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Software Product Description

DESCRIPTION

The DEC Network Integration Server (DECNIS) 500/600 product provides multiprotocol routing, bridging, and X.25 gateway services to host systems on local area networks (LANs) connected to the DECNIS or to host systems connected to the DECNIS over wide area network (WAN) connections. The DECNIS 500/600 software runs on any DECNIS 500 or 600 hardware unit.

Overview

The DECNIS software provides a routing service for:

- TCP/IP hosts

- DECnet Phase IV nodes

- DECnet/OSI Phase V nodes

- OSI-compatible systems

- Novell® NetWare® nodes

- AppleTalk® nodes

Multiprotocol routing of IP, DECnet, and OSI is implemented using the Integrated Intermediate System to Intermediate System (Integrated IS-IS) routing protocol. Routing of IP is also supported using Open Shortest Path First (OSPF), Routing Information Protocol (RIP), Border Gateway Protocol 4 (BGP-4), and Exterior Gateway Protocol (EGP). Routing of Novell NetWare and AppleTalk is implemented on the LAN using native protocols and over the WAN using encapsulation within IP.

The DECNIS software supports bridging of protocols that can not be routed. Both local bridging between LANs connected to the same DECNIS unit, and remote bridging between two DECNIS units connected over WAN links are supported.

The DECNIS software provides X.25 gateway and relay services to connect end systems on a LAN to X.25 Data Terminal Equipment (DTE) connected directly to the DECNIS or connected over an X.25 Packet Switched Data Network (PSDN).

The DECNIS software image is installed and configured on a host system called the load host. Once configured, the DECNIS software image and configuration file is loaded from the load host system to the target DECNIS unit. When loaded, the DECNIS software image can be stored in internal non-volatile FLASH) memory so that subsequent software loads can be performed without the need for loading from a load host (flash loading). DECNIS systems equipped with the MPC-II (DNSAN-BH) and MPC-III (DNSBN-AH and DNSBN-BH) can store multiple configuration and image files in non-volatile (FLASH) memory.

The DECNIS software is managed using the Network Command Language (NCL) command line interface which can be run on the DECNIS MPC-II (DNSAN-BH) or MPC-III (DNSBN-AH or DNSBN-BH) and accessed via the console, or from any Windows 95®, Windows NT®, DIGITAL UNIX® (formerly DEC OSF/1), OpenVMS for Alpha or OpenVMS for VAX system. Event logging and data tracing utilities are also available on DIGITAL UNIX, OpenVMS for Alpha and OpenVMS for VAX systems to assist problem solving by logging network events and by tracing control messages received or sent by the DECNIS software.

The DECNIS software can be managed from the POLYCENTER/NetView® network management platform or any system supporting the Simple Network Management Protocol (SNMP). SNMP sets, gets, and traps are supported where appropriate for MIB-II, Bridge MIB, FDDI MIB, DS3/E3 MIB and DIGITAL Vendor MIB variables.

IP Routing

The DECNIS software provides support for the following IP routing protocols:

- OSPF V2 (RFC 1247)

- Integrated IS-IS (RFC 1195)

- RIP (RFC 1058)

- BGP-4 (RFC 1771)

- EGP (RFCs 827, 888, and 904)

The DECNIS supports the OSPF Version 2 protocol as defined by RFC-1247. TOS 0 routing only is supported. The DECNIS OSPF implementation also supports the modifications and enhancements proposed in the replacement draft RFC, in particular the virtual link support enhancements and support for IP address supernetting. OSPF is configured using the DECNIS configuration utility and managed dynamically using the NCL command line interface.

The DECNIS supports the Integrated IS-IS routing protocol as defined in RFC 1195. When using Integrated IS-IS, the software supports equal-cost path splitting of IP data over up to four equal-cost paths. Variable, but contiguous, IP subnet masks are also supported. Integrated IS-IS is configured using the DECNIS configuration utility and managed dynamically using the NCL command line interface.

The DECNIS supports Border Gateway Protocol Version 4 (BGP-4) as defined in RFC 1771 to provide inter-Autonomous System routing. An Autonomous System is a single administrative domain in which routers exchange intra-domain routing information. BGP-4 allows the DECNIS to exchange intra-domain routes with other BGP-4 routers in other Autonomous Systems. The DECNIS is both a Border Router and BGP Speaker and implements both send and receive policies using Route Propagation and Filtering. BGP-4 is managed using the NCL command line interface. Note that an MPC-II (DNSAN-BH) or MPC-III (DNSBN-AH or DNSBN-BH) must be installed to run BGP-4.

The DECNIS also supports the RIP (RFC 1058) and EGP (RFCs 827, 888, and 904) routing protocols. Support for multiple instances of RIP and EGP is provided. In addition to IP routing protocols, the software also supports IP reachable addresses (static routes). RIP and EGP are configured using the DECNIS configuration utility and managed dynamically using the NCL command line interface. MIB-II variables as defined in RFC 1213 can also be managed using SNMP sets and gets.

The DECNIS software supports Virtual Router Cluster (also known as IP Standby), a mechanism that greatly improves the resilience of IP backbone networks. Enhancements have also been made to the Integrated IS-IS routing protocol algorithm to reduce the time taken to re-compute new routes. Virtual Router Cluster works in conjunction with Integrated IS-IS by providing fast IP router failover, should a router, its LAN connection, or one of its WAN circuits fail. In a typical network, failover is achieved in a way that is totally transparent to applications running on IP host systems.

The DECNIS software supports Protocol Independent Multicast (PIM) as specified in the draft RFCs, "PIM Protocol Specification, January 1995" and "PIM Motivation and Architecture, January 1995". The DECNIS implementation of PIM implements Dense Mode only. PIM allows IP packets to be forwarded to a defined group of hosts simultaneously. Each host in the multicast group must support RFC 1112, "Host Extensions for IP Multicasting". Note that an MPC-II (DNSAN-BH) or MPC-III (DNSBN-AH or DNSBN-BH) must be installed to run PIM.

The DECNIS software supports full propagation of routes between different routing protocols, for example between BGP-4, OSPF, Integrated IS-IS, RIP, and EGP. The propagation of IP routes learnt through one routing protocol into another protocol can be managed using the DECNIS configuration utility and the NCL command line interface. Controls can be added to include or exclude routes from single nodes, subnets, or collections of subnets. For RIP and EGP, controls can set up between multiple instances of each protocol.

The DECNIS software communicates with IP hosts and gateways on the local LAN using the ARP protocol (RFC 826). Proxy ARP (RFC 1027) is also supported. The DECNIS software also supports Path MTU Discovery technique as specified in RFC 1191, and ICMP Router Discovery Messages as specified in RFC 1256 to allow IP hosts to distinguish the DECNIS as a router using ICMP messages and procedures. Using ICMP, the DECNIS periodically broadcasts ICMP Router Advertisement messages and responds to ICMP Router Solicitation messages from IP Hosts. All management parameters defined in RFC 1256 are supported. DECNIS also supports an IP Helper function which allows IP routing to forward packets for particular UDP ports to particular IP addresses. Popular UPD ports which can make use of this feature include TFTP (port 69), DNS (port 53), Time Service (port 37), NETBios Name Server (port 137) and NETBios Datagram Server (port 138).

The DECNIS software supports IP routing over CSMA/CD, FDDI, PPP, HDLC, Frame Relay, SMDS and ATM PVCs, or dynamically assigned X.25 circuits. The DECNIS supports IP routing over X.25 data links in accordance with RFC 877, and over PPP data links in accordance with RFC 1332. The DECNIS implements LLC encapsulation according to RFC 1483 to provide Classical IP over ATM PVCs according to RFC 1577.

IP Switching

IP Switching is a method of forwarding IP packets over ATM connections. IP Switches and IP Switch Gateways identify and label IP packets which have the same characteristics and redirect this flow of IP packets onto an ATM virtual circuit. IP Switches provide direct switching of IP packets over ATM virtual circuits in hardware,

thus removing the per-router forwarding overhead and reducing latency.

The DECNIS implements IP Switch Gateway functions to monitor, create and delete IP packet flows, associate flows with ATM virtual circuits, and pass information about flows to IP Switches.

The DECNIS uses normal IP protocols to communicate with other IP routers and IP hosts on the LAN and communicates with an IP Switch using IP Switching protocols defined in RFCs 1953 and 1954. RFC 1953 defines the types of IP packet flow; the DECNIS supports Type 2 flows based on source and destination address, time to live and version/Internet header length. RFC 1954 defines the flow labels that identify IP packets as part of a flow. The flow label encodes the ATM VPI/VCI to which the flow will be redirected. IP Switching uses flow labels as representations of ATM connections and interprets the label as an ATM connection identifier.

IP Switching is only supported on the DECNIS ATM-controller 631. IP Switching is configured using the *clear*VISN DECNIS Configurator utility and is managed dynamically using the NCL command line interface.

DECnet Routing

The DECNIS software implements both the DECnet Phase IV routing algorithm (routing vector) and the DECnet/OSI Phase V routing algorithm (link state routing). The DECNIS software supports both intra-area routing (level 1) and inter-area routing (level 2). The DECNIS software can run either the Phase IV or Phase V routing algorithm in either combination at each level. When running the Phase V algorithms at either level 1 or level 2, the routing software is still able to handle traffic generated by DECnet Phase IV end systems and performs any necessary address and header conversions. DECnet routing is configured using the DECNIS configuration utility and is managed using the NCL command line interface.

The DECNIS software supports path splitting over up to four routing circuits. If the cost between the router and the destination node is the same on multiple WAN circuits, then the DECNIS software splits the traffic across all the circuits.

It is also possible to route IP traffic using RIP within a DECnet Phase IV only network by running RIP over the DECnet Phase IV level 1 or level 2 links. An IS-IS routing circuit is required in order to handle IP traffic either within a level 1 area or between areas over a level 2 link.

The DECNIS supports DECnet routing over CSMA/CD, FDDI, HDLC, DDCMP, and Frame Relay circuits, and over dynamically and statically assigned X.25 circuits.

The DECNIS software also supports DECnet routing over PPP data links in accordance with RFC 1376.

OSI Routing

The DECNIS software fully implements the requirements of an OSI Intermediate System. The DECNIS software exchanges information about reachability of end systems using the OSI IS-IS Intra-Domain Routing Exchange Protocol as specified in ISO/IEC 10589. OSI-compatible end systems on the same LAN can exchange information with the DECNIS software and use the OSI End System to Intermediate System (ES-IS) Routing Exchange Protocol as specified in ISO 9542. OSI routing is configured using the DECNIS configuration utility and is managed using the NCL command line interface.

The DECNIS software supports OSI Connectionless Network Protocol (CLNP) routing as specified in ISO 8473, over CSMA/CD, FDDI, HDLC, Frame Relay and SMDS circuits, and over dynamically and statically assigned X.25 circuits. The DECNIS software also supports OSI CLNP routing over PPP data links in accordance with RFC 1377.

Novell NetWare Routing

The DECNIS software provides support of native Novell NetWare protocols over Ethernet and FDDI. Ethernet-II, 802.2, Encapsulated Ethernet (802.2 SNAP), and 802.3 RAW (Novell) data link formats are supported. The following Novell NetWare protocols are supported:

• Novell NetWare IPX Forwarding

• Novell NetWare Routing Information Protocol (RIP)

• Novell NetWare Service Access Protocol (SAP)

Novell IPX is supported over wide area links using IP encapsulation according to RFC 1234. The DECNIS software also supports native IPX over leased line circuits using the PPP data link protocol (IPXWAN) according to RFC 1362 but does not support negotiated options. Novell IPX routing is configured using the DECNIS configuration utility and is managed using the NCL command line interface.

The DECNIS software has been tested and certified for use as a LAN router with Novell NetWare by Novell's test laboratory.

AppleTalk Routing

The DECNIS software provides support of native EtherTalk®, the Apple® specification for AppleTalk over Ethernet and FDDI. EtherTalk uses 802.2 SNAP data link format. The following AppleTalk protocols are supported:

- AppleTalk Phase-II Forwarding

- AppleTalk Phase-II EtherTalk

- AppleTalk Phase-II Address Resolution Protocol (AARP)

- AppleTalk Phase-II Routing Table Maintenance Protocol (RTMP)

- AppleTalk Phase-II Name Binding Protocol (NBP)

- AppleTalk Phase-II Zone Information Protocol (ZIP)

- AppleTalk Phase-II Echo Protocol (echo replies only)

AppleTalk is supported over wide area links to other DECNIS systems using IP encapsulation. AppleTalk routing is configured using the DECNIS configuration utility and is managed using the NCL command line interface.

Bridging

The DECNIS software supports local and remote bridging between LANs for protocols that cannot be routed (e.g., DIGITAL's LAT) or that are not supported by the DECNIS routing software (e.g., Xerox® XNS). The DECNIS software supports a maximum of 15 local or remote bridge port.

DECnet, IP, OSI, IPX, and AppleTalk protocols are normally routed and cannot be bridged except in the following cases:

- DECnet, IP, IPX, and AppleTalk traffic can either be individually routed or bridged on a system wide basis. When routing is not enabled for any one or more of these protocols, it will be bridged on all interfaces. Bridge filtering can be enabled for DECnet, IP, IPX, and AppleTalk on a port-by-port basis.

- OSI null-Internet frames will always be bridged over the Ethernet or FDDI interfaces.

The DECNIS software implements the IEEE 802.1D Spanning Tree Protocol and will interoperate with other DIGITAL or IEEE 802.1D-compliant bridges in the same extended LAN. When used as a local bridge, the DECNIS software forwards data packets from one LAN interface to another LAN interface. When bridging IP packets between FDDI and Ethernet interfaces, frames larger than 1518 bytes will be fragmented before transmission over the Ethernet.

Remote bridging is supported over PPP, HDLC, Frame Relay and ATM PVCs; it is not supported over X.25 and SMDS data links.

Remote bridging is also supported between a DECNIS unit and NSC®/Vitalink® TransLAN® bridges using the Vitalink Control Protocol (VCP). Remote bridging is supported between a DECNIS 500/600 using the DEC WANcontroller 622 network interface card and NSC /Vitalink TransLAN III, IV, 320, 335 or 350 remote bridges or TransPATH 335 or 350 bridge/routers running either TransLAN V11.1.4 or TransPATH V11.2.5 software or later.

When used with TransLAN bridges only one bridging link is supported at a time; load balancing over multiple links is not supported. The Vitalink DLS protocol is not supported by the DECNIS.

Tinygram compression is supported in accordance with RFC 1220 over PPP and VCP data links. This allows Ethernet and 802.3 frames which are padded with zeros, such as LAT frames, to be compressed over remote bridging links. Bridging over multiple remote hops is supported subject to the *Bridging Configuration Guidelines* section below.

Bridging is configured using the DECNIS configuration utility and is managed using the NCL command line interface. Bridge MIB variables as defined in RFC 1493 can also be managed using SNMP sets and gets. Bridge traffic, both local and remote, may be filtered based on a combination of source or destination address and protocol type on a port-by-port basis.

Bridging Configuration Guidelines

When bridging over remote links, the performance of delay-sensitive protocols (such as LAT) cannot be guaranteed without careful consideration of the number of bridging hops and the speed of the lines connecting the DECNIS units.

DIGITAL warrants and supports the DECNIS product when used in extended LAN configurations subject to the following configuration restrictions:

- The minimum line speed supported for remote bridging between DECNIS units is 56 Kbits/s.

- Remote bridging is supported over PPP, HDLC, Frame Relay and ATM PVCs but is not supported over X.25 or SMDS circuits, or over satellite links.

- The maximum number of bridging ports supported by the DECNIS is 15. Consequently, the maximum number of remote bridging links that can be configured on the DECNIS is limited to 15.

- A maximum of seven local and remote bridges may be configured in series between any two communicating end stations. Each DECNIS unit, or any other IEEE 802.1D or LANbridge 100 compatible bridge, counts as one bridge towards this maximum configuration of seven bridges.

- Local Area VAXcluster (LAVC) is not supported over remote bridging links.

- PATHWORKS services may be restricted over remote bridging links; please refer to the relevant Software Product Descriptions for further information.

- When bridging between a DECNIS and NSC/Vitalink TransLAN, load balancing and DLS are not supported.

In addition to the above configuration restrictions, and, when using 56 Kbits/s or 64 Kbits/s links between DECNIS units for remote bridging of LAT, DIGITAL also recommends the following configuration guidelines to ensure reliable operation:

- A maximum of two serial synchronous links should be used in the spanning tree path between the LAT server and the LAT host.

- A minimum of 3 Kbits/s should be allocated for each active LAT session which needs to be supported simultaneously across the remote link. When using Tinygram compression, 2 Kbits/s should be allocated for each active LAT session.

- Links should be reserved for LAT and not shared with routed traffic such as DECnet, OSI, or IP. Also, other bridged traffic which may generate unnecessary traffic over the remote link should be filtered using the DECNIS Bridge Filtering facilities.

Routing and Bridging over PPP

The DECNIS software supports routing of IP, IPX, DECnet, and OSI protocols over PPP datalinks as defined by RFCs 1332, 1334, 1362, 1376, 1377 and RFC 1548. Bridging over PPP datalinks is also supported as defined by RFC 1220. PPP Authentication Protocol (PAP), PPP Header Compression and PPP SDU size negotiation are also supported.

Routing and Bridging over Frame Relay

The DECNIS software supports connections over Frame Relay data links as specified in the Frame Relay Specification jointly developed by DIGITAL Equipment Corporation, StrataCom®, Inc., Northern Telecom®, and Cisco® Systems Inc.

Multiple virtual circuits can be multiplexed over a single Frame Relay link using the Data Link Control Identifier (DLCI) field of the Frame Relay LAPD header. For details of the Frame Relay options implemented, refer to the *CONFORMANCE TO STANDARDS* section of this SPD.

Routing of IP, DECnet, and OSI protocols, and bridging of other protocols is supported over Frame Relay PVCs as defined in RFC 1490 using point-to-point encapsulation only, or by using PPP encapsulation within the Frame Relay frame. IPX and AppleTalk can also be routed over Frame Relay within IP. The DECNIS Frame Relay implementation supports both the LMI and ANSI-D switch control procedures.

Frame Relay is only supported on the DEC WANcontroller 622, DEC WANcontroller 622/HS, and DECNIS HSSIcontroller 641 network interface cards. A maximum of 32 Frame Relay PVCs can be configured per physical interface with an overall limit of 128 per DECNIS system. A maximum of 15 Frame Relay PVCs can be configured for remote bridging per DECNIS system.

The DECNIS supports the following Frame Relay features:

- Rate control and dynamic BECN allows the DECNIS to throttle back to the Committed Information Rate (CIR) on a per PVC basis on notification of congestion by the network. The DECNIS can throttle back to the CIR or below the CIR until notified by the network that the congestion has cleared. Management options also allow the DECNIS to limit throughput to or below the CIR on a continuous basis and not to burst beyond the CIR. This helps to control network operating costs as bursting beyond the CIR often means additional cost.

- Frame Relay counters allow network managers to monitor throughput on a per PVC basis so that they can monitor the overall performance of the network. Counters can also be used to help locate problems in the network and to check billing for network usage by the service provider.

- Queuing allows packet prioritization and filtering to be set up on a per interface basis to ensure time critical traffic is prioritize over other traffic, to help make optimum use of available bandwidth, and to avoid unnecessary traffic being sent over the network.

- DE (Discard Eligibility) allows the DECNIS to indicate to the network that certain packets can be discarded in the event of congestion. The DECNIS allows the DE bit to be set on a per queue basis, so that packets in low priority queues will be discarded first in the event of network congestion.

Routing over X.25

The DECNIS software supports routing over statically and dynamically assigned X.25 virtual circuits. Static X.25 circuits are established when the routing circuit is enabled and remain established until the routing circuit is disabled. Dynamically assigned X.25 circuits are established only when there is information to send over

the routing circuit. They are disconnected when there is no further information to send.

The DECNIS X.25 software supports routing over either Permanent Virtual Circuits (PVCs) or Switched Virtual Circuits (SVCs). Each X.25 virtual circuit can run only one routing protocol. However, different routing protocols can be run over separate virtual circuits on the same X.25 DTE connection.

Routing over Switched Multi-megabit Data Service (SMDS)

Switched Multi-megabit Data Service is a connection-less, cell-switched data transport service and is available at speeds between 56 Kbits/s and 45 Mbits/s. The DECNIS software implements the SMDS Date Exchange Interface (DXI) according to SIG-TS-001/1991 SMDS Data Exchange Interface Protocol Revision 3.2 and the Bellcore specification using SIP 3 PDUs of up to 4500 bytes with DXI CRC and with 6 octet SMDS addresses. An external SMDS CSU/DSU is required to provide SIP 2 and SIP 1 functions.

Using the WANcontroller 622/HS, the following SMDS Classes of Service are supported:

- 1.473 Mbits/s using T1 or E1 access lines

- 4 Mbits/s, 10 Mbits/s, or 16 Mbits/s using T3 or E3 access lines

Routing of IP, DECnet, and OSI protocols is supported over SMDS using OSPF, Integrated IS-IS and RIP routing protocols. IPX and AppleTalk can also be routed over SMDS using encapsulation within IP.

Routing and Bridging over ATM

The DECNIS software supports ATM AAL5 and multiple PVC connections as specified in the ATM Forum Public and Private UNI V3.0.

Routing of IP, DECnet, and OSI protocols, and bridging of other protocols, is supported over ATM PVCs using LLC encapsulation within ATM cells as defined in RFC 1483. IPX and AppleTalk can also be routed over ATM using encapsulation within IP. The DECNIS also supports Inverse ARP (RFC 1293) and Classical IP as defined in RFC 1577.

ATM is only supported on the DECNIS ATMcontroller 631 network interface card. A maximum of 127 ATM PVCs can be configured per DECNIS system. A maximum of 15 ATM PVCs can be configured for remote bridging per DECNIS system. DIGITAL's FLOWmaster® credit based rate limiting is supported by the ATM-controller 631 for interoperability with the GIGAswitch /ATM.

Note that an MPC-II (DNSAN-BH) or MPC-III (DNSBN-AH or DNSBN-BH) must be installed when using the DECNIS ATMcontroller 631.

Backup Circuits

The DECNIS supports a backup circuit feature which detects the failure of a primary routing circuit and establish an alternative or backup routing circuit for the duration of the failure. Primary routing circuits can be PPP, HDLC or DDCMP leased line circuits while secondary circuits can be leased line or switched public network services such as dialup, ISDN or X.25. Invoke and revoke timers can be set up to control the time to wait before enabling or disabling the backup circuit.

A primary circuit and a backup circuit can be grouped so that one backup circuit can be shared between a number of primary circuits to reduce costs. For example, an ISDN connection can be used as a backup circuit for a number of leased line primary circuits. Backup circuits can also be cascaded such that a backup circuit of one group can be a primary circuit of another.

Packet Prioritization

The DECNIS software supports packet prioritization on the LANcontroller 601/602 and WANcontroller 614/618 /622/622HS network interface cards so that different protocols or traffic types can be given the different priorities over LAN and WAN links. Traffic can be prioritized based on protocol type, for example IP, IPX, DECnet, OSI or bridge traffic. Within IP, traffic can be additionally prioritized based on TCP/UDP port number, protocol type or Type of Service. Bridge traffic can also be prioritized based on SAP value, PID value or Ethernet type.

The DECNIS supports up to eight levels of priority. Packets can be assigned to priority groups which are then assigned to one of the eight queues. The queues are then processed in order such that high priority packets are always transmitted first. The maximum queue length can be set for each queue to ensure that packets in each queue are processed appropriately.

A simple packet filtering mechanism for out bound WAN traffic can be implemented by assigning packets to be filtered to a specific queue whose queue length has been set to zero. Packet and byte counters allow the number of packets transmitted and discarded to be monitored on a per interface basis.

Note that the DECNIS automatically prioritizes routing and bridge control traffic to ensure that network stability is maintained at all times.

Pattern Matching

An extension to the packet prioritization mechanism allows priority packets to be further classified by packet pattern matching.   Specific bit sequences can be matched with masks and on the basis of a match, packets can be assigned to different priority queues. For example, LAT service groups can be filtered to allow only certain services to be advertised across the network.

IP Packet Filtering

The DECNIS supports IP packet filtering at the routing level to control access between IP hosts and to control bandwidth utilization on the network. Packet filtering can be set up on each interface based on:

- Protocol type such as TCP, UDP, ICMP, IP

- Source/destination address and mask

- Source/destination port and mask

- IP protocol number

- ICMP message type and mask

Combinations of filter characteristics can be set up to describe the packet types to filter. The DECNIS only filters on outgoing circuits which means that the DECNIS will receive all packets before applying packet filters.

Secure Connection Firewall

The Secure Connection Firewall (also known as the Secure Connection Manager) provides filtering of network connect requests to deny or permit access to network resources. The Secure Connection Firewall implements access control by creating logical barriers around one or more systems or groups of systems called network domains.

Nodes, circuits, applications and users can be combined into groups that share the same security requirements and access rules can be set up to apply to each group. Access rules can be based on parameters such as time of day, circuit name, user and host name, source and destination address, IP port and protocol, DECnet node and object, OSI node and application.

The Secure Connection Firewall is set up using the *clear*VISN DECNIS Configurator utility.

Data Compression

The DECNIS supports data compression on the DEC WANcontroller W622 and W622/HS network interface cards. The data compression uses a proprietary algorithm operating over HDLC data links and only interoperates with other DECNIS. The algorithm provides a typical data compression ratio of 1.7:1 depending on the type of data.

The DECNIS only supports data compression of routed (i.e. sequenced) traffic across HDLC data links. However, bridged (i.e. unsequenced) traffic can also be supported over HDLC links that are running data compression for routed traffic. Packet prioritization, pattern match filtering and IP packet filtering can also be implemented over HDLC links that are running data compression.

Since data compression is implemented in software on the DEC WANcontroller 622 and 622/HS network interface cards, the maximum line speeds that can be supported while data compression is enabled is significantly lower than the maximum speed supported without data compression. The maximum line speed at which data compression can be run reliably is 384 Kbits/s per interface for the DEC WANcontroller 622/HS and 128 Kbits/s per interface for the DEC WANcontroller 622.

X.25 Gateway

When operating as an X.25 Gateway, the DECNIS software transmits and receives X.25 packets to and from any of the following systems:

- Any DIGITAL systems which support the DNA Gateway Access Protocol (GAP)

- Any systems located on the same LAN which support the ISO Logical Link Control 2 (LLC2) protocol (as described in ISO 8881)

- Any X.25 DTE accessible over an X.25 Public Switched Data Network (PSDN) connected to the DECNIS

- Any X.25 DTE connected directly to a port of the DECNIS operating in X.25 DCE mode (ISO 8208 point-to-point mode)

- Any X.25 DTE connected to any other DECNIS accessible over the DECnet/OSI routing network

When providing wide area access to an X.25 PSDN for end systems on the LAN which use LLC2, the DECNIS software fully implements the recommendations in ISO Technical Report 10029 as a CONS LAN/WAN relay.

X.25 packets can be relayed locally between any X.25 DTE attached to the DECNIS hardware unit and any other similarly attached X.25 DTE or any X.25 system connected to the same LAN. Additionally, X.25 packets can be relayed to remote X.25 DTEs accessible to other DECNIS or DEC X.25 gateway 100/500 servers over a DECnet/OSI routing network. The software does not support the relaying of X.25 packets generated from an X.25 DTE connected to one X.25 PSDN to an X.25 DTE connected to another X.25 PSDN.

X.25 DTE and Virtual Circuit Support

The DECNIS allows multiple connections to one or more X.25 PSDNs and can share outgoing calls between all of the DTEs connected to an X.25 PSDN. Both Switched Virtual Circuits (SVCs) and Permanent Virtual Circuits (PVCs)are supported. The *X.25 Networks* section of this SPD provides details of the public X.25 PSDNs and X.25 (1988) optional facilities supported by the DECNIS X.25 software.

The number of X.25 DTEs and virtual circuits that the DECNIS X.25 software supports depends on the type of management processor installed.

Table 1
X.25 DTEs and SVCs

Processor	MPC-I	MPC-II	MPC-III	
Part Number	DNSAN-AH	DNSAN-BH	DNSBN-AH	DNSBN-BH
Dynamic Memory	8 MB	16 MB	16 MB	32 MB
Maximum DTEs per system	32	32	48	48
Maximum active SVCs per system	128	128	256	512

Notes:

- The actual number of X.25 connections that the DEC-NIS can sustain at any time may be less than indicated and depends on such factors as the rate at which calls are set up and cleared down, the level of traffic, and the ratio of routing to gateway and relay traffic.

- For routing over X.25 and X.25 gateway (GAP), one virtual circuit is established per X.25 connection. For X.25 relay (LLC2), two virtual circuits are established per X.25 connection, one incoming virtual circuit and one outgoing virtual circuit.

X.25 Accounting and Security

The following accounting information is provided by the DECNIS X.25 Gateway software:

- Logging of virtual circuit accounting when calls are cleared

- Logging of accounting records to a designated Event Logging sink

- Logging to multiple sinks for reliability

The following security mechanisms are supported by the DECNIS X.25 Gateway software:

- Inbound and outbound calls can be controlled on the basis of the remote DTE, the application, and, if applicable, the X.25 Access node

- Access to accounting sink management is restricted to authorized users

- Access to accounting source management is restricted to authorized users

Installation and Configuration

The DECNIS software image is installed on a host system called the load host. The following load hosts systems are supported:

- PCs running Microsoft Windows 95 or Windows NT

- Alpha systems running DIGITAL UNIX

- Alpha systems running OpenVMS

- VAX systems running OpenVMS

Once installed on the load host, the DECNIS software is configured using the host configuration and DECNIS configuration utilities supplied with the product. The host configuration utility allows the DECNIS units to be defined in the load host's network node database. It also allows the appropriate system image and unique configuration file for each DECNIS unit to be defined in the load host's network node database. The DECNIS configuration is used to create the unique configuration file for each DECNIS unit.

The DECNIS software image and individual configuration files are loaded from the load host system to each target DECNIS unit using BOOTP or DIGITAL's Maintenance Operation Protocol (MOP). Loading can be either locally on the same LAN or extended LAN (downline loading), or over an HDLC or PPP link from a local DECNIS unit connected directly to the target DECNIS unit (agent loading).

When using agent loading, the DECNIS system performing the loading operation must be configured to copy the required files from a suitable load host. Agent loading of DECNIS units may also be daisy-chained over a number of HDLC links provided that the first DEC-NIS in the chain is on the same LAN as the load host and each member of the chain is a DECNIS unit.

The minimum requirement is for one load host. However, the DECNIS software image and configuration files can be copied to any number of remote load hosts within the network for local loading. The DECNIS software allows BOOTP load requests broadcast over a LAN to be forwarded to a BOOTP server located anywhere within

the network. This helps to protect against loss of service if the main load host is unavailable or unable to load the system for any other reason.

When loaded, the DECNIS software image and, optionally, the configuration file, can be stored in the DECNIS internal non-volatile (FLASH) memory so that subsequent software loads can be performed without the need to load from a load host (flash loading). The FLASH memory can be updated dynamically while the DECNIS system is running without disrupting network service. The FLASH memory on the MPC-III (DNSBN-AH or DNSBN-BH) can also be partioned into separate areas for system images and configuration files to provide greater flexibility.

clearVISN DECNIS Configurator

The *clear*VISN DECNIS Configurator is a Windows 95 and Windows NT graphical utility for creating and modifying DECNIS configuration files. The utility configures system, routing and data link paramaters as well as the Secure Connection Firewall and Route Propagation and Filtering. DECNIS configurations can be generated live or generated offline for loading at a convenient time. The *clear*VISN DECNIS Configurator also loads the configuration files using BOOTP and TFTP. A *clear*VISN BOOTP/TFTP Server utility is also included with the *clear*VISN DECNIS Configurator.

A scripting feature allows extra DECNIS configuration commands to be edited and then loaded as part of the main configuration. The scripting feature allows configuration of functions that are not supported by the *clear*VISN DECNIS Configurator.

An NCL command line interface utility is also provided which sets up a Telnet session to the DECNIS console. This allows the DECNIS to be managed dynamically using the NCL command line interface.

The *clear*VISN DECNIS Configurator is included with the DECNIS Windows 95/NT software kit and is also offered as part of the *clear*VISN product set.

Updates to the *clear*VISN DECNIS Configurator are available from time to time for down load from the *clear*VISN DECNIS Configurator Home Page on the World Wide Web:

http://www.networks.digital.com/dr/cdc/

Management

The DECNIS software conforms to both the IETF Structure of Management Information and to DIGITAL's DECnet Network Architecture (DNA). Management of the DECNIS is supported using either the Simple Network

Management Protocol (SNMP) or DIGITAL's implementation of the Control Management Information Protocol (CMIP).

The DECNIS V4.1 software supports two types of management processor card:

- MPC-II (DNSAN-BH) - this card has 16 MB of dynamic memory and 4 MB of non-volatile (FLASH) memory.

- MPC-III (DNSBN-AH or DNSBN-BH) - this card has either 16 or 32 MB of dynamic memory and 4 or 8 MB of non-volatile (FLASH) memory.

Both the MPC-II and MPC-III have a console port for out-of-band management. The console port provides VT100 terminal support and full modem control for remote connection over a dial up line. The MPC-II and MPC-III also implement TCP and Telnet so that the DECNIS can be managed in an IP only environment. Telnet server only is implemented to prevent the local DECNIS console from being used to set up a remote connection to another DECNIS or IP host.

Note that the DECNIS V4.1 software also supports the MPC-I (DNSAN-AH) which has 8 MB of dynamic memory and 2 MB of non-volatile (FLASH) memory. However, some DECNIS V4.1 software features are not supported on the MPC-I. Refer to the "Hardware Requirements" section for further details.

The DECNIS software is managed dynamically using the Network Command Language (NCL) command line interface. The MPC-II (DNSAN-BH) and MPC-III (DNSBN-AH or DNSBN-BH) support on-board NCL for dynamic out-of-band management of the local DECNIS router and remote DECNIS routers from the console interface. NCL can also be run on any Windows 95/NT PC, DIGITAL UNIX, OpenVMS for Alpha or OpenVMS for VAX system to provide in-band management of DECNIS systems over the network.

Dynamic management tasks that can be performed using NCL include:

- Management of connections, for example, set up the data links, enable and disable circuits

- Monitoring of network traffic, for example, enable event logging, display counters

- Problem solving, for example, test circuit availability, perform loopback tests

Event logging and data tracing utilities are also available on DIGITAL UNIX, OpenVMS for Alpha, or OpenVMS for VAX systems to assist problem solving by logging network events and by tracing control messages received or sent by the DECNIS software.

The DECNIS software can be managed dynamically from any system supporting the Simple Network Management Protocol (SNMP). SNMP sets and gets are supported where appropriate for the variables defined in the following Management Information Bases (MIBs):

- DIGITAL Vendor MIB

- MIB-II (RFC 1213)

- Bridge MIB (RFC 1493)

- FDDI MIB (RFC 1285)

- DS3/E3 MIB (RFC 1407)

MIB-II interface support is provided for CSMA/CD, FDDI, PPP, HDLC, VCP, LAPB, DDCMP and ATM AAL5 data links. SNMP traps are also supported with the ability to send traps to up to four destinations. SNMP can only be used to manage MIB variables when IP routing is enabled.

The DECNIS responds to, but can not source, IP Pings and OSI Echo requests. The DECNIS can also forward echo requests and responses.

clear*VISN Intranet Manager*

The *clear*VISN Intranet Manager is an SNMP management utility that manages DECNIS, RouteAbout and DECswitch routers, as well as other vendors' routers. The application also supports other routers and switches that implement MIB-II and other standard MIBs.

For DECNIS, the *clear*VISN Intranet Manager provides fault detection, path tracing between selected routers, event generation and reporting, and performance monitoring. The performance monitoring includes both real time and historical views of data grouped by routers or interfaces.

The *clear*VISN Intranet Manager is available as part of the *clear*VISN product set.

DIGITAL Trace Facility

The DIGITAL Trace Facility allows data to be monitored as it flows through the software layers and modules of the DECNIS. The DTF application collects data from trace points embedded in the router software to help troubleshooting and problem analysis.

Network Sizing

The DECNIS software allows memory to be allocated to statically assigned network parameters to suit different network requirements. This memory is allocated during configuration. The memory left over can be allocated during operation to dynamically assigned network parameters when needed. This feature is called Dynamic Database Sizing.

The DECNIS configuration utility checks to ensure that memory is not over allocated and also indicates how much memory is left over for dynamically assigned parameters. When the DECNIS is running, event messages are generated if any of these parameters are approached or exceeded. Full information about which network parameters can be set and how much memory is used is included in the DECNIS documentation. Please consult your local DIGITAL office for more details and for assistance with network sizing and planning.

DECNIS Hardware

The DECNIS software requires either a DECNIS 500 or DECNIS 600 series hardware unit and one or more network interface cards. The DECNIS 500 supports up to two network interface cards and the DECNIS 600 supports up to seven network interface cards.

The following LAN interface cards occupy a single slot of the DECNIS enclosure and are supported by the DECNIS 500 and DECNIS 600 hardware units:

- DEC LANcontroller 601 — Single-port Ethernet/IEEE 802.3 interface

- DEC LANcontroller 602 — Dual-port Ethernet/IEEE 802.3 interface

The following LAN network interface cards occupy two slots of the DECNIS enclosure and are supported by the DECNIS 600 hardware unit only:

- DECNIS FDDIcontroller 621 — Single-port FDDI interface, SAS or DAS

- DECNIS ATMcontroller 631/OC-3 — Single-port ATM interface, MMF or SMF

The following WAN interface cards occupy a single slot of the DECNIS enclosure and are supported by the DECNIS 500 and DECNIS 600 hardware units:

- DEC WANcontroller 614 — Four-port, low-speed synchronous interface supporting synchronous line speeds from 1.2 Kbits/s to 128 Kbits/s or asynchronous line speeds from 1.2 Kbits/s to 38.4 Kbits/s

- DEC WANcontroller 618 — Eight-port, low-speed synchronous interface supporting synchronous line speeds from 1.2 Kbits/s to 128 Kbits/s or asynchronous line speeds from 1.2 Kbits/s to 38.4 Kbits/s

- DEC WANcontroller 622 — Dual-port, medium-speed synchronous interface supporting synchronous line speeds from 9.6 Kbits/s to 3.1 Mbits/s. Data compression is also supported at line speeds up to 128 Kbit/s.

- DEC WANcontroller 622/HS — Dual-port, high-speed synchronous interface supporting synchronous line speeds from 64 Kbits/s to 12 Mbits/s Data compression is also supported at line speeds up to 384 Kbits /s.

Communications over WAN point-to-point links is full-duplex with full modem control on all line(s).

The following WAN network interface cards occupy two slots of the DECNIS enclosure and are supported by the DECNIS 600 hardware unit only:

- DECNIS ATMcontroller 631/E3 — Single-port ATM interface, 34 Mbits/s E3

- DECNIS ATMcontroller 631/T3 — Single-port ATM interface, 45 Mbits/s T3

- DECNIS HSSIcontroller 641 — Single-port EIA-613 High Speed Serial Interface, 52 Mbits/s

Table 2 and the following notes summarize the functionality and data link support on the DECNIS WAN interface cards.

Table 2

Interface	Routing	Bridging[1]	X.25	PPP	HDLC	FR	SMDS	ATM AAL5
W614[2]	Yes	Yes	Yes	Yes	Yes	No	No	No
W618[2]	Yes	Yes	Yes	Yes	Yes	No	No	No
W622	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
W622/HS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
W631/E3	Yes	Yes	No	No	No	No	No	Yes
W631/T3	Yes	Yes	No	No	No	No	No	Yes
W641	Yes	Yes	No	Yes	Yes	Yes	No	No

Notes:

1. Bridging is not supported over X.25 and SMDS datalinks.

2. Routing over synchronous and asynchronous DD-CMP data links is also supported on the DEC WANcontroller 614 and 618 network interface cards.

Physical Line Support

The DECNIS WAN network interface cards support the following electrical interfaces:

- DEC WANcontroller 614

    — V.28 (EIA-RS232-D/EIA-RS232-C)

    — V.36/V.11 (RS449/RS422)

    — V.35

A multi-standard distribution panel with separate adapter cables provides the necessary interchange circuits for each synchronous port, allowing different interface standards to be supported on each port.

- DEC WANcontroller 618

    — V.28 (EIA-RS232-D/EIA-RS232-C)

    — V.36/V.11 (RS449/RS422)

    — V.35

Separate distribution panels with appropriate interface cables provide the necessary interchange circuits for each synchronous port allowing the same interface standard to be supported on each port. An extra adapter cable is used with the RS422/V.11 distribution panel to connect to British Telecom Kilostream services.

- DEC WANcontroller 622 and 622/HS:

    — V.36/V.11 (RS449/RS422)

    — V.35

    — X.21 (leased line services)

    — British Telecom Kilostream and Megastream

Where appropriate, separate adapter cables provide the necessary interchange circuits for each port. An X.21 adapter cable is used to connect to British Telecom Kilostream and Megastream services.

Reflected clock signals may need to be set up when using the WANcontroller 622/HS to connect to DSU/CSUs at line speeds greater than 6 Mbits/s. This depends on the interface and the length of cable used.

- DECNIS HSSIcontroller 641:

    — EIA-613 (HSSI)

A suitable DSU/CSU with an EIA-613 (HSSI) interface is required to connect to the appropriate network service.

The synchronous ports on each network interface cards provide only the electrical interface of a DTE rather than a DCE, and do not provide clock signals. An external clock source (such as a modem or DSU/CSU) is required for each synchronous connection.

Table 3 shows the adapter cables required for each of the electrical interface types.

Table 3

Adapter Cables

Electrical Interface Type	Adapter Cable	Connector Pinout
V.28/V.24 (EIA-RS232-C/D)	BS23V-02[1]	ISO 2110
V.36/X.27 (V.11, EIA-RS422/449)	BC19B-02	ISO 4902
V.35	BC19F-02	ISO 2593
X.21 (1980) (Leased services)	BC19C-02	ISO 4903
EIA-613 (HSSI)	BC19F-H3	EIA-613
BT® Kilostream and Megastream services	BC19C-02[2]	ISO 4903
BT Kilostream service (W618 only)	BC21G-02[2]	ISO 4903

Notes:

1. This should be ordered as part BS23V-02, which contains the BC23V-02 adapter cable to provide the V.28 /V.24 (RS232-D) interface and an adapter that allows it to be used for RS232-C as well. It is only supported with the DEC WANcontroller 614; it is not supported for use with the DEC WANcontroller 622 or 622/HS.

2. The BC19C-02 adapter cable is used with a 50-way D-type connector with the DEC WANcontroller 614 when connecting to the BT Kilostream service or with the DEC WANcontroller 622 or 622/HS when connecting to the BT Kilostream and Megastream services, or X.21 leased line services. When connecting the DEC WANcontroller 618 to use the BT Kilostream service, the BC21G-02 should be used in conjunction with the V.11/RS422 distribution panel.

T1 and G.703 Services

The DEC WANcontroller 622 and 622/HS support only clear channel interfaces. Connection to a T1 or G.703 line requires a V.35/RS422 to T1/G.703 DSU/CSU converter to provide framing to meet G.704. The DEC WANcontroller 622 and 622/HS do not provide either T1 framing pulses or separate channels for 64 Kbits/s control data for G.703.

The DEC WANcontroller 622 and 622/HS do not guarantee line density. T1 links can offer only 1.536 Mbits/s or 1.344 Mbits/s rates. 1.536 Mbits/s rates require the DSU/CSU converter to offer B8ZS and the line to accept bipolar violations. 1.334 Mbits/s rates require the DSU/CSU converter to offer B7.

The DEC WANcontroller 622 and 622/HS use CCITT 114 to clock data out of the DTE and will source a CCITT 113 transmit clock. CCITT 113 should be used by the DCE to receive the transmit data. The DEC WANcontroller 622 and 622/HS implement CCITT 113 as a buffered version of CCITT 114. This clocking scheme ensures both network synchronization and minimized skew between the clock and data for a range of cable lengths and parameters.

If the transmit clocking mechanism is not provided by the DCE, the DCE must provide a method of adjusting the phase of the clock used to sample the data with respect to that supplied to the DTE. This requires that the DCE provide test points to allow analysis of the clock and data wave forms and that this adjustment be performed on installation and after any subsequent alteration of the connection cable. This alternative method is also required for DCEs using the X.21 interface.

The DECNIS ATMcontroller 631/E3 supports connection to an E3 line at a line rate of 34.368M bits/s as per G.703. The DECNIS ATMcontroller 631/T3 supports connection to a DS3 line at a line rate of 44.736M bits/s as per G.703. Connection to E3 or DS3 lines is provided using dual 75 ohm BNC connectors. Certain service providers may require a separate CSU to isolate the ATMcontroller 631 from the network.

The DECNIS HSSIcontroller 641 supports connection to inverse multiplexed T1/E1, E2, E3 and T3/DS3 lines via a suitable DSU/CSU Connection is provided using an EIA-613 HSSI interface.

For more information about CSU/DSUs that have been tested with the DECNIS hardware and software, see DSU/CSUs.

X.25 Networks

Table 4 lists the public X.25 PSDNs supported by the DECNIS software.

Table 4

Public PSDNs Supported

Country	Public Network and ITU-T Revisions
Argentina	Arpac
Australia	Austpac
Austria	Datex-P
Belgium	DCS
Brazil	Renpac

<table>
<tr><td>United States</td><td>Accunet®
Autonet®
Bell Atlantic
BT® TYMNET
CompuServe®
ConnNet
Digipac
Fedexitc
Graphnet
Impacs
Infonet
Mark*Net Extended Service
PPSNET
Pulselink
Sinet
Telenet®
TYMNET
Western Union PTN-1
Worldnet</td></tr>
</table>

Table 4 (Cont.)
Public PSDNs Supported

Country	Public Network and ITU-T Revisions
Canada	Datapac (1976 or 1980) DPN-NAS Faspac Infoswitch
Chile	VTRNET
China	CNPAC
Denmark	Datapak
Ireland	Eirpac (1980)
Finland	Datapak
France	Transpac
Germany	Datex-P
Hong Kong	Datapak GDN INET Intelpak
Indonesia	SKDP
Italy	Itapac
Japan	ACE-Telnet CCVAN DDX (1976, 1980) *See Note 1* INS-P Jaisnet Venus-P (1980) TYMNET®
Luxembourg	LUXPAC
Malaysia	Maypac
Mexico	Telepac
Netherlands	Datanet 1
New Zealand	Pacnet
Norway	Datapak
Pakistan	Paknet
Philippines	Datanet
Portugal	Telepac
Singapore	Telepac
South Korea	Dacomnet
Spain	Iberpac
Sweden	Datapak
Switzerland	Telepac (1978, 1980)
Taiwan	Pacnet
Turkey	TURPAK
United Kingdom	PSS Mercury DataLink X.25

Note:

1. DIGITAL offices in Japan can supply the mandatory additional information that explains the special use of the DECNIS software with the DDX PSDN.

In addition to the public X.25 PSDNs listed in the table above, certain private PSDNs are supported by the DECNIS software and the appropriate profiles are included in the product.

Connection to public X.25 PSDNs not listed in the table above are not supported by DIGITAL at the time of publication. Please consult your local DIGITAL office for any questions you have concerning other public X.25 networks.

Table 5 shows the X.25 optional facilities supported by the DECNIS software.

Table 5

Optional X.25 Facilities Supported by the DECNIS Software

Optional Facility	ITU-T X.25 (1988)	DECNIS Software Support		
		Connector	Relay	Routing
1. Online facility registration	6.1	No	No	No
2. Extended packet sequence numbering	6.2	Yes	Yes	Yes
3. D-bit modification	6.3	No	No	No
4. Packet retransmission	6.4	No	No	No
5. Incoming calls barred	6.5	N/A	Yes	N/A
6. Outgoing calls barred	6.6	N/A	Yes	N/A
7. One-way logical channel outgoing	6.7	Yes	Yes	Yes
8. One-way logical channel incoming	6.8	Yes	Yes	Yes
9. Non-standard default packet size	6.9	Yes	Yes	Yes
10. Non-standard default window size	6.10	Yes	Yes	Yes
11. Default throughput class assignment	6.11	N/A	See Note 1	N/A
12. Flow control parameter negotiation	6.12	Yes	Yes	Yes
13. Throughput class negotiation	6.13	Yes	See Note 1	Yes
14. Closed User Group (CUG)	6.14.1	Yes	See Note 1	Yes
15. CUG with outgoing access	6.14.2	Yes	See Note 1	Yes
16. CUG with incoming access	6.14.3	Yes	See Note 1	Yes
17. Incoming calls barred within CUG	6.14.4	N/A	No	N/A
18. Outgoing calls barred within CUG	6.14.5	N/A	No	N/A
19. CUG selection	6.14.6	Yes	See Note 1	Yes
20. CUG with outgoing access selection	6.14.7	No	See Note 1	No
21. Absence of both CUG selection facilities	6.14.8	Yes	See Note 1	Yes
22. Bilateral CUG	6.15.1	Yes	See Note 1	Yes
23. Bilateral CUG with outgoing access	6.15.2	Yes	See Note 1	Yes
24. Bilateral CUG selection	6.15.3	Yes	See Note 1	Yes
25. Fast select	6.16	Yes	See Note 1	Yes
26. Fast select acceptance	6.17	Yes	See Note 1	Yes
27. Reverse charging	6.18	Yes	See Note 1	Yes
28. Reverse charging acceptance	6.19	Yes	Yes	Yes
29. Local charge prevention	6.20	N/A	No	N/A
30. NUI subscription	6.21.1	Yes	See Note 1	Yes
31. NUI override	6.21.2	N/A	No	N/A
32. NUI selection	6.21.3	Yes	See Note 1	Yes
33. Charging information	6.22	Yes	See Note 1	Yes
34. RPOA subscription	6.23.1	N/A	N/A	N/A
35. RPOA selection	6.23.2	Yes	See Note 1	Yes
36. Hunt group	6.24	See Note 2	No	See Note 2
37. Call redirection	6.25.1	N/A	No	N/A
38. Call deflection subscription	6.25.2.1	N/A	No	N/A
39. Call deflection selection	6.25.2.2	See Note 3	No	No
40. Call redirection or call deflection notification	6.25.3	Yes	See Note 1	Yes
41. Called line address modified notification	6.26	Yes	See Note 1	Yes
42. Transit delay selection and indication	6.27	Yes	See Note 1	Yes
43. TOA/NPi address selection and indication	6.28	No	No	No
44. Calling Address Extension	G.3.1	Yes	See Note 1	Yes
45. Called Address Extension	G.3.2	Yes	See Note 1	Yes
46. Minimum throughput class	G.3.3.1	Yes	See Note 1	Yes
47. End-to-end transit delay	G.3.3.2	Yes	See Note 1	Yes
48. Priority	G.3.3.3	Yes	See Note 1	Yes
49. Protection	G.3.3.4	Yes	See Note 1	Yes
50. Expedited data negotiation	G.3.4	Yes	See Note 1	Yes

Notes:

1. The X.25 relay does not act on any of these fields. The information contained in these fields is passed transparently and has only end-to-end significance.

2. PSDN hunt groups are supported but each DTE must be assigned a unique address independent of the hunt group address.

3. Support for this facility depends on the user application and the X.25 client implementation. Refer to the X.25 client product SPD for details.

4. For connector mode operation, the facilities supported by the DECNIS software may be restricted by the X.25 client implementation. Refer to the X.25 client product SPD for details.

The DECNIS software does not support the following items of the ITU-T X.25 recommendation:

— Multi-link protocol

— Use of the D-bit in outgoing packets

Frame Relay Networks and Switches

The DECNIS software has been tested and is known to be compatible with the Frame Relay networks and switches listed in Table 6.

Table 6
Frame Relay Networks and Switches

Frame Relay	Vendor and Network or Switch
Networks:	BT GNS Frame Relay Service
	AT&T® Interspan Frame Relay Service
	MCI® Frame Relay Service
	Sprint Frame Relay Network Service
Switch:	Cascade STDX 3000 and 6000
	StrataCom IPX 16/32

Please consult your local DIGITAL office for information concerning other public networks and switches.

SMDS Networks and Switches

The DECNIS software has been tested and is known to be compatible with the SMDS networks and switches listed in Table 7.

Table 7
SMDS Networks and Switches

SMDS	Vendor and Network or Switch
Networks:	MCI® SMDS Network Service
Switches:	Cascade STDX 3000 and 6000

Please consult your local DIGITAL office for information concerning other public networks and switches.

DSU/CSUs

The DECNIS hardware and software has been tested and is known to be compatible with the Data Service Unit/Channel Service Units (DSU/CSUs) shown in Table 8.

Table 8
DSU/CSUs

DSU/CSU Vendor	Model
MetroData	FM4000 E1/G.703 DSU
	FM4800 E2/G.703 DSU
	FM4900 E3/G.703 DSU
Digital Link	DL3100 T3 Digital Service MUX
	DL3100E E3 Digital Service MUX
	DL3200 T3 SMDS DSU
	DL3200E E3 SMDS DSU
	DL3800 T1 Inverse MUX
	DL3800E E1 Inverse MUX

Please consult your local DIGITAL office for information concerning other public networks and switches.

Performance

When operating over serial line connections the overall packet rate will be less than that indicated by the aggregate line speeds and is determined by such factors as:

• Type of traffic (routing updates or data packets) and data rates

• Mix of protocol types

• Proportion of leased line to X.25 and Frame Relay traffic

• The path of messages passing through the product (WAN-to-WAN, WAN-to-LAN, or LAN-to-LAN)

• Communications line characteristics

- Frequency and type of errors on the serial links

- Network topology

- Protocol overhead

Please contact your local DIGITAL office for further details of the performance characteristics of the DECNIS product.

CONFORMANCE TO STANDARDS

The DECNIS software conforms to the following IEEE and ISO standards and ITU-T Recommendations:

- IEEE 802.1D-1990—Media Access Control (MAC) Bridges

- ISO 8802-2 — Local Area Networks/Part 2: Logical Link Control

- ISO 8802-3 — Local Area Networks/Part 3: CSMA /CD Access Method and Physical Layer Specification

- ISO 8473 — Specification of Protocol to Provide the Connectionless-mode Network Service

- ISO 9542 — End System to Intermediate System (ES-IS) Routing Exchange Protocol for Use in Conjunction with ISO 8473

- ISO/IEC 10589 — Intermediate System to Intermediate System (IS-IS) Intra Domain Routing Exchange Protocol for Use in Conjunction with ISO 8473

- ISO 3309 — High-level Data Link Control (HDLC) Frame Structure

- ISO 7776 — High-level Data Link Control (HDLC) Procedures: X.25 LAPB-compatible DTE Data Link Procedures

- ITU-T recommendation X.25 (1978, 1980, 1984 or 1988) using the LAPB or LAPBE variants of the data link

- ISO 8208 — X.25 Packet Level Protocol for Data Terminal Equipment

- ISO 8881 — Use of X.25 Packet Level Protocol in Local Area Networks (LLC2)

- ISO TR 10029 Operation of an X.25 Interworking Unit (CONS LAN/WAN Relay)

The DECNIS software conforms to the following Internet RFCs and draft RFCs:

- RFC 768 — User Datagram Protocol (UDP)

- RFC 791 — Internet Protocol (IP)

- RFC 792 — Internet Control Message Protocol (ICMP)

- RFC 826 — Address Resolution Protocol (ARP)

- RFC 827, 888 & 904 — Exterior Gateway Protocol (EGP)

- RFC 877 — Standard for the transmission of IP datagrams over public data networks (X.25)

- RFC 922 — Broadcasting Internet Datagrams in the Presence of Subnets

- RFC 950 — Internet Standard Subnetting Procedure

- RFC 951 — BOOTSTRAP Protocol (BOOTP)

- RFC 783 — TFTP Protocol (Revision 2)

- RFC 1009 — Requirements for Internet Gateways

- RFC 1027 — Using ARP to implement transparent subnet gateways

- RFC 1058 — Routing Information Protocol (RIP)

- RFC 1155 — Structure and Identification of Management Information for TCP/IP-based Internets

- RFC 1157 — Simple Network Management Protocol (SNMP)

- RFC 1191 — Path MTU Discovery

- RFC 1195 — Use of OSI IS-IS for Routing in TCP/IP and Dual Environments

- RFC 1213 — Management Information Base for Network Management of TCP/IP-based Internets (MIB-II)

- RFC 1220 — Point-to-Point Protocol Extensions for Bridging

- RFC 1234 — Tunneling IPX Traffic through IP Networks

- RFC 1247 — Open Shortest Path First Routing V2

- RFC 1256 — ICMP Router Discovery Messages

- RFC 1285 — FDDI Interface Type (SMT 6.2) MIB

- RFC 1209 — The Transmission of IP Datagrams over the SMDS Service

- RFC 1293 — Inverse Address Resolution Protocol

- RFC 1332 — The PPP Internet Protocol Control Protocol (IPCP)

- RFC 1334 — PPP Authentication Protocols (PAP only)

- RFC 1362 — Novell IPX Over Various WAN Media (IPXWAN)

- RFC 1376 — The PPP DECnet Phase IV Control Protocol (DNCP)

- RFC 1377 — The OSI Network Layer Control Protocol (OSINLCP)

- RFC 1407 — Definitions of Managed Objects for the DS3/E3 Interface Type (Near End Group only)

- RFC 1483 — Multiprotocol Encapsulation over ATM Adaption Layer 5

- RFC 1490 — Multiprotocol Interconnect over Frame Relay (point-to-point encapsulation only)

- RFC 1493 — Definitions of Managed Objects for Bridges

- RFC 1542 — Clarifications and Extensions for the Bootstrap Protocol

- RFC 1548 — The Point-to-Point Protocol (PPP)

- RFC 1577 — Classical IP and ARP over ATM

- RFC 1771 — A Border Gateway Protocol 4 (BGP-4)

- RFC 1953 — Ipsilon Flow Management Protocol Specification for IPv4

- RFC 1954 — Transmission of Flow Labelled IPv4 on ATM Data Links

- Draft RFC — "PIM Protocol Specification, January 1995"

- Draft RFC — "PIM Motivation and Architecture, January 1995".

The DECNIS software conforms to the following Frame Relay standards:

- RFC 1490 — Multiprotocol Interconnect over Frame Relay (Point-to-Point encapsulation only)

- *Frame Relay Specification with Extensions document V1.0*, September 1990

- Frame Relay Forum's (FRF) User-Network Interface (UNI) agreement

- ANSI T1.617 *DSS1 - Signaling Specification for Frame Relay Bearer Service* (including the PVC management procedures specified in Annex D)

- ANSI T1.618 *DSS1 - Core Aspects of Frame Relay Protocol for use with Frame Relay Bearer Service*

- ITU-T Q.922 *ISDN Data Link Specification for Frame Mode Bearer Services*

- ITU-T Q.933 *ISDN Signaling Specification for Frame Mode Bearer Services* (including the PVC management procedures specified in Annex A)

The DECNIS software conforms to the following SMDS standards:

- SIG-TS-001/1991 SMDS Data Exchange Interface Protocol Revision 3.2

INSTALLATION

If the DECNIS hardware unit is to be used for connection to a public X.25 or Frame Relay network, DIGITAL recommends that a customer's first purchase of the product include installation services. These services provide for installation of the software product by an experienced DIGITAL software specialist.

HARDWARE REQUIREMENTS

Management Processor Requirements

The following DECNIS features require an MPC-II (DNSAN-BH) or MPC-III (DNSBN-AH or DNSBN-BH):

- DECNIS ATMcontroller 631

- DECNIS HSSIcontroller 641

- Protocol Independent Multicast (PIM)

- Border Gateway Protocol 4 (BGP-4)

- TCP/Telnet

- Secure Connection Firewall

- IP Switching

Load Host Requirements:

The following load host processors are supported subject to the restrictions listed in the *Processor Restrictions* section of this SPD.

- Any Intel® 80386, 80486, Pentium® PC supported by the Windows 95 or Windows NT operating system.

- Any Alpha processor supported by the DIGITAL UNIX or OpenVMS for Alpha operating systems.

- Any VAX processor supported by the OpenVMS for VAX operating system.

The DIGITAL UNIX SPD (41.61.*) and the OpenVMS for Alpha and VAX SPD (25.01) contain lists of supported processors.

Processor Restrictions:

Each PC on which the DECNIS software is installed must have:

- At least 16 MB of memory (RAM)

- At least 20 MB of hard disk space for installation and 16MB for permanent use

- 50 MB of hard disk space for each dump file

- A direct LAN or serial line WAN connection to the DECNIS hardware unit.

- A CD-ROM drive from which to install the software

Each Alpha or VAX processor on which the DECNIS software is installed must have:

- A direct LAN or serial line WAN connection to the DECNIS hardware unit

- An appropriate device from which to install the software:

  — CD-ROM drive

  — TK50 tape drive

Disk Space Requirements (Block Cluster Size = 1)

Load Host	Installation	Permanent Use
Windows 95 Windows NT	20 MB	16 MB
DIGITAL UNIX	22 MB	16 MB
OpenVMS for Alpha	105,000 blocks	60,000 blocks
OpenVMS for VAX	150,000 blocks	60,000 blocks

These counts refer to the disk space required on the system disk. The sizes are approximate; actual sizes may vary depending on the user's system environment, configuration, and software options. The space indicated for permanent occupancy does not include the space required to receive an upline dump if that facility is enabled. The amount of space required for dumps depends on the exact hardware configuration. This could be from 20,000 to 100,000 blocks (10 MB to 50 MB) for each dump depending on the DECNIS configuration.

SOFTWARE REQUIREMENTS

Each PC used as a load host must be running either:

- Microsoft Windows 95 V1.0 or later

or:

- Microsoft Windows NT V3.5 or later

Each Alpha system used as a load host must be running either:

- DIGITAL UNIX Operating System V3.1 or later

- DECnet/OSI for DIGITAL UNIX V3.1 or later

or:

- OpenVMS Operating System for Alpha V6.2 or later

- DECnet/OSI for Alpha V6.2 or later

Each VAX system used as a load host must be running:

- OpenVMS Operating System for VAX V6.2 or later

- DECnet/OSI for OpenVMS VAX V6.2 or later

When using the DECNIS for X.25 Gateway and Relay services, the following X.25 client systems are supported:

- Wide Area Networking (WAN) Support V2.0 for DIGITAL UNIX Systems (previously known as X.25 for DIGITAL UNIX Systems)

- X.25 for OpenVMS Alpha Systems, V1.1

- DIGITAL X.25 Client for OpenVMS Alpha Systems V1.2

- DECnet/OSI for OpenVMS VAX V6.2 or later

Note that when using X.25 Gateway or Relay services, access to a DIGITAL Name Service (DNS) server is optional.

GROWTH CONSIDERATIONS

The minimum hardware requirements for any future software version of this product may be different from the hardware requirements of this software version.

DISTRIBUTION MEDIA

For Windows 95/NT PCs:

CD-ROM only

For DIGITAL UNIX Systems:

CD-ROM only

For OpenVMS Alpha Systems:

CD-ROM only

For OpenVMS VAX Systems:

TK50 streaming tape only

ORDERING INFORMATION

Software Licenses

DECNIS software licenses allow unrestricted use of the specific software features to which they relate. The following license is included with each DECNIS hardware platform or packaged system:

DECNIS Router License: QL-GX7A9-AA

The DECNIS Router License includes the use of all DECNIS software functionality, including IP, DECnet, and OSI routing, and X.25 gateway services. It also allows use of local or remote bridging, Novell NetWare and AppleTalk routing, and the VCP protocol, all of which in previous software releases required separate software licenses.

Software Media and Documentation

Software media and documentation for Windows 95/NT Operating System:
    QA-GX7AG-H8

Software media and documentation for DIGITAL UNIX Operating System:
    QA-GX7AD-H8

Software media and documentation for OpenVMS for Alpha Operating System:
    QA-GX7AE-H8

Software media and documentation for OpenVMS for VAX Operating System:
    QA-GX7AA-H5

The software media and documentation kits for DIGITAL UNIX, OpenVMS for Alpha, and OpenVMS for VAX include a Microsoft ***Help version of the *DECNIS Problem Solving Guide*.

Software documentation only for DIGITAL UNIX, OpenVMS for Alpha and OpenVMS for VAX Operating Systems:
    QA-GX7AA-GZ

Software Product Services:
    QT-GX7A*-**

*   Denotes variant fields. For additional information on available licenses, services, and media, refer to the appropriate price book.

SOFTWARE LICENSING

A DECNIS software license is required for each DECNIS 500/600 hardware unit on which the DECNIS software is used (except as otherwise specified by DIGITAL).

The licensing provisions of DIGITAL's Standard Terms and Conditions specify that the software and any part thereof (but excluding those parts specific to the load hosts) may be used only on the DECNIS 500/600 hardware unit on which the software is operated, but may be copied, in whole or in part (with the proper inclusion of DIGITAL's copyright notice and any proprietary notices on the software) between multiple load hosts.

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SOFTWARE PRODUCT SERVICES

A variety of service options are available. For more information, please contact your local Digital office.

SOFTWARE WARRANTY

DIGITAL has designed the DECNIS software to operate with equipment conforming to the standards listed in this Software Product Description. When connecting to the public X.25 and Frame Relay networks listed in this Software Product Description, DIGITAL cannot offer its standard warranty for this product unless it has been configured appropriately. If the product has not been configured appropriately, the product will not be supported by DIGITAL.

Each X.25 and Frame Relay network listed in the Software Product Description indicates DIGITAL's commitment to supporting the DECNIS software for that public service. However, it does not imply that the appropriate networking authority has granted network certification for the product. Please contact your local DIGITAL office for the current information on certification status.

Warranty for this software product is provided by DIGITAL with the purchase of a license for the product as defined in the Software Warranty Addendum of this SPD.

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