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DECNIS Software Overview

An overview of the DECNIS 500/600 software features and functions.

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Abstract

This document provides an overview of the DECNIS 500/600 multiprotocol router/bridge software and outlines the functions and features of the product. The information in this document is aimed at helping Digital resellers, account teams and support personnel in preparing customer bids.

Introduction

The DEC Network Integration Server (DECNIS) 500 and 600 are scalable, high performance multiprotocol bridge routers. The DECNIS 500/600 provide local and wide area multiprotocol routing, bridging, and X.25 gateway services to host systems on Local Area Networks (LANs). The DECNIS 500/600 provides routing 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 traffic is also supported using Open Shortest Path First (OSPF), Routing Information Protocol (RIP) 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 also supports 802.1d local and remote bridging over wide area links for protocols that can not be routed by the DECNIS.

The DECNIS can also provide 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 is also able to provide routing over X.25 PSDNs and routing and bridging over Frame Relay networks.

The DECNIS software image is installed and configured on a host system termed the load host. MS-DOS PCs, DEC OSF/1 for Alpha AXP, Open VMS for VAX, and RISC/ULTRIX load host systems are supported. Once configured, the DECNIS software image and configuration script is loaded from the load host system to the target DECNIS unit. When loaded, the DECNIS software image can be stored in internal nonvolatile memory so that subsequent software loads can be performed without the need for loading from a load host (flash loading).

The DECNIS software is managed from any MS-DOS, DEC OSF/1 AXP, OpenVMS or ULTRIX system using the Network Command Language (NCL) command line interface. Event logging and data tracing utilities are also available

on DEC OSF/1 AXP, OpenVMS or ULTRIX 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 also 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 for MIB-II, Bridge and FDDI MIB variables.

DECNIS 500 and 600 Hardware Overview

The DECNIS 500 and 600 hardware consists of the following components:

- Enclosure, either 4 slot (DECNIS 500) or 9 slot (DECNIS 600), including power supply and fan tray
- Management processor card with 8MB of dynamic RAM and 2MB of NV-RAM
- Pool memory card, either 2MB (DECNIS 500) or 8MB (DECNIS 600) of dynamic RAM
- Network interface cards

The management processor card occupies slot 1 of the enclosure and the pool memory card occupies slot 2 of the enclosure, leaving 2 free slots for network interface cards in the DECNIS 500 and 7 free slots in the DECNIS 600.

The following network interface cards are available for the DECNIS 500/600:

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

- DEC LANcontroller 602 - Dual-port Ethernet/IEEE 802.3 AUI or Thinwire interface

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

- DEC WANcontroller 622 - Dual-port, high-speed serial interface supporting synchronous line speeds from 9.6 Kbits/s to 2 Mbits/s.

- DEC FDDIcontroller 621 - Single-port FDDI interface, SAS or DAS

The FDDIcontroller 621 is supported in the DECNIS 600 only.

More details of the DECNIS hardware are provided in *DECNIS Hardware Overview*, NIPG Marketing document number NIPG-009. Details of the DECNIS performance are provided in *DECNIS 600 Performance*, NIPG Marketing document number NIPG-001.

IP Routing

The DECNIS software supports the following IP routing protocols:

- OSPF V2 (RFC 1247)
- Integrated IS-IS (RFC 1195)
- RIP (RFC 1058)
- 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 enhacements and support for IP address super- netting. Management of OSPF is via the DECNIS configurator utility and the NCL command line interface.

The DECNIS supports the Integrated IS-IS routing 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. Management of Integrated IS-IS is via the DECNIS configurator utility and the NCL command line interface.

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). Management of RIP and EGP is via the DECNIS configurator utility and the NCL command line interface. MIB-II variables as defined in RFC 1213 can also be managed using SNMP sets and shows.

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.

The DECNIS software supports full propagation of routes between different routing protocols, for example between OSPF, Integrated IS-IS, RIP and EGP. The propagation of IP routes learnt through one routing protocol into another protocol can be controlled using the DECNIS configurator 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 supports IP routing over CSMA/CD, FDDI, PPP, HDLC, and Frame Relay circuits, or dynamically assigned X.25 circuits. The DECNIS also supports IP routing over X.25 dynamic circuits in accordance with RFC 877, and over PPP data links in accordance with RFC 1332.

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) and 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. Management of DECnet routing is via the DECNIS configurator utility and 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 desti- nation node is the same on multiple serial 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, PPP, HDLC, 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. Information about reachability of end systems is exchanged using the OSI Intermediate System to Intermediate System (IS-IS) Intra-Domain Routing Ex- change Protocol as specified in ISO/IEC 10589. OSI-compatible end systems on the same Local Area Network can exchange infor- mation with the DECNIS software and use the OSI End System to Intermediate System (ES-IS) Routing Exchange Protocol as spec- ified in ISO 9542. Management of OSI routing is via the DECNIS configurator utility and the NCL command line interface.

The DECNIS software supports OSI Connectionless Network Protocol (CLNP) routing as specified in ISO 8473, over CSMA/CD, FDDI, PPP, HDLC, and Frame Relay circuits, and over dynamically and statically assigned X.25 circuits. The DECNIS software 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 IPX V3.x and V4.x protocols over Ethernet and FDDI. Ethernet-II, 802.2, Encapsulated Ethernet (802.2 SNAP), and 802.3 RAW (Novell) datalink 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 via IP encapsulation according to RFC 1234. Network management of Novell IPX routing is via the DECNIS configurator utility and the NCL command line interface.

The DECNIS software has been tested and certified for use as a LAN router with Novell Netware V3.11 and V4.01 by Novell's test laboratory in Utah, USA.

A DECNIS PC LAN Protocol software license is required for each DECNIS hardware unit running Novell NetWare.

AppleTalk Routing

The DECNIS software provides support of native EtherTalk, the Apple specification for AppleTalk over Ethernet and FDDI. EtherTalk uses 802.2 SNAP datalink 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 via IP encapsulation according to the draft RFC.

Network management of AppleTalk is via the DECNIS configurator utility and the NCL command line interface.

A DECNIS PC LAN Protocol software license is required for each DECNIS hardware unit running AppleTalk.

Bridging

The DECNIS software supports both local and remote bridging of protocols which cannot be routed (e.g., Digital's LAT) or which are not supported by the DECNIS routing software (e.g., Xerox XNS). DECnet, IP, OSI, IPX, and AppleTalk protocols are normally routed and cannot be bridged except in the following cases:

- 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 IP, IPX, and AppleTalk on a port-by-port basis.
- OSI null-Internet frames will always be bridged over either 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 Ethernet and FDDI interfaces, frames larger than 1518 bytes will be fragmented before transmission over Ethernet. When used as a remote bridge, the DECNIS software forwards data packets from one LAN interface, through the DEC WANcontroller 622 interface card, to a similar card on another DECNIS hardware unit.

Remote bridging is also supported between a DECNIS unit and NSC/Vitalink TransLAN bridges using the VCP protocol. 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.

Remote bridging is only supported on the high-speed DEC WANcontroller 622 network interface card over PPP, Frame Relay, and HDLC data links; it is not supported over X.25 data links. Remote bridging is not supported on the DEC WANcontroller 614 or 618 network interface cards.

Tinygram compression is supported in accordance with RFC 1220 over PPP and VCP datalinks. 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 specified below.

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.

Management of bridging is via the DECNIS configurator utility and the NCL command line interface. Bridge MIB variables as defined in RFC 1286 can also be managed using SNMP sets and shows.

A DECNIS Bridge license is required for each DECNIS hardware unit running local or remote bridging.

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.

Remote bridging and routing of IP, IPX, DECnet, OSI, AppleTalk, protocols is supported over Frame Relay data links using PPP encapsulation within the Frame Relay frame. 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 network interface card.

For full details of the DECNIS Frame Relay implementation, please refer to *DECNIS Frame Relay*, NIPG Marketing Document Number NIPG-005-02.

Routing over X.25

The DECNIS software supports the use of statically and dynami- cally assigned X.25 routing circuits. Static X.25 circuits are established when the routing circuit is enabled and remain set up 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 software supports more than one connection to one or more X.25 PSDNs. The software can share outgoing calls be- tween all the DTEs connected to a PSDN. The DECNIS 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.

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 serial 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 using the DECNIS X.25 Gateway service, the following Digital X.25 client systems are supported:

- VAX P.S.I. Access
- DECnet/OSI for OpenVMS VAX
- DEC X.25 Gateway Client for ULTRIX
- DECnet/OSI for DEC OSF/1 AXP
- X.25 for DEC OSF/1 Systems

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 X25gateway 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.

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 in 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 autho- rized users
- Access to accounting source management is restricted to authorized users

The DECNIS software supports both Permanent Virtual Circuits (PVCs) and Switched Virtual Circuits (SVCs) and allows multiple connections to one or more PSDNs. Most major international public X.25 PSDNs are supported.

For more details about the DECNIS X.25 implementation and a current list of public X.25 PSDNs and X.25 (1988) optional facilities supported by the DECNIS,

refer to the DECNIS Software Product Description (SPD 36.05.0x) or *DECNIS X.25*, NIPG Marketing Document Number NIPG-010-01.

Installation and Configuration

The minimum requirement is for one load host system on which to install and configure the DECNIS software. However, the DECNIS software can be copied to any number of load hosts. This helps to protect against loss of service if a single load host is unavailable or unable to load the system for any other reason. The following load hosts systems are supported:

- PCs running MS-DOS
- Alpha AXP systems running DEC OSF/1 AXP
- VAX systems running OpenVMS
- RISC systems running ULTRIX

Once installed on the load host, the DECNIS software is configured using the host configuration utility and the DECNIS configurator utility which are supplied with the product. The host configuration utility allows the DECNIS units to be defined in the host network node database. The DECNIS configurator allows the configuration scripts for multiple DECNIS units to be defined.

The DECNIS software image and individual configuration script 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 a serial link via 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 chained over a number of serial links provided that the first DECNIS in the chain is on the same LAN as the load host and each member of the chain is a DECNIS unit.

The DECNIS software image and configuration can also be copied to remote load host systems for local loading. The DECNIS software allows BOOTP requests broadcast over a local area network to be forwarded to a BOOTP server located at an IP address anywhere within the network.

When loaded, the DECNIS software image and, optionally, the configuration can be stored in internal nonvolatile memory so that subsequent software loads can be performed without the need for loading from a load host (flash loading).

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 software is managed dynamically from any MS-DOS, DEC OSF/1 AXP, OpenVMS or ULTRIX system using the Network Command Language (NCL) command line interface. Dynamic management tasks that can be performed 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 DEC OSF/1 AXP, OpenVMS or ULTRIX 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 also be managed dynamically from POLYCENTER/ Netview network management platforms or from any system supporting the Simple Network Management Protocol (SNMP). Gets and sets are fully supported for writeable objects. MIB-II support includes manipulation of Address resolution table entries and Interface table entries for CSMA/CD, FDDI, PPP, HDLC, Frame Relay, LAPB, VCP and DDCMP interface types. All interfaces, except CSMA-CD, can be turned on or off. The following Management Information Bases (MIBs) and MIB groups are supported.

- Digital Vendor MIB elanext V2.7:
  - effdi
  - ebridge
  - eauth

- MIB-II (RFC 1213)
  - system
  - interfaces
  - at

  - ip
  - icmp
  - udp
  - egp
  - transmission
  - snmp

- Bridge MIB (RFC 1493)
  - dot1dBase
  - dot1dStp
  - dot1dTp
  - dot1dStatic

- FDDI MIB (RFC 1512)
  - snmpFddiSMT
  - snmpFddiMAC
  - snmpFddiPORT
  - snmpFddiATTCHMENT

The following SNMP traps are also supported by the DECNIS:

- coldStart
- warmStart
- linkUp, with MIB-II interface index number
- linkDown, with MIB-II interface index number
- authenticationFailure
- egpNeighborLoss, with IP address of EGP neighbor
- newRoot
- topologyChange

SNMP can only be used to access MIB variables and SNMP traps generated when IP routing is enabled.

Physical Line Support

The following synchronous Network Interface Cards are supported by the DECNIS 500 and 600 hardware units with the following physical line characteristics:

- DEC WANcontroller 614 - Four-port, low-speed serial 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. This card supports X.25 gateway functions and routing only over PPP, HDLC, DDCMP and LAPB datalinks.

- DEC WANcontroller 618 - Eight-port, low-speed serial inter- face 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. This card supports X.25 gateway functions and routing only over PPP, HDLC, DDCMP and LAPB datalinks.

- DEC WANcontroller 622 - Dual-port, high-speed serial inter- face supporting synchronous operation at line speeds from 9.6 Kbits/s to 2 Mbits/s. This card supports routing and remote bridging over PPP, HDLC, Frame Relay, LAPB and VCP datalinks.

Communication over serial lines is full-duplex with full modem control on all line(s). The table below summarizes data link support on the serial line interface cards.

Interface	HDLC	PPP	LAPB	DDCMP	Frame Relay	Remote Bridging
W614	Yes	Yes	Yes	Yes	No	No
W618	Yes	Yes	Yes	Yes	No	No
W622	Yes	Yes	Yes	No	Yes	Yes

Network Sizing

The DECNIS software allows memory to be allocated to individual network parameters to suit different network requirements. These items are preallocted in the DECNIS memory during configuration. The memory left over is available for dynamically allocated network parameters which can be allocated when needed.

The DECNIS configurator program checks to ensure that the available memory is not overallocated and also indicates how much memory is left over for dynamically assigned parameters. When the DECNIS is running, event messages will be generated if any of these parameters are approached or exceeded. Full information about which parameters may be set and how much memory is used is included in the DECNIS documentation.

Bridging Configuration Guidelines

When bridging over remote links using the DEC WANcontroller 622 network interface cards, 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.

Extended LAN configurations are supported subject to the following configuration restrictions:

- Remote bridging is only supported on the DEC WANcontroller 622 network interface card; it is not supported on the DEC WANcontroller 614 or 618 network interface card.

- Remote bridging is not supported over LAPB data links.

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

- Remote bridging over satellite links is not supported.

- A maximum of seven local and remote bridges may be config- ured 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 VAXclusters are not supported over remote bridging links.

- Digital's PC Systems Architecture (PCSA) 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.

LAT Bridging Guidelines

In addition to the above configuration restrictions and when using 56 Kb/s or 64 Kb/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 Kb/s should be allocated for each active LAT session which needs to be supported simultaneously across the remote link. When using

Tinygram compression, 2 Kb/s should be allocated for each active LAT session.

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

Public Networks Supported

Details of the public Frame Relay and X.25 networks that are currently supported by the DECNIS software are provided in the following documents:

- *DECNIS Software Product Description* (SPD 36.05.07-x)
- *DECNIS Frame Relay*, NIPG Marketing Document Number NIPG-005
- *DECNIS X.25*, NIPG Marketing Document Number NIPG-010

In addition to the public X.25 networks listed in the SPD, certain private X.25 networks are supported by the DECNIS software. The appropriate profiles are included with the DECNIS software.

Performance

Details of the performance of the DECNIS product are provided in the following documents:

- *DECNIS 600 Performance,* NIPG Marketing Document Number NIPG-001

When operating over serial line connections the overall performance and packet rate will be less than that indicated by the aggregate line speed 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

Load Host Requirements

Each IBM compatibe PC used as a load host for the DECNIS have:

- MS-DOS V5.1 or V6.x installed
- Optionally, one of the following PC LAN operating systems:
  - PATHWORKS for DOS V4.x and V5.x
  - Novell NetWare V3.1x or V4.x
  - MicroSoft LAN Manager
- At least 4MB of free system memory (RAM)
- At least 80MB of hard disk space for load and dump files
- A 3.5-inch floppy disk drive from which to install the software
- A direct Ethernet connection via a controller which uses either a Digital native datalink (DLL) or NDIS driver.

The following PC Ethernet controllers have been tested and are known to work with the DECNIS PC software:

- 3Com EtherLink III series
- Digital EtherWORKS and EtherWORKS 3 family
  DEPEA Personal Ethernet Adapter
- D-Link DE-600 Pocket LAN Adapter

Note that Digital Ethernet NDIS drivers for the EtherWORKS family can also be used with the previous DEPCA family. Ethernet controllers other than those listed in the above table that have their own NDIS drivers may work with the DECNIS software but have not been tested.

Each Alpha AXP system acting as a load host for the DECNIS must have:
- DEC OSF/1 V1.x
- DECnet/OSI for DEC OSF/1 AXP V1.1

Each VAX system acting as a load host for the DECNIS must have:
- Open VMS for VAX Operating System V5.5 - V5.6
- DECnet/OSI for OpenVMS for VAX V.5. - V5.6

Each RISC system acting as a load host for the DECNIS must have:
- ULTRIX Operating System V4.3A
  or
  ULTRIX Worksystem Software V4.3A
- DECnet/OSI for ULTRIX for RISC V5.1A

Each Alpha AXP, VAX or RISC system must also have:

- A valid system configuration for the relevant operating system
- A direct LAN or serial line WAN connection to the DECNIS hardware unit
- A suitable device from which to load the DECNIS software:
  - Alpha AXP system - CDROM drive
  - RISC system - TK50 drive
  - VAX system - TK50 or 16MT9 drive

The DECNIS software requires around 16Mbytes (72,000 blocks) of free hard disk space for installation and around 8Mbytes (36,000 blocks) of free hard disk space for operation.

Software Licenses

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

- DECNIS Router License: QL-GX7A9-AA

The DECNIS Router License includes the use of IP, DECnet, and OSI routing, and X.25 routing and gateway services provided by the DECNIS software.

One or more of the following DECNIS software licenses are required for each DECNIS hardware unit using the specific software features to which the licenses relate:

- DECNIS Bridge License: QL-GZNA9-AA

This license is required for each DECNIS hardware unit running local or remote bridging.

- DECNIS PCLAN License: QL-08VA9-AA

This license is required for each <keep>(DECNIS) hardware unit running Novell NetWare and/or AppleTalk.

- DECNIS Vlink License: QL-0PDA9-AA

This license is required for each DECNIS hardware unit which is connected to remote NSC/Vitalink TransLAN bridges over synchronous lines using the VCP protocol.

Conformance to IEEE and ISO Standards and CCITT Recommendations

The DECNIS software conforms to the following IEEE and ISO standards and CCITT 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 Struc- ture
- ISO 7776 - High-level Data Link Control (HDLC) Procedures: X.25 LAPB-compatible DTE Data Link Procedures
- CCITT 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)

Conformance to Internet Engineering Task Force (IETF) RFCs

The DECNIS software conforms to the following Internet 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 1285 - FDDI management Information Base
- RFC 1331 - The Point-to-Point Protocol (PPP) for the Transmission of Multi-Protocol Datagrams over Point-to-Point Links
- RFC 1332 - The PPP Internet Protocol Control Protocol (IPCP)
- RFC 1376 - The PPP DECnet Phase IV Control Protocol (DNCP)
- RFC 1377 - The OSI Network Layer Control Protocol (OSINLCP)
- RFC 1493 - Definitions of Managed Objects for Bridges
- RFC 1512 - FDDI Management Information Base

Conformance to Frame Relay Standards

The DECNIS software conforms to the following Frame Relay standards:

- 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
- CCITT Q.922 ISDN Data Link Specification for Frame Mode Bearer Services
- CCITT Q.933 ISDN Signaling Specification for Frame Mode Bearer Services (including the PVC management procedures specified in Annex A)

NSC/Vitalink Bridge Interoperabilty

The DEC WANcontroller 622 network interface card supports the Vitalink Communications Protocol (VCP) for interoperability with 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.

DECbrouter 90 Interoperability

The DECNIS 500/600 software supports Cisco Systems, Inc. implementation of HDLC (CHDLC) which is provided on the DECbrouter 90, a joint development between Digital and Cisco. Interoperability over synchronous links between DECNIS 500/600 and Cisco routers is possible for remote bridging and routing of IP, DECnet and OSI over CHDLC and Frame Relay datalinks, and for IP over X.25 according to RFC 877. Full details of the level of interoperability is shown in *DECNIS/DECbrouter 90 Interoperability*, NIPG Marketing document number NIPG-012.

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