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Technical Reference

Token-Ring Network PC Adapter

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Technical Reference

Token-Ring Network PC Adapter

Note: This product is intended for use within a single establishment and within a single, homogeneous user population. For sensitive applications requiring isolation from each other, management may wish to provide isolated cabling or to encrypt the sensitive data before putting it on the network.

Second Edition (June 1986)

Changes are made periodically to the information herein; these changes will be incorporated in new editions of this publication.

Federal Communications Commission (FCC) Statement

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

United Kingdom Safety Requirements

The IBM Token-Ring Network PC Adapter and the IBM Token-Ring Network PC Adapter II are made to high safety standards. They comply inherently with telecommunications safety standard BS6301. They are not designed to provide protection from excessive voltages appearing externally at their interfaces. Therefore, when these products are connected to a public telecommunications network via any other equipment, and you connect to these products items not supplied by IBM United Kingdom Ltd., you must comply with mandatory telecommunications safety requirements.

You may do this either by choosing products that also are approved as complying to BS3601 or British Telcom Technical Guide No. 26, or by the use of approved safety barriers. Consult the local office of your public telecommunications operator for advice and permission to make the connection.

Preface

This manual provides information for using the IBM Token-Ring Network PC Adapter and the Adapter II and supporting software routines in an IBM Personal Computer.

It is intended for use by those who are:

- Preparing programs that will use an IBM Personal Computer with the IBM Token-Ring Network
- Using the IBM Token-Ring Network PC Adapter cards in IBM PC-compatible devices
- Obtaining information to aid in producing an adapter card for use in an IBM PC.

This manual is divided into the following chapters.

- Chapter 1 provides an overview of the IBM Token-Ring Network, its components, and information about the protocols used on the network.

- Chapter 2 describes the interfaces available for application program use. Control blocks are described in detail. Items common to the DLC and direct interfaces are covered.

- Chapter 3 describes each of the commands and command blocks that may be used with the DLC interface. Logical Link Control supporting information is included.

- Chapter 4 describes each of the commands and command blocks that may be used with the direct interface.

- Chapter 5 describes the use of NETBIOS-compatible programs when used with the IBM Token-Ring

Network PC Adapter. This chapter also describes the command block and each of the commands that may be used with the NETBIOS interface.

- Chapter 6 describes controlling the adapter card directly when the IBM-supplied supporting software routines are not used. The added functions provided by the Adapter II are explained.

- Chapter 7 describes return codes and exception conditions.

- Chapter 8 describes the adapter card's physical characteristics.

- Appendix A contains a directory of all valid commands and the related interfaces for each.

- Appendix B provides information about problem determination and compatibility with the IBM Token-Ring Network.

- Appendix C explains how to obtain additional information about the NETBIOS interface.

- A list of abbreviations and a glossary list and define terms that are used in this manual.

- A diskette containing sample program listings is included with this package.

Prerequisite Publications

Information from the following publications is necessary for use of this manual.

- *IBM Token-Ring Network PC Adapter Guide to Operations*, (available with the adapter and diskette)
- *IBM Token-Ring Network Architecture Reference*
- *IBM PC Network Technical Reference*
- *IEEE Standards for Token-Ring Networks: Logical Link Control*, ANSI/IEEE Std 802.2-1985, ISO/DIS 8802/2.
- *IEEE Standards Token-Ring Access Method:*, ANSI/IEEE Std 802.5-1985, ISO/DP 8802/5.

Related Publications

This manual refers to the following IBM publications for additional information:

- *A Building Planning Guide for Communication Wiring*, G320-8059 *
- *IBM Cabling System Planning and Installation Guide*, GA27-3361 *
- *Using the IBM Cabling System with Communication Products*, GA27-3620 *
- *IBM Token-Ring Network Introduction and Planning Guide*, GA27-3677 *

- *IBM Personal Computer, Computer Language Series, Macro Assembler*

- *IBM Token-Ring Network Problem Determination Guide*, SX27-3710 *

- *IBM Token-Ring Network Administrator's Guide*

- *Advanced Program-to-Program Communications for the IBM Personal Computer Programming Guide*

- *Advanced Program-to-Program Communications for the IBM Personal Computer Installation and Configuration*

For assistance in obtaining IBM manuals, see your place of purchase. For asterisk (*) items, see your IBM representative or IBM branch office.

IBM Token-Ring Network OEMI

The following documents make up the IBM Token-Ring Network Other Equipment Manufacture Interface.

- *IBM Cabling System Technical Interface Information*
- *IBM Token-Ring Network PC Adapter Technical Reference*
- *IBM Token-Ring Network Architecture Reference*
- *Token-Ring Access Method and Physical Layer Specification*, IEEE Std 802.5-1985

For assistance in obtaining IBM manuals, see your place of purchase.

Changes in This Edition

This revised edition covers the IBM Token-Ring Network PC Adapter II as well as the original Adapter.

It also includes minor corrections and additions.

Contents

Figures

Chapter 1. Overview of the IBM Token-Ring Network

The IBM Token-Ring Network, a token-ring, star-wired local area network, can accommodate up to 260 attaching devices (printers, processors, controllers). These attaching devices can be connected to one another by a series of cables, access units, and special adapter cards installed in the attaching devices.

Application programs running in each work station (such as an IBM Personal Computer) can direct the adapter to become a part of the ring. This manual describes the commands used by programs to control the Token-Ring Network Adapter's activity on the network. Refer to the *IBM Token-Ring Network Introduction and Planning Guide* for more information about the network.

Components of the IBM Token-Ring Network

Cable connects work areas to wiring closets and wiring closets to one another.

Access Units, such as IBM 8228 Multistation Access Units, are connected to the ring with patch cables. To each 8228 Access Unit you may connect up to eight attaching devices, such as IBM Personal Computers.

Adapter cards, such as the IBM Token-Ring Network PC Adapter, are installed in attaching devices to enable the devices to communicate with one another on the network.

Software such as the NETBIOS Program, the Advanced Program-to-Program Communications for the IBM PC (APPC/PC) program, and the Adapter Support Interface allow communication on the network using adapters. The interfaces of these programs are used by application programs (in the IBM PC) that direct the adapter to become a part of the ring.

The IBM Token-Ring Network PC Adapters

An IBM Token-Ring Network PC Adapter consists of:

- An adapter card
- An Adapter Support Interface or equivalent.

There are two types of adapter cards.

- The IBM Token-Ring Network PC Adapter
- The IBM Token-Ring Network PC Adapter II.

  The Adapter II is identical to the Adapter but has an additional 8K bytes of shared RAM for a total of 16K bytes. In addition, it provides commands to perform bridge functions. The bridge functions are not accessible through the Adapter Support Interface.

To use an adapter with an IBM Token-Ring Network you will also need:

- Disk Operating System (DOS), version 3.2 or higher
- An attachment cable to connect the adapter card to the IBM Token-Ring Network.
- An application program.

You may also need one or both of the following:

- The NETBIOS Program
- The APPC/PC program.

The IBM Token-Ring Network PC Adapter Card plugs into an IBM PC expansion slot. On the card is a front end to communicate with the ring, a protocol handler to process information to and from the ring, and an interface to the IBM PC containing some shared random access memory (RAM). This interface communicates with the IBM PC via the I/O bus. Programmed I/O (PIO) and Memory Mapped I/O (MMIO) operations are used to access the adapter.

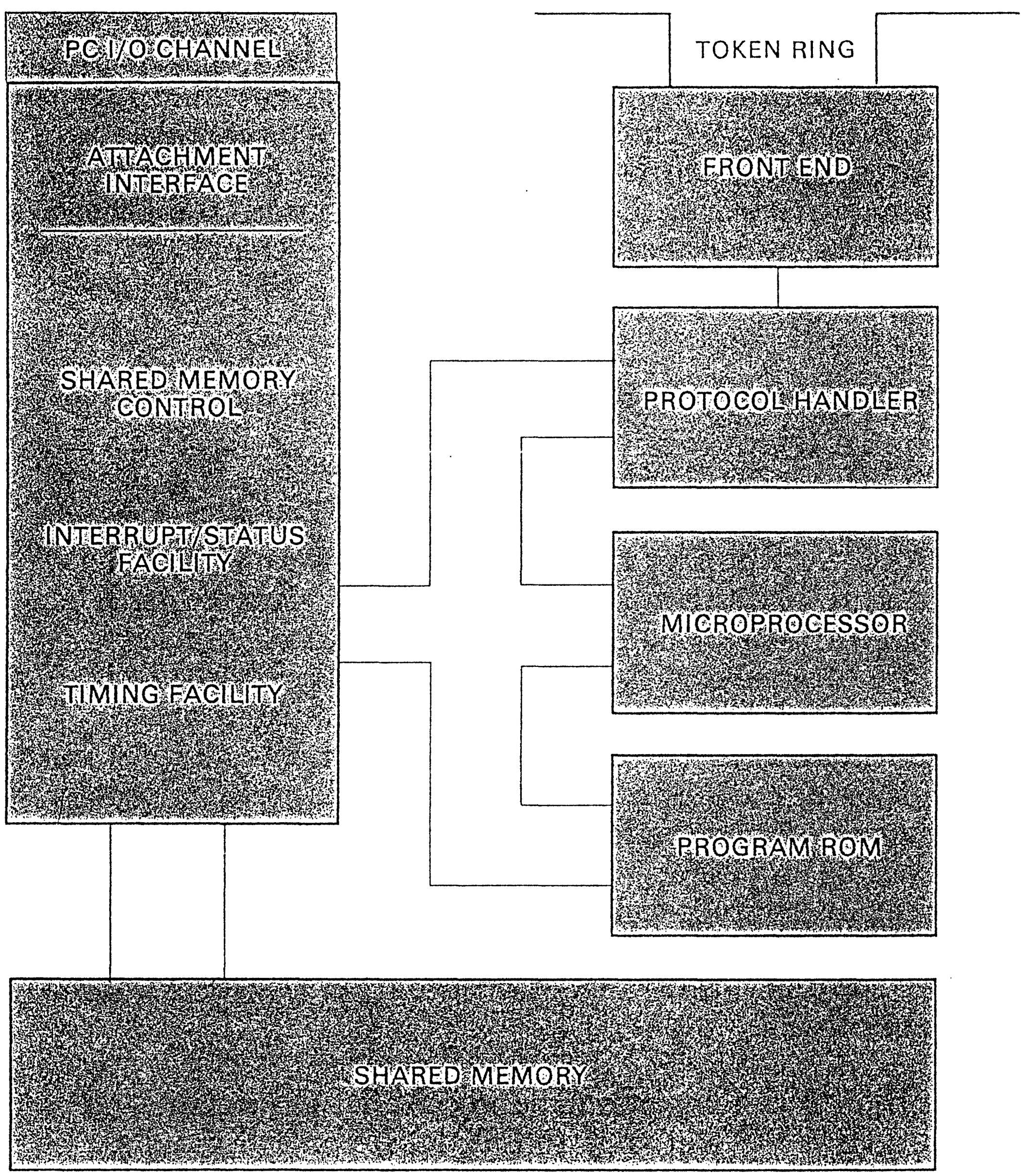


Figure 1-1. Adapter Blocks

The adapter card contains switches that are set upon installation to define the location of the MMIO domain in the IBM PC memory map. These switches can be read using a PIO instruction. See "The Adapter Card Switches" on page 6-4 and the *IBM Token-Ring Network PC Adapter Guide to Operations* for more about the switches.

Interfaces

An Adapter Support Interface is supplied on a diskette with the adapter card and, if used, must be loaded into the IBM PC memory. The IBM PC interface of this Adapter Support Interface provides two levels of entry to the token-ring network: the DLC interface, and the direct interface. The Adapter Support Interface then communicates with the three interfaces of the adapter card:

1. The direct interface
2. The DLC Station interface
3. The DLC SAP interface.

The Adapter Support Interface allows an application program to use the adapter card by providing control blocks in IBM PC memory and calling the Adapter Support Interface with an interrupt instruction. This frees the application program from the burden of communicating with the shared RAM on the adapter card as well as handling interrupts. This Adapter Support Interface must be loaded after DOS has been loaded.

Advanced Program-to-Program Communications for the IBM Personal Computer (APPC/PC) uses the DLC interface to handle transaction program (APPC/PC) control blocks.

The NETBIOS Program expands the DLC interface to handle IBM PC Network (NETBIOS) control blocks.

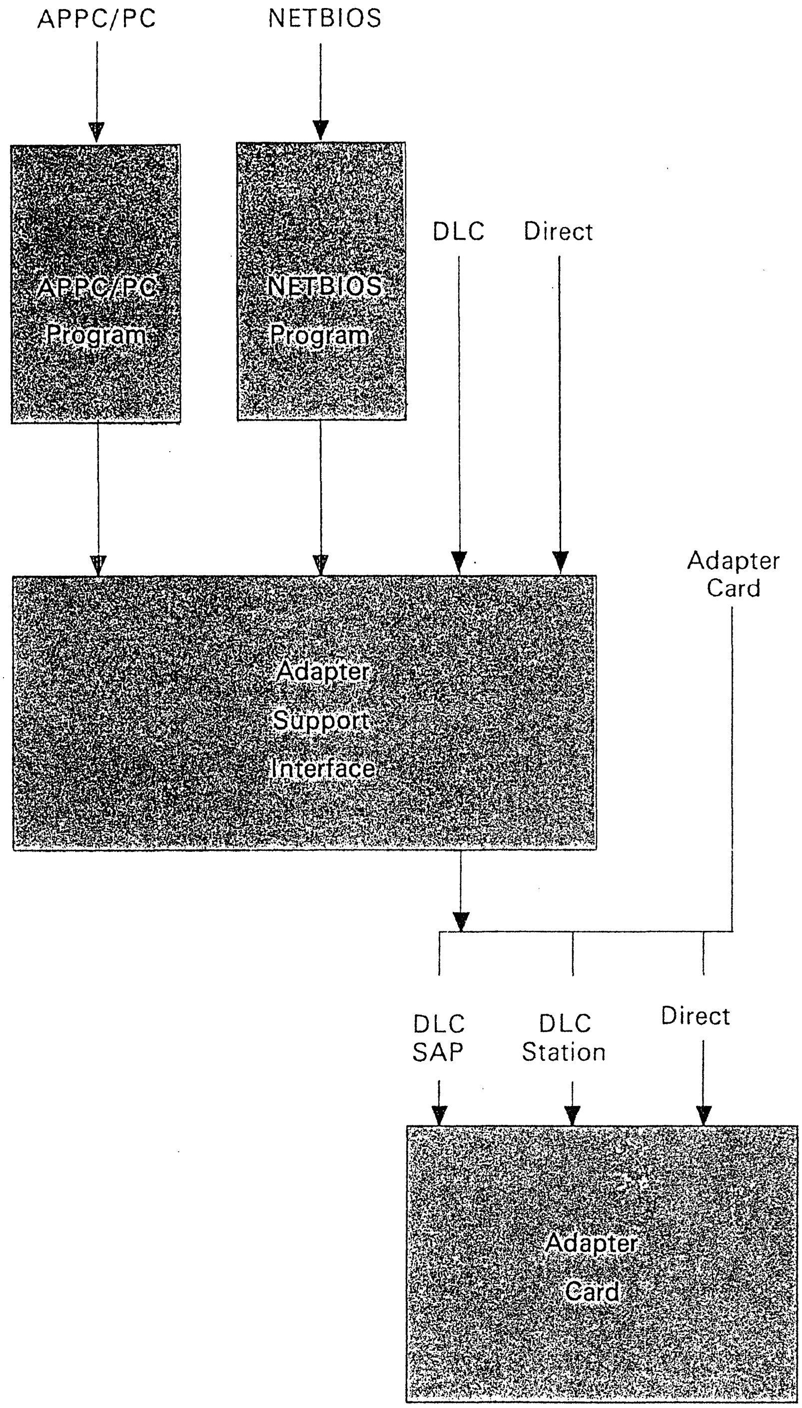


Figure 1-2. Interfaces

If the Adapter Support Interface is used, a network application program assembles a control block containing a command and related information for the adapter.

Control is passed to the Adapter Support Interface and the application awaits the results.

Appendix A, "Valid Commands," contains a directory of all commands, their related interfaces, and where a description of each is located.

If the Adapter Support Interface is not used, all the responsibility of operating the adapter card must be handled by the application program.

The adapter card provides three interfaces:

The direct interface
The DLC Service Access Point (SAP) interface
The DLC Station interface.

The functions of the DLC interfaces of the adapter card and the Adapter Support Interface are compatible with the service specifications of the Institute of Electrical and Electronic Engineers Inc.(IEEE) 802.2 Logical Link Control. Detailed information on these interfaces is contained in Chapter 6, "The Adapter Card Interface."

Each of the following interfaces provides a means of communicating with the adapter. Depending on which you choose, the code you provide will share the responsibility for control of the adapter with the Adapter Support Interface.

The DLC Interface

This provides an interface to applications using the Logical Link Control sublayer of Data Link Control protocol. The interface may be used in two ways.

- For IEEE type 1 communication: connectionless communication between devices providing no guarantee of delivery (through the DLC SAP interface).

- For IEEE type 2 communication: connection-oriented services using Logical Link Control (LLC) protocol (through the DLC station interface).

Much of the communication overhead function is provided by the adapter and Adapter Support Interface, which permit simple application programming.

Detailed use of this interface is described in Chapter 3, "The DLC Interface." See the *IBM Token-Ring Network Architecture Reference* for more about communication using DLC and LLC.

The Direct Interface

The direct interface permits control functions to the adapter card using standard control blocks and parameters.

This interface provides the ability to open and close an adapter, obtain error status, and set addresses. It also permits transmission of frames directly without LLC protocol assistance.

Detailed use of this interface is described in Chapter 4, "The Direct Interface."

The APPC/PC Interface

For the Token-Ring Network adapter to be used with APPC/PC application programs, the APPC/PC Program must be loaded into the IBM PC along with the Adapter Support Interface. Refer to *Advanced Program-to-Program Communications for IBM Personal Computer Installation and Configuration Guide.* How to design and write APPC/PC transaction programs is explained in *Advanced Program-to-Program Communications for the IBM Personal Computer Programming Guide.*

The NETBIOS Interface

For the Token-Ring Network adapter to be used with NETBIOS application programs, the NETBIOS Program must be loaded into the IBM PC along with the Adapter Support Interface. Using the NETBIOS Program is explained in Chapter 5, "The NETBIOS Interface."

The Adapter Card Interface

The adapter card interface provides access to the Token-Ring Network through the three interfaces mentioned earlier:

The direct interface
The DLC Service Access Point (SAP) interface
The DLC Station interface.

If a program is written to use the adapter card interfaces, that program will replace the Adapter Support Interface and will be totally responsible for handling the adapter card. Control and command information must be loaded into shared RAM located on the adapter card and all sequencing and interrupt handling must be managed by the application program using this interface. An application program must be written to replace the Adapter Support Interface if the bridge functions of the IBM Token-Ring Network PC Adapter II are to be used. The *IBM Token-Ring Network Bridge Program* already includes all the necessary programming code to use these functions.

Detailed information about operating the adapter card is contained in Chapter 6, "The Adapter Card Interface."

Communicating on the IBM Token-Ring Network

The IBM Token-Ring Network uses a Medium Access Control (MAC) protocol to control data flow, monitor ring conditions, and encapsulate and route data for devices attached to the physical ring. The token and frame are involved in this Token-Ring Network communication. This protocol is not totally explained in this manual. See the *IBM Token-Ring Network Architecture Reference* for more detail about this protocol.

Adapter Communication on the Network

An IBM PC is ready to become part of the network when:

- An IBM Token-Ring Network PC Adapter has been installed.
- The Token-Ring Network PC Adapter cable has been connected to an access unit, such as the IBM 8228 Multistation Access Unit.
- An operating system such as DOS has been loaded into the IBM PC.
- The IBM Token-Ring Network PC Adapter Support Interface, or equivalent, has been loaded into the IBM PC
- A Token-Ring Network application program has been loaded into the IBM PC.

The Token-Ring Network PC Adapter card and the Adapter Support Interface in the IBM PC provide interfaces that permit implementing Data Link Control (DLC) protocols.

An additional program, the NETBIOS Program, or equivalent, is also needed to allow the Adapter Support Interface to operate with PC Network programs.

See the *IBM PC Network Technical Reference* for the command sequences required for the NETBIOS interface.

To communicate on the network, a device adapter obtains a token and changes the token to a frame containing control information and data. The frame is then passed around the ring, and each device on the ring monitors the frame and retransmits it. When the frame reaches the device to which the data is addressed, the device copies the frame as it is retransmitting it and indicates in the frame that the data has been received. The frame continues in the same direction around the ring until it returns to the device that sent the frame. The sending device removes the frame from the ring, replacing it with a token.

Transmission of Data on the Network

1. When the adapter is instructed by an application program to "open" following an instruction to "initialize," it goes through a series of diagnostics before attempting to attach to the network. The adapter card verifies:

   - The correct operation of the adapter card
   - That a cable between the attaching device and the 8228 Access Unit exists
   - That a test message sent along the lobe cable (the cable between the attaching device and the 8228 Access Unit) can pass through the cable and return unchanged.

   Note: Some possible error results may be delayed until after the "open" has completed.

2. The "open" command tells the adapter to send a direct current signal to the 8228 Access Unit to which it is attached. This causes the attaching device to become an active part of the ring, receiving, monitoring, and retransmitting ring traffic.

3. The adapter places data on the ring by changing a token into a frame that will pass around the ring in place of the token.

A token is a unique sequence of bits in 3 bytes transmitted on the ring. The sequence is a start delimiter followed by an access control field of 1 byte and ending with an end delimiter byte. Each byte is 8 bits in length without parity. Both the start delimiter (SD) and the end delimiter (ED) are unique bit arrangements recognized by all adapters compatible with an IBM Token-Ring Network. The access control (AC) field controls access to the ring.

SD	AC	ED
1 Byte	1 Byte	1 Byte

Figure 1-3. Token Format

The same 3 bytes are included in a frame. However, a bit is set on in the AC byte to indicate a frame rather than a token. Additional control and information bytes are included between the AC byte and the ED byte.

Frames

A frame consists of:

- A start delimiter (SD) byte
- An access control (AC) byte with the frame bit on
- A frame control (FC) byte
- Destination address bytes
- Source address bytes
- Optional routing field bytes
- Optional DLC header field
- Information (data) bytes
- The frame check sequence (FCS) byte
- The end delimiter (ED) byte
- The frame status (FS) byte.

Refer to Figure 1-4 on page 1-13.

The physical, or LAN, header consists of the SD byte, the AC byte, the 1-byte frame control (FC) field, 6 bytes of destination address, 6 bytes of source address, and from zero to 18 bytes of routing information. This is followed by the user-provided data. Finally the physical trailer (PT) is included, consisting of 4 bytes of frame check sequence (FCS) field, the ED byte, and the FS byte.

The frame may be either of two types:

- MAC frame
- Non-MAC frame.

Medium Access Control (MAC) frames contain information about the status of an adapter or the ring itself.

Certain MAC frames may be received by the adapter and provided to the application program at the direct interface. Some MAC frames may be sent to the adapter for transmission on the ring using the direct interface of either the Adapter Support Interface or the adapter card. See "Medium Access Control (MAC) Frames" on page 2-30 for details of these frame formats.

Some *Non-MAC frames* contain data and messages that users transmit to one another.

Some *Non-MAC frames* contain DLC protocol-only information transmitted by the adapter. Frames used with Data Link Control (DLC) operations are defined as Logical Link Control (LLC) frames.

The 2 most significant bits of the FC byte define the frame type. The types are:

B'00' = MAC frame
B'01' = LLC frame (non-MAC)
B'10' = reserved
B'11' = reserved

Frame formats are described in detail in the *IBM Token-Ring Network Architecture Reference.* Bit sequences in that manual and possibly other documentation may differ from IBM PC format in that the most significant bit of a byte is designated **7** for the IBM PC and may be called **0** elsewhere. Only the representation differs. The byte's content is not altered.

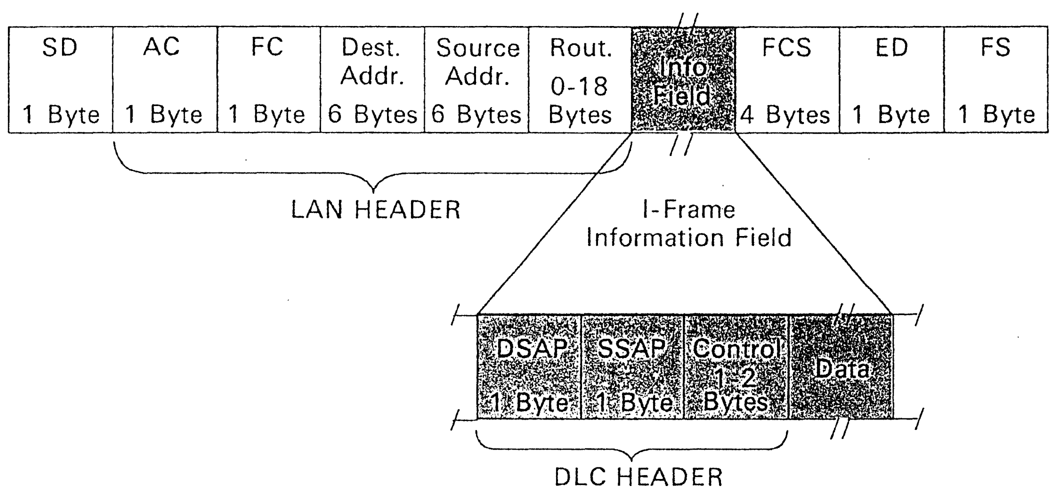


Figure 1-4. Frame Format. Bits are transmitted in bytes, most significant bit (bit 7) first.

Chapter 2. Common Programming Information

An Adapter Support Interface is supplied with the adapter card and, if used, must be loaded into the IBM PC memory. The IBM PC interface of this Adapter Support Interface provides two levels of entry to the Token-Ring Network:

- The DLC interface
- The Direct interface.

(If the NETBIOS Program is also loaded into IBM PC memory, the IBM PC Network [NETBIOS] interface is provided. See Chapter 5, "The NETBIOS Interface," for more about NETBIOS.)

The Adapter Support Interface communicates with the three interfaces of the adapter card. It allows an application program to use the adapter card by providing control blocks in IBM PC memory and calling the Adapter Support Interface with an interrupt instruction. This frees the application program from the burden of communicating with the shared RAM on the adapter card as well as handling interrupts. This Adapter Support Interface must be loaded after the operating system, such as DOS, has been loaded.

When loaded, the Adapter Support Interface issues to the control program an interrupt with a X'21' vector and a function code of X'31'. This indicates "terminate process and remain resident." See Appendix B, "Problem Determination and Compatibility" on page B-1.

A network application program assembles a control block containing a command and related information for the adapter. The application program then puts the IBM PC main memory address of this control block into the IBM PC's registers ES (extra segment) and BX (base). At this point, the application program issues an interrupt instruction with a X'5C' vector.

The Adapter Support Interface responds to the X'5C' interrupt, analyzes the control block, copies information from the control block into the shared RAM, and informs the processor on the adapter card. The processor on the adapter card performs the commands defined in the shared RAM control block. Upon completion of the command, the adapter card updates the information in the RAM and issues a hardware interrupt to return to the Adapter Support Interface.

The Adapter Support Interface responds to the hardware interrupt, analyzes the information in the RAM, updates the control block in IBM PC main memory, sets the necessary registers in the IBM PC, and passes control back to the application program. The application program routine at the address specified in the control block runs and if necessary issues an interrupt to return to the Adapter Support Interface.

The Sample Program Diskette

Sample program listings are included on the diskette provided with this manual. These listings provide examples of the NETBIOS interface use and the DLC interface use. The direct interface commands necessary to use the DLC interface are shown also.

Print out the files READ.ME, SMPLSND.LST, and SMPLRCV.LST with the DOS TYPE command. (Do a "MODE LPT1:132,8," or equivalent, to print 132-character lines.)

Adapter Support Interface Control Blocks

The application program must prepare a control block to request an activity from the adapter when the Adapter Support Interface is used. When the Adapter Support Interface analyzes the control block, it can determine which interface is needed by the content of the first bytes.

The control block is called a command control block (CCB) if directed to the direct interface or the DLC interface. If the NETBIOS Program is loaded, and the control block is directed to the NETBIOS interface, it is called the Message Control Block (MCB). (The Token-Ring Network PC Adapter MCB is the same as the NCB in PC Network.) See Chapter 5, "The NETBIOS Interface," for more about the MCB.

When the Adapter Support Interface is loaded into the IBM PC, it checks both possible adapter locations to see if a card is installed and whether it is a Token-Ring Network PC Adapter card or a PC Network card. Thereafter, when the Adapter Support Interface receives a control block directed to the PC Network card, it will pass it directly to that card if it is installed. All control blocks directed to the Token-Ring PC Adapter card will be processed by the Adapter Support Interface.

The contents of the control block are explained below.

The CCB

The content of the first field indicates to the Adapter Support Interface which type of interface the application program wishes to use. If the first field contains either X'00', X'01', X'02', or X'03', the block is considered to be a CCB and either the *direct interface* or the *DLC interface* is being used. That field would be the CCB_ADAPTER field.

If the first field contains a byte greater than X'03', the *NETBIOS interface* is being used and the control block is considered to be an MCB. The MCB is described under "MCB Field Explanations" on page 5-4. The NETBIOS Program must have been loaded when a NETBIOS command is issued or the Adapter Support Interface will return an X'FB' (NETBIOS Program not loaded in PC) return code.

OFF-SET	FIELD NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	CCB_ADAPTER	1	DB	Adapter 0 or 1
1	CCB_COMMAND	1	DB	Command field
2	CCB_RETCODE	1	DB	Completion code
3	CCB_WORK	1	DB	Adapter Support Interface work area
4	CCB_POINTER	4	DD	Queue pointer and Adapter Support Interface work area
8	CCB_CMD_CPLT	4	DD	Command completion user appendage
12	CCB_PARM_TAB	4	--	Parameters or pointer to CCB parameter table

Figure 2-1. CCB (Command Control Block)

The above control block definition is to be used with both the direct interface and the DLC interface.

CCB Field Explanations

CCB _ADAPTER

Explanation: Defines which adapter card is to be used. Must be either X'00' to use the first, or primary adapter card (PC IO address X'0A20') or X'01' for the second, or alternate, adapter card (PC IO address X'0A24'). The adapter card must have the corresponding switch set. Values of X'02' and X'03' are reserved and if used, a CCB_RETCODE of X'1D' (Invalid CCB_ADAPTER value) is returned. Values greater than X'03' indicate that the NETBIOS interface is to be used. See Chapter 5, "The NETBIOS Interface" on page 5-1.

CCB _COMMAND

Explanation: Indicates the command to perform. A value of X'FF' is assigned as invalid. See Appendix A, "Valid Commands" on page A-1 for reserved and valid commands.

CCB _RETCODE

Explanation: The completion code as provided by the Adapter Support Interface. For all commands, this field is set to X'FF' by the Adapter Support Interface when the CCB is received. While the field is X'FF', the application program must not alter the CCB or any associated data. When the adapter completes the command, the Adapter Support Interface sets this field to the appropriate completion code. For all commands, X'00' means successful completion. See "DLC and Direct Interface Return Codes (CCB_RETCODE)" on page 7-2 for descriptions of all return codes.

CCB _WORK

Explanation: A work area field for the Adapter Support Interface to use.

CCB _POINTER

Explanation: While the CCB_RETCODE is X'FF', the Adapter Support Interface uses this field for command processing.

The application program uses this field as follows:

- When the adapter is closed, the application program interrogates this field to find the next command (CCB) in a queue of outstanding commands.

- When a DLC link station is sending "I" frames, multiple transmissions may be acknowledged at one time. All acknowledged "I" frames are queued and presented at one time to the program. That is, the Adapter Support Interface issues an interrupt providing a return code in one CCB. In the CCB_POINTER field of that CCB is the address of another CCB that is to receive the same return code. This continues until a CCB_POINTER field is zero ending the queue.

CCB _CMD_CPLT

Explanation: The address of a user appendage that the Adapter Support Interface will go to upon command completion. The appendage allows the user to obtain control after a command has been completed. See "Appendages" on page 2-8. When the user's appendage receives control at this point, the address of the CCB that was completed will be in registers ES and BX and the CCB_RETCODE will also be in register AL. Register AH will be X'00'. See "CCB Command Completion" on page 2-7.

CCB _PARM_TAB

Explanation: This field points to additional parameters that are command-specific. These parameters are explained with the related command descriptions.

If the parameters required are 4 or fewer bytes in length, they are provided in the CCB_PARM_TAB field instead of in an area pointed to by the field.

Command Completion

When a valid control block is presented to the Adapter Support Interface by an interrupt X'5C', the Adapter Support Interface provides a return code to the application program.

CCB Command Completion

For a DLC or direct interface command using a CCB, as soon as any immediate command processing has been done by the Adapter Support Interface, it queues the command, sets the CCB_RETCODE to X'FF', and returns to the application program. At that point the application may continue with other processing, but may not disturb the CCB or associated data. (The CCB_RETCODE is still X'FF'.) When the command is completed, the Adapter Support Interface will set the return code in both the AL register and the CCB_RETCODE field and check the CCB_CMD_CPLT field. The CCB_CMD_CPLT is used to point to the command completion appendage.

- If the CCB_CMD_CPLT field is not zero, the Adapter Support Interface interrupts the application program at the address provided. The application program continues with the command completion appendage located at the address specified by the contents of the CCB_CMD_CPLT field and returns to the Adapter Support Interface when completed.

  Upon entry, the command completion appendage may obtain the final return code from either the AL register or the CCB_RETCODE field.

- If the CCB_CMD_CPLT field contains X'00000000', the application program has not supplied a command completion appendage and the Adapter Support Interface performs no further action for this CCB and does not interrupt the application program. In that case, the application program must monitor the

CCB_RETCODE for a change from X'FF', indicating the adapter has completed the command and updated the return code.

If the Adapter Support Interface immediately determines that the adapter cannot execute the command, it sets the CCB_RETCODE field with the error code.

There are some commands that execute entirely in the IBM PC and do not use the adapter card hardware. When this is the case:

- The completion code is set when the Adapter Support Interface returns from the interrupt that initiated the command.
- If the command completion appendage is defined, it will be given control before the Adapter Support Interface returns from the interrupt.

This is an exception and is explained with the command descriptions to which it applies.

Appendages

User-supplied appendages provide exit points from the Adapter Support Interface. These appendages are short subroutines that may improve the application program's ability to handle information or events. See Chapter 5, "The NETBIOS Interface" on page 5-1 for routines used with the NETBIOS Program.

To ensure the integrity of the system, the appendages should have the following characteristics:

1. The amount of code executed should be limited, as this routine is an I/O appendage and is executing with interrupts masked off. The appendage is used because a point has been reached where information should be saved for subsequent use.

2. When the appendage is entered, the keyboard and DOS timer are disabled, and no more interrupts can be serviced from this adapter until the appendage is completed.

3. When control is passed to the appendage, interrupts are disabled and it appears to the appendage that the appendage was entered via an 8086 INT instruction: the stack is established such that an 8086 IRET instruction will properly return control and restore flags.

   When appendage processing is complete, the appendage code must execute the 8086 IRET as the last instruction.

   The Adapter Support Interface will have saved all registers on the stack prior to giving control to the appendage. Twenty four bytes of the stack will have been used by the Adapter Support Interface when processing the adapter interrupt. When the appendage is entered, there are 242 bytes of stack space available.

4. Execution of the IRET by the appendage will return control to the Adapter Support Interface at the point at which it had transferred control to the appendage. The Adapter Support Interface will restore all registers and return control to the program that was originally interrupted.

Upon entry to the appendages:

- The CX register contains the adapter card number.
- The CS register points to the appendage code (current segment).
- The SS and SP registers define the current stack.
- Other registers, if used, are defined in the specific appendage descriptions.

The types of user appendages are:

- Command completion appendage

  A per-command exit that allows asynchronous command completion. The application program may provide several Command Completion Appendages and selectively point to a specific one in each CCB.

  The entry point is indicated by the address in the CCB_CMD_CPLT field (which should not be X'00000000', indicating no appendage) of the related CCB.

  The address of the CCB that the adapter completed will be in registers ES and BX. The return code will be in CCB_RETCODE and the AL register (AH=X'00').

- Data received appendage

  This appendage is defined in the RECEIVED_DATA field of the parameter table of the RECEIVE command.

- Exception conditions

  These appendages are a set of exit points that allow the Adapter Support Interface to report hardware and software error conditions and certain status information to the user. When any exception state occurs, all outstanding adapter commands will have the CCB_RETCODE field of their CCBs set for the appropriate reason, and will be queued and passed to the exception appendage. The command completion appendage will not be taken. See the CCB_POINTER field description on page 2-5 for more about queues.

  - PC-Detected error appendage

    This appendage is defined in the PC_ERROR_EXIT field of the CCB for a DIR.INITIALIZE command and a DIR.MODIFY.OPEN.PARMS command, or in the PC_ERROR_EXIT field of the DIRECT_PARMS table of a DIR.OPEN.ADAPTER command.

The Adapter Support Interface passes parameters to the appendage on entry. Register CX contains the adapter card number. Register AL contains the error code. Refer to "PC-Detected Errors" on page 7-56 for the code meanings.

- Ring status appendage

  This appendage is defined in the RING_STATUS_EXIT field of the CCB for a DIR.INITIALIZE command and a DIR.MODIFY.OPEN.PARMS command, or in the PC_ERROR_EXIT field of the DIRECT_PARMS table of a DIR.OPEN.ADAPTER command.

  The Adapter Support Interface passes parameters to the appendage on entry. Register CX contains the adapter card number. Register AX contains the ring status. Refer to "Ring Status" on page 7-47 for the code meanings.

- Adapter check appendage

  This appendage is defined in the ADAPTER_CHECK_EXIT field of a DIR.INITIALIZE command and a DIR.MODIFY.OPEN.PARMS command, or in the PC_ERROR_EXIT field of the DIRECT_PARMS table of a DIR.OPEN.ADAPTER command. See pages 4-10 and 4-16. Refer to "Adapter Check Reason Codes" on page 7-45 for the reason code meanings.

  Adapter open errors take the normal command completion appendage.

– DLC status appendage

This appendage is defined in the DLC_STATUS_EXIT field of the CCB parameter table for a DLC.OPEN.SAP command.

The Adapter Support Interface passes parameters to the appendage on entry. Register CX contains the adapter card number. Register AX contains the DLC status code. Register SI contains a user-defined value from the USER_STAT_VALUE field in the parameter table of the DLC.OPEN.SAP command. Registers ES and BX point to the DLC status table. Refer to "DLC Status Codes" on page 7-24 for the code meanings and the DLC status table.

Addressing

Each Token-Ring Network adapter using the ring has an address called the NODE_ADDRESS. When frames are sent on the ring by adapters, the frame contains two of these addresses: a source address and a destination address. The frame is sent to the destination address adapter by the source address adapter.

Additional address and link information to be used in other transmission layers may be included in the frame following the LAN addresses. Additional addressing is used in the implementation of both the DLC and NETBIOS. These are described further in their related chapters.

An adapter card is provided with a permanent NODE_ADDRESS encoded on it. Additionally, the application program has the capability to provide a temporary replacement for this address and to provide a group address for the adapter. A special group address, called the functional address, can be set also.

See the *IBM Token-Ring Network Architecture Reference* for uses and restrictions for these types of addresses.

Types of Stations

There are several types of stations that can be defined to the adapter. They are referred to by the STATION_ID field in command descriptions. The direct station is automatically assigned by the adapter when it is opened and is referred to by three STATION_IDs. This station automatically is prepared to receive frames from the ring when opened, but the application program must issue a Receive command to make the information available at the Direct interface. The three STATION_IDs are described below and differ only in how they handle receiving of frames. See Chapter 3, "The DLC Interface," for more about stations.

The direct station's STATION_IDs are:

- X'0000'

  This STATION_ID of the direct station receives all information not directed to other defined stations. This station may transmit MAC and non-MAC (data) frames.

- X'0001'

  This STATION_ID of the direct station receives MAC frames and transmits either MAC or non-MAC frames.

- X'0002'

  This STATION_ID of the direct station receives non-MAC frames and transmits either MAC or non-MAC frames.

Additionally, other stations can be opened by the application program. Service access points (SAPs) can be opened and are defined for communications with service access points in other devices connected to the network.

An application program can also open link stations within a SAP for connection-oriented service (DLC use). SAPs can be prepared to operate in one of two possible modes, both compatible with IEEE 802.2 specifications. They are:

- A point of service where the XID command frame handling is performed by the DLC function of the adapter.
- A point of service where the XID command frames are passed to the application program for handling. Any response must originate from the application program.

See the TRANSMIT.XID command description for details.

DLC in the Adapter

With the exception of moving data to and from IBM PC memory, the LLC sublayer of Data Link Control is handled by the adapter. The application program defines items for the adapter such as service access points (SAPs) and link stations. Refer to Chapter 3, "The DLC Interface," for more about SAPs and links.

Once an application program has set up and opened links, the adapter will monitor, direct, and provide necessary fields for transmit and receive communication.

The adapter maintains control information about each SAP and station. The SAP XID option indicates to the adapter what to do in supporting the XID frames as they are transmitted or received.

Frames received for link stations that do not have a Receive command outstanding are directed to the SAP. If that SAP does not have a Receive command outstanding, the link station will enter a local busy state. See "Link Station States" on page 3-8. Frames received or directed to a SAP that does exist but for which a receive command is not outstanding are discarded. If the SAP does not exist, the frame is passed to the direct station, where it will be received according to the frame type. If there is no Receive command active for the applicable direct station, the frame will be discarded. In these instances, the transmitting and receiving adapters have successfully completed a data exchange with no errors, but at the LLC layer level, verification of the exchange is not complete.

The DLC interface supports link-connection-type communication and ensures link connection prior to permitting the transmission and the following receipt of information frames.

Transmitting, Receiving, and Buffers

There are two Receive commands. They are:

- RECEIVE
- RECEIVE.MODIFY

There are multiple transmit commands, one for each type of frame that may be transmitted. They are:

- TRANSMIT.DIR.FRAME
- TRANSMIT.I.FRAME
- TRANSMIT.UI.FRAME
- TRANSMIT.XID.CMD
- TRANSMIT.XID.RESP.FINAL
- TRANSMIT.XID.RESP.NOT.FINAL
- TRANSMIT.TEST.CMD

When an adapter is opened, buffers are prepared in shared RAM for use in receiving and transmitting data. Like control blocks, buffer space exists in shared RAM, and in the application program area of IBM PC memory.

The adapter card transmits to the ring from buffer space in shared RAM. This space must be loaded from buffers in IBM PC memory by the Adapter Support Interface (or its equivalent) as the adapter card needs data. Likewise, data received from the ring by the adapter card is placed into shared RAM. The Adapter Support Interface or equivalent obtains the data from there and places it in buffer space in IBM PC memory. When the Adapter Support Interface is used, the application program must provide the buffer space in the application program area of IBM PC memory. The control fields of these buffers may be prepared and maintained by the Adapter Support Interface or the application program as determined by the application program. The application program provides to the Adapter Support Interface the location in IBM PC memory of the buffer space by way of parameters in the control block. Transmit and receive buffers are available as buffer pools.

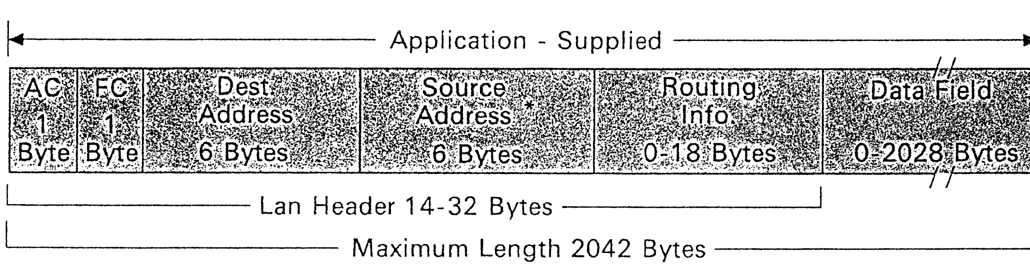
For Receive commands, the Adapter Support Interface **must** control the buffers. If the application program prepares and controls the buffers, it must provide buffers to the Adapter Support Interface for Receive commands by issuing a Buffer Free command. The buffer can be retrieved from the Adapter Support Interface by a Buffer Get command.

Transmit Buffer Fields

There are three frame formats transmitted by the adapter:

1. MAC frames
2. Non-MAC I frames
3. Other non-MAC frames.

The portions of the frames prepared by the application program must be prepared in buffers. When the Adapter Support Interface moves the buffer contents into the transmit buffer space in shared RAM, the adapter fills in some fields with proper values. For those fields, buffer space must be assigned in the application-prepared buffer. For non-MAC I frames, the adapter provides the DLC header field without using space in either the application-provided buffer or the adapter transmit buffer. For other non-MAC frames the adapter places the DLC header field values into the adapter transmit buffers when the buffer content is moved to the adapter transmit buffers. Space for this field is not required in the application buffer, but the length of the entire frame will include the DLC header field.



* The adapter will provide the source field values.

Figure 2-2. MAC frame

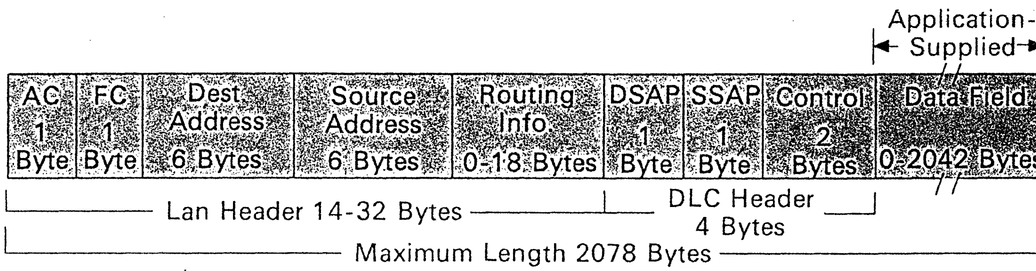
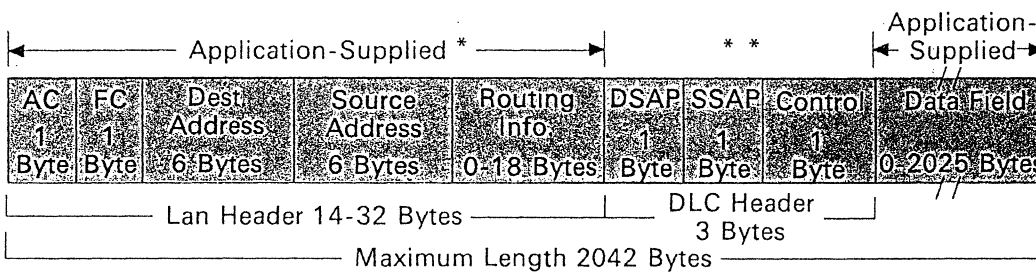


Figure 2-3. Non-MAC I frame



* The LAN header space, including the destination address and routing information fields, is provided by the application program in the first buffer. The adapter fills in the source address field values.

** The adapter places the DLC header values in 3 bytes of the adapter transmit buffer. None of the application's buffer space is needed for the DLC header.

Figure 2-4. Other non-MAC frame

The lengths of the application-supplied fields plus the adapter-supplied DLC header field must not exceed the maximum length as shown in Figures 2-2, 2-3, and 2-4. If the DHB length is less than the maximum length shown, then the frame maximum length is limited to 6 bytes less (for overhead) than the length of the DHB.

Buffer Pools

The following commands are associated with generating, defining, and handling pools of transmit and receive buffers in the Adapter Support Interface area of IBM PC memory.

- DIR.OPEN.ADAPTER: Allocates direct interface buffer pool
- DIR.MODIFY.OPEN.PARMS: Changes direct interface buffer pool allocation
- DLC.OPEN.SAP: Allocates DLC interface buffer pool for a specific SAP
- BUFFER.GET: Get one or more buffers from a SAP pool for later transmit use.
- BUFFER.FREE: Return one or more buffers back into a pool
- RECEIVE: Receive data into buffers
- RECEIVE.MODIFY: Receive data into optional buffers
- TRANSMIT: Send data from buffers

Buffer pools can be allocated for every SAP defined to the adapter and for the direct interface direct station at STATION_IDs X'0000', X'0001', and X'0002'. Every SAP defined may have one pool of buffers defined for its use.

Each buffer pool is independent of the others and has the following characteristics:

- The application program must use these buffers for the Receive command. Their use is optional for transmit commands.

- All link stations operating within a specific SAP use the same buffer pool.

- All buffers in a pool have the same length.

- Every buffer has a 12-byte overhead, to contain a forward pointer and length information controlled by the Adapter Support Interface.

- When a buffer pool is defined:

  - The buffer length defined must be a multiple of 16 bytes.
  - The user-defined length includes the 12-byte overhead.
  - The minimum user-defined length is 80 bytes (68 data bytes plus 12 bytes of overhead).

- The application program may allow the Adapter Support Interface to prepare and control the buffer pool, or it may take that responsibility itself. If buffer pools controlled by the Adapter Support Interface are used, they are obtained and returned by Buffer Get and Buffer Free commands. If the application program controls the buffers, it must prepare the control fields in the prescribed format. Since the buffers controlled by the Adapter Support Interface must be used for receives, either buffers prepared by the Adapter Support Interface are used or the application program provides a prepared buffer to the Adapter Support Interface by issuing a Buffer Free command.

Note: The impact of a SAP having no more available buffers may vary depending upon the data being received. See the Receive command description.

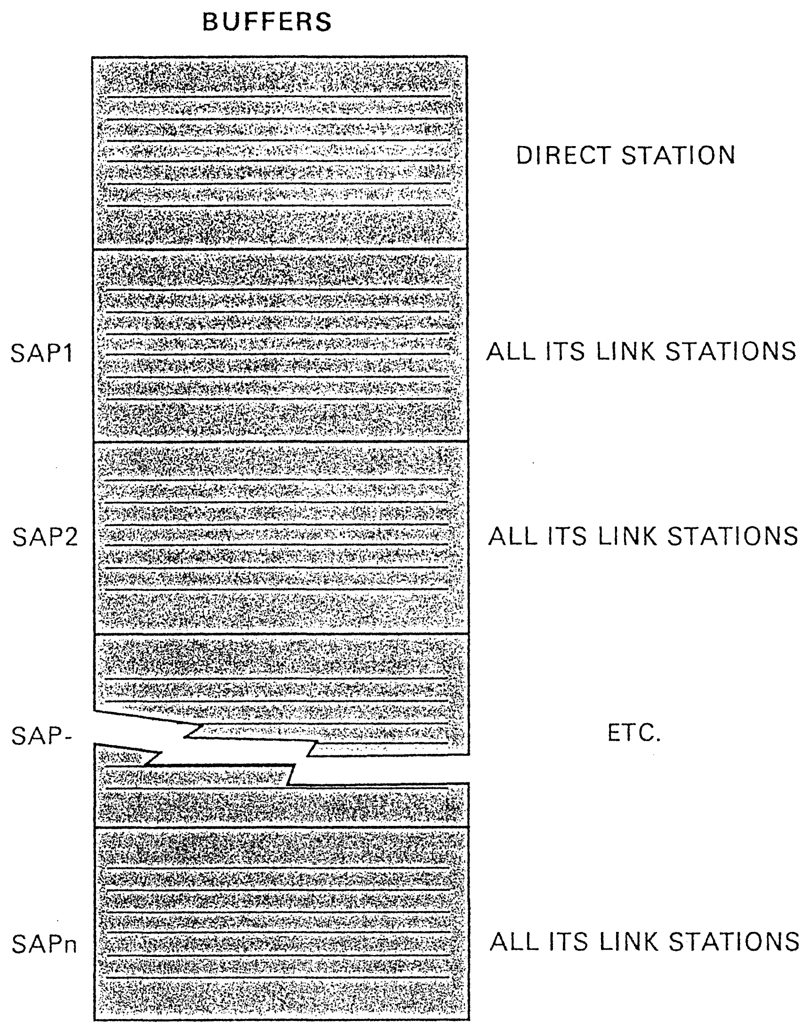


Figure 2-5. Buffer Pool Organization

Receive Buffers

Data is received from the ring into receive buffers in shared RAM on the adapter card. If there is a Receive command outstanding for the SAP or link station, the data is then moved by the Adapter Support Interface to the appropriate buffer pool in IBM PC memory. The application program then processes the data and issues a Buffer Free command to return the buffer to the pool.

Receive Buffer Formats

The Adapter Offset field, in bytes 8-9 of each buffer, allows all buffers to be handled similarly regardless of the amount of information in the buffer prior to the actual received data. For example, each of the two formats for buffer one differ from subsequent buffer formats. By interrogating the contents of the Adapter Offset field, the format of any buffer can be determined. See the RECEIVE command and the RECEIVE.MODIFY command descriptions for buffer assignment.

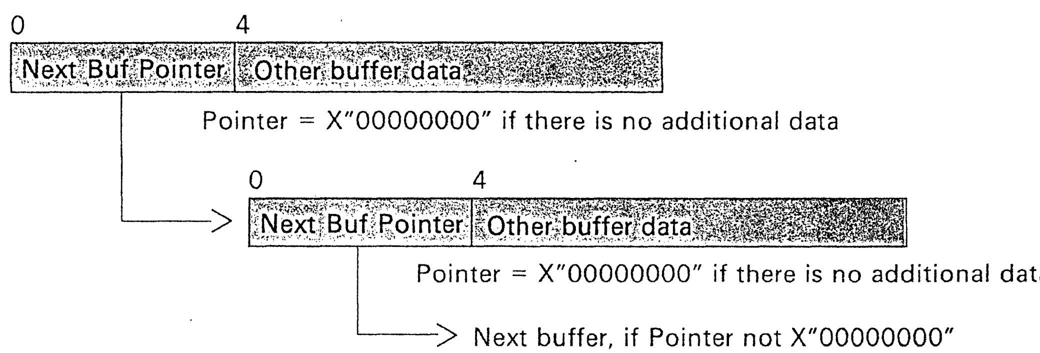


Figure 2-6. Receive Buffer Formats

Buffer One: Option = Not Contiguous MAC/DATA

OFF-SET	FIELD NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	BUF POINTER	4	DD	Pointer to the next buffer or X'00000000' if no additional buffers
4	RCV LEN	2	DW	Length of entire receive frame
6	LENGTH IN BUFFER	2	DW	Length of data in buffer beginning at byte X (received data)
8	ADAPTER OFFSET	2	DW	Offset from the beginning of the buffer to byte 58 (user space). Use this value with the buffer segment - segment+offset.
10	USER LENGTH	2	DW	The length of the USER SPACE field defined by the ADAPTER OFFSET parameter (bytes 58-X)
12	STATION ID	2	DW	Receiving station ID
14	OPTIONS	1	DB	Option byte from RECEIVE parameter table
15	MESSAGE TYPE	1	DB	Type of message received
16	BUFFERS LEFT	2	DW	The number of buffers left in the SAP buffer pool
18	RCV FS	1	DB	Received Frame Status field
19	ADAPTER NUM	1	DB	Adapter number (0 or 1)
20	LAN HEADER LENGTH	1	DB	The length of the LAN Header field (bytes 22-53)
21	DLC HEADER LENGTH	1	DB	The length of the DLC Header (bytes 54-57): If the value is X'00' this is for the direct interface.
22	LAN HEADER	32	DB	The LAN header received with the frame. The actual length is defined by LAN LENGTH.

OFF-SET	FIELD NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
54	DLC HEADER	4	DB	The DLC header received with the frame, if applicable. The actual length is defined by DLC LENGTH. (Contents undefined if DLC LENGTH = 0.)
58	USER SPACE	-	--	An area in the buffer for use by the application program. The length is defined by USER LENGTH (bytes 10-11).
X	RCVD DATA	-	DB	The data received following the DLC Header in the frame.

Buffer One: Option = Contiguous MAC/DATA

OFF-SET	FIELD NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	BUF POINTER	4	DD	Pointer to the next buffer or X'00000000' if no additional buffers.
4	RCV LEN	2	DW	Length of entire receive frame.
6	LENGTH IN BUFFER	2	DW	Length of data in buffer beginning at byte X (received data).
8	ADAPTER OFFSET	2	DW	Offset to byte 20 (user space). Use this value with the buffer segment - segment+offset
10	USER LENGTH	2	DW	The length of the USER SPACE field defined by the ADAPTER OFFSET parameter (bytes 20-X)
12	STATION ID	2	DW	Receiving station ID
14	OPTIONS	1	DB	Option byte from RECEIVE parameter table
15	MESSAGE TYPE	1	DB	Type of message received
16	BUFFERS LEFT	2	DW	The number of buffers left in the SAP buffer pool

OFF-SET	FIELD NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
18	RCV FS	1	DB	Received Frame Status field
19	ADAPTER NUM	1	DB	Adapter number (0 or 1)
20	USER SPACE	-	--	An area in the buffer for use by the application program. The length is defined by USER LENGTH (bytes 10-11).
X	RCVD DATA	-	DB	The data received in the frame including the LAN Header and the DLC Header.

Explanation of Certain Buffer Fields

MESSAGE TYPE

Explanation: (byte 15) Type of message received

Legend

X'02' = MAC frame (Direct Station only)
X'04' = I frame (Information frame - application data - link stations only)
X'06' = UI frame
X'08' = XID command (poll bit)
X'0A' = XID command (not poll bit)
X'0C' = XID response (final bit)
X'0E' = XID response (not final bit)
X'10' = TEST response (final bit)
X'12' = TEST response (not final bit)
X'14' = Other, Used for non-MAC frame (Direct Station only)

USER SPACE

Explanation: This space may be loaded by the application program. It is not altered by the Adapter Support Interface or by the received frame data.

RECEIVED FS DATA

Explanation: Frame Status (FS) byte (byte 18)

BIT	MEANING
7	Address recognized indicator (A)
6	Frame copied indicator (C)
5	Reserved
4	Reserved
3	Address recognized indicator (A)
2	Frame copied indicator (C)
1-0	Reserved

RECEIVED DATA

Explanation: (bytes X - end of buffer)

If option = CONTIGUOUS:

- This data begins with the LAN Header from the received frame.

If option = NOT CONTIGUOUS:

- If MESSAGE TYPE = X'02' or X'14', this is the data immediately following the LAN Header from the received frame.

- If MESSAGE TYPE is not X'02' or X'14', this is the data immediately following the DLC Header from the received frame.

Additional data that will not fit into this buffer is placed in buffer two and subsequent buffers.

Buffer Two and Subsequent Buffers

OFF-SET	FIELD NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	BUF POINTER	4	DD	Pointer to the next buffer or X'00000000' if no additional buffers
4	RCV LEN	2	DW	Length of entire receive frame
6	LENGTH IN BUFFER	2	DW	Length of data in buffer beginning at byte X (received data)
8	ADAPTER OFFSET	2	DW	Offset to byte 12 (user space). Use this value with the buffer segment - segment+offset
10	USER LENGTH	2	DW	The length of the USER SPACE field defined by the ADAPTER OFFSET parameter (bytes 12-X)
12	USER SPACE	-	--	An area in the buffer for use by the application program. The length is defined by USER LENGTH (bytes 10-11).
X	RCVD DATA	-	DB	A continuation of the data received in the frame

Transmit Buffers

The application program issues a Buffer Get command, moves data into the assigned buffer and adds necessary header information, and issues the transmit command. The Adapter Support Interface moves the contents of the buffer into shared RAM on the adapter card and interrupts the adapter card to proceed with the transmission. When the Transmit command has completed, the application program should issue a Buffer Free for all buffers except the XMIT_QUEUE_TWO buffer which is freed by the Adapter Support Interface when the transmission is successful (return code is zero).

The total amount of data in all buffers of one issued command must fit into one adapter transmit buffer in shared RAM. The adapter transmit buffer size is defined by the DIR.OPEN.ADAPTER command

DHB_BUFFER_LEN parameter, with the maximum being 2048 bytes.

6 bytes are used as overhead
14 bytes are used for the access control (AC) byte, the frame control (FC) byte, and the LAN Header source and destination address fields.
The remaining length will be reduced if routing information is used (up to 18 bytes) and if a DLC Header is included (up to 4 bytes). If both are used, the space available for data would be 2006 bytes.

Note: *The LAN and DLC headers are not placed in the transmit buffer for an I frame transmission as a result of a TRANSMIT.I.FRAME command making an additional 36 bytes available.*

See Figure 2-8 on page 2-31 and "Transmit Buffer Fields" on page 2-17.

Transmit Buffer Formats

The transmit buffers must be formatted as defined here.

Four groups of buffers are definable by transmit commands. See "Transmit" on page 3-72. They are:

- XMIT_QUEUE_ONE
- XMIT_QUEUE_TWO
- BUFFER_ONE
- BUFFER_TWO

XMIT_QUEUE_ONE and XMIT_QUEUE_TWO may each consist of one or more buffers.

Any combination of XMIT_QUEUE_ONE, XMIT_QUEUE_TWO, BUFFER_ONE, and BUFFER_TWO can be selected for use. (BUFFER_TWO may not be used alone.) However, they will be transmitted sequentially beginning with XMIT_QUEUE_ONE and ending with BUFFER_TWO whenever more than one is selected. XMIT_QUEUE_ONE could contain header information that seldom or never needs modifying, XMIT_QUEUE_TWO could contain data or device-specific header information, and BUFFER_ONE could contain the actual data to be transmitted. BUFFER_TWO, if used, might contain additional data. Buffers in XMIT_QUEUE_TWO are freed by the Adapter Support Interface if the transmission is successful (return code is zero).

BUFFER_ONE and BUFFER_TWO are user-defined and contain only data. Any buffer group may be excluded by providing a buffer length of zero in the transmit command CCB.

The buffers defined by XMIT_QUEUE_ONE and XMIT_QUEUE_TWO are as follows:

OFF-SET	FIELD NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	NEXT BUF POINTER	4	DD	Pointer to the next buffer or X'00000000' if there are no additional buffers.
4		2	--	Reserved
6	LENGTH IN BUFFER	2	DW	Length of data in buffer beginning at byte 12 plus the user length.
8	USER DATA	2	DW	Available for user
10	USER LENGTH	2	DW	Length of the user space starting at byte 12
12	USER SPACE	2	DW	User space followed by data to be transmitted. If there is no user data, the transmit data starts at byte 12.

The USER SPACE may be loaded by the application program. The USER SPACE information is not transmitted.

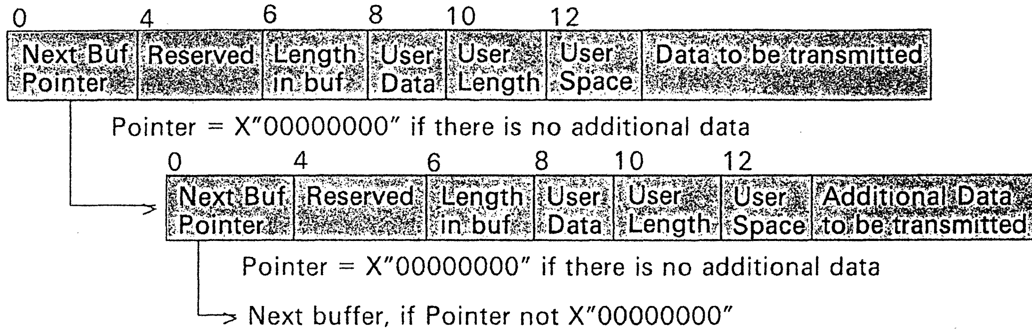


Figure 2-7. Transmit Buffers

Medium Access Control (MAC) Frames

Control of the ring is handled by the adapter card using frames designated as MAC frames.

Some of the activity of ring control and status is presented to the IBM PC by the adapter. Likewise, there are some actions that an application program can be involved in and initiate transmission of a MAC frame.

Warning: Use great care when deciding to transmit MAC frames. For more information about ring activity, see the *IBM Token-Ring Network Architecture Reference.*

A frame is designated as a MAC frame by the frame type bits within the frame control (FC) field. See frame type on page 1-12. The physical header portion of the figure below shows the location of the frame control field within the frame.

SD	AC	FC	Dest. Addr.	Source Addr.	Rout. 0-18 Bytes	Info. Field	FCS	ED	FS
1 Byte	1 Byte	1 Byte	6 Bytes	6 Bytes			4 Bytes	1 Byte	1 Byte

LAN HEADER

Figure 2-8. Frame Format. Bits are transmitted in bytes, high-order bit (bit 7) first.

LAN Header

When a frame is transmitted from the direct station using the direct interface, the entire frame must be prepared by the application program. When transmitting, the adapter will fill in the space designated for the source address and will obtain the remainder of the frame from the application program. The LAN header layout is shown in Figure 2-8.

Chapter 3. The DLC Interface

The DLC interface provides an interface to applications using the Logical Link Control sublayer of Data Link Control protocol. The interface may be used in two ways.

- For IEEE type 1 communication: connectionless communication between devices providing no guarantee of delivery.
- For IEEE type 2 communication: connection-oriented services using Logical Link Control (LLC) protocol.

Much of the communication overhead function is provided by the adapter and Adapter Support Interface, which permit simple application programming. See the *IBM Token-Ring Network Architecture Reference* for more about communication using DLC and LLC.

SAPs, Stations, and IDs

An adapter in an IBM PC has an address for use on the IBM Token-Ring Network. This address (the NODE_ADDRESS) is permanently encoded on the card. A NODE_ADDRESS must be unique on the Token-Ring Network. Refer to "Addressing" on page 2-12 for additional information about NODE_ADDRESS.

Using the LLC sublayer of DLC, the adapter controls link activities with service access points (SAPs) and link stations. For two device application programs to communicate, each must set up a SAP in its adapter. Then each must either:

- Send a frame from its SAP to that of the other device and application program, or
- Establish a link from its SAP to that of the other, and then send frames to the other.

Both uses of the DLC interface, connection and connectionless operations, use service access points (SAPs) for communication on the Token-Ring Network. An application program can set up several SAPs for an adapter and within each SAP can set up several link stations. These link stations can then be directed to connect to link stations that have been set up in other adapters (or even the same adapter). A SAP can be established to operate in one of two ways:

1. XID command frames will be handled by the DLC function of the adapter.
2. XID command frames will be passed to the application program for handling.

An option is set when the SAP is opened defining the handling of received XID commands. XID responses are always passed to the application program.

When an application program opens a SAP, the program assigns a SAP_VALUE and the adapter assigns a STATION_ID. Communication between the application program and the Adapter Support Interface refer to a SAP by the 2-byte STATION_ID. For SAPs, the first byte of the STATION_ID represents the SAP and the second byte is zero. When a link is set up within a SAP, the adapter assigns another STATION_ID which has the SAP number in the first byte and the link station number in the second byte. The adapter does not repeat link numbers in other SAPs. Both SAPs and link stations are pointed to using the STATION_ID field. For example, X'0100' represents a SAP and X'0108' represents a link assigned to that SAP.

When a SAP is prepared for communication with another SAP on the ring, the application program accesses the STATION_ID and provides a destination SAP_VALUE. By specifying the local 2-byte STATION_ID, and a NODE_ADDRESS (the DESTINATION_ADDR) and 1-byte

SAP_VALUE of the SAP at the destination device, the application program can open a link station. When both devices have opened a SAP and link station, a connect command actually initiates establishing the link connection.

SAPs may be opened with SAP_VALUES indicating individual or group SAPs. All individual SAPs must have even-numbered (least significant bit is off) SAP_VALUES. All group SAPs must have odd-numbered (least significant bit is on) SAP_VALUES. A group SAP may receive frames but may not transmit frames. When an individual SAP is opened, an option may be selected to open the corresponding (next higher addressed) group SAP. If SAP X'04' were opened with the group option selected, group SAP X'05' would also be opened. An individual SAP may be designated as belonging to one or more group SAPs using the DLC.OPEN.SAP or DLC.MODIFY command. A SAP may be deleted from a group SAP using a DLC.MODIFY command. All members of a group SAP must have the same XID option as the individual SAP for which the group SAP was initially opened.

All SAPs belonging to a group SAP will receive the frames directed to the group SAP.

Refer to Figure 1-4 on page 1-13. For a transmitted frame, the destination address in the LAN header is the remote NODE_ADDRESS. The source address in the LAN header is the local NODE_ADDRESS. The DSAP is the destination SAP_VALUE (RSAP_VALUE), and the SSAP is the local SAP_VALUE. At the receiving end the interpreting of local and remote fields will be exchanged. For example, the destination address field is the local NODE_ADDRESS of the receiving adapter.

The maximum number of group and individual SAPs possible is 254. The maximum number of link stations per SAP is 255. However, RAM and memory constraints will limit the number of SAPs and link stations that may be open at one time. See "Calculating RAM and Work Area Usage" on page 3-19 to calculate the number of SAPs and link stations.

More information about these SAPs and links are included with related command descriptions. See *IBM Token-Ring Network Architecture Reference* for detailed information.

SAPs Opened Automatically

The adapter sets up some SAPs automatically. They are:

- Null SAP X'00'
- Global SAP X'FF'

The Null SAP is opened automatically by the adapter (SAP value = X'00'). It represents the LLC as a whole. The Null SAP provides the ability to respond to remote nodes even when no SAP has been activated. This SAP supports only connectionless service and responds only to XID and Test Frames. The Null SAP is not accessible to the local application program.

The Global SAP is opened automatically by the adapter (SAP value = X'FF'). It is a group SAP with all open individual SAPs as members. XID, TEST, and UI frames directed to the Global SAP will be passed to each open SAP in turn, with the DSAP field in the received frame buffer set equal to the receiving individual SAP_VALUE, where they will be handled according to frame type.

If the NETBIOS Program is to be used, SAP X'F0' will be required.

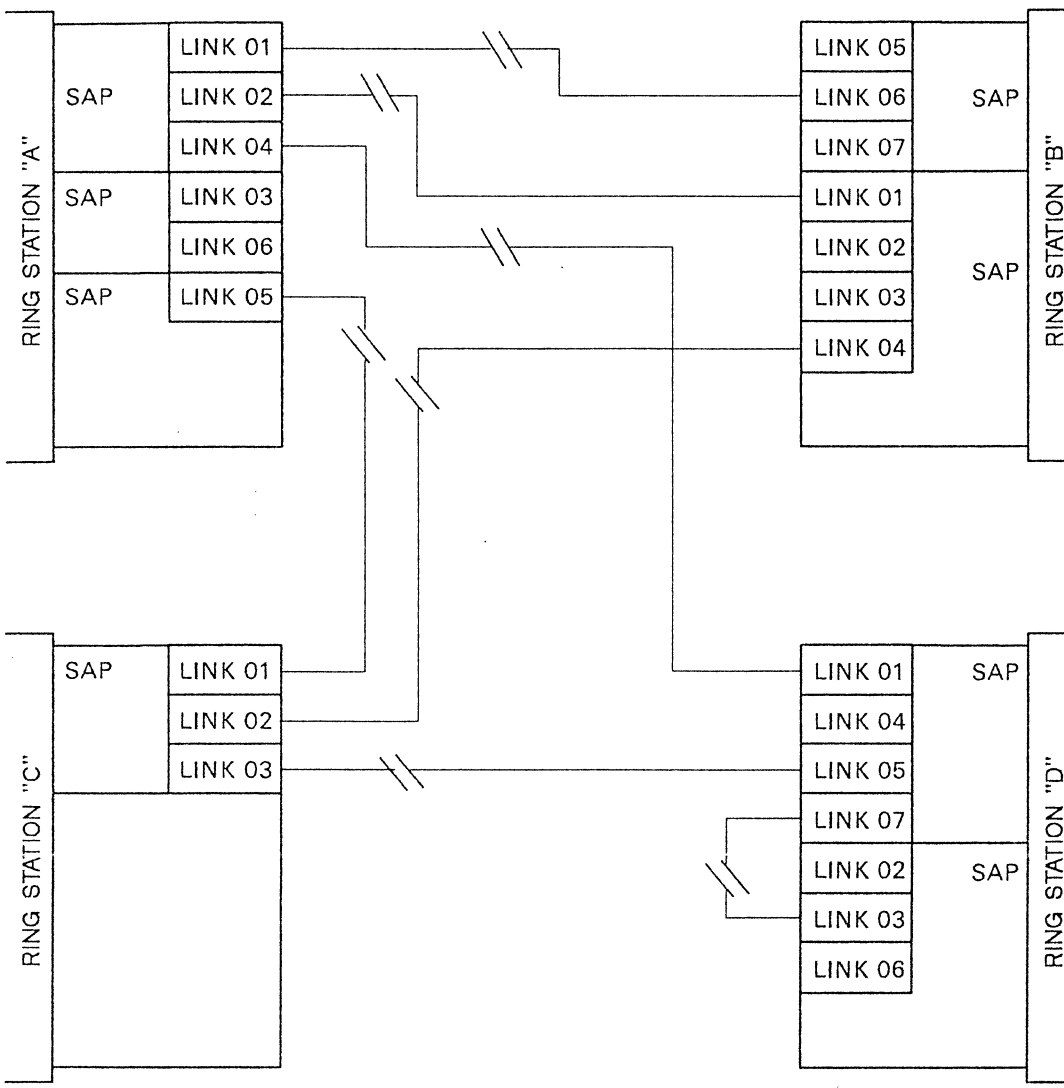


Figure 3-1. SAPs and Link Stations

Types of Service

The IBM Token-Ring Network supports IEEE 802.2 type 1 and type 2 service. Type 1 is connectionless service allowing transmission and receipt of Unnumbered Information (UI) frames, Exchange ID (XID) frames, and TEST frames. Type 1 uses unnumbered LLC Protocol Data Units (LPDUs). Frames sent using this type of service are not followed by a transmission from the receiving device verifying correct receipt and sequence of events unless provided by an application program in that device. The transport layer does verify error-free communication and provide the sending application with the result. Recovery and retry actions must be controlled by the application program. Type 2 is connection-oriented service using protocol functions compatible with IEEE 802.2 as described in the *IBM Token-Ring Network Architecture Reference.* Type 2 provides guaranteed delivery and uses numbered LLC Protocol Data Units (LPDUs).

Command Sequences

When Logical Link Control protocol is used, commands must be issued in certain sequences to obtain the desired result.

In all cases, the adapter must be initialized and opened prior to the use of any transmit and receive commands.

A possible sequence could be:

Command	**Comments**
DIR.INITIALIZE	Select, clear, and test adapter card
DIR.OPEN.ADAPTER	Make ready, set parameters, and connect the adapter to the ring
RECEIVE	Prepare for received data for direct station
DLC.OPEN.SAP	Allocate a Service Access Point

Command	Comments
RECEIVE	Prepare for received data for this SAP
DLC.OPEN.STATION	Prepare a link station
RECEIVE	Prepare for received data for this link station
DLC.CONNECT.STATION	Initiate the communication link with remote station

The DIR.INITIALIZE command should be issued only if the adapter is known to be dedicated to the application program. The DIR.INTERRUPT command can be issued to determine if a DIR.INITIALIZE command is needed.

After this sequence has been completed, the application program can transmit and receive data on a link station in the following manner:

- **Receiving data**

  Check the receive return code if no appendage was used, or check to see if the appendage routine has received data. After moving data from the receive buffer, issue a BUFFER.FREE command to return the buffer to the pool.

- **Transmitting data**

  Issue a BUFFER.GET command to obtain enough buffers to contain the transmit data, move the data to the buffers, and issue a TRANSMIT.I.FRAME command. Issue a BUFFER.FREE command when the transmit is completed if buffers are not freed by the Adapter Support Interface.

When preparing to leave the application program, the following commands should be issued:

Command	Comments
DLC.CLOSE.STATION	Close the link station
DLC.CLOSE.SAP	Close the SAP
DIR.CLOSE.ADAPTER	Remove from the ring

Link Station States

DLC protocol in the adapter maintains primary and secondary states for each link station. Only one of the primary states may be active at a time. If the application program issues a command to a link station that is not valid for the current state, the command will be rejected with a return code of X'41' (Protocol Error). If a link station is not established, there is no control block and no primary and secondary states exist. Then the link station is "non-existent." DLC.MODIFY and DLC.FLOW.CONTROL commands are accepted in all states.

Changes in DLC status of the link station are reported to the interface. See "DLC Status Codes" on page 7-24 and "Suggested Actions in Response to DLC Status" on page 7-25 along with the following state information.

The primary states are:

- **Link Closed**

  No commands other than DLC.MODIFY and DLC.FLOW.CONTROL will be accepted when the link is in this state. All received frames will be ignored in this state. The state is entered when:

  - A DM response to a SABME or DISC has been queued for transmission. The close command that caused the transmission will be completed when the transmission is completed.
  - A DM or UA response to a DISC has been received. The close command that caused the transmission will be completed when the transmission is completed.

- A reset command has been received, but a transmission has already been queued or is in process and must be completed before the link station can be released.

- **Disconnected**

  All received frames will be ignored in this state except DLC frames with the poll bit set, and for which a DM is transmitted, and a SABME which is reported to the IBM PC. A DLC.CLOSE.STATION or DLC.CONNECT.STATION command will be accepted when this state is active. The state is entered when:

  - A DLC.OPEN.STATION command has been accepted.
  - A SABME for a previously non-existent station has been accepted.
  - A DM response or DISC command from the paired station has been received.
  - The retry count has been exhausted due to timeouts.

- **Disconnecting**

  This state is normally entered when:

  - The initial in-process return code is supplied after receipt of a DLC.CLOSE.STATION command. This state will be maintained until one of the following occurs:
    - Either a UA or DM response to the transmitted DISC command is received,
    - A SABME command is received and a DM response has been successfully transmitted, or
    - The retry count expires.

    Exit from this state is normally to link-non-existent or link-closed state. Since the DLC.CLOSE.STATION command remains in process while the link is in disconnecting state, no other commands will be accepted. All received frames other than SABME, DISC, UA, and DM will be ignored while in this state.

This disconnecting state may also be entered upon expiration of the retry count in FRMR received. In this case, exit is to the disconnected state.

- **Link Opening**

  Unexpected received frames are ignored in this state. The state is entered by:

  - A DLC.CONNECT.STATION command being issued by the IBM PC. Before entering this state, the adapter will transmit either a SABME command, or a UA response if a SABME has been received from the remote station.

    If a SABME was transmitted, the adapter expects a UA response. On receipt of the UA response, it will transmit an RR command-poll and change to the link-opened (checkpointing) state.

    If a UA was transmitted, the adapter expects either a supervisory command or an information frame, on receipt of which it will change state to link opened state (possibly with remote busy).

    If the expected frame is not received and the retry count is exhausted, the link will be returned to the disconnected state unless a SABME has been received.

    The DLC.CONNECT.STATION command will be returned with a successful return code or with an indication that the remote station failed to respond.

- **Resetting**

  All received frames except DISC, DM, FRMR, and SABME will be ignored. Only DLC.CLOSE.STATION and DLC.CONNECT.STATION commands will be accepted by the adapter when in this state. The state is entered when:

- A SABME command frame is received from the remote station when the link is open and not in disconnected state or link closed state.

- **Frame Reject Sent**

  All received frames except DISC, DM, FRMR, and SABME will be ignored. Only DLC.CLOSE.STATION and DLC.CONNECT.STATION commands will be accepted by the adapter when in this state. The state is entered when:

  - An illegal frame is received and a FRMR frame has been transmitted.

- **Frame Reject Received**

  All received frames except DISC, DM, and SABME will be ignored. Only DLC.CLOSE.STATION and DLC.CONNECT.STATION commands will be accepted by the adapter when in this state. The state is entered:

  - When a FRMR has been received.

- **Link Opened**

  This is the only state in which information transfer is allowed and in which TRANSMIT commands will be accepted. In this state the adapter will handle sequential delivery and acknowledgment of information frames, together with retransmission if required. The state is entered when:

  - The adapter passes from the link opening state after the SABME-UA exchange, which completes the connection protocol.

The link station secondary states are:

- **Checkpointing**
  A poll is outstanding, I frame transmission is suspended.

- **Local Busy (user)**
  A DLC.FLOW.CONTROL command with a set-local-busy option has been accepted. I frame reception has been suspended until a DLC.FLOW.CONTROL command with a reset-local-busy (user) option has been accepted.

- **Local Busy (buffer)**
  An out-of-buffer return code has been set by the IBM PC in response to a request for data service on a receive. I frame reception has been suspended until a DLC.FLOW.CONTROL command with a reset-local-busy (buffer) option has been accepted.

- **Remote Busy**
  An RNR frame has been received from the remote station. I frame transmission is suspended until a receive ready or reject response, or a SABME command, or an in-sequence I response frame with the F bit set to B'1' has been received.

- **Rejection**
  An out-of-sequence I frame has been received from the remote station and an REJ transmitted. I-frame reception is suspended until an in-sequence I frame or a SABME has been received.

- **Clearing**
  A poll is outstanding and a confirmation of clearing local busy is required after the response is received.

- **Dynamic Window**
  The remote station is on a different ring, and there appears to be congestion through the bridge(s).

Timers

The DLC functions use three timers:

- T1, the Response timer
- T2, the Acknowledgment timer
- Ti, the Inactivity timer.

See the *IBM Token-Ring Network Architecture Reference* for details about the timers.

The rate at which each of these timers is stepped and the value at which they time out are selectable by parameters. The rate of stepping is referred to as the "tick" and is set with fields in the DLC open parameters provided to the adapter with the DIR.OPEN.ADAPTER command. The timer value, or count at which it expires and interrupts the adapter, is selected with parameters provided to the adapter when a DLC.OPEN.SAP, DLC.OPEN.STATION, or DLC.MODIFY command is issued.

Each timer is divided into two groups of possible values.

1. If the value selected is between 1 and 5, the short timer rate will be used and is referred to as group 1.
2. If the value selected is between 6 and 10, the long timer rate will be used and is referred to as group 2.

Therefore, there are three timers with two rates selectable for each, or six parameters to be selected with the DIR.OPEN.ADAPTER command.

Each DLC.OPEN.SAP command will set the values for the three timers for that specific SAP using the rates selected for the entire adapter by the DIR.OPEN.ADAPTER command. For example, if the value of the T1 timer in one SAP is 4 and the value for the T1 timer in another SAP is 7, the short rate of stepping is selected for the Response timer on the one SAP and the long rate of stepping is selected for the Response timer in the other SAP. The group 2 timer values should be used when longer delays are expected such as when in a multi-ring environment.

The time of expiration is not exact, but falls into a range starting with the calculated time. More information about the ranges is included with the parameter field explanations. The next section includes guidelines for selecting timer values.

Guidelines for Selecting Parameter Values

Following are some basic guidelines to consider when selecting parameter values for the IBM Token-Ring Network PC Adapter. There are several basic parameters that may affect the performance obtained when using the Data Link Control (DLC) functions of the adapter. In most cases the default values will provide efficient operation. See "Timers" on page 3-13 and the parameter fields of the DLC.OPEN.SAP, DLC.MODIFY and, DLC.OPEN.STATION commands. The parameters that are outlined here are:

Parameter	***Pseudo Parameter***
Response Timer (T1)	The TIMER_T1 parameter of a DLC.OPEN.SAP, DLC.MODIFY or, DLC.OPEN.STATION command.

Parameter	*Pseudo Parameter*
Inactivity Timer (Ti)	The TIMER_Ti parameter of a DLC.OPEN.SAP, DLC.MODIFY or, DLC.OPEN.STATION command.
Receiver Acknowledgment Timer (T2)	The TIMER_T2 parameter of a DLC.OPEN.SAP, DLC.MODIFY or, DLC.OPEN.STATION command.
Maximum Length I-Field (N1)	The MAX_I_FIELD parameter of a DLC.OPEN.SAP, DLC.MODIFY or, DLC.OPEN.STATION command.
Maximum Number of Retransmissions (N2)	The MAX_RETRY_CNT parameter of a DLC.OPEN.SAP, DLC.MODIFY or, DLC.OPEN.STATION command.
Number of I-Format LPDUs Received before Sending Acknowledgment (N3)	The MAX_IN parameter of a DLC.OPEN.SAP, DLC.MODIFY or, DLC.OPEN.STATION command.

Parameter	*Pseudo Parameter*
Number of Acknowledgments Needed to Increment Ww (Nw)	The MAXOUT_INCR parameter of a DLC.OPEN.SAP, DLC.MODIFY or, DLC.OPEN.STATION command.
Maximum Number of Outstanding I-Format LPDUs (TW)	The MAXOUT parameter of a DLC.OPEN.SAP, DLC.MODIFY, or DLC.OPEN.STATION command.

Response Timer (T1)

The Response Timer (T1) is maintained by the sending adapter whenever an I-format LPDU or a command LPDU with the poll bit set to B'1' is sent. Should this timer expire before a response is received, the sending adapter solicits remote link station status by sending a supervisory command LPDU with the poll bit set to B'1'. The T1 timer should therefore be greater than the total delays that the frame might encounter within the sending node, the network, and the receiving node. Normal settings for the T1 parameter should be in the range of 1 to 2. For instance, a setting above 2 seconds may result in noticeable delays to those responses that must be retransmitted (typically less than 3 percent of the total frames).

Inactivity Timer (Ti)

The Inactivity Timer (Ti) runs whenever the Response Timer (T1) is not running. Expiration of this timer suggests that the link may have been lost. The Inactivity Timer (Ti) should be five to ten times greater than T1.

Receiver Acknowledgment Timer (T2)

A link station starts T2 when an I-format LPDU is received into IBM PC memory. T2 is stopped when an acknowledgment is sent either with an outgoing frame or when the number of I-format LPDUs received before sending acknowledgment (N3) value is reached. If T2 expires, the link station must send an acknowledgment as soon as possible. The value of T2 must be less than that of T1, to ensure that the remote link station will receive the delayed acknowledgment before T1 expires. Typical values for T2 will normally be 80 to 256 milliseconds.

Maximum Length of I-field (N1)

The Maximum Length of I-field (N1) parameter is used primarily to enable a pair of stations to establish the maximum size frame that can be received by either station. For example, one station may be able to transmit and receive frames up to 2K bytes each while the other can only send and receive frames of 1K bytes or smaller. The stations might establish the 1K frame size by exchanging XID information, for instance. Under no circumstance should the N1 value exceed the total amount of receive RAM available on the adapter card. Also, since the N1 value implies that a station may transmit frames of length N1 bytes, N1 should not exceed the Data Hold Buffer (DHB) size (the DHB_BUF_LEN parameter of the DIR.OPEN.ADAPTER command) for the adapter in that station.

A key factor in selecting the N1 value is the receive buffer capacity of the destination adapter. Server devices, for example, may support several sessions concurrently, and therefore have a more limited buffer capacity than a workstation. (See "Calculating RAM and Work Area Usage" on page 3-19.)

Typical values of N1 should not exceed 1042 bytes. N1 should never exceed 2042 bytes with the IBM Token-Ring Network PC Adapter. N1 values smaller than 512 bytes may result in a perceived decrease in station-to-station response times.

Maximum Number of Retransmissions (N2)

The Maximum Number of Retransmissions (N2), or MAX_RETRY_CNT, count defines the maximum number of attempts in which a sending adapter will perform the checkpoint procedure following the expiration of the T1 timer. The combination of T1 and N2 should be great enough to allow for error detection and recovery on the Token-Ring Network. This count also prevents continual retransmission of the same I frame.

Typical values for N2 will be 10 or less.

Maximum Number of Outstanding I-Format LPDUs (TW) and Number of I-format LPDUs Received before Sending Acknowledgment (N3)

The TW and N3 counts should be considered together since they establish the ratio of acknowledgment frames to I-format LPDU frames. However, the N3 value should be compared only with the TW value of the remote link station, not the local station. The values of TW and N3 can affect the response perceived by the user in some cases. However, in most instances, the default values will provide the best general performance. The following guidelines should be considered:

- The TW count will allow the sender to transmit TW frames before it is forced to halt and wait for an acknowledgment. Therefore, the receiver should be able to absorb that number of frames, either in its SAP buffers or within the buffers in IBM PC memory. A small value of TW will reduce the chances that frames will have to be retransmitted due to buffer congestion at the receiver. The TW/N3 ratio thus provides a flow control mechanism to prevent overruns at the receiver.
- The TW value should always be greater than or equal to N3 value. Network response can be severely degraded if N3 exceeds TW.
- Very little network overhead or adapter processing is required to send or receive an

acknowledgment frame. Therefore, every frame can be acknowledged without a perceptible degradation in performance.

- Even though the maximum values allowed for TW and N3 are 127 each, practical values should not exceed 8 for TW or 4 for N3.
- If a small maximum frame size is selected (128 or 256 bytes), TW/N3 values of 6/3 or 8/4 may give better performance than the default values of 2/1.

Working window (Ww), and Window increment (Nw)
There are two counts associated with the dynamic window algorithm for flow control. The purpose of the dynamic window algorithm is to allow the sending station to temporarily reduce the transmit window (Tw) whenever network or receive adapter congestion is resulting in lost frames. By temporarily reducing the window size, the flow of frames over that link is reduced, thus permitting the congested node to recover from the temporary overload.

Calculating RAM and Work Area Usage

The Adapter Support Interface provides 1K bytes of work area for each adapter. During initialization it returns to the operating system (DOS) 1K bytes of memory used for initialization. If only one adapter is present, it returns the 1K bytes that would have been assigned to the additional adapter as work area.

The assignment of Adapter Support Interface work area is as follows:

1. 48 bytes for the direct interface
2. 36 bytes for *each* SAP
3. 6 bytes for *each* link station

The application program can assign work area by setting parameters in the DIR.OPEN.ADAPTER Command.

The NETBIOS Program provides 9K bytes of work area for each adapter. When the NETBIOS Program is loaded, assignment of this work area may be altered. As with the Adapter Support Interface, the application program can assign work area by setting parameters in the DIR.OPEN.ADAPTER command.

The assignment of NETBIOS Program work area is as follows:

1. 640 bytes for the NETBIOS Program
2. 20 bytes for *each* name in the name table
3. 16 bytes for *each* link station
4. 40 bytes for *each* session
5. 100 bytes for *each* outstanding MCB
6. 120 bytes for *each* transmit buffer

The DIR.OPEN.ADAPTER command defines functions that require space in shared RAM. The remainder of shared RAM is configured for receive buffers.

The assignment of shared RAM is as follows:

1. 1588 bytes for adapter work and communication area
2. 64 bytes for *each* SAP
3. 14 plus 2 times (the maximum group SAP members) bytes for *each* group SAP
4. 144 bytes for *each* link station
5. 96 to 2048 bytes for *each* adapter transmit buffer defined by the application program.

For example, the 8K bytes of shared RAM would support a configuration of:

1. 32 link stations with 8 SAPs (4 link stations per SAP)
2. A default selection of 600 bytes for the DHB.

This leaves 884 bytes for receive buffers.

The 16K bytes of shared RAM on an Adapter II would support a configuration of:

1. 64 link stations with 8 SAPs
2. A default selection of 600 bytes for the DHB.

This leaves 4468 bytes for receive buffers.

The Adapter has 8K bytes of shared RAM and the Adapter II has 16K bytes of shared RAM available.

The Adapter II with 16K bytes of shared RAM can provide more receive buffer capacity or greater transmit capacity than the Adapter with 8K bytes of shared RAM. The Adapter II is recommended if more than 10 link stations or if two maximum-length (2048-byte) transmit buffers are required.

The Command Control Block

OFF-SET	FIELD NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	CCB_ADAPTER	1	DB	Adapter 0 or 1
1	CCB_COMMAND	1	DB	Command field
2	CCB_RETCODE	1	DB	Completion code
3	CCB_WORK	1	DB	Adapter work area
4	CCB_POINTER	4	DD	Queue pointer and Adapter Support Interface work area
8	CCB_CMD_CPLT	4	DD	Command completion user appendage
12	CCB_PARM_TAB	4	--	Parameters or pointer to CCB parameter table

Figure 3-2. CCB (Command Control Block).

Refer to "The CCB" on page 2-3 for definition of the fields.

Command Descriptions

All the commands use a control block, as defined earlier; an MCB for all NETBIOS Program commands and a CCB for all other commands using the DLC and direct interfaces. All differing uses of variables in the control block and additional control information, such as parameter tables, are included with these command descriptions. The possible return codes are listed with each command description.

Each command description begins with a box containing the command name. The hexadecimal number at the top of the box is the command code value. Whenever parameter tables are included, descriptions of the parameters follow the table.

Hex 27

BUFFER.FREE

Function: Return one or more buffers to the SAP's buffer pool.

Explanation: When the buffer is placed back in the buffer pool, bytes 4 and 5 (buffer length) of the buffer are set to zero. This command is executed entirely by the Adapter Support Interface in the IBM PC. Therefore, the command completion appendage is not required, as the command is complete upon return from the X'5C' interrupt. However, the command completion appendage will be taken if provided.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed; should be open
X'09' Adapter not initialized; should be initialized
X'1B' The CCB_PARM_TAB pointer is invalid
X'1C' A pointer in CCB Parm table is invalid
X'1D' Invalid CCB_ADAPTER value
X'40' Invalid STATION_ID

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	STATION_ID	2	DW	SAP/DIRECT station ID: defines the buffer pool
2	BUFFER_LEFT	2	DW	Number of buffers left in the pool *
4		4	DB	Reserved
8	FIRST_BUFFER	4	DD	Address of first buffer to free

* Indicates a returned value set by the adapter.

STATION _ID

Explanation: Defines the SAP that the buffer is currently assigned to. The SAP_NUMBER portion of the STATION_ID must identify a valid opened SAP or X'00' (DIRECT STATION), the STATION_NUMBER portion is ignored.

BUFFER _LEFT

Explanation: Defines the number of buffers in the pool after the command has been completed. The Adapter Support Interface will return the correct value when the command is completed.

FIRST _BUFFER

Explanation: The address in IBM PC memory of the first buffer to be freed. If this value is zero, no buffer will be freed and the command will be completed with a CCB_RETCODE of X'00'. If this field is detected as invalid, the command will be completed with a CCB_RETCODE of X'1C'.

Hex 26
BUFFER.GET

Function: Get one or more buffers from the SAP's buffer pool.

Explanation: This command is executed entirely in the Adapter Support Interface by the IBM PC. Therefore, the command completion appendage is not required, as the command is complete upon return from the X'5C' interrupt. However, the command completion appendage will be taken if provided.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'09' Adapter not initialized—should be initialized
X'19' Inadequate buffers available for request
X'1B' The CCB_PARM_TAB pointer is invalid
X'1D' Invalid CCB_ADAPTER value
X'40' Invalid STATION_ID

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	STATION_ID	2	DW	SAP/DIRECT station ID: defines the buffer pool
2	BUFFER_LEFT	2	DW	Number of buffers left in the pool *
4	BUFFER_GET	1	DB	Number of buffers to get
5		3	DB	Reserved
8	FIRST_BUFFER	4	DD	Address of first buffer obtained *

* Indicates a returned value set by the adapter.

STATION _ID

Explanation: Defines the SAP buffer pool that the buffer is to be taken from. The SAP_NUMBER portion of the STATION_ID must identify a valid opened SAP or X'00' (DIRECT STATION), the STATION_NUMBER portion is ignored.

BUFFER _LEFT

Explanation: Defines the number of buffers in the pool after the command has been completed. The Adapter Support Interface will return the correct value when the command is completed.

BUFFER _GET

Explanation: This defines the number of buffers to get from the pool. If there is an inadequate number of buffers in the pool, the command will terminate with a CCB_RETCODE of X'19' (inadequate buffers available for request). If the value is set to 0, the default of 1 is used.

Note: *This command could cause a link station to go into a "local busy" condition, if too many buffers are taken.*

FIRST _BUFFER

Explanation: The address in IBM PC memory of the first buffer which was obtained. The adapter will return the correct value when the command is completed. If no buffers are obtained, this field will be set to X'00000000'.

Hex 16
DLC.CLOSE.SAP

Function: Close (deactivate) a Service Access Point (SAP).

Explanation: The STATION_ID of the SAP to be closed is placed in the first 2 bytes of the CCB_PARM_TAB parameter by the application program. The CCB_PARM_TAB field at offset 12 is defined for this command as a double word (DW) for the STATION_ID and as 2 bytes (DB) for the reserved portion. If any station associated with the SAP is open, the command will terminate with a CCB_RETCODE of X'47', SAP cannot close unless all link stations are closed.

Note: If a 47 error code results when a DLC.CLOSE.SAP command closely follows a DLC.CLOSE.STATION command for the last open station for that SAP, reissue the DLC.CLOSE.SAP command.

If a RECEIVE command is outstanding for the SAP, it will terminate with an X'0A' return code and the RECEIVE command's CCB address will be placed in the CCB_POINTER field of this command CCB. The command completion appendage of the RECEIVE command will not be taken.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'0B' Command canceled—adapter closed while command in process
X'1D' Invalid CCB_ADAPTER value

X'40' Invalid station ID
X'47' SAP cannot close unless all link stations are closed
X'48' Group SAP cannot close—all member SAPs not closed
X'4C' Sequence error—cannot close while commands are outstanding

Hex 1A
DLC.CLOSE.STATION

Function: Close (deactivate) a link station.

Explanation: The STATION_ID of the link station to be closed is placed in the first 2 bytes of the CCB_PARM_TAB field of the CCB by the application program. The CCB_PARM_TAB field at offset 12 is defined for this command as a double word (DW) for the STATION_ID and as 2 bytes (DB) for the reserved portion.

If a receive command is outstanding for this link station, it will be terminated with CCB_RETCODE X'0A' and its address will be placed in the CCB_POINTER of the DLC.CLOSE.STATION command. The CCB_CMD_CPLT appendage of the receive command will not be taken. Any pending transmit commands will be aborted immediately.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'0B' Command canceled—adapter closed while command in process
X'1D' Invalid CCB_ADAPTER value
X'40' Invalid station ID
X'4B' Station closed without remote acknowledgment
X'4C' Sequence error—cannot close while commands are outstanding

Hex 1B
DLC.CONNECT.STATION

Function: Start or complete a SABME-UA exchange to place both the local and remote link stations in a data transfer state. This is the first time ring activity takes place between two devices.

Explanation: The CCB_PARM_TAB points to a 8-byte parameter table.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'02' Duplicate command—one already outstanding
X'04' Adapter closed—should be open
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'0B' Command canceled—adapter closed while command in process
X'1B' The CCB_PARM_TAB pointer is invalid
X'1C' A pointer in CCB Parm table is invalid
X'1D' Invalid CCB_ADAPTER value
X'40' Invalid station ID
X'41' Protocol error—link in invalid state for command
X'44' Invalid routing information field length
X'4A' Sequence error—incompatible command in progress
X'4D' Unsuccessful link station connection attempt

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	STATION_ID	2	DW	Link station ID to be connected
2		2	DB	Reserved
4	ROUTING_ADDR	4	DD	Address in IBM PC memory of 18 bytes of token-ring network routing information

STATION _ID

Explanation: The station ID of the link station in the local adapter.

ROUTING _ADDR

Explanation: If the remote partner for this link station is on a different ring, routing information is necessary for frames to be exchanged. If the link station has been established because of a DLC.OPEN.STATION command, the routing information must be provided with this command. If the link station was established because of receipt of a SABME from the remote partner, the adapter will obtain the routing information from the received frame and ignore any provided with this command. The DLC.CONNECT.STATION command may also be used to provide new routing information if there is a link failure. The information must be provided in the format in which it will be used in transmitted frames. If this field is set to zero, or if the length field of the routing information control block is zero, and no SABME is outstanding, the remote partner will be assumed to be on the same ring. Refer to the *IBM Token-Ring Network Architecture Reference* for more about routing information and XID. Also, refer to any documentation related to implementation by bridges in your network.

Hex 1D
DLC.FLOW.CONTROL

Function: Control the flow of data across a specified link station on a SAP, or every link station on a SAP by setting and resetting a local busy status. See "Link Station States" on page 3-8.

Explanation: The CCB_PARM_TAB field at offset 12 is defined for this command as a double word (DW) for the 2-byte STATION_ID and as 2 bytes (DB) for the 1-byte FLOW_CONTROL (option bits) and 1 reserved byte.

STATION _ID

Explanation: The first 2 bytes of the CCB_PARM_TAB parameter contain either the STATION_ID of a specific link station on a SAP or the STATION_ID of a SAP. If the ID is a SAP ID, all the link stations on the SAP are affected. If the ID is a link station ID, only that specific station is controlled.

FLOW _CONTROL

Explanation: Contains bits that define options. Bit 7 is the high-order bit (leftmost bit position).

- Bit 7: Used to set/reset a local busy state
  - If this bit is off (0), then the link station will enter the "local busy" state (Bit 6 is ignored).
  - If this bit is on (1), then the local busy state is reset based on the condition of bit 6.
- Bit 6: Used to indicate the type of "local busy" state which is being reset (bit 7 = 1).
  - If this bit is off (0), it indicates a "user-set" local busy state is to be reset.
  - If this bit is on (1), it indicates a local busy state caused by either an

"out-of-receive-buffers" state, or "no receive command outstanding" state, will be reset.

- Bits 0 - 5: Reserved.

  Should be set to zeros, but are not checked by the adapter.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'0B' Command canceled—adapter closed while command in process
X'1D' Invalid CCB_ADAPTER value
X'40' Invalid station ID

Hex 1C
DLC.MODIFY

Function: Modify certain work values of an open link station or the default values of a SAP.

Explanation: This command allows altering the values without the need to close and reestablish the SAP and links. The values to be modified are contained in the parameter table pointed to by the CCB_PARM_TAB field of the CCB.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'07' Command canceled—unrecoverable failure
X'08' Unauthorized access priority
X'09' Adapter not initialized—should be initialized
X'0B' Command canceled—adapter closed while command in process
X'1B' The CCB_PARM_TAB pointer is invalid
X'1D' Invalid CCB_ADAPTER value
X'40' Invalid station ID
X'42' Parameter exceeded maximum allowed
X'45' Requested group membership in non-existent Group SAP
X'49' Group SAP has reached maximum membership
X'4E' Member SAP not found in Group SAP list

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0		2	DW	Reserved
2	STATION_ID	2	DW	SAP station or link station ID
4	TIMER_T1	1	DB	T1 value (response timer)
5	TIMER_T2	1	DB	T2 value (acknowledgment timer)
6	TIMER_TI	1	DB	Ti value (inactivity timer)
7	MAXOUT	1	DB	Maximum transmits without a receive acknowledgment
8	MAXIN	1	DB	Maximum receives without a transmit acknowledgment
9	MAXOUT_INCR	1	DB	Dynamic window increment value
10	MAX_RETRY_CNT	1	DB	N2 value
11		3	DB	Reserved
14	ACCESS_PRIORITY	1	DB	Ring access priority
15		4	DB	Reserved
19	GROUP_COUNT	1	DB	Length of data in GROUP_LIST
20	GROUP_LIST	4	DD	Address of a list of Group SAP numbers

STATION _ID

Explanation: The link station ID whose working values are to be changed or the SAP ID whose defaults are to be changed.

TIMER _T1

Explanation: Specifies the time period between 1 and 10 used to determine an inoperative condition on a link. The time intervals are defined by the DIR.OPEN.ADAPTER command. If the value is zero, the current value will remain.

TIMER _T2

Explanation: Specifies the time period between 1 and 10 used to delay transmission of an acknowledgment for a received I-LPDU for a link station being modified in this SAP. The time intervals are defined by the DIR.OPEN.ADAPTER command. If the value is zero, the current value will remain. If the value is greater than 10, the timer will not be used.

TIMER _Ti

Explanation: Specifies the time period between 1 and 10 used to determine an inactive condition on a link. The time intervals are defined by the DIR.OPEN.ADAPTER command. If the value is zero, the current value will remain.

MAXOUT

Explanation: Specifies the maximum number of sequentially numbered transmitted I-LPDUs that the link station using this SAP may have outstanding at any one time. The maximum valid value is 127. If the value is zero, the current value will remain.

MAXIN

Explanation: Specifies the maximum number of sequentially numbered received I-LPDUs that the link station using this SAP may receive prior to sending an acknowledgment. The maximum valid value is 127. If the value is zero, the current value will remain.

MAXOUT _INCR

Explanation: This dynamic window increment value is used to reduce bridge congestion. If the two end points of the link are on different rings, and the adapter detects an error condition requiring retransmission, the MAXOUT parameter will be set to 1. It will then be incremented by 1 each time MAXOUT_INCR frames are acknowledged by the remote station, until it reaches the application-requested value. For more details, see the *IBM Token-Ring Network Architecture Reference*. If the value is zero, the current value will remain.

MAX _RETRY_CNT

Explanation: Specifies the number of retries for an unacknowledged command LPDU, or in the case of an I-LPDU timeout, the number of times that the non-responding remote link station will be polled with an RR/RNR command LPDU. This count is used in conjunction with the Response Timer and should be great enough to ensure time for ring error detection and recovery. This parameter prevents continual retransmission of the same I frame. The maximum valid value is 255. If the value is zero, the current value will remain.

ACCESS _PRIORITY

Explanation: The transmit access priority value to be placed in the AC byte of all transmissions from the SAP or link station. The format is B'nnn00000', where 'nnn' is the access priority value. If the access priority is higher than authorized for the adapter, the command will terminate with a CCB_RETCODE of X'08' (unauthorized access priority).

GROUP _COUNT

Explanation: The number, from 0 to 13, of group SAPs as defined by the GROUP_LIST field.

GROUP _LIST

Explanation: This field may be used either to request membership in additional group SAPs for an individual SAP, or to request that membership be canceled. The GROUP_COUNT parameter indicates the number of valid values in this field. If the low-order bit of a SAP value is zero, additional membership is requested. If the low-order bit of a SAP value is one, membership is canceled.

This field is ignored if the GROUP_COUNT parameter is zero.

Hex 15
DLC.OPEN.SAP

Function: This command activates a SAP and reserves a number of link stations for the SAP.

Explanation: This command can be used to define:

- An individual SAP
- A group SAP
- A SAP as a member of a group.

The application program is responsible for checking that the parameters are reasonable.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'06' Option(s) invalid, or incompatible
X'07' Command canceled—unrecoverable failure
X'08' Unauthorized access priority
X'09' Adapter not initialized—should be initialized
X'0B' Command canceled—adapter closed while command in process
X'16' Requested buffer size exceeds pool length
X'18' Invalid buffer length
X'1B' The CCB_PARM_TAB pointer is invalid
X'1C' A pointer in CCB Parm table is invalid
X'1D' Invalid CCB_ADAPTER value
X'42' Parameter exceeded maximum allowed
X'43' Invalid SAP_VALUE or value already in use
X'45' Requested group membership in non-existent Group SAP
X'46' Resources not available
X'49' Group SAP has reached maximum membership

If the return code is X'45' or X'49', the SAP has been opened, but there has been some problem with the GROUP_LIST parameter.

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	STATION_ID	2	DW	SAP station ID (X'nn00') *
2	USER_STAT_VALUE	2	DW	User value passed back on DLC status
4	TIMER_T1	1	DB	T1 value (response timer)
5	TIMER_T2	1	DB	T2 value (acknowledgment timer)
6	TIMER_TI	1	DB	Ti value (inactivity timer)
7	MAXOUT	1	DB	Maximum transmits without a receive acknowledgment
8	MAXIN	1	DB	Maximum receives without a transmit acknowledgment
9	MAXOUT_INCR	1	DB	Dynamic window increment value
10	MAX_RETRY_CNT	1	DB	N2 value
11	MAX_MEMBERS	1	DB	Maximum SAPs for a group SAP
12	MAX_I_FIELD	2	DW	Maximum received information field
14	SAP_VALUE	1	DB	SAP value to be assigned
15	OPTIONS_PRIORITY	1	DB	SAP options and ring access priority
16	STATION_COUNT	1	DB	Number of link stations to reserve
17		2	DB	Reserved
19	GROUP_COUNT	1	DB	Length of data in GROUP_LIST
20	GROUP_LIST	4	DD	Address of a list of Group SAP numbers
24	DLC_STATUS_EXIT	4	DD	I/O appendage exit - DLC status change
28	DLC_BUF_SIZE	2	DW	Size of buffers in pool
30	DLC_POOL_LEN	2	DW	Length of pool buffer
32	DLC_POOL_ADDR	4	DD	Starting address of buffer pool

* Indicates a returned value set by the adapter.

STATION _ID

Explanation: The STATION ID returned by the adapter. This value is used to identify this SAP in subsequent commands.

USER _STAT_VALUE

Explanation: On entry to the DLC status appendage (defined by parameter DLC_STATUS_EXIT), this value is passed back to the user in register SI.

TIMER _T1

Explanation: Specifies the time period between 1 and 10 used to determine an inoperative condition on a link. The time intervals are defined by the DIR.OPEN.ADAPTER command. If the value is zero, the default of 5 is used.

TIMER _T2

Explanation: Specifies the time period between 1 and 10 used to delay transmission of an acknowledgment for a received I-LPDU for a link station in this SAP. The time intervals are defined by the DIR.OPEN.ADAPTER command. If the value is zero, the default of 2 is used. If the value is greater than 10, the timer will not be used.

TIMER _Ti

Explanation: Specifies the time period between 1 and 10 used to determine an inactive condition on a link. The time intervals are defined by the DIR.OPEN.ADAPTER command. If the value is zero, the default of 3 is used.

MAXOUT

Explanation: Specifies the maximum number of sequentially numbered transmitted I-LPDUs that the link station(s) using this SAP may have outstanding at any time. The maximum valid value is 127. If the value is zero, the default of 2 is used.

MAXIN

Explanation: Specifies the maximum number of sequentially numbered received I-LPDUs that the link station using this SAP may have prior to sending an acknowledgment. The maximum valid value is 127. If the value is zero, the default of 1 is used.

MAXOUT _INCR

Explanation: This dynamic window increment value is used to reduce bridge congestion. If the two end points of the link are on different rings, and the adapter detects an error condition requiring retransmission, the MAXOUT parameter will be set to 1. It will then be incremented by 1 each time MAXOUT_INCR frames are acknowledged by the remote station, until it reaches the application-requested value. For more details, see the *IBM Token-Ring Network Architecture Reference.* If the value is zero, the default of 1 is used.

MAX _RETRY_CNT

Explanation: Specifies the number of retries for an unacknowledged command LPDU, or in the case of an I-LPDU timeout, the number of times that the non-responding remote link station will be polled with an RR/RNR command LPDU. This count is used in conjunction with the Response Timer and should be great enough to ensure time for ring error detection and recovery. This parameter prevents continual retransmission of the same I frame. The maximum valid value is 255. If the value is zero, the default of 8 is used.

MAX _MEMBERS

Explanation: The maximum number of individual SAPs that may be assigned membership in the group SAP if this SAP is to be a group SAP as well as an individual SAP. Membership in the group SAP is assigned as the member SAPs are opened. This parameter may not exceed the similar parameter provided with the DIR.OPEN.ADAPTER command and will default to that value if this parameter is zero.

MAX _I_FIELD

Explanation: This parameter applies to the information field in received I frames for link stations, and will be ignored if STATION_COUNT is zero. If the value is zero, the default of 600 is used.

SAP _VALUE

Explanation: This is the value of the SAP to be assigned. The value must not be zero and the low-order bit must be off (B‘nnnnnnn0’). Do not use X‘00’, X‘02’, or X‘FE’.

This is the SSAP for transmitted messages and the DSAP for received messages.

OPTIONS _PRIORITY

Explanation: Various SAP options, each represented by a bit. The bit being on (value of B‘1’) indicates taking the option. The high-order bit is the leftmost bit, 7.

- Bits 7-5 are ring access priority.

The transmit access priority to be placed in the AC byte of all transmissions from the SAP. If the access priority is too high, the command will terminate with the CCB_RETCODE set to X'08' (unauthorized access priority). This value is typically B'000'.

- Bit 4 is reserved. It should be zero.

- Bit 3 is the XID handling option.

  If this bit is zero, the XID command frames are handled for this SAP by the DLC function of the adapter.

  If this bit is 1, the XID command frames for this SAP are passed to the application program.

- Bit 2 is the individual SAP bit.

  If this bit is 1, the SAP is an individual SAP.

  The STATION_COUNT parameter must be zero if bit 2 is not 1.

- Bit 1 is the group SAP bit.

  If this bit is 1, the SAP is a group SAP.

- Bit 0 is the member of a group SAP bit.

  If this bit is 1, the SAP is a member of a group SAP. See the GROUP_COUNT and GROUP_LIST parameters.

  At least one of the bits 0, 1, and 2 must be on. Bit 0 can be on only if bit 2 is on.

STATION _COUNT

Explanation: The number of link stations to reserve. This parameter is to provide link station resources so that subsequent DLC.OPEN.STATION commands may be issued.

If the requested number of stations is not available, the command will terminate with a CCB_RETCODE of X'46' (resources not available).

If the value is zero, no station may be opened for the SAP.

GROUP _COUNT

Explanation: The number, from 0 to 8, of group SAPs that this SAP will have membership in as defined in the GROUP_LIST field.

GROUP _LIST

Explanation: This field points to a list of group SAP_VALUES. The GROUP_COUNT parameter indicates the number of valid values in this field.

This field is ignored if the GROUP_COUNT parameter is zero.

DLC _STATUS_EXIT

Explanation: This field points to the beginning of an appendage routine provided by the application program. This routine will receive control whenever DLC status changes for this SAP.

DLC _BUF_SIZE

Explanation: The size of the buffers in the SAP buffer pool. This is the size in multiples of 16 with a minimum of 80 of the entire buffer including all adapter overhead. If this value is zero, the default of 160 is used.

DLC _POOL_LEN

Explanation: The number of 16-byte blocks in the SAP buffer pool.

If this value is zero, the default of 256 (4096 bytes) is used. If the DLC_POOL_ADDR is zero, this parameter is ignored.

DLC _POOL_ADDR

Explanation: The starting address in IBM PC memory where the adapter is to build the SAP buffer pool. If this value is zero, the application program has the responsibility of building the buffer pool, and the DLC_BUF_SIZE parameter must indicate that size.

Hex 19

DLC.OPEN.STATION

Function: This command allocates resources for a link station.

Explanation: The Adapter Support Interface performs functions to set up the link station in the adapter, but no ring communication takes place. A DLC.CONNECT.STATION command must be issued to either the local or remote link station by its application program to initiate ring communications. Thereafter, a DLC.CONNECT.STATION command must be issued at the other station to complete establishing the link.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'05' Required parameter(s) not provided
X'07' Command canceled—unrecoverable failure
X'08' Unauthorized access priority
X'09' Adapter not initialized—should be initialized
X'0B' Command canceled—adapter closed while command in process
X'1B' The CCB_PARM_TAB pointer is invalid
X'1C' A pointer in CCB Parm table is invalid
X'1D' Invalid CCB_ADAPTER value
X'40' Invalid STATION_ID
X'42' Parameter exceeded maximum allowed
X'43' Invalid SAP_VALUE or value already in use
X'46' Resources not available
X'4F' Invalid remote address—may not use a group address

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	SAP_STATION_ID	2	DW	SAP station ID
2	LINK_STATION_ID	2	DW	Link station ID (X'nnss') *
4	TIMER_T1	1	DB	T1 value (response timer)
5	TIMER_T2	1	DB	T2 value (acknowledgment timer)
6	TIMER_TI	1	DB	Ti value (inactivity timer)
7	MAXOUT	1	DB	Maximum transmits without a receive acknowledgment
8	MAXIN	1	DB	Maximum receives without a transmit acknowledgment
9	MAXOUT_INCR	1	DB	Dynamic window increment value
10	MAX_RETRY_CNT	1	DB	N2 value
11	RSAP_VALUE	1	DB	The remote SAP value
12	MAX_I_FIELD	2	DW	Maximum received information field
14	ACCESS_PRIORITY	1	DB	Ring access priority
15		1	DB	Reserved
16	DESTINATION_ADDR	4	DD	Pointer to remote station address

* Indicates a returned value set by the adapter.

SAP _STATION_ID

Explanation: The SAP ID value passed to the adapter.

LINK _STATION_ID

Explanation: The link station ID value assigned by the adapter.

TIMER _T1

Explanation: Specifies the time period between 1 and 10 used to determine an inoperative condition on a link. The time intervals are defined by the DIR.OPEN.ADAPTER command. If the value is zero, the default is as defined by the DLC.OPEN.SAP command.

TIMER _T2

Explanation: Specifies the time period between 1 and 10 used to delay transmission of an acknowledgment for a received I-LPDU for this SAP. The time intervals are defined by the DIR.OPEN.ADAPTER command. If the value is zero, the default is as defined by the DLC.OPEN.SAP. If the value is greater than 10, the timer will not be used.

TIMER _Ti

Explanation: Specifies the time period between 1 and 10 used to determine an inactive condition on a link. The time intervals are defined by the DIR.OPEN.ADAPTER command. If the value is zero, the default as defined by the DLC.OPEN.SAP command is used.

MAXOUT

Explanation: Specifies the maximum number of sequentially numbered transmitted I-LPDUs that the link station may have outstanding at any time. The maximum valid value is 127. If the value is zero, the default as defined by the DLC.OPEN.SAP command is used.

MAXIN

Explanation: Specifies the maximum number of sequentially numbered received I-LPDUs that the link station may have prior to sending an acknowledgment. The maximum valid value is 127. If the value is zero, the default as defined by the DLC.OPEN.SAP command is used.

MAXOUT_INCR

Explanation: This dynamic window increment value is used to reduce bridge congestion. If the two end points of the link are on different rings, and an error condition requiring retransmission is detected, the MAXOUT counter will be set to one. It will then be incremented by one each time MAXOUT_INCR frames are acknowledged by the remote station, until it reaches the value requested by the application program in the MAXOUT parameter. For more details see the *IBM Token-Ring Network Architecture Reference.* If the value is zero, the default as defined by the DLC.OPEN.SAP command is used.

MAX_RETRY_CNT

Explanation: Specifies the number of retries for an unacknowledged command LPDU, or in the case of an I-LPDU timeout, the number of times that the non-responding remote link station will be polled with an RR/RNR command LPDU. The maximum valid value is 255. If the value is zero, the default as defined by the DLC.OPEN.SAP command is used.

RSAP _VALUE

Explanation: This is the value of the remote SAP partner. It must follow the same guidelines as the SAP_VALUE parameter of the DLC.OPEN.SAP command, and it must be an individual SAP. A group SAP may not have a link station.

MAX _I_FIELD

Explanation: This parameter applies to the information field in received I frames for this link station. If the value is zero, the default is as defined by the DLC.OPEN.SAP command.

ACCESS _PRIORITY

Explanation: The ring access priority to be placed into the AC byte of all transmissions from the link station. The format is B'nnn00000', where 'nnn' is the access priority value.

If the access priority is higher than authorized for the adapter, the command will terminate with a CCB_RETCODE of X'08' (unauthorized access priority).

DESTINATION _ADDR

Explanation: This field points to a 6-byte destination NODE_ADDRESS of the remote adapter. The high-order bit must be zero.

Hex 14

DLC.RESET

Function: This command resets either one SAP and all associated link stations, or all SAPs and all associated link stations.

Explanation: The CCB_PARM_TAB field contains the STATION_ID value in the 2 high-order bytes. A STATION_ID value of X'0000' defines all SAPs and all link stations. A STATION_ID value of X'nn00' defines SAP 'nn' and all its link stations. The 2 remaining bytes are reserved.

All the outstanding commands will be terminated for the SAP(s) and station(s). All communications will cease and the SAP(s) and station(s) resources will be released. They must be reopened to be used further.

When this command is completed, all outstanding commands that were terminated may be located using the CCB_POINTER.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed–should be open
X'07' Command canceled–unrecoverable failure
X'09' Adapter not initialized–should be initialized
X'0B' Command canceled–adapter closed while command in process
X'1B' The CCB_PARM_TAB pointer is invalid
X'1D' Invalid CCB_ADAPTER value
X'40' Invalid STATION_ID

Hex 1E
DLC.STATISTICS

Function: This command reads and optionally resets the DLC logs specified. The log is transferred to the buffer indicated by the parameter table.

Explanation: For "Adapter" and "DIRECT INTERFACE" logs, see the DIR.READ.LOG command.

If the STATION.ID indicates a SAP and no link station data, this command executes totally in the IBM PC. The return code is available upon return from the software interrupt.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'0B' Command canceled—adapter closed while command in process
X'15' Lost log data due to inadequate buffer space - log reset
X'1B' The CCB_PARM_TAB pointer is invalid
X'1D' Invalid CCB_ADAPTER value
X'40' Invalid STATION_ID

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	SAP_STATION_ID	2	DW	Identify the log to read
2	LOG_BUF_LENGTH	2	DW	Size of buffer at LOG_BUFF_ADDRESS

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
4	LOG_BUF_ADDR	4	DD	Address to place the log data
8	LOG_ACT_LENGTH	2	DW	Actual length of log *
10	OPTIONS	1	DB	Command options

* Indicates a returned value set by the adapter.

STATION _ID

Explanation: The SAP or link station (X'nnss') for which the statistics are to be read (and optionally reset).

LOG _BUF_LENGTH

Explanation: The length of the buffer defined by LOG_BUF_ADDR.

LOG _BUF_ADDR

Explanation: The address in IBM PC memory of the buffer (defined by the application program) where the log data is to be placed.

LOG _ACT_LENGTH

Explanation: The value returned by the adapter of the actual length of the log that was requested. If this value is greater than the value of LOG_BUF_LENGTH, not all of the log has been transferred. CCB_RETCODE will contain X'15' (lost data).

OPTIONS

Explanation: Command options

- Bit 7 : If this bit is on, the counters will be reset to zero where appropriate.
- Bits 0 - 6 : Reserved. Should be zero, but not checked.

Log Formats

SAP log (maintained in IBM PC memory)

If the DLC.STATISTICS command request is for a SAP log (X'nn00'), or a DIRECT station log (X'00ss'), the format of the data placed in the buffer is:

Bytes 0 - 3:	Number of frames transmitted
Bytes 4 - 7:	Number of frames received
Bytes 8 -11:	Number of frames discarded (no receive command)
Bytes 12 -15:	Number of times data was lost
Bytes 16 -17:	Number of buffers available in the SAP buffer pool

LINK STATION log (maintained in the adapter)

If the DLC.STATISTICS command request is for a link station log (X'nnss'), the format of the data placed in the buffer is:

Bytes 0 - 1:	Number of I frames transmitted
Bytes 2 - 3:	Number of I frames received
Byte 4:	Number of I frames received with errors
Byte 5:	Number of I frames transmitted with error resulting

Bytes 6 - 7:	Number of times T1 expired (other than in data-transfer mode)
Byte 8:	Last command/response received
Byte 9:	Last command/response sent
Bytes 10:	Link Primary State
Bytes 11:	Link Secondary State
Bytes 12:	Send state variable
Bytes 13:	Receive state variable
Bytes 14:	Last received NR
Bytes 15:	Length of network header used in station transmissions
Bytes 16 -47:	Network header used in station transmissions

Notes:

1. *See "Link Station States" on page 3-8 and 6-73 for more about bytes 10 and 11.*

2. *For the SAP counters that are 4 bytes long, an overflow condition is not reported. For 1-byte and 2-byte counters, an overflow indication is given by a DLC status change when the counter reaches X'80' or X'8000' respectively, and the counter continues to increment.*

3. *Some values are not counters, and these are not reset when the reset option is selected.*

4. *Each value that is not a counter is in DB format as are some counters.*

Hex 28

RECEIVE

Function: Receives data for the station defined in the STATION_ID field of the CCB.

Explanation: When a receive command is issued, it is queued in the IBM PC, awaiting received data for the specified station. Multiple receive commands may be active at one time, but only one for each specific STATION_ID. Once data is received for an outstanding receive command and there are adequate receive buffers available in the pool, the following takes place:

1. The adapter will fill receive buffers from the appropriate buffer pool and place the address of the first buffer in the receive command parameter table.

2. If the optional RECEIVED_DATA user appendage is not defined or the return code is not X'00', the command will be completed in the same way as any other command. The CCB_CMD_CPLT user exit will be taken with the CCB address in registers ES and BX.

3. If the optional RECEIVED_DATA user appendage is defined and the return code is X'00', the following happens:

   a. The address of the CCB is placed in registers DS and SI.

   b. The address of the first receive data buffer is placed in registers ES and BX.

   c. The RECEIVE_DATA user appendage exit is taken.

The receive command will remain active to receive any data that follows. Therefore, once a receive command is issued for a station, it will continue to be active until terminated by an exception condition.

When a DLC.CLOSE.SAP or DLC.CLOSE.STATION is issued, the receive command associated with that SAP or station will be terminated with CCB_RETCODE X'0A' and the address of the RECEIVE command CCB will be placed in the CCB_POINTER field of the command causing the SAP or station to close. The RECEIVE command's command completion appendage is not taken.

Valid Return Codes:

X'00' Operation completed successfully

If the optional RECEIVED_DATA user appendage exit is taken, this command never actually returns a return code of X'00'. When the parameter table is passed to the appendage upon receipt of data, there is an implied return code of X'00'. The actual return code will remain X'FF' (command in process). A return code is set only when the command terminates, such as when a lost data condition occurs, or if the RECEIVED_DATA appendage is not defined.

X'01' Invalid command code
X'02' Duplicate command, one already outstanding
X'04' Adapter closed—should be open
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'0A' Command canceled by user request
X'0B' Command canceled—adapter closed while command processing
X'1A' USER LENGTH too large for buffer length
X'1B' The CCB_PARM_TAB pointer is invalid
X'1C' A pointer in CCB Parm table is invalid
X'1D' Invalid CCB_ADAPTER value

X'20' Lost data on receive—no buffers available
X'21' Lost data on receive—inadequate buffer space
X'40' Invalid STATION_ID

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	STATION_ID	2	DW	Defines the station receiving data
2	USER_LENGTH	2	DW	Length of user data in buffers
4	RECEIVED_DATA	4	DD	Optional user exit for received data
8	FIRST_BUFFER	4	DD	First receive buffer address from the adapter *
12	OPTIONS	1	DB	RECEIVE options

* Indicates a returned value set by the adapter.

STATION _ID

Explanation: Defines the station and the kind of data the station will receive. The STATION_ID is defined in "Types of Stations" on page 2-13 . It identifies the station to receive data as follows:

- X'0000' = Direct station, receive both MAC and non-MAC frames
- X'0001' = Direct station, receive MAC frames
- X'0002' = Direct station, receive non-MAC frames
- X'nn00' = SAP, receive data for SAP 'nn'
- X'nnss' = Link station, receive data for SAP 'nn', station 'ss'.

Every station that is defined to the adapter may have a RECEIVE command outstanding, but there may be only one RECEIVE command for any specific station.

Note: If no receive command is active for link station X'nnss', the frame will be received by SAP X'nn00' if it has a receive command active.

USER _LENGTH

Explanation: This field specifies the length of a user space in the buffer for private data. The data placed in the receive buffer starts at an offset specified by the ADAPTER OFFSET field of the receive buffer. The information placed in the user space is not altered by the Adapter Support Interface or the received frame data. See "Buffer Pools" on page 2-19 for the receive buffer.

RECEIVE _DATA

Explanation: The address of a user-provided appendage routine that will be taken to receive data. By coding this parameter, the application program may receive data and keep the same receive command active to receive subsequent data.

FIRST _BUFFER

Explanation: A value returned by the adapter indicating the address of the first buffer. This is the same address value that is placed in registers ES and BX. If the address is X'00000000', there is no receive data.

OPTIONS

Explanation: Options set by the application to inform the Adapter Support Interface how to present received information to the application.

- BIT 7 = CONTIGUOUS MAC

  Applicable only if the received frame is a MAC frame.

If this bit is on, the entire frame is placed into the buffers as a continuous data string.

If this bit is off, the 32-byte LAN HEADER is placed in buffer one (at offset 22) and all the received data is placed in buffer one following that.

- BIT 6 = CONTIGUOUS DATA

  Applicable only if the received frame is a non-MAC frame.

  If this bit is on, the entire frame is placed into the buffers as a continuous data string.

  If this bit is off, the 32-byte LAN HEADER is placed in buffer one (at offset 22), the DLC HEADER is placed in buffer one (at offset 54), and all the received data is placed in buffer one following that.

- BIT 5 = BREAK

  If this bit is on, the first received data is placed in the second receive buffer. The first buffer contains only the buffer header data.

- BITS 4-0 = Reserved; should be zero, but is not checked.

See "Buffer Pools" on page 2-19.

Hex 29
RECEIVE.CANCEL

Function: Cancel a receive command on any specific SAP or link station including the direct station.

Explanation: The STATION_ID specifies for which SAP or station a pending receive is to be canceled. The CCB_PARM_TAB field at offset 12 is defined for this command as a double word (DW) for the 2-byte STATION_ID and as 2 bytes (DB) for the 1-byte FLOW_CONTROL (option bits) and 1 reserved byte.

The canceled RECEIVE CCB, if there is one, is terminated with a CCB_RETCODE value of X'0A', command canceled by user request. The RECEIVE command's command completion appendage will not be taken.

The RECEIVE.CANCEL command is executed entirely in the Adapter Support Interface in the IBM PC. Therefore, the command completion appendage is not required, as the command is complete upon return from the X'5C' interrupt. However, the RECEIVE.CANCEL command's command completion appendage will be taken if provided.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'09' Adapter not initialized—should be initialized
X'1D' Invalid CCB_ADAPTER value
X'40' Invalid STATION_ID

Hex 2A
RECEIVE.MODIFY

Function: This command receives data and puts some of the data into a buffer other than the SAP buffer.

Explanation: This command operates the same as the RECEIVE command, with the following exceptions:

1. There are no options.
2. Only data (non-MAC) frames may be read.
3. Data is read into one SAP buffer and, additionally, one user buffer.
4. The format of received data (that is, the data following the DLC header) is assumed to be:

   llllhh...hhdd...dd
   where:
   - *llll* is a 2-byte field whose value is its own length (2) plus the length of the *hh...hh* field.
   - *hh...hh* is a message header.
   - *dd...dd* is message data.
5. When data is received:
   - A SAP buffer is obtained by the Adapter Support Interface.
   - The first 58 bytes of the SAP buffer are prepared exactly as when executing a RECEIVE command with the option *not continuous data.*
   - At byte 58 (plus user length, if applicable), the received *llllhh...hh* is placed into the SAP buffer. (If the data exceeds the length of the buffer, the frame is discarded by the Adapter Support Interface and no indication is given to the application program.)
   - The Adapter Support Interface calls an appendage provided by the application program with the SUBROUTINE parameter using a Call Far instruction. This appendage

will provide the length and location of an optional buffer.

6. When the Adapter Support Interface has the address and length of the additional buffer, the *dd...dd* information is placed into the buffer.
7. When the received data appendage is taken, SAP buffer bytes 6-7 (length in buffer) will be set to X'FFFF' if the received data was longer than the user's buffer. Any excess data is lost.

Valid Return Codes:

X'00' Operation completed successfully

If the optional RECEIVED_DATA user appendage exit is taken, this command never actually returns a return code of X'00'. When the parameter table is passed to the appendage upon receipt of data, there is an implied return code of X'00'. The actual return code will remain X'FF' (command in process). A return code is set only when the command terminates, such as when a lost data condition occurs, or if the RECEIVED_DATA appendage is not defined.

X'01' Invalid command code
X'02' Duplicate command, one already outstanding
X'04' Adapter closed—should be open
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'0A' Command canceled by user request
X'0B' Command canceled—adapter closed while command processing
X'1A' USER LENGTH too large for buffer length
X'1B' The CCB_PARM_TAB pointer is invalid
X'1C' A pointer in the CCB parm table is invalid
X'1D' Invalid CCB_ADAPTER value
X'20' Lost data on receive—no buffers available
X'21' Lost data on receive—inadequate buffer space
X'40' Invalid STATION_ID

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	STATION_ID	2	DW	Defines the station receiving data
2	USER_LENGTH	2	DW	Length of user data in buffers
4	RECEIVED_DATA	4	DD	Optional user exit for received data
8	FIRST_BUFFER	4	DD	First receive buffer address from the adapter *
12	SUBROUTINE	4	DD	The address of a subroutine

* Indicates a returned value set by the adapter.

STATION _ID

Explanation: Defines the station and the kind of data the station will receive. The STATION_ID is defined in "Types of Stations" on page 2-13. It identifies the station to receive data as follows:

- X'0000' = Direct station, receive non-MAC frames only
- X'0002' = Direct station, receive non-MAC frames
- X'nn00' = SAP, receive data for SAP 'nn'
- X'nnss' = Link station, receive data for SAP 'nn', station 'ss'.

Every station that is defined to the adapter may have a RECEIVE command outstanding, but there may be only one RECEIVE or RECEIVE.MODIFY command for any specific station.

USER_LENGTH

Explanation: This field specifies the length of a user space in the buffer for private data. The data placed in the receive buffer starts at an offset specified by the ADAPTER OFFSET field of the receive buffer. The information placed in the user space is not altered by the Adapter Support Interface or the received frame data. See "Buffer Pools" on page 2-19 for the receive buffer.

RECEIVE_DATA

Explanation: The address of an appendage routine provided by the application program that will be taken to receive data. By coding this parameter, the application program may receive data and keep the same receive command active to receive subsequent data.

FIRST_BUFFER

Explanation: A value returned by the adapter indicating the address of the first buffer. This is the same address value that is placed in registers ES and BX. If the address is X'00000000', there is no receive data.

SUBROUTINE

Explanation: The address of a subroutine or appendage that the Adapter Support Interface calls to obtain the address and length of the additional buffer. This field must be provided. When the SUBROUTINE is entered:

1. Registers ES and BX point to the SAP buffer.
2. Registers ES and DI point to offset 30 of the SAP buffer (the Token-Ring Network source address of the frame).

3. Registers AX and SI point to this adapter's node address in shared RAM.
4. Register CX contains the adapter number.
5. Register DX contains the number of bytes left in the frame.

When the appendage subroutine is completed, it must set the AL register and issue a Far Return instruction.

- If the AL register is set to zero, registers ES and DI point to a receive buffer and register CX indicates the length of the receive buffer.
- If the AL register is not set to zero, the Adapter Support Interface returns the SAP buffer to the pool, the received data is discarded, and the received data appendage is not taken.

  Note: If the frame is an I frame, the data is treated by the adapter's DLC logic as if it had been successfully received.

See "Buffer Pools" on page 2-19.

Hex 0A
TRANSMIT.DIR.FRAME

Function: Transmits data for the direct station.

Explanation: This command may be used only for the direct stations. It is invalid for all STATION_IDs except direct stations.

The entire transmission frame must be prepared by the application, including the LAN Header and any required data headers.

The first buffer must contain only the LAN Header. The LAN Header in the user's buffer must reserve the space for the adapter to insert the Token-Ring Network source address. The user's buffer is not altered. The adapter sets the source address into the transmit buffer in shared RAM. However, the Adapter Support Interface passes the high-order bit of the Source Address, used to indicate the presence of routing information, as supplied by the application program to the adapter. The high-order bit is loaded, as it was supplied, into shared RAM. The adapter verifies that the access priority and source class (MAC frames only) are valid. See "LAN Header" on page 2-31 for the configuration of the header.

Refer to "Transmit" on page 3-72 for information common to all transmit commands.

Hex 0B
TRANSMIT.I.FRAME

Function: Transmits "information" data for a link station.

Explanation: This command may be used only for a link station. The adapter provides the LAN header and the DLC header information. Only the actual data portion of the message is provided by the application and the maximum length is 2042 bytes.

Refer to "Transmit" on page 3-72 for information common to all transmit commands.

Transmit Completion

Under normal conditions, this command will terminate when verification of its receipt has been received from the receiving link station. Since link stations are controlled by the DLC functions of the adapter, the two adapters involved exchange DLC information to verify delivery at the link level in addition to the verification at the physical level.

1. If the return code is X'00' (operation completed successfully), and the link station's MAXOUT parameter is not a value of 1, multiple TRANSMIT.I.FRAME commands may be completed at the same time. All frames acknowledged by a specific received acknowledgment are completed at the same time. The completed TRANSMIT.I.FRAME commands will be queued in the order in which they were issued, each one pointing to the next by the CCB_POINTER field until the last CCB which has zeros in the field. The adapter will take the appendage exit of the first CCB in the queue.

2. In a case where transmit commands are queued and an abortive condition occurs, all outstanding

TRANSMIT.I.FRAME commands will be queued and ended with appropriate return codes, as described in the previous example.

3. If the return code is X'28' (invalid frame length), the link station will enter the disconnected state.

Hex 11
TRANSMIT.TEST.CMD

Function: Request the adapter to transmit a Test command frame with the poll bit set.

Explanation: This command may be used only for a SAP. The adapter provides the DLC header. The application program must provide the LAN header and the optional test information.

Refer to "Transmit" on page 3-72 for information common to all transmit commands.

Hex 0D
TRANSMIT.UI.FRAME

Function: Transmits unnumbered information data for a SAP.

Explanation: This command may be used only by a SAP. The adapter provides the DLC header information. The application must provide the LAN header and data portions of the message.

Verification that the destination adapter received the message may be checked from the FS field when the frame is removed by the transmitting adapter. However, no further receive verification takes place.

Refer to "Transmit" on page 3-72 for information common to all transmit commands.

Hex 0E

TRANSMIT.XID.CMD

Function: Transmits an XID command with the poll bit set on.

Explanation: This command may be used only by a SAP. The adapter provides the LAN header and the DLC header information. If the SAP option indicates that the adapter handles XID commands, the adapter will provide the data.

Refer to "Transmit" on page 3-72 for information common to all transmit commands.

Hex 0F

TRANSMIT.XID.RESP.FINAL

Function: Transmits an XID response with the final bit on.

Explanation: This command may be used only by a SAP opened with the SAP option specifying the application program will handle XID commands. The adapter provides the LAN header and the DLC header information.

Refer to "Transmit" on page 3-72 for information common to all transmit commands.

Hex 10

TRANSMIT.XID.RESP.NOT.FINAL

Function: Transmits an XID response with the final bit off.

Explanation: This command may be used only by a SAP opened with the SAP option specifying the application program will handle XID commands. The adapter provides the LAN header and the DLC header information.

Refer to "Transmit" for information common to all transmit commands.

Transmit

The seven transmit commands are variations of the same basic transmit command. The command completion, parameter table and field explanations, and return codes are explained here. All differences are noted with the specific command description.

Command Completion

The transmit command will terminate when the frame has gone around the ring and has been read back in by the adapter card's ring interface.

If the FS field is X'CC' (both "address recognized" and both "frame copied" bits on) and there are no other error conditions, the CCB_RETCODE will be X'00'. If the FS field is anything other than X'CC', the command will terminate with a CCB_RETCODE of X'22' (error on frame transmission - check TRANSMIT.FS data).

Valid Return Codes:

X'00' Operation completed successfully

See TRANSMIT.I.FRAME on page 3-69 for an additional explanation.

X‘01’ Invalid command code
X‘04’ Adapter closed—should be open
X‘07’ Command canceled—unrecoverable failure
X‘08’ Unauthorized access priority
X‘09’ Adapter not initialized—should be initialized
X‘0A’ Command canceled by user request
X‘0B’ Command canceled—adapter closed while command processing
X‘1D’ Invalid CCB_ADAPTER value
X‘22’ Error on frame transmission—check TRANSMIT.FS data
X‘23’ Error in frame transmit or strip process
X‘24’ Unauthorized MAC frame
X‘25’ Maximum commands exceeded
X‘27’ Link not transmitting I frames—state changed from link opened
X‘28’ Invalid transmit frame length
X‘40’ Invalid STATION_ID
X‘41’ Protocol error—link in invalid state for command
X‘44’ Invalid routing information field length
X‘4A’ Sequence error—incompatible command in process

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	STATION_ID	2	DW	Defines the station sending data
2	TRANSMIT_FS	1	DB	Stripped FS field *
3	RSAP	1	DB	Remote SAP value
4	XMIT_QUEUE_ONE	4	DD	Address of the first transmit queue
8	XMIT_QUEUE_TWO	4	DD	Address of the second transmit queue
12	BUFFER_LEN_ONE	2	DW	Length of transmit buffer BUFFER_ONE

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
14	BUFFER_LEN_TWO	2	DW	Length of transmit buffer BUFFER_TWO
16	BUFFER_ONE	4	DD	The address of the first transmit buffer
20	BUFFER_TWO	4	DD	The address of the second transmit buffer

* Indicates a returned value set by the adapter.

STATION _ID

Explanation: Defines what station is sending the data. The STATION_ID is explained in“Types of Stations” on page 2-13 . It identifies the station that is to transmit data as follows:

- X‘0000’ = Direct station, transmit both MAC and non-MAC frames (TRANSMIT.DIR.FRAME only)
- X‘0001’ = Direct station, transmit both MAC and non-MAC frames (TRANSMIT.DIR.FRAME only)
- X‘0002’ = Direct station, transmit both MAC and non-MAC frames (TRANSMIT.DIR.FRAME only)
- X‘nn00’ = SAP, transmit data for SAP ‘nn’ (Any transmit except TRANSMIT.DIR.FRAME and TRANSMIT.I.FRAME)
- X‘nnss’ = Link station, transmit data for SAP ‘nn’, station ‘ss’. (Transmit.I.FRAME only)

Note: A station may have more than one TRANSMIT command outstanding at one time. The Adapter Support Interface will stack TRANSMIT commands.

TRANSMIT _FS

Explanation: This is the FS field as returned by the adapter. It is a copy of the FS field after the frame has gone around the ring and has been read back by the ring interface of the adapter. See "Frame Status" on page 7-44.

The TRANSMIT_FS field can be interrogated for the reason for transmission failure if the command terminates with CCB_RETCODE of X'22'.

This field is not returned by the adapter when the transmit command is for a link station, because all transmission retry is handled by the link facilities on the adapter card. The FS field is explained in the *IBM Token-Ring Network Architecture Reference.*

RSAP

Explanation: The SAP_VALUE of the remote SAP that the sending (local) SAP is communicating with.

This value is ignored if the sending station is a link station or a direct station.

XMIT _QUEUE_ONE

Explanation: The address of the first (or only) buffer in a queue of buffers to be transmitted. The data in all the buffers will be transmitted as one frame.

The buffers in this queue will not be released (freed) upon command completion.

This transmit queue of buffers will not be used if the value is X'00000000'.

If the NEXT BUF POINTER field of the first buffer is not zero, there are additional buffers in this XMIT_QUEUE_ONE queue.

See "Transmit Buffers" on page 2-27 for details of transmit queues and buffers.

XMIT _QUEUE_TWO

Explanation: The address of the second queue of buffers to be transmitted.

If there are buffers in XMIT_QUEUE_ONE, the data in XMIT_QUEUE_TWO buffers will be transmitted following the data in XMIT_QUEUE_ONE buffers as one frame.

The buffers in this queue will be freed upon command completion, if the return code = X'00', prior to the adapter taking the appendage exit.

This transmit queue of buffers will not be used if the value is X'00000000'.

If the NEXT BUF POINTER field of the buffer is not zero, there are additional buffers in this XMIT_QUEUE_TWO queue.

See "Transmit Buffers" on page 2-27 for details of transmit queues and buffers.

BUFFER _LEN_ONE

Explanation: The length of the transmit buffer, containing the data to be transmitted, located at the address pointed to by BUFFER_ONE field.

If this field is 0, all the following fields are ignored.

BUFFER _LEN_TWO

Explanation: The length of the transmit buffer, containing the data to be transmitted, located at the address pointed to by BUFFER_TWO field.

If this field is 0, buffer two is not used.

BUFFER _ONE

Explanation: The address of the buffer containing data to be transmitted.

The length of the buffer is defined by BUFFER_LEN_ONE.

The buffer is not used if BUFFER_LEN_ONE is 0.

See "Transmit Buffers" on page 2-27 for details of transmit queues and buffers.

BUFFER _TWO

Explanation: The address of the buffer containing data to be transmitted.

The length of the buffer is defined by BUFFER_LEN_TWO. The data is transmitted following the data in XMIT_QUEUE_ONE and XMIT_QUEUE_TWO as one frame.

The buffer is not used if BUFFER_LEN_TWO is 0.

The data follows the data in BUFFER ONE as part of the same frame.

See "Transmit Buffers" on page 2-27 for details of transmit queues and buffers.

Chapter 4. The Direct Interface

The direct interface permits control functions to be performed on the adapter using standard control blocks and parameters.

This interface provides the ability to open and close an adapter, obtain error status, and set addresses.

This interface also permits transmission of frames directly with no protocol assistance. When using the direct interface a device application program can communicate with another device and use a simple form without links and link stations. The direct interface supports three direct stations. See "Types of Stations" on page 2-13. All received frames not directed to an active SAP or link station default to the direct station.

The Command Control Block

OFF-SET	FIELD NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	CCB_ADAPTER	1	DB	Adapter 0 or 1
1	CCB_COMMAND	1	DB	Command field
2	CCB_RETCODE	1	DB	Completion code
3	CCB_WORK	1	DB	Adapter work area
4	CCB_POINTER	4	DD	Queue pointer and Adapter Support Interface work area
8	CCB_CMD_CMPL	4	DD	Command completion user appendage
12	CCB_PARM_TAB	4	--	Parameters or pointer to CCB parameter table

Figure 4-1. CCB (Command Control Block)

Refer to "The CCB" on page 2-3 for explanation of the fields.

Command Descriptions

All the commands use a control block as defined earlier. A message control block (MCB) for all NETBIOS Interface commands and a command control block (CCB) for all other commands using the DLC and direct interface. All differing uses of variables in the control block and additional control information, such as parameter tables, are included with these command descriptions.

Each command description begins with a box containing the command name. The hexadecimal number at the top of the box is the command code value. Whenever parameter tables are included, descriptions of the parameters follow the table.

Hex 0A
TRANSMIT.DIR.FRAME

Explanation: Refer to 3-68 for transmit command descriptions.

Hex 2C
DIR.CANCEL.TIMER.GROUP

Function: Cancel a group of timer commands that were previously initiated by DIR.TIMER.SET commands.

Explanation: The CCB_PARM_TAB field points to the address of a command completion appendage. All timers that have the address assigned by the DIR.TIMER.SET command that initiated the timer will be terminated with a return code of X'0A' (command canceled by user request).

When the DIR.TIMER.SET command is terminated, the command completion appendage will not be taken. The queue of all canceled command CCBs will be pointed to by the CCB_POINTER field of the DIR.CANCEL.TIMER.GROUP command.

This command is executed entirely in the Adapter Support Interface in the IBM PC. Therefore, the command completion appendage is not required, as the command is complete upon return from the X'5C' interrupt. However, the command completion appendage will be taken if provided. This command may be issued either when the adapter is open or when it is closed.

Valid Return Codes:

X'00' Operation completed successfully

X'01' Invalid command code
X'09' Adapter not initialized–should be initialized
X'1D' Invalid CCB_ADAPTER value

Hex 04
DIR.CLOSE.ADAPTER

Function: Close the adapter and terminate all ring communications or terminate the "open wrap test."

Explanation: The command will force an immediate shutdown of ring communications, and all outstanding commands will have the control block field CCB_RETCODE set with X'0B' (command canceled, adapter closed while command in process).

The CCB_POINTER field will be set with the address of a queue of CCBs that have been terminated by this command.

If the adapter was opened with a *lock* code, this command must have the same hexadecimal value in the first 2 bytes of the CCB_PARM_TAB field in order to close the adapter. If the key code is not provided or is not correct, the DIR.CLOSE.ADAPTER command will be rejected with a CCB_RETCODE of X'05' (required parameters not provided).

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed–should be open
X'05' Required parameters not provided
X'07' Command canceled–unrecoverable failure
X'09' Adapter not initialized–should be initialized
X'1D' Invalid CCB_ADAPTER value.

Hex 2B

DIR.DEFINE.MIF.ENVIRONMENT

Function: Define the environment required for a NETBIOS emulation program to operate with the Adapter Support Interface.

Explanation: This command informs the Adapter Support Interface of the interactive routines to be provided by the NETBIOS emulation program. The adapter number in the CCB must be a value from X'00' to X'03', but the environment will be defined for both Token-Ring Network PC adapters if they are installed in the IBM PC. This command will not have any effect on a PC Network Adapter if there is one installed. The command may be issued when an adapter is either open or closed. This command is executed entirely in the Adapter Support Interface in the IBM PC. Therefore, the command completion appendage is not required, as the command is complete upon return from the X'5C' interrupt. However, the command completion appendage will be taken if provided.

Note: *A NETBIOS emulation program must at some time post a completion code to the NCB (MCB) presented to it by an application program. If no command completion appendage (MCB_POST@) has been provided, the emulation program should end with an IRET instruction to return to the Adapter Support Interface which will return to the application program.*

If an appendage has been defined, the emulation program should end with the following instruction sequence to cause the Adapter Support Interface to call the appendage.

CLI	
LES BX,NCBADDR	ES AND BX POINT TO NCB
STC	SET CARRY FLAG TO INDICATE POST
RET FAR 2	RETURN (AROUND FLAGS ON STACK)

This special handling of the flags is the indication to the Adapter Support Interface that the appendage (MCB_POST@) is to be called. That appendage should end with an IRET instruction.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'1B' The CCB_PARM_TAB pointer is invalid
X'1C' A pointer in the CCB parm table is invalid

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	MCB_INPUT@	4	DD	The address of MCB module
4	MCB_OPEN@	4	DD	The address of the open module
8	MCB_CLOSE@	4	DD	The address of the close module
12	MCB_ENABLE@	4	DD	The address of the interrupt module *

* Indicates a returned value set by the adapter.

MCB _INPUT

Explanation: This field must have a value other than zero. It must contain the address of a module or routine that the Adapter Support Interface can jump to when it has determined that the control block is an MCB rather than a CCB. Registers ES and BX will point to the MCB. Register AL contains flags as defined in the PDT.TRACE CCB entry byte 1. See page 4-47.

The specified module or routine must end with an IRET instruction back to the application program that issued the MCB. It does not return to the Adapter Support Interface.

The module will be entered with the same stack used by the application program that issued the MCB. It is the responsibility of the module to return the stack and registers as they were when the module was entered. Only the return address and flags are on the stack when entered.

MCB _OPEN

Explanation: This field must have a value other than zero. It must contain the address of a module or routine that the Adapter Support Interface can call when it has opened an adapter. It does this to inform the NETBIOS emulator that the adapter is open. Registers ES and BX will point to the CCB used to open the adapter. Register CX contains the adapter number.

The specified module or routine must end with a Far Return instruction back to the Adapter Support Interface, with register AL set to indicate the return code. If the AL register is set to zero, the NETBIOS emulator indicates a good return. If AL is not zero, the DIR.OPEN command will be completed with a return code of X'10' (adapter open—NETBIOS interface not operational).

MCB _CLOSE

Explanation: This field must have a value other than zero. It must contain the address of a module or routine that the Adapter Support Interface can call when it has closed an adapter for any reason. Register CX contains the adapter number.

The specified module or routine must end with a Far Return instruction back to the Adapter Support Interface.

MCB _ENABLE

Explanation: The Adapter Support Interface will return the address of a routine that is to be called when interrupts are to be enabled.

Hex 00
DIR.INTERRUPT

Function: This command is available to force an adapter interrupt. It performs no operation. The adapter must have been initialized, but does not have to be opened for this command to be accepted.

Explanation: No parameter table is required.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'1D' Invalid CCB_ADAPTER value

Hex 20 DIR.INITIALIZE

Function: This command initializes the Adapter Support Interface areas in the IBM PC, resets all adapter tables and buffers, and directs the adapter to run the bring-up tests.

Explanation: The command resets the adapter and any commands in process will be terminated with no return code supplied.

This command must be issued before any other command may be issued. The command may be issued at any time. It will execute immediately and terminate any command in the Adapter Support Interface queue.

Note: If the application program does not have dedicated use of the adapter, a DIR.INTERRUPT command should be issued to determine if the adapter has already processed a DIR.INITIALIZE command.

The adapter's programmable timer will be started and set to interrupt the IBM PC at 100-millisecond intervals.

The command will terminate either when the adapter issues an interrupt indicating completion or when 12 seconds have expired. If 12 seconds have expired, CCB_RETCODE is set to X'07' indicating an adapter hardware failure.

No command completion appendage is needed.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code

X'02' Duplicate command—one already outstanding
X'07' Command canceled—unrecoverable failure
X'14' Invalid shared RAM segment or size
X'1B' The CCB_PARM_TAB pointer is invalid
X'1C' A pointer in CCB Parm table is invalid
X'1D' Invalid CCB_ADAPTER value.

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	BRING_UPS	2	DW	Bring-up error code *
2	SRAM_ADDRESS	2	DW	Segment value of adapter shared RAM **
4		4	--	Reserved
8	ADPTR_CHK_EXIT	4	DD	I/O appendage exit, adapter check
12	RING_STATUS_EXIT	4	DD	I/O appendage exit, ring status change
16	PC_ERROR_EXIT	4	DD	I/O appendage exit, error in IBM PC

* Indicates a returned value set by the adapter.
** If the specified value is not used the value being used is returned.

BRING _UPS

Explanation: Indicates the results of the adapter bring-up testing. If the value is not X'0000', the command will terminate with a CCB_RETCODE of X'07' (command canceled—unrecoverable failure). See "Bring-up Errors" on page 7-48 for a list of bring-up error codes and descriptions.

SRAM _ADDRESS

Explanation: This defines the IBM PC memory segment where the adapter shared RAM is to be addressed. The value should be on a 16K boundary. If the value is coded as zero, the default is used for the adapter specified and that value will be returned in this field:

For adapter 0, the segment value of X'D800'.
For adapter 1, the segment value of X'D400'.

If, when the Adapter Support Interface was loaded into the IBM PC, the operator entered a value for the *srn* field, that value will be used as the default value for the shared RAM segment.

ADPTR _CHK_EXIT

Explanation: The address of a user-provided appendage routine that will be taken when an adapter error condition is detected. If the value is zero, no exit is defined. This exit may also be overridden by the DIR.OPEN.ADAPTER command. See "Exception Indications" on page 7-45 for adapter check error codes.

RING _STATUS_EXIT

Explanation: The address of a user-provided appendage routine that will be taken when the adapter ring status changes. This exit may also be overridden by the DIR.OPEN.ADAPTER command. See "Exception Indications" on page 7-45 for ring status codes.

PC _ERROR_EXIT

Explanation: The address of a user-provided appendage routine that will be taken when the Adapter Support Interface detects an error condition in the IBM PC. This exit may also be overridden by the DIR.OPEN.ADAPTER command. See "Exception Indications" on page 7-45 for IBM PC errors.

Hex 01 DIR.MODIFY.OPEN.PARMS

Function: This command is used to modify certain values set by the DIR.OPEN.ADAPTER command.

Explanation: This command will be rejected if either a BUFFER.FREE command has been issued, or a RECEIVE command is active at the direct interface, or if a direct interface buffer pool has been defined.

After this command has been issued successfully, it may not be issued again until a DIR.RESTORE.OPEN.PARMS command has been issued and successfully completed.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'02' Duplicate command–one already outstanding
X'04' Adapter closed–should be open
X'07' Command canceled–unrecoverable failure
X'09' Adapter not initialized–should be initialized
X'16' Requested buffer size exceeds pool length
X'18' Invalid buffer length
X'1B' The CCB_PARM_TAB pointer is invalid
X'1C' A pointer in CCB Parm table is invalid
X'1D' Invalid CCB_ADAPTER value

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	DIR_BUF_SIZE	2	DW	The size of the new direct interface SAP buffers.
2	DIR_POOL_BLOCKS	2	DW	The length in 16-byte blocks, of buffers in the new direct interface buffer pool.
4	DIR_POOL_ADDRESS	4	DD	The starting segment of the new direct interface buffer pool.
8	ADPT_CHK_EXIT	4	DD	New I/O appendage exit: adapter check
12	RING_STATUS_EXIT	4	DD	New I/O appendage exit: ring status
16	PC_ERROR_EXIT	4	DD	New I/O appendage exit: error in IBM PC
20	OPEN_OPTIONS	2	DW	New options (wrap option is ignored)

See the same parameters under the DIR.OPEN.ADAPTER command description following.

Hex 03
DIR.OPEN.ADAPTER

Function: This command makes the adapter ready for either normal ring communication or an adapter wrap test. All buffers and tables will be re-initialized.

Explanation: This command may not be issued unless the adapter is in a "closed " state, such as that following a DIR.INITIALIZE or a DIR.CLOSE.ADAPTER command. No command other than a DIR.INITIALIZE is allowed until the DIR.OPEN.ADAPTER command has been completed.

The DIR.OPEN.ADAPTER parameter table has four pointers that point to function-oriented tables. These tables contain open parameters for the adapter itself, the DIRECT interface, the DLC interface, and the NETBIOS interface. See "Added NETBIOS Capabilities" on page 6-114 for using NETBIOS with the Adapter II.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'02' Duplicate command—one already outstanding
X'03' Adapter open—should be closed
X'05' Required parameter(s) not provided
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'10' Adapter open—NETBIOS interface not operational
X'12' Available work area exceeded
X'16' Requested buffer size exceeds pool length
X'18' Invalid buffer length
X'1B' The CCB_PARM_TAB pointer is invalid
X'1C' A pointer in CCB Parm table is invalid
X'1D' Invalid CCB_ADAPTER value

X'30' Inadequate receive buffers for adapter to open
X'32' Invalid NODE_ADDRESS
X'33' Invalid adapter receive buffer length defined
X'34' Invalid adapter transmit buffer length defined

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	ADAPTER_PARMS	4	DD	Pointer, adapter parameters
4	DIRECT_PARMS	4	DD	Pointer, direct interface parameters
8	DLC_PARMS	4	DD	Pointer, DLC parameters
12	MSG_PARMS	4	DD	Pointer, NETBIOS parameters

Notes:

1. ADAPTER_PARMS *and* DIRECT_PARMS *are not optional and a value of other than zero must be provided.*

2. DLC_PARMS *must be defined (not zero) if any interface other than the direct interface is to be used. If this field value is zero, the DLC and NETBIOS interfaces are not operational.*

3. MSG_PARMS . *See page 5-11 for the NETBIOS Open Parameters table. If this field value is zero, when the NETBIOS interface is used, all default values will be used.*

Adapter Parms Open Parameters

OFF-SET	PARAMETER NAME	LEN (Bytes)	8086 Type	DESCRIPTION
0	OPEN_ERROR_CODE	2	DW	Open adapter errors detected *
2	OPEN_OPTIONS	2	DW	Various options

OFF-SET	PARAMETER NAME	LEN (Bytes)	8086 Type	DESCRIPTION
4	NODE_ADDRESS	6	DB	This station's ring address **
10	GROUP_ADDRESS	4	DB	Set group address
14	FUNCTIONAL_ADDR	4	DB	Set functional address
18	NUM_RCV_BUFFERS	2	DW	Number of receive buffers
20	RCV_BUFFER_LEN	2	DW	Length of the receive buffers
22	DHB_BUFFER_LEN	2	DW	Length of the transmit buffers
24	DATA_HOLD_BUF	1	DB	Number of transmit buffers
25		1	DB	Reserved
26	LOCK_CODE	2	DW	A protection code to control closing the adapter
28	PROD_ID_ADDR	4	DD	Address of the 18-byte product ID

* Indicates a returned value set by the adapter.
** If the specified value is not used the value being used is returned.

OPEN _ERROR_CODE

Explanation: Indicates the results of the open adapter testing. If the value is not X'0000', the command will terminate with a CCB_RETCODE of X'07' (command canceled—unrecoverable failure). See "Exception Indications" on page 7-45 for open error codes.

OPEN _OPTIONS

Explanation: Various options, each defined by a bit. A bit on (1) indicates that the option is to be taken. Bit 15 is the high-order (leftmost) bit.

- **Bit 15** Wrap interface
  The adapter will not attach itself to the ring.

Instead it will cause all user transmit data to be wrapped as received data.

- **Bit 14** Disable Hard Error
  Prevents ring status changes involving "Hard Error" and "Transmit Beacon" bits from causing interrupts.

- **Bit 13** Disable Soft Errors
  Prevents ring status changes involving "Soft Error" bit from causing interrupts.

- **Bit 12** Pass Adapter MAC Frames
  Pass, as direct interface data to the IBM PC, all adapter class MAC frames that are received but not supported by the adapter. If this option is off, these frames will be ignored.

- **Bit 11** Pass Attention MAC Frames
  Pass, as direct interface data to the IBM PC, all attention MAC frames that are not equal to the previously received attention MAC frame. If this option is off, these frames will not be passed to the application program.

- **Bits 9 - 10** Reserved
  Should be zero, but are not checked by the Adapter Support Interface.

- **Bit 8** Contender
  When the contender bit is on, it allows the adapter to participate in monitor contention if the opportunity occurs. When the contender bit is off, and the need is detected by another adapter, this adapter will not participate.
  If the need for determining a new active monitor is detected by this adapter, monitor contention processing will be initiated by this adapter in either case.

- **Bit 7** Pass Beacon MAC frames
  Pass, as direct interface data to the IBM PC, the first beacon MAC frame and all subsequent

beacon MAC frames that have a change in the source address or the beacon type.

- **Bits 0 - 6** Reserved
  Should be zero, but are not checked by the Adapter Support Interface.

See the *IBM Token-Ring Network Architecture Reference* for more about ring operation.

NODE _ADDRESS

Explanation: The 6-byte specific node address of this station on the ring. The value must not be all ones. The two high-order (leftmost) bits must be B'01'. For other restrictions and details about addresses, see the *IBM Token-Ring Network Architecture Reference.* If the value is zero, the address encoded on the adapter will be the node address by default and that value will be placed in this field by the Adapter Support Interface for return to the application program.

If, when the Adapter Support Interface was loaded, the NODE_ADDRESS parameter (na0 or na1) was provided, that address will be used rather than the address provided in this parameter field. If the na0 or na1 parameter was provided as a zero, the adapter encoded address will be used instead of the address provided in this parameter field. In either case the address used will be returned in this field by the Adapter Support Interface for return to the application program. If the LOCK_CODE field is other than zero, this field will be handled as if the NODE_ADDRESS parameter (na0 or na1) was not entered.

GROUP _ADDRESS

Explanation: Sets the group address for which the adapter will receive messages. If the value is zero, no group address is set.

FUNCTIONAL _ADDR

Explanation: Sets the functional address for which the adapter will receive messages. The most significant bit and the least significant bit of this field are ignored by the adapter. If the value is zero, no functional address is set.

Note: *If the NETBIOS interface is made operational, it will re-issue a DIR.SET.FUNCTIONAL.ADDRESS command using all bits set in the current functional address and adding X'00000080' to the bits being used.*

NUM _RCV_BUFFERS

Explanation: The number of receive buffers in shared RAM needed for the adapter to open. The adapter will configure all remaining RAM as receive buffers after other memory requirements have been met. Receive buffers are chained. If the number available is less than the number requested, the DIR.OPEN.ADAPTER command will fail. If the number available is greater than the number requested, no action will occur. If this value is less than 2, the default of 8 will be used.

RCV _BUFFER_LENGTH

Explanation: The length of each of the receive buffers in the adapter shared RAM.

The value must be a multiple of 8 with 96 as minimum and 2048 as maximum. If the value is zero, the default of 112 will be used. Each buffer holds 8 fewer bytes of data then the specified size. Therefore, a buffer defined as 112 bytes long can hold only 104 bytes of data. The 8 bytes are overhead needed by the adapter.

DHB _BUFFER_LEN

Explanation: The length of each of the transmit buffers in the adapter shared RAM.

The value must be a multiple of 8 with 96 as minimum and 2048 as maximum. If the value is zero, the default of 600 will be used. Each buffer holds 6 fewer bytes of data then the specified size. Therefore, a buffer defined as 600 can hold only 594 bytes. The 6 bytes are overhead needed by the adapter.

DATA _HOLD_BUF

Explanation: This defines the number of transmit buffers in the adapter shared RAM in which the data from the IBM PC may be stored.

The adapter will accept any value between zero and 255, but the integrity of adapter operation cannot be guaranteed if the value is greater than 2. Requesting two buffers may improve adapter performance by allowing a frame to be moved into the second buffer while the adapter is transmitting from the first. However, this will reduce the storage available for receive buffers. Transmit buffers are not chained. If the value is zero, the default of 1 will be used.

LOCK _CODE

Explanation: A code provided by the application program to *lock* the adapter open. Only a DIR.CLOSE.ADAPTER command which has a matching *key* code can close the adapter. When using this feature you must make sure that the adapter is closed when the application is finished, or all application programs using the adapter must follow consistent rules about opening and closing the adapter. This field permits one application program to supervise adapter closing when more than one application or operation has access.

It is recommended that the user-application program code this field as zero.

PRODUCT _ID_ADDR

Explanation: The address in IBM PC memory where an 18-byte product ID is located.

The product ID provides indications about the IBM PC and programs used. The field must point either to a location containing all zeros, or to a product ID field prepared as follows:

Byte 0	X'01' indicates IBM PC; X'09' indicates non-IBM PC,
Byte 1	X'10'
Bytes 2-5	The machine type from the serial number tag at rear of IBM PC (the last 4 digits). Enter in EBCDIC. For example, for serial number=61382, code the field as: (F0 F0 F0 F6 F1 F3 F8 F2)
Bytes 6-17	Zero-filled

Direct Parms Open Parameters

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	DIR_BUF_SIZE	2	DW	Size of buffers in "direct" buffer pool
2	DIR_POOL_BLOCKS	2	DW	The length in 16-byte blocks, of buffers in "direct" buffer pool
4	DIR_POOL_ADDRESS	4	DD	Starting segment of "direct" buffer pool
8	ADPT_CHK_EXIT	4	DD	I/O appendage exit - adapter check
12	RING_STATUS_EXIT	4	DD	I/O appendage exit - ring status change
16	PC_ERROR_EXIT	4	DD	I/O appendage exit - error in PC
20	WORK_ADDR	4	DD	Adapter work area - segment value
24	WORK_LEN_REQ	2	DW	Adapter work area length - requested
26	WORK_LEN_ACT	2	DW	Adapter work area length - actual *

* Indicates a returned value set by the adapter.

DIR _BUF_SIZE

Explanation: The size of the entire direct station buffer including adapter overhead space. The minimum length is 80 bytes and the length must be a multiple of 16. If the value is zero, the default of 160 is used.

DIR _POOL_BLOCKS

Explanation: The number of 16-byte blocks assigned as the Direct Station buffer pool. If the value is zero, the default of 256 (4096 bytes) is used. If DIR_POOL_ADDRESS is zero, this parameter is ignored.

DIR _POOL_ADDRESS

Explanation: The segment value of the address in IBM PC memory where the Adapter Support Interface is to build the Direct Station buffer pool. See "Buffer Pools" on page 2-19. If the value is zero, the application program has the responsibility of building its own buffer pool. If this is the case, the DIR_BUF_SIZE parameter must still indicate the size of each buffer.

ADPT _CHK_EXIT

Explanation: The address of a user-provided appendage routine that will be taken when the adapter detects an error in the adapter. If the value is zero, the default is as defined by the DIR.INITIALIZE command.

RING _STATUS_EXIT

Explanation: The address of a user-provided appendage routine that will be taken when the adapter ring status changes. If the value is zero, the default is as defined by the DIR.INITIALIZE command.

PC _ERROR_EXIT

Explanation: The address of a user-provided appendage routine that will be taken when the Adapter Support Interface detects an error in the IBM PC. If the value is zero, the default is as defined by the DIR.INITIALIZE command.

WORK _ADDR

Explanation: A segment value in IBM PC memory where a work area has been allocated for the Adapter Support Interface. This value is ignored if the WORK_LEN_REQ field is zero.

WORK _LEN_REQ

Explanation: The length of the work area in IBM PC memory defined by the parameter WORK_ADDR. The length must be enough to contain all Adapter Support Interface work areas defined by the DIR.OPEN.ADAPTER parameters DLC_MAX_SAP and DLC_MAX_STATIONS. To calculate the IBM PC memory space needed, use the formula:

IBM PC RAM (bytes) =
48 (direct interface stations) plus
36 times the number of SAPs (DLC_MAX_SAP) plus
6 times the number of stations (DLC_MAX_STATIONS)

If this value is 0, the internal work area is used and the WORK_ADDR field will be ignored.

WORK _LEN_ACT

Explanation: The returned value for the length of the work area in IBM PC memory required by the Adapter Support Interface. If the actual length is greater than the work area (internal or specified), the command will terminate with the CCB_RETCODE field containing: X'12' (available work area exceeded).

ɿrms Open Parameters

ⱥRAMETER ⱥME	LEN (Bytes)	8086 Type	DESCRIPTION
.C_MAX_SAP	1	DB	Maximum number of SAPs
.C_MAX_STA	1	DB	Maximum number of link stations
.C_MAX_GSAP	1	DB	Maximum number of group SAPs
.C_MAX_GMEM	1	DB	Maximum members per group SAP
.C_T1_TICK_ONE	1	DB	DLC timer T1 interval, group one
.C_T2_TICK_ONE	1	DB	DLC timer T2 interval, group one
.C_TI_TICK_ONE	1	DB	DLC timer Ti interval, group one
.C_T1_TICK_TWO	1	DB	DLC timer T1 interval, group two
.C_T2_TICK_ONE	1	DB	DLC timer T2 interval, group two
.C_TI_TICK_ONE	1	DB	DLC timer Ti interval, group two

ɅAX_SAP

:planation: The maximum number of SAPs that n be opened at one time. The maximum value that allowable may be limited by the amount of ailable IBM PC RAM work area in the Adapter pport Interface or by the amount of adapter shared ⱥM. If the NETBIOS interface is opened, one of ɜ SAPs is required for Adapter Support Interface ɜ and therefore is unavailable for application ɔgram use. If the value is zero, the default is 2.

ɅAX_STA

:planation: The maximum number of link stations ɿt can be opened at one time. The maximum value ɿt is allowable may be limited by the amount of ailable IBM PC RAM work area in the Adapter pport Interface or by the amount of adapter shared ⱥM. If the NETBIOS interface is opened, some of ɜ link stations will be used by the SAP assigned for

Adapter Support Interface use. If the value is zero, the default is 6.

DLC _MAX_GSAP

Explanation: The maximum number of group SAPs that can be opened at one time. If the value is zero, no group SAPs are allowed.

DLC _MAX_GMEM

Explanation: The maximum number of SAPs that can be assigned to any given group.

DLC _T1_TICK_ONE

Explanation: The number of 40-millisecond intervals between timer "ticks" for the short DLC timer T1 (T1 timer values 1 - 5). If the value is zero, the default of 5 (200 - 400 milliseconds) is used.

DLC _T2_TICK_ONE

Explanation: The number of 40-millisecond intervals between timer "ticks" for the short DLC timer T2 (T2 timer values 1 - 5). If the value is zero, the default of 1 (40 - 80 milliseconds) is used.

DLC _TI_TICK_ONE

Explanation: The number of 40-millisecond intervals between timer "ticks" for the short DLC timer Ti (Ti timer values 1 - 5). If the value is zero, the default of 25 (1 - 2 seconds) is used.

DLC _T1_TICK_TWO

Explanation: The number of 40-millisecond intervals between timer "ticks" for the long DLC timer T1 (timer values 6 - 10). If the value is zero, the default of 25 (1 - 2 seconds) is used.

DLC _T2_TICK_TWO

Explanation: The number of 40-millisecond intervals between timer "ticks" for the long DLC timer T2 (timer values 6 - 10). If the value is zero, the default of 10 (400 - 800 milliseconds) is used.

DLC _TI_TICK_TWO

Explanation: The number of 40-millisecond intervals between timer "ticks" for the long DLC timer Ti (timer values 6 - 10). If the value is zero, the default of 125 (5 - 10 seconds) is used.

See page 5-11 for the NETBIOS Open Parameters table.

Hex 08

DIR.READ.LOG

Function: This command reads and resets the adapter logs. The log data is transferred to the buffer indicated in the parameter table.

Explanation: This command may be issued when the adapter is open. The logs are reset by this command. The logs are also reset by the DIR.OPEN.ADAPTER command and an adapter reset, either power-on reset or a reset initiated from the IBM PC. This command is executed entirely by the Adapter Support Interface in the IBM PC.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'0B' Command canceled—adapter closed while the command was in process.
X'13' Invalid LOG_ID
X'15' Lost log data due to inadequate buffer space - log reset
X'1B' The CCB_PARM_TAB pointer is invalid
X'1D' Invalid CCB_ADAPTER value.

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	LOG_ID	2	DW	Identify the log to read
2	LOG_BUF_LENGTH	2	DW	Size of the buffer at LOG_BUF_ADDR
4	LOG_BUF_ADDR	4	DD	Address to place log data

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
8	LOG_ACT_LENGTH	2	DW	Actual length of log *

* Indicates a returned value set by the adapter.

LOG _ID

Explanation: Identifies the log to read as follows:

- X'0000' = Adapter error log
- X'0001' = Direct interface error log
- X'0002' = Both logs

LOG _BUF_LENGTH

Explanation: The length of the buffer defined by LOG_BUF_ADDR.

LOG _BUF_ADDR

Explanation: The address in IBM PC memory of the buffer (defined by the application program) where the log data is to be placed.

LOG _ACT_LENGTH

Explanation: The actual length of the log as returned by the adapter. If this value is greater than that defined by the LOG_BUF_LENGTH parameter, the full log was not transferred. CCB_RETCODE will contain X'15' (lost data).

Log Formats

- Adapter log

  When one or more log counters reaches a maximum value, the application program ring status appendage routine will be taken with ring status indicating a counter overflow.

The information read from this log is 14 bytes long and returned to the buffer in this order:

Byte 0: Line error
Byte 1: Internal error
Byte 2: Burst error
Byte 3: A/C error
Byte 4: Abort delimiter
Byte 5: Reserved
Byte 6: Lost frame
Byte 7: Receive congestion
Byte 8: Frame copied error
Byte 9: Frequency error
Byte 10: Token error
Byte 11: Reserved
Byte 12: Reserved
Byte 13: Reserved

- Direct Interface Log

  The direct interface log consists of 18 bytes of counters, each 4 bytes long and returned to the buffer in this order:

  Byte 0- 3: Number of frames successfully transmitted
  Byte 4- 7: Number of frames received
  Byte 8-11: Number of frames discarded (no Rcv command)
  Byte 12-15: Lost data count
  Byte 16-17: Number of buffers available in buffer pool

- Both Adapter and Direct Interface logs

  Both logs will be placed in the buffer. The adapter log is first, followed by the direct interface log.

Hex 02
DIR.RESTORE.OPEN.PARMS

Function: This command is used to restore certain adapter open parameter values modified by the DIR.MODIFY.OPEN.PARMS command.

Explanation: This command is rejected with a X'06' return code if a DIR.MODIFY.OPEN.PARMS has not previously been issued and completed successfully.

No parameter table is required. The parameter table pointer is used as adapter work space.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'06' Option(s) invalid or incompatible
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'1D' Invalid CCB_ADAPTER value

Hex 07
DIR.SET.FUNCTIONAL.ADDRESS

Function: Set the functional addresses for which the adapter will receive messages.

Explanation: This command may be used to change the initial functional address values that were set with the DIR.OPEN.ADAPTER command.

The functional address bits to be changed are placed in the CCB_PARM_TAB field of the CCB. If the most significant bit of the field is off (0), the bits in the adapter functional address corresponding to the bits provided in the remainder of the CCB_PARM_TAB field are set on. If the most significant bit of the field is on (1), the bits in the adapter functional address corresponding to the bits provided in the remainder of the CCB_PARM_TAB field are reset. The least significant bit is ignored and both the least and most significant bit will always be set to zero in the adapter. For example, X'FFFFFFFF' will reset all functional address bits.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'0B' Command canceled—adapter closed while the command was in process
X'1D' Invalid CCB_ADAPTER value

Hex 06
DIR.SET.GROUP.ADDRESS

Function: Set the group address for which the adapter will receive messages.

Explanation: This command may be used to change the initial group address value that was set with the DIR.OPEN.ADAPTER command.

The group address is set in the CCB_PARM_TAB field of the CCB. If no group address is desired, set the value to X'00000000'.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed–should be open
X'07' Command canceled–unrecoverable failure
X'09' Adapter not initialized–should be initialized
X'0B' Command canceled–adapter closed while the command was in process
X'1D' Invalid CCB_ADAPTER value

Hex 2D

DIR.SET.USER.APPENDAGE

Function: Change the appendage addresses set by the DIR.OPEN.ADAPTER command.

Explanation: This command will set the appendage addresses as defined in the CCB parameter table if the CCB_PARM_TAB field value is other than zero. If the CCB_PARM_TAB field is set to zero, the appendage addresses will be restored to their values before the **last** DIR.SET.USER.APPENDAGE command was completed successfully.

This command may be issued only when the adapter is open. If the adapter was opened with an OPEN_LOCK, then this command will take no action and will complete with a return code of X'00'. This command is executed entirely in the Adapter Support Interface in the IBM PC. Therefore, the command completion appendage is not required, as the command is complete upon return from the X'5C' interrupt. However, the command completion appendage will be taken if provided.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'1B' The CCB_PARM_TAB pointer is invalid
X'1D' Invalid CCB_ADAPTER value.

CCB Parameter table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	ADPT_CHK_EXIT	4	DD	I/O appendage - adapter check
4	RING_STATUS_EXIT	4	DD	I/O appendage - ring status change
8	PC_ERROR_EXIT	4	DD	I/O appendage - error in PC

Refer to the parameter descriptions described with the DIR.OPEN.ADAPTER command beginning on page 4-16.

Hex 21

DIR.STATUS

Function: This command reads the general status information.

Explanation: The return code is available in the CCB and the status information is in the location pointed to by the CCB_PARM_TAB when the command is completed. This command is executed entirely in the Adapter Support Interface in the IBM PC. Therefore, the command completion appendage is not required, as the command is complete upon return from the X'5C' interrupt. However, the command completion appendage will be taken if provided.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'09' Adapter not initialized—should be initialized
X'0C' Command completed successfully—adapter not open
X'1B' The CCB_PARM_TAB pointer is invalid
X'1D' Invalid CCB_ADAPTER value

CCB Parameter Table

OFF-SET	PARAMETER NAME	LEN (Bytes)	8086 Type	DESCRIPTION
0	ENCODED_ADDR	6	DB	Adapter's permanent encoded address *
6	NODE_ADDRESS	6	DB	This adapter's ring address *
12	GROUP_ADDRESS	4	DB	This adapter's group address *
16	FUNCTIONAL_ADDR	4	DB	* This adapter's functional address

OFF-SET	PARAMETER NAME	LEN (Bytes)	8086 Type	DESCRIPTION
20	MAX_SAP	1	DB	* Maximum allowable SAPs
21	OPEN_SAP	1	DB	* Number of SAPs open
22	MAX_STATION	1	DB	* Maximum allowable link stations
23	OPEN_STATION	1	DB	* Number of link stations open
24	AVAIL_STATION	1	DB	* Number of link stations available
25	ADAPTER_CONFIG	1	DB	Adapter configuration *
26	MICROCODE_LEVEL	10	DB	The adapter's microcode level *
36	ADPTR_PARM_ADDR	4	DD	Shared RAM address of Adapter Parms *
40	ADAPTER_MAC_ADDR	4	DD	Shared RAM address of Adapter MAC buffer *
44	TICK_COUNTER_ADDR	4	DD	Address of the timer tick counter *
48	LAST_RING_STATUS	2	DW	Most recent ring status issued *

* All entries are returned by the Adapter Support Interface to the CCB_PARM_TAB in IBM PC memory.

ENCODED _ADDR

Explanation: The permanent address encoded on the adapter.

NODE _ADDRESS

Explanation: The adapter ring address as set by the DIR.OPEN.ADAPTER command.

GROUP _ADDRESS

Explanation: The adapter group ring address as set by the DIR.OPEN.ADAPTER command or the DIR.SET.GROUP.ADDRESS command.

FUNCTIONAL _ADDR

Explanation: The adapter functional ring address as set by the DIR.OPEN.ADAPTER command or the DIR.SET.FUNCTIONAL.ADDRESS command.

MAX _SAP

Explanation: The maximum number of SAPs allowed as set by the DIR.OPEN.ADAPTER command.

OPEN _SAP

Explanation: The number of SAPs that have been opened by DLC.OPEN.SAP commands.

MAX _STATION

Explanation: The maximum number of link stations allowed as set by the DIR.OPEN.ADAPTER command.

OPEN _STATION

Explanation: The number of link stations that have been opened by DLC.OPEN.STATION commands.

AVAIL _STATION

Explanation: The number of link stations that have not been reserved by DLC.OPEN.SAP commands.

ADAPTER _CONFIG

Explanation: The adapter configuration bits as follows:

Bit 7: PC Network Adapter card present
Bit 6: Undefined
Bit 5: Undefined
Bit 4: Undefined
Bit 3: Zero
Bit 2: Shared RAM size (0=8K, Adapter only)
(1=16K, Adapter II only)
Bit 1: Undefined
Bit 0: Undefined

MICROCODE _LEVEL

Explanation: The number representing the engineering level of the adapter microcode.

ADPTR _PARM_ADDR

Explanation: The address of an IBM PC read-only region of the adapter shared RAM containing adapter parameters. Refer to "Adapter Status Parameter Table" on page 7-43 for the parameter table layout.

TICK _COUNTER_ADDR

Explanation: The address of a 4-byte field where the number of 100 millisecond timer interrupts received from the adapter's timer since the last DIR.INITIALIZE command is being accumulated. The tick counter may be interrogated, but *should not be disturbed.*

LAST _RING_STATUS

Explanation: The most recent ring status change.

Hex 23
DIR.TIMER.CANCEL

Function: Cancel a timer that was previously initiated by a DIR.TIMER.SET command.

Explanation: The CCB_PARM_TAB field points to the address of the CCB of the DIR.TIMER.SET command that initiated the timer.

When the DIR.TIMER.CANCEL command is completed, the DIR.TIMER.SET command is also completed with a CCB_RETCODE value of X'0A' (command canceled by user request), and the DIR.TIMER.SET command completion appendage is not taken.

This command is executed entirely in the Adapter Support Interface in the IBM PC. Therefore, the command completion appendage is not required, as the command is complete upon return from the X'5C' interrupt. However, the command completion appendage will be taken if provided.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'09' Adapter not initialized—should be initialized
X'11' DIR.TIMER.SET or DIR.TIMER.CANCEL error
X'1D' Invalid CCB_ADAPTER value

Hex 22

DIR.TIMER.SET

Function: Set a special programmable timer to expire in some multiple of half-second periods from 0 to 12,000 (100 minutes).

Explanation: When the specified time expires, the command completes, with the CCB_RETCODE set to X'00'. The timer expires after the next tick if the value is set to zero.

The first 2 bytes of the CCB_PARM_TAB parameter are set to the time in half-seconds, and the next 2 bytes is the adapter timer work area.

This command may be issued any time after the adapter has been initialized while the adapter is either open or closed, but if a command follows that changes the adapter open/closed state, all outstanding timers will be canceled. The number of timers that may be set is limited only by the number of commands that may be outstanding.

This command is executed entirely in the Adapter Support Interface in the IBM PC. Therefore, the command completion appendage is not required, as the command is complete upon return from the X'5C' interrupt. However, the command completion appendage will be taken if provided.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'07' Command canceled—unrecoverable failure
X'09' Adapter not initialized—should be initialized
X'0A' Command canceled by user request
X'11' DIR.TIMER.SET or DIR.TIMER.CANCEL error
X'1D' Invalid CCB_ADAPTER value

Hex 24
PDT.TRACE.ON

Function: This command provides an interrupt trace for all adapter traffic.

Explanation: The command provides entries for the following activities:

1. Each CCB when it is issued to the adapter if the initial return code is X'FF'.

2. Each CCB completion.

3. Each MCB when issued by the application program (return code = X'FF')

4. All adapter interrupts to the IBM PC. If the interrupt is a timer interrupt only, a trace entry is not made, but the timer interrupts are counted for reporting. Then when a non-timer interrupt occurs, a timer trace entry is made containing the accumulated timer interrupts followed by a trace entry for the non-timer interrupt.

Only one trace command can be active. The trace includes all activity for either or both adapter locations. The command is terminated by either a PDT.TRACE.OFF command or an exception, when issued.

This command is executed entirely in the Adapter Support Interface in the IBM PC. Therefore, the command completion appendage is not required, as the command is complete upon return from the X'5C' interrupt. However, the command completion appendage will be taken if provided.

The CCB_ADAPTER field of the CCB may be any value between X'00' and X'03'.

The location of the trace table is pointed to by the value placed in the CCB_PARM_TAB field by the application program.

Valid Return Codes:

X'02' Duplicate command—one already outstanding
X'06' Option(s) invalid, or incompatible
X'0A' Command canceled by user request
X'1B' The CCB_PARM_TAB pointer is invalid

CCB Parameter Table

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	TABLE_LENGTH	2	DW	Length of the TRACE_TABLE
2	CURRENT_OFF	2	DB	Offset of the current trace entry *
4	START_TICK_0	4	DD	Adapter 0 timer tick count, trace start *
8	STOP_TICK_0	4	DD	Adapter 0 timer tick count, trace stop *
12	START_TICK_1	4	DD	Adapter 1 timer tick count, trace start *
16	STOP_TICK_1	4	DD	Adapter 1 timer tick count, trace stop *
20		12	--	Adapter work area
32		--	--	Trace table

* Indicates a returned value set by the adapter.

TABLE _LENGTH

Explanation: The length of the requested trace table with a minimum value of 256. The entries are 16 bytes long. If the length specified is not a multiple of 16, the last 1-15 bytes will be unused.

CURRENT _OFF

Explanation: The offset from the TRACE_TABLE value of the most recent table entry.

The table will wrap around when full. If the first entry in the table is the PDT.TRACE.ON command, the table has not wrapped.

START _TICK_0

Explanation: The value of the Adapter 0 timer tick counter, as set by the adapter, when the trace started.

Adapter ticks occur every 100 milliseconds.

STOP _TICK_0

Explanation: The value of the Adapter 0 timer tick counter, as set by the adapter, when the trace stopped.

START _TICK_1

Explanation: The value of the Adapter 1 timer tick counter, as set by the adapter, when the trace started.

STOP _TICK_1

Explanation: The value of the Adapter 1 timer tick counter, as set by the adapter, when the trace stopped.

TRACE _TABLE

Explanation: The trace table starts here. The length is defined by the TABLE_LENGTH field.

Trace Table Formats

Four trace entry formats are used and each trace entry is 16 bytes long.

The SS and SP registers point to 26 bytes of stack space used by the Adapter Support Interface when the trace entry is made.

1. **CCB Trace Entry**

Byte 0	**Byte 1**	**Byte 2**	**Byte 3**	**Bytes 4-7**
Adapter number (0/1)	Flags: 76543210	CCB Command	Return code	SS:SP registers

Bytes 8-11	**Bytes 12-15**
Address of the interrupted application code	ES:BX registers

The command code (byte 2) will be zero if not applicable. If this entry is the result of a request for data by the adapter following a Transmit CCB, the specific transmit command code will be inserted.

Byte 1: Flags:

Bit 7:	Adapter initialized
Bit 6:	Initialize in process
Bit 5:	Adapter opened
Bit 4:	Open in process
Bit 3:	SRB busy
Bit 2:	Block bit on
Bit 1:	Always 0
Bit 0:	No adapter

The ES and BX registers point to the CCB.

2. **Adapter Interrupt Trace Entry (except timer)**

Byte 0	Byte 1	Byte 2	Byte 3	Bytes 4-7
ISRP High: 76543210 and adapter number (0/1)	ISRP Low: 76543210	Command code of the interrupt	Return code	SS:SP registers

Bytes 8-11	Bytes 12-15
Address of the interrupted application code	ES:BX registers

Byte 0: Interrupt Status Register, Processor (ISRP) high and adapter number:

Bit 7:	NMI disabled (always 1)
Bit 6:	Interrupt enabled (always 1)
Bit 5:	Parity error in shared RAM

Bit 4:	Timer expired (100-millisecond programmable timer)
Bit 3:	Adapter check
Bit 2:	Shared RAM access violation
Bit 1:	Always on
Bit 0:	Adapter number (0 or 1)

Byte 1: Interrupt Status Register, Processor (ISRP) Low:

Bit 7:	Reserved
Bit 6:	Adapter check
Bit 5:	SRB response
Bit 4:	ASB free
Bit 3:	ARB command
Bit 2:	SSB response
Bit 1:	Always 0
Bit 0:	Always 0

The ES and BX registers point to the applicable CCB or buffer if the interrupt is a result of a CCB, otherwise these bytes will be zero.

3. **Adapter Timer Interrupt Trace Entry**

Byte 0	Byte 1	Byte 2-3	Bytes 4-7
ISRP High & adapter number adapter 0=X'D2' adapter 1=X'D3'	X'00'	2-byte counter: number of timer interrupts, adapter 0 and 1	SS:SP registers

Bytes 8-11	Bytes 12-15
Address of the interrupted application code	ES:BX registers

When no other interrupts are occurring, timer interrupts are maintained for reporting. The counter is updated for each timer interrupt (either adapter). The accumulated interrupts will be placed in a timer interrupt trace entry when a non-timer interrupt occurs producing another trace entry. The ES and BX registers point to the DIR.TIMER.SET CCB if this timer interrupt causes a DIR.TIMER.SET command to be completed. Otherwise, this field will be zero.

4. **MCB Trace Entry**

Byte 0	Byte 1	Byte 2-3	Bytes 4-7
X'0F' X'1F' X'2F'(see below)	Adapter number (0/1)	MCB command and return code	SS:SP registers

Bytes 8-11	Bytes 12-15
Address of the interrupted application code	ES:BX registers

The ES and BX registers point to the MCB.

When a post routine is used while trace is active, three entries are made in the trace table.

Byte 0 contains:

- X'0F' for the entry when the MCB is first issued
- X'1F' when going to the user-supplied post routine
- X'2F' when returning from the post routine.

Hex 25

PDT.TRACE.OFF

Function: This command terminates the PDT.TRACE.ON command.

Explanation: The results of the PDT.TRACE.OFF command (when successful) are:

- The PDT.TRACE.ON command's CCB_RETCODE field is set to X'0A'.
- The PDT.TRACE.OFF command's CCB_RETCODE field is set to X'00'.
- The PDT.TRACE.OFF command's CCB_POINTER field contains the address of the PDT.TRACE.ON CCB that was terminated.
- The CCB_CMD_CMPL completion exit of the PDT.TRACE.OFF command, if defined, is taken.
- The CCB_CMD_CMPL completion exit of the PDT.TRACE.ON command is ignored.

If a PDT.TRACE.ON command is not outstanding:

- The PDT.TRACE.OFF command's CCB_RETCODE field is set to X'00'.
- The PDT.TRACE.OFF command's CCB_POINTER field contains 0.
- The CCB_CMD_CMPL completion exit of the PDT.TRACE.OFF command, if defined, is taken.

This command is executed entirely in the Adapter Support Interface in the IBM PC. Therefore, the command completion appendage is not required, as the command is complete upon return from the X'5C' interrupt. However, if the command completion appendage is provided, it will be used as defined above.

Valid Return Codes:

Always X'00'

Chapter 5. The NETBIOS Interface

The NETBIOS Program can be used with either of the IBM Token-Ring PC Adapters to extend the Adapter Support Interface by permitting NETBIOS (Network Basic Input/Output System) application programs to operate with the Token-Ring Network. All the communication functions from the physical layer through the session layer are handled by the Token-Ring Network PC Adapter card, the NETBIOS Program, and Adapter Support Interface when application programs use the NETBIOS interface.

NETBIOS is a software interface between the IBM Token-Ring Network and IBM Personal Computer network programs. NETBIOS puts the features of a Token-Ring Network into a standard format.

NETBIOS places most of the responsibility for communication on the ring with the NETBIOS Program, the Adapter Support Interface, and the adapter. That burden does not need to be handled by the network application program.

Two basic types of data transfer are supported. Reliable data transfer is provided by the *session* layer. If data is lost or errors occur, the NETBIOS Program will return an error code to the NETBIOS interface. Data transfer using datagram support goes directly to the *link* layer. This type of transfer does not contain any features such as those found in the session or the transport layer.

A common use of this type of data transfer is for broadcast messages to groups of devices such as in link setup operations.

Refer to the *IBM PC Network Technical Reference* for information about PC Network program logic.

The following are needed to use NETBIOS application programs with the Token-Ring Network:

- An IBM Token-Ring Network PC Adapter card
- The Adapter Support Interface
- The NETBIOS Program

Names

You must communicate on the network by using names.

The NETBIOS Program maintains a table of names that the adapter is known by on the ring. These names are provided to the NETBIOS Program by the application program. A name can be a unique name or a group name. The adapter checks the network to verify that a unique name is not already in use at another adapter. A group name can be used by several adapters. The application program can communicate with other names that are known by the user or the application program. If the name is in the local adapter table, a session is established to the local adapter (but perhaps another application). Each adapter can hold up to 16 selectable names and one permanent node name. Each name has a length of 16 characters and all 16 are always used in a name. A permanent name is always present and consists of 10 bytes of binary zeros followed by the unique adapter NODE_ADDRESS. The next 16 names can be added to the name table.

Using Application Programs with the IBM Token-Ring Network

Application programs prepared to use the NETBIOS interface of the IBM PC Network will operate with either of the IBM Token-Ring Network PC Adapters with no changes required. See "The Sample Program Diskette" on page 2-2 to see sample program listings.

When a command completion appendage is defined for the NETBIOS interface, the appendage is pointed to by the address in the MCB_POST@ field described later in this chapter.

Modifications Required

All program updates for programs used with NETBIOS must be installed.

For instructions on obtaining more information concerning the frames that are transmitted in response to various NETBIOS commands, see Appendix C, "Obtaining Additional NETBIOS Information" on page C-1.

The Message Control Block

If the NETBIOS interface is to be used and the NETBIOS Program is loaded, the interface is operated using a control block called the Message Control Block (MCB). (The IBM Token-Ring Network PC Adapter MCB is the same as the NCB in PC Network.)

If a command is sent to the adapter through the NETBIOS interface, and required adapter initializing commands have not been previously issued, the NETBIOS Program will provide the preparatory functions automatically.

Shared RAM segment locations will be requested from the Adapter Support Interface as follows:

Adapter 0 - X'D800'
Adapter 1 - X'D400'

If these memory locations are not acceptable for your IBM PC configuration, you will have to specify others with load parameters when the Adapter Support Interface is loaded into memory, or you will have to provide a program or routine to issue DLC commands to open the adapter and select the RAM memory assignment you require. That program should be run prior to issuing commands to the NETBIOS interface. See the DIR.INITIALIZE command description beginning on page 4-10.

If a DIR.OPEN.ADAPTER command is issued by the application and the NETBIOS Program is active, it will issue a DLC.OPEN.SAP automatically. See "Added NETBIOS Capabilities" on page 6-114 for information about using the open command to provide additional sessions when the Adapter II is used.

MCB Field Explanations

The content of the first field indicates to the NETBIOS Program and Adapter Support Interface which type of interface the application program wishes to use. If the first field contains either X'00', X'01', X'02', or X'03', the block must be a CCB and either the *direct interface* or the *DLC interface* is being used. That field would be the CCB_ADAPTER field, described in"The CCB" on page 2-3 . The NETBIOS Program would pass the control block to the Adapter Support Interface to be handled as it would if the NETBIOS Program were not loaded.

If the first field contains a byte greater than X'03', the *NETBIOS interface* is being used and the control block must then be an MCB. That field would be the MCB_COMMAND field. If the NETBIOS Program had not been loaded, a return code of X'FB' (NETBIOS code not loaded in PC), will result.

The following chart shows the contents of the control block.

OFF-SET	FIELD NAME	LEN (Bytes)	8086 Type	DESCRIPTION
0	MCB_COMMAND	1	DB	Command field
1	MCB_RETCODE	1	DB	Return field
2	MCB_LSN	1	DB	Local session number
3	MCB_NUM	1	DB	Number of application name
4	MCB_BUFFER@	4	DD	Pointer to message buffer address (segment:offset)
8	MCB_LENGTH	2	DW	Buffer length (in bytes)
10	MCB_CALLNAME	16	DB	Name on local or remote NETBIOS interface. This field has a different use for the MSG.CHAIN.SEND command.
26	MCB_NAME	16	DB	Name on local NETBIOS interface
42	MCB_RTO	1	DB	Receive timeout
43	MCB_STO	1	DB	Send timeout
44	MCB_POST@	4	DD	Pointer to post routine (segment:offset)
48	MCB_LANA_NUM	1	DB	Use X'00' for the first adapter card. Use X'01' for the second adapter card.
49	MCB_CMD_CPLT	1	DB	Command status
50	MCB_RESERVE	14	DB	Reserved area for all commands except MSG.RESET

Figure 5-1. MCB (Message Control Block)

Note: Field names ending with @ indicate an address throughout this document.

MCB _COMMAND

Explanation: The command to be performed by the adapter. The high-order bit defines the wait/no-wait option.

The no-wait option allows maximum throughput.

Wait means that the NETBIOS Program will return to the application program when the adapter has completed the command. When the adapter completes the command, check either the AL register or the MCB_RETCODE field for the completion code.

No-wait means that the NETBIOS Program will return control to the application while the command is in operation and the post routine, if specified, will be given control when the adapter has completed the command. With the no-wait option, two return codes are returned. One code is returned when the command is accepted by the NETBIOS Program and the other is returned with the completion interrupt. If the first return code in the AL register is not X'00', the adapter will not proceed and therefore will not provide a second return code.

MCB _RETCODE

Explanation: The completion code as provided by the NETBIOS Program.

While the value is X'FF', the application program must not change either the control block or any data associated with the command. If the no-wait option is used without being interrupted on command completion, the MCB_CMD_CPLT field, not the MCB_RETCODE field, contains the final return code.

- Return code value of X'00' indicates successful completion of the command.

- Return code values of X'01' through X'3F' indicate terminations that are described with the various command descriptions.

- Return code values of X'40' through X'4F' indicate user errors that are described with the various command descriptions. These error codes are unique for the IBM Token-Ring PC Adapter card and might not agree with other uses of NETBIOS.

- Return code values of X'50' through X'FE' indicate an IBM PC error or an adapter card error and are described with the various command descriptions. These error codes are unique for the IBM Token-Ring PC Adapter card and might not agree with other uses of NETBIOS.

When a "no-wait" command is completed, the NETBIOS Program interrupts the user application program at the address in the MCB_POST@ field. The AL register and the MCB_RETCODE field contains the final return code.

Never program a loop on the MCB_RETCODE field looking for a command to be completed. Loop on the MCB_CMD_CPLT field.

MCB _LSN

Explanation: A 1-byte field indicating the local session number. This is the number of the session the application program has with another name on the network. This is valid only after a MSG.CALL or MSG.LISTEN command has been completed successfully. For MSG.SEND and MSG.RECEIVE commands under session support, this field must be provided. The field must be a number between X'01' and X'FE'.

This field is not used for datagram support.

MCB _NUM

Explanation: A 1-byte number provided by the NETBIOS Program after a MSG.ADD.NAME or MSG.ADD.GROUP.NAME command is executed. This number, not the name, must be used with all datagram support commands and for MSG.RECEIVE.ANY commands.

The number for the permanent node name is always X'01'. The NETBIOS Program uses a modulo 255 technique to provide numbers from X'02' to X'FE' for the remaining names.

MCB _BUFFER@

Explanation: A 4-byte field containing the address of the buffer area assigned by the application program. This field is in define double-word (DD) format (offset:segment) and must be a valid address in IBM PC memory. Refer to the *IBM PC Network Technical Reference* for information about messages and buffers.

MCB _LENGTH

Explanation: This field of 2 bytes indicates the length in bytes of the data buffer. For receive commands, the field is updated by the NETBIOS Program to indicate the number of bytes actually received. For send commands, the application program sets this field to indicate the number of bytes to be sent.

MCB _CALLNAME

Explanation: This is a 16-byte name of the remote station that the application program wants to communicate with.

For a MSG.CHAIN.SEND command, the first 6 bytes are used to specify the second buffer. The first 2 bytes are the length of the buffer and the remaining 4 bytes are the address of the buffer in IBM PC memory.

MCB _NAME

Explanation: The name that the adapter is known by on the network. The name is 16 bytes long. The permanent node name (NODE_ADDRESS encoded on the adapter card) may be used as a name. The permanent node name is 10 bytes of zeros followed by the 6 bytes of NODE_ADDRESS.

The maximum number of names that an adapter may be known by is determined by the DIR.OPEN.ADAPTER command. (The default is 17.)

MCB _RTO

Explanation: A 1-byte field used by the MSG.CALL and MSG.LISTEN commands to specify a timeout period for all receives associated with that session. The timeout value is specified in increments of 500 milliseconds. If X'00' is specified, the default is no timeout. The timeout period may be different for each session, but is fixed when the session is established. The timeout period at the other end of the session may also be different.

MCB _STO

Explanation: A 1-byte field used by the MSG.CALL and MSG.LISTEN commands to specify a timeout period for all sends associated with that session. The timeout value is specified in increments of 500 milliseconds. If X'00' is specified, the default is no timeout. The timeout period may be different for each session, but is fixed once the session is established. The timeout period at the other end of the session may also be different. Send timeouts should be used with caution because they will always end the session if they expire.

MCB _POST@

Explanation: A 4-byte field that indicates the location of the routine (appendage) in the IBM PC to be executed when the adapter has completed a command. This is used for the no-wait option commands only. This field is in define double-word (DD) format (offset:segment) and must be a valid address in IBM PC memory. Only AL, CS, ES, and BX registers are set for the MCB being completed. The post routine is called by the NETBIOS Program interrupt and should end with an interrupt return instruction. No registers have to be saved or restored by the post routine.

If the post address is all zeros, the post routine will not be called by the NETBIOS Program and the application program must check the MCB_CMD_CPLT field for a change from X'FF'.

MCB _LANA_NUM

Explanation: Defines which adapter card is to be used. Must be either X'00' to use the first (primary) adapter card (PC IO address X'0A20') or X'01' for the second (alternate) adapter card (PC IO address X'0A24'). The adapter card must have the corresponding (primary/alternate) switch set correctly. Values of X'02' and X'03' are reserved.

MCB _CMD_CPLT

Explanation: If a no-wait command was issued and the MCB_POST@ is all zeros, the command completion status is placed here by the NETBIOS Program. Otherwise, the application program must check the MCB_RETCODE field. A value of X'FF' means that the command is proceeding. Any other value indicates that the command has been completed either successfully or with an error. See "NETBIOS Interface Return Codes (MCB_RETCODE)" on page 7-29.

MCB _RESERVE

Explanation: A 14-byte reserved field. Some commands make use of this field and explanations are included with those command descriptions.

Message Parms Open Parameters

These parameters are used when the application program uses the NETBIOS interface. The parameters must be provided at open time and for each MSG.RESET command. If any of these parameters causes an error, the command will terminate with a CCB_RETCODE or MCB_RETCODE as follows:

- If a DIR.OPEN.ADAPTER command, the CCB_RETCODE is X'10' (adapter open—NETBIOS interface not operational). This can occur if the

MSG_MAX_NAMES or MSG_MAX_SESSIONS values are not less than 255, or if there is insufficient work space available to satisfy the values of MSG_STATIONS, MSG_MAX_NAMES, MSG_MAX_MCB, and MSG_MAX_SESSIONS.

- If a NETBIOS interface command, the MCB_RETCODE is X'FC' (NETBIOS interface parameters on DIR.OPEN.ADAPTER were invalid). This can occur if any of the remaining parameters are found to be invalid when the NETBIOS Program issues its DLC.OPEN.SAP command.

OFF-SET	PARAMETER NAME	LEN (Bytes)	8086 TYPE	DESCRIPTION
0		4	--	Adapter work area
4	MSG_TIMER_T1	1	DB	T1 value (response timer)
5	MSG_TIMER_T2	1	DB	T2 value (acknowledgment timer)
6	MSG_TIMER_TI	1	DB	Ti value (inactivity timer)
7	MSG_MAXOUT	1	DB	Maximum transmits without a receive acknowledgment
8	MSG_MAXIN	1	DB	Maximum receives without a transmit acknowledgment
9	MSG_MAXOUT_INCR	1	DB	Dynamic window increment value
10	MSG_MAX_RETRY	1	DB	N2 value
11		1	DB	Adapter work area
12		3		Reserved
15	MSG_ACCESS_PRI	1	DB	Ring access priority
16	MSG_STATIONS	1	DB	Maximum NETBIOS interface link stations
17		19	--	Adapter work area
36	MSG_MAX_NAMES	1	DB	Maximum names in names table
37	MSG_MAX_MCB	1	DB	Maximum outstanding MCBs
38	MSG_MAX_SESSIONS	1	DB	Maximum sessions
39	Reserved	1	DB	
40	Reserved	1	DB	
41	MSG_OPTIONS	1	DB	Various options

OFF-SET	PARAMETER NAME	LEN (Bytes)	8086 TYPE	DESCRIPTION
42	MSG_POOL_LENGTH	2	DW	Length of area at MSG_POOL_ADDRESS
44	MSG_POOL_ADDRESS	4	DD	Starting segment of Message work area
48	MSG_XMIT_TIMEOUT	1	DB	Time to wait for one query
49	MSG_SEND_COUNT	1	DB	Maximum number of times to transmit queries

MSG _TIMER_T1

Explanation: Specifies the time period between 1 and 10 used to determine an inoperative condition on a link. The time intervals are defined by the DIR.OPEN.ADAPTER command. If the value is zero, the default of 5 is used.

Note: If a session is opened and the remote node is on a different ring, the timer value is set to 5 plus the number of bridges to a maximum timer value of 10.

MSG _TIMER_T2

Explanation: Specifies the time period between 1 and 10 used to delay transmission of an acknowledgment for a received I-LPDU for link stations using this SAP. The time intervals are defined by the DIR.OPEN.ADAPTER command. If the value is zero, the default of 2 is used. If the value is greater than 10, the acknowledgment timer is not implemented and acknowledgments will be sent at the earliest opportunity. See the note under MSG_TIMER_T2 description.

MSG _TIMER_Ti

Explanation: Specifies the time period between 1 and 10 used to determine an inactive condition on a link. The time intervals are defined by the DIR.OPEN.ADAPTER command. If the value is zero, the default of 3 is used.

MSG _MAXOUT

Explanation: Specifies the maximum number of sequentially numbered transmitted I-LPDUs that a link station on the NETBIOS interface SAP may have outstanding at any one time. The maximum valid value is 127. If the value is zero, the default of 2 is used.

MSG _MAXIN

Explanation: Specifies the maximum number of sequentially numbered received I-LPDUs that a link station on the NETBIOS interface SAP may receive prior to sending an acknowledgment. The maximum valid value is 127. If the value is zero, the default of 1 is used.

MSG _MAXOUT_INCR

Explanation: This dynamic window increment value, is used to reduce bridge congestion. If the two end points of a session are on different rings, and the adapter detects an error condition requiring retransmission, the MAXOUT counter will be set to 1. It will then be incremented by one each time MAXOUT_INCR frames are acknowledged by the remote station, until it reaches the value of this field. If this field is set to a value of zero, the default of one is used. For more details, see the *IBM Token-Ring Network Architecture Reference.*

MSG _MAX_RETRY

Explanation: Specifies the number of retries for an unacknowledged command LPDU, or in the case of an I-LPDU timeout, the number of times that the non-responding remote link station will be polled with an RR/RNR command LPDU. The maximum valid value is 255. If the value is zero, the default of 8 is used.

MSG _ACCESS_PRI

Explanation: The transmit access priority value to be placed in the AC byte of all transmissions from the link station and SAP. The format is B'nnn00000', where 'nnn' is the access priority value. No checking is done and the low-order 5 bits are ignored. If the access priority is higher than allowed for the adapter, the error will be detected on the first transmission.

MSG _STATIONS

Explanation: The number of link stations that may be active at one time. This value must not exceed the value of DLC_MAX_STATIONS. During execution of a MSG.RESET command, this value must not exceed the current number of available link stations. If the value is zero, the default of 6 is used.

MSG _MAX_NAMES

Explanation: The maximum number of names that may be in the name table. The adapter itself is entered as a name, using one of the positions. The maximum valid value is 254. If the value is zero, the default of 17 is used.

MSG _MAX_MCB

Explanation: The number of MCBs that may be outstanding at one time.

Note: *This value indicates the number of "no-wait" and "wait" commands that may be issued.*

The maximum valid value is 255. If the value is zero, the default of 12 is used.

MSG _MAX_SESSIONS

Explanation: The maximum number of sessions that may be active at one time. The maximum valid value is 254. If the value is less than the value of MSG_STATIONS, the MSG_STATIONS value is used.

MSG _OPTIONS

Explanation: Various options, each represented by a bit. If the bit has a value of B'1', the option is active. The high-order bit is the leftmost bit, 7.

- Bit 7 is "auto open."

  When received by the adapter system interface, bit 7 causes a MSG.RESET command to close and then open the adapter. If bit 7 is zero, the MSG.RESET command will not perform the close and will ignore the fields containing the "number of sessions" and the "number of commands." (They remain as defined in the DIR.OPEN.ADAPTER command.)

- Bit 6 is reserved.

- Bit 5 is "this ring only"

  When this bit is set on, the NETBIOS Program will assume that all nodes are on the same ring.

- Bits 4 - 0 are reserved.

MSG _POOL_LENGTH

Explanation: The number of bytes of IBM PC memory assigned by the application for the NETBIOS interface work area pool. If the value is zero, the NETBIOS Program internal work area in IBM PC memory as defined at load time is used.

MSG _POOL_ADDRESS

Explanation: The starting address of the NETBIOS interface work area pool for the Adapter Support Interface to build tables, buffers, and control blocks. If the MSG_POOL_LENGTH value is zero, this parameter is ignored.

MSG _XMIT_TIMEOUT

Explanation: A value to define the amount of time that the NETBIOS interface will wait for a response to a private query on the network (such as an "add name query"). The value is in half-second increments. A value of 10 represents a time of 5 seconds. If the value is zero, the default of 1 (1/2 second) is used. If the value is greater than 20, 20 (10 seconds) is used.

MSG _SEND_COUNT

Explanation: A value to define the number of times that private network queries, such as an "add name query," will be transmitted for a given command. If a query is transmitted more than one time, the next one is transmitted after the MSG_XMIT_TIMEOUT expires. If the value is zero, the default of 6 is used. If the value is greater than 10, 10 is used.

NETBIOS Interface Notes

The number of stations determines how many physical nodes the adapter may establish connection with at one time.

The number of sessions determines how many different NETBIOS interface sessions may be active at one time.

There may be multiple sessions on one station.

The NETBIOS Program provides internal work area in IBM PC memory as defined at load time for buffers and work area. The application program may define its own space by properly coding the MSG_POOL_ADDRESS and MSG_POOL_LENGTH parameters.

To calculate whether additional work space in bytes is needed, use the following formula:

> 640 plus
> 20 times the maximum names (MSG_MAX_NAMES) plus
> 16 times the maximum stations (MSG_STATIONS) plus
> 40 times the maximum sessions (MSG_SESSIONS) plus
> 100 times the maximum commands (MSG_MAX_MCB) plus
> 120 times the number of transmit buffers

Note: The remainder of the defined work area is configured as transmit buffers and there must be room for at least 10.

All tables and buffers, except the receive buffers, must be in the same segment. Therefore, if these tables use more than the defined work area, the area defined by the application program must be large enough to hold all this information.

The receive buffers are allocated by the adapter from the defined work area and any application program assigned memory after all other memory requirements are complete.

Command Completion

When a valid control block is presented to the NETBIOS Program by an interrupt X'5C', the NETBIOS Program provides a return code to the IBM PC system. The command completion is handled differently for an MCB than for a CCB.

For a NETBIOS interface command using an MCB, if the command issued is a wait-type command, control is not returned to the next instruction until the adapter has completed the command. When the command does complete, the return code will be in both the AL register and the MCB_RETCODE field.

If the command is not a wait-type, the NETBIOS Program presents two return codes. An immediate return code is posted to the AL register.

If the initial return code in the AL register is other than X'00', the adapter cannot execute the command and adapter processing ends.

If the immediate return code is not a failure code, the adapter continues and provides a final return code when the adapter has finished the command.

If the MCB_POST@ field of the MCB is zero, the final return code is placed in the MCB_CMD_CPLT field, which must be checked for change by the application program.

If the application is checking the MCB_CMD_CPLT field, a change of value from X'FF' indicates command completion. This value is the final return code.

If the MCB_POST@ field is not zero, the NETBIOS Program will give control to the post routine after setting the final return code in both the AL register and the MCB_RETCODE field. The application program continues with the instruction located at the address specified by the contents of the MCB_POST@ field (the command completion appendage).

When the NETBIOS Program interrupts the application program upon command completion, the final return code may be obtained from either the AL register or the MCB_RETCODE field.

The final return code is in the MCB_CMD_CPLT field if no command completion appendage is used and in the MCB_RETCODE field if an appendage is supplied by the application program.

The NETBIOS Commands

Each command description begins with a box containing the command name. The hexadecimal number at the top of the box is the command code value. Both the wait and no-wait values are supplied when applicable. Whenever parameter tables are included, descriptions of the parameters follow the table.

Hex 36 Wait B6 Immediate

MSG.ADD.GROUP.NAME

Function: This command adds a 16-character name to the table of names. The name cannot be used by any other station across the network as a unique name, but can be added by any station as a group name. This is a name that this station will be known by.

Explanation: When the NETBIOS interface processes this command, it sends name query requests on the network. If no reply is received, the name is assumed to be unique and is added to the table of names. The adapter returns the number of the name in the MCB_NUM field. This number is used in datagram support and for MSG.RECEIVE.ANY commands.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_NAME
MCB_POST@ (If the no-wait option is used)

Fields Returned:

MCB_RETCODE
MCB_NUM
MCB_RESERVE (If error X‘4X’ or X‘FX’ occurs)

Valid Return Codes:

Immediate

X‘00’ Good return
X‘03’ Invalid command
X‘21’ Interface busy
X‘22’ Too many commands outstanding
X‘23’ Invalid number in MCB_LANA_NUM field
X‘4X’ Unacceptable ring status
X‘FX’ Adapter/PC unusual condition/error

Final

X‘00’ Good return
X‘03’ Invalid command
X‘0D’ Duplicate name in local name table
X‘0E’ Name table full
X‘15’ Name not found or cannot specify “*” or null
X‘16’ Name in use on remote NETBIOS interface
X‘19’ Name conflict detected
X‘21’ Interface busy
X‘22’ Too many commands outstanding
X‘23’ Invalid number in MCB_LANA_NUM field
X‘4X’ Unacceptable ring status
X‘FX’ Adapter/PC unusual condition/error

Hex 30 Wait   B0 Immediate

MSG.ADD.NAME

Function: This command adds a 16-character name to the table of names. The name must be unique across the network. This is a name that this station will be known by.

Explanation: When the NETBIOS interface processes this command, it sends name query requests on the network. If no reply is received, the name is assumed to be unique and is added to the table of names. The adapter returns the number of the name in the MCB_NUM field. This number is used in datagram support and for MSG.RECEIVE.ANY commands.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_NAME
MCB_POST@ (If the no-wait option is used)

Fields Returned:

MCB_RETCODE
MCB_NUM
MCB_RESERVE (If error X'4X' or X'FX' occurs)

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'03' Invalid command
X'0D' Duplicate name in local name table
X'0E' Name table full
X'15' Name not found or cannot specify "*" or null
X'16' Name in use on remote NETBIOS interface
X'19' Name conflict detected
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 10 Wait 90 Immediate

MSG.CALL

Function: This command opens a session with another name specified by the MCB_CALLNAME field using the local name specified by the supplied MCB_NAME field.

Explanation: The destination name station must have an MCB.LISTEN command outstanding in order for the session to be established. Sessions may be established with either a local or remote name. Multiple sessions may be established with the same pair of names. All send or receive commands for this session will be aborted if they are unsuccessful after the specified timeout intervals. The timeout intervals are specified in 500-millisecond units. (A value of zero means that no timeout will occur.) The system timeout intervals and retry count are constants in the NETBIOS interface. The MCB.CALL command itself aborts if unsuccessful after the system timeout interval. When the call is completed, a local session number (LSN) is assigned and used thereafter to refer to the established session.

Local session numbers (MCB_LSN) are assigned in a round-robin technique, starting from the next available value within the range of 1 to 254.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_NAME
MCB_CALLNAME
MCB_POST@ (If the no-wait option is used)
MCB_RTO (500 milliseconds increments) If the field is set at X'00', no receive timeout will occur.
MCB_STO (500 milliseconds increments) If the field is set at X'00', no send timeout will occur.

Fields Returned:

MCB_RETCODE
MCB_LSN
MCB_RESERVE (If error X'4X' or X'FX' occurs)

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'03' Invalid command
X'05' Command timed out
X'09' No resource available
X'0B' Command canceled
X'11' Local session table full
X'12' Session open rejected; no LISTEN at called name
X'14' Cannot find name called or no answer
X'15' Name not found or cannot specify "*" or null
X'18' Session ended abnormally
X'19' Name conflict detected
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 35
MSG.CANCEL

Function: This command requests that the command, whose MCB is at the address given by MCB_BUFFER, be canceled.

Explanation: Use caution when canceling a MSG.SEND command, because cancelation will always end the session.

It is not valid to cancel these commands.

- MSG.ADD.NAME
- MSG.ADD.GROUP.NAME
- MSG.DELETE.NAME
- MSG.SEND.DATAGRAM
- MSG.SEND.BROADCAST.DATAGRAM
- MSG.SESSION.STATUS
- MSG.RESET
- MSG.CANCEL
- MSG.UNLINK

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_BUFFER@ (Address of the MCB to be canceled)

Fields Returned:

MCB_RETCODE
MCB_RESERVE (If an error occurs X'4X' or X'5X')

Valid Return Codes:

X'00' Good return
X'03' Invalid command
X'23' Invalid number in MCB_LANA_NUM field
X'24' Command completed while cancel occurring

X'26' Command not valid to cancel
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 17 Wait 97 Immediate
MSG.CHAIN.SEND

Function: This command sends data to the session partner as defined by the session number in the MCB_LSN field. The data to send is in the buffer pointed to by the MCB_BUFFER@ field. Two buffers can be chained together with this command.

Explanation: The data in the second buffer is concatenated to the data in the first buffer and sent as a single message. The MCB.CALLNAME field is used to specify the length and address of the second buffer. The length is specified in the first 2 bytes and the second buffer address in the next 4 bytes. When a session is closed by the remote side, all MSG.CHAIN.SEND commands pending for the closed session will be returned with a "session closed" status. If a local MSG.HANG.UP command is issued with any pending MSG.CHAIN.SEND commands, the MSG.CHAIN.SEND commands are completed.

If a session is aborted, a "session ended abnormally" status is returned. If the MSG.CHAIN.SEND timeout expires, the session is aborted and a "command timed out" status is returned. Timeout values for the MSG.CHAIN.SEND are associated with the session when a MSG.CALL or MSG.LISTEN is issued and cannot be specified with this command.

Message size must be between 0 and 131,070 bytes long.

If more than one MSG.SEND or MSG.CHAIN.SEND is pending, the data is transmitted in a first-in first-out order within a session.

If the MSG.SEND cannot be completed for any reason, the session ends abnormally and the session is dropped. This is done to guarantee data integrity.

MSG.SEND commands without corresponding MSG.RECEIVEs at the session partner consume resources on the NETBIOS interface. It is not advisable to issue many MSG.SENDs without corresponding MSG.RECEIVEs.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_LENGTH
MCB_BUFFER@
MCB_POST@ (If the no-wait option is used)
MCB_LSN
MCB_CALLNAME (Specifies the second buffer)

- Bytes 0 - 1 = MCB_LENGTH2 DW format
- Bytes 2 - 5 = MCB_BUFFER2@ DD format

Fields Returned:

MCB_RETCODE
MCB_RESERVE (If error X'4X' or X'FX' occurs)

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'03' Invalid command
X'05' Command timed out
X'08' Illegal local session number
X'0A' Session closed
X'0B' Command canceled
X'18' Session ended abnormally

X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 31 Wait B1 Immediate

MSG.DELETE.NAME

Function: This command deletes a 16-character name from the table of names.

Explanation: If the name has active sessions when the MSG.DELETE.NAME command is issued, the name is flagged as "de-registered" and the "command completed, name has active sessions" status is returned to the user. The delete is delayed until the sessions associated with the name are closed. A de-registered name is not usable by subsequent MCBs.

If the name has only pending non-active session commands when the MSG.DELETE.NAME command is issued, the name is removed and the "command completed" status is returned to the user. The pending non-active session commands are terminated immediately with the "name was deleted" status. Non-active session commands are :

- MSG.LISTEN
- MSG.RECEIVE.ANY
- MSG.RECEIVE.DATAGRAM
- MSG.RECEIVE.BROADCAST.DATAGRAM

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_NAME
MCB_POST@ (If the no-wait option is used)

Fields Returned:

MCB_RETCODE
MCB_RESERVE (If error X'4X' or X'FX' occurs)

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'03' Invalid command
X'0F' Command complete, name has active session and is now de-registered
X'15' Name not found or cannot specify "*" or null
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 78 Wait F8 Immediate
MSG.FIND.NAME

Function: This command finds the location on the network of a 16-character name. The name is specified in the MCB_CALLNAME field.

Explanation: The adapter sends a name query request on the network. If any remote nodes have the requested name registered, they respond with an indication of how they have the name registered (unique/group).

If no response is received within the system timeout period, the adapter returns a return code of X'05' (command timed out). If responses are received, the adapter returns the number of nodes that responded, followed by the first or only LAN header from each responding node. The LAN header contains the adapter address of the remote node where the name is located. The returned data is located at the buffer address specified by the MCB_BUFFER@ field, and the MCB_LENGTH indicates the number of bytes of data stored.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_LENGTH
MCB_BUFFER@
MCB_POST@ (If the no-wait option is used)
MCB_CALLNAME

Fields Returned:

MCB_RETCODE
MCB_RESERVE (If error X'4X' or X'FX' occurs)
MCB_LENGTH

Valid Return Codes:

Immediate

X‘00’ Good return
X‘03’ Invalid command
X‘21’ Interface busy
X‘22’ Too many commands outstanding
X‘23’ Invalid number in MCB_LANA_NUM field
X‘4X’ Unacceptable ring status
X‘FX’ Adapter/PC unusual condition/error

Final

X‘00’ Good return
X‘01’ Illegal buffer length
X‘03’ Invalid command
X‘05’ Command timed out
X‘19’ Name conflict detected
X‘21’ Interface busy
X‘22’ Too many commands outstanding
X‘23’ Invalid number in MCB_LANA_NUM field
X‘4X’ Unacceptable ring status
X‘FX’ Adapter/PC unusual condition/error

Data Areas Returned

OFF-SET	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	2	DW	Number of nodes responding (will be greater than one only if used as a group name)
2	1	DB	Reserved
3	1	DB	Status: X'00' = unique name X'01' = group name
4	1	DB	The LAN header length (14 bytes if no routing information)
5	xxx	DB	The LAN header from the remote node(s) where the name is located (contains the address of the remote node)

See “LAN Header” on page 2-31 for a description of the header data.

Hex 12 Wait 92 Immediate

MSG.HANG.UP

Function: This command closes the session with another name on the network specified by the local session number.

Explanation: A "good return" status is returned when a session closes normally and a "session closed" status or an "illegal session number" is returned if the session is already closed or never existed.

When a MSG.HANG.UP command is issued to the adapter, all pending (local) MSG.RECEIVE commands are terminated and returned to the issuer with "session closed" in the MCB_RETCODE field. The termination is valid whether or not any data had been transferred by the pending command. If a local MSG.SEND command is pending, the MSG.HANG.UP command is delayed until the send has been completed. This delay is true whether or not the command has begun to transfer data, or is waiting for the remote side to issue a MSG.RECEIVE command. The MSG.HANG.UP is performed when any of the following conditions occur:

- The MSG.SEND completes.
- The MSG.SEND has aborted.
- The MSG.SEND fails because the session was terminated by the other side with a MSG.HANG.UP.
- The MSG.SEND fails because of the timeout specified when the session was opened.

If one of the above conditions does not occur within the system timeout period after the MSG.HANG.UP command is issued, the MSG.HANG.UP command is returned with a "command timed out" status and the session is aborted.

When a session closes, all MSG.SEND and MSG.RECEIVE commands pending on the closed session are returned to the user with a "session closed" status. If a MSG.RECEIVE.ANY command is pending on the local name used by the session, it is returned to the issuer with a "session closed" status. Only a single MSG.RECEIVE.ANY command will be returned even though many MSG.RECEIVE.ANY commands are pending. Even though a single MSG.RECEIVE.ANY command is returned, many MSG.SENDs or MSG.RECEIVEs can be returned when pending.

When a session is abnormally terminated, all outstanding commands on that session will be returned to the issuer with a "session ended abnormally" status.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_LSN
MCB_POST@ (If the no-wait option is used)

Fields Returned:

MCB_RETCODE
MCB_RESERVE (If error X'4X' or X'FX' occurs)

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'03' Invalid command
X'05' Command timed out
X'08' Illegal local session number
X'0A' Session closed
X'0B' Command canceled
X'18' Session ended abnormally
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 11 Wait 91 Immediate

MSG.LISTEN

Function: This command enables a session to be opened with the name specified in the MCB_CALLNAME field, using the name specified by the MCB_NAME field.

X'11' - MSG.LISTEN (wait) waits for some station to call. Use this command carefully because it does not time out and the program will hang until the command is satisfied.

X'91' - MSG.LISTEN (immediate) returns immediately and posts when a station calls.

Explanation: If the MCB_CALLNAME field has "*," a session will be established with any network node that issues a MSG.CALL to the local name.

MSG.LISTEN for a specific name has priority over a MSG.LISTEN for any name. Sessions may be established with either a local or remote name. Multiple sessions may be established with the same pair of names.

All MSG.SEND and MSG.RECEIVE commands for this session will be aborted if they are unsuccessful after the specified timeout interval. If a MSG.SEND times out, the session is abnormally terminated.

The timeout intervals are specified in 500-millisecond units. (A value of zero means that no timeout will occur.) An MSG.LISTEN command will not time out, but a MSG.LISTEN occupies a session entry and is considered a pending session in information returned in a MSG.STATUS command. Local session numbers (LSN) are assigned in a round-robin technique starting with the next available value within the range from 1 to 254. Also, if "*" is used for the called name, the name that made the call will be returned in the MCB_CALLNAME field.

The error "name conflict detected" is returned if, during the completion for a MSG.LISTEN command, a name exists in more than one table. All nodes with the name registered, except the one where the MSG.LISTEN command has returned successfully, will report the "name conflict detected" error.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_NAME
MCB_CALLNAME (This may be specified in the first byte as "*." The "*" is used to listen for a call from any name to the local name. If a name is specified in this field, it takes priority over a name of "*.")
MCB_POST@ (If the no-wait option is used)
MCB_RTO (500-millisecond increments) (If the field is set at X'00', no receive timeout will occur.)
MCB_STO (500-millisecond increments) (If the field is set at X'00', no send timeout will occur.)

Fields Returned:

MCB_RETCODE
MCB_LSN
MCB_CALLNAME (If listen any is used, specified with "*")
MCB_RESERVE (If error X'4X' or X'FX' occurs)

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status

X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'03' Invalid command
X'09' No resource available
X'0B' Command canceled
X'11' Local session table full
X'15' Name not found or cannot specify "*" or null
X'17' Name deleted
X'18' Session ended abnormally
X'19' Name conflict detected
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 15 Wait 95 Immediate

MSG.RECEIVE

Function: This command receives data from the session partner that sends data to you.

X'15' - MSG.RECEIVE : (wait) Use this command carefully because the program will stop for the duration of the timeout.

X'95' - MSG.LISTEN : (immediate) This command returns immediately and posts when the command is complete.

Explanation: If more than one MSG.RECEIVE command is outstanding, they are posted in the following order:

1. MSG.RECEIVE
2. MSG.RECEIVE.ANY for a specified name
3. MSG.RECEIVE.ANY for any name.

Once the commands are sorted, all of the MSG.RECEIVE commands are processed in a first-in, first-out order. Timeout values are specified during a MSG.CALL or MSG.LISTEN and cannot be specified with this command.

When a session is closed, either by a local session close command or by the remote side closing the session, all pending MCBs for that session are returned with a "session closed" status.

A return code of X'06' is posted in the MCB_RETCODE field if the receive buffer is not large enough for the message being received. Another receive can be issued to obtain the rest of the information before a MSG.SEND timeout occurs.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_LSN
MCB_BUFFER@
MCB_POST@ (If the no-wait option is used)
MCB_LENGTH

Fields Returned:

MCB_RETCODE
MCB_LENGTH
MCB_RESERVE (If error X'4X' or X'FX' occurs)

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'03' Invalid command
X'05' Command timed out
X'06' Message incomplete
X'08' Illegal local session number
X'0A' Session closed
X'0B' Command canceled
X'18' Session ended abnormally
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 16 Wait 96 Immediate

MSG.RECEIVE.ANY

Function: This command receives data from any session partner. You must use the name number instead of the name when issuing this command.

X'16' - MSG.RECEIVE.ANY (wait) Use this command carefully because the program will stop for the duration of the timeout.

X'96' - MSG.RECEIVE.ANY (immediate) This command returns immediately and posts when the command is complete.

Explanation: If more than one MSG.RECEIVE command is outstanding, they are posted in the following order:

1. MSG.RECEIVE
2. MSG.RECEIVE.ANY for a specified name
3. MSG.RECEIVE.ANY for any name.

If the MCB_NUM field is set to X'FF' by the application program, then the receive is for any remote name that you have a session with, for any of your names. The NETBIOS Program will set the MCB_NUM field to the number of the name for which the data was received when the return code is presented.

When a session is closed, either by a local session close command, by the remote side closing the session, or a session abort, one MSG.RECEIVE.ANY or MSG.RECEIVE name will be posted with "session closed" or "session aborted" regardless of the number of session receives that may be pending. If a MSG.RECEIVE.ANY or a MSG.RECEIVE name is pending, it will post a "session closed" with the MCB_LSN field containing the session number that closed. A MSG.RECEIVE.ANY with no name specified will post only if no MSG.RECEIVE.ANY name is pending for the session with that name.

A return code of X'06' is posted in the MCB_RETCODE field if the receive buffer is not large enough for the message being received. Another receive can be issued to obtain the rest of the information before a timeout occurs.

Application programs should use "MSG.RECEIVE.ANY to any name" with caution as this command can receive messages for other programs running in the Personal Computer.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_LENGTH
MCB_BUFFER@
MCB_POST@ (If the no-wait option is used)
MCB_NUM

Fields Returned:

MCB_RETCODE
MCB_LSN
MCB_LENGTH
MCB_RESERVE (If error X'4X' or X'FX' occurs)
MCB_NUM (If X'FF' was specified in this field)
when issued

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'03' Invalid command
X'06' Message incomplete
X'0A' Session closed
X'0B' Command canceled
X'13' Illegal name number
X'17' Name deleted
X'18' Session ended abnormally
X'19' Name conflict detected
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 23 Wait A3 Immediate
MSG.RECEIVE.BROADCAST.DATAGRAM

Function: This command receives a datagram message from any name on the network that issues a MSG.SEND.BROADCAST.DATAGRAM.

Explanation: There is no timeout associated with this command.

A "message incomplete" status is returned if the receive buffer is not large enough for the data being received. The remaining data is lost at this point.

X'23' MSG.RECEIVE.BROADCAST.DATAGRAM (wait) Use this command with care because all processing stops until the datagram is received.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_LENGTH
MCB_BUFFER@
MCB_POST@ (If the no-wait option is used)
MCB_NUM

Fields Returned:

MCB_RETCODE
MCB_RESERVE (If error X'4X' or X'FX' occurs)
MCB_LENGTH
MCB_CALLNAME

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding

X‘23’ Invalid number in MCB_LANA_NUM field
X‘4X’ Unacceptable ring status
X‘FX’ Adapter/PC unusual condition/error

Final

X‘00’ Good return
X‘03’ Invalid command
X‘06’ Message incomplete
X‘0B’ Command canceled
X‘13’ Illegal name number
X‘17’ Name deleted
X‘19’ Name conflict detected
X‘21’ Interface busy
X‘22’ Too many commands outstanding
X‘23’ Invalid number in MCB_LANA_NUM field
X‘4X’ Unacceptable ring status
X‘FX’ Adapter/PC unusual condition/error

Hex 21 Wait   A1 Immediate

MSG.RECEIVE.DATAGRAM

Function: This command receives a datagram message from any name on the network directed to the indicated application program.

Explanation: There is no timeout associated with this command. If the application program does not have a MSG.RECEIVE.DATAGRAM command outstanding when the MSG.SEND.DATAGRAM is issued at another device, data will be lost.

This command will receive a group-named datagram but not a broadcast datagram.

A "message incomplete" status is returned if the receive buffer is not large enough for the data being received. The remaining data is lost at this point.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_LENGTH
MCB_BUFFER@
MCB_POST@ (If the no-wait option is used)
MCB_NUM (If X'FF', then receive a datagram from any name on the network for any name in the local table.)

Fields Returned:

MCB_RETCODE
MCB_RESERVE (If error X'4X' or X'FX' occurs)
MCB_LENGTH
MCB_CALLNAME

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'03' Invalid command
X'06' Message incomplete
X'0B' Command canceled
X'13' Illegal name number
X'17' Name deleted
X'19' Name conflict detected
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 32
MSG.RESET

Function: This command resets the NETBIOS interface status, clears the name and session tables, and aborts all sessions.

Explanation: Other actions depend on the setting of the DIR.OPEN.ADAPTER parameter MSG_OPTION.

- If the MSG OPTION bit 7 is off (0), the number of sessions (MCB_LSN) and the number of control blocks (MCB_NUM) fields remain undisturbed. They remain as defined by the DIR.OPEN.ADAPTER command.
- If the MSG OPTION bit 7 is on (1), the adapter will be closed and reopened. When it is opened, the number of sessions (MCB_LSN) and the number of control blocks (MCB_NUM) fields are set with the new values supplied with this command.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_LSN (The number of sessions [if 0, the default is 6])
MCB_NUM (The number of MCBs [if 0, the default is 12])

Fields Returned:

MCB_RETCODE
MCB_RESERVE

Valid Return Codes:

X'00' Good return
X'03' Invalid command
X'23' Invalid number in MCB_LANA_NUM field

X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 14 Wait 94 Immediate

MSG.SEND

Function: This command sends data to the session partner as defined by the session number in the MCB_LSN field. The data to send is in the buffer pointed to by the MCB_BUFFER@ field.

Explanation: When a session is closed by the remote side, all MSG.SEND commands pending for the closed session will be returned with a "session closed" status. If a local MSG.HANG.UP command is issued with any pending MSG.SEND commands, the MSG.SEND commands are complete.

If a session aborts, a "session ended abnormally" status is returned. If the MSG.SEND timeout expires, the session is aborted and a "command timed out" status is returned. Timeout values for the MSG.SEND are associated with the session when a MSG.CALL or MSG.LISTEN was issued and cannot be specified with this command.

Message size must be between 0 and 65,535 bytes long.

If more than one MSG.SEND or MSG.CHAIN.SEND is pending, the data is transmitted in a first-in, first-out order within a session.

If the MSG.SEND cannot be completed for any reason, the session ends abnormally and the session is dropped. This guarantees data integrity.

MSG.SEND commands without corresponding MSG.RECEIVEs at the session partner consume resources on the NETBIOS interface. It is not advisable to issue many MSG.SENDs without corresponding MSG.RECEIVEs.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_LENGTH
MCB_BUFFER@
MCB_POST@ (If the no-wait option is used)
MCB_LSN

Fields Returned:

MCB_RETCODE
MCB_RESERVE (If error X'4X' or X'FX' occurs)

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'03' Invalid command
X'05' Command timed out
X'08' Illegal local session number
X'0A' Session closed
X'0B' Command canceled
X'18' Session ended abnormally
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 22 Wait A2 Immediate
MSG.SEND.BROADCAST.DATAGRAM

Function: This command sends a datagram message to every station that has a MSG.RECEIVE.BROADCAST.DATAGRAM command outstanding.

Explanation: If the remote station does not have a MSG.RECEIVE.BROADCAST.DATAGRAM command outstanding, it will not get the message. If a station issues a MSG.SEND.BROADCAST.DATAGRAM and has a MSG.RECEIVE.BROADCAST.DATAGRAM outstanding, the station will receive its own message. If a station has several broadcast messages pending, the next send command issued will satisfy all MSG.RECEIVE.BROADCAST commands.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_LENGTH
MCB_BUFFER@
MCB_POST@ (If the no-wait option is used)
MCB_NUM

Fields Returned:

MCB_RETCODE
MCB_RESERVE (If error X'4X' or X'FX' occurs)

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status

X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'01' Illegal buffer length
X'03' Invalid command
X'13' Illegal name number
X'19' Name conflict detected
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 20 Wait A0 Immediate

MSG.SEND.DATAGRAM

Function: This command sends a datagram message to any unique name or group name on the network.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_LENGTH
MCB_BUFFER@
MCB_POST@ (If the no-wait option is used)
MCB_NUM
MCB_CALLNAME

Fields Returned:

MCB_RETCODE
MCB_RESERVE (If error X'4X' or X'FX' occurs)

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'01' Illegal buffer length
X'03' Invalid command
X'13' Illegal name number
X'19' Name conflict detected
X'21' Interface busy
X'22' Too many commands outstanding

X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Hex 34 Wait B4 Immediate

MSG.SESSION.STATUS

Function: This command obtains the status of one or all sessions for a local name.

Explanation: This command will get the status for all of the names in the name table if "*" is specified in the first byte of the MCB_NAME field.

The minimum valid buffer length is 4 bytes. An "illegal buffer length" status is returned if the MCB_LENGTH field is less than 4.

A "message incomplete" status is returned if the MCB_LENGTH field is less than the status data being generated. To obtain all status data, the buffer length must be at least 36 times the number of sessions being reported plus 4.

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)
MCB_LENGTH
MCB_BUFFER@
MCB_POST@ (If the no-wait option is used)
MCB_NAME (Specify "*" for all names)

Fields Returned:

MCB_RETCODE
MCB_RESERVE (If error X'4X' or X'FX' occurs)
MCB_LENGTH

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy

X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'01' Illegal buffer length
X'03' Invalid command
X'06' Message incomplete
X'15' Name not found or cannot specify "*" or null
X'19' Name conflict detected
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Data Areas Returned

OFF-SET	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	1	DB	Number of sessions being reported
1	1	DB	Number of sessions with this name
2	1	DB	Number of MSG.RECEIVE.DATAGRAM and MSG.RECEIVE.BROADCAST.DATAGRAM commands outstanding
3	1	DB	Number of MSG.RECEIVE.ANY commands outstanding
4	1	DB	Local session number
5	1	DB	State of the session. This byte is represented as follows: Listen outstanding X'01' CALL pending X'02' Session established X'03' HANG UP pending X'04' HANG UP complete X'05' Session aborted X'06'
6	16	DB	Local name
22	16	DB	Remote name

OFF-SET	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
38	1	DB	Number of MSG.RECEIVEs outstanding
39	1	DB	Number of MSG.SEND and MSG.CHAIN.SENDs outstanding

Note: The contents of bytes 4 - 39 (36 bytes) are repeated for every name, if adequate buffer space is available.

Hex 33 Wait B3 Immediate

MSG.STATUS

Function: This command requests the status of either a local or remote NETBIOS interface.

Explanation: The MCB_CALLNAME field specifies which interface to get the status from. If the first byte of the field contains "*," the local NETBIOS interface status is returned. The status information is returned to the buffer defined by the MCB_BUFFER@ field. The minimum number of bytes is 60. The maximum buffer size needed to hold the status information is 18 times the maximum number of names plus 60.

A return code of X'06' is posted in the MCB_RETCODE field for either of two reasons:

1. The receive buffer is not large enough for the data.

2. When obtaining remote status information, the status data that was to be transmitted exceeded the maximum datagram length.

   In either case the data was loaded into the specified buffer until the buffer was full or until the maximum length was exceeded.

Fields Required:

MCB_BUFFER@
MCB_LENGTH
MCB_CALLNAME (Local or remote or "*" for local)
MCB_POST@ (If no-wait option used)
MCB_LANA_NUM (Adapter number 0 or 1)

Fields Returned:

MCB_RETCODE
MCB_LENGTH
MCB_RESERVE (If error X'4X' or X'FX' occurs)

Valid Return Codes:

Immediate

X'00' Good return
X'03' Invalid command
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Final

X'00' Good return
X'01' Illegal buffer length
X'03' Invalid command
X'05' Command timed out
X'06' Message incomplete
X'0B' Command canceled
X'19' Name conflict detected
X'21' Interface busy
X'22' Too many commands outstanding
X'23' Invalid number in MCB_LANA_NUM field
X'4X' Unacceptable ring status
X'FX' Adapter/PC unusual condition/error

Data Areas Returned

OFF-SET	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	6	DB	Adapter's burned-in address
6	1	DB	Always X'00'
7	1	DB	Always X'00'

MSG.STATUS

OFF-SET	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
8	2	DW	X'FFnn' -- nn is the software level number
10	2	DW	Duration of reporting period (in minutes)
12	2	DW	Number of FRMR frames received
14	2	DW	Number of FRMR frames received
16	2	DW	Number of I-frames received in error
18	2	DW	Number of aborted transmissions
20	4	DW	Number of successfully transmitted packets
24	4	DW	Number of successfully received packets
28	2	DW	Number of I-frames transmitted in error
30	2	DW	Lost data (out of SAP buffers) -- the counter does not increment beyond X'FFFF'
32	2	DW	Number of times DLC T1 timer expired
34	2	DW	Number of times DLC Ti timer expired
36	4	DD	Address of extended status information (local status only; undefined for remote status)
40	2	DW	Current number of free MCBs
42	2	DW	Configured maximum MCBs
44	2	DW	Maximum MCBs (always 255)
46	2	DW	Number of times a local station went busy
48	2	DW	Maximum datagram packet size
50	2	DW	Number of pending sessions
52	2	DW	Configured maximum pending sessions
54	2	DW	Maximum pending sessions (always 254)
56	2	DW	Maximum size of session data packet
58	2	DW	Number of names in the local name table
60	XXXX	DB	Local name table; each name requires 18 bytes

Notes:

1. All counters roll over from X'F...F' to X'0...0' unless stated otherwise.

2. Address of extended status information (offset 36)

   This is the IBM PC memory location of adapter-specified status. The data is in a fixed location and a MSG.STATUS need not be reissued. The data may be interrogated, but should not be disturbed.

This data is available only for local status. The pointer is undefined for remote status.

The format of the data is (type DW, 2-byte fields):

Bytes 0 - 1 : DIR.INITIALIZE bring-up error code
Bytes 2 - 3 : DIR.OPEN.ADAPTER error code
Bytes 4 - 5 : Latest ring status
Bytes 6 - 7 : Latest adapter check reason code
Bytes 8 - 9 : Latest PC-detected error (contents of AX register)
Byte 10 : Latest operational error code (4X or 5X). See note 3 on page 5-66.
Byte 11 : CCB return code of the latest implicit command. See note 3 on page 5-66.

Adapter counters
Bytes 12 -13 : Line errors
Bytes 14 -15 : Internal errors
Bytes 16 -17 : Burst errors
Bytes 18 -19 : A/C error
Bytes 20 -21 : Abort delimiter
Bytes 22 -23 : Reserved
Bytes 24 -25 : Lost frame
Bytes 26 -27 : Receive congestion
Bytes 28 -29 : Frame copied errors
Bytes 30 -31 : Frequency errors
Bytes 32 -33 : Token errors
Bytes 34 -35 : Reserved
Bytes 36 -37 : Reserved
Bytes 38 -39 : Reserved

The adapter counters are valid only if no ring status appendage is defined. If an appendage is defined, it is the responsibility of the user to maintain these counts. When no appendage is defined, these counters are updated when ring status bit 7 (counter overflow) is reported. (The counters wrap from X‘FFFF’ to X‘0000’.)

These counters are the same as obtained with a DIR.READ.LOG command. Any application program that issues a DIR.READ.LOG command will cause these counters to be incorrect as to the correct total since they are reset by the DIR.READ.LOG command.

3. When the NETBIOS interface is initiated, a DIR.INITIALIZE and DIR.OPEN.ADAPTER are sometimes executed and a DLC.OPEN.SAP is executed. Bytes 10 and 11 are useful for determining the reason for certain '4X' return codes. Byte 10 provides the last of these CCB commands that was executed, and byte 11 contains the related CCB return code.

4. Number of pending sessions (offset 50)

   The pending session is either a MSG_CALL pending, a MSG_LISTEN pending, a session established, session aborted, MSG_HANG_UP pending, or MSG_HANG_UP complete.

5. Local name table (offset 60 +)

   The first 16 bytes of each entry represent the name and the last 2 bytes represent the name status. The first status byte is equal to the name number (MCB_NUM). The second status byte is the status when it is masked with a X'87'. The mask is used to get the last 3 bits of the byte. The other bits are reserved and may have non-zero values.

   Nrrrr000 - Trying to register a name
   Nrrrr100 - A registered name
   Nrrrr101 - A de-registered name
   Nrrrr110 - A detected duplicate name
   Nrrrr111 - A detected duplicate name with de-register pending

   Where: r = Reserved bit
   Where: N = 0 if the name is a unique name
   Where: N = 1 if the name is a group name

   DE-REGISTERED NAME: If the name to be deleted still has an active session when a "MSG_DELETE_NAME" command is issued, the name is marked as "de-registered" and the name is removed from the local names table as soon as the session is completed.

Hex 79 Wait F9 Immediate

MSG.TRACE

Function: This command activates a trace of all the MCBs issued to the NETBIOS interface and some of the CCBs issued by the NETBIOS Program, including transmits and receives.

Explanation: Both the immediate and the wait command are completed immediately and no post address is used.

To initiate the trace, the MCB_NUM field must be set to X'FF', the MCB_LENGTH field must be set to the length of the trace table (1024 or greater), and the MCB_BUFFER@ must be set to the address of the trace table location in IBM PC memory. The MCB_LANA_NUM field must be set to a valid adapter number, but the trace will be active for both adapters. The automatic adapter open function of the NETBIOS Program will not occur when this command is issued. This command may be issued either when an adapter is open or or when it is closed.

To terminate the trace, this command is issued with the MCB_NUM field set to '00'. In this case the MCB_LENGTH and MCB_BUFFER@ fields are not used.

To terminate the trace locally and at remote adapters that have the NETBIOS Program running and a trace active, set the MCB_NUM field to X'01' (remote trace off). This will terminate the MSG.TRACE and also issue a PDT.TRACE.OFF command to terminate the Adapter Support Interface trace. It will also cause a request to be sent to the NETBIOS Program at all remote adapters to issue MSG.TRACE (off) and PDT.TRACE.OFF commands. If the local trace is not active, the command may still be issued to terminate remote traces even though the command will be completed with a return code of X‘0D’.

Fields Required:

MCB_BUFFER@ (Trace table address)
MCB_LENGTH (Trace table length (at least 1024))
MCB_NUM
(X‘FF’ = trace on,
X‘00’ = local trace off,
X‘01’ = local and all remote trace off)
MCB_LANA_NUM (Adapter number 0 or 1)

Fields Returned:

MCB_RETCODE
MCB_RESERVE (if error X‘4X’ or X‘FX’)
MCB_BUFFER@ (Address of the trace table (returned when trace off option requested in MCB_NUM field))
MCB_LENGTH (Length of the trace table (returned when trace off option requested in MCB_NUM field))

Valid Return Codes:

Final

X‘00’ Good return
X‘01’ Illegal buffer length
X‘0D’ Trace already on/off
X‘13’ Invalid trace option
X‘23’ Invalid number in MCB_LANA_NUM field

Trace Entry Format

Each trace entry is 32 bytes long. The initial entry is the table header. The next entry is the first trace entry. When all the trace table entry locations have been used, the table is wrapped back to the first entry overwriting previous entries. The initial, or header, entry is not overwritten.

Trace Table Header
1st Trace Entry
2nd Trace Entry
• • •
Nth Trace Entry

The Trace Table Header format is:

Byte	Usage
0-1	Offset of trace table
2-3	Segment of trace table
4-5	Length of trace table
6-15	Reserved
16-17	Number of entries
18-27	Reserved
28-29	Offset to end of table (from segment)
30-31	Offset to next entry (from segment)

The Trace Table Entry format

Bytes 0 through 5 of all the trace table entries are the same format. The format of the remainder of the entry is dependent upon the content of bytes 2 (type) and 3 (modifier).

Byte	Usage
0-1	Adapter X'AAAA' = Adapter 0 X'BBBB' = Adapter 1 X'FFFF' = See note
2	Type
3	Modifier of Type
4-5	Number of 100-millisecond ticks since last entry

Note: *If this command is the first use of the NETBIOS Program since it was loaded, the X'FFFF' entry will appear for the next MCB command issued. That should be the only occurrence of an X'FFFF' entry.*

Byte 2 Type	Byte 3 Modify	Meaning	Bytes 6-31
FF	00	MCB Issued	Byte 6 = The byte preceding the MCB Byte 7 = The byte following the MCB Byte 8-11 = MCB Post address Byte 12-15 = Address of data in IBM PC Memory Byte 16-32 = First 16 bytes of the MCB
	01	MCB Immediate return	Byte 6 = The byte preceding the MCB Byte 7 = The byte following the MCB Byte 8-11 = MCB Post address Byte 12-15 = Address of data in IBM PC Memory Byte 16-32 = First 16 bytes of the MCB
	02	MCB final (no-wait) return	Byte 6 = The byte preceding the MCB Byte 7 = The byte following the MCB Byte 8-11 = MCB Post address Byte 12-15 = Address of data in IBM PC Memory Byte 16-32 = First 16 bytes of the MCB
EE	00	Ring Status	Byte 6-7 = DS Byte 8-9 = SS Byte 10-11 = SP Byte 12-15 = Address of data in IBM PC Memory Byte 16-17 = Ring Status
	01	Adapter Support Interface internal error	Byte 6-7 = DS Byte 8-9 = SS Byte 10-11 = SP Byte 12-15 = Address of data in IBM PC Memory Byte 16-17 = Error Code
	02	Adapter Status	Byte 6-7 = DS Byte 8-9 = SS Byte 10-11 = SP Byte 12-15 = Address of data in IBM PC Memory Byte 16-17 = Status Code
	03	DLC Status	Byte 6-7 = DS Byte 8-9 = SS Byte 10-11 = SP Byte 12-15 = Address of data in IBM PC Memory Byte 16-17 = Node Address Byte 18-19 = DLC Status Byte 20-24 = FRMR Data Byte 25 = Access Priority Byte 26-31 = Remote Node Address

Byte 2 Type	Byte 3 Modify	Meaning	Bytes 6-31
0B	The CCB return code	Transmit I frame	Byte 6-7 = DS Byte 8-9 = SS Byte 10-11 = SP Byte 12-15 = Address of data in IBM PC Memory Byte 16-32 = NETBIOS header transmitted
0D	The CCB return code	Transmit UI frame	Byte 6-7 = DS Byte 8-9 = SS Byte 10-11 = SP Byte 12-15 = Address of data in IBM PC Memory Byte 16-32 = NETBIOS header transmitted
28	00	Data received and processed	Byte 6-7 = DS Byte 8-9 = SS Byte 10-11 = SP Byte 12-15 = Address of data in IBM PC Memory Byte 16-32 = NETBIOS header received
	FF	Data received and not processed	Byte 6-7 = DS Byte 8-9 = SS Byte 10-11 = SP Byte 12-15 = Address of data in IBM PC Memory Byte 16-32 = NETBIOS header received
Any Other CCB Cmd Code	The CCB return code	Any other CCB command	Byte 6-7 = DS Byte 8-9 = SS Byte 10-11 = SP Byte 12-15 = Address of data in IBM PC Memory Byte 16-32 = Image of the CCB

Hex 70
MSG.UNLINK

Function: This command is provided for NETBIOS compatibility. The NETBIOS Program treats this as a “no-operation.”

Fields Required:

MCB_LANA_NUM (Adapter number 0 or 1)

Fields Returned:

MCB_RETCODE
MCB_RESERVE (If error X‘4X’ or X‘FX’ occurs)

Valid Return Codes:

X‘00’ Good return
X‘03’ Invalid command
X‘21’ Interface busy
X‘23’ Invalid number in MCB_LANA_NUM field
X‘4X’ Unacceptable ring status
X‘FX’ Adapter/PC unusual condition/error

Chapter 6. The Adapter Card Interface

When the Adapter Support Interface is not used, the application program must perform the control functions and interrupt handling for the adapter card. Memory Mapped I/O (MMIO) and Programmed I/O (PIO) operations are used to access the adapter card interfaces. The IBM PC **IN** and **OUT** instructions are used for the PIO operations. The application program must load the commands and parameters into the shared RAM, and also turn on interrupt bits in the areas of adapter MMIO domain where the interrupt status registers are assigned. The application program must then interrogate control blocks and registers when the adapter has updated shared RAM.

Note: *The sequence of placing bytes in RAM on the adapter card is in the IBM format rather than in the Intel format used in IBM PC memory.*

The sequence of operations, the shared RAM assignments, and the command and response codes are defined further in this chapter.

Basic Operations

Controlling the adapter card requires that several functions be performed.

1. Use a PIO Read to determine the setting of the adapter switches.

2. Issue a PIO Reset to the adapter card to cause adapter initialization.

3. Issue a PIO Release to unlatch the reset and cause the bring-up tests to run.

4. When the adapter interrupts the IBM PC to indicate completion of the initialization, read the adapter switches to determine the address of the MMIO region. Use that address to set the RAM relocation register (RRR) to the address in IBM PC memory where you want the shared RAM to be assigned.

5. Obtain the results of the initialization from the system request block (SRB) pointed to by the contents of the write region base (WRB) register in shared RAM.

6. Set OPEN.ADAPTER command information in the system request block (SRB) in the RAM.

7. Then set interrupt information in the interrupt status register-adapter (ISRA) in the MMIO region.

   This causes an interrupt to the adapter to process the provided information.

   The adapter then loads the response into the system request block (SRB) in shared RAM.

   - In the case of the first command (the OPEN.ADAPTER), the response includes the control block addresses to be used thereafter.

   The adapter then sets interrupt bits in the MMIO region to cause an interrupt to the IBM PC indicating that the adapter has something to report, such as that the command is completed.

8. React to the interrupts generated by the adapter, gather details, reset the interrupt, and for transmit and receive activities only, respond to the adapter in the adapter status block (ASB)

The above-mentioned registers and blocks are described later in this chapter.

PIO Commands

Four specific PIO commands and one global command are accepted by an adapter.

- A PIO Write (OUT instruction) to X'02Fn' is a Global Interrupt Release. This resets interrupt generating circuits in all adapters sharing the IBM PC interrupt facilities. The specific interrupt level is defined by the value of "n".

- SWITCH READ
  A PIO Read (IN instruction) to X'0A20' (adapter 0) or X'0A24' (adapter 1) returns the 1-byte contents of the ROM/MMIO domain switches. The switches must be set when the adapter is installed to define where in the IBM PC-addressable memory the adapter card registers will be located. A PIO Write to this address is ignored. See Figure 6-1 on page 6-4 and the *IBM Token-Ring Network PC Adapter Guide to Operations*.

- ADAPTER RESET
  A PIO Write (OUT instruction) to X'0A21' (adapter 0) or X'0A25' (adapter 1) causes an unconditional adapter reset to be latched on. The entire adapter is held reset until an Adapter Release is received from the IBM PC. The adapter reset state is identical to power-on-reset except that RRR register bit 0 is not reset. While the adapter is held reset the IBM PC cannot access either the MMIO region or the shared RAM. A PIO Read to this address is ignored.

- ADAPTER RELEASE
  A PIO Write (OUT instruction) to X'0A22' (adapter 0) or X'0A26' (adapter 1) turns off an adapter reset condition that has been previously latched on by an

Adapter Reset from the IBM PC. Before the adapter can be completely reset, at least 50 milliseconds must elapse between the Adapter Reset and the Adapter Release PIO instructions. If the adapter is not latched in a reset condition, the command is ignored. A PIO Read to this address is ignored.

- ADAPTER INTERRUPT RELEASE
  A PIO Write (OUT instruction) to X'0A23' (adapter 0) or X'0A27' (adapter 1) resets and re-enables the adapter interrupt generation circuitry. Since this leaves all other IBM PC adapters disabled, this adapter is able to monopolize the interrupt facilities. A PIO read to this address is ignored.

The Adapter Card Switches

The MMIO domain is mapped to any contiguous 8K block within the last 512K of the 1M PC address space.

If the ROM in the MMIO domain of your adapter card contains "BIOS" code that executes at power-on time, the domain will be limited to the 96K of "BIOS" space (X'C8000-E0000').

The switch settings are defined in the following chart.

MMIO Domain Switches

Boundary *	Bit in the PC address	Bit in the Byte read	Switch
256K	18	7	1
128K	17	6	2
64K	16	5	3
32K	15	4	4
16K	14	3	5

Boundary *	Bit in the PC address	Bit in the Byte read	Switch
8K	13	2	6
Interrupt	Switches	1	7
		0	8

* = plus 512K

Interrupt Level Switches

The interrupt level select switch values are:

7 off, 8 off	Interrupt level 7
7 off, 8 on	Interrupt level 6
7 on, 8 off	Interrupt level 3
7 on, 8 on	Interrupt level 2

MMIO Domain

The MMIO domain is a contiguous 8K region containing registers, ROM space, and permanent information.

With the MMIO domain address from the adapter switches obtained by using the PIO instruction, MMIO load or store instructions can be used to set data into or read from the adapter registers. Four MMIO functions are used.

- READ
  Read the contents of an adapter control register into the IBM PC memory.
  A READ is performed by issuing a load instruction in the IBM PC with an address pointing to the MMIO region of the adapter.

- WRITE
  Transfer the contents of an IBM PC register directly into the selected adapter card register.
  A WRITE is performed by issuing a store instruction in the IBM PC with an address pointing to the MMIO

region of the adapter and the 2 bits in the address assigned as CMD set to B'00'.

- SET
  OR the contents of an IBM PC register into the selected adapter card register.
  An OR, or SET, is performed by issuing a store instruction in the IBM PC with an address pointing to the MMIO region of the adapter and the 2 bits in the address assigned as CMD set to B'10'.

- RESET
  AND the contents of an IBM PC register into the selected adapter card register.
  An AND, or RESET, is performed by issuing a store instruction in the IBM PC with an address pointing to the MMIO region of the adapter and the 2 bits in the address assigned as CMD set to B'01'.

The address driven to the adapter by the IBM PC contains several fields.

Bits 19 through 9 select the MMIO region.
Bits 8 and 7 select the 128-byte area within the region.
- Attachment control area (B'00')
- Adapter identification area (B'1n')
- A reserved area (B'01' – do not access)

Bits 5 and 6 select the specific write function (CMD) to be performed.
Bits 4 through 0 select the specific register and byte.

See MMIO Layout and 6-1, 6-2, and 6-3.

MMIO Layout

OFFSET FROM @	CONTENTS
0000	X'55'
0001	X'AA'
0002	Length /512
0003	ROM entry
	Reserved for ROM — 7674 bytes
1DFF	ROM Checksum
1E00	Attachment Control Area 128 bytes
1E80	Reserved 128 bytes
1F00	Adapter Identification Area 256 bytes

@ = The address obtained from the switch settings at X'0A20' (X'0A24').

The ROM Area

All but the last 512 bytes of the MMIO domain are reserved for IBM PC program *BIOS* storage.

The Attachment Control Area

This area in the MMIO region contains the registers for controlling operations of the adapter. It is located at X'1E00' beyond the MMIO domain origin and is 128 bytes long. Of these 128 bytes, 16 bytes are used for the eight 2-byte registers.

The registers included are:

- RRR — RAM Relocation register
- WWC — Write window close management register
- WWO — Write window open management register
- WRB — Write region base management register
- ISRP — Interrupt status register-PC
- ISRA — Interrupt status register-adapter
- TCR — Timer control register
- TVR — Timer value register

These registers are accessed by both the IBM PC and the adapter. The IBM PC cannot *lock* a register to prevent adapter access.

Communication

Two registers in the Attachment Control Area — the interrupt status register-adapter (ISRA) and the interrupt status register-PC (ISRP) — are used by the IBM PC program and the adapter respectively to cause interrupts to one another.

Other registers in the Attachment Control Area and Control Blocks in shared RAM are also used for communication between the IBM PC and the adapter. The control blocks are explained in "Shared RAM" on page 6-24.

The majority of communication actions use the following areas:

From PC to Adapter	Usage	From Adapter to PC	Located in
ISRA	Interrupts	ISRP	MMIO
SRB	Requests	ARB	Shared RAM
SSB	Status	ASB	Shared RAM

The Registers

All of the registers in the Attachment Control Area consist of two 1-byte registers: a high-order byte and a low-order byte.

RAM Relocation Register

The RAM relocation register (RRR) is set to indicate where the shared RAM is to be located in the IBM PC memory map. RRR high register must be set with the 16K boundary address for the RAM origin.

Bit 0 of the RRR low register allows selection of an alternate address for the first adapter processor instruction fetch after reset. This selection is to be used in conjunction with the *adapter partial reset* function if an alternate initial microprogram load (IMPL) address is required. This bit takes on special significance during the adapter partial reset state controlled by RRR low bit 7. This bit can be changed only from the IBM PC and is mapped as a read-only bit to the adapter.

The adapter reset bit (RRR low bit 7) allows the IBM PC (or adapter) to place the adapter in the adapter partial reset state. When the IBM PC writes a 1 to this bit, the adapter partial reset state is established. The hardware reset signal is applied to the processor, and all circuitry not associated with the IBM PC access to the card. This state is different than the *adapter reset* state initiated by a PIO operation which holds the entire adapter in a power-on-reset condition. Since the adapter processor is held reset when this bit is active, only the IBM PC can reset this bit. The IBM PC may reset this bit directly by writing a zero to this position using an MMIO Write (RESET MMIO commands are not defined for RRR bits) or indirectly by issuing a PIO Adapter Reset command.

In addition, the adapter partial reset state is established following the expiration of the deadman timer or following a (40 millisecond) timer overrun. (See the timer registers later in this chapter.) Unlike the adapter reset state, a subset of normal adapter operation is defined for the IBM PC interface when the adapter is in adapter partial reset state. All IBM PC operations allowed under normal conditions are allowed in the adapter partial reset state and function as defined with the following exceptions:[1]

- Write region (WRB > 0) and/or write window (WWC > WWO > 0) definitions are overridden by the adapter reset bit and depend upon the state of the adapter RRR IMPL bit. The IBM PC has access to the shared RAM domain and access is subject only to the state of the RRR IMPL bit. If the RRR IMPL bit is active (one), then the IBM PC has write access to the entire shared RAM domain (there is no write protection anywhere). If the RRR IMPL bit is inactive (zero), then the IBM PC cannot write anywhere in the shared RAM domain even if a write region and/or write window is defined by nonzero contents of the RAM management registers (the entire shared RAM domain is write protected).

- The three adapter timers and adapter dead man timer are held in the reset state. Also, the *adapter partial reset* condition inhibits the operation of the IBM PC timer.

The remaining RRR bits, though readable, are controlled by the adapter.

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[1] IBM PC software may also see differences during the *adapter partial reset* state which would be attributable to no adapter microcode response, that is, the PC should not attempt to do anything that requires an adapter response.

Write Management Registers

The write window close management (WWC) register, the write window open management (WWO) register, and the write region base management (WRB) register, are used by the adapter to dynamically control the IBM PC write access in the shared RAM. Only the adapter can write into these three registers. The adapter can concurrently define two separate and independent PC write areas within the shared RAM domain: the *write region* and the *write window*. The size of each of these areas can be individually defined in word (2-byte) increments from 2 bytes to the maximum size of the shared RAM domain. The two areas differ only in how they are bounded. The write region always extends from the highest address of the shared RAM domain down to a variable origin specified by the write region base (WRB) register. The write window extends from a variable base defined by the write window open (WWO) register to a variable limit defined by the write window close (WWC) register.

Normally, the interface mechanism allows the IBM PC read-only access to the entire shared RAM domain until the adapter is opened and IBM PC write-access areas are defined by the adapter. However, IBM PC write access to the shared RAM is governed by another mechanism (RRR low register bit 0, IMPL) during the adapter partial reset (RRR low bit 7, is a 1) state. If RRR low register bit 0 (IMPL) is on, then the IBM PC has write access to the entire shared RAM domain. If RRR low register bit 0 is zero, then the IBM PC cannot write anywhere in the shared RAM domain even if a write region and/or write window is implied by nonzero contents of the RAM management registers.

The two high-order bits of the management registers are always zero to limit the RAM domain to 16K bytes. Also, the low-order bit in each is zero since all write boundaries are word (2-byte) aligned.

The write window base (WRB) register contains either zero or the offset of the beginning of the write region.

This field will contain zero until the adapter is opened, and when it is zero, no write region is available.

The write window open (WWO) register contains either zero or the offset of the beginning of the write window. This field will contain zero until the adapter is opened, and when it is zero, no write window is available.

The write window close (WWC) register contains either zero or the offset of the ending of the write window. This field will contain zero until the adapter is opened, and when it is zero, no write window is available.

Read-Only Area

Any address in the shared RAM not given specific IBM PC write access by the shared RAM management registers will be IBM PC read-only access. An IBM PC write (MMIO or DMA) to any of these read-only memory addresses or to any RAM management register MMIO address will not be completed and will activate the PC Access error interrupt condition (ISRA high register bit 5 and ISRP high register bit 2). Since the origin of the write region (WRB) and the write window (WWO) must be greater than zero if either write area is to be defined, the first 2 bytes of the shared RAM domain must always be read-only to the IBM PC.

Interrupt Registers

The interrupt status register-adapter (ISRA) and the interrupt status register-PC (ISRP) are used by the IBM PC program and the adapter respectively to cause interrupts to one another.

There are also bits used by the adapter in these registers that can be interrogated by the IBM PC to determine conditions.

Interrupt Status Register-Adapter

The PC program sets bits in the ISRA low register to interrupt the adapter. These are bits 0 through 5. The remaining bits are controlled by the adapter and may be interrogated by the IBM PC for information about the adapter.

The ISRA High

BIT	NAME	DESCRIPTION
7	Reserved	
6	Timer interrupt	At least one of the Timer Control Register (TCR) timers has an interrupt to present to the adapter.
5	Access interrupt	When this bit is on, it indicates a shared RAM access violation or an illegal MMIO operation to an Attachment Control Area register has occurred. See bit 2 of the ISRP high register for more details.
4	Deadman timer has expired	The deadman timer contained in the Timer Control Register (TCR) has expired, indicating an adapter microcode problem. This bit is one of the conditions that can set ISRP high bit 3.
3	Adapter processor check	This bit does not latch on but follows the state of the adapter processor machine check indication. This bit is one of the conditions that can set ISRP high bit 3.
2	Reserved	
1	Adapter hardware interrupt mask	When this bit is on, it prevents adapter hardware interrupts (ISRA high bit 5) from being presented to the adapter processor.
0	Adapter software interrupt mask	When this bit is on, it prevents adapter software interrupts (ISRA low bits 0-7) from being presented to the adapter processor.

The ISRA Low

BIT	NAME	DESCRIPTION
7	Reserved	
6	Bridge frame forward request	The application program has placed a frame in the bridge transmit buffers and is requesting that the frame be forwarded (Adapter II only).
5	Command in SRB	The application program has placed a command in the SRB and is informing the adapter.

BIT	NAME	DESCRIPTION
4	Response in ASB	The application program has placed the response to an ARB request in the ASB and is informing the adapter.
3	SRB free request	The application program wants to use the SRB, but a previous request is still being processed by the adapter. The adapter will return an "SRB free" interrupt when the SRB return code field has been set to X'FF'.
2	ASB free request	The application program wants to use the ASB, but a previous response is still being processed by the adapter. The adapter will return an "ASB free" interrupt when the ASB return code field has been set to X'FF'.
1	ARB free	The command in the ARB has been read by the application program and the ARB is available. If the command requires a response from the application program (receive and transmit only), it will be provided in the ASB later.
0	SSB free	The response in the SSB has been read by the application program and the SSB is available.

Interrupt Status Register-PC

The adapter sets bits in the ISRP to interrupt the IBM PC. Methods of interrupting and blocking interrupts and a method of the IBM PC acknowledging an interrupt are provided in this register.

The ISRP High

BIT	NAME	DESCRIPTION
7	NMI Interrupt control	When this bit is on, all interrupts to the IBM PC, bits 2 and 3 (error), bit 4 (timer)of ISRP high, and bits 0-7 of ISRP low, are presented collectively to one interrupt request line if ISRP high bit 6 is on. When this bit is zero, the error and timer interrupts are presented to the NMI interrupt line (IBM PC channel check on pin A01). The bit can be set by either the adapter or the IBM PC.
6	Interrupt enable	When this bit is on, interrupt requests will be presented to the IBM PC. When this bit is off, all interrupts are masked off. The bit can be set by either the adapter or the IBM PC.

BIT	NAME	DESCRIPTION
5	Reserved	
4	Timer interrupt	The Timer Control Register (TCR) timer has an interrupt to present to the IBM PC.
3	Error interrupt	The adapter has had either a machine check occur, the adapter deadman timer expire, or the 40-millisecond timer overrun.
2	Access interrupt	When this bit is on, it indicates a shared RAM access violation or an illegal MMIO operation to an Attachment Control Area register has occurred. The following conditions will set the PC access error (ISRP high bit 2) : • Any IBM PC write to a write-protected location in the shared RAM domain • Any IBM PC write to a RAM management (WRB,WWC,WWO) register • Any IBM PC write to the high-order byte of the interrupt status register-adapter (ISRA High) • Any IBM PC write to a nonzero encoded interrupt field of either interrupt register (ISRP or ISRA). Nonzero encoded interrupt fields must be manipulated using SET and RESET MMIO commands.
1	Shared interrupt blocked	When this bit is on, it indicates that the IBM PC shared interrupt logic has detected a pulse on the interrupt request line to which it is connected. Further IBM PC interrupt generation is blocked until this condition is reset by issuing either a PIO Global Interrupt Release or a PIO Adapter Interrupt Release to the adapter. This bit is reset to zero after initial power-on. *Note: This bit may be set by any interrupting adapter (including this adapter) on this interrupt level.*
0	Primary/Alternate address	This bit reflects the setting of the adapter primary/alternate switch. If this bit is off, the primary adapter address is selected. If this bit is on, the alternate adapter address is selected.

The ISRP Low

BIT	NAME	DESCRIPTION
7	Reserved	
6	Adapter check	The adapter has encountered an unrecoverable error and is closed. The reason for the check may be read from the shared RAM using the address in the write window close management register in the attachment control area of the MMIO region. The information returned is defined in "Adapter Check Data" on page 6-17.
5	SRB response	The adapter has recognized an SRB request and has set the return code in the SRB. A return code of: • X'00' : Indicates successful completion of the SRB request. • X'01'-X'FE' : Indicates unsuccessful completion of the SRB request. • X'FF' : Indicates that the request has been accepted and is in process. A subsequent SSB response will be issued at the command completion. This interrupt bit is set for this return code only if the IBM PC has set the "SRB Free Request" bit in the ISRA.
4	ASB free	The adapter has read the response provided in the ASB, and the ASB is available for another response. This interrupt bit is set only if the IBM PC has set the "ASB Free Request" bit in the ISRA or if an error has been detected in the response.
3	ARB command	The ARB contains a command for the IBM PC to act on.
2	SSB response	The SSB contains a response to a previous SRB command from the IBM PC.
1	Bridge frame forward complete	The adapter has completed transmitting a frame forwarded by the bridge application program (Adapter II only).
0	Reserved	

Adapter Check Data

When the ISRP low bit 6 is set, indicating an adapter check, the address in the write window close management register will point to data defining the reason for the check.

The data is in the following format:

Bytes 0-1	Adapter check reason code
Bytes 2-3	Parameter 1
Bytes 4-5	Parameter 2
Bytes 6-7	Parameter 3

See "Adapter Check Reason Codes" on page 7-45. The reason codes and parameter values can be useful when the adapter card is returned to IBM for service.

Timer Control Register (TCR)

This register controls timing for both IBM PC and the ring. The high-order portion is used along with the timer value register (TVR) to control the IBM PC programmable timer. The low-order portion controls the fixed-duration timers provided as a hardware base for the adapter microcode timing routines.

The TCR High

BIT	NAME	DESCRIPTION
7	IBM PC programmable timer interrupt mask	This bit controls the timer interrupt operation. When this bit is on, the timer interrupts the IBM PC when the programmable count expires. When the bit is off, the timer will not interrupt the IBM PC, and the timer status must be obtained by polling either the TCR register or the TVR high register. The timer interrupt, like all IBM PC interrupts, is also subject to the interrupt enable bit (ISRP high bit 6).
6	IBM PC programmable timer reload mode	If this bit is on, the timer is automatically reloaded from the TVR low register when the countdown expires (reaches zero). When this bit is off, the timer must be reprogrammed or restarted after each countdown.
5	IBM PC programmable timer count gate	This bit enables or disables timer counting and also allows reloading of the initial countdown from the value stored in the TVR. When the bit is set to one, the timer is enabled and counting commences. When reset to zero, the timer is disabled, and decrementing of the timer count is halted. The countdown may be resumed by writing a one back to this bit, since the count contained in the timer is not changed when the gate bit is cleared. However, if a gate set is received when the gate bit is already on and timer count is at zero, the countdown value is reloaded from the TVR and a full countdown begins.
4	IBM PC programmable timer overrun status	This bit is set when an overrun condition is detected with the IBM PC timer interrupt. If the timer interrupt has not been reset before the end of the next timing period, the overrun bit is set at the end of that period. Once set, this status bit remains active until reset to zero by the IBM PC.

BIT	NAME	DESCRIPTION
3	IBM PC programmable timer count status	This bit is set by the adapter when the timer contains a nonzero countdown value (the timer is loaded but not necessarily counting). If this bit is a one, the nonzero value contained in the timer counter can be obtained by reading the TVR high register. Otherwise, reads to the TVR high register return zeros. When the timer countdown is halted by the clearing the gate bit and the count value is not zero, this bit will remain active (a one). The IBM PC can only read this bit.
2	IBM PC interlock	This interlock allows a adapter diagnostic routine to check the functional capability of the IBM PC timing facility without interference from IBM PC. When set to one, this bit prevents IBM PC MMIO writes from updating the contents of the TVR and the IBM PC portion (except this bit) of the TCR. This bit should be set only when the adapter diagnostic procedures require exclusive use of the IBM PC programmable timer.
1	Reserved	
0	Adapter timer	

The TCR Low

BIT	NAME	DESCRIPTION
7-0	Adapter timer	

Timer Value Register (TVR)

This register contains the IBM PC timer initial countdown value in the low-order portion and the state of the IBM PC timer count in the high-order portion. For each byte, the possible values range from 10 milliseconds (X'01') to 2.55 seconds (X'FF') in 10-millisecond increments.

If the timer contains zeros, writing a byte to the TVR low register will transfer the new low-order TVR byte to the timer. Counting is then subject to the state of the TCR gate bit. A read of the TVR high register will return the actual contents of the IBM PC timer counter at the time the read is received by the adapter. Writes to the TVR high register are ignored.

If the counter is loaded (nonzero), a write to the TVR low register will not cause the timer to be reloaded. The loading of the new TVR value to the timer is governed by the state of the TCR gate and TCR reload bits.

The value returned when reading the TVR high register depends upon the state of the TCR count and TCR gate bits. When the timer is loaded (the TCR count status bit is one), the value returned from the TVR high register is the actual timer count at the time of the read. If the TCR gate bit is one, then the counter will be counting and the value returned will reflect the current instantaneous counting state. Reading the TVR low register will always return the last value written to it (zero following initial power-on). Both TVR high and low registers are cleared after power is initially turned on.

BIT	NAME	DESCRIPTION
8-15	IBM PC programmable current count	As described above
0-7	IBM PC programmable timer initial count	As described above

TVR TIMER VALUE	CURRENT COUNT								INITIAL COUNT							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0

TCR TIMER CONTROL	PC TIMER						ADAPTER TIMERS									
	PROGRAM			STATUS			DM	MASK				OVRN		IRPT		
	M	R	G	O	C	PD	DR	SE	SI	LI	LR	SI	LI	SE	SI	LI

ISRA ADPT. IRPT/STAT	I/F			STATUS			MASK		SOFTWARE ENCODED							
		T	A	D	M		H	S								

ISRP PC IRPT/STAT	LEBP		INTERFACE				STAT		SOFTWARE ENCODED							
	NC	EN		T	E	A	B	PS		6	5	4	3	2	1	

WRB WWO:WWC RAM MANAGEMENT	PC OFFSET ADDRESS															
	0	0	13	12	11	10	9	8	7	6	5	4	3	2	1	0

RRR RAM RELOCATION	PC ORIGIN 8K/1M														CS	IA
	19	18	17	16	15	14	13		7				3	2		0

PARTIAL RESET

ALWAYS 0

RAM SIZE 0 = 8K, 1 = 16K

IMPL ADR (0=PRIMARY 1=ALTERNATE)

Figure 6-1. Attachment Control Area Registers

	REGISTER	IBM PC 7......0	IBM PC 7......0	ADAPTER 7......0	ADAPTER 7......0
0	RRR	WWWWWWWR	WOOOORRW	WWWWWWWR	WOOOORWR
1	WRB	OORRRRRR	RRRRRRRO	OOWWWWWW	WWWWWWWO
2	WWO	OORRRRRR	RRRRRRRO	OOWWWWWW	WWWWWWWO
3	WWC	OORRRRRR	RRRRRRRO	OOWWWWWW	WWWWWWWO
4	ISRP	XXOXXXRR	XXXXXXXX	XXOXXXRR	XXXXXXXX
5	ISRA	ORRRRRRR	XXXXXXXX	ORXRRRXX	XXXXXXXX
6	TCR	XXXXRXRR	RRRRRRRR	XXXXRXXX	XXXXXXXX
7	TVR	RRRRRRRR	WWWWWWWW	RRRRRRRR	WWWWWWWW

O = RESERVED (READS ZERO)
R = READ-ONLY
W = READ-WRITE
X = READ-WRITE-SET-RESET

Figure 6-2. Attachment Control Area Access Summary

		PC ACA BYTE ADDRESSING							
		LOW (EVEN) BYTE				HIGH (ODD) BYTE			
REGISTER		READ	WRITE	RESET	SET	READ	WRITE	RESET	SET
0	RRR	1E00	1E00	--	--	1E01	1E01	--	--
1	WRB	1E02	--	--	--	1E03	--	--	--
2	WWO	1E04	--	--	--	1E05	--	--	--
3	WWC	1E06	--	--	--	1E07	--	--	--
4	ISRP	1E08	1E08	1E28	1E48	1E09	1E09	1E29	1E49
5	ISRA	1E0A	--	--	--	1E0B	1E0B	1E2B	1E4B
6	TCR	1E0C	1E0C	1E2C	1E4C	1E0D	--	--	--
7	TVR	1E0E	--	--	--	1E0F	1E0F	--	--

Figure 6-3. Attachment Control Area Addressing Summary

The Adapter Identification Area

This area consists of 256 bytes of adapter identification read-only memory (ROM). It is located at X'1F00' beyond the MMIO domain origin. The encoded address, the adapter card part number, and the adapter card serial number are located in this area.

Only 4 bits (a "nibble") of data are contained in each adapter identification area byte. The content of the high-order 4 bits is not defined. Only the 4 low-order bits are provided to the IBM PC I/O channel data bus.

Since the IBM PC interface to the adapter identification area is only 1-byte wide (word operands are split into consecutive byte bus cycles by the IBM PC 8088 microprocessor), the IBM PC can access all the nibbles in the adapter identification area with any combination of byte or word instructions at even or odd addresses.

OFF-SET	REGISTER NAME	BYTE LEN	DESCRIPTION
1F00	Encoded Address	6	The encoded permanent node address for this card
1F06	Reserved	18	
1F18	Encoded Address complement	6	Ones complement of the encoded node address
1F1E	Reserved	18	
1F30	Token-Ring Adapter Identifier	4	X'5049434F'
1F34	Reserved	12	
1F40	Base card identifier	4	A representation of the base card part number
1F34	Reserved	12	

Shared RAM

Communication between the adapter and the IBM PC is by means of I/O interrupts initiated in registers in the MMIO region and by control blocks in the shared RAM.

There are four control blocks used to pass requests and the status of requests between the IBM PC and the adapter.

1. The system request block (SRB) — The SRB is used to pass a command from the IBM PC to the adapter. If the command is completed upon receipt by the adapter, either successfully or with an error, the return code for the command will be passed back to the IBM PC in the SRB with an interrupt raised. If further processing is required by the adapter, a return code of X'FF' and a command correlator will be placed in the SRB, but no interrupt to the IBM PC will result. The adapter will return later, unless the SRB free request is set, to update the system status block (SSB) with status related to that command and interrupt the IBM PC.

   The SRB can be located initially by using the address in the write region base (WRB) register in the attachment control area of the MMIO domain. Initially the SRB will be large enough to contain 60 bytes (X'3C') needed to issue an OPEN.ADAPTER command, but will thereafter be 28 bytes (X'1C') in length. The SRB location after an OPEN.ADAPTER command is issued will be returned upon completion of the OPEN.ADAPTER command.

2. The system status block (SSB) — The SSB is used to pass the results of an SRB command to the IBM PC when the SRB has been returned initially with an in-process return code X'FF'. If multiple commands of the same type are outstanding, the Station ID and command correlator provided in the SRB with the X'FF' return code may be used to identify the command(s) being completed.

   The location of the SSB is returned by the adapter card upon completion of an OPEN.ADAPTER command.

3. The adapter request block (ARB) — The ARB is used by the adapter to pass information or issue a command to the IBM PC.

   If information is passed with the ARB, no response is expected other than an indication that the information has been read and the ARB is available for reuse by the adapter.

   If a command is passed with the ARB, a response is expected from the IBM PC in the adapter status block (ASB) when the command is complete.

   The location of the ARB is returned by the adapter card upon completion of an OPEN.ADAPTER command.

4. The adapter status block (ASB) — The ARB is used by the IBM PC to respond to a command received from the adapter in the ARB. The response may indicate either successful completion of the command or that an error has occurred.

The location of the ASB is returned by the adapter card upon completion of an OPEN.ADAPTER command. The return code field of the ASB is initialized to X'FF' by the adapter when the OPEN.ADAPTER command is completed.

Shared RAM Layout

The adapter card will assign locations in shared RAM when the adapter is opened in a format such as this:

Beginning of shared RAM

PC read-only address space	Adapter private variables and work areas Length: 1496 bytes
	System status block (SSB) Length: 20 bytes
	Adapter request block (ARB) Length: 28 bytes
	Receive buffers Length: space remaining after all SAPs/Stations are defined
	SAP and link station control blocks Length: as defined by maximum number of SAPs/Stations
PC read/write address space	Data holding buffer (DHB) Length: as specified at open adapter time. There may be one or more DHBs.
	System request block (SRB) Length: 28 bytes
	Adapter status block (ASB) Length: 12 bytes

End of shared RAM

If the bridge function of the Adapter II is used, shared RAM is formatted with an additional area. See "The Bridge Functions" on page 6-89 for the shared RAM layout and a description of the bridge functions available.

Operating the Adapter Card

The adapter card must be initialized before any commands may be processed. Initializing the adapter card is performed using the PIO operations. Commands thereafter are performed using MMIO load and store instructions.

The method of initializing and obtaining the results, is:

1. Issue an Adapter Reset PIO command
2. Delay for at least 50 milliseconds
3. Issue an Adapter Release PIO operation
4. Read the write region base (WRB) register contents in response to the interrupt initiated by the adapter setting bit 2 in ISRP low.
5. Set the RAM Relocation Register (RRR) to the address you will use for shared RAM
6. Use the address from the WRB and the address of shared RAM to address the initial location of the SRB where the adapter will have posted the results of the initialization.

The SRB will contain the following response:

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'80' : Initialization complete
1		5	Reserved
6	BRING_UP_CODE	2	The bring-up result code
8	ENCODED_ADDRESS	2	RAM address of the adapter's permanent encoded address
10	LEVEL_ADDRESS	2	RAM address of the adapter microcode level
12	ADAPTER_ADDRESS	2	Address of the adapter addresses

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
14	PARMS_ADDRESS	2	Address of the adapter parameters
16	MAC_ADDRESS	2	Address of adapter MAC buffer

BRING _UP_CODE

Explanation: One of the following codes will be provided to indicate the results of the bring-up tests.

X'0000' Initialization completed successfully
X'0020' Processor Initialization failed
X'0022' ROM test diagnostic failed
X'0024' RAM test diagnostic failed
X'0026' Instruction test diagnostic failed
X'0028' Interrupt test diagnostic failed
X'002A' Memory interface hardware diagnostic failed
X'002C' Protocol handler diagnostic failed

ADAPTER _ADDRESS

Explanation: This parameter provides the starting address offset in shared RAM of the following information. This information is accessible as long as the adapter is initialized and/or open.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	NODE_ADDRESS	6	Adapter node address
6	GROUP_ADDRESS	4	Adapter group address
10	FUNCTIONAL_ADDR	4	Adapter functional address

PARMS _ADDRESS

Explanation: This parameter provides the starting address offset in shared RAM where the following information is located. This information is accessible as long as the adapter is initialized and/or open.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	PHYS_ADDR	4	Adapter physical address
4	UP_NODE_ADDR	6	Next active upstream node address
10	UP_PHYS_ADDR	4	Next active upstream physical address
14	POLL_ADDR	6	Last poll address
20		2	Reserved
22	ACC_PRIORITY	2	Transmit access priority
24	SOURCE_CLASS	2	Source class authorization
26	ATT_CODE	2	Last attention code
28	SOURCE_ADDR	6	Last source address
34	BEACON_TYPE	2	Last beacon type
36	MAJOR_VECTOR	2	Last major vector
38	RING_STATUS	2	Ring status
40	SOFT_ERROR	2	Soft error timer value
42	FE_ERROR	2	Front end error counter
44	LOCAL_RING	2	Number of the ring
46	MON_ERROR	2	Monitor error code
48	BEACON_TRANSMIT	2	Beacon transmit type
50	BEACON_RECEIVE	2	Beacon receive type
52	FRAME_CORREL	2	Frame correlator save
54	BEACON_NAUN	6	Beaconing station NAUN
60		4	Reserved
64	BEACON_PHYS	4	Beaconing station physical address

Commands

There are three general categories of IBM PC-to-adapter card commands:

1. Direct
2. DLC (IEEE 802.2 SAP and station interfaces)
3. Data transmission.

These commands have certain qualities in common.

1. The command request is made by loading information in the SRB and setting ISRA low bit 5.
2. The adapter checks the validity of the SRB contents and either:
   - Completely processes the command, sets a return code other than X'FF', and interrupts the IBM PC by setting ISRP low bit 5, or
   - Performs initial processing only, sets the return code to X'FF', and provides a command correlator. ISRP low bit 5 will be set only if an SRB Free Request Interrupt is initiated by the IBM PC setting bit 3 of ISRA low.
3. Depending on the command the adapter may request further data using the ARB and DHB. The IBM PC will use the ASB to indicate that the requested data has been moved.
4. When processing for a request that is in process (return code = X'FF') is complete, the adapter will put the final return code in the SSB and will interrupt the IBM PC by setting ISRP low bit 2.
5. After the IBM PC has read the return code from the SSB, it will interrupt the adapter by setting ISRA low bit 7.

Adapter SRB Commands

The commands placed into the SRB by the IBM PC are similar to those provided to the Adapter Support Interface. The SRB is also used in a similar format to the CCB used with the direct interface of the Adapter Support Interface.

Direct Interface Commands

The following commands, listed in alphabetical order, may be issued by the application program to the adapter card. These commands affect the state of the adapter as a whole, rather than specific SAPs or link stations, and do not involve LLC processing.

The adapter card must have been successfully initialized before any of these commands can be performed. The first command presented to the adapter after initialization must be an OPEN.ADAPTER command. After successful completion of that command, any of the other direct interface commands may be issued. Once a CLOSE.ADAPTER command has been processed, the adapter card must be opened again before any other commands can be accepted.

All direct interface commands will be returned with ISRA interrupt low bit 5 set and return information located in the SRB. Return code X‘FF’ (in-process) is never set for these commands.

COMMAND NAME	CODE
DIR.CLOSE.ADAPTER	X'04'
DIR.INTERRUPT	X'00'
DIR.MODIFY.OPEN.PARMS	X'01'
DIR.OPEN.ADAPTER	X'03'
DIR.READ.LOG	X'08'
DIR.RESTORE.OPEN.PARMS	X'02'

COMMAND NAME	CODE
DIR.SET.FUNCTIONAL.ADDRESS	X'07'
DIR.SET.GROUP.ADDRESS	X'06'

A description of the SRB content for each of the commands follows. The command is explained and the fields provided by the IBM PC and those returned by the adapter are shown.

See "The Bridge Functions" on page 6-89 for the direct interface commands used for bridge functions.

04 DIR.CLOSE.ADAPTER

Function: Close the adapter and terminate all ring communication or the "open wrap test."

Explanation: This command will be accepted anytime after the adapter card has been opened. Commands that have been accepted by the adapter card and not completed will remain incomplete and will not be returned to the IBM PC. The adapter will be removed from the ring, if it was active, and the write region base (WRB) register will be reset to the value set at initialization time.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'04' : DIR.CLOSE.ADAPTER
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return

When the adapter card completes the operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code

00
DIR.INTERRUPT

Function: Force an adapter interrupt. This command performs no function.

Explanation: The adapter must have been initialized, but does not have to be opened for this command to be accepted.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'00' : DIR.INITIALIZE
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return

When the adapter card completes the operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code

01
DIR.MODIFY.OPEN.PARMS

Function: Used to modify the OPEN_OPTIONS set by the DIR.OPEN.ADAPTER command.

Explanation: The wrap option bit 15 will be ignored.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'01' : DIR.MODIFY.OPEN.PARMS
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		1	Reserved
4	OPEN_OPTIONS	2	New options (wrap bit left unaltered in adapter)

See the DIR.OPEN.ADAPTER command for a description of the OPEN_OPTIONS parameter.

When the adapter card completes the operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open

03
DIR.OPEN.ADAPTER

Function: Prepare the adapter card for either normal ring communication or an adapter wrap test.

Explanation: This command will be accepted after successful initialization of the adapter card. Once an open adapter command has been completed successfully, the adapter card must be closed or reset before another open adapter command will be accepted. After this command has been returned with a X'00' return code, the adapter will be in automatic receive mode and frames may be transmitted and received using the direct interface. DLC interface commands may also be issued.

The information provided along with this command is used to configure RAM. Space is allocated for:

- The adapter card work areas
- The communication areas
- The requested individual and group SAP control blocks
- The requested link station control blocks
- The requested number of DHBs.

The remaining RAM space will be configured as receive buffers using the supplied receive buffer length parameter. The adapter card will then check that the number of available receive buffers is equal to or greater than the number requested. If the number of receive buffers is inadequate, the open adapter command will be rejected. See "Additional Functions of the Adapter II" on page 6-89 for more about RAM space and buffers when using an Adapter II.

Length of SRB

The SRB in shared RAM is defined as 28 bytes in length and all IBM PC commands to the adapter except the DIR.OPEN.ADAPTER require 28 or fewer bytes. The SRB after initialization and before an open command has been completed starts at the initial write region base address and can accept enough information for the open parameters.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'03' : DIR.OPEN.ADAPTER
1		7	Reserved
8	OPEN_OPTIONS	2	Open options – See description

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
10	NODE_ADDRESS	6	This adapter's ring address
16	GROUP_ADDRESS	4	The group address to set
20	FUNCT_ADDRESS	4	The functional address to set
24	NUM_RCV_BUF	2	Number of receive buffers
26	RCV_BUF_LEN	2	Length of receive buffers
28	DHB_LENGTH	2	Length of transmit buffers
30	NUM_DHB	1	Number of DHBs
31		1	Reserved
32	DLC_MAX_SAP	1	Maximum number of SAPs
33	DLC_MAX_STA	1	Maximum number of link stations
34	DLC_MAX_GSAP	1	Maximum number of group SAPs
35	DLC_MAX_GMEM	1	Maximum members per group SAP
36	DLC_T1_TICK_ONE	1	DLC timer T1 interval, group one
37	DLC_T2_TICK_ONE	1	DLC timer T2 interval, group one
38	DLC_TI_TICK_ONE	1	DLC timer Ti interval, group one
39	DLC_T1_TICK_TWO	1	DLC timer T1 interval, group two
40	DLC_T2_TICK_TWO	1	DLC timer T2 interval, group two
41	DLC_TI_TICK_TWO	1	DLC timer Ti interval, group two
42	PRODUCT_ID	18	Product Identification

OPEN _OPTIONS

Explanation: Various options, each defined by a bit. A bit on (1) indicates that the option is to be taken. Bit 15 is the high-order (leftmost) bit.

- **Bit 15** Wrap Interface

  The adapter will not attach itself to the ring. Instead it will cause all user transmit data to be wrapped as received data.

- **Bit 14** Disable Hard Error

  Prevents ring status changes involving "Hard Error" and "Transmit Beacon" bits from causing interrupts.

- **Bit 13** Disable Soft Errors

  Prevents ring status changes involving "Soft Error" bit from causing interrupts.

- **Bit 12** Pass Adapter MAC Frames

  Pass as direct interface data to the IBM PC all adapter-class MAC frames that are received but not supported by the adapter. If this option is off, these frames will be ignored.

- **Bit 11** Pass Attention MAC Frames

  Pass as direct interface data to the IBM PC all attention-class MAC frames that are not equal to the previously received attention MAC frame.

- **Bits 9 - 10** Reserved

  Should be zero, but are not checked by the adapter card.

- **Bit 8** Pass Beacon MAC frames

  Pass as direct interface data to the IBM PC the first Beacon MAC frame and all subsequent beacon MAC frames that have a change in the source address or the beacon type.

- **Bit 7** Contender

  When the contender bit is on, it allows the adapter to participate in monitor contention if the opportunity occurs. When the contender bit is off, and the need for contention is detected by another adapter, this adapter will not participate.

  If the need for determining a new active monitor is detected by this adapter, monitor contention processing will be initiated by this adapter in either case.

- **Bits 0 - 6** Reserved

  Should be zero, but are not checked by the adapter card.

NODE _ADDRESS

Explanation: The 6-byte specific node address of this station on the ring. The value must not be all ones. The high-order (leftmost) bit must be zero. If the value is zero, the adapter's encoded address will be the node address by default.

GROUP _ADDRESS

Explanation: Sets the group address for which the adapter will receive messages. If the value is zero, no group address is set. The group address can also be set, or changed, by a SET.GROUP.ADDRESS command.

FUNCT _ADDRESS

Explanation: Sets the functional address for which the adapter will receive messages. Bits 0 and 31 are ignored. If the value is zero, no functional address is set. The functional address can also be set, or changed, by a SET.FUNCT.ADDRESS command.

NUM _RCV_BUF

Explanation: The number of receive buffers in shared RAM needed for the adapter to open. The adapter will configure as receive buffers all remaining RAM after other memory requirements have been met. If the number available is less than the number requested, the DIR.OPEN.ADAPTER command will fail. If the number available is greater than the number requested, no action will occur. If this value is less than 2, the default of 8 will be used.

RCV _BUF_LEN

Explanation: The length of each of the receive buffers in the shared RAM. Receive buffers will be chained together to hold a frame that is too long for one buffer. However, only one frame will be put into a single buffer.

The value must be a multiple of 8; 96 is the minimum and 2048 is the maximum. If the value is zero, the default of 112 will be used. Each buffer holds 8 fewer bytes of data than the specified size. Therefore, a buffer defined as 112 bytes long can hold only 104 bytes of data. The 8 bytes are overhead needed by the adapter.

DHB _LENGTH

Explanation: The length of each of the transmit buffers in the shared RAM. Only one buffer is used to hold transmit data, including header information, for a given frame for the direct interface and SAP interface. For the link station interface, this length applies to the information field of I frames.

The value must be a multiple of 8; 96 is the minimum and 2048 is the maximum. If the value is zero, the default of 600 will be used. Each buffer holds 6 fewer bytes of data then the specified size. Therefore, a buffer defined as 600 bytes long can hold only 594 bytes. The 6 bytes are overhead necessary for use by the adapter.

NUM _DHB

Explanation: This defines the number of transmit buffers in the adapter shared RAM in which the data from the IBM PC may be stored.

The adapter will accept any value between zero and 255, but the integrity of adapter operation cannot be guaranteed if the value is greater than 2. Requesting two buffers may improve adapter performance by allowing a frame to be moved into the second buffer while the adapter is transmitting from the first. However, this will reduce the storage available for receive buffers. If the value is zero, the default of 1 will be used.

DLC _MAX_SAP

Explanation: The maximum number of individual SAPs that can be opened at one time. The maximum value allowed is 126. Each individual SAP control block requires 64 bytes of shared RAM. If this parameter is set to zero, no open SAP commands will be accepted and the DLC SAP and the DLC link station interfaces will not be available. However, the null and the global SAPs will be activated.

DLC _MAX_STA

Explanation: The maximum number of link stations that can be opened at one time. It does not determine the number of link stations that may be open for any one SAP. Each link station control block requires 144 bytes of shared RAM. If this parameter is not zero, the DLC_MAX_SAP parameter must not be zero.

DLC _MAX_GSAP

Explanation: The maximum number of group SAPs that can be opened at one time. Each group SAP control block requires 14 bytes plus two times the DLC_MAX_GMEM parameter value in shared RAM. If the value is zero, no group SAPs are allowed, but the global SAP will be activated.

The corresponding individual SAP control block, requiring 64 bytes, is required in order to open a group SAP. That is, group SAP X‘05’ requires that individual SAP X‘04’ must be established first.

DLC _MAX_GMEM

Explanation: The maximum number of SAPs that can be assigned to any given group. This parameter will be ignored if the DLC_MAX_GSAP parameter is zero and may not be zero if that field is not zero.

DLC _T1_TICK_ONE

Explanation: The number of 40-millisecond intervals that make up a "tick" for DLC timer T1 (T1 timer values 1 - 5). If the value is zero, the default of 5 (200 - 400 milliseconds) is used.

DLC _T2_TICK_ONE

Explanation: The number of 40-millisecond intervals between timer "ticks" for DLC timer T2 (T2 timer values 1 - 5). If the value is zero, the default of 1 (40 - 80 milliseconds) is used.

DLC _TI_TICK_ONE

Explanation: The number of 40-millisecond intervals between timer "ticks" for DLC timer Ti (Ti timer values 1 - 5). If the value is zero, the default of 25 (1 - 2 seconds) is used.

DLC _T1_TICK_TWO

Explanation: The number of 40-millisecond intervals between timer "ticks" for DLC timer T1 (timer values 6 - 10). If the value is zero, the default of 25 (1 - 2 seconds) is used.

DLC _T2_TICK_TWO

Explanation: The number of 40-millisecond intervals between timer "ticks" for DLC timer T2 (timer values 6 - 10). If the value is zero, the default of 10 (400 - 800 milliseconds) is used.

DLC _TI_TICK_TWO

Explanation: The number of 40-millisecond intervals between timer "ticks" for DLC timer Ti (timer values 6 - 10). If the value is zero, the default of 125 (5 - 10 seconds) is used.

PRODUCT _ID

Explanation: The address in IBM PC memory where an 18-byte product ID is located.

SRB Response

When the adapter card completes the open command, bytes 6 through 15 in the SRB are set with return parameters and the return code is placed in the RETCODE field. The adapter card then interrupts the IBM PC by setting ISRP low bit 5. The SRB content will then be as follows.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'03' : DIR.OPEN.ADAPTER
1		1	Reserved
2	RETCODE	1	Return code - See below
3		3	Reserved
6	OPEN_ERROR_CODE	2	Valid if RETCODE is X'07' See "Adapter Open Errors" on page 7-49

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
8	ASB_ADDRESS	2	Address of the ASB
10	SRB_ADDRESS	2	Address of the SRB
12	ARB_ADDRESS	2	Address of the ARB
14	SSB_ADDRESS	2	Address of the SSB

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'03' Adapter open—should be closed
X'05' Required parameter(s) not provided
X'07' Command canceled—unrecoverable failure
X'30' Inadequate receive buffers for adapter to open
X'32' Invalid NODE_ADDRESS
X'33' Invalid adapter receive buffer length defined
X'34' Invalid adapter transmit buffer length defined

08 DIR.READ.LOG

Function: Read and reset the adapter card error counters.

Explanation:

If one of the counters reaches a count of 255, the IBM PC will be informed by a command in the Adapter Request Block (ARB) and an interrupt. The adapter card will accept this command anytime after the adapter is opened and before a close adapter command is issued.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'08' : DIR.READ.LOG
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		3	Reserved
6	LOG_DATA	14	14 bytes of log data set by the adapter card

ADAPTER ERROR COUNTERS

Refer to the *IBM Token-Ring Network Architecture Reference* for more about these error counters.

Byte 0: Line errors
Byte 1: Internal errors
Byte 2: Burst errors
Byte 3: A/C errors
Byte 4: Abort delimiters
Byte 5: Reserved
Byte 6: Lost frames
Byte 7: Receive congestion count
Byte 8: Frame copied errors
Byte 9: Frequency errors
Byte 10: Token errors
Byte 11: Reserved
Byte 12: Reserved
Byte 13: Reserved

When the adapter card completes the operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open

01

DIR.RESTORE.OPEN.PARMS

Function: Used to modify the OPEN_OPTIONS set by the DIR.OPEN.ADAPTER command.

Explanation: The wrap option bit 15 will be ignored.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'02' : DIR.RESTORE.OPEN.PARMS
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		1	Reserved
4	OPEN_OPTIONS	2	New options (wrap bit left unaltered in adapter)

See the DIR.OPEN.ADAPTER command for a description of the OPEN_OPTIONS parameter.

When the adapter card completes the operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open

07 DIR.SET.FUNCT.ADDRESS

Function: Set the functional address for which the adapter card will receive messages.

Explanation:

If this command is issued with the FUNCT_ADDRESS field containing all zeros, any previously set functional address will be disabled. The adapter card will accept this command anytime after the adapter is opened and before a close adapter command is issued.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'07' : DIR.SET.FUNCTIONAL ADDRESS
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		3	Reserved
6	FUNCT_ADDRESS	4	New functional address to set

When the adapter card completes the operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open

06

DIR.SET.GROUP.ADDRESS

Function: Set the group address for which the adapter card will receive messages.

Explanation:

The adapter card will accept this command anytime after the adapter is opened and before a close adapter command is issued.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'06' : DIR.SET.GROUP.ADDRESS
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		3	Reserved
6	GROUP_ADDRESS	4	New group address to set

When the adapter card completes the operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open

DLC SRB Commands

The following commands, listed in alphabetical order, may be issued by the application program to the adapter card. These commands apply to SAPs and link stations, and make use of LLC protocols. Some of these commands apply only to the SAP interface (Open and close SAP), and some apply only to the station interface (Open, connect, close station, statistics). The remainder apply to both interfaces.

Refer to Chapter 2, "Common Programming Information" for more details about Logical Link Control.

The adapter card must have been initialized and opened with direct interface commands before any of these commands will be accepted by the adapter.

COMMAND NAME	CODE
DLC.CLOSE.SAP	X'16'
DLC.CLOSE.STATION	X'1A'
DCL.CONNECT.STATION	X'1B'
DLC.FLOW.CONTROL	X'1D'
DLC.MODIFY	X'1C'
DLC.OPEN.SAP	X'15'
DLC.OPEN.STATION	X'19'
DLC.RESET	X'14'
DLC.STATISTICS	X'1E'

16 DLC.CLOSE.SAP

Function: Close (deactivate) a service access point (SAP) and free the associated control block(s).

Explanation:

This command will be rejected if any links are open for the specified SAP, or if the SAP was opened with a group option specified and there are any active members in the group. If the specified SAP is a group member, its membership should be canceled using a DLC.MODIFY command prior to this command being issued. If an adapter card command to the IBM PC is outstanding for the specified SAP when the DLC.CLOSE.SAP command is issued, the IBM PC must complete that action before this command will be completed.

Note: If a 47 error code results when a DLC.CLOSE.SAP command closely follows a DLC.CLOSE.STATION command for the last open station for that SAP, reissue the DLC.CLOSE.SAP command.

Any frames directed to the specified SAP that have been received by the adapter, but for which a receive ARB has not been posted, will be discarded.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'16' : DLC.CLOSE.SAP
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		1	Reserved
4	STATION_ID	2	ID of the SAP to be closed

When the adapter card completes the operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'40' Invalid STATION_ID
X'47' SAP cannot close unless all link stations are closed
X'48' Group SAP cannot close until all member SAPs are closed

X'4C' Unable to close—commands outstanding

1A DLC.CLOSE.STATION

Function: Close one link station.

Explanation: The link control block will be freed for use by another link station on the same SAP.

This command will be rejected if there is a DLC.CLOSE.STATION or a DLC.CONNECT.STATION command outstanding for the specified link station. If the command is accepted, the adapter will either:

- Transmit a DISC command to the remote station and enter disconnecting mode while waiting for an acknowledgment
- Send a DM response if there is a SABME or DISC command outstanding, or if the link is in the disconnecting state, and close the link station when the response has been transmitted.

If there are outstanding Transmit I Frame requests when this command is accepted, they will not be returned by the adapter card. If an adapter card command to the IBM PC is outstanding for the specified Link Station when DLC.CLOSE.STATION command is issued, the IBM PC must complete that action before this command will be completed. Any frames directed to the specified link station that have been received by the adapter card but not processed will be handled according to the state the adapter card enters upon receipt of this command. Those link station states would be either disconnecting state or link closed state.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'1A' : DLC.CLOSE.STATION
1	CMD_CORRELATE	1	Set by the adapter card upon return
2	RETCODE	1	Set by the adapter card upon return
3		1	Reserved
4	STATION_ID	2	ID of the link station to be closed

If there is no immediate error, the adapter card sets the RETCODE field to X'FF' (command in process), sets the CMD_CORRELATE field in the SRB, and interrupts the IBM PC by setting ISRP low bit 2 if an SRB Free Request interrupt is received by the adapter. When the command is completed later, the IBM PC will be interrupted with a response in the SSB.

If there is an immediate error, the adapter card sets the RETCODE field with the error code and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'FF' Command in process
X'01' Invalid command code
X'02' Duplicate command, one already outstanding
X'04' Adapter closed—should be open
X'40' Invalid STATION_ID
X'4C' Unable to close—commands outstanding

Final RETCODE in SSB

X'00' Operation completed successfully
X'4B' Station closed—no remote acknowledgment

1B

DLC.CONNECT.STATION

Function: To initiate a SABME_UA exchange to place both the local and remote link stations in data transfer state, or to respond to a SABME command received after a link station is open.

Explanation: This command will not be accepted if the link station is in the Disconnecting or Link Closed state, or if a DLC.CLOSE.STATION or DLC.CONNECT.STATION command is in process. Any outstanding transmit commands queued to the link station will be lost.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'1B' : DLC.CONNECT.STATION
1	CMD_CORRELATE	1	Set by the adapter card upon return
2	RETCODE	1	Set by the adapter card upon return
3		1	Reserved
4	STATION_ID	2	ID of the link station to be closed
6	ROUTING_INFO	18	See below

ROUTING _INFO

Explanation: See the ROUTING_ADDR field of DLC.CONNECT.STATION command on page 3-31.

If there is no immediate error, the adapter card sets the RETCODE field to X'FF' (command in process), sets the CMD_CORRELATE field in the SRB, and interrupts the IBM PC by setting ISRP low bit 2 if an SRB Free Request interrupt is received by the adapter. When the command is completed later, the IBM PC will be interrupted with a response in the SSB. A successful return code indicates that the local link station has entered the Link Opened state. An unsuccessful return code indicates that it has entered the Disconnected state.

If there is an immediate error, the adapter card sets the RETCODE field with the error code and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'FF' Command in process
X'01' Invalid command code
X'02' Duplicate command—one already outstanding
X'04' Adapter closed—should be open
X'40' Invalid STATION_ID
X'41' Protocol error—link in invalid state for command
X'44' Invalid routing information
X'4A' Sequence error—command in process

Final RETCODE in SSB

X'00' Operation completed successfully
X'4D' Unsuccessful link station connection attempt

1D DLC.FLOW.CONTROL

Function: To control the flow of data across a specified link station on a SAP, or every link station on a SAP.

Explanation: Local Busy state is set either because of a user request, or because a RECEIVED.DATA command from the adapter card to the IBM PC has been rejected due to a buffer shortage. In the latter case, the condition must be reset by the IBM PC program when buffers become available, by using this command with option bit 6 set.

This command affects the secondary state of target link stations, causing the Local Busy states to be set or reset. The command will complete successfully even if it makes no change to the existing state. That is, a request to reset Local Busy will be accepted even if the link is not in Local Busy state.

If the STATION_ID is a SAP (X'nn00'), the command will be applied to all link stations included in the SAP. If the STATION_ID is a link station (X'nnss'), the command will be applied only to the specified link station.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'1D' : DLC.FLOW.CONTROL
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		1	Reserved
4	STATION_ID	2	ID of the link station or SAP
6	FLOW_OPTIONS	1	Option byte

- Bit 7: Set/Reset Local Busy State

  If this bit is zero, the related link station(s) will enter the Local Busy link secondary state. If the station is in the Link Opened primary state and not already in Local Busy state, a Receiver Not Ready supervisory frame will be transmitted. Then I Frames received for this station will be discarded until this condition is reset by the application program.

  If this bit is on, option bit 6 will be checked to determine whether Local Busy (user set) or Local Busy (buffer set) should be reset. If both Local Busy states are reset after this command has been accepted and the primary link state is Link Opened, the link will enter either the checkpointing or clearing secondary state to ensure that the remote station is aware that the condition has been reset.

- Bit 6: User/Buffer Reset

  If this bit is zero and option bit 7 is 1, Local Busy (user set) will be reset.

  If this bit is 1 and option bit 7 is 1, Local Busy (buffer set) will be reset.

  If option bit 7 is zero, this bit is ignored.

- Bits 6-0: Reserved

When the adapter card completes the operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'02' Duplicate command—one already outstanding
X'04' Adapter closed—should be open
X'40' Invalid STATION_ID

1C
DLC.MODIFY

Function: To modify certain working values of an open link station or the default values of a SAP.

Explanation: The values to be updated are included in SRB.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'1C' : DLC.MODIFY
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		1	Reserved
4	STATION_ID	2	Set by the adapter card upon return
6	TIMER_T1	1	T1 value — response timer
7	TIMER_T2	1	T2 value — acknowledgment timer
8	TIMER_TI	1	Ti value — inactivity timer
9	MAXOUT	1	Max transmits without a receive acknowledgment
10	MAXIN	1	Max receives without a transmit acknowledgment
11	MAXOUT_INCR	1	Dynamic window increment value
12	MAX_RETRY_COUNT	1	N2 value
13	ACCESS_PRIORITY	1	New access priority for transmission
14	SAP_GSAP_MEM	1	Number of following group SAPs
15	GSAPS	n	GSAP list, maximum 13

STATION _ID

Explanation: If this is a SAP STATION_ID, the command will affect the default values held in the SAP control block, but not the current values of open link stations. If it is a link station STATION_ID, the command will affect the current values of the designated (open) link station.

TIMER _T1 – TIMER_TI

Explanation: These values must be less than 11 for T1 and Ti. If a value greater than 10 is provided for T2, the acknowledgment timer will not run. If the field is zero, the existing value will remain unchanged.

MAXOUT

Explanation: This parameter may not exceed 127. If the field is zero, the existing value will remain unchanged.

MAXIN

Explanation: This parameter may not exceed 127. If the field is zero, the existing value will remain unchanged.

MAXOUT _INCR

Explanation: This parameter may not exceed 255. If the field is zero, the existing value will remain unchanged.

MAX _RETRY_COUNT

Explanation: This parameter may not exceed 255. If the field is zero, the existing value will remain unchanged.

ACCESS _PRIORITY

Explanation: If the requested access priority exceeds the limit authorized for the adapter it will be rejected. The access priority is contained in the 3 low-order bits of this byte.

SAP _GSAP_MEM

Explanation: The number of SAP_VALUES in the GSAPS field. This field is only checked and used if the SAP was opened as a group member. The maximum value is 13. (The most SAP_VALUES that the SRB length will accomodate).

GSAPS

Explanation: This field is used for an individual SAP to request membership in additional group SAPs for an individual SAP, or to request that membership be cancelled. If the low-order bit of a SAP_VALUE is zero, it indicates that additional membership is being requested.. If the low-order bit of a SAP_VALUE is 1, it indicates that membership should be cancelled. The group SAPs must be open when the assignment is requested, and all members of a group SAP must have the same XID handling option selected. If an error is found while processing the list of group SAPs, an error return code will be set and processing will stop. The SAP_GSAP_MEM field will be overwritten with the value of the failing group SAP. Other parameter changes will take place as requested.

SRB Response

When the adapter card completes the modify command, the return code is placed in the RETCODE field. The adapter card then interrupts the IBM PC by setting ISRP low bit 5.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'08' Unauthorized access priority
X'40' Invalid STATION_ID
X'42' Parameter exceeded maximum allowed
X'45' Membership requested in non-existent group SAP
X'49' Group SAP has reached maximum membership
X'4E' Member SAP not found in group SAP list

15 DLC.OPEN.SAP

Function: Open (activate) a service access point (SAP) and allocate an individual SAP control block.

Explanation: A group SAP control block and one or more link station control blocks may also be allocated by this command.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'15' : DLC.OPEN.SAP
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		1	Reserved
4	STATION_ID	2	Set by the adapter card upon return

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
6	TIMER_T1	1	T1 value — response timer
7	TIMER_T2	1	T2 value — acknowledgment timer
8	TIMER_TI	1	Ti value — inactivity timer
9	MAXOUT	1	Max transmits without a receive acknowledgment
10	MAXIN	1	Max receives without a transmit acknowledgment
11	MAXOUT_INCR	1	Dynamic window increment value
12	MAX_RETRY_COUNT	1	N2 value
13	GSAP_MAX_MEM	2	Maximum number of SAPs for a group SAP
14	MAX_I_FIELD	2	Maximum received information field length
16	SAP_VALUE	1	SAP value to be assigned
17	SAP_OPTIONS	1	Option byte — see below
18	STATION_COUNT	1	Number of link stations to reserve
19	SAP_GSAP_MEM	1	Number of members allowed in group SAPs
20	GSAPS	n	GSAP list — maximum = 8

STATION _ID

Explanation: The adapter card will set this to the STATION ID to be used in future commands referencing this SAP.

TIMER _T1 – TIMER_TI

Explanation: These values must be less than 11 for T1 and Ti. If a value greater than 10 is provided for T2, the acknowledgment timer will not run. If the field is zero, the adapter card will provide defaults. The default values are fixed, but their effect depends on the "TICK" values or defaults selected with the DIR.OPEN.ADAPTER command.

MAXOUT

Explanation: This parameter may not exceed 127. If a zero is provided, the default of 2 will be used.

MAXIN

Explanation: This parameter may not exceed 127. If a zero is provided, the default of 1 will be used.

MAXOUT _INCR

Explanation: This parameter may not exceed 255. If a zero is provided, the default of 1 will be used.

MAX _RETRY_COUNT

Explanation: This parameter may not exceed 255. If a zero is provided, the default of 8 will be used.

SAP _VALUE

Explanation: The value that will be used as the source SAP in transmitted frames and recognized as the destination SAP in received frames. The low-order bit of this field will be ignored. A DLC.OPEN.SAP command always allocates an individual SAP control block. A value of X'00' will always be rejected and a value of X'FE' will be rejected if the group SAP option is requested. If option bit 1 is a 1, the SAP_VALUE with the low-order bit set to 1 will be the group SAP value. In other words, the next higher (odd-numbered) SAP control block will be allocated to be a group SAP.

MAX _I_FIELD

Explanation: This parameter defines the maximum length of a received I frame for a link station. If the STATION_COUNT parameter is zero, this field is ignored. If this field is zero, the default will be 600 bytes long. The maximum length is 4905 bytes.

SAP _OPTIONS

Explanation:

Bits 7-5	Priority	The transmission priority for this SAP and its link stations. If the requested priority exceeds the limit authorized for the adapter, the command will be rejected.
Bit 4	Reserved	Should be zero. Not checked.
Bit 3	XID handling option	If this is zero, XID commands are handled by the adapter card. If this is 1, XID commands are passed to the application program.
Bit 2		If this bit is 1, the SAP will handle frames as an individual SAP.
Bit 1		If this bit is 1, the SAP will handle frames as a group SAP.
Bit 0	Group member	If this bit is 1, the SAP may be a member of a group SAP.

STATION _COUNT

Explanation: This parameter specifies the maximum number of link stations that may be open for this SAP at the same time, and applies only if the SAP is an individual SAP. If the number of link stations requested for this SAP, together with those already requested for previously opened SAPs, exceeds the DLC_MAX_STATIONS parameter value from the DIR.OPEN.ADAPTER command, the DLC.OPEN.SAP command will be rejected.

GSAP _MAX_MEM

Explanation: The maximum number of individual SAPs that may be assigned membership in the group SAP if this SAP is designated to be a group SAP as well as an individual SAP. Membership is assigned in the group SAP as the individual SAPs are opened. This parameter may not exceed the similar parameter provided with the DIR.OPEN.ADAPTER command and will default to that value if it is zero.

SAP _GSAP_MEM

Explanation: The number of SAP_VALUES in the GSAPS field. The maximum value is 8.

GSAPS

Explanation: This field is used for an individual SAP to request membership in group SAPs. The SAP_GSAP_MEM parameter indicates the number of valid values in this field. If additional membership is required, the DLC.MODIFY command may be used for the requests. The group SAPs must be open when the assignment is requested, and all members of a group SAP must have the same XID handling option selected. If an error is found while processing the list of group SAPs, an error return code will be set and processing will stop. The SAP_GSAP_MEM field will be overwritten with the value of the failing group SAP. This will not affect the status of the SAP.

SRB Response

When the adapter card completes the open command, the return code is placed in the RETCODE field. The adapter card then interrupts the IBM PC by setting ISRP low bit 5.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'06' Option(s) missing, invalid, or incompatible
X'08' Unauthorized access priority
X'42' Parameter exceeded maximum allowed
X'43' Invalid SAP_VALUE or value already in use
X'45' Membership requested in non-existent group SAP
X'46' Requested resources not available
X'49' Group SAP has reached maximum membership

19 DLC.OPEN.STATION

Function: Allocate resources to support a logical link connection.

Explanation: These resources may also be allocated when a SABME is received against an open SAP and the appropriate station is not already open.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'19' : DLC.OPEN.STATION
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		1	Reserved
4	STATION_ID	2	SAP ID (X'nn00')
6	TIMER_T1	1	T1 value — response timer
7	TIMER_T2	1	T2 value — acknowledgment timer

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
8	TIMER_Ti	1	Ti value — inactivity timer
9	MAXOUT	1	Max transmits without a receive acknowledgment
10	MAXIN	1	Max receives without a transmit acknowledgment
11	MAXOUT_INCR	1	Dynamic window increment value
12	MAX_RETRY_COUNT	1	N2 value
13	RSAP_VALUE	2	The remote SAP value
14	MAX_I_FIELD	2	Maximum received information field length
16	STATION_OPTIONS	1	Option byte — see below
17		1	Reserved
18	REMOTE_ADDRESS	6	Ring address of the remote station

STATION _ID

Explanation: The application program must specify the SAP STATION_ID (X'nn00') and the adapter card will set the link id (ss portion of X'nnss') to be used in future commands referencing this SAP.

TIMER _T1 – MAX_RETRY_COUNT

Explanation: See the same parameters for the DLC.OPEN.SAP command on page 6-62.

SAP _VALUE

Explanation: The value that will be used as the destination SAP in transmitted frames and recognized as the source SAP in received frames. The low-order bit of this field must be zero, indicating an individual SAP. A value of X'00' (the null SAP) will be rejected.

MAX _I_FIELD

Explanation: This parameter defines the maximum length of a received I frame. If this field is zero, the value from the SAP control block will be used.

STATION _OPTIONS

Explanation:

Bits 7-5	Priority	The transmission priority for this link station. If the requested priority exceeds the limit authorized for the adapter, the command will be rejected. If a zero is provided, an access priority of zero is used.
Bits 4-0	Reserved	Should be zero. Not checked.

REMOTE _ADDRESS

Explanation: The 6-byte NODE_ADDRESS of the remote station. The high-order bit of the high-order byte of this field must be zero, indicating a specific address.

SRB Response

When the adapter card completes the open command, the return code is placed in the RETCODE field. The adapter card then interrupts the IBM PC by setting ISRP low bit 5.

This command should be followed by a DLC.CONNECT.STATION command, which should include the routing information if the remote station is on a different ring.

Valid Return Codes:

X'01' Invalid command code
X'04' Adapter closed—should be open
X'05' Required parameter(s) not provided
X'08' Unauthorized access priority
X'40' Invalid STATION_ID
X'42' Parameter exceeded maximum allowed
X'43' Invalid SAP_VALUE or value already in use
X'46' Requested resources not available
X'4F' Invalid remote address

14 DLC.RESET

Function: Reset either one SAP and all associated link stations, or all SAPs and all associated link stations.

Explanation:

After the command is completed the affected SAPs and link stations will be closed. No commands or communication directed to them will be accepted. The reset command will not complete until all related resources can be freed. This means that transmissions already queued to the ring hardware and commands from the adapter card to the IBM PC must be complete before this command will be completed. Frames received for the affected SAPs and link stations but not yet passed to the IBM PC will be discarded by the adapter card. The same is true for frames received while the reset is in progress. Requests queued to SAPs and link stations for which completion is not already in process will not be completed.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'14' : DIR.RESET
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		1	Reserved
4	STATION_ID	2	ID of the SAP(s)/station(s) to be reset X'0000' = all SAPs and all stations X'nn00' = SAP nn and all its stations

When the adapter card completes the operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'40' Invalid STATION_ID

1E
DLC.STATISTICS

Function: Read statistics for a specific link station.

Explanation:

The error counters (first five station statistics) may be reset if requested. If a counter overflows (high-order bit of the field changes from zero to 1), a DLC status adapter request block (ARB) will be presented to the IBM PC, indicating that this command should be issued.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'1E' : DLC.STATISTICS
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		1	Reserved
4	STATION_ID	2	The link station to obtain statistics from
6	COUNTERS_ADDR	2	Address of the statistics *
8	HEADER_ADDR	2	Address of the LAN header *
10	HEADER_LENGTH	1	Length of the LAN header *
10	RESET_OPTION	1	Option byte — see below

* Indicates a value set by the adapter card.

COUNTERS _ADDR

Explanation: An address within the SRB where a copy of the counter contents is located. The IBM PC application program should move this information into IBM PC memory before reusing the SRB.

HEADER _ADDR

Explanation: The address of the LAN header consisting of the access control (AC) field, the frame control (FC) field, the destination address, the source address, and the routing information. If no routing information is present, the header length will be 14 bytes. The source address field will not be set until the first frame is transmitted for the link station, except that the high-order bit of the high-order byte is set on if routing information is present.

RESET _OPTION

Explanation:

Bit 7 If this bit is zero, the adapter will not alter the contents of the error counters. If this bit is 1, the adapter will reset the contents of the error counters.

Bits 6-0 Reserved

The Link Station Statistics

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	I_FRAME_XMIT_COUNT	2	The number of I frames transmitted *
2	I_FRAME_RCV_COUNT	2	The number of I frames received *
4	I_FRAME_XMIT_ERR	1	The number of I frames transmitted with resulting errors *
5	I_FRAME_RCV_ERR	1	The number of I frames received with resulting errors *
6	T1_EXPIRED	2	The number of times T1 expired *

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
8	STATION_RCVD_CMD	1	The last command or response received *
9	STATION_SENT_CMD	1	The last command or response sent *
10	STATION_PRMY_STATE	1	The link primary state — see below *
11	STATION_SCDY_STATE	1	The link secondary state — see below *
12	STATION_VS	1	The send state variable *
13	STATION_VR	1	The receive state variable *
14	STATION_VA	1	The last received NR *

* Indicates a value set by the adapter card.

STATION _PRMY_STATE

Explanation: This field indicates the link station's primary state as maintained in the control block at the time the DLC.STATISTICS command is completed. It consists of eight mutually exclusive bit flags, as follows:

Bit 7: Link Closed
Bit 6: Disconnected
Bit 5: Disconnecting
Bit 4: Link Opening
Bit 3: Resetting
Bit 2: FRMR Sent
Bit 1: FRMR Received
Bit 0: Link Opened

STATION _SCDY_STATE

Explanation: This field indicates the link station's secondary state as maintained in the control block at the time the DLC.STATISTICS command is completed. It consists of seven non-exclusive bit flags, as follows:

Bit 7:	Checkpointing
Bit 6:	Local Busy (user set)
Bit 5:	Local Busy (buffer set)
Bit 4:	Remote Busy
Bit 3:	Rejection
Bit 2:	Clearing
Bit 1:	Dynamic Window Algorithm Running
Bit 0:	Reserved (may appear as 0 or 1)

When the adapter card completes the operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'40' Invalid STATION_ID

Transmit Commands

There is only one basic transmit command with several subcommands indicating the type of data to be transmitted. All the commands have the same format, the only difference being the actual command code.

When a transmit command is presented to the adapter card, it indicates a request to send data. The actual data is not given to the adapter card until the adapter card issues the TRANSMIT.DATA.REQUEST command to the IBM PC.

The processing sequence for transmit commands is:

1. The IBM PC application program issues a Transmit command to the adapter card.

2. The adapter card sets a command correlator and in-process return code in the SRB.

3. The adapter card issues a TRANSMIT.DATA.REQUEST command (X'82') to the IBM PC using the Adapter Request Block (ARB). This command supplies the command correlator, the STATION_ID, and the DHB address in shared RAM where the IBM PC should start to transfer the data.

4. The IBM PC moves the data into the DHB.

5. The IBM PC responds with a command block in the adapter status block (ASB) containing the original transmit command used in the SRB, the command correlator, the STATION_ID, and the transmit data length information.

6. The adapter card transmits the frame.

7. The adapter card sets completion information in the system status block (SSB) on completion of the transmission for the direct and SAP interfaces, or on receipt of acknowledgment, or determination that acknowledgment will not be received for the link station interface. It then interrupts the IBM PC.

The transmit commands are:

COMMAND NAME	CODE
TRANSMIT.DIR.FRAME	X'0A'
TRANSMIT.I.FRAME	X'0B'
TRANSMIT.UI.FRAME	X'0D'
TRANSMIT.XID.CMD	X'0E'
TRANSMIT.XID.RESP.FINAL	X'0F'
TRANSMIT.XID.RESP.FINAL	X'10'
TRANSMIT.TEST.CMD	X'11'

Transmit Summary

- Direct Station

  May use only the TRANSMIT.DIR.FRAME command. No retry is provided.

- SAP Station

  May use all commands except the TRANSMIT.DIR.FRAME and TRANSMIT.I.FRAME commands. No retry is provided.

  The TRANSMIT.XID.RESP commands should be issued only to a SAP that has the XID handling option selected to pass XID frames to the application.

- Link Station

  May use only the TRANSMIT.I.FRAME command. All transmission retry is handled by the adapter card.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'xx' : TRANSMIT.xxx
1	CMD.CORRELATE	1	Set by the adapter card upon return
2	RETCODE	1	Set by the adapter card upon return
3		1	Reserved
4	STATION_ID	2	ID of the station sending the data

If there is no immediate error, the adapter card sets the RETCODE field to X'FF' and sets the command correlator field. The adapter card will interrupt the IBM PC by setting ISRP low bit 2 if an SRB Free Request interrupt is received by the adapter card.

If there is an immediate error, the adapter card sets the RETCODE field with the appropriate code and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'FF' Command in process
X'01' Invalid command code
X'04' Adapter closed—should be open
X'25' Maximum commands exceeded
X'40' Invalid STATION_ID
X'41' Protocol error—link in invalid state for command
X'4A' Sequence error—command in process

When the adapter card completes the transmit command it prepares the system status block (SSB) and interrupts the IBM PC by setting ISRP low bit 2. If more than one TRANSMIT.I.FRAME command is being reported, the command correlate field will contain the correlator for the last command completed.

The SSB will contain:

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'xx' : The transmit command from the SRB
1	CMD.CORRELATE	1	PC/Adapter command correlator
2	RETCODE	1	Completion code
3		1	Reserved
4	STATION_ID	2	ID of the station providing status
6	TRANSMIT_ERROR	1	If RETCODE=X'22' the returned FS byte

SSB Return Codes

Valid Return Codes:

X'00' Operation completed successfully
X'08' Unauthorized access priority
X'22' Error on frame transmission—check TRANSMIT_FS data
X'23' Error in frame transmit or strip process

X'24' Unauthorized MAC frame
X'27' Link not transmitting I frames—state changed from link opened
X'28' Invalid transmit frame length command

Adapter-to-IBM PC Commands

The commands listed below, in alphabetical order, may be issued to the IBM PC by the adapter card.

The commands have the following in common:

- The adapter card prepares the command in the ARB and interrupts the IBM PC by setting ISRP low bit 3.
- The IBM PC reads the command information and interrupts the adapter card by setting ISRA low bit 1 to acknowledge receipt of the command and indicate that the adapter may reuse the ARB.
- If a response is required, the IBM PC will put the response information in the ASB and interrupt the adapter card by setting ISRA low bit 4.
- After reading the ASB response the adapter card will either:
  - Set the return code to X'FF' and interrupt the IBM PC by setting ISRP low bit 4 if the ASB Free Request interrupt bit is set, or
  - Set a return code indicating that an error has been detected and interrupt the IBM PC by setting ISRP low bit 4 regardless of the state of the ASB Free Request interrupt bit.

The Adapter to IBM PC Commands are:

COMMAND NAME	CODE
DLC.STATUS	X'83'
RECEIVED.DATA	X'81'
RING.STATUS.CHANGE	X'84'
TRANSMIT.DATA.REQUEST	X'82'

83
DLC.STATUS

Function: The adapter card is indicating a change in DLC status to the IBM PC.

Explanation: When the IBM PC has read the command information from the ARB, it will interrupt the adapter card by setting ISRA bit 1 to acknowledge receipt of the command and indicate that the adapter may reuse the ARB. No response is required for this command. However, refer to "Suggested Actions in Response to DLC Status" on page 7-25.

The ARB content is:

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'83' : DLC.STATUS
1		3	Reserved
4	STATION_ID	2	ID of the SAP(s)/station(s) presenting status
6	STATUS	2	DLC status indicator — see below
8	FRMR_DATA	5	Data sent/received with FRMR response
13	ACCESS_PRIORITY	1	New access priority for SAP/Station
14	REMOTE_ADDRESS	6	The physical ring address of the remote station
21	RSAP_VALUE	1	Remote station's SAP_VALUE

STATUS

More than 1 bit may be set in the status word if the adapter card had to wait for the ARB to become available. The bit meanings are:

Bit 15:	Link lost
Bit 14:	DM or DISC received, or DISC acknowledged
Bit 13:	FRMR received
Bit 12:	FRMR sent
Bit 11:	SABME received for an open link station
Bit 10:	SABME received, link station opened
Bit 9:	Remote station has entered Local Busy state
Bit 8:	Remote station has left Local Busy state
Bit 7:	Ti Timer has expired
Bit 6:	DLC counter overflow
Bit 5:	Access priority reduced
Bit 4-0:	Reserved

81 RECEIVED.DATA

Function: This command informs the IBM PC that data for a particular STATION_ID has been received. The data must be moved from the receive buffers in shared RAM and placed into buffers in IBM PC memory.

Explanation: When the IBM PC has completed processing the RECEIVED.DATA command, it will provide a return code in the ASB and interrupt the adapter card by setting ISRA low bit 4. If the return code is X‘20’, and the frame was an I frame destined for a link station, the adapter card will set Local Busy state (buffer set) for the affected link station. It is the IBM PC application program’s responsibility to determine whether or not receipt of a partial I frame is acceptable, and also to reset the local-busy state when buffers become available.

The ARB content is:

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'81' : RECEIVED.DATA
1		3	Reserved
4	STATION_ID	2	ID of the receiving station — see below
6	RECEIVE_BUFFER	2	Address of the first receive buffer in RAM
8	LAN_HDR_LENGTH	1	The length of the LAN header field
9	DLC_HDR_LENGTH	1	The length of the DLC header field
10	FRAME_LENGTH	2	Length of the entire frame
12	MSG_TYPE	1	Category of the message received — see below

STATION_ID

This field will indicate the link station, the SAP, or (if X'0000') the direct station that the data is destined for.

DLC_HDR_LENGTH

This is the actual DLC header length if the message is a non-MAC frame and the destination is either a SAP or a link station.

It is equal to X'00' if the message is either a MAC frame or a non-MAC frame and the destination is the direct station.

MSG_TYPE

X'02': MAC frame

X'04': I frame
X'06': UI frame
X'08': XID command poll
X'0A': XID command not-poll
X'0C': XID response final
X'0E': XID response not-final
X'10': TEST response final
X'12': TEST response not-final
X'14': Other or unidentified

The ASB Response from the IBM PC

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'81' : RECEIVED.DATA
1		1	Reserved
2	RETCODE	1	Return (completion) provided by the IBM PC program
3		1	Reserved
4	STATION_ID	2	ID of the station receiving data
6	RECEIVE_BUFFER	2	Address of the first receive buffer in RAM

Return Code to the Adapter Card

X'00': Operation completed successfully
X'20': Lost data on receive — no buffers available

Return Code to the IBM PC

X'FF': Response valid — ASB available
X'01': Unrecognized command code
X'26': Unrecognized command correlator
X'40': Invalid STATION_ID

Note: For this response only, "Unrecognized command correlator" means that the receive buffer address is not that which is expected by the adapter card.

The Received Data

Received data is held in the adapter card shared RAM in one or more receive buffers, depending on the length of the frame. The address of the first, or only, receive buffer will be provided to the IBM PC in the ARB with the RECEIVE.DATA command. In the last, or only, buffer containing the frame, bytes 2 and 3 will contain X'0000', otherwise they will contain the address of the next buffer plus 2 bytes.

The Receive Buffer Format

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0		2	Reserved
2	BUFFER_POINTER	2	Address of the next buffer plus 2, or zero if this is the last buffer
4		1	Reserved
5	RECEIVE_FS	1	FS/Address match (last buffer only)
6	BUFFER_LENGTH	2	Length of the data in this buffer
8	FRAME_DATA	n	Frame data

RECEIVE_FS

Bit 7: Address recognized indicator
Bit 6: Frame copied indicator
Bit 5: Reserved
Bit 4: Reserved
Bit 3: Address recognized indicator
Bit 2: Frame copied indicator
Bit 1-0: Reserved

84
RING.STATUS.CHANGE

Explanation: The adapter card is indicating a change in the ring status to the IBM PC.

The status provided with this command is the current ring status and may possibly equal the last status if the adapter card has had to wait for the ARB to become available.

When the IBM PC has read the command information from the ARB, it will interrupt the adapter card by setting ISRA low bit 1 to acknowledge receipt of the command and indicate that the adapter may reuse the ARB. No response is required for this command.

The ARB content is:

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'84' : RING.STATUS.CHANGE
1		5	Reserved
6	RING_STATUS	2	Current ring status — See "Ring Status" on page 7-47

82
TRANSMIT.DATA.REQUEST

Explanation: This command informs the IBM PC that data for a transmit command previously issued by the IBM PC is needed.

When the IBM PC has read the command information from the ARB, it will interrupt the adapter card by setting ISRA low bit 1 to acknowledge receipt of the command and indicate that the adapter may reuse the ARB.

Commands to the IBM PC

When the IBM PC has completed processing the TRANSMIT.DATA.REQUEST command, it will provide a return code in the ASB and interrupt the adapter card by setting ISRA low bit 4. Only a successful return code is expected by the adapter card in response to this request. The IBM PC program should make sure that the transmit request is valid before issuing the original command to the adapter card.

The ARB content is:

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'82' : TRANSMIT.DATA.REQUEST
1	CMD_CORRELATE	1	PC/Adapter card command correlator
2		2	Reserved
4	STATION_ID	2	ID of the sending station
6	DHB_ADDRESS	2	The address of the DHB to put the data in

The DHB Contents after the Data Move

1. TRANSMIT.I.FRAME

   This is the data to be transmitted. The adapter card provides the LAN and DLC headers.

2. TRANSMIT.DIR.FRAME

   This is the entire message, including the LAN and any additional headers with space reserved for the LAN source address to be inserted by the adapter card. If the LAN header contains routing information, the IBM PC must set the high-order bit of the high-order byte of the source address field on.

3. All other commands

   These include the LAN header with space reserved for the LAN source address to be inserted by the adapter card, followed by 3 bytes reserved for the adapter card to insert the DLC header, followed by the data. The adapter card will determine whether or not the LAN header includes routing information by checking the length field in the ASB accompanying the DHB.

The ASB Response from the IBM PC

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	The transmit command as provided in the original SRB command
1	CMD_CORRELATE	1	PC/Adapter card command correlator
2	RETCODE	1	return (completion) provided by the IBM PC program
3		1	Reserved
4	STATION_ID	2	ID of the station sending data
6	FRAME_LENGTH	2	Length of the entire frame
8	HEADER_LENGTH	1	Length of the LAN header — required only for a SAP
9	RSAP_VALUE	1	Remote SAP — the DSAP in the transmitted frame — required only for a SAP

Return Code to the Adapter Card

X'00': Operation completed successfully

Commands to the IBM PC

Return Code to the IBM PC

X'FF':	Response valid – ASB available
X'01':	Unrecognized command code
X'26':	Unrecognized command correlator
X'40':	Invalid STATION_ID

Additional Functions of the Adapter II

The IBM Token-Ring Network Adapter II provides additional functions and capabilities not provided by the IBM Token-Ring Network Adapter. They are:

- 8K bytes of additional shared RAM for a total of 16K bytes
- Bridge functions for passing frames between rings
- Additional NETBIOS capabilities
- An additional DLC command.

The additional 8K bytes of shared RAM can be used for additional SAP and link station control blocks and for additional buffers when the bridge functions are not being used.

The additional functions are described in the following sections.

The Bridge Functions

By using two IBM Token-Ring Adapter II cards in one IBM PC, each connected to a separate ring, a bridge application program can forward frames from either ring to the other. This is called a bridge between the two rings.

The bridge function is provided by:

- Two additional SRB commands: X'09' and X'0C'
- An additional ARB command: X'85'
- Two additional areas in shared RAM
  - Bridge transmit control area
  - Bridge transmit buffers
- Two additional interrupt status register bits, ISRA low bit 6 and ISRP low bit 1.

A DIR.CONFIG.BRIDGE.RAM command must be issued prior to the DIR.OPEN.ADAPTER command. This ensures that the shared RAM will be prepared with the bridge transmit areas allocated when the open is performed.

After the adapter has been opened, a DIR.SET.BRIDGE.PARM command must be issued to enable frames to be received for forwarding.

An adapter that is opened for bridge functions interrogates all frames passing on the ring. Any received frame that does not have any other address match for the adapter and has a routing information (RI) field is to be forwarded. See the *IBM Token-Ring Network Architecture Reference* for more about routing frames.

When the adapter receives a frame from the ring for forwarding, the adapter issues an ARB command (the RECEIVE.BRIDGE.DATA command) to the IBM PC.

The application program must move the frame data from the receive buffers of the receiving adapter in shared RAM to the transmit buffers in the shared RAM of the adapter connected to the other ring. Then the application program must inform the receiving adapter that the frame has been accepted by responding to the ARB with an ASB.

The application program must set ISRA low bit 6 to initiate transmitting the frame now in the bridge transmit buffer in shared RAM of the transmit adapter. When the adapter has completed transmitting the frame, it sets ISRP low bit 1 to inform the application program.

The bridge transmit control area is used during the transmission to monitor buffer use and availability.

Shared RAM Layout for Bridge Use

The Adapter II will assign locations in shared RAM when the adapter is opened for bridge use in a format such as this:

Beginning of shared RAM

PC read-only address space	Adapter private variables and work areas Length: 1496 bytes
	System status block (SSB) Length: 20 bytes
	Adapter request block (ARB) Length: 28 bytes
	Receive buffers Length: space remaining after all SAPs/Stations are defined
	SAP and link station control blocks Length: as defined by maximum number of SAPs/Stations
PC read/write address space	Data holding buffer (DHB) Length: as specified at open adapter time. There may be one or more DHBs.
	System request block (SRB) Length: 28 bytes
	Adapter status block (ASB) Length: 12 bytes
	Bridge transmit control area Length: 16 bytes
	Bridge transmit buffers Length: Defined by the DIR.CONFIG.BRIDGE.RAM command

End of shared RAM

The bridge transmit control area and the bridge transmit buffers are the additional fields defined in shared RAM for bridge functions.

If the bridge function of the Adapter II is not activated, all of the additional 8K bytes of shared RAM are available for SAP and link station control blocks and for buffers.

The Bridge Commands

The following two commands are provided to allow the use of the bridge functions of the IBM Token-Ring Network PC Adapter II.

COMMAND NAME	CODE
DIR.SET.BRIDGE.PARMS	X'09'
DIR.CONFIG.BRIDGE.RAM	X'0C'

09 DIR.SET.BRIDGE.PARMS

Function: This command provides values and conditions for the adapter to use when copying frames for forwarding.

Explanation: A DIR.CONFIG.BRIDGE.RAM command must have previously been completed successfully and the adapter must be open for this command to be accepted. A return code of X'05' (Required parameter[s] not provided) is returned if the DIR.CONFIG.BRIDGE.RAM command was not previously completed successfully. The adapter does not check for parameters missing from this command.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'09' : DIR.SET.BRIDGE.PARMS
1		1	Reserved
2	RETCODE	1	Set by the adapter upon return
3		3	Reserved
6	SOURCE_RING	2	Source ring number
8	TARGET_RING	2	Target ring number
10	BRIDGE_NUMBER	2	Individual bridge number
12	PARTITION_BITS	1	Number of partition bits
13	LMTD_BROADCAST	1	Limited broadcast path indicator
14	TOKEN_PRIORITY	1	Access priority for forwarding frames

SOURCE _RING

Explanation: The adapter compares the value in this field with the routing information source ring field in frames received from the ring when determining if the frame is to be forwarded. This value must be the number of the ring to which this adapter is connected. For instance, the valid range of values is X'001' to 'FFF' if the PARTITION_BITS parameter value is 4. The SOURCE_RING value must be different from the TARGET_RING value.

Note: *All bridges connected to a specific ring must refer to the ring with the same ring number value.*

TARGET _RING

Explanation: The adapter compares the value in this field with the routing information target ring field in frames received from the ring when determining if the frame is to be forwarded. This value must be the number of the ring to which the other adapter in this IBM PC is connected. For instance, the valid range of values is X'001' to 'FFF' if the PARTITION_BITS parameter value is 4. The TARGET_RING value must be different from the SOURCE_RING value. See the note above.

BRIDGE _NUMBER

Explanation: The adapter compares the value in this field with the routing information bridge number field in frames received from the ring when determining if the frame is to be forwarded.

PARTITION _BITS

Explanation: The value in this field is used to determine what portion of each 2-byte segment in the routing information field contains the bridge number. A value of 4 indicates that the low-order 4 bits of the segment is the bridge number. The remaining 12 bits contain the ring number. There is no default value for this field. The application program is responsible for maintaining a validity check on the value used. All bridges in the network must use the same value for this field or its equivalent. See "Routing Control Field" in the *IBM Token-Ring Network Architecture Reference.*

LIMITED _BROADCAST

Explanation: The value in this field is used to determine the handling of limited broadcast frames that are received. If the value is zero, limited broadcast frames will be discarded. If the value is other than zero, limited broadcast frames will be forwarded.

TOKEN _PRIORITY

Explanation: This value indicates the priority token that can be captured or requested for bridge forward frame use. The maximum value allowed is 4. A value greater than 4 will cause a return code of X'08' (Unauthorized access priority).

This parameter does not affect the priority of frames sent by the application program using the standard transmit buffer path. Refer to the transmit command section from page 3-68 to page 3-77.

SRB Response

When the adapter completes the DIR.SET.BRIDGE.PARMS operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed—should be open
X'05' Required parameter(s) not provided
X'08' Unauthorized access priority

0C DIR.CONFIG.BRIDGE.RAM

Function: This command tells the adapter how much shared RAM to allocate for bridge transmit control area and buffers.

Explanation: The adapter must have been initialized and must not be open for this command to be accepted. When subsequent commands are issued, the conditions enabled by this command are incorporated.

In addition to the allocation of shared RAM, this command:

- Forces the bridge functional address to be set by a subsequent DIR.OPEN.ADAPTER or DIR.SET.FUNCTIONAL.ADDRESS command independent of the value provided by the command.

Once set, this functional address can be reset only by either closing and reinitializing the adapter, or issuing a DIR.CONFIG.BRIDGE.RAM command with a RAM size of zero.

- Allows the ring parameter server (RPS) functional address to be set by a subsequent DIR.OPEN.ADAPTER or DIR.SET.FUNCTIONAL.ADDRESS command.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'0C' : DIR.CONFIG.BRIDGE.RAM
1		1	Reserved
2	RETCODE	1	Set by the adapter card upon return
3		5	Reserved
8	RAM_SIZE	2	The amount of RAM for bridge transmit space

RAM _SIZE

Explanation: The number of 8-byte blocks of shared RAM to dedicate for bridge transmit buffers and the associated bridge transmit control area. The transmit buffers will be formatted identically to the receive buffers when the adapter is opened. The minimum value for this field is 3 (24 bytes).

SRB Response

When the adapter completes the command, it sets return values in SRB bytes 8 through 11 and the return code is placed in the RETCODE field. The adapter then interrupts the IBM PC by setting ISRP low bit 5. The SRB content will then be as follows.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'0C' : DIR.CONFIG.BRIDGE.RAM
1		1	Reserved
2	RETCODE	1	Return code - See below
3		5	Reserved
8	BRIDGE_XMIT	2	Address of bridge transmit control area
10	SRB_ADDRESS	2	Address of the SRB

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'03' Adapter open—should be closed

The Additional Adapter-to-IBM PC Command

An additional ARB command is provided by the IBM Token-Ring Network PC Adapter II for notification of frames received for bridge forwarding.

85

RECEIVED.BRIDGE.DATA

Function: This command informs the IBM PC that the adapter has received a frame that does not have any other address match for the adapter (such as specific, group, or functional address match) and has an RI field.

Explanation: All frames received by the adapter as bridge frames will be given to the IBM PC via the direct interface (station X'0000'). Therefore, until the IBM PC issues an ASB response to the RECEIVE.BRIDGE.DATA ARB command, no other ARB interrupts for data received on the direct interface can be issued to the IBM PC. This includes both MAC and additional frames to be forwarded.

The application program must set ISRA low bit 1 to indicate that the command has been read from the ARB. After the application program has completed processing the command and written the ASB, ISRA low bit 4 must be set to indicate completion to the adapter.

Frames that have a destination address match are passed to the IBM PC via the normal RECEIVE.DATA ARB (X'81'). The application program must determine if these frames are to be received, forwarded, or both.

The ARB contains:

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'85' : RECEIVE.BRIDGE.DATA
1		3	Reserved
4	STATION_ID	2	ID of the receiving station — always X'0000'
6	RECEIVE_BUFFER	2	Address of the first receive buffer in RAM
8	LAN_HDR_LENGTH	1	The length of the LAN header field
9		1	Reserved
10	FRAME_LENGTH	2	Length of the entire frame (including CRC)
12	MSG_TYPE	1	Category of the message received — always X'14' (other)

Note: The last 4 bytes of data in the receive buffer for a frame received via a RECEIVE.BRIDGE.DATA (X'85') ARB are the received CRC.

The ASB Response from the IBM PC

The application program should respond to the RECEIVE.BRIDGE.DATA (X'85') ARB with a RECEIVED.DATA (X'81') ASB as shown here.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'81' : RECEIVED.DATA
1		1	Reserved
2	RETCODE	1	Return (completion) provided by the IBM PC program
3		1	Reserved
4	STATION_ID	2	ID of the station receiving data — always X'0000' (direct interface)
6	RECEIVE_BUFFER	2	Address of the first receive buffer in RAM

Return Code to the Adapter

X'00': Operation completed successfully

Return Code to the IBM PC

X'FF': Response valid — ASB available
X'01': Unrecognized command code
X'26': Unrecognized command correlator
X'40': Invalid STATION_ID

Note: For this response only, "Unrecognized command correlator" means that the receive buffer address is not that which is expected by the adapter.

The Received Data

See the RECEIVED.DATA ARB command description for details about the receive buffers.

Transmitting Bridge Forwarded Frames

Transmitting frames forwarded by a bridge application program using the Adapter II is performed differently than normal transmitting. The frame data can be moved directly from the receive buffers in the shared RAM of the receiving adapter to the transmit buffers in the shared RAM of the transmit adapter.

The bridge transmit control area allows the adapter and the application program to jointly manage the transmit buffer pool. The locations of the bridge transmit control area and the bridge transmit buffers in shared RAM are available at the completion of the DIR.CONFIG.BRIDGE.RAM SRB command.

The Bridge Transmit Control Area

The format of the 16-byte bridge transmit control area is:

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0		2	Reserved
2	INPUT_COUNT	1	Count of the buffers in use by the IBM PC
3	OUTPUT_COUNT	1	Count of the buffers transmitted by the adapter
4	RETURN_COUNT	1	Count of the buffers returned to the IBM PC by the adapter after transmission
5		1	Reserved for IBM PC use
6	MAX_BUFFERS	2	The total number of bridge transmit buffers
8	NEXT_BUFFER	2	The address of the next available buffer
10	OLD_BUFFER	2	The address of the buffer containing the next data to transmit
12		4	Reserved for adapter work area

INPUT _COUNT

Explanation: This field must be set by the application program to indicate the number of bridge transmit buffers filled. The adapter may only read this field.

OUTPUT _COUNT

Explanation: This field is set by the adapter to indicate the number of buffers that have been transmitted (successfully or unsuccessfully). The IBM PC may only read this field.

RETURN _COUNT

Explanation: This field is set by the application program to indicate the number of buffers that have been returned after transmission by the adapter. The adapter does not use this field.

MAX _BUFFERS

Explanation: This field contains the total number of bridge transmit buffers formatted when the adapter is opened with the bridge functions active. The IBM PC may only read this field.

NEXT _BUFFER

Explanation: When the adapter is opened it sets this field with the address in shared RAM of the first bridge transmit buffer. Thereafter, the adapter will neither read nor write this field.

OLD _BUFFER

Explanation: When the adapter is opened it sets this field with the address in shared RAM of the first bridge transmit buffer (the same as the NEXT_BUFFER field). Thereafter, the adapter will neither read nor write this field.

Initiating Transmission

The application program must follow these steps to transmit frames using the bridge transmit control area.

1. Determine the number of transmit buffers that are currently available by the following calculation using 8-bit unsigned arithmetic.
   Number of buffers available = MAX_BUFFERS - INPUT_COUNT + RETURN_COUNT

2. If buffers are available, the application program then fills the data area of the buffer(s), sets the BUFFER_LENGTH field to the length of data in the buffer, and sets the XMIT_CONTROL field in the buffer appropriately (see "The Bridge Transmit Buffer Layout" on page 6-105).

   If an insufficient number of buffers are available to hold the entire frame to be transmitted, the application program may fill the available buffers and wait until additional buffers become available. The application program must not update the INPUT_COUNT field until the entire frame is copied into the bridge transmit buffers and the "last-buffer-indicator" bit in the XMIT_CONTROL field has been set.

3. After the application program has placed an entire frame into the bridge transmit buffers, it must update the bridge transmit control area as follows:

   - It must update the NEXT_BUFFER field to point to the next available buffer (that is, the contents of the BUFFER_POINTER field of the last buffer used are stored in the NEXT_BUFFER field of the bridge transmit control area).

   - It must increment the INPUT_COUNT field by the number of bridge transmit buffers used by the frame.

The application program must ensure that the "last-buffer-indicator" bit in the XMIT_CONTROL field has been set in the last buffer before updating the INPUT_COUNT field.

Note: Failure to do this can result in an adapter check with a reason code of X'0001' (program-detected error).

4. The application program should then set the frame forward request (ISRA low bit 6) to indicate to the adapter that a bridge frame is ready for forwarding.

   After the adapter has transmitted the frame (successfully or unsuccessfully) it will update the OUTPUT_COUNT field of the bridge transmit control area and set the frame forward complete (ISRP low bit 2) bit to interrupt the IBM PC.

5. The application program must then update its fields in the bridge transmit control area so that joint buffer management may be maintained. For example, it would set the RETURN_COUNT field equal to the OUTPUT_COUNT field value.

   Note: The BUFFER_POINTER field of the last buffer of a frame always points to the first buffer of the next frame to be transmitted, because the bridge transmit buffers are linked in a circular queue.

The Bridge Transmit Buffer Layout

Bridge frames are transmitted out of special buffers dedicated to bridge traffic. These buffers are formatted when the adapter is opened with bridge functions selected and are the same length as the receive buffers in that adapter. If both adapters are opened with the same parameters, the logic required to copy frames from the receive buffers of one adapter to the transmit buffers of the other is minimal.

There are two formats for the bridge transmit buffers: one for buffers filled by the application program with the frame to forward and another for the buffers that are returned to the IBM PC after the adapter has transmitted the frame. The formats for the buffers are:

The Bridge Transmit Buffers (before transmission)

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	FRAME_LENGTH	2	The length of the entire frame (including CRC) — In first buffer only
2	BUFFER_POINTER	2	Address of the next buffer plus 2
4	XMIT_CONTROL	1	Control bits
5		1	Reserved
6	BUFFER_LENGTH	2	Length of the data in this buffer
8	FRAME_DATA	n	Frame data

FRAME _LENGTH

Explanation: This field must be set by the application program to indicate the entire length of the frame to be transmitted. This field is valid in only the first buffer of the frame. The field is reserved in the remainder of buffers for the frame.

BUFFER _POINTER

Explanation: This field points to the BUFFER_POINTER field of the next available bridge transmit buffer. This field must not be altered by the application program. It must only be interrogated.

XMIT _CONTROL

Explanation: This field is set by the application program to control the CRC generation and to flag the last buffer of a frame. The bit meanings are:

Bits 7-5: Reserved
Bit 4: CRC Generation (required in first buffer only)
0 = CRC is to be calculated by the adapter and inserted after the buffer data.
1 = The last 4 bytes of data in the last buffer for the frame are the CRC to be sent with the frame.
Bits 3-1: Reserved
Bit 0: Last buffer indicator
0 = There are additional buffer(s) for the frame.
1 = This is the last buffer for the frame.

BUFFER _LENGTH

Explanation: This field contains the total number of bytes to be transmitted from this buffer.

The Bridge Transmit Buffers (after transmission)

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	LAST_BUFFER	2	The address of the last buffer in the frame, plus 2 — first buffer only
2	BUFFER_POINTER	2	Address of the next buffer plus 2
4	XMIT_STATUS	1	Transmit completion status — last buffer only

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
5	STRIP_FS	1	The FS byte as removed from the frame — last buffer only
6	FRAME_LENGTH	2	Length of the entire frame (including CRC) — last buffer only
8	NUMBER_BUFFERS	1	The number of buffers in the frame — last buffer only
9		n	Data area

LAST _BUFFER

Explanation: This field contains the address of the BUFFER_POINTER field of the last buffer in the transmitted frame. This field is valid in only the first buffer of the frame. The field is reserved in the remainder of buffers for the frame.

BUFFER _POINTER

Explanation: This field points to the BUFFER_POINTER field of the next available bridge transmit buffer.

XMIT _STATUS

Explanation: This field is set by the adapter to indicate the transmit completion status of the frame. The bit meanings are:

Bit 7: Purge indicator
0 = The frame has not been purged.
1 = The frame was not transmitted but was purged from the transmit queue by the adapter. The adapter may purge frames from the transmit queue under three conditions:

1. The ring the adapter is connected to is beaconing.
2. The source routing indicator bit in the source address field is not set.
3. The frame is a MAC frame with a source class and destination class of "ring station."

When this bit is set, all other status bits except the "last-buffer-indicator" are invalid.

Bit 6: Strip frame error detect (SFED)
When this bit is set, the adapter detected a transmission error when removing the frame from the ring.

Bit 5: Strip error detect indicator (SEDI)
This bit is a representation of the error-detected bit found in the ending delimiter (ED) byte of the frame after transmission.

Bits 4-1: Transmit completion code 4-1
These bits represent a transmit completion code which is placed into the last transmit buffer of a frame. The field definitions are:

Bits 4-3 - Parallel completion

00 = Good completion
01 = DMA parity error
10 = DMA underrun
11 = Next buffer available

Bits 2-1 - Serial completion

00 = Good completion
01 = PTT timeout
10 = Corrupted token
11 = Either an implicit or explicit abort was stripped

Bit 0: Last buffer indicator
This bit is always set to indicate the last buffer of a transmitted frame.

STRIP _FS

Explanation: This field contains the frame status (FS) byte of the frame after transmission. This field is valid for only the last buffer of a frame. It is valid only when the purge bit in the XMIT_STATUS field is zero.

FRAME _LENGTH

Explanation: This field contains the value of the FRAME_LENGTH field before the frame was transmitted. This field is valid for only the last buffer of a frame.

NUMBER _BUFFERS

Explanation: This field contains the number of bridge transmit buffers used for the frame. This field is valid for only the last buffer of a frame.

Note: This field overwrites the first byte of data in the last buffer of the frame.

The Reallocate Function

The IBM Token-Ring Network PC Adapter II provides an additional DLC command function.

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DLC.REALLOCATE

Function: This command provides the capability to reallocate link station control blocks.

Explanation: A given number of closed link station control blocks can be removed from a SAP and returned to the adapter pool, or removed from the adapter pool and added to a SAP.

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
0	COMMAND	1	X'17' : DLC.REALLOCATE
1		1	Reserved
2	RETCODE	1	*
3		1	Reserved
4	STATION_ID	2	The affected SAP
6	OPTION_BYTE	1	Add/subtract option — see below

OFF-SET	PARAMETER NAME	BYTE LEN	DESCRIPTION
7	STATION_COUNT	1	The number of link station control blocks to move
8	ADAPTER_COUNT	1	The number of link station control blocks for the adapter *
9	SAP_COUNT	1	The number of link station control blocks for the SAP *

* Indicates a returned value set by the adapter.

OPTION _BYTE

Explanation:

Bit	Value	Meaning
7	0	Take the link station control blocks from the adapter pool and add them to the SAP.
	1	Take the link station control blocks from the SAP and add them to the adapter pool.
6-0		Reserved

STATION _COUNT

Explanation: The number of link station control blocks to be moved as indicated by the OPTION_BYTE. If more control blocks are requested than are available in the adapter pool or SAP, all those available will be moved.

ADAPTER _COUNT

Explanation: The number of link station control blocks available for the adapter (that is, not allocated to a SAP) after the command has completed. This field is valid only if the command completed with a return code of X'00' or X'40'

SAP _COUNT

Explanation: The number of link station control blocks available for the SAP specified in the STATION_ID field (that is, not in use for an open station) after the command has completed. This field is valid only if the return code is X'00'.

SRB Response

When the adapter completes the operation, it sets the return code in the SRB and interrupts the IBM PC by setting ISRP low bit 2.

Valid Return Codes:

X'00' Operation completed successfully
X'01' Invalid command code
X'04' Adapter closed–should be open
X'40' Invalid STATION_ID

Added NETBIOS Capabilities

The IBM Token-Ring Network PC Adapter II provides an additional option for NETBIOS use. The number of sessions allowed is increased from 32 to 64.

To use the additional sessions, the application program using the NETBIOS Program must issue a DIR.INITIALIZE command and a DIR.OPEN.ADAPTER command prior to any MCB commands being issued. The following parameters provided with the DIR.OPEN.ADAPTER command must all be set to the requested number of sessions (for example, 64).

- The MSG_STATIONS parameter of the MSG_PARMS table
- The MSG_MAX_SESSIONS parameter of the MSG_PARMS table
- The DLC_MAX_STA parameter of the DLC_PARMS table.

MCB commands can then be issued.

The number of sessions allocated can be verified by interrogating the "configured maximum pending sessions" field provided by the MSG.STATUS command.

If a MSG.RESET command is issued with the MSG OPTION bit off, the number of sessions will remain unchanged. If the MSG OPTION bit is on, the maximum number of sessions that can be defined will be 32. The adapter must be closed and explicitly reopened as explained above to again obtain the larger number of sessions for NETBIOS use.

Chapter 7. Return Codes

This chapter includes:

- DLC and direct return codes
- NETBIOS return codes
- Other reason and status codes
- Exception indications
- Formats of special returned tables

DLC and Direct Interface Return Codes (CCB_RETCODE)

Hex Code	Meaning
00	Operation completed successfully
01	Invalid command code
02	Duplicate command—one already outstanding
03	Adapter open—should be closed
04	Adapter closed—should be open
05	Required parameter(s) not provided
06	Option(s) invalid or incompatible
07	Command canceled—unrecoverable failure
08	Unauthorized access priority
09	Adapter not initialized—should be initialized
0A	Command canceled by user request
0B	Command canceled—adapter closed while command in progress
0C	Command completed successfully—adapter not open
0D	Reserved
10	Adapter open—NETBIOS Interface not operational
11	DIR.TIMER.SET or DIR.TIMER.CANCEL error
12	Available work area exceeded
13	Invalid LOG.ID
14	Invalid shared RAM segment or size
15	Lost log data, inadequate buffer space—log reset
16	Requested buffer size exceeds pool length
17	Command invalid—NETBIOS Interface operational
18	Invalid buffer length
19	Inadequate buffers available for request
1A	User length too large for buffer length
1B	The CCB_PARM_TAB pointer is invalid
1C	A pointer in the CCB parm table is invalid
1D	Invalid CCB_ADAPTER value
20	Lost data on receive—no buffers available

Figure 7-1 (Part 1 of 2). DLC and Direct Interface Command Return Codes

Hex Code	Meaning
21	Lost data on receive—inadequate buffer space
22	Error on frame transmission—check TRANSMIT.FS data
23	Error in frame transmit or strip process
24	Unauthorized MAC frame
25	Maximum commands exceeded
26	Unrecognized command correlator
27	Link not transmitting I frames—state changed from link opened
28	Invalid transmit frame length
2D	Reserved
30	Inadequate receive buffers for adapter to open
31	Reserved
32	Invalid NODE_ADDRESS
33	Invalid adapter receive buffer length defined
34	Invalid adapter transmit buffer length defined
40	Invalid STATION_ID
41	Protocol error—link in invalid state for command
42	Parameter exceeded maximum allowed
43	Invalid SAP_VALUE or value already in use
44	Invalid routing information field length
45	Requested group membership in non-existent group SAP
46	Resources not available
47	SAP cannot close unless all link stations are closed
48	Group SAP cannot close—individual SAPs not closed
49	Group SAP has reached maximum membership
4A	Sequence error: incompatible command in progress
4B	Station closed without remote acknowledgment
4C	Sequence error—cannot close, DLC commands outstanding
4D	Unsuccessful link station connection attempted
4E	Member SAP not found in group SAP list
4F	Invalid remote address—may not be a group address
FF	Command in progress

Figure 7-1 (Part 2 of 2). DLC and Direct Interface Command Return Codes

DLC Interface Return Code Descriptions

Hex 00

Explanation: Operation completed successfully.

Hex 01

Explanation: Invalid command code.

Cause: CCB_COMMAND did not contain a recognized command code.

Action: Try again, using a valid command.

Hex 02

Explanation: Duplicate command—one already outstanding.

Cause: Only one command of this type may be outstanding at one time.

Action: Wait for the previously issued command to complete.

Hex 03

Explanation: Adapter open—should be closed.

Cause: This command may be issued only when the adapter is not open.

Action: Close the adapter or issue the correct command.

Hex 04

Explanation: Adapter closed—should be open.

Cause: This command may be issued only when the adapter is open.

Action: Open the adapter.

Hex 05

Explanation: Required parameter(s) not provided.

Cause: At least one required parameter for which no default is available is coded as zero.

Action: Correct the value and try again.

Hex 06

Explanation: Option(s) invalid, or incompatible.

Cause: The options selected are not a valid combination. For example, this return code may be set if an attempt is made to add a SAP that has an XID command handling option different from that of the SAP being added to. In that case the command will have completed up to the point where the failing item in the GSAP list was encountered. Otherwise, no action will have been taken for the command.

Action: Correct the options and try again or issue a DLC modify for the remaining GSAP list members.

Hex 07

Explanation: Command canceled—unrecoverable failure.

Cause: The adapter has been closed because of an error condition.

Action: Analyze the error indications. If the error is not permanent, issue DIR.INITIALIZE and DIR.OPEN.ADAPTER.

Hex 08

Explanation: Unauthorized access priority.

Cause: The requested access priority has not been authorized.

Action: Reduce the value and try again.

Hex 09

Explanation: Adapter not initialized—should be initialized.

Cause: This command may be completed only if the adapter is initialized.

Action: Issue the DIR.INITIALIZE command.

Hex 0A

Explanation: Command canceled by user request.

Cause: This is the expected response when a command is canceled by an application program command.

Action: None.

Hex 0B

Explanation: Command canceled—adapter closed while command in progress.

Cause: A DIR.CLOSE.ADAPTER command was issued while this command was in process.

Action: As appropriate for the application program.

Hex 0C

Explanation: Command completed successfully—adapter not open.

Cause: Information only. The command may execute even though the adapter is not open.

Action: None.

Hex 10

Explanation: Adapter open—NETBIOS Interface not operational.

Cause: One of the following:

- The DIR.OPEN.ADAPTER command has been

passed NETBIOS Interface parameters and the NETBIOS Interface code is not loaded.

- One or more NETBIOS Interface parameters in the DIR.OPEN.ADAPTER command was incorrect.

  Note: This can occur if the MSG_MAX_NAMES or MSG_MAX_SESSIONS values are not less than 255, or if there is insufficient work space available to satisfy the values of MSG_STATIONS, MSG_MAX_NAMES, MSG_MAX_MCB, and MSG_MAX_SESSIONS.

Action:

- To continue without the NETBIOS Interface, do nothing. The adapter is open.
- To use the NETBIOS Interface, close the adapter, make appropriate changes, and reissue DIR.OPEN.ADAPTER.

Hex 11

Explanation: DIR.TIMER.SET or DIR.TIMER.CANCEL error.

DIR.TIMER.SET:

Cause: The TIMER_VALUE is not in the 0 - 1200 range.

Action: Set a valid value and try again.

DIR.TIMER.CANCEL:

Cause: The DIR.TIMER.SET command to be canceled was not found.

Action: None

Hex 12

Explanation: Available work area exceeded.

Cause: Requested parameters exceeded allotted memory. Either the Adapter Support Interface work area or the work area provided by the application program is not adequate.

Action: Reduce MAX.STATION and/or MAX.SAP values or increase memory to the value returned in parameter DLC.WORK.LEN.ACT.

Hex 13

Explanation: Invalid LOG.ID.

Cause: The requested LOG.ID is not defined.

Action: Adjust the value accordingly.

Hex 14

Explanation: Invalid shared RAM segment or size.

Cause: The value is not an allowable value.

Action: Adjust the value accordingly.

Hex 15

Explanation: Lost log data, inadequate buffer space—log reset.

Cause: The buffer pointed to by DIR.READ.LOG or DLC.STATISTICS was too short to continue the entire log contents. The information that could not be placed in the buffer was *lost* if the command indicated "reset."

Action: The next time the command is issued, increase the size of the buffer.

Hex 16

Explanation: Requested buffer size exceeds pool length.

Cause: The buffer pool is not large enough to hold one buffer.

Action: Issue the command with either smaller buffers or larger pool.

Hex 17

Explanation: Command invalid—NETBIOS interface operational.

Cause: The command being issued would cause a change to NETBIOS Interface parameters that are currently operational.

Action: To issue the command, the adapter must be closed and then re-opened, either without the NETBIOS Interface, or with NETBIOS Interface parameters that avoid the conflict.

Hex 18

Explanation: Invalid buffer length.

Cause: The specified buffer size must be at least 80 bytes and a multiple of 16.

Action: Specify the buffer size accordingly.

Hex 19

Explanation: Inadequate buffers available for request.

Cause: A request was made for more buffers than were available.

Action: Either issue the command requesting fewer buffers, or wait until more buffers become available and try again.

Hex 1A

Explanation: USER LENGTH too large for buffer length.

Cause: The user requested area is too large.

Action: Adjust the user space required.

Hex 1B

Explanation: The CCB_PARM_TAB pointer is invalid.

Cause: The CCB_PARM_TAB field value is either pointing into the IBM PC interrupt vector area or the offset is too near the end of the segment and wrap-around will occur on some of the fields.

Action: Re-issue the command with the CCB_PARM_TAB field corrected.

Hex 1C

Explanation: A pointer in the CCB Parm table is invalid.

Cause: A pointer value in the CCBs parameter table is either pointing into the IBM PC interrupt vector area or the offset is too near the end of the segment and wrap-around will occur on some of the fields.

Action: Re-issue the command with the CCB_PARM_TAB field corrected.

Hex 1D

Explanation: Invalid CCB_ADAPTER value.

Cause: Either the value is outside the acceptable range or the adapter does not exist.

Action: Verify the correct value and that the adapter is installed.

Hex 20

Explanation: Lost data on receive—no buffers available.

Cause: There were no available buffers in the SAP's buffer pool. The message was lost.

Action: Free some buffers via BUFFER.FREE. If this is a link station, issue a DLC.FLOW.CONTROL command. Then reissue the receive command.

Hex 21

Explanation: Lost data on receive—inadequate buffer space.

Cause: There was inadequate buffer space in the SAP's buffer pool to contain the entire message. As much of the message as possible was placed into receive buffers. The remainder of the message was lost.

Action: Free some buffers via BUFFER.FREE and reissue the receive command.

Hex 22

Explanation: Error on frame transmission—check TRANSMIT_FS data.

Cause: The frame may or may not have been received by the destination adapter, as indicated by the FS byte.

Action: As appropriate for the application program.

Hex 23

Explanation: Error in frame transmit or read back checking

Cause: An error was detected either during the frame transmit or when the frame was read back and checked.

Action: As appropriate for the application program.

Hex 24

Explanation: Unauthorized MAC frame.

Cause: Possible causes:

- The adapter is not authorized to send a MAC frame with the specified source class.
- The source class was zero.
- An attempt has been made to transmit a MAC frame via a SAP.

Action: Adjust the value and try again.

Hex 25

Explanation: Maximum commands exceeded.

Cause: The maximum number of transmit commands that may be outstanding for a given station at any time (128) has been exceeded.

Action: Issue the transmit command at some later time.

Hex 26

Explanation: Unrecognized command correlator.

Cause: The command correlation sent to the adapter during ASB communications is invalid.

Action: The application program will never see this return code, since the Adapter Support Interface will assume a PC Hard Error state.

Hex 27

Explanation: Link not transmitting I frames—state changed from link opened.

Cause: This return code will be set in a transmit CCB whenever the link station leaves link opened state because of a received frame (for instance, DISC), or because of a timeout. It will *not* be set if the link leaves link opened state because of receipt of a CCB (for instance, DLC.CLOSE.STATION).

Action: The LINK STATION may be closed via DLC.CLOSE.STATION, or an attempt may be made to re-establish the connection via DLC.CONNECT.STATION. If the remote station is on a different ring, a different route may be required in order to re-establish the link.

Hex 28

Explanation: Invalid transmit frame length.

Cause: The frame length, as specified, is either too short to contain sufficient header information, or too long for the adapter's transmit buffer. If the transmit was for a link station, it has entered the disconnected state.

Action: Transmit frames must be no longer than the maximum transmit length, as defined by DIR.OPEN.ADAPTER.

Hex 30

Explanation: Inadequate receive buffers for adapter to open.

Cause: The requested DIR.OPEN.ADAPTER parameters have not allowed adequate receive buffer space in the adapter's shared RAM.

Action: Reduce the RAM requirements in the DIR.OPEN.ADAPTER command (for example, the number of link stations).

Hex 31

Explanation: Reserved.

Hex 32

Explanation: Invalid NODE_ADDRESS.

Cause: The defined node address is invalid.

Action: Adjust the value accordingly. Refer to the *IBM Token-Ring Network Architecture Reference* for node address restrictions.

Hex 33

Explanation: Invalid adapter receive buffer length defined.

Cause: The value is either greater than the allowable maximum or less than the allowable minimum.

Action: Adjust the value accordingly.

Hex 34

Explanation: Invalid adapter transmit buffer length defined.

Cause: The value is either greater than the allowable maximum or less than the allowable minimum.

Action: Adjust the value accordingly.

Hex 40

Explanation: Invalid STATION_ID.

Cause: Either the requested station ID does not exist or the station ID request is invalid for this command.

Action: Make the appropriate changes and reissue the command.

Hex 41

Explanation: Protocol error—link in invalid state for command.

Cause: The requested command cannot be accepted because of the existing primary link state of the link station. A DLC.CONNECT.STATION command will not be accepted if the link is in the disconnected or closed state. A transmit command will not be accepted if the link is in any state other than opened.

Action: According to the situation.

Hex 42

Explanation: Parameter exceeded maximum allowed.

Cause: One of the parameter values is greater than acceptable.

Action: Use an acceptable value.

Hex 43

Explanation: Invalid SAP_VALUE or value already in use.

Cause: For a DLC.OPEN.SAP command, this return code indicates that the SAP_VALUE has already been used or the specified SAP is the Null or Global SAP.

For a DLC.OPEN.STATION command, this return code indicates that this SAP already has a link to the specified RSAP_VALUE and DESTINATION_ADDR combination, or the remote SAP specified was the Null SAP, Global SAP, or a group SAP.

Action: Use an acceptable value. Do not use X'00' or X'FE'.

Hex 44

Explanation: Invalid routing field length.

Cause: The indicated routing field is either too short, greater than 18 bytes long, or is an odd number of bytes long.

Action: Set the length field to a correct value.

Hex 45

Explanation: Requested group membership in non-existent group SAP.

Cause: Membership has been requested in a group SAP which is not open.

Note: The command has been completed up to the point at which the adapter encountered the error. The SAP has been opened if the command was DLC.OPEN.SAP, or the other parameters have been changed if the command was DLC.MODIFY.

Action: According to the situation.

Hex 46

Explanation: Resources not available.

Cause:

- DLC.OPEN.SAP: There are inadequate SAP control blocks or link stations available to satisfy the open.

- DLC.OPEN.STATION: All link stations assigned to this SAP are in use.

Action: According to the situation, close some SAPs/stations or wait.

Hex 47

Explanation: SAP cannot close unless all link stations are closed.

Cause: At least one link station is open for this SAP.

Action: Close all link stations and try again.

Note: If a 47 error code results when a DLC.CLOSE.SAP command closely follows a DLC.CLOSE.STATION command for the last open station for that SAP, reissue the DLC.CLOSE.SAP command.

Hex 48

Explanation: Group SAP cannot close—all member SAPs not closed

Cause: At least one individual member SAP of this group SAP is open.

Action: Delete all SAPs in the group using the DLC.MODIFY command and try again.

Hex 49

Explanation: Group SAP has reached maximum membership

Cause: As stated.

Note: The command has completed up to the point at which the adapter encountered the error. The SAP has been opened if the command was DLC.OPEN.SAP, or the other parameters have been changed if the command was DLC.MODIFY.

Action: According to the application program.

Hex 4A

Explanation: Sequence error—incompatible command in progress.

Cause: The station is in the process of closing or establishing a connection.

Action: Await completion or issue a reset.

Hex 4B

Explanation: Station closed without remote acknowledgment.

Cause: The adapter issued a DISC command to the remote station as a result of receiving a DLC.CLOSE.STATION SRB. No acknowledgment has been received from the remote adapter and the link station has been closed.

Action: According to the application program.

Hex 4C

Explanation: Sequence error—cannot close while commands are outstanding.

Cause: Commands are in process. This prevents closing the SAP or link station.

Action: Wait until all outstanding commands are complete, or issue a reset.

Hex 4D

Explanation: Unsuccessful link station connection attempt.

Cause: The DLC.CONNECT.STATION command could not establish a requested connection.

Action: Determine the cause for the failure and try again when resolved.

Hex 4E

Explanation: Member SAP not found in group SAP list.

Note: The command has completed up to the point at which the adapter encountered the error. The SAP has been opened if the command was DLC.OPEN.SAP, or the other parameters have been changed if the command was DLC.MODIFY.

Cause: A request was issued to delete an individual member SAP from a group SAP. The SAP was not found to be assigned to the group.

Action: Verify the SAP number.

Hex 4F

Explanation: Invalid remote address—may not be a group address.

Cause: The high order bit of the DESTINATION_ADDR is set to 1, indicating a group address. A link may not be established with a group of adapters.

Action: Verify the remote address.

Hex FF

Explanation: Command in process.

Cause: As stated.

Action: None.

DLC Status Codes

Certain conditions that arise in the DLC function of the adapter card are reported to a DLC Status Appendage. DLC status codes are presented to the appendage in the AX register. The CX register contains the adapter number (0 or 1). Registers ES and BX point to the DLC status table. See "Appendages" on page 2-8 for more about providing an appendage to use these codes.

DLC Status Codes (Register AX)

BIT	FUNCTION	MEANING
15	Link lost	
14	DM or DISC received, or DISC acknowledged	
13	FRMR received	Five bytes of reason code data are contained in the area pointed to by the address in the ES:BX register (FRMR_DATA).
12	FRMR sent	Five bytes of reason code data are contained in the area pointed to by the address in the ES:BX register (FRMR_DATA).
11	SABME received for an open link station	
10	SABME received, link station opened	A new link station has been opened by the adapter. A DLC.OPEN.STATION command should NOT be issued for that link station. A DLC.CONNECT.STATION command must be issued to accept the SABME or a DLC.CLOSE.STATION command to reject it. The STATION_ID, remote node address (DESTINATION_ADDR) , and remote SAP value (RSAP_VALUE) are provided in the status table pointed to by the address in the ES and BX registers.
9	Remote station has entered a "local busy" condition	

BIT	FUNCTION	MEANING
8	Remote station has left a "local busy" condition	
7	Ti has expired	
6	DLC counter overflow	One or more of the DLC LINK STATION's DLC log counters has reached maximum value. A DLC.STATISTICS command should be issued.
5	Access Priority lowered	The new access priority (ACCESS_PRIORITY) is in the area pointed to by the address in the ES:BX register.
4 - 1	Reserved	
0	Local station has entered a "local busy" condition	*

Note: ** This code is reported only when the state has changed because of an "out-of-buffers" condition when the Adapter Support Interface cannot accept an I-frame. It is not reported because of a DLC.FLOW.CONTROL command being issued by the network application program.*

It is the responsibility of the application program to issue a "flow control on" command to reset the "local busy" condition.

Suggested Actions in Response to DLC Status

- **Link Lost**
  It appears that the connection to the remote partner has been lost, or that the remote station has been closed. A DLC.CLOSE.STATION Command may be issued to free the control block, or a DLC.CONNECT.STATION command (possibly with different routing information) may be issued to attempt to reestablish the connection.

- **DM or DISC received**
  The remote partner is attempting to terminate the connection. A DLC.CLOSE.STATION command should be issued.

- **FRMR Received**
  The remote partner has detected a DLC protocol error in the frame received from this station. Either a DLC.CLOSE.STATION or DLC.CONNECT.STATION command should be issued.

- **FRMR Sent**
  The local adapter has detected a DLC protocol error in a frame received from the remote partner. The remote partner should either disconnect or attempt to reconnect. However, if a Ti Timer-expired DLC Status interrupt is received after receipt of this interrupt, a DLC.CLOSE.STATION or DLC.CONNECT.STATION command should be issued to the local station.

- **SABME Received for an Open Link Station**
  The remote station wishes to reset an existing connection. A DLC.CONNECT.STATION command may be issued to reestablish the connection, or a DLC.CLOSE.STATION command may be issued to terminate. Any outstanding transmit commands will be returned upon receipt of the SABME with a X'27' (link not transmitting I frames—state changed from link opened) return code. On completion of a DLC.CONNECT.STATION command, it is the responsibility of the local station to reissue any transmits it wishes to have retransmitted.

- **SABME Received, Link Station Opened**
  A control block has been allocated and a station has been opened, in disconnected state, in response to a SABME received from a remote station. The connection request may be accepted by issuing a DLC.CONNECT.STATION command, or rejected by

issuing a DLC.CLOSE.STATION command.

- **Remote Station Has Entered Local Busy**
  The remote station has temporarily stopped receiving I frames, probably because of buffer congestion. The local station will stop sending I frames. The application may choose to issue transmit commands for the affected station, up to the maximum number accepted by the adapter, but they will be queued until the remote station leaves the local busy state.

- **Remote Station Has Left Local Busy**
  The local station will resume I-frame transmission.

- **Ti Timer Expired**
  This status is not returned while the link is in link opened-state. In other states it is returned to indicate that there is no activity on the link, and that the IBM PC may therefore wish to close the link to free up the control block.

- **DLC Counter Overflow**
  One or more of the error counters maintained for the link station has reached half of its maximum value. The counter will wrap back to zero when it reaches its maximum value. The application program should issue a DLC.STATISTICS command to read and reset the counters.

- **Access Priority Reduced**
  The access priority requested for this SAP or link station is now less than that authorized for the adapter. The new priority is in the Adapter Status Table or if the adapter card is being operated without the Adapter Support Interface, in ARB byte 13. There is no IBM PC application program action required as this is for information only. However, a DLC.MODIFY command may be issued to change the access priority.

DLC Status Table

OFF-SET	8086 TYPE	CONTENTS
0	DW	STATION.ID
2	DW	Contents of register AX
4	DB	FRMR_DATA: 5 bytes of reason code that are applicable when an FRMR is either transmitted or received.
9	DB	ACCESS_PRIORITY: The new access priority that is applicable when status bit 5 is on. The format is: B'nnn00000' where "nnn" is the access priority.
10	DB	REMOTE_NODE: The 6-byte node address of a newly opened link station. Applicable when status bit 10 is on.
16	DB	Remote SAP_VALUE: The 1-byte SAP address of a newly opened link station. Applicable when status bit 10 is on.

NETBIOS Interface Return Codes (MCB_RETCODE)

Hex Code	Meaning
00	Good return
01	Illegal buffer length
03	Invalid command
05	Command timed out
06	Message incomplete
08	Illegal local session number
09	No resource available
0A	Session closed
0B	Command canceled
0D	Duplicate name in local name table
0E	Name table full
0F	Command completed—name has active session and is now de-registered
11	Local session table full
12	Session open rejected
13	Illegal name number
14	Cannot find name called
15	Name not found or cannot specify "*" or null
16	Name in use on remote NETBIOS interface
17	Name deleted
18	Session ended abnormally
19	Name conflict detected
21	Interface busy
22	Too many commands outstanding
23	Invalid number in MCB_LANA_NUM field
24	Command completed while cancel occurring
26	Command not valid to cancel
4E	Ring status—one or more of bits 12, 14, 15 on for longer than 60 seconds
4F	Ring status—one or more of bits 8-11 on

Figure 7-2 (Part 1 of 2). NETBIOS Interface Command Return Codes

Hex Code	Meaning
F7	Error on implicit DIR.INITIALIZE
F8	Error on implicit DIR.OPEN.ADAPTER
F9	Adapter Support Interface internal error
FA	Adapter check
FB	NETBIOS program not loaded in PC
FC	DIR.OPEN.ADAPTER or DLC.OPEN.SAP failed - check parameters
FD	Unexpected adapter close

Figure 7-2 (Part 2 of 2). NETBIOS Interface Command Return Codes

NETBIOS Interface Return Code Descriptions

Hex 00

Explanation: Operation completed successfully.

Hex 01

Explanation: Illegal buffer length.

Cause: The requested buffer length is illegal for the MSG.SEND.DATAGRAM, MSG.SEND.BROADCAST, MSG.STATUS, or MSG.SESSION.STATUS command.

Action: Specify the correct size for the buffer and retry.

Hex 03

Explanation: Invalid command.

Cause: As stated.

Action: Issue the correct command.

Hex 05

Explanation: Command timed out.

Cause: As stated.

Action: Reissue the same command or another command. If a send timed out, there may not be a receive outstanding from the other name.

Hex 06

Explanation: Message incomplete.

Cause: The application program received part of a message because the specified buffer length is not large enough to receive the full message.

Action:

- MSG.RECEIVE and MSG.RECEIVE.ANY: Issue another receive to get the rest of the message before the remote side times out.
- MSG.STATUS, MSG.SESSION.STATUS, MSG.RECEIVE.DATAGRAM, and MSG.RECEIVE.BROADCAST.DATAGRAM: The remaining data is lost.

  Note: If the command was a MSG.STATUS, this error code could occur because the remote side could not transmit the entire status update if the data was of greater length than the maximum length UI-frame that may be transmitted.

Hex 08

Explanation: Illegal local session number.

Cause: The session number specified is not one of the active sessions.

Action: Reissue the command with the correct active session number.

Hex 09

Explanation: No resource available.

Cause: Trying to establish a session with a remote application program that has no more room in the session table.

Action: Reissue the command at a later time.

Hex 0A

Explanation: Session closed.

Cause: The name from the transmitting side closed the session.

Action: None.

Hex 0B

Explanation: Command canceled.

Cause: As stated.

Action: None.

Hex 0D

Explanation: Duplicate name in local name table.

Cause: Tried to specify a name that is currently in the name table.

Action: Reissue the command and specify another name.

Hex 0E

Explanation: Name table full.

Cause: The number of names has exceeded that defined by the DIR.OPEN.ADAPTER command (default=17).

Action: Wait until a delete name is issued so an entry will become available.

Hex 0F

Explanation: Command completed, name has active session and is now de-registered.

Cause: The name to be deleted is active in a session now, but is de-registered. When the name is marked de-registered and has active sessions, it still occupies a slot in the table. The name is unusable for any new sessions.

Action: Close all the sessions using this name.

Hex 11

Explanation: Local session table full.

Cause: There are no available entries on the session table. (The number of sessions is user-specified in MSG.RESET or DIR.OPEN.ADAPTER. command).

Action: Wait until a session has closed so an entry will become available.

Hex 12

Explanation: Session open rejected.

Cause: No LISTEN command is outstanding on the remote NETBIOS Interface.

Action: Wait until a LISTEN is issued on the remote NETBIOS Interface.

Hex 13

Explanation: Illegal name number

Cause: The number of the name has been changed or was never specified.

Action: Must use the most recent number that was assigned to the name.

Hex 14

Explanation: Cannot find name called or no answer.

Cause: No response to the MSG.CALL command received.

Action: Try again later.

Hex 15

Explanation: Name not found or cannot specify "*" or null.

Cause: The name specified is not in the table, or the first character of the name is either an ASCII asterisk or "00."

Action: Try again with another name that has been verified to be correct.

Hex 16

Explanation: Name in use on remote NETBIOS interface.

Cause: Name found in another table. Names used in the network are unique and can only be used in one place.

Action: Either specify another name or have the name changed at the remote end.

Hex 17

Explanation: Name deleted.

Cause: As stated.

Action: Add the name to the table and reissue the command.

Hex 18

Explanation: Session ended abnormally.

Cause: A "session send" terminated because of a timeout or hardware problem.

Action: Check the remote for status and check the cable. Re-establish the session. The application programs must take care to re-establish synchronization of the data transferred within the failed session.

Hex 19

Explanation: Name conflict detected.

Cause: Network protocol has detected two or more identical names on the network.

Action: Identical names on the network should be removed.

Hex 21

Explanation: Interface busy.

Cause: NETBIOS Interface is either busy or out of local resources.

Note: *This condition can also be caused by any of the ring status bits 12, 14, or 15 being on.*

Action: Try again later.

Hex 22

Explanation: Too many commands outstanding.

Cause: As stated.

Action: Try again later.

Hex 23

Explanation: Invalid number in MCB_LANA_NUM field.

Cause: Tried to specify a value other than "00" or "01," or the adapter is not present.

Action: Verify that the adapter is present, or correct the value and try the command again. Use "00" for the primary adapter and "01" for the alternate.

Hex 24

Explanation: Command completed while cancel occurring.

Cause: Tried to cancel a command that had already been completed.

Action: None.

Hex 26

Explanation: Command not valid to cancel.

Cause: Tried to cancel a command that is invalid to cancel.

Action: Verify the correctness of the cancel command.

Hex 4E

Explanation: Ring status—one or more of bits 12, 14, or 15 on longer than 60 seconds.

Cause: As stated.

Action: Check the extended status last ring status code. The only NETBIOS Interface command that may be issued is MSG.RESET.

Note: *This return code is not reported at all if some ring status bits 8 - 11 are also on. This return code is reported to the application only if the* *ring status bits 12, 14, or 15 remain on longer than 60 seconds.*

Hex 4F

Explanation: Ring status—one or more of bits 8 - 11 on.

Cause: As stated.

Action: Check the extended status last ring status code. The only NETBIOS Interface command that may be issued is MSG.RESET.

Hex F7

Explanation: Error on implicit DIR.INITIALIZE.

Cause: As stated.

Action: Check the extended status bring-up error code. The only NETBIOS Interface command that may be issued is MSG.RESET.

Hex F8

Explanation: Error on implicit DIR.OPEN.ADAPTER.

Cause: As stated.

Action: Check the extended status bring-up error code. The only NETBIOS Interface command that may be issued is MSG.RESET.

Note: *There is a possibility that a DIR.OPEN.ADAPTER could fail because of a temporary timing condition. Because of this, before reporting this return code, the*

DIR.OPEN.ADAPTER is retried twice at thirty-second intervals.

Hex F9

Explanation: Adapter Support Interface internal error.

Cause: As stated.

Action: Check the PC-detected error code. The only NETBIOS Interface command that may be issued is MSG.RESET.

Hex FA

Explanation: Adapter check.

Cause: As stated.

Action: Check the adapter check reason code. The only NETBIOS Interface command that may be issued is MSG.RESET.

Hex FB

Explanation: NETBIOS Interface code not loaded in the PC.

Cause: The NETBIOS Program is not loaded and available, but a control block has been received by the Adapter Support Interface with a value greater than X'04' in the first field.

Action: Load and start the NETBIOS Program and reissue the command or correct the control block.

Hex FC

Explanation: DIR.OPEN.ADAPTER or DLC.OPEN.SAP failed—check parameters.

Cause: As stated.

Action: Correct the parameters in error and execute the DIR.OPEN.ADAPTER command again. Note that the DLC.OPEN.SAP command is executed on initial start and restart of the NETBIOS Interface. The parameters used are obtained from the DIR.OPEN.ADAPTER command (executed either explicitly or implicitly).

Note: *There is a possibility that a DIR.OPEN.ADAPTER could fail because of a temporary timing condition. Because of this, before reporting this return code, the DIR.OPEN.ADAPTER is tried again twice at thirty-second intervals.*

Hex FD

Explanation: Unexpected adapter close.

Cause: The adapter was closed while the NETBIOS interface was executing.

Action: Issue a MSG.RESET command.

Notes:

For the following codes 'F7' to 'FD':

1. *The condition to be reported via MCB_ RETCODE is the last to have occurred.*

2. *Extended status information, with the exception of adapter counters, is available in the MCB_RESERVE field of the command block. In the case of the*

MSG.RESET command, it is the status prior to the MSG.RESET.

3. *Ring status information:*

   - *Any ring status bits 8 - 11 on, cause error code '4F'.*
   - *Any ring status bits 12, 14, or 15 on, for longer than 60 seconds, cause error code '4E'. Code '4F' has priority over code '4E'.*
   - *Ring status bits 6 and 7 do not cause errors. If bit 7 (counter overflow) is on, nothing is reported. If no ring status appendage is defined, the local NETBIOS Interface counters will be updated via the DIR.READ.LOG command. Bit 6 (single station) is ignored.*

Adapter Status Parameter Table

This information is placed in IBM PC memory by the Adapter Support Interface in response to a DIR.STATUS command. The Adapter Support Interface places a pointer address in the ADAPTER_PARMS_ADDR field of the DIR.STATUS command's parameter table.

OFF-SET	PARAMETER NAME	LENGTH (BYTES)	8086 TYPE	DESCRIPTION
0	PHYS_ADDR	4	DB	Adapter physical address
4	UP_NODE_ADDR	6	DB	The upstream node address
10	UP_PHYS_ADDR	4	DB	The upstream physical address
14	POLL_ADDR	6	DB	Last poll address
20	AUTH_ENV	2	DB	Authorized environment
22	ACC_PRIORITY	2	DB	Transmit access priority
24	SOURCE_CLASS	2	DB	Source class authorization
26	ATT_CODE	2	DB	Last attention code
28	SOURCE_ADDR	6	DB	Last source address
34	BEACON_TYPE	2	DB	Last beacon type
36	MAJOR_VECTOR	2	DB	Last major vector
38	RING_STATUS	2	DB	Ring status
40	SOFT_ERROR	2	DB	Soft error timer value
42	FE_ERROR	2	DB	Front end error counter
44	LOCAL_RING	2	DB	Number of ring
46	MON_ERROR	2	DB	Monitor error code
48	BEACON_TRANSMIT	2	DB	Beacon transmit type
50	BEACON_RECEIVE	2	DB	Beacon receive type
52	FRAME_CORREL	2	DB	Frame correlation save
54	BEACON_NAUN	6	DB	Beaconing station NAUN
60		4	DB	Reserved
64	BEACON_PHYS	4	DB	Beaconing station physical address

Frame Status

The frame status (FS) byte is returned to the application program with return information for some commands. Some values and their meanings are:

X'CC'	=	The frame was copied
X'00'	=	The frame was not copied (the destination adapter must not be on the ring)
X'88'	=	The destination adapter recognized the frame, but did not copy it (possibly due to being overloaded).

See the *IBM Token-Ring Network Architecture Reference* for more about the FS byte.

Exception Indications

When an adapter check occurs, the Adapter Support Interface will close the adapter, all ring communication will cease, and the adapter check appendage, if defined, will be taken. On entry, the CX register will contain the adapter number, the AX will contain the adapter check reason code, and the ES and BX registers will point to the following table. While interrogating the information, the application should either move the data to private memory or keep all interrupts masked off.

OFF-SET	8086 TYPE	CONTENTS
0	DD	A pointer to the first of a queue of commands that were outstanding when the adapter closed
4	DW	Adapter check reason code
6	DW	Parameter 0: Set per reason-code
8	DW	Parameter 1: Set per reason-code
10	DW	Parameter 2: Set per reason-code

Adapter Check Reason Codes

VALUE	FUNCTION	MEANINGS/PARAMETERS
8000	Adapter inoperative	See note.
4000	Reserved	
2000	Reserved	
1000	Illegal op code	The adapter detected an illegal op code (micro failure).
0800	Local bus parity error	The adapter local bus detected a parity error.
0400	Parity error	
0200	Reserved	
0100	Internal parity error	

Exception Indications

VALUE	FUNCTION	MEANINGS/PARAMETERS
0080	Parity error - Ring transmit	The adapter local bus detected a parity error while transmitting on the ring.
0040	Parity error - Ring receive	The adapter local bus detected a parity error while receiving from the ring.
0020	Transmit underrun	
0010	Receive overrun	
0008	Unrecognized interrupt	
0004	Unrecognized error interrupt	
0003	Adapter detected no IBM PC service	
0002	Unrecognized supervisory request	
0001	Program request	Software-detected error

Note: Adapter inoperative (8000)

When a machine check occurs in the adapter processor, it is reported to the Adapter Support Interface via an "adapter check interrupt." The IBM PC may receive this interrupt before the adapter processor is able to set the adapter check bits. Therefore the Adapter Support Interface does the following:

1. *If a reason code is set, that code is passed to the appendage.*

2. *If a reason code is not set, the Adapter Support Interface goes into a tight loop for 250 milliseconds. The Adapter Support Interface then checks the reason code set by the adapter processor and does one of the following:*

   a. *If a code is set, the Adapter Support Interface passes that code to the appendage.*

b. *If no code is set, the Adapter Support Interface assumes that the adapter processors machine check handler was not capable of executing because of the severity of the processor's problem. The Adapter Support Interface then sets a value of (8000) in the adapter check reason code and passes that code to the appendage.*

Ring Status

Whenever ring status changes, the application program will be notified if the ring status appendage has been defined in the RING_STATUS_EXIT field of the CCB for a DIR.INITIALIZE or in the RING_STATUS_EXIT field of the DIRECT_PARMS table of the DIR.OPEN.ADAPTER command.

The AX register contains the ring status code and the CX register contains the adapter number.

Ring Status Codes

BIT	FUNCTION	MEANING
15	Signal loss	Absence of any received signal detected.
14	Hard error	Beacon frames are being transmitted or received.
13	Soft error	This adapter has transmitted a soft error report MAC frame.
12	Transmit beacon	The adapter is transmitting beacon frames.
11	Lobe wire fault	An open or short circuit has been detected in the lobe data path. (The adapter will be closed.)

BIT	FUNCTION	MEANING
10	Auto-removal error 1	An adapter hardware error has been detected following the beacon auto-removal process. The adapter has been removed from the ring. (The adapter will be closed.)
9	Reserved	
8	Remove received	A remove MAC frame has been received. The adapter will be closed.
7	Counter overflow	One of the adapter error log counters has been incremented from 254 to 255. (The DIR.READ.LOG command should be issued.)
6	Single station	The adapter has opened and is the only station on the ring. (The bit will be reset when another station is detected.)
5	Ring Recovery	The adapter is transmitting or receiving Monitor Contention MAC frames. This bit will be reset upon receipt of a Ring Purge MAC frame.
0 - 4	Reserved	

Bring-up Errors

Bring-up testing is done when the DIR.INITIALIZE command is executed. If these tests are not completed successfully indicating an adapter failure, the bring-up error code will be returned in the BRING_UP field of the DIR.INITIALIZE parameter table. The CCB_RETCODE in the CCB will also contain '07' (command canceled: unrecoverable failure) when the command is terminated.

Bring-up Error Codes

CODE	MEANING
'0020'	Diagnostics could not execute
'0022'	ROM (ROS) diagnostics failed

CODE	MEANING
'0024'	Shared RAM diagnostics failed
'0026'	Processor instruction test failed
'0028'	Processor interrupt test failed
'002A'	Shared RAM interface register diagnostics failed
'002C'	Protocol-handler diagnostics failed
'0040'	Adapter's programmable timer for the IBM PC failed (set by the PC code)
'0042'	Cannot write to shared RAM (set by the PC code)
'0044'	Reading from shared RAM read-only area caused an invalid error indication (interrupt) (set by the PC code)
'0046'	Writing into shared RAM read-only area did not cause an error indication (interrupt) (set by the PC code)
'0048'	Initialization timed out

Adapter Open Errors

Adapter open testing is done when the DIR.OPEN.ADAPTER command is executed. If these tests do not complete successfully indicating either an adapter failure or a ring problem, the open error codes will be returned in the OPEN_ERROR_CODE field of the DIR.OPEN.ADAPTER parameter table. The CCB_RETCODE in the CCB will also contain '07' (command canceled—unrecoverable failure) when the command is terminated.

Open Error Codes

The open errors are returned in 2 bytes. The high-order byte is always zero and the low-order byte contains:

1. The phase of testing in which the error was encountered is in the high-order nibble (half- byte) of the low-order byte.
2. The error condition is in the low-order nibble of the low-order byte.

Phases

VALUE	MEANING
'1n'	Lobe media test
'2n'	Physical insertion
'3n'	Address verification
'4n'	Roll call poll
'5n'	Request parameters

Errors

VALUE	MEANING
'n1'	Function failure
'n2'	Signal loss
'n3'	Wire fault
'n4'	Frequency error
'n5'	Timeout
'n6'	Ring failure
'n7'	Ring beaconing
'n8'	Duplicate node address
'n9'	Parameter request
'nA'	Remove received
'nB'	Reserved
'nC'	Reserved

Suggested Actions in Response to Open Errors

When the following *Phase - Error* combination values are presented, they are the result of certain specific occurrences. Explanation of the occurrences follow with recommended actions listed. A list of recommended actions for both the application program and the IBM PC operator are provided following the explanations.

Explanations of Occurrences

- **X'11' Lobe Media, Function Failure**
  Failure Definition The testing of the lobe between the adapter and the access unit has been unsuccessful because the lobe has a bit-error rate that is too high or the adapter cannot receive successfully.
  Recommended Actions 1, 3, and 5

- **X'26' Physical Insertion, Ring Failure**
  Failure Definition The adapter, acting as an active monitor, was unable to complete the ring purge function successfully indicating an error condition has occurred since the successful completion of monitor contention (when this adapter became the active monitor).
  Recommended Actions 1 and 2a

- **X'27' Physical Insertion, Ring Beaconing**
  Failure Definition The adapter has either detected a monitor contention failure or received a beacon MAC frame from the ring.
  Recommended Actions 1 and 2b

- **X'2A' Physical Insertion, Timeout**
  Failure Definition The adapter has received a remove ring station MAC frame indicating that a network management function has directed this adapter to get off the ring.
  Recommended Actions 2a and 4

- **X'32' Address Verification, Signal Loss**
  Failure Definition The adapter has detected a 250-millisecond signal loss (receiver cannot recognize signal) indicating that an error condition has occurred since the adapter successfully completed the ring signal recognition phase of the open operation.
  Recommended Actions 1 and 2a

- **X'35' Address Verification, Timeout**
  Failure Definition The insertion timer has expired before this function completed indicating that the ring may be congested, experiencing a high bit-error rate,

or losing an abnormally high number of tokens or frames, thus preventing successful Address Verification MAC frame transmissions.
Recommended Actions 1 and 2a

- **X'36' Address Verification, Ring Failure**
  Failure Definition The adapter, acting as an active monitor, was unable to complete the ring purge function successfully indicating an error condition has occurred since the successful completion of monitor contention (when this adapter became the active monitor).
  Recommended Actions 1 and 2a

- **X'37' Address Verification, Ring Beaconing**
  Failure Definition The adapter has either detected a monitor contention failure or received a beacon MAC frame from the ring.
  Recommended Actions 1 and 2b

- **X'38' Address Verification, Duplicate Node Address**
  Failure Definition The adapter has detected that another station on the ring has an adapter address equal to the adapter address being tested.
  Recommended Action 4

- **X'3A' Address Verification, Remove Received**
  Failure Definition The adapter has received a remove ring station MAC frame indicating that a network management function has directed this specific address to get off the ring.
  Recommended Actions 2a and 4

- **X'42' Ring Poll, Signal Loss**
  Failure Definition The adapter has detected a 250-millisecond signal loss (receiver can not recognize signal) indicating that an error condition has occurred since the adapter successfully completed the ring signal recognition phase of the open operation.

Recommended Actions 1 and 2a

- **X'45' Ring Poll, Timeout**
  Failure Definition The insertion timer has expired before this function completed indicating that the ring may be congested, experiencing a high bit error rate, or losing an abnormally high number of tokens or frames, thus preventing the adapter's successful reception of either the ring poll request or response MAC frame, or transmission of the required ring poll response MAC frame.
  Recommended Actions 1 and 2a

- **X'46' Ring Poll, Ring Failure**
  Failure Definition The adapter, acting as an active monitor, was unable to complete the ring purge function successfully indicating an error condition has occurred since the successful completion of monitor contention (when this adapter became the active monitor).
  Recommended Actions 1 and 2a

- **X'47' Ring Poll, Ring Beaconing**
  Failure Definition The adapter has either detected a monitor contention failure or received a beacon MAC frame from the ring.
  Recommended Actions 1 and 2b

- **X'4A' Ring Poll, Remove Received**
  Failure Definition The adapter has received a remove ring station MAC frame, indicating that a network management function has directed this adapter to get off the ring.
  Recommended Actions 2a and 4

- **X'55' Request Parameters, Timeout**
  Failure Definition The insertion timer has expired before this function completed indicating that the ring may be congested, experiencing a high bit-error rate, or losing an abnormally high number of tokens or frames, thus preventing successful transmission of the request parameter MAC frame or reception of either

the set parameters 1 or set parameters 2 MAC frame (required response to the adapter's request).
Recommended Actions 1 and 2a

- **X'56' Request Parameters, Ring Failure**
  Failure Definition The adapter, acting as an active monitor, was unable to complete the ring purge function successfully, indicating an error condition has occurred since the successful completion of monitor contention (when this adapter became the active monitor).
  Recommended Actions 1 and 2a

- **X'57' Request Parameters, Ring Beaconing**
  Failure Definition The adapter has received a beacon MAC frame from the ring.
  Recommended Actions 1 and 2b

- **X'59' Request Parameters, Parameter Request**
  Failure Definition The adapter has detected that the ring parameter server is present on the ring, but that the required response (set parameters 1 or set parameter 2 MAC frame) has not been received in the allotted time, indicating that the ring may be congested, experiencing a high bit-error rate, or losing an abnormally high number of tokens or frames.
  Recommended Actions 1 and 2a

- **X'5A' Request Parameters, Remove Received**
  Failure Definition The adapter has received a remove ring station MAC frame, indicating that a network management function has directed this adapter to get off the ring.
  Recommended Actions 2a and 4

The Recommended Actions

Action Number	Description
1	After delaying at least 30 seconds, retry the open two times, inserting the same delay between each retry.
2a	If this error persists, direct the IBM PC operator to contact the network administrator for assistance and provide "Open Error" information.
2b	If this error persists, direct the IBM PC operator to contact the network administrator for assistance and provide information from the "Adapter Status Parameter Table."
3	Direct the IBM PC operator to contact the network administrator for assistance and provide "Open Error" information.
4	Direct the IBM PC operator to contact the network administrator for assistance and provide "Node Address" information and try attaching to the ring after 6 minutes.
5	If this error persists, problem determination of the adapter or lobe is necessary. Contact your network administrator for problem determination assistance.

PC-Detected Errors

Whenever a PC-detected error is presented to an appendage, codes are provided to define the error.

The AL register contains the error code and the CX register contains the adapter number.

The PC-detected error codes are:

Code		Meaning
X'0000'	=	Spurious interrupt detected
X'0001'	=	Access violation—an attempt to write into the read-only portion of shared RAM has occurred.
X'01xx'	=	An ARB command code error, where xx is the command code.
X'02xx'	=	An ARB return code error, where xx is the return code from the adapter.
X'03xx'	=	An SRB/SSB command code error, where xx is the CCB command code.
X'04xx'	=	ARB transmit data request error—the transmit CCB was not found—where xx is the command correlator from the adapter.

Chapter 8. Adapter Card Information

Power

The adapter card uses one voltage from the IBM PC, +5 volts DC. The typical power consumption is approximately 1400 milliamps at 5 volts DC, or 7.0 watts.

Card I/O Pins

The pins at the IBM PC I/O connector are used as described in the following chart.

Pin	D/R	Type	Signal Name
A01	R	OC	- I/O CH CHK
A02	D/R	TS	+ D7
A03	D/R	TS	+ D6
A04	D/R	TS	+ D5
A05	D/R	TS	+ D4
A06	D/R	TS	+ D3
A07	D/R	TS	+ D2
A08	D/R	TS	+ D1
A09	D/R	TS	+ D0
A10	R	OCF	+ I/O CH RDY
A11	D	LS	+ AEN
A12	D	TS	+ A19
A13	D	TS	+ A18
A14	D	TS	+ A17
A15	D	TS	+ A16
A16	D	TS	+ A15
A17	D	TS	+ A14
A18	D	TS	+ A13
A19	D	TS	+ A12
A20	D	TS	+ A11

Adapter Card Information

Pin	D/R	Type	Signal Name
A21	D	TS	+ A10
A22	D	TS	+ A9
A23	D	TS	+ A8
A24	D	TS	+ A7
A25	D	TS	+ A6
A26	D	TS	+ A5
A27	D	TS	+ A4
A28	D	TS	+ A3
A29	D	TS	+ A2
A30	D	TS	+ A1
A31	D	TS	+ A0
B01			Ground
B02	D	LS	- Reset DRV
B03			+ 5 VDC
B04	R	OC	+ IRQ2
---			- 5 VDC
---	R	TS	+ DRQ2
---			- 12 VDC

---			+ 12 VDC
B10			Ground
B11	D	8288	- MEMW
B12	D	8288	- MEMR
B13	D	8288	- IOW
B14	D	8288	- IOR
---	D	8237	- DACK3
---	R	TS	+ DRQ3
---	D	8237	- DACK1
---	R	TS	+ DRQ1
B19	D	LS	- MREF
---	D	LS	+ CLK
B21	R	OC	+ IRQ7
B22	R	OC	+ IRQ6
---	R	OC	+ IRQ5
---	R	OC	+ IRQ4
B25	R	OC	+ IRQ3
---	D	8237	- DACK2
---	D	LS	+ T/C
---	D	8288	+ ALE
B29			+ 5 VDC
---	D	8284	+ OSC
B31			Ground

Legend

Pin

--- The pin is not used by the adapter.

D/R

D	Driven by the IBM PC I/O channel. Received by the adapter
R	Driven by the adapter. Received by the IBM PC I/O channel

Type

OC	Open Collector or tri-state in open collector configuration
OCF	Open Collector fast (output driven high, then tri-stated)
TS	Tri-state (74LS TTL)
LS	Totem pole or always enabled tri-state (74LS TTL)
8288	Bus Control
8284	Clock Gen
8237	DMA Control

IBM PC I/O Channel Pin Definitions

The signal requirements are further explained in the *Technical Reference* of your Personal Computer.

All circuit loads are no more than two LS TTL loads per pin.

Pin A01 - I/O CH CK

I/O channel check line is used to generate a non-maskable interrupt to the IBM PC if an uncorrectable adapter or system interface error is detected. The line is driven active (low) to indicate an error and it must remain low for at least two IBM PC system clock cycles to be detected. This line must be driven with an open collector configuration.[1]

Pins A02 through A09 + D7 to D0

Data bus bits D0 to D7 are for the processor, memory, and the adapter. D0 is the least significant bit and D7 is the most significant bit.

---

1 The term "open collector" refers to either an open collector device or a tri-state device with the input grounded and the enable controlling the output.

Data is valid on these lines after the issuance of a read or write command and must remain valid for the duration of the command. The lines are active when high.

Pin A10 + I/O CH RDY

The I/O channel ready line indicates ready when active (high). This line is pulled low by the memory or I/O adapter to lengthen a memory or I/O cycle. I/O CH RDY is activated as soon as the decision is made in the adapter to service the IBM PC request. The early latching of this signal ensures that the adapter will always incur an extra wait. The maximum time that this line can be pulled low (inactive) by the adapter is 10 clock cycles.

Pin A11 + AEN

The address enable line is used to de-gate the processor and other adapters from the I/O bus to allow DMA transfers to take place. The line is active (high) during all DMA operations and inactive (low) during I/O operations. When this line is active, the DMA controller has control of the bus, data bus, and the memory and I/O read and write command lines. This line must be used as part of the adapter select decode for I/O operations to prevent false selects during DMA operations.

Pins A12 through A31 + A19 to A0

Address bits 19 through 0 are used to address memory and I/O adapters within the IBM PC system. A0 is the least significant bit and A19 is the most significant bit. These 20 address lines allow access of up to 1 megabyte of memory. The lower 16 bits are used for I/O operations and all 16 must be decoded by the adapter. These lines are active when high. During an I/O operation the unused bits A16 through A19 will be low. The addresses on this bus are generated by either the IBM PC processor or the DMA controller and gated by the line AEN.

Pin B02 + Reset Drv

The reset drive line is used to reset or initialize adapter logic. The line is active when high and will be active for at least 100 milliseconds at power on or during a low line voltage condition. This line is synchronized to the falling edge of the IBM PC system clock.

Pins B21, B22, B25 and B04 + IRQ 7, 6, 3, 2

The IRQ request lines 2 to 7 are used by the adapter to signal the IBM PC for attention. IRQ 2 is the highest priority and IRQ 7 is the lowest. These lines are normally high and a request is created by a low shift of at least 125 nanoseconds and not more than 1000 nanoseconds. The interrupt is recognized on the low-to-high transition. The IRQ lines must be capable of being enabled and disabled by the IBM PC application program. The lines should be driven with an open collector configuration to allow sharing.

Pin B11 - MEMW

The memory write command line, when active (low), instructs the PC memory to store the data present on the data bus at the address present on the address bus The data on the data bus will be valid after the MEMW is active and must be held on the bus until the MEMW goes inactive. The address on the address bus must be valid prior to MEMW going active and must remain valid until the MEMW goes inactive.

Pin B12 - MEMR

The memory read command line when active (low) instructs the IBM PC memory to drive its data onto the data bus. The address on the address bus must be valid prior to the MEMR line going active and must remain valid during the read operation. The memory data must remain valid on the data bus until the MEMR line goes inactive.

Pin B13 - IOW

The input/output write command line, when active (low), instructs the adapter to read data from the IBM PC data bus. The address on the address bus must be valid prior to the IOW line going active and must remain valid during the write operation. The data on the data bus will be valid after the IOW line goes active and must remain valid until the IOW line goes inactive.

Pin B14 - IOR

The input/output read command line, when active (low), instructs the adapter to drive its data onto the IBM PC data bus. The address on the address bus must be valid prior to the IOR line going active and must remain valid during the read operation. The data on the data bus must be valid after the IOR line goes active and must remain valid until the IOR line goes inactive.

Pin B19 - MREF

The memory refresh line, when active (low) is used by the IBM PC system logic to indicate to the adapter that a memory refresh cycle is in progress.

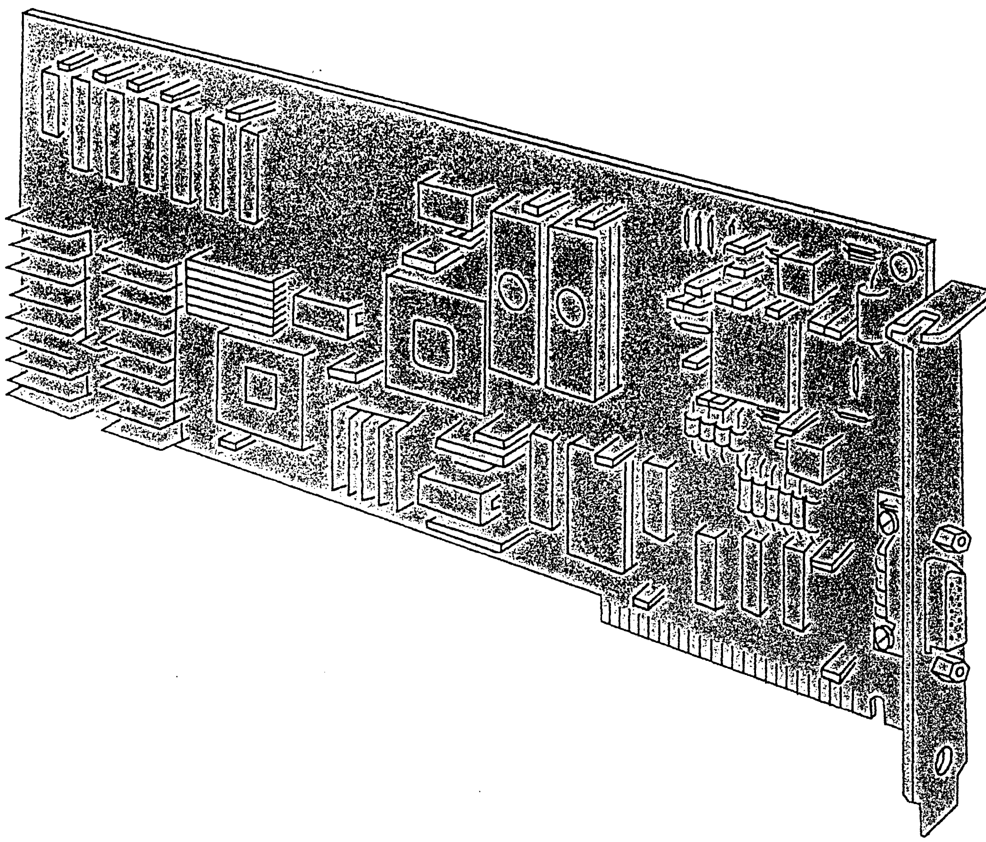

Figure 8-1. The IBM Token-Ring Network PC Adapter Card

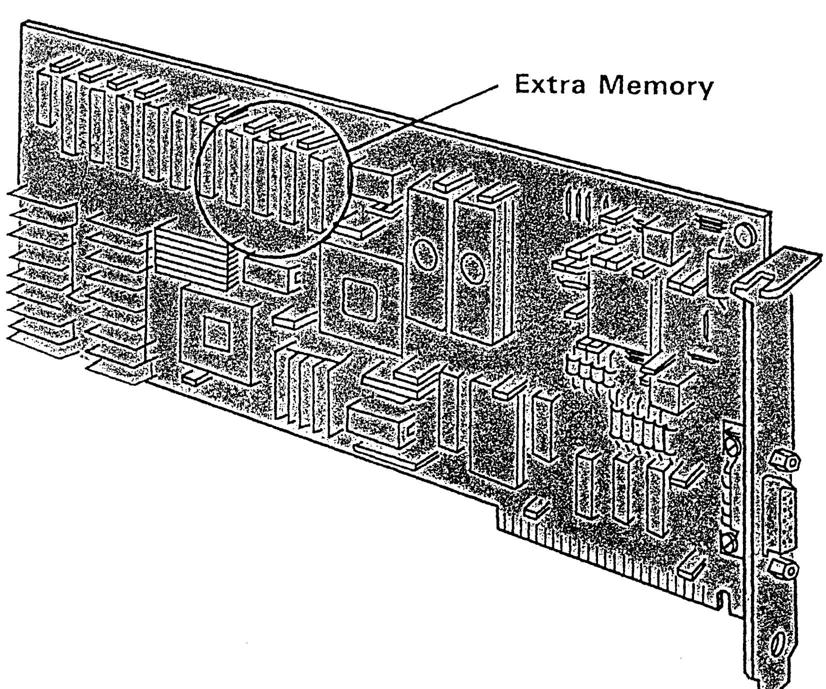

Figure 8-2. The IBM Token-Ring Network PC Adapter II Card

The Adapter Network Cable

A cable is required to connect the IBM Token-Ring Network PC Adapter card to the cabling system used by the IBM Token-Ring Network. IBM P/N 6339098 is available for use with the IBM Cabling System. A cable with built-in filters housed in a nine-pin D-connector at the IBM PC end and a six-pin modular plug at the cabling end is available for Type 3 Media use. This cable is not available from IBM. Consult your IBM representative or local branch office for a list of suppliers.

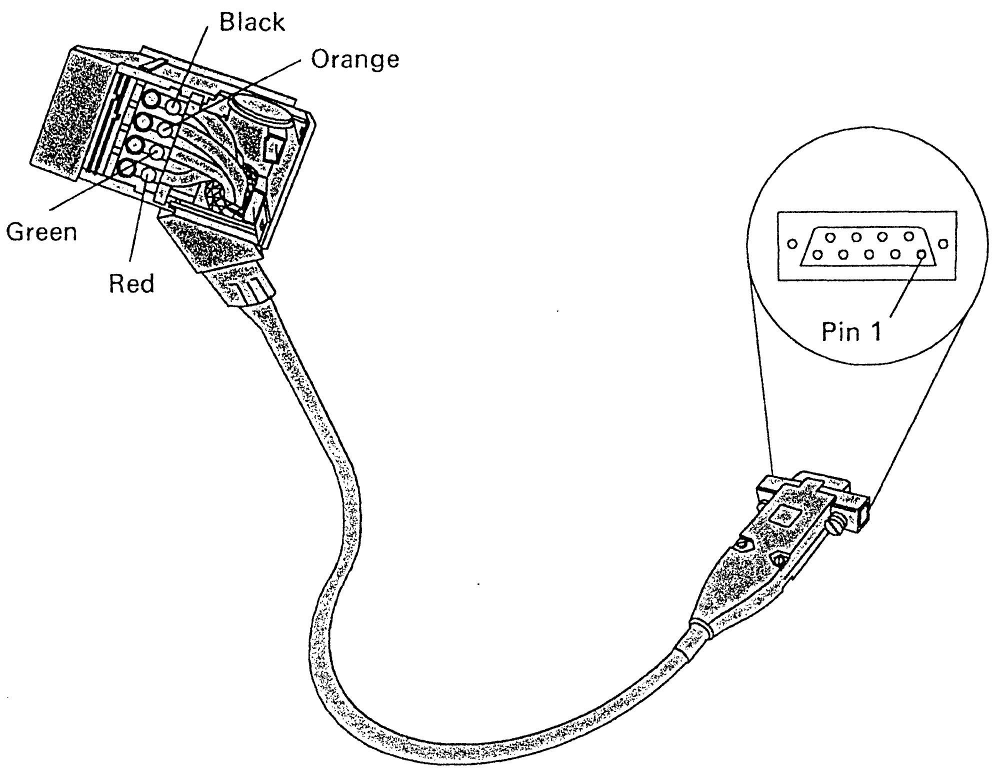

Figure 8-3. Adapter Cable P/N 6339098

Adapter Card D connector Pin	Wire Number	Wire Color	Data Connector Pin	Usage
Shield (ground)	1	Shield	Shield (ground)	Ground
1	4	Red	Red	Receive
5	3	Black	Black	Transmit
6	5	Green	Green	Receive
9	2	Orange	Orange	Transmit

Figure 8-4. P/N 6339098 Cable Schematic

Adapter Card Information

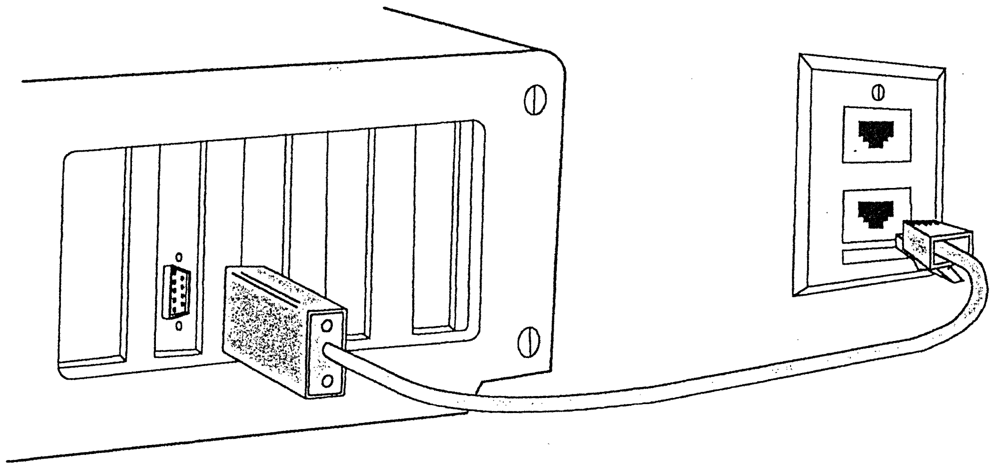

Figure 8-5. A Type 3 Media Filter

Adapter Card D connector Pin	Wire Color	6-PIN Connector Pin	Usage
1	Orange	3	Receive
5	Black	2	Transmit
6	Blue	4	Receive
9	Yellow	5	Transmit

Figure 8-6. A Type 3 Media Filter Schematic

Appendix A. Valid Commands

The following charts show the valid commands found in control blocks. An **X** indicates what interface(s) the command may be directed to. A command sent to the NETBIOS interface can request the adapter to complete the command before allowing the PC program to continue. An additional bit (high order) is included in the hexadecimal command code to request this wait for completion.

Notes:

1. *Command codes X'05', X'09', X'0C', X'17', X'2E', and X'2F' are reserved. Command code X'FF' is invalid.*

2. *The commands used to operate the adapter card directly, without the Adapter Support Interface, are not listed here. See Chapter 6, "The Adapter Card Interface."*

PSEUDO COMMAND NAME	Page.	HEX Code	DIR I F	DLC I F	MSG I F	MSG wait
BUFFER.FREE	3-23	27		x		
BUFFER.GET	3-25	26		x		
DIR.CANCEL.TIMER GROUP	4-3	2C	x			
DIR.CLOSE.ADAPTER	4-4	04	x			
DIR.DEFINE.MIF ENVIRONMENT	4-5	2B	x			
DIR.INITIALIZE	4-10	20	x			
DIR.INTERRUPT	4-9	00	x			
DIR.MODIFY.OPEN.PARMS	4-14	01	x			
DIR.OPEN.ADAPTER	4-16	03	x			
DIR.READ.LOG	4-30	08	x			
DIR.RESTORE.OPEN.PARMS	4-33	02	x			

Figure A-1 (Part 1 of 3). Valid Commands

PSEUDO COMMAND NAME	Page.	HEX Code	DIR I F	DLC I F	MSG I F	MSG wait
DIR.SET.FUNCTIONAL ADDRESS	4-33	07	x			
DIR.SET.GROUP.ADDRESS	4-35	06	x			
DIR.SET.USER.APPENDAGE	4-36	2D	x			
DIR.STATUS	4-38	21	x			
DIR.TIMER.CANCEL	4-42	23	x			
DIR.TIMER.SET	4-43	22	x			
DLC.CLOSE.SAP	3-27	16		x		
DLC.CLOSE.STATION	3-29	1A		x		
DLC.CONNECT.STATION	3-30	1B		x		
DLC.FLOW.CONTROL	3-32	1D		x		
DLC.MODIFY	3-34	1C		x		
DLC.OPEN.SAP	3-39	15		x		
DLC.OPEN.STATION	3-47	19		x		
DLC.RESET	3-52	14		x		
DLC.STATISTICS	3-53	1E		x		
MSG.ADD.NAME	5-23	30			x	
		B0				x
MSG.ADD.GROUP.NAME	5-21	36			x	
		B6				x
MSG.CALL	5-25	10			x	
		90				x
MSG.CANCEL	5-27	35			x	
MSG.CHAIN.SEND	5-29	17			x	
		97				x
MSG.DELETE.NAME	5-32	31			x	
		B1				x
MSG.FIND.NAME	5-34	78			x	
		F8				x
MSG.HANG.UP	5-36	12			x	
		92				x
MSG.LISTEN	5-39	11			x	
		91				x
MSG.RECEIVE	5-42	15			x	
		95				x
MSG.RECEIVE.ANY	5-44	16			x	
		96				x

Figure A-1 (Part 2 of 3). Valid Commands

PSEUDO COMMAND NAME	Page.	HEX Code	DIR I F	DLC I F	MSG I F	MSG wait
MSG.RECEIVE.BROADCAST. DATAGRAM	5-47	23			x	
		A3				x
MSG.RECEIVE.DATAGRAM	5-49	21			x	
		A1				x
MSG.RESET	5-51	32			x	
MSG.SEND	5-53	14			x	
		94				x
MSG.SEND.BROADCAST. DATAGRAM	5-55	22			x	
		A2				x
MSG.SEND.DATAGRAM	5-57	20			x	
		A0				x
MSG.SESSION.STATUS	5-59	34			x	
		B4				x
MSG.STATUS	5-62	33			x	
		B3				x
MSG.TRACE	5-68	79			x	
		F9				x
MSG.UNLINK	5-73	70			x	
PDT.TRACE.OFF	4-52	25	x			
PDT.TRACE.ON	4-44	24	x			
RECEIVE	3-57	28	x	x		
RECEIVE.CANCEL	3-62	29	x	x		
RECEIVE.MODIFY	3-63	2A		x		
TRANSMIT.DIR.FRAME	3-68	0A	x			
TRANSMIT.I.FRAME	3-69	0B		x		
TRANSMIT.TEST.CMD	3-70	11		x		
TRANSMIT.UI.FRAME	3-70	0D		x		
TRANSMIT.XID.CMD	3-71	0E		x		
TRANSMIT.XID RESP.FINAL	3-71	0F		x		
TRANSMIT.XID.RESP NOT.FINAL	3-72	10		x		

Figure A-1 (Part 3 of 3). Valid Commands

Appendix B. Problem Determination and Compatibility

Problem Determination Considerations

Your program must either provide indications to an operator about ring status or the Ring Diagnostic or an equivalent must be loaded each time an operator needs to know that information. The Ring Diagnostic is documented in *IBM Token-Ring Network Problem Determination Guide.*

The Ring Diagnostic is on a diskette provided with the Token- Ring PC Adapter Card. The Ring Diagnostic indicates the condition of the adapter card and can collect data from error reporting MAC frames on the ring.

Compatibility

If your program will be used on a ring with IBM PCs using other ring network programs, care must be taken to avoid duplication of names and interaction of links.

For example, devices A, B, and C may be using the Token-Ring Network with the IBM PC Network Program and devices D, E, and F are using another network program to communicate over the same Token-Ring Network. Each network program must participate in communications within its own network and protocol only.

PC Network programs will take more time to start up on the Token-Ring than on the PC Network. That is normal.

Requirements

An operating system such as DOS must provide for the following software interrupt services.

- X'21' with function code X'31' (Terminate process and remain resident)
- X'21' with function code X'4C' (Terminate process)
- X'15' An interrupt to support multitasking as explained in *IBM PC Network Technical Reference* (only when the NETBIOS Program is used).

Appendix C. Obtaining Additional NETBIOS Information

For details concerning the frames that are transmitted in response to the various NETBIOS commands, write to the following address (reference "NETBIOS"):

IBM Corporation
Network Systems Department
H45/002-2E
PO Box 12195
Research Triangle Park, North Carolina 27709

List of Abbreviations

AC	access control field
A/C	Address recognized/Frame copied
ARB	adapter request block
ASB	adapter status block
CCB	Command Control Block
DB	Define Byte
DD	Define Doubleword
DHB	data holding buffer
DISC	disconnect
DLC	Data Link Control
DM	Disconnect Mode
DMA	Direct Memory Access
DSAP	Destination Service Access Point
DW	Define Word
ED	Ending Delimiter
FC	Frame Control field
FCS	Frame Check Sequence field
FRMR	FRaMe Reject
FS	Frame Status field
GSAP	Group Service Access Point
I	information (frame)
IEEE	Institute of Electrical and Electronic Engineers, Inc.
I/O	input/output
ISRA	Interrupt Status Register, Adapter
ISRP	Interrupt Status Register, PC
LAN	local area network
LLC	Logical Link Control
LPDU	Logical Link Control Protocol Data Unit
LSAP	Local Service Access Point
LSB	least significant bit
MAC	Medium Access Control
MCB	Message Control Block
MMIO	Memory Mapped Input Output
MSB	most significant bit
PDU	Protocol Data Unit

PIO programmed input output

PU protocol unit

RAM random access memory

RR/RNR Receiver Ready/Receiver Not Ready

RSAP remote service access point

SABME Set Asynchronous Balanced Mode Extended

SAP service access point

SD starting delimiter

SDLC Synchronous Data Link Control

SNA System Network Architecture

SRAM shared random access memory

SRB system request block

SSB system status block

SSAP Source Service Access Point

UA Unnumbered Acknowledgment

UI Unnumbered Information

XID eXchange IDentification

Glossary

Definitions from draft proposals and working papers under development by the ISO/TC97 vocabulary subcommittee are identified by the symbol "(TC97)," indicating that final agreement has not yet been reached among its participating members.

A

access channel control. The collection of logic and protocol machines that manages the transfer of data from the link stations to medium access control and from medium access control to the link stations.

access control byte. The byte following the start delimiter in a token or frame. It is used to control access to the ring.

access priority. The maximum priority that a token can have for the adapter to use it for transmission.

access procedure. The procedure or protocol used to gain access to a shared resource. In a local area network the shared resource is the medium. The medium access procedures specified by the IEEE 802 standard are CSMA/CD token, bus, and ring.

active monitor. A function in a single adapter on a ring network that initiates the transmission of tokens and provides token error recovery facilities. Any active adapter on a network has the ability to provide the active monitor function if the current active monitor fails.

adapter. In the IBM Token-Ring Network, the circuit card within a communicating device, and its associated software, that enable the device to communicate over the network.

Adapter Support Interface. The software used to operate IBM Token-Ring Network adapter cards in an IBM Personal computer and provide a common interface to application programs.

appendage. An application program routine provided to assist in handling a specific occurrence.

attach. To connect a device logically to a ring. To participate in the data passing protocol of the ring.

auto removal. Removing a device from the data passing activity without human intervention. This action is accomplished by the adapter.

B

beacon. A frame sent by an adapter indicating a serious network problem, such as a broken cable.

beaconing. To send beacon frames continuously.

bridge. A device that links one network to another of the same type.

buffer. A memory area reserved for use in performing input/output operations.

bypass. To eliminate a component from a network by allowing the path to go past it.

C

checksum. A value that when ORed with a sum calculated from accumulating all the bits in the field will result in zero.

completion code. The final return code provided by the adapter as a result of an issued command.

control block. In the IBM Token-Ring Network, a specifically formatted block of information provided from the application program to the Adapter Support Interface to request an operation.

cyclic redundancy check. A numeric value derived from the bits in a message that is used to check for any bit errors in transmission.

D

data frame. See frame.

datagram. A particular type of information encapsulation at the network layer of the adapter protocol for NETBIOS. No explicit acknowledgment for the information is sent by the receiver. Instead, transmission relies on the "best effort" of the link layer.

data link. Any physical link, such as a wire or a telephone circuit, that connects one or more devices or communication controllers.

data link layer (or level). (TC97)In open systems architecture, the layer that provides the functions and procedures used to establish, maintain, and release data link connections between elements of the network.

delimiter. In the IBM Token-Ring Network, a bit pattern that defines the limits of a frame or token on a ring.

device. An input/output unit such as a terminal, display, or printer.

distribution panel. A wiring board that provides a patch panel function and mounts in a rack.

downstream. On a network, the direction of data flow.

F

faceplate. A plate for mounting cable data and telephone jack connectors. It comes in two varieties, wall-mounted and surface-mounted.

frame. The unit of transmission in the Token-Ring Network. It includes delimiters, control characters, information, and checking characters. A frame is created when a token has data appended to it by a node.

H

hard error. A serious error on the network that requires that the network be reconfigured or that the source of the error be removed before the network can resume reliable operation.

I

idles. Signals sent along a network when neither frames nor tokens are being transmitted.

initialize. In the IBM Token-Ring Network, to prepare the adapter card (and the Adapter Support Interface if used) for use by an application program.

L

link. In the IBM Token-Ring Network, the logical connection between nodes including the end-to-end link control procedures.

link connection. All physical components and protocol machines that lie between the communicating link stations of a link. The link connection may include a switched or leased physical data circuit, a local area network, or an X.25 virtual circuit.

link station. A protocol machine in a node that manages the elements of procedure required for the exchange of data traffic with another communicating link station.

lobe. The section of cable that connects a device to an access unit.

lobe receptacle. An outlet on a wiring concentrator for connecting a lobe.

local area network. A network in which communications are limited to a moderate-sized geographic area such as a single office building, warehouse, or campus, and which do not extend across public rights-of-way.

local busy. A state that may occur in the adapter indicating that it can not handle additional frame activity for a given link station.

Logical Link Control Protocol Data Unit (LPDU). The unit of information exchanged between link stations in different nodes.

The LPDU consists of the DSAP and SSAP address fields, the control field, and the information field (if present).

M

MAC frame. Frames that control the operation of the IBM Token-Ring Network and any ring station operations that affect the ring.

medium. A physical carrier of electrical energy.

medium access control. The sub-component of DLC that supports medium-dependent functions and uses the services of the physical layer to provide services to logical link control. MAC includes the medium access port.

memory mapped I/O (MMIO). In an IBM PC, a method of accessing an input or output port as if it were a memory location.

monitor. In the IBM Token-Ring Network, the function required to initiate the transmission of a token on the ring and to provide soft-error recovery in case of lost tokens, circulating frames, or other difficulties. The capability is present in all ring stations.

N

NAUN. Nearest active upstream neighbor. For any station on a ring, the station that is sending frames or tokens directly to it.

network. (1)(TC97)An interconnected group of nodes. (2)The assembly of equipment through which connections are made between data stations.

network administrator. A person who manages the use and maintenance of a network.

network management. The conceptual control element of a data station that interfaces with all of the layers of that data station and is responsible for the resetting and setting of control parameters, obtaining reports of error conditions, and determining if the station should be connected to or disconnected from the medium.

node. An endpoint of a link or a junction common to two or more links in a network.

node address. The address of an adapter on the ring.

numbered frames. Information segments arranged in numbered order for accountability.

O

open. (1) To make an adapter ready for use. (2) A break in an electrical circuit.

P

patch cable. In the IBM Token-Ring Network, a cable with IBM Cabling System connectors at each end, used to connect together components, devices, and cables of the network.

path. In a network, a route between any two nodes.

programmed I/O (PIO). In an IBM PC, a method of accessing an input or output port with specific instructions.

post. To affix to a usual place. Used with NETBIOS to indicate providing items such as a return code at the end of a command or function. Also used to define an appendage routine.

R

receive. To obtain a message transmitted from a device.

remove. To stop an adapter from participating in data passing on the network.

return code. A hexadecimal value provided by the adapter to indicate the result of an action.

ring (network). A network configuration consisting of a series of attaching devices connected by unidirectional transmission links to form a closed path.

Ring Diagnostic. In the IBM Token-Ring Network, a program to be run in an IBM Personal Computer that provides the user information regarding the performance of the ring.

ring in. On an access unit, the receive or input receptacle.

ring out. On an access unit, the transmit or output receptacle.

ring sequence. The order in which components are connected to a ring.

ring status. The condition of the network.

ring topology. A logically circular, unidirectional transmission path without defined ends. Control can be distributed or centralized.

routing. The assignment of the path by which a message will reach its destination.

S

SABME. Set Asynchronous Balanced Mode Extended. A DLC command used in the establishing of a link.

segment. A portion of a network. It may contain cables, components, or lobes.

service access point. The logical point at which an n + 1-layer entity acquires the services of the n-layer. In this document, the layer is assumed to be DLC. A single SAP can have many links terminating in it. These link "end-points" are represented in DLC.LAN by link stations.

session. The data transport connection resulting from a call or link between two devices.

soft error. An error on a network that can impair the network's performance but does not, by itself, affect its reliability.

start delimiter. The first byte of a token or frame. It consists of a special recognizable bit arrangement.

star wiring. A wiring arrangement in which an individual cable runs from each work area to a concentration point.

T

terminal. A device or work station.

token. A sequence of bits passed from station to station along the network. It consists of a starting delimiter, a frame control field, and an ending delimiter. The frame control field contains a token indicator bit that indicates to a receiving station that the token is ready to accept information. If the station has data to send along the network, it appends the data to the token. The token then becomes a *frame*.

token ring. A network with a ring topology that passes tokens from station to station.

transmission medium. A physical carrier of electrical energy.

transmit. To send information from one place for reception elsewhere.

U

unnumbered acknowledgment. A DLC command used in establishing a link and in answering receipt of DLC frames.

upstream. On a network, the direction opposite that of data flow.

W

wire fault. An error condition caused by a break in the wires or a short between the wires in a segment of cable.

wiring closet. A room that contains one or more distribution racks and panels that are used to connect various cables together (via patch cables) to form physical networks.

work area. An area in which terminal devices (such as displays, keyboards, and printers) are located.

work station. An input/output device that allows either the transmission of data or the reception of data (or both) from a host system, as needed to perform a job; for example, a display station or printer.

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