IBM 3174/3274 CONTROLLER TO DISTRIBUTED FUNCTION DEVICE
Product Attachment Information

July, 1986

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1.0 Introduction

This document is a description of the attachment interface between a distributed function device and a properly customized control unit.

The terms "Terminal", "Device", "TCA Device", "Distributed Function Terminal (DFT)" and "Distributed Function Device" are used interchangeably in this document.

The distributed function device attaches to a control unit adapter port via a transmission cable which uses Device Cluster Adapter transmission protocol. A program in the control unit communicates with a program in the device through a portion of shared memory in the device called the Terminal Control Area (TCA), which is addressable from the control unit by Device Cluster Adapter commands. Devices are solicited by POLLing and are requested to perform functions by means of several Device Cluster Adapter commands which cause program interrupts. Host data streams are treated as pass-thru data to the device constituting a function split which makes the control unit largely independent of the device and of the functional characteristics of its data streams.

The following publications are listed for reference and may be useful in understanding this document:

IBM 3270 Information Display System, IBM 3270 Information Display System Introduction, GA27-2739

IBM 3270 Information Display System, IBM 3274 Control Unit Description and Programmer's Guide, GA23-0061

IBM 3270 Information Display System, IBM 3274 Control Unit Customizing Guide - Configuration Support P, GA23-0176

IBM 3270 Information Display System, IBM 3274 Control Unit Customizing Guide - Configuration Support D, GA23-0065

IBM 3270 Information Display System, IBM 3174 Subsystem Control Unit Customizing Guide, GA23-0214

IBM 3270 Information Display System, IBM 3174 Subsystem Control Unit User's Guide, GA23-0216

IBM 3270 Information Display System, IBM 3174 Subsystem Control Unit Functional Description, GA23-0218

IBM 3270 Information Display System, IBM 3174 Reference Summary, GX20-1878

1.1 Basic Operation

Communications between the device and the control unit is via a 128 byte Terminal Control Area (TCA) within the device buffer. (See "TCA Buffer Format" on page 27.) Requests may be either synchronous, asynchronous, or expedited.

- Synchronous Requests

  Synchronous requests are initiated by the controller and start a series of synchronized transmissions between the CU and the device. This interaction continues until the requested communications task is completed or ends in error.

  To request a particular action of the device, the controller places an appropriate code (a function request) in the TCA Buffer along with any associated parameters and/or data before issuing a Start Operation command.

  The device processes the function request and then posts synchronous status to indicate whether or not processing completed normally. The control unit reads the completion

code and processes it as required (see "Synchronous Event Synchronization" on page 35).

(In this document, read and write operations are described from the controller's point of view; i.e., data is read from the device and written to the device.)

On write type data transfer operations, the data to be written must reside in the device buffer before the Start Operation command is issued. On read type operations, the device places the data in the specified buffer locations as part of processing the request.

- Asynchronous Requests

  The device may also make a request for service from the control unit by placing a request code in the TCA Buffer. Additional parameters may also be passed via the TCA Buffer as needed.

  The control unit then reads the request code and processes it when internal contention conditions allow. Processing by the control unit consists of acknowledging the request and issuing more function requests as required to service the device. Once the request is acknowledged, the device is free to present another asynchronous request.

- Expedited Requests

  Devices may present prioritized requests (Expedited Status) in the TCA buffer for functions which must be processed on an immediate basis. Instead of waiting for its normal turn, the device is serviced on a high priority basis. Expedited Status Requests take precedence over both Synchronous and Asynchronous Requests.

  The function request code and any associated parameters are placed in the TCA Buffer. Subsequently, the control unit acknowledges and processes the request.

1.2 Function Split

The Device/CU interface must operate in one of three distinct environments:

1. A 3270 protocol Binary Synchronous Control (BSC) control unit.

2. A 3270 protocol local channel attachment control unit.

3. An SNA FID2 Control Unit.

The split of unique functions for each of the three environments is as follows:

	CONTROL UNIT	DEVICE
BSC	BSC protocols including: Transparency Select Specific POLL General POLL Inbound Blocking Line Control Line Error Recovery Test Header Creation	Data Stream from STX to EOT/EOB Read Command Detection
SNA	Physical Unit Services (PUS) Activate/Deactivate Logical Unit (ACTLU/DACTLU) Session Termination on Power-Off (single session) Outbound Routing CNM - Alert & RTM	All other SNA Functions ACTLU/DACTLU Parameter Passing
Local Channel	Local Channel protocols: Channel End Device End CNM - Alert & RTM	Channel Command Processing: Data Stream Processing Test Header Creation
Functions Common to any of above	Error Logging Indicator Event Status Power On/Off Hung Device Detection Communication Area Management Limited CU File Access	I/O Event Initiation Device Error Reporting Device RAS and Testing Local Function Operator Indicators Hung CU Detection

Note: The CU serves primarily as a multiplexer converting host link protocols to transmission line protocols and vice versa.

Figure 1. Function Split

1.3 TCA Ownership

Ownership of the TCA Buffer fields is governed by rules that depend on the current state of the interface between the device and the control unit. Violation of ownership rules constitutes an interface synchronization error. If a synchronization error is detected, the interface may be forced to disconnect by the offended party.

Note: In this document TCA addresses are designated as @X'yyyy', where @ stands for TCA address, and X means the yyyy in single quotes is a hexadecimal value of the TCA address.

Reserved fields in the TCA are excluded from the following discussion. While the interface is connected, reserved fields in the TCA between @X'0000' to @X'003F' belong to the device and reserved fields between @X'0040' to @X'007F' belong to the control unit. Exceptions to this general rule are discussed in section "Interface Connected-and-Idle" on page 5.

In the interest of upward compatibility, reserved fields should be set to zero by sender and not used by receiver, thus establishing a current functional subset.

1.4 Interface States

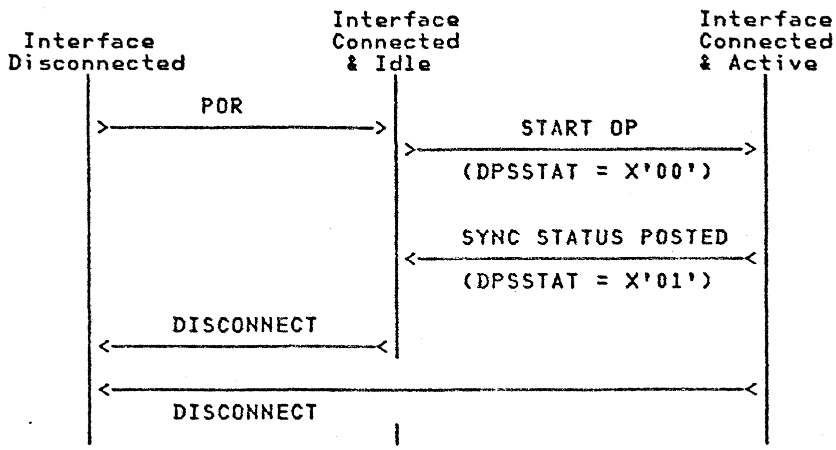

Figure 2. Interface States

1.4.1 Interface Disconnected

While in the disconnected state, the device owns the entire TCA and data buffer. The interface is considered disconnected when the control unit no longer services device requests or status, or the device does not answer POLLs. The disconnected state is exited when the device generates a Power On Reset (POR).

At any given point in time, it may be impossible for the device to tell what the connection state of the interface is. Therefore, when in doubt, the device should always consider the interface as connected.

The interface should be in the disconnected state before the device sends an unsolicited POR to the control unit. The control unit treats a POR that is received while the interface is not disconnected as an interface synchronization error and forces the interface to be disconnected. The next POR is then treated normally.

Some events that cause the interface to disconnect:

- The device has failed to respond to 32 consecutive POLLs. The control unit retries the original poll up to 31 additional times. If the device fails to respond, a '32 retry' indication is presented to the CU by the Device Cluster Adapter and the device is disconnected from the interface. This condition includes physical power off.
- The device receives a RESET Command. On receipt of this command, the device assumes that the interface is disconnected. A POR must be generated by the device to re-establish the connection to the control unit.
- CUDSER does not have a value of X'0000'. The control unit writes a non-zero value in CUDSER when the interface is logically disconnected because a device specific error was detected.

- The device fails to provide required identification data either at POR time, or at FC time following WCUS(20) (see "WCUS(20) - Device Identification" on page 44.).

1.4.2 Interface Connected

The connected state is established when the CU sends a WCUS(10) - CU READY to the device. While in the connected state, the device and the control unit communicate through a shared TCA and data buffer. At any given point in time, each location is owned exclusively by either the control unit or the device. When a location is not owned, it MUST NOT be altered. Ownership is determined by whether or not the interface is idle or active.

1.4.3 Interface Connected-and-Idle

The interface is considered connected-and-idle after the device has posted Synchronous Status for a control unit requested function. It is also considered connected-and-idle from the time POR is sent to the control unit until the Start Operation command is received for the first function request.

While in the connected-and-idle state, the control unit owns @X'0040' to @X'007F' in the TCA Buffer and all of the data buffer. The device owns @X'0000' through @X'003F' with the following exceptions:

- Device Asynchronous Status present (DPASTAT)

  The device owns DPASTAT until it sets that location to a value of X'01' indicating that Asynchronous Status is present. The device must set the Asynchronous Status and parameter values in DALTAD and DAEP through DAEP4 prior to setting DPASTAT to a value of X'01'. At that point, ownership belongs to the control unit until the control unit sets DPASTAT to a value of X'00' to acknowledge the Asynchronous Status. Ownership of DPASTAT then returns to the device.

  DPASTAT is used as a toggle switch and may only set to X'01' or X'00'. Other values are invalid.

- Device Synchronous Status present (DPSSTAT)

  The device owns DPSSTAT until it sets that location to a value of X'01' indicating that a function request has completed or terminated and that Synchronous Status is present. The device must set the Synchronous Status and parameter values (in @X'0002' through @X'0005') prior to setting DPSSTAT to a value of X'01'. DPSSTAT belongs to the control unit until the control unit sets DPSSTAT to a value of X'00' indicating that a function request has been presented to the device and a Start Operation command has been issued. Ownership of DPSSTAT then returns to the device.

  DPSSTAT is used as a toggle switch and may only set to X'01' or X'00'. Other values are invalid.

- Expedited Post/Acknowledge flag (EXFAK)

  The device owns EXFAK until it sets that address to a value of X'01' indicating Expedited Status is present. The device must set the Expedited Status and parameter values and its Logical Terminal address in EXFLT prior to setting EXFAK to a value of X'01'. At that point, ownership belongs to the control unit until the control unit sets EXFAK to a value of X'00' acknowledging the servicing of Expedited Status. Expedited Status is acknowledged by issuing a Read Terminal ID command (alternate Start Operation). The control unit may load response parameters in fields EXFD1-EXFD4 before acknowledging Expedited Status. Ownership of EXFAK then returns to the device.

  EXFAK is used as a toggle switch and may only set to X'01' or X'00'. Other values are invalid.

  Certain device requests must be serviced on a priority basis whether the device is active or idle. Expedited Status has service priority over normal Asynchronous Status. Expedited Status can be processed while the device is in a connected-and-active state,

or in those cases where Host Transaction Timing is active but no function request is processing.

1.4.4 Interface Connected-and-Active

The interface is considered connected-and-active from the time that the control unit receives clean status to a POLL on a Start Operation command queue until the time when the device posts Synchronous Status in DSSV. (See note below.) While in the connected-and-active state, the control unit owns the data buffer exclusive of any area specified by request parameters on data transfer type requests.

Contention in this area may be caused by a command queue retry by the control unit which may cause parts of the TCA buffer to be rewritten. Contention is avoided by issuing separate command queues to write to the TCA and to issue the Start Operation command. If the Write command queue fails, rewriting data to the TCA on retries is not noticed by the device since it only examines control unit altered TCA locations when a Start Operation command is received. If the Start Operation command queue fails, the retries are detected by the device by examining the value at CUSYN. If CUSYN has not been toggled, the Start Operation is a retry and should be ignored. If a Start Operation command is received while another Start Operation is in process and CUSYN has been toggled (see note below), an interface synchronization error has occurred and must be reported to the control unit by the device.

CUSYN is considered toggled if its value has been changed from X'00' to X'01', or if its value has been changed from X'01' to X'00'.

Note: A command queue is a series of commands and data that are issued by the control unit to a device without an intervening POLL command. There may or may not be ending sequences between the commands and/or data.

1.5 Device States

This figure is described in the paragraphs which follow it:

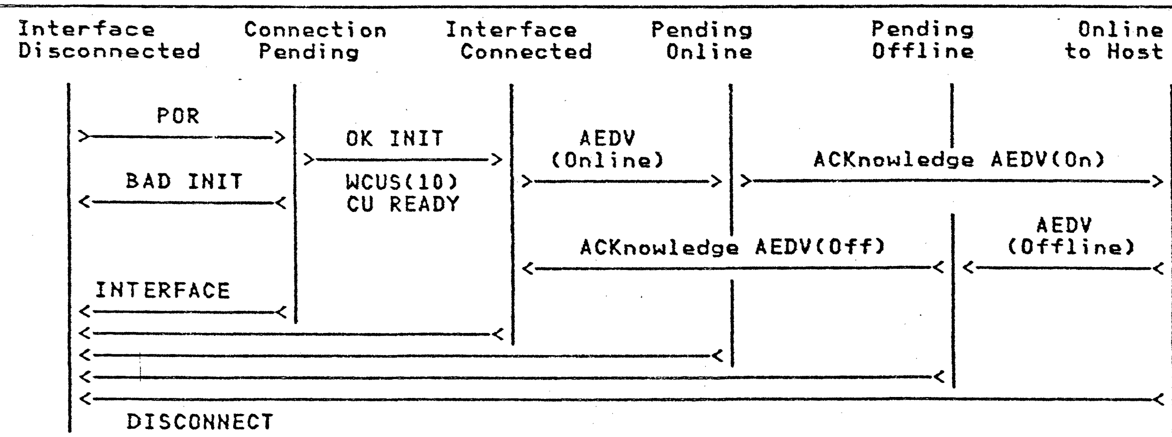

Figure 3. Device States: Device states reflect the active level of communications between the device and an upstream entity. Interface disconnection may occur from any state.

1.5.1 Interface Disconnected

The Interface Disconnected state is equivalent to the disconnected state described in "Interface Disconnected" on page 4. In this state, the control unit is no longer servicing requests or retrieving status from the device and/or the device is not responding to POLLs from the control unit. The device is not recognized by the control unit. (See Figure 3.)

1.5.2 Connection Pending

The Connection-Pending state exists between the time that the device sends a POR to the control unit and the time that the control unit posts WCUS(10) - CU READY. While the device is in the Connection-Pending state, the control unit performs the initialization necessary to be capable of recognizing the device. Once the TCA is initialized properly, the device is capable of processing function requests and error conditions. (See Figure 3 on page 6.)

1.5.3 Interface Connected

The Interface Connected state is entered when CU READY is posted to the device via a WCUS(10) - CU READY function request. While in the Interface-Connected state, the device is recognized by the control unit, but cannot communicate to the host. The device may make function requests of the control unit to use locally owned resources but may not attempt to communicate with the host. The control unit discards any outbound transmissions for the device. The Interface-Connected state is also entered when the device requests that it be taken offline from the host via AEDV. See "AEDV" on page 83. (Also refer to Figure 3 on page 6.)

1.5.4 Pending Online

The device is in the Pending Online state when an Online-to-Host request is waiting the CU's acknowledgment of Asynchronous Status (via AEDV(Online)). (See Figure 3 on page 6.)

1.5.5 Online-to-Host

The CU puts the device in the Online-to-Host state when specifically requested to do so by the device (AEDV(OnLine)). The device remains in the Online-to-Host state until either it is returned to an Interface-Connected state via AEDV(OffLine) or until it is disconnected from the interface. While in the Online-to-Host state, the device communicates with the control unit as described for the Interface Connected state. In addition, upstream communications and outbound transmissions between the host and the device (i.e., WDAT, WLCC, LOCK, RDAT, PDAT, and CTCCS function requests) are now allowed. (See Figure 3 on page 6.)

1.5.6 Pending Offline

The device is in the Pending Offline state when an Offline-to-Host request is waiting the CU's acknowledgment of AEDV(Offline). (See Figure 3 on page 6.)

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2.0 Device Hardware

The CU is the owner of the transmission line and controls all flow through the interface. In general, the CU POLLs the device for status changes, writes to the device, or reads from the device. The device is required to have an addressable buffer which is accessed by Device Cluster Adapter Read and Write Commands. Higher level functions are communicated via data placed in the buffer. The CU initiates a function by writing data into the device buffer and then telling the device to interpret the data. The device initiates a function by placing data in the buffer and responding to a POLL with status requesting the CU to interpret the data.

2.1 General Description

Data to be transmitted from a controller to a device or vice versa is carried on a single transmission line per device. If the transmission line is a coaxial cable, it must be type RG62AU with a maximum length of 1.5 kilometers. Data is transmitted in a serial by bit fashion using a binary dipulse technique. (See "Transmission Line Protocol" on page 10 for transmission line protocol.) Data to be transmitted over the transmission line has a bit rate of 2.3587 MHz.

Twelve bits (numbered 1 through 12) are assembled to form a transmission word (frame) for communication in either direction over the line. The first bit of each frame is always a "one (1)" bit, and is referred to as the "Sync Bit". This bit is used to delimit successive frames. The last bit of each twelve (12) bit word is referred to as the "Frame Parity" bit. This bit maintains even parity for that frame when added to the preceding eleven (11) bits. Frames may be contiguous. When they are, the sync bit of the next frame directly follows the parity bit of the preceding frame with no intervening pad bits.

Communication is as follows:

- Starting Transmission

  When the transmission line is inactive between transmissions, Idle Bits (an uninterrupted series of "one" bits) are sent by the controller. Sending frames to a device requires both controller and device to be in synchronization. The start of a frame is recognized when the controller sends a "quiesce" sequence followed by a Code Violation Sequence (CVS). This is defined as a series of at least five (5) idle bits followed by a high level for 1 1/2 bit times and a low level for 1 1/2 bit times. The next bit time contains the 'sync' bit of the first frame to be sent. (See "Line Quiesce Pattern" on page 10.)

- To the Device

  A word from the controller to a device is either a command or a data word as determined by bit 11. Commands (bit 11 = 1) may perform either a read (bit 9 = 1) or a write (bit 9 = 0) operation at the device.

  Each write type command which is received at the device without error results in a TT/AR (Transmission Turnaround/Auto Response) following the last contiguous word sent from the controller. A TT/AR consists of a 12 bit response word with only the sync bit (#1) and the frame parity bit (#12) turned on. A TT/AR is also referred to in this document as a 'clean status' response.

  The 12 bit command word from the controller to a device contains address bits (which must be zero) and a command code. The address portion of the command word is three zero bits in length (bits 2, 3, 4) which provides five bits for command codes (bits 5, 6, 7, 8 and 9). (See "Command Word" on page 15 for details.)

  Data words (bit 11 = 0) are also 12 bits in length. The data byte resides in bits 2-9 with odd parity maintained for this byte by bit 10. (Details in "Data Word" on page 15.)

  Spare bits in all commands and responses must be zero.

* To the Controller

  A word from a device in response to a read type command is either data or status (including TT/AR). The device must respond with one of these frames within 5.5 microseconds after receiving the ending sequence from the controller (see "Transmission End Sequence (Mini-Code Violation)" on page 11). This requirement applies to both read and write type commands. The 5.5 microseconds is measured from the end of the last bit time of the received ending sequence to the beginning of the first bit time of the response starting sequence. (See "Transmission Starting Sequence".) Failure of the device to respond in time results in a time-out error.

* Ending Transmission

  To clearly define where a transmission ends, a Mini-Code Violation (MCV) is sent following the last transmitted word. This is defined as a 'zero' as the first bit of a frame (in place of the usual 'sync' bit) followed by a low level for two bit times (no mid bit-time level transition). If no TT/AR is expected, the controller resumes sending idle bits (line inactive). (See "Transmission End Sequence (Mini-Code Violation)" on page 11.)

2.2 Transmission Line Protocol

The dipulse technique is controlled by the driver receiver logic that guarantees a voltage transition of the transmission line at mid-bit time.

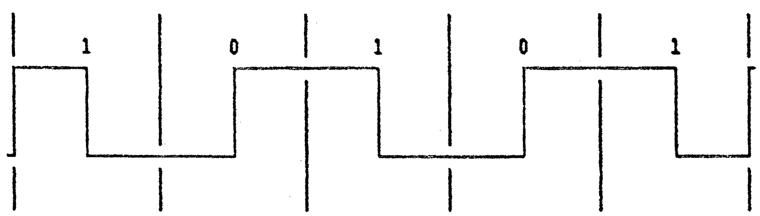

Figure 4. Normal Biphase Data Pattern: Waveform changes level at mid-point of each bit-time. Direction of change indicates the binary value (1 or 0).

2.2.1 Transmission Starting Sequence

Prior to valid data being transmitted, the line must be conditioned to ensure that bit and byte synchronization can be achieved. This requires the transmission of a line quiesce and code violation pattern which is generated by the line driver logic.

2.2.1.1 Line Quiesce Pattern

It is necessary to establish an equilibrium switching condition on the line after the null condition of line turn around before valid data can be properly detected at the receiver. Each data sequence from either controller or device after line turn around is therefore preceded by the 5 bit biphase encoded data shown in the following figure. The bit polarity is shown at the logic to Driver/Receiver interface. Polarity on the line is inverted.

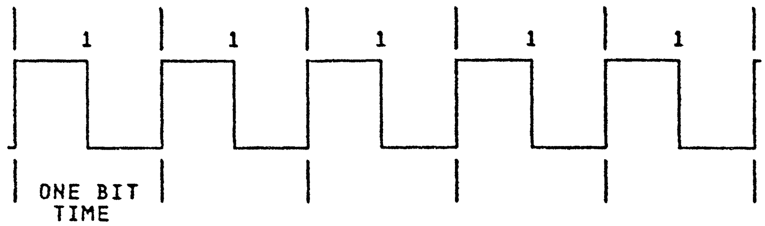

Figure 5. Line Quiesce Pattern

2.2.1.2 Unique Control Code Violation

A unique control code violation follows the line quiesce pattern to differentiate between the quiesce pattern and the start of the valid data following the code violation. This is necessary because, due to varying line lengths, it is not possible to predict where the received data becomes valid. However, the code violation provides a clean reference mark for start of transmission.

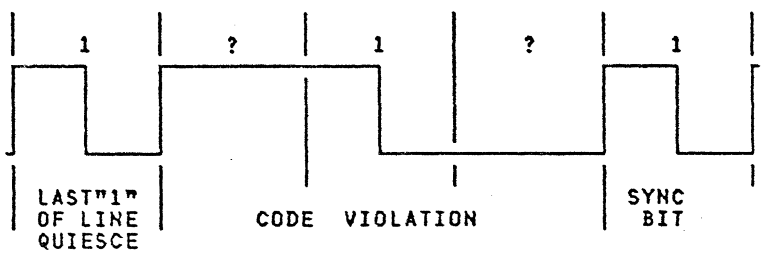

Figure 6. Unique Control Code Violation Pattern: A unique balanced code violation sequence containing leading and trailing buffer bits.

The trailing buffer bit is actually the sync bit of the following data byte. This code violation is unique in that it contains pulse widths (1 1/2 bit pulse widths) not present in normal biphase data (1/2 or 1 bit pulse widths) shown in Figure 4 on page 10 for comparison.

Each bit has a mid-bit transition. Thus, once decoded, the code violation pattern provides, in addition to a reference mark for start of transmission, an unequivocal definition of bit boundaries.

A means must be provided for re-establishing line synchronization with the device by using the receipt of a legitimate code violation to reset the device's SERDES.

2.2.2 Transmission End Sequence (Mini-Code Violation)

In order that the receiver demodulation logic be reset at the end of a transmission so that a subsequent transmission may be properly demodulated, the special ending sequence shown below is used.

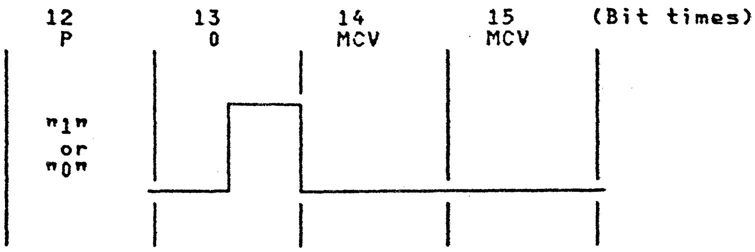

Figure 7. Ending Sequence Pattern

The last data word transmitted has 15 bits. The first 12 bits are as previously defined (starting with sync and ending with a parity bit). The thirteenth bit is a zero followed by two bit times without a mid-bit transition. (These are referred to as mini-code violations.) The first mini-code violation is always used to reset the receiver logic. The second merely guarantees that the line does not discharge and generate a spurious clock pulse while the logic is detecting the first Mini Code Violation. The zero in the thirteenth bit position allows for discriminating a transmit check condition, generated as a result of illegally padded zero bits between bytes, from a normal ending sequence.

2.2.3 Transmission Line Waveforms

Bits on the line appear as positive and negative going pulses. Binary data is phase encoded such that a 212 nanosecond (ns) up-level followed by a 212 ns down-level represents a binary 0. Similarly, a 212 ns down-level followed by a 212 ns up-level represents a binary 1. A predistorted pulse is generated for every transition from an up-level to a down-level or vice versa.

The waveforms shown in Figure 8 on page 13 and Figure 9 on page 13 are the signals measured across the line at the transmitting unit (either control unit or device). The waveforms shown in: figref refid=fi. and Figure 11 on page 14 show the signal across the line at the receiving end of 1.5 kilometers of coaxial transmission medium.

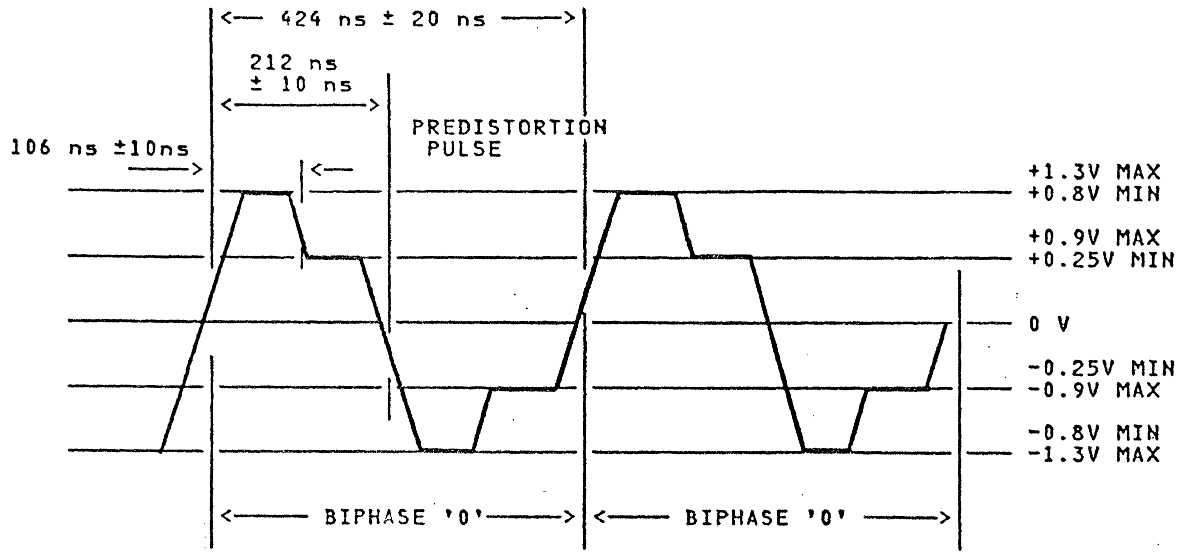

Figure 8. Waveform at Transmitting Unit

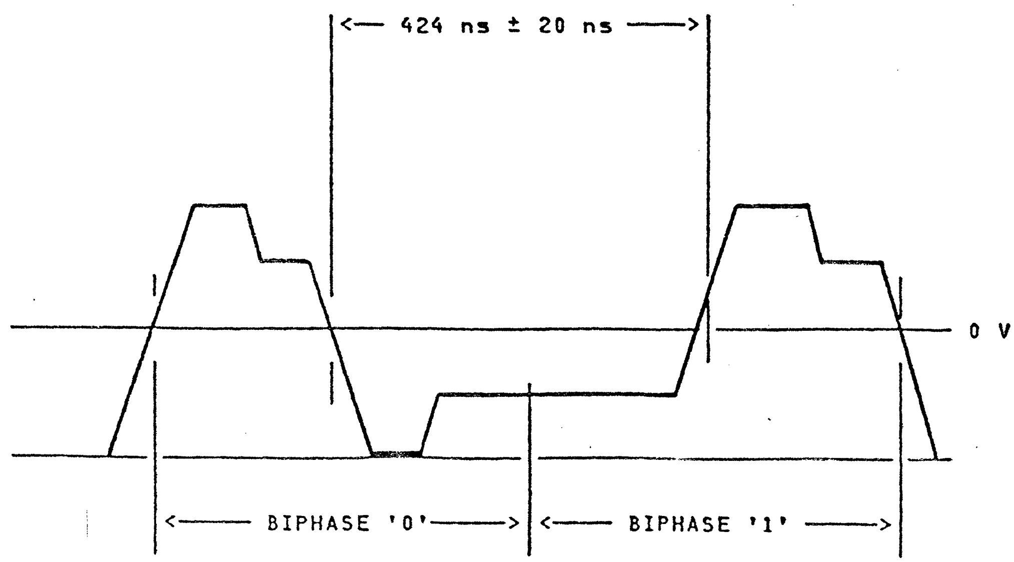

Figure 9. Waveform at Transmitting Unit: All Rise and Fall Times 30 ns MAX. Rise and Fall Times are Exaggerated For Clarity.

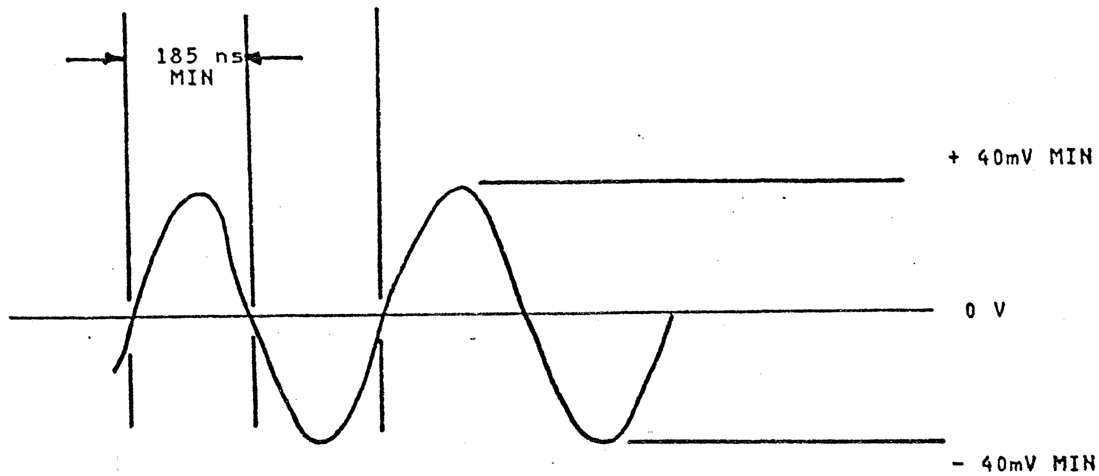

Figure 10. Waveform at Receiving End of 1.5 Kilometers

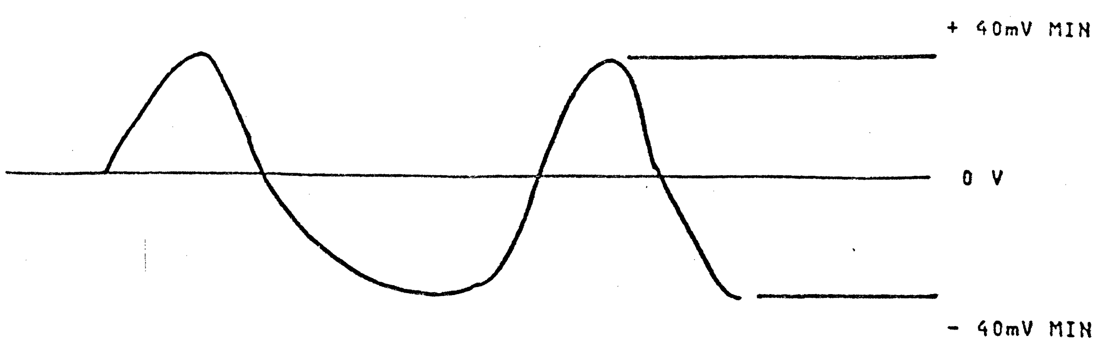

Figure 11. Waveform at Receiving End of 1.5 Kilometers

2.3 Transmission Word Formats

Commands and/or data are sent by the control unit to the TCA Devices. A device must then return either data or status (including TT/AR). All three transmission types are contained in 12 bit words (frames) as described below.

2.3.1 Command Word

Commands are sent from control unit to device in this format:

1	2	3	4	5	6	7	8	9	10	11	12
1	0	0	0	X	X	X	X	X	0	1	X

Sync |<– Adr –>| |<—— Command ——>| C/D FP

Bit 1 = Sync Bit (always = 1)
Bits 2-4 = Address bits (always 000 for TCA)
Bits 5-9 = Command bits (see "Command Codes" on page 17)
Bit 10 = Reserved (value = 0)
Bit 11 = Command word identifier (value = 1)
Bit 12 = Frame Parity bit (maintains even parity for bits 1-12)

Figure 12. Command Word Format

The command word address in bits 2-4 must be zero for TCA Devices. **Devices must not respond with TT/AR** (clean response) if any other value is present in these bits. The control unit treats this type of error as a Transmit Check (see "Transmit Check" on page 26).

2.3.2 Data Word

Data words are sent to the controller following read commands or to the device after write commands using the following format:

1	2	3	4	5	6	7	8	9	10	11	12
1	X	X	X	X	X	X	X	X	X	0	X

Sync |<———— Data ————>| DP C/D FP

Bit 1 = Sync Bit (always = 1)
Bits 2-9 = Data (bit 2 is most significant)
Bit 10 = Data Parity bit (maintains odd parity for bits 2-10)
Bit 11 = Data Word identifier (value = 0)
Bit 12 = Frame Parity (maintains even parity for the bits 1-12)

Figure 13. Data Word Format

Data of less than 8 significant bits is right justified and the high-order bits are set to zero by the originator.

2.3.3 Common Status Word

Status is returned by the device to the control unit in the following format:

1	2	3	4	5	6	7	8	9	10	11	12
1	0	0	0	0	X	0	0	0	0	0	X
Sync									SWI		FP

Bit 1 = Sync Bit (always = 1)
Bits 2-5 = Reserved (always = 0000)
Bit 6 = Status Available. When set to 1, indicates status (synchronous, asynchronous, or expedited) has been set in the Status Register.
(See "Synchronous Status" on page 73
or "Asynchronous Status Events" on page 79
or "Expedited Status Requests" on page 89.)
Bits 7-9 = Common status bits (reserved, must = 000)
Bit 10 = Common Status Word identifier (Bit = 0 for Common Status)
Bit 11 = Reserved (must = 0)
Bit 12 = Frame Parity bit (maintains even parity for bits 1-12)

Figure 14. Common Status Word Format

A status word is always sent (in response to a POLL command) from a device that has power on and has completed its POR sequence. Prior to receiving POR Response from a device, the controller holds the device deactivated. The controller POLLs the device but ignores any response except POR Response. A response of all zeros except for bits 1 and 12 indicates that there are no error conditions to be reported up line and no operator activity requiring service. This response is referred to as TT/AR or a "clean" response.

2.3.4 Special Status Word

Special Status is reported by the TCA Device to advise the control unit that it has become available for service.

1	2	3	4	5	6	7	8	9	10	11	12
1	X	X	X	X	X	X	X	X	1	0	X
Sync	<—— Special Status Bits ——>								SWI		FP

Bit 1 = Sync Bit (always = 1)
Bits 2-9 = Special Status bits (Valid codes listed below)
Bit 10 = Special Status Word identifier (Value = 1 for Special Status)
Bit 11 = Reserved, (must = 0)
Bit 12 = Frame Parity bit (maintains even parity for bits 1-12)

The only Special Status code currently used by TCA Devices is:

2345 6789	
0000 0010	Device has powered on or received RESET since last POLL. This code is sent only in response to the first POLL received after a Power On (or RESET Command) sequence is complete. See 'RESET' in "Write Commands" on page 22.

Figure 15. Special Status Word Format

2.4 Command Codes

The following commands apply to TCA attached distributed function devices:

READ COMMANDS (XXXX1) = Read type command
(XXX11) = Response Parity Checked
(XXX01) = Parity Not Checked

bits 56789	
00001	POLL
00011	READ DATA
00101	Reserved
00111	Reserved
01001	READ TERMINAL ID
01011	READ MULTIPLE (4)/(32)
01101	Reserved
01111	Reserved
10001	POLL/ACK
10011	Reserved
10101	Reserved
10111	Reserved
11001	Reserved
11011	Reserved
11101	Reserved
11111	Reserved

WRITE COMMANDS (XXXX0) = Write type command

bits 56789	
00000	Reserved
00010	RESET
00100	LOAD ADDRESS COUNTER HIGH

00110	Reserved
01000	START OPERATION
01010	Reserved
01100	WRITE DATA
01110	Reserved
10000	Reserved
10010	Reserved
10100	LOAD ADDRESS COUNTER LOW
10110	Reserved
11000	Reserved
11010	LOAD SECONDARY CONTROL REGISTER
11100	DIAGNOSTIC RESET
11110	Reserved

Note: In response to the reserved read commands, the device **must** return an all zero data word with bad parity (bits 2 through 10 all zero) regardless of bit 8 in the read command.

The reserved write commands reset the previous command. If no other command or data word directly follows the reserved command, TT/AR takes place.

2.4.1 Read Commands

2.4.1.1 00001 POLL and 10001 POLL/ACK

Both the POLL and POLL/ACK commands (like all TCA command words) must have bits 2-4 of the command word set to zero. If bits 2-4 are other than zero when examined by the device, the status response is withheld by the device. (See "Command Word" on page 15.)

The format of the POLL command is:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	0	0	0	0	1	0	1	1	POLL
Sync				|<—— Command ——>|						C/D	FP	

Bit 1	=	Sync Bit (always = 1)
Bits 2,3,4	=	Must be 000
Bits 5-9	=	00001 POLL command
Bit 10	=	Reserved (value = 0)
Bit 11	=	Command word identifier (value = 1)
Bit 12	=	Frame Parity Bit (maintains even parity for bits 1-12)

Figure 16. POLL Command Format

The format of the POLL/ACK command is:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	1	0	0	0	1	0	1	0	POLL/ACK
Sync				<— Command —>						C/D	FP	

Bit 1 = Sync Bit (always = 1)
Bits 2,3,4 = Must be 000
Bits 5-9 = 10001 POLL/ACK command
Bit 10 = Reserved (value = 0)
Bit 11 = Command word identifier (value = 1)
Bit 12 = Frame Parity Bit (maintains even parity for bits 1-12)

Figure 17. POLL/ACK Command Format

The response word to a POLL is a one word status response (see "Common Status Word" on page 16). If a non-zero status word is sent to the controller, the device should anticipate receiving a POLL/ACK to acknowledge the acceptance of the first status word, respond with clean status (TT/AR) and reset the previously returned status bits. Upon receipt of the clean status response the controller may issue another POLL, without the ACK bit, and the device must respond with the second status word. If the second POLL does not have the ACK bit on, the device must respond with the first status word again. Repetitive POLLing and POLL/ACKing of the device may continue until an all zero status response to a POLL is received at the controller or the controller reaches an error threshold.

The priority of POLL response is:

1) POR complete Special status code.
2) Base Status (Bit 6 on)

If a Status Bit is returned and not ACK'd, the same bit must be returned in the next POLL response.

If there is no status to send, an all zero POLL response (TT/AR) is sent indicating that service is not required at the device and the controller is released to POLL the next device.

2.4.1.2 00011 READ DATA

The READ DATA command causes the addressed device to respond with one data word from storage at the current address counter value. The address counter steps up once at the completion of the command. The ending sequence must follow the 12th (FP) bit of the response word.

The format of the READ DATA command is:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	0	0	0	1	1	0	1	0	READ DATA
Sync				|<—— Command ——>|						C/D	FP	

```
Bit  1     =  Sync Bit (always = 1)
Bits 2,3,4 =  Must be 000
Bits 5-9   =  00011   READ DATA command
Bit  10    =  Reserved (value = 0)
Bit  11    =  Command word identifier (value = 1)
Bit  12    =  Frame Parity Bit (maintains even parity for bits 1-12)
```

Figure 18. READ DATA Command Format

2.4.1.3 01001 READ TERMINAL ID

The READ TERMINAL ID command causes the device to respond with one data word. The ending sequence must follow the 12th (FP) bit of the response word (Command Chaining not permitted here). In addition, the command interrupts the device processor. The control unit acknowledges Expedited Status using Read Terminal ID as an 'Alternate Start OP' mechanism.

The format of the READ TERMINAL ID command is:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	0	1	0	0	1	0	1	0	READ TERMINAL ID
Sync				|<—— Command ——>|						C/D	FP	

```
Bit  1     =  Sync Bit (always = 1)
Bits 2,3,4 =  Must be 000
Bits 5-9   =  01001   READ TERMINAL ID command
Bit  10    =  Reserved (value = 0)
Bit  11    =  Command word identifier (value = 1)
Bit  12    =  Frame Parity Bit (maintains even parity for bits 1-12)
```

Figure 19. READ TERMINAL ID Command Format

The format of the RESPONSE DATA WORD is as follows:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	0	0	0	0	1	0	0	0	RESPONSE DATA WORD
Sync	|<———— Data Byte ————>|								DP	C/D	FP	

Bit 1 = Sync Bit (always = 1)
Bit 2-9 = Data Byte (value x'01' = intelligent device)
Bit 10 = Data Parity bit (maintains odd parity for bits 2-10)
Bit 11 = Data Word identifier (value = 0)
Bit 12 = Frame Parity bit (maintains even parity for bits 1-12)

Figure 20. Response Data Word Format

The reception of this data word by the controller indicates that there is an intelligent device on the other end of the line. To obtain further information on the type of terminal device, the controller issues READ MULTIPLE to read 4 bytes from TCA fields DTID1-DTID4. The contents of these locations must not be changed while the terminal is powered on.

2.4.1.4 01011 READ MULTIPLE (4)/READ MULTIPLE (32)

This command causes the device to respond with one or more data words from storage beginning at the current I/O address counter value. The number of bytes returned is dependent on the low-order bit position of the Secondary Control Register (SCR) See "11010 LOAD SECONDARY CONTROL REGISTER" on page 25).

The format of the READ MULTIPLE Command is:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	0	1	0	1	1	0	1	1	READ MULTIPLE
Sync				|<—— Command ——>|						C/D	FP	

Bit 1 = Sync Bit (always = 1)
Bits 2,3,4 = Must be 000
Bits 5-9 = 01011 READ MULTIPLE Command
Bit 10 = Reserved (value = 0)
Bit 11 = Command word identifier (value = 1)
Bit 12 = Frame Parity Bit (maintains even parity for bits 1-12)

Figure 21. READ MULTIPLE Command Format

When the low-order bit of the SCR is 0, a Read Multiple (4) is executed. The read terminates (with ending sequence) when the two low-order bits of the address counter step to 00. A maximum of four bytes are returned. This is the default operation if the device does not support the SCR.

When the low-order bit of the SCR is 1, a Read Multiple (32) is executed. The read terminates (with ending sequence) when the five low-order bits of the I/O address counter step to 00000. A maximum of 32 bytes are returned.

2.4.2 Write Commands

Many of the Write Commands are defined as being followed by one (or more) bytes of data. The device executes the command following receipt of the data byte. If a second command is received instead of the data byte for the first command, the first command is lost and the second command sequence started. Write type commands remain active until reset by the next command (including POLL). Data sent while no command is stored is lost with TT/AR being returned.

2.4.2.1 00010 RESET

In the device, the RESET command resets any pending status in the adapter hardware and interrupts the microprocessor. The microprocessor must terminate any operation in process and respond with TT/AR. The control unit then disconnects the interface. Subsequently, when the control unit issues a POLL command, the adapter responds with a POR complete status code.

The format of the RESET command is:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	0	0	0	1	0	0	1	1	RESET
Sync				<—— Command ——>						C/D	FP	

```
Bit 1        =  Sync Bit (always = 1)
Bits 2,3,4   =  Must be 000
Bits 5-9     =  00010  RESET command
Bit 10       =  Reserved (value = 0)
Bit 11       =  Command word identifier (value = 1)
Bit 12       =  Frame Parity Bit (maintains even parity for bits 1-12)
```

Figure 22. RESET Command Format

After a RESET command is executed, the adapter is able to accept and execute any valid command. The message buffer and the controller output area must be cleared. The following portion of the device output area is initialized to these values: (See "TCA Buffer Format" on page 27)

Bytes 00 through 0B	All zero.
Bytes 0C through 11	Terminal ID bytes initialized.
Bytes 12 through 7F	All zero.
Bytes 80 and above	Device Dependent Information (See "Initialization" on page 33.)

The RESET command is only issued during error recovery and the controller IML sequence. The device must be capable of accepting two or more successive RESET commands (without intervening POLL commands) and responding with a single POR Response to a subsequent POLL. Prior to returning POR Response the device may terminate communication with the controller.

Note: POR Complete must not be returned if the RESET (either Command, Power-On, or operator initiated) failed, i.e., if the device detects an error during initialization.

2.4.2.2 00100 LOAD ADDRESS COUNTER HIGH

This command, when followed by one data word, loads bits 2-9 of the data word into the 8 high-order bits of the address counter. Devices must suppress TT/AR response if bits 2-9 of the data word which follows this command have ones in any of the high-order bit positions that are beyond the allowed addressing range. (This prevents invalid buffer addresses.) The control unit treats this type of error as a Transmit Check (See "Transmit Check" on page 26.).

The format of the LOAD ADDRESS COUNTER HIGH command is:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	0	0	1	0	0	0	1	1	LOAD ADDR COUNTER HIGH
Sync				<—— Command ——>						C/D	FP	

Bit 1 = Sync Bit (always = 1)
Bits 2,3,4 = Must be 000
Bits 5-9 = 00100 LOAD ADDRESS COUNTER HIGH command
Bit 10 = Reserved (value = 0)
Bit 11 = Command word identifier (value = 1)
Bit 12 = Frame Parity Bit (maintains even parity for bits 1-12)

Figure 23. LOAD ADDRESS COUNTER HIGH Command Format

Note: Write commands must not be "chained" to Load Address Counter commands; that is, TT/AR and controller verification must take place to insure transmission error recoverability.

2.4.2.3 01000 START OPERATION

The START OPERATION command is used to invoke processing of a function request. The adapter interrupts the microprocessor. Upon completion of the operation, the device stores synchronous status in the TCA buffer and sets status available (bit 6) in the POLL response. To prevent controller microcode timeout, the device must complete the operation within a specified time (see "Process Timings" on page 98).

The format of the START OPERATION command is:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	0	1	0	0	0	0	1	1	START OP
Sync				|<— Command —>|						C/D	FP	

Bit 1 = Sync Bit (always = 1)
Bits 2,3,4 = Must be 000
Bits 5-9 = 01000 START OP command
Bit 10 = Reserved (value = 0)
Bit 11 = Command word identifier (value = 1)
Bit 12 = Frame Parity Bit (maintains even parity for bits 1-12)

Figure 24. START OPERATION Command Format

2.4.2.4 01100 WRITE DATA

The WRITE DATA command causes the device to accept all following data words for storage in the buffer until another command is received. The data to be stored in the buffer must be loaded at the location indicated by the address counter. The address counter must step up once for each data word received.

Note: The controller is responsible for preventing address overflow while writing (or reading) the device buffer.

The format of the WRITE DATA command is:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	0	1	1	0	0	0	1	0	WRITE DATA
Sync				|<— Command —>|						C/D	FP	

Bit 1 = Sync Bit (always = 1)
Bits 2,3,4 = Must be 000
Bits 5-9 = 01100 WRITE DATA command
Bit 10 = Reserved (value = 0)
Bit 11 = Command word identifier (value = 1)
Bit 12 = Frame Parity Bit (maintains even parity for bits 1-12)

Figure 25. WRITE DATA Command Format

2.4.2.5 10100 LOAD ADDRESS COUNTER LOW

The LOAD ADDRESS COUNTER LOW command, followed by one data word, loads bits 2-9 of the data word into the 8 low-order bits of the address counter.

The format of the LOAD ADDRESS COUNTER LOW command is:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	1	0	1	0	0	0	1	0	LOAD ADDR COUNTER LOW
Sync				<—— Command				——>		C/D	FP	

```
Bit  1     =  Sync Bit (always = 1)
Bits 2,3,4 =  Must be 000
Bits 5-9   =  10100   LOAD ADDRESS COUNTER LOW command
Bit  10    =  Reserved (value = 0)
Bit  11    =  Command word identifier (value = 1)
Bit  12    =  Frame Parity Bit (maintains even parity for bits 1-12)
```

Figure 26. LOAD ADDRESS COUNTER LOW Command Format

2.4.2.6 11010 LOAD SECONDARY CONTROL REGISTER

This command results in the value of Bit 9 of the subsequent data word to be loaded into the low-order bit position of the Secondary Control Register. Depending on the value of Bit 9, all following READ MULTIPLE Commands:

- Bit 9 = 0 Terminate READ MULTIPLE (4) when the 2 low-order bits of the address counter step to 00. (4 byte boundary)
- Bit 9 = 1 Terminate READ MULTIPLE (32) when the 5 low-order bits of the address counter step to 00000. (32 byte boundary)

The Secondary Control Register is set to zeros by POR, the RESET command, and whenever the interface is disconnected. Intelligent devices not supporting Read Multiple (32) treat the Load Secondary Control Register command as a reserved command.

The format of the LOAD SECONDARY CONTROL REGISTER command is:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	1	1	0	1	0	0	1	1	LOAD SECONDARY CTL REG
Sync				<—— Command				——>		C/D	FP	

```
Bit  1     =  Sync Bit (always = 1)
Bits 2,3,4 =  Must be 000
Bits 5-9   =  11010   LOAD SECONDARY CTL REG command
Bit  10    =  Reserved (value = 0)
Bit  11    =  Command word identifier (value = 1)
Bit  12    =  Frame Parity Bit (maintains even parity for bits 1-12)
```

Figure 27. LOAD SECONDARY CONTROL REGISTER Command Format

2.4.2.7 11100 DIAGNOSTIC RESET

The DIAGNOSTIC RESET command is similar to the RESET command discussed previously, and is intended for service only to permit dumps.

The format of the DIAGNOSTIC RESET command is:

1	2	3	4	5	6	7	8	9	10	11	12	
1	0	0	0	1	1	1	0	0	0	1	1	DIAGNOSTIC RESET
Sync				<— Command —>						C/D	FP	

```
Bit  1     =  Sync Bit (always = 1)
Bits 2,3,4 =  Must be 000
Bits 5-9   =  11100   DIAGNOSTIC RESET command
Bit  10    =  Reserved (value = 0)
Bit  11    =  Command word identifier (value = 1)
Bit  12    =  Frame Parity Bit (maintains even parity for bits 1-12)
```

Figure 28. DIAGNOSTIC RESET Command Format

2.4.3 Transmit Check

A Transmit check is defined as follows:

1. A 0 in the sync bit location not followed by a Mini Code Violation.
2. The loss of mid-bit transition detected at other than normal ending sequence time.
3. A transmission parity error (bits 1-12 not having even parity).
4. A data parity error (bits 2-10 in a data word not maintaining odd parity).
5. Bits 2, 3 and 4 of a command word other than zero.
6. One (1) bits in unused bit positions of the data word associated with a LOAD ADDRESS COUNTER HIGH command which represent addresses not implemented by the device.

When a transmit check is sensed in the device, the device ceases accepting data and all commands and suppresses the TT/AR. The stored command, if any, is not reset. Normal operations resume upon receipt of the Line Quiesce/Code Violation.

The controller also tests conditions 1-4 above and provides for error recovery. Controllers that only implement 1 byte Read commands need not perform the complete ending sequence test (Item 1 above).

3.0 Device Buffer

The size of the device buffer (TCA and data) must be AT LEAST 4K bytes for SNA attachments and 8K bytes for non-SNA attachments to off-load control unit buffers and achieve concurrent line and control unit use with device processing.

In both SNA and Non-SNA environments, interleaving of function requests may occur via the queued TCA buffer. The controller owns the TCA buffer. The device must maintain maximum availability of the buffer thereby preventing excessive dedication of controller resources.

The buffer is split into two logical sections. @X'0000' to @X'007F' are fixed format and the remainder is allocated at the discretion of the CU. (See "TCA Buffer Map" on page 30 for a map of the TCA Buffer.)

3.1 TCA Buffer Format

Name	Address	Description
DPASTAT	X'00'	Asynchronous status present flag X'00' = last asynchronous status is acknowledged. X'01' = last asynchronous status is unacknowledged. X'02-FF' = Reserved values
DPSSTAT	X'01'	Synchronous status present flag X'00' = last synchronous status is acknowledged. X'01' = last synchronous status is unacknowledged. X'02-FF' = Reserved values
DSSV	X'02'	Synchronous status value.
DSSP	X'03'	Synchronous status parameter 1
DSSP2	X'04'	Synchronous status parameter 2
DSSP3	X'05'	Synchronous status parameter 3
DALTAD	X'06'	Logical Terminal Address
DAEV	X'07'	Asynchronous status event value.
DAEP	X'08'	Asynchronous status event parameter 1
DAEP2	X'09'	Asynchronous status event parameter 2
DAEP3	X'0A'	Asynchronous status event parameter 3
DAEP4	X'0B'	Asynchronous status event parameter 4
DTID1	X'0C'	Terminal ID (see Note 1)
DTID2	X'0D'	Product ID Qualifier (see Note 2)
DTID3	X'0E'	Reserved
DTID4	X'0F'	Reserved
DBUF	X'10-11'	Device buffer size in bytes (valid after power-on reset (POR))
--	X'12-1F'	Reserved
EXFLT	X'20'	LT Address
EXFRQ	X'21'	Expedited Status value
EXFP1	X'22'	Expedited Status Parameter 1
EXFP2	X'23'	Expedited Status Parameter 2
EXFP3	X'24'	Expedited Status Parameter 3
EXFP4	X'25'	Expedited Status Parameter 4
EXFAK	X'26'	Post/Acknowledgment flag byte X'00' = Last Expedited Status is acknowledged. X'01' = Last Expedited Status is unacknowledged. X'02-FF' = Reserved values
--	X'27'3F'	Reserved

Figure 29. TCA Buffer Fields - Part 1: Device owned area. See notes following Part 2.

CUDP	X'40-41'	Data address within the device buffer. (Must be aligned on HW boundary).
CULTAD	X'42'	Logical Terminal Address
--	X'43'	Reserved
CUFRV	X'44'	Synchronous function request value (See "Synchronous Function Requests" on page 39)
CUSYN	X'45'	Request synchronization switch (toggle).
CUFRP1	X'46'	Synchronous Function Request Parameter 1
CUFRP2	X'47'	Synchronous Function Request Parameter 2
CUFRP3	X'48'	Synchronous Function Request Parameter 3
CUFRP4	X'49'	Synchronous Function Request Parameter 4
--	X'4A-4F'	Reserved.
CUDPORT	X'50'	Device port number (0 - 31)
CUAT	X'51'	Control unit host attachment protocol (see Note 3)
CUDSER	X'52-53'	Error code value for last-ditch-command-queue.
CULTA1-5	X'54-58'	LT Addresses (See "Control Unit Initialization" on page 35)
--	X'59-5B'	Reserved
EXFD1	X'5C'	Expedited Status Response parameter 1 (if needed)
EXFD2	X'5D'	Expedited Status Response parameter 2 (if needed)
EXFD3	X'5E'	Expedited Status Response parameter 3 (if needed)
EXFD4	X'5F'	Expedited Status Response parameter 4 (if needed)
EXTIME	X'60'	Host transaction timing X'00' = Device Transaction Timing mode is in effect. X'01' = Host Transaction Timing mode is in effect. X'02-FF' = Reserved values
CUDSL	X'61'	DSL Type X'00' = 3274 type DSL X'01' = 3174 type DSL X'02-FF' = Reserved values
--	X'62-7D'	Reserved
CUSLVL	X'7E-7F'	Controller TCA Support Level (see Note 4 and "Controller TCA Support Level" on page 95)
CUDATA	X'80-max'	Data Area (see "Initialization" on page 33)

Figure 30. TCA Buffer Fields - Part 2: Controller owned area. See following notes.

Note:

1. DTID1 aligns on an address with PCIA printer ID.

DTID1 0123 4567	Description
B'x... ....'	No function (May be either 1 or 0).
B'.1.. ....'	"Ready to dump" (used for DIAGNOSTIC RESET command)
B'..00 00..'	Reserved bits (must be zero)
B'.... ..10'	TCA Device

2. A Product ID Qualifier is required for product distinction on secondary diskette directory and file access requests.

   The product ID qualifier in DTID2 must be initialized at POWER-ON/RESET by the distributed function device.

DTID2 Value	Description
X'00'	3290 Disk Files
X'01'	3179 Model G Files
X'02'	3193 Files
X'03-FF'	Reserved

3. CUAT (attachment protocol) has the following flags defined:

```
 ┌CUAT Bits┐
  0123 4567
  ──── ────
B'0... ....'    TP Attached
B'1... ....'    Local Attached
B'.0.. ....'    SNA Protocol
B'.1.. ....'    Non-SNA Protocol
B'..00 0000'    Reserved Bits (2-7)
```

4. CUSLVL is a sixteen bit field that indicates the optional TCA functions supported b the controller. It has the following flags defined (see also "Controller TCA Suppor Level" on page 95)

```
┌────CUSLVL Bits────┐
 0123 4567 89AB CDEF
 ──── ──── ──── ────
 0000 0000 00.. .00.  Reserved Bits
                           (Should be zero.)
 .... .... ..00 0000  Base TCA Function Support
                           (See "Base TCA Support Level" on page 95.)
 .... .... ..1. ....  AEEB Extension for END Busy
                           (See "AEEB Extension for End Busy Support" on page 95
 .... .... ...1 ....  Enhanced TCA Buffer Management
                           (See "Enhanced Buffer Management Support" on page 95.
 .... .... .... 1...  Device Initiated UNBIND
                           (See "Device Initiated UNBIND Support" on page 95.)
 .... .... .... ...1  Non-SNA Slow Device Support/Extended AEDV
                           ("Slow Device Support/Extended AEDV Status" on page 9
```

3.2 TCA Buffer Map

Offset	Byte 0	Byte 1	Byte 2	Byte 3	Area
X'00'	DPASTAT	DPSSTAT	DSSV	DSSP	Device Owned Area
X'04'	DSSP2	DSSP3	DALTAD	DAEV	
X'08'	DAEP	DAEP2	DAEP3	DAEP4	
X'0C'	DTID1	DTID2	DTID3	DTID4	
X'10'	DBUF		(RESERVED)		
X'14'	(RESERVED)				
X'18'	(RESERVED)				
X'1C'	(RESERVED)				
X'20'	EXFLT	EXFRQ	EXFP1	EXFP2	
X'24'	EXFP3	EXFP4	EXFAK	(RESERVED)	
X'28'	(RESERVED)				
X'2C'	(RESERVED)				
X'30'	(RESERVED)				
X'34'	(RESERVED)				
X'38'	(RESERVED)				
X'3C'	(RESERVED)				
X'40'	CUDP		CULTAD	(RESERVED)	C U Owned Area
X'44'	CUFRV	CUSYN	CUFRP1	CUFRP2	
X'48'	CUFRP3	CUFRP4	(RESERVED)		
X'4C'	(RESERVED)				
X'50'	CUDPORT	CUAT	CUDSER		
X'54'	CULTA1	CULTA2	CULTA3	CULTA4	
X'58'	CULTA5	(RESERVED)			
X'5C'	EXFD1	EXFD2	EXFD3	EXFD4	
X'60'	EXTIME	CUDSL	(RESERVED)		
X'64'	(RESERVED)				
X'68'	(RESERVED)				
X'6C'	(RESERVED)				
X'70'	(RESERVED)				
X'74'	(RESERVED)				
X'78'	(RESERVED)				
X'7C'	(RESERVED)		CUSLVL		

See "TCA Buffer Format" on page 27 for a description of the TCA Buffer Fields.

3.3 TCA Buffer Data Area

Bytes at @X'0080' - @X'....' of the TCA Buffer are controlled and allocated by the CU and are altered by the device only on request from the CU. The data in @X'0080' - @X'....' is preceded by a four byte message header (except when a device has posted a POR or in response to a WCUS(20)). The content of the message header is described in Figure 31 on page 31.

Length		Flag Bits		Data Area (length varies)			
0	1	2	3	4	5	.	.

Length Field contains length of message in CUDATA (Length + Flags + Data).

Flags Field contains:

Flag Bits 0123 4567 89AB CDEF		Valid Out-Bound (from CU)	Valid In-Bound (to CU)
1...	First of Message	X	X
.1..	Last of Message	X	X
..1.	WCTL FMH + Query Reply SFF .	-	X
..0.	WCTL PCIA Data Format (Base)	-	X
...1	BSC Transparency Required	X	X
.... 1...	BSC Test Request Function .... (CU generates actual %/ msg header)	-	X
.... .1..	SNA Channel Buffer Overrun .... (Maximum RU size exceeded)	X	-
.... ..0.	Permanently Reserved	-	-
....0	Reserved Bit	-	-
.... 1...	FMH Present (Local Copy) .... (See "QUERY" on page 125.)	X	-
.... .1..	Query Reply Expected (Local Copy)	X	-
....00 0000	Reserved Bits (Should be zero) ...	-	-

Figure 31. CUDATA Message Header Format

For SNA attachments, outbound data requested by function request X'03' (WDAT), does not use bits 0 and 1. Segmented data is indicated by the Transmission Header.

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4.0 Device Control

Device control is composed of interchanges between the CU and the device in a particular sequence to achieve a desired state. This section defines the rules governing those interchanges.

4.1 Initialization

Sequencing of power on is a CU responsibility. If a device is powered up before the CU, then the CU must issue a RESET command to that device to force power-on initialization. At the time a POR is sent to the CU, the device must have @X'0000-007F' of its buffer set to zero except for Terminal ID DTID1, DTID2, and DBUF which are set to the appropriate values. The CU identifies the device via the Read Terminal ID command and by reading the contents of DTID1 in the device communications area. The DTID1 byte must remain unaltered while power is on in the device. The value in DBUF may only be initialized at POR and once set must not be changed.

In addition, @X'0080-0084' must contain the appropriate device information (as outlined below) when the device returns a POR.

Note: If the power-on response is the result of a "Diagnostic Reset" command and the device has set DTID1 bit 1 = B'1', indicating that it is ready to dump, the TCA buffer starting at @X'0080' must not be altered with the device information. Use of fields described in Figure 33 on page 34 for power-on information is optional; however, if these fields are not used, they must be = X'00'. This information is read back and stored in the controller. It is intended for enhanced network management and device problem determination purposes.

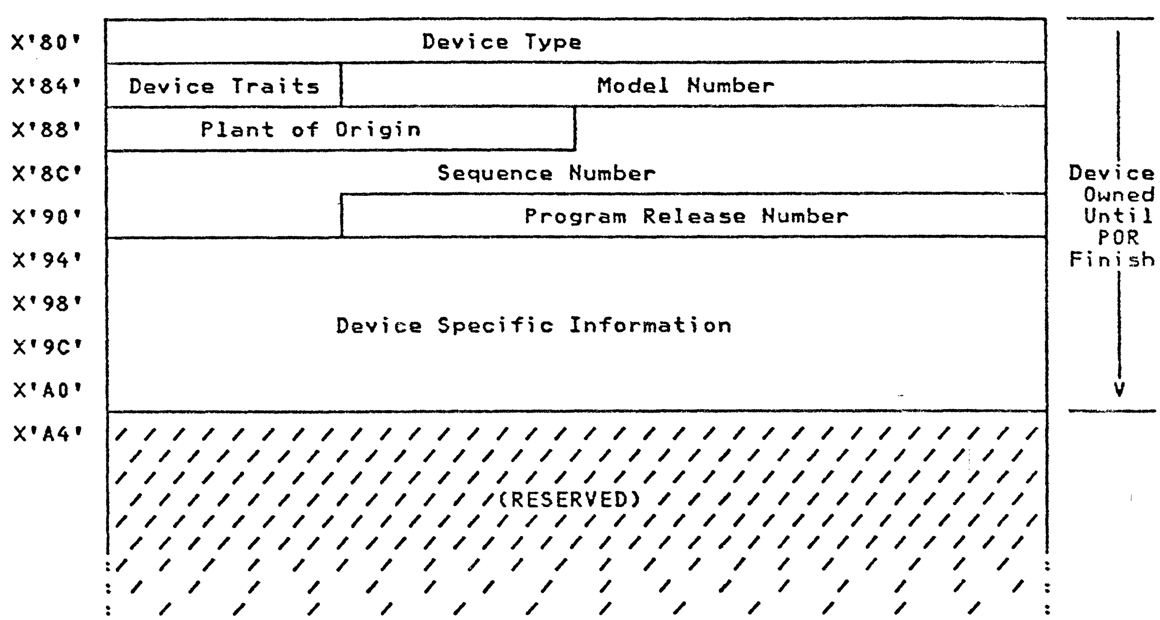

Figure 32. CUDATA Map after POR: (Depicts both Mandatory and Optional fields.)

See "Initialization" for a description of this format.

Content	Location	Format	Description
Device Type	X'0080-0083'	X'FxFxFxFx'	Device Type in numeric EBCDIC. (For Non-IBM Products, this field must be right-justified and padded with X'F0' if necessary.)
Device Character	X'0084' (Bits 0-3)	X'1'	Hardware or Microcode
		X'E'	Customer Programmable Machine
	(Bits 4-7)	X'1'	IBM Machine
		X'9'	Non-IBM Machine
		Other Values	Reserved

Figure 33. POR Device Information -- MANDATORY: These fields must be supplied by the device at POR time. Failure to supply these fields to the control unit will result in an interface disconnect.

Content	Location	Format	Description
Model #	X'0085-87'	X'------'	Model Number in AE EBCDIC chars. right-justified, padded with X'40' chars. X'000000' (unknown or n/a)
Origin	X'0088-89'	X'----'	Plant of Manufacture: EBCDIC per IBM Standard CB-0-2021-00 X'0000' if unknown or n/a.
Sequence#	X'008A-90'	X'--..--'	Seven Digit Sequence Number in AE EBCDIC, right-justified and padded with X'F0' chars. X'00..00' if unknown or n/a.
Pgm Level	X'0091-93'	X'------'	Release Level of Program in AE EBCDIC, right-justified and padded with X'F0'. X'000000' if unknown or n/a.
EC Level	X'0094-A3'	X'--.....--'	Maximum 16 Digits; Device Specific Information in AE EBCDIC. User defined Padding & Justification.

Figure 34. POR Device Information -- OPTIONAL: These fields are OPTIONAL for TCA, but MANDATORY for CNM.

NOTES:

1. The Device Serial Number is represented by a combination of the Origin and the Sequence fields.

2. AE Characters are EBCDIC 0-9, A-Z, $, #, @, period, null. N/A = not applicable. Device Specific Information may be Release or EC Levels or any other data a product may wish to supply to identify its characteristics.

4.1.1 Control Unit Initialization

CULTA1-5 fields, in addition to CUDPORT, CUAT, CUDSL, and CUSLVL, are initialized by the control unit after identifying the device, reflecting customization data. These fields,

once initialized, are not subsequently modified. The device addresses are ordered from lowest address to highest address. The CULTA fields where an address is not defined will be set to X'FF'. Each port may be customized for one, two, three, four or five terminals on a given port. If only CULTA1/CULTA2 are initialized, the CU supports only two Logical Terminals. If all addresses have been initialized then the CU supports up to a maximum of 5 Logical Terminals on the attached port.

4.2 Synchronous Event Synchronization

The CU prepares a function request by performing the following:

- DPSSTAT is set to X'00' to acknowledge Synchronous Status, or DPASTAT is set to X'00' to acknowledge Asynchronous Status.
- The data address, if any, is written into CUDP.
- The function request value is written into CUFRV.
- The request synchronization flag at CUSYN is toggled.
- Any associated parameters are written into CUFRP1-4.
- The data, if any, is written in the CUDATA area pointed to by CUDP.
- Expedited Status, EXTIME, may be updated.

If the above is successful, then by separate command queue, the request is initiated with a Start Operation command. Otherwise, Command Queue Retry is attempted, whereupon the control unit rewrites all of the above fields with the original values.

Command queue retry may cause CUSYN, DPASTAT, or DPSSTAT fields to be re-written. These fields must not be examined by the device until a Start Operation is issued.

The Start Operation command causes the device to interpret and process the function request. When the processing is complete, the device stores the completion code in DSSV and any associated parameters in DSSP-DSSP3 before posting Synchronous Status Present (X'01' at DPSSTAT). Then the Status Available bit is set on in the Common Status Word and made available as a POLL response. When the status is available, the CU reads DSSV and its parameters at DSSP-DSSP3, and processes the posted status.

The device hardware must reset the status available bit in the Common Status Word upon receipt of POLL ACK.

The CU must not issue a second function request until synchronous status for the first request has been read and acknowledged except when an error causes a non-zero value to be written to CUDSER. In this case a Start Operation command may be issued anytime, but only if the intention is to force disconnection of the interface.

4.3 Asynchronous Event Sequence

The device reports an asynchronous event to the CU by placing the event identification in DAEV and any associated parameters in DAEP-DAEP4 before posting Asynchronous Status Present (X'01 in DPASTAT) and by subsequently setting the Status Available bit in the Common Status Word.

Following receipt of a Status Available response, the CU reads DPASTAT, DAEV, and DAEP-DAEP4 and processes them as appropriate. The CU acknowledges receipt of the status by writing X'00' to DPASTAT and sending a function request to the device. On receipt of a Start Operation command while DPASTAT is X'00', the device may report a queued asynchronous event.

Only one asynchronous event may be reported and unacknowledged at any time. It is the responsibility of the device to queue any asynchronous events while waiting for an acknowledgment.

If the CU cannot process an asynchronous event immediately, the CU queues that event until it can be processed. If the event is unacknowledged, the CU need only remember that an event occurred.

4.4 Expedited Status Interface

Expedited Status (ES) provides a means to service device requests on an immediate basis independent of other states of the device or its logical terminals. Expedited Status communication uses assigned TCA fields. Expedited Status requests from the device are given priority over Synchronous Status and Asynchronous Status device requests. Expedited Status requests are used to communicate status of intermediate steps or asynchronous events that occur during concurrent execution of a function request which has not been completed. The device puts the status in EXFRQ, and any parameters in EXFP1-4 before posting Expedited Status Present (X'01' in EXFAK). The device then sets the Status Available bit on in the Common Status Word. The controller signals the device when processing has completed by setting EXFAK to X'00' and then issuing a Read Terminal ID command which causes a TCA interrupt. The Read Terminal ID command, in this context, is an alternate means of interrupting the device processor and is called the "Alternate Start Operation".

4.4.1 Expedited Status, Typical Transmission Line Sequence

```
Description              Controller               Device

Device Request                                    Store ES Request and
                                                  Post ACK Flag
Post Line Status.
                         POLL ------------------->

                              <------------------ status bit

Read Status              Read ES ---------------->

                              <------------------ data

Process Request Code

        .
        .
        .

Write EXFAK & data       Write Data ------------->

Interrupt Device         Alt. START OP ---------->

                              <------------------ Data Response

Device Interrupt         START OP --------------->

Device Post-Processing
```

Figure 35. CU to Device Transmission Line Sequence for ES

When the device posts EXFAK = X'01', it indicates it has completed ES communications. The CU acknowledges ES via the RTID (Alternate Start OP). The device must not examine the TCA ES area until receipt of this command. As with function request synchronization, the Read Terminal ID command must be issued in a separate operation after posting the request acknowledgment X'00' in EXFAK. Should the device receive multiple TCA interrupts resulting from error recovery, receipt of additional interrupts must be ignored, as determined by the value in EXFAK. The device must recognize the difference between an initial interrupt and retry.

4.4.2 Status Prioritization

The Common Status Word response to POLL can potentially represent device requests to service any or all of the three device status paths: Expedited, Synchronous, and Asynchronous. To process the status response to POLL, the control unit reads EXFAK, DPSSTAT, and DPASTAT. Status is serviced in the order of Expedited, Synchronous, and Asynchronous (high to low priority). Asynchronous Status processing may be deferred (remain unacknowledged) until the conclusion of the current Expedited or Synchronous Transaction.

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CUFRV Value	Name	Notes (1)	Notes (2)	Function
X'00'	----	*	.	Reserved
X'01'	CNOP	.	.	Control No-Operation
X'02'	WCUS	.	.	Write Control Unit Status
X'03'	WDAT	.	*	Write Data from Host
X'04'	WDBD	.	.	Write Data-Base Data
X'05'	RDCOPY	.	.	Read block of SNA Character String (SCS) Data for Local Copy
X'06'	WLCC	.	*	Write Local Channel Command
X'07'	LOCK	.	*	Non-SNA host selection, device ready request
X'08'	RDAT	.	*	Generate inbound (Read) Data for host
X'09'	WCTL	.	.	Write printer Characteristics for Local Copy
X'0A'	PDAT	.	*	Prepare read Data prior to host notification
X'0B'	CTCCS	.	*	Terminate Chained Command Sequence
X'0C'	RDBD	.	.	Request Data-Base Data
X'0D'	RPID	.	.	Read Printer Identification
X'0E-FF'		*	.	Reserved

Figure 36. Synchronous Function Requests

Notes:

1. The device must respond with ERFR.
2. Must not be issued by CU when device is in the Interface Connected state. This causes ERFR response from device.

5.1 CNOP

The Control No-Operation (CNOP) function request has no function other than to allow a Start Operation command to be issued without a specific function being performed. It may be used to acknowledge asynchronous events. CNOP has no parameters.

Field	Value	Description
CUFRV	X'01'	CNOP Function Request
CUFRP1	n/a	Not used
CUFRP2	n/a	Not used
CUFRP3	n/a	Not used
CUFRP4	n/a	Not used
CULTAD	X'FF'	Not used
CUDP	n/a	Not used

Figure 37. CNOP Parameters

5.2 WCUS

The Write Control Unit Status (WCUS) function request is used to report CU state changes and CU events that are detected by the CU and normally communicated to the operator. The CU does not manage device indicators or indicator areas. (The device does not communicate indicator reset to the CU.)

WCUS is classified as either:

1. An anticipated event, contextually valid to a given multi-step sequence, such as 'copy request queued' or 'printer printing'. Multiple events are prioritized in a contextual logic progression. Events are grouped by function.

2. Unscheduled status reported per external conditions asynchronously, such as the Reminders and LU Status groups shown in the list at the end of this subsection. Unscheduled status is allowed to interrupt normal protocol sequences and take priority over a scheduled event. Unscheduled status may be delayed due to processing algorithms in the CU or the device.

If the device is not online to the host, the following unscheduled status is deferred until the device is online to host:

- Communications Check Reminder
- LU Status Group
- Printer Assignment

WCUS function requests for Logical Unit/Physical Unit status are sent at POR time, when the device goes Online to the Host, and whenever the status of the device changes. (See following figure.)

If a read or write file function request completes with error, an appropriate WCUS is sent to the device (see also "RDBD" on page 68).

Other WCUS function requests are defined for status conditions associated with device initiated local copy operations and for diskette operations.

Note: The type of WCUS is determined by the hex value in CUFRP1 and is referred to as WCUS(yy) where yy is equal to the hex value of CUFRP1. For example, a WCUS with value X'20' (Device Identification) in CUFRP1, is referred to as a WCUS(20). Further definition is provided by the values in CUFRP2-CUFRP4.

Any WCUS condition not recognized by the device must be acknowledged with normal function complete status.

GROUP NAME	CONDITION NAME	EVENT/ STATUS	CUFRP1 WCUS #	CUFRP2-4	CULTAD	CUDP
Input Inhibit	Machine Check	Event	X'01'	X'000NNN'	X'FF'	n/a
	Commun. Check Reminder	"	X'02'	X'000NNN'	X'FF'	n/a
	Program Check	"	X'03'	X'000NNN'	LT	n/a
Readiness Group	CU Ready, DSL Allowed	Event	X'10'	X'000000'	X'FF'	n/a
	CU Ready, No DSL Allowed	"	X'10'	X'020000'	X'FF'	n/a
Identity	Device Identification	Status	X'20'	X'000000'	X'FF'	X'0080'
Reminders	Communications Check	Status	X'30'	X'000NNN'	X'FF'	n/a
	No Reminder	"	X'31'	X'000000'	X'FF'	n/a
	Disk Not Ready (Cover Opened)	"	X'60'	X'000000'	X'FF'	n/a
	Disk Ready (Cover Closed)	"	X'61'	X'000000'	X'FF'	n/a
LU Status	LU Active	Status	X'40'	(Note 3)	LT	n/a
	LU Not Active	"	X'41'	X'000000'	LT	n/a
	PU Changed Active State	"	X'41'	X'000000'	X'FF'	n/a
	RTM Parameters	"	X'42'	RTM Parms	LT	n/a
Local Copy	Request Queued	Status	X'51'	X'000000'	X'FF'	n/a
	Long Term Busy	"	X'52'	X'000000'	X'FF'	n/a
	Printer Exception:					
	Intervention Required	"	X'53'	X'nn0100'	X'FF'	n/a
	Equipment Check (EC)	"	X'53'	X'nn0200'	X'FF'	n/a
	Data Check (DC) including Datastream Errors	"	X'53'	X'nn0300'	X'FF'	n/a
	Invalid Printer Number	"	X'54'	(Note 4)	X'FF'	n/a
	Assignment Not Allowed	"	X'55'	X'nn0000'	X'FF'	n/a
	Printer Assigned	"	X'56'	X'nn0000'	X'FF'	n/a
	Printer Available	"	X'57'	X'000000'	X'FF'	n/a
	Printing Started	"	X'58'	X'nn0000'	X'FF'	n/a
	Request Dequeued	"	X'59'	X'000000'	X'FF'	n/a
	Local Copy Unconfigured	"	X'5A'	X'000000'	X'FF'	n/a
	Print Complete	"	X'5B'	X'nn0000'	X'FF'	n/a
	Printer Operational	"	X'5C'	X'nn0000'	X'FF'	n/a
Disk Completion	Fatal Hardware Error	Status	X'70'	X'000000'	X'FF'	n/a
	Disk Media Error	"	X'70'	X'040000'	X'FF'	n/a
	Disk Overrun	"	X'70'	X'060000'	X'FF'	n/a
	Disk Not Ready	"	X'70'	X'0A0000'	X'FF'	n/a
	Wrong Disk	"	X'70'	X'140000'	X'FF'	n/a
	File Not Found	"	X'71'	X'020000'	X'FF'	n/a
	File Not Writeable	"	X'71'	X'080000'	X'FF'	n/a
	File Locked (Contention)	"	X'71'	X'0C0000'	X'FF'	n/a
	File Overflow	"	X'71'	X'0E0000'	X'FF'	n/a
	File Not Readable	"	X'71'	X'100000'	X'FF'	n/a
	File Not Locked	"	X'71'	X'120000'	X'FF'	n/a

Figure 38. WCUS Parameters

Note:

1. NNN numbers are the 3270 error codes which are packed decimal and right-justified in CUFRP2-4. These errors do not disconnect the interface.
2. nn numbers from 00 to FD are the Printer Port Address or Class Number. Where nn = X'FE', Printer Selection is possible following matrix change. If nn = X'FF', no assignment has been made.
3. CUFRP2 = Byte 1 of the ACTLU RU.
4. X'nn0000' - Invalid number was not accepted. Printer remains set to nn, the last valid number.

5.2.1 WCUS(01) - Machine Check

A Machine Check Event will result in WCUS(01). An Error Code is placed right justified in CUFRP3 and CUFRP4.

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'01'	WCUS(01) - Machine Check
CUFRP2	X'00'	Not used
CUFRP3-4	X'0NNN'	3270 Error Code (Packed Decimal)
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not used

5.2.2 WCUS(02) - Communications Check

This WCUS is issued to report a Communications Check Event.

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'02'	WCUS(02) - Communications Check
CUFRP2	X'00'	Not used
CUFRP3-4	X'0NNN'	3270 Error Code (Packed Decimal)
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not used

5.2.3 WCUS(03) - Program Check

A Program Check Event is reported by WCUS(03).

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'03'	WCUS(03) - Program Check
CUFRP2	X'00'	Not used
CUFRP3-4	X'0NNN'	3270 Error Code (Packed Decimal)
CULTAD	LT	Logical Terminal Address
CUDP	n/a	Not used

5.2.4 WCUS(10) - CU READY

WCUS(10) is used by the control unit to report a readiness state of the interface to the TCA device.

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'10'	WCUS(10) - CU Ready
CUFRP2	X'00' X'02'	DSL Allowed DSL Not Allowed
CUFRP3-4	X'0000'	Reserved
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not used

5.2.5 WCUS(20) - Device Identification

When a device reports AEDV(Online), the controller may issue a WCUS(20). When the Start Op is issued to the device, the controller has placed information in the TCA buffer to identify itself to the device. (See Figure 39 on page 45.)

When the device responds Function Complete to this command, it may first place its corresponding device information in the TCA buffer (see Figure 42 on page 48) or may simply choose to return the FC without updating the buffer with its data (not support the command).

Upon receipt of FC from the device, the controller reads the appropriate area of the TCA buffer. If the device has provided its own information, the controller updates the information received at device POR time (see "Initialization" on page 33) and then checks that the device type and flag byte are valid. As noted in "Initialization" on page 33, other device information is optional.

If the device has failed to provide the required information, either at POR or via a WCUS(20) response, the controller disconnects the interface with a 240 Machine Check.

The device information is stored in the controller and is intended for enhanced network management and device problem determination purposes. It is recommended that the device

retain the information provided by the controller in the WCUS(20) function request, and make this information available to the device operator upon request.

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'20'	WCUS(20) - Device Identification
CUFRP2	X'00'	Not used
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	X'0080'	Address of Data Area

Location	Data	Comment
X'0080'	X'--'	Length of Data
X'0081'	X'00'	Data Format Identifier
X'0082-83'	X'----'	Controller Identification Characters. (See Note)
X'0084-87'	X'FxFxFxFx'	Device Type of Controller in EBCDIC (Numeric)
X'0088'		
(Bits 0-3)	X'1'	Hardware or Microcode
	X'E'	Customer Programmable Machine (other values are reserved)
(Bits 4-7)	X'1'	IBM Machine
	X'9'	Non-IBM Machine (other values are reserved)

Figure 39. Mandatory ID Information Supplied by CU

Note:

The controller identification characters are unique EBCDIC characters assigned to a control unit type.

Some or all of the following optional information may also be included, depending on the length byte (@X'0080') above:

Location	Data	Comment
X'0089-8B'	X'------'	Model Number in EBCDIC AE (X'000000' if unknown or N/A) (see Note)
X'008C-8D'	X'----'	Plant of Manufacture; EBCDIC per IBM Standard CB-0-2021-000 (X'0000' if unknown or N/A)
X'008E-94'	X'--...--'	Seven Digit Sequence Number in EBCDIC AE, right justified and padded with X'F0' (X'00...00' if unknown or N/A)
X'0095-97'	X'------'	Release Level of Program in EBCDIC AE, right justified and padded with X'F0' (X'00..00' if unknown or N/A)
X'0098-A7'	X'--...--'	Maximum 16 Digits of Device Specific Information in EBCDIC AE, User Defined Padding and Justification (X'00...00' if unknown or N/A)
X'00A8-FF'	X'00...00'	Reserved

Figure 40. Optional ID Information from CU

Note:

AE Characters are EBCDIC 0-9, A-Z, $, #, @, period, null. Device specific information may be Release or EC Levels or any other data a product may wish to supply to identify its characteristics.

EBCDIC	Hex	EBCDIC	Hex	EBCDIC	Hex	EBCDIC	Hex
[4]*	00	>	6E	I	C9	W	E6
.	4B	?	6F	J	D1	X	E7
<	4C	:	7A	K	D2	Y	E8
(	4D	'	7D	L	D3	Z	E9
+	4E	=	7E	M	D4	0	F0
&	50	"	7F	N	D5	1	F1
*	5C	A	C1	O	D6	2	F2
)	5D	B	C2	P	D7	3	F3
;	5E	C	C3	Q	D8	4	F4
-	60	D	C4	R	D9	5	F5
/	61	E	C5	S	E2	6	F6
,	6B	F	C6	T	E3	7	F7
%	6C	G	C7	U	E4	8	F8
_	6D	H	C8	V	E5	9	F9

* Defaults to 4-in-the-box if no value is specified.

Figure 41. Control Unit Type ID Characters: Each control unit type is assigned a character (or two) from this list which will be displayed on the Operator Information Line when the device to control unit connection is established.

The device is responsible for displaying the EBCDIC characters corresponding to the hexadecimal values in bytes @X'0082' and @X'0083' in the Readiness and System Connection

Indicator area (columns 0-5) of the Operator Information Line. If @X'0082' contains X'00', only the EBCDIC character associated with the contents of @X'0083' is displayed. If byte @X'0082' is not zero, the EBCDIC character associated with byte @X'0082' is displayed, in the Readiness and System Connection Indicator area, immediately preceding the EBCDIC character associated with the contents of @X'0083'. If bytes @X'0082-83' contain X'0000', the "4 in the box" character is displayed. (See EXAMPLES, below.)

EXAMPLES:

Contents of @X'0082-83'	Character(s) Displayed	Comments
X'00 00'	[4]	"4 in-the-box" (3274 type controller)
X'00 E2'	S	"S" (3174 type controller)
X'F3 C7'	3G	
X'00 4C'	<	
WCUS(20) not issued yet	[?]	"question mark in-the-box" (CU type unknown)

Note:

If it is necessary to indicate a control unit connection following receipt of WCUS(10), but before WCUS(20) as when using DSL devices, the "Question-Mark-in-the-Box" character, should be used to indicate that the connection has been established but the specific controller type is not yet known. The proper controller identifier character(s) will replace this designation following receipt of the WCUS(20) controller information.

When a device that does not support the WCUS(20) function request returns FC to the controller, the ID byte in the data area remains as set by the controller.

If the device chooses to update or supplement its POR parameters, the TCA buffer must appear as follows:

Location	Data	Comment
X'0080'	X'--'	Length of Data
X'0081'	X'01'	Data Format Identifier
X'0082-83'		Options Supported by Distributed Function Device (Flags)
(Bits 0-D)	zeros	Reserved (see Note)
(Bit E)	B'1'	Device Supports Read 32 Version of Read Multiple Command.
(Bit F)	B'0'	Reserved (see Note)
X'0084-87'	X'FxFxFxFx'	Device Type in EBCDIC (Numeric)
X'0088'		
(Bits 0-3)	X'1'	Hardware or Microcode
	X'E'	Customer Programmable Machine
		(other values are reserved)
(Bits 4-7)	X'1'	IBM Machine
	X'9'	Non-IBM Machine
		(other values are reserved)

Note: Reserved bits in this field must be set to zero by the device but are not checked by the controller.

Figure 42. ID Information Supplied by the Device

Some or all of the following information may also be included, depending on the length byte above:

Location	Data	Comment
X'0089-8B'	X'------'	Model Number in EBCDIC AE characters. Right-justified and padded with spaces (X'40'), or X'000000' if unknown or n/a.
X'008C-8D'	X'----'	Plant of Manufacture; EBCDIC per IBM Standard CB-0-2021-000 (X'0000' if unknown or n/a).
X'008E-94'	X'--...--'	Seven Digit Sequence Number in EBCDIC AE. Right justified and padded with X'F0' (X'00...00' if unknown or n/a).
X'0095-97'	X'------'	Release Level of Program in EBCDIC AE. Right justified and padded with X'F0' or (X'000000' if unknown or n/a).
X'0098-A7'	X'--...--'	Maximum 16 characters of Device Specific Information in EBCDIC AE. User Defined Padding and Justification (X'00...00' if unknown or n/a).

Figure 43. Additional ID Information Supplied by the Device

Note: AE Characters are EBCDIC 0-9, A-Z, $, #, @, period, null. Device specific information may be Release or EC Levels or any other data a product may wish to supply to identify its characteristics.

5.2.6 WCUS(30) - Communications Check

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'30'	WCUS(30) - Communications Check
CUFRP2	X'00'	Not used
CUFRP3-4	X'0NNN'	3270 Error Code (Packed Decimal)
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not used

5.2.7 WCUS(31) - No Reminder

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'31'	WCUS(31) - No Reminder
CUFRP2	X'00'	Not used
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not used

5.2.8 WCUS(40) - LU Active

When a Logical Unit becomes Active (ACTLU issued), it is reported to the device via WCUS(40).

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'40'	WCUS(40) - LU has become Active
CUFRP2	X'xx'	RU Byte 1
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	LT	Logical Terminal Address
CUDP	n/a	Not used

5.2.9 WCUS(41) - LU Inactive or PU Activity Change

When a Logical Unit becomes Inactive (DACTLU issued) it is reported to the device via WCUS(41). WCUS(41) is also used to report a change of the state of a PU (DACTPU or ACTPU issued).

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'41'	WCUS(41) - LU has become inactive (or) PU has become inactive (or) PU has become active
CUFRP2	X'00'	Not used
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	LT X'FF'	Logical Unit has become Inactive Physical Device state change
CUDP	n/a	Not used

5.2.10 WCUS(42) - RTM Control

The Response Time Monitor (RTM) interface and Last Transaction Time (LTT) display can be enabled or disabled at any time via a WCUS(42) function request from the CU. If a WCUS(42) function request is not received from the CU, the RTM interface defaults to the disabled state.

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'42'	WCUS(42) - RTM Control
CUFRP2	X'00'	RTM Disabled for Logical Terminal in CULTAD
	other	RTM Enabled for Logical Terminal
CUFRP3	X'00'	LTT Not Authorized
	X'01'	LTT Authorized
CUFRP4	X'00'	Not used
CULTAD	LT	Logical Terminal Address
CUDP	n/a	Not used

Refer to "Response Time Monitor" on page 89 for a complete description of the RTM interface.

5.2.11 WCUS(51) - Local Copy Request Queued

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'51'	WCUS(51) - Request Queued
CUFRP2	X'00'	Not used
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not used

5.2.12 WCUS(52) - Local Copy Long Term Busy

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'52'	WCUS(52) - Long Term Busy
CUFRP2	X'00'	Not used
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not used

5.2.13 WCUS(53) - Printer Exception

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'53'	WCUS(53) = Printer Exception
CUFRP2	X'nn'	Printer Port Address or Port Number
CUFRP3	X'01' X'02' X'03'	Intervention Required (IR) Equipment Check (EC) Data Check (DC) (Includes Data Stream Errors)
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not Used

5.2.14 WCUS(54) - Invalid Printer Number

This WCUS is used to report an unsuccessful attempt to set an invalid printer address. The invalid number is rejected and the assignment remains set to the most recent valid address for this device. This number, nn, is reported in CUFRP2. CUFRP3 and CUFRP4 must be zero.

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'54'	WCUS(54) - Invalid Printer Number
CUFRP2	X'nn'	Previous Valid Printer Address
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not Used

5.2.15 WCUS(55) - Assignment Disallowed

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'55'	WCUS(55) - Assignment Disallowed
CUFRP2	X'nn'	Printer Address
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not Used

5.2.16 WCUS(56) - Printer Assigned

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'56'	WCUS(56) - Printer Assigned
CUFRP2	X'nn'	Printer Address Assigned
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not Used

5.2.17 WCUS(57) - Printer Available

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'57'	WCUS(57) - Printer Available
CUFRP2	X'00'	Not Used
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not Used

5.2.18 WCUS(58) - Printing Started

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'58'	WCUS(58) - Printing Started
CUFRP2	X'nn'	Printer Address
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not Used

5.2.19 WCUS(59) - Request Dequeued

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'59'	WCUS(59) - Request Dequeued
CUFRP2	X'00'	Not Used
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not Used

5.2.20 WCUS(5A) - Request Not Configured

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'5A'	WCUS(5A) - Request Not Configured
CUFRP2	X'00'	Not Used
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not Used

5.2.21 WCUS(5B) - Print Complete

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'5B'	WCUS(5B) - Print Complete
CUFRP2	X'nn'	Printer Address
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not Used

5.2.22 WCUS(5C) - Printer Operational

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'5C'	WCUS(5C) - Printer Operational
CUFRP2	X'nn'	Printer Address
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not Used

5.2.23 WCUS(60) - Disk Not Ready

This Reminder Status is issued to report a disk that becomes Not Ready; i.e., an interlocked cover being opened.

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'60'	WCUS(60) - Disk Not Ready
CUFRP2	X'00'	Not used
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not used

5.2.24 WCUS(61) - Disk Ready

This Reminder Status is issued when a disk which had previously reported WCUS(60) - Disk Not Ready, changes to the Ready state.

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'61'	WCUS(61) - Disk Ready
CUFRP2	X'00'	Not used
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not used

5.2.25 WCUS(70) - Disk Error

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'70'	WCUS(70) - Disk Error
CUFRP2	X'00' X'04' X'06' X'0A' X'14'	Fatal Hardware Error Disk Media Error Disk Overrun Disk Not Ready Wrong Disk
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not Used

5.2.26 WCUS(71) - File Error

Field	Value	Description
CUFRV	X'02'	WCUS Function Request
CUFRP1	X'71'	WCUS(71) - File Error
CUFRP2	X'02' X'08' X'0C' X'0E' X'10' X'12'	File Not Found File Not Writeable File Locked (Contention) File Overflow File Not Readable File Not Locked
CUFRP3	X'00'	Not used
CUFRP4	X'00'	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not Used

5.3 WDAT

The Write Data (WDAT) function request is used to pass data received from the host to the Device. The CU allocates a portion of the data area of the TCA buffer, places the length, flags, and data in the allocated area, and issues the WDAT function request with the starting address of the allocated area specified in CUDP.

For Non-SNA local channel attachment (NLCA) only, CUFRP2 is set to X'04' if the current command is chained to the next command. All other bit combinations are reserved. CUFRP1, CUFRP3 & CUFRP4 are not used.

CUFRP1-4 are not applicable for BSC and SNA attachments.

For SNA attachments, the Logical Terminal address on Write Data from host (WDAT) requests is contained in the Destination Address Field (DAF) of the data. Although the current Logical Terminal address must be obtained in the Transmission Header (DAF), CULTAD contains a valid, online Logical Terminal address.

Field	BSC Value	SNA Value	NLCA Value	Description
CUFRV	X'03'	X'03'	X'03'	WDAT Function Request
CUFRP1	n/a	n/a	n/a	Not used
CUFRP2	n/a	n/a	X'04'*	Command chained to next
CUFRP3	n/a	n/a	n/a	Not used
CUFRP4	n/a	n/a	n/a	Not used
CULTAD	LT	LT	LT	Logical Terminal Address
CUDP	X'xxxx'	X'xxxx'	X'xxxx'	Address of Data Area

* Bit significant field. Other bits are reserved and should not be used.

Figure 44. WDAT Parameters

Note: CUDP points to a 4 byte message header and data in CUDATA. See Figure 31 on page 31.

5.4 WDBD

The Write Data Base Data (WDBD) function request is used to pass data (retrieved from a file) to the device as the result of an AEDBA. The CU performs the same actions as for WDAT if the action is successful, plus setting CUFRP1 to a one byte file identifier requested asynchronously by the device, and setting CUFRP2 to a flag value.

Field	Value	Description
CUFRV	X'04'	WDBD Function Request
CUFRP1	X'xx'	File Identifier
CUFRP2	X'00' X'80'*	File retrieved from Disk File retrieved from CU Memory
CUFRP3	n/a	Not used
CUFRP4	n/a	Not used
CULTAD	X'FF'	Physical Device Function Request
CUDP	X'xxxx'	Address of Data Area

* Bit significant field. Other bits are reserved.

Figure 45. WDBD Parameters

Data is prepared in the TCA buffer with a 4-byte header (length & flags). Multiple WDBD function requests may be required to transfer a data file. Device buffer control flags First Of Message/Last Of Message (FOM/LOM) are set accordingly. If the device returns FRA status, the CU terminates the request (except when LOM).

5.5 RDCOPY

RDCOPY, sent in response to an AECOPY request, causes the device to send a block of the local copy data stream in SCS (SNA Character String) format to the control unit.

Field	Value	Description
CUFRV	X'05'	RDCOPY Function Request
CUFRP1	n/a	Not used
CUFRP2	n/a	Not used
CUFRP3	X'xx'	Maximum Length of Data Block (high order byte)
CUFRP4	X'xx'	Maximum Length of Data Block (low order byte)
CULTAD	X'FF'	Physical Device Function Request
CUDP	X'xxxx'	Address of Data Area

Figure 46. RDCOPY Parameters

5.6 WLCC

The Write Local Channel Command (WLCC) function request is used for an NLCA CU and is used to pass a local channel command to the Device.

Field	Value	Description
CUFRV	X'06'	WLCC Function Request
CUFRP1	X'6F' X'7E' X'F1' X'F2' X'F3' X'F5' X'F6'	Erase All Unprotected (EAU) Erase Write Alternate (EWA) Write Read Buffer Write Structured Field (WSF) Erase/Write (E/W) Read Modified (RM)
CUFRP2	B'.... .1..' B'.... ...1' B'0000 0.0.'	Current command chained from previous command. Inbound data sent to host. Reserved bits. Must be zero.
CUFRP3	n/a	Not used
CUFRP4	n/a	Not used
CULTAD	LT	Logical Terminal Address
CUDP	n/a	Not used

Figure 47. WLCC Parameters

A WLCC sequence for an inbound data stream may be prematurely terminated, e.g., before the device sends EOM, if the controller issues a CTCCS and command chaining is not active or if the controller issues another WLCC in a command chaining environment.

An example flow follows.

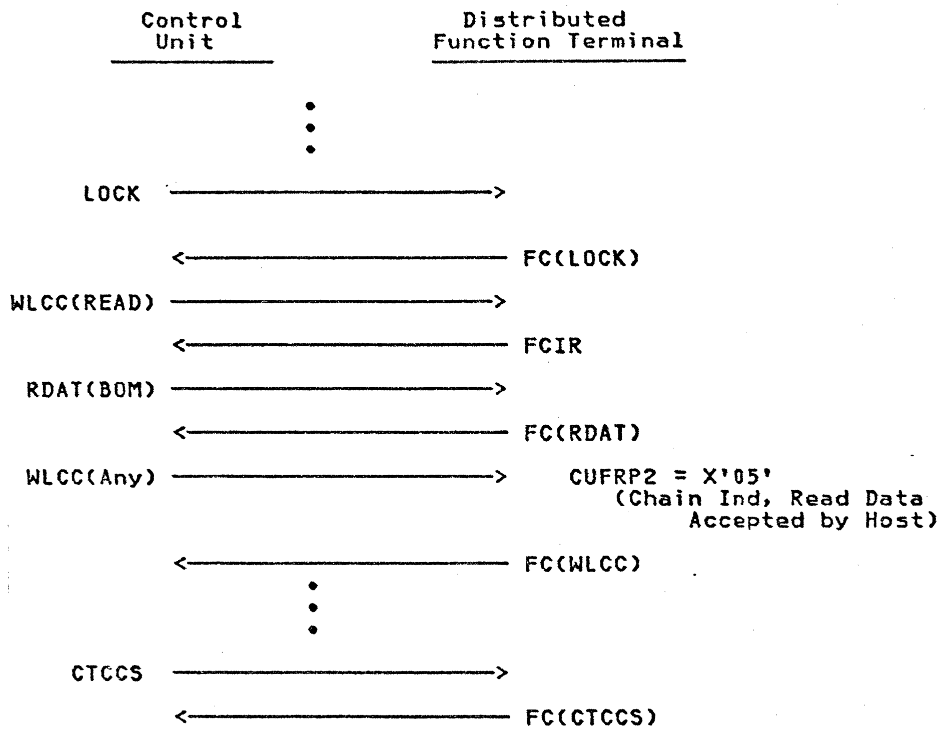

Figure 48. WLCC Sequence Prematurely Terminated by Another WLCC

5.7 LOCK

For non-SNA attachments, the LOCK function request (logical terminal based) is used to synchronize device and control unit to a ready state at host selection time. Each outbound host sequence is prefaced by a LOCK function request. Normal responses are FC, FCSE(BUSY) or FCSE(IR). FCSE(BUSY) response to a LOCK occurring outside of an AEEP sequence is only valid if End Busy support is active.

For BSC attachments or for NLCA attachments where the control unit does not support the Enhanced Buffer Management function, parameters are not provided with the LOCK function request. If, however, the Enhanced Buffer Management function is present with an NLCA attachment CUFRP1 is set to indicate whether prepared data is valid or has been destroyed.

Field	Value	Description
CUFRV	X'07'	LOCK Function Request
CUFRP1*	X'00' X'01' X'02-FF'	Prepared Data Destroyed Prepared Data Valid Reserved
CUFRP2	n/a	Not used
CUFRP3	n/a	Not used
CUFRP4	n/a	Not used
CULTAD	LT	Logical Terminal Address
CUDP	n/a	Not used

Figure 49. LOCK Parameters: (* LOCK uses CUFRP1 parameters only with Enhanced Buffer Management support)

The LOCK is not a valid request in SNA attachments.

5.8 RDAT

The RDAT is used for inbound data processing (device to host) in non-SNA attachments and in SNA attachments to transfer responses which do not exceed 64 bytes. The data length may not exceed the maximum length.

Data is prepared in the TCA buffer with a 4 byte header (length & flags). See Figure 31 on page 31 for data area contents.

Field	Value	Description
CUFRV	X'08'	RDAT Function Request
CUFRP1-2	X'xxxx'	Number of Data Segments (See note)
CUFRP3-4	X'xxxx'	Maximum Segment Length
CULTAD	LT	Logical Terminal Address
CUDP	X'xxxx'	Address of Data Area

Note: CUFRP1/CUFRP2 is set for SNA attachment only. In non-SNA, this parameter is not present and the device must assume a value of X'0001'.

Figure 50. RDAT Parameters

5.9 WCTL

WCTL provides the characteristics of the printer for local copy operation in the TCA buffer location specified by CUDP, including APL support, LU FMH support for Set Attribute, PS loaded Alias names and flags, and printer switch settings. The CU ensures that the printer characteristics are mapped into the appropriate WCTL fields as described below.

Field	Value	Description
CUFRV	X'09'	WCTL Function Request
CUFRP1	n/a	Not used
CUFRP2	n/a	Not used
CUFRP3	n/a	Not used
CUFRP4	n/a	Not used
CULTAD	X'FF'	Not used
CUDP	X'xxxx'	Address of Data Area

Figure 51. WCTL Parameters

The Data Area pointed to by CUDP contains printer characteristics as shown in the following figure:

Byte#	Len	Value	Description
0-1	2	X'xxxx'	Message Length
2-3	2	1... .... .1.. ....0. ....1. ....0 0000 0000 0000	First of Message Last of Message Present PCIA Data Format (Base) FMH Query SF Format (Extended) Reserved bits (must be zero)
4-11	8	X'00' (8 bytes)	Reserved
12	1	Highlight/ Functions Supported 0... .... 1... ....1. .000 00.0	 No Highlighting Supported Highlight Underline Supported Local Save/Restore SF and Query List SF Supported Reserved bits
13	1	X'00'	Reserved
14	1	Features/ Display Screen Size 1... .... .1.. .... ..1. ....1 0000	 Extended Attribute Buffer(EAB) Installed APL/3289 Text Print Feature Installed PCS Feature Installed SCS EBCDIC Feature Installed Reserved bits
15	1	X'00'	Reserved
16	1	Features ..1. ....1 .... 00.. 0000	 Color Supported (Extended Color if Byte 12, Bit 0 = 1) LU1 FMH Supported Reserved bits
17	1	X'00'	Reserved
18-29	12	Alias Table - (dynamic state of PS RAMS, if present) Each entry consists of a one byte Alias and a one byte PS variable flag corresponding to byte 8 of LPS Structured Field. (If the Alias = X'FF' the flag is ignored.)	

Figure 52. WCTL Data

Notes:

1. In order to use Graphic Escape in the data stream the printer must indicate support of APL in its terminal ID.
2. The controller "corrects" the terminal ID for printer type 0001.
3. Both the device and the printer must have matching aliases and CB bit equal to "compare."

Before including a Set Attribute (SA) sequence for a specific extended function in the printer data stream, the device must interrogate the state of the corresponding extended function bit in the WCTL data. It is important that the DFT device check each extended function bit independently. The presence of one particular extended function does not necessarily indicate that all extended functions (and the associated SA sequences) are supported by the target printer. The SA sequence for General Reset, however, is valid if

one or more of the extended function bits are active. The control unit protects the DFT device from anomalies in the negotiated printer to control unit interface by insuring that the extended function bit for highlight, PS, or color is set only if the printer can accept SA sequences for that particular function.

5.10 PDAT

The control unit issues a PDAT in response to an AEEP from the device.

In SNA environments:

PDAT is used to prepare and transmit all inbound messages. Additionally, PDAT must be employed to send SNA responses when the response is larger than 64 bytes and Enhanced Buffer Management is supported.

One and only one complete RU must be constructed using the segmenting parameters. If the Bind specifies a smaller RU size, then the Bind takes precedence. (See "ATTACHMENT CONSIDERATIONS" on page 139.)

In Non-SNA environments:

PDAT is used to prepare inbound data before notifying the host in order to improve line/channel utilization and controller throughput.

Data is prepared in the TCA buffer with a 4 byte header containing length & flags.

Field	Value	Description
CUFRV	X'0A'	PDAT Function Request
CUFRP1-2	X'xxxx'	Maximum Number of Data Segments (See note)
CUFRP3-4	X'xxxx'	Maximum Segment Length
CULTAD	LT	Logical Terminal Address
CUDP	X'xxxx'	Data Area Address

Note: CUFRP1-2 is set to the maximum number of data segments for SNA attachments. In Non-SNA, this parameter is not present and the device must assume a value of X'0001'.

Figure 53. PDAT Parameters

PDAT processing is an integral part of a AEEP sequence which ends when the device returns synchronous completion status to the PDAT.

Controller		Device	Comments
	<——————————	AEEP	Request for Inbound Operation
PDAT	——————————>		Prepare Data Request
	<——————————	FC	End of AEEP Sequence

Figure 54. AEEP SEQUENCE

5.11 CTCCS

Terminate Chained Command Sequence (CTCCS) is used in non-SNA only to indicate the end of a selection sequence. This corresponds to End-Of-Transmission (EOT) in BSC and end of command chaining in NLCA.

CTCCS Parameters are shown below. The content of CUFRP2 is bit significant; Unused bits are set to zero.

FIELD	VALUE	DESCRIPTION
CUFRV	X'0B'	CTCCS Function Request
CUFRP1	n/a	Not used
CUFRP2	X'00'	Normal termination. CUFRP2 value X'00' is also used in the event of a WSF chaining error, in which case a WCUS(03) Program Check is written after the CTCCS.
	X'01'	Read Data accepted by Host
	X'02'	Sequence terminated due to invalid select command processing by controller. WCUS(03) Program Check, is written following CTCCS.
	X'08'	Sequence terminated due to Communications Chk. For Binary Synchronous Control this means that a 501 Communications Check has occurred. The device must determine whether the state is to be reset (to state 1) or the request is to be reissued. For NLCA, this flag tells the device to reset to state 1. This parameter is set when a Communications Check has occurred as a result of a Channel Systems Reset (505) being received from the host. This parameter may also be set if a Selective Reset has been received after the device has been selected (locked).
	all other values	Reserved. Bits not shown are set to zero.
CUFRP3	n/a	Not used
CUFRP4	n/a	Not used
CUDP	n/a	Not used
CULTAD	LT	Logical Terminal Address

Figure 55. CTCCS Parameters.

5.12 RDBD

In response to asynchronous Data Base Store requests (AEDBS), the CU generates a Request for Data Base Data (RDBD) to the device to load the file in the device buffer in the same manner as data is requested for RDAT.

Data is prepared in the buffer with a 4 byte header (length and flags). The file may require multiple RDBDs to complete as indicated by segment flags.

Successful update of the file is indicated only by the acknowledgment of Asynchronous Status. Request failures are indicated by disk completion status with WCUS(70) or WCUS(71).

If a READ is attempted of a locked file larger than a cache buffer, a file locked WCUS(71) with CUFRP2-CUFRP4 set to X'0C0000' is passed to the requesting device. This is to prevent downstream loading a partially updated file.

If the CU is unable to respond to the AEDBS with a RDBD then the CU issues WCUS. See "Down Stream Loading" on page 121 for details of WCUS parameters.

Note: File access is protected with Read/Write Lock to other devices during the transaction.

Field	Value	Description
CUFRV	X'0C'	RDBD Function Request
CUFRP1	X'xx'	File parameter requested by AEDBS
CUFRP2	n/a	Not used
CUFRP3-4	X'xxxx'	Maximum data length allowed by CU
CULTAD	X'FF'	Not used
CUDP	X'xxxx'	Address of Data Area

Figure 56. RDBD Parameters

5.13 RPID

Read Printer ID (RPID) requests the device to respond with:

1. Printer port address, class number, or assignment request (X'FE') in DSSP.

or

2. Function Request Aborted (FRA) to terminate the sequence. See "Print ID Sequence" on page 124.

Field	Value	Description
CUFRV	X'0D'	RPID Function Request
CUFRP1	n/a	Not used
CUFRP2	n/a	Not used
CUFRP3	n/a	Not used
CUFRP4	n/a	Not used
CULTAD	X'FF'	Physical Device Request
CUDP	n/a	Not used

Figure 57. RPID Parameters

5.14 Table Summary

Function Reqst	CUFRV	CUFRP1	CUFRP2	CUFRP3	CUFRP4	CUDP	CULTAD
CNOP	01	--	--	--	--	--	X'FF'
WCUS	02	PP	PP	PP	PP	ODA	RR
WDAT (NLCA)	03	--	FF	--	--	DA	LT
WDAT (SNA/BSC)	03	--	--	--	--	DA	LT
WDBD	04	FN	FF	--	--	DA	X'FF'
RDCOPY	05	--	--	<——LS——>		DA	LT
WLCC	06	CC	FF	--	--	--	LT
LOCK (BSC)	07	--	--	--	--	--	LT
LOCK (NLCA)	07	FF	--	--	--	--	LT
RDAT	08	<——NS——>		<——LS——>		DA	LT
WCTL	09	--	--	--	--	DA	X'FF'
PDAT	0A	<——NS——>		<——LS——>		DA	LT
CTCCS	0B	--	FF	--	--	--	LT
RDBD	0C	FN	--	<——LS——>		DA	X'FF'
RPID	0D	--	--	--	--	--	X'FF'

Notes:

- -- = does not apply or is not used by CU, ignore parameter - contents are unpredictable.
- PP = parameter data for WCUS.
- DA = data buffer address.
- ODA = optional data buffer address (not applicable to all forms of the function request)
- CC = channel command.
- FF = function dependent flags.
- NS = Number of segments (2 byte field).
- LS = maximum length of segment (2 byte field).
- FN = Data Base item name - 1 byte identifier.
- LT = Logical Terminal Address
- RR = Content depends on WCUS number. For specifics, see Figure 38 on page 42.

Figure 58. Synchronous Function Request Parameters: A table of applicable function requests showing permitted parameters.

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6.0 Synchronous Status

When the device has completed processing of a function request, it places completion status in DSSV and any associated parameters in DSSP-DSSP3. If the request involved generation of data, the data is placed in the buffer location indicated by CUDP. A message header at this location defines the length and attributes of the data (see Figure 31 on page 31).

The device then posts value X'01' at DPSSTAT and indicates Status Available to the CU.

The following values are defined for DSSV:

Name	DSSV Value	Description
FCSE	X'02'	Function Complete with Synchronous Error
FC	X'04'	Function Complete
FCIR	X'06'	Function Complete with Input Required
ERFR	X'08'	Error in Function Request
FRA	X'0A'	Function Request Aborted
FCDEF	X'0C'	Function Complete/Status Deferred

Figure 59. Synchronous Completion Status: Undefined values cause interface disconnect.

6.1 FCSE

Function Complete with Synchronous Error (FCSE) indicates request processing was terminated due to the condition designated by the parameter placed in DSSP. The controller also logs an error message as indicated by DSSP2. (See Figure 60.).

Name	DSSV	DSSP	Description		DSSP2	DSSP3
FCSE	X'02'	X'01'	Device Busy		n/a	n/a
FCSE	X'02'	X'02'	Device Error	(6NN)	X'nn'	B'xxxx 0000'
FCSE	X'02'	X'03'	Command Reject	(7NN)	X'nn'	B'xxxx 0000'
FCSE	X'02'	X'04'	Intervention Required (e.g., security key off)		n/a	n/a
FCSE	X'02'	X'05'	Data Check	(6NN)	X'nn'	B'xxxx 0000'
FCSE	X'02'	X'06'	Operation Check	(7NN)	X'nn'	B'xxxx 0000'

Notes:

1. FCSE(BUSY), (DSSP=X'01), may be used to indicate local function busy only if End Busy Support is active.
2. FCSE(IR), (DSSP=X'04'), must be returned to indicate local function busy if End Busy Support is not available.
3. DSSP2, when used, contains the two low-order digits (packed decimal) of the message number 6NN or 7NN. The leading number 6 or 7 is implied by the value in DSSP.
4. The half-byte field xxxx is device dependent and is used for RAS purposes.

Figure 60. FCSE Parameters

This status is not used in SNA because the Device (rather than the CU) is responsible for reporting synchronous errors to the host.

The device displays in DSSP2 internally detected machine and program checks as 6NN and 7NN numbers, respectively. The numbers 601-699 and 701-799 have been reserved for device use.

6.2 FC

Function Complete (FC) is used to report normal synchronous function completion (no errors) and to answer RPID requests (for printer ID).

Name	DSSV	DSSP	Description	DSSP2	DSSP3
FC	X'04'	X'00'	Function Complete (OK)	n/a	n/a
			(Only used to respond to RPID)		
FC	X'04'	X'mm'	FC (Printer Port Address or Port Number)	n/a	n/a
FC	X'04'	X'FE'	FC (Matrix changed but valid assignment possible)	n/a	n/a

Figure 61. FC Parameters

6.3 FCIR

Function Complete with Input Required (FCIR) is used to request a Read Data for host (RDAT) function request by the CU. The device is prepared to accept an RDAT function request.

In NON-SNA attachments, FCIR is used to report normal completion of a WDAT or WLCC function request which contained a Read command. If the FCIR is sent in response to a WLCC function request, then DSSP indicates whether an RDAT function request is required, or if prepared inbound data is already available in the buffer.

Name	DSSV	DSSP*	Description	DSSP2	DSSP3
FCIR	X'06'	X'00'	RDAT must be issued to prepare data.	n/a	n/a
FCIR	X'06'	X'01'	Data is available in the TCA buffer.	n/a	n/a

Note: * DSSP has no meaning in SNA attachments.

Figure 62. FCIR Parameters

For SNA Attachments:

If Enhanced Buffer Management is active

FCIR may **only** be used if:

The length of the response RU does not exceed 64 bytes.

Note: The control unit reads only the first 64 bytes of an RU response via a subsequent RDAT if FCIR is used. The device should interrogate the message length field, (CUFRP3/CUFRP4) of the subsequent RDAT function request.

6.4 ERFR

ERFR indicates that an interface failure was detected. The CU logs a unique 2NN error (machine check) against the CU microcode before disconnecting the device (see "Unrecoverable Errors" on page 100).

The device places a value in DSSP as follows:

Name	DSSV	DSSP	Description	DSSP2	DSSP3
ERFR	X'08'	X'00'	CUAT Invalid/Unsupported	n/a	n/a
ERFR	X'08'	X'01'	CUFRV Invalid/Unsupported	n/a	n/a
ERFR	X'08'	X'02'	CUFRP Invalid/Unsupported	n/a	n/a
ERFR	X'08'	X'03'	CUDP Invalid/Unsupported	n/a	n/a
ERFR	X'08'	X'04'	CUSYN Synchronization Error	n/a	n/a
ERFR	X'08'	X'05'	Reserved		
ERFR	X'08'	X'06'	Flag Error(s) in WDAT Data	n/a	n/a
ERFR	X'08'	X'07-0F'	Reserved		
ERFR	X'08'	X'10-FF'	Device Specific Errors		

Figure 63. ERFR Parameters

6.5 FRA

Function Request Aborted (FRA) is used by the device as a mechanism to cope with contention situations. Generally, it is a means of canceling an asynchronous request because another event of greater significance has occurred. For example, the device generates an AEEP request but responds FRA to the PDAT or RDAT to service it, because the operator pressed the RESET key.

Name	DSSV	DSSP	Description	DSSP2	DSSP3
FRA	X'0A'	n/a	Function Request Aborted	n/a	n/a

Figure 64. FRA Parameters

6.6 FCDEF

When Slow Device option is supported by the controller (see "Slow Device Support/Extended AEDV Status" on page 95), Function Complete Deferred (FCDEF) is valid for Non-SNA attachments only. This completion status is used to report function complete with deferred status while providing availability of the TCA buffer for the processing of other Function Requests which are not directed toward the LT posting the FCDEF status.

Name	DSSV	DSSP	Description	DSSP2	DSSP3
FCDEF	X'0C'	X'00'	Display or Printer with Start Print Bit Not Set	n/a	n/a
FCDEF	X'0C'	X'01'	Printer with Start Print Bit Set.	n/a	n/a

Figure 65. FCDEF Parameters

1. FCDEF can only be returned if data associated with the Function Request indicated EOM.

2. FCDEF cannot be returned if chaining is in effect. For Non-SNA Local Channel, information concerning chaining is provided with the WDAT which carried the EOM data. For BSC, chaining information is not provided (a limitation of the BSC host protocols; non-chaining scenarios must be ensured by convention between the host and the device if FCDEF is to be used).

3. The DSSP associated with FCDEF must be set as follows:

   X'00' = Display, or Printer with Start Print Bit NOT set

   X'01' = Printer with Start Print Bit set (printer only)

4. Once FCDEF has been returned, The device must post AESTAT, AEDV(Offline), or Power Off to insure proper synchronization with the host.

5. FCDEF cannot be returned if an unacknowledged LT specific Asynchronous Request (i.e., an outstanding AEEP that has not been ACK'ed with PDAT) has been posted for that LT.

6. LT specific Asynchronous Requests can not be posted if FCDEF has been returned for the LT and if AESTAT or AEDV(Offline) have not been posted.

If any of the above rules are violated, The device is disconnected by the control unit with a 240 Machine Check.

Flows depicting the use of FCDEF are provided in "Non-SNA Slow Device Capability" on page 103.

6.7 Valid Synchronous Status Responses

	FC	FCIR	ERFR	FRA	FCDEF	FCSE(BUSY)	FCSE(DEVICE ERROR)	FCSE(COMMAND REJECT)	FCSE(INTERV REQUIRED)	FCSE(DATA CHK)	FCSE(OP CHK)
						01	02	03	04	05	06 <----(DSSP)
CNOP	BSL	...	BSL	...	...	...	...	...	...	...	...
WCUS	BSL	...	BSL	...	...	...	...	...	...	...	...
WDAT	BSL	BS.	BSL	...	*B.L	...	B.L	B..	B.L	B.L	B.L
WDBD	BSL	...	BSL	BSL	...	...	...	...	...	...	...
RDCOPY	BSL	...	BSL	...	...	...	...	...	...	...	...
WLCC	..L	..L	BSL	...	...	...	..L	...	...	...	...
LOCK	B.L	...	BSL	...	...	B.L	B.L	...	B.L	...	...
RDAT	BSL	...	BSL	B..	...	...	B.L	...	...	B.L	...
WCTL	BSL	...	BSL	BSL	...	...	...	...	...	...	...
PDAT	BSL	...	BSL	BSL	...	...	...	...	...	...	...
CTCCS	B.L	...	BSL	...	...	...	...	...	...	...	...
RDBD	BSL	...	BSL	BSL	...	...	...	...	...	...	...
RPID	BSL	...	BSL	BSL	...	...	...	...	...	...	...

B = Bisync S = SNA L = NLCA

* = (Valid only with Slow Device Support)
For BSC, only valid after W, E/W, E/WA, EAU or WSF.
For NLCA, valid from a device only if there is no command chaining.

Figure 66. Valid Synchronous Status Responses: Interface disconnection will result from ERFR, FCSE(DEV ERR), or any response not specifically permitted by this table.

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7.0 Asynchronous Status Events

Asynchronous Status Events are initiated by the device placing an event value in DAEV and any associated parameters in DAEP-DAEP4, and then posting a value of X'01' at DPASTAT. The device then indicates Status Available to the CU.

Name	DAEV Value		Description
AEER	X'20'		Asynchronous Error
AEEP	X'22'	[1]	Inbound Event Pending
AEDBA	X'24'	[2]	Data Base Access Needed
AEEB	X'26'	[1]	End IR/Busy
AEDV	X'28'		Device-CU Local Status
AEFREE	X'2A'		Release Printer
AEPID	X'2C'		Request Printer Assignment
AECOPY	X'2E'		Copy Request
AECAN	X'30'		Cancel Copy Request
AEDBS	X'32'	[2]	Request Data Base Store
AESTAT	X'34'		Asynchronous Response to Start Operation

Notes:

[1] Invalid Asynchronous Status request when device is in the Interface Connected state. Results in disconnection of interface.

[2] Invalid Asynchronous Status request when device is in the Online-to-Host state. Results in disconnection of interface.

Figure 67. DAEV Event Values

7.1 AEER

The device displays in DAEP2 internally detected machine and program checks as 6NN and 7NN numbers, respectively. The numbers 601-699 and 701-799 have been reserved for device use. These must be reported to the CU as AEER status. In addition, the four high order bits of DAEP3 are used by the device for RAS purposes. This field is device/controller dependent. Bits 4 through 7 of DAEP3 must be zero. DAEP4 is treated as a device defined (and dependent) error qualifier. Any non-zero value in DAEP4 is stored by the control unit as the most recent error qualifier for potential FRU isolation.

When the device is attached to an SNA controller, AEER status is used to generate Alerts for errors detected by the device. Alert is a Communications Network Management (CNM) function that flows on the SSCP-PU session. AEER status generates a Network Management Vector Transport (NMVT) formatted record for 6NN and 7NN errors only. Alert requires unique controller and host support. The Logical Unit (LT) address must be identified for program checks since they are PLU-SLU session related. Therefore, DALTAD must contain a valid Logical Unit address for 7NN errors.

DAEV	DAEP	AEER Condition	DAEP2	DAEP3	DAEP4	DALTAD
X'20'	X'01'	Temporary Error	(6) X'nn'	B'xxxx 0000'	Qualifier	X'FF'
X'20'	X'02'	Permanent Error	(6) X'nn'	B'xxxx 0000'	Qualifier	X'FF'
X'20'	X'03'	Program Check	(7) X'nn'	B'xxxx 0000'	Qualifier	LT
X'20'	X'04'	Log Only	X'00'	B'xxxx 0000'	X'00'	X'FF'

Notes:

1. DAEP2, when used, contains the two low-order digits (packed decimal) of the error code 6NN or 7NN. The leading number 6 or 7 is implied by the value in DAEP.
2. The half-byte field xxxx is for Device dependent RAS purposes.
3. Permanent Error (DAEP = X'02') disconnects the interface.
4. The Qualifier is stored by the CU if non-zero.

Figure 68. AEER Parameters

7.2 AEEP

Inbound Event Pending (AEEP) is raised when any inbound message is to be forwarded to the host.

DAEV	DAEP	Status Request	DAEP2	DAEP3	DAEP4	DALTAD
X'22'	X'00'	Inbound Event Pending	X'00'	X'00'	X'00'	LT

Figure 69. AEEP Parameters

For Non-SNA attachments:

AEEP is used for "AID" generating keys such as when the operator presses the ENTER key, and for WSF READ Partition operations.

For SNA attachments:

AEEP is typically used to generate inbound requests and responses to be transmitted to the host.

If Enhanced Buffer Management is not supported

AEEP MUST NOT be used to respond to SNA BIND/UNBIND requests. For this case, FCIR MUST be used (see "FCIR" on page 74).

Devices should not post an AID to the CU if a Communications Check Reminder - WCUS(30), has been posted but not cleared with WCUS(31) - No Reminder.

7.3 AEDBA

Asynchronous Data Base Access (AEDBA) is used to IML (Initial Microcode Load) a downstream-load device and to perform other Data Base requests. The CU is expected to access the IML data base by performing the request as indicated in the parameters associated with AEDBA.

If the data base access is unsuccessful, the CU issues WCUS(70) Disk Error, or WCUS(71) File Error, or WCUS(60) Disk Not Ready. A Disk Reminder may or may not have been previously issued. See "Down Stream Loading" on page 121 for specific error conditions.

AEDBA asynchronous status can only be presented by the device when it is in the Interface-Connected state (offline from host); otherwise, the controller will disconnect the device.

DAEV	DAEP	DAEP2	AEDBA Request	DAEP3	DAEP4	DALTAD
X'24'	X'xx'	X'00'	Normal Read/Only Access	X'yy'	X'00'	X'FF'
X'24'	X'xx'	X'80'	Read (write required)	X'yy'	X'00'	X'FF'

Note:

DAEP = X'xx'		This value identifies the Data Base File. A subsequent WDBD results in the data transfer of the indicated data entity.
DAEP2 =	0...	Normal access (Read only) transaction
	1...	Read with requirement to Write (update) file on disk. Once initiated, the transaction must be completed. The CU puts a Read/Write Lock on the disk file to other devices until the transaction is completed.
	.000 0000	Reserved bits (1-7), must be zero.
DAEP3 = X'yy'		Diskette Type

Figure 70. AEDBA Parameters

7.4 AEEB (Non-SNA Only)

AEEB is used to report END IR or END BUSY (when Extended End Busy Support is present) if either IR or BUSY, respectively, had been previously reported on an FCSE completion or if IR is reported via an AESTAT asynchronous status event. AEEB(End Busy) is sent to clear FCSE(BUSY) only if FCSE(BUSY) was posted outside of an AEEP.

This request is considered global (multi-Logical Terminals). The device is responsible for determining which LTs owe the host Device End status.

The parameters associated with AEEB are as follows:

DAEV	DAEP	AEEB Status Request	DAEP2	DAEP3	DAEP4	DALTAD
X'26'	X'01'	END IR	LT Bit Map	X'00'	X'00'	X'FF'
X'26'	X'02'	END BUSY	LT Bit Map	X'00'	X'00'	X'FF'

Note:

DAEP2 = LT Bit Map	Indicates which on-line LTs owe the host a Device End based on either FCSE(IR), AESTAT(IR), or FCSE(BUSY) being returned. All zeros is invalid.

Figure 71. AEEB Parameters

DAEP2 Bit	0	1	2	3	4	5	6	7
	CULTA1	CULTA2	CULTA3	CULTA4	CULTA5	0	0	0

Figure 72. AEEB LT Bit-Map DAEP2

```
Host                   Control Unit         Device

                            .
                            .
                            .

SELECT --------------->
                       LOCK ------------------->
                       <----------------------- FCSE(BUSY)
<--------------------- Device Busy
                            .
                            .
                            .
                       <----------------------- AEEB(End Busy)
<--------------------- Device Busy Clear
SELECT --------------->
                       LOCK ------------------->
                            <------------------ FC
                            .
                            .
                            .
```

Figure 73. GENERALIZED FLOW: FCSE(BUSY) AND AEEP NOT PENDING (Extended End Busy Support present)

7.5 AEDV

The Device-CU Local Status (AEDV) is sent to the CU to request that Logical Terminals be taken offline or put online to the host and to indicate Dump Complete. Parameter values indicate the functions to be performed:

DAEV	DAEP	AEDV Status Request	DAEP2	DAEP3	DAEP4	DALTAD
X'28'	X'01'	AEDV(Online)	Bit Map	(note)	X'00'	X'FF'
X'28'	X'02'	AEDV(Offline)	(note)	X'00'	X'00'	X'FF'
X'28'	X'03'	AEDV(Dump Complete)	X'00'	X'00'	X'00'	X'FF'

Note: For details of this parameter, see "AEDV(Online)" on page 84 or "AEDV(Offline)" on page 84.

Figure 74. AEDV Parameters

7.5.1 AEDV(Online)

This form of AEDV Asynchronous Status is used by the device to request that one or more of its Logical Terminals be put online to the host. When a device requests online to a controller, DAEP2 contains an ordered bit map corresponding to CULTA1-5 which reflects the Logical Terminals that are requesting online status. (See "Control Unit Initialization" on page 35.)

```
DAEP2 Bit 0.......1.......2.......3.......4.......5.......6.......7
          |       |       |       |       |       |       |       |
       CULTA1  CULTA2  CULTA3  CULTA4  CULTA5     0       0       0
```

Figure 75. AEDV On-Line LT Bit-Map DAEP2: Each bit set to "one" in the bit map represents a request to the controller to put that Logical Terminal online to the host.

The controller must be capable of processing multiple Logical Terminal power on requests in the same AEDV status.

The device cannot request a Logical Terminal to be put online if the associated CULTA field has not been initialized with a valid address. Any attempt by the host to communicate with a valid Logical Terminal address which has not requested online status is treated by the control unit as communication to a powered off device.

When Slow Device Support/Extended AEDV Status is active, AEDV(Online) requires a second parameter (DAEP3) which contains an ordered bit map corresponding to DAEP2 indicating whether a Logical Terminal has display-like or printer-like characteristics. A bit in DAEP3 is checked by the controller if the corresponding bit in DAEP2 is set to "one" (requesting online status). The bit is ignored if the corresponding bit in DAEP2 is zero.

```
DAEP3 Bit 0.......1.......2.......3.......4.......5.......6.......7
          |       |       |       |       |       |       |       |
          x       x       x       x       x       0       0       0
                                                (---Reserved Bits---)

     where x equals:      0 = Display-like characteristics
                          1 = Printer-like characteristics
```

Figure 76. AEDV(Online) LT Bit-Map DAEP3: Describes the type of terminal to be brought online.

A device may not request a change from display to printer characteristics for a Logical Terminal without first requesting that the Logical Terminal be taken offline.

DAEV	DAEP	CUSLVL (Support Level)	DAEP2	DAEP3	DAEP4	DALTAD
X'28'	X'01'	Bit F=0 (Base Support)	Bit Map	X'00'	X'00'	X'FF'
X'28'	X'01'	Bit F=1 (Slow Device)*	Bit Map	Bit Map	X'00'	X'FF'

Figure 77. AEDV(Online) Parameters
* See "Slow Device Support/Extended AEDV Status" on page 95.

7.5.2 AEDV(Offline)

This form of AEDV Asynchronous Status is used by the device to request that all of its online Logical Terminals be taken offline from the host. The DAEP2 parameter must equal

zero. At least one Logical Terminal must be online for this request to be valid. This is equivalent to the physical device being powered off to the host.

When the controller supports the Slow Device option (see "Slow Device Support/Extended AEDV Status" on page 95), if DAEP2 is non-zero, it must contain an ordered bit map corresponding to CULTA1-5 reflecting the Logical Terminals that are being taken offline:

```
DAEP2 Bit 0.......1.......2.......3.......4.......5.......6.......7
          |       |       |       |       |       |       |       |
       CULTA1  CULTA2  CULTA3  CULTA4  CULTA5     0       0       0
                                               (---Reserved Bits---)
```

Figure 78. AEDV Off-Line LT Bit-Map DAEP2

A bit set to "one" in the bit map represents a request to the controller to take the Logical Terminal it represents offline from the host. It is equivalent to a power off to the host. The controller must be capable of processing multiple Logical Terminal power off requests in the same AEDV status.

The Logical Terminals whose bits are zero in the above byte remain in an unchanged state. If they were online to the host, they remain online. If they were offline, they remain offline. It is a violation of the interface for a Logical Terminal that is already offline to have its bit set in an AEDV(Offline) request.

DAEV	DAEP	CUSLVL (Support Level)	DAEP2	DAEP3	DAEP4	DALTAD
X'28'	X'02'	Bit F=0 (Base Support)	X'00'	X'00'	X'00'	X'FF'
X'28'	X'02'	Bit F=1 (Slow Device)*	Bit Map	X'00'	X'00'	X'FF'

Figure 79. AEDV(Offline) Parameters
* See "Slow Device Support/Extended AEDV Status" on page 95.

7.5.3 AEDV(Dump Complete)

This form of AEDV Asynchronous Status is used by the device to indicate that it has completed the transmission of a dump to the controller. It is only valid when used to terminate a dump operation that was initiated by the controller via a Diagnostic Reset command.

DAEV	DAEP	Asynchronous Request	DAEP2	DAEP3	DAEP4	DALTAD
X'28'	X'03'	AEDV(Dump Complete)	X'00'	X'00'	X'00'	X'FF'

Figure 80. AEDV(Dump Complete) Parameters

7.6 AEFREE (SNA only)

AEFREE is a device request for printer release from Local Copy Hold. This is allowed only when a printer previously held for Local Copy is to be released without requesting AECOPY (see "Printer Hold (SNA only)" on page 128 or "AECOPY" on page 86.)

Printer Release (without AEFREE request) is forced by Activate Logical Unit (ACTLU), Deactivate Logical Unit (DACTLU), and UNBIND if the printer is in Hold state.

AEFREE is sent only when all Logical Units are finished with the copy hold.

An out of sequence AEFREE is responded to with WCUS(5A) if local copy is not configured.

DAEV	DAEP	AEFREE Status Request	DAEP2	DAEP3	DAEP4	DALTAD
X'2A'	X'00'	Release Local Copy Device	X'00'	X'00'	X'00'	X'FF'

Figure 81. AEFREE Parameters

7.7 AEPID

AEPID is a device request for printer assignment (see "Print ID Sequence" on page 124). An out of sequence AEPID is responded to with WCUS(5A) if local copy is not configured.

DAEV	DAEP	AEPID Status Request	DAEP2	DAEP3	DAEP4	DALTAD
X'2C'	X'00'	Printer Assignment Request	X'00'	X'00'	X'00'	X'FF'

Figure 82. AEPID Parameters

7.8 AECOPY

AECOPY is a device request for Local Copy. The copy request is classified by the value of DAEP as to operator initiated and host initiated requests:

DAEV	DAEP	Request for local copy	DAEP2	DAEP3	DAEP4	DALTAD
X'2E'	X'00'	Initiated by Operator	X'00'	X'00'	X'00'	X'FF'
X'2E'	X'01'	Host Initiated	X'00'	X'00'	X'00'	X'FF'

Figure 83. AECOPY Parameters

An out of sequence AECOPY is responded to with WCUS(5A) if local copy is not configured. (See "COPY Sequence" on page 124.)

7.9 AECAN

AECAN is a device request to cancel a queued local copy request. An out of sequence AECAN is responded to with WCUS(5A) if local copy is not configured. (See "Device Cancel" on page 137.)

DAEV	DAEP	Asynchronous Request	DAEP2	DAEP3	DAEP4	DALTAD
X'30'	X'00'	Cancel Queued Copy Request	X'00'	X'00'	X'00'	X'FF'

Figure 84. AECAN Parameters

7.10 AEDBS

A Data Base Store operation is requested by AEDBS. The one byte parameter DAEP specifies the file (item name) to be modified. The AEDBS asynchronous status can only be presented by the device when it is in the Interface-Connected State (Offline from Host); otherwise, the controller disconnects the device. An AEDBS is followed by a RDBD (Request for Data Base Data) from the CU.

DAEV	DAEP	AEDBS Asynchronous Request	DAEP2	DAEP3	DAEP4	DALTAD
X'32'	X'xx'	Data Base Store Operation	X'00'	X'00'	X'00'	X'FF'

Note: DAEP xx = represents the file to be modified

Figure 85. AEDBS Parameters

7.11 AESTAT (Non-SNA Only)

When the Slow Device option is supported by the controller, Asynchronous Response to Start Operation (AESTAT) is used to report asynchronous function complete. (See "TCA Buffer Format" on page 27.)

The rules which apply to the use of AESTAT are as follows:

1. AESTAT is only valid when the reporting LT (specified by the DALTAD) has previously posted FCDEF.

2. The parameters associated with the AESTAT can indicate normal or abnormal completion as depicted in the following figure.

DAEV	DAEP	Asynchronous Status	DAEP2	DAEP3	DAEP4	DALTAD
X'34'	X'00'	Good Completion	X'00'	X'00'	X'00'	LT
X'34'	X'02'	Device Error	(6) X'nn'	B'xxxx 0000'	X'00'	LT
X'34'	X'03'	Command Reject	(6) X'nn'	B'xxxx 0000'	X'00'	LT
X'34'	X'04'	Intervention Required	X'00'	X'00'	X'00'	LT
X'34'	X'05'	Data Check	(6) X'nn'	B'xxxx 0000'	X'00'	LT
X'34'	X'06'	Operation Check	(7) X'nn'	B'xxxx 0000'	X'00'	LT

Note:

a. DAEP2, when non-zero, contains the two low-order digits (packed decimal) of the message number 6NN or 7NN. The leading number 6 or 7 is implied by the value in DAEP.

b. The information provided for DAEP values X'02', X'03', X'05', and X'06' must follow the same guidelines as the corresponding values for FCSE (see "FCSE" on page 73).

c. The half-byte field xxxx is used for device dependent RAS purposes.

Figure 86. AESTAT parameters

3. Restrictions on the use of each parameter value apply and must be followed. The figure below outlines the restrictions.

Configuration/ FCDEF response	DAEP Value X'00'	X'02'	X'03'	X'04'	X'05'	X'06'
NLCA/FCDEF(00)	X	X	-	X	X	X
NLCA/FCDEF(01)	X	X	-	X	X	X
BSC/FCDEF(00) No WACK support	X	X	-	X	-	-
BSC/FCDEF(01) No WACK support	X	X	-	X	X	-
BSC/FCDEF(00) WACK support	X	X	X	X	X	X
BSC/FCDEF(01) WACK support	X	X	-	X	X	-

Key X = allowed
- = not allowed

Note: BSC indicates WACK or No WACK support. This is directly related to the HOST protocols to which the controller must adhere.

Figure 87. AESTAT Restrictions

If any of the above rules are violated, the device is disconnected by the control unit with a 240 Machine Check.

Flows depicting the use of AESTAT are provided in section "Non-SNA Slow Device Capability" on page 103.

8.0 Expedited Status Requests

The expedited status communication area of the TCA contains several contiguous fields. Expedited Status (ES) provides a device timer interval interrupt to the control unit which measures elapsed time for a Start Operation (function request) in progress. ES requests also service the RTM (Response Time Monitor) start/stop timer function and can be used to determine if the CU is active.

Expedited Status is initiated by the device setting the Logical Terminal address in EXFLT, the Expedited Status function request in EXFRQ, any parameters in EXFP1-4 and then posting status available (X'01') at EXFAK. The control unit responds to Expedited Status by writing any response parameters into EXFD1-4 and setting EXFAK to the value X'00' (Acknowledge). The CU's acknowledgment is completed by a Read Terminal ID command. The CU must not issue a function request as part of the response to Expedited Status.

EXFRQ Value	Description
X'02'	Device Busy Timer Interval
X'04'	Start RTM Timer
X'06'	Stop RTM Timer
Other Values are	Reserved

Figure 88. ES Function Requests

8.1 Device Busy Timing Interval

All function requests are timed by the controller for hung device detection. If the controller does not receive Expedited Status from the device within .75 seconds, the device is disconnected with a Machine Check 207 error code for device timing mode. The device must report busy status or synchronous completion status within this interval (see "Process Timings" on page 98). Device timing begins at receipt of the function request. EXFLT is set to X'FF' to indicate a physical device level function.

In the idle state the device may use the Device Busy Timer Interval function request as a NO-OP to detect whether or not the control unit is active. See "CU Active" on page 97.

8.2 Response Time Monitor

The control unit Response Time Monitor is a mechanism whereby end-to-end user response time can be measured depending on a definition dictated by the controller customizing process or, in certain cases, an application in the host. Response times for each Logical Terminal are measured and maintained in the controller. However, since each device processes its own data stream, it must also implement some of the RTM function.

Response time is measured on a Logical Terminal basis. Default parameters are established during the controller customizing process for all Logical Terminals and may be updated through the host interface for each Logical Terminal. Upon receipt of an AEDV(Online) request (assuming the controller supports RTM) the CU sends a WCUS(42) for each active Logical Terminal. The WCUS(42) notifies the device whether the RTM interface is enabled or disabled (see "WCUS(42) - RTM Control" on page 51). WCUS(42) also notifies the device whether or not the operator is authorized to view the Last Transaction Time indicator. For those devices that support the controller RAS tests, this authority also pertains to the operator's ability to view the RTM logs for all devices on the cluster.

Response time is defined as the time interval from the beginning of an Attention ID (AID) host operation (e.g., ENTER key) to receipt of a resulting data stream (processed by the device) that satisfies the RTM STOP definition. However, an abnormal condition could cause an ABORT of the RTM transaction timing. (An accurate description of the RTM STOP

definitions and ABORT conditions may be found in the RTM Final Functional Specification.) The CU (or the host) provides the device with the appropriate RTM definition, the device notifies the CU when to START and STOP (or ABORT) the RTM transaction timing, and the CU passes the resulting time interval back to the device when appropriate.

The device may initiate an RTM transaction via the Start RTM Timer Expedited Status request only when the RTM interface is enabled for that Logical Terminal. The proper (current) RTM definition is supplied by the CU in response to Start RTM Timer request. The RTM definition remains in effect throughout the RTM transaction. The RTM transaction ends when:

1. The appropriate STOP condition is met (detected by the device),
2. An Abort condition is detected and reported by the device,
3. An Abort condition is detected and reported by the CU,
4. The Logical Terminal disconnects,
5. The device interface is disconnected (e.g., the device powers off)

The device must not issue either a Start RTM Timer or Stop RTM Timer expedited status request if the controller has not sent a WCUS(42) indicating that RTM is supported on the controller. The improper issuance of a Start or Stop RTM Timer request by the device is interpreted by the controller as an interface error and results in the device being disconnected from the interface.

8.2.1 Start RTM Timer (X'04')

The Start RTM Timer expedited status request is associated with initiating an inbound host event (AID). When an LT (which is in the Online-to-Host state) begins an inbound operation (e.g.,pressing an ENTER key or other AID operation) and that Logical Terminal has RTM enabled as indicated by the controller, the device must indicate this start condition to the controller via a Start RTM Timer request (EXFRQ = X'04') with the Logical Terminal address in EXFLT.

The controller acknowledges the Start RTM Timer expedited status request with the following response parameters at EXFD1 and EXFD2:

EXFD1 Value	Description
X'00'	RTM Interface Disabled for this Logical Terminal
X'01'	Time to First Character
X'02'	Time to Keyboard Available
X'03'	Time to Change Direction/End Bracket (valid for SNA attachment only)
X'04-FF'	Reserved values

EXFD2 Value	Description
X'00'	Last Transaction Time NOT Authorized
X'01'	Last Transaction Time Authorized
X'02-FF'	Reserved values

Figure 89. Start RTM Timer Response Parameters

The RTM transaction is considered active if the CU responds to Start RTM Timer request with a non-zero RTM definition. Conversely, the RTM transaction is considered not active or not started if the CU's response is EXFD1 = X'00' (RTM disabled).

The device must not issue a Start RTM Timer request for a Logical Terminal with an outstanding active RTM transaction. This is a violation of the RTM interface.

If the CU responds RTM Disabled to the Start RTM Timer request, the device must not issue either Start RTM Timer or Stop RTM Timer requests until notified that RTM is enabled via WCUS(42) (see "WCUS(42) - RTM Control" on page 51.)

If the RTM hardware becomes non-functional, the controller reports this to the device via a WCUS(01) 382 Machine Check. The device must not issue a Start RTM Timer request for any Logical Terminal. If a Start RTM Timer request is received, the Logical Terminal is notified that RTM is disabled. A subsequent Start RTM Timer request from that same Logical Terminal (with RTM disabled) violates this interface and may cause the CU to disconnect.

8.2.2 Stop RTM Timer (X'06')

When the device detects that an appropriate RTM Stop or Abort condition for an active RTM transaction has occurred, it notifies the CU with the Stop RTM Timer expedited status request X'06' in EXFRQ with the Logical Terminal address in EXFLT and one of the following values in EXFP1:

EXFP1 Value	Description
X'00'	Stop timer for this Logical Terminal and record time.
X'01'	Abort timer for this Logical Terminal. Do not record the time in the RTM log.
X'02-FF'	Reserved values

Figure 90. Stop RTM Timer Request Parameters

The controller acknowledges the Expedited Status by placing a 16 bit unsigned value in EXFD1/EXFD2 which represents the Last Transaction Time in 25 millisecond increments. In addition, the following is placed in EXFD3:

EXFD3 Value	Description
X'00'	Valid Last Transaction Time
X'01'	Invalid Last Transaction Time (for example, Abort or RTM hardware problem in controller)
X'02-FF'	Reserved values

Figure 91. Stop RTM Timer Response Parameters

The RTM transaction ends (or becomes non-active) with the CU's acknowledgment of the Stop RTM Timer request.

The device must end each active RTM transaction with Stop RTM Timer expedited status (for the proper Logical Terminal) unless the Logical Terminal is disconnected or the device is powered off. In this case, the controller terminates the outstanding RTM transaction(s).

The device is responsible for detecting and reporting all Abort conditions to the controller, except when the Logical Terminal is disconnected or the RTM hardware becomes non-functional.

The device must not request Stop RTM Timer expedited status unless an RTM transaction is active for that Logical Terminal. The device must only return one Stop RTM Timer request for each outstanding Start RTM Timer request, and must not issue multiple Start requests for a given Logical Terminal. Any violation of this rule causes the controller to disconnect the interface.

Note: The last transaction time is included in the controller response regardless of whether or not the operator is authorized to view it.

If the device is notified that the RTM hardware is non-functional (via WCUS(01) 382 Machine Check), the RTM transaction is considered aborted by the CU. If the device issues a Stop RTM Timer request, the CU responds with an Invalid Last Transaction Time (denoted by EXFD3 = X'01').

Examples of the RTM flow follow.

```
                Control Unit                          Device

                   <------------------------------------- AEDV(Online)
              ACK  ------------------------------------->
                                   •
                                   •
         WCUS(42)  ------------------------------------->
           RTM enabled/LTT display enabled
                   <------------------------------------- FC
                                   •
                                   •
                   <------------------------------------- ES (START RTM)
RTM Definition/LTT
display enabled    ------------------------------------->
                                   •
                                   •
         WCUS(42)  ------------------------------------->
           RTM enabled/LTT display disabled
                   <------------------------------------- FC
                                   •
                                   •
                   <------------------------------------- ES (STOP RTM)
 LAST TRANSACTION
  TIME (time valid)------------------------------------->
```

Note: The last transaction time is not displayed by the device in this case, since the last notification was that LTT display was disabled.

The Expedited Status request illustrated below, flows on a higher priority than the Synchronous Status function request, WCUS(42). Therefore, the CU must respond to either the STOP or ABORT after the RTM interface is disabled in this manner.

```
                   <------------------------------------- ES (START RTM)
RTM Definition/LTT
display enabled    ------------------------------------->
                                   •
                                   •
         WCUS(42)  ------------------------------------->
     RTM disabled
                   <------------------------------------- FC
                                   •
                                   •
                   <------------------------------------- ES (STOP RTM,
                                                              or ABORT)
 LTT not valid     ------------------------------------->
```

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9.0 Controller TCA Support Level

CUSLVL is set by the controller prior to WCUS(10) CU READY time to reflect the optional functions which it supports. Devices must not use optional features which are not supported by the CU because this may cause an interface synchronization check and the device may be disconnected with a 240 Machine Check. For layout of CUSLVL bits, see Note 4 following Figure 30 on page 28.

9.1 Base TCA Support Level

CUSLVL is a 16 bit field that indicates whether an option is supported by the control unit. Each option is bit significant within the 16 bit field. Bits without assigned options are reserved and must = B'0'. A value of X'0000' in CUSLVL indicates that the controller does not support any options. Each bit in the field, designated as bit 0 - F, when set to B'1' indicates a particular option is supported as follows:

9.2 Slow Device Support/Extended AEDV Status

CUSLVL bit F indicates the controller supports Slow Device for non-SNA attachments. (See "Non-SNA Slow Device Capability" on page 103 for detailed description.) Also, with Slow Device active, the controller supports extended AEDV status as outlined in "AEDV(Online)" on page 84 and "AEDV(Offline)" on page 84.

9.3 Device Initiated UNBIND Support

CUSLVL bit C indicates that the controller supports receipt of a device initiated UNBIND.

9.4 Enhanced Buffer Management Support

CUSLVL bit B indicates that the controller supports Enhanced TCA Buffer Management.

This option provides a flag field associated with the LOCK function request (applicable to non-SNA attachments) indicating whether or not prepared inbound data (to the host) in the TCA buffer has been overlaid by outbound data functions.

9.5 AEEB Extension for End Busy Support

CUSLVL bit A indicates that the controller supports synchronous status response of FCSE(BUSY) to a LOCK request occurring outside of an AEEP sequence, e.g., to indicate a local function busy condition, etc. The device is subsequently required to create an AEEB(END BUSY) asynchronous status event to inform the host that the Busy condition has ended.

If AEEB End Busy is not active, the device must respond FCSE(IR) to a LOCK request occurring outside of an AEEP sequence should a local function busy condition exist.

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10.0 RAS Considerations

A portion of device control is involved with verification that the interface, the device, and the CU are functional. These considerations are discussed in the following sections.

CU detected errors are conveyed to affected TCA devices via WCUS function request or the CUDSER. Device detected errors may be passed to the CU via AEER or FCSE.

Error Codes fall into these categories:

0NN & 1NN Codes - Reserved
2NN Error Codes - Device or Device Cluster Adapter Errors detected by the control unit

3NN Error Codes - Controller Errors Detected by the Controller

4NN Error Codes - Application Program Checks detected by the control unit

5NN Error Codes - Communication Line or Channel Errors detected by the control unit

6NN Error Codes - TCA Device Detected Hardware/Microcode Errors

7NN Error Codes - TCA Device Detected Data Stream or Application Program Checks

8NN Error Codes - Reserved

9NN Error Codes - Reserved

Figure 92. Error Codes

More information about these error codes may be found in the control unit and/or specific device specifications.

10.1 CU Active

While the CU is active, it periodically POLLs the device. If the device detects an absence of polling or other line activity for a sustained period of time, it assumes the CU is inactive.

A CU could be polling, but not otherwise functional. The device can detect this by periodically presenting Expedited Status. If the Expedited Status request is not acknowledged within 10 seconds, the CU is not functional. The device must not present Expedited Status for the purpose of soliciting a CU response more frequently than once every 30 seconds.

10.2 Device Active

If the device is idle and cannot honor any function requests, then it must not answer or acknowledge POLLs. The CU treats the device as powered off during this period of time, and may notify the host of the condition. The device must exit the powered off state by responding to POLL with the POR response. Power off/Power on transitions must not occur more frequently than once every 5 seconds.

If the CU issues a function request to the device and the device does not report back with either FC or Expedited Status (See "Device Busy Timing Interval" on page 89) within .75

seconds, the CU assumes the device is malfunctioning and terminates all further communication with the device (except POLLing) until a POR is received. During the disconnect sequence, the controller attempts to write machine check status into CUDSER. Expedited Status maintains the active (busy) state while the Synchronous Status indicates Function Complete, X'04' at DSSV.

10.3 Process Timings

There are two types of timeout requirements for Controller/Device Communications:

- Device Response Timing
- Host Transaction Timing.

Both types of timing are performed by the device and are reported to the controller via Expedited Status (ES).

EXTIME indicates which type of timing the device is to execute. The default state of this field, X'00', indicates Device Response timing only. Host Transaction timing in addition to Device Response timing occurs only when EXTIME, is set to X'01'.

Device Response timing mode requires the device to report Expedited Status - Device Busy every .375 to .75 seconds from the issuance of a synchronous function request until the device reports synchronous status for the corresponding function request. This requirement is independent of whether the device is online to or offline from the host and is applicable for all function requests. Control unit implementations may always enforce Device Timing mode or optionally couple such enforcement to the conservation of vital resources within the control unit. That is, Device Timing mode may be enforced only when critical controller resources (elements, which if restricted, result in the degradation of the controller's throughput capability) are retained by the device. Examples of such elements include: inbound/outbound host buffers, the host link, local printers, etc. When enforced, a minimum of 8 ES Timer Interrupts must be accommodated by the control unit. Whether or not Device Timing mode is being enforced, devices are required to present ES Timer Interrupts at least every .75 seconds during the execution of a synchronous function request. It is recommended that all device implementations be structured such that synchronous status can be returned for all synchronous function requests in less than a second, independent of Device Response timing enforcement or specific controller attachment. The ability to respond within the established controller limits may depend on the number of messages associated with a particular function request, the size of messages, and the number of functions supported. If the device times out, the interface is disconnected with a 207 Machine Check (device response timing mode timeout).

During Host Transaction timing, the device must report ES - Device Busy every .375 to .75 seconds until the Host Transaction timing field, EXTIME, is reset to X'00', independent of function requests and device states. The control unit initiates Host Transaction timing by setting the Host Transaction timing field, EXTIME, to X'01'. A device should check for a change in EXTIME on each START OP and RTID command. A maximum of 9 ES Timer Interrupts may be presented by the device. If the device times out, the interface is disconnected with a 243 Machine Check (host timing mode timeout) and appears powered off to the host. Host Transaction timing is not invoked in SNA attachment environments.

The following figure depicts possible process timing situations where enforcement of Device Response Timing is dependent on the utilization of vital controller resource elements.

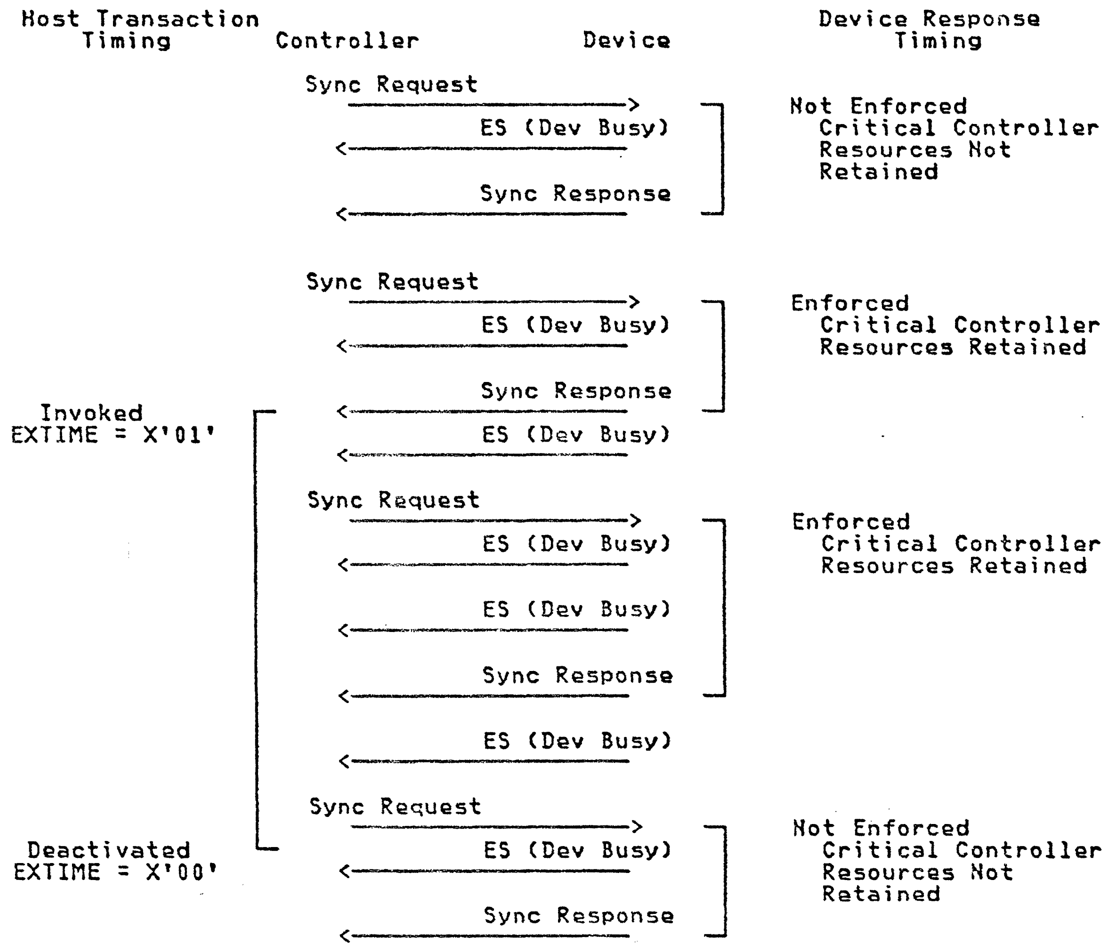

Figure 93. Example of Process Timing Scenarios

10.4 Error Events

The Device must report errors as asynchronous events. The frequency of reporting hardware errors must be limited to avoid overrunning the CU. If an error or error sequence is occurring repeatedly, it must not be reported on each occurrence unless manual intervention (such as an operator depressing a RESET key), a new host transmission, or a delay of at least 1 second occurs.See "FCSE" on page 73 and "AEER" on page 79 for a description of the mechanism for reporting such errors.

10.4.1 Error Event Logging

The Device must report each error to the control unit for maintenance statistics when the error occurs (under the constraints defined in the preceding paragraph). The CU maintains

report summary counters for host program errors, transient hardware errors, and permanent hardware errors regardless of whether or not the device is powered on.

Devices are not required to report disk access errors (630, 632, 633, 635, or 636) to the controller. If they are sent by the device, the controller logs them but does not generate an Alert because these codes are either generated as the result of a 3NN code sent to the device from the controller or are considered a non-error condition such as "disk not ready" (see "Down Stream Loading" on page 121).

10.4.2 Line Error Recovery

A transmission error from the CU to the device is detected by the device hardware which must then ignore that transmission and inhibit the Transmission Turnaround/Auto Response (TT/AR). When the control unit does not get the TT/AR, it stops immediately and goes into error recovery state.

If the error occurs on the transmission from the device to the CU (TT/AR) error on parity error), the CU stops and goes into error recovery state.

10.4.2.1 Retry of Non Start-Operation

When a string of command and data transmissions fails, the control unit attempts recovery by retrying the operation. This is possible due to the design of the device adapter and control unit which prevents any invalid commands or data from being processed or stored into the device's memory.

10.4.2.2 Retry of the Start-Operation

The recovery from a transmission containing a Start Operation command is similar to the above but has several implications which must be understood. There are four different error states which are possible as the result of a Start Operation command failure.

1. The Start Operation command was lost on the transmission from the CU to the device. In this case when the command is reissued by the CU, the device processes it normally.

2. The Start Operation command was received by the device but the TT/AR response was lost on the device to CU transmission. In this case the device is presented with an interrupt and the CU attempts recovery by resending the Start Operation command.

   a. The device may not yet have started to process the first Start Operation command. In this case the device must NO-OP the second Start Operation command and no problems arise.

   b. The device has started to process the function request specified by the Start Operation command but has not completed processing the request. The device-CU hand-shaking protocol allows the device to recognize the second Start Operation command as a duplicate and ignore it.

   c. The device has completed processing the function request, has posted the completion (synchronous) status, but the CU has not yet processed the completion status. Since the Synchronous Status has not been acknowledged by the CU, the device must also recognize and ignore the second Start Operation command.

10.4.2.3 Unrecoverable Errors

In the event that the CU receives invalid device status, the CU initiates the device disconnect action of posting a non-zero error code (the value of which is the machine check indicator to be displayed) at CUDSER and issuing a Start Operation command. The device must test CUDSER for a non-zero value with the receipt of each Start Operation command. Certain device errors cause device disconnect without the posting of a non-zero value at

CUDSER. The device is only re-connected when it returns a POR response. Retry and synchronization states described below are **not** applicable.

10.4.2.4 Detection of Synchronization Errors

It is essential that the CU and the device be able to maintain synchronization over the line interface at all times. This interface is controlled via CU commands and by status bytes in the device buffer.

Every time a new function request is made, CUSYN must be toggled between X'01' and X'00'. The device must interpret the toggled value of CUSYN when a new function request is made, as the acknowledgement of the previous Synchronous Status.

Command queue retry causes a Start Operation command to be issued multiple times, but CUSYN is not changed. This allows the device to ignore the additional Start Operation command(s) if the first one was actually received.

If CUSYN is toggled, but the device is still processing a function request when a second Start Operation command is issued, the device must report a fatal synchronization error to the CU with ERFR(IR). The controller then puts the device into the Interface Disconnected state.

At power-on time, the device must set CUSYN to X'00'. The device expects the first function request from the CU to set CUSYN to X'01'. The CU maintains the value of CUSYN to avoid reading it from the device buffer prior to each Start Operation command.

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11.0 Non-SNA Slow Device Capability

Note: In subsequent discussions, the 3274 control unit supports the following subset implementations:

a. NLCA Environments

- FCDEF(00)

  Display on Printer with Start Print Bit Not Set

- FCDEF(01)

  Printer with Start Print Bit Set

b. BSC Environments

- FCDEF(01)

  Printer with Start Print Bit Set

The TCA interface is comprised of multiple functions, both LT and non-LT specific. The common vehicle for communicating with the device is the synchronous function request mechanism. As the architecture is currently defined, this mechanism is serial. The ability to process a synchronous request is dependent on the device's ability to return synchronous status. For a particular class of devices, there could be an extended period of elapsed time between initiation of a synchronous event and its subsequent completion. Depending on the operating environment, such "slow" devices have the following impacts on the subsystem:

1. Controller resources used to manage the LT and non-LT specific function could be severely restricted, thus reducing the controller's ability to process requests for the entire subsystem.

2. The response time for other logical terminals within the same physical device could become intolerable.

In such an environment, the optimum situation is to permit other logical terminals within the same physical device to communicate with the controller/host while the "slow" LT is still processing. Therefore, the "slow" LT must be able to relinquish TCA buffer ownership before the data has been totally processed. Thus the emergence of the slow-device capability.

What follows are a set of major points and flow examples addressing the extent of support for slow devices.

- The non-SNA slow device function is optionally supported on the controller as indicated by CUSLVL Bit F being set to'1' during device initialization (see "TCA Buffer Format" on page 27).

- If a device can process and validate the data stream as fast as it can move it out of the TCA buffer, then the device should post FC/FCSE completion status. If, however, the device can merely move the data out of the TCA buffer (and validate the data in certain BSC environments) within the timeout period permitted by the control unit but requires a substantial amount of additional time (in excess of the timeout period permitted by the control unit) to complete processing of the data stream, then the device should use the slow device support and post Function Complete/Status Deferred (FCDEF) completion status. Posting FCDEF status signifies that the TCA buffer is available, but the corresponding logical terminal is still busy until AESTAT is returned. This permits both the controller and the device to multiplex the processing of data for other logical terminals.

- One of two specific types of FCDEF status, FCDEF(00) and FCDEF(01), may be posted by the slow device depending on the particular conditions at the device. This designation by the device is a necessary part of the slow device support. Specific status handling (control unit to host) differs for printers with the start print bit set

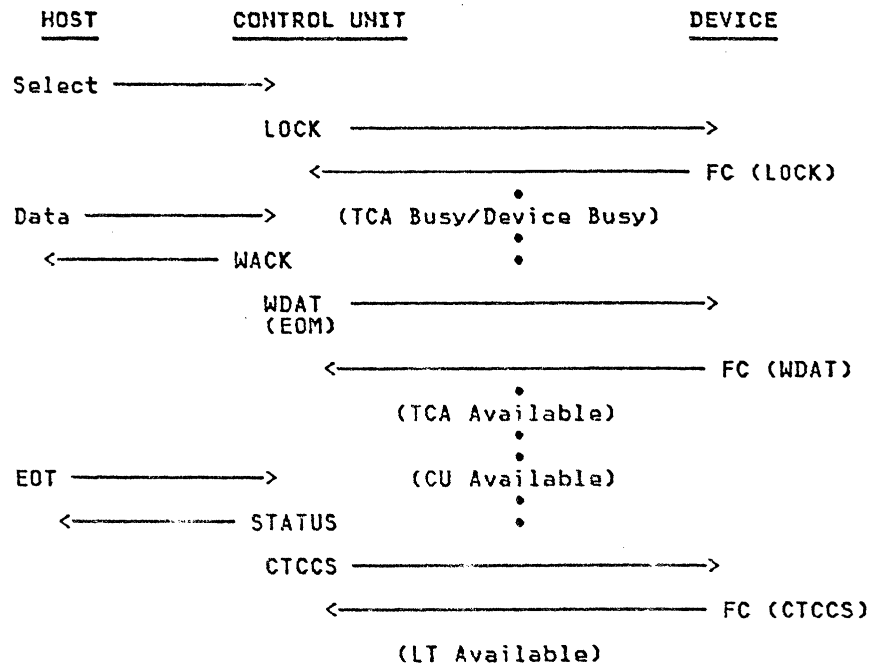
(FCDEF(DSSP=01)) as opposed to displays or printers with the start print bit not set (FCDEF(DSSP=00)).

- If the device is attached via BSC protocols, the requirement to validate the data before responding FCDEF is dependent on the type of FCDEF response X'00' or X'01' and whether WACK is required by the device or not. The correlation table provided for AESTAT (see "AESTAT (Non-SNA Only)" on page 87) indicates when the data can be validated.
- For both attachments (NLCA and BSC), the use of FCDEF while chaining is active is not permitted. For NLCA devices, chaining is indicated by a parameter associated with the WDAT prior to the next WLCC which carries the chained command (see Figure 106 on page 116). For BSC, host protocols do not provide the information required by the control unit to indicate to the device that a new command and data block has been chained to the message just processed. This must be insured, by convention, between the host and the attaching device.
- If AESTAT(IR) is posted, AEEB(IR) must be used to clear the condition for the associated LT.
- FCDEF and AESTAT are invalid for SNA attachments. SNA TCA has no requirement to implement these codes since asynchronous status (AEEP) can adequately cover all asynchronous device requirements.

```
  HOST         CONTROL UNIT                  DEVICE

Select ----------->
                 LOCK  ------------------------>
                   <------------------------  FC (LOCK)
                                •
Data ------------->     (TCA Busy/Device Busy)
                                •
                 WDAT  ------------------------>
                 (EOM)          •
                                •
                    <------------------------  FC (WDAT)
                                •
  <----------  WACK       (TCA Available)
                                •
                                •
EOT ------------->         (CU Available)
                                •
   <---------  STATUS           •
                 CTCCS ------------------------>
                    <------------------------  FC (CTCCS)

                          (LT Available)
```

Note: (Normal Flow is presented here to provide a perspective and contrast with subsequent Slow Device flows.)

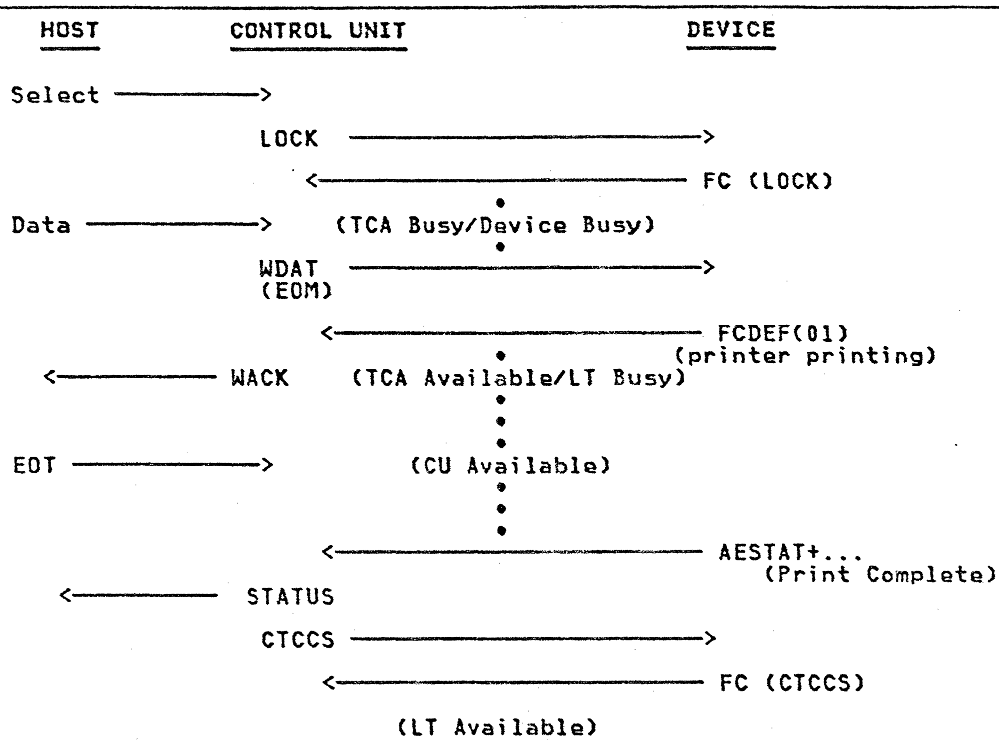
Figure 94. DFT Protocol (BSC): Enhanced (WACK) Host Support (DFT appears as Printer)



Note:

This diagram (representing normal flow) is presented here to provide a perspective and contrast with subsequent Slow Device flows for NLCA environments.

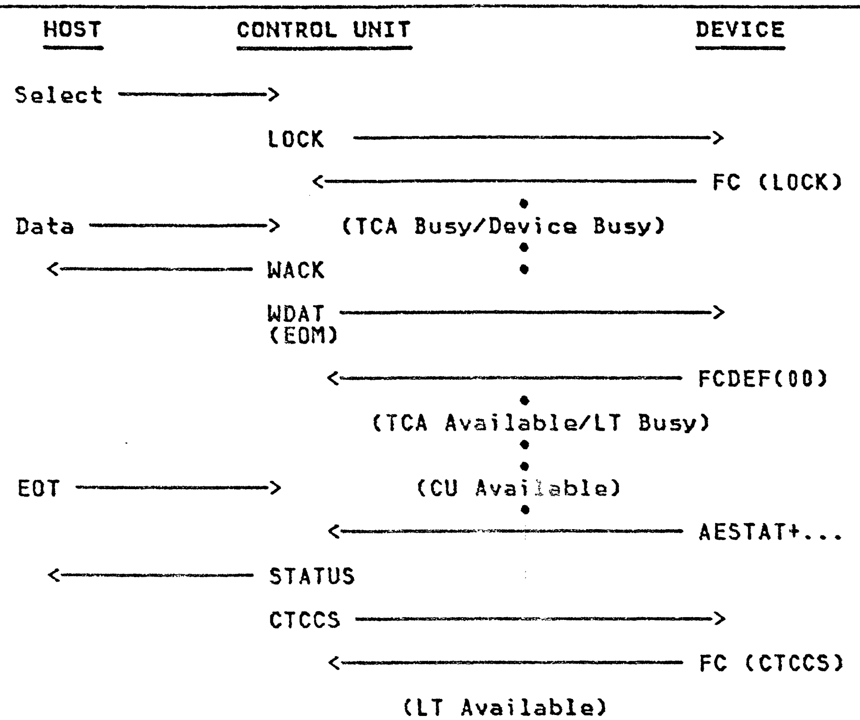
Figure 95. DFT Protocol (BSC): Enhanced (WACK) Host Support (DFT appears as Display)



Note:

1. The data must be validated before FCDEF(01) is posted.
2. For a similar scenario where WACK Support is **NOT** present, the data must be validated before FCDEF(01) is posted.

Figure 96. Slow Device Protocol (BSC): Enhanced (WACK) Host Support (DFT appears as printer with Start Print bit set)



Note:

1. The data does not have to be validated before FCDEF(00) is posted.
2. The Host must respond EOT to WACK.

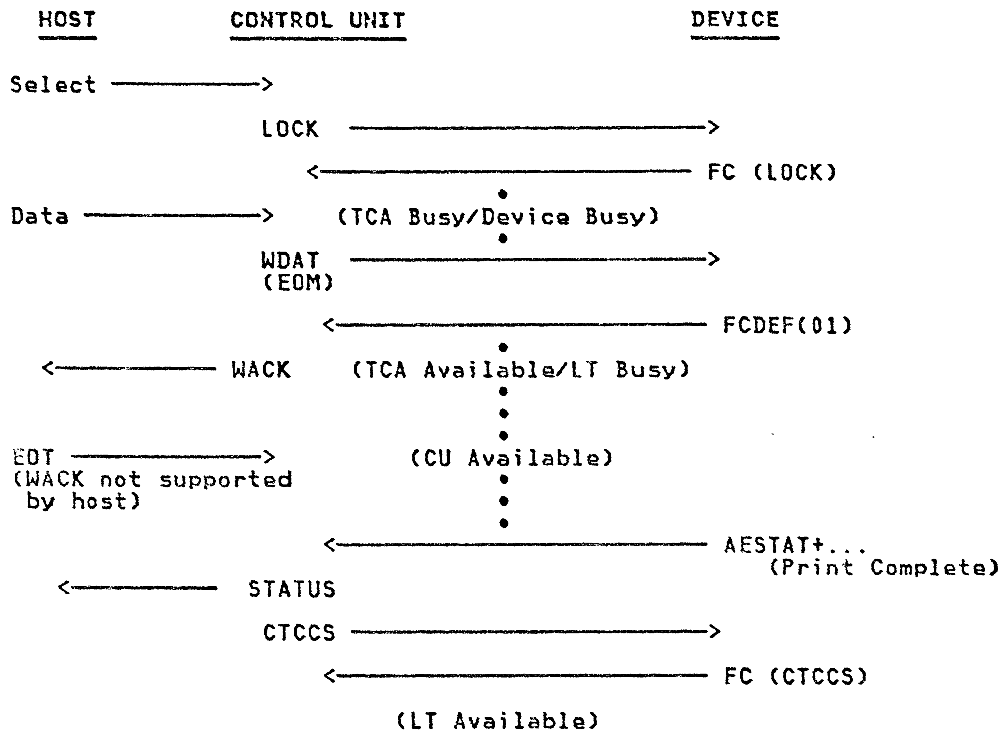
Figure 97. Slow Device Protocol (BSC): Enhanced (WACK) Host Support (DFT appears as Display)

```
  HOST        CONTROL UNIT                     DEVICE

Select ---------->
                   LOCK  ----------------------->
                      <----------------------- FC (LOCK)
                                  •
Data  ----------->      (TCA Busy/Device Busy)
                                  •
                   WDAT ------------------------>
                   (EOM)
                       <---------------------- FCDEF(00)
                                  •
   <------------- WACK   (TCA Available/LT Busy)
                                  •
EOT  ------------>          (CU Available)
                                  •
                       <---------------------- AESTAT+...

   <------------- STATUS
                   CTCCS ----------------------->
                       <---------------------- FC (CTCCS)

                           (LT Available)
```

Note:

1. The data does not have to be validated before FCDEF(00) is posted.
2. The Host must respond EOT to WACK.

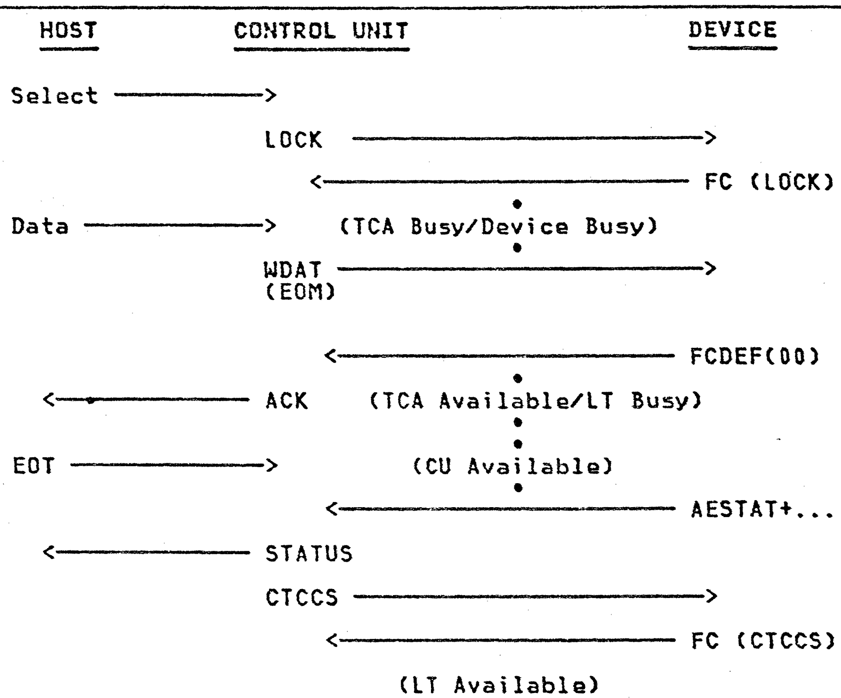
Figure 98. Slow Device Protocol (BSC): Enhanced (WACK) Host Support (printer without Start Print Bit set)



Note:

The data must be validated before FCDEF(01) is posted.

Figure 99. Slow Device Protocol (BSC): No Enhanced (WACK) Host Support (DFT appears as printer with Start Print bit set)



Note:

The data must be validated before FCDEF(00) is posted.

Figure 100. Slow Device Protocol (BSC): No Enhanced (WACK) Host Support (DFT appears as display)

```
  HOST          CONTROL UNIT                     DEVICE

Select ----------->
                 LOCK  ------------------------->
                   <------------------------- FC (LOCK)
                                  .
Data ------------->     (TCA Busy/Device Busy)
                                  .
                 WDAT -------------------------->
                 (EOM)

                    <------------------------ FCDEF(00)
                                  .
 <------------ WACK     (TCA Available/LT Busy)
                                  .
                                  .
EOT -------------->          (CU Available)
                                  .
                    <------------------------ AESTAT+...

 <-------------- STATUS
                 CTCCS ------------------------->
                    <------------------------ FC (CTCCS)

                         (LT Available)
```

Note:

The data must be validated before FCDEF(00) is posted.

Figure 101. Slow Device Protocol (BSC): No Enhanced (WACK) Host Support (DFT appears as printer without Start Print Bit set)

```
  HOST         CONTROL UNIT                      DEVICE

Select ----------->
(for Printer)    LOCK  --------------------------->

                   <--------------------------- FC (LOCK)
                                 •
Data ------------->   (TCA Busy/Device Busy)
  for printer                    •

                WDAT  ---------------------------->
                (EOM)
                   <--------------------------- FCDEF(01)
                                 •
  <------------ WACK    (TCA Available/LT Busy)
                                 •
EOT ------------->          (CU Available)
                                 •
Select ----------->              •
(for display)    LOCK  --------------------------->
                                 •
                   <--------------------------- FC (LOCK)
                                 •
Data ------------->   (TCA Busy/Device Busy)
 for display                     •
                   <--------------------------- AESTAT+...
                                                     (from Printer)
  <------------ WACK

                WDAT  ---------------------------->
                (EOM)
                   <--------------------------- FC (WDAT)
                                 •
                        (TCA Available/LT Busy)
                                 •
EOT ------------->          (CU Available)
                                 •
    <---------- Status           •
           (Display)
               CTCCS (Display) ------------------>
                   <--------------------------- FC (CTCCS)
    <---------- Status      (Display Available)
           (Printer)
               CTCCS (Printer) ------------------>
                   <--------------------------- FC (CTCCS)
                            (Printer Available)
```

Note:

The point at which status information can be directed to the host for AESTAT completion is attachment protocol dependent. The DFT should make no assumptions concerning the order of status processing.

Figure 102. Slow Device Protocol (BSC): Multiple Logical Units (Display and Printer, Start Print Bit Set)

```
HOST         CONTROL UNIT                     DEVICE

Select ----------->
 or Command
              LOCK   ----------------------------->
                  <------------------------------ FC (LOCK)
                                 •
                    (TCA Busy/Device Busy)
                                 •
             WLCC --------------------------------->
  Data ----------->
   (Channel is Free)
                   <------------------------------ FC (WLCC)
                                 •
    <--------- DIO     (CU Available/LT Busy)
      (Device In                 •
        Operation)               •
             WDAT -------------------------------->
             (EOM)
                   <------------------------------ FC (WDAT)
                                 •
    <--------- STATUS    (TCA Available)
                                 •
             CTCCS -------------------------------->
                   <------------------------------ FC (CTCCS)

                        (LT  Available)
```

Note:

This diagram (representing normal flow) is presented here to provide a perspective and contrast with subsequent Slow Device flows for NLCA environments.

Figure 103. DFT Protocol (NLCA)

```
  HOST          CONTROL UNIT                    DEVICE

Select ----------->
 or Command
                  LOCK  ------------------------->
                     <---------------------------- FC (LOCK)
                                  .
                        (TCA Busy/Device Busy)
                                  .
                WLCC ---------------------------->
Data ------------->
   (Channel is Free)
                      <--------------------------- FC (WLCC)
                                  .
   <---------- DIO        (CU Available)
                                  .
                WDAT(EOM) ----------------------->

                      <--------------------------- FCDEF(01)
                                  .
                         (TCA Available/LT Busy)
                                  .
                                  .
                      <--------------------------- AESTAT+...
   <---------- STATUS
               CTCCS ---------------------------->
                      <--------------------------- FC (CTCCS)

                             (LT Available)
```

Note:

The data does not have to be validated before FCDEF(01) is posted.

Figure 104. Slow Device Protocol (NLCA): Printer
(DFT appears as printer with Start Print bit set)

```
  HOST          CONTROL UNIT                       DEVICE

Select ---------->
 or Command
                   LOCK  ------------------------>
                      <------------------------- FC (LOCK)
                                 •
                      (TCA Busy/Device Busy)
                                 •
                 WLCC ---------------------------->
Data ------------->
   (Channel is Free)
                       <------------------------- FC (WLCC)
                                 •
   <--------- DIO         (CU Available)
                                 •
              WDAT(EOM) ---------------------->

                       <------------------------- FCDEF(00)
                                 •
                      (TCA Available/LT Busy)
                                 •
                                 •
                       <------------------------- AESTAT+...
   <--------- STATUS
              CTCCS ------------------------->
                       <------------------------- FC (CTCCS)

                          (LT Available)
```

Note:

The data does not have to be validated before FCDEF(00) is posted.

Figure 105. Slow Device Protocol (NLCA): Display/Printer (DFT appears as a display, or printer with Start Print bit not set)

```
   HOST         CONTROL UNIT                     DEVICE

 Select ---------->
                  LOCK  ------------------------>
                     <------------------------- FC (LOCK)
                                  •
                      (TCA Busy/Device Busy)
                                  •
               WLCC ---------------------------->
 Data ------------>
                      <------------------------- FC (WLCC)

               WDAT ---------------------------->
               (EOM-Chain IND)
                      <------------------------- FCSE+Op Check
                                  •
                         (TCA Available)
                                  •
    <---------- STATUS    (CU Available)
                                  •
   (Channel is Free)              •
               CTCCS --------------------------->
                      <------------------------- FC (CTCCS)

                          (LT Available)
```

Note:

1. Command chaining is invalid for a display or printer. The device must reject the datastream with an Op Check.

2. If the device were to respond FCDEF instead of FCSE, the control unit and the channel could be hung depending on the specific attachment protocols.

Figure 106. Slow Device Protocol (NLCA): Chaining (Command Chaining to Display or Printer)

```
   HOST         CONTROL UNIT                      DEVICE

 Select ──────────>
  or Command
 (for Printer)     LOCK  ─────────────────────────>

                       <───────────────────────── FC (LOCK)
                         (TCA Busy/Device Busy)
                                   •
                   WLCC  ─────────────────────────>
 Data ───────────>
  for printer
 (Channel is Free) <───────────────────────────── FC (WLCC)
     <────────── DIO       (CU Available)
                                   •
                  WDAT  ──────────────────────────>
                  (EOM)
                       <────────────────────────── FCDEF(01)
                           (TCA Available/LT Busy)
 Select ──────────>                •
  or Command                       •
 (for display)     LOCK  ─────────────────────────>

                       <───────────────────────── FC (LOCK)
                         (TCA Busy/Device Busy)
                                   •
                   WLCC  ─────────────────────────>
 Data ───────────>
  for display
 (Channel is Free) <───────────────────────────── FC (WLCC)
                                   •
     <────────── DIO       (CU Available)
                                   •
                       <───────────────────────── AESTAT+...
                                                       (from Printer)
              WDAT(EOM) ──────────────────────────>

                        <───────────────────────── FC (WDAT)
     <────────── Status    (TCA Available)
              (Display)            •
                 CTCCS (Display) ─────────────────>

                        <───────────────────────── FC (CTCCS)
     <────────── Status     (Display Available)
              (Printer)            •
                 CTCCS (Printer) ─────────────────>

                        <───────────────────────── FC (CTCCS)
                            (Printer Available)
```

Note:

The point at which status information can be directed to the host for AESTAT completion is attachment protocol dependent. The DFT should make no assumptions concerning the order of status processing.

Figure 107. Slow Device Protocol (NLCA): Multiple LTs (Display and Printer, Start Print Bit Set)

The following figure depicts a TCA printer Intervention Required condition which is detected after FCDEF(01) is posted.

```
  HOST          CONTROL UNIT                       DEVICE

 Select ----------->
  or Command        LOCK ------------------------------>
                       <------------------------------- FC (LOCK)
                                       •
                           (TCA Busy/Device Busy)
                                       •
                WLCC ---------------------------------->
 Data ------------->
    (Channel is Free)
                         <----------------------------- FC (WLCC)
                                       •
      <---------- DIO          (CU Available)
                                       •
                    WDAT ------------------------------>
                    (EOM)
                       <------------------------------- FCDEF(01)
                                       •
                                       •
                           (TCA Available/LT Busy)
                                       •
                       <------------------------------- AESTAT(IR)
      <---------- Status
                  CTCCS --------------------------->
                       <--------------------------- FC (CTCCS)
                                       •
                                       •
                                       •
                       <------------------------------- AEEB (IR Cleared)
      <---------- Status      (LT Available)
```

Figure 108. Printer IR Handling (NLCA)

The diagram below shows a TCA printer Intervention Required condition detected after FCDEF(01) is posted.

```
HOST          CONTROL UNIT                    DEVICE

Select ---------->
                  LOCK ------------------------->
                    <------------------------- FC (LOCK)
                               .
Data  ---------->    (TCA Busy/Device Busy)
                               .
                  WDAT ------------------------->
                 (EOM)

                     <------------------------- FCDEF(01)
                               .
  <---------- WACK    (TCA Available/LT Busy)
                               .
                               .
                               .
EOT   ---------->            (CU Available)
                               .
                               .
                               .
                     <------------------------- AESTAT(IR)
   <--------- STATUS
                 CTCCS ------------------------->
                     <------------------------- FC (CTCCS)
                               .
                               .
                               .
                    <------------------------ AEEB (IR Cleared)
    <-------- Status      (LT Available)
```

Figure 109. Printer IR Handling (BSC)

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12.0 Data Base Operations

Data Base operations are initiated by the device with either AEDBA or AEDBS. These asynchronous events can only be initiated while the device is in the Interface-Connected state (offline from host); otherwise, the controller disconnects the interface. File ID & Product ID Qualifiers are used to control specific data base operations. The CU accesses or stores data base information and communicates with the device using WDBD, RDBD, CNOP, and WCUS function requests.

12.1 Down Stream Loading

All requests employed in down stream loading use a one byte file identifier. These DSL files represent microcode and data entities required by the device. The device Load Disk must contain a disk directory with entries for each file (including shared tables in the control unit). DSL files are normally accessed in ascending disk sequence to minimize control unit response time. Each file must begin and end on a record boundary.

Requests which cannot be satisfied cause WCUS status to be written to the requesting device. The device posts the error according to Datastream Architecture protocols.

Access errors may include the following:

- Machine Checks: (See "WCUS(70) - Disk Error" on page 58.)

  Fatal Hardware Error
  Disk Media Initialization Error
  Unrecoverable Disk Overrun Error
  Attempt to Access a Not Ready Disk
  Wrong Disk Error

- Disk Completion Errors: (See "WCUS(71) - File Error" on page 58.)

  File Not Found Error
  File Not Writeable Error
  File Locked (Contention) Error
  File Overflow Error
  File Not Readable Error
  File Not Locked Error

The device is required to display the following 6NN error numbers for disk access errors in the control unit.

Device Number	WCUS Value	Probable Cause: Result
630*	7000	Fatal hardware error: disk adapter interface is disabled.
631	7102	File not found: possible device logic error.
632*	7004	Disk media error - defective diskette: replace.
633*	7006	Disk overrun - bad record: replace diskette.
634	7108	Attempted to write a non-writeable file: possible device logic error.
635*	700A	Disk not ready: cover may be open/no disk.
636*	710C	Disk file locked (terminal contention): retry.
637	710E	Disk file overflow attempting to write too many records: possible device logic error.
638	7110	Disk file not readable: protocol error.
639	7112	Disk file not locked (attempt to Write a file not locked): protocol error.
640	7014	Wrong disk in control unit: replace diskette and retry.

Note: (*) The device is not required to report 630, 632, 633, 635 or 636 errors to the control unit (AEER Status). If they are sent, the control unit may log them, but does not generate an ALERT either because the control unit already generated a 3NN alert (e.g., disk hardware error) or because the condition is not considered an error (e.g., "disk not ready").

Figure 110. 6NN Disk Access Errors

13.0 Local Copy

This section describes the interface to support a device local copy capability, including printer assignment, host (SNA ONLY) or operator (Non-SNA) initiated copy requests, data stream transfer, control unit events with status significant to the device, and a set of usable protocols.

13.1 Data Stream Interface to Subsystem Printers

The device must generate a pass-thru SNA Character String (SCS) Data Stream using a set of device controls including New Line (NL), Carriage Return (CR), Form Feed (FF), Set Horizontal Format (SHF), Set Vertical Format (SVF), Set Line Density (SLD), Horizontal Tab (HT), Vertical Tab (VT), Set Attribute (SA) if the printer supports extended data stream functions, and Graphic Escape (GE) if the printer has APL ROS installed. The printer selected must support SCS. Device characteristics of the printer are given to the device for evaluation. The device must send only valid SCS characters and control codes to the printer.

If the amount of data being copied exceeds the physical size of the print buffer, then multiple data transfers with intervening print operations must be performed in order to accommodate the large presentation space. The printer remains allocated to the device until the copy has been completed. SCS chaining is used to emulate a logical unit of work. To the printer the request must appear as a host SCS print chain. The device may split orders (such as SA, GE) across segmented messages.

Function Management Headers are not supported on this interface.

For Multiple Logical Unit considerations only a single queued local copy request is allowed per device.

The controller sets First-In-Segment First-In-Chain (FISFIC) on First of Message (FOM) data in the message header and Last-In-Segment Last-In-Chain (LISLIC) on Last of Message (LOM) data sent to the printer.

13.2 Synchronous and Asynchronous Actions

Synchronous Function Requests used with Local Copy:

WCUS	Report CU Status	("WCUS" on page 40)
RDCOPY	Read Data Block	("RDCOPY" on page 60)
WCTL	Describe Printer	("WCTL" on page 64)
RPID	Request Device ID	("RPID" on page 69)

Asynchronous Status used with Local Copy:

AEFREE	Release Held Printer	("AEFREE (SNA only)" on page 85)
AEPID	Assignment Request	("AEPID" on page 86)
AECOPY	Local Copy Request	("AECOPY" on page 86)
AECAN	Cancel Request	("AECAN" on page 86)

13.3 Initial Printer Assignment

At AEDV(Online) time, the control unit issues a WCUS with the default printer assignment if the control unit has been configured for local copy and the Print Authorization Matrix (PAM) allows local copy from this port.

13.4 Print ID Sequence

The device may request printer assignment by sending AEPID Asynchronous Status. The CU responds with an RPID, to which the device must return FC. DSSP must contain either the current printer port address/class number or an indication that the matrix has been changed (X'FE').

These digits are checked for numeric validity before they are passed to the control unit. The control unit responds with one of the following:

- WCUS(56) - Printer Assigned
- WCUS(54) - Invalid Printer Number
- WCUS(55) - Assignment Disallowed
- FRA - Function Request Aborted (Sequence is terminated)

  FRA is caused by:

  - An RPID is received without a previous AEPID from the device
    or
  - An AEPID Request is sent by the device at the same time that:

    1. a WDAT (outbound message) is issued.
       or
    2. a WCUS(56) (PAM change) is requested.
       or
    3. a LOCK request is received.

An AEPID received during a copy that is currently printing causes the interface to the control unit to be disconnected. The device must not send AEPID during buffer transfer.

13.5 COPY Sequence

The device must check that the pressing of the PRINT key or the host requested write is allowed, i.e., the current host state allows the print request, and a copy request is not currently queued. (AECOPY while queued causes the interface to be disconnected.)

The device may send Asynchronous Status, AECOPY, to the control unit. It is not necessary to send the printer or class number as the CU already has this information.

The CU responds WCUS(51) If Local Copy Request is queued, or with WCUS(5A) if Local Copy is not supported.

Note: Some CU's may send a second WCUS(51). Devices must disregard this if it occurs.

Following a WCUS(51), if the printer is not available, the control unit returns additional status via WCUS indicating one of the following:

WCUS(52) (Long Term Busy)

WCUS(55) (Assignment Disallowed)

WCUS(53) (Printer Exception; either Intervention Required, or Equipment Check)

When the printer becomes available (or immediately if the printer is free), the function request WCTL is issued. The control unit has placed the printer characteristics in the TCA buffer at the address specified by the value in CUDP. The actual format of this data has been defined previously (see "WCTL" on page 64). If the characteristics are acceptable, FC is returned. If the characteristics are unacceptable, ERFR or FRA is returned (depending on the reason) and the copy request is terminated.

If the device returned FC Status, the control unit issues an RDCOPY request. The device must place the copy data in the TCA buffer at the address specified by CUDP. CUFRP3/CUFRP4 must contain the target length for the data.

The entire buffer transfer may be accomplished with a series of RDCOPY function requests. Printing starts after one full buffer of data is loaded into the printer. The smaller of the TCA and printer buffer is used to determine the actual amount of data that is printed at one time. The device is notified via WCUS(58) that printing has started. Following the entire transfer, the controller writes WCUS(59), Local Copy Request Dequeued.

The print phase of the copy sequence is terminated by the control unit returning one of the following via WCUS:

```
Printer exception WCUS(53)  (failure during printing)
        or
Print complete    WCUS(5B)  (good completion)
```

13.5.1 Second Request Processing

During the final segment print of the copy data, after the previous request has been dequeued, a second request may be queued. The copy sequence operates as described above, unless the printer fails while printing the last segment of the previous request. Second Request Abort processing is defined to be the rejection of a subsequent copy request when the printer fails on the first request. The controller does not send any additional status to the device when this situation occurs. The request is simply dequeued. A race condition occurs when WCUS(53) (Printer Exception) is sent at the same time that the second copy request (AECOPY) is issued. The controller services the copy request normally up to the point that WCTL is issued. At this point, the device sends FRA to the WCTL, thus ending the sequence.

13.6 QUERY

In order to provide local copy to advanced printers with variable pitch and potentially other functions which can affect the print format, the device is able to send Query requests to and receive Query replies from the assigned printer before generating a local copy data stream. New printers indicate support of the architecture for Query List in their Terminal ID (PCIA). This information is conveyed to the intelligent display by the Extended WCTL (Flag bit 2 = B'1') request. Consistent with the local copy interface, the display must not pass any data stream to the printer which would produce error status or unknown results.

A local Save/Restore function is performed by the control unit to an advanced printer which supports Save/Restore Structured Field architecture. This operation is transparent to the device, except to point out that the device should **not** assume responsibility for initiating the function. This capability allows the device to change pitch and maximum presentation position without adversely affecting output formats set by a host application sharing the printer. The control unit initiates a Save Structured Field to the printer at the beginning of the device local copy transaction and later initiates a Restore Structured Field at the conclusion of the transaction.

In order to allow Query information to flow between the display and the printer, Function Management Headers and Structured Fields are supported as pass-thru data over the local copy interface.

The local copy protocols are unchanged with printers which do not support Function Management Headers or in instances when the use of Query is unnecessary. The existing interface continues to be supported without modification.

Initial printer characteristics are supplied to the device via a WCTL function request. This includes Printer ID (PCIA) and the current Alias Table. If the display requires dynamic format information from the printer the Extended WCTL (Flag bit 2 = B'1') function is requested. The Extended WCTL contains Query Reply data read directly from the printer, whereas, a Base WCTL (Flag bit 2 = B'0') conveys the information present in the printer PCIA area. The Query function is handled as a conversational element of the Load Transfer phase, initiated by the first RDCOPY (Read Copy) request and completed in an Extended WCTL request. The Load/Print Phase of local copy is initiated subsequent to the RDCOPY Query/Extended WCTL reply.

Note: Local copy always results in multiple transfers. WCUS(58) and WCUS(59) status changes are not issued during RDCOPY Query/WCTL processing.

RDCOPY Query:

The data stream constructed by the device must conform to architecture commencing with a Function Management Header (FMH). The message must not exceed 256 bytes and must set First of Message/Last of Message (bits 0 & 1) in the Device Buffer Control Flags (see "TCA Buffer Data Area" on page 31).

Two new flags are defined:

1. Function Management Header present (local copy only), bit 8.

2. Query Reply expected (local copy only), bit 9.

The controller accepts a valid Query request on the first RDCOPY request with buffer control flags having the value X'C0C0' followed by the Function Management Header/Structured Field data.

The controller transfers the query message to the printer and issues a start print. Upon completion, the controller transfers the Query Reply data from the printer to the display and issues an Extended WCTL function request. The maximum amount of data transferred is 512 bytes. The WCTL flag byte is set to X'E000' (First of Message, Last of Message, Query Reply). The display responds with FC.

The controller issues another RDCOPY to receive printable data. Normal copy sequences are resumed.

QUERY EXAMPLE
(Details of device responses are omitted)

```
Function          Printer           Control Unit                  Device
--------          -------           ------------                  ------

PRINTER ASSIGNMENT
------------------

                                                 AECOPY Print Request
                                              <-----------------
                             WCUS(51) request ----------------->
                 (Printer             queued
                   Available)
                                    Base WCTL ----------------->
                 <------------ Save Structured Field

LOAD TRANSFER
-------------

                                       RDCOPY ----------------->
                                              <----------------- COPY DATA: Query
                 <------------ Query                             (FMH Present/
                                                                  Query Reply
                 (Query                                               Extended)
                   Reply)
                                Extended WCTL ----------------->
                                       RDCOPY ----------------->
                                              <----------------- Copy Data

PRINT
-----
 (printing
    started)           WCUS(58) Start Print ----------------->
                 (Normal
                   Sequence)
                    WCUS(5B) Print Complete ----------------->
                 <------------ Restore SF
```

13.7 Device Cancel Sequence

To cancel an operator initiated copy request that is queued, the device sends Asynchronous Status, AECAN, to the control unit. See "Device Cancel" on page 137.

The device may also cancel the copy sequence by returning an FRA response to the WCTL. See "Device Cancel/WCTL Race Condition" on page 137 for cancel race description.

To cancel the copy sequence after the buffer transfer has started but before the buffer transfer is complete, the device must respond to a RDCOPY request with FC, NL and the LOM flag set to terminate the print. This is necessary as a full presentation space copy could potentially require a long time to print.

AECAN must not be sent during a host initiated copy sequence. If sent, the controller disconnects the interface.

13.8 Printer Hold (SNA only)

If a host copy request had been rejected (due to local copy), then when a printer which may be allocated to the device becomes available, the control unit holds the printer (reject a new begin bracket). If the printer is still needed for host copy, a Host Initiated Copy Request (AECOPY(01)), is returned. If the device no longer needs the printer for host copy, it must send Asynchronous Status AEFREE.

PRINTER RELEASE EXAMPLE (Details of device responses are omitted)

```
                      Control Unit            Device

                              <--------------- AECOPY(Host Initiated)
                     WCUS(51) --------------->
     WCUS(52) or WCUS(53,01)  --------------->
 (Printer becomes available)
       WCUS(57) (Prt Avail)   --------------->

If printer is still needed by device:

                              <--------------- AECOPY(Host Initiated)
                     WCUS(51) --------------->
                              <--------------- AEFREE

If printer is no longer needed by device:

                              <--------------- AEFREE
```

If the printer which is being held has a component failure, the device is notified with WCUS(57) Printer Available. The device must notify the host, allowing a retransmission of the copy request. When the device retries the copy, it receives WCUS(53) - Printer Exception.

13.9 Printer Cleanup

If the device powers off during multiple data transfers, printer cleanup of New Line (NL) is required. When the device fails, NL (with last of message set) is sent to the printer to prevent a subsequent print from overprinting the last printed line. If the printer fails with a temporary error such as data check, parameter error, or IR (non-power off), the NL sequence is sent by the CU when required to preserve subsequent print integrity.

13.10 Usable Copy Protocols

A set of diagrams depicting the flow of certain Local Copy sequences for the device are shown below. These examples are not intended to be all-inclusive.

13.10.1 Print ID

To change the printers authorized for copy, the device operator presses the PRINT ID key. The device is responsible for tracking its own current printer assignment state by making the proper request.

This is how it is processed by the control unit

```
Control Unit                             Device

               <------------------------- AEPID
         RPID -------------------------->
               <------------------------- FC (mm)
 WCUS(XX,YY) -------------------------->
```

XX CU STATUS	YY CUFRP2	COMPLETION STATUS
WCUS(54)	X'nn'	Invalid Printer ID
WCUS(55)	X'nn'	Local Copy Assignment Disallowed
WCUS(56)	X'nn'	Printer Assigned (DSSP = Address)

```
nn =  xx    Printer port address or
              print class number
   = 'FF'   No assignment

mm =  xx    Printer port address or
              print class number
   = 'FE'   Matrix changed but valid
              assignment possible
```

13.10.1.1 Print ID/Print Number Request Contention (Race Condition)

If an AEPID is sent to the control unit at the same time the control unit is sending a WDAT, LOCK, or WCUS(56) - Printer Assigned function request to the device, an FRA terminates the sequence as follows:

```
        Control Unit                         Device

                   <---------------  AEPID
                                .
                                .
                                .
                                .
      WDAT, LOCK or WCUS(56)  ------------->
                   RPID  ---------------------->
               <-----------------------  FRA

                        (EXIT PRINT ID MODE)

                 (The device executes the WDAT, LOCK, or WCUS(56)
                  and returns FC.)
```

Figure 111. Printer Race Condition

13.10.2 Matrix Change

The Print Authorization Matrix (PAM) is changed via host application combined with an operator keyboard request. As the result of a matrix change, the appropriate indicator is broadcast to all devices via WCUS(56).

WCUS(56,nn) Printer Assignment Response

Current assignment no longer valid	nn = 'FF'
Current assignment no longer valid but new assignment available	nn = 'FE'
Current assignment still valid	nn = Same nn Printer Assignment
No current assignment and a new one exists	nn = New nn Printer Assignment

Note: If the CU is not customized for copy, there is no initial WCUS. Thus, the device must assume no assignment initially (at POR).

13.10.3 Copy Data > Print Buffer

A normal print sequence occurs when the PRINT key is pressed even though the copy data is greater than the printer buffer.

Function	Printer	Control Unit	Device
PRINTER ASSIGNMENT		<————	AECOPY Print Request
		WCUS(51) ————>	
		(REQUEST QUEUED)	
	(Printer Available)		
		WCTL ————>	
LOAD TRANSFER		RDCOPY (1) ————>	
		<————	Copy Data
	(Data written to printer buffer)		
	(Printer buffer full)		
PRINT			
(Printing Started)		WCUS (58,YY) ————>	
	(Print completed)		
CONTINUATION OF LOAD TRANSFER			
		RDCOPY (2) ————>	
	(Data written to printer buffer)	<————	Copy Data
	(Printer buffer full)		
PRINT			

Note: YY (see note in next figure)

Figure 112. NORMAL PRINT SEQUENCE: (Data greater than print buffer size)

At this point the PRINT and LOAD TRANSFER phases are repeated until Last-Of-Message is received from the device, as follows:

Function	Printer	Control Unit	Device

CONTINUATION OF LOAD TRANSFER

RDCOPY (n) ————————>

<———————— COPY DATA (LOM)

(Data written to printer buffer)

(END COPY DATA)

PRINT

(Printing started) •
•
•
WCUS(59) ————————>
(REQUEST DEQUEUED) •
•
(Print completed) •
(COPY COMPLETE)

WCUS (XX,YY,ZZ) ————————>
(Completion Status)

CUFRV	XX CUFRP1	YY CUFRP2	ZZ CUFRP3	COMPLETION STATUS
02	58	nn	00	Printing Started
02	5B	nn	00	Print Complete
02	53	nn	01	Printer Exception, Intervention Required
02	53	nn	02	Printer Exception, Equipment Check
02	53	nn	03	Printer Exception, Data Check or Parameter Error

nn = Printer port address or print class number (X'FF'= no assignment)

Figure 113. NORMAL PRINT SEQUENCE (Continued): (Data greater than print buffer size)

13.10.4 Copy Rejection

13.10.4.1 Prior To Service

If the local copy terminates due to some error or suspension of processing, the copy is rejected in the following manner:

```
                     Control Unit            Device
                     ------------            ------

                          <-------------------- AECOPY

                 WCUS(51) -------------------->
          (Request Queued)           .
                                     .
              (Error/Suspension Encountered)
                                     .
                                     .
              WCUS(XX,YY,ZZ) -------------------->
         (Completion Status)
```

CUFRV	XX CUFRP1	YY CUFRP2	ZZ CUFRP3	COMPLETION STATUS
02	52	00	00	Local Copy Long Term Busy (host initiated only)
02	53	nn	01	Printer Exception, Intervention Required
02	53	nn	02	Printer Exception, Equipment Check
02	55	nn	00	Unauthorized due to matrix change
02	55	nn	00	"TO" device not a printer
02	55	nn	00	Printer w/o SNA Character String
02	55	nn	00	Printer in System Mode
02	55	nn	00	No printer assigned

nn = Printer port address or print class number (X'FF'= no assignment)

Figure 114. COPY REJECTED, Printer Unavailable: (while request queued)

13.10.4.2 Long Term Busy

```
Function        Printer            Control Unit              Device

PRINT KEY
                                         <------------------ AECOPY
                (Printer
                 allocated          WCUS(51) ------------------>
                 to host)        (REQUEST QUEUED)

                                    WCUS(52) ------------------>
                (Long Term Busy)                 .
                                                 .
                (Printer                         .
                 freed up
                 by host)                        .
                                        WCTL ------------------>
                (Implied
                 request
                 queued)

     (PRT OPERATIONAL - Refer to "Copy Data > Print Buffer" on page 131
      at RDCOPY or (PRT NOT FUNCTIONAL - after data transfer started)

                                WCUS(53,YY,ZZ) ---------------->
                               (Completion Status)
```

CUFRV	CUFRP1	YY CUFRP2	ZZ CUFRP3	COMPLETION STATUS
02	53	nn	01	Printer Exception, Intervention Required
02	53	nn	02	Printer Exception, Equipment Check

nn = Printer port address or print class number (X'FF'= no assignment)

Figure 115. COPY REJECTED, Long Term Busy: (PRINT Key Request only)

13.10.4.3 Immediate Rejection - Copy Unauthorized

Copy rejection can also occur for this sequence

```
                         Control Unit              Device

                                <---------------- AECOPY

                     WCUS(XX,YY,ZZ) ---------------->
                   (Completion Status)
```

CUFRV	XX CUFRP1	YY CUFRP2	ZZ CUFRP3	COMPLETION STATUS
02	5A	00	00	Local Copy not configured
02	53	nn	02	Printer Exception, Second Request Race Condition

nn = Printer port address or print class number
(X'FF'= no assignment)

Figure 116. COPY REJECTED, Unauthorized Request

13.10.4.4 Printer Error During Data Transfer

If an error on the printer is encountered during the Load Transfer phase, no printing takes place in the sequence below:

```
                          Control Unit          Device

                               <--------------- AECOPY

                        WCUS(51) --------------->
                 (REQUEST QUEUED)
                              •
                              •
                  (Printer available)

                            WCTL --------------->

                          RDCOPY --------------->

                               <--------------- COPY DATA
(Data written to printer buffer)
                              •
 --Printer error--            •
    Before printing started:
       (If other PRT avail, refer to
       "Copy Data > Print Buffer" on page 131 at WCTL)
            Otherwise, and
    After printing started:

                  WCUS(53,YY,ZZ) --------------->
```

CUFRV	CUFRP1	YY CUFRP2	ZZ CUFRP3	COMPLETION STATUS
02	53	nn	01	Printer Exception, Intervention Required (Includes Power-Off)
02	53	nn	02	Printer Exception, Equipment Check

nn = Printer port address or print class number (X'FF'= no assignment)

Figure 117. COPY REJECTED, Error During Printing

13.10.5 Device Cancel

AECAN dequeues the request only if the request is queued but not actually being serviced.

```
                         Control Unit                Device

                                   <-------------------- AECAN

                    WCUS (56,YY,00) -------------------->
                     (Completion Status)

                     YY
CUFRV  CUFRP1  CUFRP2  CUFRP3   COMPLETION STATUS
  02     56      nn      00     Printer Assigned (Queued and not being serviced
                                                              or not queued)
               nn = Printer port address or print class number
                      (X'FF'= no assignment)
```

Figure 118. COPY REJECTED, Device Cancel Sequence

13.10.6 Device Cancel/WCTL Race Condition

If an asynchronous AECAN request is sent to the control unit by the device at the same time the control unit is sending a WCTL function request to the device after an operator initiated copy request has been queued, the following sequence occurs:

```
                         Control Unit           Device

                                   <---------------- AECOPY (00)

                         WCUS(51) ---------------->
                    (Request Queued)
                                   <---------------- AECAN
                                          .
                                          .
                                          .
                             WCTL ---------------->

                                   <---------------- FRA

                    WCUS(56,YY,00) ---------------->
                   (Completion Status)

                     YY
CUFRV  CUFRP1  CUFRP2  CUFRP3   COMPLETION STATUS
  02     56      nn      00     Printer Assigned (Previous Printer assignment)
               nn = Printer port address or print class number
                      (X'FF'= no assignment)
```

Figure 119. COPY REJECTED, WCTL Race Condition

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14.0 ATTACHMENT CONSIDERATIONS

A significant portion of the interface is attachment dependent. This section describes those dependencies.

14.1 SNA Attachment

The CU handles all Physical Unit Services (PUS) and link connection status. The CU also processes Activate Logical Unit (ACTLU) and Deactivate Logical Unit (DACTLU). The Device is informed of the status of the link, Physical Unit, and Logical Unit via the corresponding WCUS. Session status is monitored to allow CU termination of the session at device power off.

14.1.1 SNA ACTPU/DACTPU, ACTLU/DACTLU

WCUS function requests for Logical Unit/Physical Unit status are only sent once per status change, or when the device goes online to the host.

14.1.2 SNA BIND

The control unit detects Request/Response Units containing BIND commands. If a BIND is for a powered off Device, the control unit returns a negative response. If the device is powered on, the BIND is transferred to the device. The CU checks the response to BIND requests to permit proper termination of the host session in the event of a device power off. If the response is positive, a BOUND state is set. If the response is negative, it is simply transferred inbound to the host. The device must reject BINDs in the BOUND state which carry a different Origin Address Field than expected.

The following rules apply for BIND response processing:

If Enhanced Buffer Management is NOT supported:

Device must respond with FCIR.

If Enhanced Buffer Management IS supported:

Device should use AEEP.

If Enhanced Buffer Management IS supported and the SNA response is longer than 64 bytes:

Device MUST use AEEP.

14.1.3 SNA Outbound UNBIND

The control unit detects Request/Response Units containing UNBIND commands. If an UNBIND is for a powered off device, the control unit returns a negative response to the host. If the device is powered on, the UNBIND is transferred to the device. The CU checks the response to UNBIND to enable proper termination of the host session in the event of a device power off. If the response is positive, an UNBOUND state is set. If the response is negative, it is simply transferred inbound to the host. The device must reject an UNBIND request which has a different Origin Address Field than expected.

The following rules apply for UNBIND response processing:

If Enhanced Buffer Management is NOT supported:

Device must respond with FCIR.

If Enhanced Buffer Management IS supported:

Device should use AEEP.

If Enhanced Buffer Management IS supported and if the SNA response is longer than 64 bytes:

Device MUST use AEEP.

14.1.4 SNA Inbound UNBIND

With the proper controller support, the device may issue UNBIND requests to the host. The CU subsequently checks the host's response to such device initiated UNBIND requests. If the response is positive, the controller assumes the session to be UNBOUND. If the response is negative, the current session remains unchanged.

14.1.5 Device Power Off, TCA Disconnect, or Offline Status Change (AEDV)

If a device power off, TCA disconnect, or offline status change occurs while the device is BOUND, UNBIND and NOTIFY (if supported) are sent inbound to the host. The Origin Address Field/Destination Address Field combination saved at BIND time is used.

Any subsequent FMDATA, in-process chains, or segments sent by the host, are rejected.

14.1.6 SNA Outbound Segmenting

A segment is sent to the device with a single WDAT function request. The First of Message (FOM) and Last of Message (LOM) flags associated with the data area are not used with the WDAT.

Segments sent to the device via WDAT are checked by the control unit for:

1. Length is not less than 6, or

   not less than 9 if FISFIC

2. Format ID = 2 (FID2 type)
3. DAF = Device Logical Unit Address

Segments failing any of these tests are not sent to the device.

14.1.7 SNA Inbound Segmenting

Segment gathering of the inbound data must be done by the device based on the segmenting information passed to it with the PDAT or RDAT. The flags associated with the data area for these requests refer to a single RU as a message.

The segments must be contiguous in storage on halfword boundaries each containing a length field and a flags field. The length must be the true length of the segment, i.e., the length of length field + flag field + headers + data. The length can be an odd number. The flags field must have the First of Message flag set in the first segment and the Last of Message flag set in the last. First of Message and Last of Message flags must be off in all other segments.

14.1.8 SNA Responses

The following high level sequence illustrates the SNA Response Flow for devices when the Enhanced Buffer Management support is not present in the control unit.

```
                                                  DISTRIBUTED
      HOST             CONTROL UNIT             FUNCTION DEVICE

         Host Request
        ------------------>
                       WDAT  --------------------->
                             <--------------------    FCIR
                       RDAT  --------------------->
                             <--------------------    FC
        Response Sent
       <------------------
```

Figure 120. SNA RESPONSE FLOW for Devices: (Enhanced Buffer Management not supported by CU)

The following high level sequence illustrates the SNA Response Flow for devices if the response is longer than 64 bytes and Enhanced Buffer Management is supported by the controller.

```
                                                  DISTRIBUTED
      HOST             CONTROL UNIT                 DEVICE

         Host Request
        ------------------>
                       WDAT  --------------------->
                             <--------------------    FC
                             <--------------------    AEEP
                       PDAT  --------------------->
                             <--------------------    FC
        Response Sent
       <------------------
```

Figure 121. SNA RESPONSE FLOW: (Enhanced Buffer Management supported by CU)

14.2 BSC Attachment

The CU handles Binary Synchronous Communications protocols including transparency, inbound blocking, specific POLL, general POLL, selection, and line control. Checkpoint/restore is NOT supported. The device does not receive a WDAT for a block of data until a valid BCC has been received by the CU. However, the data may be written to the TCA buffer as it is received. The control unit issues a Start Operation only after the full block has been verified.

14.2.1 BSC Inbound Operation

The device sends AEEP status to the control unit as a result of either an operator Attention ID (AID) generating action (such as ENTER key or Test key) or by a host READ PARTITION Structured Field.

The controller improves its thru-put by issuing a PDAT request prior to queueing the device on an inbound service list. The device prepares the appropriate inbound data for the PDAT function request. FC is returned when either all the data to be sent has been prepared or the TCA message size has been reached.

When the controller is ready to send data to the host, it issues an RDAT to the device using the same parameters as it did with the PDAT. The device must recognize that the appropriate data has already been generated and immediately return FC to the controller.

The message flags on the request indicate to the controller whether further RDATs are required. All subsequent RDAT requests from the controller require that the data stream be prepared synchronously by the device. CTCCS is issued to the device when either a last of message RDAT is processed or the host terminates the inbound event.

The PDAT and RDAT parameters may be found in Figure 53 on page 66 and Figure 50 on page 63.

```
Control Unit     Device        Comments
____________     ______        ________

                            Request for inbound operation
      <------------ AEEP

                            Prepare data request
 PDAT  ------------>

                            Data ready in TCA buffer,
      <------------ FC      schedule host request to wait for POLL

                            Read data after POLL
 RDAT  ------------>

                            Immediate response from the device
      <------------ FC

                            Generate additional inbound data (if required)
 RDAT  ------------>

                            Data read, response delayed by
      <------------ FC      the device processing time.

                            Final ACK0/ACK1 received from host
 CTCCS ------------>

                            OK
      <------------ FC
```

Figure 122. BSC Inbound Sequence

14.2.2 BSC Operator Reset

If the operator aborts the inbound operation prior to PDAT (or RDAT), an FRA response must be returned to the PDAT or RDAT request when it occurs. In this case, the controller aborts the inbound request.

14.2.3 BSC Transparency

When sending data inbound in transparency mode, the length of the data prepared must be one less than the maximum length specified in CUFRP3/CUFRP4 of the PDAT function request. This is to allow for the insertion of a Data Link Escape (DLE) character (by the CU).

14.2.4 BSC Test Request Key

If a Test Request key action is to be performed, the Test Request flag in the data header must be set and the appropriate inbound data placed in the buffer. The length of the inbound data prepared must be 2 bytes less than the maximum allowed (one byte test request header + one for transparency).

The CU generates the actual SOH%/STX header on the message to the host.

14.2.5 BSC Inbound/Outbound Contention

An inbound data request (AEEP) remains in a read pending state until RDAT is issued by the CU.

If a LOCK request is issued to the same Logical Terminal that has the inbound data pending, the read pending state must be reset by the device and the inbound data request (AEEP) must not be rescheduled.

If a LOCK request to a different LT is issued, the read pending state must be preserved by the device. The device must reschedule AEEP for the original Logical Terminal after receiving Terminate Chained Command Sequence (CTCCS) to the outbound operation.

If a Lock request is made after an operator AID action (AEEP) and before its recognition by the control unit (PDAT), the LOCK must be rejected by the device with FCSE(Busy). The receipt of a completion status to the subsequent PDAT (the CU's normal response to the AEEP), indicates to the controller that the busy condition no longer exists. In this case, AEEB(End Busy) must not be posted by the device.

14.2.6 BSC Outbound Processing

An outbound message is defined (for Beginning/End of Message flags) as the data contained between STX, ESC and ETX/ETB. The amount of data which is transferred to the device at one time is limited by BSC Architecture.

If a Read command is encountered, the device returns status FCIR and waits for an RDAT request.

When selection is terminated, CTCCS is issued.

Control Unit	Device	Comments
LOCK ————>		Lock request when select received
<————	FC	Lock performed
WDAT ————>		Indicate outbound data in TCA buffer
<————	FC	Datastream processed
CTCCS ————>		End Sequence
<————	FC	OK

Figure 123. BSC Outbound Sequence

Control Unit	Device	Comments
WDAT ————>		Indicate outbound data in TCA buffer
<————	FCIR	Request for data (WDAT contained Read Command as part of data)
RDAT ————>		Read data from buffer
<————	FC	Datastream processed

Figure 124. BSC Outbound Sequence With WDAT Read Command

14.3 NLCA Attachment

The control unit processes the local channel protocols not requiring device interactions as well as those requiring an immediate response to enhance channel performance. The device is responsible for processing commands and data stream.

14.3.1 NLCA Inbound Operation

The device sends AEEP status to the controller as a result of either an operator AID generating action (such as ENTER or the Test key) or by a host READ Partition Structured Field. It is then the responsibility of the controller to set attention status on the channel. The device must wait for a READ type command from the host.

The CU improves its thru-put by issuing a PDAT request prior to sending ATTN to the host. The device prepares the appropriate inbound data for the PDAT request. FC is returned when either all the data to be sent has been prepared or the TCA message size has been reached.

In certain circumstances, prepared data may be destroyed either by local operations or by outbound data processing which occurs during the period between PDAT and host selection. If the Enhanced Buffer Management option is supported by the controller, the LOCK function request includes a parameter in CUFRP1 indicating whether the prepared data is valid or must be reloaded into the TCA buffer (see "LOCK" on page 62).

If the control unit does not support the Enhanced Buffer Management function, the device must assume any prepared data has been destroyed should a data oriented request other than a Read Modified be received.

When the control unit receives a Read or Select Read type command for the device, the appropriate Read command is passed as parameter CUFRP1 of the WLCC function request. If the command is Read Modified, a PDAT request has previously been processed, and the prepared data has not been destroyed by an intervening operation, status FCIR(DA) is returned. The CU may then read the data from the TCA buffer without making an RDAT request. If more data remains to be sent (as indicated by the message flags), the CU must issue RDAT requests which causes the datastream to be prepared synchronously.

If the command is Read Buffer, or PDAT has not been processed, or the prepared data has been destroyed by an intervening operation, status FCIR(READ) is returned. The control unit should follow with RDAT function requests until all of the read data has been transmitted. The device sets the last of message flag in the header for the last block sent to the control unit.

The controller may prematurely terminate a sequence prior to receipt of EOM by issuing a new WLCC (during command chaining) or by issuing CTCCS (if command chaining is not active).

Parameter CUFRP2 of the next WLCC or the CTCCS function request is set to X'01' if the host read operation was successful.

CONTROLLER		DEVICE	Comments
	<————————	AEEP	Request for inbound operation
PDAT	————————>		Prepare data request
	<————————	FC	Data ready in TCA buffer, queue to host to send ATTN
LOCK	————————>		Lock request when select received (CUFRP1 = X'01', Prepared data is valid)
	<————————	FC	Lock performed
WLCC(RM)	————————>		Send Read Modified command
	<————————	FCIR	Device ready to send read data (Data Avail, DSSP=X'01')
RDAT	————————>		Generate additional inbound data
	<————————	FC	Data ready, response delayed by the device processing time.
CTCCS	————————>		End Sequence
	<————————	FC	OK

Note: The CUFRP1 parameter of the LOCK is valid only if the Enhanced Buffer Management option is supported by the control unit.

Figure 125. Inbound Operation - Prepared Data Not Destroyed: Data prepared in the TCA Buffer has not been destroyed by an intervening operation.

```
 HOST        C.U.              DEVICE            Comments

                    <------------- AEEP   Request for inbound
                                           operation

               PDAT ------------->        Prepare data request

                    <------------- FC     Data ready in TCA buffer;
                                           queue to host to send ATTN

 <---------- ATTN                         AID Generated
 SELECT
  WRITE ---------->

               LOCK ------------->        Lock request; prepared
                 (CUFRP1 = X'01')          data valid

                    <------------- FC     Lock performed

        WLCC(WRITE) ------------->        Send Write type command

                    <------------- FC     Device ready to accept
                                           data

               WDAT ------------->        Prepared data overlaid

                    <------------- FC     Datastream processed

              CTCCS ------------->        End Sequence

 SELECT             <------------- FC     OK
     RM ---------->

               LOCK ------------->        Lock request; prepared
                 (CUFRP1 = X'00')          data overlaid

                    <------------- FC     Lock performed

           WLCC(RM) ------------->        Send Read Modified command

                    <------------- FCIR   No device data available
                      (DSSP = X'00')

               RDAT ------------->        Regenerate inbound data

                    <------------- FC     Data ready, response
                                           delayed by device
 <---------- DATA SENT                     processing time

              CTCCS ------------->        End Sequence

                    <------------- FC     OK
```

Note: The CUFRP1 parameter of the LOCK is valid only if the Enhanced Buffer Management option is supported by the control unit.

Figure 126. Prepared Inbound Data with Intervening Write

14.3.2 NLCA Operator Reset

If the operator aborts the inbound operation prior to PDAT, FRA status must be returned to the subsequent PDAT request. The control unit ignores receipt of the previous AEEP from this device and does not issue ATTN to the host. In this case, the control unit aborts the inbound request.

14.3.3 NLCA Test Request Key

For Test Request reads, the device builds the test request message, SOH%/STX, in the data area. The Test Request bit in the data header message flags is not set.

14.3.4 NLCA Inbound/Outbound Contention

If a LOCK request is made after an operator AID action (AEEP) and before its recognition by the control unit (PDAT), the LOCK must be rejected by the device with FCSE(Busy). The receipt of a completion status to the subsequent PDAT (the CU's normal response to the AEEP), indicates to the controller that the busy condition no longer exists. In this case, AEEB(End Busy) must not be posted by the device.

14.3.5 NLCA Host Commands Other Than Read Modified

If a Read request other than WLCC(Read Modified) is received, the device must invalidate the data already prepared and return FCIR(Read). When the Read Data for host request is received, the new data is generated as appropriate for the command.

Receipt of a Write type command invalidates the prepared data, and the device returns FC.

14.3.6 NLCA Outbound Processing

An outbound message is defined (between Begin/End of Message flags) as the data associated with a Select or Command sequence. The amount of data which is transferred to the device at one time is limited by the channel architecture and control unit restrictions. All sequences are initiated with a LOCK request. The specific command is issued to the device via a separate request, WLCC. Data following the command is send by WDATs. Command chaining requires the device to process multiple WLCCs. When the sequence is completed, CTCCS is issued by the CU.

CONTROL UNIT		DEVICE	Comments
LOCK	————————>		Lock request when select received
	<————————	FC	Lock performed
WLCC(command)	————————>		Send Write type command
	<————————	FC	The device ready to accept data
WDAT	————————>		Indicate outbound data in TCA buffer
	<————————	FC	Datastream processed
CTCCS	————————>		End Sequence
	<————————	FC	OK

Figure 127. NLCA Outbound Processing

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15.0 Communications Network Management (CNM)

Response Time Monitor (RTM) and Alert are CNM functions that use the SNA SSCP-PU (controller) session to transmit data. In addition, RTM is supported on non-SNA attachments as a Subsystem only function (no host interface).

15.1 Response Time Monitor

The Response Time Monitor is a mechanism whereby end-to-end user response time can be measured depending on a definition dictated by the controller customizing process or, in certain cases, an application in the host. Response times for each logical terminal are measured and maintained in the controller. (See "Response Time Monitor" on page 89 for a more detailed definition and description of the RTM.)

15.2 Alert Function (SNA Only)

The Alert function is a mechanism whereby the controller can pass error conditions relating to problems within the subsystem to a host via the SNA SSCP-PU session. If supported by the controller, such errors are passed up to the host via the Network Management Vector Transport (NMVT) and do not require any additional support from the attached device. The Alert function does require NPDA programming support in the host that supports the controller. This CNM function is intended for enhanced customer network problem determination and management.

In addition to those errors detected by the controller on behalf of attached devices, errors detected by distributed function devices are reported to the controller via AEER status reflecting a 6NN or 7NN error code (see "AEER" on page 79). These errors typically cause an alert record to be sent to the host.

Note: Certain 6NN errors do not result in the generation of an alert record by the controller since they are the result of controller detected problems or are considered status rather than error conditions (see "Down Stream Loading" on page 121).

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