controller has been specified
- FSMCMD$K_ERR_NO_PC which means that no physical controller has been specified
- FSMCMD$K_ERR_NOSCHDEV which means the device does not exist
- FSMCMD$K_ERR_ONLY_ONE_SLOT which means two controllers are being added but there is only one slot in the failover set
- FSMCMD$K_ERR_PC_ACTIVE which means the physical controller is currently active and cannot be removed
- FSMCMD$K_ERR_PC_ALREADY_ACTIVE which means the physical controller is already active on a SET/CURRENT command
- FSMCMD$K_ERR_PC_BROKE which means that the device driver has detected that the specified physical device is faulty
- FSMCMD$K_ERR_PC_IN_USE which means that the physical controller is already in use within a failover set
- FSMCMD$K_ERR_PC_NOT_IN_FAILSET which means the physical device is not in the failover set
- FSMCMD$K_ERR_TOO_MANY_PCS which means there are too many PC items
- FSMCMD$K_ERR_SAME_ZONE which means that same zone partnership is not allowed

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