ISDN PCTA - SESSION LAYER (NetBIOS)

INTERFACE DESCRIPTION

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Introduction

This document describes the session layer interface of Northern Telecom's Integrated Services Digital Network (ISDN) personal computer terminal adapter (PCTA). The document gives application programmers information that will allow them to write programs for the PCTA.

The session interface, as seen by programs above it, is compatible with the NetBIOS interface (as specified in IBM's PC-NET Technical Reference Manual), except that certain commands are not implemented and that some ISDN-specific commands have been added. The commands implemented and the exceptions are listed under General Description on page 7 and 8.

The reader is assumed to be familiar with ISDN and assembly-language programming for the IBM PC.

Implementation Notes

If the application being developed is one that connects two or more PCs through the network, the application program can be tested by connecting two PCs, both equipped with PCTA cards, back to back. Back-to-back testing is described in the PCTA Technical Guide[1] and NTP 297-2451-205.

When running any application, see the PCTA User Guide for details on the proper setup of the ISDN configuration file.

A useful debugging aid for any application is the ISDNERR program. A description of the ISDNERR program can be found in the PCTA User Guide. Session errors in the 200 and 300 range indicate an application error in using the ISDN software.

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[1] Available in the third quarter of 1988.

Datagram Commands

Datagram commands are not supported.

References

MS-NETWORK[*] : OEM User's Kit.
Microsoft Inc., 1985

PC-Net Technical Reference Manual. IBM
Corporation, 1985

PCTA Technical Guide. Northern Telecom
Inc.

PCTA User Guide. Northern Telecom Inc.

Personal Computer Terminal Adapter,
Operating Requirements, Installation, and
Verification, NTP 297-2451-205,
Northern Telecom Inc.

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[*] MS-NETWORK is a trademark of
Microsoft Inc.

ISDN Terminal Adapter Overview

The IBM PC-based ISDN personal computer terminal adapter (PCTA) is a board assembly that fits into the PC's input/output (I/O) bus slots, enabling the PC to connect to ISDN. Associated with the board is software running in the PC's memory. This software interfaces PC applications to the board and gives these applications networking capability.

The PCTA attaches to the ISDN at the T reference point. It is also possible to attach a T2317 ISDN phone to that same T reference point to allow communication between the phone and the PC. This means that the PCTA has a data networking capability, and can communicate with the phone which, in turn, communicates with the network.

The PCTA can run on any machine that is one hundred percent compatible with the IBM PC XT and AT range of machines.

Figure 1

The PCTA provides the following:

¥   Hardware is contained on two full-length, IBM PC-expansion-slot-compatible boards (this will be a single board in the next phase). Hardware is powered from the IBM PC bus.

¥   IBM PC software is supplied with drivers to interface the popular commercial Disk Operating System (DOS) applications with the board.

The PCTA supports the following:

¥   ISDN layer 1 T interface (point-to-point, short, and extended passive buses)
¥   ISDN layer 2 Q.921 multi-frame Link Access Protocol D-channel (LAPD)

¥   X.25 layer 2 Link Access Protocol Balanced (LAPB)
¥   T-link protocol for circuit-switched calls
¥   Q.931 functional signaling protocol for circuit-switched calls
¥   X.25 layer˚3
¥   NetBIOS at the session layer

The PCTA can communicate with a T2317 phone, using a version of the ISDN layer˚3 Q.931 stimulus signaling protocol.

Main Components

The PCTA system can be divided into three main areas.

Terminal Adapter Hardware

The PCTA's hardware consists of boards which can be installed in the I/O slots of the IBM PC. These boards, a main PCTA card, and a full-length daughter board provide the necessary physical interface between the IBM PC and an ISDN T interface.

The ISDN T interface consists of one 16 kbit/s D-channel and two 64 kbit/s B-channels multiplexed into two (send and receive) serial bit streams. The main card provides the PC interface and D/B-channel control, while the daughter board provides support hardware, serial processing, and the ISDN T-loop interface. Simultaneous access to the D-channel and one B-channel (user selectable) is provided.

Terminal Adapter Firmware

The PCTA hardware consists of a microprocessor-based subsystem which is managed and controlled by firmware. A bootstrap Read-Only Memory (ROM) provides immediate control of the PCTA after powerup. A program in Random-

Access Memory (RAM,) downloadable from the PC, is used to provide flexible software control of the PCTA's D-channel and B-channel functions and protocols. This PCTA firmware is stored on disk and is downloaded to the PCTA upon installation of the ISDN base software.

The firmware provides control and signaling for the D-channel according to the ISDN protocols. The B-channels are handled with whatever protocols are necessary for the particular application at the time.

In relation to the open-system-interconnect (OSI) reference model for layered communications, the PCTA's D-channel and B-channel control firmware provides the proper layer 2 functions between the PC (layer˚3 and higher), and the physical-loop interface residing in the PCTA (layer 1).

IBM PC Base Software

This software is loaded from disk into the IBM PC upon user request. It is a RAM-resident background program, and provides control over the PCTA's operations, management of logical data channels, and management of the PC's facilities. It also provides the software interface for all applications that involve the PCTA. This software is not to be confused with PCTA firmware. The PCTA firmware is also read from disk, but it is downloaded to the PCTA by the PC base software when it is installed.

Because the software is loaded from disk, updates and expanded applications packages may be available from Northern Telecom (NT) or other vendors as they are developed.

PC Software

Applications are built on the base hardware and software:

¥   an IBM personal computer board that performs the layer 1 (T interface) and layer 2 (LAPB/LAPD) functions of an Integrated Services Digital Network (ISDN) terminal adapter

¥   an NT T2317 phone

¥   PC RAM-resident base software comprising:

-                terminal adapter (TA) board drivers (direct memory access, called DMA, for data transfer to the board)
-                network layers (Q.931 and X.25)
-                session layer (provides the NetBIOS interface)

Note: The transport and session layers of the PCTA base software do not contain protocols. ISDN specifies only layers 1 through 3. Higher end-to-end protocols are provided by the application.

MS-Network

To understand the session layer, it is useful to look at MS-Network a software package produced by Microsoft. It enables DOS-compatible programs to access DOS resources (for example, disks and printers) across a network.

Microsoft allows original-equipment-manufacturer (OEM) vendors to attach a product to the package at the OSI layer 6 to layer 5 boundary. The vendor conforms to the NetBIOS interface at that boundary and supplies layers 5 through 1.

Originally, MS-Network was intended to be used in conjunction with a local area network (LAN). But in this implementation of it, NT provides layers 5 through 1 based on ISDN, a wide area network. This arrangement allows existing applications to access data across the ISDN network.

The following figure shows a typical server-requestor configuration using ISDN as the transport mechanism.

Figure 2

Figure 2 shows the components involved in a server-to-requestor (workstation) dialogue. Northern Telecom supplies layers 1 and 2 on the PCTA board and layers 3, 4, and 5 in PC software. MS-Network supplies layers 6 and 7. It uses DOS interrupts for the interface to the application at layer 7.

Control of the Phone

Applications such as Northern Telecom's Call Manager can use the PCTA to control the T2317 phone. This is done by interfacing to the session layer which communicates with SAPI˚17 layer˚3. Layer˚3 uses a form of the Q.931 stimulus signaling protocol to talk to the phone. SAPI˚17 receives all of the messages communicated between the phone and the network and uses them to keep track of call activity.

In addition, applications can send requests to SAPI˚17 to have it ask the T2317 phone to dial and answer calls. Appendix A gives some detail on how this process works.

General Description

The session layer presents the PCTA's NetBIOS interface to PC software applications. NetBIOS is the industry-standard interface that allows PC software (through PC-DOS) to talk to a variety of different network hardware implementations. (NetBIOS is documented in IBM's PC-Net Technical Reference Manual.) One such hardware implementation is the ISDN PCTA board.

The session layer as defined by IBM's NetBIOS does not strictly comply with the OSI definition of session layer, in that there is no session-to-session communication by means of session headers.

The PCTA's conformance to IBM's NetBIOS standard is close, but certain commands are not implemented. The NetBIOS commands that have been implemented are as follows:

Command	Description
CANCEL	Cancels the command whose SCB is found at the specified address.
ADD_NAME	Adds a 16-character name to the local sessions name table.
DEL_NAME	Deletes a 16-character name from the local sessions name table. A HANG_UP request must be issued for all active calls associated with this name and pending LISTEN commands associated with this name must be cancelled.
CALL	Opens a session with a remote name. The remote party that is called must have an outstanding LISTEN for the session to be established.
LISTEN	The name that is called must have an outstanding LISTEN request for the session to be established. A call is accepted when the remote name and address and the remote network number of a call match the local name and address and local network number of a LISTEN request.
HANG_UP	Ends a session. This command closes outstanding RECEIVE requests and waits for outstanding SEND requests to be completed. It then generates the necessary CANCEL commands to the network layer. The SESSION STATUS is updated accordingly.
SEND_DOUBLE	Sends two blocks of data as one data block for a given session number.
SEND	Sends data associated with a session number.
RECEIVE	Receives data for a specified session.
RECEIVE_ANY	Receives data for any active session associated with a specified local name number.

The following commands have been added to the NetBIOS interface:

Command	Description
VOICE_CALL	Is used by an application to set up a call to the phone. This command and all further commands relating to this session are passed to the SAPI˚17 network layer.
DIAL	Sets up a circuit-switched B-channel connection.
DROP	Clears a circuit-switched B-channel connection or refuses an incoming circuit-switched B-channel call.
ANSWER	Accepts an incoming circuit-switched B-channel call.
CS_CALL	Establishes the protocol over an active B-channel (that is, establishes end-to-end data connectivity)
CS_PARAMETER	Renegotiates the end-to-end parameters for an active call using the T-link protocol.
CS_CONTROL	Allows the application to force certain link-signaling parameters to a particular state (it refers to Electronic Industries Association (EIA) leads when you are using T-link).
REGISTER	Allows applications to REGISTER to use the circuit-switching capabilities of ISDN PCTA base software.
DEREGISTER	Disconnects an application from the circuit-switching capabilities.

Note: The following commands are not supported:

¥   all datagram commands (including broadcast commands)
¥   UNLINK
¥   NAME_STATUS
¥   RESET
¥   STATUS

ISDN Session Interfaces

This section describes the entry point of the session layer.

Figure 4

All commands and associated parameters are passed to the session layer in a session control block (SCB). The SCB is a block of memory. The application owns the SCB, but once the SCB has been given to the session layer, its contents must not be altered until processing has been completed.

The application activates the session layer by issuing interrupt 5Ch (where h indicates hexadecimal notation).with registers ES˚:˚BX pointing to the SCB, which contains the command being issued.

When the session layer receives the command, it either accepts or rejects it. If the command is rejected, an immediate error occurs. When this happens, the AL register is set to the value of the error, as is the return code of the SCB and the AH register is set to 01h. These immediate errors are listed under Session Commands on page 13.

If the command is accepted, the immediate error code is set to zero, and AH is set to zero.

On immediate return to the application, the Command Done field of the SCB indicates whether the command has been completed. If the command has been completed, the return code is in the Return Code field; otherwise, the code indicates a pending state that is, FFh.

Once the command is completed, the session layer calls the application's asynchronous notification routine (ANR) to confirm the completion. See Command Options on page 13. The return code appears in the Return Code field of the SCB.

Session indication blocks (SIBs) extend the NetBIOS interface to inform applications of unsolicited network events which may affect their operation.

Session indication blocks are sent to an application, if that application first registers with the session layer. See Circuit-Switching NetBIOS Extensions on page 23. The session layer calls the application's SIB notification address with registers ES˚:˚BX pointing to the SIB. See Description of the SIB Fields on page 12 for the SIB structure. The SIB is owned by the session layer. The application cannot alter the SIB content, except the Return Code field for certain SIB codes.

Note: An application using the circuit-switching features of the ISDN PCTA must register with the session layer. The application's SIB routine should be very short and cannot issue NetBIOS commands. It must also return with an IRET instruction. SIBs only apply to circuit-switched calls.

Description of SCB Fields

Figure 5

Command Code

The Command Code field contains the command to execute. The most significant bit is used to indicate the wait or no-wait option. If it is set to zero, the wait option is selected. If it is set to one, the no-wait option is selected.

With the no-wait option, an immediate return code is sent when the command is received by the session. A second return code is sent on completion of the command (in the Return Code field). If the wait option is selected, the command will be completed before the session layer returns.

Return Code

The Return Code field is used to indicate the immediate return code for no-wait commands and the final return code for wait commands. It also indicates the final return code for no-wait commands interrupting the user application by calling the asynchronous notification routine (ANR). If the Return Code field contains a valid code, the AL register is usually set to the return-code value. If the ANR address field is equal to zero, the application is not interrupted on command completion and has to poll the Command Done field to determine when the command has been completed.

The value of the Return Code field may be changed during processing by the session layer, but it should not be used as an indication of completed processing.

Session Number

The Session Number field is generated by the session layer when a CALL, VOICE_CALL, CS_CALL or a LISTEN command is issued. This number must be retained by the application and used for subsequent commands relating to the active call, for example SEND, RECEIVE, and HANG_UP.

Name Number

The Name Number field is returned by the session in response to an ADD_NAME command. The number should be used for all datagram support commands and for RECEIVE_ANY commands.

Note: Datagrams are currently not implemented.

Buffer Address

The Buffer Address field points to a buffer to be used with a command. It and should be in the double word address pointer form.

Buffer Length

The Buffer Length field indicates the length of the buffer to be used with a command. When the application receives data, this value is updated to reflect the amount of data actually received.

Remote Network Name

This field indicates the name of the party with whom you want to communicate. All 16 bytes must be used, so the name should be padded with blanks if necessary. The name used must appear in the session name list of the ISDN configuration program.

For the SEND_DOUBLE command, the first six bytes of this field are used to specify the second data buffer as follows: the first two bytes indicate the length of the buffer and the next four bytes indicate the buffer address in the double word address pointer form.

Local Network Name

The Local Network Name field indicates the name by which you are known by the network. All 16 bytes must be used, so the name should be padded with blanks if

necessary. The name used must appear in the session name list of the ISDN configuration program.

Receive Timeout

The Receive Timeout field is used by CALL and LISTEN commands to specify a timeout period for all RECEIVE commands associated with that session. The timeout value is specified in increments of 500˚ms. If 00h is specified, the default is no timeout.

Currently, all timeouts are dictated and handled by the network (that is, this field is ignored).

Send Timeout

The Send Timeout field is used by CALL and LISTEN commands to specify a timeout period for all SEND commands associated with that session. The timeout value is specified in increments of 500 ms. If 00h is specified, the default is no timeout.

Currently all timeouts are dictated and handled by the network (that is, this field is ignored).

Asynchronous Notification Routine (ANR) Address

The ANR Address field indicates the routine to be called when the session has finished processing an asynchronous command. The application ANR must establish any registers it needs when it is entered and must restore them before exiting. Only the the ES˚:˚BX registers registers set to point to the SCB are returned. The routine must also return with an IRET and should be short and return immediately.

If the ANR Address field is set to binary zero, the session will not interrupt the application on command completion. But the FFh (where h indicates hexadecimal notation) in the Command Done field will change when the command is completed.

LAN Adapter Number

The LAN Adapter Number field indicates the number of the LAN adapter (LANA) for which this command is destined. The default LANA for ISDN is zero, but it can be changed in the configuration data file if needed. If the LANA number in this field does not match the LANA number in the configuration data, then the previous address at INT 5Ch (that is, the previously loaded INT 5Ch software) is called to handle the command.

Command Done

The Command Done field indicates the status of a command . A value of FFh indicates that the command is pending. Any other value indicates that the command is completed. This byte is useful if the ANR address was specified as zeros using the no-wait option.

Data Control (Q Bit)

The Data Control field is used by applications requiring access to the X.25 packet-header Q bit. Bit 7 is used to indicate the value of the Q bit. All other bits must be set to zero. The application can set or clear the Q bit for outgoing X.25 packets. The X.25 layer sets or clears this bit to reflect the value of incoming packets.

Buffer2 Address

The Buffer2 Address field points to the second buffer, which is used by applications to pass up to 16 bytes of user data to X.25 in the CALL command.

Buffer2 Length

The Buffer2 length indicates the length of the user data in the CALL command.

Application ID

An application that registers for SIB notification is given an application ID by the session. This value is set by the session layer on a REGISTER command, and must be used for subsequent circuit-switching commands.

Description of SIB Fields

Figure 6

Command Code

The Command Code field defines the type of indication block.

05h	= RELEASE
06h	= ESTABLISH
21h	= CALL_STATUS
22h	= CALL_OFFER
23h	= CALL_DROP
24h	= CALL_FAILURE
31h	= CONTROL_CHANGE

Return Code

The Return Code field is only used as a response to the CALL_OFFER SIB command. The application must set the return code to either "maybe" or "reject," depending on whether or not the application wishes to accept the call. A "maybe" return should be followed with either an ANSWER or a DROP command.

FFh = reject
FEh = maybe

Cause

The Cause field indicates the CCITT cause or the control lead information, if it is a control-lead SIB.

The control-lead information will be in the following form:

```
bit 7                    bit 0
0  0  0  BK  CD  CTS  0  DSR
```

where

BK	=	break
CD	=	carrier detect
CTS	=	clear to send
DSR	=	data set ready

Buffer Address

The Buffer Address field points to a buffer if the SIB type requires additional information to be placed in a buffer. The address is in the following double word address pointer form.

Buffer Length

This field indicates the length of the buffer in the buffer address.

Reserved

These fields do not contain any meaningful information.

Session Commands

This section describes the commands supported by the session layer.

General Information

Command Options

There are two options that can be used to issue session commands:

¥   the wait option
¥   the no-wait option

When an application uses the wait option, it has to check either the Return Code field or the AL register for the return code. A program issuing a command using the wait option will not get control back until the command has been completed.

When an application uses the no-wait option, it gets an immediate return code and continues its current process. The application should check the AL register or the return code to see if the command was accepted. The AL register is set to zero if the command is accepted. If the command is accepted but not complete, the Command Done field contains the code FFh. This mechanism is a standard NetBIOS option.

The application must be able to handle any command complete interrupts (that is, ANR calls) that occur before the NetBIOS interface has finished processing the accepted command.

Commands using the wait option cannot be queued by the session layer. They must be executed upon reception. If a wait command is received when the session is still processing previously issued commands, the wait command is rejected.

Immediate Errors

An immediate-error code sent from the session layer indicates that the session has not done any processing on the command. It has been rejected because of the current state of the ISDN software.

INSERT TABLE "IMMEDIATE RETURN CODES"

Notes for Session Commands

All of the commands, except the CANCEL command, can be used with either the wait or the no-wait option. The CANCEL command must use the wait option.

The LAN Adapter Number field in the SCB must be set on every command issued to the session. An application choosing a value other than zero must ensure that users are aware that the PCTA configuration data must be changed correspondingly. The application will be unable to operate with applications using the default LAN adapter number (for example, MS-Network and Call Manager).

Each command using the no-wait option may specify an ANR address in the SCB. If the ANR Address field of the SCB is zero, then the application will not be notified on completion of the command. The application will have to poll the Command Done field for a value other than a hexadecimal FFh to indicate command completion.

In the descriptions of the commands, the following conventions apply:

¥   The SCB fields not preceded by a symbol are set by the application and are unchanged by the session layer.
¥   Fields preceded by an asterisk (*) are set by the application and altered by the session.

¥   Fields preceded by the symbol   application.
    &sq are returned by the session to the

General Commands

**CANCEL
(35h)**

Cancels the command whose SCB is found at the address specified in the Buffer Address field.

It is only valid to cancel CALL, LISTEN, SEND, SEND_DOUBLE, RECEIVE, VOICE_CALL, CS_CALL, CS_PARAMETER, CS_CONTROL, RECEIVE_ANY, ANSWER, or DIAL commands.

Fields Used	Description
Command Code	35h
Buffer Address	Address of SCB to CANCEL
&sq Return Code	
24h	Command completed before CANCEL received
26h	Command invalid to CANCEL

Name Commands

**ADD_NAME
(30h or B0h)**

This command sets a local name. Each active application may add local names to a maximum of 32 names for all applications.

Fields Used	Description
Command Code	30h or B0h
Local Network Name	Name to be added in the list
&sq Name Number	Name number to be used with RECEIVE_ANY commands
&sq Return Code	
0Eh	Name table full-there are 32 active local names: reissue when a local name has been deleted.
16h	Name supplied by application not found in directory

**DEL_NAME
(31h or B1h)**

This command deletes a local name. The name can only be deleted if there are no active sessions and no outstanding LISTEN commands associated with it.

Fields Used   **Description**

Command Code   31h or B1h

Local Network   Name to be deleted from the list
Name

&sq Return Codes

   15h   Invalid name: specified name cannot be found in directory.
   16h   Application cannot delete a name with either an active session
                                 or a LISTEN command associated with it.

Session Support Commands

**CALL
(10h or 90h)**

This command opens a session with a name to be called. The remote name that is called must have an outstanding LISTEN command for the session to be established. The name is translated to an address by the session.

The session then uses the appropriate network service in order to issue the CALL command. The session generates the session number that is returned to the application.

The second buffer is checked for a non-zero length. If there is one, then the buffer is assumed to point to user data which X.25 must send with the call packet. The buffer must be less than 16 bytes long.

Fields Used	Description
Command Code	10h or 90h
Remote Network Name	Name that a session is going to be established with
Local Network Name	Name identifying the calling party
Buffer2 Address	Address of the buffer containing the user data
Buffer2 Length	Length of the user data is less than or equal to 16 bytes
&sq Session Number	Session number to be used for subsequent commands relating to this session
&sq Return Codes	
01h	Illegal buffer length: user data is longer than 16 bytes.
05h	CALL command timed out before completing. The called party did not respond: address called may be incorrect.
09h	No channels available for CALL command.
0Bh	Command cancelled
12h	Remote device not listening or network error
14h	Remote name specified cannot be found in the directory.
15h	Local name specified cannot be found in the directory.

LISTEN
(11h or 91h)

A name that is called must have an outstanding LISTEN command for the session to be established. A call is accepted when the remote name and address and the remote network number of a call matches the local name and address and local network number of a LISTEN command.

When a LISTEN command is answered, the directory is searched for the address and the corresponding name. If these are found, the name is sent to the application layer. If the remote name cannot be found, then the address is passed to the application layer as an ASCII address.

Note: If an incoming X.25 call-request packet contains any user data, it will be returned in the first RECEIVE or RECEIVE_ANY buffer supplied. The data will be less than or equal to 16 bytes.

Fields Used:	**Description**
Command Code	11h or 91h
* Remote Network Name	This is the name of a remote party with whom a session is going to be established. The * character means LISTEN_ANY, that is, listen for calls from any remote party. The most specific LISTEN command is used to answer an incoming call. The name returned is the name with which a session has been established.
Local Network Name	Name identifying the called party (that is, the local application)
&sq Session Number	Session number to be used for subsequent commands relating to the established session
&sq Return Codes	
0Bh	Command was cancelled.
14h	Remote name specified in the LISTEN command cannot be matched in the directory.
15h	Local name supplied in LISTEN command cannot be found in directory: address entry in directory is invalid for the local name.

HANG_UP
(12h or 92h)

This command ends a session. Outstanding RECEIVE commands are cancelled, but outstanding SEND commands are allowed to complete. If any RECEIVE_ANY commands apply to this session, the first applicable one is returned to the application to indicate that the session has ended.

Fields Used	**Description**
Command Code	12h or 92h
Session Number	Session number generated by LISTEN, VOICE_CALL, CS_CALL or CALL commands
&sq Return Code	

0Ah   Attempted to hang up a closed session

SEND
(14h or 94h)

Send data for a session number.

Fields Used	Description
Command code	14h or 94h
Session Number	Session number for which data is to be sent
Buffer Address	Buffer where the data to be sent resides
Buffer Length	Size of the buffer to be sent
Data Control	High bit indicates whether or not the Q bit should be set in the X.25 packets. It is usually set to zero.

&sq Return Codes

05h	Command timed out
0Ah	SEND command issued for a closed session
0Bh	Command cancelled
18h	Session ended abnormally.

SEND_DOUBLE
(17h or 97h)

This command is also known as CHAIN_SEND. It allows two blocks of data to be sent as one block.

Fields Used	Description
Command code	17h or 97h
Session Number	Session number for which data is to be sent
Buffer Address	First buffer where the data to be sent resides
Buffer Length	Size of the first buffer to be sent
Remote Network Name	The first word represents the length of the second buffer. The next double word contains the address of the second buffer.
Data Control	High bit indicates whether or not the Q bit should be set in the X.25 packets. It is usually set to zero.

&sq Return Code

05h	Command timed out
0Ah	SEND command issued for a closed session
0Bh	Command cancelled
18h	Session ended abnormally.

RECEIVE
(15h or 95h)

This command allows data to be received from a specified session.

When T-link data is received, the first byte of the receive buffer contains an error status byte, followed by the actual data.

The bits in the error status byte have the following meaning (bit 0 is the least significant bit):

Bit 0: Parity error.
The data in the block contains parity errors

Bit 1: SCC receiver overrun.
The serial-communications controller (SCC) has reported one or more receiver overrun errors while data was being received into this data block. This does not necessarily mean that data was lost, but it should not occur in normal operation.

Bit 2: Discarded data.
Received data has been discarded because a buffer was not available in which to store it. In this case, data is definitely lost.

Bit 3 through 7:
Undefined and set to 0.

Fields Used	Description
Command Code	15h or 95h
Local Session Number	Session number for which data is to be received
Buffer Address	Buffer to which received data will be transferred
* Buffer Length	Maximum size of the receive buffer; on return, it indicates the number of bytes actually transferred to the application.
&sq Data Control	High bit indicates the state of the Q bit of incoming X.25 packets.
&sq Return Code	
01h	Illegal buffer length; a buffer length of zero was specified.
06h	Data outstanding for application, but no receive buffers are available: issue another RECEIVE command.
0Ah	RECEIVE command issued for a closed session.
0Bh	Command cancelled.
18h	Session ended abnormally.

Note: The application should ensure that there is always at least one RECEIVE outstanding on any active session. On a VOICE_CALL session there can only be one outstanding RECEIVE.

RECEIVE_ANY (16h or 96h)

The only difference between this command and the RECEIVE command is that RECEIVE_ANY allows data to be received for any active session associated with a specific name number, or any other active session.

The user should use different local names for each application that is used. If not, an application that issues a RECEIVE_ANY command may receive data that is actually intended for another application using the same local name.

Similarly, an application should not issue a RECEIVE_ANY command for all active sessions, unless it can be certain that it is the only active application.

Fields Used	Description
Command Code	16h or 96h
* Name Number	If this field is equal to FFh, the RECEIVE_ANY is for any remote names with which a session has been established. If FFh was specified, the name number of the session that used the buffer is returned.
&sq Session Number	Session number for which data has been received.
Buffer Address	Buffer to which the data to be received is going to be transferred.
* Buffer Length	Maximum size of the RECEIVE buffer. On return, indicates the number of bytes actually transferred to the application.
&sq Data Control	High bit indicates the state of the Q bit of incoming X.25 packets.
&sq Return Codes	
01h	Illegal buffer length: specified a length of zero.
06h	Data outstanding for application, but no receive buffers are available: issue another RECEIVE or RECEIVE_ANY command.
0Ah	Command issued for a closed session
0Bh	Command cancelled
13h	Invalid name number specified
18h	Session ended abnormally.

SAPI˚17 NetBIOS Extensions

The following return codes may be
returned from SAPI˚17 on any of the
commands that it processes (that is,
SEND, RECEIVE, VOICE_CALL, HANG_UP).

Return Code	Description
61h	link not ready
62h	no VOICE_CALL active
63h	fatal link error
64h	TEI removed

VOICE_CALL **(3Fh or BFh)**	This command is an extension to NetBIOS. It is used by a SAPI˚17 application to set up a connection to the phone. It is assigned a session number by the session layer and then passed to SAPI˚17. Any further SEND, RECEIVE, or HANG_UP commands issued for this session number are passed to SAPI˚17.

Field Used	Description
Command Code	3Fh or BFh
&sq Session Number	Session number to be used for subsequent commands relating to this session
&sq Return Code	
05h	Command timed out
11h	Cannot establish a second SAPI˚17 session.

Circuit-Switching NetBIOS Extension

To make use of the circuit-switching capabilities of the ISDN PCTA, an application must first issue a REGISTER command with the session. The returned application ID must be used with each circuit-switching command.

The circuit-switched call is connected using either the ANSWER or the DIAL command. The CS_CALL command is then used to establish a session using the T-link protocol over the active B-channel. Data is sent and received using the NetBIOS SEND and RECEIVE commands. The CS_PARAMETER and CS_CONTROL commands can be issued to alter respectively the end-to-end parameters and the EIA leads.

The session is terminated with a HANG_UP command, and then the connection is terminated with a DROP command -- the order is important. The application should deregister before terminating its operation.

The circuit-switching commands may return any of the following return codes, in addition to the ones listed under the individual commands.

Return Code	Description
3Ah	Circuit-switching not available
3Bh	Invalid application ID
50h	Link down
51h	Fatal link error
52h	TEI removed
53h	Call in progress
54h	Invalid parameter
55h	Call idle
56h	Invalid call reference
57h	Normal call clearing
58h	User busy
59h	No user responding
5Ah	Call rejected
5Bh	Destination out of service
5Ch	Incomplete number
5Dh	Circuit or channel not available
5Eh	Temporary failure
5Fh	Resources unavailable

DIAL **(50h or D0h)**	The DIAL command is used to set up a circuit-switched B-channel connection. **Note:** When a DIAL command is issued to a busy number, a CALL_STATUS SIB command with cause code of user busy (58h) will be sent to the application. The DIAL command will then be completed.

Field Used	Description
Command Code	50h or D0h
Application ID	Identifies the application issuing the command. The application must previously have registered with the session to obtain an application ID.
Buffer Address	Points at the buffer that contains the directory number and the bearer capability (protocol, data rate). The buffer format is:

<bearer capability, dial, address, end byte>.

bearer capability	00h, n (length, 1 byte), n bytes
	
	Note: The acceptable bearer capability encodings are:
	
	1) 00h = code
	      02h = length
	      88h, 90h, gives 64 Kbps unrestricted, digital.
	
	2) 00h = code
	      02h = length
	      89h, 90h, gives 64 Kbps restricted, digital.

dial address	01h, n (length, 1 byte), n bytes of ASCII (digits 0-9, # or *)
end byte	FFh - one byte indicating that this is the end of the buffer

On return, the call reference is placed in the buffer. The returned buffer format is:

<call reference, channel ID, connected number, redirecting address, end byte>

call reference	one byte to be used with the DROP command - indicates a unique identifier for the call
channel ID	one byte indicating which B-channel the network supplied for CALL (B1 = 1, B2 = 2).

	connected number	indicates to whom you are actually connected, which may not be the same number you dialled (that is, if the call was redirected). 02h, n (length, 1 byte), n bytes of ASCII (digits 0-9, A-Z, a-z, *, +, -, #)
	redirecting address	(optional) if the call was forwarded. 03h, length, n bytes of ASCII (digits 0-9, A-Z, a-z, *, +, -, #)
	end byte	FFh
* Buffer Length	Indicates the length of the buffer passed to the session. The length is then updated by the session to reflect the length of the buffer passed back to the application.	

&sq Return Code

3Ah	Circuit-switching is not available.
50h	Link down
51h	Fatal link error
52h	TEI removed
53h	Call in progress
54h	Invalid parameter
57h	Normal call clearing
59h	No user responding
5Ah	Call rejected
5Bh	Destination out of service
5Ch	Incomplete number
5Dh	Circuit or channel not available
5Eh	Temporary failure
5Fh	Resources unavailable

**DROP
(51h or D1h)**

This command is used to clear a circuit-switched B-channel connection or to refuse an incoming switched B-channel connection. It is used in response to a CALL_OFFER SIB, or to terminate an answer or a dial connection.

Field Used	Description
Command Code	51h or D1h
Application ID	Identifies the application issuing the command.
Buffer Address	The call reference is placed in a buffer by the application. Call reference is a one-byte value which is passed to the application in either a CALL_OFFER SIB or in response to a DIAL command. The buffer format is:

<call reference, end byte>.

call reference	one byte indicating the call to drop (passed to the application in the dial ANR or in the call offer SIB).
end byte	FFh

Field Used	Description
Buffer Length	Reflects the length of the call reference plus the end byte.
&sq Return Code	The DROP command will succeed for all cases except an invalid call reference and

50h	Link down
51h	Fatal link failure
52h	TEI removed
55h	Call idle
3Ah	Circuit-switching not available

ANSWER (52h or D2h)

This command is used to accept an incoming circuit-switched call. It is used in response to a CALL_OFFER SIB command.

Fields Used	**Description**
Command Code	52h or D2h
Application ID	Identifies the application issuing the command.

Buffer Address

The call-reference byte from the SIB is placed in a buffer by the application. The channel ID for the answered call will be returned in the buffer. The format of the returned buffer is:

<call reference, channel ID, end byte>.

call reference	one end byte indicating the call to answer (passed to the application in the call offer SIB)
channel ID	one byte indicating the B-channel which the network supplied for the call (B1=1, B2=2)
end byte	FFh

* Buffer Length

Reflects the length of the call reference passed to the session by the application. It is updated by the session to reflect the length of the returned call reference.

&sq Return Code

3Ah	Circuit-switching is not available.
3Ch	Unacceptable ANSWER: application ID invalid or reply to CALL_OFFER was not "maybe."
50h	Link down
51h	Fatal link failure
52h	TEI removed
54h	Invalid parameters
55h	Call idle
56h	Invalid call reference
57h	Normal call-clearing
5Eh	Temporary failure

CS_CALL (40h or C0h)

This command is used to establish the T-link protocol over an active B-channel to establish end-to-end connectivity.

Fields Used	Description
Command Code	40h or C0h
Application ID	Identifies the application issuing the command.
* Remote Network Name/Local network Name	The application uses the Remote Network Name field and the Local Network Name field as the buffer in which to pass the desired connection parameters with the far end. The parameters negotiated with the far end are then passed back to the application in this buffer. The format of the buffer is:

.

Parameter	Index	Values	
Control lead	00h	see CS_CONTROL and CONTROL_LEAD SIB **Note:** The control-lead parameter can only be sent with the CS_CONTROL command.	
Protocol	01h	2 = T-link	
Baud rate	02h	0 = 300 baud	
		1 = 600 baud	
		2 = 1200 baud	
		3 = 2400 baud	
		4 = 4800 baud	
		5 = 9600 baud	
		6 = 19200 baud	
Call attribute	03h	0 = answer	
		1 = originate	
Parity enable	04h	0 = disable	1 = enable
Parity selection	05h	0 = even	1 = odd
		2 = mark	3 = space
Word Length	06h	0 = 7 bits	1 = 8 bits
Echo	07h	0 = off	1 = on
Loop from far end	08h	0 = disable	1 = enable
Loop to far end	09h	0 = disable	1 = enable
end byte		FFh	

&sq Session Number	Returned. The session number is to be used with subsequent commands relating to this session.
&sq Return Code	
09h	A previous call was active or pending when the CS_CALL command was issued.
12h	Call rejected by the network

31h   No B-channel is available to place the call.
3Ah   Circuit-switching is not available.

CS_PARAMETER (42h or C2h)

This command is used by the application to renegotiate the connection parameters with the far end. To the application, it appears as though the call is still active with altered parameters. In reality, the call has been reestablished. Only the altered parameters must be specified in the parameter buffer. The control leads can only be changed using the CS_CONTROL command.

Fields Used	Description
Command Code	42h or C2h
Application ID	Identifies the application issuing the command.
* Remote Network Name	Exactly the same as the CS_CALL command, except that only the changed parameters need be specified.
Session Number	Session number to which this parameter change is to be applied
&sq Return Code	
0Ah	No active call
3Ah	Circuit-switching is not available.

CS_CONTROL (41h or C1h)

This command is used by the application to force certain link signaling parameters to a particular state (for T-link this implies the EIA leads).

Fields Used	Description
Command Code	41h or C1h
Application ID	Identifies the application issuing the command.
Session Number	Identifies the session to which the command is applied.
Remote Network Name	The buffer used to pass the control lead information. The buffer format is:

<start byte, control lead byte, end byte>

start byte	00h
control lead byte:	bit 7 bit 0
	0 0 0 BK RTS 0 0 DTR
	where:
	BK = break
	RTS = request to SEND
	DTR = data terminal ready
end byte	FFh

&sq Return Code	
0Ah	No active call
3Ah	Circuit-switching is not available.

REGISTER (60h or E0h)

This command provides the session layer with an address to call when a session indication block (SIB) is to be sent to the upper layer. It also provides the application with an ID for use with the circuit-switching commands.

Fields Used	Description
Command Code	60h or E0h
&sq Application ID	Returned by PCTA NetBIOS.
Buffer Address	This field is used to pass the address that is used by the session layer to pass SIBs to the application. The address is in the double word address pointer form.
&sq Return Code	
09h	Too many applications have registered with the session.

DEREGISTER (61h or E1h)

This command is used to disconnect an application from the session layer. Once it is issued, SIBs are no longer sent to the application and the circuit-switching commands can no longer be used.

Fields Used	Description
Command Code	61h or E1h
Application ID	Identifies the application issuing the command.
&sq Return Code	
3Bh	Bad application ID

SIB Commands

The address supplied in the REGISTER command is used by the session layer to call the application when a SIB is to be sent. The registers ES˚:˚BX point to the SIB structure. See Description of SIB Fields on page 12.

RELEASE (05h)

This SIB command is sent when the B-channel circuit-switched connection is released by either the far end or the network.

Fields Used	Description
Command Code	05h

ESTABLISH (06h)

This SIB command is sent by the circuit-switch handler when an establish code is received that is not a result of an application CS_CALL or CS-PARAMETER command. The establish code is probably a result of parameter renegotiation by the far end.

Fields Used	Description
Command Code	06h
Buffer Address	Points to the buffer that contains the parameter information. It is in the same format as for the CS_CALL command.
Buffer Length	Length of the buffer

CONTROL_CHANGE (31h)

This SIB is sent by the circuit-switch handler to indicate changes in the EIA information as set by the far end.

Fields Used	Description
Command Code	31h
Cause	Control lead information as described in the SIB field description

---

CALL_OFFER (22h)

This SIB command is issued by Q.931 functional signaling to indicate that an incoming call has been received. Later (see note below), the application must issue an ANSWER command to the session if it wants to receive the call (usually after asking the user). The application must provide a return code "reject" or "maybe".

Fields Used	Description
Command Code	22h
&sq Return Code	Indicates whether or not the application will accept the call, that is whether or not the application will issue a subsequent ANSWER or DROP SCB.
FFh	Reject
FEh	May accept
Buffer Address	The buffer gives the details of the call being offered to the application. The format of the buffer is:

<call reference, bearer capability, calling line ID, redirecting ID, end byte>

call reference	first byte of buffer - indicates a unique identifier for the call
bearer capability	00h, n (length, 1 byte), n bytes **Note:** The acceptable bearer capability encodings are: 1) 00h = code 02h = length 88h, 90h, gives 64 Kbps unrestricted, digital. 2) 00h = code 02h = length 89h and 90h, gives 64 Kbps restricted, digital.
calling line id	02h, n (one byte), n ASCII bytes (0-9, A-Z, a-z, space, #, *, -, +)
redirecting id	03h, n (one byte), n ASCII bytes (0-9, A-Z, a-z, space, #, *, -, +) (optional)
end byte	FFh

Buffer Length   Length of the buffer
                           Note: Upon receiving the CALL_OFFER SIB command the
                           application must wait until it receives a CALL_STATUS SIB
                           with the information type 05h (alerting sent) before notifying
                           the user. Otherwise timeouts may occur and the call will clear.
                           An ANSWER/DROP SCB must be sent after the user has selected
                           whether or not to answer the call. The application must have
                           responded with "maybe" in the CALL_OFFER SIB Return Code
                           field.

CALL_DROP (23h)

This SIB is used by Q.931 functional signaling or the session layer to indicate that a call was dropped.

Fields Used	**Description**
Command code	23h
Buffer Address	The call reference will be in the byte pointed to by the buffer address.
Buffer Length	Length of the buffer
Cause	
50h	Link down
51h	Fatal link error
52h	TEI removed
57h	Normal call clearing
5Eh	Temporary failure

CALL_STATUS (21h)

This SIB is used by Q.931 functional signaling to indicate the status of a call.

Fields Used	**Description**	
Command Code	21h	
Buffer Address	The buffer format is:	
	<call reference, information type, address information, end byte>	
	call reference	first byte of buffer
	information type	second byte of buffer
		01h = alerting
		02h = proceeding
		03h = progress (that is, user busy comes as the cause code with progress)
		04h = connected
		05h = alerting sent, will follow a CALL_OFFER command. Signals that the user may now be alerted and polled for answering.
	address information	optional, in the form: n, n bytes
	end byte	FFh
Buffer Length	Length of the buffer	
Cause		
58h	User busy	

5Ch   Incomplete number

CALL_FAILURE (24h)
This SIB is sent by Q.931 functional signaling when an internal failure to the PCTA has occurred.

Fields Used	Description
Command Code	24h
Cause	
50h	Link down
51h	Fatal link error
52h	TEI removed

Appendix A: Call Control

The SAPI˚17 Concept

This section is designed to help application programmers who are writing applications to control the phone (accessing the SAPI˚17 layer of the ISDN PCTA base software). It describes the messages that are sent to or received from the network (T2317 phone) across the NetBIOS layer.

Figure 3

Channel Establishment

When an application initializes itself, it must issue a VOICE_CALL command to the session layer. If the VOICE_CALL command fails, no communication can be made with the phone.

Call Control

Once a call is successfully established, the application must issue a RECEIVE command to the session to permit incoming messages from the phone to be received from SAPI˚17, layer˚3. When the RECEIVE command is satisfied with data from the phone, another RECEIVE command must be issued immediately to accept more data. Effectively, there must always be a RECEIVE command outstanding to permit the application to be interrupted with incoming data.

Messages are sent to the SAPI˚17 layer by means of a SEND command issued to the session layer.

Error Recovery

Commands to the PCTA NetBIOS may fail fatally or non-fatally.

When an error occurs, the RECEIVE command that may be outstanding and any outstanding SEND commands will be returned to the application. The

application must then issue a HANG_UP. When the HANG_UP ANR is called, the application may then re-issue a VOICE_CALL to re-establish a link to the phone. The following error codes may be returned:

    61h = Link down (temporary)
    63h = Fatal link error
    64h = TEI removed

A VOICE_CALL command may fail fatally when the link is gone completely or the TEI has been removed by the network. In these cases, the application should not attempt to reestablish a call.

Messages from the Application to the ISDN Phone

The messages that are sent to control the ISDN phone are communicated by means of NetBIOS SEND commands (that is, in the buffer pointed to by the Buffer Address and Buffer Length SCB fields). The following list describes the format of messages sent using the commands:

¥ Call

    - request code = 01h (one byte)
    - digit string length = n (one byte)
    - digit string (n bytes)

¥ Keypad

    - request code = 02h (one byte)
    - digit string length = n (one byte)
    - digit string (n bytes)

¥ Release

    - request code = 03h (one byte)

¥ Answer

- request code = 04h (one byte)
- call appearance to ANSWER command (one byte)

Messages from the Network (Phone)

The following messages are received from the network in a RECEIVE SCB.

¥ Keypad information

Keypad information is received when the user has initiated a call either from the PC or the T2317 and the call is ringing on the terminating end. The format of the keypad message is:

- request code = 02h (one byte)
- digit string length = n (one byte)
- digit string (n bytes)

¥ Origination address (OAD)

This message is received when an incoming call is received by the T2317. The format of the originating address message is:

- request code = 03h (one byte)
- digit string length = n (one byte)
- digit string (n bytes)

¥ Connected address (CAD)

The application receives a connected-address message when a voice connection has been established with the other party, if the parties have a voice connection.

For example, if a user initiates a call to another party on the ISDN network (either from the PC or the T2317), the first digit string received consists of the keypad digits pressed to make the call. While the call is ringing at the other end, this information remains but is replaced by the connected address, if the other party answers the call. The new digits received will show the full 7-digit number of the other party.

If the call is redirected, the connected address will reflect that of the actual number to which the call was routed to and the redirect address (RAD) will reflect the address through which it was routed. If the call left the ISDN network, the trunk name or the standard digit string ******* that indicates an off-network call may be displayed,. In the last case, the display appends a message indicating that the call left the ISDN network. In any case, the address information sent by the network is what the application receives. The format of the connected address message is:

- request code = 04h (one byte)
- digit string length = n (one byte)
- digit string (n bytes)

¥ Destination address (DAD)

A destination address is received mainly when short codes are used (for example, with a speed call the network receives the speed-call code and returns a DAD with the address information accompanying the code). The format of the destination address message is:

- request code = 05h (one byte)
- digit string length = n (one byte)
- digit string (n bytes)

¥ Redirecting address (RAD)

A redirecting address is received when a call has been routed from its original destination by a feature such as call-forwarding. To the originator, the RAD indicates that the other party has forwarded his or her phone to another location, and the CAD, when received, indicates the number of the phone to which the caller really is connected. To the destination party, the RAD indicates

the number that the caller actually called.

The format of the redirecting address message is:

  - request code = 06h (one byte)
  - digit string length = n (one byte)
  - digit string (n bytes)

¥ **Activate call**

The activate-call message, received when a call that has been idle or on hold (explicitly through the HOLD key on the phone or implicitly through the activation of some feature such as 3-way call), goes in use for dialing or just resuming. The message includes the call appearance or the directory number (DN) that is being activated. The format of the activate-call message is:

  - request code = 07h (one byte)
  - call appearance or DN value (one byte)

¥ **Toggle CM**

The T2317 phone has a special key that awakens a background application (such as Call Manager) from a dormant state or forces a resumption of the foreground application (such as Lotus 123). The effect of the toggle is exactly that of the invocation sequence and exit sequence from the PC keyboard. If the key is pressed when the background application is active, it exits back to the foreground application, otherwise the background application wakes up. The format of the toggle CM message is:

  - request code = 08h (one byte)

¥ **Hold call**

The hold message is received when a call appearance that is active (that is, ringing or fully connected) becomes inactive but not idle. The format of the hold call message is:

  - request code = 09h (one byte)
  - call appearance (one byte)

¥ **Idle call**

A call becomes idle only if it was previously active or on hold. When this message is received, it implies there was no log record generated for the call. Such a state would be induced by picking up the handset or selecting a DN to make a call. Pressing a specific DN lights the corresponding lamp on the phone and will cause the activate code to be sent to the application to indicate that the line is in use. If the handset is replaced or the RELEASE key is pressed without a call being made, the idle-call message is sent to the application, indicating that the line is now idle. The format of the idle-call message is:

  - request code = 10h (one byte)
  - call appearance or DN value (one byte)

¥   **Call record**

The receipt of a call-record message is an implicit notification that a call has ended and the line is idle. The call-record message contains information pertaining to the call such as the start time, the RAD (if the call was redirected), the CAD and end time if answered, or the keypad, DAD, and OAD codes if the call was not answered. The format of the call-record message is:

  - request code = 01h (one byte)
  - call appearance or DN value (one byte)
  - call record = one or more combinations of the following:

  a) Connection sub-record:
     connection identifier (one byte);
     originating flag (one byte);
     answered flag (one byte);
     redirected flag (one byte);
     start time (6 bytes);
     disconnect time (6 bytes);
     address type (one byte);
     address or digit string (1 byte
        length = n, n bytes);
     redirect address or digit string
        (1 byte length = n, n bytes):

  b) Feature sub-record:
     feature identifier (one byte);
     feature number (one byte);
     feature state (one byte).

The session layer may return failure codes on requests made to it. The return codes are:

  61h = link down (temporary)
  63h = fatal link failure
  64h = TEI removed

The application should reissue the request if the link is not ready; however, if the link cannot be established, or if the TEI has been removed, the problem is assumed to be fatal and no attempt to reestablish the link should be made.

Appendix B: List of Network Commands

This is a list of network commands at the presentation layer interface (Interrupt 5Ch). All of the following commands can be used with the no-wait option except for RESET and CANCEL, which have to use the wait option. The no-wait option is selected when a command has the most significant bit masked with one. For example, a CALL command using the no-wait option would be (10h and 80h) = 90h. Commands which are not supported return with a code of "command not supported" to the calling program.

NetBIOS Commands

NetBIOS command	Supported	Not Supported
ADD GROUP NAME(36h)		^
ADD_NAME (30h)	^	
CALL (10h)	^	
CANCEL (35h)	^	
DEL_NAME (31h)	^	
GENERAL STATUS (33h)		^
HANG_UP (12h)	^	
LISTEN (11h)	^	
RECEIVE (15h)	^	
RECEIVE BROADCAST DATAGRAM (23h)		^
RECEIVE DATAGRAM (21h)		^
RECEIVE_ANY (16h)	^	
RESET (32h)		^
SEND (14h)	^	
SEND BROADCAST DATAGRAM (22h)		^
SEND DATAGRAM (20h)		^
SEND_DOUBLE (17h)	^	
SESSION STATUS (34h)		^

SAPI°17 NetBIOS Extensions

NetBIOS command

VOICE_CALL (3Fh)

Circuit-Switching NetBIOS Extensions

NetBIOS command

ANSWER   (52h)

CS_CALL (40h)

CS_CONTROL (41h)

CS_PARAMETER (42h)

DEREGISTER (61h)

DIAL (50h)

DROP   (51h)

REGISTER (60h)

Appendix C: NetBIOS Errors

These are the errors that can be received, by the application layer, in response to an SCB. The error codes are placed in the error-code field of the SCB.

Error Code	Error	Error Code	Error
00h	No error (success)	15h	Name not found or no valid name
01h	Illegal buffer length	16h	Name is in use
03h	Illegal command	18h	Session ended abnormally
05h	Command timed out		
06h	Message incomplete, issue another command	19h	Name conflict detected
		21h	Interface busy
08h	Session number out of range	22h	Too many commands outstanding, retry later
09h	No resource available	23h	Reserved
0Ah	Session closed	24h	Command completed while CANCEL occurring
0Bh	Command cancelled		
0Dh	Duplicate name	26h	Command not valid to CANCEL
0Eh	Name table full	31h	Internal error (can result from an invalid address file)
11h	Local session table full		
12h	Session open rejected	32h	Transport not installed
13h	Illegal name number	FFh	Command is not yet finished
14h	No call name		

NetBIOS Error Extensions

Error Code	Error	Error Code	Error
3Ah	Circuit-switching not available.	5Ah	Q.931 call rejected
3Bh	Bad application ID	5Bh	Q.931 destination out of service
3Ch	Unacceptable answer; application ID invalid or reply to CALL_OFFER command was not previously "maybe"	5Ch	Q.931 incomplete number
		5Dh	Q.931 circuit or channel not available
40h	Already resetting	5Eh	Q.931 temporary failure
42h	Virtual circuit resetting		
4Fh	X.25 software error	5Fh	Q.931 resources unavailable
50h	Q.931 link down	61h	SAPI˚17 link not ready
51h	Q.931 fatal link error	62h	SAPI˚17 no voice call active
52h	Q.931 TEI removed		
53h	Q.931 call in progress	63h	SAPI˚17 fatal link error
54h	Q.931 invalid parameter	64h	SAPI˚17 TEI removed
55h	Q.931 call idle	65h	Invalid command
56h	Q.931 invalid call reference		
57h	Q.931 normal call clearing		
58h	Q.931 user busy		
59h	Q.931 no user responding		

List of Abbreviations

ANR	Asynchronous notification routine	SAPI	Service access point identifier
CAD	Connected address	SCB	Session control block
CCITT	International Consultative Committee for Telephone and Telegraph	SCC	Serial-communications controller
		SIB	Session indication block
DAD	Destination address	TA	Terminal adapter
DN	Directory number	TEI	Terminal endpoint identifier
DOS	Disk operating system		
ID	Identification	T2317	Northern Telecom's ISDN phone
ISDN	Integrated services digital network		
LAN	Local area network		
LANA	Local area network adapter		
MS-NET	Microsoft Network		
NetBIOS	Network basic input output-system		
OAD	Origination address		
OEM	Original equipment manufacturer		
OSI	Open systems interconnection		
PC	Personal computer		
PCTA	Personal computer terminal adapter		
RAD	Redirect address		
RAM	Random-access memory		
ROM	Read-only memory		

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