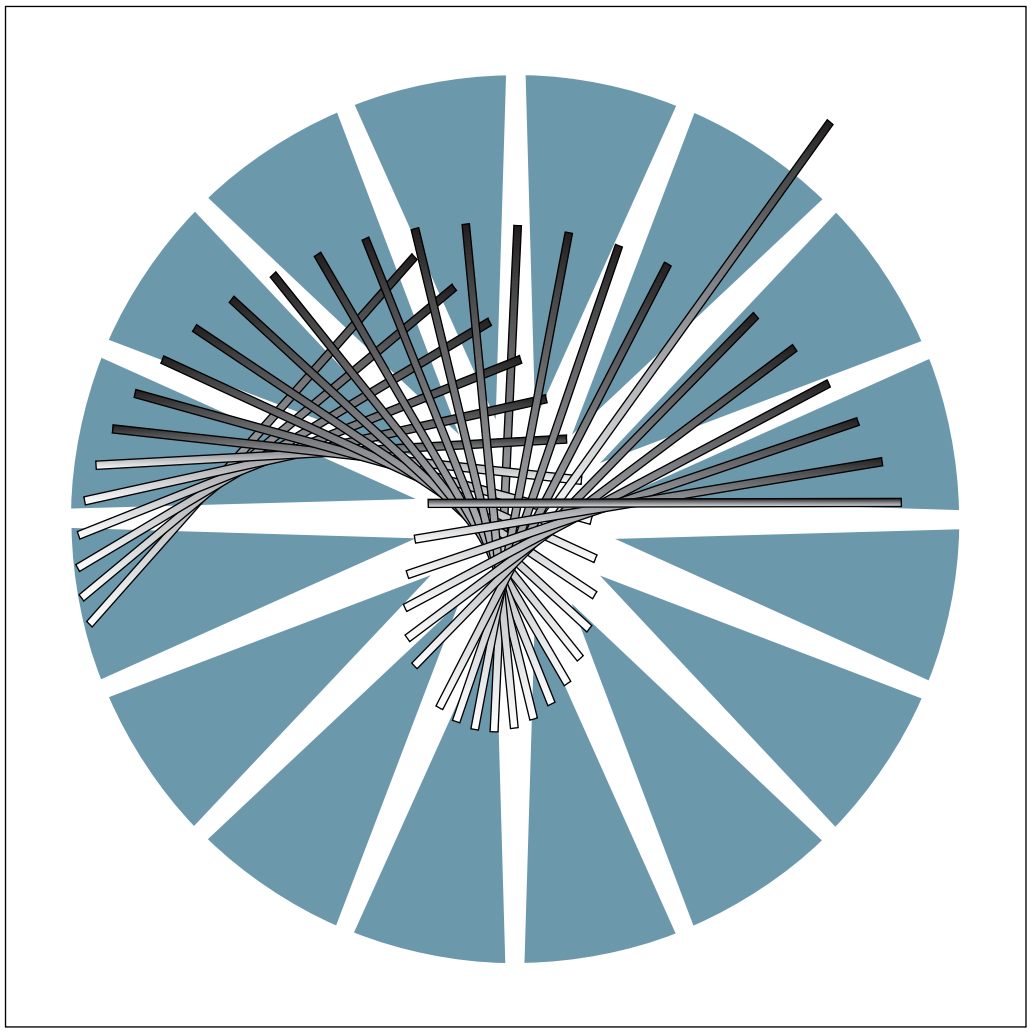
3745 Communication Controller Models A
3746 Nways Multiprotocol Controller
Models 900 and 950

# Overview



GA33-0180-08

3745 Communication Controller Models A
3746 Nways Multiprotocol Controller
Models 900 and 950

# Overview

GA33-0180-08

**Note!**

Before using this information and the product it supports, please read the general information under “Notices” on page ix.

**Ninth Edition (September 1997)**

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VM.ESA
VSE/ESA
VTAM

# About This Overview

This overview contains information on the following IBM* communication controllers:

- IBM 3745 Models 17A, 21A, 31A, 41A, and 61A (3745 Models A).
- IBM 3746 Nways* Multiprotocol Controller Model 900 (3746-900) functioning as one of the following:
  - Systems Network Architecture (SNA) subarea routing Network Control Program (NCP).
  - 3746 Advanced Peer-to-Peer Networking (APPN*)/High Performance Routing (HPR) Network Node (NN).
  - 3746 Internet Protocol (IP) high end router.
- IBM 3746 Nways Multiprotocol Controller Model 950 (3746-950) functioning as the following:
  - 3746 APPN/HPR Network Node (NN).
  - 3746 IP high end router.

This overview also explains how the IBM 3745 Model A, the IBM 3746 Model 900, and the IBM 3746 Model 950 are an enhancement to current growth in network development and technology. These enhancements include:

- Extending the functionality of the controller's Multiaccess Enclosure (MAE) with a set of multiprotocol transport software and routing protocols, designed to improve access scalability and load-balancing to S/390 and IP/web servers connected to an Internet or Intranet network.
- Introducing new, high speed ATM adapters using fiber optic technology for multi-mode or single-mode network access.
- Releasing new, high speed 3746 processors (Type 3), fully compatible in the field with existing processors, and field upgradable.
- Reducing network costs by using Frame-relay technology to consolidate separate networks into a single, multi-protocol transport network.
- Using Advanced Peer-to-Peer Networking*/High Performance Routing (APPN/HPR) to simplify networking implementation and evolution.
- Introducing high performance IP routing for the integration of Internet and Intranet networks with access to IP website applications.
- Incorporating comprehensive network availability, with non-disruptive re-routing of user sessions around network component failure.
- Applying powerful network management tools, for example, NetView*, NetView Performance Monitor (NPM), and Nways Enterprise Manager.
- Facilitating transport of data over leased connections using Frame-relay, Synchronous Data Link Control (SDLC), Point-to-Point protocol (PPP), switched circuits using SDLC, and carrier networks providing Frame-relay, X.25 or Integrated System Digital Network (ISDN) services.
- Allowing native routing of multiple protocols (SNA, APPN/HPR, IP) without protocol encapsulation over the same media, for example a Wide Area Network (WAN) connection using Frame-relay technology.
- Utilizing High Performance Routing (HPR) to enable complete network availability without network congestion. HPR utilizes the maximum amount of

bandwidth available, end to end, between S/390 servers in a parallel SYSPLEX environment and network access nodes, for example:

- IBM PS/2* with Communication Manager/2 or Communication Server/2
- IBM 2210 Nways Multiprotocol Router
- IBM 2216 Nways Multiaccess Connector
- IBM 2217 Multiprotocol Concentrator.

## Conventions Used in This Overview

Throughout this overview, the term:

| | |
|---|---|
| 3745 Model A and 3745 | Refers to IBM 3745 Models 17A, 21A, 31A, 41A, and 61A (with or without attached 3746 expansion units Models A11, A12, L13, L14, L15, 900). |
| 3746 Model 900 and 3746-900 | Refers to IBM 3746 Nways Multiprotocol Controller Model 900. |
| 3746 Model 950 and 3746-950 | Refers to IBM 3746 Nways Multiprotocol Controller Model 950. |
| 3746-900 Network Node (NN) | Refers to the part of 3746-900, operating as an APPN/HPR network node. |
| 3746-900 IP Router | Refers to a function of the 3746-900, operating as an IP router. |
| 3746 network node | Refers to the 3746-900 and 3746-950 Network Node (APPN/HPR). |
| 3746 IP Router | Refers to the 3746-900 and 3746-950 IP Router. |
| 3746 9x0 | Refers to the 3746-950 and 3746-900. |

## Who Should Read This Overview

This overview is intended for:

- Information technology and network managers
- Network architects
- Network planners.

The reader should have an understanding of networking, and be familiar with the functions of the 3745, the 3746-900, and the 3746-950.

The reader should also be familiar with the IBM Enterprise Systems Connection Architecture* (ESCON*) environment and related products. For general information about ESCON, see *Introducing Enterprise Systems Connection*, GA23-0386.

Background knowledge of IP, APPN, HPR, distributed networking, and Frame-relay concepts will be very helpful in reading this overview.

## How This Overview Is Organized

Chapter 1, “General Information on IBM Communication Controllers,” is an overview of the 3745, the 3746-900, and the 3746-950.

Chapter 2, “New Enhancements to Communication Controllers,” describes newly released enhancements to the 3745, the 3746-900, and the 3746-950.

Chapter 3, “New Solutions and Future Growth,” summarizes the functionality of the 3745 Model A and the 3746 9x0, with a review of future developments for advances in network technology.

Chapter 4, “Network Solutions,” describes the networking solutions that the 3745 and the 3746 9x0 can bring to your network. These solutions include the following:

- SNA environment
- APPN or mixed SNA and APPN environment
- Multi-protocol environment (IP and SNA)
- Migration from an SNA to an APPN environment
- Migration from an SNA to a multi-protocol environment.

Chapter 5, “Flexible and Expandable Connectivity,” describes the advantages of the 3746 9x0 connectivity, and includes examples of three adapter types.

Chapter 6, “System Management,” describes how to manage the 3745 and the 3746 9x0, with an outline of problem management facilities, including NetView, NetView Performance Monitor (NPM), Controller Configuration and Management (CCM), Telnet, the Service Processor, the Network Node Processor (NNP), Distributed Access Console Facility (DCAF), and the IBM Remote Support Facility (RSF).

Chapter 7, “High Availability,” describes how the 3745 and the 3746-9x0 are high availability solutions in the design of your network.

Appendix A, “Minimum Configuration of the 3745 and 3746,” describes the minimum hardware and software requirements for running your controller.

Appendix B, “3746 Model 900 and 950 Expansion,” describes the expansion features of the 3745, 3746-900s, &950s., and the MAE.

Appendix C, “Connectivity of the 3746 9x0 APPN/HPR Network Node” describes the connectivity of the controller network node (NN).

## What Is New in This Overview

This revised edition gives information on the latest developments to IBM 3746 Models 900 and 950, and enhancements to the Multiaccess Enclosure (MAE). This includes information on the following:

- New processors (type 3), with improved performance and increased connectivity.
- Enhancements to the MAE, including the following:
  - New ATM adapters
  - Network Dispatcher program
  - Routing Information Protocol (RIP) Version 2.
- HPR functions, including Rapid Transport Protocol (RTP), and Automatic Network Routing (ANR). This supports fast routing and one hundred percent availability, end to end.
- A Multilink Transmission group in an HPR environment. This allocates variable bandwidths for allowing fluctuations in traffic loads.
- Multi-protocol routing over X.25 links. This reduces operating costs for WAN connections.
- Increased connectivity for large network requirements. The IBM 3746 network node can attach 5000 nodes and PUs, support 15,000 APPN/DLUR sessions and, as an Automatic Network Routing (ANR) or intermediate HPR routing node, support any number of sessions. A future release will add the ability to support up to 30,000 APPN/DLUR sessions.

These new functions and features have been designed for installation in the field, so that existing installations can remain intact, and network planning can proceed smoothly.

## Where to Find More Information


- "Customer Documentation for the 3746 Model 950" on page D-1.
- "Customer Documentation for the 3745 (Models 210, 310, 410, 610, 21A, 31A, 41A, and 61A), and 3746 (Model 900)" on page D-3.
- "Additional Customer Documentation for the 3745 Models 130, 150, 160, 170, and 17A" on page D-8.

- *IBM 3746 APPN/HPR Implementation Guide*, GG24-2536.
- *IBM 3746 IP Implementation Guide*, GG24-4845.
- *SNA Network to APPN Network Migration Experience*, SG24-4656.
- *Introducing Enterprise Systems Connection*, GA23-0386.

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# Chapter 1. General Information on IBM Communication Controllers

## The Development of the IBM Communication Controller Family

For more than two decades, IBM's advanced line of communication controllers have been the solution for rapid changes in network technology. In particular, the 3745, the 3746-900, and the 3746-950 have proved cost effective for network migration, and superior in function and adaptability.

IBM communication controllers include the following:

- 3745 Models 130, 140, 150, 160, and 170.
- 3745 Models 210, 310, 410, and 610.
- 3745 Models 17A, 21A, 31A, 41A, and 61A (3745 Models A).
- 3746 Model 900 (3746-900).
- 3746 Model 950 (3746-950).

These communication controllers were originally designed for the attributes and advantages of SNA. Later innovations in the same line incorporated developments in APPN and IP. The following examples illustrate the adaptability of IBM communication controllers to advances in network design and development:

- The 3746-950 can operate as an APPN Network Node, independent from any 3745 running a Network Control Program (NCP).
- Enhancements to the IBM 3746 Model 900 support the same routing functions as the 3746-950.
- The 3746-900 can operate as an APPN network node, and simultaneously operate as an NCP-controlled SNA subarea node, or APPN composite network node (CNN).
- The 3746 APPN networking can be upgraded to HPR routing (APPN/HPR) and utilize the power of IP routing.

With these design improvements, and by supporting APPN/HPR and IP, the 3746 Models 900 and 950 form a new generation of communication controllers, the *3746 Nways Multiprotocol Controllers*. These controllers function as the basis of efficient and reliable multi-protocol networks that support both centralized SNA applications and distributed client/server applications, including IP traffic.

Figure 1-1 on page 1-4 illustrates the development of 3745 and 3746 Communication Controllers in line with the evolution of networking systems.

## The Evolution from SNA to Multiprotocol Networking

The development of SNA communication controllers began in the 1980s when Low-Entry Networking (LEN) was introduced. This development continued with APPN and advances in HPR and IP routing.

APPN/HPR performs the following:

- Flexible, peer-to-peer connectivity for smaller system users (such as AS/400*, PS/2*).
- Simpler configuration and system definitions than earlier versions of SNA products.
- Dynamic reconfiguration and network changes without disrupting network operations, for greater network availability.
- An open network architecture that allows inter-operability between different vendor equipment.
- One hundred percent network availability, with non-disruptive re-routing of sessions in the event of network failure.save

Key characteristics of APPN/HPR include the following:

- Dynamic overview of the current network topology.
- Network management services, for example, automatic location of network end-system and intermediate-system resources.
- Dynamic selection of the best routes to remote users and applications.
- Ensuring transmission priority and traffic congestion control.
- Enabling high data throughput, in particular between S/390 Servers and the network.

In line with the development of APPN/HPR, the routing facilities of the 3746 IP include the following:

- Fully-fledged IP routing functions.
- Concurrent IP, APPN/HPR, and SNA routing.
- Efficient access control to complement traditional filtering.
- High data throughput between network and S/390 Servers running TCP/IP applications.
- Support of Simple Network Management Protocol (SNMP).

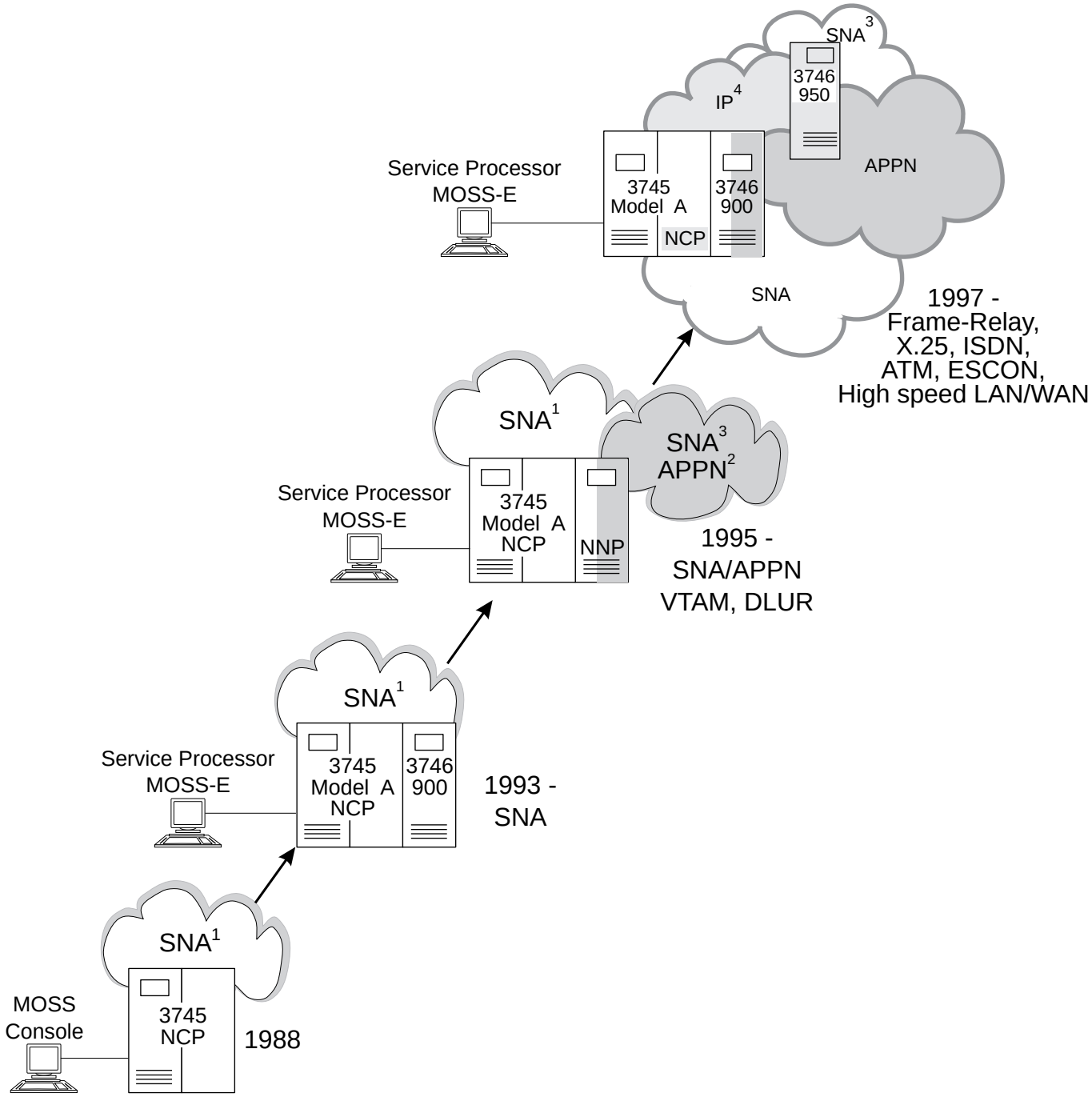
## The Network Control Program (NCP) and Internet Protocol (IP)

The NCP IP of the 3745 runs in conjunction with the IP program of the 3746. A new, internal connection is available between the NCP IP router of the 3745 and the IP router of the 3746-900. This allows you to use the 3745 to access the host for IP traffic flowing from the 3746-900 IP router.

Additionally, support for IP in the 3746-900 has been advanced to include more protocols (OSPF, RIP, and BGP), and high performance throughput increased to more that 30 times that of the 3745.

## APPN/HPR and IP Routing

By integrating the 3746-900 and the 3746-950 into your network, you can add the advantages of APPN/HPR and IP, and still support your existing SNA configurations.




**Notes:**

1. This controller configuration supports SNA networking and the APPN composite network node function in conjunction with NCP and VTAM.
2. APPN networking, using a network node processor (NNP), independent from NCP and VTAM.
3. Connectivity with SNA devices using the Dependent Logical Unit Requester support (DLUR).
4. IP networking using the NNP, independent from NCP and MVSTCP/IP.

*Figure 1-1. The Networking Evolution of IBM 3745 and 3746 Controllers*

# Chapter 2. New Enhancements to Communication Controllers

## The 3745 Model A

As a standalone, the 3745 Model A forms the basis of 3745-based SNA or APPN/HPR networks under NCP control, while providing support for APPN/HPR network nodes.

The 3745 Model A incorporates the following features:

- Support of the 3746 Model 900.
- Up to 16 MB of storage per 3745 central control unit (CCU) for 3745 Models 31A and 61A.
- A service processor which provides maintenance and operator subsystem - extended (MOSS-E) functions.

## 3745 IP Connection to the 3746

An enhancement of the 3745 NCP Version 7 Release 6 allows an internal connection between the NCP IP router and the IP router of the 3746. The parallel channel of the 3745 can communicate with the host for the IP traffic of the attached 3746 IP router without an external connection.

## The 3746 Model 900

The 3746 Model 900 was originally utilized to increase connectivity for the 3745 through high-performance ESCON adapters, token-ring adapters, and a number of leased SDLC lines. The 3746-900 can operate as any of the following:

- SNA node controlled by NCP.
- APPN/HPR composite network node (CNN) controlled by NCP and Virtual Telecommunications Access Method (VTAM*).
- APPN/HPR network node, independent of the NCP and VTAM, controlled by the network node processor.
- IP router, independent of the NCP and TCP/IP MVS, controlled by the NNP.

The 3746-900 can operate simultaneously in multiple modes, as in the following examples:

- APPN/HPR network node and SNA node (NCP).
- APPN/HPR network node and APPN composite network node (NCP).
- SNA node (NCP) and IP router.
- APPN/HPR network node and IP router.
- APPN/HPR network node, IP router, and SNA node (NCP) or APPN/HPR composite network node (NCP).

In the above example modes, the adapters of the 3746-900 share the traffic controlled by the 3746 Network Node, traffic controlled by NCP, and traffic controlled by the 3746 IP router.

## Enhancements to the 3746-900

When controlled by the Network Node (NN) processor, the 3746-900 can perform APPN/HPR network node and IP Routing functions over communication line, token-ring, and ESCON adapters. These adapters run 3746 NN traffic, 3746 IP traffic, and NCP traffic simultaneously.

Enhancements to the 3746-900 are as follows:

- New, faster ATM adapter performance on the Multiaccess enclosure (MAE) and support for Routing Interface Protocol (RIP) Version 2, and HPR over ATM.
- Frame-relay Frame Handler (FRFH) under the NNP control.
- Frame-relay link support for bandwidth management via Committed Information Rate (CIR) and Bandwidth Reservation System (BRS) under the NNP control.
- IP traffic on PPP links using BRS.
- Connectivity increase to support 5000 PUs and 15,000 APPN/DLUR sessions.
- Capacity for twice the number of APPN sessions and IP, APPN, HPR lines.
- New, faster processor Type 3.
- Increased processor Type 3 capacity for APPN/DLUR, HPR PUs and sessions.
- Improved price-to-performance ratio for IP routing and APPN/HPR traffic.
- Integration of existing adapters with new adapters (Type 1, Type 2, and Type 3).
- Field upgrades of existing adapters to Type 3 adapters.
- Hardware connection between the 3746 switch and the Multiaccess Enclosure (MAE).
- Improved availability and recovery through reducing microcode upgrade time and microcode version selection.
- 3746 IP internal coupling to the 3745 NCP IP.

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## The 3746 Model 950

The 3746-950 was designed to support APPN/HPR network node and IP routing functions, using adapters to run network node traffic and IP traffic simultaneously. The 3746-950 is primarily a high connectivity and high performance platform for APPN/HPR and IP networks.

## Enhancements to the 3746-950

Enhancements to the 3746-950 are as follows:

- New, faster ATM adapter performance on the Multiaccess enclosure (MAE) and support for Routing Interface Protocol (RIP) Version 2, and HPR over ATM.
- Frame-relay Frame Handler (FRFH) under the NNP control.
- Frame-relay link support for bandwidth management via Committed Information Rate (CIR) and Bandwidth Reservation System (BRS) under the NNP control.
- IP traffic on PPP links using BRS.
- Connectivity increase to support 5000 PUs and 15,000 APPN/DLUR sessions.
- Capacity for twice the number of APPN sessions and IP, APPN, HPR lines.
- New, faster processor Type 3.
- Increased processor Type 3 capacity for APPN/DLUR, HPR PUs and sessions.
- Improved price-to-performance ratio for IP routing and APPN/HPR traffic.
- Integration of existing adapters with new adapters (Type 1, Type 2, and Type 3).
- Field upgrades of existing adapters to Type 3 adapters.

- Hardware connection between the 3746 switch and the Multiaccess Enclosure (MAE).
- Improved availability and recovery through reducing microcode upgrade time and microcode version selection.
- 3746 IP internal coupling to the 3745 NCP IP.

Similar to the 3746-900, the 3746-950 provides a valuable set of IP functions including Open Shortest Path First (OSPF), Routing Information Protocol (RIP), and Border Gateway Protocol (BGP).

Another enhancement for both the 3746-900 and the 3746-950 is the Session Services Extended, a function that allows the controller to connect to a border node in another APPN network. Users migrating from SNA networks to APPN can use SSE to migrate SNA Network Interconnection (SNI) links as well.

SSE also functions as a Network Node (NN) server for a VTAM end node, allowing topology and directory services to be off-loaded from VTAM to the 3746 NN.

## Processors

Significant improvements have been made to the processors of the 3746 to increase speed and functionality. These processors include communication line (CLP3), token-ring (TRP3), and ESCON (ESCP3) processors, the control bus service processor (CBSP3), and the main service processor. The improved performance of each processor is as follows:

- CLP3, supporting up to:
  - 3000 PUs (1000 PUs over SDLC, 2000 PUs over Frame-relay, X.25, or ISDN), of which up to 2000 PUs, with a total of 8000 APPN/Dependent LU sessions, can be controlled by the 3746 NN.
  - 2000 Frame-relay virtual circuit (DLCI).
- TRP3, supporting up to 2000 PUs with a total of up to 8000 APPN/Dependent LU sessions controlled by the 3746 NN.
- ESCP3, supporting up to:
  - 16 logical connections with S/390 server partitions running VTAM or TCP/IP.
  - 15000 APPN/Dependent LU sessions controlled by the 3746 NN.
- CBSP3, required to support 30,000 APPN/DLUR sessions.
- Service processor 2, required to support 240 lines of the following:
  - SDLC
  - Frame-relay
  - X.25
  - PPP.

| Table 2-1. Processor Performance Percentages | | |
|---|---|---|
| **Processor** | **Percentage** | **Protocol** |
| CLP3 | Up to 100% | APPN/HPR |
| CLP3 | Up to 100% | IP |
| TRP3 | Up to 70% | APPN/HPR |
| TRP3 | Up to 40% | IP |
| ESCP3 | Up to 60% | APPN/HPR |
| ESCP3 | Up to 30% | IP |

**Note:** Field upgrades are available for type 2 processors to type 3 processors, and type 1 processors to type 3 processors.

## The Multiaccess Enclosure (MAE)

The Multiaccess Enclosure (MAE) is a recent addition to the communications controller family, designed to provide a range of high-speed, high-availability connectivity options.

Each MAE houses eight adapter slots with up to eight ports per adapter. Through IBM 2216 technology, the MAE allows multiple traffic routing for TCP/IP, SNA/DLUR, APPN, and HPR protocols. The MAE provides support for WAN protocols (SDLC, PPP, Frame-relay, and X.25), and multiple ports are designed to allow a high WAN port density for cost effective traffic control.

**Note:** The Multiaccess Enclosure for the 3746 Model 900 can route traffic independently of the NCP.

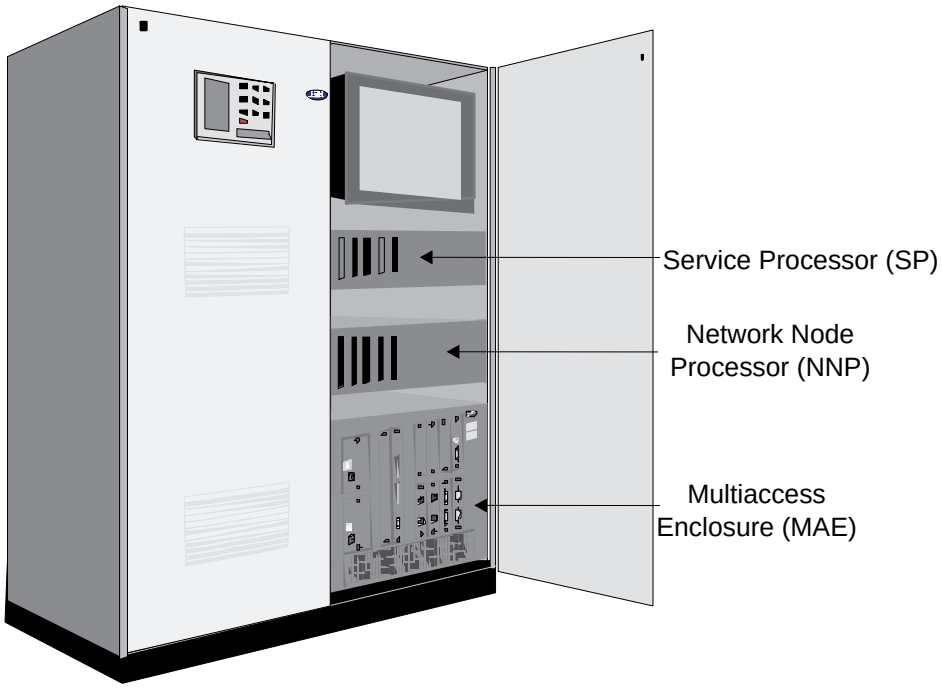



*Figure 2-1. Communication Controller with a Multiaccess Enclosure (MAE)*

## MAE Adapters

The Multiaccess Enclosure can be installed with the following adapter cards:

- Asynchronous Transfer Mode (ATM), supporting ATM forum-compliant LAN Emulation client, classical IP routing, and native HPR over ATM.
- ESCON, supporting Multi-Path+ Channel (MPC+), LAN Channel Station (LCS), and Link Services Architecture (LSA).
- World-wide ISDN, supporting Frame-relay and PPP.
- Ethernet, supporting Ethernet 2.0, IEEE 802.3, and ISO 8802.3.
- Token-ring, supporting IEEE 802.5 and ISO 88025.5.
- V.35 or V.36 WAN adapters, supporting line speeds for a modem attachment, or line speeds for direct attachment.
- X.21, supporting line speeds for a modem attachment, or line speeds for a direct attachment.
- V.24/EIA 232, supporting line speeds for a modem attachment, or line speeds for a direct attachment.

## MAE Hardware and Software

The MAE base includes the following hardware:

- Power supply
- Cooling fan
- System card containing:
  - PowerPc microprocessor
  - 64 MB DRAM
  - PCMCIA token-ring card and cable (for connecting to the Service Processor).
- Eight adapter slots
- Two 8228 MAUs
- Cables for the service processor and the MAUs
- A direct hardware attachment to the controller switch (see the note below).
- Alternatively, a token-ring card for connecting to 2 TIC3s on the 3746-9x0 for IP traffic (provided by the user).

Code for operating the MAE is pre-loaded before shipping.

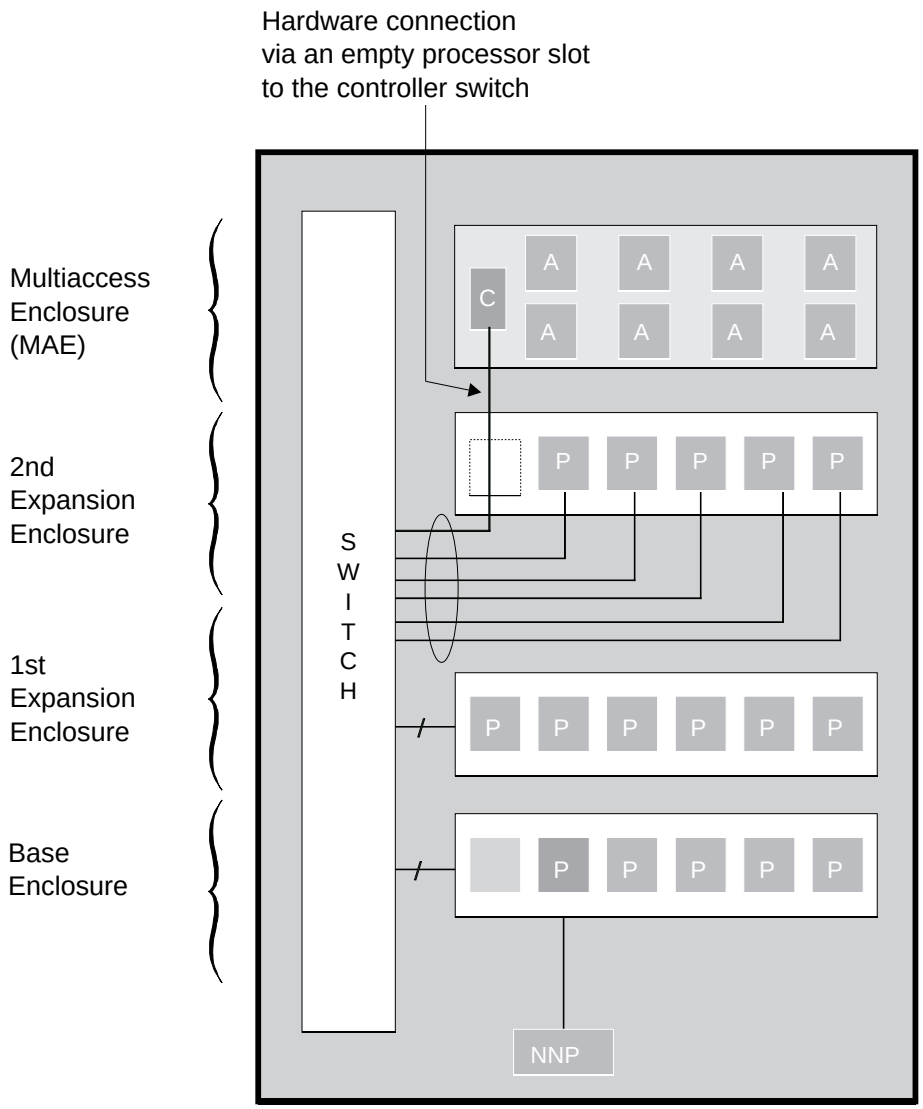
**Note:** If you have a Multiaccess Enclosure already installed, field upgrade packages are available free of charge. This package provides a high-speed direct hardware attachment to the 3746 connectivity switch. Please specify this with your order.

# Enhancements to the MAE

## Hardware

The MAE can be connected directly to an empty processor slot of the 3746, with a hardware connection to the controller switch. This direct hardware coupling increases transaction speeds three-fold, as well as freeing the token-ring connection previously required between the MAE and the 3746.

The MAE has effectively become a super processor, providing multiple interfaces for the 3746-9x0.




**Legend**:
C Connector
A Adapter
P Processor
NNP Network Node Processor

*Figure 2-2. The MAE with a hardware connection to the controller connectivity switch*

## Adapters

New MAE adapters cards include the following:

- Multimode Fiber (MMF), a fiber optic cable with an ATM support chip for segmentation and reassembly (SAR), and SONET OC3c framing.
- Single Mode Fiber (SMF), a fiber optic cable with an ATM support chip for segmentation and reassembly (SAR), and SONET OC3c framing.

The following are previews of future enhancements to MAE cards:

- Fiber Distributed Data Interface (FDDI), a technology for access to token-rings with a 100 mbps speed, and supporting transparent bridge filtering.

- High Speed Serial Interface (HSSI) using T3/E3 speed, for improving the DTE/DCE interfaces.
- F-Ethernet, operating at 100 mbps, supporting the latest Ethernet technology.

## Value Added Network Functions

Enhancements to the MAE for strengthening network operations include the following:

- Interactive Network Dispatcher for routers, which provides a data load balancing function for adjacent IP servers. Load information is based on the following information:
  - Number of active connections per server
  - Number of new connections per server within a timed interval
  - Recorded response times from HTTP and FTP servers.

  Interactive Network Dispatcher is transparent to the user, and as it is commonly available on other platforms, many will find it useful for e-mail servers, Web servers, distributed parallel databases, and other TCP/IP applications.
- Branch Extender for APPN, a function that effectively controls the growth of too many network nodes by limiting the gateway node to downstream devices, and mapping a default path for upstream services. Branch Extender provides the following services:
  - Reduces topology database size and traffic
  - Provides direct connection between sub-networks without using an Extended Border Node (EBN)
  - Registers resources from a branch to a central server on the network.

  Branch Extender can be run through any data link supported by APPN.
- MAE adapters support RIP Version 2, enabling, for example, the MAE ESCON adapter to reduce loads on the host by using an IP multicast address to broadcast periodic RIP (Version 2) messages.
- The ATM adapter supports native HPR through SVC and PVC connections (AIW 8192).

Other enhancements include the following:

- Support for Configurable Quality of Service (QoS) for LAN emulation connections.
- Next Hop Resolution Protocol (NHRP) for enabling short-cut routes for IP across ATM networks.
- Backup gateway for end stations on LAN emulation connections.
- Server Cache Synchronization Protocol (SCSP) for distributing SRP servers to eliminate an single point of failure.

All the above protocols and native ATM bridging can be multiplexed onto a single ATM permanent virtual circuit.

Future enhancements will include TN3270 server support for IP access to SNA applications. The TN3270e server maps 3270 flow through IP networks into SNA sessions. This enables a migration to pure IP networking, while retaining access to applications through SNA.

## Frame-Relay Enhancements to the 3746 Model 900 and the 3746 Model 950

The Frame-relay links of the 3746-900 and 3746-950 NNP have been enhanced to provide superior switching-node capabilities. By using Frame-relay Frame Handler (FRFH), the adapters of the 3746-900 and 3746-950 can perform full-frame switching functions. This reduces the time for traffic to flow through intermediate nodes, shortens the response time for available user interfaces, and facilitates automatic non-disruptive recovery in the event of network failure. Additional Frame-relay enhancements include:

- Frame-relay dial circuit configurable on a V.25 bis interface.
- Data compression configurable for PVC to run over a Frame-relay interface.
- Congestion management through Simple Network Management protocol (SNMP).

## Frame-Relay Congestion Management

In compliance with ITU-T X.36 requirement for congestion management, the 3746-900 and 3746-950 utilizes Committed Information Rate (CIR) for monitoring data flow in networks. The 3746-900 and 3746-950 use CIR to operate as Data Terminal Equipment (DTE). This function adapts data in transit to the network to the current capacity of the network, effectively enabling the 3746-900 and the 3746-950 to control the variable flow of traffic through every virtual circuit of the network.

In conjunction with CIR, the 3746-900 and the 3746-950 utilizes the Bandwidth Reservation System (BRS). This can reserve a percentage of the bandwidth to selected protocols flowing through the same virtual circuit, for example, APPN and IP.

## Additional Protocol Enhancements for MAE Links

**Point-To-Point Protocol (PPP)**

The following supporting protocols have been added:

- Bandwidth Allocation Protocol/Bandwidth Allocation Control Protocol (BAP/BACP) for dynamically placing existing or new links over ISDN B channels.
- Support for authentication servers to avoid creating names and passwords for routers.
- Encryption Control Protocol (ECP) using Data Encryption Standard (DES) Cipher Block Chaining (CBC) mode.

**Advanced Peer-to-Peer Networking/High Performance Routing (APPN/HPR)**

Support for router attachment to ATM networks without LAN emulation or encapsulation. Router support includes the following functions:

- ATM signalling of bandwidth, QoS, and ATM addressing.
- Extension of ATM route selections.
- Support for SVCs on connected networks.
- HPR over ATM MIB extensions.
- Mapping between ARB and ATM characteristics.

Configuring the router as a focal point on the network with up to eight backups enables the initiation of a management session with NetView.

**Data Link Switching (DLSw)**

Support for the following:

- Configuring SAP and MAC addresses to override circuit priority.
- Protocol support for network partners to exchange MAC addresses.
- NetBIOS spoofing, to eliminate alive frames on a dial-on-demand link.

**Internet Protocol (IP)**

RIP Version 2 to provide the following:

- Route tags to for Exterior Gateway Protocol (EGP).
- Support for variable subnet masks.
- Optimizing routes with next hop addressing.
- Password authentication.
- Multicasting.

Other enhancements to IP routing include the following:

- IP hosts or subnets can be configured with four static routes, either for backup purposes or for alternative routes.
- Multiple network interfaces can be defined as a single IP subnet, to avoid dividing large Frame-relay networks into multiple IP subnets.
- Extended OSPF to reduce the overhead costs of frequently used circuits.
- As a defense against data corruption, Trivial File Transfer Protocol (TFTP) servers can be disabled.
- Redirect messages from Internet Control Message Protocol (ICMP) can be disabled or re-routed through specific interfaces.
- IP Routing is enhanced by using BRS on PPP leased lines. This allows a percentage of the bandwidth to be reserved for IP applications using the same line.

**Wide Area Network (WAN)**

Enhancements include the following:

- Assigning BRS class and priority levels to TCP/IP packets, based on the User Datagram Protocol (UDP) or TCP port number.
- Capacity for a 4 or 8 port WAN concentrator, supporting Frame-relay, SDLC, SDLC Relay, V.25 bis, X.25, and PPP.
- If traffic reaches a specified threshold, a back-up Frame-relay, PPP, or X.25 link can be specified for IP over Frame-relay.
- Adapters can be enabled or disabled from a single operator console, without requiring information on the interfaces configured for WAN re-route.

**Integrated Services Digital Network (ISDN)**

Support for I.430 and I.431 enables interconnections to leased-line services from NTT.

**Ethernet**

Locally administered MAC addresses can be configured to override the default, burned in address.

## Adapter Connectivity and Performance

Improvements have been made to adapter connectivity and performance, by adding more PUs or APPN/DLUR sessions per adapter, and increasing throughput for NCP-, IP-, and APPN-dependent LU traffic. These improvements upgrade existing CLP type 2, TRP type 2, and ESCON type 2 processors to type 3 processors.

# Chapter 3. New Solutions and Future Growth

## 3746 Nways Multiprotocol Controller

The 3746 Nways Multiprotocol Controller Models 900 and 950 allow you to design a manageable, reliable and cost effective network - today - that can readily adapted to meet the networking requirements of tomorrow. Flexibility in 3746 design allows you to perform the following:

- Link your MVS/ESA server to an Intranet or Internet network with high speed native IP support.
- Use APPN/HPR to run high performance networks, with full availability of host based SNA applications.
- Save costs by connecting to public or private Frame-relay or X.25 networks.
- Extend your investment in both TCP/IP and SNA applications.
- Utilize ATM adapters for connectivity to ATM environments.
- Run high speed adapters for LAN and WAN networking.

## 3746 IP Routing

The 3746 performs channel-attached IP routing and supports a complete set of TCP/IP functions, including RIP1, OSPF2, and BGP4 (the MAE supports RIP2). To enable common IP routing functionality across the network, the 3746 shares a code base with the IBM 2210 Multiprotocol Routers, and IBM 2216 Multiaccess Connectors.

3746 IP Routing has the following advantages:

- High data throughput between S/390 servers and the network, allowing consolidation of S/390 front-end equipment (SNA and IP).
- Efficient access controls and filtering.
- Single front-end equipment to access TCP/IP MVS and VTAM applications, which in turn simplifies the requirements for installing the S/390.
- Cost reduction of network ownership by consolidating IP and SNA networks over a single multiprotocol transport network, using Frame-relay or ATM as the protocol for data link control.
- Standard SNMP support allowing network management via NetView/6000 or other platforms.
- Concurrent IP, APPN/HPR and SNA (NCP) routing over the same adapters.
- Native routing of IP, APPN/HPR, and SNA (NCP) traffic on the same media (ESCON, token-ring, Ethernet, X.25, and Frame-relay).

## 3746 APPN/HPR

The addition of HPR to the 3746 platform enables you to implement high-availability solutions for both the data center and the network, and to achieve improved throughput between S/390 servers and the network. For example:

- The 3746 HPR platform provides increased throughput by a factor of up to 30 compared to 3745 SNA subarea performance in an NCP environment.

- You can use a 3746 with Automatic Network Routing (ANR) along with devices that support HPR end point support (Rapid Transport Protocol - HPR/RTP), such as the following:
  - Communication Server/2
  - IBM 2210 Multiprotocol Router
  - IBM 2216 Multiaccess Connector
  - IBM 2217 Multiprotocol Concentrator.

APPN/HPR allows you to build a network with complete availability, twenty-four hours a day, three-hundred and sixty-five days a year.

3746 HPR advantages include:

- High data throughput between the S/390 servers and the network.
- Dynamic re-routing around failed nodes and links without session loss.
- Extended bandwidth and traffic load balancing over Multi-Link Transmission Group (MLTG) including mixed media.
- Synergy with the parallel SYSPLEX processor implementation, providing end-to-end non-disruptive path switching to applications.
- Enhanced congestion control for improving link efficiency.
- Improved routing performance for intermediate nodes.
- Required storage amounts reduced in intermediate nodes.

## 3746 Frame-Relay

The 3746 support of Frame-relay is independent of NCP and based on RFC 1490 for Boundary Access Node (BAN) and Boundary Network Node (BNN), as well as for TCP/IP and HPR routing.

The 3746 operating as a Frame-relay terminating point can use a variety of Frame-relay devices, either directly connected via leased lines, or connected to a public or private Frame-relay network.

IBM Frame-relay devices for network access include the 2210/6611 multiprotocol routers, 2216 Multiaccess Connectors, 2217 Multiprotocol Concentrators, 2218 Frame-Relay Access Devices, and 3174 controllers.

A 3746 using Frame-relay has the following cost-effective advantages:

- A multiprotocol transport network, with native routing of IP, SNA and APPN/HPR over the same WAN connection, save costs on bandwidth, network administration, and network management.
- A single channel-attached and high throughput terminating point for multiprotocol traffic.
- A single user to run the S/390 front-end of a multiprotocol network.

## 3746 Nways Multiprotocol Controllers (APPN Specifics)

As APPN/HPR network nodes, the 3746 Models 900 and 950 help you build a flexible networking environment, capable of evolving to meet your future networking requirements. Using the Dependant Logical Unit Requester (DLUR), your backbone network can evolve to APPN/HPR without changing user applications and workstations.

## APPN Advantages

APPN operates without a hierarchy, establishing highly dynamic networks where nodes are easily connected and disconnected, and session routes determined according to the current status of the network. The 3746 as a network node has the following advantages:

- Dynamic and automatic networking.
- Network growth independent of platform.
- Simpler configuration and administration, including dynamic definition of resources and routes.
- Network adaptability to changes in configuration and workloads.
- Interoperability with SNA networks and SNA applications.
- End-to-end management.
- Open architecture.
- Scalability.

## Solutions

The 3746-900 and 3746-950, operating as network nodes, provide a unique solution for preserving SNA networks and utilizing advances in APPN. These solution consist of the following:

- Integration of APPN/DLUR traffic controlled by the 3746 network node and SNA traffic controlled by NCP (3746-900).
- Field-installable functions.
- Smooth and cost-effective equipment adaptability.

### The Evolution to APPN

The 3746-900 can be upgraded to a stand-alone 3746-950 by installing the channel, line, and LAN connections of the 3745 and then detaching it from the 3745.

DLUR with VTAM in the 3746-950 can replace or consolidate one or more IBM 3720, 3725, or 3745. This means substantial benefits for throughput, price-to-performance ratio, physical installation requirements, and software changes.

The connectivity of the 3746-900 and 3746-950 for ESCON channels, communication lines, and LANs is unmatched by other existing APPN products. The 3746-900 and the 3746-950 offer a significant increase in data throughput and transactions rate through the following:

- APPN routing performed by the adapters with no intervention by NCP.
- Direct VTAM access via ESCON channel adapters.

The 3746-900 and 3746-950 is the preferred solution in mid- or long-term strategies to migrate from an SNA network to an APPN network. Evolution to APPN is made simpler by the 3746-900 capacity to share network node resources between SNA and APPN.

In this respect, one of the functions of the MAE is to provide access to both SNA and TCP/IP based host applications through channel access protocols. The ESCON channel adapters of the MAE can run a variety of channel access protocols, including Multi-Path Channel+ (MPC+), a protocol that effectively

improves the performance of APPN/HPR, while reducing the consumption of host cycles.

### Customer Comments

Previous customer experience has shown the benefits of migration to APPN. The following reflects some customers' comments on the advantages of APPN:

- Avoid retrofits to accommodate new users and applications.
- Eliminate administrative overheads of a widespread client/server system.
- Reduce the time of link definition normally required with VTAM, keeping support costs down for new or additional programmers.
- Deliver new and unique applications that reduce the time and cost of developing new programs.
- Distribute APPC client/server applications cost-effectively and quickly.

## Growth

The 3746-900 and the 3746-950 network nodes benefit from the high performance of the 3746 Nways Controllers. Improved cost-per-port and cost-per-performance ratio provide economical solutions for network growth.

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# More About the 3745 Model A and the 3746 Models 9x0

## Business Solutions

The 3745 Model A, the 3746-900, and the 3746-950 bring new design solutions and adaptability to today's fast changing advances in network systems and technology. Examples of this adaptability are as follows:

- The 3746 Models 9x0 ESCON channel, token-ring, and communication line adapters can concurrently route SNA, IP and APPN/HPR traffic.
- The 3745 Model A can operate ACF/NCP Version 7 to expand networking capabilities.

The improved connectivity of the 3746 Models 9x0 (up to 32 lines operating at speeds above 256 kbps up to 2 mbps, and more for the MAE) allows more lines operating at faster transmission speeds.

Frame-relay links connected to the 3746 9x0 allow each virtual connection between end stations to be assigned individual communication rates (percentage of the bandwidth). This allows mission-critical data requiring short response times to be carried at a faster rate, and other less critical traffic, such as file transfers between LAN servers and S/390 Server databases, to be assigned a lower rate using the remaining bandwidth.

The 3746 Models 9x0 Frame-relay boundary access node (BAN) function allows equipment, such as the IBM 2210/6611 multiprotocol routers, IBM 2216 Multiaccess Connector, and IBM 2218 Frame-Relay Access Device (FRAD), to access the SNA backbone via either:

- Private leased line
- Public frame-relay connection.

Frame-relay BAN has the following advantages:

- Dynamic routing of the SNA flows, instead of static predefined DLCI switching. This allows authorized downstream PUs to access host applications over an SNA backbone.
- Direct access from BAN equipment to the 3746 Models 9x0 which removes the requirement of an intermediate router, locally attached to a token-ring port.
- MAC address support which allows any number of downstream PUs to be connected to the router, with access to the 3746 Models 9x0 over the same Frame-relay DLCI number.

The Frame-relay SAP multiplexing of the 3746 Models 9x0 will allow units, such as the IBM 2217 or IBM 3174, to use a single frame-relay DLCI number for multiple downstream SNA stations. This simplifies network administration and reduces the costs of frame-relay services.

The high performance of 3746 9x0 adapters provides the following:

- Opportunities to support more data transfer.
- More efficient interaction between user and host applications, for example, image processing or database access in a client/server environment.

The price-to-performance ratio of the 3746 9x0 adapters is cost-effective if you are consolidating multiple 37xx installations on to 3746 9x0 machines.

The reliability and availability of the 3745 and 3746 Models 9x0 contribute to the success of businesses dependent on cost-effective and efficient networks.

## System Management Solutions

The consolidation of front-end processing on fewer pieces of equipment is made possible by the following attributes of the 3746-900 and 3746-950:

- Multiprotocol routing
- High level performance
- Connectivity to native ESCON channels
- Extended communication line capacity
- Extended LAN capacity.

Consolidation simplifies network management and reduces associated operational costs.

### Cabling

A new method of cabling using line connection boxes (LCBs) and the active remote connectors (ARCs) saves floor space around the 3745/3746 frames, and decreases the number of cables between the machine and the modem.

Line interfaces and the cables can be relocated with the modems, requiring less time and effort to install, and easy access if needed.

### Service Processor

The stand-alone service processor running MOSS-E complements the 3745 MOSS and replaces the operator console of the 3745 first generation (Models 130 to 610). MOSS-E includes new functions for easy maintenance and remote control of the 3746-900 and 3746-950. Some of the functions of the service processor are listed below:

- A single service processor can run up to four 3745s, and two 3746 9x0s with one operating as a 3746 IP router, or APPN/HPR network node, or both.
- The service processor of the 3745 and 3746 9x0 automatically:
  - Reports problems to the IBM remote support facility (RSF)
  - Loads microcode fixes.
- A service processor can be remotely accessed by an OS/2 workstation running DCAF via SNA, APPN, or IP networks to:
  - Save the cost of access via a switched telephone network.
  - Provide reliable and efficient remote control of the 3745/3746 via high speed communication lines.

Remote access via a switched network uses the service processor RSF port and modem, which reduces the modem and switched line loads and saves telephone line costs.

## User Productivity Solutions

The 3746-900 and the 3746-950 increases user productivity by providing a number of solutions, including line switching, availability, expansion, and connectivity performance.

### Line switching

Frame-relay switching throughput in the 3746-900 increases the efficiency of bandwidth utilization in many traffic environments, whether interactive or file transfer. The 3745/3746-900 SNA flow control and frame-relay congestion functions holds the Frame-relay throughput at T1 (1544 mbps) or E1 (2048 mbps) speeds or subspeeds.

The 3746-900 Frame-relay switching and communication rate support allow protocols other than IP, SNA, and APPN/HPR to be carried by a 3745/3746-900 based Frame-relay network. This means that the communication rate of an individual virtual circuit can be assigned to protocols between two end stations, providing a high-quality transport network for these protocols.

### Availability

User productivity depends partly on the availability of the network. Maintenance support of 3745 Models A and 3746 9x0 enables short turn around times between problem detection and problem repair. The 3745 and 3746 9x0 automatically reports problems to the RETAIN system at the IBM remote support facility (RSF), a faster and more efficient method of problem solving.

If there is a problem with the microcode, RETAIN automatically sends any available fix to the calling 3745 or 3746 9x0 controller. The controller, in turn, informs the operator that a fix has been received.

The 3746 9x0 is designed for high availability, and can run continuously during the following procedures:

- Maintenance (concurrent diagnosis and maintenance).
- Installation and reconfiguration of ESCON channel, token-ring, and communication line processors and couplers (concurrent upgrade).

### Expansion

Consolidating existing communication controllers on a single 3745/3746-900 or 3746-950 reduces the workload of system programmers. For example, reducing NCPs will reduce the number of NCP generations.

Migrating communication lines, LAN, and channel connections from the 3745 conventional adapters to 3746-900 adapters reduces the load on the 3745s.

### Connectivity

The high throughput of the ESCON channel adapter combined with the high-performance LAN and WAN adapters significantly reduces data transfer times. This is an asset during peak traffic hours, when adapters may be overloaded.

## Performance

Performance features of the 3746-900 and the 3746-950 include the following:

- By assuming control of data link functions in the 3745 ACF/NCP, the 3746-900 reduces the workload of the NCP, freeing the resources of the 3745 CCU for NCP activities, for example SNA routing.
- Given the same traffic load, the 3745 with a 3746 Model 900[1] operates faster than a 3745 alone. For example, in a pure token-ring and ESCON environment, the 3745/3746 Model 900 maximum data throughput is up to three times that of a 3745 standalone.
- The 3746 Model 900 CLAs increase the number of high-speed lines (there can be up to 32 lines operating at up to 2048 mbps), to allow for more users, improved traffic rate between and applications, and shorter response times.
- The CLA provides Frame-relay frame switching in the 3746 Model 900, independent of the ACF/NCP in the attached 3745. This allows higher switching throughput and frees the 3745 of traffic loads, enabling more processing power to be dedicated to SNA routing.
- The ESCON channel adapter of the 3746 9x0 is designed for fast transfer of large volumes of data, especially highly-interactive client/server applications. Depending on the traffic type (SNA, IP, APPN, or HPR/ANR), a 3746 9x0 with an ESCON channel adapter and a token-ring adapter can transfer data files five to ten times faster than a 3745 equipped with a parallel channel adapter and a token-ring adapter.
- The ESCON channel adapter of the 3746 9x0 supports EMIF to access multiple host images via a single ESCON channel, increasing the utilization of ESCON hardware.

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[1] The actual performance depends on several factors, for example, the system configuration and the mix of traffic types. The configuration aid CF3745 provides performance capabilities for adapters and controllers in specific configurations and traffic environments.

## Growth

The 3745 can migrate toward 3746 ESCON connectivity, Frame-relay technology, and 3746 IP and APPN/HPR routing to allow for more users and network access. The 3746 9x0 permits large number of users and high volume of data in the network. Greater access to networks through the 3745, the 3746-900, and the 3746-950 can be achieved through the following:

- The ESCON channel adapters of the 3746 Model 9x0 can perform the following:
  - Concentrate network traffic on fewer physical interfaces.
  - Route traffic to appropriate ESCON channels via ESCON director(s).
  - Communicate with several LPARs over a single ESCON channel using EMIF.
- The token-ring adapters of the 3746 9x0 can be increased to provide up to 32 LAN ports.
- High throughput in the 3746 9x0 is possible through the following:
  - The 4 mbps/16 mbps token-ring adapters of the 3746-900 off-load the 3745 internal bus and CCU. Up to 70% of the CCU processing load can be saved in for SNA (NCP) traffic by connecting the token-ring LANs to the 3746-900 instead of to the 3745.
  - Token-ring adapter efficiency. Depending on the type of traffic, the adapter throughput can approximately reach the speed of the token-ring LAN (16 mbps). This increases the amount of traffic flowing through a single token-ring port of the 3745, allowing large token-ring backbones to access host data bases and applications.
  - High throughput to the S/390 Servers. In token-ring environments, the 3746 9x0 maximum data throughput is up to 30 times greater than a 3745 standalone.
- The CLAs of the 3746 9x0 provide excellent an price-to-performance ratio for SDLC, Frame-relay, X.25 and ISDN communication lines. The 3746-900 saves the 3745 up to 50% of the CCU processing load, allowing twice the amount of SNA traffic controlled by NCP[2]. Other networks and traffic can be consolidated on the 3745/3746 network, and existing networks opened to new users.
- Frame-relay switching off-loaded to the 3746-900 adapters relieves the 3745 of the corresponding traffic load, and allows an increase in the load of other traffic controlled by the NCP (usually SNA). Frame-relay on the 3746 9x0 supports much higher throughputs than a stand-alone 3745 (not using a 3746-900).
- The 16 MB storage of the 3745 Models 31A and 61A provides the following options:
  - To operate with ACF/NCP load modules of up to 12 megabytes, allowing twice the amount of workstations connected to an SNA network subarea controlled by a ACF/NCP.
  - Greater availability of network designs via alternate paths and duplicate user definitions in ACF/NCP.
- The 3745 Models 31A and 61A has the processing power to manage growth in traffic from increasing the connectivity of the 3745/3746 Model 900.
- The 3745/3746 Model 900 SNA node can migrate to a 3746 IP routing and APPN/HPR node.

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[2] The actual maximum throughput depends on the 3745 model and the type of traffic.

# Chapter 4. Network Solutions

This chapter describes networking solutions that the 3745 and the 3746 9x0 can bring to your network. As these solutions depend on the environment of your network, the following examples illustrates how the 3745 and 3746 9x0 can be applied to each particular environment:

- SNA networking, in which a 3745 with a 3746 Model 900 operates with NCP in a VTAM dependent network.
- APPN/HPR networking, in which a 3746 Model 950 and a 3746-900 operate independently from NCP in a distributed network.
- Mixed SNA and APPN/HPR networking, in which a 3746 Model 900 operates both as an SNA subarea node and a APPN/HPR node.
- Multiprotocol networking, in which 3746 Models 900 and 950 route SNA, APPN/HPR and IP protocols.

This chapter is divided into five parts which describe the following network scenarios:

- The 3746 Model 900 and the 3745 operating in an SNA network.
- The 3746 Nways Controller operating in an SNA/APPN/HPR network.
- The 3746 Nways Controller operating in a multiprotocol environment.
- 3745 and 3746 Model 900 evolution to APPN/HPR.
- 3745 and 3746 Model 900 evolution to multiprotocol.

## 3745 and 3746 Model 900 Operating in an SNA Network

The 3746 Model 900 supports the Advanced Communication Function (ACF)/ Network Control Program (NCP) running in the 3745, usually SNA PU type 4 support. This includes:

- Multilink transmission group (MLTG) support.
- Connectivity to X.25 networks in conjunction with one of the following:
  - X.25 NCP Packet Switching Interface (NPSI) program running in the 3745.
  - ACF/NCP supporting SNA Qualified Logical Link Control (QLLC) connections.
- Primary Rate Interface (PRI) to ISDN networks (Euro-ISDN) for SNA traffic.
- Frame-relay networking, including boundary network node (BNN) function.
- Frame-relay network, including boundary access node (BAN) function.

## Multilink Transmission Group Support

A multilink transmission group (MLTG) is a logical group of physical links for SNA traffic between two 3745/3746-900s. An MLTG can include various transmission media using different data link protocols (Frame-relay, SDLC, ISDN B-channel) and Token-ring LANs. The traffic is automatically distributed over the physical links of the MLTG. If a physical link fails, MLTG provides automatic and non-disruptive data re-routing over other links of the MLTG.

# Connectivity to X.25 Networks

## NPSI Support (SNA and non-SNA Traffic)

The Communication Line Processors (CLP) support ITU-T X.25 protocol in conjunction with the X.25 NCP Packet Switching Interface (NPSI) program running with ACF/NCP in the 3745. This allows the 3746-900 to carry all NPSI, SNA, and non-SNA traffic flows over connections to an X.25 private or public network.

## NCP Support (SNA Traffic)

From the release of NCP Version 7, Release 4, the 3746-900 X.25 Support feature allows the CLPs to perform X.25 Data Link Control (DLC) and Data Packet functions for SNA traffic. Data routing is performed by the NCP, which means that NPSI is not required, and performance is significantly improved as shown below:

- For X.25 SNA traffic, the data throughput of the 3746-900 is multiplied by a factor of up to 10[1]., allowing a 3745 Model 31A to support up to 10, 000 packets per second (128 bytes/packet).
- For X.25 SNA traffic, the load of the 3745 processor (CCU) attached to the 3746-900 is reduced by up to 90%.
- X.25 lines can be used efficiently, close to 100% utilization, and at every speed up to 2.048 mbps.

The X.25 Support of the 3746-900 complies with the ITU-T X.25 revision of 1993, and supports the following:

- Link Access Procedure - Balanced (LAPB) Modulo 8 and 128.
- Packet Layer Protocol (PLP) Modulo 8 and 128.
- Data packet segmentation and reassembly.
- SNA QLLC DTE connections (non-SNA connections require NPSI support).
- BNN subarea, INN subarea, APPN, and HPR/ANR traffic controlled by NCP.
- Permanent Virtual Circuit (PVC) and Switched Virtual Circuit (SVC) connections at speeds of up to 2.048 mbps.
- Extended Numbering (TOA/NPI format).
- Concurrent operations with SDLC, frame relay, X.25 NPSI, ISDN and PPP[2] lines on the same communication line processor.
- Direct attachment of X.25 DTEs (OSI 8208).
- Performance monitoring and accounting through NetView Performance Monitor (NPM).
- Remote NCP loading using mini NCP load modules.

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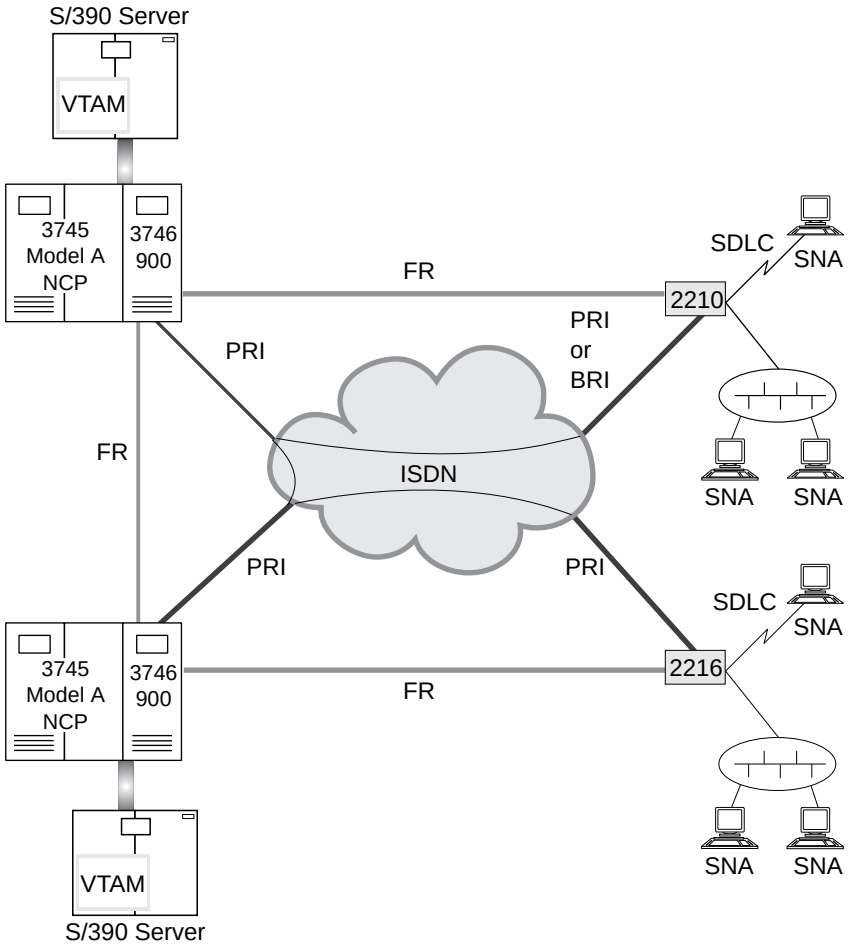
1 The improvement factor varies, depending on the network environment and traffic characteristics (message size, packet size, etc).

2 Point-to-Point Protocol lines are supported by the 3746 IP Router.

# Connectivity to ISDN Networks

## Primary Rate Interface Support (Euro-ISDN)

The 3746-900 supports Frame-relay over ISDN Primary Rate Interface (PRI) to conform with the Euro-ISDN standard. The ISDN PRI ports of the 3746-900 allow ACF/NCP to route SNA traffic and APPN/HPR traffic to remote equipment supporting Frame-relay over ISDN, such as the IBM 2210 Nways Multiprotocol Router, the IBM 2216 Nways Multiaccess Connector, or another IBM 3746 Model 900.




**Legend**:
PRI Primary Rate Interface (30B + D channels)
BRI Basic Rate Interface (2B + D channels)
FR Frame Relay (via leased connections or frame-relay network)

*Figure 4-1. Connectivity to ISDN Network*

An ISDN PRI port on the 3746-900 provides one ISDN D channel reserved for ISDN signalling, and 30 ISDN B channels at 64 kbps for transport of user data. The ISDN B channels of a PRI port are reserved for connections with one or multiple remote equipment. Each PRI port supports 30 simultaneous ISDN connections at 64 kpbs. The 3746-900 does not support ISDN connections that include multiple B channels (H0, H11, and H12), or ISDN calls using the bonding function. However, multiple ISDN B channels connecting two 3746 Model 900s can be used as a single logical connection (MLTG) to provide high bandwidth for communication between two ACF/NCPs.

The 3746-900 can automatically call remote equipment over ISDN. For incoming calls, the calling party's ISDN number is passed to VTAM for a verification process through the user's exit routine. Figure 4-1 on page 4-3 represents a sample network that uses Frame-relay and ISDN connections, both primary (PRI) and basic (BRI). The 3746-900 PRI ports enable the following operations over a switched user network:

- Call on demand
- Additional bandwidth
- Frame-relay backup.

## Call on demand

When equipment does not need to be permanently connected to the 3746 Model 900, ISDN can establish connections specifically for the duration of data transmissions. Up to a maximum of 30 ISDN B channels per PRI port (1920 kbps) can be allocated to provide the necessary bandwidth.

## Additional bandwidth

The advantages of additional bandwidth are as follows:

- When traffic rates exceed the capacity of permanent connections, temporary connections over ISDN can be used to provide additional bandwidth. This means that the maximum bandwidth required for peak traffic times does not need to be permanently available for leased connections.
- For NCP-to-NCP traffic between two 3745/3746-900s, the Frame-relay connection can be supported at peak traffic time by one or more ISDN B channel connections (see Figure 4-1 on page 4-3).
- The MLTG support of NCP allows Frame-relay and all the ISDN connections to be aggregated as a single logical connection between two controllers.

## Frame-Relay Back Up

NetView alerts from a Frame-relay link failure or port failure can be used to trigger one or multiple ISDN calls (one per B channel) from the 3746-900 to the remote Frame-relay terminating equipment. The following are scenarios of backup for frame-relay:

- If a frame-relay connection with the 2210 fails, the 3746-900 restores the connection with the 2210's BRI port (two ISDN B channels at 2 x 64 kbps). (See Figure 4-1 on page 4-3.)
- For NCP-to-NCP traffic between two 3745/3746-900s, a MLTG can be defined to include the Frame-relay link(s) with the ISDN B channels required to back-up a failing Frame-relay link (a maximum bandwidth of 1920 kbps per ISDN PRI port at 30 x 64 kbps). If the Frame-relay connection fails, the 3746-900 performs the ISDN calls to the second 3746-900. All the ISDN B channels of

the MLTG are treated as a single logical connection between the two controllers (see Figure 4-1 on page 4-3). Once the Frame-relay connection is restored and active in the MLTG, the ISDN connections can be released non-disruptively through the Command list of NetView. An effective way to avoid equipment disruption during a Frame-relay failure is to establish one permanent ISDN B channel between the two 3746-900s.

## Frame-Relay Networking

ACF/NCP Version 7 Release 2, and higher support Frame-relay connections on the 3746-900.

The 3745 and the 3746 Model 900 can be used to build a Frame-relay network using leased lines.

The Communication line adapters (CLAs) of the 3746 Model 900 support frame-relay terminating equipment (FRTE) and Frame-relay frame handler (FRFH).

### Frame-Relay Switching (FRFH)

Equipment that encapsulates messages in Frame-relay frames (I-233) can transparently communicate with each other across 3745/3746 Model 900-based Frame-relay networks.

Frame-relay switching is off-loaded from the 3745 CCU to the adapters of the 3746 Model 900. This provides high switching rates, making the 3745/3746-900 a powerful Frame-relay node. Each CLA can switch up to 3000 Frame-relay frames per second (64 bytes per frame).

### Bandwidth Reservation

The 3745 and 3746 Model 900 can select the minimum bandwidth allocation of individual virtual circuits between two end stations. This establishes the given communication rate of traffic flow on any given connection (virtual circuit). Any unused bandwidth is automatically allocated to active connections, allowing traffic on these connections to flow faster than the minimum defined communication rate.

### Frame-Relay Boundary Access Node (BAN)

Frame-relay boundary access node (BAN) allows the 3745 and 3746-900 to communicate with Frame-relay devices and any SNA physical units (PUs) downstream. Frame-relay devices are connected via leased lines or a Frame-relay network, and can include the following:

- 2216 Nways Multiaccess Connector
- 2210 and 6611 router
- 2217 Multiprotocol Concentrator
- 2218 Frame-relay Access Device (FRAD)
- PS/2 equipped with Route Expander/2.

**Dynamic route selection**

The 3745/3746-900, in conjunction with ACF/NCP Version 7 Release 3 (and higher), dynamically routes the SNA flow from the downstream PUs to the appropriate destination, eliminating the need for an additional router adjacent to the 3745/3746-900.

**Multiple stations over the same DLCI**

Frame-relay BAN uses the Remote Function Call (RFC) 1490 bridged-frame format. BAN support by the 3745, 3746-900, 2210, 2216, 2217, 2218, PS/2, and 6610 uses medium access control (MAC) address multiplexing to minimize system definition in the boundary access node and NCP. This allows a practically unlimited number of stations to use the same Data Link Connection Identifier (DLCI) number.

The number of stations using the same DLCI is limited only by the bandwidth of the Frame-relay link between the Frame-relay access node and the 3745 or 3746-900.

**Multiple DLCIs over the same Frame-relay link**

Although only one DLCI is needed between the 3745 or 3746-900 and the Frame-relay device, Frame-relay BAN can support multiple DLCIs between controllers and Frame-relay devices.

**Frame-relay support for other Communication Controllers**

Installed Communication Controllers that do not support frame-relay connections (for example, the IBM 3720 and 3725) can be connected to an IBM 2210 or 2216. The 372x traffic is bridged over the Frame-relay link (BAN function) by the 2210 or 2216. The 372x can then communicate with NCP Version 7 Release 5 over the Frame-relay port of the 3746-900. This function of the 3746-900 and NCP is called Frame-relay BAN for NCP subarea traffic.

## Frame-Relay Boundary Network Node (BNN)

Frame-relay BNN allows the 3745 and the 3746 Model 900 to route SNA traffic for Frame-relay attached equipment, such as the following:

- 2217 Nways Multiprotocol Concentrator
- 3174 Establishment Controller
- PS/2 with Route Expander.

Up to 127 physical units connected to an IBM 3174 Establishment Controller can access the 3745 or the 3746 Model 900 over a single DLCI. This function is called service access point (SAP) multiplexing. The Frame-relay BNN function uses RFC 1490 routed-frame format.

## Data Link Control Identifiers (DLCI)

Depending on the 3746-900 configuration, each communication line processor (CLP) can support between 500 or 3000 DLCIs for identifying Permanent Virtual Circuits (PVCs).

Figure 4-2 on page 4-7 illustrates Frame-relay support for the 3745/3746-900.

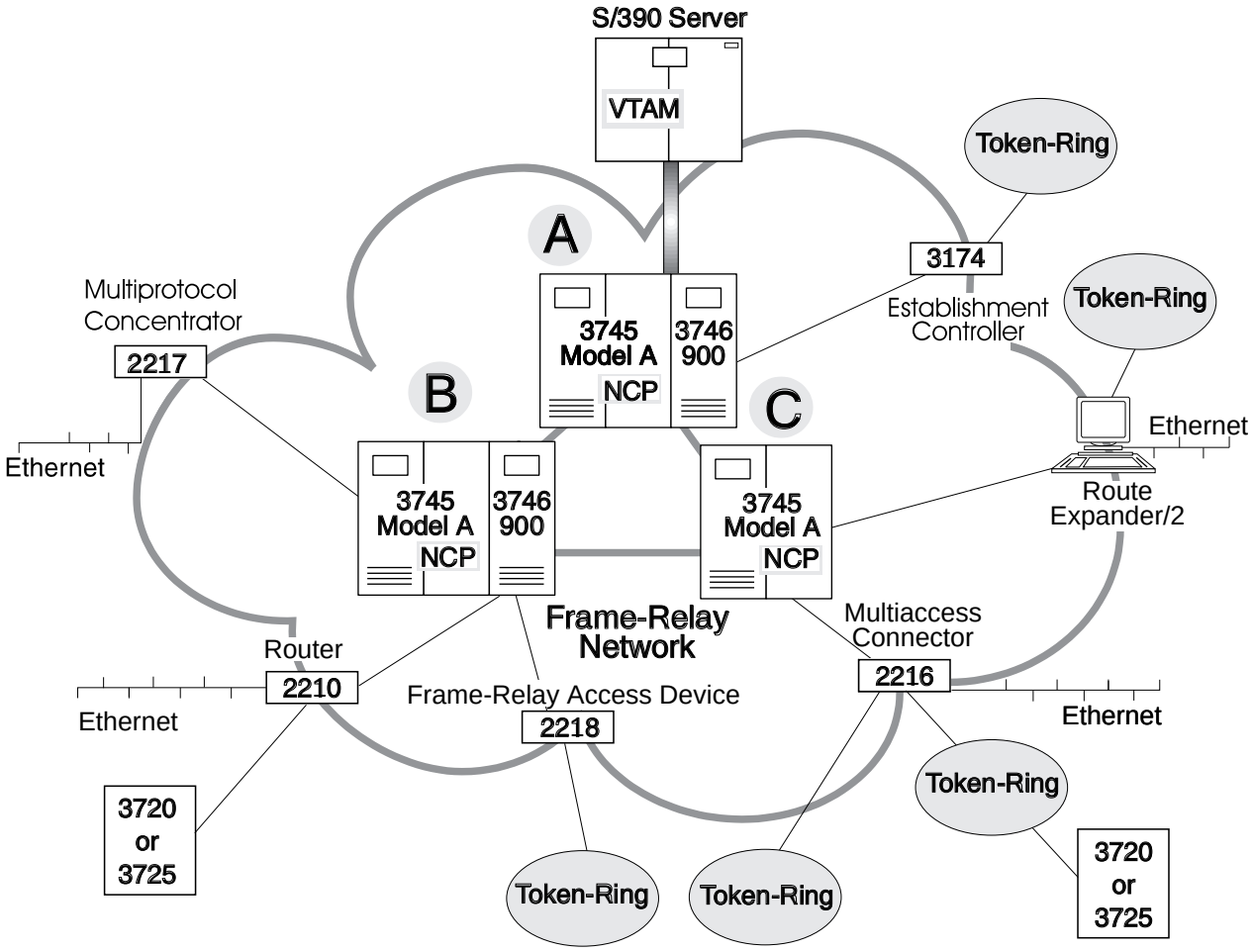



*Figure 4-2. Frame-Relay Networking for the 3745/3746 Model 900*

## Non Disruptive Route Switching

Frame-relay networking in the 3745/3746 Model 900 provides a significant increase in availability, as described in the following functions:

- Frame-relay frame switching substitute subport. This function provides alternate Frame-relay virtual circuit capability for SNA and non-SNA traffic to allow automatic, non-disruptive route switching between Frame-relay terminating equipment connected to 3745 or 3746 Model 900 controllers.

  For example, in Figure 4-2, non-SNA devices connected to the 2210 can communicate with partner devices connected to the 2216, either via nodes **B** and **C** or via nodes **B**, **A**, and **C**.

- Multilink transmission group (MLTG) support for SNA traffic. This function allows automatic, non-disruptive route switching if lines or intermediate nodes fail. Several Frame-relay links or virtual circuits on different physical links (possibly going through intermediate 3745s and 3746-900s), can function as a single, logical end-to-end transmission group.

  For example, in Figure 4-2, the circuit grouping of **A**-**B** and **A**-**C**-**B** can form an MLTG, allowing SNA traffic between Frame-relay node **B** and S/390 applications to flow via two different physical paths.

## Internet Protocol (IP) Routing

NCP (NCP V7R4) supports native IP routing over the following:

- Frame-relay lines connected to the 3745
- Token-ring LANs attached to the 3745
- Parallel channel adapters of the 3745
- ESCON channel adapters of the 3746-900.

A single Frame-relay DLCI can support both IP and SNA traffic (for example BAN traffic) for an RFC 1490 compliant Frame-relay device. Using separate DLCIs allows the line bandwidth to be allocated differently for SNA and IP traffic.

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# 3746 Nways Controller Operating in an SNA/APPN/HPR Network

When operating in an APPN/HPR or mixed SNA and APPN/HPR environment, the 3746-900 and 3746-950 provide the following networking capabilities:

- APPN/HPR network node services
- DLUR services
- ANR and RTP services for HPR traffic.

## APPN/HPR Network Node

The 3746 9x0 supports APPN/HPR network node functions including network node services for the APPN end nodes connected to the 3746 (adjacent end nodes). As a network node, the 3746 has the following functions:

- Automatic update of the network connection topology.
- Dynamic location of network resources.
- Computation of network routes.
- Registration of adjacent end nodes to the APPN central directory server node (for example, VTAM).

The 3746 Network Node supports the following types of end-node connections (see Figure 4-3 on page 4-9):

- APPN (PU type 2.1, such as PS/2s and IBM 3174s).
- Non-APPN (PU types 1.0 and 2.0, such as 3270-type devices)
- LEN (PU type 2.1, such as IBM System/36* or nodes without APPN installed, for example, an IBM AS/400*, IBM 3174, IBM PS/2, or other PCs).

The 3746 9x0 APPN/HPR control point functions are performed by the network node processor. Data is routed by adapters without any control point intervention, either port-to-port within an adapter or adapter-to-adapter. This allows the 3746 9x0 to support high speed data transfer.

## Dependent Logical Unit Requester (DLUR)

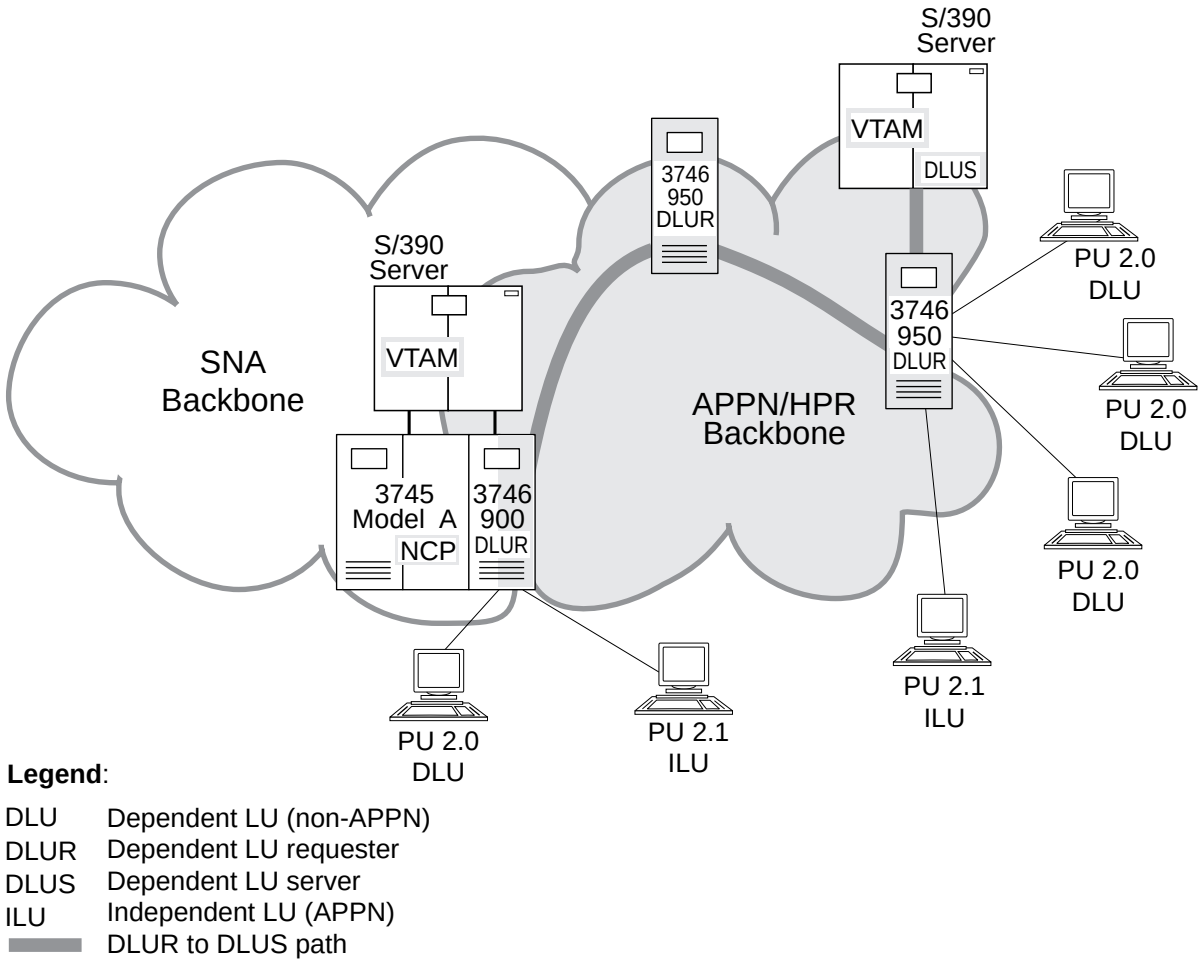


*Figure 4-3. Support for Dependent LUs*

The 3746 network node allows existing host-dependent SNA devices to access S/390 applications across an APPN/HPR backbone network. For example, a physical unit type 1.0 or 2.0 attached to the 3746 controller can access applications in either S/390 servers across the network (see Figure 4-3). This is made possible under the following conditions:

- Host-dependent logical units (LUs) run a control session with their VTAM system services control point (SSCP), and instruct the dependent LUs to request VTAM to set up LU-LU sessions. In an LU-LU session, the dependent LU (secondary LU) can exchange data with the application LU (primary LU).
- In an APPN environment, dependent LUs (DLU) must reside on, or be owned by an APPN node with DLUR. The DLUR node requests the dependent logical unit server (DLUS) of a VTAM network node to provide SSCP services for dependent LUs. Sessions are established for the dependent LUs by the flow of SSCP-PU or SSCP-LU data through two LU 6.2 sessions between the DLUR node and DLUS node.

The 3746 9x0 provides DLUR, in conjunction with the DLUS support of VTAM Version 4 Release 2 or higher. In a network with multiple VTAMs, only one VTAM with DLUS support is required.

The DLUS can be placed in any APPN/HPR network, provided that an APPN path exists between the DLUS and each DLUR.

## High-Performance Routing (HPR)

Both the IBM 3746 Model 900 and 3746 Model 950 support HPR, an extension of APPN architecture designed to establish fast links with low error rates. HPR enhances the flow of data through routing mechanisms and provides the following:

- Dynamic re-routing around failed nodes and links without loss of sessions.
- Better routing performance.
- Enhanced congestion control to improve link efficiency.
- Reduction of storage required in intermediate nodes.
- High data throughput between the S/390 servers and the network.
- Synergy with the parallel SYSPLEX processor. This provides end-to-end non-disruptive path switching to the applications, including support by the S/390 of multi-node persistent session (product direction).

The HPR architecture is comprised of two layers:

- ANR in the intermediate nodes, the HPR base.
- RTP in the edge nodes, the HPR transport tower.

## ANR Layer

ANR routes data packets across an HPR network, and uses a new form of addressing to identify network routes. This form of addressing is based on the links and nodes that make up the route, and consists of labels contained in the data packet header. Each label describes the outbound link for exiting an intermediate node, so that the processing performed in each intermediate node is reduced. ANR layer has the following advantages:

- Source-independent routing.
- Connectionless, stateless, and fast routing, without the need for hop-by-hop error recovery procedures (non-ERP mode).
- Removal of incoming packets during line congestion.

## RTP Layer

RTP establishes end-to-end connections between edge nodes of the APPN/HPR network. Each RTP connection carries traffic for multiple end-to-end user and control sessions. RTP works with ANR in forwarding packets across an HPR network. The RTP layer results in the following advantages:

- Transport of APPN and SNA boundary traffic (DLUR).
- Selective transmission based on class of service.
- Using Adaptive Rate Base (ARB) for controlling flow and avoiding network congestion.
- End-to-end error recovery and selective re-transmission.
- Non-disruptive re-routing around network failures.

## HPR Multi-Link Transmission Group (MLTG)

HPR MLTG operates between two 3746-9x0 Network Nodes in conjunction with CS/2. MLTG enables the 3746 Models 900 and 950 to use a variable bandwidth on a single logical Transmission Group (TG) composed of multiple physical links or LANs. This is an advantage when single or multiple sessions require more bandwidth than a single physical link or LAN can provide.

The MLTG is defined by a single TG number. This is reported and recorded as a single TG by the Topology Management, and viewed as a single TG in the route calculation process. If there are errors in the link rates, error recovery can be determined on an individual link basis. If links become obsolete, they can be removed from the MLTG to save costs.

HPR MLTG is supported over SDLC, Frame-Relay, X.25 links, Token-Ring and Ethernet LANs.

## 3746 Model 900 as a Mixed SNA and APPN/HPR Node

In a mixed SNA and APPN/HPR network, the 3746-900 can operate as the following:

- An SNA node (PU type 4) for network resources owned by the NCP running the 3745.
- An APPN/HPR network node (PU type 2.1) for resources owned by the 3746 APPN/HPR control point.

Figure 4-3 on page 4-9 shows a scenario where a 3745/3746-900 is channel-attached to a VTAM, and operating as an interchange node (ICN). As an ICN, the 3745/3746-900 allows the following types of access:

- SNA devices connected on the SNA back bone to applications over the APPN/HPR backbone.
- SNA/APPN devices connected on the APPN/HPR backbone to access S/390 applications over the SNA backbone.

This effectively provides any-to-any networking.

## X.25 Network Connectivity

Supporting X.25 for natively controlling X.25 connections removes the need of support from NCP or the NCP Packet Switching Interface (NPSI). This means that the 3746 can attach to private or public X.25 networks as DTE nodes for routing APPN, SNA/DLUR, HPR, and IP traffic over X.25 connections. Support for X.25 would include the following:

- QLLC connections for APPN, SNA/DLUR, and HPR traffic.
- Routing of mixed APPN, SNA/DLUR, HPR, IP, and SNA/NCP traffic on the same X.25 link.
- PVC and SVC connections.
- Up to 2.048 mbps speed.
- Direct DTE-to-DTE attachment.
- SDLC, Frame-relay, ISDN, X.25, X.25 NCP, and X.25 NPSI links attached to a single CLP.

## Frame-relay Networking

The 3746-900 and 3746-950 provide Frame-relay networking functions similar to those provided by NCP for 3746-900 (see “3745 and 3746 Model 900 Operating in an SNA Network” on page 4-1).

## Physical Media

The 3746-900 network node and 3746-950 provide the same connectivity. Both support:

- ATM
- Token ring and Ethernet LANs
- Leased Frame-relay links
- Switched and leased SDLC links
- ESCON channels
- Frame-relay network connections
- X.25 network connections.

The 3746 network node supports RFC 1490, including:

- Frame-relay BAN
- Frame-relay BNN.

More information about the adapters that support the 3746 network node connectivity can be found in Chapter 5, “Flexible and Expandable Connectivity.”

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# 3746 Nways Controller Operating in a Multiprotocol Environment

The IBM 3746 9x0 operates as an IP router and APPN/HPR network node, enabling separate networks to be consolidated over a single multiprotocol transport network, while routing established SNA boundary traffic.

## Internet Protocol (IP) Routing

The 3746-900 and 3746-950 support a highly developed set of IP routing functions, similar to the 2210 Nways Multiprotocol Router and the 2216 Nways Multiaccess Connector. The 3746 IP router allows dynamic routing of IP traffic over token-ring and Ethernet LANs, ESCON channels, frame-relay and X.25 networks, leased lines (using Frame-relay or PPP), and ATM bridging. As IP routers, the 3746-900 and 3746-950 can connect the following:

- Multiple networks to form an Internet.
- Dissimilar networks for routing data from one network to another.

The 3746 native IP support includes the following protocols:

- RIP (Version 1). A method for routers to exchange topology information with other routers on the Internet. RIP arranges information on a router's database to be sent to other connected routers. RIP Version 2 is fully supported on the MAE (see “Value Added Network Functions” on page 2-7).
- OSPF (Version 2). Support for different kinds of networks, for example PPP and broadcast (Ethernet or token-ring) networks. OSPF is the recommended topology exchange protocol for the Internet.
- Border gateway protocol (BGP V4). Support for non-hierarchical topologies, and functions as a dynamic routing protocol for running two or more autonomous

systems. BGP filters information on path attributes as a method for selecting the best route.

IP packets are routed by the adapters, either port-to-port within the adapter, or adapter-to-adapter.

The NNP of the 3746 performs the same configuration and management functions as the IP router and the APPN/HPR network node.

The IP router performs the following:

- Standard SNMP support for network management via NetView/AIX* or other platforms.
- Concurrent IP, APPN/HPR and SNA (NCP) routing over the same adapters.
- Efficient control of access and filtering.
- High data throughput between S/390 servers and the network, allowing consolidation of S/390 front-end equipment (SNA and IP).
- Single front-end equipment access to TCP/IP MVS and VTAM applications (simplifying the installation of S/390 servers).
- Cost reduction by consolidating IP and SNA networks over a single multiprotocol transport network (using Frame-relay for data link control).
- Native routing of IP, APPN/HPR and SNA (NCP) traffic on the following media:
  - ATM
  - PPP
  - ESCON channel
  - Token-ring LAN
  - Ethernet LAN
  - Frame-relay link
  - X.25 link.

Native routing, versus encapsulation, preserves the advantages of each individual protocol.

**Note:** NCP traffic is not supported for ATM or PPP DLCs.

## 3745 and 3746 Model 900 Evolution to APPN/HPR

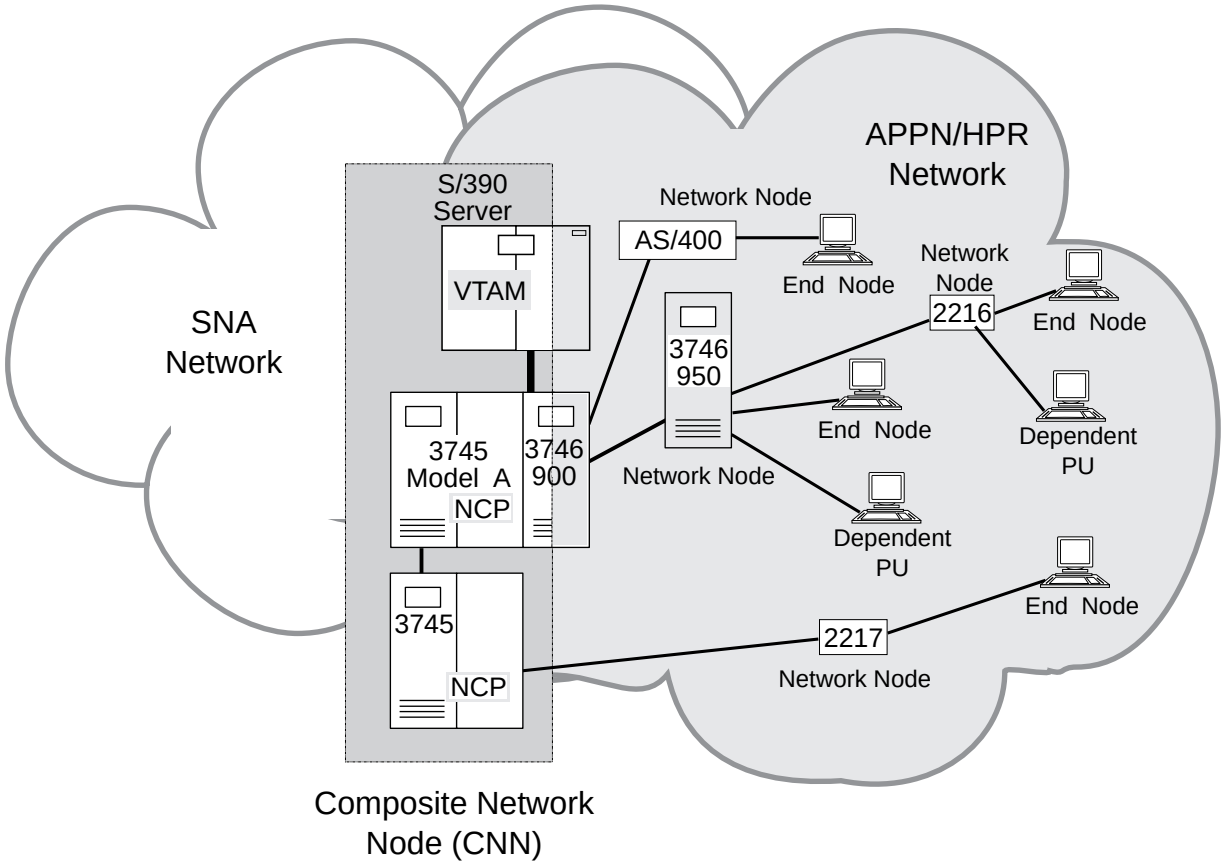



*Figure 4-4. APPN/HPR Composite Network Node in an APPN/HPR Network*

## Composite Network Node Function (3745/3746-900)

VTAM and NCP function as a composite network node (CNN), allowing an SNA network to communicate with an APPN/HPR network. A CNN consists of a VTAM and one or more 3745s or 3745/3746-900s working together as an APPN/HPR network node (see Figure 4-4). The communication controllers of a CNN support APPN and HPR/ANR protocols and appear to an attached node as a single network node. In addition to Network Node functions, the 3745s and 3746-900s of a CNN support SNA protocols, providing an SNA boundary for attached dependent logical units. A CNN supports ANR for HPR traffic, and allows SNA-based networks to migrate to APPN/HPR-based networks.

## 3745 and 3746 Model 900 Migration to APPN/HPR using a CNN

The CNN interconnects 3745 network nodes, enabling them to be individually upgraded to APPN network nodes (for example, replacing the 3745 with the 3746-950). As shown in Figure 4-4, a front-end 3746-900 can operate within a CNN for SNA connections, and also as an APPN network node for any APPN connections that can be moved to the 3746. These connections primarily include:

- All controllers that have migrated to APPN network nodes (see the 3746-950 in Figure 4-4).

- Other network nodes (see the AS/400 in Figure 4-4).
- Non-native APPN units, operating under DLUR in the 3746 (in conjunction with the DLUS function of VTAM).
- The VTAM network node.

VTAM, as an interchange node, operates as a PU type 5 within the composite network node, and as a PU type 2.1 within the APPN network.

Connecting the 3746-900 NN internally to the 3745/3746-900 CNN allows one network node to communicate with another.

Connecting to the 3746-900 network node has the following advantages:

- Higher data throughput by means of routing via the 3746 adapters instead of the 3745.
- Freeing the 3745 of heavy traffic.
- 3745 storage requirements for PUs and sessions controlled by the 3746-900 NN are reduced, increasing the connectivity independently of the 3745 storage limit.

## 3725 and 3745 Migration to APPN/HPR without a CNN

The dependent LU requester (DLUR) function of the 3746-950 or other APPN/HPR equipment can facilitate the migration of VTAM-dependent SNA networks to 3746-based APPN/HPR networks (see page 4-9).

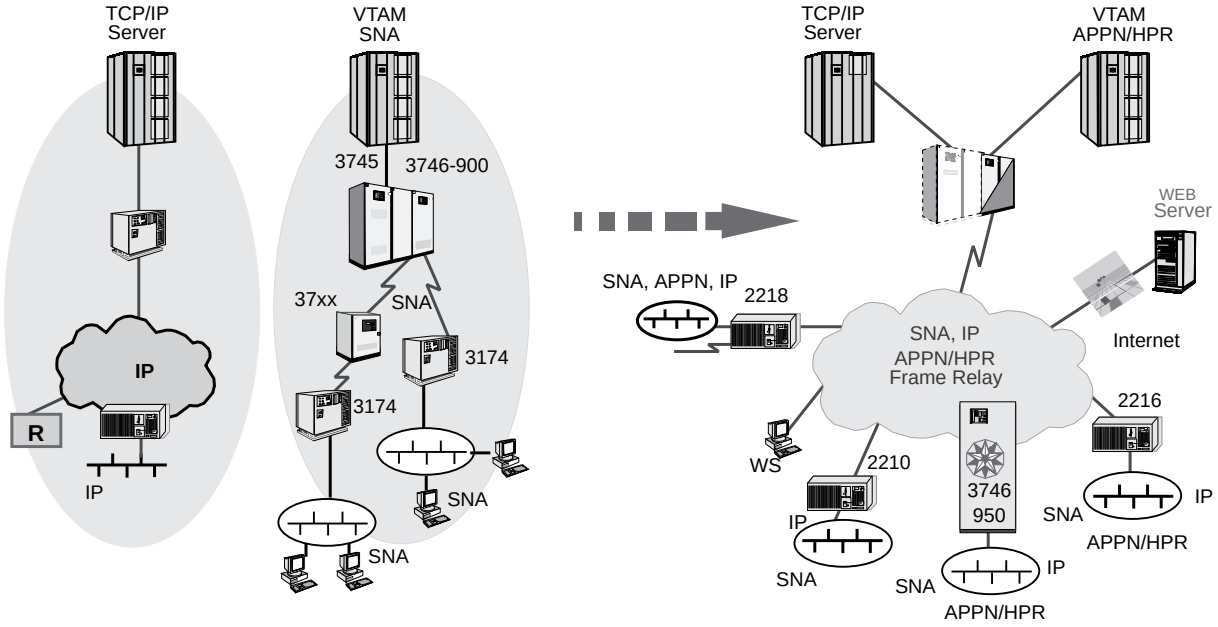
A possible scenario would be as follows:

1. Configure VTAM with a dependent LU server (DLUS) in the communication management configuration (CMC) of the S/390 server.
2. From the SNA network periphery, progressively replace the 3725s and 3745s with IBM 2216 Multiaccess Connectors and 3746-950s operating as APPN/HPR Network Nodes (NN) with dependent LU support.

VTAM and NCP can also allow APPN/HPR network nodes to access VTAM APPN/HPR nodes across the remaining part of the SNA backbone.

## 3745 and 3746 Model 900 Evolution to Multiprotocol

A multiprotocol Frame-relay backbone network can be created with controller-based and router-based networks. All nodes, controllers and routers, would be fully interoperable, using Frame-relay RFC 1490.




Branch concentration, usually through SNA equipment (for example, a 3174) and an IP router, can be performed by a single concentrator, routing multiple protocols over a Frame-relay connection. The concentrator could be any of the following:

- 2210 Nways Multiprotocol Router
- 2217 Nways Multiprotocol Concentrator
- 2218 Nways Frame-Relay Access Device.

Regional concentration and access to the backbone network (for example, through a 3720, 3725, or 3745) and an IP Router can be performed by a single 2216 Nways Multiaccess Connector or a 3746-950 for large sites.

S/390 server access to a TCP/IP server gateway (for example, through a 3725 or a 3745 connected to a 3746-900) can be performed by a 3745 attached to a 3746-900 or a 3746-950. Any installed 3746-900 can be upgraded for IP routing and APPN/HPR, or converted to a 3746-950.

Consolidating networks with the 3746 Nways Controllers has the following advantages:

- Reduction of circuit costs (single link for multiple protocols).
- Reduction of network management costs, network complexity, and personal skill requirements (only one network infrastructure).
- Lower bandwidth costs by utilizing these solutions:
  - Native routing of SNA, IP, APPN, and HPR to lower the overhead of protocol encapsulation into a single network protocol.
  - Bandwidth management, using COMRATE for traffic under the control of NCP, with Committed Information Rate (CIR) and Bandwidth Reservation

System (BRS) for traffic under the control of the network node processor (NNP).

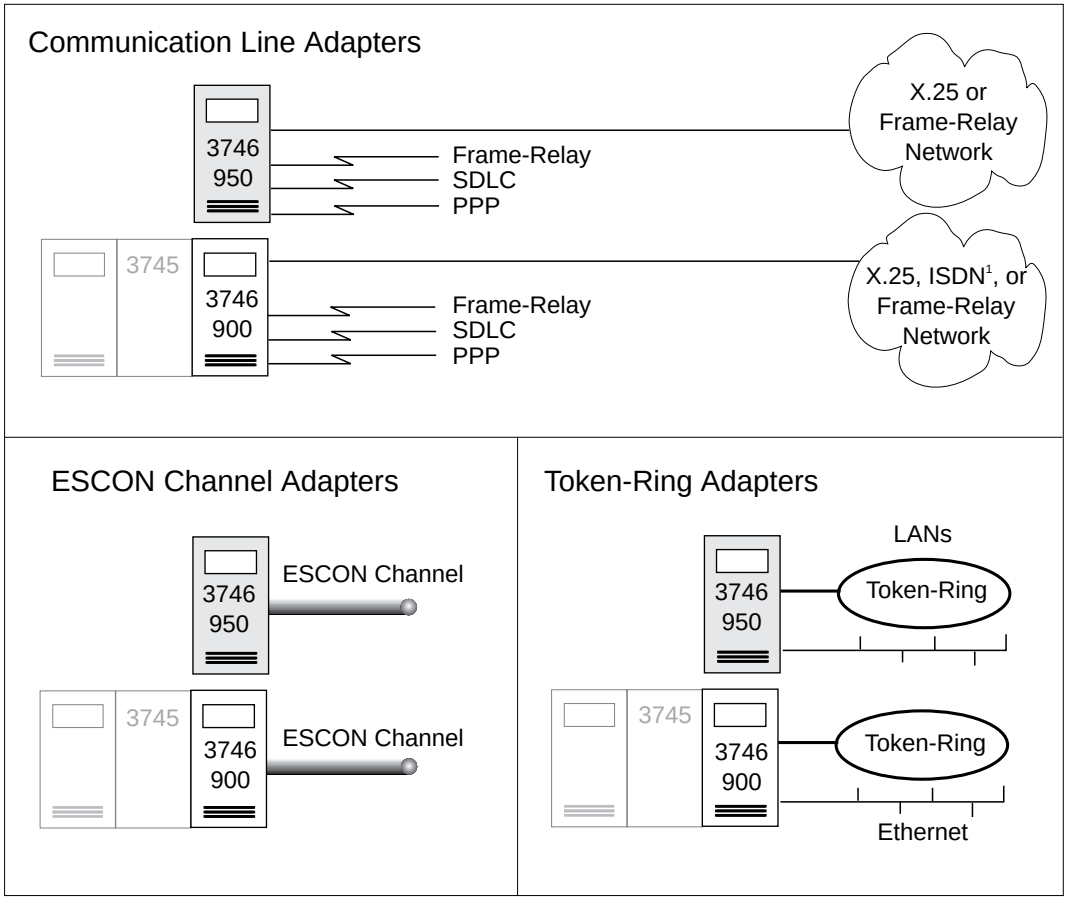
- Communication with a remote router rather than a local router connected to the controller (the 3746 and remote routers support Frame-relay BAN).
- Flexibility in network attachment, network topology, and server location.

# Chapter 5. Flexible and Expandable Connectivity

The 3746-900 and the 3746-950 share the same connectivity options which include the following:

- Space for 16 adapters.
- Connection to the MAE via an empty processor slot.
- A choice between three of the following adapter types (see Figure 5-1):
  - Communication Line Adapter (CLA)
  - ESCON Channel Adapter (ESCA)
  - Token-Ring Adapter (TRA).
  - ATM adapters in the MAE.
  - Ethernet adapters in the MAE.

Each type of adapter and their specific licensed internal code (APPN/HPR, APPN/HPR and IP, or NCP for the 3746-900) can be configured during installation.




[1]Connectivity to ISDN networks requires ACF/NCP support in the 3745.

*Figure 5-1. Three Adapter Options for Different Types of Connectivity*

The 3746 NN can support a total of up to:

- 240 lines.
- 5000 PUs, APPN/HPR nodes and SNA PUs.
- 15,000 APPN and dependent LU sessions.

  **Note:** A future release will support 30,000.

As an HPR/ANR node, the 3746 NN supports any number of HPR/ANR sessions.

For a summary of the 3746 network node and adapter connectivity, refer to Appendix C, “Connectivity of the 3746 9x0 APPN/HPR Network Node” on page C-1.

## 3746 9x0 Network Environment

Figure 5-2 shows an example of 3745, 3746-900, and 3746-950 network using Frame-relay, X.25, and ATM environments.

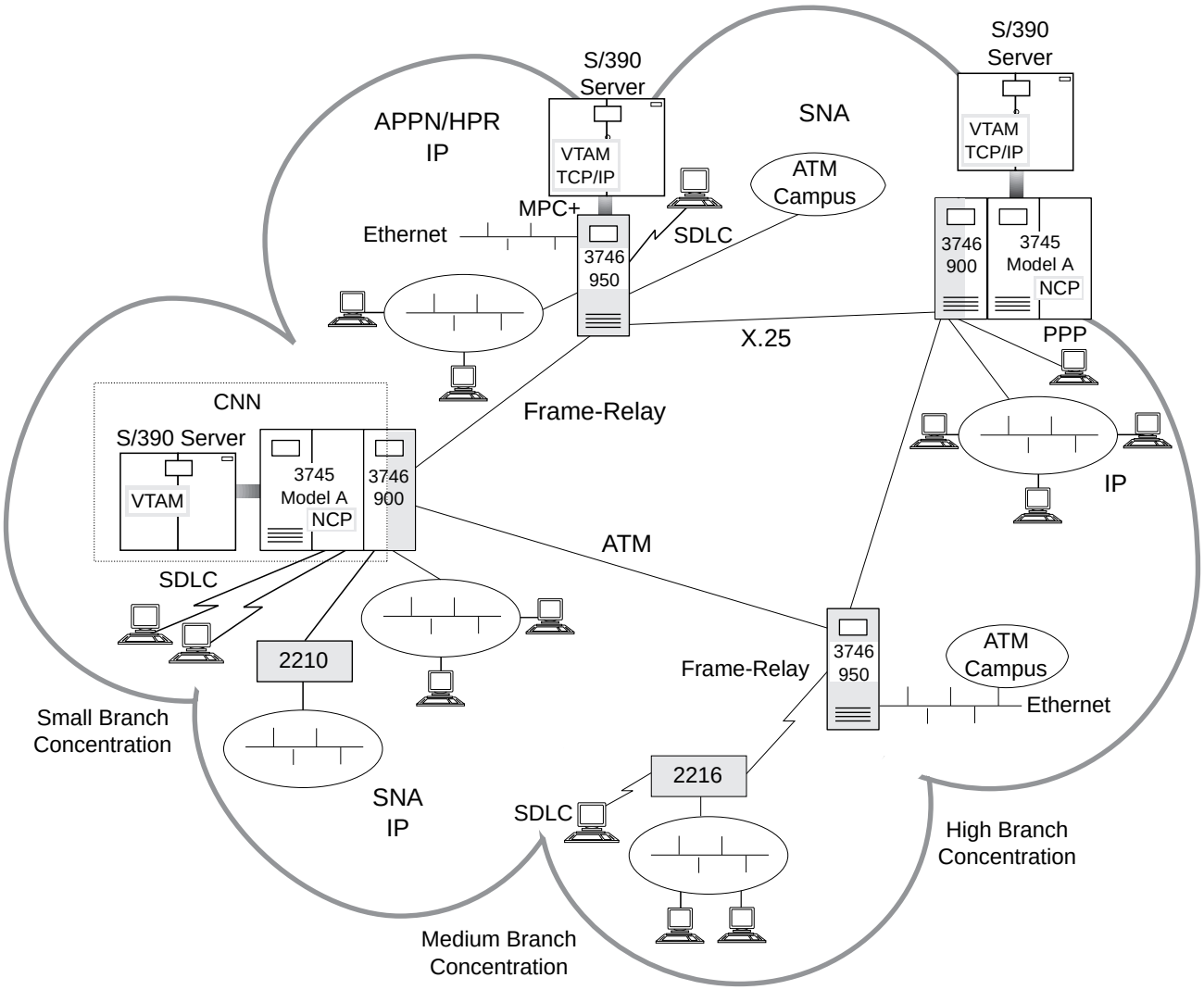



*Figure 5-2. 3746 Model 900 and Model 950 Network Environment*

## Communication Line Adapter (CLA)

The 3746 9x0 communication line adapter (CLA) consists of the following (see Figure 5-3 on page 5-3):

- Communication line processor (CLP, CLP2, and CLP3).

- Any mix of up to four line interface couplers (LIC), types 11, 12, or 16 (LIC11, LIC12, or LIC16).

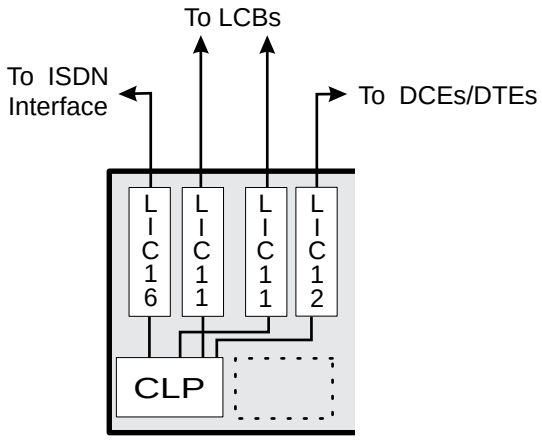



*Figure 5-3. Communication Line Adapter.*

The CLA of the 3746 provide the following:

- High connectivity and increased performance
- Cabling flexibility
- Backup capability (using CLP pairs).

Up to 120 active communication lines can be attached to each CLP.

Communication lines operate in half- or full-duplex mode, using SDLC, PPP, Frame-relay, or X.25 line protocols. The LIC16 uses Frame-relay for primary access to Euro-ISDN.

**Note:** ISDN connections are not supported by the 3746 NN or the 3746 IP router. Support for ISDN can be programmed in the 3746-900 with ACF/NCP (see page B-14).

CLAs support:

- V.24 leased and switched lines (600 bps up to 28.8 kbps)
- V.35 leased lines (56 kpbs up to 2.048 mbps)
- X.21 leased and switched lines (600 bps up to 2.048 mbps)
- V.25 bis protocol over V.24 switched lines.

**Note:** The X.21 switched operation is only supported for connecting an external ISDN terminal adapter to an SDLC port controlled by ACF/NCP (3746-900).

CLAs with speeds up to 256 kbps are connected to the LIC11 through a line connection box (LCB). LCBs can be remote from the 3746 9x0, while housing the active remote connectors (ARCs) that provide the interface to line equipment. LCBs provide flexibility, expandability, and simplified cabling.

High availability is optimized when each CLP backs up the other in pairs. For further information, refer to Chapter 7, “High Availability.”

## 3746 Model 900 With NCP Support

If CLP operations in the 3746 APPN/HPR or 3746 IP routing are deactivated, the connectivity options for CLP3 are as follows:

- For SDLC connectivity, each CLP3 can support a 1000 PUs simultaneously (for example, 3174s and downstream PUs). Any ratio of PU-sharing between the LICs on the same processor can be used, for example, 100 PUs can be activated via one LIC11 and 200 via a second LIC11, 300 via a third LIC11, and so on.
- In addition to SDLC connectivity, each CLP3 can support a total of up to 3000 PUs over the following:
  - Any mix of Frame-relay and ISDN interfaces
  - 3000 Virtual Circuits over X.25 connections (one PU per SVC or PVC)
  - Any mix of the above up to 3000.
- Each CLP3 can support 2000 data link connection identifiers (DLCIs), of either Frame-relay terminating equipment (FRTE), or Frame-relay switching equipment (FRSE), distributed at random over active Frame-relay and ISDN lines. The CLP3 supports multiplexing for multiple SNA stations (PUs) over a single Frame-relay DLCI. The following equipment can function for stations on a Frame-relay DLCI:
  - 3174 Establishment Controller
  - 2217 Nways Multiprotocol Concentrator
  - 2210 and 6611 Multiprotocol Routers
  - 2216 Nways Multiaccess Connector
  - 2218 Frame-relay Access Device
  - PS/2 (running Route Expander/2).

## Support for the 3746 NN and 3746 IP

When a 3746-900 or a 3746-950 operate as an APPN/HPR or IP router, the connectivity options of a CLP3 are as follows:

- Support for a maximum of 2000 DLCIs over Frame-relay connections. For the 3746-900, this includes DLCIs over ISDN connections (controlled by NCP). Any Frame-relay or X.25 port can concurrently handle APPN, Dependent LU, HPR, IP, and NCP traffic (for the 3746-900).
- Support for any mix of the following Frame-relay and X.25 stations up to 2000:
  - PUs multiplexed over Frame-relay DLCIs including ISDN connections for the 3746-900
  - Up to 2000 Frame-relay DLCIs for IP traffic
  - PUs connected over X.25 with one PVC or SVC per active PU
  - X.25 Virtual Circuits carrying IP traffic
  - X.25 Virtual Circuits controlled by NPSI for the 3746-900.

The CLP3 of the 3746-900 can be shared between traffic controlled by NCP, the 3746 NN (APPN, Dependent LU, and HPR traffic), and the IP Router. The connectivity options of the 3746-900 CLP3 are as follows:

- SDLC port supporting:
  - NCP traffic from CCU-A
  - NCP traffic from CCU-B (for a 3745 running two active NCPs)
  - 3746 Network Node traffic.
- PPP port supporting 3746 IP Router traffic.
- Frame-relay or X.25 port supporting:
  - NCP traffic from one CCU
  - 3746 Network Node traffic

  - 3746 IP traffic
  - Any mix of the above.
- ISDN port supporting NCP traffic from one CCU.
- The CLP3 supports up to 3000[1] PUs over SDLC lines and 1000[1] PUs over any mix of Frame-relay, X.25 and ISDN lines, of which a maximum of 2000[1] PUs can be controlled by the 3746 NN. The remaining PUs are controlled by the NCP(s) running in the 3745. The CLP3 supports up to 8000[1] APPN/Dependent LU sessions controlled by the 3746 Network Node, and any number of HPR sessions (ANR) established by HPR edge nodes.

The CLP3 of the 3746-950 can be shared between traffic controlled by the 3746 NN (APPN, Dependent LU, and HPR) and traffic controlled by the 3746 IP router. A given port can be assigned to the 3746 NN traffic (SDLC port), the 3746 IP router traffic (PPP port), or both traffic through a Frame-relay or X.25 port. The connectivity options for the 3746-950 CLP3 are as follows:

- Support for up to 3000[1] active PUs (APPN/HPR nodes and/or dependent PUs) over a mix of SDLC, Frame-relay and X.25 lines.
- Support for up to 8000[1] APPN/Dependent LU sessions, and any number of HPR sessions (ANR) established by HPR edge nodes.
- The CLP3 can support up to 2000 Virtual Circuits carrying IP traffic, including X.25 PVCs, X.25 SVCs, and up to 2000 Frame-relay DLCIs. This number includes all the PUs multiplexed over Frame-relay DLCIs, as well as any other X.25 Virtual Circuits (one PVC or SVC per remote active PU).

**Note:** For more information about CLAs, refer to Appendix A, “Minimum Configuration of the 3745 and 3746.”

## ESCON Adapters

Native support of ESCON architecture provides flexibility in the design of host connections. ESCON channel adapters allow communication with the IBM ES/3090*, ES/9000*, and 9672 processors (S/390 servers).

ESCON channels have the following advantages:

- Connectivity over greater distances between the 3745/3746 and the S/390. For example, the standard connection between a 3746 and a S/390 is up to 3 km. By using ESCON Directors, the S/390 can be up to 43 km away.
- More configuration flexibility.
- Increased performance.
- Decreased sensitivity to noise.

An ESCON channel adapter consists of the following:

- One processor (ESCP2 and ESCP3)
- One coupler (ESCC2).

The ESCON channel processor type 3 (ESCP3) supports traffic routing for the 3746 network node and 3746 IP Router, enhancing the ESCON performance of NCP traffic (for the 3746-900).

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[1] Not all the maximum connection capabilities of the CLP3 (SDLC lines, PUs controlled by NCP, PUs, and 3746 network node sessions) are possible simultaneously. See also note 10 of Table C-1 on page C-1.

The ESCON coupler type 2 (ESCC2) provides:

- Higher data throughput for applications (for example, file transfer between S/390s and distributed servers).
- Enhanced performance in heavy interactive traffic environments using small messages.

When used in the 3746-900, the ESCP3 can concurrently support:

- NCP traffic for the Central Control Units (CCU) of the associated 3745.
- 3746 network node traffic.
- 3746 IP router traffic.

## ESCON Multiple Image Facility (EMIF)

The 3746 9x0 supports ESCON Multiple Image Facility (EMIF) (see Figure 5-4). EMIF allows several logical partitions (LPARs) to share the same ESCON channel. A single ESCON channel adapter (ESCA) can communicate with several LPARs in a S/390 server without the need of an ESCON director.

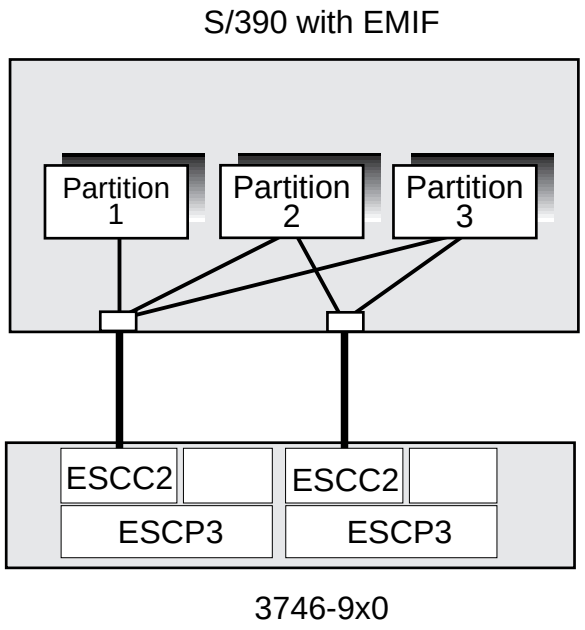


*Figure 5-4. Example of EMIF Support with a 3746 9x0*

## ESCON Adapter Connectivity

ESCON adapters have the following connectivity options:

- An ESCON channel adapter (ESCA) in the 3746-950 can communicate with 16 host logical stations (VTAMs, TCP/IPs, and TPFs) in up to 16 LPARs.
- An ESCON adapter in the 3746-900 can be shared by the 3746 NN, one or two active NCPs in the 3745, and the 3746 IP Router. Each ESCA supports up to 16 logical connections to host LPARs and stations. Any mix of 3746- or NCP-controlled logical connections to VTAMs, TPFs, and TCP/IPs can occur.
- An ESCON adapter supports up to 15000[2] APPN data sessions controlled by the 3746 network node.

[2] See note 10 of Table C-1 on page C-1.

- An ESCON adapter supports any number of HPR sessions (ANR) between HPR edge nodes and HPR VTAM nodes.

The following brief scenarios illustrate the flexibility of ESCON adapters:

- An ESCON adapter connects the 3746 9x0 to an S/390 server via ESCON optical fiber pairs. To provide higher availability, two ESCON adapters can be attached to the S/390, either directly or by using one or two ESCON directors. This provides a duplicate path between the 3745/3746-900 or the 3746-950 and the S/390.
- Parallel transmission groups can be established in ACF/NCP(s) running in the 3745 attached to the 3746-900 by using two or more channels (ESCON and/or parallel).
- Parallel APPN/HPR transmission groups can be established for the 3746 NN by using two or more ESCON connections.

## Token-Ring Adapters

A token-ring adapter (TRA) in a 3746-900 and 3746-950 consists of the following:

- One token-ring processor (TRP2 or TRP3)
- One or two token-ring couplers type 3 (TIC3).

The TRA of the 3746-900 routes SNA, APPN/HPR, and IP traffic over Ethernet LANs through the Ethernet connection.

The enhanced TRP increases the processing power, doubles the memory size, and supports the 3746 NN and IP routing.

### 3745 (NCP Support)

The 3746-900 of a 3745 can support a large number of token-ring LANs. This has the following advantages:

- Reduces the number of token-ring adapters in the 3745 base frame.
- Increases Ethernet and high speed line capacity.

This means that 3745 has a capacity of 16 Ethernet ports, or eight high-speed lines, or a mixture of the two, and that the 3746-900 has a maximum capacity for 32 or 33 token-ring LANs[3].

### 3746-900 With NCP Support

The TRP3, in conjunction with one or two TIC3s, can connect up to 2000 PUs simultaneously (PS/2s, or 3174s and downstream PUs). When two TIC3s are connected to the same TRP, any ratio of PU-sharing between the TIC3s can be utilized. The following shows a number of TIC connectivity options:

- 1900 PUs can be active on one TIC3 while 100 can be activated via the other TIC3.
- 500 PUs can be active on the TIC3 of the CBSP or CBSP2 (see Figure A-1 on page A-2).
- 500 PUs can also be active on the TIC3 of the TRP connected to the CCU-B of the 3745[3].

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[3] For 3745 Models 41A and 61A, a token-ring coupler slot is used by the controller bus coupler to connect to the second CCU. For more information, see “Controller Bus Coupler - Feature Number 5602” on page B-10.

The TIC3 can operate close to the token-ring media speed (16 mbps), providing very high throughput between workstations and S/390 applications or S/390 databases and local servers.

## 3746 Network Node and 3746 IP Support

The following are the connectivity potentials for a TRP3 in a 3746-900 and a 3746-950:

- Each TRP3 of a 3746-900 can connect up to 2000 active PUs. The remaining PUs are controlled by the NCP(s) running in the 3745.
- Each TRP3 supports a maximum of up to $8000^2$ APPN/Dependent LU sessions controlled by the 3746 network node.
- Each TRP3 supports any number of ANR sessions over HPR connections between HPR/RTP edge nodes, and can connect any number of IP stations.
- The TRP3 can concurrently carry traffic controlled by the 3746 NN, the 3746 IP Router and one or two NCPs. Each TIC3 can carry traffic for the 3746 NN (APPN/DLUR/HPR), the 3746 IP Router, and one NCP.

**Note:** A token-ring LAN that attaches PUs controlled by NCP in CCU-A and PUs controlled by NCP in CCU-B will need two TIC3 ports.

# Chapter 6. System Management

Management of the 3745 Model A, the 3746-900, and the 3746-950 involves the following processes:

- Configuration.
- Activation of 3746 lines or ports.
- Display of 3746 status information.
- Maintenance operation (for example, line tests).
- Problem determination and resolution.

These management processes are performed by the following programs and utilities:

- NetView and Network Performance Monitor (NPM)
- The service processor
- The network node (NN) processor.

## NetView*

NetView/390 can perform all the network management functions needed for the 3745 controlled by NCP, and for the 3746 Network Node. NetView/AIX can perform all the network management functions needed for 3746 IP Router.

These programs include the following:

- Alert reporting.
- Graphic displays of IP and APPN/HPR network topologies.
- Automated operator commands triggered via NetView/390 alerts.
- Display of hardware and network status reports on the NetView status monitor.
- Control of resources, using APPN commands (Activation, Inactivation, Display)

## The Service Processor

The service processor performs the following:

- Runs Maintenance and Operator Subsystem-Extended (MOSS-E)[1] functions.
- Runs the Controller Configuration and Management (CCM) application of the 3746-900 and the 3746-950.
- Provides access to the 3746 APPN/HPR Control Point functions of the NN processor.
- Provides access to the 3746 IP management functions of the NN processor.
- Provides an operator interface.

[1] IBM Licensed Internal Code.

## The Network Node (NN) processor

The network node(NN) processor performs the following:

- The 3746 APPN/HPR Control Point, including the Dependant Logical Unit Requester (DLUR) function.
- The 3746 IP Router management functions.
- The 3746 configuration for APPN/HPR and IP.

## Using System Management Tools

The following is a summary of some of the system management tools used in the 3745, the 3746-900, and the 3746-950.

## Controller Configuration and Management (CCM) Application

The Controller Configuration and Management (CCM) application simplifies the configuration of the 3746 IP router and NN resources. For example:

- Parameter default values can be changed and saved as new default values. This is an aid for configuring identical lines, ports, or stations.
- Configuration file management facilities, for example:
  - Importing/exporting configurations
  - Managing ports, stations, and APPN/DLUR sessions.
- Configuration definitions are dynamically cross-checked for consistency.

CCM also provides support for the following:

- Configuration changes that deactivate or activate resources without interrupting the operations of the 3746.
- Simple definitions and operations through delete, copy, and search functions.
- Management of IP operations.
- HPR/ANR.
- Frame-relay Terminal Equipment (FRTE).
- Definition of the NetView Performance Monitor (NPM).
- ESCON definitions for SNA (NCP), APPN/DLUR, HPR, and IP.

## Telnet Support for Internet Protocol Operations

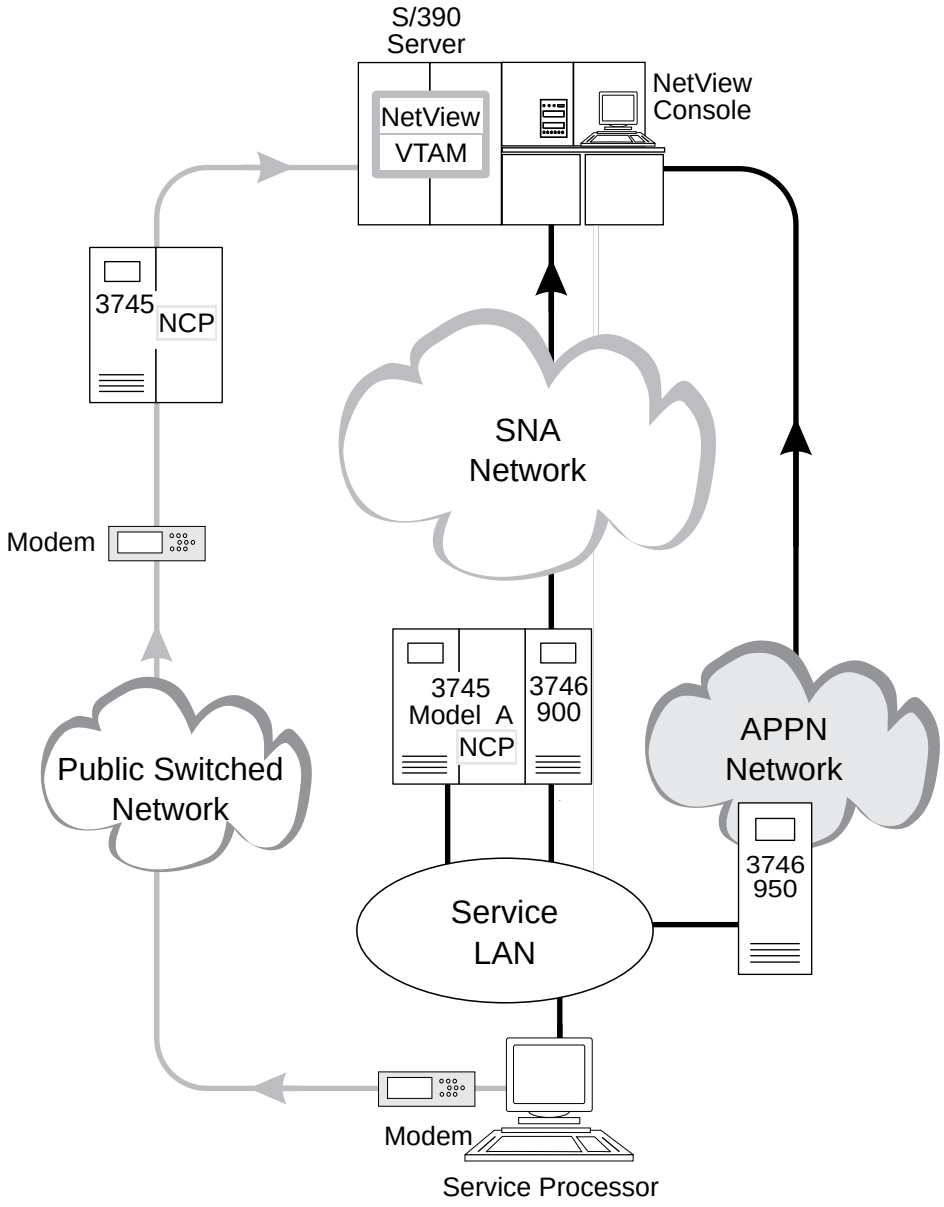
As well as using CCM, IP resources for configuring and managing stations can be accessed through Telnet.

## NetView/390

The NetView/390 program supports:

- Alert reporting for the 3745, the 3746-900, and the 3746-950.
- Displays of the APPN/HPR networking topology, including the local topology of the 3746 network.
- Operator commands, for example activating and deactivating the 3746 NN (these can be automated and triggered by alerts).

NetView is optional, yet recommended for network problem determination. The 3745 and 3746 9x0 alerts are sent to NetView over the SNA or APPN network. The MOSS-E reports 3746 9x0 and service processor alerts to NetView via the mainstream or alternate paths shown in Figure 6-1 on page 6-3.




**Legend**:

Mainstream Path through SNA or APPN network

Alternate Path

*Figure 6-1. Alert Reporting to NetView*

**Notes:**

If the NetView console is a NetView Graphic Monitor Facility (NGMF) workstation running Distributed Console Access Facility (DCAF), it can also be used as a remote console to access the MOSS-E via the service processor.

If the path to the user network is unavailable, a NGMF workstation (or any workstation running DCAF) can also use the public switched network to access the service processor.

The NGMF workstation, via the Topology Manager of the NetView/390 program, provides a graphic display of the APPN/HPR network topology, including:

- APPN topology agent nodes
- Transmission Groups (TG)
- Ports
- Logical Links
- Network Nodes
- End Nodes (EN)
- Low Entry Networking Nodes (LEN).

For more information see Figure 6-2.

Controller Configuration and Management (CCM) can be used to display the local topology of the 3746 APPN/HPR network nodes (end nodes and dependent PUs). With DCAF running in the NGMF workstation, the operator can remotely access 3746 network nodes and run the 3746 node configuration, local topology display, and network management functions of the CCM. Changes in configuration and status are updated dynamically on the NetView graphic display.

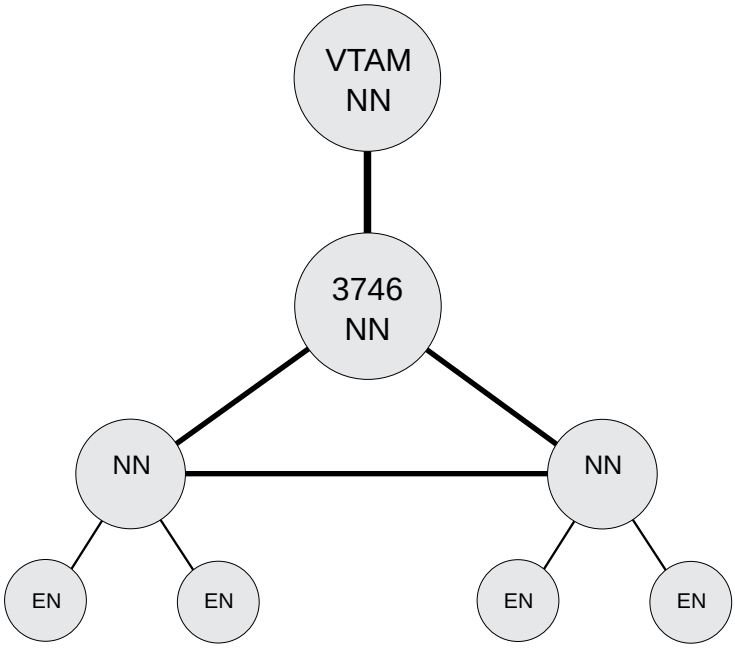



*Figure 6-2. APPN/HPR Topology View of the Network*

## Legend:

**EN** End Node
**LEN** Low Entry Networking
**NN** Network Node
**TG** Transmission Group

## NetView Performance Monitor

NPM reports data on the 3746 9x0 configuration and traffic activity of resources used in APPN/DLUR and HPR traffic. This includes processor load and storage utilization of all the 3746 9x0 adapters, token-ring couplers, lines, Frame-relay DLCIs and stations, and X.25 links. Performance monitoring is an aid in capacity planning for the 3745 and 3746 9x0.

## NetView for AIX

The SNMP agent of the 3746 IP Router supports standard MIBs, and the new MIB for ESCON. This allows the 3746 IP Router to be operated from NetView for AIX or other SNMP management platforms. In conjunction with the enhanced Router and Bridge Manager, NetView for AIX supports:

- IP alerts from the 3746.
- IP router topology display, including the 3746s.
- IP traffic counters.
- IP MIB access.

## IBM Service Support

Service support for 3745 Models A and 3746 9x0 is provided through automatic problem reports sent to the IBM support center (also called the remote technical assistance information network, or RETAIN*) and NetView (see Figure 6-3 on page 6-6). When a problem is detected in the 3745 or the 3746 9x0, the following occurs:

- A report is stored in an event log of the MOSS-E.
- An alarm is displayed on the service processor screen.
- An alert is sent to NetView.

Users of the remote support facility (RSF) can choose whether problems and error data are reported to the IBM support center automatically or by the operator.

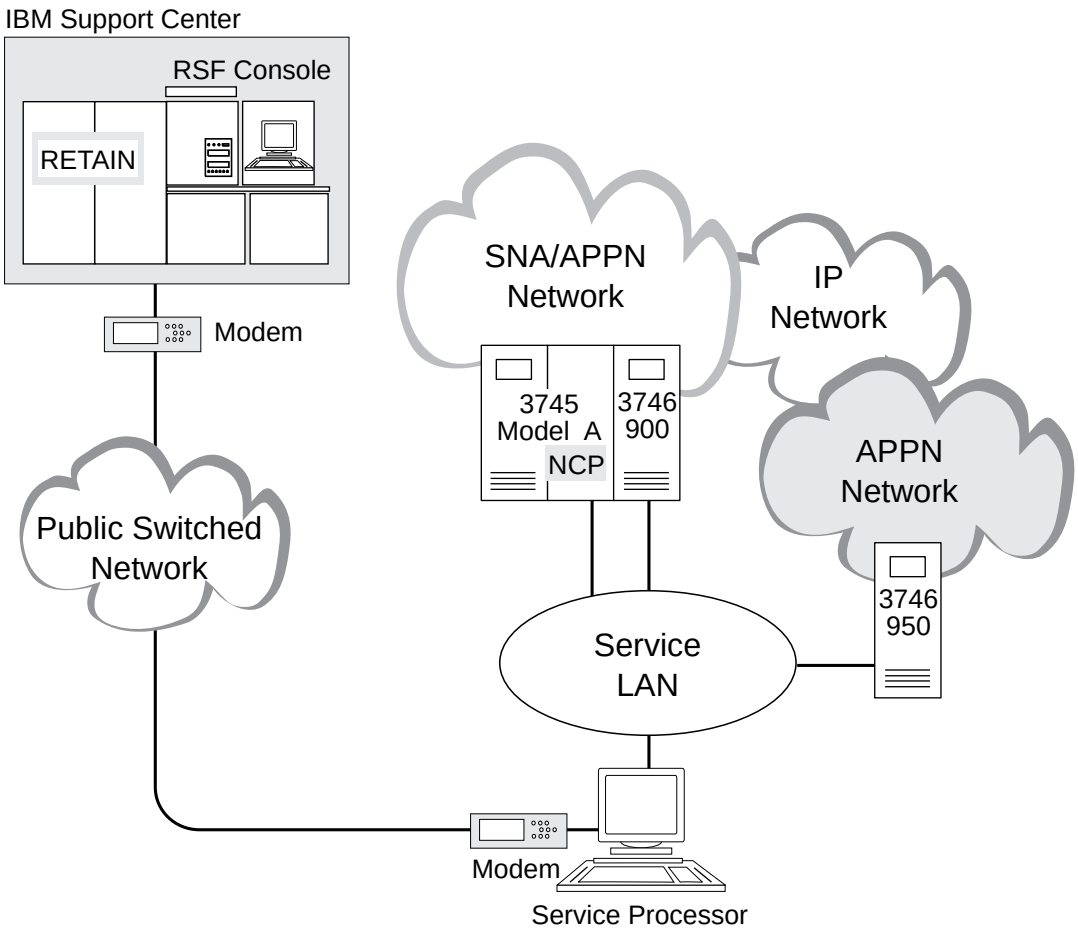



*Figure 6-3. RSF and RETAIN Connections*

Other services provided by IBM support center include the following:

- Microcode changes for correcting problems can be automatically transferred from the support center to the service processor hard disk.
- If additional help is required, the support center can remotely access the service processor.
- If hardware failure is the problem, an IBM service representative will visit your site with replacement parts.

**Note:** If you have NetView, you can investigate a problem by using NetView alerts, and find additional information (3745 and 3746 9x0 alarms) at the service processor.

If you do not have NetView, you can review the messages stored in the VTAM event log (LOGREC) and find additional information (the alarms) at the service processor.

## More on the Service Processor

The service processor provides a single user interface for the 3745, 3746-900, and 3746-950 to perform operator and service functions.

The service processor runs the MOSS-E and performs the following:

- Maintenance and operator subsystem (MOSS) functions in the 3745.

  **Note:** The MOSS screens are the same as the operator consoles of the 3745 Models 130, 150, 160, 170, 210, 310, 410, and 610.
- Graphic representation and status of controllers connected to the service processor.
- Maintenance of the 3746 9x0, and operating the 3746 Network Node and IP Router.

The MOSS-E works in a multitask and window environment, and provides contextual on-line help.

The service processor also performs the following:

- Runs CCM[2] application for:
  - Configuring the 3746 9x0 APPN/HPR NN and IP Router (CCM includes the ESCON Generation Assistant functions).
  - Displaying information about the 3746 9x0 resources (for example, current local network topology).
  - Managing multiple configurations of 3746 9x0 resources.
- Loads the microcode of the 3746 9x0.
- Stores the 3746 9x0 files. For example, the configuration data file-extended (CDF-E) file contains information about 3746 9x0 hardware resources.
- Reports 3746 9x0 box errors as alerts to NetView and sends error codes to the IBM Remote Support Facility (RSF). These error codes can also be stored locally and displayed.

## Connecting the Service Processor

The service processor communicates with the 3745 MOSS, the 3746 9x0, and the network node processor via a service LAN (16 Mbps token-ring). The service LAN can be shared with other 3745s and 3746 9x0s.

If the service LAN connects a 3746-900 operating as an IP router or APPN/HPR network node, or a 3746-950, the connection of user stations to the service LAN is not supported (the service LAN must be isolated from user traffic). Only DCAF stations can be connected to the service LAN (for remotely controlling the service processor or operating the 3746 NN and 3746 IP router). If access to the remote console occurs via bridges, appropriate LAN filtering must protect the service LAN segment. A service processor access unit is provided with the service processor for the LAN connection to the communication controllers attached to it.

The 3745 has specific MOSS hardware and microcode to support communication with the service processor.

---

[2] CCM is also available in a stand-alone OS/2 version.

**Note:** Console ports of the 3745 Models 130, 150, 160, 170, 210, 310, 410, and 610 do not appear on the 3745 Model A.

## Sharing the Service Processor

The service processor can have the following maximum configuration:

- Four 3745s and two 3746-900s operating in an SNA mode (controlled by NCP).
- Four 3745s, one 3746-900 operating in an SNA mode (controlled by NCP), and one 3746-950 (see Figure 6-4).
- Four 3745s and two 3746-900s, one of which operates as an IP Router and APPN/HPR network node (see Figure 6-5).

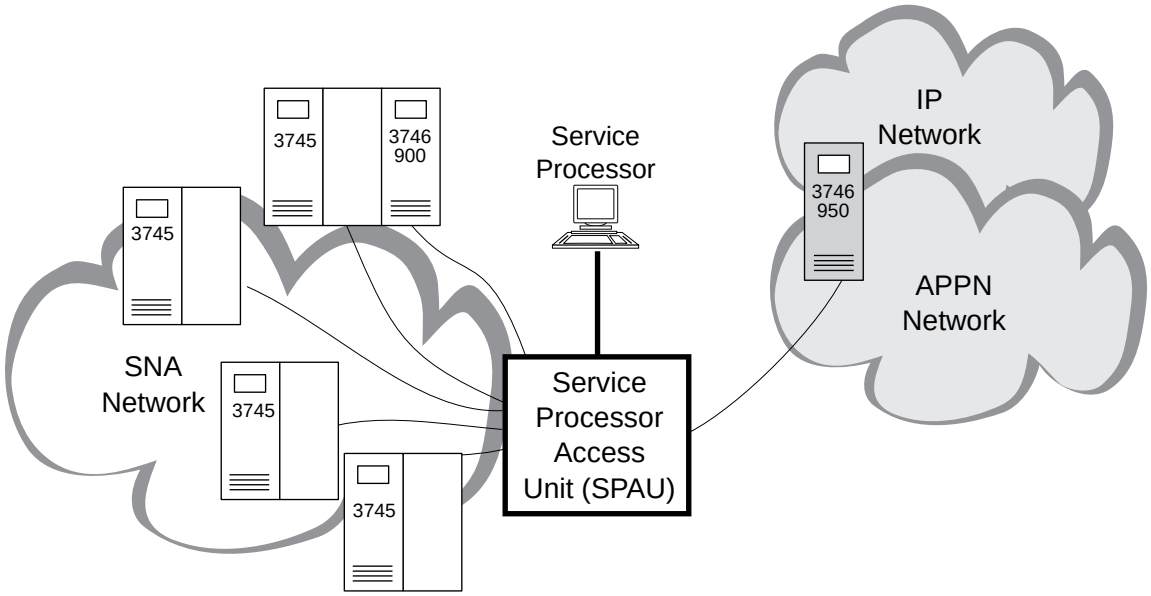



*Figure 6-4. Example 1 of Maximum Configuration for a Service Processor. The service processor connects to four 3745s, one 3746-900 (SNA), and one 3746-950 (IP, APPN/HPR).*

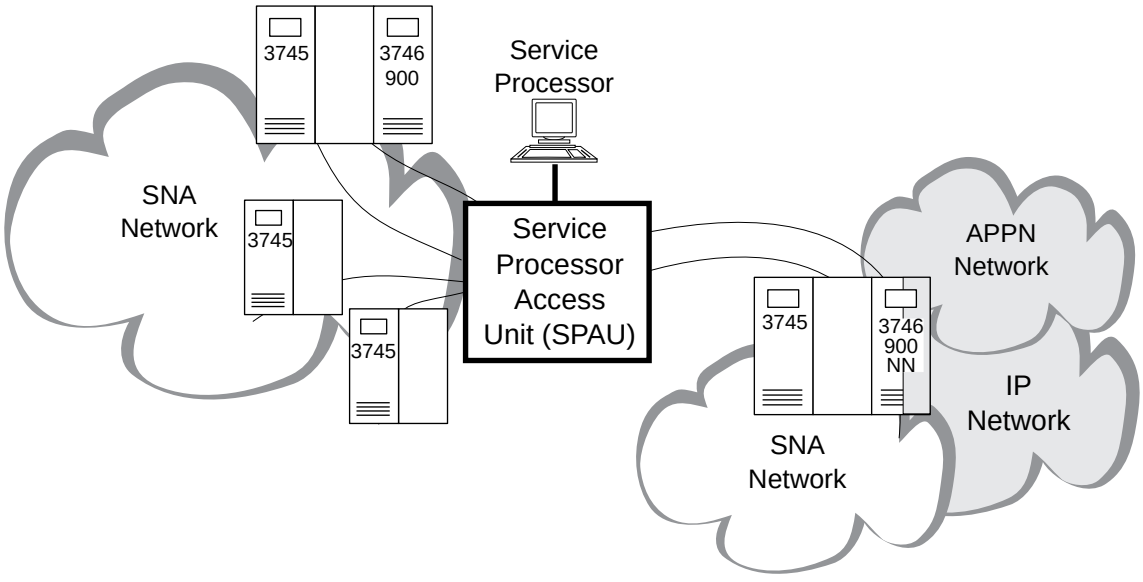



*Figure 6-5. Example 2 of a Maximum Configuration for a Service Processor. The service processor connects to four 3745s and two 3746-900s, one of them operating as an IP router and APPN/HPR NN.*

**Note:** IBM recommends that all controllers be in the same room and within 10 m of the service processor to facilitate service access.

Connecting an additional machine to a service processor does not interrupt the machines that are already running.

Large installations that need more than four 3745s and two 3746 9x0s require several service processors. However, a single DCAF console located at a central control point can access and control all the 3745s and 3746s. (This means that a token-ring bridge cannot be installed between the service processor and the 3745s and 3746s it controls.)

## Backing Up the Service Processor

Although the normal network operations are not affected if the service processor is temporarily inoperable, a second or backup service processor will provide a higher level of reliability.

During normal operations, the backup service processor is not connected to the service processor LAN and remains powered OFF most of the time. The hard disk of the backup service processor should be a duplicate of the active service processor. If recovery is necessary, then the failing service processor should be disconnected from the LAN, and the backup service processor connected and started up.

When a backup service processor has been installed, backing up requires the following:

1. Copying the configuration data of the active MOSS-E to the hard disk of the backup service processor.
2. Copying the active MOSS-E microcode to the hard disk of the backup service processor.
3. Repeating step 1 and 2 after each configuration or code change.

---

## Network Node Processor

The 3746-950 and 3746-900 IP Router and APPN/HPR network node are equipped with a network node processor which provides the following:

- APPN/HPR Control Point functions for the 3746 network node, including the DLUR functions.
- IP management functions of the 3746 Router.
- Support for CCM, accessed through MOSS-E interface of the service processor, in order to:
  - Configure 3746 9x0 NCP (ESCON only), APPN, and IP resources.
  - Manage 3746 9x0 network node and IP resources.
  - Activate and deactivate ports and APPN/HPR stations.
  - Display information on local topology and resources for the 3746 9x0.
- Utility for storing IP and network node files, containing network node configuration parameters.

**Note:** The NN processor can be configured for Dual Mode (see 7-2).

## Accessing the Service Processor Via DCAF

Different types of consoles can access the service processor MOSS-E by using the Distributed Console Access Facility (DCAF). In this case, the service processor becomes the DCAF target and the consoles DCAF remote (controlling) workstations (see Figure 6-6).

**Note:** Only one remote console can control the service processor at a given time.

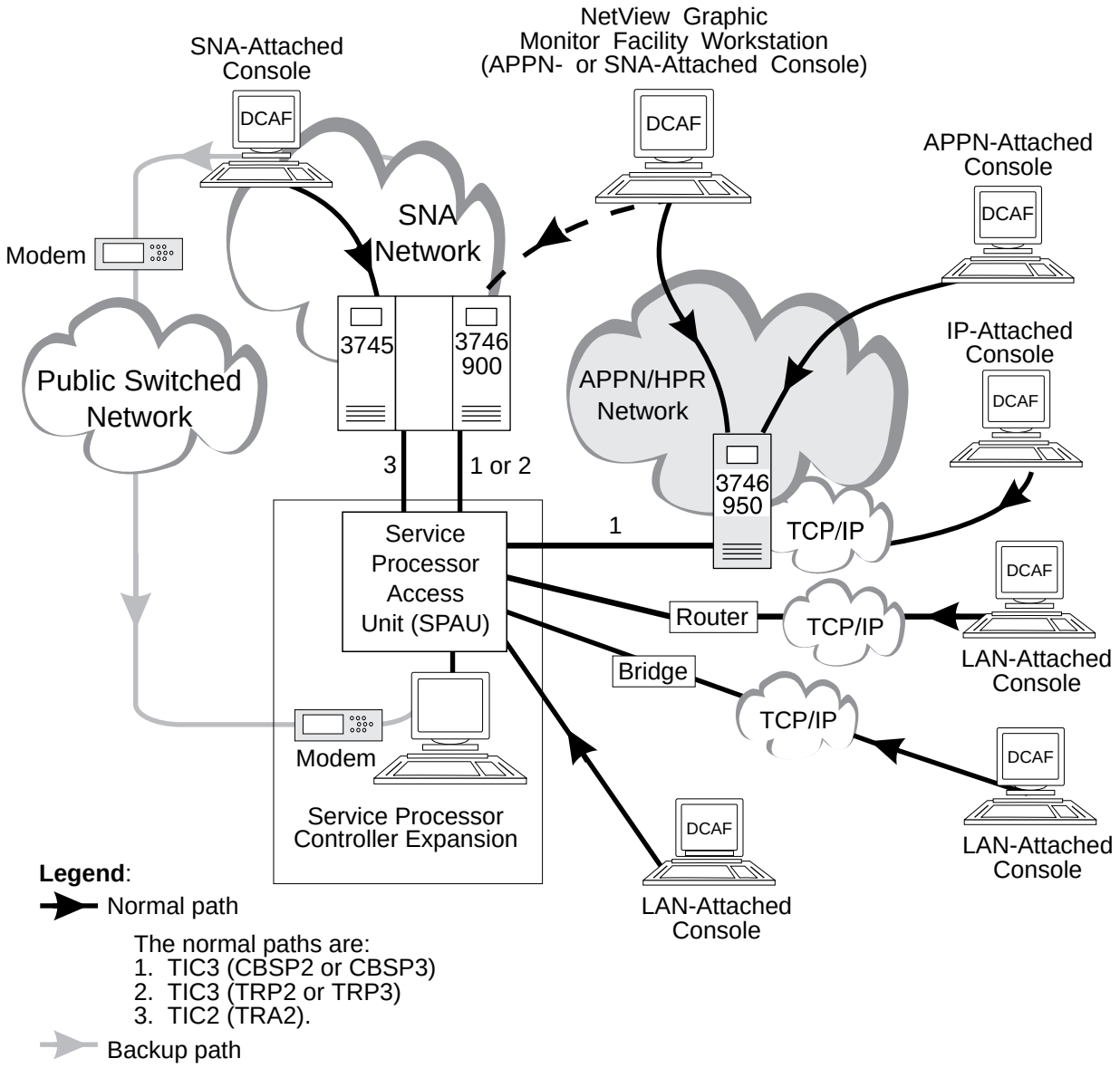



*Figure 6-6. Console Attachments*

The following are examples of workstations (PS/2 or equivalent) that can be used as remote workstations via DCAF:

- LAN-attached (APPC type) consoles attached either directly to the same token-ring LAN as the service processor, or indirectly through token-ring LAN bridges.
- LAN-attached (TCP/IP type) consoles attached to the service LAN via a bridge with filtering.

**Note:** This type of console attachment is supported in any service processor configuration with or without a 3746 Nways Controller connected to the service LAN.

- SNA-attached consoles.
- APPN-attached consoles communicating with the service processor via an LU6.2 session over network backbone.

  **Note:** The connection between service processor LAN and an installed 3745 MOSS cannot be used for this LU 6.2 session.

- Modem-attached consoles using a public switched telephone network to access the service processor via a SDLC port and modem. This path can be used as a backup, in case the normal SNA or APPN path through the network is not available.

  **Note:** The same port and modem is used for Remote Support Facility (RSF) and Remote Technical Assistance Information Network (RETAIN) calls.

## Hardware Requirements and Recommendations

For remote workstations, IBM recommends using:

- PS/2s (or equivalent) with at least a 80386 microprocessor and VGA display (for example, an IBM 8515 color display).
- A hard disk of at least 80MB and at least 10MB of storage (RAM).
- A pointing device.
- A QWERTY keyboard is necessary. If this type of keyboard is not available, then the QWERTY equivalent keys must be used. For example, on an AZERTY keyboard, you must use the "q" key when you want to type an "a".

  **Note:** To find the equivalent keys on IBM non-QWERTY keyboards, refer to OS/2 documentation on keyboard layouts or codes.

- For a LAN-attached console (APPC or TCP/IP type), an IBM Token-Ring Network Adapter A, operating at 16 Mbps.
- For a modem-attached console, a synchronous modem (such as an IBM 7857 or equivalent) and a multiprotocol adapter (MPA) card.

  **Note:** If the modem does not provide dialing capability, a telephone set must be provided for dialing the service processor.

  Required characteristics of the service processor modem are provided in the *Migration and Planning Guides*, GA33-0183 and GA33-0349.

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## Accessing the 3746 IP Router Via Telnet

As well as the DCAF capabilities described in “Accessing the Service Processor Via DCAF” on page 6-10, it is possible to access the 3746 IP router for configuration and management purposes via Telnet on an IP station.

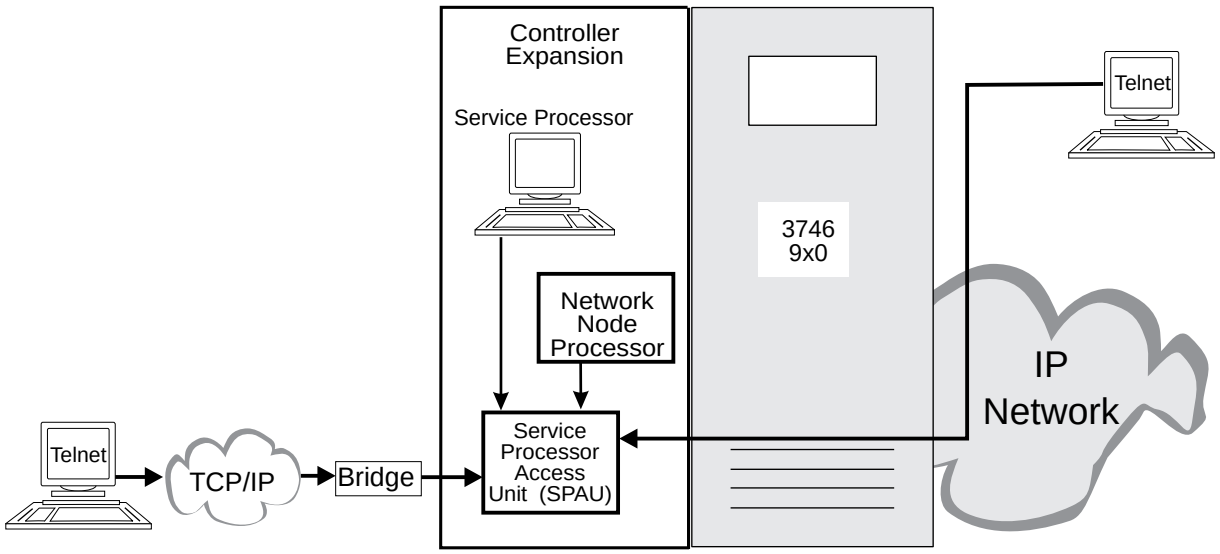



*Figure 6-7. Telnet Remote Console Attachments.*

**Attention**

The remote console does not allow operators to access MOSS-E functions.

## Hardware Requirements and Recommendations

To access the 3746 IP router via Telnet, any workstation must support IP with Telnet Client. Attachments can be the following:

- LAN (token-ring, Ethernet)
- WAN links (Frame-relay, Point-to-Point Protocol).

## Fast NCP Dump Transfer

The service processor reserves hard disk space for up to four NCP dumps from an attached 3745 Model A. Only one dump per CCU can be stored at a time.

MOSS-E can transfer NCP dumps from the service processor hard disk to the following:

- The S/390 Server via the SNA backbone. This is used instead of a VTAM command, and significantly reduces the dump transfer time (recommended for the 16 MB CCU storage feature). This method uses 3270 terminal emulation on the service processor to transfer the dump file.
- An optical disk for mailing or hand-carrying to your software support center.

# Chapter 7. High Availability

The 3745 Model A, the 3746-900, and the 3746-950 are designed to continue operating during upgrade procedures and maintenance, and remain fully functional in the event of network disruption or congestion. This design facility includes the following:

- Backup
- Microcode management
- Concurrent upgrade
- Concurrent maintenance
- Customer access
- Component reliability.

## Backup

The following equipment is designed to increase the availability of the 3745, 3746-900, and 3746-950:

**Second Power Supply**

Installing a second power supply to automatically and non-disruptively take over network operations if the active power supply fails.

**Twin-Backup or Twin-Dual Mode (3745 CCUs)**

The 3746-900 controlled by the NCP can be adapted to function as a 3745 Model 41A and Model 61A, operating with two active NCPs, one in each CCU. This results in the following:

- Each ESCON channel adapter can carry traffic for both CCUs.
- Any LAN or WAN port can be activated by the NCP in either CCU.
- After deactivation by one NCP, the LAN or WAN port can be activated in the other NCP.

**Token-Ring LANs**

The TICs of the 3745, the 3746-900, and the 3746-950 support TIC port swapping, duplicate TIC address, and token-ring non-disruptive route switching.

**Note:** The 3746 network node and IP router does not support TIC port swapping.

**Communication Line Processor**

Two adjacent CLPs, properly configured, can operate in backup mode. Normally, each processor normally controls one or two LICs. If one processor fails, the second CLP automatically takes control of the LICs attached to the failed processor. This increases controller availability for users of communication lines.

**ESCON Directors**

ESCON directors (ESCDs) can have backup channel connections for increased system availability.

**Parallel Transmission Groups (TG)**

In an NCP environment, parallel TGs can be installed on:

- ESCON
- Parallel channels.

In an APPN/HPR environment, parallel TGs can be installed on:

- ESCON
- LAN ports
- Frame-relay and SDLC links.

**Multi-link Transmission Groups**

Support for MLTG can be configured in the following:

- 3745 and 3746-900 SNA subarea traffic controlled by NCP (see page 4-1).
- 3746 HPR traffic (see page 4-12).

**Frame Relay Frame Switching Substitute Subport**

Substitute subports are available in the 3745 and 3746-900 for Frame-relay PVCs to be controlled by the NCP (see page 4-7).

**Service Processor Backup**

Installing a second service processor for higher availability. For more information, see “Backing Up the Service Processor” on page 6-9.

**Dual Network Node Processor**

Installing two network node processors in the 3746-900 and the 3746-950 for higher availability. This is similar to the twin-standby mode of network node processors in 3745 Models 41A and 61A. Each NNP alternates active and standby modes. If the active network node processor fails, the standby network node processor becomes active.

**Persistent Communications (LU-LU Sessions)**

The 3746 network node processor establishes user sessions via the adapters of the 3746, but does not route the traffic. When LU-LU sessions has been established, all the user traffic is routed by the adapters. This means that established user traffic (for example, user sessions with S/390 Server applications) remains interrupted if the network node processor fails.

## Microcode Management

Microcode change levels (MCLs) can be either:

- Automatically down-loaded on the service processor via RETAIN.
- Installed on the service processor from an optical disk (containing licensed internal code upgrades).

Two 3746-900s, or one 3746-900 and one 3746-950, attached to the same service processor, can have different microcode levels.

## Concurrent Upgrade

A processor, coupler, LCB, or ARC can be installed on a 3746-900 or 3746-950 while the machine is running. Adapters can be installed on the 3745 Models 21A, 31A, 41A, and 61A while the machine is running (except new adapters that require the same power supply of an adapter already installed).

The configuration of a 3745 Models 21A, 31A, 41A, and 61A low-speed scanner can be upgraded while the machine is running, provided the 3745 is not using the resources of the 3746-900.

**Note:** Concurrent upgrades can occur no matter what type of routing protocol is used (SNA, IP, or APPN/HPR).

## Concurrent Maintenance

Concurrent maintenance for the 3746-900 and 3746-950 is a method of running the machine with backup equipment, while your IBM service representative diagnoses the problem with any failed equipment.

A processor, coupler, LCB, or ARC can be replaced on a 3746-900 or a 3746-950 while the machine is running. Adapters can be replaced on the 3745 Models 21A, 31A, 41A, and 61A while the machine is running (except for new adapters that require the same power supply of an adapter already installed).

**Note:** Concurrent maintenance can occur no matter what type of routing protocol is used (SNA, IP, or APPN/HPR).

## Customer Access

ARCs, LCBs, and associated cables are user-accessible. You can modify the hardware configuration for low- and medium-speed lines, or replace an LCB or ARC without needing an IBM service representative.

**Note:** Couplers for the 3746 9x0 are not user-accessible for installation or replacement.

## Reliable and Duplicated Components

All components of the 3746-900 and 3746-950 are designed for high reliability. Some components are duplicated beyond the minimum requirements of the machine in case of equipment failure. For example:

- Adapters and couplers are individually attached to the power supply so that if one fails, the others continue to work.
- There are multiple cooling fans so that if one fails, the remaining fans can sufficiently cool the frame.

# Appendix A. Minimum Configuration of the 3745 and 3746

This chapter describes the minimum configuration and the equipment required for running a 3745, a 3746-900, and a 3746-950.

## 3745 Minimum Configuration

The 3745 Models 17A, 21A, 31A, 41A, and 61A have the following features:

- Service Processor running the MOSS-E (mandatory).
- 16 MB storage (this is an option only for the 31A and 61A models).

**Note:** Only the 3745 Model A supports a 3746 Model 900 attachment.

## Service Processor (MOSS-Extended) - Feature Number 5021 and 5052

The service processor includes the MOSS-E required for running the 3745 and 3746 9x0, and has been enhanced to support 240 lines of any type (SDLC, Frame-relay, X.25, or PPP) under the control of the NN.

An RSF modem is provided with the service processor in selected countries, depending on national telecommunication regulations.

One service processor can handle up to four 3745s and two 3746 9x0s.

A service processor access unit (SPAU) is included with the service processor. The SPAU includes 8 ports for token-ring connections to the controllers, the service processor, and the network node processor. The 3746 9x0 base enclosure comes with a token-ring port (a TIC3) for communications with the service processor.

## 16 MB Storage - Feature Number 7200

This provides a CCU storage of 16 MB for the 3745 Models 31A and 61A only. When this feature is installed, the ACF/NCP load modules will use up to 12 MB.

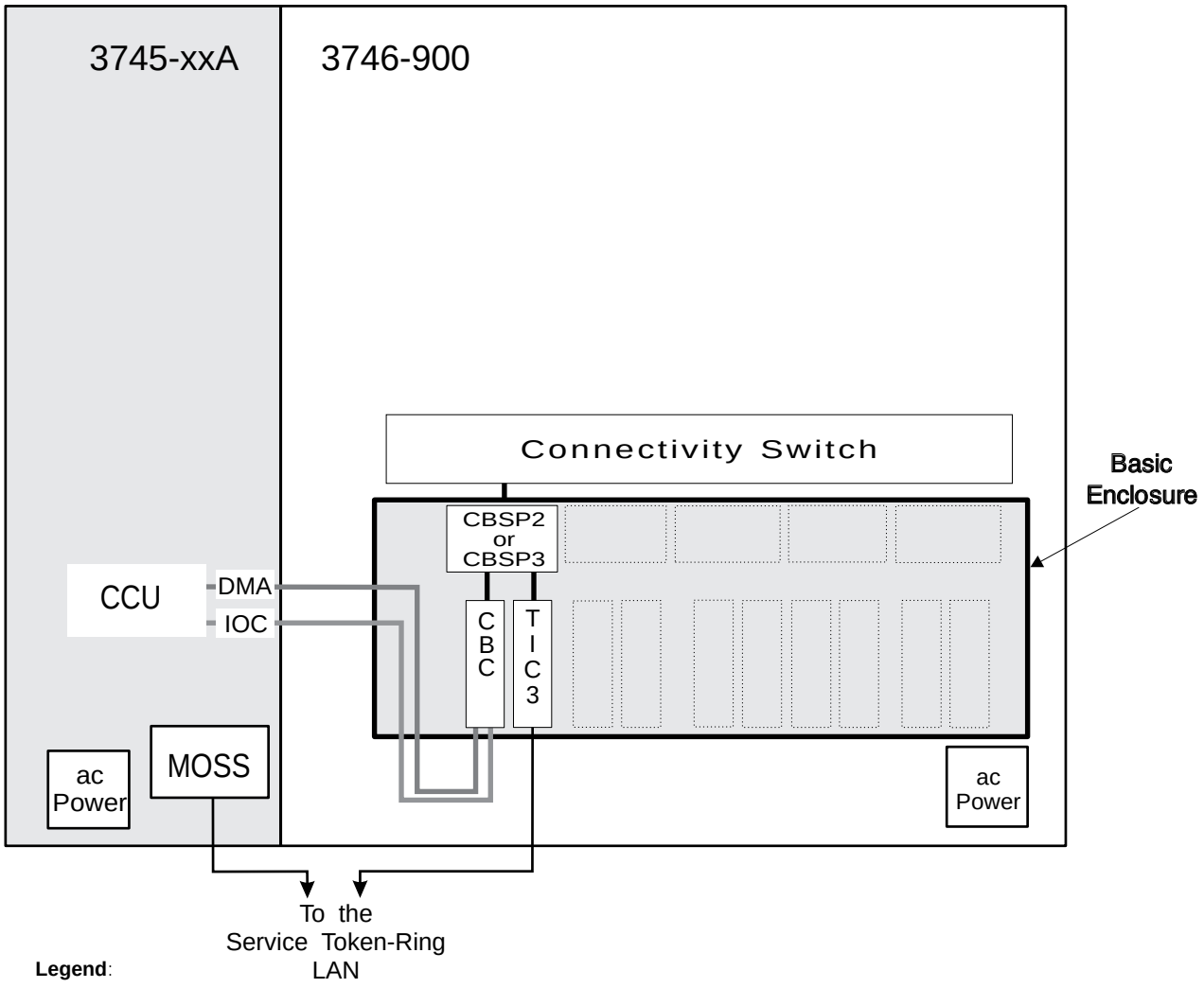
To take advantage of this feature, these models can be upgraded to the following:

- 3745 Models 210, 310, and 21A, upgraded to a 3745 Model 31A.
- 3745 Models 410, 610, and 41A, upgraded to a 3745 Model 61A.

**Note:** The amount of storage in the CCUs of Model 61A must be the same. The amount of storage in the CCUs of Model 41A must be the same (limited to 8 MB).

## 3746 Model 900 and 950 Minimum Configuration

The minimum configuration for a 3746-900 to operate is the hardware attachments to the CCU of the 3745 and the service processor (see Figure A-1).

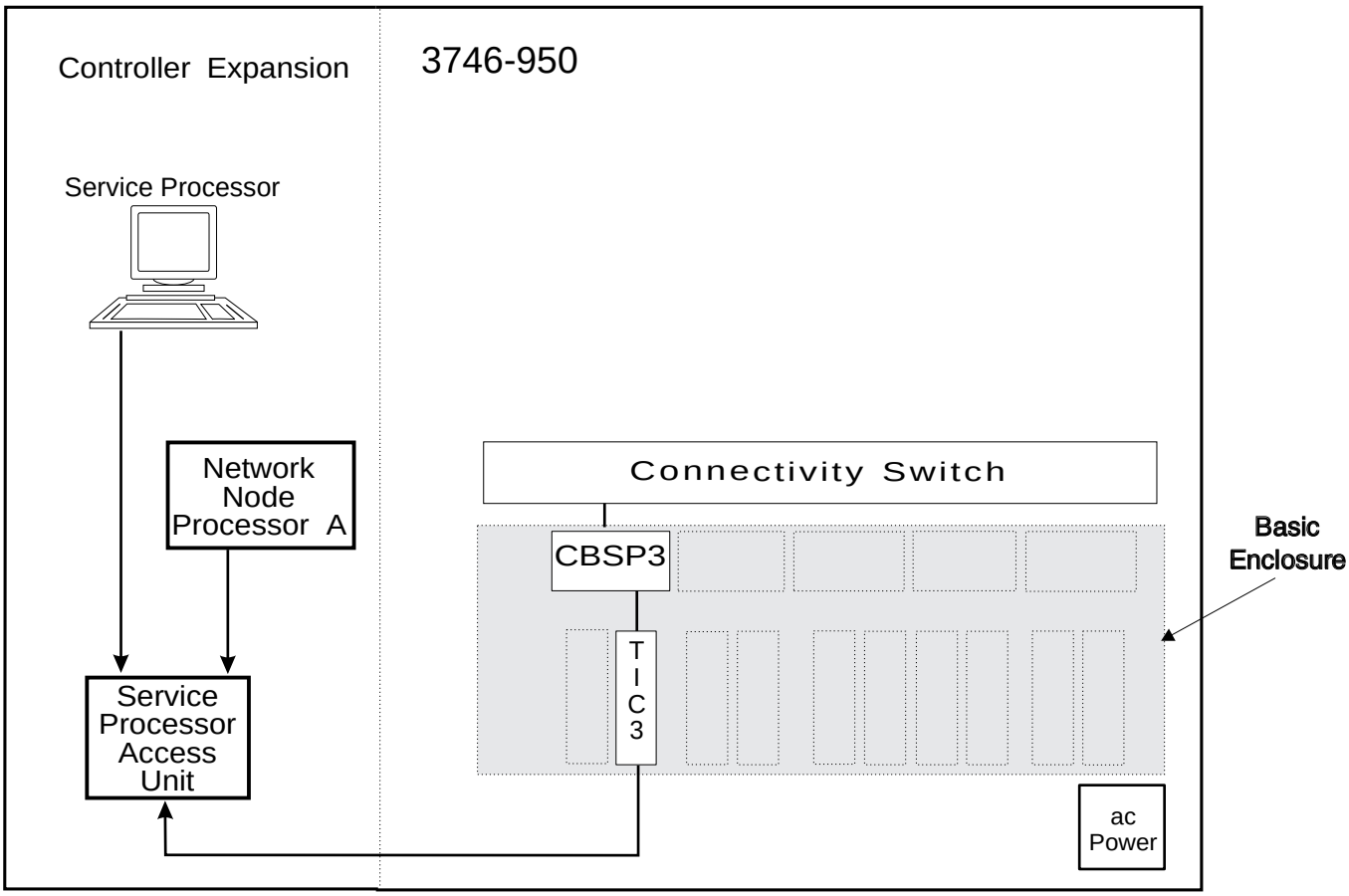



**Legend**:

| | |
|---|---|
| CBC | Controller bus coupler |
| CBSP | Controller bus and service processor |
| CCU | Central control unit |
| DMA | Direct Memory acess |
| IOC | Input/output control |
| TIC3 | Token-ring coupler type 3 |

*Figure A-1. The 3746-900 Minimum Configuration. The 3746-900 is attached to a single CCU 3745.*

The minimum configuration for a 3746-950 to operate is the hardware for the 3746 IP Router and APPN/HPR control point, and the hardware attachment to the service processor (see Figure A-2).




**Legend**:

CBSP2 Controller bus and service processor type 2

TIC3 Token-ring coupler type 3

*Figure A-2. The 3746-950 Minimum Configuration*

The minimum configuration for a 3746 9x0 includes the following:

**ac power**
The ac power supply requires a *single phase*, 200-240V, 50-60Hz source. The voltage and frequency varies according to local country and voltage requirements.

**Basic enclosure**
The basic enclosure includes four processor slots and eight coupler slots.

**CBSP**
*Available only on the 3746-900.*

The controller bus and service processor (CBSP) connects the controller bus coupler (CBC) to the connectivity switch.

**CBSP2 and CBSP3**
*Now delivered on the 3746 9x0, and as an upgrade of already installed 3746-900s.* The CBSP2 and CBSP3 connects the 3746 9x0 to the service token-ring LAN

via a TIC3, and supports the 3746 network node and IP router functions.

**TIC3**

The TIC3 connects the CBSP, CBSP2, or CBSP3 to the service processor access unit (SPAU). User workstations operating at 16 mbps can access host applications via this TIC3.

**Note:** User workstations cannot operate on the service LAN of a 3746-950 or a 3746-900 operating as an IP router or APPN/HPR network node.

**Connectivity switch**

The high speed connectivity switch connects all the adapters, allows the IP and APPN/HPR traffic to be switched directly from adapter to adapter. The NCP traffic flows through the CBSP, CBSP2 or CBSP3 and the 3745 CCU.

**Controller bus coupler**

*Only available on the 3746-900.*

The CBC attaches the Input/Output Control (IOC) bus and the Direct Memory Access (DMA) bus of the first 3745 CCU to the 3746-900 CBSP[1].

**Controller expansion**

Required for the 3746 IP router and network node and the 3746 Model 950. Houses the network node processor and service processor. The controller Expansion, the Network Node Processor, and the Service Processor are features of the 3745 Models A or 3746 Models 9x0. See Appendix B, “3746 Model 900 and 950 Expansion” on page B-1.

**Control panel**

The control panel on the front door is similar in design and function to the one on the 3745.

**Cooling unit**

There are six fans.

[1] The IOC bus is used for control and the DMA bus for data transfer between the 3745 CCU and the 3746-900. These buses are attached to the internal connectivity switch of the 3746 Model 900 via the CBC and the CBSP.

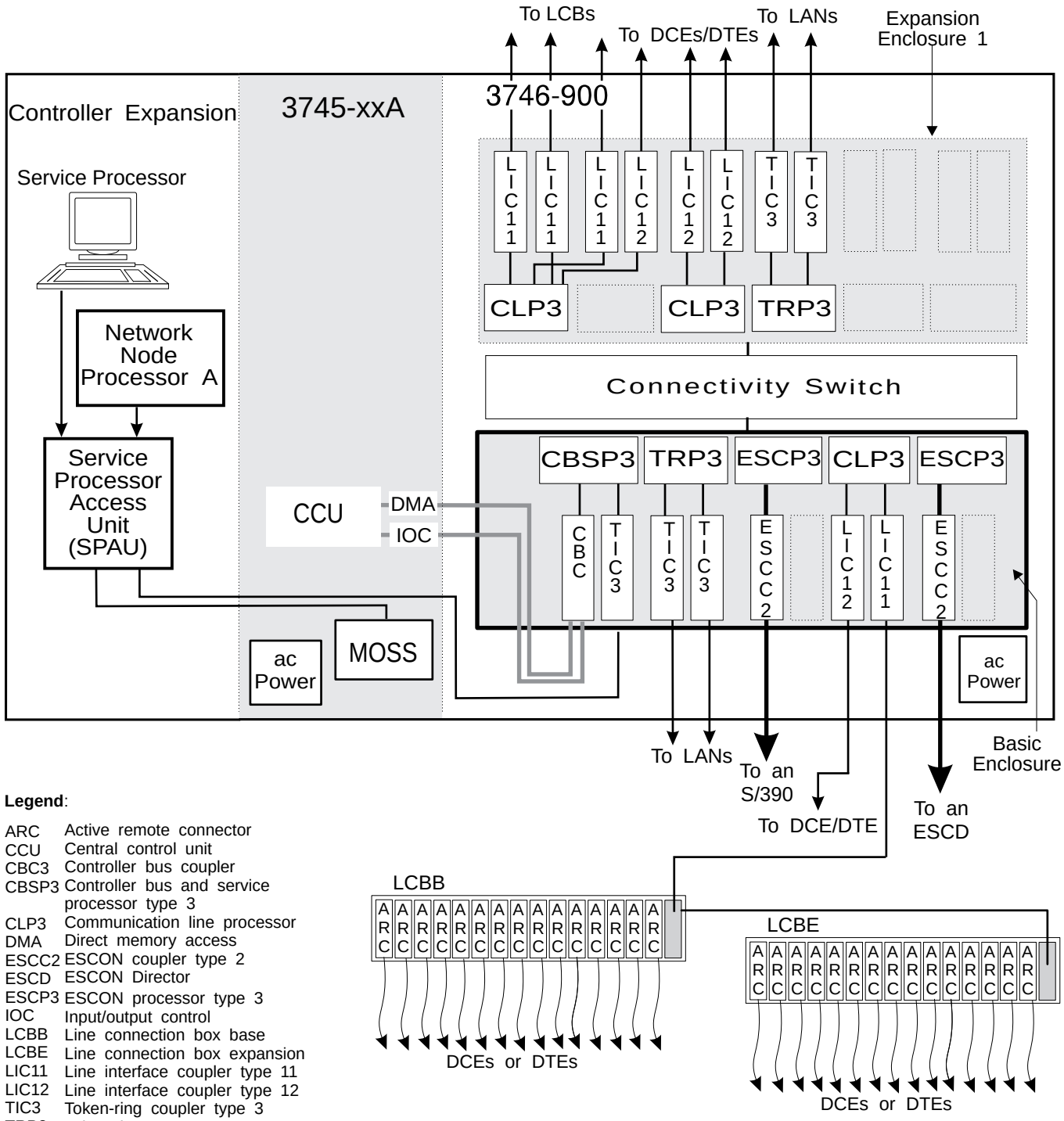
# Appendix B. 3746 Model 900 and 950 Expansion

The basic enclosure of each communication controller houses up to four adapters, and a second or third expansion enclosure can house up to six adapters each, bringing the total to 16 adapters. Adapter types can be mixed in each enclosure and placed in any position. This allows flexibility in configuring the combination of adapters in the enclosure, and for upgrading established configurations according to the evolution of your system.

Expansion possibilities are further advanced by the MAE, designed as an extension to existing controllers. The MAE can house a further eight adapters, supporting protocols other than those of the 3746-9x0, and running these network interfaces independent of NCP control. Communication speeds for the MAE are greatly increased by a direct hardware connection to the controller switch. The hardware connection is installed in an empty processor slot of the controller.

Figure B-1 on page B-2 and Figure B-2 on page B-3 respectively show the expansion enclosure of a 3746-900 and a 3746-950.

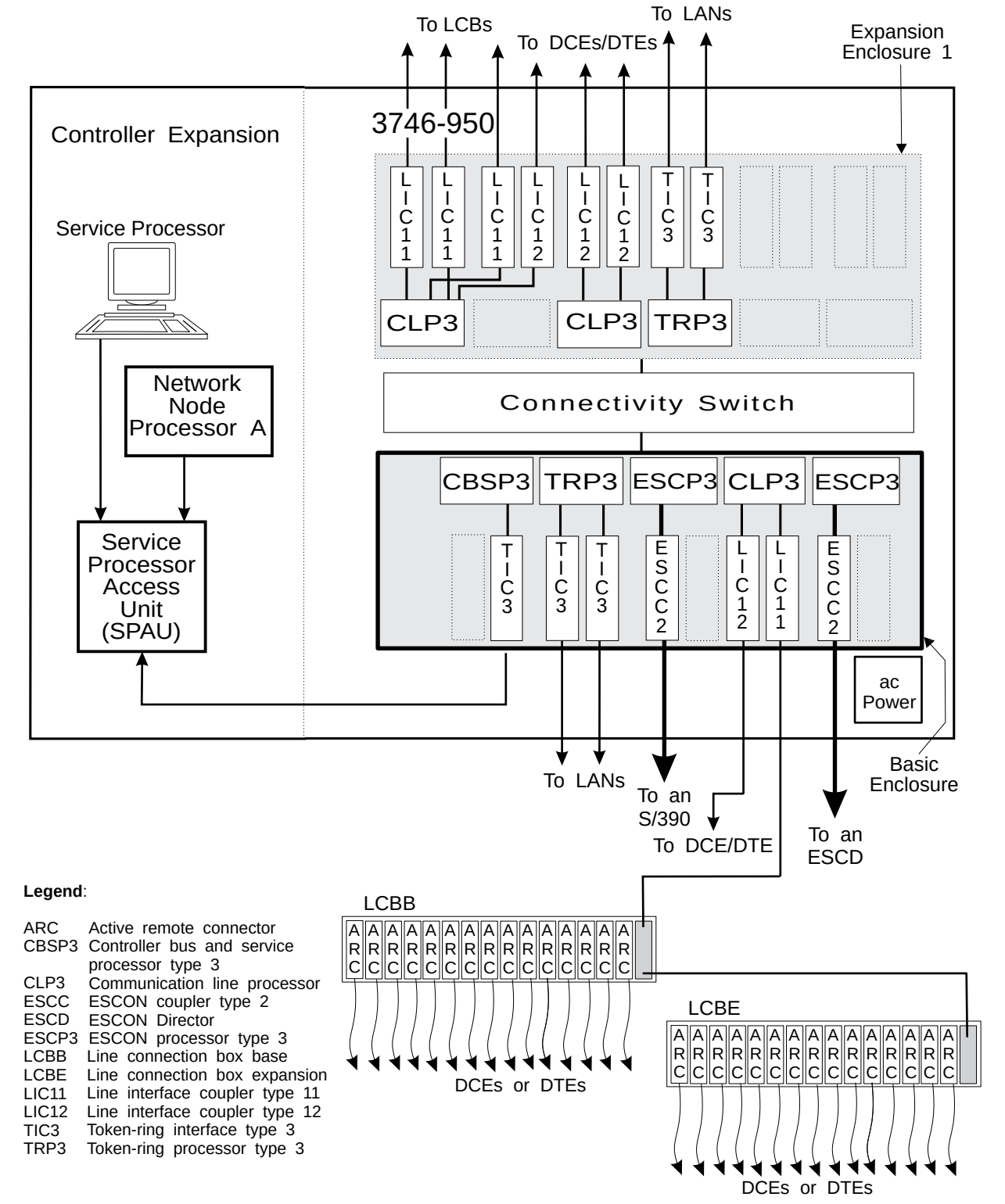
Figure B-3 on page B-4 shows the MAE integrated with the controller.




**Legend**:

| | |
|---|---|
| ARC | Active remote connector |
| CCU | Central control unit |
| CBC3 | Controller bus coupler |
| CBSP3 | Controller bus and service processor type 3 |
| CLP3 | Communication line processor |
| DMA | Direct memory access |
| ESCC2 | ESCON coupler type 2 |
| ESCD | ESCON Director |
| ESCP3 | ESCON processor type 3 |
| IOC | Input/output control |
| LCBB | Line connection box base |
| LCBE | Line connection box expansion |
| LIC11 | Line interface coupler type 11 |
| LIC12 | Line interface coupler type 12 |
| TIC3 | Token-ring coupler type 3 |
| TRP3 | Token-ring processor type 3 |

*Figure B-1. An Example of a Configuration for a 3746-900. This configuration includes two ESCON channel adapters, two token-ring adapters, and three communication line adapters between two enclosures.*

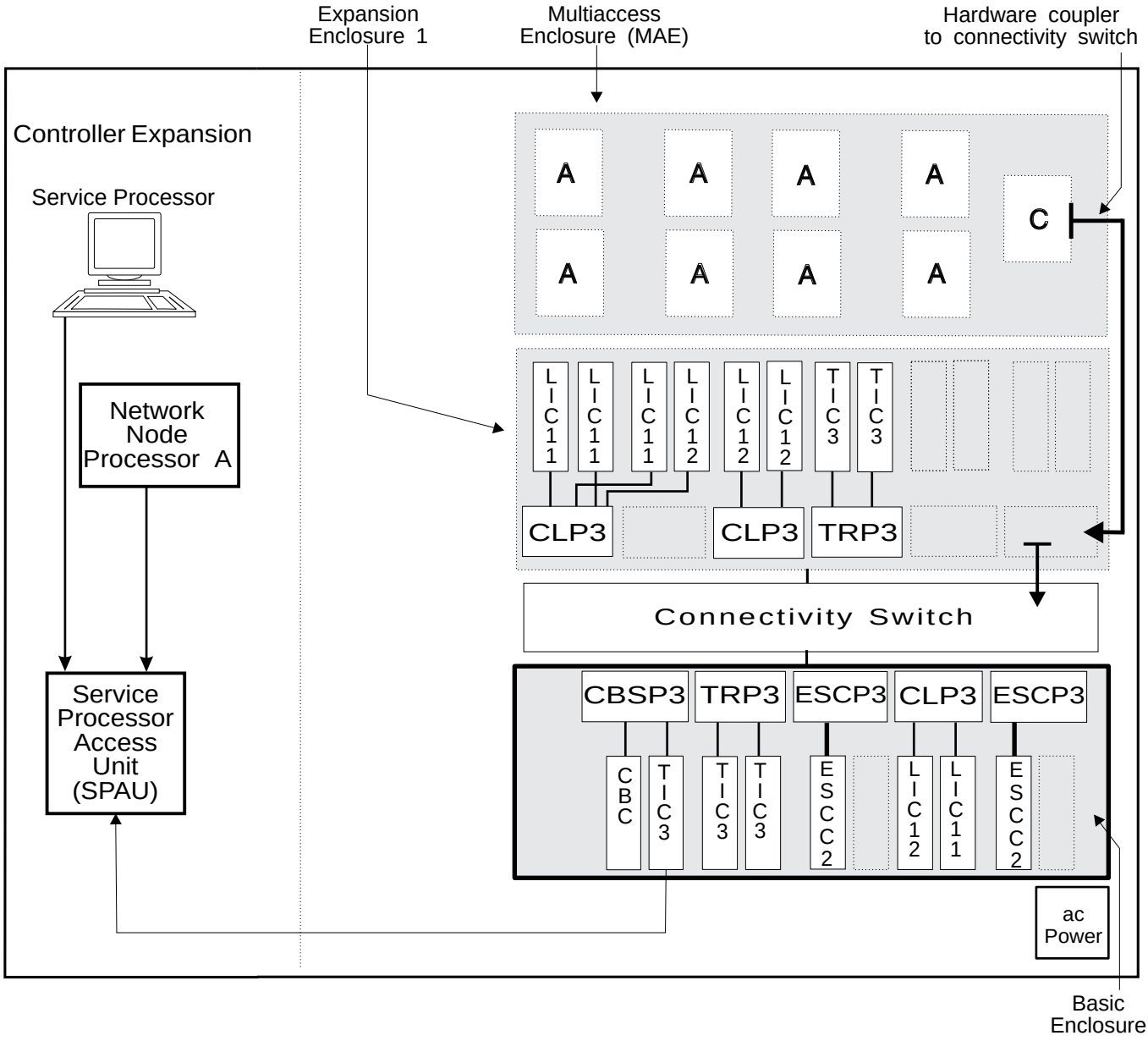



**Legend**:

| | |
|---|---|
| ARC | Active remote connector |
| CBSP3 | Controller bus and service processor type 3 |
| CLP3 | Communication line processor |
| ESCC | ESCON coupler type 2 |
| ESCD | ESCON Director |
| ESCP3 | ESCON processor type 3 |
| LCBB | Line connection box base |
| LCBE | Line connection box expansion |
| LIC11 | Line interface coupler type 11 |
| LIC12 | Line interface coupler type 12 |
| TIC3 | Token-ring interface type 3 |
| TRP3 | Token-ring processor type 3 |

Controller

*Figure B-2. An Example of a Configuration for a 3746 Nways Multiprotocol. This configuration includes two ESCON channel adapters, two token-ring adapters, and three communication line adapters between two enclosures.*




**Legend**:

| | |
|---|---|
| A | Adapter |
| C | Coupler |
| CBC3 | Controller bus coupler |
| CBSP3 | Controller bus and service processor type 3 |
| CLP3 | Communication line processor |
| ESCC2 | ESCON coupler type 2 |
| ESCD | ESCON Director |
| ESCP3 | ESCON processor type 3 |
| LIC11 | Line interface coupler type 11 |
| LIC12 | Line interface coupler type 12 |
| TIC3 | Token-ring coupler type 3 |
| TRP3 | Token-ring processor type 3 |

*Figure B-3. The MAE installed into a Communication Controller*

## Communication Line Adapters

The communication line adapter (CLA) consists of several components:

- The communication line processor (CLP), feature number 5200, has up to four LICs which provide data links for the following:
  - Frame-relay, SDLC, and PPP links.
  - Frame-relay network connections.
  - X.25 network connections.

  The CLP also supports:
  - Two-way alternate data link control support (half-duplex mode).
  - Two-way simultaneous data link control support (full-duplex mode).
  - Port swapping capability for NCP-controlled lines (3746-900).
  - Wrap test support for NCP-controlled lines (3746-900).
  - LPDA2 support for NCP-controlled lines (3746-900).
- The line interface couplers (LIC) types 11, 12, or 16:

  **Line Connection Box**

  A line connection box (LCBB or LCBE) can have up to 15 active remote connectors (ARCs) in any one of the following:

  - 3746-900
  - 3746-950
  - Controller expansion (Feature Number 5023)
  - Standard 19-inch rack.

  An LCB is divided into four ARC groups called LCB areas, three of which have four ARCs, and the remaining group three ARCs. Operating specifications for ARCs are as follows:

  - Up to four ARCs operating at up to 64 kbps per group.
  - One ARC operating at a speed higher than 64 kbps per group.

  **LIC11** LIC11, feature number 5210, consists of the following:

  - The LIC11 itself.
  - The line connection box base (LCBB) connected to the LIC11.

  LIC11 supports the following ITU-T lines:

  - V.24 switched and leased lines, with speeds from 600 bps to 28.8 kbps.
  - V.25 bis functions (for example, IBM 7852, 7855, and 7857).
  - V.34 modem synchronous communication.
  - V.35 leased lines operating at speeds up to 256 kbps.
  - X.21 leased lines operating at speeds from 600 bps to 256 kbps.
  - X.21 switched connection in the 3746-900 NCP for an ISDN terminal adapter (Basic Rate Interface) attachment.

  The LIC11 can operate up to 30 lines with speeds of 600 bps to 64 kbps, or eight lines operating at speeds above 64 kbps. The LIC11 connects to the DCEs/DTEs through the LCBB and the LCBE.

  **LIC12** The line interface coupler type 12, feature number 5212, operates a leased line at speeds from 56 kbps up to 2.048 mbps. The port of the LIC12, depending on the external cable used, provides the following type of ITU-T interface:

  - V.35.

– X.21 (supported by NCP in the 3746-900 for an ISDN terminal adapter (Primary Rate Interface).

**LIC16** The LIC16, feature number 5216, supports PRI for Euro-ISDN. The LIC16 operates under the control of the NCP and supports SNA traffic over 30 ISDN-B channels at 64 kbps.

## Line Connection Box Expansion - Feature Number 5202

An optional feature, the LCBE is connected to the LCBB as part of the LIC11 feature (see Figure B-1 on page B-2).

The LCBE connects to the LCBB via a 35-centimeter cable. Like the LCBB, it can house up to 15 ARCs and has the same characteristics as the LCBB (see page B-5).

## Active Remote Connector - Feature Numbers 64xx, 65xx, 66xx

ARC cards are housed in the LCBs. The cable and connector provide the necessary physical and electrical interface for connecting a data circuit-terminating equipment (DCE or modem) or data terminal equipment (DTE) to the 3746 9x0 (see Figure B-1 on page B-2).

There are several ARC types defined by the following:

- Cable attachment.
- Interface (V.24, V.35, or X.21).
- Type of attachment (either modem- or direct-attached).
- Cable length (from 0.6 m to 15 m).

Two categories of ARC features are available:

- ARCs with a standard ITU-T interface connector to attach to a DCE (modem) or a DTE (terminal).
- ARCs attached to either a DCE or a DTE through cables originally designed for 3745 LIC types 1, 3, and 4.

## ESCON Channel Adapters

An ESCON channel adapter (ESCA) provides the following:

- Support for 3746 native IP routing to MVS TCP/IP.
- Compatibility with IBM 9032 ESCON Directors (ESCDs) Models 1, 2, and 3).
- Support for parallel TGs (through direct attachment to the S/390 or through one or two ESCDs) in SNA traffic controlled by NCP, or APPN/HPR traffic controlled by the 3746 network node.
- To function as an IPL port for loading NCP and activating the 3745/3746-900.

The ESCA consists of the following features (see Figure B-1 on page B-2 and Figure B-2 on page B-3):

**ESCON channel processor type 3 (ESCP3), feature number 5523**
The ESCP3 supports 16 logical connections to S/390 server partitions running VTAM or TCP/IP.

**ESCON channel coupler type 1 (ESCC), feature number 5501 or ESCON channel coupler type (ESCC2), feature number 5502**
The ESSC and ESSC2 contain the interface to the ESCON multimode,

duplex fiber-optic channel cable. ESCC2 is an enhancement of ESSC, providing the same functions, but with an increase in throughput and channel utilization. Any ESCC can be field upgraded to an ESCC2. There is one ESCON channel coupler per ESCON channel processor.

**Note:** The ESCC is not available with the 3746-950.

ESCPs support the standard ESCON fiber distance (3 km), but do not support the ESCON extended distance feature. However, longer distances are possible through an ESCD using ESCON Extended Distance interface. An S/390 can be accessed from up to 23 km away or alternatively, accessed from up to 43 km away, through two cascaded ESCDs, each with the Extended Distance interface.

Table B-1 shows the maximum 3745/3746-900-to-S/390 and 3746-950-to-S/390 distances for various ESCON configurations. See also Figure B-4.

*Table B-1. Maximum 3746 9x0-to-S/390 Distances*

| **Extended Distance Links** | **Direct Host Connection** km (miles) | **One ESCON Director** km (miles) | **Two Cascaded ESCON Directors** km (miles) |
|---|---|---|---|
| 0 | 3 (1.8) | 6 (3.7) | 9 (5.5) |
| 1 | - | 23 (14.3) | 26 (16.1) |
| 2 | - | - | 43 (26.7) |

Figure B-4 illustrates the maximum 3746 9x0-to-S/390 distances.

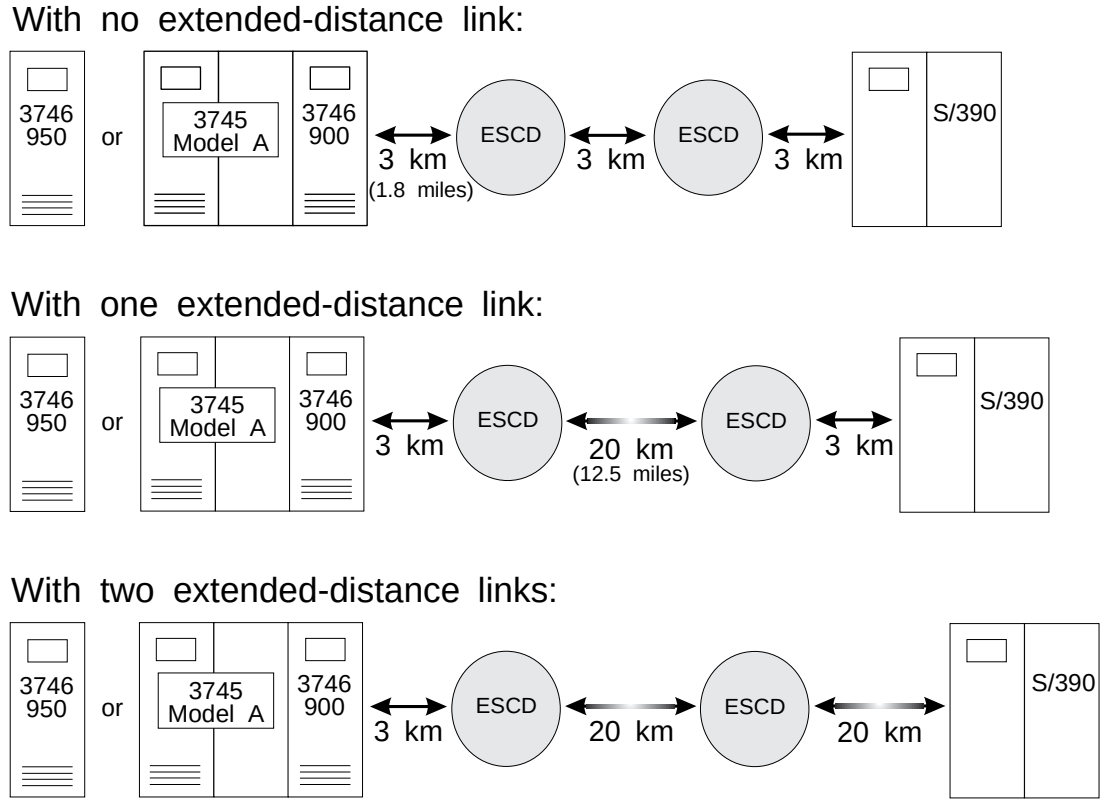



*Figure B-4. Extended ESCON Support. This figure shows the different possible distances between the 3746 9x0 and the S/390 through ESCON support.*

## Token-Ring Adapters

The functions of the token-ring adapter (TRA) are as follows:

- 3746 IP routing, 3746 APPN/HPR routing, SNA traffic.
- Support for 4 mbps and 16 mbps token-ring LANs.
- Early token release (for 16 mbps).
- Variable frame sizes.
- Swapping token-ring ports controlled by the NCP (3746 Model 900).
- Duplicate TIC addresses.

The service processor token-ring LAN operates at 16 mbps.

The TRA consists of two components (see Figure B-1 on page B-2):

**Token-Ring Processor type 3 (TRP3), feature number 5623**
The TRP3 supports 2000 PUs, and 8000 APPN/DLU sessions for PUs controlled by the 3746 NNP.

**Token-Ring Interface Coupler type 3 (TIC3), feature 5601**
The TIC3 handles the medium access control (MAC). One or two TICs can be connected to each processor.

## Ethernet Attachments Features 5631 and 5632

Two Ethernet features are available for respectively interfacing the token-ring processor (feature number 5631) or the token-ring interface coupler type 3 (feature number 5632).

## Service Processor (MOSS-E) - Feature Number 5052

A service processor is required for a 3746-900 and a 3746-950 to operate as an IP router or APPN/HPR network node. Service Processor Feature Number 5052 supports up to 240 lines, and replaces Service Processor Feature 5021 which is no longer available. A new service processor can be ordered with either the 3746-900, the 3746-950 or a 3745 Model A (see "3745 Minimum Configuration" on page A-1).

## Expansion Enclosure 1 - Feature Number 5015

Adding an expansion enclosure to the 3746-900 or 3746-950 increases the capacity to 10 processors and 20[1] or 21 coupler slots. The expansion enclosure has six processor slots on the front side and twelve coupler slots on the back (see Figure B-1 on page B-2 and Figure B-2 on page B-3).

## Expansion Enclosure 2 - Feature Number 5016

Adding a second expansion enclosure to the 3746-900 or 3746-950 increases the capacity to 16 processors and 32[2] or 33 coupler slots. The expansion enclosure has six processor slots on the front side and twelve coupler slots on the back.

---

1 For 3745 Models 41A and 61A, one coupler slot is used by the controller bus coupler to connect to the second CCU. For more information, see "Controller Bus Coupler - Feature Number 5602" on page B-10.

## Network Node Base Upgrade - Feature Number 5019

The network node base required for IP router and APPN/HPR network node operations is included in the basic machine configuration of the 3746-900 and 3746-950 (see the CBSP3 in Figure B-1 on page B-2 and Figure B-2 on page B-3). For a 3746-900 that is not equipped with the network node base, the network node base upgrade changes the CBSP to CBSP2 or CBSP3.

## Service Processor Upgrade - Feature Number 5026

An upgrade increases the hard disk capacity of the service processor. This is required for a service processor to support a 3746 Nways Controller Model 900 or 950, operating as an IP router or APPN/HPR network node.

## Network Node Processor (NNP) - Feature Number 5022 or 5122

The NNP feature is mandatory for the 3746-950 and 3746-900 to operate as an IP router or APPN/HPR network node. The NNP contains the hardware and the licensed internal code required to support the APPN/HPR network node control point and IP router SNMP agent.

A second network node processor can be installed for higher availability (see 7-2).

## Network Node Processor Memory Expansion - Feature Number 5027

A 64MB memory expansion allows the network node processor to support more than 3000 PUs and nodes, and more than 9000[2] APPN and DLUR sessions (LU-LU sessions).

## Controller Expansion - Feature Number 5023

A controller expansion is an extension of the 3745 Model A or 3746 9x0, and can also be installed as a stand-alone unit. A controller expansion houses the network node processor(s) and Ethernet attachment features. It is recommended for installing the service processor (including the keyboard, the display, the RSF modem, and the service processor access unit). Line Connection Boxes can be housed in the Controller Expansion.

Two controller expansions are necessary for housing all the features of a large network environment.

## Side Covers - Feature Number 5024

Two side covers required for a standalone controller expansion, or one attached to a 3745-17A. This feature is not required for a controller expansion bolted to a 3746-950, a 3746-900, or a 3745 Model 21A, 31A, 41A, or 61A.

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[2] ANR sessions are supported in any quantity, and are not part of this number of sessions.

## Controller Bus Coupler - Feature Number 5602

A second controller bus coupler (CBC) is required to connect the 3746-900 to the second CCU of a 3745 Model 41A and 61A. The CBC is installed in one of the TRA coupler slots and uses a standard TRP2. The remaining coupler slot can be used by a TIC3 to connect to a token-ring LAN.

**Note:** This feature is not available for the 3746-950

## Power Supply Feature Number 5000 and 5005

The 3746 can be powered from a second power supply:

- Dual Power Input (single phase, 200-240 V ac, 50-60 Hz), feature number 5000.
- dc Input Backup (-48 V), feature number 5005.

In the event of a power failure, these features automatically take over without disrupting network operations.

## X.25 Support - Feature Number 5030

The X.25 features performs the following:

- In the 3746-900 and the 3746-950, directs the CLP to perform X.25 DLC and Data Packet functions over PVC and SVC.
- In the 3746-900, supports SNA Qualified Logical Link Control (QLLC) for NCP subarea and peripheral traffic. This means that the following are not needed:
  - NPSI in the 3745.
  - SNA QLLC traffic for the 3746.
  - Network Node and IP traffic for the 3746 IP Router.
  - In the 3746-950, supports SNA QLLC traffic (APPN, SNA/DLUR, HPR) and IP traffic for the 3746 IP Routing.

## IP Routing - Feature Number 5033

The IP Routing feature is required for the 3746-900 and 3746-950, and provides the following:

- Licensed internal code for the IP functions of CBSP, CBSP2 or 3, TRP, TRP2 or 3, ESCP2 or 3, and CLP or CLP3 processors.
- IP management functions of the network node processor (SNMP agent, Telnet).

## Service Processor Memory Expansion - Feature Number 5028

This 64MB Memory Expansion allows the service processor feature number 5021 (rack-mountable and tower versions) to support large configurations, for example:

- A Service Processor shared between multiple 3745s and 3746 9x0s. This feature is required when an additional 3745 or 3746 9x0 is connected to the service processor.
- 3746 9x0 with two expansion enclosures.

Large configurations increase the activity of the service processor and more memory is required to prevent excessive memory swapping on disk.

The service processor (32MB memory) may also slow down to allow for a response by the operator, for example while using CCM.

**Note:** Memory expansion is not required for the service processor feature number 5052 which already has a 96 MB memory base. Also, it cannot be installed in the service processor feature number 5020 (the desktop version), including those with a service processor upgrade, feature number 5026.

## The Multiaccess Enclosure (MAE) - Feature Number 3000

The Multiaccess Enclosure (MAE) is an extension to your existing communication controller. The base enclosure of the MAE houses eight adapter slots for extending the APPN, APPN/DLUR, HPR, and IP routing capacities of existing networks. A mix of communication interfaces within the MAE allows for greater flexibility in network design and evolution.

## Multiaccess Enclosure with Direct Attachment - Feature Number 3001

A high speed, hardware attachment from the MAE to the 3746 connectivity switch, designed for IP traffic. The direct attachment is installed in an empty processor slot of the controller base.

## Multiaccess Enclosure Extended Functions - Feature Number 5804

A set of multiprotocol routing protocols and transport software, enabling the controller to have greater scalability and load-balancing capacity for S/390 and IP/web servers on the Internet or Intranet. Protocol enhancements apply to the following:

- Frame-relay
- PPP
- ISDN
- WAN
- APPN/HPR
- DLSw
- IP.

Transport software includes the following:

- Network Dispatcher
- Branch Extender.

Protocol and software support for ATM includes the following:

- QoS
- NHRP
- SCSP.

For more information on protocol enhancements, see “Additional Protocol Enhancements for MAE Links” on page 2-8. For more information on transport software and ATM, see “Value Added Network Functions” on page 2-7.

# 3745 and 3746 Model 900 Migration Paths and Upgrades

## Upgrading Your 3745 and 3746 Model 900

The capabilities of the 3745 Model A can be extended with the following upgrades:

- Models 130, 150, 160, or 170 to a Model 17A.
- Models 210, 310, 410, or 610 to a Model 21A, 31A, 41A, or 61A.

The capabilities of the 3746-900 can be extended with an upgrade to a 3746 Nways Controller Model 900 or 950 (in the field).

Upgrading your 3745 Model A and 3746 Model 900 takes advantage of the networking evolution and preserves your existing investment in communication controllers.

The summary below shows the migration paths that are available to upgrade your network. This includes the following equipment:

- 3745 (see Figure B-5).
- 3746-900 to a 3746 IP router and APPN/HPR network node.
- 3746-900 to a 3746 Model 950 (see Figure B-5).

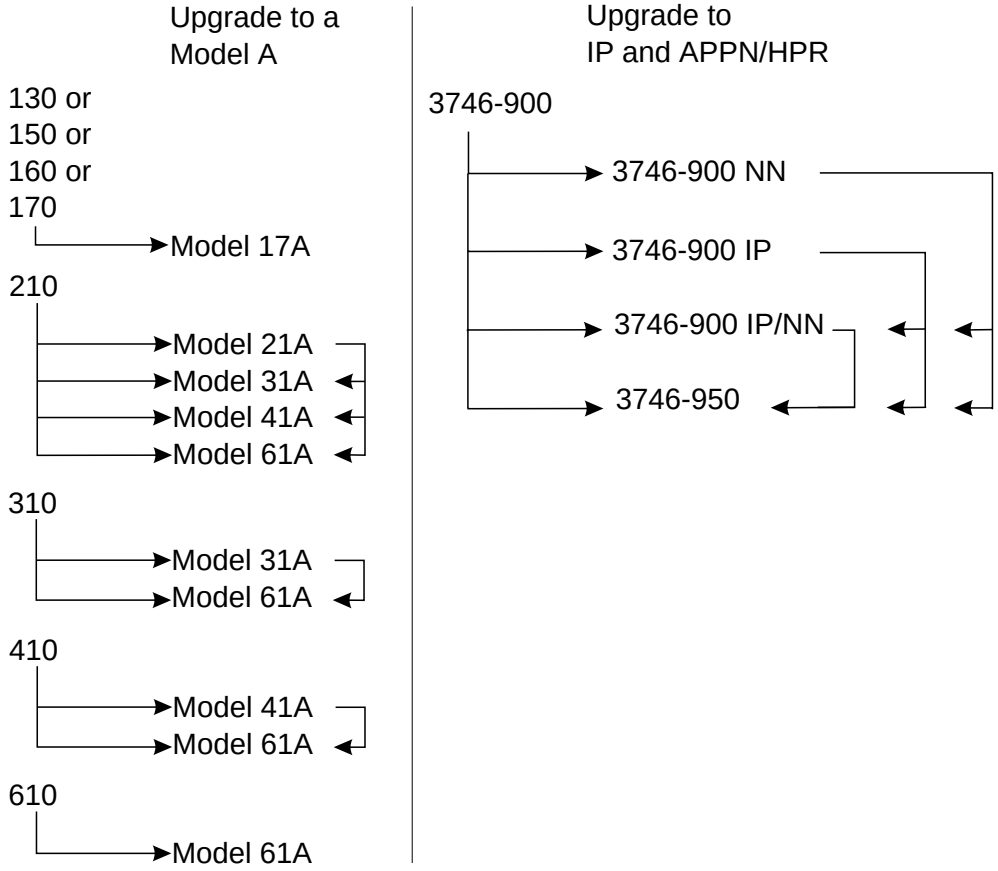



*Figure B-5. Upgrading a 3745 or 3746*

See the following notes for a brief description on the changes that are required for upgrading your equipment:

**Notes:**

- To upgrade your 3745 requires an IBM service representative to make hardware and microcode changes, including the installation of the service processor.
- To upgrade your 3746-900 to a 3746 IP router or APPN/HPR network node requires installing the network node base upgrade (see page B-9), if this is not already installed. The following must also be installed for the upgrade to work:
  - Service processor feature 5052 (feature 5020 can be used, after an upgrade with feature 5026).
  - Network Node Processor feature 5022 or 5122.
- To upgrade your 3746-900 to a 3746-950 requires ordering a 3746 model conversion, and a network node base upgrade CBSP2 or CBSP3, if the latter is not already installed.

## Upgrading to a More Powerful NCP-Controlled 3745

When you upgrade a 3745 by connecting a 3746-900 or installing 16 MB of storage, the potential growth in network traffic may require more processing power.

To increase the processing power of a 3745-21A, for example, you can upgrade the 3745 to the CCU of a model 31A and 61A, or to the second CCU of a model 41A and 61A (see Figure B-6).

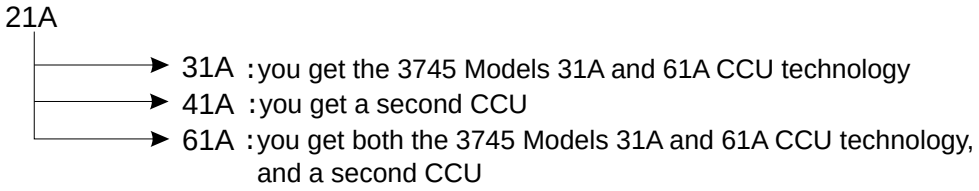



*Figure B-6. Example of a 3745 Upgrade*

## Adding 3746 Expansion Unit Models A11 or A12

The 3746-900 is installed as the rightmost expansion unit of a 3745 Model 21A, 31A, 41A, or 61A. A new 3746-A11 or 3746-A12 must be installed between the 3745 and the 3746-900, effectively taking the place of the 3746-900. This requires closing down 3745 operations, and reassembling the expansion units so that the new 3746-A11 or 3746-A12 can be placed between the 3745 and the 3746-900.

It is recommended that an empty 3746-A11 or 3746-A12 be installed with the 3746-900 for the following reasons:

- Future migration of the 3745.
- To avoid interrupting the 3745 operations.

**Note:** This feature is unavailable for the 3745 Model 17A.

# Programming Support

## Network Control Programs and System Support Programs

The 3745 Models A and 3746 Model 900 are supported by the basic versions (V) and releases (R) of IBM licensed programs, as shown in Table B-2.

**Note:** NCP is not required for the 3746 Nways Controller Model 900 to operate as an IP router or APPN/HPR network node. Programming requirements depend only on the 3746-900 interfaces and functions that need to be supported by programs running in the attached 3745 Model A (NCP, NPSI, or other). Basic support includes NCP V6R3 for the 3745 Model 17A, and NCP V7R6 for other 3745 Models A.

*Table B-2. Programming Support for the 3745 Models A and 3746 Model 900.*

| S/390 Operating System | NCP[1] | NRF | SSP | EP[2] | 3746-900 Support | | | | | | 3745 Models A | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ESCON | Token Ring | Communication Lines[7] | | | | 21A 31A 41A 61A | 17A |
| | | | | | | | SDLC | FR | X.25, BAN[3] | Euro-ISDN | | |
| MVS, VM | V6R2 | R8 | V3R8 | R11 | Yes | Yes | No | No | No | No | Yes | No |
| MVS | V6R3 | R8 | V3R9 | R11 | Yes | Yes | Yes | No | No | No | Yes | Yes |
| MVS, VM, VSE | V7R1 | R9 | V4R1 | R12 | Yes | Yes | Yes | No | No | No | Yes | Yes |
| MVS | V7R2 | R9 | V4R2 | R12 | Yes | Yes | Yes | Yes | No | No | Yes | Yes |
| MVS | V7R3 | R9 | V4R3 | R12 | Yes | Yes | Yes | Yes | Yes[4] | No | Yes | Yes |
| MVS, VM, VSE | V7R4 | R9 | V4R4 | R12 | Yes | Yes | Yes | Yes | Yes[5] | No | Yes | Yes |
| MVS,VM,VSE | V7R5 | R9 | V4R5 | R12 | Yes | Yes | Yes | Yes[6] | Yes[5/6.] | Yes | Yes | Yes |

**Notes:**

1. If you have a 3746-900 installed, the 3746-900 feature is required in NCP. NCP V7 is required for NCP Tier C, which provides no-charge support for all the adapters of the 3746 Nways Controller Model 900 (3746-900 equipped with a network node processor).
2. The partitioned emulation programming (PEP) extension of NCP is provided by EP. EP communication over ESCON channels is not supported.
3. Frame-relay boundary access node function.
4. X.25 requires NPSI V3R8.
5. NPSI is not required for SNA communications over X.25. NPSI is required only for non-SNA traffic.
6. Frame-relay BAN for NCP INN traffic, and Frame-relay line sharing between NCP traffic and 3746 IP router and APPN/HPR network node.
7. PPP lines are not supported by NCP, but by the IP routing feature of the 3746 Model 900.

**Legend:**

**BAN** Boundary Access Node
**EP** Emulation Program
**FR** Frame-Relay
**ISDN** Integrated Services Digital Network
**NCP** Network Control Program
**NRF** Network Routing Facility
**SSP** System Support Programs

## Host-Resident Communications Support

### TCP/IP for MVS

To support native IP routing over ESCON channels, TCP/IP Version 3 Release 1 or Release 2 with PTFs (documented in APAR II09903) is required. This APAR also includes PTFs on MVS.

### TCP/IP for VM

This program does not provide support for IP routing channel connections to the 3745 or 3746.

### ACF/VTAM*

- To support ESCON channels, NCP requires the following ACF/VTAM versions:
  - For MVS/ESA*, Version 3 Release 4.1 or higher.
  - For VM/ESA*, Version 3 Release 4 or higher.
  - For VSE/ESA*, Version 3 Release 3 or higher.
- To support APPN over ESCON channels, the 3746-900 and 3746-950 requires ACF/VTAM Version 4 Release 1 or higher.
- To support DLUs, the Dependent LU Requester of the 3746-900 and 3746-950 requires the Dependent Logical Unit Server (DLUS) function of ACF/VTAM Version 4 release 4 is recommended.
- To support APPN/HPR over ESCON channels, the 3746-900 and 3746-950 require ACF/VTAM Version 4 Release 4 is recommended.

### Transaction Processing Facility (TPF)

To support ESCON channel operation requires at least TPF Version 3 or Version 4.

### NetView/390

NetView is recommended for network management of the 3745 and 3746. Different versions of NetView provide the following:

- Support for full alerts in the 3745 with a 3746-900 controlled by NCP provided by NetView Version 2 Release 4.
- Support for full alerts 3746 network nodes provided by NetView Version 3 Release 1. Alert support for 3746 network nodes is also provided by NetView Version 2 Release 4 after alert customization.
- Support for APPN/HPR network nodes in the 3746-900 and 3746-950 provided by the APPN Topology Manager function of NetView Version 3 Release 1 (also provided by the APPNTAM feature of NetView Version 2 Release 4).

### NetView for AIX

Network management for the 3746 IP router requires:

- Router and Bridge Manager (RABM), available with Nways Enterprise Manager program number 5777-AAK, RABM available with Nways Campus Manager LAN for AIX (V2R1), and Nways Campus Manager Suite for AIX (V2R1). Order Part Number 84H0030, 84H0031, 84H0032, or 84H0033 (media dependant).
- Software, such as NetView for AIX, at the level required by the above network management programs.

### NetView Performance Monitor (NPM)

The following table indicates NPM support and APAR number depending on the Version and Release level.

*Table B-3. NPM Support and Required APAR Numbers*

| Support | V1R6 | V2R1 | V2R2 |
|---|---|---|---|
| 3745/3746-900 (NCP) | No APAR | No APAR | No APAR |
| 3746-900; Frame-relay (NCP V7R2) | N/A | PTF | No APAR |
| 3746-900; X.25 (NPSI V3R8, NCP V7R4) | N/A | OW10583 | OW10583 |
| 3746-900 adapter utilization; processor, storage, TIC3 (NCP V7R3) | N/A | OW08565<br>OW10584 | OW08565<br>OW10584 |
| 3746-900 composite network node; LAN counters for non-ERP traffic (ANR) over TIC3 (NCP V7R4) | OW17878 | OW17876 | OW17876 |
| 3746-900 and 950; APPN/DLUR and HPR (3746 Network Node) | N/A | OW08565<br>OW10584<br>OW17876<br>OW19447 | OW08565<br>OW10584<br>OW17876<br>OW19447 |

### NTune*

NTune MON monitors the network, and in conjunction with NTune NCP running in the 3745, provides on-line interactive tuning of NCP keyword parameters. Optimization of network performance is greatly simplified by NTune products.

For the 3746 network nodes, similar facilities are provided by CCM.

### NETDA/2

NETDA/2, running on PS/2, provides network definition aids which simplify SNA, APPN/HPR, and Frame-relay network design activities.

## Distributed Console Access Facility (DCAF)

### Minimum Programming Requirements

**Note:** DCAF will be renamed to TME10 Remote Control. This will supply the DCAF 1.3 Base and CSD to level 1.33.

You need the following minimum program levels on your workstation to remotely access the service processor:

- OS/2 Version 2.1 or higher.
- Communications Manager/2 Version 1.11 or higher, or Communication Server/2.
- Distributed Console Access Facility (DCAF), Version 1.31 with CSD UB20924 or higher. (See note above.)
- LAN Adapter Protocol Support (LAPS) Version 2.2 or higher for LAN-Attached workstations.
- TCP/IP Version 2.0 or higher for LAN-attached (TCP/IP type) workstations.

**Notes:**

- Network Transport Services/2 (NTS/2) should be installed for LAN-attached consoles and SNA-attached consoles connected to an SNA network via a LAN.
- Accessing the service processor via an SNA or APPN/HPR network backbone requires the following:
  - DCAF remote workstations and gateway workstations configured as physical units type 2.1 (PU 2.1). If the DCAF workstation is downstream from a 3174 control unit, the 3174 must have either of the following:
    - Configuration Support B plus 8Q0800 Programming Request for Price Quotation (PRPQ).
    - Configuration Support C (APPN feature).
  - When using 3725 Communication Controllers in the network backbone, the controllers must be loaded with NCP V4R3 and operate under VTAM V3R2 or higher.
  - When using 3720 and 3745 Communication Controllers in the network backbone, the controllers must be loaded with NCP V5R2 or higher and operate under VTAM V3R2 or higher.

## Telnet Access

### Programming Requirements

To remotely access the network node processor functions, ensure that your remote workstation runs an operating system that supports TCP/IP, including the Telnet Client program.

## Expansion Units

Your 3746 Model 900 and 3746 Model 950 can be expanded by simply adding more enclosures and installing new adapters into any available slot.

ESCON, token-ring, and communication line adapters can be mixed in the same enclosure.

If you fill the slots with only one type of adapter, you will still have the following:

- 16 ESCON channel couplers.
- 32 or 33 token-ring couplers.
- 32 LICs for one of the following:
  - 32 high-speed lines up to 2 mbps
  - 240 medium-speed line interfaces up to 256 kbps
  - 480 (V.35/X.21) medium- and low-speed line interfaces up to 64 kbps
  - 600 (V.24) medium- and low-speed line interfaces up to 64 kbps.

See Table B-4 and Table B-5 on page B-18 for information about maximum configurations in a 3746-900 and 3746-950 with a single type of adapter.

To read a table, select a single type of adapter in the first column of either Table B-4 on page B-18 or Table B-5 on page B-18.

*Table B-4. Configuration for the 3746-900 with One Type of Adapter*

| **3745-17A, 3745-21A and 3745-31A** | | | | |
|---|---|---|---|---|
| **Adapter Type ↓** | **ESCON Channel Ports** | **Token-Ring LAN Ports (TIC3)**[1] | **Low-/Medium-Speed Lines (LIC11)** | **High-Speed Lines (LIC12)** |
| **ESCA** | 16 | 1 | - | - |
| **TRA (TIC3)** | - | 33 | - | - |
| **CLA (CLP+LIC11)** | - | 1 | 600[2] | - |
| **CLA (CLP+LIC12)** | - | 1 | - | 32[2] |
| **3745-41A and 3745-61A** | | | | |
| **Adapter Type ↓** | **ESCON Channel Ports** | **Token-Ring LAN Ports (TIC3)**[1] | **Low-/Medium-Speed Lines (LIC11)** | **High-Speed Lines (LIC12)** |
| **ESCA** | 15 | 2 | - | - |
| **TRA (TIC3)** | - | 32 | - | - |
| **CLA (CLP+LIC11)** | - | 2 | 540[2] | - |
| **CLA (CLP+LIC12)** | - | 2 | - | 30[2] |

**Note:**

1. The service token-ring used to interconnect the service processor, 3745, and 3746-900 is available for user stations, unless the 3746 Model 900 is operated as an APPN/HPR network node or IP router.
2. Up to 120 lines (total of LIC 11 and LIC 12 lines) can be controlled by the 3746 network node, and IP Router.

*Table B-5. Maximum Configurations of the 3746-950 when Containing a Single Type of Adapter*

| **Adapter Type ↓** | **ESCON Channel Ports** | **Token-Ring LAN Ports (TIC3)**[1] | **Low-/Medium-Speed Lines (LIC11)** | **High-Speed Lines (LIC12)** |
|---|---|---|---|---|
| **ESCA** | 16 | - | - | - |
| **TRA (TIC3)** | - | 32 | - | - |
| **CLA (CLP+LIC11)** | - | - | 240[2] | - |
| **CLA (CLP+LIC12)** | - | - | - | 32[2] |

**Note:**

1. The service token-ring used to interconnect the service processor, the network node processor, and the 3746 Model 950 *is not available* for user stations.
2. Maximum number of active lines (total of LIC11 and LIC12 lines) controlled by the 3746 network node and IP router is 240.

# Appendix C. Connectivity of the 3746 9x0 APPN/HPR Network Node

The number of PUs, Frame-relay DLCIs, and sessions available through the enhanced adapters ESCP3, TRP3, and CLP3 are given in the following tables.

## Adapter Connectivity

Table C-1 shows the maximum number of PUs, Frame-relay DLCIs, and APPN or Dependent LU sessions that various 3746-900 and 3746-950 adapters can run.

**Note:** The above assumes that these adapters are not loaded with IP routing software. For IP routing adapters, the maximum number of PUs and sessions controlled by the 3746 network node may be lower, due to the storage used by the IP routing software.

The available storage in the processors determines the actual maximum number of 3746-controlled PUs and sessions. When reviewing the maximum number of ESCON logical link stations (16), the maximum number of NCP-controlled PUs (column **NCP** in Table C-1) in the 3746-900, and the total number of PUs (column **Total** in Table C-1), remember that these are numbers that cannot be exceeded.

*Table C-1. Adapter Level Connectivity*

| Adapter | 3746 Model 900 | | | | 3746 Model 950 | |
|---|---|---|---|---|---|---|
| | PUs[1] | | | Sessions[2] 3746 NN | PUs[1] | Sessions[2] |
| | 3746 NN | NCP | Total | | | |
| **ESCP2** | 16[9] | 16 | 16[9] | 5000 | 16[9] | 5000 |
| **ESCP3** | 16 | 16 | 16 | 15000 | 16 | 15000 |
| **TRP2**[10] | 1000 | 2000 | 2000 | 4500 | 1000 | 4500 |
| **TRP3** | 2000 | - | 2000 | 8000 | 2000 | 8000 |
| **CLP with:** | | | | | | |
| **3000 DLCIs**[4] | - | 4000[6] | 4000[6] | - | - | - |
| **500 DLCIs**[10] | 1000[8] | 2000[7] | 2000[7] | 3500 | 1000[8] | 3500 |
| **CLP3 with:** | | | | | | |
| **2000 DLCIs** | 2000 | - | 3000 | 8000 | 3000 | 8000 |

**Legend**

| | | | |
|---|---|---|---|
| **CLP** | Communication line processor (CLP and type 3) | **DLCI** | Data link connection identifier |
| **ESCP** | ESCON processor (type 2 and type 3) | **NN** | Network node |
| **PU** | Physical unit | **TRP** | Token-ring processor (type 2 and type 3) |

**Notes related to table A-4:**

1. Adjacent PUs or ESCON logical link stations, such as end nodes, network nodes, LEN nodes, dependent PUs, gateway downstream PUs, and X.25 Virtual Circuits. For the 3746-900, the total of NCP-controlled and 3746-controlled stations cannot exceed the total in the third column.
2. LU sessions (Independent and Dependent LUs) routed by the 3746 adapter, including LU-LU sessions with non-adjacent nodes. This does not include the following:
   - Any number of HPR/ANR sessions between HPR/RTP nodes.

- Sessions routed by NCP for the 3746-900, depending on the storage capacity of the 3745.

3. TRP or TRP2 used to connect the 3745 CCU-B to the 3746-900.
4. For a 3746-900, if neither 3746 APPN/HPR nor 3746 IP routing is used in any CLP.
5. For any 3746-950 or 3746-900 using the APPN/HPR network node or IP Routing support.
6. Up to 1000 SDLC PUs and any mix of up to 3000 Frame-relay PUs, ISDN PUs, and X.25 virtual circuits (one PVC or SVC per PU).
7. Up to 1000 SDLC PUs and any mix of up to 1000 Frame-relay PUs, ISDN PUs, and X.25 virtual circuits (one PVC or SVC per PU).
8. Up to 1000 PUs over SDLC, Frame-relay, and X.25 lines.
9. Any logical stations (TCP/IP) used by the 3746 IP router.
10. All the maximum connection capabilities may not be possible simultaneously. The maximum number of resources in a given processor (3746-controlled PUs, NCP-controlled PUs, 3746-controlled sessions, SDLC links) depends on the following:
    - Number of active resources in other categories.
    - IP Routing feature.
    - In a CLP, the mix of lines (SDLC, Frame-relay, X.25).

## Network Node Connectivity

Table C-2 gives the total number of PUs, APPN and Dependent LU sessions, and the lines that a 3746 network node can run with any adapter configuration.

*Table C-2. Network Node-Level Connectivity*

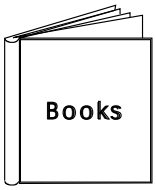
| **Connectivity** | | **Comments** |
|---|---|---|
| **Type** | **Number** | |
| PU | 5000 | End Nodes, LEN Nodes, network nodes, Dependent PUs. |
| Sessions | 30000 | All the LU-LU sessions using 3746 DLUR and APPN routing, including sessions involving non-adjacent nodes. HPR/ANR sessions between HPR nodes connected to the 3746 are in addition to this number of sessions and can be in any quantity. |
| SDLC Line | 240 | Frame-relay, SDLC, X.25 (and PPP). |
| **Note:** For the 3746 Model 900, the resources beyond these network node quantities are controlled by NCP(s) either as part of a PU type 4 (SNA) node or part of an APPN composite network node (CNN). | | |

# Appendix D. Bibliography

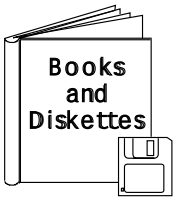
## Customer Documentation for the 3746 Model 950

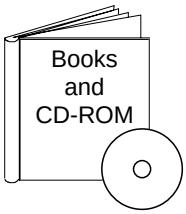
*Table D-1 (Page 1 of 2). Customer Documentation for the 3746 Model 950*

This customer documentation has the following formats:








**Preparing for Operation**

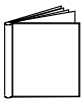
GA33-0400

***IBM 3745 Communication Controller All Models***[1]
***IBM 3746 Expansion Unit Model 900***
***IBM 3746 Nways Multiprotocol Controller Model 950***

***Safety Information***[2]

Provides general safety guidelines.

**Evaluating and Configuring**



GA33-0180

***IBM 3745 Communication Controller Models A***[3]
***IBM 3746 Nways Multiprotocol Controller***
***Models 900 and 950***

***Overview***

Gives an overview of connectivity capabilities within SNA, APPN, and IP networking.

GA33-0349

***IBM 3746 Nways Multiprotocol Controller***
***Models 900 and 950***

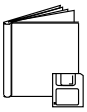
***Migration and Planning Guide***

Network node planning for:

- Field upgrades
- Network integration
- Physical installation
- Configuration using the *Controller Configuration and Management* program.

*Table D-1 (Page 2 of 2). Customer Documentation for the 3746 Model 950*

**Operating and Testing**



SA33-0356

***IBM 3746 Nways Multiprotocol Controller Model 950***

***User's Guide*[2]**

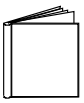
Explains how to:

- Carry out daily routine operations on Nways controller
- Install, test, and customize the Nways controller after installation
- Configure user's workstations to remotely control the service processor using:
  - DCAF program
  - Telnet client program

On-line information

***Controller Configuration and Management Application***

Provides a graphical user interface for configuring and managing a 3746 APPN/HPR network node and IP Router, and its resources.
Is also available as a stand-alone application, using an OS/2 workstation.
Defines and explains all the 3746 Network Node and IP Router configuration parameters through its online help.



SH11-3081

***IBM 3746 Nways Multiprotocol Controller Models 900 and 950***

***Controller Configuration and Management: User's Guide*[2]**

Explains how to use CCM and gives examples of the configuration process.

**Managing Problems**

On-line information

***Problem Analysis Guide***

An online guide to analyze alarms, events, and control panel codes on:

- IBM 3745 Communication Controller Models A[3]
- IBM 3746 Nways Multiprotocol Controller Models 900 and 950.

SA33-0175

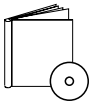
***IBM 3745 Communication Controller Models A*[3]**
***IBM 3746 Expansion Unit Model 900***
***IBM 3746 Nways Multiprotocol Controller Model 950***

***Alert Reference Guide***

Provides information about events or errors reported by alerts for:

- IBM 3745 Communication Controller Models A[3]
- IBM 3746 Nways Multiprotocol Controller Models 900 and 950.

**CD-ROM Bibliography**



SK2T-6012

***IBM Networking Softcopy Collection Kit***

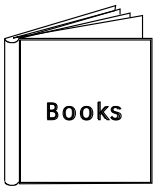
Allows customers to consult manuals via CD-ROM viewer.

[1] Models 130 to 61A.
[2] Documentation shipped with the 3746-950
[3] 3745 Models 17A to 61A.

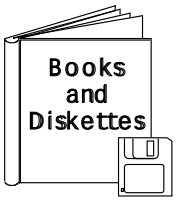
# Customer Documentation for the 3745 (Models 210, 310, 410, 610, 21A, 31A, 41A, and 61A), and 3746 (Model 900)

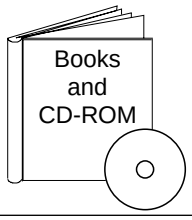
*Table D-2 (Page 1 of 5). Customer Documentation for the 3745 Models X10 and X1A, and 3746 Model 900*

This customer documentation has the following formats:

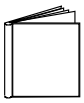







**Finding Information**



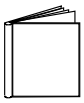
SA33-0172

***IBM 3745 Communication Controller***
***Models 210 to 61A***
***IBM 3746 Expansion Unit Model 900***

***Customer Master Index***[1]

Provides references for finding information in the customer documentation library.

**Evaluating and Configuring**

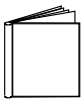


GA33-0092

***IBM 3745 Communication Controller***
***Models 210, 310, 410, and 610***

***Introduction***

Gives an introduction of the IBM Models 210 to 610 capabilities. For Models A refer to the *Overview*, GA33-0180.



GA33-0180

***IBM 3745 Communication Controller Models A***[2]
***IBM 3746 Nways Multiprotocol Controller***
***Models 900 and 950***

***Overview***

Gives an overview of connectivity capabilities within SNA, APPN, and IP networking.

GA33-0183

***IBM 3745 Communication Controller Models A***[2]
***IBM 3746 Expansion Unit Model 900***

***Migration and Planning Guide***

Prepares 3745 Models A and 3746 Model 900 planning for:

- Field upgrades
- Network integration (NCP control)
- Physical installation

*Table D-2 (Page 2 of 5). Customer Documentation for the 3745 Models X10 and X1A, and 3746 Model 900*

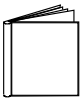
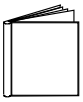
| | | |
|---|---|---|
| **Preparing Your Site** | | |
|  | GC22-7064<br>GN22-5490 | ***Input/Output Equipment***<br>***Installation Manual-Physical Planning***<br><br>***Technical News Letter***<br><br>Provides information for physical installation for the 3745 Models 130 to 610. For 3745 Models A and 3746 Model 900, refer to the *Migration and Planning Guide*, GA33-0183. |
|  | GA33-0127 | ***IBM 3745 Communication Controller***<br>***Models 210, 310, 410, and 610***<br><br>***Preparing for Connection***<br><br>Helps for preparing the 3745 Models 210 to 610 cable installation. For 3745 Models A refer to the *Connection and Integration Guide*, SA33-0129. |
| **Preparing for Operation** | | |
|  | GA33-0400 | ***IBM 3745 Communication Controller All Models***[3]<br>***IBM 3746 Nways Multiprotocol Controller***<br>***Models 900 and 950***<br><br>***Safety Information***[1]<br><br>Provides general safety guidelines. |
|  | SA33-0129 | ***IBM 3745 Communication Controller All Models***[3]<br>***IBM 3746 Nways Multiprotocol Controller Model 900***<br><br>***Connection and Integration Guide***[1]<br><br>Contains information for connecting hardware and integrating network of the 3745 and 3746-900 after installation. |
|  | SA33-0416 | ***Line Interface Coupler Type 5 and Type 6***<br>***Portable Keypad Display***<br><br>***Migration and Integration Guide***<br><br>Contains information for moving and testing LIC types 5 and 6. |

*Table D-2 (Page 3 of 5). Customer Documentation for the 3745 Models X10 and X1A, and 3746 Model 900*

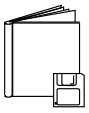
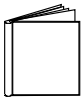
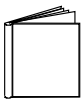
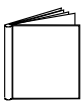
| | | |
|---|---|---|
|  | SA33-0158 | ***IBM 3745 Communication Controller All Models***[3]<br>***IBM 3746 Nways Multiprotocol Controller Model 900***<br><br>***Console Setup Guide***[1]<br><br>Provides information for:<br>• Installing local, alternate, or remote consoles for 3745 Models 130 to 610<br>• Configuring user workstations to remotely control the service processor for 3745 Models A and 3746 Model 900 using:<br>– DCAF program<br>– Telnet Client program |
| **Customizing Your Control Program** | | |
|  | SA33-0178 | ***Guide to Timed IPL and Rename Load Module***<br><br>Provides VTAM procedures for:<br>• Scheduling an automatic reload of the 3745<br>• Getting 3745 load module changes transparent to the operations staff. |
| **Operating and Testing** | | |
|  | SA33-0098 | ***IBM 3745 Communication Controller All Models***[4]<br><br>***Basic Operations Guide***[1]<br><br>Provides instructions for daily routine operations on the 3745 Models 130 to 610. |
|  | SA33-0177 | ***IBM 3745 Communication Controller Models A***[2]<br>***IBM 3746 Nways Multiprotocol Controller Model 900***<br><br>***Basic Operations Guide***[1]<br><br>Provides instructions for daily routine operations on the 3745 Models 17A to 61A, and 3746 Model 900 operating as an SNA node (NCP), APPN/HPR Network Node and IP Router. |
|  | SA33-0097 | ***IBM 3745 Communication Controller All Models***[3]<br><br>***Advanced Operations Guide***[1]<br><br>Provides instructions for advanced operations and testing, using the 3745 MOSS console. |

*Table D-2 (Page 4 of 5). Customer Documentation for the 3745 Models X10 and X1A, and 3746 Model 900*

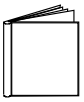
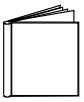
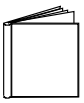
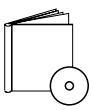
| | | |
|---|---|---|
|  | On-line Information | ***Controller Configuration and Management Application***<br><br>Provides a graphical user interface for configuring and managing a 3746 APPN/HPR Network Node and IP Router, and its resources.<br>Is also available as a stand-alone application, using an OS/2 workstation.<br>Defines and explains all the 3746 Network Node and IP Router configuration parameters through its online help. |
|  | SH11-3081 | ***IBM 3746 Nways Multiprotocol Controller Models 900 and 950***<br><br>***Controller Configuration and Management: User's Guide***[5]<br><br>Explains how to use CCM and gives examples of the configuration process. |
| **Managing Problems** | | |
|  | SA33-0096 | ***IBM 3745 Communication Controller All Models***[3]<br><br>***Problem Determination Guide***[1]<br><br>A guide to perform problem determination on the 3745 Models 130 to 61A. |
|  | On-line Information | ***Problem Analysis Guide***<br><br>An online guide to analyze alarms, events, and control panel codes on:<br>• IBM 3745 Communication Controller Models A[2]<br>• IBM 3746 Nways Multiprotocol Controller Models 900 and 950. |
|  | SA33-0175 | ***IBM 3745 Communication Controller Models A***[2]<br>***IBM 3746 Expansion Unit Model 900***<br>***IBM 3746 Nways Multiprotocol Controller Model 950***<br><br>***Alert Reference Guide***<br><br>Provides information about events or errors reported by alerts for:<br>• IBM 3745 Communication Controller Models A[2]<br>• IBM 3746 Nways Multiprotocol Controller Models 900 and 950. |
| **CD-ROM Bibliography** | | |
|  | SK2T-6012 | ***IBM Networking Softcopy Collection Kit***<br><br>Allows customers to consult manuals via CD-ROM viewer. |

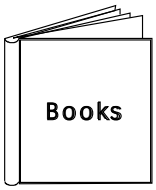
*Table D-2 (Page 5 of 5). Customer Documentation for the 3745 Models X10 and X1A, and 3746 Model 900*

[1] Documentation shipped with the 3745.
[2] 3745 Models 17A to 61A.
[3] 3745 Models 130 to 61A.
[4] Except 3745 Models A.
[5] Documentation shipped with the 3746-900.

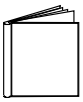
## Additional Customer Documentation for the 3745 Models 130, 150, 160, 170, and 17A

*Table D-3. Additional Customer Documentation for the 3745 Models 130 to 17A*

This customer documentation has the following format:




**Finding Information**



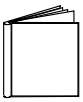
SA33-0142

***IBM 3745 Communication Controller***
***Models 130, 150, 160, 170, and 17A***
***IBM 3746 Nways Multiprotocol Controller Model 900***

***Customer Master Index***[1]

Provides references for finding information in the customer documentation library.

**Evaluating and Configuring**



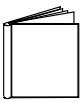
GA33-0138

***IBM 3745 Communication Controller***
***Models 130, 150, and 170***

***Introduction***

Gives an introduction about the IBM Models 130 to 170 capabilities, including Model 160. For Model 17A refer to the *Overview*, GA33-0180.

**Preparing Your Site**



GA33-0140

***IBM 3745 Communication Controller***
***Models 130, 150, 160, and 170***

***Preparing for Connection***

Helps for preparing the 3745 Models 130 to 170 cable installation. For 3745 Model 17A refer to the *Connection and Integration Guide*, SA33-0129.

[1] Documentation shipped with the 3745.

# List of Abbreviations

| | |
|---|---|
| **ac** | alternating current |
| **ACF** | Advanced Communication Function |
| **AIW** | APPN Implementation Workshop |
| **AIX** | Advanced Interactive Executive |
| **ANR** | Automatic Network Routing |
| **APAR** | Authorized Program Analysis Report |
| **APPC** | Advanced Program-to-Program Communication |
| **APPN** | Advanced Peer-to-Peer Networking |
| **ARB** | Adaptive Rate-Base congestion control |
| **ARC** | Active Remote Connector |
| **ATM** | Asychronous Transfer Mode |
| **BACP** | Bandwidth Allocation Control Protocol |
| **BAN** | Boundary Access Node |
| **BAP** | Bandwidth Allocation Protocol |
| **BGP** | Border Gateway Protocol |
| **BNN** | Boundary Network Node |
| **bps** | bits per second |
| **Bps** | bytes per second |
| **BRI** | Basic Rate Interface |
| **BRS** | Bandwidth Reservation System |
| **CBC** | Control Bus Coupler<br>Cipher Block Chaining |
| **CBSP** | Controller Bus and Service Processor |
| **CCITT** | Comité Consultatif International Télégraphique et Téléphonique. (The international telegraph and telephone consultative committee, now ITU-T) |
| **CCM** | Controller Configuration and Management |
| **CCU** | Central Control Unit |
| **CDF-E** | Configuration Data File - Extended |
| **CDLC** | Channel Data Link Control |
| **CIR** | Committed Information Rate |
| **CLA** | Communication Line Adapter |
| **CLP** | Communication Line Processor |
| **CMC** | Communication Management Configuration |
| **CNN** | Composite Network Node |
| **dc** | direct current |
| **DCAF** | Distributed Console Access Facility |
| **DCE** | Data Circuit-Terminating Equipment |
| **DES** | Data Encryption Standard |
| **DLC** | Data Link Control |
| **DLCI** | Data Link Connection Identifier |
| **DLSw** | Data Link Switching |
| **DLU** | Dependent Logical Unit |
| **DLUR** | Dependent Logical Unit Requester |
| **DLUS** | Dependent Logical Unit Server |
| **DMA** | Direct Memory Access |
| **DOS** | Disk Operating System |
| **DRAM** | Dynamic Random Access Memory |
| **DTE** | Data Terminal Equipment |
| **EBN** | Extended Border Node |
| **ECP** | Encryption Control Protocol |
| **EGP** | Exterior Gateway Protocol |
| **EIA** | External Interface Adapter |
| **EMIF** | ESCON Multiple Image Facility |
| **EN** | End Node |
| **EP** | Emulation Program |
| **ERP** | Error Recovery Procedure |
| **ES** | Enterprise System |
| **ESA** | Enterprise Systems Architecture |
| **ESCA** | ESCON channel adapter, also called ESCON adapter |
| **ESCC** | ESCON channel coupler type 1, also called ESCON coupler type 1 |
| **ESCD** | ESCON Director |
| **ESCON** | Enterprise Systems Connection |
| **ESCP** | ESCON channel processor, also called ESCON processor |
| **FDDI** | Fiber Distributed Data Interface |
| **FR** | Frame-Relay |
| **FRAD** | Frame-Relay Access Device |
| **FRFH** | Frame-Relay Frame Handler |
| **FRSE** | Frame-Relay Switching Equipment |
| **FRTE** | Frame-Relay Terminating Equipment |
| **FTP** | File Transfer Protocol |
| **HPR** | High Performance Routing |
| **HSSI** | High Speed Serial Interface |
| **HTTP** | Hypertext Transfer Protocol |

**Hz** Hertz

**ICMP** Internet Control Message Protocol

**ICN** Interchange Node

**IEEE** Institute of Electrical and Electronics Engineers

**INN** Intermediate Network Node

**I/O** Input/Output

**IOC** Input/Output Control

**IP** Internet Protocol

**ISDN** Integrated Service Digital Network

**ITU-T** International Telecommunication Union - Telecommunication (formerly: CCITT)

**kbps** kilobits per second

**km** kilometer; 0.62 mile

**LAN** Local Area Network

**LAPB** Link Access Procedure - Balanced

**LAPS** LAN Adapter Protocol Support

**LCB** Line Connection Box

**LCBB** Line Connection Box Base

**LCBE** Line Connection Box Expansion

**LCS** LAN Channel Station

**LEN** Low Entry Networking

**LIC** Line Interface Coupler

**LPAR** Logical Partition

**LPDA2** Link Problem Determination Aid-2

**LSA** Link Services Architecture

**LU** Logical Unit

**m** meter; 3.28 feet; 39.37 inches

**MAC** Medium Access Control

**MAU** Multistation Access Unit

**mbps** Megabit per second

**MB** Megabyte; 1 048 476 bytes

**MCL** Microcode Change Level

**MIB** Management Information Base

**MLTG** Multi-Link Transmission Group

**MMF** Multimode Fiber

**MOSS-E** Maintenance and Operator Subsystem - Extended

**MPA** Multiprotocol Adapter

**MPC** Multi-Path Channel

**MVS** Multiple Virtual Storage

**NCP** Network Control Program

**NGMF** NetView Graphic Monitor Facility

**NHRP** Next Hop Resolution Protocol

**NN** Network Node

**NNP** Network Node Processor

**NPI** Numbering Plan Identification

**NPM** NetView Performance Monitor

**NPSI** NCP packet switching interface

**NRF** Network Routing Facility

**NTS** Network Transport Services

**OSI** Open System Interconnection

**OSPF** Open Shortest Path First

**PCMCIA** Personal Computer Memory Card International Association

**PEP** Partitioned Emulation Programming

**PLP** Packet Layer Protocol

**PPP** Point-to-Point Protocol

**PRI** Primary Rate Interface

**PRPQ** Programming Request for Price Quotation

**PTF** Program Temporary Fix

**PU** Physical Unit

**PVC** Permanent Virtual Circuit

**QLLC** Qualified Logical Link Control

**RABM** Router And Bridge Manager

**RETAIN** Remote Technical Assistance Information Network

**RFC** Remote Function Call

**RIP** Routing Information Protocol

**RSF** Remote Support Facility

**RTP** Rapid Transport Protocol

**SAP** Service Access Point

**SAR** Segmentation and Reassembly

**SCSP** Server Cache Synchronization Protocol

**SDLC** Synchronous Data Link Control

**SMF** Single Mode Fiber

**SNA** Systems Network Architecture

**SNI** SNA Network Interconnection

**SNMP** Simple Network Management Protocol

**SPAU** Service Processor Access Unit

**SSCP** System Services Control Point (VTAM)

**SSE** Session Services Extended

**SSP** System Support Program

**SVC** Switched Virtual Circuit

**TCP** Transmission Control Protocol

**TFTP** Trivial File Transfer Protocol

**TOA** Type Of Address

**TAM** Topology and Accounting Management

**TIC** Token-Ring Interface Coupler

**TG** Transmission Group

**TPF** Transaction Processing Facility

**TRA** Token-Ring Adapter

**TRP** Token-Ring Processor

**UDP** User Datagram Protocol

**URL** Uniform Resource Locator

**VM** Virtual Machine

**VSE** Virtual Storage Extended

**VTAM** Virtual Telecommunications Access Method

**WAN** Wide Area Network

# Glossary

This glossary defines new terms used in this manual. It also includes terms and definitions from the *IBM Dictionary of Computing,* SC20-1699.

**Advanced Communication Function (ACF)**. A group of IBM licensed programs, principally VTAM programs, for example, TCAM*, NCP, and SSP, that use the concepts of Systems Network Architecture (SNA), including distribution of function and resource sharing.

**advanced peer-to-peer networking (APPN)**. Data communications support that routes data in a network between two or more advanced program-to-program communications (APPC) systems that do not need to be adjacent.

**authorized program analysis report (APAR)**. A report of a problem caused by a suspected defect in a current unaltered release of a program.

**boundary network node (BNN)**. (1) In SNA, deprecated term for *boundary node (BN)*. (2) In NCP, deprecated term for *peripheral node*.

**bits per second (bps)**. In serial transmission, the instantaneous bit speed with which a device or channel transmits a character.

**central control unit (CCU)**. In the 3745, the controller hardware unit that contains the circuits and data flow paths needed to execute instructions and to control its storage and the attached adapters.

**communication line adapter (CLA)**. A functional unit that converts the serial-by-bit output of a station to a parallel bit form and from a parallel bit form to a serial-by-bit input to a station.

**communication management configuration (CMC)**. In VTAM, configuring a single host processor to allow for the consolidation of many network management functions for the entire network.

**configuration data file - extended (CDF-E)**. A 3746-900 MOSS-E file that contains a description of all the hardware features (presence type, address, and characteristics).

**control subsystem**. The part of the controller that stores and executes the control program, and monitors the data transfers over the channel and transmission interfaces.

**controller**. A device that directs the transmission of data over the data links of a network; its operation may be controlled by a program executed in a processor to which the controller is connected or it may be controlled by a program executed within the device. Examples are the IBM 3705, IBM 3725/3726, IBM 3720, IBM 3745 and IBM 3746.

**data circuit-terminating equipment (DCE)**. The equipment installed at the user's premises that provides all the functions required to establish, maintain, and terminate a connection, and the signal conversion between the data terminal equipment (DTE) and the line. For example, a modem is a DCE.

**data terminal equipment (DTE)**. That part of a data station that serves as a data source, data link, or both, and provides for the data communication control function according to protocols. For example, the IBM 3745 can be a DTE.

**dependent logical unit (DLU)**. Any logical unit (LU) that is made active by a command from the host system over a data link. Such logical units can be used only as secondary logical units, and can have only one active LU-to-LU session at a time. Contrast with independent logical unit.

**disk operating system (DOS)**. An operating system for computer systems that use disks and diskettes for auxiliary storage of program and data.

**direct memory access (DMA)**. The transfer of data between memory and input/output units without processor intervention.

**Distributed Console Access Facility (DCAF)**. An IBM licensed program that lets a user at one workstation to remotely monitor, control, and operate another workstation.

**emulation program (EP)**. An IBM control program that allows a channel-attached 3705 or 3725 communication controller to emulate the functions of an IBM 270x device. See also network control program.

**End node (EN)**. In SNA, a node in an APPN network that can be a source or a target node, but does not provide any routing or session services to any other node.

**Enterprise Systems Architecture (ESA)**. A set of IBM products and services that provides a dynamically connected environment within an enterprise.

**ESCON adapter**. See ESCON channel adapter (ESCA).

**ESCON channel**. A channel having an Enterprise System Connection* channel-to-control-unit I/O interface that uses optical cables as a transmission medium.

**ESCON channel adapter (ESCA)**. A controller hardware unit used to attach the controller to a host via ESCON fiber optics. An ESCA consists of an ESCON channel processor and an ESCON channel coupler.

**ESCON channel coupler (ESCC, ESCC2)**. A controller hardware unit which is the interface between the ESCON channel processor and the ESCON fiber optic cable.

**ESCON channel processor (ESCP)**. A controller hardware unit which provides the channel data link control for the ESCON channel adapter.

**ESCON coupler**. See ESCON channel coupler (ESCC, ESCC2).

**ESCON director (ESCD)**. A device that provides connectivity capability and control for attaching any two links to each other.

**ESCON processor**. See ESCON channel processor (ESCP).

**hertz (Hz)**. A unit of frequency equal to one cycle per second.

**Host**. See host processor.

**host processor**. (1) A processor that controls all or part of a user application network. (2) In a network, the processing unit where the access method for the network resides. (3) In an SNA network, the processing unit that contains a system services control point (SSCP). (4) A processing unit that executes the access method for attached communication controllers. Also called *host.*

**IBM service representative**. An individual in IBM who does maintenance services for IBM products or systems. (Also called an *IBM customer engineer* or *IBM CE*.)

**input/output control (IOC)**. The circuit that controls the input/output from/to the channel adapters and scanners via the IOC bus.

**integrated services digital network (ISDN)**. A digital end-to-end telecommunication network that supports multiple services including, but not limited to, voice and data.

**International Telecommunication Union (ITU)**. The specialized telecommunication agency of the United Nations, established to provide standardized communication procedures and practices, including frequency allocation and radio regulations worldwide. (Formerly CCITT).

**Internet Protocol (IP)**. In TCP/IP, a protocol that routes data from its source to its destination in an Internet environment.

**LAN-attached console**. A PS/2 attached to the token-ring LAN that has the service processor attached. It is used to operate remotely the MOSS and MOSS-E via DCAF.

**line**. See transmission line.

**line interface coupler (LIC)**. A circuit that attaches up to four transmission cables to the controller (from DTEs, DCEs, or telecommunication lines).

**link access protocol-balanced (LAPB)**. A protocol used for accessing an X.25 network at the link level. LAPB is a duplex, asynchronous, symmetric protocol, used in point-to-point communication.

**Link Problem Determination Aid (LPDA*)**. A series of test commands executed by an IBM DCE to determine which of various network components may be causing an error in the network.

**local area network (LAN)**. A computer network located on a user's premises within a limited geographical area. Communication within a LAN is not subject to external regulation; however, communication across the LAN boundary may be subject to some form of regulation.

**logical unit (LU)**. In SNA, a port through which an end user accesses the SNA network in order to communicate with another end user and through which the end user accesses the functions provided by system services control points (SSCPs). An LU can support at least two sessions, one with an SSCP and one with another LU, and may be capable of supporting many sessions with other logical units.

**low entry networking node (LEN)**. In an APPN network, a node that uses the LU session type 6.2 node type 2.1 architecture without the APPN extension.

**maintenance and operator subsystem (MOSS)**. The part of the 3745 that provides operating and servicing facilities to the user and IBM service representative.

**maintenance and operator subsystem-extended (MOSS-E)**. The licensed internal code loaded on the service processor fixed disk to provide maintenance and operator facilities to the user and IBM service representative.

**medium access control (MAC)**. For LAN, the method of determining which device has access to the transmission medium at any time.

**modem (modulator-demodulator)**. See DCE.

**multistation access unit (MAU)**. In the IBM token-ring network, a wiring concentrator that connects up to eight nodes to a ring.

**NetView Performance Monitor (NPM)**. An IBM licensed program that collects, monitors, analyses, and displays data relevant to the performance of a VTAM telecommunication network. It runs as an on-line VTAM application program.

**Network Control Program (NCP)**. An IBM licensed program that provides communication controllers supports for single-domain, multiple domain, and interconnected network capability.

**network node processor (NNP)**. The processor that is running the APPN Network Node functions of the 3746-900 or 3746-950.

**Network Routing Facility (NRF)**. An IBM licensed program that resides in the NCP, which provides a path for messages between terminals, and routes messages over this path without going through the host processor.

**nonswitched line**. A connection between systems or devices that does not have to be made by dialing. The connection can be point-to-point or multipoint. The line can be nonswitched or private. Contrast with *switched line.*

**operator console**. The IBM Operator Console that is used to operate and service a 3745 Model 130, 150, 160, 170, 210, 310, 410, or 610 through the MOSS.

**partitioned emulation programming (PEP)**. A function of a network control program that enables a communication controller to operate some telecommunication lines in network control mode while simultaneously operating others in emulation mode.

**permanent virtual circuit (PVC)**. In X.25 communications, a virtual circuit that have a logical channel permanently assigned to it at each DTE. Call-establishment protocols are not required. Contrast with switched virtual circuit.

**physical unit (PU)**. In SNA, the component that manages and monitors the resources, such as attached links and adjacent link stations, associated with a node, as requested by an SSCP via an SSCP-PU session. An SSCP activates a session with the physical unit in order to indirectly manage, through the PU, resources of the node such as attached links. This term applies to type 2.0, type 4, and type 5 nodes only.

**qualified logical link control (QLLC)**. An X.25 protocol that allows the transfer of data link control information between two adjoining SNA nodes that are connected to an X.25 packet-switching data network.

**remote console**. A PS/2 attached to the 3745 either by a switched line (with modems) or by one of the communication lines of the user network.

**remote support facility (RSF)**. RSF provides IBM maintenance assistance when requested via the public switched network. It is connected to the IBM RETAIN database system.

**service access point (SAP)**. A logical point made available by an adapter where information can be received and transmitted.

**service processor**. The processor, based on a PS/2, which is attached to the 3745 and 3746-900 or 3746 Model 950 via a token-ring LAN. It continuously transfers code to and from the processors inside the controller.

**service representative**. See IBM service representative.

**switched line**. A transmission line with which the connections are established by dialing, only when data transmission is needed. The connection is point-to-point and uses a different transmission line each time it is established. Contrast with *nonswitched line*.

**switched virtual circuit (SVC)**. A virtual circuit that is requested by a virtual call. It is released when the virtual circuit is cleared. Contrast with permanent virtual circuit.

**Synchronous Data Link Control (SDLC)**. A discipline conforming to subsets of the Advanced Data Communication Control Procedures (ADCCP) of the American National Standards Institute (ANSI) and High-level Data Link Control (HDLC) of the International Organization for Standardization, for managing synchronous, code-transparent, serial-by-bit information transfer over a link connection. Transmission exchanges may be duplex or half-duplex over switched or nonswitched links. The configuration of the link connection may be point-to-point, multipoint, or loop.

**system support program (SSP)**. An IBM program that manages programs and the operation of associated devices, such as the display station and printer.

**telecommunication line**. Any physical medium, such as a wire or microwave beam, that is used to send data.

**token-ring interface coupler type 3 (TIC3)**. A circuit that attaches an IBM Token-Ring network to an IBM 3746-900 or 3746-950.

**token-ring adapter (TRA)**. Line adapter for IBM Token-Ring Network, composed of one token-ring

processor card (TRP), and two token-ring interface couplers (TICs).

**transmission group (TG)**. In SNA, a group of links between adjacent subarea nodes appearing as a single logical link for routing messages.

**transmission line**. The physical means for connecting two or more DTEs (via DCEs). It can be nonswitched or switched. Also called a *line*.

**twin**. Configuration with two CCUs.

**twin-backup**. Mode of operation identical to twin-dual with fallback capability.

**twin-dual**. Mode of operation with two CCUs operating simultaneously in two distinct subareas.

**twin-standby**. Mode of operation with one CCU active and the other in standby, ready to take over.

**Virtual Storage Extended (VSE)**. An IBM licensed program whose full name is Virtual Storage Extended/Advanced Function. It is a software operating system controlling the execution of programs.

**Virtual Telecommunication Access Method (VTAM)**. A set of programs that maintain control of the communication between terminals and application programs running under DOS, OS/1, and OS/2 operating systems.

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**3745 Communication Controller Models A**
**3746 Nways Multiprotocol Controller**
**Models 900 and 950**
**Overview**

**Publication No. GA33-0180-08**

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