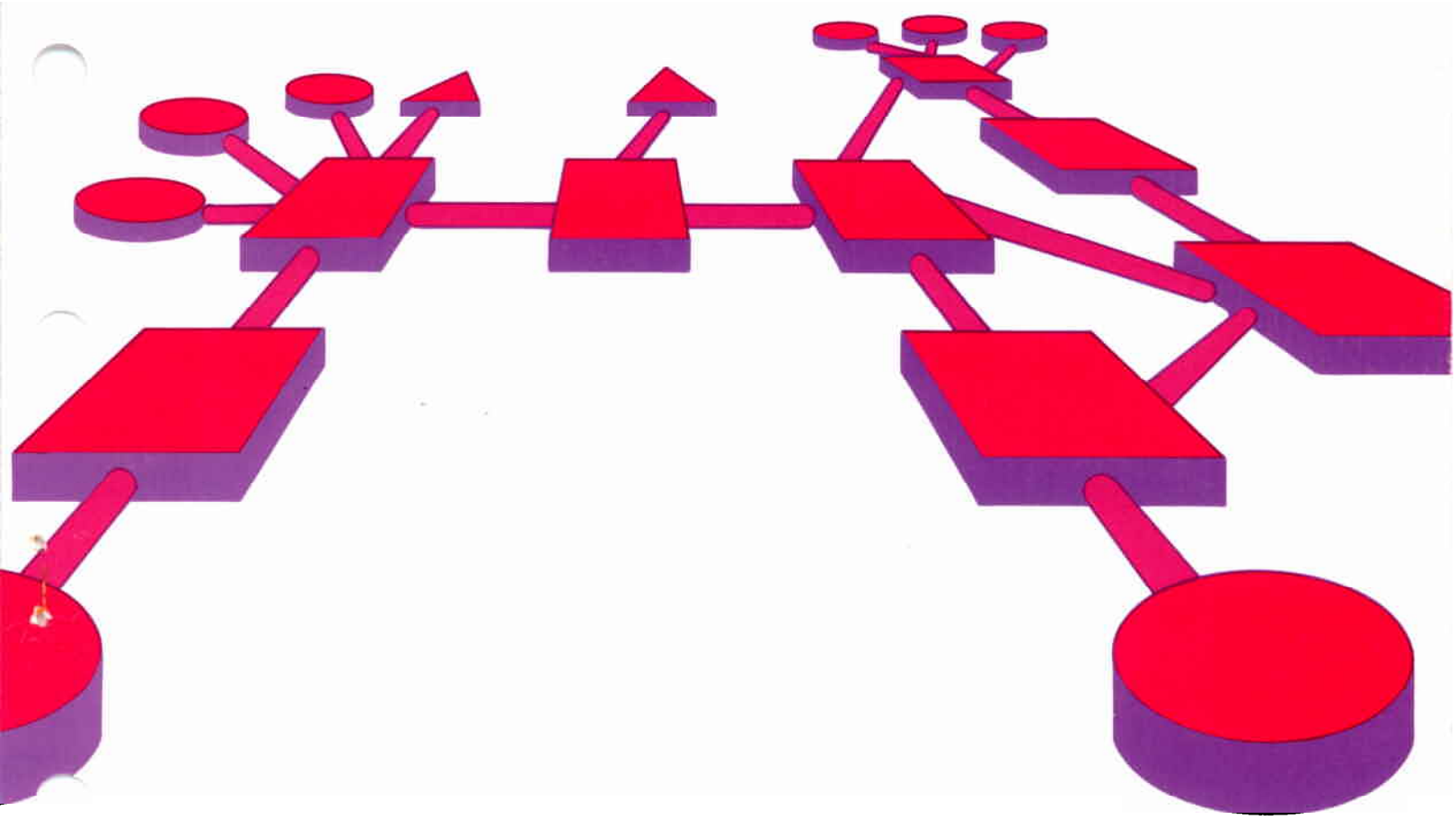
Order No. AA-K181A-TK

DECnet
DIGITAL Network Architecture

Network Management
Functional Specification

Version 2.0.0



DECnet
DIGITAL Network Architecture
(Phase III)

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Version 2.0.0

October 1980

This document describes the functions, structures, protocols, algorithms, and operation of the DIGITAL Network Architecture Network Management modules. It is a model for DECnet implementations of Network Management software. Network Management provides control and observation of DECnet network functions to users and programs.

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1.0 INTRODUCTION

This document describes the structure, functions, operation, and protocols of Network Management. Network Management is that part of the DIGITAL Network Architecture that models the software that enables operators and programs to plan, control, and maintain the operation of centralized or distributed DECnet networks. DIGITAL Network Architecture (DNA) is the model on which DECnet network software implementations are based. Network software is the family of software modules, data bases, hardware components, and facilities used to tie DIGITAL systems together in a network for resource sharing, distributed computation, or remote system communication.

DNA is a layered structure. Modules in each layer perform distinct functions. Modules within the same layer (either in the same or different nodes) communicate using specific protocols. The protocols specified in this document are the Network Information and Control Exchange (NICE) protocol, the Loopback Mirror protocol, and the Event Receiver protocol.

Modules in different layers interface using subroutine calls or a similar system-dependent method. In this document, interface communications between layers are referred to as calls or requests because this is the most convenient way of describing them functionally. An implementation need not be written as calls to subroutines. Interfaces to other DNA layers are not specified in detail, however, Appendix I describes which Network Management user commands (Network Control Program) support each DNA interface.

In this document network nodes are described by function as executor, command, host, and target. The executor is an active network node connected to one end of a line being used for a load, dump, or line loop test and is the node that executes requests. The command node is the node in which the Network Management request originates. The host is a node that provides a higher level service such as a file system. The target is a node that is to receive a load, loop back a test message, or generate a dump. Executor, command, and host nodes may be three different nodes, all the same node, or any combination of two nodes. A glossary at the end of this document defines many Network Management terms.

This document describes commands that can be standardized across different DECnet implementations. An implementation may use only a subset of the commands described herein. Moreover, commands and functions specific to one particular operating system are not described.

This document specifies the functional requirements of Network Management. Both algorithms and operational descriptions support this specification. However, an implementation is not required to use the same algorithms. It is only required to have the functions (or a subset of them) specified.

This is one of a series of functional specifications for the DIGITAL Network Architecture, Phase III. This document assumes that the reader is familiar with computer communications and DECnet. The primary audience for this specification consists of implementers of DECnet systems, but it may be of interest to anyone wishing to know details of DECnet structure. The other DNA Phase III functional specifications are:

DNA Data Access Protocol (DAP) Functional Specification, Version 5.6.0, Order No. AA-K177A-TK

DNA Digital Data Communications Message Protocol (DDCMP) Functional Specification, Version 4.1.0, Order No. AA-K175A-TK

DNA Maintenance Operations Protocol (MOP) Functional Specification, Version 2.1.0, Order No. AA-K178A-TK

DNA Network Services (NSP) Functional Specification, Version 3.2.0, Order No. AA-K176A-TK

DNA Transport Functional Specification, Version 1.3.0, Order No. AA-K180A-TK

DNA Session Control Functional Specification, Version 1.0.0, Order No. AA-K182A-TK

The DNA General Description (Order No. AA-K179A-TK) provides an overview of the network architecture and an introduction to each of the functional specifications.

2.0 FUNCTIONAL DESCRIPTION

Network Management enables operators and programs to control and monitor network operation. Network Management helps the manager of a network to plan its evolution. Network Management also facilitates detection, isolation, and resolution of conditions that impede effective network use.

Network Management provides user commands and capability to user programs for performing the following control functions:

1. **Loading remote systems.** A system in one node can down-line load a system in another node in the same network.

2. **Configuring resources.** A system manager can change the network configuration and modify message traffic patterns.

3. **Setting parameters.** Line, node, and logging parameters (for example, node names) can be set and changed.

4. **Initiating and terminating network functions.** A system manager or operator can turn the network on or off and perform loopback tests and other functions.

Network Management also enables the user to monitor network functions, configurations, and states, as follows:

1. **Dumping remote systems.** A system in one node can up-line dump a system to another node in the same network.

2. **Examining configuration status.** Information about lines and nodes can be obtained. For example, an operator can display the states of lines and nodes or the names of adjacent nodes.

3. **Examining parameters.** Line and node parameters (for example, timer settings, line type, or node names) can be read.

4. **Examining the status of network operations.** An operator can monitor network operations. For example, the operator can find out what operations are in progress and whether any have failed.

5. **Examining performance variables.** A system manager can examine the contents of counters in lower DNA layers to measure network performance. In addition, Network Management's Event Logger provides automatic logging of significant network events.

Besides controlling and monitoring the day-to-day operation of the network, the functions listed above work to collect information for future planning. These functions furnish basic operations (primitives) for detecting failures, isolating problems, and repairing and restoring a network.

2.1 Design Scope

Network Management functions satisfy the following design requirements:

1. **Common interfaces.** Common interfaces are provided to operators and programs, regardless of network topology or configuration, as much as possible without impacting the

quality of existing products. There is a compromise between the compatibility of network commands across heterogeneous systems and the compatibility within a system between network and other local system commands.

2. **Subsetability.** Nodes are able to support a subset of Network Management components or functions.

3. **Ease of use.** Invoking and understanding Network Management functions are easy for the operator or user programmer.

4. **Network efficiency.** Network Management is both processing and memory efficient. It is line efficient where this does not conflict with other goals.

5. **Extensibility.** There is accommodation for future, additional management functions, leaving earlier functions as a compatible subset. This specification serves as a basis for building more sophisticated network management programs.

6. **Heterogeneity.** Network Management operates across a mixture of network node types, communication lines, topologies, and among different versions of Network Management software.

7. **Robustness.** The effects of errors such as operator input errors, protocol errors, and hardware errors are minimized.

8. **Security.** Network Management supports the existing security mechanisms in the DIGITAL Network Architecture (for example, the access control mechanism of the Session Control layer).

9. **Simplicity.** Complex algorithms and data bases are avoided. Functions provided elsewhere in the architecture are not duplicated.

10. **Support of diverse management policies.** Network Management covers a range between completely centralized and fully distributed management.

The following are not within the scope of Version 2.0.0 of Network Management:

1. **Accounting.** This specification does not provide for the recording of usage data that would be used to keep track of individual accounts for purposes of reporting on or charging users.

2. **Automation.** This specification does not provide for automatic execution of complex algorithms that handle network repair or reconfiguration. More automation can be expected in future revisions of this specification.

3. **Protection against malicious use.** There is no foolproof protection against malicious use or gross errors by operators or programs.

4. **Upward compatibility of user interfaces.** The interfaces to the user layer are not necessarily frozen with this version. Observable data may change with the next version. Because of this, a function such as node-up keyed to a spooler in an implementation would not be wise.

2.2 Relationship to DIGITAL Network Architecture

DIGITAL Network Architecture (DNA), the model upon which DECnet implementations are based, outlines several functional layers, each with its own specific modules, protocols, and interfaces to adjacent layers. Network Management modules reside in the three highest layers.

The general design of DNA is as follows in order from the highest to the lowest layer:

1. **The User layer.** The User layer is the highest layer. It supports user services and programs. The Network Control Program (NCP) resides in this layer.

2. **The Network Management layer.** The Network Management layer is the only one that has direct access to each lower layer for control purposes. Modules in this layer provide user control over, and access to, network parameters and counters. Network Management modules also perform up-line dumping, down-line loading, and testing functions.

3. **The Network Application layer.** Modules in the Network Application layer support I/O device and file access functions. The Network Management module within this layer is the Loopback Mirror, providing logical link loopback testing.

4. **The Session Control layer.** The Session Control layer manages the system-dependent aspects of logical link communication.

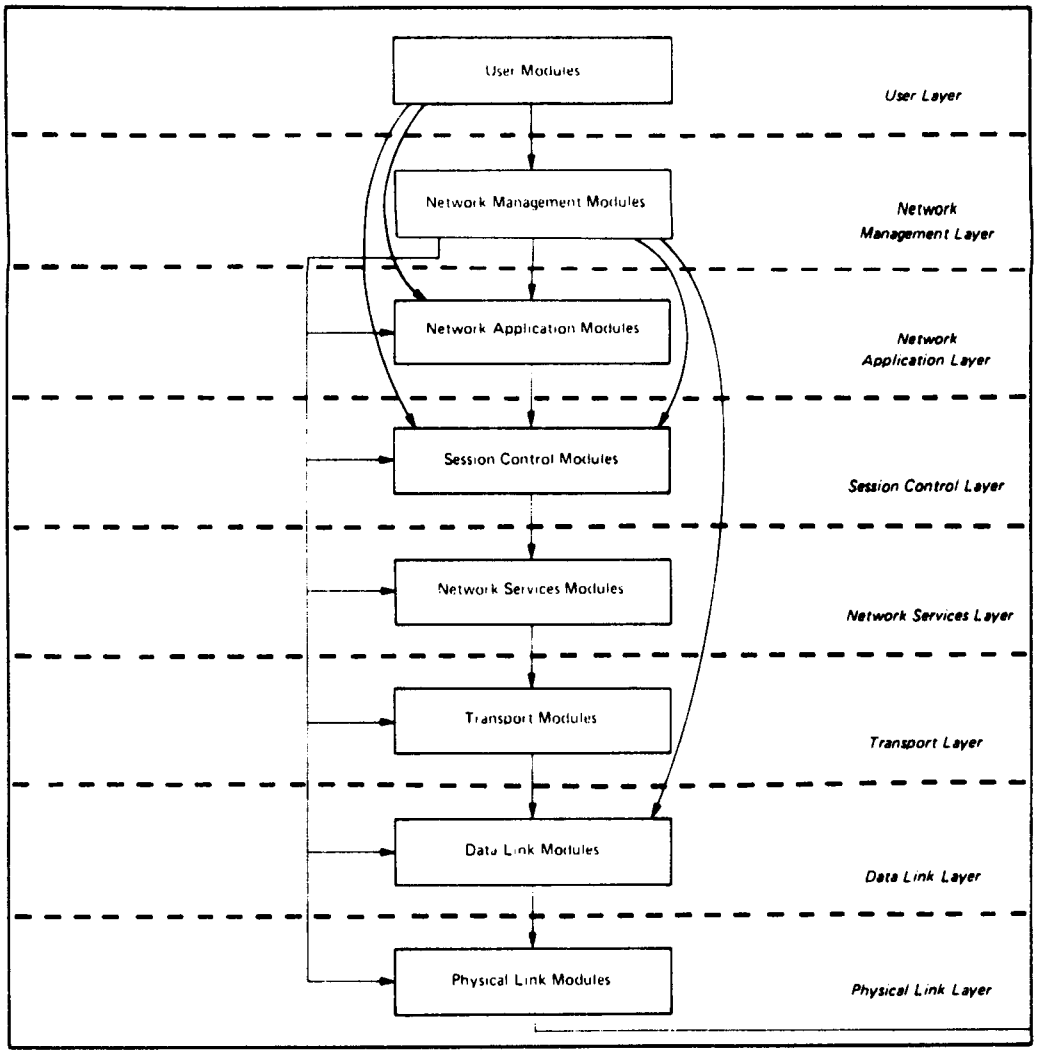
5. **The Network Services layer.** The Network Services layer controls the creation, maintenance, and destruction of logical links, using the Network Services Protocol and modules.

6. **The Transport layer.** Modules in the Transport layer route messages between source and destination nodes.

7. **The Data Link layer.** The Data Link layer manages the communications over a physical link, using a data link protocol, for example, the Digital Data Communications Message Protocol (DDCMP).

8. **The Physical Link layer.** The Physical Link layer provides the hardware interfaces (such as EIA RS-232-C or CCITT V.24) to specific system devices.

Figure 1 shows the relationship of the Network Management layer to the other DNA layers.



Horizontal arrows show direct access for control and examination of parameters, counters, etc. Vertical and curved arrows show interfaces between layers for normal user operations such as file access, down-line load, up-line dump, end-to-end looping, and logical link usage.

Figure 1 Network Management Relation to DNA

2.3 Functional Organization within DIGITAL Network Architecture

The functional components of Network Management are as follows:

User layer components

Network Control Program (NCP). The Network Control Program enables the operator to control and observe the network from a terminal. Section 3 specifies NCP.

Network Management layer components

Section 4 specifies the Network Management layer components and their operation. Figure 2 shows the relationship of Network Management layer modules in a single node.

Network Management Access Routines. These routines provide user programs and NCP with generic Network Management functions, and either convert them to Network Information and Control Exchange (NICE) protocol messages or pass them on to the Local Network Management Function.

Network Management Listener. The Network Management Listener receives Network Management commands from the Network Management level of remote nodes, via the NICE protocol. In some implementations it also receives commands from the local Network Management Access Routines via the NICE protocol. It passes these requests to the Local Network Management Function.

Local Network Management Functions. These take function requests from the Network Management Listener and the Network Management Access Routines and convert them to system dependent calls. They also provide interfaces to lower level modules directly for control purposes.

Line Watcher. The Line Watcher is a module in a node that can sense service requests on a line from a physically adjacent node. It controls automatically-sensed down-line load or up-line dump requests.

Line Service Functions. These provide the Line Watcher and the Local Network Management Functions with line services needed for service functions that require a direct interface to the data link layer (line level testing, down-line loading, up-line dumping, triggering a remote system's bootstrap loader and setting the line state). The Line Service module maintains internal states as well as line substates.

Event Logger. The Event Logger provides the capability of logging significant events for operator intervention or future reference. The process concerned with the event (for example, the Transport module) provides the data to the Event Logger, which can then record it.

Network Application Layer Components

Loopback Mirror. Access and service routines communicate using the Logical Loopback Protocol to provide node level loopback on logical links. Section 5 describes this Network Application layer component.

Object Types

The Network Management architecture requires three separate object types. Each has a unique object type number.

The object types and numbers are:

Type	Object Type Number
Network Management Listener	19
Loopback Mirror	25
Event Receiver	26

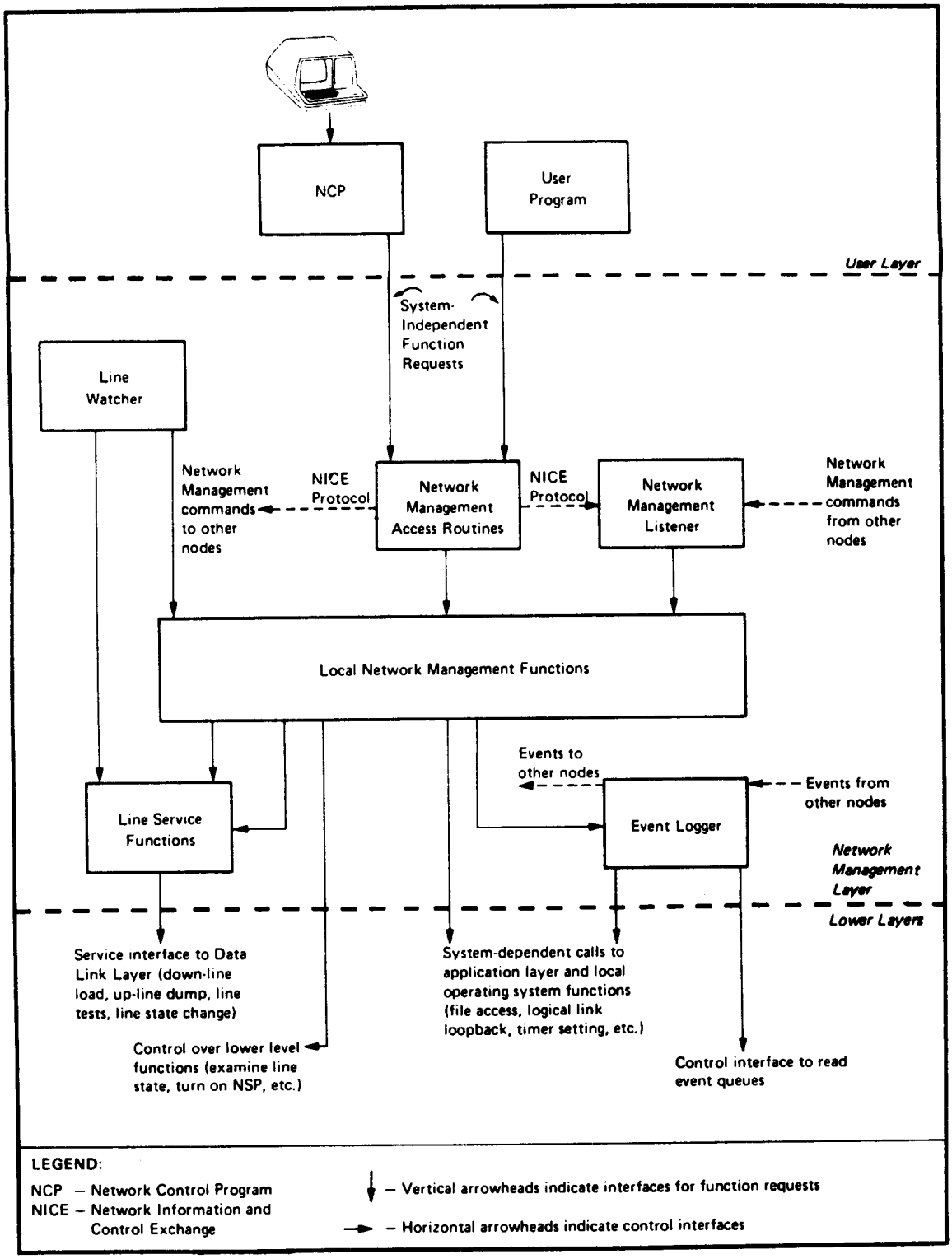


Figure 2 Network Management Layer Modules and Interfaces in a Single Node

3.0 NETWORK CONTROL PROGRAM (NCP)

This section is divided into three parts. Section 3.1 describes the NCP functions. Section 3.2 provides rules for the operation of NCP, including such topics as input and output formatting, access control, and status and error messages. Section 3.3 presents a detailed description of all the NCP commands.

3.1 Network Control Program Functions

There are two types of NCP commands:

1. **Internal commands.** These are directed to NCP itself and cannot be sent to remote nodes. These are the SET and DEFINE EXECUTOR NODE node-id, CLEAR and PURGE EXECUTOR NODE, and SHOW QUEUE commands; the TELL prefix; and the EXIT command (Section 3.2).

2. **Commands that use the Network Management interface.** These use the Network Management Listener, via the Network Information and Control Exchange (NICE) protocol, when sent across logical links to remote nodes. NCP commands directed to the local node have the option of either using the Network Management Listener, via the Network Management Access Routines and the NICE protocol, or of passing requests directly to the Local Network Management Function from the Network Management Access Routines. The method chosen is implementation-specific.

The NCP command language enables an operator to perform the following network functions:

- Changing parameters (Section 3.1.1)
- Gathering information (Section 3.1.2)
- Down-line loading (Section 3.1.3)
- Up-line dumping (Section 3.1.4)
- Testing line and network (Section 3.1.5)
- Zeroing counters (Section 3.1.6)

3.1.1 **Changing Parameters** - The parameters are line, node, or logging options specifically described in Appendix A.

Some examples of changing parameters are:

- Setting a line state to ON
- Changing a node name associated with a node address
- Setting the routing cost for a line
- Setting a node to be notified of certain logged events

Parameters may be set either as dynamic values in volatile memory using the SET command or as permanent values in a mass-storage default data base using the DEFINE command. The volatile data base is lost when the node shuts down; the permanent data base remains from one system initialization to the next. Parameters can be either status, such as line state, or characteristics that are determined by SET, DEFINE, CLEAR, and PURGE commands. Characteristics are static in the sense that once set, either at system generation time or by an operator, they remain constant until cleared or reset. Status consists of dynamic information (such as line state) that changes automatically when functions are performed.

Permanent values take effect whenever the permanent data base is re-read. The timing of the values' taking effect is implementation-dependent. Volatile values take effect immediately.

Setting line states does not change line ownership, which is Transport or its equivalent. Line states can be set, however, to control the use of the line by its owner. To Transport, the line is either OFF or ON. To Network Management, a line can also be in a SERVICE state, a state which precludes normal traffic, and which temporarily prevents Transport from using the line. The SERVICE state is used for loading, dumping, and line testing. The ON and SERVICE states have various substates that inform the operator what function the line is performing. When states are displayed, the substates are indicated as a tag on the end of the operator-requested state.

3.1.2 **Gathering Information** - The information gathered includes characteristics, status, and counters associated with the line, logging, and node entities (detailed in Appendix A). Examples of gathering information are:

- Displaying the state of a line
- Reading and then zeroing line counters
- Displaying characteristics of all reachable nodes
- Showing the status of all commands in progress at a node

Characteristics and status are described in Section 3.1.1.

Counters are error and performance statistics such as messages sent and received, time last zeroed, and maximum number of logical links in use.

3.1.3 **Down-line Loading** - Down-line loading is the process of transferring a memory image from a file to a target system's memory. This requires that the executor, the node executing the command, have direct access to the line to the target. The file may be located at another remote node, in which case the executor uses its system-specific remote file access procedures. The executor supports or has access to a data base of defaults for a load request. Section 4.2.1 describes the down-line load operation in the Network Management layer.

3.1.4 **Up-line Dumping** - Up-line dumping is the process of transferring the dump of a memory image from a target system to a destination file. Section 4.2.2 describes the up-line dump operation.

3.1.5 Testing Line and Network - Testing line and network can be accomplished by message looping at both the line and node levels. Testing requires receiving a transmitted message over a particular path that is looped back to the local node by either hardware or software.

Node level testing uses logical links and normal line usage. The lines involved are in the ON state, and the Session Control, Network Services, and Transport layers are used.

During line level testing, the line being tested is in the SERVICE state; normal usage is precluded. Network Management accesses the Data Link layer directly, bypassing intermediate layers. Section 4.2.4 describes line and network testing.

3.1.6 Zeroing Counters - Using NCP, an operator can set line and node counters to zero.

3.2 Network Control Program Operation

This section describes general rules concerning the operation of NCP.

The SET, DEFINE, CLEAR, and PURGE commands must successfully act on either all parameters entered or on none of them. One parameter per command is all that can be expected to take effect on any system, although a system may allow some parameters to be grouped on the same command.

3.2.1 Specifying the Executor - Since a command does not have to be executed at the node where it is typed, the operator must be able to designate on what node the command is to be processed. The operator has two options for controlling this:

1. Specifying a default executor for a set of commands

2. Naming the executor with the commad

At NCP start-up time, the default executor is the node on which NCP is running or the node that was previously defined with the DEFINE EXECUTOR NODE command. The default executor is changed using the SET, DEFINE, CLEAR, or PURGE EXECUTOR NODE commands (see Sections 3.3.1.2 and 3.3.2.1).

With any command, the operator can override the default executor by specifying which node is to execute the command. This is accomplished by entering "TELL node-identification" as a prefix to the command. The specified node identification applies only to the one command and does not affect the default executor or any subsequent commands.

3.2.2 **Program Invocation, Termination, and Prompting** - The way NCP is invoked or terminated is system-dependent. If a name is used for the program, it must be "NCP." The EXIT command terminates NCP.

The following rules apply to the initial NCP prompt:

For an NCP that accepts only a single outstanding command, the prompt is always the same:

```
NCP>
```

For an NCP that accepts several outstanding commands where it is obvious that NCP is prompting, the prompt is:

```
#n>
```

For the multiple-outstanding-command case where it is not obvious that NCP is prompting, the prompt is:

```
NCP#n>
```

In any case, n is the command's request number, which will identify the output for the command.

An implementation that cannot integrate the request number with the prompt, can display the request number when the command is accepted.

3.2.3 **Privileged Commands** - Network and system planners must determine which commands should be limited to privileged users. The exact determination of privilege is an implementation-dependent function. Privilege is generally determined in a system-specific way according to the privileges of the local user or the access control provided at logical link connection time.

3.2.4 **Input Formats** - Command input is in the form of arguments delimited by tabs or blanks. Either a single or multiple tab or blank may be used to delimit arguments.

Null command lines. Null command lines will result in a command prompt being re-issued.

Node identification and access control. Nodes are identified by address or name. The primary identification is the address (a Session Control requirement). The keyword EXECUTOR can be substituted for NODE executor-node-identification. If a node identification represents a node to be connected to, access control information may be necessary or desired. If so, the access control follows the node identification, the maximum length of each field being 39 bytes. Specific systems may limit the amount of access control information they will accept. The format is:

```
{ LOOP NODE      }
{SET EXECUTOR NODE}node-id [USER user-id][PASSWORD password][ACCOUNT account]
{   TELL         }
```

where:

LOOP NODE node-id — Is an NCP command used to initiate a node loopback test (Section 3.3.6.2). The access control applies only to the command.

SET EXECUTOR NODE node-id	Is an NCP command used to set the node identification and access control for the default executor node (Section 3.3.1.1). The access control prevails until changed by another SET EXECUTOR command or a TELL or LOOP NODE command.
TELL node-id	Is an NCP command prefix used to pass one command and access control information to a specific node. The access control applies only to that one command.
[USER user-id]	Is access control information that provides the identification of the user.
[PASSWORD password]	Is access control information furnishing a password.
[ACCOUNT account]	Is access control information supplying an account identification.

For example:

```
TELL BOSS USER [211,1] PASSWORD secret ACCOUNT xyz CLEAR KNOWN LINES

SET EXECUTOR NODE 97 ACCOUNT xyz
```

String input. String input (every argument that is not a node name, keyword or number) is defined by the executor node and the length limitations of the NICE protocol. For consistency from one implementation to another, the following rules apply to NCP's parsing algorithm for these types of arguments:

- Implementations will provide both a transparent and a non-transparent technique for specifying these arguments.
- The transparent technique will act on any string of characters enclosed in quotation marks ("XXXXX"). A quote within the string will be indicated by a double quotation mark ("XXX""XX").
- The non-transparent technique will act on any string of characters that does not contain blanks or tabs. An exception to this occurs where it is possible to recognize syntactically that blanks or tabs are not intended as delimiters.

Keywords. Implementations must accept keywords in their entirety. However, the user may abbreviate keywords when typing them in. The minimum abbreviation is system-specific.

The command formats specified in this document are to be the formats used for NCP input. They may be modified only in the sense that unsupported commands or options may be left out. It is permissible to prefix a command with an identifier such as OPR NCP. However, this prefix should not affect the remainder of the command syntax or semantics. Optional system-specific guide words such as TO or FOR can be added to NCP commands if they do not interfere with defined key words.

The NCP command language does not use a question mark as a syntactic or semantic element. The question mark is left available for use according to operating system conventions.

An implementation may recognize locally defined names for lines or accept other non-standard line identifications as string inputs.

3.2.5 Output Characteristcs - The output format specified in this document is to be considered the basic pattern for all NCP output. Implementations may differ as long as common information is readily identifiable. The following example shows three commands and their resultant output. User-furnished information is underlined to distinguish it from the program output.

```
#23>LOAD NODE MANILA

#24>LOAD NODE TOKYO

#25>
REQUEST #24; LOAD FAILED, LINE COMMUNICATION ERROR
SHOW QUEUE
REQUEST #25; SHOW QUEUE

REQUEST
NUMBER  EXECUTOR     COMMAND  STATUS

  21    6 (HNGKNG)   SHOW     COMPLETE
  22    6 (HNGKNG)   SET      COMPLETE
  23    6 (HNGKNG)   LOAD     IN PROGRESS
  24    6 (HNGKNG)   LOAD     FAILED
  25    N/A          SHOW     IN PROGRESS
#26>
REQUEST #23, LOAD COMPLETE
```

Passwords are not displayed. Instead, an ellipsis (...) indicates that a password is set. Section 3.3.8 provides details concerning output for requested information (SHOW and LIST commands).

3.2.6 Status and Error Messages - Status and error messages inform the NCP user of the consequence of a command entry. NCP gives each command a request number, which it displays with status and error messages. NCP displays status or error messages when the status of the command changes as long as the user does not begin to type a new command. The general form of status and error messages is:

```
REQUEST #n;  [entity,] command status [,error-message]
```

where:

n	Is the command's request number.
entity	Is a specific entity described in Appendix A.
command	Is a command indicator.
status	Is the status of the operation, one of COMPLETE, FAILED, or NOT ACCEPTED. If it is COMPLETE, there is no error-message. If it is FAILED or NOT ACCEPTED, there is an error-message.
error-message	Is the reason for a failure.

Commands that act on plural entities (for example, SET KNOWN LINES) have a separate status message for each individual entity and one for the entire operation. In this case, each entity is identified with its own status message.

In an NCP that allows only one command at a time, COMPLETE messages are not displayed, and the request number is not included. An example of output for a command that has failed follows:

```
LOAD FAILED, LINE COMMUNICATION ERROR
```

NCP prints unrecognized return codes or error details as decimal numbers. For example:

```
Request #5;  SHOW failed, Management return #-34
SET FAILED, parameter not applicable, detail #2300
```

Error messages are either those from the set of NCP error messages in Appendix E, the NICE error returns in Appendix D or implementation specific.

3.3 Network Control Program Commands

This section describes NCP commands.

The following symbols are used in NCP command syntax descriptions:

[ ]	Brackets indicate optional input. In most cases these are the entity parameters and entity parameter options for a command.
UPPER CASE	Upper case letters signify actual input, that is keywords that are part of NCP commands.
lower case	Lower case letters in a command string indicate a description of an input variable, not the actual input.
spaces	Spaces between variables (not keywords) in a command string delimit parameters.
hyphens	Multi-word variables are hyphenated.
{ }	Braces indicate that any of the enclosed parameters is applicable.
<	This designates keywords or messages that may be returned on a SHOW command. This is used in Appendix I.

All NCP commands have the following common syntax:

command entity parameter-option(s)

where:

command	Specifies the operation to be performed, such as SHOW or LOAD.
entity	Specifies the entity (component) to which the operation applies, such as LINE or KNOWN NODES.
parameter-option(s)	Qualifies the command by providing further specific information.

Table 1 lists the complete set of NCP commands specified in this document. Details concerning options and explanations of each command follow in the text. Appendix I lists the NCP commands supporting each Network Management interface.

Table 1
NCP Commands

Command	Entity	Parameter	
{SET / DEFINE}	EXECUTOR	NODE	destination-node
	{LINE line-id / KNOWN LINES}	ALL	
		CONTROLLER	controller-mode
		COST	cost
		COUNTER TIMER	seconds
		DUPLEX	duplex-mode
		NORMAL TIMER	milliseconds
		SERVICE	service-control
		SERVICE TIMER	milliseconds
		STATE	line-state
		TRIBUTARY	tributary-address
		TYPE	line-type
	{LOGGING sink-type / KNOWN LOGGING}	EVENT event-list	[source-qual][sink-node]
		KNOWN EVENTS	
		NAME	sink-name
		STATE	sink-state
*	{NODE node-id / KNOWN NODES}	ADDRESS	node-address
		ALL	
		BUFFER SIZE	memory-units
		COUNTER TIMER	seconds
		CPU	cpu-type
		DELAY FACTOR	number
		DELAY WEIGHT	number
		DUMP ADDRESS	number
		DUMP COUNT	number
		DUMP FILE	file-id
		HOST	node-id
		IDENTIFICATION	id-string
		INACTIVITY TIMER	seconds
		INCOMING TIMER	seconds
	**	LINE	line-id
		LOAD FILE	file-id
		MAXIMUM ADDRESS	number
		MAXIMUM BUFFERS	number
		MAXIMUM COST	number
		MAXIMUM HOPS	number
		MAXIMUM LINES	number
		MAXIMUM LINKS	number
		MAXIMUM VISITS	number

Legend:

* EXECUTOR may be substituted for NODE node-id.

** The node-id with the LINE parameter is a name. With all other parameters, it can be either a name or address.

! Used only with NODE node-id.

(continued on next page)

Table 1 (Cont.)
NCP Commands

Command	Entity	Parameter
*	{NODE node-id / KNOWN NODES}	NAME node-name OUTGOING TIMER seconds (CONT.) RETRANSMIT FACTOR number ROUTING TIMER number SECONDARY DUMPER file-id SECONDARY LOADER file-id SERVICE DEVICE device-type SERVICE LINE line-id SERVICE PASSWORD password SOFTWARE IDENTIFICATION file-id SOFTWARE TYPE program-type STATE node-state TERTIARY LOADER file-id TYPE node-type
{CLEAR / PURGE}	EXECUTOR	NODE
	{LINE line-id / KNOWN LINES}	ALL COUNTER TIMER
	{LOGGING sink-type / KNOWN LOGGING}	EVENT event-list [source-qual][sink-node] KNOWN EVENTS NAME
{CLEAR / PURGE}	* {NODE node-id / KNOWN NODES}	ALL COUNTER TIMER CPU DUMP ADDRESS DUMP COUNT DUMP FILE HOST IDENTIFICATION INCOMING TIMER LINE LOAD FILE NAME OUTGOING TIMER SECONDARY DUMPER SECONDARY LOADER SERVICE DEVICE SERVICE LINE SERVICE PASSWORD SOFTWARE IDENTIFICATION SOFTWARE TYPE TERTIARY LOADER
TRIGGER	{NODE node-id / VIA line-id}	[[SERVICE] PASSWORD password] ![VIA line-id]

(continued on next page)

Table 1 (Cont.)
NCP Commands

Command	Entity	Parameter
LOAD	{NODE node-id {VIA line-id	[ADDRESS node-address] [CPU cpu-type] [FROM load-file] [HOST node-id] [NAME node-name] [SECONDARY [LOADER] file-id] [SERVICE DEVICE device-type] [[SERVICE] PASSWORD password] [SOFTWARE IDENTIFICATION software-id] [SOFTWARE TYPE program-type] [TERTIARY [LOADER] file-id] ![VIA line-id]
DUMP	{NODE node-id {VIA line-id	[DUMP ADDRESS number] [DUMP COUNT number] [SECONDARY [DUMPER] file-id] [SERVICE DEVICE device-type] [[SERVICE] PASSWORD password] [TO dump-file] [VIA line-id]
LOOP	* {LINE line-id {NODE node-id	[COUNT count] [WITH block-type] ![VIA length]
SHOW	QUEUE	
{LIST {SHOW	{ACTIVE LOGGING {KNOWN LOGGING {LOGGING sink-type	{EVENTS {STATUS {CHARACTERISTICS {SUMMARY	{SINK NODE node-id {KNOWN SINKS
	{ACTIVE LINES {ACTIVE NODES {EXECUTOR {KNOWN LINES {KNOWN NODES {LINE line-id {LOOP NODES {NODE node-name	{CHARACTERISTICS {COUNTERS {STATUS {SUMMARY	
ZERO	* {LINE line-id {NODE node-id {KNOWN LINES {KNOWN NODES	COUNTERS
EXIT		

3.3.1 **SET and DEFINE Commands** - These commands modify volatile and permanent parameters. The SET command modifies the volatile data base; the DEFINE command changes the permanent data base. Section 4.2.5 describes the change parameter operation.

The general form of the commands is:

```
{SET   }
{      } entity parameter
{DEFINE}
```

Entity is one of the following:

```
EXECUTOR
LINE  line-identification
LOGGING sink-type
NODE  node-identification
KNOWN LINES
KNOWN LOGGING
KNOWN NODES
```

Parameter is one (or more, if allowed by the implementation) of the parameter options defined for the specified entity.

3.3.1.1 **SET and DEFINE EXECUTOR NODE destination-node** - The SET and DEFINE EXECUTOR NODE commands, processed by NCP, change the executor node for subsequent commands. Access control information may be supplied as described in Section 3.2.4.

3.3.1.2 **SET and DEFINE KNOWN Entity Commands** - These commands set volatile and permanent parameters for each one of the specified entities known to the system. The format is:

```
{SET   }
{      } KNOWN plural-entity parameter
{DEFINE}
```

Plural entity is one of LINES, LOGGING or NODES.

The parameters are the same as for the SET and DEFINE entity commands (Sections 3.3.1.3, 3.3.1.4, and 3.3.1.5). However, DEFINE KNOWN plural-entity ALL has no meaning. SET KNOWN plural-entity ALL loads all permanent entity parameters into the volatile data base.

3.3.1.3 **SET and DEFINE LINE Commands** - These commands set volatile and permanent line parameters for the line identified. The format is:

```
{SET   }                  ALL
{      } LINE line-id     CONTROLLER          controller-mode
{DEFINE}                  COST                cost
                          COUNTER TIMER       seconds
                          DUPLEX              duplex-mode
                          NORMAL TIMER        milliseconds
                          SERVICE             service-control
                          SERVICE TIMER       milliseconds
                          STATE               line-state
                          TRIBUTARY           tributary-address
                          TYPE                line-type
```

where:

line-id	Is as specified in Section A.1.
ALL	With SET, puts permanent line parameters associated with the line in the volatile data base. With DEFINE, creates a permanent data base entry for one line.
CONTROLLER controller-mode	Sets the controller mode for the line. The values for controller mode are as follows: LOOPBACK — This is for software controlled loopback of the controller. NORMAL — This is for normal controller operating mode. The command automatically turns the line OFF before setting the mode and back to the original state after.
COST cost	Sets the routing line cost. The cost is a decimal number in the range 1 to 25. The cost parameter is a positive integer value associated with using a line and is used in the Transport routing algorithm (Transport Functional Specification).
COUNTER TIMER seconds	Sets a timer whose expiration causes a line counter logging event. Table 7 lists the line counters. These counters constitute the data for certain logged events (Table 12). The line counters are recorded as data in the event and then zeroed. Seconds is specified as a decimal number in the range 1-65535.
DUPLEX duplex-mode	Sets the hardware duplex mode of the line. The possible modes are: FULL — Full-duplex HALF — Half-duplex
NORMAL TIMER milliseconds	Specifies the maximum amount of time allowed to elapse before a retransmission is necessary. This is used for normal operation of the line. Timing is implementation-dependent. This timer applies to the use of the data link protocol (for example, DDCMP).

SERVICE service-control

Specifies whether or not the service operations (loading, dumping, line loopback testing) are allowed for the line. The service-control values are as follows:

ENABLED — The line may be put into SERVICE state and service functions performed.

DISABLED — The line may not be put into SERVICE state and service functions may not be performed.

SERVICE TIMER milliseconds

Specifies the maximum amount of time allowed to elapse before a receive request completes while doing service operations on the line. Service operations are down-line load, up-line dump, or line loop testing. The timer value is an integer number in the range 1-65535. This timer applies to the use of the service protocol (for example, MOP).

STATE line-state

Sets the line's operational state at the executor node. The possible states are as follows:

ON — The line is available to its owner for normal use, with the exception of temporary overrides for service functions.

OFF — The line is not used by any network or network-related software. The line is functionally non-existent.

SERVICE — This state applies only to the volatile data base (SET command). The line is available for active service functions: load, dump, and line loop. The line can provide passive loopback - direct line software-looped testing (Figure 8) - if no active service function is in progress.

CLEARED — This state applies only to the permanent data base (DEFINE command). A line in this state has space reserved in system tables but has no other databases or parameters in volatile memory. This state is only applicable in systems that can implement it.

If the line is set to its existing state a null operation (NOP) results.

NOTE

An implementation may choose to effect service functions in the ON state, as temporary overrides to normal traffic. In this case, error messages must clearly indicate when a line is in a temporary service condition.

TRIBUTARY tributary-address — Sets the physical tributary address of the line. The tributary address is a decimal number in the range 0-255. It reflects the bit setting of the hardware switch-pack for the tributary.

TYPE line-type — Sets up the line for the data link protocol operation together with the DUPLEX option. Line type is one of the following:

POINT	For a point to point line
CONTROL	For a multipoint control station
TRIBUTARY	For a multipoint tributary

3.3.1.4 **SET and DEFINE LOGGING Commands** - This set of commands is used to control event sinks (where events are logged) and event lists (that control which events get logged). Appendix F specifies events. The command format is:

```
{SET   }
{      } LOGGING sink-type  EVENT event-list  [source-qual][sink-node]
{DEFINE}                    KNOWN EVENTS       [source-qual][sink-node]
                            NAME  sink-name
                            STATE  sink-state
```

where:

sink-type — Is one of CONSOLE, FILE, or MONITOR. Determines the ultimate sink for events. Section A.2 specifies the sink-type format.

[sink-node] — Specifies a node that receives events. It is of the form:

```
SINK NODE node-id
     or
SINK EXECUTOR
```

This option can either precede or follow KNOWN EVENTS or EVENT event-list. The node identification is specified in Section A.2. If a sink node is not supplied, the default is executor.

[source-qualifier]

Selects a specific entity for certain event classes. It has the form:

```
LINE line-id
     or
NODE node-id
```

This option can either precede or follow KNOWN EVENTS or EVENT event-list.

EVENT event-list

Enables the recording of the events specified by the event list. The event list consists of event class.event type(s). The types (Table 12) are specified in ranges using hyphens and in lists using commas. For example:

```
3.0-2
4.1-4,8,10
5.3-4,9
6.1,3,5
```

Wild card notation indicates all types of events for a particular class. For example:

```
3.*
```

NAME sink-name

Establishes device or file names for sink types CONSOLE and FILE, respectively. It specifies a process identification for a MONITOR.

KNOWN EVENTS

Enables the recording of all events known to the executor node for the specified sink node.

STATE sink-state

Controls the operation of the sink specified by sink type. The possible values of sink state are:

- ON — The sink is available for receiving events.
- OFF — The sink is not available and any events destined for it should be discarded.
- HOLD — The sink is temporarily unavailable and events should be queued.

The following is an example of the SET LOGGING command:

```
SET LOGGING CONSOLE SINK NODE MANILA EVENT 6.2 LINE KDZ-0-1.4
```

3.3.1.5 **SET and DEFINE NODE Commands** - These commands set volatile or permanent parameters for a node. Certain parameters can be set only for the executor node or for adjacent nodes. See Table 9. The format for the command is:

```
{SET   }
{      } NODE  node-id
{DEFINE}
```

ADDRESS	node-address
ALL	
BUFFER SIZE	memory-units
COUNTER TIMER	seconds
CPU	cpu-type
DELAY FACTOR	number
DELAY WEIGHT	number
DUMP ADDRESS	number
DUMP COUNT	number
DUMP FILE	file-id
HOST	node-id
IDENTIFICATION	id-string
INACTIVITY TIMER	seconds
INCOMING TIMER	seconds
LINE	line-id
LOAD FILE	file-id
MAXIMUM ADDRESS	number
MAXIMUM BUFFERS	number
MAXIMUM COST	number
MAXIMUM HOPS	number
MAXIMUM LINES	number
MAXIMUM LINKS	number
MAXIMUM VISITS	number
NAME	node-name
OUTGOING TIMER	seconds
RETRANSMIT FACTOR	number
ROUTING TIMER	seconds
SECONDARY DUMPER	file-id
SECONDARY LOADER	file-id
SERVICE DEVICE	device-type
SERVICE LINE	line-id
SERVICE PASSWORD	password
SOFTWARE IDENTIFICATION	software-id
SOFTWARE TYPE	program-type
STATE	node-state
TERTIARY LOADER	file-id
TYPE	node-type

where:

node-id	Specifies node name or node address (Section A.3). In some cases, noted below, the node identification must be a node name. EXECUTOR can be substituted for NODE executor-node-identification.
ADDRESS node-address	Sets the address of the executor node. This cannot be used to set the address of any other node.
ALL	With SET this moves all parameters associated with the node identified from the permanent data base into the volatile data base. With DEFINE it creates a permanent data base entry for the node identified.

BUFFER SIZE memory-units

Sets the size of the line buffers. The size is a decimal integer in the range 1-65535. This size is in memory units (Appendix C). It is the actual buffer size and therefore must take into account such things as protocol overhead. There is one buffer size for all lines.

COUNTER TIMER seconds

Sets a timer whose expiration causes a node counter logging event. Node counters are listed in Table 10. They constitute data for certain logged events (Table 12). The node counters will be recorded as data in the event and then zeroed. Seconds is specified as a decimal number in the range 1-65535.

CPU cpu-type

Sets the default target node CPU type for down-line loading the adjacent node. The possible values are:

PDP 8
PDP 11
DECSYSTEM 10
DECSYSTEM 20
VAX

DELAY FACTOR number

Sets the number by which to multiply one sixteenth of the estimated round trip delay to a node to set the retransmission timer to that node. The round trip delay is used in an NSP algorithm that determines when to retransmit a message (NSP functional specification). The number is decimal in the range 1-255.

DELAY WEIGHT number

Sets the weight to apply to a current round trip delay estimate to a remote node when updating the estimated round trip delay to a node. The number is decimal in the range 1-255. On some systems the number must be 1 less than a power of 2 for computational efficiency (NSP functional specification).

DUMP ADDRESS number

Sets the address in memory to begin an up-line dump of the adjacent node.

DUMP COUNT number

Determines the default number of memory units to up-line dump from the adjacent node.

DUMP FILE file-id

Sets the identification of the file to write to when the adjacent node is up-line dumped. The file identification is a string that is interpreted depending on the system where the file is.

HOST node-id	Sets the identification of the host node. For the executor, this is the node from which it requests services. For an adjacent node, it is a parameter that the adjacent node receives when it is down-line loaded. If no host is specified, the default is executor node.
IDENTIFICATION id-string	Sets the text identification string for the executor node (for example, "Research Lab"). The identification string is an arbitrary string of 1-32 characters. If the string contains blanks or tabs it must be enclosed in quotation marks ("). A quotation mark within a quoted string is indicated by two adjacent quotation marks ("").
INACTIVITY TIMER seconds	Sets the maximum duration of inactivity (no data in either direction) on a logical link before the node checks to see if the logical link still works. If no activity occurs within the maximum number of seconds, NSP generates artificial traffic to test the link (NSP functional specification). The range is 1-65535.
INCOMING TIMER seconds	Sets the maximum duration between the time a connect is received for a process and the time that process accepts or rejects it. If the connect is not accepted or rejected by the user within the number of seconds specified, Session Control rejects it for the user. The range is 1-65535.
LINE line-id	Defines a loop node and sets the identification of the line to be used for all traffic from the node. Loop node identification must be a node name. No line can be associated with more than one node name.
LOAD FILE file-id	Sets the identification of the file to read from when the node is down-line loaded. The file identification is a string that is interpreted depending on the file system of the executor.
MAXIMUM ADDRESS number	Sets the largest node address and, therefore, number of nodes that can be known about. The number is an integer in the range 1-65535.
MAXIMUM BUFFERS number	Sets the total number of buffers allocated to all lines. In other words, it tells Transport how big its own buffer pool is. The count number is a decimal integer in the range 0-65535.

MAXIMUM COST number	Sets the maximum total path cost allowed from the executor to any node. The path cost is the sum of the line costs along a path between two nodes (Transport functional specification). The maximum is a decimal number in the range 1-1023.
MAXIMUM HOPS number	Sets the maximum routing hops from the node to any other reachable node. A hop is the logical distance over a line between two adjacent nodes (Transport functional specification). The maximum is a decimal number in the range 1-31.
MAXIMUM LINES number	Sets the maximum number of lines that this node can know about. The number is a decimal in the range 1-65535.
MAXIMUM LINKS number	Sets the maximum active logical link count for the node. The count is a decimal number in the range 1-65535.
MAXIMUM VISITS number	Sets the maximum number of nodes a message coming into this node can have visited. If the message is not for this node and the MAXIMUM VISITS number is exceeded, the message is discarded. The number is a decimal in the range MAXIMUM HOPS to 255.
NAME node-name	Sets the node name to be associated with the node identification. Only one name can be assigned to a node address or a line identification. No name can be used more than once in the node.
OUTGOING TIMER seconds	Sets a time-out value for the duration between the time a connect is requested and the time that connect is acknowledged by the destination node. If the connect is not acknowledged within the number of seconds specified, Session Control returns an error. The range is 1-65535.
RETRANSMIT FACTOR number	Sets the maximum number of times the source NSP will restart the retransmission timer when it expires. If the number is exceeded, Session Control disconnects the logical link for the user (NSP functional specification). The number is decimal in the range 1-65535.
ROUTING TIMER seconds	Sets the maximum duration before a routing update is forced. The routing update produces a routing message for an adjacent node (Transport functional specification). Seconds is a decimal integer in the range 1-65535.
SECONDARY DUMPER file-id	Sets the identification of the secondary dumper file for up-line dumping the adjacent node.

SECONDARY LOADER file-id

Sets the identification of the secondary loader file, for down-line loading the adjacent node.

SERVICE DEVICE device-type

Sets the service device type that the adjacent node uses for service functions when in service slave mode (see Section 4.1.4.2). The device type is one of the standard line device mnemonics.

SERVICE LINE line-id

Establishes the line to the adjacent node for down-line loading and up-line dumping. Sets the default if the VIA parameter of either the LOAD or DUMP commands is omitted. When down line loading a node (Section 3.3.4), the node identification must be that of the target node.

SERVICE PASSWORD password

Sets the password required to trigger the bootstrap mechanism on the adjacent node. The password is a hexadecimal number in the range 0-FFFFFFFFFFFFFFFF (64 bits).

SOFTWARE IDENTIFICATION software-id

Sets the identification of the software that is to be loaded when the adjacent node is down-line loaded. Software-id contains up to 16 alphanumeric characters.

SOFTWARE TYPE program-type

Sets the initial target node software program type for down-line loading the adjacent node. Program type is one of:

```
SECONDARY [LOADER]
TERTIARY [LOADER]
SYSTEM
```

STATE node-state

Sets the operational state of the executor node. The possible states are:

ON	Allows logical links.
OFF	Allows no new links, terminates existing links, and stops routing traffic through.
SHUT	Allows no new logical links, does not destroy existing logical links, and goes to the OFF state when all logical links are gone.
RESTRICTED	Allows no new incoming logical links from other nodes.

TERTIARY LOADER file-id

Sets the identification of the tertiary loader file, for down-line loading the adjacent node.

TYPE node-type	Sets the type of the node as one of the following:	
	ROUTING	Full routing node.
	NONROUTING	Node with no routing capability.
	PHASE II	Phase II node.

3.3.2 **CLEAR and PURGE Commands** - These commands clear parameters from the volatile and permanent data bases. The CLEAR command affects the volatile data base; the PURGE command affects the permanent data base. Not all parameters can be cleared individually. A cleared or purged parameter or entity identification is the same as one that has not been set or defined. The general form of the command is:

{CLEAR / PURGE} entity parameter

The entities are the same as for the SET and DEFINE commands (Section 3.3.1).

3.3.2.1 **CLEAR and PURGE EXECUTOR NODE Commands** - The CLEAR EXECUTOR NODE command resets the executor to the node on which NCP is running. Note that CLEAR EXECUTOR does not return the executor to that defined in the permanent data base. The PURGE EXECUTOR NODE command redefines the executor in the permanent data base as the local node. Access control is reset as well.

3.3.2.2 **CLEAR and PURGE KNOWN Entity Commands** - These commands clear and purge parameters for all of the specified entity known to the system. The format of the command is:

{CLEAR / PURGE} KNOWN plural-entity parameter

Plural entity is one of LINES, LOGGING or NODES.

Parameter is one or possibly more of the parameters associated with the CLEAR and PURGE entity commands (Sections 3.3.2.3, 3.3.2.4, and 3.3.2.5).

3.3.2.3 **CLEAR and PURGE LINE Commands** - These commands clear line parameters from the volatile and permanent data bases. The command format is:

{CLEAR / PURGE} LINE line-id ALL / COUNTER TIMER

where:

ALL	Clears all parameters associated with the line identified and the line identification itself from the volatile or permanent data base.
COUNTER TIMER	Clears the timer that controls the periodic logging of the line's counters. This implies that they are no longer to be logged.

3.3.2.4 **CLEAR and PURGE LOGGING Commands** - These commands, in conjunction with the SET and DEFINE LOGGING commands, control event sinks and event lists. The same general definitions (sink-node, sink-type, and source-qualifier) that apply to the SET LOGGING command (Section 3.3.1.4) apply here.

{CLEAR / PURGE} LOGGING sink-type

EVENT event-list [source-qual] [sink-node]
KNOWN EVENTS [source-qual][sink-node]
NAME

where:

EVENT event-list	Disables the recording of the events specified by the event list (event-class.event-type). Appendix F specifies events. Section 3.3.1.4 details the format of the event list. The sink node option turns off events for the specified sink node. If no sink node is specified, the EXECUTOR is assumed.
NAME	Clears the sink name assigned to the sink type. The sink then becomes the default for the specific system, either no sink or some system-specific standard.
KNOWN EVENTS	Disables the recording of all events known to the executor node for the sink node.

3.3.2.5 **CLEAR and PURGE NODE Commands** - These commands clear volatile (using CLEAR) or permanent (using PURGE) parameters for the node. Node identification can be either a node name or a node address, except for the LINE option where it must be a name. EXECUTOR may substitute for NODE executor-node-identification.

{CLEAR / PURGE} NODE node-id

ALL
COUNTER TIMER
CPU
DUMP ADDRESS
DUMP COUNT
DUMP FILE
HOST
IDENTIFICATION
INCOMING TIMER
LINE
LOAD FILE

NAME
OUTGOING TIMER
SECONDARY DUMPER
SECONDARY LOADER
SERVICE DEVICE
SERVICE LINE
SERVICE PASSWORD
SOFTWARE IDENTIFICATION
SOFTWARE TYPE
TERTIARY LOADER

where:

ALL	Clears all parameters associated with the node identified.
DUMP FILE	Clears the identification of the file to write to when the node is up-line dumped.
HOST	Clears the identification of the host node.
INCOMING TIMER	Clears the node's incoming timer.
LINE	Clears the loop node entry associated with the line.
IDENTIFICATION	Clears the node's identification string.
LOAD FILE	Clears the identification of the file to read from when the node is down-line loaded.
NAME	Clears the node name for the node.
OUTGOING TIMER	Clears the node's outgoing timer.
SECONDARY DUMPER	Clears the identification of the secondary dumper file.
SECONDARY LOADER	Clears the identification of the secondary loader file.
SERVICE DEVICE	Clears the service device type.
SERVICE LINE	Clears the identification of the line associated with the node-id specified for the purposes of down-line load, up-line dump, and line loop test.
SERVICE PASSWORD	Clears the password required to trigger the bootstrap mechanism on the node.
SOFTWARE IDENTIFICATION	Clears the identification of the target's initial load software.
SOFTWARE TYPE	Clears the identification of the target node software program type for down-line loading.
TERTIARY LOADER	Clears the identification of the tertiary loader file.

3.3.3 **TRIGGER Command** - This command triggers the bootstrap of the target node so that the node will load itself. It initiates the load of an unattended system. This command will work only if the target node either recognizes the trigger operation with software or has the necessary hardware in the correct state. Section 3.3.4 describes the parameter options. Parameters specified with a command override the default parameters of the same type. Section 4.2.3 describes the trigger operation. The format of the command is:

```
TRIGGER  {NODE  node-id}  [[SERVICE] PASSWORD  password]
         {VIA   line-id}  [VIA                 line-id]
                          [[SERVICE] PASSWORD  password]
```

3.3.4 **LOAD Command** - This command initiates a down-line load. There are two variations. Section 3.3.4.1 describes the parameters used with this command. Node identification is either the node name or the node address of the target node. This command works only if the conditions for trigger are met, or if the target node has been triggered locally. Section 4.2.1 describes the operation of down-line loading.

3.3.4.1 **LOAD NODE Command** - This loads the node identified on the line identified or on the line obtained from the permanent data base. Any parameter not specified in the command line defaults to whatever is specified in the permanent data base at the executor node.

```
LOAD NODE node-id   [ADDRESS              node-address]
                    [CPU                  cpu-type]
                    [FROM                 load-file]
                    [HOST                 node-id]
                    [NAME                 node-name]
                    [SECONDARY [LOADER]   file-id]
                    [SERVICE DEVICE       device-type]
                    [[SERVICE] PASSWORD   password]
                    [SOFTWARE
                       IDENTIFICATION     software-id]
                    [SOFTWARE TYPE        program-type]
                    [TERTIARY [LOADER]    file-id]
                    [VIA                  line-id]
```

where:

[ADDRESS node-address] — Indicates the address the target node is to use.

[CPU cpu-type] — Indicates the target CPU type. The possible values are:

PDP 8
PDP 11
DECSYSTEM 10
DECSYSTEM 20
VAX

[FROM load-file] — Indicates the file from which to load.

[HOST node-id] — Indicates the identification of the host to be sent to the target node.

[NAME node-name]	Specifies the name the target node is to use.
[SECONDARY [LOADER] file-id	Provides the identification of the secondary loader file.
[SERVICE DEVICE device-type]	Indicates the device type that the target node will use for service functions when it is in service slave mode (see Section 4.1.4.2).
[[SERVICE] PASSWORD password]	Supplies the boot password for the target node. A hexadecimal number in the range 0-FFFFFFFFFFFFFFFF.
[SOFTWARE IDENTIFICATION software-id]	Provides the load software identification. Software identification is up to 16 alphanumeric characters.
[SOFTWARE TYPE program-type]	Indicates the target node software program type. Program-type is one of: SECONDARY [LOADER] TERTIARY [LOADER] SYSTEM
[TERTIARY [LOADER] file-id]	Provides the identification of the tertiary loader file.
[VIA line-id]	Indicates the line to load over.

3.3.4.2 **LOAD VIA Command** - With this command format, the executor loads the target over the specified line, obtaining the node identification from the permanent data base if necessary. The command format is:

```
LOAD VIA line-id [ADDRESS                node-address]
                 [CPU                    cpu-type]
                 [FROM                   load-file]
                 [HOST                   node-id]
                 [NAME                   node-name]
                 [SECONDARY [LOADER]     file-id]
                 [SERVICE DEVICE         device-type]
                 [[SERVICE] PASSWORD     password]
                 [SOFTWARE IDENTIFICATION file-id]
                 [SOFTWARE TYPE          program-type]
                 [TERTIARY [LOADER]      file-id]
```

3.3.5 **DUMP Command** - This command performs an up-line dump. Parameters not supplied default to those in the permanent data base at the executor node (see Section 3.3.1.5). There are two variations, as follows:

```
DUMP NODE node-id [[DUMP] ADDRESS     number]
                  [[DUMP] COUNT       number]
                  [TO                 dump-file]
                  [SECONDARY [DUMPER] file-id]
                  [SERVICE DEVICE     device-type]
                  [[SERVICE] PASSWORD password]
                  [VIA                line-identification]
```

```
DUMP VIA line-id  [[DUMP] ADDRESS      number]
                  [[DUMP] COUNT        number]
                  [TO                  dump-file]
                  [SECONDARY [DUMPER] file-id]
                  [SERVICE DEVICE      device-type]
                  [[SERVICE] PASSWORD password]
```

3.3.6 **LOOP Command** - This command causes test blocks to loop back from the specified line or node. It is limited by what the Loopback Mirror and the passive looper can handle. There are two variations, as described in the next two sections. Section 4.2.4 describes the loop test operation.

When a loop test fails, the error message contains added explanatory information, in the form either

```
     UNLOOPED COUNT = n
or
     MAXIMUM LOOP DATA = n
```

Where the unlooped count is the number of messages not yet looped when the test failed and maximum loop data is the maximum length that can be requested for the loop test data.

3.3.6.1 **LOOP LINE Command** - The line loop performs loopback testing on a specific line, which is unavailable for normal traffic during the test. The optional parameters can be entered in any order. Parameters not specified default to their values in the permanent data base at the executor node. The command format is as follows:

```
LOOP LINE line-id  [COUNT        count]
                   [WITH         block-type]
                   [LENGTH       length]
```

where:

LOOP COUNT count	Sets the block count for loop tests. Count is an integer in the range 0 to 65535.
LOOP LENGTH length	Sets the length of a block for loop tests. Length is an integer in the range 0 to 65535.
LOOP WITH block-type	Sets the block-type for loop tests. The possible values for block-type are ONES, ZEROES or MIXED.

3.3.6.2 **LOOP NODE Command** - A node loop will not interfere with normal traffic, but will add to the network load. The parameter options available are the same as for the line loop (Section 3.3.6.1). The node loop can take place within one node or between two nodes. In the latter case, the remote node is the one specified (Figures 6 and 7, Section 4.2.4). EXECUTOR may be substituted for NODE executor-node-identification.

3.3.7 **SHOW QUEUE Command** - This command displays the status of the last few commands entered at the default executor. The number of commands displayed varies with each implementation. The executor for commands not sent across the network is shown as N/A (not applicable). Completed commands need not be displayed. Every command in progress must be shown in request number order. Implementations that do not allow multiple outstanding commands do not need this command.

An example of output follows:

```
REQUEST #13; SHOW QUEUE

REQUEST
NUMBER    EXECUTOR          COMMAND     STATUS

9         6 (HNGKNG)        LOAD        FAILED
10        6 (HNGKNG)        SHOW        COMPLETE
11        10 (MANILA)       LOAD        IN PROGRESS
12        6 (HNGKNG)        SET         COMPLETE
13        N/A               SHOW        IN PROGRESS
```

3.3.8 **SHOW and LIST Commands** - These commands are used to display information. The SHOW command displays information from the volatile data base. The LIST command displays information from the permanent data base. The general command format is either:

```
{SHOW}
{LIST}  entity [information-type] [qualifiers]
```

or:

```
{SHOW}
{LIST}  [information-type] entity [qualifiers]
```

The entities are:

```
ACTIVE LINES
ACTIVE LOGGING
ACTIVE NODES
EXECUTOR
KNOWN LINES
KNOWN LOGGING
KNOWN NODES
LINE              line-id
LOGGING           sink-type
LOOP NODES
NODE              node-name
```

KNOWN plural entities are all those known to the system, regardless of state. ACTIVE plural entities are a subset of KNOWN as defined in the glossary. When displaying plural nodes, the executor display is returned first, if it is included. Any loop nodes are returned last.

The information types are:

```
CHARACTERISTICS
COUNTERS
EVENTS
STATUS
SUMMARY
```

Appendix A contains definitions of the information types. The tables in Appendix A specify the information returned for each information type on the SHOW command. The qualifiers vary according to the specific entity, except one that is common to all entities that have qualifiers:

TO alternate-output

This qualifier directs the output to an alternate output file or device (for example, a disk file or a line printer) rather than the default terminal display. The output is text in the same format it would have on the terminal. The format of the alternate output specification is system-dependent.

When there is no information to display in response to a SHOW command display the phrase "no information" in place of the data.

3.3.8.1 **Information Type Display Format** - All of the SHOW and LIST command information-type options have the same general output format. The header of that format is:

REQUEST #n; entity information-type AS OF dd-mon-yy hh-mm

For example:

REQUEST #21; KNOWN LINES STATUS AS OF 8-JUL-79 10:55

REQUEST #43; EXECUTOR NODE CHARACTERISTICS AS OF 10-SEP-79 10:56

REQUEST #45; KNOWN NODES SUMMARY AS OF 10-SEP-79 10:57

The requested information follows the header. The general format of the information is:

entity-type = entity-id

data

If the entity type is NODE, then one of EXECUTOR, REMOTE, or LOOP must precede it.

This information format repeats for each individual entity. A SHOW or LIST command with no information type should default to SUMMARY.

3.3.8.2 **Counter Display Format** - Counters are identified by standard type numbers as defined in Tables 7 and 10, Appendix A. Counters are displayed in ascending order by type. The display format for counters is:

```
value description[, INCLUDING:]
        qualifier-1
             .
             .
             .
        qualifier-n
```

The value is the value of the counter, up to 10 digits for a 32-bit counter. It is a decimal number with no leading zeros. Zero values distinguish the case of no-counts from the case where a counter is not

kept. If the counter has overflowed, it is displayed as the overflow value minus one, preceded by a greater-than sign. For example, an overflowed 8-bit counter would be displayed as ">254."

The description is the standard text that goes with the counter type as defined in Tables 7 and 10. If the counter type is not recognized, the description "COUNTER #n" is used, where n is the counter type number.

If the counter has an associated bit map, the word "including" is appended to the description, with a list of qualifiers. A qualifier is the standard text for the bit position in the bit map. A qualifier is displayed only if the corresponding bit is set. If the standard text for the bit is not known, the qualifier "QUALIFIER #n" is used, where n is the bit number.

For example:

```
REQUEST #21;  LINE COUNTERS AS OF 20-FEB-79 15:29

LINE = DUP-6

       532    ARRIVING PACKETS RECEIVED
       416    DEPARTING PACKETS SENT
         0    ARRIVING CONGESTION LOSS
       400    TRANSIT PACKETS RECEIVED
       353    TRANSIT PACKETS SENT
        45    TRANSIT CONGESTION LOSS
     52379    BYTES RECEIVED
     41640    BYTES SENT
       963    DATA BLOCKS RECEIVED
       423    DATA BLOCKS SENT
         5    DATA ERRORS INBOUND, INCLUDING:
                NAK'S SENT REP RESPONSE
         0    DATA ERRORS OUTBOUND
```

3.3.8.3 **Tabular and Sentence Formats** - Non-counter information permits two general formats. The first is easier to scan, the second is more extensible. The first is a tabular form, with each individual entity fitting on one line under a global header. Using this form, unrecognized parameter types are more clumsily handled and the amount of information per individual entity is limited to what will fit on one output line. The second is a sentence form. It adapts easily to a large number of parameters per individual entity and readily handles unrecognized parameter types.

In either form, the order of parameter output is the same in all implementations, even though in a particular implementation, some parameters may be unrecognized. The output format for unrecognized parameters is:

```
PARAMETER #n = value
```

where n is the decimal parameter number and value is the parameter value, formatted according to its data type.

Appendix A describes parameter types and their output order. In the sentence form of output, parameters that are logically grouped together should appear on the same line. Appendix A details these logical groupings.

The general output format of the data for tabular form is:

```
entity-type     parameter-type     parameter-type...

entity-id       parameter-value    parameter-value...
     .                  .                  .
     .                  .                  .
     .                  .                  .
```

An example of output of the data in tabular form follows:

```
REQUEST #39;  KNOWN LINES STATUS AS OF 18-SEP-78 15:20

LINE          STATE        ADJACENT NODE

DMC-1         ON           4 (BOSTON)
DMC-3         OFF
DL-0          ON-LOADING   12
```

If NCP did not recognize an adjacent node parameter, the output would specify the type number of the parameter and the value according to the parameter data type. (See Tables 6 to 10, Appendix A, for type numbers.)

The general output format of the data for sentence form is:

```
entity-type = entity-id

   par-type = par-value, par-type = par-value, ...
   par-type = par-value, ...
          .
          .
```

An example of output of the data for sentence form follows.

```
REQUEST #39;  KNOWN LINES STATUS AS OF 18-SEP-78 15:20

LINE = DMC-1

   STATE = ON, ADJACENT NODE = 4 (BOSTON)

LINE = DMC-3

   STATE = OFF

LINE = DL-0

   STATE = ON, ADJACENT NODE = 12
```

The output format for the logging entity differs in the event display. For example, for the following command:

```
SHOW LOGGING CONSOLE SUMMARY KNOWN SINKS
```

A correct output would be

```
Logging Summary as of 7-MAR-79 10:55

Logging CONSOLE

   State = ON, NAME = COO:

   Sink node = 15 (HALDIR), EVENTS =

           0.0,6
           Line KDZ-0-1.3, 3.6-7
           3.6-13

   Sink node = 16 (EOWYN), Events =

           0.0
           Line KDZ-0-1.3, 6.0-1
```

3.3.8.4 **Restrictions and Rules on Returns** - The following restrictions and rules apply to returns on SHOW and LIST entity information type commands.

1. **Node parameters.** The parameters displayed for the SHOW and LIST NODE commands depend on which node is specified. Table 8, Appendix A, indicates these restrictions. The keywords EXECUTOR, REMOTE or LOOP must precede NODE in a display of a node to clarify what is displayed.

2. **Line states.** The returns on the SHOW and LIST LINE STATUS commands must show the line substate as well as the state. Table 2, following, lists line states and substates. Table 3, following, lists all the possible line state transitions and their causes.

3. **Loop nodes.** Information for a single loop node is returned when requested by the loop node name. Information for multiple loop nodes is returned at the end of the display for KNOWN or ACTIVE NODES. It is the exclusive display for LOOP NODES.

4. **Counters.** COUNTERS can only be displayed with the SHOW commands, and with line or node entities.

5. **Events.** EVENTS applies only to the logging entity. Sink node identification must be address and name (if a name exists), even for the executor.

3.3.9 **ZERO Command** - This command causes a specified set of counters to be set to zero. The command generates a counters zeroed event that causes counters to be logged before they are zeroed. The counters zeroed are those the executor node supports for the specified entity. The command format is:

```
                 ⎧NODE    node-id⎫
ZERO             ⎪LINE    line-id⎪   [COUNTERS]
                 ⎪KNOWN   LINES  ⎪
                 ⎩KNOWN   NODES  ⎭
```

3.3.10 **EXIT Command** - This command terminates an NCP session.

Table 2
Network Management Line States

State	Substate	Meaning
OFF	none	Line not usable by anything
ON	running	Line in normal use by owner
	-STARTING	Line in owner (Transport) initialization cycle
	-REFLECTING	Line in use for passive (direct line-software looped) loopback
	-AUTOSERVICE	Line reserved for Line Watcher use
	-AUTOLOADING	Line in use by Line Watcher for load
	-AUTODUMPING	Line in use by Line Watcher for dump
	-AUTOTRIGGERING	Line in use by Line Watcher for trigger
	-LOADING	Line in use by operator for load
	-DUMPING	Line in use by operator for dump
	-LOOPING	Line in use by operator for active line loopback
	-TRIGGERING	Line in use by operator for trigger
SERVICE	idle	Line reserved by operator for active service function
	-REFLECTING	Line in use for passive (direct line-software looped) loopback
	-LOADING	Line in use by operator for load
	-DUMPING	Line in use by operator for dump
	-LOOPING	Line in use by operator for active line loopback
	-TRIGGERING	Line in use by operator for trigger

Table 3
Line State Transitions

Old State	New State	Cause of Change
Any	OFF	Operator command, SET LINE STATE OFF
OFF	ON-STARTING	Operator command, SET LINE STATE ON
	SERVICE	Operator command, SET LINE STATE SERVICE
ON	ON-STARTING	Data Link restarted by Transport (from either end)
	ON-REFLECTING	Line loopback message received from remote system
	ON-AUTOSERVICE	Service request received by Line Watcher
	ON-LOADING	Operator command, LOAD
	ON-DUMPING	Operator command, DUMP
	ON-LOOPING	Operator command, LOOP LINE
	ON-TRIGGERING	Operator command, TRIGGER
	SERVICE	Operator command, SET LINE STATE SERVICE
ON-STARTING	ON	Transport initialization complete
	ON-REFLECTING	Line loopback message received from remote system
	ON-AUTOSERVICE	Service request received by Line Watcher
	ON-LOADING	Operator command, LOAD
	ON-DUMPING	Operator command, DUMP
	ON-LOOPING	Operator command, LOOP LINE
	ON-TRIGGERING	Operator command, TRIGGER
	SERVICE	Operator command, SET LINE STATE SERVICE
ON-REFLECTING	ON-STARTING	Passive line loopback terminated
	ON-AUTOSERVICE	Service request received by Line Watcher

(continued on next page)

Table 3 (Cont.)
Line State Transitions

Old State	New State	Cause of Change
ON-REFLECTING (CONT.)	ON-LOADING	Operator command, LOAD
	ON-DUMPING	Operator command, DUMP
	ON-LOOPING	Operator command, LOOP LINE
	ON-TRIGGERING	Operator command, TRIGGER
	SERVICE	Operator command, SET LINE STATE SERVICE
ON-AUTOSERVICE	ON-STARTING	Line released by Line Watcher
	ON-AUTOLOADING	Load initiated by Line Watcher
	ON-AUTODUMPING	Dump initiated by Line Watcher
	ON-AUTOTRIGGERING	Trigger initiated by Line Watcher
ON-AUTOLOADING	ON-AUTOSERVICE	Load complete
ON-AUTODUMPING	ON-AUTOSERVICE	Dump complete
ON-AUTOTRIGGERING	ON-AUTOSERVICE	Trigger complete
ON-LOADING	ON-STARTING	Load complete
ON-DUMPING	ON-STARTING	Dump complete
ON-LOOPING	ON-STARTING	Active line loop complete
ON-TRIGGERING	ON-STARTING	Trigger complete
SERVICE	SERVICE-REFLECTING	Line loopback message received from remote system
	SERVICE-LOADING	Operator command, LOAD
	SERVICE-DUMPING	Operator command, DUMP
	SERVICE-LOOPING	Operator command, LOOP LINE
	SERVICE-TRIGGERING	Operator command, TRIGGER
SERVICE	ON-STARTING	Operator command, SET LINE STATE ON

(continued on next page)

Table 3 (Cont.)
Line State Transitions

Old State	New State	Cause of Change
SERVICE-REFLECTING	SERVICE	Passive line loopback complete
	SERVICE-LOADING	Operator command, LOAD
	SERVICE-DUMPING	Operator command, DUMP
	SERVICE-LOOPING	Operator command, LOOP LINE
	SERVICE-TRIGGERING	Operator command, TRIGGER
SERVICE-LOADING	SERVICE	Load complete
SERVICE-DUMPING	SERVICE	Dump complete
SERVICE-LOOPING	SERVICE	Active line loop complete
SERVICE-TRIGGERING	SERVICE	Trigger complete

4.0 NETWORK MANAGEMENT LAYER

This layer, the heart of Network Management, contains the modules and data bases providing most of the functions requested by Network Control Program (NCP) commands. The Network Management layer also provides automatic event-logging and an interface to user programs for network control and information exchange. Section 4.1 describes the Network Management modules. Section 4.2 outlines the operation of the functions associated with each Network Information and Control Exchange (NICE) message, including algorithms for implementation. Section 4.3 details the Network Management layer message formats as well as NICE connect and accept data formats and the Event message binary data format.

4.1 Network Management Layer Modules

This section describes the Network Management layer modules (Figure 2) and some of the algorithms for implementing them.

4.1.1 Network Management Access Routines and Listener - The Network Management Access Routines receive NICE commands from the Network Control Program (NCP) and user programs. Network Management Access Routines pass NICE messages to the remote or local Network Management Listener via logical links. They also pass local function requests to the Local Network Management Functions. The Network Management Listener receives NICE command messages via logical links from the Network Management Access Routines in the local node or in other nodes.

The method used for processing Network Management functions within a single node is implementation-dependent. The Network Management Access Routines can pass all local function requests to the Local Network Management Functions. Alternatively, the access routines can pass NICE messages to the Network Management Listener via a logical link. The latter method cannot be used for functions, such as turning the network on, that occur before a logical link is possible.

4.1.2 Local Network Management Functions - The Local Network Management Functions receive the following types of requests from other modules:

- System-independent function requests from the local NCP via the Network Management Access Routines.
- NICE function requests from other nodes via the Network Management Listener.
- NICE function requests from the local node via the Network Management Listener.
- Automatically-sensed service requests from the Line Watcher.

The Local Network Management Functions have the following interfaces to other modules or layers:

- **Line Service Functions.** The Local Network Management Functions have a control interface to the Line Service Functions for setting and changing line states. The Local

Network Management Functions have a "user" interface to the Line Service Functions for handling functions that are necessary for service functions (such as up-line dumping, down-line loading, and line level testing) to be performed.

- **Control interfaces to lower layers.** The Local Network Management Functions interface with lower layers directly for control and observation of lower level counters and parameters. An example of such an interface is examining a node counter.

- **Function requests to lower layers and to local operating system.** The Local Network Management Functions pass such function requests as file access, node level loopback, and timer setting to the application layer or to the local operating system in the form of system-dependent calls.

- **Event logging.** The Local Network Management Functions interface with the Event Logging module in order to set event logging parameters that control such things as which events are logged and at what sink node they are logged.

Section 4.2 supplies algorithms for handling Network Management function requests.

4.1.3 Line Watcher - The Line Watcher module senses data link level service requests to up-line dump or load coming on a line from an adjacent node.

The Line Watcher senses a request by calling the Line Service Functions. Using parameters from that message, the Line Watcher then determines the request type and calls the Local Network Management Functions to accomplish the request.

The algorithm for implementing the Line Watcher is as follows:

```
Call Line Service Functions to set Line Service request for line
IF Line Service requested
   Set line state to ON-AUTOSERVICE (Local Network Management
                                     Functions)
   Determine function needed
   Call Network Management Functions to perform needed function(s)
   Reset line state to ON (Local Network Management Functions)
ENDIF
```

Section 4.2.5 describes the algorithms for setting and resetting line states for the Line Watcher.

4.1.4 Line Service Functions - The Line Service Functions provide Local Network Management Functions with line state changing and line handling services. They are used for functions requiring a direct interface to the Data Link layer. The functions that use the Line Service Functions are:

- Down-line load (Section 4.2.1)
- Up-line dump (Section 4.2.2)
- Trigger bootstrap (Section 4.2.3)

- Line test (Section 4.2.4.2)

  1. Active at the executor node

  2. Passive at the target node (for unattended system)

- Set line state (Section 4.2.5)

The Line Service Functions provide the following services:

- Condition a node to be dumped, loaded or have a loopback test performed. This state of the target node is called service slave mode, a mode in which the entire processor is taken over. Control rests with the executor.

- Notify a higher level that active line services (load, dump) are needed.

- Provide transmit/receive interface to higher level for active line services.

4.1.4.1 **States and Substates** - To arbitrate the use of the line, Line Service Functions maintain states and substates. Table 4, following, shows these as well as corresponding line states and substates displayed with the NCP SHOW LINE STATUS command. Table 4 also shows related Line Service functions.

The line can go from any substate to service slave mode.

Table 4
Line Service States, Substates and Functions and Their Relationship to Line States

Line State	Line Substate	Line Service State	Line Service Substate	Line Service Function in Progress or Allowed
ON		passive	idle	Pass message to higher level
ON	-STARTING	passive	idle	Pass message to higher level
ON	-REFLECTING	passive	reflecting	Passive loopback
ON	-LOADING	open	loading	Receive and transmit loading messages
ON	-DUMPING	open	dumping	Receive and transmit dumping messages
ON	-TRIGGERING	open	triggering	Receive and transmit triggering messages

(Continued On Next Page)

Table 4 (Cont.)
Line Service States, Substates and Functions and
Their Relationship to Line States

Line State	Line Substate	Line Service State	Line Service Substate	Line Service Function in Progress or Allowed
ON	-LOOPING	open	looping	Receive and transmit looping messages
ON	-AUTOSERVICE	closed	idle	Pass message to higher level
ON	-REFLECTING	closed	reflecting	Passive loopback
ON	-AUTOLOADING	open	loading	Receive and transmit loading messages
ON	-AUTODUMPING	open	dumping	Receive and transmit dumping messages
ON	-AUTOTRIGGERING	open	triggering	Receive and transmit triggering messages
SERVICE		closed	idle	Pass message to higher level
SERVICE	-REFLECTING	closed	reflecting	Passive loopback
SERVICE	-LOADING	open	loading	Receive and transmit loading messages
SERVICE	-DUMPING	open	dumping	Receive and transmit dumping messages
SERVICE	-TRIGGERING	open	triggering	Receive and transmit triggering messages
SERVICE	-LOOPING	open	looping	Receive and transmit looping messages
OFF		off	idle	-

4.1.4.2 **Priority Control** - The Line Service Functions must make sure that higher priority functions take over, and that lower priority functions are resumed when higher priority functions are complete. The priorities are as follows from highest (1) to lowest (5):

1. Enter service slave mode (MOP primary mode) for passive line loopback, receiving down-line load, sending up-line dump, and transferring control. Control rests with the executor node. Some implementations may require hardware support.

2. No line operation (off state). In some implementations, this is the first priority.

3. Active service functions (send down-line load, trigger bootstrap, receive up-line dump, perform active line loopback).

4. Passive line loopback.

5. Normal operation (line available for use by owner).

4.1.4.3 **Line State Algorithms** - The algorithms that follow are a model for implementation of the Line Service states. If these algorithms are followed, the proper state transitions will take place. The algorithms refer to Data Link maintenance mode. This is a Data Link layer mode (DDCMP functional specification).

Set line state to off:

```
Call Data Link to halt line
Set substate to idle
```

Set line state to passive:

```
IF line state is off or closed
   IF substate is not reflecting
      Set substate to idle
   ENDIF
ELSE
   Fail
ENDIF
```

Set line state to closed:

```
IF line state is off, passive, or open
   IF line state is off or passive and substate is not reflecting
Call Data Link to set line mode to maintenance
      Set substate to idle
   ENDIF
ELSE
   Fail
ENDIF
```

Set line state to open:

```
IF line state is passive or closed
   Call Data Link to set line mode to maintenance
   IF substate is reflecting
      Terminate passive loopback
   ENDIF
   Record substate according to open parameter
ELSE
   Fail
ENDIF
```

NOTE

The Data Link call to set the line mode to maintenance is a single operation that will succeed regardless of the state in which Data Link has the line when the call is issued.

4.1.4.4 **Line Handling Functions** - The line handling services of the Line Service Functions and the algorithms for implementing them follow.

1. Handling line in passive state (for entering service slave mode, passive loopback and passing message to a higher level):

```
WHILE line state is passive
   Call Data Link to see if line mode has gone to maintenance
   IF line mode has gone to maintenance
      Call Data Link to receive the service message
      IF enter service slave mode message
         Enter service slave mode
      ELSE IF loop data message
         Perform passive loopback algorithm
      ELSE IF looped data message
         Ignore
      ELSE
         On request, pass message to higher level
      ENDIF
      IF line state is still passive
         Call Data Link to halt line
      ENDIF
   ENDIF
ENDWHILE
```

2. Handling line in closed state (for entering service slave mode and performing passive loopback):

```
WHILE line state is closed
   Call Data Link to receive message
   IF enter service slave mode message
      Enter service slave mode
   ELSE IF loop data message
      Perform passive loopback algorithm
   ENDIF
ENDWHILE
```

3. Handling line in open state (for entering service slave mode, receiving a message, and transmitting a message):

```
WHILE line state is open
   IF transmit requested
      Call Data Link to transmit message
   ELSE IF receive requested
      IF data overrun recorded
         Return data overrun error
      ELSE
         Post receive requested
      ENDIF
   ENDIF
   Call Data Link to receive message
   IF enter service slave mode message
      Enter service slave mode
   ELSE
      IF receive posted
         Return message
      ELSE
         Record data overrun
      ENDIF
   ENDIF
ENDWHILE
```

4. Handling passive line loopback (passive at the remote or target node):

```
(Initial message already received)
Set substate to reflecting
WHILE substate is reflecting
   IF loop data message
      Call Data Link to transmit looped data message with received da
      Call Data Link to receive a message
      IF timeout or start received or error or loopback terminated
         Set substate to idle
      ENDIF
   ELSE
      Set substate to idle
   ENDIF
ENDWHILE
```

4.1.5 **Event Logger** - This module, diagrammed in Figure 3, following, records events that may help maintain the system, recover from failures, and plan for the future. Events originate in each of the DNA layers. Appendix F describes the specified events and corresponding event parameters. A system manager controls event recording with the SET LOGGING EVENT event-list command (Section 3.3.1.4). The event list entered may require the Event Logger to filter out the recording of certain events.

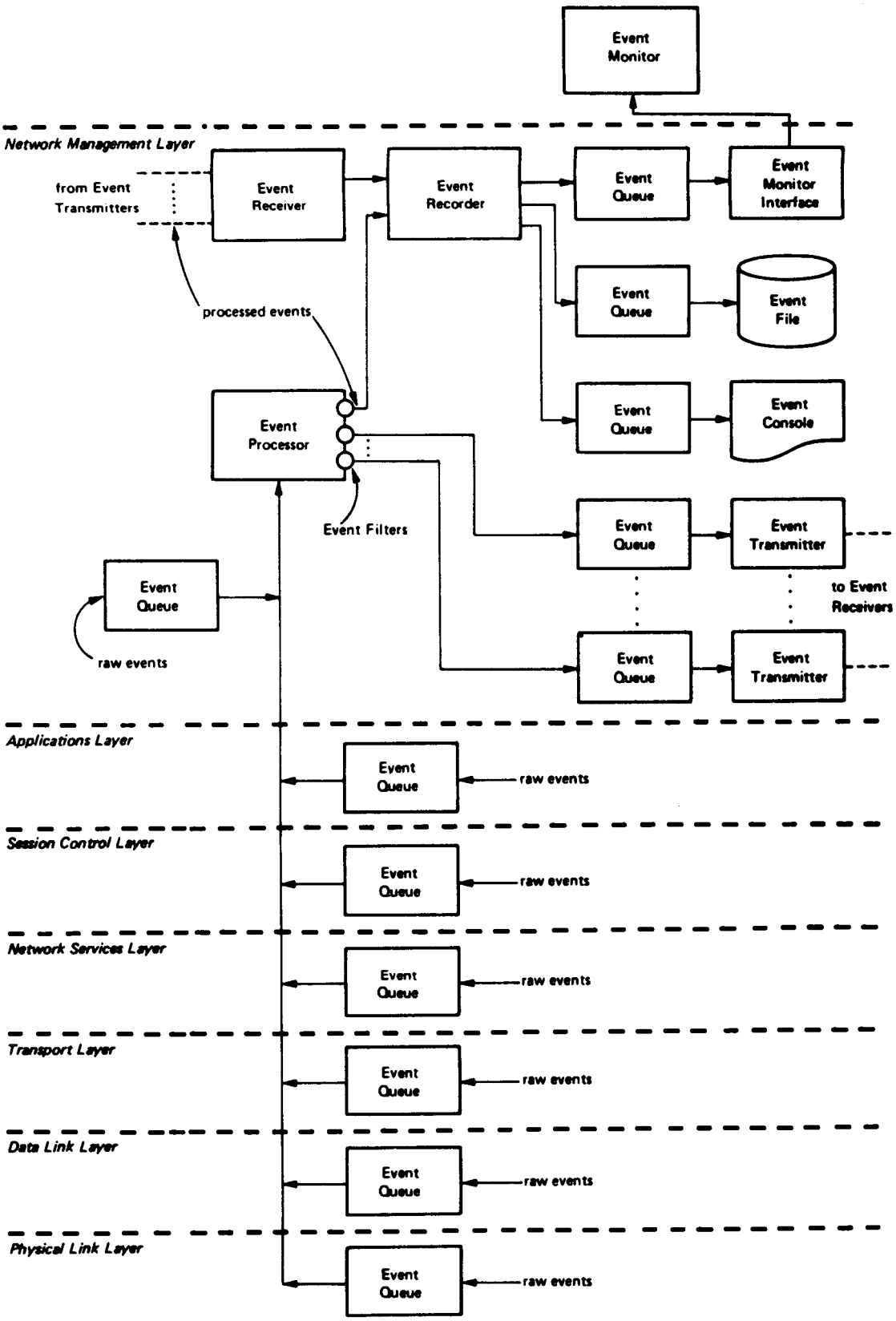


Figure 3 Event Logging Architectural Model

DECnet Event Logging is specified to meet the following goals:

- Allow events to be logged to multiple sink nodes including the source node.
- Allow an event to be logged to multiple logging sinks on any sink node.
- Allow the definition of subsets of events for a sink on a node by event type and source node.
- Include the following logging sinks: console, file, and monitor program.
- Allow sharing of sinks between network event logging and local system event logging.
- Minimize processing, memory, and network communication required to provide event logging.
- Never block progress of network functions due to event logging performance limitations.
- Minimize loss of event logging information due to resource limitations.
- Record loss of event logging information due to resource limitations.
- When required due to resource limitations, discard newer information (which can often be regained by checking current status) in favor of older.
- Minimize impact of an overloaded sink on other sinks.
- Standardize content and format of event logging information to the extent practical, providing a means of handling system specific information.
- Allow independent control of sinks at sink node, including sink identification and sink state. Sink states include use of sink, non-use of sink, and temporary unavailability of sink.

4.1.5.1 **Event Logger Components** - As shown in Figure 3, the Event Logger consists of the following components, described in this section:

- Event queue
- Event processor
- Event transmitter
- Event receiver
- Event recorder
- Event console
- Event file
- Event monitor interface
- Event monitor

Event queue -- There are several event queues (Figure 3). Each one buffers events to be recorded or transmitted, and controls the filling and emptying of the queue.

An event queue component has the following characteristics:

- It buffers events on a first-in-first-out basis.
- It fills a queue with one module; empties it with another.
- It ensures that the filling module does not see an error when attempting to put an event on the queue.

Since event queues are not of infinite length, events must be lost. The filling module must record the loss of an event as an event, not as an error because of the third characteristic above. This event is called an "events-lost" event. An implementation requires the following algorithm at each event queue:

```
IF queue is full
     Discard the event
ELSE IF this event would fill the queue
     Discard the event
     IF last event on queue is not "events-lost"
        Queue an "events-lost" event (which fills the queue)
     END IF
ELSE
     Queue the event
ENDIF
```

The event queue component handles "events-lost" events according to the following rules.

1. Consider such events "raw" for raw event queues and "processed" for processed event queues.
2. Flag such events for the sink types of the lost events.
3. Time stamp such events with the time of first loss.
4. Filter such events only if all events for the queue are also filtered.

Event Processor -- This component performs the following functions:

1. Scans the lower level event queues, collecting raw event records.
2. Modifies raw events into processed events. Raw events contain the following fields:

EVENT CODE	ENTITY IDENTIFICATION	DATA

Processed events contain the following fields:

EVENT CODE	SOURCE NODE ID	SINK FLAGS	ENTITY NAME	DATE AND TIME STAMP	DATA

3. Compares the processed events with the event filters for each defined sink node, including the executor. Following are the characteristics of the filters used to control event logging:

   - The event source node maintains all filters.
   - Each event sink node has a separate set of filters at the source node.
   - Each sink node set of filters contains a set of filters for each sink (monitor, file, or console).
   - Each sink node set of filters contains a set of global filters, one global filter for each event class. It also contains one or more specific filters, each for a particular entity within an event class.
   - Each filter contains one bit for each event type within the class. The bit reflects the event state. SET if the event is to be recorded, CLEAR if it is not.
   - The filtering algorithm sees first if there is a specific filter that applies to the event. If so, the algorithm uses the specific filter. If not, the algorithm uses the global filter for the class.
   - Commands from higher levels create and change filters using the EVENTS event-list option. When the specific filters match the global filter, the event processor deletes specific filters.
   - Although the filters are modeled in the event processor, in some implementations, to reduce information loss or for efficiency reasons, it may be necessary to filter raw events before they are put into the first event queue. A reasonable, low-overhead way to implement this is by providing an event on/off switch at the low level. The high level can turn this switch off if the event is filtered out by all possible filters. This avoids a complex filter data base or search at the low level, but prevents flooding the low level event queue with unwanted events.

4. Passes events not filtered out to the event recorder for the executor or to the appropriate event queue for other sink nodes.

Event Transmitter. Using a logical link, this component transmits event records from its queue to the event receiver on its associated sink node.

Event Receiver. This component receives event records over logical links from event transmitters in remote event source nodes. It then passes them to the event recorder.

Event Recorder. This module distributes events to the queues for the various event sinks according to the sink flags in the event records.

Event Console. This is the event logging sink at which human-readable copies of events are recorded.

Event File. This is the event logging sink at which machine-readable copies of events are recorded. To Network Management, it is an append-only file.

Event Monitor Interface. This interface makes events available to the Network Management Functions for reading by higher levels.

Event Monitor. This user layer module is an "operator's helper." It monitors incoming events by using the Network Management Access Routines and may take action based on what it has seen. Its specific responsibilities and algorithms are undefined for the near term.

4.1.5.2 **Suggested Formats for Logging Data** - Following are suggested text formats for logging data. System specific variations that do not obscure the necessary data or change standard terminology are allowed.

The date field in the output is optional if it is obvious from the context of the logging output.

Milliseconds can be used in the event time data if it is possible to do so. If not supported, this field will not be printed. It is possible for two times given the same second to be logged and printed out of order.

General format:

```
EVENT TYPE class.type[, event-text]
FROM NODE address[(node-name)]OCCURRED [dd-mon-yy]hh:mm:ss:[.uuu]
[entity-type[entity-name]]
[data]
```

For example:

```
Event type 4.7, Packet ageing discard
From node 27 (DOODAH), occurred 9-FEB-79 13:55:38
Packet header = 2 23 91 20

Event type 0.3, Automatic line service
From node 19 (ELROND), occurred 9-FEB-79 16:09:10.009
Line KDZ-0-1.3, Service = Load, Status = Requested
```

Or, on a node that does not recognize the events:

```
Event type 4.7
From node 27, occurred 9-FEB-79 13:55:38
Parameter #2 = 2 23 91 20

Event type 0.3
From node 19, occurred 9-FEB-79 16:09:10.009
Line KDZ-0-1.3, Parameter #0 = 0, Parameter #1 = 0
```

4.2 Network Management Layer Operation

This section describes how Network Management operates with regard to each general function. Each function relates to a particular NICE message. Algorithms are given for most functions. There is also some user information in several of the descriptions, especially that concerning testing. Finally, there is a section explaining how NICE handles logical links. Appendix D lists status and error messages for NICE commands, and Section 4.3.12 explains the response message formats.

4.2.1 **Down-line Load Operation** - The down-line capability allows the loading of a memory image from a file to a target node. The file may reside at the executor node or at another node. Any node can initiate the load.

The requirements for a down-line load are as follows:

- The target node must be directly connected to the executor node via a physical line. The executor node provides the line level access.

- The target node must be running a minimal cooperating program (refer to the MOP functional specification). This program may be a primary loader from a bootstrap ROM. The down-line load procedure may actually involve loading a series of programs, each of which calls the next program until the operating system itself is loaded. The initial program request information determines the load file contents.

- The direct access line involved must be in the ON or SERVICE state.

- The executor must have access to the file. The location of the file can be either specified in the load request or looked up by the Local Network Management Function.

  Local Network Management modules are used to obtain local files. Remote files are obtained via remote file access techniques. (Refer to the DAP functional specification.)

  Figure 4, following, shows local and remote file access for a down-line load.

- The executor must have access to a node data base, which can be either local or remote.

- The target node must be able to recognize the trigger operation with software or hardware or must be triggered locally.

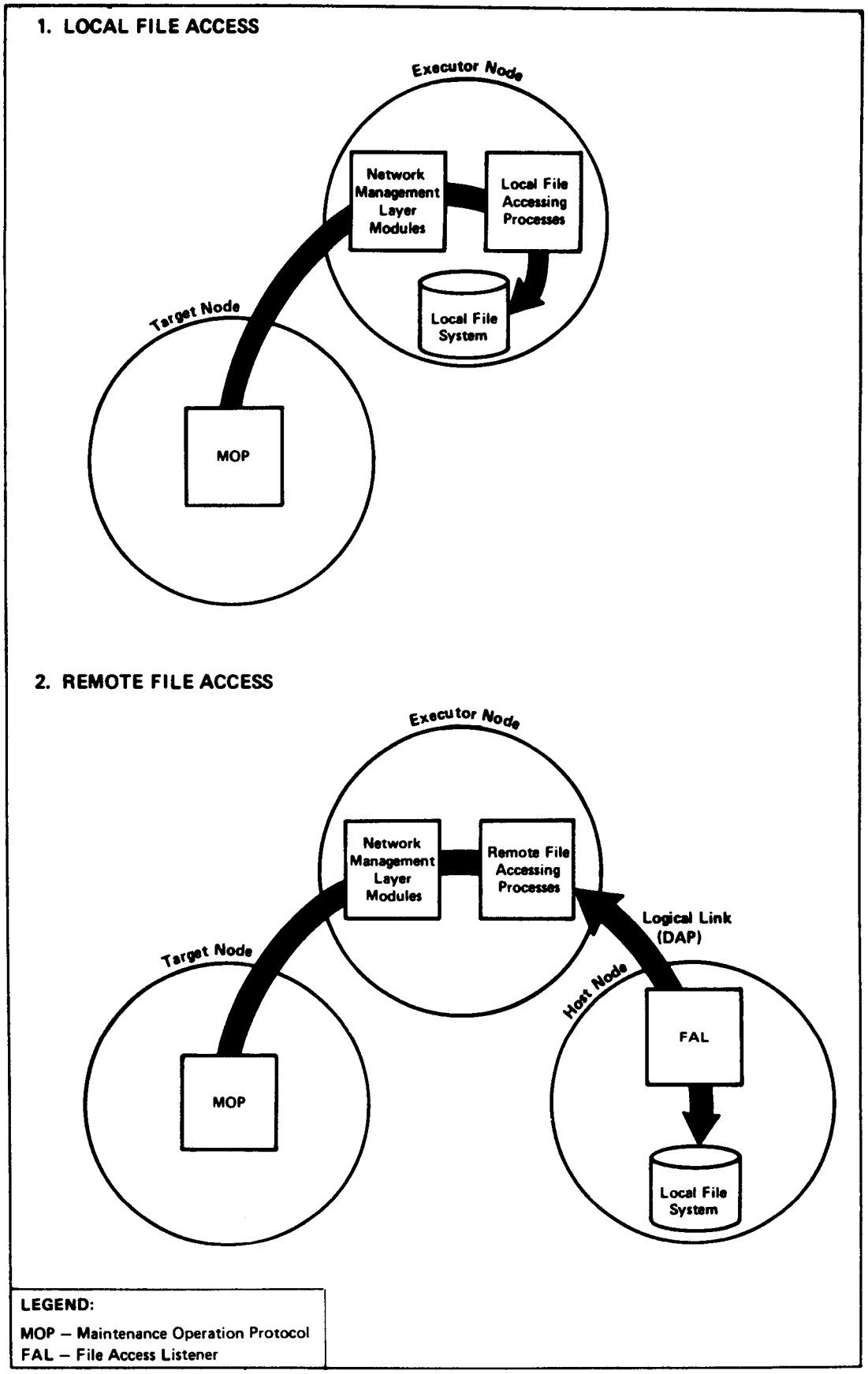


Figure 4 Down-line Load File Access Operation

Either the target or executor node (or a remote command node) can initiate a down-line load. The target node initiates the load by triggering its boot ROM. The executor node initiates the load with either a trigger command or a load request. If the executor does not have the initial program request or the target does not respond to the attempt to load it, the executor should trigger the target.

Once the target is triggered, it requests the down-line load. The target node may be programmed to request the load over the line that the trigger message came. Or, the target node could request the load from another executor. The Line Watcher at the executor senses the first program request from the target node (usually a request for the secondary loader, described below). Or, if the operation was initiated by a Network Management load request, the program request is received as a response to that request. Figure 5, following, shows the down-line load request operation.

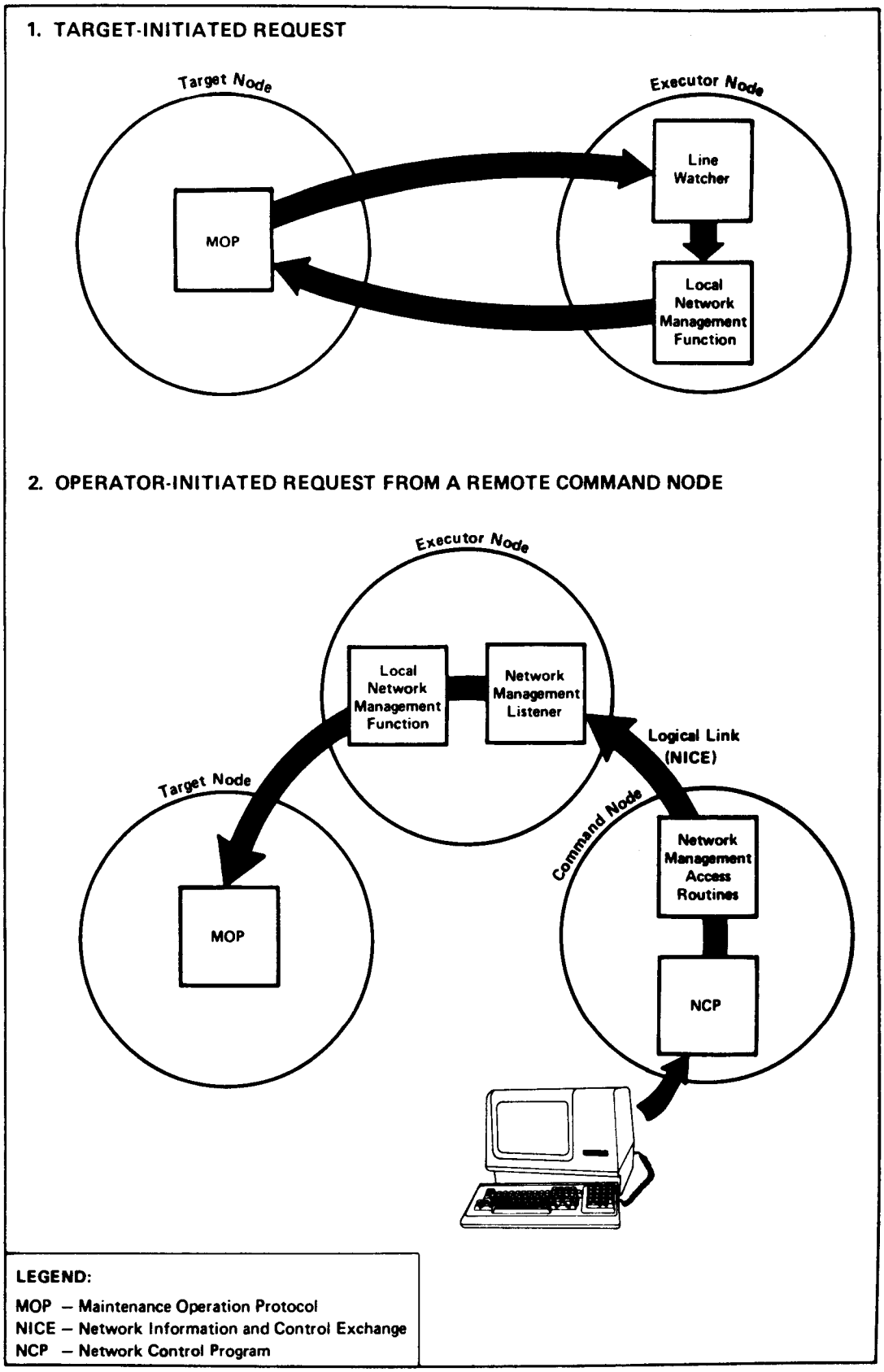


Figure 5 Down-line Load Request Operation

The executor proceeds with the load according to the options in the initial request.

Several fields in the NICE request down-line load message may be either furnished as overrides or defaulted to the values in the node data base. Any information left to default is first obtained from the data base.

The executor identifies the target node by address, name, or line. The name and address parameters may be supplied as overrides to those in the data bases. The address or line identification key into the node data base. If line is used, then address is obtained from the data base entry. If a target is identified by name, then address is determined by normal name to address mapping and used to key into the data base.

The address the target is to have is always sent to the target during the down line load request operation. This target address is either obtained from the node data base or supplied as an override.

The name the target is to have, if any, is either supplied with the request as an override or obtained by normal address-to-name mapping.

Host identification follows similar rules to target identification. The host node address must be sent to the target. If both name and address are not supplied, address is obtained from the node data base. Name, if any, is obtained by normal address-to-name mapping, if not supplied.

The executor controls the process of loading the requested programs until the operating system is loaded. The executor is responsible for understanding the service protocol (for example, MOP) from and to the target.

The first program to run in the target node, called the primary loader, is typically loaded directly from its own bootstrap ROM. It then requests, over the communications line, the next program in the sequence. This program, the secondary loader, may have certain restrictions on the way it is loaded, depending on the capabilities of the primary loader. This process may extend through a tertiary loader. The final program to be loaded is defined as the operating system, although it does not necessarily have to be capable of being a network node. Within a single down-line load process (possibly including "loader loads") each program loaded is expected to request another, except for the operating system, which does not.

When the down-line load has been completed (in other words, the operating system successfully loaded) or aborted due to an error, the executor sends the proper response back to the command node to finish up the process.

The content of the load image file is specified in Appendix C.

The algorithm for handling the down-line load is as follows:

```
Call Line Service Function to open line for load
Perform load calling Line Service Function to transmit and receive
Call Line Service Function to close line
```

4.2.2 **Up-line Dump Operation** - The up-line dump capability of the Network Management layer allows a system to dump its memory to a file on a network node.

The requirements for such a dump correspond with those for a down-line load:

- The system being dumped must be connected to a network node (executor) by a specific physical line.

- The system being dumped must run a minimal cooperative program that can communicate over the line with the executor. The protocol used is implementation-dependent (refer to the MOP specification).

  If the executor determines that the program is not there, then executor must supply the program. This is the secondary dumper.

- The line used must be in the ON or SERVICE state and returned afterwards to its original state.

- The executor must have access to the file receiving the dump. If the file is remote, the executor transfers the data using remote file access routines. (Refer to the DAP Functional Specification.)

The system to be dumped can indicate that it is capable of being dumped. In this case, the Line Watcher at the executor node senses the possibility of a dump and can pass a dump request to the Local Network Management Functions at the executor node. Alternatively, the executor or a remote command node can initiate the dump with an NCP DUMP command. In this case, the executor node's Local Network Management Functions receive the request from the Network Management Access Routines or the Network Management Listener.

The Local Network Management Functions proceed according to the options in the request. Any required information that has been left to default is first obtained from the node data base. The Local Network Management Functions then accomplish the dump using the system-dependent service protocol (for example, MOP), and the local operating system's file system or network remote file transfer facilities. If the remote system does not respond, the executor can trigger the remote system and load a secondary dumping program.

In cases where the dump was not initiated by the target node, when the requested memory has been dumped to a file or the dump has been aborted, the executor sends an appropriate response back to the node requesting the operation.

The content of the dump file is specified in Appendix C.

The algorithm for performing the up-line dump is as follows:

```
Call Line Service Function to open line for dump
Perform dump calling Line Service Function to transmit and receive
Call Line Service Function to close line
```

4.2.3 **Trigger Bootstrap Operation** - The trigger bootstrap capability of the Network Management layer allows remote control of an operating system's restart capability. Since a system being booted is not necessarily a fully functional network node, the operation must be performed over a specific physical line (specified by a line-identification). The node on the network side of the line is called the executor node.

The NCP TRIGGER command can initiate the trigger bootstrap function via the Network Management Listener and/or the Network Management Access Routines. The Local Network Management Functions at the executor node receive the request.

When the Local Network Management Functions receive a NICE trigger bootstrap request, they proceed according to the options in the request. Any required information which has been left to default is obtained from the node data base.

The physical line being used must be in the ON or SERVICE state at the executor node's end. The executor uses the system-dependent service protocol (for example, MOP) to perform the operation.

When the operation is complete, the executor sends its response to the command node.

Once the target node is triggered, it will then load itself in whatever manner its bootstrap ROM is programmed to operate. This could include requesting a down-line load either from the executor that just triggered it or some other. The target node could load itself from its own mass storage.

The algorithm for implementing the trigger bootstrap is as follows:

```
Call Line Service function to open line for trigger
Perform trigger, calling line service to transmit
Call Line Service function to close line
```

4.2.4 **Loop Test Operation** - There are two types of loop tests, node level and line level. Both types are loopback tests that loop a standard test block a specified number of times.

If either test fails, the response explains the failure. If the test fails because the test message was too long, the error return is "invalid parameter value, length" (Appendix D) and the test data field of the error message contains the maximum length of the loop test data, exclusive of test data overhead. If the test fails for any other reason, the test data field contains the number of messages that had not been looped when the test was declared a failure.

The unlooped count need not be returned for success or for errors that occur before looping can begin (for example, connect errors, command message format, or content errors). The only exception to this is the case that the value of the length parameter is too large, since this requires a return of the maximum length.

4.2.4.1 **Node Level Testing** - There are two general categories of node level tests (shown in Figures 6 and 7, following). Both use normal traffic that requires logical links. Both have variations that use the Loopback Mirror and NCP LOOP NODE commands. The difference is that the first type uses what might be called "normal" communication, while the second type sets up a loop node name established with the NCP SET NODE LINE command.

The four ways in which node level messages travel are:

1. Local to local
2. Local to remote
3. Local to local loopback (using an operator-controlled loopback device with a loop node defined with the line to be used)
4. Local to remote loopback (using two connected nodes with a loop node defined with the line to be used)

The first two ways are used for the "normal" communication tests. The last two ways are used for the loop node name tests.

Test data can be a Loopback Mirror test message that is repeated a defined number of times, a file that is transferred in any of the ways listed above, or a message generated by a user task.

The set up commands for various types of node level tests are described in Figures 6 and 7.

The operation of node level testing that uses Network Management modules is as follows. The Local Network Management Functions receive the NCP LOOP NODE command from the Network Management Listener and/or Network Management Access Routines. If a line is involved in the test, it must be in the ON state. if the Loopback Mirror is involved, the message is passed to the Loopback Mirror Access Routines (see Section 5). One logical link loop test uses a loop node with a routing node on the remote end of the line (Figure 6). This test returns the test data on the line chosen by the Transport algorithm at the routing node.

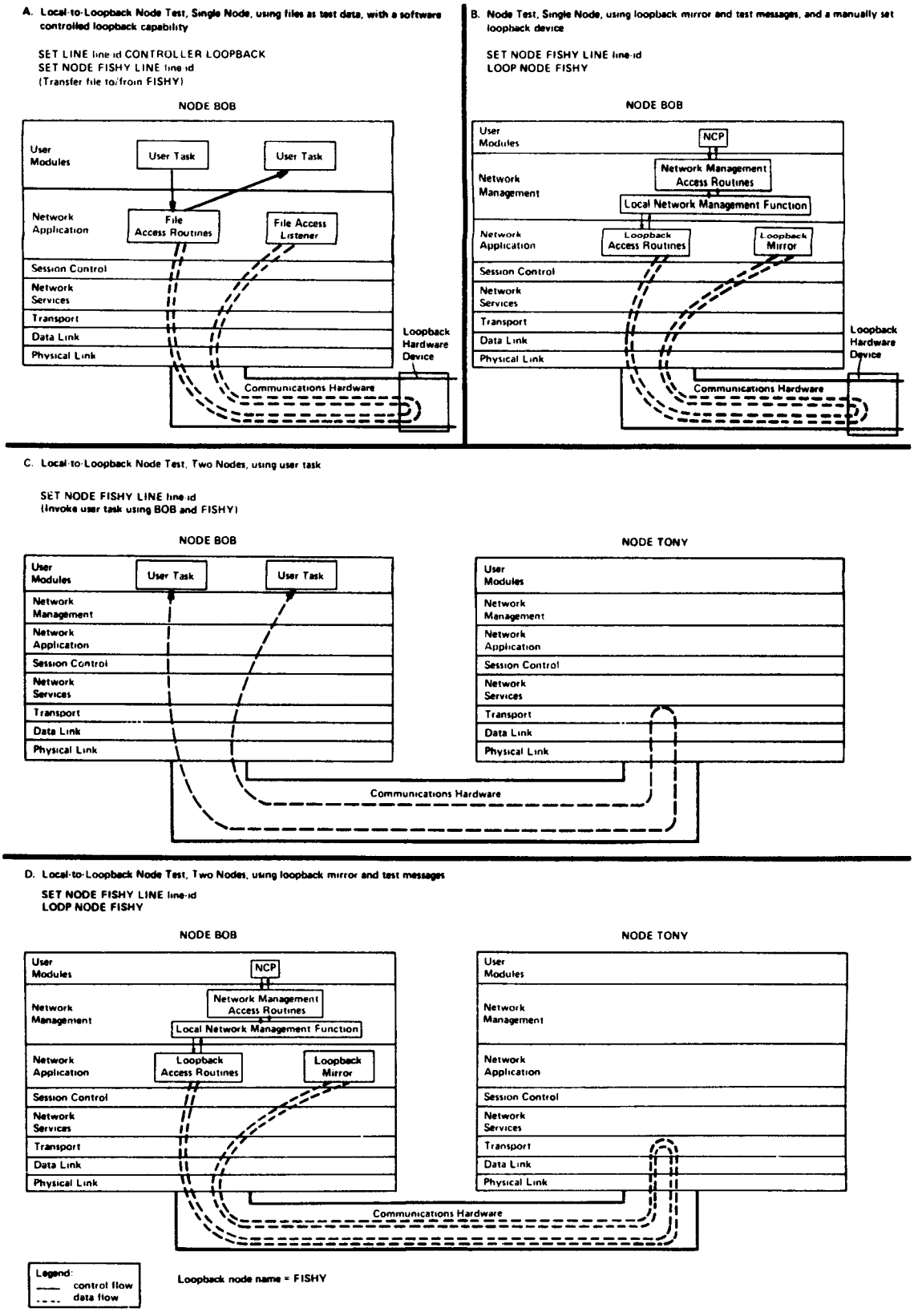


Figure 6 Examples of Node Level Testing Using a Loopback Node Name with and without the Loopback Mirror

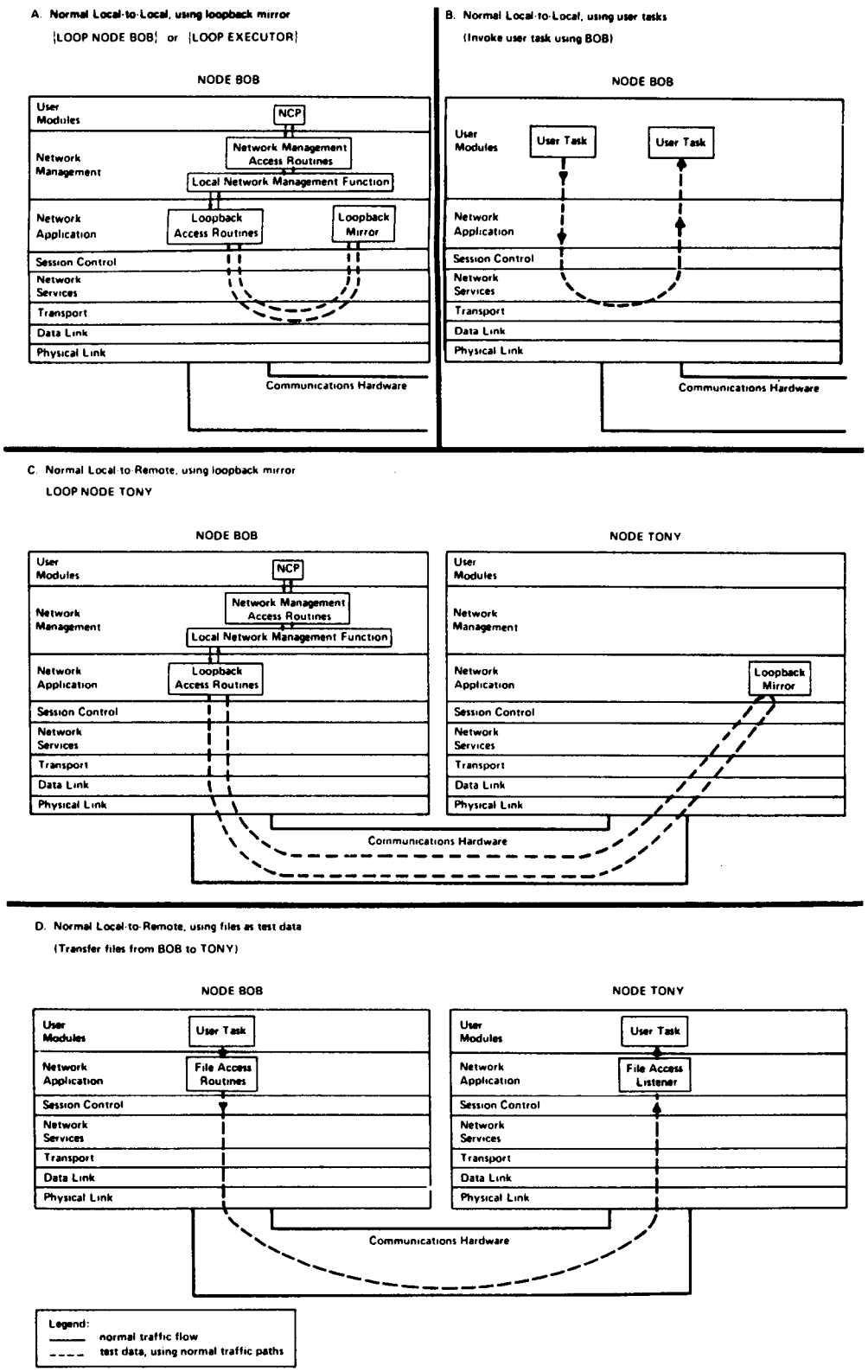


Figure 7 Examples of Node Level Logical Link Loopback Test with and without the Loopback Mirror

4.2.4.2 **Data Link Testing** - Line level testing requires a direct interface between the Line Service Function and the Data Link layer. Figure 8 at the end of this section shows two types of line level tests:

1. Direct line loopback, hardware looped

2. Direct line loopback, software looped

Line loopback requires the use of line service software (for example, MOP), with the line to be tested in the ON or SERVICE state.

The hardware-looped option requires an operator-controlled loopback controller, a modem set to loopback mode, a ROM with loopback capabilities at the remote end, or some other equivalent operation. It is recommended that the operator turn off the line, reconfigure the hardware, and then turn the line back on. Alternatively, the operator may leave the line in the ON state, and any resulting synchronization problem will be logged as an error.

The algorithm for the active loop test is as follows:

```
Set not done
Call Line Service Functions to open line for active loop
WHILE not done
     Call Line Service Function to transmit loopback data message
     Call Line Service Function to receive message
     IF error OR count exhausted OR message is not loop data or looped data
     OR received data does not match sent data
          Set done
     ENDIF
ENDWHILE
Call Line Service Function to close line
```

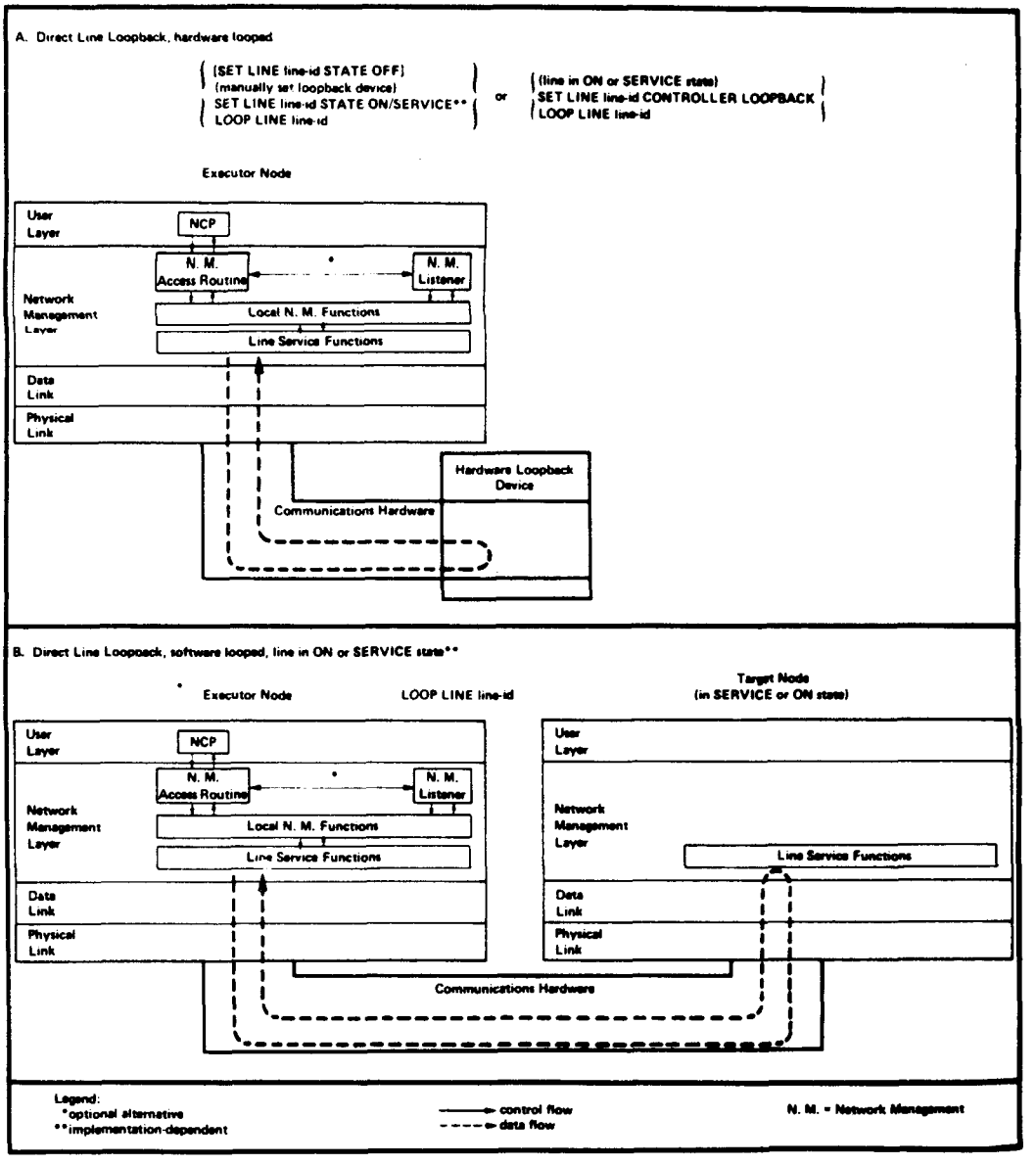


Figure 8 Physical Link Loopback Tests and Command Sequences Effecting Them

4.2.5 Change Parameter Operation - When a NICE change parameter request is received, the specified parameters are changed, usually by interfacing with the local operating system. An appropriate response is then returned to the requestor. The options of the change parameter request indicate the desired operation (either specifying a different value or removing the value) and the entity it relates to. The operation can be done either for volatile or permanent parameters.

The request may contain zero or more parameters. If there are none, the operation applies to the entire entity entry (in other words, the NCP ALL parameter). All parameters in the message should be checked before any are changed in the data base. If one parameter fails the check, then the operation should fail. A single response indicates success or failure for single-entity operations.

A change parameter request may apply to a group of entities. In this case, success or failure is individual. The entire request does not fail if a single entity request fails. An initial fail return implies no further responses are coming. A special success return indicates more responses will follow, one for each entity in the group.

Changing the line state requires the following capabilities:

For operator:

- Set line state to OFF
- Set line state to ON
- Set line state to SERVICE

For the Line Watcher:

- Set line state to ON-AUTOSERVICE
- Reset line state from ON-AUTOSERVICE

All of the algorithms imply recording the line state if they succeed. The line state algorithms follow.

Set line state to OFF:

```
Call Transport to set line state to off
Call Line Service Function to set line state to off
```

Set line state to ON:

```
Call Line Service Function to set line state to passive
IF success
   Call Transport to set line state to on
ELSE
   Fail
ENDIF
```

Set line state to SERVICE:

```
Call Line Service Function to set line state to closed
IF success
   Call Transport to set line state to off
ELSE
   Fail
ENDIF
```

Set line state to ON-AUTOSERVICE:

```
IF line state is ON
   Perform algorithm to set line state to service
ELSE
   Fail
ENDIF
```

Reset line state from ON-AUTOSERVICE:

```
If line state is ON-AUTOSERVICE:
   Perform algorithm to set line state to on
ENDIF
```

4.2.6 **Read Information Operation** - When a read information request is received, a response is returned, followed by the requested data in the form of standard Network Management data blocks (Appendix A). The data may be obtained either from within the Local Network Management Function itself or by interfacing with the system as appropriate.

The many restrictions and special situations relating to reading specific parameters or counters are described in Appendix A. Additional information is in Section 3.3.8 (SHOW command).

A fail return in the first response implies no further responses are coming. A special success return indicates the command message was accepted and more will follow.

4.2.7 **Zero Counters Operation** - When a zero counters request is received, the appropriate counters are cleared by interfacing with the local operating system. An appropriate response is then returned to the requestor.

If a read and zero was requested, the counters are returned as if a read information had been requested.

A fail return on the first response implies no further responses are coming. Success is a single return for single-entity operations. For multiple-entity operations, success is a special success return implying further responses.

4.2.8 **NICE Logical Link Handling** - This section describes the logical link algorithms that Network Management uses when sending NICE messages. The version data formats are in Section 4.3.12. The determination that a received version number is acceptable is always the responsibility of the higher version software, whether it is the command source or the listener.

The recommended buffer size for NICE messages is 300 bytes.

The Network Management Listener algorithm follows:

```
Receive connect request
(Optionally) Determine privilege level based on access control
IF resources available and received version number OK
   Send connect accept with version number in accept data
   WHILE connected (see Note, below)
      Receive command message
      IF message received
          Process command message according to command and privilege
          Send response message(s)
      ENDIF
   ENDWHILE
ELSE
   IF received version number not OK
      Send connect reject with version skew reason in reject data
   ELSE
      Send connect reject
   ENDIF
ENDIF
```

NOTE

The algorithms used for connections is implementation dependent. For example, connections can be maintained permanently, only while the executor is set, timed-out, or one per command.

The Network Management command source algorithm follows:

```
Send connect request with version number in connect data
IF connect accepted
   IF received version number OK
      WHILE desired
          Send command message
          Receive response message(s)
      ENDWHILE
   ENDIF
   Disconnect link
ELSE
   IF connect rejected by listener
      IF reject data indicates version skew
          Failure due to version skew
      ELSE
          Failure due to listener resources
      ENDIF
   ELSE
      Failure due to network connect problem
   ENDIF
ENDIF
```

4.2.9 **Algorithm for Accepting Version Numbers** - A version number consists of three parts -- version, ECO (Engineering Change Order), and user ECO (Section 4.3.12). In general, another version is acceptable if it is greater than or equal to this version. If less than this version, it is optionally acceptable as determined by product requirements.

When comparing two version numbers, compare the second parts only if the first parts are equal, and so on.

4.2.10 **Return Code Handling** - Use the following return code handling algorithm to call the Network Management access routines:

```
Initiate function
IF return code = more
   WHILE return code < > done
      Perform next operation
      Process success/failure
   ENDWHILE
ELSE
   Process success/failure
ENDIF
```

Note that an initiate call starts the function, and an operate call performs the function (one entity at a time in the case of plural entities).

4.3 Network Management Layer Messages

This section describes the NICE and Event Logging Messages, NICE response message format, and NICE connect and accept data format.

NICE is a command-response protocol. Because the Network Management layer is built on top of the Network Services and Data Link layers, which provide logical links that guarantee sequential and error-free data delivery, NICE does not have to handle error recovery.

In the message descriptions that follow, any unused bits or bytes are to be reserved and set to zero to allow compatibility with future implementations. Conditions such as non-zero reserved areas and unrecognized codes or unused bytes at the end of a field or message should be treated as errors, and no operation should be performed other than an appropriate error response.

The entire message should be parsed and checked for validity before any operation is performed.

4.3.1 **NICE Function Codes** - The Phase III NICE protocol performs the following message functions. The last one is for system specific commands, not specified in this document.

Function CODE	NICE Function
15	Request down-line load
16	Request up-line dump
17	Trigger bootstrap
18	Test
19	Change parameter
20	Read information
21	Zero counters
22	System-specific function

4.3.2 **Message and Data Type Format Notation** - The Network Management message format and data type descriptions use the following notation.

FIELD (LENGTH) : CODING = Description of field

where:

FIELD — Is the name of the field being described

LENGTH — Is the length of the field as:

1. A number meaning number of 8-bit bytes.
2. A number followed by a "B" meaning number of bits.
3. The letters "EX-n" meaning extensible field with n being a number meaning the maximum length in 8-bit bytes. If no number is specified the length is limited only by the maximum NICE message. Extensible fields are variable in length consisting of 8-bit bytes, where the high-order bit of each byte denotes whether the next byte is part of the same field. The -1 means the next byte is part of this field while a 0 denotes the last byte.

Extensible fields can be binary or bit map; if binary, then 7 bits from each byte are concatenated into a single binary field; if bit map, then 7 bits from each byte are used independently as information bits. The bit definitions define the information bits after removing extension bits and compressing the bytes.

4. The letters "I-n" meaning image field with n being a number which is the maximum length in 8-bit bytes of the image. The image is preceded by a 1-byte count of the length of the remainder of the field. Image fields are variable length and may be null (count-Ø). All 8 bits of each byte are used as information bits. The meaning and interpretation of each image field is defined with that specific field.

5. The character "*" meaning remainder of message. A number following the asterisk indicates the minimum field length in bytes.

CODING — Is the representation type used.

where:

A = 7-bit ASCII

Б = Binary

BM = Bit Map (where each bit or group of bits has independent meaning)

C = Constant

NOTES

1. If length and coding are omitted, FIELD represents a generic field with a number of subfields specified in the descriptions.

2. Any bit or field which is stated to be "reserved" shall be zero unless otherwise specified. Any bit or field not described is reserved.

3. All numeric values in this document are shown in decimal representation unless otherwise noted.

4. All fields are presented to the physical link protocol least significant byte first. In an ASCII field, the leftmost character is in the low-order byte.

5. Bytes in this document are numbered with bit Ø the rightmost (low-order, least-significant) bit, and bit 7 the leftmost (high-order, most-significant) bit. Fields and bytes of other lengths are numbered similarly.

6. Corresponding data type format notation used in Tables 6, 8, and Appendix F is described at the beginning of Appendix A.

4.3.3 Request Down-line Load Message Format

FUNCTION CODE	OPTION	NODE	LINE	PARAMETER ENTRIES

where:

FUNCTION CODE (1) : B = 15

OPTION (1) BM — Is one of the following options:

Option bits	Value/Meaning
0	0 = Identify target by node-id. 1 = Identify target by line-id.

NODE — Is the target node identification in node-id format (see Appendix A) as key into defaults data base (present only if option bit 0 = 0). Plural nodes options are not allowed.

LINE — Is the line identification in line id format (see Appendix A). Plural lines options not allowed. Present only if option bit 0 = 1.

PARAMETER ENTRIES — are zero or more of PARAMETER ENTRY consisting of:

DATA ID	DATA

where:

DATA ID (2) : B — Is the parameter type number (see note below and Appendix A).

DATA — Is the parameter data (Appendix A).

NOTE

The parameters allowed are the following node parameters:

ADDRESS
CPU
HOST
LOAD FILE
NAME
SECONDARY LOADER
SERVICE DEVICE
SERVICE LINE (allowed only if bit 0 = 0)
SERVICE PASSWORD
SOFTWARE IDENTIFICATION
SOFTWARE TYPE
TERTIARY LOADER

4.3.4 Request Up-line Dump Message Format

FUNCTION CODE	OPTION	NODE	LINE	PARAMETER ENTRIES

where:

FUNCTION CODE (1): B = 16

OPTION (1) : BM — Is one of the following options:

Option bits	Value/Meaning
0	0 = Identify target by node-id.
1	1 = Identify target by line-id.

NODE — Identifies the node to be dumped (present only if option bit 0 = 0). Format is defined in Section A.3.

LINE — Specifies the line over which to dump (present only if option bit 0 = 1). Format is defined in Section A.1.

PARAMETER ENTRIES — are zero or more of PARAMETER ENTRY consisting of:

DATA ID	DATA

where:

DATA ID (2) : B — Is the parameter type number (see note below and Appendix A).

DATA — Is the parameter data (Appendix A).

NOTE

The parameters are selected from the node parameters. Only certain parameters are allowed in the dump message. They are:

DUMP ADDRESS
DUMP COUNT
DUMP FILE
SECONDARY DUMPER
SERVICE LINE (allowed only
    if option bit 0 = 0)
SERVICE PASSWORD

4.3.5 Trigger Bootstrap Message Format

FUNCTION CODE	OPTION	NODE	LINE	PARAMETER ENTRIES

where:

FUNCTION CODE (1): B = 17

OPTION (1) : BM Is one of the following options:

Option bits	Value/Meaning
0	0 = Identify target by node-id. 1 = Identify target by line-id.

NODE Identifies the node to trigger boot on (present only if option bit 0 = 0). The format is defined in Section A.3.

LINE Identifies the line over which to trigger the boot (present only if option bit 0 = 1). The format is defined in Section A.1.

PARAMETER ENTRIES are zero or more of PARAMETER ENTRY consisting of:

DATA ID	DATA

where:

DATA ID (2) : B Is the parameter type number (see note below and Appendix A).

DATA Is the parameter data (Appendix A).

NOTE

The parameters are selected from the node parameters. Only certain parameters are allowed in the trigger message. They are:

SERVICE LINE (allowed only if option bit 0 = 0)
SERVICE PASSWORD

4.3.6 Test Message Format

FUNCTION CODE	OPTION	NODE	USER	PASSWORD	ACCOUNTING	LINE	PARAMETER ENTRIES

where:

FUNCTION CODE (1): B = 18

OPTION (1) : BM Is one of the following options:

Option bits	Value/Meaning
0	0 = Node type loop test 1 = Line type loop test

If node type loop test:

7	0 = Default access control 1 = Access control included

For node type loop tests only (option 0), four parameters are as follows:

NODE Identifies the node to loopback the test block in node-id format (Section A.3). Plural node options are not allowed.

USER (I-39): A Is the user-id to use when connecting to node. Present only if option bit 7 = 1.

PASSWORD (I-39): A Is the password to use when connecting to node. Present only if option bit 7 = 1.

ACCOUNTING (I-39):A Is the accounting information to use when connecting to node. Present only if option bit 7 = 1.

For line tests only (option 1), one parameter is as follows:

LINE Identifies the line to send the test on in line-id format (Section A.1). Plural lines options not allowed.

PARAMETER ENTRIES Are zero or more of PARAMETER ENTRY, consisting of:

DATA ID	DATA

where:

DATA ID (2) : B Is the parameter type number (Appendix A).

DATA Is the parameter data (Appendix A).

NOTE

The parameters are selected from the node parameters. Only certain parameters are allowed in the test message. They are:

LOOP COUNT
LOOP LENGTH
LOOP WITH

4.3.7 Change Parameter Message Format

FUNCTION CODE	OPTION	ENTITY ID	PARAMETER ENTRIES

where:

FUNCTION CODE (1): B = 19

OPTION (1): BM Is one of the following options:

Bits	Meaning
7	0 = Change volatile parameters.
	1 = Change permanent parameters.
6	0 = Set/define parameters.
	1 = Clear/purge parameters.
0-1	Entity type (Appendix A).

ENTITY ID Identifies the particular entity (Appendix A).

PARAMETER ENTRIES Are zero or more of PARAMETER ENTRY consisting of:

DATA ID	DATA

where:

DATA ID (2) : B Parameter type number (Appendix A).

DATA New value according to DATA ID (Appendix A). Present only if option bit 6 = 0.

4.3.8 Read Information Message Format

FUNCTION CODE	OPTION	ENTITY ID

where:

FUNCTION CODE (1): B = 20

OPTION (1): BM Is one of the following options:

Bits	Meaning
7	0 = Read volatile parameter 1 = Read permanent parameter
4-6	Information type as follows: 0 = Summary 1 = Status 2 = Characteristics 3 = Counters 4 = Events
0-1	Entity type (Appendix A).

ENTITY ID Identifies the particular entity (Appendix A).

4.3.9 Zero Counters Message Format

FUNCTION CODE	OPTION	ENTITY ID

where:

FUNCTION CODE (1): B = 21

OPTION (1): BM Is one of the following options:

Bits	Meaning
7	1 = Read and zero 0 = Zero only
0-1	Entity type (Appendix A). (line or node only)

ENTITY ID Identifies the particular entity, if required (Appendix A).

4.3.10 NICE System Specific Message Format

FUNCTION CODE	SYSTEM TYPE	REMAINDER

where:

FUNCTION CODE (1) : B = 22

SYSTEM TYPE (1) : B Represents the type of operating system command to which command is specific.

Value	System
1	RSTS
2	RSX family
3	TOPS-20
4	VMS

REMAINDER (*) : B Consists of data, depending on system specific requirements.

4.3.11 NICE Response Message Format

RETURN CODE	ERROR DETAIL	ERROR MESSAGE	ENTITY ID	TEST DATA	DATA BLOCK

where:

RETURN CODE (1) : B Is one of the standard NICE return codes (Appendix D).

ERROR DETAIL (2) :B Is more detailed error information according to the error code (e.g., a parameter type). Zero if not applicable. If applicable but not available, its value is 65,535 (all bits set). In this case it is not printed.

ERROR MESSAGE (I-72) : A Is a system dependent error message that may be output in addition to the standard error message.

[ENTITY ID] Identifies a particular entity (Appendix A) if operation is on plural entities, or operation is read information or read and zero counters. If the entity is the executor node, bit 7 of the name length is set.

[TEST DATA] (2) : B Is the information resulting from a test operation (Test message only). This is only required if a test failed and if data is relevant. Section 4.2.4 explains contents.

[DATA BLOCK] Is one of the data blocks described in Appendix A (for read information message or read and zero message).

If a response message is short terminated after any field, the existing fields may still be interpreted according to standard format. This means, for example, that a single byte return is to be interpreted as a return code.

Responses to messages not noted as exceptions above are single responses indicating return code, error detail, and error message.

A success response to a request for plural entities is indicated by a return code of 2, followed by a separate response message for each entity. Each of these messages contains the basic response data (return code, error detail, and error message) and the entity id. A return code of -128 indicates the end of multiple responses.

4.3.12 NICE Connect and Accept Data Formats

- The first three bytes of the connect accept data are:

VERSION	DEC ECO	USER ECO

where:

VERSION (1) : B Is the version number

DEC ECO (1) : B Is the DIGITAL ECO number

USER ECO (1) : B Is the user ECO number

4.3.13 **Event Message Binary Data Format** - This section describes the generalized binary format of event data. It applies to messages on logical links and, as much as possible, to files.

The buffer size for event messages is 200 bytes.

The format of an event logging message is:

FUNCTION CODE	SINK FLAGS	EVENT CODE	EVENT TIME	SOURCE NODE	EVENT ENTITY	EVENT DATA

where:

FUNCTION CODE (1) : B = 1, meaning event log

SINK FLAGS (1) : BM Are flags indicating which sinks are to receive a copy of this event, one bit per sink. The bit assignments are:

Bit	Sink
0	Console
1	File
2	Monitor

EVENT CODE (2) : BM Identifies the specific event as follows:

Bits	Meaning
0-4	Event type
6-14	Event class

EVENT TIME Is the source node date and time of event processing. Consists of:

JULIAN HALF DAY	SECOND	MILLISECOND

where:

JULIAN HALF DAY (2) : B = Number of half days since 1 Jan 1977 and before 9 Nov 2021 (0-32767). For example, the morning of Jan 1, 1977 is 0.

SECOND (2) : B = Second within current half day (0-43199).

MILLISECOND (2) : B = Millisecond within current second (0-999). If not supported, high order bit is set, remainder are clear, and field is not printed when formatted for output.

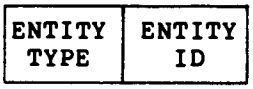
SOURCE NODE — Identifies the source node. It consists of:

where:

NODE ADDRESS (2) : B = Node address (see Section A.3).

NODE NAME (I-6) : A = Node name, 0 length, if none.

EVENT ENTITY — Identifies the entity involved in the event, as applicable. Consists of:



where:

ENTITY TYPE (1) : B — Represents the type of entity, as follows:

Value	Entity Type	ENTITY ID Field
-1	none	none
0	Line	LINE ID
1	Node	NODE ID

ENTITY ID — Identifies the entity. Depends on type, defined below.

where:

LINE ID (I-16) : A — Identifies a line entity.

NODE ID — Identifies a node entity, same form as for SOURCE NODE.

EVENT DATA (*) : B — Is event specific data, zero or more data entries as defined for NICE data blocks, parameter types according to event class.

5.0 APPLICATION LAYER NETWORK MANAGEMENT FUNCTIONS

The only Network Management function specified for the application layer is the loopback mirror.

5.1 Loopback Mirror Modules

The Loopback Mirror service tests logical links either between nodes or within a single node. It consists of an access interface -- the Loopback Access Routine; service routines -- the Loopback Mirror; and a simple protocol -- the Logical Loopback Protocol.

5.2 Loopback Mirror Operation

When the Loopback Mirror accepts a connect, it returns its maximum data size in the accept data. This is the amount of data it can handle, not counting the function code.

When a Logical Loopback message is received, it is changed into the appropriate response message and returned to the user (Figure 7, Section 4). The Loopback Mirror continues to repeat all traffic offered. The initiator of the link disconnects it.

5.3 Logical Loopback Message

Section 4.3.2 describes message format notation.

If the function code is not valid, or the message is too long, the failure code is returned.

5.3.1 Connect Accept Data Format

MAXIMUM DATA

where:

MAXIMUM DATA (2) : B Is the maximum length, in bytes, that the Loopback Mirror can loop.

5.3.2 Command Message Format

FUNCTION CODE	DATA

where:

FUNCTION CODE (1) : B = 0

DATA (*) : B Is the data to loop.

5.3.3 **Response Message**

RETURN CODE	DATA

where:

RETURN CODE (1) : B Indicates Success (1) or Failure (-1).

DATA (*) : B Is the data as received, if success.

APPENDIX A

NETWORK MANAGEMENT ENTITIES, PARAMETERS, AND COUNTERS: FORMATS AND DATA BLOCKS

This appendix describes the formats of all entities, entity parameters and entity counters, as well as the returns used in the NICE protocol and Event Logging messages in response to a request for information.

There are three entities: LINE, LOGGING and NODE. The entities also have plural forms: KNOWN and ACTIVE LINES, LOGGING and NODES, and LOOP NODES. The glossary defines the entities.

Type Number. Each entity, parameter and counter is assigned a type number. The entity type numbers are as follows:

Type Number	Keyword
0	NODE
1	LINE
2	LOGGING

The parameter and counter type numbers appear in the tables in this appendix.

Entity Identification Formats. Each entity is assigned an identification format at both NCP and Network Management layer level. These formats also appear below in appropriate sections.

Entity Parameter and Counter Formats. Each parameter and counter is assigned a format at both NCP and Network Management layer level, described below in appropriate sections. The notation used for the parameter formats is described in Section 4.3.2.

Parameter Display Format and Automatic Parsing Notation. Each parameter is assigned a data type at Network Management layer level that corresponds with the format of the parameter. This information allows NCP to format and output most parameter values in a simple way, even if NCP does not recognize the parameter type.

The notation used in the parameter tables in this appendix to describe these data types is as follows:

Notation	Data Type
C-n	Coded, single field, maximum n bytes
CM-n	Coded, multiple field, maximum n fields
AI-n	ASCII image field, maximum n bytes
DU-n	Decimal number, unsigned, maximum n bytes
DS-n	Decimal number, signed, maximum n bytes
H-n	Hexadecimal number, maximum n bytes
HI-n	Hexadecimal image, maximum n bytes

NICE Returns. A response to a SHOW command consists of the identification of the particular entity to which it applies and zero or more data entries. The data entries are either parameter or

counter entries, depending on the information requested. Entries are in ascending order, by type, so that they can be easily grouped for output.

When an implementation recognizes the parameter type of a coded field, the output should be the keyword(s) or other interpretation that corresponds to the code for that parameter type. If the parameter type is not recognized, the field should be formatted as hexadecimal.

The format of a data entry is as follows:

DATA ID (2): BM Identifies:

Bit	Meaning
15	0 = Parameter data 1 = Counter data

If bit 15 is clear, the rest of the bits are as follows:

Bits	Meaning
0-11	Parameter type, interpreted according to entity type.
12-14	Reserved

If bit 15 is set, the rest of the bits are as follows:

Bits	Meaning
0-11	Counter type
12	0 = not bit mapped 1 = bit mapped
13-14	Counter width 0 = reserved 1 = 8 bits 2 = 16 bits 3 = 32 bits

DATA TYPE (1): BM Identifies data type, present only for parameter data

Bit	Meaning
7	1 = Coded, interpreted according to PARAMETER TYPE. 0 = Not coded.

If bit 7 is set, the rest of the bits are as follows:

Bit	Meaning
6	0 = Single field. Bits 0-5 are the number of bytes in the field. 1 = Multiple field. Bits 0-5 are the number of fields, maximum 15; each field is preceded by a DATA TYPE.

If bit 7 is not set, the rest of the bits are as follows:

Bit	Meaning
6	1 = ASCII image field. Bits 0-5 zero. 0 = Binary number. Bits 0-3 are data length. 0 implies data is image field. Bits 4 and 5, used to indicate how to format the binary number for output, are:

Value	Meaning
0	Unsigned Decimal Number
1	Signed Decimal Number
2	Hexadecimal Number
3	Octal Number

BIT MAP (2): BM — Is the counter qualifier bit map, included only if data id is counter and counter is bit mapped.

DATA: B — Is the data, according to data id and type.

The data required for setting a parameter or counter is the entity identification, the DATA ID, and the DATA. The information required for clearing a parameter or counter is the entity identification and the DATA ID. When a parameter is displayed, the information is entity id, DATA ID, DATA TYPE, BITMAP (if applicable) and DATA. The purpose of the data type field is to provide information for an output formatter. Thus the formatter can know how to format a parameter value even if its parameter type is unrecognized.

A coded multiple (CM) field cannot appear as a data type for a field within a coded multiple type parameter value.

All numbers are low byte first in binary form whether image or not. The image option for numbers can only be used for parameters where it is explicitly required. All number bases except hexadecimal have a maximum length of four bytes.

Indicate counter overflow by setting all bits in the DATA field.

The following ranges are reserved for system specific counters or parameters:

Range	Reserved for
2100-2299	RSTS specific
2300-2499	RSX specific
2500-2699	TOPS-20 specific
2700-2899	VMS specific
2900-3899	Future use
3900-4095	Customer specific

Information Types. Each parameter is associated with one or more information types. The parameter tables in this appendix use the following symbols to indicate information types for each parameter.

Symbol	Keyword	Associated Entity
C	CHARACTERISTICS	All entities
S	STATUS	All entities
*	SUMMARY	All entities
EV	EVENTS	LOGGING

Applicability Restrictions. All node parameters and counters cannot be displayed at every node; nor can all line counters be displayed for every line-id. In the following tables, which describe the entity parameters and counters, the following symbols note these restrictions:

Symbol	Applicability
A	Adjacent node only
DN	Destination node only (includes executor)
E	Executor node only
N	Node by name only
L	Loop nodes
R	Remote nodes (all nodes except executor and loop nodes)
S	Sink node only
ST	Multipoint station (when no tributary number was specified in the request line-id)
T	Multipoint tributary (when a tributary number was specified in the request line-id)

Setability Restrictions. Some parameters have user setability restrictions, indicated in this appendix by the following notation:

Symbol	Meaning
RO	Read only
WO	Write only, in the sense that it appears in a different form in a read function. (For example, a node name can be set, but it is read as part of a node id.)

A.1 LINE Entity

Lines may be referred to individually or as a group. The formats for specifying line entities symbolically are as follows:

```
LINE line-id
KNOWN LINES
ACTIVE LINES
```

A line identification consists of a device identification (dev), a controller number (c), a unit number (u), if a mulitple line controller, and a tributary number (t), if multipoint. These fields represent the actual local hardware for the line. If the device is

not a multiplexer, the unit number is not allowed. The tributary number is a logical tributary number and is not to be confused with the tributary address used to poll the tributary. The tributary number is used by Network Management to identify the tributary. The tributary address is used by the multipoint algorithm at the Data Link level to identify a tributary (DDCMP functional specification). If the device is not multipoint, the tributary number is not allowed. An omitted unit and/or tributary number in a line-identification implies the entire controller and/or station.

A line identification consists of one to sixteen upper or lower case alphanumeric characters. The line-identification format is as follows:

```
dev-c-u.t
```

Some examples:

```
DMC-0          (DMC, controller 0)
DMC-1          (DMC11, controller 1)
DZ-0-1         (DZ11, controller 0, unit 1)
DZ-1-0         (DZ11, controller 1, unit 0)
DV-0-0.8       (DV11, controller 0, unit 0, tributary 8)
DV-3-0.0       (DV11, controller 3, unit 0, tributary 0)
DL-1.3         (DL11, controller 1, tributary 3)
```

"Wild cards" are permitted in line identifications. A wild card is an asterisk (*) that replaces a controller, unit, or tributary number in a line identification. Wild cards specify known lines in the range indicated by their position in the line identification.

The following represent legal uses of wild cards:

Line Identification	Meaning
DMC-*	Known DMC lines.
DZ-3-*	Known units on DZ controller 3.
DZ-3-4.*	Known tributaries on DZ controller 3, unit 4.
DZ-3-*.*	Known units and tributaries on DZ controller 3.

The following represent illegal uses of wild cards:

```
*

DZ-*-3
```

When represented in binary, line identification is one of three choices, depending on the function it will be applied to. The format is as follows:

LINE FORMAT (1) : B — Line format type, with the following values:

Number	Type
-2	Active lines
-1	Known lines
>0	Length of line-id

LINE ID : A — The ASCII line identification if LINE FORMAT > 0.

The complete parsing of a line identification can take place only at the executor node. This is because the executor is the only node that can know what device mnemonics and other line characteristics are applicable to itself.

The following table contains all currently recognized DECnet line devices:

Table 5
DECnet Line Devices

Mne	Multiplexer	Description
**DP	N	DP11-DA synchronous line interface
DU	N	DU11-DA synchronous line interface (includes DUV11)
DL	N	DL11-C, -E asynchronous serial line interface
**DQ	N	DQ11-DA synchronous serial line interface
DA	N	DA11-B, -AL unibus link
DUP	N	DUP11-DA synchronous line interface
DMC	N	DMC11-DA/AR, -MA/AL, -FA/AR interprocessor link
DLV	N	DLV11-E asynchronous line interface
DMP	N	DMP11 multipoint interprocessor link
DTE	N	DTE20 interprocessor link
DV	Y	DV11-AA/BA synchronous link multiplexer
DZ	Y	DZ11-A, -B asynchronous serial line multiplexer
KDP	Y	KMC11/DUP11-DA synchronous line multiplexer
KDZ	Y	KMC11/DZ-11-A asynchronous line multiplexer
**KL	N	KL8-J serial line interface
PCL	Y	PCL11-B multiple CPU link

A.1.1 **Line Parameters** - The line entity has the following parameters:

LINE STATE (1) : B Represents the line state, as follows:

Value	Keyword
0	ON
1	OFF
2	SERVICE
3	CLEARED

** not supported by Phase III DECnet

LINE SUBSTATE (1) : B Represents the line substate, with the following values:

Value	Keyword
0	STARTING
1	REFLECTING
2	LOOPING
3	LOADING
4	DUMPING
5	TRIGGERING
6	AUTOSERVICE
7	AUTOLOADING
8	AUTODUMPING
9	AUTOTRIGGERING

LINE SERVICE (2) : B Represents line service control with the following values:

Value	Keyword
0	ENABLED
1	DISABLED

LINE COUNTER TIMER (2) : B
Is the number of seconds between line counter log events.

LINE LOOPBACK NAME (I-6) : A
Is the name to be associated with a line as a result of a "SET NODE node-id LINE line-id" command.

LINE ADJACENT NODE Identifies the node on the other end of this line. Consists of:

NODE ADDRESS NODE NAME

where:

NODE ADDRESS (2) : B = Adjacent node address.

NODE NAME (I-6) : A = Name, zero length for none.

LINE BLOCK SIZE (2) : B Is Transport's block size for this line.

LINE COST (1) : B Represents the line cost.

NORMAL TIMER (2): B Is the number of milliseconds before a reply should be received from the remote station.

LINE CONTROLLER (1): B Represents the line controller mode, with the following values:

Value	Keyword
0	NORMAL
1	LOOPBACK

LINE DUPLEX (1) : B Represents the line duplex, with the following values:

Value	Keyword
0	FULL
1	HALF

LINE TYPE (1) : B Represents the line type, with the following values:

Value	Keyword
0	POINT
1	CONTROLLER
2	TRIBUTARY

LINE SERVICE TIMER (2) : B
Is the line service timer value.

LINE TRIBUTARY (1) : B Is the line multipoint tributary address.

Table 6 summarizes the line parameter data blocks.

Table 6
Line Parameters

Param. Type Number	NICE Data Type	Inf. Type	Set. Rest.	NCP Keywords
0	C-1	S*		STATE
1	C-1	S*	RO	substate (not a keyword)
100	C-1	C		SERVICE
110	DU-2	C		COUNTER TIMER
400	AI-6	S*	RO	LOOPBACK NAME
800	CM-1/2	S*	RO	ADJACENT NODE
	DU-2			node address
	AI-6			node name (optional if none)
810	DU-2	S	RO	BLOCK SIZE
900	DU-1	C		COST
1110	C-1	C		CONTROLLER
1111	C-1	C		DUPLEX
1112	C-1	C		TYPE
1120	DU-2	C		SERVICE TIMER
1121	DU-2	C		NORMAL TIMER
1140	DU-1	C		TRIBUTARY

A.1.2 **Line Counters** - The line entity counters are listed in Table 7, following. The definition of each counter and the way that it is incremented can be found in the functional specification for the

appropriate layer (NSP functional specification, Version 3.2; Transport functional specification, Version 1.3; and DDCMP functional specification, Version 4.1). Due to hardware characteristics, some devices cannot support all counters. In general, those counters that make sense are supported for all devices. Specific exceptions related to the DMC are noted in Appendix H.

Line counters are specified for the following layers only:

Layer	Type Number Range
Network Management	0
Transport	800's
Data Link	1000's

Table 7
Line Counters

NOTE

When a line is point-to-point, both groups (ST and T) of the line counters are returned.

Appl.	Type Number	Bit Width	Standard Text	Bit Number Standard Text
T	0	16	Seconds Since Last Zeroed	
T	800	32	Arriving Packets Received	
T	801	32	Departing Packets Sent	
T	802	16	Arriving Congestion Loss	
T	810	32	Transit Packets Received	
T	811	32	Transit Packets Sent	
T	812	16	Transit Congestion Loss	
T	820	8	Line Down	
T	821	8	Initialization Failure	
T	1000	32	Bytes Received	
T	1001	32	Bytes Sent	
T	1010	32	Data Blocks Received	
T	1011	32	Data Blocks Sent	
T	1020	8	Data Errors Inbound	0 NAKs Sent Header Block Check error 1 NAKs Sent Data Field Block Check error 2 NAKs Sent REP Response
T	1021	8	Data Errors Outbound	0 NAKs Received Header Block Check error 1 NAKs Received Data Field Block Check error 2 NAKs Received REP Response

(continued on next page)

Table 7 (Cont.)
Line Counters

Appl.	Type Number	Bit Width	Standard Text	Bit Number Standard Text
T	1030	8	Remote Reply Timeouts	
T	1031	8	Local Reply Timeouts	
T	1040	8	Remote Buffer Errors	0 NAKs Received Buffer Unavailable 1 NAKs Received Buffer Too Small
T	1041	8	Local Buffer Errors	0 NAKs Sent Buffer Unavailable 1 NAKs Sent Buffer Too Small
T	1050	16	Selection Intervals Elapsed	
T	1051	8	Selection Timeouts	0 No Reply to Select 1 Incomplete Reply to Select
ST	1100	8	Remote Process Errors	0 NAKs Received Receive Overrun 1 NAKs Sent Header Format Error 2 Selection Address Errors 3 Streaming Tributaries
ST	1101	8	Local Process Errors	0 NAKs Sent Receive Overrun 1 Receive Overruns, NAK not Sent 2 Transmit Underruns 3 NAKs Received Header Format Error

A.2 LOGGING Entity

The logging entity identification is the sink type. Logging may be referred to by individual sink types or by the sink types as a group. The formats for specifying logging entities symbolically are as follows:

Format	Meaning
LOGGING sink-type	A particular logging sink type
KNOWN LOGGING	All logging sink types known to the executor node
ACTIVE LOGGING	All known sink types that are in ON or HOLD state

A sink type is one of the following:

CONSOLE
FILE
MONITOR

When represented in binary, sink type is:

SINK TYPE (1) : B Represents the logging sink type as follows:

Value	Meaning
-2	Active sink types
-1	Known sink types
1	CONSOLE
2	FILE
3	MONITOR

Appendix F defines all the event classes and their associated events and parameters (not to be confused with the logging parameters).

Line and node counters provide information for event logging. There are no logging entity counters specified, just status, characteristics, and events.

The logging sink types have the following parameters:

STATE (1) : B Represents the sink type state with the following values:

Value	Keyword
0	ON
1	OFF
2	HOLD

NAME (I-255) : A
Is the name of the logging sink. If not set, the logging sink name defaults to a system-specific value.

SINK NODE

Is the sink node identification that applies to all following event parameters until another sink node id is encountered. If not present, it defaults to executor node. The format for setting this parameter is described in Section A.3. Plural options are not allowed. When reading parameter, sink node consists of:

NODE ADDRESS	NODE NAME

where:

NODE ADDRESS (2) : B Node address

NODE NAME (I-6) : A Node name, 0 length for none

EVENTS

Are the sink type events, consisting of:

ENTITY TYPE	ENTITY ID	EVENT CLASS	EVENT MASK

where:

ENTITY TYPE (1) : B Represents the entity type as follows:

Value	Meaning
-1	No entity
0	NODE
1	LINE

ENTITY ID

Is the entity id according to ENTITY TYPE, present only for NODE or LINE.

If ENTITY TYPE is NODE, format is as described for sink node.

If entity type is LINE, format is:

LINE ID (I-16) : A = Line id.

EVENT CLASS (2) : BM Entity class specification:

Bits	Meaning
14-15	0 = Single class 2 = All events for class 3 = KNOWN EVENTS
0-8	Event class if bits 14-15 equal 0 or 2.

EVENT MASK (I-8) : B Event mask, bits set to correspond to event types (Table 12, Section F.2). Low order bytes first. High order bytes not present imply 0 value. Format for NCP input or output is a list of numbers corresponding to the bits set (Section 3.3.1.4). Only present if EVENT CLASS is for a single class (bits 14-15 = 0).

NOTE

The wild card and KNOWN EVENTS specifications are for changing events only. Return read events as a class and mask.

Table 8 summarizes the logging parameters.

Table 8
Logging Parameters

NOTE

Symbols are explained at the beginning of this appendix.

Param.	NICE Data Type	Info Type	Appl. Restr.	NCP Keywords
0	C-1	S*	E	STATE
100	AI-255	C*	E	NAME
200	CM-1/2 DU-2 AI-6	EV*	S	SINK NODE Node address Node name (optional if none)
201	CM-2/3/4/5 C-1 DU-2 AI-6 AI-16 C-2 HI-8	EV*	S	EVENTS Entity type Node address (if entity type is node) Node name (if entity type is node) Line id (if entity type is line) Event class Event mask (if single event class indicated)

A.3 NODE Entity

The node entity is referred to by its keyword, NODE, followed by the node identification. The node identification is either the node address or node name except where limited in the command descriptions

(Section 3.3). Nodes, as a group, can be referred to as KNOWN or ACTIVE (see the glossary for definitions). The possible node entities are as follows:

```
NODE    node-id
EXECUTOR
ACTIVE NODES
KNOWN NODES
LOOP NODES
```

When the executor or loop nodes are mixed in a multiple return with remote nodes, return the executor first, and the loop nodes last.

A node address is a unique decimal in the range 1 to MAXIMUM ADDRESS. Node address is the primary identification of a node, due to its use in the DIGITAL Network Architecture. Transport routes messages to node addresses only. Node names are optionally added in the Session Control layer as a convenience for users. A node address can have only one node name associated with it. However, implementations can use system-specific methods to provide users with "alias" node names (Transport Functional Specification).

A node name consists of one to six upper case alphanumeric characters with at least one alpha character. A node name must be unique within a node and should be unique within the network.

The format for displaying node identification is:

NODE = node-address [(node-name)]

For example:

NODE = 19 (ELROND)

The parentheses are only used if the node has a name. When represented in binary, node identification is one of four choices (limited by applicability to a particular function). All choices begin with a format type. The input format is as follows:

NODE FORMAT (1) : B Represents the node format type, as follows:

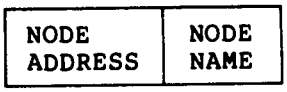
Number	Type
-3	Loop nodes, no further data
-2	Active nodes, no further data
-1	Known nodes, no further data
0	Node address
>0	Length of node name, followed by the indicated number of ASCII characters.

In the ENTITY ID field of a response message bit 7 set indicates the node identification is the executor node.

NODE ADDRESS (2) : B Is the node address if NODE FORMAT = 0. When used as input, a node address of zero implies the executor node.

NODE NAME : A Is the node name if NODE FORMAT >0.

The usual binary output format is as follows:



where:

NODE ADDRESS (2) : B Is the node address. When supplied as output a node address of 0 indicates a loop node.

NODE NAME (I-6) : A Is the node name, 0 length implies none.

A.3.1 **Node Parameters** - The node entity has the following parameters:

NODE STATE (1) : B

Represents the executor or destination node state with the following values:

Value	Keyword	Node
0	ON	Executor
1	OFF	Executor
2	SHUT	Executor
3	RESTRICTED	Executor
4	REACHABLE	Destination
5	UNREACHABLE	Destination

Except for the executor node state, this is a read only parameter.

NODE IDENTIFICATION (I-32) : A Is the node identification string (for example, operating system and version number).

NODE MANAGEMENT VERSION

Is the node Network Management version, consisting of the following:

VERSION (1) : B Version number

ECO (1) : B Engineering Change Order (ECO) number

USER ECO (1) : B User ECO number

NODE SERVICE LINE (I-16) : A Is the line used to perform down-line load and up-line dump functions.

NODE SERVICE PASSWORD (I-8) : B Is the node service password for down-line loading and up-line dumping the node. The length in binary form corresponds to the length of the text form.

NODE SERVICE DEVICE (1) : B Is the device type over which the node handles service functions when in service slave mode. Code as defined in the MOP Functional Specification and correspond to the standard Network Management device mnemonics.

NODE CPU (1) : B

Is the CPU type of the node for down-line loading with the following values:

Value	Type
0	PDP 8
1	PDP 11
2	DECSYSTEM 10 20
3	VAX

NODE LOAD FILE (I-255) : A

Is the node load file.

NODE SECONDARY LOADER (I-255) : A

Is the node secondary loader file.

NODE TERTIARY LOADER (I-255) : A

Is the node tertiary loader file.

NODE SOFTWARE TYPE (1) : B

Is the target node software program type for down-line loads with the following values:

Value	Program Type
0	SECONDARY LOADER
1	TERTIARY LOADER
2	SYSTEM

NODE SOFTWARE IDENTIFICATION (I-16) : A

Is the load software identification.

NODE DUMP FILE (I-255) : A

Is the node dump file.

NODE SECONDARY DUMPER (I-255) : A

Is the node secondary dumper file.

NODE DUMP ADDRESS (4) : B

Is the address to begin up-line dump of the node.

NODE DUMP COUNT (4) : B

Is the number of memory units to up-line dump from the node.

NODE HOST

Is the host identification for reading (SHOW or LIST) only. Consists of:

NODE ADDRESS (2) : B — Host node address.

NODE NAME (I-6) : A — Host node name, zero length if none.

NODE HOST

Is the identification of the node that node being down-line loaded may use for support functions. (Used for changing the parameter.) Format is as described for the node entity. Plural options not allowed.

NODE LOOP COUNT (2) : B

Is the default count for loop test.

NODE LOOP LENGTH (2) : B

Is the default length for loop test.

NODE LOOP WITH (1) : B

Is the default block type for loop test with the following values:

Type	Contents
0	ZEROES
1	ONES
2	MIXED

NODE COUNTER TIMER (2) : B

Is the number of seconds between node counter log events.

NODE NAME (I-6) : A

Is the node name.

NODE LINE (I-16) : A

Is the line used to get to the executor node and associated with a loopback node-name.

NODE ADDRESS (2) : B

Is the executor node address.

NODE INCOMING TIMER (2) : B

Is the node incoming timer.

NODE OUTGOING TIMER (2) : B

Is the node outgoing timer.

NODE ACTIVE LINKS (2) : B

Is the number of logical links from the executor to the destination node.

NODE DELAY (2) : B

Is the average round trip delay in seconds to the destination node. Kept on a remote node basis.

NODE NSP VERSION

Is the node NSP version. Format same as for Network Management version.

NODE MAXIMUM LINKS (2) : B

Is the node maximum links.

NODE DELAY FACTOR (1) : B

Is the node delay factor.

NODE DELAY WEIGHT (1) : B

Is the node delay weight.

NODE INACTIVITY TIMER (2) : B

Is the node inactivity timer.

NODE RETRANSMIT FACTOR (2) : B

Is the node retransmit factor.

NODE TYPE (1) : B

Represents the executor node type with the following values:

Value	Keyword
0	ROUTING
1	NONROUTING
2	PHASE II

NODE COST (2) : B

Is the total cost over the current path to the destination node. Kept on a remote node basis.

NODE HOPS (1) : B

Is the total number of hops over the current path to a destination node. Kept on a remote node basis.

NODE LINE (I-16) : A

Is the line used to get to a node other than the executor.

NODE ROUTING VERSION — Is the node routing version. Format same as for Network Management version.

NODE TYPE (1) : B — Represents the adjacent node type, with the following values:

Value	Keyword
0	ROUTING
1	NONROUTING
2	PHASE II

NODE ROUTING TIMER (2) : B — Is the node routing timer value.

NODE MAXIMUM ADDRESS (2) : B — Is the node maximum address.

NODE MAXIMUM LINES (2) : B — Is the node maximum lines value.

NODE MAXIMUM COST (2) : B — Is the node maximum cost value.

NODE MAXIMUM HOPS (1) : B — Is the node maximum hops value.

NODE MAXIMUM VISITS (1) : B — Is the node maximum visits value.

NODE MAXIMUM BUFFERS (2) : B — Is the node maximum buffers value.

NODE BUFFER SIZE (2) : B — Is the node buffer size value.

Table 9 summarizes the node parameter data blocks.

Table 9
Node Parameters

NOTE

Symbols are explained at the beginning of this appendix.

Param. Type Number	NICE Data Type	Inf. Type	Appl. Rest.	Set. Rest.	NCP Keywords
0	C-1	S*		E,R	STATE
100	AI-32	C*	E		IDENTIFICATION
101	CM-3	C	E	RO	MANAGEMENT VERSION
	DU-1				version number
	DU-1				ECO number
	DU-1				User ECO number
110	AI-16	C	A		SERVICE LINE
111	H-8	C	A		SERVICE PASSWORD
112	C-1	C	A		SERVICE DEVICE
113	C-1	C	A		CPU
120	AI-255	C	A		LOAD FILE
121	AI-255	C	A		SECONDARY LOADER
122	AI-255	C	A		TERTIARY LOADER
125	C-1	C	A		SOFTWARE TYPE
126	AI-16	C	A		SOFTWARE IDENTIFICATION

(continued on next page)

Table 9 (Cont.)
Node Parameters

Param. Type Number	NICE Data Type	Inf. Type	Appl. Rest.	Set. Rest.	NCP Keywords
130	AI-255	C	A		DUMP FILE
131	AI-255	C	A		SECONDARY DUMPER
135	DU-4	C	A		DUMP ADDRESS
136	DU-4	C	A		DUMP COUNT
140	CM-1/2	C	A,E	RO	HOST
	DU-2				Node address
	AI-6				Node name (optional if none)
141	n/a		A,E	WO	HOST
150	DU-2	C	E	RO	LOOP COUNT
151	DU-2	C	E	RO	LOOP LENGTH
152	C-1	C	E	RO	LOOP WITH
160	DU-2	C	E,R		COUNTER TIMER
500	n/a	n/a	E,R	WO	NAME
501	AI-16	C*	L,N		LINE
502	n/a	n/a	E	WO	ADDRESS
510	DU-2	C	E		INCOMING TIMER
511	DU-2	C	E		OUTGOING TIMER
600	DU-2	S*	E,R	RO	ACTIVE LINKS
601	DU-2	S*	R	RO	DELAY
700	CM-3	C	E	RO	NSP VERSION
	DU-1				Version number
	DU-1				ECO number
	DU-1				User ECO number
710	DU-2	C	E		MAXIMUM LINKS
720	DU-1	C	E		DELAY FACTOR
721	DU-1	C	E		DELAY WEIGHT
722	DU-2	C	E		INACTIVITY TIMER
723	DU-2	C	E		RETRANSMIT FACTOR
810	C-1	S	A	RO	TYPE
820	DU-2	S	R	RO	COST
821	DU-1	S	R	RO	HOPS
822	AI-16	S*	R	RO	LINE
900	CM-3	C	E	RO	ROUTING VERSION
	DU-1				Version number
	DU-1				ECO number
	DU-1				User ECO number
901	C-1	C	E		TYPE
910	DU-2	C	E		ROUTING TIMER
920	DU-2	C	E		MAXIMUM ADDRESS
921	DU-2	C	E		MAXIMUM LINES
922	DU-2	C	E		MAXIMUM COST
923	DU-1	C	E		MAXIMUM HOPS
924	DU-1	C	E		MAXIMUM VISITS
930	DU-2	C	E		MAXIMUM BUFFERS
931	DU-2	C	E		BUFFER SIZE

A.3.2 Node Counters - Table 10, below, lists the node counters. The definition of each counter and the way it is to be incremented is given in the functional specifications for the layer containing the counter.

Node counters are specified for the following layers only:

Layer	Type Number Range
Network Management	0
Network Services	600's, 700
Transport	900's

Table 10
Node Counters

Appl.	Type Number	Bit width	Standard Text
DN	0	16	Seconds Since Last Zeroed
DN	600	32	Bytes Received
DN	601	32	Bytes Sent
DN	610	32	Messages Received
DN	611	32	Messages Sent
DN	620	16	Connects Received
DN	621	16	Connects Sent
DN	630	16	Response Timeouts
DN	640	16	Received Connect Resource Errors
E	700	16	Maximum Logical Links Active
E	900	8	Aged Packet Loss
E	901	16	Node Unreachable Packet Loss
E	902	8	Node Out-of-Range Packet Loss
E	903	8	Oversized Packet Loss
E	910	8	Packet Format Error
E	920	8	Partial Routing Update Loss
E	930	8	Verification Reject

APPENDIX B

MEMORY IMAGE FORMATS

Since the PDP-8, PDP-11, VAX-11, and DECsystem-10, or DECSYSTEM-20 memory addressing requirements differ, different formats are required for memory image data. In each case, it is essential to know the number of bytes that represent the smallest individually addressable memory location. A format summary is provided below.

PDP-8

Each three bytes represents two 12-bit words. that is, the memory address is incremented by two for each three bytes. Byte 1 is the low 8-bits of memory word 1. Byte 2 is the low 8-bits of memory word 2, and byte 3 is the high 4-bits of memory words 1 and 2.

PDP-11
VAX-11

Each byte represents one memory byte. That is, the memory address is incremented with each byte.

DECsystem-10
DECSYSTEM-20

Each five bytes represents one 36-bit word. That is, the memory address is incremented by one for each five bytes. Byte 1 is the highest 8-bits of the word. Bytes 2 through 4 follow. The high 4-bits of byte 5 are the low 4-bits of the word. The low 4-bits of byte 5 are discarded.

APPENDIX C

MEMORY IMAGE FILE CONTENTS

The files containing memory images for a down-line load or an up-line dump have the same contents. The format may vary from one operating system to another, but the contents are functionally the same in all cases. The minimum control information required is as follows:

- **The type of the target system (PDP-8, PDP-11, VAX-11, DECsystem-10, or DECSYSTEM-20).** This is necessary to know how to interpret and update memory address information.

- **Transfer address.** This is the startup address for the program. This field is generally meaningless for a dump file.

The image information required is as follows:

- **Memory address.** This is the address where image goes for a load or comes from a dump.

- **Block length.** Number of memory units in image block.

- **Memory image.** This is the contiguous block of memory associated with the above address. The format requirements are as specified in Appendix B. The memory image can be of any length.

APPENDIX D

NICE RETURN CODES WITH EXPLANATIONS

This appendix specifies the NICE return codes.

In all cases, the number specified is for the first byte of the return code.

The error detail that sometimes follows the return codes is two bytes long. Since some systems may have trouble implementing the error details, a value of 65,535 (all 16 bits set) in the error detail field means no error detail. In other words, in this case, no error detail will be printed.

If a response message is short terminated after any field, the existing fields may still be interpreted according to the standard format.

A printed error message consists of the standard text for the first byte. If the second and third bytes have a defined value, this is followed by a comma, a blank, and the keyword(s) for the values.

Number	Standard test	Meaning
1	(none)	Success.
2	(none)	The request has been accepted, and more responses are coming.
3	(none)	Success, partial reply. More parameters for entity in next message. Can only be embedded in a more/done sequence. Each message still contains fields up through ENTITY ID.
-1	Unrecognized function or option	Either the function code or option field requested a capability not recognized by the Local Network Management Function. Also, the error code for function codes 2-14 (Phase II), and for system-specific commands when the system type matches the receiving system.
-2	Invalid message format	Message too long or too short (i.e., extra data or not enough data), or a field improperly formatted for data expected.

(continued on next page)

Number	Standard test	Meaning
-3	Privilege violation	The requestor does not have the privilege required to perform the requested function.
-4	Oversized Management command message	A message size was too long. The NICE message for the command was too long for the Network Management Listener to receive.
-5	Management program error	A software error occurred in the Network Management software. For example, a function that could not fail did fail. Generally indicates a Network Management software bug.
-6	Unrecognized parameter type	A parameter type included in, for example, a change parameter message not recognized by the Network Management Function. The error detail is the low and high bytes of the parameter type number, interpreted according to the entity involved.
-7	Incompatible Management version	The function requested cannot be performed because the Network Management version skew between the command source and the command destination is too great.
-8	Unrecognized component	An entity (component) was not known to the node. The error detail contains the entity type number.*
-9	Invalid identification	The format of an entity identification was invalid. For example, a node name with no alpha character, or KNOWN used where not allowed. The error detail contains the entity type number.*
-10	Line communication error	Error in transmit or receive on a line. Can only occur during direct use of the Data Link user interface.
-11	Component in wrong state	An entity (component) was in an unacceptable state. For example, a down line load attempted over a line that is OFF, or a node name to be used for a loop node already assigned to a node address. The error detail contains the entity type number.*

(continued on next page)

<table>
<tr><th>Number</th><th>Standard test</th><th>Meaning</th></tr>
<tr><td>-13</td><td>File open error</td><td>A file could not be opened.

The error detail is defined as follows:
<table><tr><th>Value</th><th>Keywords</th></tr><tr><td>0
1
2
3
4
5</td><td>PERMANENT DATABASE
LOAD FILE
DUMP FILE
SECONDARY LOADER
TERTIARY LOADER
SECONDARY DUMPER</td></tr></table></td></tr>
<tr><td>-14</td><td>Invalid file contents</td><td>The data in a file was invalid. The error detail is defined as for error #-13.</td></tr>
<tr><td>-15</td><td>Resource error</td><td>Some resource was not available. For example, an operating system resource not available.</td></tr>
<tr><td>-16</td><td>Invalid parameter value</td><td>Improper line-identification type, load address, memory length, etc. The error detail is the low and high bytes of the parameter type number, interpreted according to the entity involved.</td></tr>
<tr><td>-17</td><td>Line protocol error</td><td>Invalid line protocol message or operation. Can only occur during direct line access. In the case of a line loop test, it indicates that an error was detected during message comparison that should have been caught by the line protocol.</td></tr>
<tr><td>-18</td><td>File I/O error</td><td>I/O error in a file, such as read error in system image or loader during down-line load.

The error detail is defined as for error #-13.</td></tr>
</table>

(continued on next page)

<table>
<tr><th>Number</th><th>Standard test</th><th>Meaning</th></tr>
<tr><td>-19</td><td>Mirror link disconnected</td><td>A successful connect was made to the Loopback Mirror, but the logical link then failed.

The error detail is:
<table><tr><th>Value</th><th>Standard text</th></tr><tr><td>0</td><td>No node name set</td></tr><tr><td>1</td><td>Invalid node name format</td></tr><tr><td>2</td><td>Unrecognized node name</td></tr><tr><td>3</td><td>Node unreachable</td></tr><tr><td>4</td><td>Network resources</td></tr><tr><td>5</td><td>Rejected by object</td></tr><tr><td>6</td><td>Invalid object name format</td></tr><tr><td>7</td><td>Unrecognized object</td></tr><tr><td>8</td><td>Access control rejected</td></tr><tr><td>9</td><td>Object too busy</td></tr><tr><td>10</td><td>No response from object</td></tr><tr><td>11</td><td>Remote node shut down</td></tr><tr><td>12</td><td>Node or object failed</td></tr><tr><td>13</td><td>Disconnect by object</td></tr><tr><td>14</td><td>Abort by object</td></tr><tr><td>15</td><td>Abort by Management</td></tr><tr><td>16</td><td>Local node shut down</td></tr></table></td></tr>
<tr><td>-20</td><td>No room for new entry</td><td>Insufficient table space for new entry.</td></tr>
<tr><td>-21</td><td>Mirror connect failed</td><td>A connect to the Network Management Loopback Mirror could not be completed. The error detail is the same as for error #-19.</td></tr>
<tr><td>-22</td><td>Parameter not applicable</td><td>Parameter not applicable to entity. For example, setting a tributary address for a point-to-point line or an attempt to set a controller to loopback mode when the controller does not support that function. The error detail contains the parameter type of the parameter that is not applicable.</td></tr>
</table>

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Number	Standard test	Meaning
-23	Parameter value too long	A parameter value was too long for the implementation to handle. The error detail is the low and high bytes of the parameter type number, interpreted according to the entity involved.
-24	Hardware failure	The hardware associated with the request could not perform the function requested.
-25	Operation failure	A requested operation failed, and there is no more specific error code.
-26	System-specific Management function not supported	Error return for system-specific functions unless the system type is for the system receiving the command. May be further explained by a system-specific error message.
-27	Invalid parameter grouping	The request for changing multiple parameters contained some that cannot be changed with others.
-28	Bad loopback response	A loopback message did not match what was expected, either content or length.
-29	Parameter missing	A required parameter was not included. The error detail is the low and high bytes of the parameter type number, interpreted according to the entity involved.
-128	(none)	No message printed. Done with multiple response commands (e.g., read information for known lines).

*NOTE

Error codes -8, -9, and -11 indicate problems with the primary entity to which a command applies. They may also apply to a secondary entity, such as the line in a LOAD NODE command.

APPENDIX E

NCP COMMAND STATUS AND ERROR MESSAGES

NCP has the following standard status and error messages.

Standard Text	Meaning
	Status Messages
COMPLETE	The command was processed successfully.
FAILED	The command did not execute successfully.
NOT ACCEPTED	The command did not get past syntax and semantic checking. No attempt was made to execute it. The text of the error message may vary as long as the meaning is clearly the same.
	Error Messages
Unrecognized command	The command typed by the user was not recognized.
Unrecognized keyword	Something in the command keyword was not recognized.
Value out of range	A parameter value was out of range. This message may be followed by a comma, a blank and the parameter keyword(s).
Unrecognized value	A parameter value was unrecognizable. This message may be followed by a comma, a blank and the parameter keyword(s).
Not remotely executable	NCP is functionally unable to send a command to a remote node.
Bad management response	The Network Management Access Routines received unrecognizable information.
Listener link disconnected	A successful connect was made to the Network Management Listener, but the logical link then failed. Optional error detail is as in NICE error message -19 (Appendix D).

(continued on next page)

Standard Text	Meaning
	Error Messages
Listener connect failed	A connect to the Network Management Listener could not be completed. The optional error detail is as in NICE error message -21 (Appendix D).
Total parameter data too long	NCP command overflows maximum NICE message for this implementation.
Oversized Management response	NCP could not receive a NICE message because it was too long.

APPENDIX F

EVENTS

F.1 Event Class Definitions

Table 11, following, defines the event classes. The event class as shown in Table 11 is a composite of the system type and the system specific event class.

Table 11
Event Classes

Event Class	Description
0	Network Management Layer
1	Applications Layer
2	Session Control Layer
3	Network Services Layer
4	Transport Layer
5	Data Link Layer
6	Physical Link Layer
7-31	Reserved for other common classes
32-63	RSTS System specific
64-95	RSX System specific
96-127	TOPS-20 System specific
128-159	VMS System specific
160-479	Reserved for future use
480-511	Customer specific

F.2 Event Definitions

In the following descriptions, an entity related to an event indicates that the event can be filtered specific to that entity. Binary logging data is formatted under the same rules as the data in NICE data blocks (see Appendix A). Section F.3 describes the event parameters associated with each event type.

Table 12 shows the events for each class.

Table 12
Events

Class	Type	Entity	Standard Text	Event Parameters and Counters •
0	0	none	Event records lost	none
0	1	node	Automatic node counters	Node counters
0	2	line	Automatic line counters	Line counters
0	3	line	Automatic line service	Service Status
0	4	line	Line counters zeroed	Line counters
0	5	node	Node counters zeroed	Node counters
0	6	line	Passive loopback	Operation
0	7	line	Aborted service request	Reason
2	1	none	Local node state change	Reason Old state New state
2	1	none	Access control reject	Source node Source process Destination process User Password Account
3	0	none	Invalid message	Message
3	1	none	Invalid flow control	Message Current flow control
3	2	node	Data base reused	NSP node counters
4	0	none	Aged packet loss	Packet header
4	1	line	Node unreachable packet loss	Packet header
4	2	line	Node out-of-range packet loss	Packet header
4	3	line	Oversized packet loss	Packet header
4	4	line	Packet format error	Packet beginning
4	5	line	Partial routing update loss	Packet header Highest address
4	6	line	Verification reject	Node
4	7	line	Line down, line fault	Reason
4	8	line	Line down, software fault	Reason Packet header
4	9	line	Line down, operator fault	Reason Packet header Expected node
4	10	line	Line up	Node
4	11	line	Initialization failure, line fault	Reason
4	12	line	Initialization failure, software fault	Reason Packet header
4	13	line	Initialization failure, operator fault	Reason Packet header Received version
4	14	node	Node reachability change	Status
5	0	line	Locally initiated state change	Old state New state

(continued on next page)

Table 12 (Cont.)
Events

Class	Type	Entity	Standard Text	Event Parameters and Counters *
5	1	line	Remotely initiated state change	Old state New state
5	2	line	Protocol restart received in maintenance mode	none
5	3	line	Send error threshold	Line counters, including station
5	4	line	Receive error threshold	Line counters, including station
5	5	line	Select error threshold	Line counters, including station
5	6	line	Block header format error	Header (optional)
5	7	line	Selection address error	Selected tributary Received tributary Previous tributary
5	8	line	Streaming tributary	Tributary status Received tributary
5	9	line	Local buffer too small	Block length Buffer length
6	0	line	Data set ready transition	New state
6	1	line	Ring indicator transition	New state
6	2	line	Unexpected carrier transition	New state
6	3	line	Memory access error	Device register
6	4	line	Communications interface error	Device register
6	5	line	Performance error	Device register

* Counters are defined in Appendix A.

F.3 Event Parameter Definitions

The following parameter types are defined for the Network Management layer (class 0):

Type	Data Type	Keywords
0	C-1	SERVICE
1	CM-1/2/3	STATUS
	C-1	Return code
	C-2	Error detail (optional if no error message)
	AI-72	Error message (optional)
2	C-1	OPERATION
3	C-1	REASON

where:

SERVICE (1): B Represents the service type as follows:

Value	Keyword
0	LOAD
1	DUMP

STATUS Is the operation status, consisting of:

RETURN CODE	ERROR DETAIL	ERROR MESSAGE

where:

RETURN CODE (1) : B = Standard NICE return code, with added interpretation:

Value	Keyword
0	REQUESTED
>0	SUCCESSFUL
<0	FAILED

ERROR DETAIL (2) : B = Standard NICE error detail.

ERROR MESSAGE(I-72) : A = Standard NICE optional error message.

OPERATION (1) : B Represents the operation performed, as follows:

Value	Keyword
0	INITIATED
1	TERMINATED

REASON (1) : B Represents the reason aborted, as follows:

Value	Reason
0	Receive timeout
1	Receive error
2	Line state change by higher level
3	Unrecognized request
4	Line open error

The following parameter types are defined for the Session Control layer (class 2):

Type	Data Type	Keywords
0	C-1	REASON
1	C-1	OLD STATE
2	C-1	NEW STATE
3	CM-1/2 DU-2 AI-6	SOURCE NODE node address node name (optional if none)
4	CM-1/2/3/4 DU-1 DU-1 DU-1 AI-16	SOURCE PROCESS Object type Group code, (if specified and process name present) User code, (if specified and group code present) Process name, if specified
5	CM-1/2/3/4	DESTINATION PROCESS Same as for SOURCE PROCESS
6	AI-39	USER
7	C-1	PASSWORD
8	AI-39	ACCOUNT

where:

REASON (1) : B — Represents the reason for state change, as follows:

Value	Meaning
0	Operator command
1	Normal operation

OLD STATE (1) : B — Represents the old node state, as follows:

Value	Meaning
0	ON
1	OFF
2	SHUT
3	RESTRICTED

NEW STATE (1) : B — Represents the new node state, coded same as OLD STATE.

SOURCE NODE — Is the source node identification, consisting of:

NODE ADDRESS	NODE NAME

where:

NODE ADDRESS (2) : B = Node address (see Section A.3).

NODE NAME (I-6) : A = Node name, 0 length if none.

SOURCE PROCESS — Is the source process identification, consisting of:

OBJECT TYPE	GROUP CODE	USER CODE	PROCESS NAME

where:

OBJECT TYPE (1): B = Object type number

GROUP CODE (1): B = Group code number

USER CODE (1): B = User code number

PROCESS NAME(I-16):A = Process name

DESTINATION PROCESS — Is the destination process identification, defined as for SOURCE PROCESS.

USER (I-39) : A — Is the user identification

PASSWORD (1) : B — Is the password indicator. A value of zero indicates a password was set. Absence of the parameter indicates no password was set.

ACCOUNT (I-39) : A — Is the account information

The following parameter types are defined for the Network Services layer (class 3):

Type	Data Type	Keywords
0	CM-4	MESSAGE
	H-1	Message flags
	DU-2	Destination node address
	DU-2	Source node address
	HI-6	Message type dependent data
1	DU-1	CURRENT FLOW CONTROL

where:

MESSAGE (I-12) : B — Is the message received (NSP information only). Consists of:

MESSAGE FLAGS	DESTINATION NODE	SOURCE NODE	DATA

where:

MESSAGE FLAGS(1):B = Message flags

DESTINATION NODE(2):B = Destination node address

SOURCE NODE(2):B = Source node address

DATA(I-6):B = Message type dependent data

CURRENT FLOW CONTROL (1) : B Is the current flow control value

The following parameter types are defined for the Transport layer (class 4):

Type	Data Type	Keywords
0	CM-4 H-1 DU-2 DU-2 H-1	PACKET HEADER Message flags Destination node address Source node address Forwarding data
1	HI-6	PACKET BEGINNING
2	DU-2	HIGHEST ADDRESS
3	CM-1/2 DU-2 AI-6	NODE node address node name (optional if none)
4	CM-1/2 DU-2 AI-6	EXPECTED NODE node address node name (optional if none)
5	C-1	REASON
6	CM-3 DU-1 DU-1 DU-1	RECEIVED VERSION Version number ECO number User ECO number
7	C-1	STATUS

where:

PACKET HEADER Is the packet header consisting of:

MESSAGE FLAGS	DESTINATION NODE ADDRESS	SOURCE NODE ADDRESS	FORWARDING DATA

where:

MESSAGE FLAGS (1):B = Message definition flags

DESTINATION NODE ADDRESS(2):B = Address of destination node

SOURCE NODE ADDRESS (2): B = Address of source node

FORWARDING DATA (1):B = Message forwarding data

PACKET BEGINNING (6) : B Is the beginning of packet.

HIGHEST ADDRESS (2) : B Is the highest unreachable node address.

NODE Is the node identification in the same format as SOURCE NODE in Session Control events.

EXPECTED NODE Is the expected node identification in the same format as SOURCE NODE in Session Control events.

REASON (1) : B Is the failure reason:

Value	Meaning
0	Line synchronization lost
1	Data errors
2	Unexpected packet type
3	Routing update checksum error
4	Adjacent node address change
5	Verification receive timeout
6	Version skew
7	Adjacent node address out of range
8	Adjacent node block size too small
9	Invalid verification seed value
10	Adjacent node listener receive timeout
11	Adjacent node listener received invalid data

RECEIVED VERSION — Is the received version number, consisting of:

VERSION	ECO	USER ECO

where:

VERSION (1): B = Version number.

ECO (1): B = ECO number.

USER ECO (1): B = User ECO number.

STATUS (1) : B — Represents the node status, as follows:

Value	Meaning
0	REACHABLE
1	UNREACHABLE

The following parameter types are defined for the Data Link layer (class 5):

Type	Data Type	Keywords
0	C-1	OLD STATE
1	C-1	NEW STATE
2	HI-6	HEADER
3	DU-1	SELECTED TRIBUTARY
4	DU-1	PREVIOUS TRIBUTARY
5	C-1	TRIBUTARY STATUS
6	DU-1	RECEIVED TRIBUTARY
7	DU-2	BLOCK LENGTH
8	DU-2	BUFFER LENGTH

where:

OLD STATE (1): B — Represents the old DDCMP state, as follows:

Value	Meaning
0	HALTED
1	ISTRT
2	ASTRT
3	RUNNING
4	MAINTENANCE

NEW STATE (1): B — Represents the new DDCMP state, as defined for OLD STATE.

HEADER (I-6): B — Is the block header

SELECTED TRIBUTARY(1): B — Is the selected tributary address

RECEIVED TRIBUTARY(1): B — Is the received tributary address

PREVIOUS TRIBUTARY(1): B Is the previously selected tributary address

TRIBUTARY STATUS (1): B Is the tributary status, as follows:

Value	Meaning
0	Streaming
1	Continued send after timeout
2	Continued send after deselect
3	Ended streaming

BLOCK LENGTH (2): B Is the received block length from header, in bytes

BUFFER LENGTH (2): B Is the buffer length, in bytes

The following parameter types are defined for the Physical Link layer (class 6):

Type	Data Type	Keywords
0	H-2	DEVICE REGISTER
1	C-1	NEW STATE

where:

DEVICE REGISTER(2): B Represents a single device register. When more than one, they should be output in standard order.

NEW STATE (1): B Represents the new modem control state, as follows:

Value	Meaning
0	OFF
1	ON

APPENDIX G

JULIAN HALF-DAY ALGORITHMS

The following algorithms will convert to and from a Julian half-day in the range 1 January 1977 through 9 November 2021 as used in the binary format of event logging records.

The algorithms will operate correctly with 16 bit arithmetic. The arithmetic expressions are to be evaluated using FORTRAN operator precedence and integer arithmetic.

In all cases, the input is assumed to be correct, i.e., the day is in the range 1 to maximum for the month, the month is in the range 1-12, the year is in the range 1977-2021 and the Julian half-day is in the range 0-32767.

To convert to Julian half-day:

```
JULIAN = (3055*(MONTH+2)/100-(MONTH+10)/13*2-91
         +(1-(YEAR-YEAR/4*4+3)/4)*(MONTH+10)/13+DAY-1
         +(YEAR-1977)*365+(YEAR-1977)/4)*2
```

To convert from Julian half-day:

```
HALF = JULIAN/2
TEMP1 = HALF/1461
TEMP2 = HALF-TEMP1
YEAR = TEMP2/365
IF TEMP2/1460*1460 = TEMP2 AND (HALF+1)/1460 > TEMP1
  YEAR = YEAR-1
ENDIF
TEMP1 = TEMP2-(YEAR*365)+1
YEAR = YEAR+1977
IF YEAR/4*4 = YEAR
  TEMP2 = 1
ELSE
  TEMP2 = 0
ENDIF
IF TEMP1 > 59+TEMP2
  DAY = DAY+2-TEMP2
ELSE
  DAY = TEMP1
ENDIF
MONTH = (DAY+91)*100/3055
DAY = DAY+91-MONTH*3055/100
MONTH = MONTH-2
IF HALF*2 = JULIAN
  HALF = 0
ELSE
  HALF = 1
ENDIF
```

The algorithm was certified to work using the following FORTRAN program running in FORTRAN IV+ on RSX-11M:

```
          INTEGER*4 COUNT
          INTEGER*2 JULTES,JULIAN,DAY,MONTH,YEAR,JULTEM,HALF
!
          DO 1099 COUNT=0,32767
            JULTES=COUNT
            CALL UNJUL(JULTES,HALF,DAY,MONTH,YEAR)
            JULTEM=JULIAN(DAY,MONTH,YEAR)+HALF
            IF (JULTEM.EQ.JULTES) GOTO 1099
              TYPE 10,JULTES,JULTEM,HALF,DAY,MONTH.YEAR
10            FORMAT (X,'Error!',617)
1099      CONTINUE
          END
!
! INTEGER FUNCTION TO CONVERT DAY, MONTH AND YEAR TO JULIAN HALF-DAY
!
          INTEGER*2 FUNCTION JULIAN(DAY,MONTH,YEAR)
          INTEGER*2 DAY,MONTH,YEAR
!
          JULIAN = (3055*(MONTH+2)/100-(MONTH+10)/13*2-91
         & +(1-(YEAR-YEAR/4*4+3)/4)*(MONTH+10)/13+DAY-1
         & +(YEAR-1977)*365+(YEAR-1977)/4)*2
          RETURN
          END
!
! SUBROUTINE TO CONVERT JULIAN HALF-DAY TO DAY, MONTH AND  YEAR
!
          SUBROUTINE UNJUL(JULIAN,HALF,DAY,MONTH,YEAR)
          INTEGER*2 JULIAN,HALF,DAY,MONTH,YEAR,TEMP1,TEMP2
!
          HALF = JULIAN/2
          TEMP1 = HALF/1461
          TEMP2 = HALF-TEMP1
          YEAR = TEMP2/365
          IF (TEMP2/1460*1460.EQ.TEMP2.AND.(HALF+1)/1460.GT.TEMP1)
         & YEAR = YEAR-1
          TEMP1 = TEMP2-(YEAR*365)+1
          YEAR=YEAR+1977
          TEMP2 = 0
          IF (YEAR/4*4.EQ.YEAR) TEMP2 = 1
          DAY = TEMP1
          IF (TEMP1.GT.59+TEMP2) DAY = DAY+2-TEMP2
          MONTH = (DAY+91)*100/3055
          DAY = DAY+91-MONTH*3055/100
          MONTH = MONTH-2
          TEMP1 = 0
          IF (HALF*2.NE.JULIAN) TEMP1 = 1
          HALF = TEMP1
          RETURN
          END
```

APPENDIX H

DMC DEVICE COUNTERS

The following counters are the only ones applicable to the DMC device.

Number	Standard Text
1000	Bytes received
1001	Bytes sent
1010	Data blocks received
1011	Data blocks sent
1020	Data errors inbound
	0 NAKs sent, header block check error
	1 NAKs sent, data field block check error
1021	Data errors outbound
1030	Remote reply timeouts
1031	Local reply timeouts
1041	Local buffer errors
	0 NAKs sent, buffer unavailable

None of the other standard counters can be kept due to the nature of the DMC hardware. The "Data errors outbound" counter is kept with no bitmap. It represents the sum of all NAKs received.

Since the counters kept by the DMC firmware cannot be zeroed in the way that driver-kept counters can, the recommended technique for providing the zero capability is to copy the base table counters when a zero is requested. The numbers returned when counters are requested are then the difference between the saved counters and the current base table.

APPENDIX I

NCP COMMANDS SUPPORTING EACH NETWORK MANAGEMENT INTERFACE

This appendix shows the NCP commands supporting the Network Management interface to each of the lower DNA layers.

〈 This notation precedes keywords or text returned on SHOW or LIST commands

A. Network Management Layer Interface

{SET / DEFINE}	EXECUTOR	NODE	destination-node
	{LINE / KNOWN LINE} line-id	ALL	
		COUNTER TIMER	seconds
		SERVICE	service-control
		STATE	line-state
	{LOGGING / KNOWN LOGGING} sink-type	ALL	
		EVENT event-list	source-qual sink-node
		KNOWN EVENTS	source-qual sink-node
		NAME	sink-name
		STATE	sink-state
	NODE node-id	ALL	
		COUNTER TIMER	seconds
		CPU	cpu-type
		DUMP ADDRESS	number
		DUMP COUNT	number
		DUMP FILE	file-id
		HOST	node-id
		IDENTIFICATION	string
		LOAD FILE	file-id
		SECONDARY DUMPER	file-id
		SECONDARY LOADER	file-id
		SERVICE DEVICE	device-type
		SERVICE LINE	line-id
		SERVICE PASSWORD	password
		SOFTWARE IDENTIFICATION	file-id
		SOFTWARE TYPE	program-type
		TERTIARY LOADER	file-id

A. Network Management Layer Interface (Cont.)

CLEAR PURGE	{NODE KNOWN NODES} node-id	ALL COUNTER TIMER CPU DUMP ADDRESS DUMP COUNT DUMP FILE HOST IDENTIFICATION LOAD FILE PARAMETERS SECONDARY DUMPER SECONDARY LOADER SERVICE DEVICE SERVICE LINE SERVICE PASSWORD SOFTWARE IDENTIFICATION SOFTWARE TYPE TERTIARY LOADER	
CLEAR PURGE	{LOGGING sink-type KNOWN LOGGING}	EVENT event-list KNOWN EVENTS NAME	source-qual sink-node source-qual sink-node
TRIGGER	{NODE node-id VIA line-id}	SERVICE PASSWORD *VIA	password line-id
LOAD	{NODE node-id VIA line-id}	ADDRESS CPU FROM HOST NAME SECONDARY LOADER SERVICE DEVICE SERVICE PASSWORD SOFTWARE IDENTIFICATION SOFTWARE TYPE TERTIARY LOADER *VIA	node-address cpu-type load-file node-id node-name file-id device-type password file-id program-type file-id line-id

* not allowed when first option is VIA

A. Network Management Layer Interface (Cont.)

DUMP	{NODE node-id VIA line-id}	DUMP ADDRESS DUMP COUNT SECONDARY DUMPER SERVICE DEVICE SERVICE PASSWORD TO dump-file *VIA line-id	number number file-id device-type password	
LOOP	{LINE line-id NODE node-id}	COUNT WITH LENGTH	count block-type length	
{SHOW LIST}	{LINE line-id KNOWN LINES}	CHARACTERISTICS	⟨SERVICE	
		COUNTERS	⟨seconds since last zeroed	
		STATUS	⟨STATE-substate	
	{LOGGING sink-type KNOWN LOGGING ACTIVE LOGGING}	{SINK node-id KNOWN SINKS}	STATUS	⟨STATE
			CHARACTERISTICS	NAME
			EVENTS	See Section A.2

A. Network Management Layer Interface (Cont.)

{SHOW / LIST}	{ACTIVE NODES / EXECUTOR / LOOP NODES / KNOWN NODES / NODE node-id}	CHARACTERISTICS	ADDRESS COUNTER TIMER CPU DUMP ADDRESS DUMP COUNT DUMP FILE HOST IDENTIFICATION LOAD FILE MANAGEMENT VERSION NAME SECONDARY DUMPER SECONDARY LOADER SERVICE DEVICE SERVICE LINE SERVICE PASSWORD SOFTWARE IDENTIFICATION SOFTWARE TYPE TERTIARY LOADER
		COUNTERS	⟨seconds since last zeroed
SHOW	QUEUE		
ZERO	{LINE line-id / KNOWN LINES}	COUNTERS	
	{NODE node-id / KNOWN NODES}	COUNTERS	

B. Session Control Layer Interface

{SET / DEFINE}	{NODE node-id / KNOWN NODES}	ALL ADDRESS node-address INCOMING TIMER seconds LINE line-id NAME node-name OUTGOING TIMER seconds STATE node-state	
{CLEAR / PURGE}	{NODE node-id / KNOWN NODES}	ALL INCOMING TIMER LINE line-id NAME OUTGOING TIMER	
{SHOW / LIST}	{EXECUTOR / KNOWN NODES / ACTIVE NODES / LOOP NODES / NODE node-id}	CHARACTERISTICS	⟨INCOMING TIMER / LINE / NAME / OUTGOING-TIMER
	{EXECUTOR / KNOWN NODES / ACTIVE NODES / LOOP NODES / NODE node-id}	STATUS	⟨NAME / STATE
	LINE line-id	STATUS	⟨NODE-NAME

C. Network Services Layer Interface

{SET / DEFINE}	EXECUTOR	ALL	
		DELAY FACTOR	number
		DELAY WEIGHT	number
		INACTIVITY TIMER	seconds
		MAXIMUM LINKS	number
		RETRANSMIT FACTOR	number
{SHOW / LIST}	EXECUTOR	CHARACTERISTICS	DELAY FACTOR DELAY WEIGHT INACTIVITY TIMER MAXIMUM LINKS NSP VERSION RETRANSMIT FACTOR
		COUNTERS	See Table 10
		STATUS	ACTIVE LINKS DELAY
ZERO	{EXECUTOR / KNOWN NODES}	COUNTERS	

D. Transport Layer Interface

{SET / DEFINE}	{LINE / KNOWN LINES} line-id	ALL	
		COST	cost
	{NODE / KNOWN NODES} node-id	ALL	
		BUFFER SIZE	memory-units
		MAXIMUM ADDRESS	number
		MAXIMUM BUFFERS	number
		MAXIMUM COST	number
		MAXIMUM HOPS	number
		MAXIMUM LINES	number
		MAXIMUM VISITS	number
		ROUTING TIMER	seconds
		TYPE	node-type

D. Transport Layer Interface (Cont.)

{SHOW / LIST}	{LINE line-id / KNOWN LINES / ACTIVE LINES}	CHARACTERISTICS	⟨COST
{SHOW / LIST}	{LINE line-id / KNOWN LINES / ACTIVE LINES}	STATUS	⟨BLOCK SIZE
	{LINE line-id / KNOWN LINES / ACTIVE LINES}	COUNTERS	See Table 7
	{EXECUTOR / KNOWN NODES / ACTIVE NODES / LOOP NODES / NODE node-id}	CHARACTERISTICS	⟨BUFFER SIZE MAXIMUM ADDRESS MAXIMUM BUFFERS MAXIMUM COST MAXIMUM HOPS MAXIMUM LINES MAXIMUM VISITS ROUTING TIMER ROUTING VERSION
	{EXECUTOR / KNOWN NODES / ACTIVE NODES / LOOP NODES / NODE node-id}	STATUS	COST HOPS LINE STATE TYPE
	{EXECUTOR / KNOWN NODES / ACTIVE NODES / LOOP NODES / NODE node-id}	COUNTERS	See Table 10
ZERO	{LINE line-id / KNOWN LINES}	COUNTERS	

E. Data Link/Physical Link Layers Interface

{SET / DEFINE}	{LINE / KNOWN LINES} line-id	ALL	
		CONTROLLER	controller-mode
		DUPLEX	duplex-mode
		NORMAL TIMER	milliseconds
		SERVICE TIMER	milliseconds
		TRIBUTARY	tributary-address
		TYPE	line-type
{CLEAR / PURGE}	LINE line-id	ALL	
{SHOW / LIST}	{ACTIVE LINES / LINE / KNOWN LINES} line-id	CHARACTERISTICS	DUPLEX CONTROLLER PROTOCOL TRIBUTARY TIMER SERVICE
	{ACTIVE LINES / LINE / KNOWN LINES} line-id	COUNTERS	See Table 7

GLOSSARY

NOTE

Terms that derive from other related specifications (such as hops, cost, delay, etc.) are defined in those specifications.

active lines

Active lines are known lines in the ON or SERVICE state.

active logging

Active logging describes all known sink types that are in the ON or HOLD state.

active nodes

All reachable nodes as perceived from the executor node are active nodes.

adjacent node

A node removed from the executor node by a single physical line.

characteristics

Parameters that are generally static values in volatile memory or permanent values in a permanent data base. A Network Management information type. Characteristics can be set or defined.

cleared state

Applied to a line: a state where space is reserved for line data bases, but none of them is present.

command node

The node where an NCP command originates.

controller

The part of a line identification that denotes the control hardware for a line. For a multiline device that controller is responsible for one or more units.

counters

Error and performance statistics. A Network Management information type.

data link

A physical connection between two nodes. In the case of a multipoint line, there can be multiple data links.

entity

LINE, LOGGING, or NODE. These are the major Network Management keywords. Each one has several parameters with options. LINE and NODE also have specified counters. There are also plural entities: KNOWN and ACTIVE LINES, LOGGING, and NODES.

executor node

The node in which the active Local Network Management Function is running (that is, the node actually executing the command); the active network node physically connected to one end of a line being used for a load, dump, or line loop test.

filter

A set of flags for an event class that indicates whether or not each event type in that class is to be recorded.

global filter

A filter that applies to all entities within an event class.

hold state

Applied to logging. A state where the sink is temporarily unavailable and events for it should be queued.

host node

The node that provides services for another node (for example, during a down-line task load).

information type

One of CHARACTERISTICS, COUNTERS, EVENTS or SUMMARY. Used in the SHOW command to control the type of information returned. Each entity parameter and counter is associated with one or more information types.

known lines

All lines addressable by Network Management in the appropriate data base (volatile or permanent) on the executor node. They may not all be in a usable state.

known logging

All logging sink-types addressable by Network Management in the appropriate data base.

known nodes

All nodes with address 1 to maximum address that are either reachable or have a node name plus all names that map to a line.

line

A physical path. In the case of a multipoint line, each tributary is treated as a separate line. Line is a Network Management entity.

line identification

The device, controller, unit and/or tributary assigned to a line.

line level loopback

Testing a specific data link by sending a repeated message directly to the data link layer and over a wire to a device that returns the message to the source.

logging

Recording information from an occurrence that has potential significance in the operation and/or maintenance of the network in a potentially permanent form where it can be accessed by persons and/or programs to aid them in making real-time or long-term decisions.

logging console

A logging sink that is to receive a human-readable record of events, for example, a terminal or printer.

logging event type

The identification of a particular type of event, such as line restarted or node down.

logging file

A logging sink that is to receive a machine-readable record of events for later retrieval.

logging identification

The sink type associated with the logging entity (file, console or monitor).

logging sink

A place that a copy of an event is to be recorded.

logging sink flags

A set of flags in an event record that indicate the sinks on which the event is to be recorded.

logging sink node

A node to which logging information is directed.

logging source node

The node from which logging information comes.

logging source process

The process that recognized an event.

logical link

A connection between two nodes that is established and controlled by the Session Control, Network Services, and Transport layers.

loopback node

A special name for a node, that is associated with a line for loop testing purposes. The SET NODE LINE command sets the loopback node name.

monitor

An event sink that is to receive a machine-readable record of events for possible real-time decision making.

node

An implementation that supports Transport, Network Services, and Session Control. Node is a Network Management entity.

node address

The required unique numeric identification of a specific node.

node identification

Either a node name or a node address. In some cases an address must be used as a node identification. In some cases a name must be used as a node identification.

node name

An optional alphanumeric identification associated with a node address in a strict one-to-one mapping. No name may be used more than once in a node. The node name must contain at least one letter.

node level loopback

Testing a logical link using repeated messages that flow with normal data traffic through the Session Control, Network Services, and Transport layers within one node or from one node to another and back. In some cases node level loopback involves using a loopback node name associated with a particular line.

off state

Applied to a node: a state where it will no longer process network traffic. Applied to a line: a state where the line is unavailable for any kind of traffic. Applied to logging: a state where the sink is not available, and any events for it should be discarded.

on state

Applied to a node: a state of normal network operation. Applied to a line: a state of availability for normal usage. Applied to logging: a state where a sink is available for receiving events.

physical link

An individually hardware addressable communications path.

processed event

An event after local processing, in final form.

raw event

An event as recorded by the source process, incomplete in terms of total information required.

reachable node

A node to which the executor node's Transport believes it has a usable communications path.

remote node

To one node, any other network node.

restricted state

A node state where no new logical links from other nodes are allowed.

service password

The password required to permit triggering of a node's bootstrap ROM.

service slave mode

The mode where the processor is taken over and the adjacent, executor node is in control, typically for execution of a bootstrap program for down-line loading or for up-line dumping.

service state

A line state where such operations as down-line load, up-line dump, or line loopback are performed. This state allows direct access by Network Management to the line.

shut state

A node state where existing logical links are undisturbed, but new ones are prevented.

sink

(see logging sink)

specific filter

A filter that applies to a specific entity within an event class and type.

station

A physical termination on a line, having both a hardware and software implementation, that is a controller and/or a unit and is part of a line identification.

status

Dynamic information relating to entities, such as their state. A Network Management information type. Also, a message indicating whether or not an NCP command succeeded.

substate

An intermediate line state that is displayed as a tag on a line state display.

summary

An information type meaning most useful information.

target node

The node that receives a memory image during a down-line load, generates an up-line dump, or loops back a test message.

tributary

A physical termination on a multipoint line that is not a control station. Part of the line-identification for a multipoint line.

unit

Part of a line-identification. Together with the controller forms a station.

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or
Country

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