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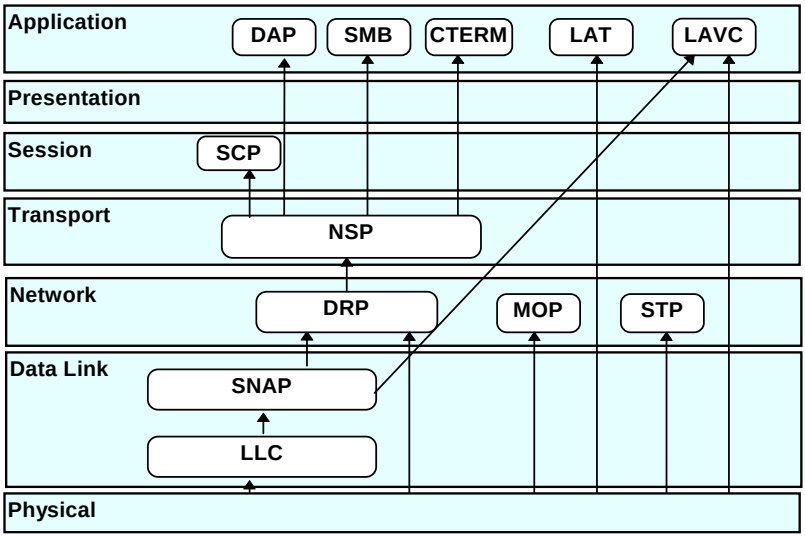
DECnet Protocols

Digital Equipment Corporation (DEC) developed the DECnet protocol to allow high-speed communication between DEC minicomputers across local and wide area networks. The DECnet suite includes the following protocols:

- RP: Routing Protocol.
- MOP: Maintenance Operation Protocol.
- NSP: Network Service Protocol.
- SCP: Session Control Protocol.
- DAP: Data Access Protocol.
- CTERM: Command Terminal.
- LAT: Local Area Transport.
- STP: Spanning Tree Protocol.
- LAVC: Local Area VAX Cluster.

The following diagram illustrates the DECnet protocol suite in relation to the OSI model:



DECnet protocol suite in relation to the OSI model

RP

The Routing Protocol (RP) distributes routing information among DECnet hosts. It defines routing classes into two levels: level 1, which handles routing within a single DECnet routing area; and level 2, which handles routing between areas.

Frames

RP frames can be one of the following types:

[Level 1 hello]	Routing update from a level 1 router.
[Level 2 hello]	Routing update from a level 2 router.
[Endnode hello]	Routing update from an endnode.
[L1 router msg]	Routing status for a local area.
[L2 router msg]	Routing status for other areas.
[Routed data]	Segment of user data.

Frame Parameter

All RP frames have the following parameter:

Node address

Node address. The DECnet area and node given in the decimal dot form: Area.Node (where Area can extend from 1-63 and Node can extend from 1-1023).

Hello Parameters

Hello frames have the following parameters:

Routing priority

Routing priority on a scale of 100 (not used for [endnode hello] frames).

Hello period

Period between routing update hello messages.

Version

The version in use.

Multicast status
Y indicates that this protocol supports multicast traffic on the link; N indicates it does not support multicast traffic.

Maximum
Maximum frame size supported on the link (1500 for Ethernet).

Router Parameters

RP router frames have the following parameters:

Source node
The ID of the sending node.

Number of IDs
Number of IDs contained in the routing table for this level 1 routing message.

Number of areas
Number of areas contained in the routing table for this level 2 message.

Data Parameters

RP [routed data] frames have the following parameters:

Request return
When set to 1, sender is requesting that the other party return the frame. When set to 0, sender is suggesting that the other party discard the frame.

Return path
When set to 1, frame is on return path; when set to 0, frame is on outbound path.

Intra-Ethernet
When set to 1, frame is from a directly connected Ethernet segment; when set to 0, the system forwarded the frame from another segment.

Version
Must be 0.

MOP

The Maintenance Operation Protocol (MOP) is used for utility services such as uploading and downloading system software, remote testing and problem diagnosis.

Frames

MOP frames can be one of the following commands:

[memory load data]	Contains memory load data.
[mem load request]	Request fort memory load segment.
[mem load w/addr]	Memory load with transfer address.
[par load w/addr]	Parameter load with transfer address.
[dump service req]	Request for assistance with dump operation.
[mem dump request]	Request for next memory dump segment.
[memory dump data]	Contains memory dump data.
[dump completed]	Acknowledgment of dump completion.
[volunteer assist]	Offer of dump/load/loop assistance.
[request program]	Request for system or loader program.
[rem boot request]	Request for boot program.
[remote ID reqst]	Request for remote console identification.
[remote system ID]	Remote console identification information.
[counters request]	Request for communication information counters.
[counters reply]	Communication information counters.
[reserve console]	Remote console in reserved state.
[release console]	Release of remote console from reserved state.
[rem console poll]	Poll of remote console for status.
[rem console rply]	Response to remote console poll.
[loopback request]	Request to loopback enclosed data.
[loopback reply]	Response to loopback request with data.

Memory Dump and Memory Load Frames

MOP memory dump and memory load frames use the following parameters:

Load number

Data segment sequence number of the current memory data segment.

Load address
Memory load address for storage of the memory data.

Transfer address
Starting memory address of the current segment.

Memory address
Starting physical memory address for the dump.

Count
Number of memory locations to dump.

Version
Protocol format version, currently 1.

Memory size
Size of physical machine memory.

Bits
Generally set to 2 for compatibility reasons.

Buffer size
Local buffer size in bytes.

Communication device
Device type of the requesting system. The following device codes can be used:

Code	Device
DP	DP11-DA
UNA	DEUNA
DU	DU11-DA
CNA	DECNA
DL	DL11-C/E/WA
QNA	DEQNA
DQ	DQ11-DA
CI	Comp. Intercon.
DA	DA11-B/AL
PCL	PCL11-B
DUP	DUP11-DA
DMC	DMC11-DA/FA/MA/MD
DN	DN11-BA/AA

Code	Device
DLV	DLV11-E/F/J
DMP	DMP11
DTE	DTE20 (PDP11-KL10)
DV	DV11-AA/BA
DZ	DZ11-A/B/C/D
KDP	KMC11/DUP11-DA
KDZ	KMC11/DZ11-A/B/C/D
KL	KL8-J
DMV	DMV11
DPV	DPV11
DMF	DMF-32
DMR	DMR11-AA/AB/AC/AE
KMY	KMS11-PX (X.25)
KMX	KMS11-BD/BE (X.25)

Parameter Load Frames

MOP parameter load frames have the following fields:

Load number
The data segment sequence number of the current data segment.

Target name
ASCII system name for target system.

Target address
Hex address of target system.

Host system name
ASCII system name of host.

Host system address
Hex address of host system.

Host system time
Current time for host system.

Request Program Frames

MOP [request program] frames have the following fields:

Communication device
Refer to the values given for dump/load frames above.

Version
Version currently in use.

Type
Type of program that the system requested:

Secondary	A secondary loader program.
Tertiary	A tertiary loader program.
System	An operating system program.

Software ID
Software type that the system requested:

Standard O/S	Standard operating system software.
Maint system	Maintenance system software.

Processor
System processor type:

PDP-11	PDP-11 system.
Comm Srv	Communications server.
Profess	Professional.

Boot Request Frames

Boot request frames have the following fields:

Verification number
A verification code that must match before this protocol can honor a boot request.

Boot server
Boot system device type:

Req	Requesting system.
Def	Default boot server.
<device>	Specified device.

Software ID
The software type as given for the [request program] frame above.

Remote Console Frames

MOP remote console frames have the following fields:

Receipt number
Used to identify a particular request.

Command status
Console command data status given as OK if received, or Lost if not received.

NSP

The Network Services Protocol (NSP) provides reliable virtual connection services with flow control to the network layer Routing Protocol (RP).

Frames

NSP frames can be one of the following commands:

[data segment]	Carries higher level data.
[interrupt]	Carries urgent data.
[data request]	Carries data flow control information.
[interrupt rq]	Carries interrupt flow control information.
[data ackn]	Acknowledges receipt of data.
[control ackn]	Acknowledges receipt of interrupt messages.
[connect ackn]	Acknowledges a [connect init] frame.
[connect init]	Requests a logical link connection.
[connect ackn]	Acknowledges a link connection.
[discnct init]	Requests disconnection of a link.
[discnct ackn]	Acknowledges disconnection of a link.
[no operation]	No operation performed.

Parameters

NSP frames can contain the following fields:

Destination link address
Destination port of the link.

Source link address
Source port of the logical link.

Acknowledge number
The segment number of the last message received successfully or, if followed by {NAK}, the segment number of the message for which the system requests a retransmission.

Acknowledge other
Same as acknowledge number, but used to acknowledge other data.

Segment number
Number of the current data frame.

Flow control
Can indicate the following services:

Seg_reqst	Data segment request count.
SCP_reqst	Session control protocol request count.

Flow control information
The data segment messages can include flow control messages ({send} or {stop}) to indicate the desired action of the receiving system.

BOM/EOM
Beginning of message/end of message. Indicates the start or end of a data segment message.

SCP

The Session Control Protocol (SCP) manages logical links for DECnet connections.

Frames

SCP frames can be one of the following commands:

[connect data]	Transfers connection parameters.
[disconnect]	Supplies disconnect status information.
[reject data]	Supplies reject status information.

Connect Data Parameters

SCP [connect data] frames contain the destination name (Dest) and source name (Src) parameters that can consist of the following fields:

Object type

One of the following object types:

Type	*Description*
(User Process)	General task or end user process.
(Files-DAP 1)	File access through DAP version 1.
(Unit Record)	Unit record service.
(App. TrmSrv)	Application terminal services.
(Cmd. TrmSrv)	Command terminal services.
(RSX-11M TC1)	RSX-11M task control, version 1.
(Op Services)	Operator services interface.
(Node Manage)	Node resource manager.
(3270-BSC GW)	IBM 3270 BSC gateway.
(2780-BSC GW)	IBM 2780 BSC gateway.
(3790-SDLC)	IBM 3790 SDLC gateway.
(TPS Applic.)	TPS application.
(RT-11 DIBOL)	RT-11 DIBOL application.
(TOPS-20 T H)	TOPS-20 terminal handler.
(TOPS-20 R S)	TOPS-20 remote spooler.
(RSX-11M TC2)	RSX-11X task control, version 2.
(TLK Utility)	TLK utility.
(Files-DAP4+)	File access through DAP, version 4+.
(RSX-11S RTL)	RSX-11S remote task Loader.

Type	*Description*
(NICE Proc.)	NICE processor.
(RSTS/E MTP)	RSTS/E media transfer program.
(RSTS/E HCTH)	RSTS/E homogeneous command terminal handler.
(Mail Listen)	Mail listener.
(Host TrmHnd)	Host terminal handler.
(Con. TrmHnd)	Concentrator terminal handler.
(Loop Mirror)	Loopback mirror service.
(Event Rcvr)	Event receiver.
(VAX/VMS PMU)	VAX/VMS personal message utility.
(FTS Service)	FTS service.

Group
Group code identifier.

User
User code identifier.

Descriptor
A user-defined string of data.

Version
The SCP version, as in {SCP 1.0}.

Requestor ID
User name for access verification.

Password
Password for user verification.

Account
Link or service account data.

User data
End user connect data.

Disconnect/Reject Parameters

The decoding for SCP [disconnect] and [reject data] frames lists the reason for disconnection, as follows:

{No error}	Normal disconnect with no error.
{Shutting down}	Source node is deactivating.
{Unknown user}	Destination end user is unknown.
{Invalid username}	Destination end user invalid.
{Dest. overloaded}	Destination out of link resources.
{Unknown error}	Unspecified error.
{Link aborted}	Link aborted by third party.
{User aborted}	Link aborted by end user.
{Host overloaded}	Source is out of link resources.
{Bad ID/password}	Invalid ID or password.
{Bad account info}	Invalid account data.
{Data too long}	Connect data parameters too long.

DAP

The Data Access Protocol (DAP) provides remote file access to systems supporting the DECnet architecture.

Frames

DAP frames can be one of the following commands:

[configuration]	Exchanges information about file systems and supported protocols.
[file attribs]	Provides file attributes.
[open file]	Opens the specified file.
[create file]	Creates the specified file.
[rename file]	Renames the specified file.
[delete file]	Deletes the specified file.
[list dir]	Lists the specified directory.
[submit file]	Submits the specified batch file.
[execute file]	Executes the specified command file.
[control info]	Provides control information about the file system.
[continue]	Continues I/O operation after error.
[acknowledge]	Acknowledges open file and control information commands.
[close file]	Closes file or ends data stream.
[data message]	Carries file I/O data.
[status]	Returns status and error information.
[file index]	Specifies keys for file indexing.
[allocate]	Creates or extends a file.
[summary info]	Returns summary information about a file.
[timestamp]	Specifies time for time-stamped fields.
[protect mode]	Specifies file protection mode.
[file name]	Renames files or lists directories.
[access rights]	Specifies file access rights.

Frame Parameters

DAP commands can contain the following parameters:

Allocation size
The number of blocks allocated to a file.

Attribute
File attribute represented as follows:

Seqnt	Sequential access supported.
Relatv	Relative access supported.
Index	Indexed access supported.
Hashed	Hashed format.

Bit count
Indicates the number of unused bits in the last byte of the data message.

Bits per byte
Number of bits in each byte.

Block size
Physical media block size in bytes.

Bucket size
Bucket size used to access relative, hashed and indexed files.

Checksum
The 16-bit file checksum.

Data type
Type of file data:

ASCII	Standard 7-bit ASCII characters.
Image	Binary data.
EBCDIC	EBCDIC encoded data.
Compr	Compressed data format.
Exec	Executable code.
Privil	Privileged code.
Senstv	Sensitive data, purge after delete.

Device type
Code which indicates the type of device that DAP associates with the file.

File access mode

The open mode for file access which is specified as one of the following:

Put	Put (write) access allowed.
Get	Get (read) access allowed.
Del	Delete access allowed.
Upd	Update access allowed.
Trn	Truncate access allowed.
BIO	Block I/O access allowed.
BRO	Block and Record I/O switching allowed.
FAO	File Access Options. The file access options code.

FilSys

File system, represented as one of the following:

RMS-11	RMS-20	RMS-32
FCS-11	RT-11	None
TOPS-20	TOPS-10	OS-8

Maximum buffer size

The maximum buffer size the sending system can receive.

Operating system type

Operating system type can be of the following:

RT-11	RSTS/E	RSX-11S
RSX-11M	RSX-11D	IAS
VAX/VMS	TOPS-20	TOPS-10
RTS-8	OS-8	RSX-11M+
COPOS/11		

Password

Password required for file access.

Record attributes

Record attributes code.

Record format
Represented as follows:

Undef	Undefined record format.
FixLen	Fixed-length records.
VarLen	Variable-length records.
Var/FC	Variable-length records with fixed control format.
ASCII	ASCII stream format.

Record size
File record size in bytes.

Record number
The record used when accessing file data.

Shared access mode
The open mode for sharing file access, specified as follows:

Put	Put (write) access allowed.
Get	Get (read) access allowed.
Del	Delete access allowed.
Upd	Update access allowed.
MSE	Multi-stream access enabled.
UPI	User-provided interlocking allowed.
Nil	No shared use allowed.

Stream ID
The ID code used to multiplex data streams on one file.

System capabilities
System capabilities code.

System specific information
Information specific to homogeneous systems.

Ver
Version. The DAP version number, the DAP software version number, followed by the user modification number in parenthesis.

Continue Parameters

DAP [continue] frames indicate the recovery action as one of the following:

{try again}	Repeat the attempted operation.
{skip it}	Skip the attempted operation and continue.
{abort transfer}	Abort the I/O transfer.
{resume}	Restart the data stream if suspended.

Status Parameters

DAP [status] frames can report the following status information:

{pending}	Operation in progress.
{OK}	Operation successful.
{bad request}	Specified operation unsupported.
{open error}	Error occurred while opening file.
{I/O error}	Error occurred while transferring data.
{I/O warning}	Non-fatal I/O error occurred.
{close error}	Error occurred while closing file.
{bad format}	Message format invalid.
{sync error}	Message received out of synchronization.

CTERM

The Command Terminal (CTERM) protocol is the terminal emulation protocol of the Digital Network Architecture. CTERM uses DECnet to provide a command terminal connection between DEC terminals and DEC operating systems such as VMS and RSTS/E.

Frames

CTERM frames can be one of the following commands:

[initiate]	Initiates the command terminal connection.
[start read]	Requests a read from the terminal server.
[read data]	Transfers terminal data to the host.
[out-of-band]	Conveys an out-of-band character received by the server.
[abort read]	Requests that the current terminal data read be aborted.
[clear input]	Requests that the input and type-ahead buffers be cleared.
[write data]	Transfers terminal write data and control information.
[write status]	Transfers terminal write status.
[discard stat]	Signals whether to discard terminal output.
[read config]	Requests the current terminal characteristics.
[config data]	Transfers terminal configuration data.
[check input]	Requests the current input character count.
[input count]	Indicates the number of input characters to be read.
[input state]	Indicates the presence of new input characters.

CTERM Parameters

The following are possible CTERM parameters:

Buffer size

Size of the terminal character input buffer.

Character count

Number of characters in the input buffer.

End
Ending character position. Current position of the last character displayed.

EOP
End of prompt. Character position of the first character after the prompt.

Horizontal position
Current horizontal position of the displayed output.

Horizontal position change
Horizontal position change. Horizontal position change since the last read.

Low water mark
Position of the last character not modified.

Maximum receive size
Length of the input character buffer.

Maximum transmit
Maximum transmit buffer size.

Character
Out-of-band character. The out-of-band character received.

Postfix
Postfix new line count. New line postfix count for the current write.

Prefix
Prefix new line count. New line prefix count for the current write.

Software revision
Software revision currently in use.

Start of display
Position of the first character to display.

Termination
Termination set bitmask. The 256-bit termination set for the read.

Time out
Amount time in seconds before a read request aborts.

Version
Protocol version currently in use.

Vertical position
Current vertical position of the displayed output.

Vertical position change
Change in vertical position since the last read.

Messages

For certain CTERM frames various messages can be displayed as detailed below:

[input state] frames display the current input status as {more characters} or {no more characters}.

[write status] frames can display the write status as {some output lost} or {no output lost}.

[discard stat] frames can display the discard status as {discard} or {no discard}.

[abort read] frames display the abort request as {unconditional} or {if no more input}.

[out-of-band] frames can contain the disposition of the data as [discard].

LAT

The Local Area Transport (LAT) protocol is designed to handle multiplexed terminal traffic to/from timesharing hosts.

STP

The Spanning Tree Protocol (STP) prevents the formation of logical looping in the network. It is implemented by the 802.1d MAC Bridge Management Protocol, to provide information on bridge topology.

LAVC

The Local Area VAX Cluster (LAVC) protocol communicates between DEC VAX computers in a cluster.