



Software Product Description

PRODUCT NAME: DECbrouter 90 Systems Software V11.1(6)

SPD 48.53.06

DESCRIPTION

DECbrouter 90 Systems Software is a multiprotocol internetworking solution for linking small- and medium-sized Ethernet-to-Ethernet networks over a wide-area link. It provides full-featured remote routing of the industry's most widely implemented communication protocols. DECbrouter 90 software also supports concurrent bridging, routing, and bidirectional protocol translation between TCP/IP, X.25, and LAT™ environments.

Overview

DECbrouter 90 software supports leased-line, circuit-switched, or packet-switched networks, such as X.25, Switched Multimegabit Data Service (SMDS), or Frame Relay.

DECbrouter 90 software provides priority output queuing for use with slower-speed serial lines. One of four priorities can be assigned to a packet based on packet /protocol type, source/target host IP address, workstation MAC address, or TCP/UDP port numbers.

The DECbrouter 90 is fully interoperable with all Cisco® routers. The DECbrouter 90 and the DECNIS™ products are interoperable when used with DECnet™ IV, IP, OSI, IPX, Frame Relay, and bridging.

Bridging

DECbrouter 90 Software:

- Supports both IEEE® 802.1D and DEC™ LAN Bridge™ Spanning Tree for backward compatibility. DECbrouter 90 software also supports the implementation that provides for multiple domains for Spanning

Tree. Any number of DECbrouter 90 modules can be placed in a domain.

- Allows configuration of filters to block the passing of frames based on Ethernet addresses, protocol type, and vendor code. The bridging software can also be configured selectively to include or exclude LAT multicast service announcements.
- Provides load balancing and redundancy by assigning a set of serial lines between two bridges to a circuit group.
- Provides the ability to bridge over leased-line, X.25, and Frame Relay networks.
- Provides compression of LAT frames
- V11.1 of the DECbrouter 90 now supports concurrent routing and bridging (CRB). This feature allows a given routable protocol to be routed on some interfaces and bridged on other interfaces within the same router.

Routing: DECnet

DECbrouter 90 Systems Software implements the following:

Routing:	Intra-area routing (Level 1) Inter-area routing (Level 2)
Routing Algorithms:	DECnet Phase IV (distance vector) DECnet/OSI Phase V (link-state routing)

Path splitting is supported over all routing circuits. DECbrouter 90 software can communicate with other routers that support DECnet routing over Point-to-Point Protocol (PPP) data links in accordance with RFC 1376.

DECbrouter 90 supports Phase IV Prime. This feature supports inherent MAC addresses, which allows DECnet nodes to coexist with systems running other protocols that have MAC address restrictions.

The DECbrouter 90 supports the ability to assign alphanumeric names to DECnet host addresses. The router maintains a cache of host name-to-address mappings for use by the show, ping, and related DECnet support operations. The cache speeds the conversion of names to addresses.

Dial-on-demand routing (DDR) is supported in the DECbrouter 90 software. DECbrouter 90 can support dial-on-demand routing of the DECnet Phase IV protocol.

Dynamic DECnet route advertisements are supported when DECnet IV areas need to interconnect over a DECnet/OSI (Phase V) backbone. This feature dynamically advertises these routes in the DECnet IV table only if the route exists at the other side of the Phase V backbone. It also eliminates the need to configure matching CLNS static routes for every DECnet area that is advertised.

Routing: TCP/IP

DECbrouter 90 implementation of TCP/IP provides all major services contained in the various protocol specifications. DECbrouter 90 software also provides the TCP and UDP "little" services called Echo and Discard. These services are described in RFC 862.

DECbrouter 90 software supports both TCP and UDP at the transport layer, for maximum flexibility in services.

DECbrouter 90 software supports IP Hot Standby Router Protocol (HSRP), which detects when the designated active router fails, at which point a selected standby router assumes control of the HSRP group's MAC address and IP address. A new standby router is also selected at that time.

The DECbrouter 90 supports Next Hop Resolution Protocol (NHRP). Now routers and hosts can use NHRP to discover the addresses of other routers and hosts connected to a nonbroadcast, multiaccess network. NHRP provides an ARP-like solution whereby systems attached to an NBMA network can dynamically learn the addresses of the other systems that are part of that network.

The DECbrouter 90 supports Virtual Private Next Hop Resolution Protocol networks, which can be used to facilitate building a virtual private network. In this context, a virtual private network consists of a virtual Layer 3 network that is built on top of an actual Layer 3 network.

Hot Standby Router Protocol (HSRP) enhancements now allow multiple routers on a LAN to provide fast backup for each other. Another new HSRP feature is the ability to configure a router so that its Hot Standby priority changes based on the availability of its interfaces.

DECbrouter 90 supports BGP4 classless interdomain routing, which eliminates the concept of network classes within BGP and supports the advertising of IP prefixes. Classless interdomain routing routes can be carried by OSPF, ISIS-IP, and EGIRP.

BGP Communities facilitate and simplify the control of routing information in BGP. Destinations can be grouped into communities upon which routing decisions can be based.

V11.1 of the DECbrouter 90 software now supports Border Gateway Protocol (BGP) peer groups. This feature allows you to group neighbors with the same update policies into BGP peer groups to simplify configuration and make updating more efficient.

V11.1 of the DECbrouter 90 software supports External Route Tags. The route tag field can be used to propagate information acquired from an Exterior Gateway Protocol (EGP).

V11.1 of the DECbrouter 90 software now supports Fast-Switched Generic Route Encapsulation (GRE). GRE provides the ability to handle multiple network protocols in the same tunnel. In addition, GRE includes optional sequencing and an optional security key. This feature enables fast switching for GRE tunnels.

DECbrouter 90 supports classless routing. The router can now forward packets destined for a subnet of a network that has no network default route to the best supernet route. Without classless routing, the router discards any packet destined for a subnet that it does not recognize if no network default route exists.

The Flexible Netmask display feature in the DECbrouter 90 code allows you to display the netmask in dotted decimal, hexadecimal, or bitcount format.

V11.1 of the DECbrouter 90 software now supports Identification Protocol Support, as specified in RFC 1413.

The DECbrouter 90 supports offset to routing metrics enhancements. You can now limit an offset list to a particular interface or apply an access list to it. An offset list is the mechanism for increasing incoming and outgoing metrics to routes learned via RIP and IGRP.

DECbrouter 90 software provides the following IP extended access list enhancements:

- The established keyword is now independent of port number filtering.

- Port filtering and the established keyword are no longer presented as options during configuration unless they are applicable.
- The keyword *any* is now an abbreviation for "0.0.0.0 255.255.255.255" in standard and extended access lists.
- Port filtering now supports filtering on a range of port numbers.
- ICMP messages can be filtered by type and code.
- IGMP messages can now be filtered by message type (number) or message name (DVMRP, host-query, host report, PIM, and trace).
- Packets can now be filtered by precedence level. Levels can be selected by name or number. Known names are critical, flash, flash-override, immediate, internet, network, priority, and routine.
- When IP extended access lists are used to control access to and from router services, ICMP, IGMP, precedence, and type of service filtering are not performed.
- You can now filter on source ports for TCP and UDP using all of the same operators as destination ports.
- The protocols Enhanced IGRP, ipinip (IP in IP), and OSPF are now known to the parser. Previously, you had to use the explicit protocol numbers.
- The show IP access-list command has been added. Its output is identical to show access-list, but it is IP specific and allows you to specify a particular access list. With no argument, it displays all simple and extended IP access lists.

DECbrouter 90 software supports DNSIX extended IPSO processing enhancements. The two kinds of extended IPSO fields defined by the DNSIX 2.1 specification, Network Level Extended Security Option (NLESO) and Auxiliary Extended Security Option (AESO) fields, are supported by the implementation of extended IPSO.

DECbrouter 90 supports the DNSIX audit trail facility, which utilizes a UDP-based protocol that generates an audit trail of IPSO security violations.

DECbrouter 90 software supports IP multicast. This IP protocol supports applications being developed for communicating between either one sender and multiple receivers or multiple senders and multiple receivers. This implementation includes Protocol Independent Multicast (PIM) and the Internet Group Management Protocol (IGMP). PIM allows network administrators to add IP multicast functionality to their existing networks regardless of what routing protocol they are running. PIM will work with IGRP, Enhanced IGRP, OSPF, Integrated IS-IS, RIP, and BGP. PIM has two modes: dense mode and sparse mode.

DECbrouter 90 supports local-area mobility. This provides the ability to relocate IP hosts within a limited area without reassigning host IP addresses and without changes to the host software.

DECbrouter 90 Systems Software supports the following RFCs:

RFC 768	
RFC 826	- ARP, Proxy ARP and RARP
RFC 862	- TCP & UDP Echo Service and Discard
RFC 863	- TCP & UDP Echo Service and Discard
RFC 865	
RFC 868	- IP Address
RFC 887	- Resource Location Protocol
RFC 903	- ARP, Proxy ARP and RARP
RFC 919	- Broadcasting Datagrams
RFC 922	- Broadcasting Internet Datagrams in the Presence of Subnets
RFC 950	
RFC 951	
RFC 988	- Class D Internet Addresses Multi Cast Groups
RFC 1020	- Internet Addresses
RFC 1027	- ARP, Proxy ARP and RARP
RFC 1042	- ARP
RFC 1064	- Slip Extended BootP Requests
RFC 1108	- IP Security Option
RFC 1144	- Compressing TCP Headers
RFC 1166	- Internet Numbers
RFC 1191	- IP MTU Path Discovery

V11.1 of the DECbrouter 90 software now supports Message Digest 5 (MD5). MD5 authentication is now available for Open Shortest Path First (OSPF) and for TCP connections between Border Gateway Protocol (BGP) peers. MD5 authentication provides a standards-based method to greatly enhance the probability that the IOS software will detect and ignore hostile routing messages.

V11.1 of the DECbrouter 90 software now supports Routing Information Protocol Version 2 (RIPv2). While it shares the same basic algorithms as RIPv1, it supports new features such as authentication. RIPv2 offers two modes of authentication: a plain-text password or MD5 authentication.

V11.1 of the DECbrouter 90 software now supports RIP subnet masks. Subnetmask information makes RIP more useful in a variety of environments and allows the use of variable subnet masks on the network. Subnet masks are also necessary for implementation of "classless" addressing, such as classless interdomain routing.

V11.1 of the DECbrouter 90 software now supports RIPv2 multicasting. RIPv2 packets can be multicast instead of being broadcast. Using an IP multicast address reduces the load on hosts that do not support routing protocols. It also allows RIPv2 routers to share information that RIPv1 routers cannot hear. This is useful since a RIPv1 router may misinterpret route information because it cannot apply the supplied subnet mask.

V11.1 of the DECbrouter 90 software now supports IP multicast fast switching. Previously, IP multicast packets were only process switched.

V11.1 of the DECbrouter 90 software now supports rate limiting of IP multicast traffic. Rate limiting now allows you to control how fast a sender can transmit to a multicast group, through the use of access lists.

V11.1 of the DECbrouter 90 software now supports Protocol Independent Multicast (PIM) Nobroadcast and Multiaccess (NBMA) mode. PIM NBMA mode allows the router to replicate packets for each neighbor on the NBMA network.

V11.1 of the DECbrouter 90 software now supports multicast static routes. IP multicast static routes allow you to have multicast paths diverge from unicast paths. The most common reason for using separate unicast and multicast paths is tunneling. The multicast packets can use the tunnel without having unicast use the tunnel.

V11.1 of the DECbrouter 90 software now supports session directory (SD) listener support. The multicast backbone is widely used for multimedia conferencing. The session directory tool helps announce multimedia conference sessions and provides setup information to the potential participants. A session directory client multicasts announcement packets on a well-known multicast address and port. You can enable the router to listen for such announcements.

V11.1 of the DECbrouter 90 software now supports interactive input when tracing a branch of a multicast tree. When you use the mbranch or mrbranch commands to trace a branch of a multicast tree, you can now enter information interactively.

V11.1 of the DECbrouter 90 software now supports IP policy routing. You can now implement IP routing policies based on source or destination IP addresses or packet lengths. Policy routing provides a more flexible method for routing packets than does destination routing.

V11.1 of the DECbrouter 90 software now supports IP access list logging. The router can now send a logging message to the console when a packet passes or fails an extended access list. The message includes the access list number, whether the packet was permitted or denied, the protocol, whether it was TCP, UDP, ICMP, or a number, and, if appropriate, the source and destination addresses and source and destination port numbers.

V11.1 of the DECbrouter 90 software now supports Open Shortest Path First (OSPF) point-to-multipoint. Support for point-to-multipoint media types is added, allowing the IOS software to more optimally support Frame Relay-type networks using the OSPF routing protocol.

V11.1 of the DECbrouter 90 Software now supports Multilink PPP over single or multiple interfaces. Implementation of Multilink PPP supports the fragmentation and packet sequencing specifications in RFC 1717.

V11.1 of the DECbrouter 90 Software now supports PPP Callback. PPP Callback provides a client-server relationship between the end points of a point-to-point serial connection. This feature is a partial implementation of the PPP Callback specification in RFC 1570.

Routing: ISO CLNS

DECbrouter 90 software supports packet forwarding and routing for ISO CLNS on networks using a variety of data link layers. You can use CLNS router on serial interfaces with HDLC, LAPB, X.25, SMDS, or Frame Relay encapsulation. LAPB, SMDS, Frame Relay and X.25 encapsulation will interoperate with other vendors.

To Use:	You must:
HDLC encapsulation	Have either: DECbrouter 90 software at both ends A Cisco router at the other end of the link
X.25 encapsulation	Manually enter the NSAP-to-X.121 mapping

DECbrouter 90 software supports both the ISO developed IS-IS and the Cisco ISO Interior Gateway Routing Protocol (ISO_IGRP).

As a part of CLNS support, DECbrouter 90 software fully supports the following ISO and ANSI standards:

ISO 9542	Documents the End System-Intermediate System (ES-IS) routing exchange protocol
ISO 8473	Documents the ISO Connectionless Network Protocol (CLNP)

ISO 8348/Ad2	Documents Network Service Access Points (NSAPs)
ISO 10589	Documents Intermediate System - Intermediate System (IS-IS) Intra-domain Routing Exchange Protocol

V11.1 of the DECbrouter 90 software now supports Target Identifier Address Resolution Protocol (TARP) Support. TARP is an address resolution protocol for mapping Synchronous Optical Network (SONET) identifiers to OSI NSAPs (much like a DNS, which will return an NSAP given name string, or the reverse). Some applications that run on SONET devices identify these devices by a target identifier (TID). TARP-enabled routers cache TID-to-network address mapping. Because these applications usually run over OSI, the network addresses are OSI NSAPs.

Routing: Novell® IPX

The DECbrouter 90 implementation of the Novell IPX protocol provides the functionality of a Novell External Bridge. As a Novell External Bridge, DECbrouter 90 software can connect through high-speed serial lines from 56 kb per second to T1 speeds or X.25 lines. At this time, DECbrouter 90 implementation is not compatible with Novell file server interfaces on the wide area. You must therefore have DECbrouter 90 software on both ends of the T1 and X.25 circuits.

V11.1 of the DECbrouter 90 software now supports Sequence Packet Exchange (SPX) spoofing. Some SPX-based services in a Novell environment use SPX watchdog packets to verify the integrity of end-to-end communications when guaranteed and sequenced packet transmission is required.

V11.1 of the DECbrouter 90 software now supports Next Hop Resolution Protocol (NHRP) Enhancements for IPX. NHRP allows routers to dynamically discover data-link addresses for other routers on a WAN cloud, eliminating the need to configure network layer and data link layer-addresses for all neighbors on a WAN cloud.

DECbrouter 90 support for IPX accounting allows you to collect information about IPX packets and the number of bytes that are switched through the router.

The DECbrouter 90 implementation of Novell IPX software provides three types of filtering:

- Access lists, or packet filtering, based on source and destination networks
- Routing update filtering
- SAP™ filtering

The DECbrouter 90 also supports Novell fast switching and load sharing.

DECbrouter 90 supports the IPXWAN protocol, as defined in RFC 1362.

DECbrouter 90 software supports fast switching of Novell IPX for Frame Relay encapsulations. IPX Fast Switching is now supported on all LAN interfaces, and for WAN interconnection, when HDLC, PPP, Frame Relay, or SMDS encapsulation is used.

DECbrouter 90 supports IPX-compliant ping. The DECbrouter 90 software implements the standard IPX ping function recently specified by Novell.

The DECbrouter 90 supports NetWare® Link Services Protocol (NLSP). NLSP is a link-state routing protocol based on the OSI IS-IS protocol. This implementation of NLSP also includes NLSP MIB variables and tools to redistribute routing and SAP information between NLSP and other IPX routing protocols such as RIP, SAP, and Enhanced IGRP.

The DECbrouter 90 supports Enhanced IGRP to NLSP Route Redistribution. Enhanced IGRP to NLSP Route Redistribution is the method by which routing information is passed between Enhanced IGRP and NLSP routing domains in IPX networks. While route redistribution between Enhanced IGRP and IPX RIP is automatic by default (as redistribution between NLSP and IPX RIP), this new IOS software feature adds a comprehensive tool for enabling the direct flow of routing information between Enhanced IGRP and NLSP networks.

V11.1 of the DECbrouter 90 software now supports the ability to divide IPX networks into multiple NLSP areas. It is recommended that large IPX networks (conservatively estimated as those containing over 400 network addresses according to Novell design guidelines) be split into smaller NLSP areas. The new implementation of NLSP allows multiple instances of NLSP to run on the same router, and allow routing information to be redistributed. This allows much larger NLSP networks to exist.

V11.1 of the DECbrouter 90 software now supports IPX Input Access Lists. This is a security enhancement feature that provides the capability of applying access lists to incoming router interfaces and the added flexibility in building secure IPX networks.

V11.1 of the DECbrouter 90 software now supports IPX Per-host Load Sharing. IPX per-host load sharing process transmits successive packets (or a traffic stream) for a given end host over the same path when multiple equal-cost paths are present. Load sharing is achieved when traffic streams for different end hosts use different paths. Because per-host load sharing sends all packets destined for an end host over the same media interface, the likelihood of packets being received out of order is greatly reduced and minimizes retransmissions.

The DECbrouter 90 supports IPXWAN Version 2.0 as defined in RFC 1634. The major enhancements to IPXWAN Version 1.0 are the ability to negotiate the use of NLSP and support for unnumbered IPX links. IPXWAN Version 2.0 is supported over permanent serial lines, V.25 switched and permanent virtual circuits, and Frame Relay permanent virtual circuits.

The DECbrouter 90 supports floating static routes, which are statically configured routes that can be overridden by dynamically learned routing information. Thus, a floating static route can be used to create a path of last resort that is used only when no dynamic information is available.

Routing: AppleTalk®

DECbrouter 90 Systems Software supports the AppleTalk client/server, or distributed, network system over Ethernet, synchronous serial, and X.25 interfaces.

DECbrouter 90 software provides implementation of the following standard services in addition to standard AppleTalk packets:

- AppleTalk Protocols:
 - AppleTalk Address Resolution Protocol (AARP)
 - Datagram Delivery Protocol (DDP)
 - Routing Table Maintenance Protocol (RTMP)
 - Name Binding Protocol (NBP)
 - AppleTalk Echo Protocol (AEP)
 - AppleTalk Transaction Protocol (ATP)
 - Zone Information Protocol (ZIP)
- Support for the following services:
 - EtherTalk® 1.2 and EtherTalk 2.0, without any requirement for translation or transition routers
 - Serial protocols, including SMDS, Frame Relay, X.25, and HDLC
 - Access Control
 - Integrated node names
 - Configured and discovered port configuration
 - SNMP over AppleTalk
- Configurable protocol constants
- NBP proxy service providing compatibility between the two AppleTalk standards
- IP encapsulation of AppleTalk, IPTalk, and Columbia AppleTalk Package (CAP) support
- Interactive access to AEP and NBP provided via ping router command

- Responder support used by INTER-POLL® and the other network monitoring packages

DECbrouter 90 software also supports the extended (Phase 1) and nonextended (Phase 1) AppleTalk architecture.

DECbrouter 90 supports AppleTalk Update-based Routing Protocol (AURP). AURP is Apple Computer's new approach to AppleTalk routing. The DECbrouter implementation of AURP is fully compliant with the mandatory portions of the AURP specification, including the tunneling of AppleTalk packets inside of IP. Macintosh® hosts do not implement AURP. Thus, the DECbrouter 90 still uses RTMP to communicate with hosts and translate (or redistribute) RTMP routing information to and from AURP.

DECbrouter 90 supports ZIP reply filters. ZIP reply filters provide a second means for filtering zone information in an AppleTalk network. These filters allow zone information to be hidden from downstream routers, as configured by the network manager.

The DECbrouter 90 supports AppleTalk interenterprise routing. This feature provides support for AppleTalk internets, or domains. AppleTalk interenterprise routing allows two or more AppleTalk domains to be connected through a domain router.

DECbrouter 90 supports fast-switching enhancements of AppleTalk using Frame Relay and PPP encapsulations on serial interfaces.

V11.1 of the DECbrouter 90 software now supports AppleTalk Name Binding Protocol (NPB) filters. NPB provides directory services in AppleTalk. AppleTalk NPB filtering allows network administrators to use routers to build firewalls, dial-on-demand triggers, and queuing options based on any designed NBP type object.

V11.1 of the DECbrouter 90 software now supports AppleTalk Update-Based Routing Protocol (AURP) options. Optional features of AURP, network number mapping, loop detection, and hop count reduction have been added.

V11.1 of the DECbrouter 90 software now supports AppleTalk floating static routes. Static routes are traditionally implemented so that they always take precedence over any dynamically learned routes to the same destination network. A floating static route is a statically configured route that can be overridden by dynamically learned routing information. Thus a floating static route can help create a path of last resort that is used only when no dynamic information is available.

V11.1 of the DECbrouter 90 software now supports AppleTalk Simple Multicast Routing Protocol (SMRP). SMRP provides multicast routing functions for AppleTalk traffic. SMRP routes AppleTalk packets to all members

of a multipoint group so that packets are not replicated on a link.

V11.1 of the DECbrouter 90 software now supports fast switching of the AppleTalk multicast routing protocol. SMRP optimizes Apple Computer's QuickTime® conferencing (QTC) traffic flow over AppleTalk based routed networks.

Routing: Apollo® Domain®

DECbrouter 90 Systems Software implements the Apollo Domain routing protocol, which is the native mode networking protocol for Apollo workstations. DECbrouter 90 implementation supports packet forwarding and routing for the Apollo Domain network protocols on Ethernet and serial Interfaces, using HDLC or X.25 encapsulation.

Routing: Banyan® VINES®

DECbrouter 90 Systems Software supports the Banyan VINES (Virtual Network Systems) protocol.

The DECbrouter 90 now supports Banyan VINES floating static routes. Static routes are traditionally implemented so that they always take precedence over any dynamically learned routes to the same destination network. A floating static route can help create a path of last resort that is used only when no dynamic information is available.

DECbrouter 90 software offers address resolution to respond to address requests, and propagation of broadcast addresses. MAC-level encapsulation and name-to-address binding for VINES host names are supported, as are access lists to filter packets to or from a specific network. DECbrouter 90 implementation also includes EXEC-level commands for maintaining, monitoring, and debugging the VINES network.

DECbrouter 90 supports fast-switching enhancements of Banyan VINES. Fast switching has now been implemented for the PPP, Frame Relay, and SMDS encapsulations.

DECbrouter 90 supports Banyan VINES-compliant trace route-A. VINES-compliant and interoperable trace route facility has now been implemented.

The DECbrouter 90 code supports dial-on-demand routing (DDR) of Banyan VINES over ISDN.

Routing: XNS

DECbrouter 90 software supports a subset of the XNS protocol stack to support XNS routing. It supports routing XNS traffic over PPP serial lines running HDLC, LAPB, X.25, Frame Relay, or SMDS networks. When XNS routing is enabled, the address used is either the IEEE compliant address specified in the XNS routing configuration command or the first IEEE compliant address in the system. The address is also used as the node address for non-LAN media and notable serial links.

Fast switching for XNS provides load sharing on a per-packet basis. When you enable XNS routing, fast switching is automatically enabled.

DECbrouter 90 software also supports the Ungermann-Bass® Net/One implementation of XNS routing. Although Net/One products use XNS as the network layer, they are not equivalent to standard XNS:

- Net/One routers use an Ungermann-Bass proprietary routing protocol instead of XNS RIP. DECbrouter 90 supports both reception and generation of Ungermann-Bass routing packets.
- Net/One routers send periodic HELLO packets, which are used by end nodes to discover routers to be used in sending packets to destinations that are not on the local cable.

Software Compression

DECbrouter 90 supports synchronous serial interfaces that support point-to-point compression. The software implements a predictor compressor. Data compression is supported when using LAPB or Multi-LAPB encapsulation.

The DECbrouter 90 supports the PPP Compression Protocol (CCP), which defines a method for negotiating data compression over PPP links. These links can be either leased lines or circuit-switched WAN links such as ISDN. PPP CPP allows vendors to support multiple data compression algorithms. This implementation supports the STAC and Predictor algorithm options. Internal testing with traffic designed to simulate real-world inter-networking has shown data compression ratios of 2:1 to be achievable.

Priority Queuing with LAPB and compression are supported in the DECbrouter 90 software. Compression using LAPB as the link level protocol has been available since May 1994. LAPB was required to ensure guaranteed delivery and to keep dictionaries in synchronization. With the current software release, priority queuing capability is also provided to the LAPB implementation.

V11.1 of the DECbrouter 90 software now supports compression of data within Frame Relay packets. Compression is performed on a packet-by-packet basis.

Routing Circuits

DECbrouter 90 Systems Software supports several routing circuits: X.25, Frame Relay Serial Encapsulation, and SMDS.

X.25 Routing Circuits

DECbrouter 90 Systems Software supports the use of statically and dynamically assigned X.25 routing circuits. Static circuits are established when the routing circuit is enabled and remain set up until the routing circuits are established. Dynamically assigned 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.

V11.1 of the DECbrouter 90 software now supports transparent bridging over multiprotocol Link Accessed Procedure, Balanced (LAPB). This feature provides encapsulation of transparent bridging packets over a multiprotocol LAPB connection. IP, DECnet, AppleTalk, and other datagrams are encapsulated on an X.25 virtual circuit. Based on their X.25 addresses, X.25 calls can be routed either between serial interfaces on the same router (local switching) or across an IP network to another router (remote switching or tunneling).

DECbrouter 90 software also supports permanent virtual circuit (PVC) mapping, which is the X.25 equivalent of leased lines: they are never disconnected. The X.25 protocol maintains multiple connections over one physical link between a DTE and a DCE. These connections are called virtual circuits (VCs) or logical channels (LCs). X.25 can maintain up to 4095 virtual circuits numbered 1 to 4095.

DECbrouter 90 supports X.25 subinterfaces. X.25 networks provide multiple point-to-point virtual circuits, either permanent (PVCs) or dynamic (SVCs), through a single physical serial interface. Routing protocols that use split horizon to propagate updates are not able to route between the virtual circuits. You can define subinterfaces to assign one or more virtual circuits to separate "virtual" interfaces.

TCP header compression is supported over X.25 links.

DECbrouter 90 supports X.25 Level 2, or LAPB, encapsulation, by acting as a DTE or DCE device at the protocol level. LAPB (Link Access Procedure, Balanced) is a data encapsulation protocol that operates at Level 2. LAPB specifies methods for exchanging data in units called frames.

It is also possible to use LAPB only as a serial encapsulation method, using a leased serial line.

DECbrouter 90 supports stacker compression over LAPB Link Access Protocol, Balanced LAPB or multi-LAPB encapsulation in addition to the previously supported predictor-algorithm compression. Stacker compression is recommended when the bottleneck is caused by line bandwidth. DECbrouter 90 supports LAPB priority queuing.

DECbrouter 90 supports RFC 1356, which supersedes RFC 877, which specified how both IP and OSI could be transported across X.25 RFC 877 in two significant ways:

- Multiprotocol interoperability: All protocols are carried in a defined way.
- Single virtual circuits: Many protocols can be carried across a single virtual circuit. LLC/SNAP encapsulation of frames is used.

X.25 payload compression is supported in DECbrouter 90. Payload compression is an extension of link compression in that only the payload WAN media is compressed. In the case of X.25, the headers are not compressed so that correct switching of packets is possible.

DECbrouter 90 supports the following LAPB enhancements:

- Module 128: This allows a larger window size to be configured on a link.
- T4 timer: This allows a Receive Ready (RR) to be used as a keepalive to allow rapid link failure detection without relying on higher-layer routing protocols.
- Hardware outage timer: This allows brief hardware outages to occur without requiring that the protocol be reset.

IPX WAN on X.25 is not part of the RFC 1356 specification, but it is necessary for multivendor interoperability for IPX networks. IPXWAN is a link start-up and negotiation protocol specified by Novell in RFC 1362.

An encapsulation lapb command has been added to DECbrouter 90. It replaces the following commands, which have been obsoleted: encapsulation lapb-dce, encapsulation multi-lapb, and encapsulation multi-lapb-dce. Instead of encapsulation lapb-dce, use the command encapsulation lapb dce. Instead of encapsulation multi-lapb, use the command encapsulation lapb multi. Instead of encapsulation multi-lapb-dce, use the command encapsulation lapb dce multi.

Frame Relay Serial Encapsulation

DECbrouter 90 Systems Software supports Frame Relay as an encapsulation method. All three of the generally implemented specifications for Frame Relay logical management interfaces are supported:

- Frame Relay interface specification produced by Northern Telecom®, Digital Equipment Corporation, Stratacom, and Cisco Systems
- ANSI adopted Frame Relay specification T1.617, Annex D
- ITU-T (CCITT) Q.933 Annex A

DECbrouter 90 software implementation also conforms to the Link Access Procedure (LAP-D) under its I-series (ISDN) recommendation as I122, "Framework for Additional Packet Model Bearer Services," and IETF encapsulation in accordance with RFC 1294.

DECbrouter 90 supports Inverse Address Resolution Protocol. This protocol, defined by RFC 1293, allows routers to specify a DLCI/node identifier pair and receive the associated network-layer address over the network. The encapsulation mechanism defined in RFC 1294 can then be used to transfer datagrams across the Frame Relay networks to the destination node.

DECbrouter 90 Frame Relay supports subinterfaces. The DECbrouter 90 can now treat Frame Relay as a LAN or WAN by utilizing the subinterface option. Frame Relay circuits are divided into multiple circuits, one per DLCI or PVC. These individual circuits are treated as point-to-point circuits, allowing users to have greater control over their Frame Relay network. This functionality also allows for greater interoperability with other routing products (that is, DECNIS) that only treat Frame Relay as a WAN.

The DECbrouter 90 Frame Relay implementation currently supports routing of AppleTalk, DECnet, IP, ISO CLNS, Novell IPX, and VINES, as well as transparent bridging.

DECbrouter 90 supports TCP/IP header compression as stated in RFC 1144. This algorithm takes advantage of the fact that the TCP/IP header of one packet is predictable given the TCP/IP header of a previous packet and, hence, it is possible to achieve a compression of 40 octets down to 5 octets. This is currently supported on serial lines and X.25 networks. With this IOS release, Frame Relay support is added and header compression can be enabled on a per-DLCI basis.

V11.1 of the DECbrouter 90 software now supports Payload Compression for Frame Relay. This feature allows for payload compression of data within Frame Relay packets. Compression is performed on a packet-by-packet basis.

Frame Relay dial backup for multipoint subinterfaces is supported in the DECbrouter 90 code. Both point-to-point and multipoint Frame Relay subinterfaces can be configured with a backup interface. This feature enables individual PVCs to be backed up in case of failure. The

entire Frame Relay connection need not fail before the backup takes over.

DECbrouter 90 supports Frame Relay dial backup per DLCI in the DECbrouter 90 code. This feature allows individual Frame Relay data link connection identifiers (DLCIs) on a given physical interface to be backed up by another physical interface. If the DLCI fails and it is configured for backup, another physical interface will be used to reestablish the connection.

The DECbrouter 90 supports AutoInstall over Frame Relay. The AutoInstall feature provides simple router installation at a remote site from a centralized management location. The central location connects to the remote router via a serial line and downloads a configuration file.

The DECbrouter 90 now supports bridging as per RFC 1490, Multiprotocol Interconnect over Frame Relay.

The DECbrouter 90 supports SNA Frame Relay Access Devices (FRADs), which provide RFC 1490 support for SNA devices. They allow IBM® devices attached via SDLC and Frame Relay to connect to other IBM devices across a Frame Relay network.

V11.1 of the DECbrouter 90 software now supports fast-switched Frame Relay bridging. Fast-switched Frame Relay bridging allows Frame Relay bridging traffic (transparent bridging) to be fast switched.

Data-link connection identifier (DLCI) prioritization is now supported by the DECbrouter 90 V11.1 software. Data-link connection identifier prioritization allows up to four DLCIs to be created between any two sites so that each DLCI has a different priority level. These DLCIs can be used to send different types of traffic such as File Transfer Protocol (FTP), Telnet, or Systems Network Architecture (SNA) on different circuits.

The Frame Relay broadcast queue is a feature that identifies all broadcast traffic such as routing and SAP updates and places this traffic into a special queue that is managed independently of the normal interface queue. This special queue has its own buffers and a configurable service rate.

IPXWAN support is not part of the RFC 1490 specification, but it is necessary for multivendor interoperability for IPX networks. IPXWAN is a link start-up and negotiation protocol specified by Novell in RFC 1362.

Switched Multimegabit Data Service (SMDS)

DECbrouter 90 software provides an interface to an SMDS network using DS1 transmission facilities at the rate of 1.544 megabits per second. Connection to the network is made through a device called an SDSU—an SMDS CSU/DSU (Channel Service Unit/Digital Service

Unit). The SDSU attaches to the DECbrouter 90 software through a TS-449 connection. On the other side, the SDSU terminates a DS1 line.

The DECbrouter 90 implementation of SMDS supports the IP, DECnet, AppleTalk, XNS, Novell IPX, Ungermann-Bass Net/One, and OSI Internetworking protocols. IP routing is fully dynamic; that is, the routing tables are determined and updated dynamically. Routing of the other supported protocols requires that you establish a static routing table of SMDS neighbors in a user group. Once this is set up, all interconnected routers provide dynamic routing. You can now enter a 15-digit E.164 address, which is a full 64 bits. You must enter at least 48 bits; SMDS sets any remaining bits to F.

DECbrouter 90 supports virtual interfaces. A virtual interface is a new configuration capability that allows each destination E.164 address or a group of addresses to be considered to be connected to a separate port (subinterfaces) on a router. In turn, each virtual interface can be configured with its own addresses, routing protocols, access lists, and routing metrics.

Routing Protocols

DECbrouter 90 software supports various routing protocols:

- RIP - Routing Information Protocol (RFC 1058)
- HELLO - Interior Routing Protocol (RFC 891)
- IGRP - Interior Gateway Routing Protocol, developed by Cisco Systems
- OSPF - Open Shortest Path First Routing Protocol (OSPF V2 RFC 1247)
- EGP - Exterior Gateway Protocol (RFC 888, 904)
- BGP - Border Gateway Protocol (RFC 1276)
- Int IS-IS Integrated IS-to-IS (RFC 1195)
- Enhanced Interior Gateway Routing Protocol (EIGRP)

The Interior Gateway Routing Protocol (IGRP), developed by Cisco Systems for TCP/IP and ISO CLNS, monitors the network to determine the status of each route and selects the best route for each data packet. Network traffic, path reliability, and path speed all influence route selections.

While running IGRP or ISO-IGRP, routers can concurrently receive and understand messages sent from other network segments using different routing protocols.

Integrated IS-to-IS is based on OSI IS-IS Intra-Domain routing, with additions to support IP routing as defined in RFC 1195. 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. When using Integrated IS-IS, the software supports equal-cost path splitting of IP data over all equal cost paths. Variable but contiguous IP subnet masks are also supported.

Custom Queuing

The DECbrouter 90 supports priority and custom queuing to guarantee bandwidth allocation to all protocols including bridging.

V11.1 of the DECbrouter 90 software has increased the number of queues that can be used for custom queuing and priority queuing to 16.

V11.1 of the DECbrouter 90 software now supports the custom and priority queuing Management Information Base (MIB). This MIB provides detailed access to custom and priority queuing information.

V11.1 of the DECbrouter 90 software supports Weight Fair queuing, which is a sophisticated traffic priority management algorithm that identifies conversations (traffic streams) and then breaks up the trains of packets belonging to each conversation to ensure that the capacity is shared fairly between individual conversations.

DLSw+

DECbrouter 90 software supports Data Link Switching Plus (DLSw+). This (DLSw) solution allows construction of any-to-any networks with thousands of routers, while remaining compatible with the new DLSw standard. DLSw is an emerging SNA-over-IP routing standard that helps to integrate SNA and NetBIOS™ protocols within routable IP protocols. DLSw+ requires much simpler configuration and administration. DLSw+ provides a hierarchy that enables any-to-any networks with thousands of routers. DLSw+ allows a large SNA/NetBIOS network to be broken up into peer groups, which are connected to each other with one or more border peers.

V11.1 of the DECbrouter 90 software now supports data-link switch plus DLSw+ over QLLC/Frame Relay. DLSw+ has been enhanced to support both Qualified Logical Link Control (QLLC) and direct encapsulation in Frame Relay. QLLC support allows DLSw+ to communicate with SNA resources over an X.25 network. DLSw+ frames are encapsulated directly in Frame Relay according to RFC 1490.

V11.1 of the DECbrouter 90 software now supports DLSw+ Multidrop PU2.0/2.1 Support. Multidrop PU2.0 and PU2.1 support enables multiple PU2.1 devices to

share the same SDLC line. In addition, PU 2.0 and PU 2.1 devices can also now share the same SDLC line.

V11.1 of the DECbrouter 90 software now has 80D5 (Ethernet version 2) Support. 80D5 Ethernet version 2 is now supported by DLSw+. This extends DLSw+ to environments that have not converted to IEEE 802.3.

V11.1 of the DECbrouter 90 software now supports Local DLC Conversion over DLSw+. DLSw+ now supports local conversion between SDLC or QLLC and LLC2. With local conversion, only one DLSw+ router is required for conversion of a link-level protocol.

V11.1 of the DECbrouter 90 software now supports DLSw+ Backup Peer Enhancements. DLSw+ now allows you to specify a backup peer to use in the event that a primary peer fails. The backup feature has been enhanced to allow the backup peer to remain active after the primary recovers, to prevent disrupting SNA and NetBIOS sessions a second time.

Serial Tunneling and SDLC Transport

The DECbrouter 90 Serial Tunnel (STUN) function allows two devices using SDLC- or HDLC-compliant protocols that are normally connected by a direct serial link to be connected through one or more routers.

V11.1 of the DECbrouter 90 software now provides individual control for devices on a multidrop SDLC line, including the ability to view, shut down, bring up, and add physical units. In addition, you now have the ability to ping physical units on an SDLC line to verify reachability and more granular debugging with both hexadecimal and EBCDIC readouts.

The SDLC transport function, which is a variation of STUN, allows sessions that are using SDLC protocols and TCP/IP encapsulation to be locally terminated. SDLC Transport replaces proxy polling, a method that was used to limit traffic transmitted across a network backbone.

By replacing direct serial links with routers, serial frames can be propagated over arbitrary media and topologies to another DECbrouter 90 STUN link to an appropriate end point. The intervening network is not restricted to STUN traffic, but is multiprotocol. The DECbrouter 90 software encapsulates SDLC frame traffic into IP packets and routes them over any of the IP-supported network media. Because TCP/IP encapsulation is used, any of the routing protocols can be used to route the packets.

STUN copies frames to destinations based on address, but does not modify the frames in any way or participate in SDLC windowing or retransmission. SDLC was designed to ensure reliable data transmission across serial media with minimal, or at least predictable, time delays.

DECbrouter 90 software also implements SDLC Local Acknowledgment, also known as local termination. The current release of SDLC Local Acknowledgment capability applies only to SDLC tunneling across TCP/IP networks, not to HDLC tunneling or to the transfer of SDLC across HDLC serial links. With Local Acknowledgment turned on, the SDLC session between the two IBM end nodes is not end-to-end, but instead terminates at the two local routers.

Support of STUN SDLC local acknowledgment and prioritization allows the router adjacent to the SDLC device to terminate the SDLC session, eliminating polls and acknowledgments across the WAN.

DECbrouter 90 supports IBM SDLC half-duplex link support, SNA network Priority, SDLLC for Ethernet and Custom Queuing.

DECbrouter 90 supports expanded SDLC broadcast services. The DECbrouter 90 supports virtual multidrop, which allows multiple SDLC lines to appear as a single virtual multidrop line to a front-end process (FEP). The virtual multidrop feature has been enhanced by adding broadcast services. With SDLC broadcast services, if a DECbrouter receives an all-stations broadcast on a virtual multidrop line, the router propagates the broadcast to each SDLC line that is a member of the virtual multidrop line.

DECbrouter 90 supports two-way simultaneous SDLC transmission. This feature allows routers to sequentially poll multiple devices on a multidrop line while concurrently receiving data from another device on the same line.

DECbrouter 90 supports Qualified Logical Link Control (QLLC). QLLC is the link protocol used by SNA devices connected over an X.25 network. This feature provides conversion between QLLC/X.25 and either SDLC or LAN (LLC2). QLLC support can be used to convert remote SDLC-attached, Token-attached, or Ethernet-attached devices to QLLC, thus allowing network consolidation of traditional SNA/X.25 networks and LAN internetworks. QLLC support applies to PU2.0 devices connected over either permanent virtual circuits (PVCs) or switched virtual circuits (SVCs).

DECbrouter 90 supports DownStream Physical Unit functionality. In networks running full-stack SNA gateways, each client system appears as an SNA physical unit (PU). Each PU has a DLC connection to an upstream (that is, towards the mainframe) SNA device. In addition, each PU has a management session with ACF/VTAM on the mainframe. Because of the resulting high overhead, many environments use a gateway simply to consolidate the PUs and provide the appearance of a single PU to the mainframe. To eliminate the need for a separate gateway to provide this function, the DECbrouter 90 software supports DSPU concentration.

DECbrouter 90 supports Path MTU Discovery. Path MTU Discovery is a method for maximizing the use of available bandwidth in the network between the end points of a TCP connection.

Protocol Translator

DECbrouter 90 software supports protocol translation, which is a high-performance application-level gateway function providing connectivity among systems running differing protocols over a variety of communication media.

Security features in the DECbrouter 90 software allow restrictions to resources on the network. The network manager can specify access lists to establish which users have access to different computers. A username and password authentication scheme is supported.

V11.1 of the DECbrouter 90 software now supports Lock-and-Key Access. Lock-and-Key access allows you to set up dynamic IP access lists that grant access per user to a specific source or destination host through a user authentication process.

DECbrouter 90 software also supports the application gateway function, which translates virtual terminal protocols to allow devices running dissimilar protocols to communicate. The DECbrouter 90 software supports Telnet (TCP), LAT, and X.25 protocols, as shown below.

- Telnet <-> LAT
- Telnet <-> X.25
- LAT <-> X.25

Management

DECbrouter 90 Systems Software is managed via either an RS232 console interface or remote Telnet, LAT, or MOP connections. Some functions are also manageable via the Simple Network Management Protocol (SNMP). The DECbrouter 90 implementation of SNMP is compatible with RFCs 1155, 1157, and 1213. It also provides variables specific to Cisco and supports the Cisco private MIB.

The Management Information Base (MIB) supports RFCs 1155 and 1213. A separate document, available in RFC 1212-type format (concise MIB), describes all of the specific SNMP variables in the MIB. It also describes what is required to get minimum configuration.

DECbrouter 90 supports SNMP Version 2. The IOS software can communicate with both SNMP Version 1 and SNMP Version 2 network management stations. Most of the changes introduced in Version 2 increase SNMP's security capability. SNMP Version 2 uses the Message Digest 5 (MD5) algorithm to provide for data integrity and authentication capabilities.

The DECbrouter 90 software supports access list violation logging. For the IP protocol, access list violation logging tracks source-destination pairs of IP addresses that are generating IP access list violations.

Open Shortest Path First (SPF) Version 2 Management Information Base (MIB) is supported in the DECbrouter 90 code. This MIB provides RFC 1253 support. RFC 1253 defines standard objects and variables for managing OSPF Version 2.

The DECbrouter 90 code supports IOS privilege levels. This feature allows an administrator to establish privilege levels for this interface. The administrator can establish up to 16 levels of access. The multilevel passwords allow the administrator to specify different levels of security for different commands. The administrator can now create aliases for IOS commands.

Dial-On-Demand Routing—ISDN Connectivity

DECbrouter 90 software supports Dial-on-Demand Routing (DDR) connections in an environment using the public switched telephone network (PSTN). Traditionally, networks have been interconnected using dedicated lines for WAN connections. When used with modems, ISDN terminal adapters, or integrated ISDN capabilities, DDR provides low-volume periodic network connections over a PSTN.

DDR allows attachment to modems and ISDN terminal adapters that support V.25 bis dialing. V.25 bis is a CCITT recommendation for initiating calls using an automatic calling unit (ACU).

DECbrouter 90 supports DDR dialer hold queue. Dial-up services take a finite amount of time to establish a connection to a remote router. During this time, packets destined for the remote router can be discarded because no connection exists. This creation of a dialer hold queue allows packets that would normally be dropped to be held until a connection is established.

DECbrouter 90 supports Dial-up X.25 using ISDN. Dial-up X.25 can work via the PSTN, SW56, or ISDN (channel). Effectively, the router dials up the network in much the same manner as for dial back-up and dial-on-demand routing. Once the connection to the network is established, the X.25 layers are activated, and X.25 calls are placed.

The DECbrouter 90 supports DDR over LAPB. It is now possible to run LAPB encapsulation over DDR links, including ISDN. This feature augments the current encapsulations available, which are PPP, HDLC, and X.25

Fast call rerouting for ISDN is supported in the DECbrouter 90 code. This feature allows an ISDN router to almost instantaneously call a second or subsequent ISDN destination if the initial call fails.

DDR fast switching is supported in the DECbrouter 90 code. Fast switching is now enabled on ISDN over DDR lines, which previously could use only process switching.

Dial Backup

DECbrouter 90 software supports dial backup service, which provides protection against WAN downtime by allowing you to configure a backup serial line via a circuit-switched connection.

This feature requires that an external modem, CSU/DSU device, or ISDN terminal adapter attached to a circuit switched service be connected on the secondary serial interface. The external device must be capable of responding to a DTR signal (DTR active) by auto-dialing a connection to a preconfigured remote site.

DECbrouter 90 supports DTR dialing. The DECbrouter 90 supports connections over serial lines connected to non-V.25 bis dialing as part of the overall DDR software package.

TN3270 Emulation

DECbrouter 90 software supports TN3270 emulation. The support for protocol translators allows only outgoing TN3270 connections. LAT, TCP, and X.25 users must first establish a connection with the protocol translator, and then use the TN3270 facility from the protocol translator to make a connection to the IBM host.

The following table lists the hardware required to run DECbrouter 90 Systems Software.

DEWB1-DA REV C	DEWBR-DA REV C	DEWB2-DA REV C
DEWB1-DD REV C	DEWBR-DD REV C	DEWB2-DD REV C
DEWB1-DE REV C	DEWBR-DE REV C	DEWB2-DE REV C
DEWB1-DI REV C	DEWBR-DI REV C	DEWB2-DI REV C
DEWB1-DK REV C	DEWBR-DK REV C	DEWB2-DK REV C
DEWB1-DT REV C	DEWBR-DT REV C	DEWB2-DT REV C
DEWB1-DZ REV C	DEWBR-DZ REV C	DEWB2-DZ REV C
DEWB1-DX REV C	DEWBR-DX REV C	DEWB2-DX REV C
DEWB1-EJ REV C	DEWBR-EJ REV C	DEWB2-EJ REV C
DEWB1-NA REV C	DEWBR-NA REV C	DEWB2-NA REV C

SOFTWARE LICENSING

The software license required to run DECbrouter 90 Systems Software is included with the hardware.

This software is furnished under the licensing provisions of Digital Equipment Corporation's Standard Terms and Conditions. For more information about Digital's licensing terms and policies, contact your local Digital office.

SOFTWARE PRODUCT SERVICES

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

SOFTWARE WARRANTY

Warranty for this software microcode 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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