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# Tuning and Problem Analysis for Network Control Program (NCP) Synchronous Data Link Control (SDLC) Devices

by: D. L. Buckingham

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CONTENTS

## LIST OF ILLUSTRATIONS

# CHAPTER 1. TUNING AND PROBLEM ANALYSIS FOR NCP SDLC DEVICES

## 1.1 INTRODUCTION

This publication is intended for personnel who need additional information for performance tuning and/or debugging of Systems Network Architecture (SNA) Synchronous Data Link Control (SDLC) definitions in ACF/NCP/VS.

NOTE: ACF/NCP operands which are common to BSC/start-stop and SDLC definitions have different defaults and usage when defined for SDLC terminals. No information in this publication should be used in defining BSC/start-stop devices.

ACF/VTAM supports selected start-stop terminals under the Network Terminal Option (NTO). NTO requires NCP definition of the SDLC 3767 virtual lines and terminals. The tuning operands covered in this publication do not apply to NTO.

The subject matter in this document applies to ACF/NCP Release 2.1 and Release 3. The following publications are referenced in this document:

ACF/NCP Release 2.1

ACF/NCP/VS Network Control Program Logic, LY30-3041

ACF/NCP/VS Network Control Program - Program Reference Summary, LY30-3043

IBM Synchronous Data Link Control General Information, GA27-3093

ACF/NCP Release 3

ACF/NCP/VS Network Control Program Logic, LY30-3057

ACF/NCP/VS Network Control Program - Program Reference Summary, LY30-3058

IBM Synchronous Data Link Control General Information, GA27-3093

Tuning for NCP SDLC devices requires a knowledge of SNA sessions and the command flows to and from the host. Many documents have identified the NCP operands and have provided recommendations for specific host applications and/or specific terminal types. Unfortunately, the values provided were for a specific:

- command flow from the host
- application
- logical unit type
- configuration

The following topics identify the command flows from the host, command processing within the NCP, and how NCP operands affect the tuning.

## CHAPTER 2. SNA COMMAND FLOW

The host issues commands to the NCP and to the SDLC terminals. The commands are carried in a Path Information Unit (PIU) Request Unit (RU).

Commands are always an only in chain PIU and are never segmented by the NCP. Depending upon the command type, the flow may be expedited or normal. An expedited command is placed as the first PIU on a queue. A normal command is placed at the end of a queue.

The first byte of a request header (RH) identifies

- the PIU as a command (formatted) or user data (unformatted)
- if a command, the subcategory of function management data, network control, data flow control, or session control
- the PIU as a request or response

The request unit of a command contains the command code and command parameters. The SNA commands are listed in ACF/NCP/VS Network Control Program Logic, Appendix A: Network Commands. In this publication a subset of the RU commands and exception responses are provided in:

- Appendix A: SNA Commands for Link, Physical Unit, and Logical Unit Activation
- Appendix B: NCP Exception Responses

For a complete and current reference of the same information contained in the appendices, the IBM reference document is: ACF/NCP/VS Network Control Program - Program Reference Summary. The appropriate sections are:

- Section 2: Path Information Unit - FID1, FID2, and FID3
- Section 5: NCP Network Commands
- Section 6: SDLC Commands and Responses
- Section 9: NCP Exception Responses.

The ACF/NCP macros and operands which are referenced in this document are:

```
BUILD     BFRS=
          DIALTO=
          DSABLTO=
          ENABLTO=
          TRANSFR=

SDLCST    GROUP=
          IRETRY=
          MAXOUT=
          MODE=
          PASSLIM=
          RETRIES=
          SERVLIM=
          TADDR=
          TRANSFR=

HOST      BFRPAD=
          MAXBFRU=
          UNITSZ=

GROUP     ACTIVTO=
          REPLYTO=

LINE      ADDRESS=nnn|(nnn,nnn)
          HDXSP=
          PAUSE=
          REDIAL=
          RETRIES=
          SERVLIM=
          TRANSFR=

SERVICE   ORDER=

PU        AVGPB=
          DATMODE=
          IRETRY=
          MAXDATA=
          MAXOUT=
          PASSLIM=
          RETRIES=

LU        BATCH=
          PACING=
          VPACING=   (VTAM only)
```

TCAM provides the VPACING function by an OPACING operand coded on a TCAM TERMINAL macro.

## 2.1 SNA COMMAND FLOWS FOR SDLC LINKS

The SNA command flow is a logical sequence to activate SDLC links and link stations. The command sequence varies for switched and nonswitched lines, and for type 4 physical units and type 1 or type 2 physical units. The nonswitched command sequence is a subset of the switched command sequence.

Switched SNA Command Sequence

- Activate Link
- Activate Connect In (answer), or Connect Out (dial)
- Request Contact
- Set Control Vector (physical unit)
- Contact
- Contacted
- Activate Physical
- Request Network Address Assignment (VTAM), Assign Network Address (TCAM)
- Set Control Vector (logical unit)
- Activate Logical
- Bind or logon

Nonswitched SNA Command Sequence

- Activate Link
- Contact
- Contacted
- Activate Physical
- Activate Logical
- Bind or logon

When activating a type 4 physical unit, the command sequence ends with the Activate Physical commands.

For additional detail on the commands, see Appendix A: SNA Commands for Link, Physical Unit, and Logical Unit Activation.

## 2.2 SDLC POLLING, COMMANDS, AND RESPONSES

The unit of transfer on an SDLC link is a Basic Link Unit (BLU). The BLU components are:

| Byte | |
|---|---|
| 0 | Flag - X'7E' |
| 1 | Address of a station polled or addressed |
| 2 | Control byte |
| 3-n | PIU or PIU segment |
| n+1 | Frame check sequence byte 0 |
| n+2 | Frame check sequence byte 1 |
| n+3 | Flag - X'7E' |

The control byte identifies the frame as an information transfer (data) BLU or a control BLU.

Additional information on SDLC is in Appendix C.

### 2.2.1 INFORMATION TRANSFER (DATA) BLU

If the control byte contains a bit value of B'xxxx xxx0', bytes 3 through n contain an input or output PIU. A data BLU control byte has the following format:

| | |
|---|---|
| xxx. .... | Next expected receive sequence count |
| ...x .... | Poll/final bit |
| .... xxx. | Send sequence count |
| .... ...0 | Information transfer BLU identification |

The receive and send sequence counts of three bits allow up to seven data frames to a physical unit without an acknowledgment. The seventh data frame control byte may have the poll/final bit on in the data frame, or an eighth frame of a control BLU may be used to provide the poll/final bit indication. A control frame does not have a send sequence count, and is not considered in the maximum data frame count.

## 2.2.2 CONTROL BLU

If the control byte contains a bit value of B'xxxx xxx1', bytes 3 through n are omitted, and the BLU is for control. Control BLUs have two major categories; (1) data poll/responses and (2) physical unit contact, discontact, etc.

Data Poll/Response

There are two types of poll/response formats in data mode: (1) receive ready (RR) and (2) receive not ready (RNR).

Receive ready (RR) control byte has a format of:

```
xxx. ....  Next expected receive sequence count
...x ....  Poll/final bit
.... 0001  Receive ready BLU identification
```

A control byte of B'xxx10001' RR transmitted to a physical unit by NCP means the NCP is polling for data. The polled device may respond with (1) a receive ready (RR) or receive not ready (RNR) with the final bit on indicating no data to send, or (2) with one to seven data frames.

A data frame may contain a control byte with the final bit on, or a separate frame of RR or RNR may contain the final bit. Some terminal products send the final flag in a data frame. The NCP uses a separate RR or RNR frame with the final bit on.

The response to the RR or RNR carries the next expected sequence number to acknowledge the receipt of the previous frame(s).

Receive not ready (RNR) control byte has a format of:

```
xxx. ....  Receive sequence count (next expected)
...x ....  Poll/final bit
.... 0101  Receive not ready BLU identification
```

A control byte of B'xxx10101' RNR transmitted by NCP is polling for an acknowledgement of data frames sent, but does not allow data frames as a response. The polled device sends a response with the final bit on and the sequence number indicating the frames received without error.

The RNR frame is used by NCP and the physical unit to transmit frame sequence counts but to prohibit data transfers until an RR is sent. As an example, the RNR frame is used by terminals during transmission of segmented PIUs to ensure all segments are sent before allowing incoming data. RNR is also used when resources are not available, such as buffers, or when virtual route flow control problems exsist.

Receive ready (RR) and Receive not ready (RNR) commands are used in 'normal' link service. All other SDLC commands are used in 'special' command processing link service.

Special Command/Response Service

Special command processing is initiated after normal data service polling and transmission is suspended by:

1. a complete pass of the service order table without any active stations, or

2. the number of passes through the service order table as specified by the SERVLIM operand

SNA control commands are received from a host, and bits are set indicating the SDLC control command processing to occur. As an example, an SNA Contact command requests an SDLC Set Normal Response Mode (SNRM) command; SNA Discontact command requests an SDLC Disconnect (DISC) command; an SNA Activate Physical command initiates Receive Ready (RR) polling of a physical unit; an SNA Deactivate Physical suspends Receive Ready (RR) polling.

Special processing has a remembrance of the last service order table entry used for command processing, and begins with the next service order table entry. The service order table pointer for control commands is different from the pointer used for data frame polling and addressing.

Control processing begins with the entry following the last entry serviced, and the first service order table entry with a pending control command is processed. Control processing ends when:

1. a single command has been processed, or

2. command processing makes a complete pass of the service order table without locating a pending command

If more than one physical unit has a queued control command, only the first located physical unit with a pending command (following the last entry serviced) is processed. This physical unit becomes the 'last entry serviced', and the next queued control command is not processed until the next control service.

Some SDLC commands and responses have been renamed in Release 3. Appendix C gives a list of both Release 2.1 and Release 3 definitions.

For additional detail, see one of the following:

- Appendix C: SDLC Commands and Responses,

- ACF/NCP/VS Network Control Program - Program Reference Summary, LY30-3043 (Release 2.1) or LY30-3058 (Release 3) Section 6: SDLC Commands and Responses

- IBM Synchronous Data Link Control General Information, GA27-3093

A trace of link activity is available. The line trace is initiated by a command from the host to record selected fields of the 3705 scanner interface control word.

For a type 2 scanner the fields recorded per byte are:

- LCD - Line Control Definer, identifies a line as SDLC, BSC, or start-stop
- PCF - Primary Control Field, specifies the current state, input, output, etc.
- Time - a one byte timer field with a .1 second resolution to indicate relative time between trace entries
- SCF - Secondary Control Field, specifies a normal service request or an error condition
- PDF - Parallel Data Field, if the PCF/SCF is appropriate, the PDF contains the data byte sent or received

For a type 3 scanner, in addition to the previous fields, an extended primary control field (EPCF) and two status bytes per NCP buffer are provided. Data entries are recorded in trace data when a level 2 interrupt occurs due to end of data, end of buffer, or error condition.

For additional information on line trace fields, refer to:

- Appendix D: SDLC Line Traces
- ACF/NCP/VS Network Control Program - Program Reference Summary, LY30-3043 (Release 2.1) or LY30-3058 (Release 3), Section 13: Interface control Word (ICW)

# CHAPTER 3. SDLC LINK SCHEDULER

The SDLC Link Scheduler is initiated for an SDLC line by an Activate Link command. The Link Scheduler is executed independently for each SDLC link.

After an SDLC link is activated, and before any physical units have been activated, the link scheduler uses the service order table (SERVICE macro) to locate a physical unit to be activated. Since a search of the service order table indicates no physical units are to be activated, the Link Scheduler places this link's control block on a 2.2 second timer queue. During the 2.2 seconds other links can be serviced or lower priority tasks can be executed. The 2.2 second time queue logic is only used when the line is active and there are no devices active.

When the 2.2 second timer queue expires the link scheduler again searches for a physical unit to activate on this link. The sequence of timer queue and searching the service order table continues until a physical unit is activated.

The link scheduler processing is divided into two routines of (1) normal service and (2) special poll command processing. Normal servicing of polling for input or addressing for output cannot occur until special polling for activation is complete. When the link scheduler begins execution for an SDLC link, normal service is attempted before special poll command processing. However, because normal service cannot occur until special poll command processing occurs, the special poll command processing will be covered first.

## CHAPTER 4. SPECIAL POLL COMMAND PROCESSING

Normal link scheduler processing is terminated by:

1. a complete pass of the service order table without any active stations, or

2. the number of passes through the service order table as specified by the SERVLIM operand

When normal processing completes, special service processing occurs.

Special service processing occurs in service order table sequence searching for a pending SDLC command. If an SNA command of Contact for a type 1 or type 2 physical unit is found, this requests NCP to send an SDLC command of Set Normal Response Mode (SNRM) to the physical unit; an SNA command of Discontact requests an SDLC command of Disconnect (DISC) to be sent to the physical unit.

In ACF/NCP Release 2.1, a type 4 physical unit also uses SNRM logic; one NCP defined to send the SNRM, and the second to monitor and respond. ACF/NCP Release 3 type 4 physical units use an XID command sequence to identify the two subarea numbers; the higher subarea then sends SNRM, and the lower subarea responds.

If there was a Set Normal Response Mode (SNRM) pending (from an SNA Contact command), the link scheduler transmits the SNRM SDLC frame on the link. If no special poll is found in a pass of the service order table, special poll command processing is ended. If a special poll is found, only that one command is processed before returning to normal service. Because only one special poll is processed, it is necessary to maintain a pointer to the next service order table entry to begin processing in the next special poll service.

If one or more physical units are active, no timer is required because the SNRM is transmitted by the special poll routine. If one or more physical units are active (available for polling and addressing), control returns to the normal service routine. If no physical units are active, a 2.2 second timer queue is set.

In a pass of special poll processing, the first special poll command located is processed. Only one special poll command is processed before returning to normal service. The address of the next entry in the service order table is maintained for the next special poll cycle.

The next special poll cycle will begin with the next service order table entry following the last entry serviced. If no entries require service, the entire service order table is scanned before returning to normal service.

The response to an SDLC SNRM command is one of the following:

1. A timeout

2. Unnumbered Acknowledgement (UA) Release 3; Non-Sequence Acknowledgement (NSA) Release 2.1

3. Request Initialization Mode (RIM) Release 3; Request Initialization (RQI) Release 2.1

4. An error

If a timeout occurs, special poll processing ends. No message is sent to the host on a timeout. The SNRM is sent until a Disconnect command is received or until a response is received.

If a UA (NSA), RIM (RQI), or error occurs, the link scheduler initiates an SNA Contacted command to be sent to the host. The Contacted command identifies the physical unit contacted in the RU in bytes 3 and 4. Byte 5 of the RU identifies the type of SDLC response:

X'01' - Loaded

X'02' - Load required, an SDLC RQI was received

X'03' - Error on contact

X'04' - Loaded status for SNA 4.2 host, parameters follow.

X'05' - SNA 4.2 XID parameters not compatible

X'07' - SNA 4.2 no routing capability

X'08' - SNA 4.2 incompatible parameters for addition of link station to currently active transmission group

# CHAPTER 5. NORMAL SERVICE

Normal service consists of searching the service order table for outbound PIUs to transmit and physical units to poll. Normal service always begins with the first entry in the service order table and ends with the last entry in the service order table. When the end of the service order table is found, if (1) no terminals are active, or (2) SERVLIM passes of the service order table have occurred, special service is initiated.

When the first entry in the service order table is selected, a timer is set with the value specified in the PAUSE operand. When the last entry in the service order table has been processed, if the timer value has not expired, no processing for this link occurs until the timeout expires or outbound data arrives for this link. During the timeout the link is available for output, giving outbound data priority until the timeout interval expires.

Normal link scheduler service is initiated when:

1. the PAUSE timer queue expires

2. the timer queue is pending but outbound data arrives

3. input from the link ends (SDLC poll response with the final bit on)

4. output to the link ends (no additional PIUS, or MAXOUT or PASSLIM limits reached)

Normal link service varies according to the type of line.

A line may be either:

- half duplex, one scanner address defined in the ADDRESS operand, alternate send and receive

- duplex, two scanner addresses defined in the ADDRESS operand, concurrent send and receive

In addition, operands are defined for each physical unit to define the type of service a physical unit will receive when it is selected. Processing of messages at the logical unit queue further restricts the quantity of traffic which may be processed.

To understand the link scheduler, it is necessary to first understand the flow of data:

1. for a logical unit

2. from multiple logical units on a physical unit

3. from multiple physical units on a link

4. on a half duplex link (alternate send and receive)

5. on a full duplex link (concurrent send and receive)

The following topics identify the restrictions on link scheduler processing from logical unit to links.

## 5.1 LOGICAL UNIT AND LINK SCHEDULING

The operands related to a logical unit flow in this topic are:

| | | |
|---|---|---|
| BUILD | BFRS=nn | |
| PU | MAXDATA=nnn | |
| LU | BATCH=YES\|NO,<br>PACING=(n,m),<br>VPACING=n | <br><br>(VTAM only) |

A TCAM message control program has a TERMINAL macro with an operand of OPACING to provide the VPACING function of VTAM. OPACING and VPACING define default session pacing between the host and the boundary node NCP. Non-zero pacing defined in the Bind command overrides OPACING or VPACING, and PACING parameters.

Outbound PIUs are sent on an SSCP/PU session, SSCP/LU session, or LU/LU session. The host SSCP issues single commands, so no more than one command PIU per session may be pending. Multiple data PIUs may be sent on an LU/LU session, but they are always queued at the logical unit level, not the physical unit for transmission on the link.

The host sends data PIUs according to the definitions of VPACING (VTAM), OPACING (TCAM), or as defined in the BIND parameters. The PIU which carries the VPACING or OPACING request is processed by the NCP boundary function when the PIU is queued for transmission to the physical unit. The NCP sends a response to host pacing thus enabling the host to send another group of PIUs.

When a PIU is queued to the physical unit queue for the link, no additional PIUs within that LU/LU session are queued for the link until the first has been selected for transmission. There are two considerations with this logic.

1. This scheduling assures that all LU/LU sessions with outbound traffic will each receive one PIU before any one session receives a second PIU.

2. If only one LU/LU session has outbound traffic, when the first PIU is selected from the physical unit queue to be sent on the link, the next PIU is processed to the physical unit queue before the first PIU has been sent on the link. This allows multiple PIUs to be sent when only one session has traffic.

Assume three logical units, LU1, LU2, and LU3, on a physical unit. Three PIUs arrive and are queued for LU1; the first PIU for LU1 is processed and queued to the physical unit to be sent on the link as in Figure 1.

```
LU1 queue       PU1 queue          transmission

   PIU2            PIU1
   PIU3

LU2 queue -

LU3 queue -
```

Figure 1. LU to PU Scheduling (Part 1 of 3)

PIU4 arrives for LU3 and is processed, changing the queueing as in Figure 2. Note that only one PIU per LU/LU session is queued for transmission on the link. PIUs are transmitted in sequence within a session, but not in the sequence they arrived in the NCP.

```
LU1 queue       PU1 queue          transmission

   PIU2            PIU1
   PIU3            PIU4

LU2 queue -

LU3 queue -
```

Figure 2. LU to PU Scheduling (Part 2 of 3)

When the link scheduler selects PIU1 to be sent on the link, the link scheduler schedules LU1 to provide another PIU to the PU queue. If the PACING limit has been reached for LU1, no additional PIUs from LU1 are processed to the physical unit queue until a pacing response is received. If a pacing response is received, or not required, the queue would then appear as in Figure 3. Note that PIU1 is being transmitted, PIU4 (from LU3) is next to be transmitted, and PIU2 (from LU1) is queued to follow PIU4. Only one PIU per session is queued on the physical unit queue.

```
LU1 queue        PU1 queue          transmission

   PIU3             PIU4                PIU1
                    PIU2

LU2 queue -

LU3 queue -
```

Figure 3. LU to PU Scheduling (Part 3 of 3)

## 5.2 SEGMENTATION

Another consideration is PIU segmentation whereby the NCP breaks apart a large PIU into smaller segments which can be received by the physical unit. NCP segments only outbound data PIUs going to a type 1 or type 2 physical unit as defined by the MAXDATA operand. NCP does not segment inbound PIUs, outbound commands, or PIUs going to a type 4 physical unit.

Another consideration is the size of PIUs which require segmentation. Type 1 and type 2 physical units have buffer size limitations. A PIU is normally segmented to a maximum RU size of 256. Segmentation processing occurs before the PIU is placed on the physical unit queue.

In Figure 3, if the size of PIU2 had been greater than the MAXDATA operand allowed, the PIU is segmented and all segments queued consecutively on the physical unit queue. Figure 3 is still correct, but to illustrate each segment, Figure 4 on page 19shows each segment on the queue. All segments are queued together.

```
LU1 queue       PU1 queue           transmission

   PIU3            PIU4                 PIU1
                   PIU2, segment 1
                   PIU2, segment 2
                   PIU2, segment 3
                   PIU2, segment 4

LU2 queue -

LU3 queue -
```

Figure 4. Physical Unit Queue with Segments

When PIUs are segmented, BFRS operand should be coded at 64 or 128 (ACF/NCP Release 2.1) in order to optimize SDLC line utilization. ACF/NCP Release 3 requires a minimum value of 72 to be coded, therefore BFRS should be coded 128.

In Figure 4, PIU2 contains four segments. A first segment NCP buffer contains an ECB prefix, pads from the conversion of a FID1 to a FID2 or FID3, the transmission header, request header, and request unit in the remaining space. All nonfirst segments have a copy of the transmission header in a separate buffer which is chained to data buffers. The last segment has a variable amount of data, however the middle buffers always contain a fixed quantity of data.

As an ACF/NCP Release 2.1 example, if NCP BFRS=64, MAXOUT=265, and PIU2 contains the following fields:

```
 18 byte buffer control field
  4 byte pad from TH conversion
  6 byte transmission header (FID2)
  3 byte request header
800 byte request unit
```

The first buffer would contain all the control fields of 22 bytes, 9 bytes of TH and RH, and 33 bytes of data. The second, third and fourth buffers would each contain 64 bytes of data. The first SDLC frame (the first segment) would contain 9 bytes of TH/RH, 225 bytes of RU, or 234 bytes total. Segments are always in full multiples of NCP buffers, and therefore MAXDATA does not allow an additional buffer. An additional 64 byte buffer would have 298 bytes, but this is not allowed since MAXDATA=265.

Each additional segment requires a 6 byte TH. For each non-first segment, a separate buffer is leased to contain the TH. This buffer is then chained to the data buffers of the segment. Each middle segment contains a 6 byte TH in a separate buffer and four data buffers of 64 bytes each for a total of 262 bytes. The first segment RU provided 225 bytes and second and third segments 256 bytes or 737 bytes of RU. The fourth segment requires a single buffer of 63 bytes of RU.

Figure 5 illustrates the segment groups.

```
PIU2, segment 1
      buffer 1 - 9 byte TH/RH, 33 bytes RU
      buffer 2 - 64 bytes RU
      buffer 3 - 64 bytes RU
      buffer 4 - 64 bytes RU
                        .........225 bytes RU

PIU2, segment 2
      buffer 1 - 6 byte TH
      buffer 2 - 64 bytes RU
      buffer 3 - 64 bytes RU
      buffer 4 - 64 bytes RU
      buffer 5 - 64 bytes RU
                        .........256 bytes RU

PIU2, segment 3
      buffer 1 - 6 byte TH
      buffer 2 - 64 bytes RU
      buffer 3 - 64 bytes RU
      buffer 4 - 64 bytes RU
      buffer 5 - 64 bytes RU
                        .........256 bytes RU

PIU2, segment 4
      buffer 1 - 6 byte TH
      buffer 2 - 63 bytes RU
                        ..........63 bytes RU
```

Figure 5. ACF/NCP Release 2.1 FID2 Segments, BRFS=64, MAXDATA=265

As an ACF/NCP Release 3 example, if NCP BFRS=128, MAXOUT=265, and PIU2 contains the following fields:

```
 18 byte buffer control field
 20 byte pad from TH conversion
  6 byte transmission header (FID2)
  3 byte request header
800 byte request unit
```

The first buffer would contain all the control fields of 38 bytes, 9 bytes of TH and RH, and 81 bytes of data. The second buffer would contain 128 bytes. The first segment would contain 9 bytes of TH/RH, 209 bytes of RU, or 218 bytes total. Segments are always in full multiples of NCP buffers, and therefore MAXDATA does not allow an additional buffer. An additional 128 byte buffer would have 346 bytes, but this is not allowed since MAXDATA=265.

Each middle segment contains a 6 byte TH in a separate buffer and two data buffers of 128 bytes each for a total of 262 bytes. The first segment RU provided 209 bytes and second and third segments 256 bytes or 721 bytes of RU. The fourth segment requires a single buffer of 79 bytes of RU.

Figure 6 illustrates the segment groups.

```
PIU2, segment 1
      buffer 1 - 9 byte TH/RH, 81 bytes RU
      buffer 2 - 128 bytes RU
                          .........209 bytes RU

PIU2, segment 2
      buffer 1 - 6 byte TH
      buffer 2 - 128 bytes RU
      buffer 3 - 128 bytes RU
                          .........256 bytes RU

PIU2, segment 3
      buffer 1 - 6 byte TH
      buffer 2 - 128 bytes RU
      buffer 3 - 128 bytes RU
                          .........256 bytes RU

PIU2, segment 4
      buffer 1 - 6 byte TH
      buffer 2 - 79 bytes RU
                          ..........79 bytes RU
```

Figure 6. ACF/NCP Release 3 FID2 Segments, BRFS=128, MAXDATA=265

The remaining operand which effects a logical unit is BATCH. Each logical unit represents an NCP task for processing. If BATCH=NO (interactive) the logical unit task is a higher priority than if BATCH=YES.

If several logical units have PIUs for processing, all tasks for LUs coded BATCH=NO will be serviced before the LUs coded BATCH=YES. PIUs for BATCH=NO logical units will be placed on the physical unit queue ahead of PIUs for BATCH=YES logical units. However, as illustrated in Figure 2 on page 17, only one PIU per logical unit is transferred to the physical unit queue; therefore, the BATCH=YES logical units PIUs are queued following the BATCH=NO logical unit PIUs. But all the logical units with pending PIUs will receive one PIU before any second PIU is sent.

## 5.3 PHYSICAL UNIT AND LINK SCHEDULING

The macros and operands related to a physical unit in this topic are:

```
PU      MAXOUT=n,
        PASSLIM=n,
        TRANSFR=n
```

### 5.3.1 POLLING FOR INPUT

When a physical unit has been polled for input, if there is no traffic to be sent to the NCP, and if the physical unit is ready to receive, an SDLC receive ready (RR) response is sent. If the physical unit is not ready to receive, an SDLC receive not ready (RNR) response is sent. If there is traffic to send to the NCP, the polled physical unit may send from 1 to 7 SDLC frames. If the last data frame did not have the final bit on in the control byte, an SDLC frame of receive ready (RR) or receive not ready (RNR) is sent to the NCP to indicate an end of transmitted PIUs.

Each inbound SDLC PIU or PIU segment must be contained within the number of NCP buffers specified in the TRANSFR operand. TRANSFR defines the quantity of NCP buffers and the BUILD operand of BFRS defines the size of each buffer.

The FID0 in the following reference flows in an SDLC frame between two NCPs when both NCPs are not ACF/NCP Release 3.

The ACF/NCP Release 2.1 first NCP buffer of a frame requires:

18 bytes for control fields

n pad bytes:

- 0 pad bytes for a FID0 or FID1 (NCP/NCP link)
- 4 pad bytes for a FID2
- 8 pad bytes for a FID3

TH/RH

- FID0 14 bytes (plus 6 BTU bytes in the RU)
- FID1 13 bytes
- FID2 9 bytes
- FID3 5 bytes

RU in the space remaining in the first buffer

The ACF/NCP Release 3 first NCP buffer of a frame requires:

18 bytes for control fields

n pad bytes:

0 pad bytes for a FID4 (NCP/NCP link)
16 pad bytes for a FID0 or FID1
20 pad bytes for a FID2
24 pad bytes for a FID3

TH/RH

FID0 14 bytes (plus 6 BTU bytes in the RU)
FID1 13 bytes
FID2 9 bytes
FID3 5 bytes
FID4 29 bytes

RU in the space remaining in the first buffer

All non-first buffers are available for RU data.

If the incoming frame will not fit in TRANSFR buffers, the frame is discarded, and a negative response is sent to the transmitting physical unit. A negative response is 1) an SDLC reject (REJ) command or 2) an RR or RNR with a sequence count indicating the rejection. After the specified number of recovery retransmissions occur, a permanent physical unit error indicating a physical unit failure is sent to the owning SSCP (activating SSCP).

Even if an incoming frame fits in the LINE macro TRANSFR definition, the frame still may be discarded at the channel interface if it is too large to transfer to the host. The BUILD macro operand of TRANSFR defines the maximum buffers of a single PIU or PIU segment which may be sent over the channel. The ACF/NCP Release 2.1 default is TRANSFR=7 if no HOST macros are defined. If HOST macros are defined, the default TRANSFR is the smallest HOST value of ((MAXBFRU multiplied by UNITSZ) minus BFRPAD) divided by BFRS and discarding any fraction (round down). The ACF/NCP Release 3 value must be a minimum of 1,296 bytes to contain the maximum Explicit Route Operative PIU.

There are no operands within the NCP to control the quantity of 1 to 7 input frames per RR polling. The number of frames sent from a type 1 or type 2 physical unit (1 to 7) is dependent upon the hardware or program support of the controller.

When the physical unit responds to polling with RR, it indicates to NCP that no additional PIUs are available. The physical unit responds with RNR to obtain a link level response for the previous transmissions and requests an immediate repolling for additional frames. This also occurs when the physical unit buffers are not available for data from the NCP. The normal NCP response to an RNR is to repoll that physical unit until RR polling occurs from that physical unit. No other physical unit on this link is processed until an RR response is sent to the NCP.

When the NCP is in buffer slowdown, the NCP polls with RNR to acknowledge previous frames and defer additional input. If a physical unit is responding with RNR, the polling and responses will be RNR until NCP exits slowdown.

ACF/NCP Release 3 preallocates buffers prior to polling as coded in the PU macro operand of AVGPB. If the required number of buffers are not available, the NCP polls with RNR to acknowledge previous frames and defer additional input.

### 5.3.2 ADDRESSING FOR OUTPUT

There are two operands which define output scheduling.

- MAXOUT defines the maximum number of SDLC frames which may be sent to a physical unit before polling that physical unit for a response.

- PASSLIM defines the maximum number of SDLC frames which may be sent to a physical unit before selecting the next entry in the service order table.

An SDLC frame is either a PIU or PIU segment.

The MAXOUT operand may be coded with a value between 1 and 7. An SDLC link level response is required from a physical unit at least every 7 frames. If DIAL=NO the default is 7. If DIAL=YES the default is 1.

The MAXOUT operand is a maximum. If MAXOUT=7 and 7 or more frames are available, 7 frames are sent before the physical unit is polled for an SDLC link level response. When the MAXOUT limit is reached, or no frames are available to be sent, the physical unit is polled for an SDLC link level response.

If the NCP is not prepared to receive, the link level response may be obtained by RNR polling. RNR polling requests a link level response without data. RR polling requests a link level response and allows up to 7 frames to be received.

The PASSLIM operand may be coded with a value between 1 and 254. The PASSLIM operand defines a maximum value. If PASSLIM number of frames are available, PASSLIM frames are sent before the link scheduler goes to the next physical unit in the service order table. If PASSLIM number of frames are not available, when the last frame has been sent, the link scheduler goes to the next physical unit in the service order table.

Please note that more than seven data frames may be sent on a link before polling occurs for a link level response. As an example, if MAXOUT=7, PASSLIM=1, and 3 physical units with more than 7 PIUs each on a link would transmit one PIU for each physical unit in turn (PASSLIM=1) for six PIUs each (18 PIUs transmitted without polling). When the first physical unit is sent its seventh frame, the nineteenth frame on the link, the MAXOUT limit is reached for that physical unit and polling occurs.

There are four possible combinations of PASSLIM and MAXOUT. The actions of the link scheduler vary as follows:

1. MAXOUT limit reached, PASSLIM limit not reached and more frames to be sent.

   If the MAXOUT limit is reached, and PASSLIM has not been reached, the physical unit must be polled to acknowledge the frames previously received. Polling may be RR or RNR. When the previous frames have been acknowledged the MAXOUT counter is reset and more frames are sent.

2. PASSLIM has been reached, MAXOUT limit not reached and more frames to be sent.

   If the PASSLIM has been reached, the link scheduler selects the next entry in the service order table. No polling occurs until MAXOUT is reached or no frames are available for transmission. When the physical unit is selected again, SDLC frames are sent until PASSLIM, MAXOUT, or no frames are available.

   As an example, if PASSLIM=1, MAXOUT=3, and four PIUs are available to be sent, each time the physical unit is selected for service one PIU is sent (PASSLIM=1). The physical unit is not polled until MAXOUT is reached or no additional PIUs are available, so the next entry in the service order table is processed. When the third PIU has been sent, PASSLIM=1 has been reached for this pass, MAXOUT=3 has been reached since the last polling operation, and therefore the physical unit is polled as per the following item.

3. PASSLIM and MAXOUT limits are reached at the same time.

   When the counters reach maximum at the same time the physical unit is polled, (RR or RNR) before the link scheduler selects the next entry in the service order table.

4. No additional frames are available for transmission.

   When no addition frames are available, if buffers are available, the physical unit is polled with Ready to receive (RR) regardless of the MAXOUT or PASSLIM values. Polling resets the MAXOUT and PASSLIM counters.

   Additional PIUs may be queued to the logical unit waiting for a pacing response and not be available on the physical unit queue. The link scheduler processing only involves those PIUs or PIU segments on the physical unit queue.

## 5.4 SERVICE ORDER OF LINK SCHEDULING

The service order of link scheduling varies according to the:

- active/inactive status of physical units
- availability of SDLC frames to send or receive
- definitions of PASSLIM and MAXOUT
- half duplex (single line address) or full duplex (two line addresses) line

The link scheduler logic which follows is divided into two topics of half duplex and full duplex processing logic.

# CHAPTER 6. HALF DUPLEX LINK SCHEDULER LOGIC

The macros and operands covered in this topic are:

```
SERVICE  ORDER=(label1,...)

LINE     ADDRESS=nnn,
         HDXSP=NO|YES

PU       MAXOUT=n,
         PASSLIM=n
```

Half duplex link scheduler logic for SDLC links is selected when a single scanner address is defined in the ADDRESS operand of the LINE macro. When a single scanner address is defined, only alternate transmit and receive is supported. Output has priority over input.

NOTE: The operands of DUPLEX=FULL or DUPLEX=HALF defines the interface between the 3705 line set and the modem and does not define alternate or concurrent data transfer.

The rules for link scheduling for alternate send and receive are:

- A maximum of one PIU per LU/LU session on the physical unit link queue, but a PIU may be segmented into multiple segments. All segments are queued for consecutive link transmission, but each segment is sent as a separate frame.
- After the last PIU is transmitted, RR or RNR polling occurs.
- If an SDLC response to polling of receive not ready (RNR) is returned, no PIUs may be be sent until a polling response of ready to receive (RR) is received.
- PASSLIM is reset to 0 after the last PIU on the physical unit link queue has been sent. This allows the next PIU to be segmented with a new full PASSLIM count.
- Transmission to the selected physical unit has priority over polling under the following conditions:

  1. The current physical unit has a PIU on the link queue
  2. There is no outstanding poll
  3. The previous SDLC response was a Ready to receive (RR)
  4. The physical unit is not in error recovery
  5. PASSLIM has not been reached

If HDXSP=NO the sequence of service to physical units on a link is defined by the SERVICE macro ORDER operand. If HDXSP=YES, polling sequence is defined by the ORDER operand, but output is sent as soon as a PIU arrives.

The labels of physical units must be defined at least once and may be defined more than once in the ORDER operand. If there are three physical units on a link labeled PU1, PU2, and PU3, the SERVICE macro ORDER operand must include the three labels in any sequence. An example would be:

```
SERVICE   ORDER=(PU1,PU2,PU3)
```

The link scheduler checks each physical unit for output and/or input in turn (HDXSP=NO). The MAXOUT and PASSLIM operands are coded to limit the quantity of output to a given physical unit. A physical unit may be given priority by repeating the entry in the ORDER operand. For if priority is to be provided for PU1, the ORDER operand could be coded:

```
SERVICE   ORDER=(PU1,PU2,PU1,PU3)
```

In this example PU1 is checked for service in every alternate selection. In selection for service, PU1 has priority. The quantity of service during selection is defined by the PASSLIM operand. If PU1 is coded with PASSLIM=1 and PU2 is coded with PASSLIM=7, PU2 has a priority of service once it is selected.

The HDXSP=NO operand specifies that link scheduler service is to occur in service order table sequence with output priority. Each physical unit is searched in turn, first for output as limited by MAXOUT and PASSLIM, second for polling.

HDXSP=YES causes outgoing data that is ready for transmission to be sent at the first opportunity without having to wait for selection in the service order table sequence.

Consider the definition in Figure 7 on page 29.

```
          LINE      ADDRESS=020,
                    HDXSP=NO

          SERVICE   ORDER=(PU1,PU2,PU3)

     PU1  PU        MAXOUT=7,
                    PASSLIM=7

     LU11 LU        PACING=(1,1)


     PU2  PU        MAXOUT=7,
                    PASSLIM=7

     LU21 LU        PACING=(1,1)


     PU3  PU        MAXOUT=7,
                    PASSLIM=7

     LU31 LU        PACING=(1,1)
```

Figure 7. Half Duplex Link Scheduling, HDXSP=NO

Link scheduling occurs in sequence for PU1, PU2, and PU3. Each physical unit is checked first for output before polling. Up to 7 frames may be sent before polling for an SDLC response (MAXOUT). Up to 7 frames may be sent before selecting the next physical unit (PASSLIM).

In Figure 7 with PACING=(1,1) and a single logical unit per physical unit, only one data PIU would ever be on a physical unit queue because of the requirement for a pacing response. If the PIU can be transmitted as a single frame (not segmented) with no additional frame to send, the physical unit is polled with a ready to receive (RR), and MAXOUT and PASSLIM counters are reset. If the PIU cannot be transmitted as a single frame, the PIU is segmented into MAXDATA frames before it is placed on the link queue. PIU segments are sent until the MAXOUT/PASSLIM is reached or all segments are sent.

If the HDXSP operand in Figure 7 is changed to HDXSP=YES then arriving outbound data is sent without regard to the normal service order table sequence. As an example, assume that no outbound data is available for any physical units. The link scheduler selects PU1, and with no output to be sent, polls PU1. Before the response to polling arrives, a PIU is queued for PU3. When the response to polling PU1 arrives, the PIU for PU3 is sent. After the PIU is sent, without ready to receive (RR) polling, normal selection continues with PU2.

Another consideration for MAXOUT and PASSLIM is segmentation. All segments should be sent as a group to allow the complete message to be processed by the destination LU. If the maximum message is 2,000 bytes, MAXDATA is 265, and each segment is a full 265 bytes (256 bytes of RU plus TH), nine segments may be required to send a full message. To ensure the full message is sent, PASSLIM should be coded with a value of 9 or greater. When all frames have been sent and polling occurs, the PASSLIM is reset; therefore, a large value has the effect of sending all available frames.

Consider the definition in Figure 8. Assume each LU has a queued full screen segmented into nine frames each. Also assume that PU1 has the first group of nine segments queued for LU12 and the second group of nine segments queued for LU11. When PU1 is selected for output, the first seven frames for LU12 are sent. Because MAXOUT has been reached, RR or RNR polling occurs. Data frames may be received in response to RR polling. When the link level response is received (final bit from PU1), seven more frames are sent; two to LU12, and five to LU11. Polling occurs between segments for the SDLC link level acknowledgment. The last four segments are sent to LU11 followed by polling.

When PASSLIM has a high value and segmented PIUs are available, all segments are sent which allows that LU a begin work. PIUs for other LUs may be delayed for a short time, but the alternative is to send a portion of a PIU to each LU, and no LU being able to begin processing until the last segment has arrived.

```
          LINE      ADDRESS=020
                    HDXSP=NO

          SERVICE   ORDER=(PU1,PU2,PU3)

     PU1  PU        MAXOUT=7,
                    PASSLIM=254

     LU11 LU        PACING=(1,1)
     LU12 LU        PACING=(1,1)


     PU2  PU        MAXOUT=7,
                    PASSLIM=254

     LU21 LU        PACING=(1,1)
     LU22 LU        PACING=(1,1)
```

Figure 8. Half Duplex Link Scheduling, Segmentation

# CHAPTER 7. FULL DUPLEX LINK SCHEDULER LOGIC

The macros and operands covered in this topic are:

```
SERVICE  ORDER=(label1,...)

LINE     ADDRESS=(nnn,nnn)

PU       DATMODE=HALF|FULL,
         MAXOUT=n,
         PASSLIM=n
```

Full duplex link scheduler logic for SDLC links is selected when two scanner addresses are defined in the ADDRESS operand of the LINE macro. When two scanner addresses are defined, concurrent transmit and receive is supported. The first line is for transmit only; the second for receive only.

NOTE: DUPLEX=FULL or DUPLEX=HALF defines the interface between the 3705 line set and the modem, and does not define alternate or concurrent data transfer.

The link scheduler can transmit and receive concurrently, however not all physical units can transmit and receive concurrently. With two line addresses, the NCP can send to one physical unit while receiving from the same or a different physical unit. Physical units on a full duplex link which support concurrent transmit and receive should be coded DATMODE=FULL. As an example, the link between two NCPs should have the PU definitions coded DATMODE=FULL (the default). Some models of the 3770 terminal support DATMODE=FULL.

Type 1 and type 2 physical units which are coded (or default to) DATMODE=HALF are supported by the link scheduler as alternate transmit and receive.

## 7.1 FULL DUPLEX NCP TO NCP LINK SCHEDULER LOGIC

ACF/NCP/VS Release 2.1 and Release 3 full-duplex SDLC link scheduler changes have improved both the buffer requirements and link throughput for full-duplex links between NCPs. This improves performance on satellite and terrestrial links.

A link between two NCPs is defined with one NCP providing polling and the second NCP responding to polling. In NCP Release 2.1 the primary or secondary status is defined by the user; Release 3.0 determines the primary/secondary status at activation of the link with the higher subarea as primary.

Full-duplex link scheduler logic is selected when two scanner addresses are coded in the ADDRESS operand of the LINE macro. When two scanner addresses are defined, concurrent transmit and receive is supported. The first line is for transmit only; the second for receive only.

### 7.1.1 PRIMARY LINK SCHEDULER LOGIC

The primary link scheduler schedules both the transmit and receive links. The receive link is scheduled by the transmission of a poll, a Receive Ready (RR) or a Receive Not Ready (RNR) with the poll/final bit B'1'. The receive link is unscheduled when a poll response is received with the poll/final bit B'1'. To ensure that the receive link is scheduled, whenever the transmit link is available between transmitted data frames, the status of the receive link is checked. If the receive link is unscheduled, the transmission of a poll has priority over transmission of data frames.

After activation, the primary link scheduler can transmit at any time. The recommended operand values of MAXOUT=7 and PASSLIM=254 are assumed. If data frames are available to transmit, the primary can send frames until seven data frames are outstanding. If outstanding frames are acknowledged during the transmission, the total series of frames may exceed a count of seven, but at no time may more than seven frames be outstanding without a link level acknowledgement. The sequence count for outstanding frames is a three-bit field.

NOTE: If a response to polling is not received (data or control) before the primary REPLYTO time limit is reached, a timeout error occurs.

### 7.1.2 SECONDARY LINK SCHEDULER LOGIC

The secondary link scheduler must be prepared to receive at all times over the receive link. The secondary link scheduler may only send over the transmit link after receipt of a Receive Ready (RR) poll with the poll/final B'1' and until the secondary sends a poll response with poll/final B'1'.

If data frames are available to transmit when an RR poll is received, the secondary can send frames until seven data frames are outstanding. If data frames are not available to transmit when an RR poll is received, it is desirable on a point-to-point link to hold the poll for some time waiting for frames to arrive.

The PAUSE parameter has a new definition on the secondary end of a local/local link. The PAUSE parameter is not documented as valid on a secondary, but will be added to later documentation. The PAUSE parameter defaults to .2 seconds on the secondary link. PAUSE defines the period of time the secondary may defer an ending response to polling.

When the secondary receives a Receive Ready (RR) with the poll bit on (b'1'), if data frames are available, frames are sent to the primary until all frames are sent or seven frames are outstanding without acknowledgement from the primary. If no data frames are available to send, the secondary sends a Receive Ready (RR) with the poll/final B'0', and sets a timer for PAUSE value. If data frames arrive for transmission during the PAUSE timer value the data frames are transmitted.

NOTE: If data frames do not arrive during the PAUSE, the PAUSE value must provide a response to the primary before the primary REPLYTO limit is reached.

The secondary sends RR with the poll/final when:

1. no data frames are available to send and the PAUSE timer has expired, or

2. seven data frames are outstanding to the primary without a link level response.

When no data frames are available to send to the primary, as each data frame is received from the primary, the secondary sends an RR link level response with a poll/final B'0'. Therefore, the primary continues to receive link level responses and can continue sending frames until:

1. seven data frames are outstanding to the secondary without a link level response, or

2. no data frames are available to send, or

3. the secondary has sent a RR with the poll/final B'1' and the receive link must be rescheduled by transmitting a poll.

When no data frames are available to send the primary, during the PAUSE timer value, as frames are received from the primary each frame is immediately acknowledged by a Receive Ready (RR) with the poll/final B'0'. If the primary receives acknowledgement of transmitted frames before the MAXOUT limit is reached, the primary can continue to send without polling for a receive sequence count acknowledgment. Polling would only occur when the PAUSE expires, which requires the secondary to send a Receive Ready with the poll/final B'1', and the primary must transmit a poll again.

If the secondary is sending frames to the primary and no data frames are available in the primary to send to the secondary, the primary acknowledges each frame by an RR with the poll/final bit B'0' to allow continuous link level acknowledgements. Unless the modulo count (SDLC frame counter) is reached, the secondary could send without ending the poll.

The primary can send frames during the secondary poll PAUSE with the secondary sending RR with the poll/final bit B'0' until the PAUSE expires. When the PAUSE expires, the secondary sends RR with the poll/final bit B'1' and requires polling by the primary.

NOTE: Full-duplex secondary PAUSE should be equal to or greater than the primary PAUSE. Half-duplex secondary PAUSE should be one-half the primary PAUSE.

### 7.1.3 LOCAL/LOCAL LINK EXAMPLES

In the following figures, the primary is on the left, the secondary on the right. The following abbreviations are used:

| | |
|---|---|
| RR/B'0' | Receive Ready, poll/final of 0 |
| RR/B'1' | Receive Ready, poll/final of 1 |
| PIUn | Path Information frame number n |

Figure 9 illustrates a primary poll which results in the secondary (1) setting a timer for PAUSE value, and (2) sending a response to poll without the final bit on. The RR B'0' resets the REPLYTO in the primary. With no traffic to send in either direction, when the PAUSE timer expires, a response to poll with a final bit on is sent to the primary.

The PAUSE in the secondary before the ending response saves cycles in the primary and secondary NCPs by both waiting for traffic without unnecessary polling and responses.

```
         Primary                          Secondary
     Transmit  Receive                Transmit     Receive

     ----------------- RR/B'1' --------------------->:
                <----- RR/B'0' ----------            :
                                                     :
                                                   PAUSE
                                                     :
                <----- RR/B'1' ----------          (end)
```

Figure 9. Full Duplex, No Traffic

Figure 10 illustrates a primary poll which results in the secondary (1) setting a timer for PAUSE value, and (2) sending a response to poll without the final bit on. During the PAUSE, as each data PIU is received from the primary the secondary sends a response to poll without the final bit. This response provides a link level acknowledgement to the primary without ending the outstanding poll of the secondary and resets the REPLYTO in the primary. With no traffic to send by the secondary, when the PAUSE timer expires, a response to poll with a final bit on is sent to the primary.

During the PAUSE the secondary can send PIUs if they arrive. Because the primary does not receive an end to polling, the primary continues to send data frames without the necessity of repolling the secondary. More data PIUs are transmitted without polling overhead.

```
        Primary                               Secondary
   Transmit   Receive                     Transmit      Receive

   -------------------- RR/B'1' ------------------------->:
              <-------- RR/B'0' -----------               :
   -------------------- PIU1 ---------------------------->:
              <-------- RR/B'0' -----------             PAUSE
   -------------------- PIU2 ---------------------------->:
              <-------- RR/B'0' -----------               :
              <-------- RR/B'1' -----------             (end)
```

Figure 10. Full Duplex, Traffic on Primary Only

Figure 11 on page 36 illustrates a primary poll which results in the secondary (1) setting a timer for PAUSE value, and (2) sending data PIUs in response to poll. The secondary has data PIUs to transfer during and following the expiration of the PAUSE timer period. As each data PIU is received by the primary, the primary sends a response to poll without the final bit. This response provides a link level acknowledgement to the secondary. The REPLYTO in the secondary is set to 0 (NONE), so it is not reset in the secondary. The secondary does not end the outstanding poll until (1) the PAUSE timer has expired, and (2) the last PIU has been sent by the secondary or seven frames are outstanding.

The link level response by the primary allows the secondary to send PIUs until all PIUs are sent or until seven frames are outstanding without acknowledgement.

```
          Primary                                 Secondary
     Transmit  Receive                       Transmit     Receive

      ───────────────────── RR/B'1' ──────────────────────────>:
                   <─────── PIU1 ────────────────                :
      ───────────────────── RR/B'0' ──────────────────────────>:
                   <─────── PIU2 ────────────────                :
      ───────────────────── RR/B'0' ──────────────────────────>:
                   <─────── PIU3 ────────────────            PAUSE
      ───────────────────── RR/B'0' ──────────────────────────>:
                   <─────── PIU4 ────────────────                :
      ───────────────────── RR/B'0' ──────────────────────────>:
                   <─────── PIU5 ────────────────            (end)
      ───────────────────── RR/B'0' ──────────────────────────>
                   <─────── PIU6 ────────────────
                             ....
                             ....
                (to last PIU or 7 outstanding)
                   <─────── RR/B'1' ────────────
```

Figure 11. Full Duplex, Traffic on Secondary Only

Figure 12 on page 37 illustrates a primary poll which results in the secondary (1) setting a timer for PAUSE value, and (2) sending a series of data PIUs. The primary and secondary have data PIUs to transfer during and following the expiration of the PAUSE timer period. As each data PIU is received by the primary or secondary, the outstanding sequence count is updated. Each data PIU provides a link level acknowledgement to the receiver of previously transmitted frames. The secondary does not end the outstanding poll until (1) the PAUSE timer has expired, and (2) the last PIU has been sent by the secondary or seven frames are outstanding.

The acknowledgment of received frames by the transmission of data frames allow both primary and secondary to send data frames without polling or non-data polling responses. This eliminates polling and non-data polling response overhead.

```
           Primary                              Secondary
     Transmit  Receive                    Transmit      Receive

     ----------------- RR/B'1' --------------------->:
              <------ PIU1 ------------            PAUSE
     ----------------- PIUA ------------------------>:
              <------ PIU2 ------------              :
     ----------------- PIUB ------------------------>:
              <------ PIU3 ------------            (end)
     ----------------- PIUC ------------------------>
              <------ PIU4 ------------
                       ....
                       ....
     ----------------- PIU(n) ---------------------->
              <------ PIU(m) -----------
     ----------------- PIU(n+1) -------------------->
              <------ PIU(m+1) ---------
                       ....
              (to last PIU or 7 outstanding)
              <------ RR/B'1' ----------
```

Figure 12. Full Duplex, Traffic on Both Primary and Secondary

### 7.1.4 SATELLITE SERVICE

Satellite delay varies ground station to ground station from 240 to 350 milliseconds, depending upon the distance of the station from the equator. This averages 295 milliseconds one way between stations. Additional ground station overhead adds approximately 100 milliseconds for a one way time of approximately 400 milliseconds. Estimating a round trip delay of 800 milliseconds plus any ground delay between the ground station and data terminal equipment should define a maximum delay. In the following, only the 295 milliseconds delay is considered.

Assuming NCP to NCP transfer on a full duplex facility, for continuous data transfer the first frame acknowledgement must be received before the MAXDATA limit is reached. This means that after the last character of the first frame has been sent, there is an average satellite delay of 590 milliseconds for the response frame to reach the sending earth station (295 milliseconds to receiving station and 295 milliseconds for the link level response to return). Therefore, the transmitting station must have 590 milliseconds of data to transfer plus other overhead in the second through seventh frames to allow continuous frame transfer without reaching MAXOUT and ending the sequence for an RR or RNR response.

With an RU of 256 bytes and seven frames, a 19.2kb link provides such service. A 56kb link reaches the MAXOUT and delays for a link level response to where the link is 30% or less utilized. A multi-link transmission group of links at 19.2 is required for effective utilization of satellite service.

See Appendix E, RU Analysis for additional information.

## 7.2 FULL DUPLEX NCP TO TYPE 1 OR TYPE 2 PHYSICAL UNIT LINK SCHEDULER LOGIC

If a full duplex SDLC link has a single physical unit attached, the physical unit should be able to transmit and receive concurrently (DATMODE=FULL) or the full duplex capability of the data link will not be used. If the physical unit is full duplex (DATMODE=FULL) and only one station is on the line, PASSLIM=254 and MAXOUT=7 should be coded as in Figure 9 on page 34, Figure 10 on page 35, Figure 11 on page 36, or Figure 12 on page 37.

Multiple physical units on a full duplex link may have a mix of half duplex and full duplex physical units on the link. The DATMODE operand should be coded appropriately for each physical unit.

A full duplex link has a service order table address pointer for the receive link and for the transmit link. As transmit and receive scheduling occurs the pointers may point to different or the same physical unit. When both addresses point to the same physical unit, if that physical unit is coded DATMODE=FULL, concurrent send and receive may be scheduled.

If DATMODE=HALF, the physical unit is not supported for concurrent send and receive. If the transmit address is incremented and points to the same physical unit as the current polling address, the transmit address is incremented to the next entry in the service order table. If the receive address is incremented and points to the same physical unit as the current transmit address, polling is suspended until the output physical unit reaches end of PIUs, MAXOUT, or PASSLIM.

The full duplex link scheduler logic attempts to schedule both the receive address and transmit address as required. The receive address is scheduled by polling a physical unit; polling is initiated by sending a poll on the transmit address.

As an example, whenever the receive address becomes available, if the transmit address is busy, the receive scheduling must wait until the transmit scheduler is available to transmit polling characters.

Whenever the transmit address is available (between frames), the receive address is checked to see if polling is required. If the receive address is available, the transmit leg must transmit polling characters to reschedule the receive link. When the transmit address is available (after transmitting the polling frame), the transmit link is scheduled for output.

The rules for link scheduling for concurrent send and receive are:

- A maximum of one PIU per LU/LU session on a physical unit link queue, but a PIU may be segmented into multiple frames.
- After each PIU is transmitted, polling is attempted if there is no outstanding poll.
- When the last PIU on a physical unit queue is sent, the physical unit is polled, and MAXOUT and PASSLIM counters are reset to zero.
- If DATMODE=HALF, and if the polling and transmit point to the same physical unit, then transmit up to PASSLIM or MAXOUT.
- If the MAXOUT limit is reached (and PASSLIM is not reached) the current physical unit must be polled before more frames are sent. Because PASSLIM has not been reached, frames may not be sent to any other physical unit until PASSLIM or end of frames is reached. Polling continues through the service order table until the polling and transmit pointers are equal; then poll to get a response from the station whose MAXOUT was reached.
- If PASSLIM is reached, then increment the transmit pointer.
- If an SDLC response to polling of receive not ready (RNR) is returned, no PIUs may be be sent until a polling response of ready to receive (RR) is received.
- If DATMODE=HALF, send frames up to PASSLIM but do not poll the station if all of the following conditions are true:

  1. The receive pointer is not equal to the transmit pointer
  2. PASSLIM is less than MAXOUT
  3. Additional frames are available on the link queue
  4. Receive not ready (RNR) was not received

If any of the above conditions are not true, then poll the station.

Figure 13 on page 40 illustrates the address pointers for a full duplex link with three physical units.

```
LINE    ADDRESS=(020,021)

SERVICE ORDER=(PU1,PU2,PU3)

PU1  PU       DATMODE=HALF
              MAXOUT=7,
              PASSLIM=7

PU2  PU       DATMODE=HALF
              MAXOUT=7,
              PASSLIM=7

PU3  PU       DATMODE=FULL
              MAXOUT=7,
              PASSLIM=7
```

Figure 13. NCP Full Duplex to Type 1 or Type 2 Physical Units

Initially the poll pointer (receive) and select pointer (transmit) both point at the first physical unit, PU1. When no PIUs are queued for output, the select link is used only for polling. In this case assume multiple PIUs are available for PU1 and PU3.

Because the receive link is available, the polling frame for PU1 is scheduled for transmission. After the poll frame has been sent, the transmit link becomes available.

The transmit link scheduler checks to see if the receive leg is busy. The poll response for PU1 is pending, therefore the transmit link checks for queued data for transmission. One or more PIUs are available for transmission, so the scheduler checks for the select pointer to check the current physical unit for a queued frame. The select pointer to PU1 has a frame, but the select pointer is the same address as the current poll pointer. When a frame is available to be sent to PU1 the physical unit is checked for DATMODE=HALF or DATMODE=FULL.

PU1 is coded DATMODE=HALF, therefore the frame cannot be sent until the polling completes. The select pointer is incremented to PU2. If no frame is available for PU2, the select pointer is increment to PU3. Because a frame is available on PU3, the frame is scheduled on the transmit link. Both links are scheduled; the receive link has an outstanding poll for PU1 and may send data; the transmit link is sending a frame to PU3.

When the response to polling completes on the receive link, the link scheduler cannot poll again until the transmit link finishes sending the current frame. In the previous example, the current frame is the frame being sent to PU3.

As each frame has been sent the receive link is checked for availability. In this example the poll pointer is incremented to PU2, and the transmit link sends a poll for PU2. When the poll has been transmitted, the transmit link checks the current entry, PU3, for another frame to send.

Before sending the second frame, the PU3 MAXOUT and PASSLIM parameters are checked against a frame counter. If MAXOUT has been reached no additional frames can be sent until the physical unit has been polled. If PASSLIM has been reached, no additional frames can be sent until the next time the physical unit is scheduled. Neither limit has been reached. The current address of the service order table receive pointer is checked against the transmit pointer. The receive and transmit pointers are different physical units, so the second frame is transmitted.

When the response to polling completes for PU2, the link scheduler must wait for the transmit link to complete.

After the second frame has been sent to PU3, the poll pointer is incremented to PU3, and PU3 is polled. Before sending the third frame, the PU3 MAXOUT and PASSLIM parameters are checked against a frame counter. MAXOUT and PASSLIM have not been reached. The receive and transmit pointers do point to the same physical unit. DATMODE=FULL is coded for PU3, therefore concurrent transmit and receive is supported. Frame three is transmitted. When PU3 has been serviced, the service order table pointers are updated to service PU1.

## CHAPTER 8. ADDITIONAL PERFORMANCE OPERANDS

The following operands are primarily related to error conditions or timing problems. There are operands at the channel which also affect performance.

This section reviews the previous operands and adds operational operands which may impact SDLC link scheduling performance. The macros and operands in this section are:

```
BUILD       ACTIVTO=count|NONE,  (Release 3 only)
            DIALTO=60.0|count,
            DSABLTO=3.0|count,
            ENABLTO=2.2|count,
            SLODOWN=12|25|50,
            TRANSFR=n

SDLCST      GROUP=
            IRETRY=
            MAXOUT=
            MODE=
            PASSLIM=
            RETRIES=
            SERVLIM=
            TADDR=
            TRANSFR=

GROUP       ACTIVTO=count|NONE,  (Release 2 only)
            REPLYTO=1.0|n,
            TEXTTO=n

LINE        ADDRESS=nnn|(nnn,nnn),
            HDXSP=NO|YES,
            PAUSE=.2,
            REDIAL=(m,t,n,t),
            RETRIES=(1,1,2),
            SERVLIM=4,
            TRANSFR=n

SERVICE     ORDER=(PU1,PU2,PU1,PU3)

PU          DATMODE=HALF|FULL,
            IRETRY=NO|YES,
            MAXDATA=n,
            MAXOUT=n,
            PASSLIM=n,
            RETRIES=(,t,n)

LU          BATCH=YES|NO,
            PACING=(n,n),
            VPACING=n or OPACING=n
```

## 8.1 BUILD MACRO SDLC PERFORMANCE OPERANDS

```
ACTIVTO=count|NONE,   (Release 3 only)
DIALTO=60.0|count,
DSABLTO=3.0|count,
ENABLTO=2.2|count,
SLODOWN=12|25|50,
TRANSFR=n
```

### 8.1.1 ACTIVTO=COUNT|NONE,

The NCP Release 3 BUILD macro operand of ACTIVTO specifies the time that the secondary (polled) NCP allows to elapse since polling or addressing from the polling NCP. When the time elapses the NCP enters Automatic Network Shutdown. NCP Release 2.1 defines this operand on the GROUP macro.

### 8.1.2 DIALTO=60.0|COUNT

SDLC autodial lines use the SNA Connect Out command to dial a physical unit. The DIALTO operand defines the time for the physical unit to answer the call. The default is 60 seconds.

See the LINE macro REDIAL operand.

### 8.1.3 DSABLTO=3.0|COUNT,

When a link is disabled, if the 'data set ready' lead doesn't drop in DSABLTO time an error indicator is sent to the host. For a switched link this is detected at Abandon Connection.

### 8.1.4 ENABLTO=2.2|COUNT,

When a link is enabled, if the 'data set ready' lead doesn't turn on in ENABLTO time an Inoperative SNA command is sent to the host. For a nonswitched link this is detected after the Activate Link command has been acknowledged. For a switched link it is detected after a Connect Out (dial) or Activate Connect In (answer) command.

### 8.1.5 SLODOWN=12|25|50,

The SLODOWN operand defines the percent of remaining NCP buffers at which NCP enters slowdown. During slowdown the NCP transmits SDLC frames and polls for a link level response with Receive not Ready (RNR) polling.

### 8.1.6 TRANSFR=N

The TRANSFR operand on the BUILD macro provides the default value for the TRANSFR operand on the LINE macro which defines the maximum PIU or PIU segment to be received on a line. If a PIU or PIU segment requires more buffers than TRANSFR allows the SDLC frame is discarded. The polling sequence number is the only indication of rejection of the frame; it is necessary to check the sequence number of the transmitted SDLC frame against the sequence number of the SDLC response. The response sequence number is the next expected sequence number. If the sequence numbers are the same, the frame has been rejected.

The TRANSFR operand on the BUILD macro defines the maximum NCP buffers to be used for a single PIU or PIU segment to be sent to the host. If a PIU segment is received from a physical unit by the NCP, the segment is sent to the host as a segment. If PIU segments are assembled into a PIU, the host must provide the support. The NCP does not segment PIUs going to a host or on a link to another NCP.

## 8.2 SDLCST MACRO SDLC PERFORMANCE OPERANDS

The following operands apply to transmission groups. Two SDLCST macros are required, one for primary mode and one for secondary mode (See MODE operand). Each SDLCST macro must point to a GROUP macro appropriate for the MODE operand. If MODE=PRIMARY, the GROUP operand must point to a GROUP macro which is coded POLLED=YES. If MODE=SECONDARY, the GROUP operand must point to a GROUP macro which is coded POLLED=NO.

These GROUP macro operands are used after connection <u>instead of the GROUP macro which precedes the real LINE definition.</u> It is highly recommended that the GROUP macros referenced by the SDLCST macro be standalone GROUP macros, not GROUP macros associated with real link definitions as some operands are changed at connect time of transmission groups.

For operands other than GROUP and MODE, see the GROUP and LINE macro operands of the same name.

```
GROUP=
IRETRY=
MAXOUT=
MODE=
PASSLIM=
RETRIES=
SERVLIM=
TADDR=
TRANSFER=
```

### 8.2.1 GROUP=NAME

The GROUP operand must identify an SDLC GROUP macro definition which is valid for 1) primary (MODE=PRIMARY), or 2) secondary (MODE=SECONDARY). It is highly recommended that the GROUP macros referenced by SDLCST macros be standalone GROUP macro, not GROUP macros associated with real link definitions as some operands are changed at connect time of transmission groups.

### 8.2.2 MODE=PRIMARY|SECONDARY

The MODE operand specifies if this SDLCST is in support of a primary or secondary definition. The MODE should correspond to the GROUP macro identified in the GROUP operand.

## 8.3 GROUP MACRO SDLC PERFORMANCE OPERANDS

```
ACTIVTO=count|NONE,
REPLYTO=1.0|n,
TEXTTO=3.0|n
```

### 8.3.1 ACTIVTO=COUNT|NONE

The NCP Release 2.1 GROUP macro operand of ACTIVTO specifies the time that the secondary (polled) NCP allows to elapse since polling or addressing from the polling NCP. When the time elapses the NCP enters Automatic Network Shutdown. NCP Release 3 defines this operand on the BUILD macro.

### 8.3.2 REPLYTO=1.0|N,

If the NCP does not receive a response to RR or RNR polling, addressing, or message text before the specified time expires, a time-out error is indicated, and error recovery is initiated as defined in the RETRIES operand on the LINE and/or PU macro.

Recovery for an SDLC command of set normal response mode (SNRM) is to reschedule the command. If one or more terminals are in an active/pending state, each time the link scheduler enters the special poll mode, normal polling and data transfer is suspended until the SNRM is sent and REPLYTO time expires. If a physical unit is turned off or not connected to the link, and is in a contact pending state, it will impact performance of active terminals on the link.

On an NCP to NCP link, the REPLYTO on a polling (primary) PUTYPE=4 must allow for a PAUSE value coded on a polled PUTYPE=4. The PAUSE value allows the polled physical unit to hold the poll for PAUSE time before responding when no PIUs are available to be sent. Secondary NCPs have a REPLYTO=NONE; the ACTIVTO operand defines failure recognition.

### 8.3.3 TEXTTO=3.0|N,

The TEXTTO operand defines the time-out value, in seconds, between any two successive data characters received from a station, which results in the ending of the current poll with an error indication. The default value 3.0 seconds for an SDLC link.

See the LINE macro RETRIES operand for the definition of error recovery.

## 8.4 LINE MACRO SDLC PERFORMANCE OPERANDS

```
ADDRESS=nnn|(nnn,nnn),
HDXSP=NO|YES,
PAUSE=.2|n,
REDIAL=(,t1,n,t2),
RETRIES=NONE|(m,t,n),
SERVLIM=4|n,
TRANSFR=n
```

### 8.4.1 ADDRESS=NNN|(NNN,NNN)

The ADDRESS operand defines alternate send and receive by a single scanner address or concurrent send and receive by two addresses. The first address is the transmit link, and the second address is the receive link.

### 8.4.2 HDXSP=NO|YES

HDXSP only applies to an SDLC link with a single scanner address, alternate send and receive. HDXSP=NO specifies that physical units are serviced in the sequence defined in the SERVICE macro. HDXSP=YES specifies that physical units are serviced for input in the sequence defined in the SERVICE macro, however, output is sent to the appropriate station as it arrives from the host.

### 8.4.3 PAUSE=.2|N

The PAUSE operand provides two types of support. On the primary the PAUSE operand provides a polling delay on an SDLC link which performs polling. When an NCP is polled by another NCP, if no PIUs are available to send, the PAUSE operand allows the polled NCP to hold receive ready (RR) poll until a PIU arrives or until the PAUSE expires.

#### 8.4.3.1 Primary

When the SDLC link scheduler begins normal polling and selection service with the first entry in the service order table, a PAUSE timer is set. After the last entry in the service order table has been serviced, if the PAUSE timer has expired, service begins immediately with the first entry in the service order table (or special polling). If the PAUSE timer has not expired, polling service is suspended until the timer expires. The PAUSE does not affect output. Output is always sent as it arrives.

This operand is intended to provide a delay for nonproductive polling. The PAUSE value should be selected relative to the number of polled devices in the service order table and the time required to transmit a polling frame and receive a response. The delay provides additional 3705 machine cycles for processing rather than nonproductive polling.

#### 8.4.3.2 Secondary

The PAUSE operand provides a delay in sending a response to polling on an SDLC link which is polled. When no traffic is available to send and polling occurs, a timer is set for PAUSE time. If the time expires, a response to polling is sent. If a PIU arrives before the time expires, the PIU is sent in response to polling.

### 8.4.4 REDIAL=(,T1,N,T2)

The BUILD macro DIALTO defines a timeout failure for an attempt to dial. If the timeout expires, the REDIAL defines attempted error recovery.

The number of dialing operations within each sequence is provided by the access method; the first (omitted) operand is therefore not specified.

The t1 specifies the pause in seconds between successive dialing operations within each sequence. This time must be 0 or a multiple of 3 seconds. This time is in addition to the dialing time and DIALTO value plus the DSABLTO.

The n operand defines the number of sequences of dialing operations. A value of 255 defines an indefinite number of dialing sequences.

The t2 operand specifies the pause in seconds between successive sequences of dialing operations. The t2 value must be 0 or a multiple of 3 seconds.

### 8.4.5 RETRIES=NONE|(M,T,N)

The RETRIES operand specifies the number of attempts to recover from frame transmission errors. A transmission error may be a timeout, wrong frame check sequence, a data length exceeding TRANSFR without an ending flag, or a polling response indicating a 'next expected sequence number' requiring retransmission.

When the NCP is transmitting frames the NCP persists in retransmitting until it successfully sends the frame, until the maximum number of retries have been attempted, or until the secondary requests a disconnect (RD). An SDLC frame reject (FRMR), a polling response sequence number, or a timeout is the indication of an error.

When the NCP is receiving frames, the NCP indicates an error by polling the station with a sequence number indicating which frames were accepted and which frames were rejected. If an error occurs, the NCP repeats until (1) the frame is successfully received, (2) it has retried the receive operation the RETRIES defined limit, or (3) the station sends an abnormal response (for example, an SDLC request for initialization (RIM) or request disconnect (RD)).

The m value of retries may be defined as NONE (or 0), or 1 to 128. The default operand is (15,0,0).

The t value defines a delay of 0 to 255 seconds prior to repeating m retries for 1 to 127 retry sequences, the n value.

If m is 0 (or omitted), then both t and m must be 0 or omitted. If t is 0 (or omitted), n must be 0 (or omitted).

If n is omitted and t is not 0, n=1 is assumed if (n+1)*m is less than or equal to 128, and n=0 is assumed if (n+1)*m is greater than 128.

The n parameter specifies the number of repeats of (m,t) before indicating a permanent error condition. The default value for t is 0.

As an example, assume a frame transmission time (and response) of .5 seconds, and RETRIES=(7,5,6). The message is retransmitted 7 times for 3.5 seconds, plus a delay of 5 seconds, or 8.5 seconds. The sequence is repeated six times for 51.0 seconds; therefore, the total time required for a permanent error would be .5 (original transmit) plus 8.5 (first recovery) plus 51 (6 retries) for a total of 60 seconds. During this retry sequence time delay other stations on the link are serviced. A value of RETRIES=(1,1,2) delays other stations 4.5 seconds (1.5 plus 3.0).

If the error is indicated by a timeout, the above time is increased by the REPLYTO value for each retry error.

If the retries are not successful, an Inoperative record is sent to the host.

### 8.4.6 SERVLIM=4

The SERVLIM operand defines the number of passes through the service order table for normal service before attempting special service. Special service processes all SDLC commands except receive ready (RR) and receive not ready (RNR).

### 8.4.7 TRANSFR=N

The TRANSFR operand defines the maximum number of buffers allowed for receiving a single frame. If a PIU or PIU segment requires more buffers than TRANSFR allows, the SDLC frame is discarded. The polling sequence number is the only indication of rejection of the frame.

In calculating the number of buffers required for the maximum frame, the NCP Release 2.1 first buffer calculation must include 18 bytes for NCP prefix and allow for 10 bytes of transmission header (FID1 TH). Release 3 first buffer calculation must include 18 bytes for NCP prefix and allow for 26 bytes of transmission header (FID4 TH).

## 8.5 SERVICE MACRO SDLC PERFORMANCE OPERANDS

```
ORDER=(label,...)
```

### 8.5.1 ORDER=(LABEL,...)

The label of a physical unit may be repeated in the service order table to provide a priority service for that physical unit. MAXOUT and PASSLIM may also be used to give priority to selected physical units.

## 8.6 PU MACRO SDLC PERFORMANCE OPERANDS

```
AVGPB=n,            (Release 3)
DATMODE=HALF|FULL,
IRETRY=NO|YES,
MAXDATA=n,
MAXOUT=n,
PASSLIM=n,
RETRIES=(,t,n)
```

### 8.6.1 AVGPB=N (RELEASE 3)

The AVGPB operand specifies the average number of bytes expected from an SDLC station when the station is polled. This byte count is used to determine if enough buffer space exists to receive the expected data from a polled station. The value of n may be from the buffer size specified on the BUILD macro BFRS operand through 65,535 bytes.

Buffers are not physically allocated until required. If all stations respond to polling with data, the buffer pool may enter a slowdown condition. An alternative is to RR poll a station only when the expected buffer requirement is available. By defining the expected buffer requirements, buffers are reserved not by allocation but by commitment for the duration of the poll. If another station wants to initiate polling, polling may be delayed until committed buffers are freed. If another station is receiving data and physically requires more buffers than were committed, the buffers are provided to buffer depletion.

If a station normally responds to polling with a negative response the default of one buffer is the minimum. If the station normally responds with data, the AVGPB operand should be coded with the average byte count in the one to seven frames.

### 8.6.2 DATMODE=HALF|FULL

The DATMODE operand applies only to a full duplex link (an ADDRESS operand specifying two scanner addresses). The DATMODE operand defines a physical unit as being capable of half or full duplex mode. If DATMODE=HALF, the link scheduler will not attempt to send and receive concurrently to that device. If DATMODE=FULL, and if the poll and select pointers indicate the same device, concurrent send and receive does occur.

NOTE: The operand of DUPLEX=HALF|FULL defines the strapping between the 3705 line set and the modem for a line address and has no relationship to concurrent transmit and receive.

### 8.6.3 IRETRY=NO|YES

When a timeout (REPLYTO=) occurs following a polling operation, IRETRY=YES immediately repolls the station; IRETRY=NO polls the next station in the service order table, and retries the error polling in the next pass of the service order table.

This operand applies to data polling (RR or RNR) and does not affect special polling (SNRM or DISC).

### 8.6.4 MAXDATA=N

The MAXDATA operand defines the maximum data per frame to be transmitted to this physical unit. The value should relate to the BUILD macro BFRS operand to optimize the transmitted frame size for a minimum number of segmented frames. In most cases this is device dependent, e.g. 3274, 3276 MAXDATA=265 and 3271 SDLC models 11 and 12 MAXDATA=261.

### 8.6.5 MAXOUT=N

The MAXOUT operand defines the maximum number of frames transmitted before a link level response is required. When no frames are available on the physical unit for link transmission polling occurs without waiting for MAXOUT. When additional frames are to be sent without intervening incoming data, Receive not Ready (RNR) polling obtains the link level response without allowing incoming data.

The recommended value for this operand is 7 unless restricted by the device type. As an example, 3767 cannot accept more than 1 frame. Single frame control may be obtained by coding MAXOUT=1. When PACING=1, a PIU is not scheduled for that logical unit until a pacing response is received, however the PIU may consist of several segments in separate frames. When no frames are available for transmission, the physical unit is polled regardless of MAXOUT.

### 8.6.6 PASSLIM=N

The PASSLIM operand defines the maximum number of frames to be transmitted to this physical unit before servicing the next entry in the service order table.

If a single physical unit is defined in the service order table, or if the service order table is omitted, code PASSLIM=254.

Physical units which will receive segmented frames should have a high value if all segments are to be transmitted before going to the next entry in the service order table. As an example, PASSLIM may be coded for the maximum frames per screen multiplied by the number of LU/LU sessions to ensure all screens are complete before going on to the next physical unit.

### 8.6.7 RETRIES=(,T,N)

The error retry time delay and number of retry sequences covered in LINE macro RETRIES operand may be overridden at the PU level. The values coded (or defaulted) on the LINE macro RETRIES operand apply unless overridden by the PU macro RETRIES operand.

The retries timeout (t suboperand) and retry sequence count (n suboperand) may not be appropriate for all physical units on a line. If required, each physical unit may have a specific value rather than the line value.

## 8.7 LU MACRO SDLC PERFORMANCE OPERANDS

```
BATCH=YES|NO,
PACING=(1,1),
VPACING=n        (VTAM only)
```

ACF/TCAM provides the support defined by VPACING by coding the OPACING operand in TCAM on a TCAM TERMINAL macro in a TCAM message control program (MCP).

### 8.7.1 BATCH=YES|NO

The BATCH=YES selects a lower task dispatching priority for processing a PIU from the logical unit to the physical unit link queue. Because no LU/LU session may have more than one PIU on the physical unit link queue, if two PIUs on two sessions are available for service, the BATCH=NO session PIU is processed to the queue first. The BATCH=YES session PIU is processed before a second PIU from the other session would be processed.

### 8.7.2 PACING=(1,1)

NCP defined pacing provides default values. The first suboperand defines the number of PIUs in a pacing group; the second suboperand defines which of the PIUs carries the request for pacing response.

A nonzero pacing definition in an SNA Bind command overrides the default values in the NCP. If the Bind command provides a nonzero pacing value, the session pacing count is used from the Bind, and the first PIU of the group carries the request for pacing response. If the Bind command provides a zero pacing value, the NCP definition is used.

Pacing (or definite response) provides the limit for PIUs within an LU/LU session between the NCP and a type 1 or type 2 physical unit.

Inbound pacing, from a type 1 or type 2 physical unit, is defined in the Bind command.

### 8.7.3 VPACING=N (VTAM ONLY)

The VPACING operand defines the pacing of data from the host to the boundary node NCP. Although coded in the NCP definition, this parameter has no effect on the NCP generation or operation. It is used only by VTAM if the bind parameters define zero pacing values between the host and the NCP.

ACF/TCAM provides the support defined by VPACING by coding the OPACING operand on a TCAM TERMINAL macro.

# APPENDIX A: SNA COMMANDS FOR LINK, PU, AND LU ACTIVATION

## A.1 SNA COMMANDS

SNA commands are transferred between ACF/NCP and the host SSCP in a FID4 format if both nodes are SNA 4.2, or in a FID1 format if either or both nodes are SNA 4.1.

The FID1 Path Information Unit (PIU) contains a ten byte transmission header (TH), three byte request header (RH), and variable length request unit (RU).

NOTE: ACF/NCP Release 3 uses the FID4 for transmission to a host or NCP of equal release level; the FID0 or FID1 is imbedded within the FID4. Local flow control uses a FID4 TH (no RH) for pacing requests and responses.

The first byte of a transmission header (TH) identifies

- the format of the TH (FID0, FID1, FID2, FID3, or FID4)
- only segment, first segment, middle segment, or last segment
- expedited flow or normal flow

Commands are always an only segment. Depending upon the command type, the flow may be expedited or normal. An expedited command is placed as the first PIU on a queue. A normal command is queued at the end of a queue.

The first byte of a request header (RH) identifies

- the PIU as a command (formatted) or user data (unformatted)
- if it is a command, the RH identification subcategory: function management data, network control, data flow control, or session control
- the PIU as a request or response

The request unit of a command identifies the command and its parameters. The SNA commands are listed in ACF/NCP/VS Network Control Program Logic, Appendix A: Network Commands and ACF/NCP/VS Network Control Program - Program Reference Summary, Section 5: NCP Network Commands.

Exception responses are identified by RH byte 0, bit 5. Bit 5 with a value of 0 indicates no sense data is included. If this bit has a value of 1, the RU is displaced 4 bytes to allow for the sense data. The first 2 bytes (bytes 0 and 1) contain the exception response code. The second 2 bytes (bytes 2 and 3) contain user-specified sense information.

NCP exception responses generated within the ACF/NCP are listed in ACF/NCP/VS Network Control Program - Program Reference Summary, Section 9: NCP Exception Responses, LY30-3043 (Release 2.1) or LY30-3058 (Release 3)

If sense data is included, the RU is offset by the four bytes of sense data.

The FID1 format without sense data is:

TH - 10 bytes

RH - 3 bytes

RU - n bytes

The FID1 format with sense data is:

TH - 10 bytes

RH - 3 bytes

Sense - 4 bytes

RU - n bytes

The FID4 format without sense data is:

TH - 26 bytes

RH - 3 bytes

RU - n bytes

The FID4 format with sense data is:

TH - 26 bytes

RH - 3 bytes

Sense - 4 bytes

RU - n bytes

## A.2 SNA COMMANDS FOR NONSWITCHED SDLC LINKS

For a list of NCP Network Commands, refer to:

ACF/NCP/VS Network Control Program - Program Reference Summary, Section 5: NCP Network Commands, LY30-3043 (Release 2.1) or LY30-3058 (Release 3)

ACF/NCP Release 3 explicit routes and virtual routes are assumed active. The following identifies the command sequence for a nonswitched SDLC link.

- Activate Link - RU X'01020A'

  An Activate Link command is sent to the NCP for each SDLC link. The network address of the SDLC link to be activated is in bytes 3 and 4 of the Request Unit. The NCP initializes the line interface address but no input or output is allowed.

  The NCP sends a response to the host to acknowledge that the activate link command has been received. If the enable fails on a nonswitched link, an Inoperative command is sent to the host to indicate an error. This would occur after the response to Activate Link has been sent.

- Contact - RU X'010201'

  The Contact command is addressed to NCP physical services. The network address of the device to be contacted is provided in the request unit (RU) in bytes 3 and 4. The response to the Contact command is sent to the host prior to any attempt to perform the Contact.

  For a type 4 physical unit in NCP Release 3, an XID is exchanged to define the primary/secondary relationship; the primary then issues the Set Normal Response Mode (SNRM) SDLC command to the secondary. For a type 1 or type 2 physical unit the NCP sends an SDLC command of Set Normal Response Mode (SNRM) to the physical unit.

  If an SDLC unnumbered acknowledgement (UA) or Request Initialization Mode (RIM) response is returned from the physical unit, a Contacted command is sent from the NCP to the host to acknowledge the contact. If no response is received, a timeout occurs, and the SNRM is re-tried in a later control mode processing.

- Contacted - RU X'010280'

  The Contacted command is initiated by an Unnumbered Acknowledgement (UA) or Request Initialization Mode (RIM) SDLC response from a physical unit in answer to the Set Normal Response Mode (SNRM). This command provides the network address of the physical device contacted in the Request Unit (RU) in bytes 3 and 4.

  The Contacted command in byte 5 contains one of the following values:

  X'01' - Loaded, an SDLC UA was received

  X'02' - Load required, an SDLC RIM was received

  X'03' - Error on contact

- Activate Physical - RU X'11'

  The Activate Physical is the first command in this sequence which has a Destination Address Field (DAF) in the Transmission Header (TH) other than the address of NCP physical services. The Activate Physical command is addressed to the SDLC physical unit. This command is the first which can be sent to a physical unit.

If the device is a Type 2 Physical Unit, the command is transmitted to the physical unit. If the device is a Type 1 Physical Unit, the command is processed by the NCP and is not sent to the physical unit. If the device is a Type 4 Physical Unit, the command is processed by NCP physical services.

If this command is addressed to a type 1 physical unit, the NCP sends a response to the host.

If this command is addressed to a type 2 physical unit, the PIU is converted from FID1 to FID2, and sent to the physical unit.

When the command has been processed by the physical unit and the response is received by the NCP, the PIU is converted from a FID2 to a FID1 and the response is forwarded to the host.

The response RU contains the load module name generated by the control program for this type 2 and type 4 physical units.

The Activate Physical command completes the activation of the SSCP/PU session.

- Activate Logical RU X'0D'

The activate logical command is addressed to a specific logical unit. The command is converted from a FID1 to a FID2 for type 2 physical units and to a FID3 for type 1 physical units. The commands are transmitted on the link to the physical unit for processing, with the exception of type 1 physical unit 3270s. All commands for the type 1 physical unit 3270 (e.g. 3271 model 11, 12) are processed by the Network Control Program.

The response to the activate logical command is sent from the physical unit to the NCP as a FID2 or FID3. The NCP converts the response to a FID1 and sends the response to the host.

A positive response to this command completes the activation of the SSCP/LU session.

- Logon, Initiate Self, etc.

If the SSCP writes a 'ready' message to the terminal, a trace would show an unformatted message on the SSCP/LU session.

If the logical unit initiates the session, an unformatted logon or an initiate self command would flow from the logical unit on the SSCP/LU session. As an example, until an LU/LU session is initiated, any data entered at the terminal is processed as an unformatted logon. If the data matches a defined logon message, the application logon exit is driven to initiate a session.

If the session is initiated by an application, the Bind command would flow without the logon or initiate self. An automatic session is initiated by VTAM by coding LOGAPPL=name on the LU macro where name identifies the application or by coding in the application program. TCAM defines the application on a TERMINAL macro within TCAM.

- Bind RU X'31'

  The Bind command is sent from the host application to the logical unit identified in the destination address field (DAF). The FID1 is converted to a FID2 or FID3 and sent to the physical unit which is associated with this logical unit. (SDLC type 1 physical unit 3270 commands are processed by the NCP and not sent on the link.)

  The response to a Bind command is received by the NCP (or generated by the NCP for an SDLC 3270 model 11 or 12), converted to a FID1, and sent to the host. If the response is positive, the LU/LU session is active.

  The Bind command may provide pacing values. If pacing values are nonzero in the Bind, then those values are used. A zero pacing value in the Bind defaults to the values defined in the PACING (NCP), VPACING (VTAM), or OPACING (TCAM).

  The pacing fields are in the Bind RU at the following RU offsets:

  - Primary send (Host to NCP) - RU offset 12

  - Secondary receive (NCP to LU) - RU offset 9

  - Secondary send (LU to host) - RU offset 8

- Inoperative RU X'010281'

  The Inoperative command may be required at any point in the command sequences after the Activate Link command. The method of indicating an abnormal end or break in the processing on a link is for NCP physical services to send an Inoperative command to the host.

  The Inoperative command identifies the network address in the RU in bytes 3 and 4. If the Inoperative is for a failed link, the link network address is carried in the RU bytes 3 and 4 and a value of X'02' is placed in RU byte 5. If the Inoperative is for a physical device on a link, the physical unit network address is carried in the RU bytes 3 and 4 and byte 5 contains a X'01'.

  In addition to the Inoperative command, a Record Maintenance Statistics (RECMS) record is generated and sent to the host to record the error information.

  No response is requested from the host for an Inoperative command.

## A.3 SNA COMMANDS FOR SDLC SWITCHED LINKS

The following identifies the command sequence for a switched SDLC link.

- Activate Link - RU X'010209'

  An Activate Link command is sent to the NCP for each SDLC link. The network address of the SDLC link to be activated is in bytes 3 and 4 of the Request Unit. The NCP initializes the line interface address but no input or output is allowed. The modem is not enabled until a Connect In (answer) or Connect Out (dial) command is received.

  The NCP sends a response to the host to acknowledge receipt of the Activate Link command. The response does not indicate that the link is operational.

- Activate Connect In (answer) - RU X'010216'

- Connect Out (dial) - RU X'01020E'

  On a switched link, the link must either be enabled for answering an incoming call or provided with a telephone number for an outgoing call. One of the commands is issued for a switched link following an Activate Link command. The network address of the SDLC link to be enabled is in bytes 3 and 4 of the Activate Connect In or Connect Out command.

  The NCP sends a response to the host to acknowledge receipt of the command. The response does not indicate that the connection has occurred. When a connection is complete, the NCP sends a Request Contact command to the host.

  The Activate Connect In enables the link for an incoming call. The Connect Out command uses the autocall unit to dial the telephone number provided in the Connect Out RU starting at RU byte 9. When the connection is established, an SDLC command of XID is transmitted to the physical unit with a general poll address of X'FF'. The terminal ID identifies the physical unit type, hardware device type, and specific hardware or control program number. The XID response provides the terminal ID and NCP uses this to build a Request Contact command which is send to the host.

- Request Contact - RU X'010284'

  The Request Contact command informs the host that a physical connection has been established as a result of a Connect Out or Activate Connect In command. The network address of the link is carried in the RU in bytes 3 and 4, and the terminal ID received in the SDLC XID response is contained in the RU in bytes 5-10.

The hexadecimal value of the RU is:

| | |
|---|---|
| 0 | reserved |
| x | 1 for type 1 physical unit, 2 for type 2 physical unit |
| 0 | reserved |
| xxx | id block |
| xxxxx | id number |

- Set Control Vector (Physical Unit) - RU X'010211xx03'

  The NCP definition of the physical unit on this switched link provides an incomplete control block for any switched physical unit calling in or being called. The Set Control Vector Physical Unit provides the definition of a specific physical unit.

  The NCP uses the data provided to initialize the physical unit definition, starting at RU byte 7 as follows:

| Byte | |
|---|---|
| 3-4 | Network address |
| 5 | X'03' |
| 7 | Physical unit type (type 1 or 2) |
| 8 | Reserved |
| 9 | MAXOUT value |
| 10 | PASSLIM value |
| 11 | Immediate or deferred error recovery |
| 12-13 | Reserved |
| 14-15 | MAXDATA value |

  NCP initializes the control block representing the physical unit on this switched line and sends an acknowledgment to the host.

- Contact - RU X'010201'

  The Contact command is addressed to NCP physical services. The network address of the device to be contacted is provided in the request unit (RU) in bytes 3 and 4. The response to the Contact command is sent to the host prior to any attempt to perform the Contact. The NCP sends an SDLC command of Set Normal Response Mode (SNRM) to the physical unit.

  If an SDLC response of Unnumbered Acknowledgement (UA) Request Initialization Mode (RIM) response is returned from the physical unit, a Contacted command is sent from the NCP to the host to acknowledge the contact. If no response is received, a timeout occurs, and the SNRM is re-tried after some normal data traffic scheduling.

- Contacted - RU X'010280'

  The Contacted command is initiated by an Unnumbered Acknowledgement (UA) or Request Initialization Mode (RIM) SDLC response from a physical unit in answer to the Set Normal Response Mode (SNRM). This command provides the network address of the physical device contacted in the Request Unit (RU) in bytes 3 and 4.

  The Contacted command in byte 5 contains one of the following values:

  X'01' - Loaded, an SDLC UA was received

  X'02' - Load required, an SDLC RIM was received

  X'03' - Error on contact

- Activate Physical - RU X'11'

  The Activate Physical is the first command in this sequence which has a Destination Address Field (DAF) in the Transmission Header (TH) other than NCP physical services. The Activate Physical command is addressed to the SDLC physical unit. This command is the first which can be sent to a physical unit.

  If the device is a Type 2 Physical Unit, the command is transmitted to the physical unit.

  If the device is a type 1 physical unit, the command is processed by the NCP and is not sent to the physical unit.

  If this command is addressed to a type 1 physical unit, the NCP sends a response to the host. If this command is addressed to a type 2 physical unit, the PIU is converted from FID1 to FID2, and sent to the physical unit.

  When the command has been processed by the physical unit and the response is received by the NCP, the PIU is converted from a FID2 to a FID1 and the response is forwarded to the host.

  The response RU from a programmed physical unit contains the generated control program load module name.

  The Activate Physical command completes the activation of the SSCP/PU session.

- Request Network Address Assignment - RU X'410210'

  A pool of logical unit control blocks is created by the LUDRPOOL macro at NCP generation for use during SDLC switched connections and/or dynamic reconfiguration. The logical unit control blocks are not assigned to any switched link or physical unit at generation time.

The Request Network Address Assignment (RNAA) command requests the NCP to allocate the specified number of network addresses to the specified network resource and to update path control routing.

The RU fields in the RNAA are at the following offsets:

3-4 - Network address of the physical unit
5 - X'41' (allocate from the LUDRPOOL)
6 - Number of address to be assigned
7-n - Two byte entries, reserved byte and local address

NCP physical services sends a response to the host when the command has been processed and the network addresses have been assigned in the NCP. The response contains the halfword network addresses which were assigned beginning in byte 7.

- Set Control Vector (Logical Unit) RU X'010211xx04'

  The Set Control Vector (logical unit) command is sent to NCP physical services to provide initialization values for the LU network address in the RU bytes 3 and 4. A separate Set Control Vector (logical unit) command must be processed for each logical unit to be used during a switched connection.

  The command provides the following data at RU offsets of:

  3-4 - Network address
  5 - X'04'
  6 - Logical unit network address
  7 - n pacing count, count of PIUs
  8 - m pacing count, which PIU carries pacing request
  9 - Dispatching priority (BATCH operand of LU)

  When the logical unit control block has been initialized with the appropriate definitions a response is sent to the host.

- Activate Logical RU X'0D'

  The activate logical command is addressed to a specific logical unit. The command is converted from a FID1 to a FID2 for type 2 physical units and to a FID3 for type 1 physical units. The commands are transmitted on the link to the physical unit for processing.

  The response to the activate logical command is sent from the physical unit to the NCP as a FID2 or FID3. The NCP converts the response to a FID1 and sends the response to the host.

  A positive response to this command completes the activation of the SSCP/LU session.

- Logon, Initiate Self, etc.

  If the SSCP writes a 'ready' message to the terminal, a trace would show an unformatted message on the SSCP/LU session.

  If the logical unit initiates the session, an unformatted logon or an initiate self command would flow from the logical unit on the SSCP/LU session. If the session is initiated by an application, the Bind command would flow without the logon or initiate self.

- Bind RU X'31'

  The Bind command is sent from the host application to the logical unit identified in the destination address field (DAF). The FID1 is converted to a FID2 or FID3 and sent to the physical unit which is associated with this logical unit.

  The response to a Bind command is received by the NCP, converted to a FID1, and sent to the host. If the response is positive, the LU/LU session is active.

  The Bind command may provide pacing values. A nonzero Bind pacing value is used for a session. A zero pacing value in the Bind defaults to the values defined in the PACING (NCP), VPACING (VTAM), or OPACING (TCAM).

- Inoperative RU X'010281'

  The Inoperative command may be required at any point in the command sequences after the Activate Link command. The method of indicating an abnormal end or break in the processing on a link is for NCP physical services to send an Inoperative command to the host.

  The Inoperative command identifies the network address in the RU in bytes 3 and 4. If the Inoperative is for a failed link, the link network address is carried in the RU bytes 3 and 4 and a value of X'02' is placed in RU byte 5. If the Inoperative is for a physical device on a link, the physical unit network address is carried in the RU bytes 3 and 4 and byte 5 contains a X'01'.

  In addition to the Inoperative command, a Record Maintenance Statistics (RECMS) record is sent to the host to record the error condition.

  No response is requested from the host for an Inoperative command.

## APPENDIX B: NCP EXCEPTION RESPONSES

Exception responses are identified by RH byte 0, bit 5. If this bit has a value of 1, the RU is displaced 4 bytes to allow the 4 bytes of sense data to be included. The first 2 bytes (bytes 0 and 1) contain the exception response code. The second 2 bytes (bytes 2 and 3) contain the user-specified sense information.

The following exception response codes are generated by the NCP.

| | | |
|---|---|---|
| X'0801' | Request rejected: | resource not available |
| X'0802' | Request rejected: | intervention required |
| X'0803' | Request rejected: | missing password |
| X'0804' | Request rejected: | invalid password |
| X'0805' | Request rejected: | session limit exceeded |
| X'0806' | Request rejected: | resource unknown |
| X'0807' | Request rejected: | resource not available |
| X'0808' | Request rejected: | invalid contents ID |
| X'0809' | Request rejected: | mode inconsistency |
| X'080A' | Request rejected: | permission rejected |
| X'080B' | Request rejected: | bracket race error |
| X'080C' | Request rejected: | function not supported |
| X'080D' | Request rejected: | NAU contention |
| X'080E' | Request rejected: | LU not authorized |
| X'080F' | Request rejected: | end user not authorized |
| X'0810' | Request rejected: | missing requestor ID |
| X'0811' | Request rejected: | break |
| X'0812' | Request rejected: | insufficient resource |
| X'0813' | Request rejected: | bracket bid reject |
| X'0814' | Request rejected: | physical unit not active |
| X'0815' | Request rejected: | function active |
| X'0816' | Request rejected: | function inactive |
| X'0817' | Request rejected: | link inactive |
| X'0818' | Request rejected: | link procedure in progress |
| X'0819' | Request rejected: | RTR not required |
| X'081A' | Request rejected: | procedure error |
| X'081B' | Request rejected: | receiver in transmit mode |
| X'081C' | Request rejected: | function not executable |
| X'0820' | Request rejected: | control vector error |
| X'0821' | Request rejected: | invalid session parameters |
| X'0822' | Request rejected: | link procedure failure |
| X'0823' | Request rejected: | set control vector key not 1, 2, 3, 4, or 5 |
| X'0826' | Request rejected: | FM function not supported |
| X'082C' | Request rejected: | share limit exceeded |
| X'0833' | Request rejected: | invalid parameter |
| X'0840' | Request rejected: | procedure not valid for resource |
| X'084B' | Request rejected: | resource no available |
| X'084D' | Request rejected: | Bind parameter not acceptable by boundary function |
| X'0850' | Request rejected: | IPL/dump RPO tried on invalid station |
| X'0852' | Request rejected: | Control vector time of day |

X'1001' Request error: RU data error
X'1002' Request error: RU length error
X'1003' Request error: function unknown
X'1004' Request error: function not supported
X'1005' Request error: parameter error
X'1007' Request error: category not supported

X'2001' State error: sequence number
X'2002' State error: chaining
X'2003' State error: bracket
X'2004' State error: direction
X'2005' State error: data traffic not started
X'2006' State error: data traffic quiesced

X'4001' RH error: invalid SC or NC RH
X'4003' RH error: BB not allowed
X'4004' RH error: EB not allowed
X'4005' RH error: incomplete RH
X'4006' RH error: exception not allowed
X'4007' RH error: definite response not allowed
X'4008' RH error: pacing not supported
X'4009' RH error: change direction not allowed
X'400A' RH error: no response not allowed
X'400B' RH error: chaining not supported
X'400C' RH error: brackets not supported

X'8001' Path error: intermediate node failure
X'8002' Path error: link failure
X'8004' Path error: unrecognized DAF
X'8005' Path error: no session
X'8006' Path error: invalid FID
X'8007' Path error: segmentation not supported
X'8008' Path error: PU not active
X'8009' Path error: LU not active
X'800A' Path error: too long PIU
X'800B' Path error: incomplete TH
X'800C' Path error: DCF error
X'800D' Path error: lost contact
X'8011' Path error: route error
X'8012' Path error: wrong VR

# APPENDIX C: SDLC COMMANDS AND RESPONSES

## C.1 SDLC INTRODUCTION

The purpose of this appendix is to provide information that may help in identifying operational problems with Synchronous Data Link Control (SDLC) links. The samples included in this appendix are included only as a guide and should be updated for a specific installation.

NCP SDLC commands are:

SIM - Set initialization mode

DISC - Disconnect

SNRM - Set normal response mode

XID - Exchange identification

Test - SDLC test command

NCP SDLC responses are:

| ACF/NCP Release 2.1 | | ACF/NCP Release 3 | |
|---|---|---|---|
| NSA - | nonsequenced acknowledgement | UA - | unnumbered acknowledgement |
| RQI - | request for initialization | RIM - | request initialization mode |
| ROL - | request online | DM - | disconnect mode |
| CMDR - | command reject | FRMR - | frame reject |
| RQD - | request disconnect | RD - | request disconnect |

For current information, refer to:

IBM Synchronous Data Link Control General Information GA27-3093-2.

NOTE: GA27-3093-2 illustrations are in link transmitted sequence, so each byte is reversed from the sequence of a line trace or as displayed in storage. The following material is provided in the sequence of trace or storage display.

## C.1.1 SDLC INFORMATION TRANSFER

Synchronous Data Link Control is a discipline for serial-by-bit information transfer over a data communication channel. Transmission exchanges may be two-way simultaneous or two-way alternate. The communication channel configuration may be point-to-point or multipoint. A point-to-point configuration may be nonswitched or switched. SDLC includes comprehensive detection and recovery procedures for transmission errors that may be introduced by the communication channel.

Transmission of bits on an analog network convert the binary 0 or 1 to some form of electrical signal. A synchronous transmission is time-based to enable the identification of sequential binary digits. A receiver samples the value of the incoming signal at the same rate used for transmitting the signal. There may be minor variations in timing between transmitter and receiver, however. that make it necessary for the receiver to dynamically adjust sample timing to keep sample times midway between transitions.

Some modems are sensitive to a series of binary 1 bits or a series of binary 0 bits. The potential problem of a sequence of binary 1 bits within an SDLC frame is handled by Zero-bit Insertion; between SDLC frames it is not a problem because resynchronizing occurs when the first zero bit is received in the next flag byte (X'7E'). The potential problem of a sequence of binary 0 bits is provided by Non-Return to Zero Inverted (NRZI).

### C.1.1.1 Zero-bit Insertion

The beginning and ending characters which delimit an SDLC frame are a value of X'7E', called a flag character. Zero insertion prevents the flag pattern from occurring anywhere else in the frame. Between the beginning flag and final flag of a frame, SDLC procedures require that a binary 0 must be inserted by the transmitter after any succession of five contiguous binary 1's. Thus, no pattern of 01111110 (a flag) is ever transmitted between the beginning and ending flags. Zero bit insertion is disabled when the flag is being transmitted or between SDLC frames.

Zero insertion support is provided by hardware in the type 2 or type 3 communication scanner. The logic for zero insertion on output is to search for five contiguous binary 1's, and add a binary 0 after the fifth binary 1. After zero insertion, the binary pattern would be B'111110x', where x could be either 0 or 1. On input the data is scanned for five contiguous binary 1's followed by a binary 0 (B'111110', and the binary 0 is deleted, which restores the binary sequence to the original B'11111x' (x being either binary 0 or 1. If a binary value of X'01111110' (X'7E') is received, this is an ending flag. If a series of seven binary 1's is received prior to an ending flag, it is an abort sequence.

#### C.1.1.2 Non-Return to Zero Inverted (NRZI)

The potential problem of a sequence of binary 0 bits is provided by Non-Return to Zero Inverted (NRZI).

If the modem does not provide received-data timing, the 3705 and terminal must compensate for the lack of timing by conversion of binary 0's in the sequence. In this case, an invert-on-zero transmission coding method (also known as NRZI) is used, in which the 3705 or terminal holds the signal condition in the same state to send a binary 1. To send a binary 0, the 3705 and terminal changes the signal condition to the opposite state. Thus, the long periods of binary 0 data that sometimes occur have successive transitions in the transmitted stream. If invert-on-zero transmission coding is used, it must be used by all data terminal equipment on the data link.

When data communication equipment do not provide received-data timing, the data terminal equipment must provide invert-on-zero transmission coding to reduce the probability of losing synchronization. Invert-on-zero coding may be required or prohibited for data communication equipment with specific pattern sensitivities.

### C.1.2 SDLC STATION TYPES

Three types of stations are used in SDLC communications: primary stations, secondary stations, and configurable stations. A primary station has the responsibility for controlling a data link; it issues commands. Secondary stations receive commands and return responses. All communications on a data link are from the primary station to one or more secondary stations, and from a secondary station to the primary station. There can be only one primary station on a data link at one time.

ACF/NCP Release 3 introduced configurable stations. A configurable station is one which can be either primary or secondary on a point-to-point link. The two stations on a link both send SDLC exchange ID (XID) commands to each other. The XID contains information, including the subarea of the transmitting station. The station with the higher subarea value becomes primary, the lower subarea becomes the secondary.

### C.1.3 SDLC LINKS

The physical communication link, whether switched or nonswitched, is assumed to be constant, once it is established. The communications over this link, however, are considered to be transitory. Three transmission states can exist on a communication link: transient, idle, or active. Only one of these states can exist on a link at any one time.

### C.1.3.1 Transient State

The transient state exists when the communication link is being conditioned before initial transmission and after each transmit-receive reversal or turnaround.

### C.1.3.2 Idle State

The idle state exists when there is no SDLC control or information transmission currently in progress. A station perceives the existence of an abort after receiving a succession of 7 consecutive binary 1's. A station that is not transmitting SDLC control or information data may send signals onto the communications link. The link configuration determines the appropriate action, as follows:

- Half-duplex, primary or secondary - no signal (carrier off)
- Duplex, multipoint, secondary - no signal (carrier off)
- Duplex, multipoint, primary - all 1's (mark hold)
- Duplex, point-to-point, primary or secondary - all 1's (mark hold)

### C.1.3.3 Active State

The active state exists when a station is transmitting or receiving either information or data link control signals (via transmission frames described later). The active transmission state is the non-idle, non-transient state. The active state also exists when a series of flags (also described later) are being transmitted. In this case no information is exchanged, but the line is held in the active state. A duplex data link (concurrent transmit and receive) may be active in one direction and idle in the other.

## C.1.4 SDLC TRANSMISSION FRAMES

All transmissions on an SDLC data link are organized in a specific format called a frame. This format enables the receiving station to determine where the transmission starts and stops, whether the transmission is for that station, what actions are to be performed with the transmission, specific information for that station, and data that is used to check whether the frame was received without error.

### C.1.4.1 SDLC Frame Format

Each SDLC transmission frame has the same specific format. Each frame is made up of:

- A beginning flag of X'7E' that indicates the beginning of the frame. Multiple values of X'7E' may occur, and the last X'7E' before a non-X'7E' is considered the beginning flag.
- An address field that identifies the secondary station that is sending, or is to receive, the frame. The address field is one-byte in length.
- A control field that specifies the purpose of the particular frame.
- An optional, informational field that contains information data.
- A frame check sequence (FCS) field that enables the receiving station to check the transmission accuracy of the frame. The FSC sequence is two bytes, and immediately precede the ending flag of X'7E'.
- An ending flag of X'7E' that signals the end of the frame.

#### C.1.4.1.1 Flag

The beginning flag and the ending flag enclose the SDLC frame. The beginning flag serves as a reference for the position of the address and control fields and initiates transmission error checking. The ending flag terminates the check for transmission errors. The ending flag for one frame may serve as the beginning flag for the next frame. Alternately, the ending binary 0 of an ending flag may service as the beginning binary 0 of a beginning flag forming the pattern 011111101111110. Also, there may be multiple flags repeated between frames to maintain the active state.

Zero insertion prevents the flag pattern from occurring anywhere else in the frame. (See 1.1.1 Zero-Bit Insertion.) A frame is identifiable because it begins and ends with a flag and contains only nonflag bit patterns between flags. This characteristic does not restrict the contents of a frame because SDLC procedures require that a binary 0 must be inserted by the transmitter after any succession of five contiguous binary 1's within the frame. Thus, no pattern of 01111110 (a flag) is ever transmitted between the beginning and ending flags. Zero bit insertion is disabled when the flag is being transmitted. (See 1.1.1 Zero-Bit Insertion.)

Any ending flag may be followed by a frame, by another flag, or by an idle condition.

### C.1.4.1.2 Address Field

The address field of an SDLC frame follows immediately after the beginning flag. If the primary station is transmitting a frame, the address identifies a specific secondary station, any specific station (broadcast or general poll), or a group of stations.

A station address is any one-byte hexadecimal value other than X'00' or X'FF' which uniquely addresses a station on a link.

A broadcast (general poll) is an address of X'FF', which can be used on a point-to-point connection to poll regardless of the station address. General poll is used at initial contact for switched connections and transmission groups between NCPs.

A group address is any one-byte hexadecimal value other than X'00' or X'FF' which can be used to address a group of stations for output on a line; the group address is used in loop service, and the NCP does not support group addressing. The address of X'00' is not valid, a 'no' address.

If the secondary station is transmitting a frame, the address identifies the secondary, the origin station.

### C.1.4.1.3 Control Field

Following the address field in an SDLC frame is the control field. The control field defines the function of the frame. The control field can be in one of three formats: unnumbered format, supervisory format, or information transfer format.

Each format includes a poll or final bit as the fourth bit in the in the control field. If the fourth bit has a value of B'1' from the primary to the secondary, it is a poll bit inviting that secondary station to provide a response. If the fourth bit has a value of B'1' from a secondary station to the primary, it is a final bit indicating the secondary station is terminating the right to respond.

If a secondary station does not respond to polling within the user defined time specified in the REPLYTO operand, the primary assumes an error condition. A B'0' in this position indicates the station reserves the right to send additional frames.

The remaining bits of the control field vary by frame type.

Unnumbered Format

Unnumbered-format frames are used for such functions as:

- Initializing secondary stations
- Controlling the response mode of secondary stations
- Reporting certain procedural errors.
- Transferring data (when the data is not to be checked as to its location in a sequence of frames)

Information Transfer Format

Frames with a control field of the information transfer format are the vehicle for information transfer. The control field, besides indicating the format, contains send and receive counts (Ns and Nr) which are used to ensure that these frames are received in their proper order (Ns) and to confirm accepted information frames (Nr).

As each frame is sent from a station, a three-bit send sequence count (Ns) identifies the frame in the fifth, sixth, and seventh bits. The receiving station acknowledges received frames by either a supervisory or an information frame by sending a receive count (Nr) of the next expected frame sequence number. The next expected is one greater than received, or wraps to B'000' if the last frame received was B'111'. The leftmost three bits of a control byte in a supervisory frame are a next expected receive count (Nr).

The Ns count indicates the number of the information frame within the sequence of information frames transmitted. The Nr count transmitted in a frame is the number (Ns) of the information frame that the station transmitting the Nr expects to receive next.

Supervisory Format

Frames with a control field of the supervisory format are used to control data flow on a link and to assist in the transfer of information in that they are used to confirm preceding frames carrying information. The frames of the supervisory format do not contain an information field. These frames are used to confirm received frames, convey ready or busy conditions, and to report frame numbering errors (indicating that a numbered information frame was received out of its proper sequence, to long, etc.).

## C.1.4.1.4 Information Field

Following the control field, there may or may not be an information field. The supervisory format does not contain an information field.: Data to be transferred on the data link is contained in the information field of a frame. The information field does not have a set length, but must be a multiple of 8 bits.

### C.1.4.1.5 Frame Check Sequence Field

Following the information field (or control field if no information field) is the frame check sequence field. The more logical method of locating the frame check sequence field is to locate the final flag, with the preceding two characters being the frame check sequence field. The purpose of the frame check sequence (FCS) field is to check the receive frame for errors that may have been introduced by the communication channel. This field contains a 16-bit check sequence that is the result of a computation on the contents of the address, control, and information fields at the transmitter. The computation method used is called cyclic redundancy checking (CRC).

The receiver performs a similar computation and checks the results. As each character is received, the receiver calculates the CRC until the final flag is received. The receiver 'backs out' the final two bytes of calculation (the frame check sequence field) to check the result. The receiver accepts no frame that is found to be in error. The FSC field is followed by the ending flag, closing the frame.

### C.1.4.1.6 Final Flag Field

The final flag is a X'7E'. The final flag may also be the beginning flag of the following frame.

## C.2 SDLC COMMANDS AND RESPONSES

The three categories of SDLC commands and responses are unnumbered, supervisory, and information frames. The types of commands/responses in each category are identified in the following topics.

### C.2.1 UNNUMBERED FRAMES

A control field of an unnumbered frame has the 2 right-most bits on (B'11'). Unnumbered frames are not sequence-checked and do not use Nr or Ns sequence fields. Mode-setting unnumbered commands reset the Nr and Ns to B'000'. Excluding the poll/final bit (the fourth bit) and the fixed value of B'11' of the seventh and eight bits, the remaining bits are used to identify the specific unnumbered commands and responses.

A command carries the poll bit in the fourth bit position, while the same position in a response is called a final bit. The following is a list of Unnumbered commands and responses and the hexadecimal values with the poll/final bit on (B'1') and off (B'0').

| Command | | Poll B'1' | Poll B'0' |
|---|---|---|---|
| Unnumbered Information Frame | UI | X'13' | X'03' |
| Set Initialization Mode | SIM | X'17' | X'07' |
| Link Problem Determination Test | LPDA TEST | X'1B' | X'0B' |
| Unnumbered Poll | UP | X'33' | X'23' |
| Disconnect | DISC | X'53' | X'43' |
| Set Normal Response Mode | SNRM | X'93' | X'83' |
| Exchange Station Identification | XID | X'BF' | |
| Configure | CFGR | X'D7' | X'C7' |
| Test | TEST | X'F3' | X'E3' |

| Response | | Final B'1' | Final B'0' |
|---|---|---|---|
| Unnumbered Information Frame | UI | X'13' | X'03' |
| Request Initialization Mode | RIM | X'17' | X'07' |
| Link Problem Determination Test | LPDA TEST | X'1B' | X'0B' |
| Disconnect Mode | DM | X'1F' | X'0F' |
| Request Disconnect | RD | X'53' | X'43' |
| Unnumbered Acknowledgement | UA | X'73' | X'63' |
| Frame Reject | FRMR | X'97' | X'87' |
| Exchange Station Identification | XID | X'BF' | |
| Configure | CFGR | X'D7' | X'C7' |
| Test | TEST | X'F3' | X'E3' |
| Beacon | BCN | X'FF' | |

#### C.2.1.1 Unnumbered Information Frame (UI) - X'13' or X'03'

Unnumbered Information (UI) frame (request or response) that carries information.

#### C.2.1.2 Set Initialization Mode (SIM) - X'17' or X'07'

Set Initialization Mode (SIM), a request (primary to secondary), mode setting command which resets Nr and Ns counters to B'000'. The command initiates system-specified procedures for the purpose of initializing link-level functions. UA is the expected response. The SIM command is used to initialize the link before loading a 3705 with a remote program load.

### C.2.1.3 Request Initialization Mode (RIM) - X'17' or X'07'

Request Initialization Mode (RIM), a response, (secondary to primary) is transmitted to notify the primary station of the need for a SIM command. A 3705 sends RIM to request an initial program load.

### C.2.1.4 LPDA Test, Link Problem Determination Test - X'1B' or X'0B'

Link Problem Determination Test (LPDA TEST), command to IBM 386x modems to test path and line quality.

### C.2.1.5 Disconnect Mode (DM) - X'1F' or X'0F'

Disconnect Mode (DM), a response to indicate a secondary station is in disconnect mode (line active but physical unit not activated).

### C.2.1.6 Unnumbered Poll (UP) - X'33' and X'23'

Unnumbered Poll (UP) (command, without poll/final bit)

The Unnumbered Poll command is used with loop configurations. While a poll of all addressed (station, group, or broadcast) secondary stations is being performed, a response transmission is optional and depends on the actual need for each secondary station to transmit. If the UP is sent with the poll bit off, secondary stations will respond if one of the following conditions exist:

- The secondary has received a numbered information frame since the last time it responded.
- The secondary has received an unnumbered command that requires a response since the last time it responded.
- An exception condition has occurred since a previous response opportunity and an appropriate response frame is pending transmission or retransmission.
- The secondary has changed from ready-to-receive to not-ready-to-receive since the last time it responded.
- The secondary has changed from not-ready-to-receive to ready-to-receive since the last time it responded.
- The primary has not acknowledged an information frame transmitted by the secondary and the secondary retransmits the unacknowledged frame(s).

- The secondary is in disconnected mode and sends a DM response to request a set mode command (SNRM) to become operational.

Unnumbered Poll (UP) (command, with poll/final bit)

If the UP is sent with the poll bit on, secondary stations are required to respond. A polled station will respond either with frames it has waiting to transmit or retransmit, or, if no such frames exist, with another appropriate response (RR, RNR, or DM).

#### C.2.1.7 Disconnect (DISC) - X'53' or X'43'

Disconnect command (DISC), primary to secondary, terminates other modes and places the secondary station in a disconnect mode. The expected response is UA. A switched station then disconnects. A secondary station in disconnect mode cannot receive or transmit information frames or supervisory frames.

#### C.2.1.8 Request Disconnect (RD) - X'53' or X'43'

Request Disconnect (RD), command, secondary to primary, requests a DISC command be sent to place the secondary in disconnect mode. This command is the same as DISC, but when sent from a secondary to a primary, it is a RD. This is the method a secondary requests deactivation.

#### C.2.1.9 Unnumbered Acknowledgement (UA) - X'73' or X'63'

Unnumbered Acknowledgement (UA), a response, is the affirmative response to an SNRM, DISC, or SIM command.

#### C.2.1.10 Set Normal Response Mode (SNRM) - X'93' or X'83'

Set Normal Response Mode (SNRM), a mode setting command, resets Nr and Ns counters to B'000'. This command places the secondary station in normal response mode (NRM) for information transfer. UA is the expected response. No unsolicited transmissions are allowed from a secondary station that is in normal response mode. The secondary station remains in normal response mode until it receives a DISC or SIM command.

## C.2.1.11 Frame Reject (FRMR) - X'97' or X'87'

Frame Reject (FRMR), a response, is transmitted by a secondary station in normal response mode (NRM) only when it receives an invalid frame. A received frame may be invalid for several reasons:

- The control field is not implemented at the receiving station. This category includes unassigned commands.
- The information field is too long to fit into the receiving stations buffers. This use is optional, and some implementations use the Supervisory receive ready (RR) sequence field to reject frames which are too long.
- The control field in the received frame does not allow an information field to be received within the frame.
- The Nr that was received from the primary station is invalid.

The secondary station cannot release itself from the FRMR condition, nor does it act upon the frame that caused the condition. It repeats FRMR whenever it responds, except to an acceptable mode-setting command: SNRM, DISC, or SIM that resets the FRMR condition.

The secondary station sends an information field containg status as part of the FRMR response. The information field of a FRMR is:

- Byte 1 - The control field of the rejected frame
- Byte 2 - The secondary stations Nr and NS as nnn0sss0, where nnn is the Nr count and sss in the Ns count
- Byte 3 - Indicator field of B'0000abcd', where:
  - a with a value of B'1' indicates the receive count disagrees with the transmitted Ns.
  - b with a value of B'1' indicates a buffer overrun, the information field is too long for the buffer.
  - c with a value of B'1' indicates a prohibited information field was received in a frame with a control byte which does not allow an information field.
  - d with a value of B'1' indicates the control field was invalid or not implemented in the receiving station.

### C.2.1.12 Exchange Station Identification (XID) - X'BF'

Exchange Station Identification (XID), as a command, solicits the identification of the receiving (secondary or configurable) station. An information field may be included in the frame to convey identification of the transmitting (primary, secondary, or configurable) station. An XID response is required from the secondary station. An information field in the response may be used for identification of the responding station.

ACF/NCP Release 2 switched support of type 1 and type 2 physical units provides a 48 bit terminal ID with the following fields:

Bits

0-3 - Reserved
4-7 - Physical unit type (1 or 2)
8-15 - Reserved
16-27 - ID block, hardware by device type
28-47 - ID number, hardware or control program specified

ACF/NCP Release 3 supports ID exchanges are documented in ACF/NCP/VS Program Reference Summary, LY30-3058, Section 2: Data Area Layouts, XID.

### C.2.1.13 Configure (CFGR) - X'D7' or X'C7'

Configure (CFGR), a command or response. CFGR is used for loop stations. The configure response is transmitted to secondary stations only in response to a configure command. The structure of the configure responses are identical to those of the configure commands. If the rightmost bit in the information field of the response is set to 1, the configure function in the information field has been set. If the rightmost bit in the information field is set to 0, the configure function in the information field has been cleared. The function described in the first 7 bits of the information field are the same as the configure function that the secondary station is responding to.

#### C.2.1.13.1 Clear - X'00'

Clear causes all functions that were previously set by the configure command to be cleared by the secondary.

#### C.2.1.13.2 Beacon Test - X'02' and X'03'

Beacon Test causes the secondary receiving it to suppress the transmission of the carrier, or to begin transmitting the carrier again after suppressing it. If x is a 1-bit, the secondary is to suppress transmission. If x is a 0-bit, the secondary is to resume transmission.

### C.2.1.13.3 Monitor Mode - X'04' and X'05'

Monitor Mode - causes the addressed secondary to place itself in monitor mode (00000101), that is, a receive-only mode. Once a secondary is in the monitor mode, it cannot transmit until it receives a Monitor Mode Clear (00000100) or Clear (00000000).

### C.2.1.13.4 Wrap - X'08' and X'09'

Wrap causes the secondary station to wrap its transmission output directly into its receiving input. This effectively places the secondary station off-line for the duration of the wrap test.

### C.2.1.13.5 Self-Test - X'0A' and X'0B'

Self-Test causes the addressed secondary to begin a series of internal diagnostic tests. The response of 1 in the x byte indicates they were unsuccessful, while a 0 indicates a successful result.

### C.2.1.13.6 Modified Link Test - X'0C' and X'0D'

Modified Link Test - provides an alternate form of link test to the TEST command.

### C.2.1.14 Test (TEST) - X'F3' or X'E3'

Test (TEST) as a command may be sent to a secondary station in any mode to solicit a TEST response. If an information field is included with the command, it is returned in the response. If the secondary station has insufficient buffering available for the information field, a TEST response with no information field is returned.

### C.2.1.15 Beacon (BCN) - X'FF'

Beacon (BCN), is a response used for loop stations. When a secondary station detects the loss of communication at its input, it begins to transmit a Beacon Response. This allows the primary station to locate the problem in the loop and to take appropriate action. As soon as the input resumes normal status (the problem is solved), the secondary stops transmitting the Beacon Response.

## C.2.2 SUPERVISORY FRAMES

A control field of a supervisory frame has the 2 right-most bits on (B'01'). Supervisory frames provide the next receive (Nr) field in the leftmost three bit positions. Only supervisory and information frames acknowledge information frames. The fifth and sixth bits identify the three types of supervisory frames.

A command carries the poll bit in the fourth bit position, while the same position in a response is called a final bit. The following is a list of Supervisory commands and responses and the binary values with the poll/final bit on (B'1') and off (B'0').

| Command | | Poll B'1' | Poll B'0' |
|---|---|---|---|
| Ready to Receive | RR | B'bbb10001' | B'bbb00001' |
| Not Ready to Receive | RNR | B'bbb10101' | B'bbb00101' |
| Reject | REJ | B'bbb11001' | B'bbb01001' |
| **Response** | | **Final B'1'** | **Final B'0'** |
| Ready to Receive | RR | B'bbb10001' | B'bbb00001' |
| Not Ready to Receive | RNR | B'bbb10101' | B'bbb00101' |
| Reject | REJ | B'bbb11001' | B'bbb01001' |

### C.2.2.1 Ready to Receive (RR) - X'h1'

Ready to Receive (RR), sent by either a primary or secondary station, confirms Nr-1 frames (Nr is the next expected frame) and indicates the originating station is ready to receive. A secondary station cannot send information frames until an RR is sent from the primary with the poll bit on (B'1'). Once the secondary has received RR with the poll bit on, the secondary can send up to seven information frames to the primary. The secondary indicates an end to the invitation to send by transmitting a data frame or an RR response with the final bit on.

The RR is used to reject frames using the Nr count, including frames which have an information field which is too long. The NCP uses RR to reject frames on a half duplex link or to half duplex terminals. Most terminals use RR to reject frames.

When the primary sends RR to a terminal, the terminal may send up to seven frames before ending with a final bit. The final bit may be in an information frame, an RR frame (or an unnumbered frame in error conditions). The quantity of frames is limited by the data available, terminal implementation, user definition, or seven maximum. As an example, one implementation of 8100 allows four frames maximum from the 8100 with the final bit in the final information frame. Transmission from an NCP is limited by the MAXOUT parameter, and is always ended by a final bit in an RR frame.

### C.2.2.2 Not Ready to Receive (RNR) - X'h5'

Not Ready to Receive (RNR). sent by either a primary or secondary station, confirms Nr-1 frames (Nr is the next expected frame) and indicates the originating station is not ready to receive. RNR indicates a temporary busy condition due to buffering or other internal restraints.

The NCP uses RNR when in slowdown or when a VR is blocked to avoid input from a station. The NCP continues to send to the station to the limit of the frame send count and uses RNR to obtain a link level response without receiving data.

Physical units sends RNR to the NCP to request a link level response and to request an RR poll to allow the terminal to continue sending a group of frames, such as a series of segments. A secondary station reports the clearing of an RNR condition by transmitting an information or RR frame with the final bit on, or REJ frame with the final bit on or off.

### C.2.2.3 Reject (REJ) X'h9'

This command/response may be transmitted to request transmission or retransmission of numbered information frames. REJ confirms frames through Nr-1 and requests retransmission of numbered information frames starting at Nr contained in the REJ frame. The RR Nr field is used to reject frames, including frames which have an information field which is too long.

The NCP and most terminals do not used REJ. The NCP sends REJ on a full duplex line between full duplex devices (NCPs, 3777 MLU). The RR or RNR receive sequence number is used to reject frames received in error or which have lengths greater than can be received on a half duplex line or to half duplex terminals.

## C.2.3 INFORMATION FRAMES

A control field of an information frame has the right-most bit off (B'0'). Information frames are numbered. The Ns count provides for numbering the frame being sent in the fifth, sixth, and seventh bits. The Nr provides acknowledgement for the information frames received, indicating the next expected number in the first, second, and third bits.

In duplex mode (concurrent transmit and receive), each station reports its current Ns and Nr counts in each information frame. The expected acknowledgement is a supervisory (RR or RNR) or information frame as needed. Only information and supervisory frames acknowledge information frames. The eighth bit of B'0' identifies an information frame.

The information frame format is:

rrrxsss0

rrr is the Nr sequence field, with the number of the next expected sequence number; rrr-1 is acknowledged.

x is the poll/final bit.

sss is the sequence number of the current information frame.

An Information frame is the only frame which is sequence checked.

# APPENDIX D: SDLC LINE TRACES

## D.1 INTRODUCTION

Link activity can be traced by command from the host. The line trace is initiated by host command to record selected fields of the 3705 scanner interface control word.

For a type 2 scanner the fields recorded are:

- LCD - Line Control Definer, identifies a line as SDLC, BSC, or start-stop
- PCF - Primary Control Field, specifies the current state, input, output, etc.
- Time - a one byte timer field with a .1 second resolution
- SCF - Secondary Control Field, specifies a normal service request or an error condition
- PDF - Parallel Data Field, if the PCF/SCF is appropriate, the PDF contains the data byte sent or received

For a type 3 scanner, in addition to the previous fields, an extended primary control field (EPCF) and two status bytes are provided.

For additional information on line trace fields, refer to:

- Appendix C: SDLC Commands and Responses,
- ACF/NCP/VS Network Control Program - Program Reference Summary, LY30-3043 (Release 2.1) or LY30-3058 (Release 3), Section 13: Interface control Word (ICW)

## D.2 SDLC LINE CONTROL DEFINER (LCD)

A trace entry identifies the type of line traced by the value of the LCD field. The field is a single hexadecimal value. The valid hexadecimal character in a trace entry for SDLC is X'9'.

If a switched SDLC interface using autocall, a trace of the autocall interface will have an LCD value of X'3'. The autocall interface is defined in the LINE macro operand of AUTO=.

## D.3 TYPE 2 SCANNER AND TYPE 3 SCANNER TRACE

### D.3.1 SDLC PRIMARY CONTROL FIELD (PCF)

The following is a complete list of Primary Control Field (PCF) values for SDLC line interfaces. All of these values can be checked by displaying the Interface Control Word (ICW) at the IBM 3705 Communications Controller panel. Some of the PCF values never appear on a line trace. The only trace entries appearing on a line trace are those which are recorded from a scanner generated interrupt.

LY30-3043 (Release 2.1) or LY30-3058 (Release 3) ACF/NCP/VS Network Control Program - Program Reference Summary, Section 13: Interface Control Word (ICW), is the reference for ICW values.

PCF states set by programming are not recorded in trace entries. Only PCF states which result in an interrupt requiring program intervention are recorded as trace entries. When the trace is active for this line, the LCD, PCF, SCF and PDF are recorded.

In addition, a one-byte timer field with a tenth of a second resolution indicates the relative time difference between entries.

Following is a list of the PCF values for a Type 2 Scanner.

Type 2 Scanner

| PCF | Meaning |
|---|---|
| 0 | No-op |
| 1 | Set mode |
| 2 | Monitor data set ready on |
| 3 | Monitor ring indicate or data set ready on |
| 4 | Monitor flag, block data set ready error |
| 5 | Monitor flag, allow data set ready error |
| 6 | Receive information, inhibit data interrupts |
| 7 | Receive information, allow data interrupts |
| 8 | Transmit initial |
| 9 | Transmit normal |
| A | Transmit normal with new sync |
| B | Reserved |
| C | Transmit turnaround, request to send off |
| D | Transmit end, request to send on |
| E | Reserved |
| F | Disable |

The type 3 scanner uses a Primary Control Field (PCF) and Extended Primary Control Field (EPCF) to identify the line operation.

Following is a list of the PCF and EPCF values.

Type 3 Scanner

| PCF | EPCF | Meaning |
|---|---|---|
| 0 | x | No-op |
| 1 | x | Set mode |
| 2 | x | Monitor data set ready on |
| 3 | x | Monitor ring indicate or data set ready on |
| 4 | 0 | Monitor flag, block data set ready error |
| 5 | 0 | Monitor flag, allow data set ready error |
| 6 | 1 | Receive flags |
| 6 | 2 | Receive address |
| 6 | 3 | Receive control |
| 6 | 4 | Receive frame check sequence |
| 7 | 3 | Receive abort |
| 7 | 4 | Receive data |
| 7 | 5 | Receive end flag |
| 7 | 7 | Receive idle |
| 7 | C | Receive diagnostic 1 |
| 8 | 0 | Transmit initial |
| 9 | 0 | Transmit pad |
| 9 | 1 | Transmit clock |
| 9 | 2 | Transmit flag |
| 9 | 3 | Transmit abort |
| 9 | 4 | Transmit data |
| 9 | 5 | Transmit end flags |
| 9 | 6 | Transmit frame check sequence |
| 9 | 7 | Transmit idle |
| 9 | C | Transmit diagnostic 1 |
| A | x | Transmit initial with new sync |
| B | x | Transmit pad with new sync |
| C | x | Reserved |
| D | x | Reserved |
| E | x | Transmit continuous |
| F | x | Disable |

The type 3 scanner identifies line control characters such as flags, station address, control, etc. The type 2 scanner output must be analyzed to identify line control characters in the data field.

The recorded trace entry is the result of a change in status or data transfer.

With a type 2 scanner, of the previous listed entries, only four PCF states are recorded by an ICW interrupt. The PCF states are:

6 Receive information, inhibit data interrupts. This state is recorded in trace data to indicate a flag has been received in response to polling. This field with a value of 6 indicates a flag has been received. If there was no error, the Secondary Control Field (SCF) is a X'0E'. The Parallel Data Field (PDF) contains the residual value from the last interrupt, and does not contain the current flag that was received.

To locate the beginning or ending of a received frame, locate a PCF value of 6; half duplex lines have a PCF value of 5 followed by a PCF of 6.

7 Receive information, allow data interrupts. This state is recorded in trace data to indicate Parallel Data Field (PDF) data between flags.

The first PCF value of 7 following a PCF value of 6 contains the station address field in the Parallel Data Field (PDF). The following PDF field contains the SDLC control byte.

The last two PCF values of 7 prior to a PCF value of 6 contains the Frame Check Sequence (FCS) bytes.

If there are trace entries with a PCF value of 7 between the SDLC control byte and the FCS bytes, the PDF fields contain a Path Information Unit (PIU) of FID1, FID2, FID3 or (ACF/NCP Release 3 transmission group) a FID4.

9 Transmit normal. This state indicates frame transmission. The Secondary Control Field (SCF) indicates the ending or beginning flag with a value of X'45', and within a frame with a value of X'40'.

The first SCF value of X'45' prior to a SCF value of X'40' identifies a beginning flag for a frame. The first SCF value of X'40' PDF field contains the station address. The following PDF value contains the SDLC control byte.

The first SCF value of X'45' following an SCF value of X'40' identifies the ending flag of a frame. The two preceding PDF field contain the FCS bytes.

If there are trace entries with a SCF value of X'40' between the SDLC control byte and FCS fields, the PDF field contain a Path Information Unit (PIU) of FID1, FID2, FID3, or (ACF/NCP Release 3 transmission group) a FID4.

Figure 14 on page 92 illustrates the type 2 scanner fields for a receive PCF. Figure 15 on page 93 illustrates the type 2 scanner fields for a transmission PCF.

## D.3.2 SDLC SECONDARY CONTROL FIELD (SCF)

The Secondary Control Field (SCF) is used to indicate sense, status, and the presence of an operation modifier field between the control program and the communications scanner.

The following is a list of the values of the eight-bit field for SDLC.

Type 2 Scanner

| SCF | Meaning |
|---|---|
| 0 | Abort |
| 1 | Service request |
| 2 | Character overrun/underrun |
| 3 | Modem check |
| 4 | Receive line signal detector |
| 5 | Flag detection or disable zero-insert remembrance |
| 6 | Program flag |
| 7 | Disable zero-insert control |

Type 3 Scanner

| SCF | Meaning |
|---|---|
| 0 | Abort |
| 1 | Service request |
| 2 | Character overrun/underrun |
| 3 | Modem check |
| 4 | Level 2 interrupt not required |
| 5 | End of message |
| 6 | Program flag |
| 7 | Trace |

The type 2 scanner Secondary Control Field (SCF) value on a receive should be a X'4x'. The X'4x' is a Service request as qualified by the second character. The x value varies depending upon full duplex, half duplex, and other considerations.

In the following examples (Figure 14 on page 92, Figure 15 on page 93, and Figure 16 on page 94), various combinations of the second hexadecimal character are illustrated. These figures also show examples of SCF values.

### D.3.3 SDLC TYPE 3 SCANNER STATUS FIELDS

The type 3 ICW contains two bytes of status. The ICW bytes 14 and 15 contain the status information. The values of the status bytes are as follows.

| ICW Byte 14 Status 1 Bits | Meaning |
|---|---|
| 1... .... | Receive line signal detect |
| .1.. .... | SDLC idle detect |
| ..1. .... | BSC only |
| ...1 .... | Data check |
| .... 1... | Flag off boundary |
| .... .1.. | Two control bytes following the address byte |
| .... ..1. | BSC only |
| .... ...1 | Length check, ending flag prior to FCS |

| ICW Byte 15 Status 2 Bits | Meaning |
|---|---|
| Transmit | |
| xxxx x... | Reserved |
| .... .x.. | 1=transmit flag, 0=transmit idle |
| .... ..1. | Transmit pad before line turn |
| .... ...1 | Line turnaround |
| Receive | |
| 1... .... | Control exception, data received in control frame |
| .xx. xxxx | Reserved |
| ...1 .... | Request level 2 interrupt on line idle or flag detect |

### D.3.4 SDLC PARALLEL DATA FIELD (PDF)

The Parallel Data Field (PDF) is not a valid data character except for data send or receive operations. As an example, when a flag is received, the PDF field is set to zero and the flag (X'7E') is not presented in the PDF field. For transmit or receive operations, the PDF contains the character received or sent on the line. The field contains the SDLC control characters and text.

To analyze SDLC PDF's, it is necessary to be familiar with the format of the SDLC frame. This frame includes the Basic Link Unit (BLU), SDLC control characters, the Path Information Unit (PIU) control fields, and user data.

Refer to ACF/NCP/VS Network Control Program - Program Reference Summary, LY30-3043 (Release 2.1) or LY30-3058 (Release 3), Section 2: Data Area Layouts, Basic Link Unit (BLU); and Section 6: SDLC Commands and Responses.

All SDLC transmissions are bounded by Flag characters with a bit value of B'01111110'. Between flags, after five consecutive 1-bits are sent, a 0-bit is added at the sending end. This technique is called zero-bit insertion. On the receiving end, if after five 1-bits the next bit is zero, the zero bit is removed. Therefore, the flag character with its six 1-bits never occurs within data. Thus, any of the 256 EBCDIC characters can be transmitted as data.

The first eight bits following the first flag provide the address of the SDLC station or a general poll of X'FF'. On output to the station, the address identifies which station is to receive the frame. On input from the station, the address identifies which station is sending the frame.

The second eight bits following the first flag is a control field. This control field identifies the type of frame. If bits 6 and 7 are 01, it is a supervisory command. Bits 6 and 7 with a value of 11 identify a non-sequenced format. If bit 7 is 0, it is a data frame. The data frame contains a Receive Sequence count field in bits 0, 1, and 2, and a Transmit Sequence count in bits 4, 5, and 6. Bit 3 is a poll bit when transmitting to the terminal and a final bit when received from the terminal.

Data, if present, follows the control field. The last data character occurs at the final flag minus two. Once the final flag is found, the previous two characters are the Frame Check Sequence (FCS). The FCS is not sent to the host, but is present in line traces. In some of the references the FCS is listed as Block Check Characters (BCC). The FCS and BCC both represent the same checking characters.

## D.3.5 SDLC TYPE 2 SCANNER TRACE ENTRY FORMAT

The SDLC trace entries are recorded in the IBM 3705 Communications Controllers by command from the host. The SDLC trace entries provide a time field in addition to the fields previously covered. The time field contains a hexadecimal value indicating in tenths of a second the time elapsed between level 2 ICW interrupts. The value in this field wraps around to zero after 25.5 seconds have elapsed (hexadecimal 00 to FF).

The SDLC type 2 trace entry stored for each level 2 interrupt is four bytes long. The type 3 scanner trace entries are eight bytes long. The entries are stored in NCP buffers, allocated dynamically as the line trace progresses. These buffers are transferred to the host whenever (1) the maximum number of buffers for the line trace (determined at NCP generation BUILD macro TRANSFR operand) is filled, or (2) a time interval specified by the host expires. In both cases, the trace continues to use a new chain of buffers until the host issues a command to terminate the trace, the path to the host fails, or the NCP enters buffer slowdown.

For a type 2 scanner, a line trace entry consists of consecutive four-byte entries. The four bytes are as follows.

| | |
|---|---|
| Byte 0 | LCD/PCF |
| Byte 1 | Timer field |
| Byte 2 | SCF |
| Byte 3 | PDF |

Figure 14 illustrates a type 2 scanner trace entries of full duplex receive. Figure 15 on page 93 illustrates a type 2 scanner trace entries of full duplex transmit.

```
LCD 9 PCF 7 TIME 2F SCF 4A PDF 0C   LCD 9 PCF 7 TIME 2F SCF 4A PDF 16
LCD 9 PCF 6 TIME 2F SCF 0E PDF 16   LCD 9 PCF 6 TIME 30 SCF 0E PDF 16
LCD 9 PCF 7 TIME 30 SCF 4E PDF C6   LCD 9 PCF 7 TIME 30 SCF 4A PDF 98
LCD 9 PCF 7 TIME 30 SCF 4A PDF 2C   LCD 9 PCF 7 TIME 30 SCF 4A PDF 00
LCD 9 PCF 7 TIME 30 SCF 4A PDF 01   LCD 9 PCF 7 TIME 30 SCF 4A PDF 04
LCD 9 PCF 7 TIME 30 SCF 4A PDF 00   LCD 9 PCF 7 TIME 30 SCF 4A PDF A4
LCD 9 PCF 7 TIME 30 SCF 4A PDF 03   LCD 9 PCF 7 TIME 30 SCF 4A PDF 90
LCD 9 PCF 7 TIME 30 SCF 4A PDF A0   LCD 9 PCF 7 TIME 30 SCF 4A PDF 7D
```

Figure 14. Type 2 Scanner Full Duplex Receive

The LCD of Figure 14 identifies the line as an SDLC line.

If Figure 14 was a PCF alternating transmit (PCF 9) and receive (PCF 6 and 7) it would indicate half duplex, a single scanner address. When the PCF transition is from 7 to 6 and back to 7 it is a receive only trace of full duplex link; the transmit trace is in a different trace record.

The time value has a single transition from 2F to 30. The timer resolution is to a tenth of a second, and at the line speed of the traced line, all the recorded entries occurred within a tenth of a second.

An SDLC receive frame is delimited by a PCF of 6. The first entry of the second line contains a PCF of 6, and therefore the two previous entries with a PCF of 7 are the Frame Check Sequence (FCS) characters of the previous frame. Note that the second FCS character PDF contains a value of 16. The first PCF of 6 and SCF of 0E indicates a flag was received, but the flag was not placed in the PDF field; the residual character is recorded in this entry.

The second entry of the second line also contains a PCF of 6. This is the transition indicator of a new flag, the beginning of the next frame.

The first entry of the third line with a PCF of 7 indicates a frame character. The PDF characters beginning with this entry are:

C6 98 2C 00 01 04 00 A4 03 90 A0 7D

The PDF of C6 is the first byte of frame, the station address.

The 98 is the SDLC control byte of B'1001 1000' The rightmost bit of 0 indicates an information frame. The leftmost three bits indicate a receive sequence count of four. The fourth bit on output is the poll bit; on input, the final bit. The fifth, sixth, and seventh bits are the next expected send sequence count.

Following the BLU station address and control byte is the PIU. The 2C is the first byte of the transmission header (TH) of a FID2, only segment, normal flow. The second byte of the FID2 TH is a reserved field of 00. The 01 is the destination address; 04 the origin address. The 00A4 is the sequence number.

The 0390A0 is the request header (RH). The RH identifies the frame as a request, unformatted, only element, definite/exception response requested, begin bracket and change direction.

The 7D is the first byte of RU.

Figure 15 contains the trace entries for an SDLC link (LCD 9) in transmit mode (PCF 9). The timer values range from 2E to 31, corresponding to the receive frame of Figure 14 on page 92. Figure 14 on page 92 illustrated a response to polling from time 2F for an SDLC address of C6.

```
LCD 9 PCF 9 TIME 2E SCF 45 PDF 7E   LCD 9 PCF 9 TIME 2F SCF 40 PDF E6
LCD 9 PCF 9 TIME 2F SCF 40 PDF 71   LCD 9 PCF 9 TIME 2F SCF 40 PDF 00
LCD 9 PCF 9 TIME 2F SCF 40 PDF D0   LCD 9 PCF 9 TIME 2F SCF 45 PDF 7E
LCD 9 PCF 9 TIME 2F SCF 45 PDF 7E   LCD 9 PCF 9 TIME 2F SCF 40 PDF C6
LCD 9 PCF 9 TIME 2F SCF 40 PDF 91   LCD 9 PCF 9 TIME 2F SCF 40 PDF 3D
LCD 9 PCF 9 TIME 2F SCF 40 PDF 14   LCD 9 PCF 9 TIME 2F SCF 45 PDF 7E
LCD 9 PCF 9 TIME 31 SCF 45 PDF 7E   LCD 9 PCF 9 TIME 31 SCF 40 PDF D9
```

Figure 15. Type 2 Scanner Full Duplex Transmit

In Figure 15 the first entry illustrates a flag (PDF 7E, SCF 45). The second entry is the first byte sent, the address field of E6. The control byte, 71, rightmost bits 01 is a supervisory BLU. The leftmost 3 bits are the receive sequence count (next expected). The fourth bit of 1 is a poll bit. The fourth and fifth bits of 00 indicate a Receive Ready (RR) frame. This frame is RR polling to station E6.

The next frame begins on the fourth line with an SCF of 45, PDF of 7E. The station address is C6, RR polling (PDF 91), FCS 3D14, and final flag of 7E. This is the polling frame in Figure 15 which resulted in the frame received in Figure 14 on page 92. While station C6 is sending in the Figure 14 on page 92 frame, the transmit trace begins polling station D9 in the last line of the trace.

Figure 16 on page 94 illustrates a type 2 scanner half duplex (single scanner address, alternate transmit and receive) trace.

```
LCD 9 PCF 9 TIME B6 SCF 4D PDF 7E   LCD 9 PCF 9 TIME B6 SCF 48 PDF C2
LCD 9 PCF 9 TIME B7 SCF 48 PDF F1   LCD 9 PCF 9 TIME B7 SCF 48 PDF 5B
LCD 9 PCF 9 TIME B7 SCF 48 PDF 10   LCD 9 PCF 9 TIME B7 SCF 4D PDF 7E
LCD 9 PCF 5 TIME B7 SCF 4D PDF 7E   LCD 9 PCF 6 TIME B7 SCF 0D PDF 7E
LCD 9 PCF 7 TIME B7 SCF 4D PDF C2   LCD 9 PCF 7 TIME B7 SCF 49 PDF 9E
LCD 9 PCF 7 TIME B7 SCF 49 PDF 2C   LCD 9 PCF 7 TIME B7 SCF 49 PDF 00
LCD 9 PCF 7 TIME B7 SCF 49 PDF 01   LCD 9 PCF 7 TIME B7 SCF 49 PDF 02
LCD 9 PCF 7 TIME B7 SCF 49 PDF 00   LCD 9 PCF 7 TIME B7 SCF 49 PDF 04
LCD 9 PCF 7 TIME B7 SCF 49 PDF 03   LCD 9 PCF 7 TIME B7 SCF 49 PDF 90
```

Figure 16. Type 2 Scanner Half Duplex Transmit and Receive

In this example of alternate transmit and receive, line one is the transmission of polling characters to station C2. The transmission ends on line three. Line four (PCF 5) illustrates a Monitor flag, allow data set ready error and transition to a receive of a FID2 frame from that station.

The FID2 header is identified in the PDF 2C of line 6. The first byte of request unit (RU) is the last entry (PDF 90) in the last line.

## D.3.6 SDLC TYPE 3 SCANNER TRACE ENTRY FORMAT

The SDLC trace entries are recorded in the IBM 3705 Communications Controllers by command from the host. Trace entries are created following a scanner interrupt. Type 3 scanner interrupts are recorded only at end of NCP buffer or end of frame. The various PCF/EPCF values are available by display of the interface control word (ICW), but only limited variations are recorded except in error situations.

The type 3 scanner SDLC trace entries are variable in length, and provide various information. Because trace recording occurs at end of frame or end of buffer, the data is not recorded a byte at a time.

The SDLC trace entries provide a time field in addition to the fields previously covered. The time field contains a hexadecimal value indicating in tenths of a second the time elapsed between level 2 ICW interrupts. The value in this field wraps around to zero after 25.5 seconds have elapsed (hexadecimal 00 to FF).

Figure 17 on page 95 illustrates the key fields for a type 3 scanner trace entries of a half duplex link of polling and response. The text fields are the frame check sequence.

| | SCF | LCD | PCF | EPCF | STAT1 | STAT2 | TIME | ADDR |
|---|---|---|---|---|---|---|---|---|
| 1. | 43 | 9 | 6 | 03 | 80 | 00 | 25 | 40 |
| 2. | 47 | 9 | 7 | 05 | 80 | 00 | 25 | 40 |
| 3. | | TEXT 21CC*.. | | | * | | | |
| | SCF | LCD | PCF | EPCF | STAT1 | STAT2 | TIME | ADDR |
| 4. | 47 | 9 | 9 | 00 | 00 | 01 | 25 | 40 |
| 5. | | TEXT C06F*.? | | | * | | | |

Figure 17. Type 3 Scanner Half Duplex Polling and Response

Figure 18 on page 96 is extracted from a trace of a type 3 scanner. The numbers at the left were added for identification. The LCD field of 9 indicates an SDLC trace entry. Entries 1 and 2 is the transmission of a poll. Entries 3, 4, and 5 (PCF 6 and 7) are a receive of text from the physical unit. Entries 6, 7, and 8 are an RR response.

Entries 9 through 13 represent a polling/response sequence.

The next entries are transmission of multiple NCP buffers of data followed by a RR polling frame.

The PCF/EPCF fields indicate ending conditions only. Error conditions may indicate PCF/ECF states other than those illustrated.

```
        SCF   LCD   PCF   EPCF   STAT1   STAT2   TIME   ADDR
   1.   47    9     9     00      80      01     56     40
   2.              TEXT A629*w.           *

        SCF   LCD   PCF   EPCF   STAT1   STAT2   TIME   ADDR
   3.   43    9     6     03      80      00     56     40
   4.   47    9     7     05      80      00     56     40
   5.              TEXT 3EC1CB80 000469*.A.....    *

        SCF   LCD   PCF   EPCF   STAT1   STAT2   TIME   ADDR
   6.   43    9     6     03      80      00     56     40
   7.   47    9     7     05      80      00     56     40
   8.              TEXT 01C8*.H           *

        SCF   LCD   PCF   EPCF   STAT1   STAT2   TIME   ADDR
   9.   47    9     9     00      80      01     56     40
  10.              TEXT 3FC0*..           *

        SCF   LCD   PCF   EPCF   STAT1   STAT2   TIME   ADDR
  11.   43    9     6     03      80      00     56     40
  12.   47    9     7     05      80      00     56     40
  13.              TEXT 258E*..           *

        SCF   LCD   PCF   EPCF   STAT1   STAT2   TIME   ADDR
  14.   43    9     9     04      00      04     56     40
  15.   43    9     9     04      00      04     57     40
  16.   47    9     9     02      00      04     57     40
  17.              TEXT 3CC10381 80F5C71D 401311C2 601DE8E8 D6E4D940
  18.                   D5C5E3E6 D6D9D240 C9
  19.              TEXT C4C5D5E3 C9C6C9C3 C1E3C9D6 D540C9E2 40D7
  20.              TEXT C1F5E6F2 40404040 11C5C1D6 D540E3C8 C540D7C1
  21.                   D3D640C1 D3E3D640 D4C1D9D2 C5E3C9D5 C740E2E4
  22.                   D7D7D6D9 E340E2E8 E2E3C5D4 E240C3C5 D5E3C5D9
  23.     40D4
  24.              TEXT E5E261E5 E3C1D440 D5C5E3E6 D6D9D240 8EF8

        SCF   LCD   PCF   EPCF   STAT1   STAT2   TIME   ADDR
  25.   47    9     9     00      00      01     57     40
                   TEXT 3FC0*..           *
```

Figure 18. Type 3 Scanner Half Duplex Data Transfers

# APPENDIX E: RU AND LINE UTILIZATION CHARTS

The information contained in this document has not been submitted to any formal IBM test and is distributed on an 'As Is' basis without any warranty either expressed or implied. The use of this information or the implementation of any of these techniques is a customer responsibility and depends on the customer's ability to evaluate and integrate them into the customer's operational environment. While each item may have been reviewed by IBM for accuracy in a specific situation, there is no guarantee that the same or similar results will be obtained elsewhere. Customers attempting to adapt these techniques to their own environments do so at their own risk.

## E.1 NCP TO TERMINAL

The following figures have been produced to aid you in determining the optimum RU sizes and NCP buffer size for NCP to SNA terminals.

- Figure 19 on page 100 lists the Decimal and Hex RU sizes in ascending decimal order.
- Figure 20 on page 101 lists the Hex and Decimal RU sizes in ascending Hex order.
- Figure 21 on page 102 through Figure 25 on page 106 show the number of segments and the time to transmit an RU for all RU sizes and NCP buffer sizes of 60, 64, 96 and 128. These figures assume ACF/NCP Release 2.
- Figure 26 on page 107 through Figure 31 on page 112 show the number of segments and the time to transmit an RU for all RU sizes and NCP buffer sizes of 72, 84, 88, 96, and 128. These figures assume ACF/NCP Release 3.

For each possible RU size various NCP buffer sizes are used to compute a) the number of NCP buffers used, b) the number of segments and c) the time required to send the RU on a link.

Use this data with caution.

ASSUMPTIONS

1. There is no wait time in the CPU.
2. There is no wait time in the NCP.
3. The link is error-free.

4. Propagation delay:

   Non-satellite, delay is ignored.

   Satellite, propagation delay table calculation assumption is 295 milliseconds ground station to ground station with no other delay (absolute minimum is 240 milleseconds, maximum is approximately 295 milliseconds).

5. The times are from the sender's point of view starting at the transmission of the first frame with FID2 header to a final link level response.

6. The buffer prefix plus TH and RH in the first NCP buffer for release 2 is 31 bytes.

7. The buffer prefix plus TH and RH in the first NCP buffer for release 3 is 47 bytes.

8. MAXOUT=7, and PASSLIM is equal to or greater than the number of frames to be sent.

9. MAXDATA=265 for NCP to terminal.

10. No data response to polling, only link level responses are used in the calculations.

11. If the number of segments is greater than seven then a link delay time to send 12 bytes (polling and polling response overhead) is added to the time for each multiple of seven in excess of the first seven.

Here is the format for each segment to be sent on the link.

A. First segment

| SDLC | TH | RH | DATA | SDLC |
|---|---|---|---|---|
| 3 | 6 | 3 | d1 | 3 |

Total bytes = d1 + 15

The data length in the first NCP buffer is equal to BFRS minus buffer-prefix. Where buffer prefix is 31 for ACF/NCP Release 2 and 47 for ACF/NCP Release 3. The value for d1 is equal to the data in the first NCP buffer plus some multiple of full buffers.

B. Each middle segment

| SDLC | TH | DATA | SDLC |
|---|---|---|---|
| 3 | 6 | d2 | 3 |

Total bytes = d2 + 12

The value of d2 will always be an even multiple of NCP buffers. That is d2 = integer-portion (256/BFRS).

C. Last segment

| SDLC 3 | TH 6 | DATA d3 | SDLC 3 |
|---|---|---|---|

Total bytes = d3 + 12

The value of d3 is whatever data is left over and may be less than a full buffer or may be a multiple of buffers plus a partial buffer.

The mode table operand of RUSIZES represents a portion of the transmission services usage field (bytes 9 and 10 in the session parameter field) for a logon mode. It specifies the maximum length of data (request units) in bytes that can be sent by the primary LU and by the secondary LU with which the primary LU communicates in a session.

RUSIZES is specified as four hexadecimal digits. The leftmost digits apply to the secondary LU, and the rightmost digits apply to the primary LU. The format is the same for both sets of digits. The first digit is the mantissa (m) and the second digit is the exponent (n) in the formula m x 2 to the nth power, from which is calculated the maximum length of data that can be sent by the primary or secondary LU.

For example, RUSIZES=96A8 specifies that the secondary LU can send a maximum length of 9 x 2 to the 6th (or 576 bytes) and that the primary LU can send a maximum of 10 x 2 to the 8th (or 2560) bytes. The digit representing the mantissa must be in the range hex 8 to F while the digit representing the exponent must be in the range of hex 0 to F. If both the mantissa and exponent are set to zero or if RUSIZES is not specified, the default size of no limit is used.

The following figures provide conversion between hexadecimal and decimal for the RUSIZES operands which are valid. The exponent values of C through F are not valid because the number generated would be greater than 32,764 bytes. The largest RU value which can be addressed in the TH is 32,764.

| Hex | Decimal |
|---|---|
| X'80' | 8 |
| X'81' | 16 |
| X'82' | 32 |
| X'83' | 64 |
| X'84' | 128 |
| X'85' | 256 |
| X'86' | 512 |
| X'87' | 1024 |
| X'88' | 2048 |
| X'89' | 4096 |
| X'8A' | 8192 |
| X'8B' | 16384 |
| X'90' | 9 |
| X'91' | 18 |
| X'92' | 36 |
| X'93' | 72 |
| X'94' | 144 |
| X'95' | 288 |
| X'96' | 576 |
| X'97' | 1152 |
| X'98' | 2304 |
| X'99' | 4608 |
| X'9A' | 9216 |
| X'9B' | 18432 |
| X'A0' | 10 |
| X'A1' | 20 |
| X'A2' | 40 |
| X'A3' | 80 |
| X'A4' | 160 |
| X'A5' | 320 |
| X'A6' | 640 |
| X'A7' | 1280 |
| X'A8' | 2560 |
| X'A9' | 5120 |
| X'AA' | 10240 |
| X'AB' | 20480 |

| Hex | Decimal |
|---|---|
| X'B0' | 11 |
| X'B1' | 22 |
| X'B2' | 44 |
| X'B3' | 88 |
| X'B4' | 176 |
| X'B5' | 352 |
| X'B6' | 704 |
| X'B7' | 1408 |
| X'B8' | 2816 |
| X'B9' | 5632 |
| X'BA' | 11264 |
| X'BB' | 22528 |
| X'C0' | 12 |
| X'C1' | 24 |
| X'C2' | 48 |
| X'C3' | 96 |
| X'C4' | 192 |
| X'C5' | 384 |
| X'C6' | 768 |
| X'C7' | 1536 |
| X'C8' | 3072 |
| X'C9' | 6144 |
| X'CA' | 12288 |
| X'CB' | 24576 |
| X'D0' | 13 |
| X'D1' | 26 |
| X'D2' | 52 |
| X'D3' | 104 |
| X'D4' | 208 |
| X'D5' | 416 |
| X'D6' | 832 |
| X'D7' | 1664 |
| X'D8' | 3328 |
| X'D9' | 6656 |
| X'DA' | 13312 |
| X'DB' | 26624 |

| Hex | Decimal |
|---|---|
| X'E0' | 14 |
| X'E1' | 28 |
| X'E2' | 56 |
| X'E3' | 112 |
| X'E4' | 224 |
| X'E5' | 448 |
| X'E6' | 896 |
| X'E7' | 1792 |
| X'E8' | 3584 |
| X'E9' | 7168 |
| X'EA' | 14336 |
| X'EB' | 28672 |
| X'F0' | 15 |
| X'F1' | 30 |
| X'F2' | 60 |
| X'F3' | 120 |
| X'F4' | 240 |
| X'F5' | 480 |
| X'F6' | 960 |
| X'F7' | 1920 |
| X'F8' | 3840 |
| X'F9' | 7680 |
| X'FA' | 15360 |
| X'FB' | 30720 |

Figure 19. RUSIZES Operand Values in Ascending Hexadecimal Order

| Decimal | Hex |
|---|---|
| 8 | X'80' |
| 9 | X'90' |
| 10 | X'A0' |
| 11 | X'B0' |
| 12 | X'C0' |
| 13 | X'D0' |
| 14 | X'E0' |
| 15 | X'F0' |
| 16 | X'81' |
| 18 | X'91' |
| 20 | X'A1' |
| 22 | X'B1' |
| 24 | X'C1' |
| 26 | X'D1' |
| 28 | X'E1' |
| 30 | X'F1' |
| 32 | X'82' |
| 36 | X'92' |
| 40 | X'A2' |
| 44 | X'B2' |
| 48 | X'C2' |
| 52 | X'D2' |
| 56 | X'E2' |
| 60 | X'F2' |
| 64 | X'83' |
| 72 | X'93' |
| 80 | X'A3' |
| 88 | X'B3' |
| 96 | X'C3' |
| 104 | X'D3' |
| 112 | X'E3' |
| 120 | X'F3' |
| 128 | X'84' |
| 144 | X'94' |
| 160 | X'A4' |
| 176 | X'B4' |
| 192 | X'C4' |
| 208 | X'D4' |
| 224 | X'E4' |
| 240 | X'F4' |

| Decimal | Hex |
|---|---|
| 256 | X'85' |
| 288 | X'95' |
| 320 | X'A5' |
| 352 | X'B5' |
| 384 | X'C5' |
| 416 | X'D5' |
| 448 | X'E5' |
| 480 | X'F5' |
| 512 | X'86' |
| 576 | X'96' |
| 640 | X'A6' |
| 704 | X'B6' |
| 768 | X'C6' |
| 832 | X'D6' |
| 896 | X'E6' |
| 960 | X'F6' |
| 1024 | X'87' |
| 1152 | X'97' |
| 1280 | X'A7' |
| 1408 | X'B7' |
| 1536 | X'C7' |
| 1664 | X'D7' |
| 1792 | X'E7' |
| 1920 | X'F7' |
| 2048 | X'88' |
| 2304 | X'98' |
| 2560 | X'A8' |
| 2816 | X'B8' |
| 3072 | X'C8' |
| 3328 | X'D8' |
| 3584 | X'E8' |
| 3840 | X'F8' |
| 4096 | X'89' |
| 4608 | X'99' |
| 5120 | X'A9' |
| 5632 | X'B9' |
| 6144 | X'C9' |
| 6656 | X'D9' |
| 7168 | X'E9' |
| 7680 | X'F9' |

| Decimal | Hex |
|---|---|
| 8192 | X'8A' |
| 9216 | X'9A' |
| 10240 | X'AA' |
| 11264 | X'BA' |
| 12288 | X'CA' |
| 13312 | X'DA' |
| 14336 | X'EA' |
| 15360 | X'FA' |
| 16384 | X'8B' |
| 18432 | X'9B' |
| 20480 | X'AB' |
| 22528 | X'BB' |
| 24576 | X'CB' |
| 26624 | X'DB' |
| 28672 | X'EB' |
| 30720 | X'FB' |

Figure 20. RUSIZES Operand Values in Ascending Decimal Order

Figure 21. RU Analysis Estimate for ACF/NCP Release 2 (Part 1 of 5)

ACF/NCP Release 2 to Terminal

| Max RU | BFRS | Num of Bufs | Num of Segs | Data Bytes Per Segment: 1st | Mid | Nth | Using Land Facilities, Milliseconds to Transmit, Line Speed (bps): 2400 | 4800 | 9600 | 19200 | 56000 | Using a Satellite, Milliseconds to Transmit, Line Speed (bps): 2400 | 4800 | 9600 | 19200 | 56000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 256 | 60 | 5 | 1 | 256 | 0 | 0 | 923 | 462 | 231 | 115 | 40 | 1513 | 1052 | 821 | 705 | 630 |
| 256 | 64 | 5 | 1 | 256 | 0 | 0 | 923 | 462 | 231 | 115 | 40 | 1513 | 1052 | 821 | 705 | 630 |
| 256 | 96 | 3 | 1 | 256 | 0 | 0 | 923 | 462 | 231 | 115 | 40 | 1513 | 1052 | 821 | 705 | 630 |
| 256 | 128 | 3 | 1 | 256 | 0 | 0 | 923 | 462 | 231 | 115 | 40 | 1513 | 1052 | 821 | 705 | 630 |
| 288 | 60 | 6 | 2 | 209 | 0 | 79 | 1070 | 535 | 268 | 134 | 46 | 1660 | 1125 | 858 | 724 | 636 |
| 288 | 64 | 5 | 2 | 225 | 0 | 63 | 1070 | 535 | 268 | 134 | 46 | 1660 | 1125 | 858 | 724 | 636 |
| 288 | 96 | 4 | 2 | 161 | 0 | 127 | 1070 | 535 | 268 | 134 | 46 | 1660 | 1125 | 858 | 724 | 636 |
| 288 | 128 | 3 | 2 | 225 | 0 | 63 | 1070 | 535 | 268 | 134 | 46 | 1660 | 1125 | 858 | 724 | 636 |
| 320 | 60 | 6 | 2 | 209 | 0 | 111 | 1177 | 588 | 294 | 147 | 50 | 1767 | 1178 | 884 | 737 | 640 |
| 320 | 64 | 6 | 2 | 225 | 0 | 95 | 1177 | 588 | 294 | 147 | 50 | 1767 | 1178 | 884 | 737 | 640 |
| 320 | 96 | 4 | 2 | 161 | 0 | 159 | 1177 | 588 | 294 | 147 | 50 | 1767 | 1178 | 884 | 737 | 640 |
| 320 | 128 | 3 | 2 | 225 | 0 | 95 | 1177 | 588 | 294 | 147 | 50 | 1767 | 1178 | 884 | 737 | 640 |
| 352 | 60 | 7 | 2 | 209 | 0 | 143 | 1283 | 642 | 321 | 160 | 55 | 1873 | 1232 | 911 | 750 | 645 |
| 352 | 64 | 6 | 2 | 225 | 0 | 127 | 1283 | 642 | 321 | 160 | 55 | 1873 | 1232 | 911 | 750 | 645 |
| 352 | 96 | 4 | 2 | 161 | 0 | 191 | 1283 | 642 | 321 | 160 | 55 | 1873 | 1232 | 911 | 750 | 645 |
| 352 | 128 | 3 | 2 | 225 | 0 | 127 | 1283 | 642 | 321 | 160 | 55 | 1873 | 1232 | 911 | 750 | 645 |
| 384 | 60 | 7 | 2 | 209 | 0 | 175 | 1390 | 695 | 348 | 174 | 60 | 1980 | 1285 | 938 | 764 | 650 |
| 384 | 64 | 7 | 2 | 225 | 0 | 159 | 1390 | 695 | 348 | 174 | 60 | 1980 | 1285 | 938 | 764 | 650 |
| 384 | 96 | 5 | 3 | 161 | 192 | 31 | 1430 | 715 | 358 | 179 | 61 | 2020 | 1305 | 948 | 769 | 651 |
| 384 | 128 | 4 | 2 | 225 | 0 | 159 | 1390 | 695 | 348 | 174 | 60 | 1980 | 1285 | 938 | 764 | 650 |
| 416 | 60 | 8 | 2 | 209 | 0 | 207 | 1497 | 748 | 374 | 187 | 64 | 2087 | 1338 | 964 | 777 | 654 |
| 416 | 64 | 7 | 2 | 225 | 0 | 191 | 1497 | 748 | 374 | 187 | 64 | 2087 | 1338 | 964 | 777 | 654 |
| 416 | 96 | 5 | 3 | 161 | 192 | 63 | 1537 | 768 | 384 | 192 | 66 | 2127 | 1358 | 974 | 782 | 656 |
| 416 | 128 | 4 | 2 | 225 | 0 | 191 | 1497 | 748 | 374 | 187 | 64 | 2087 | 1338 | 964 | 777 | 654 |
| 448 | 60 | 8 | 2 | 209 | 0 | 239 | 1603 | 802 | 401 | 200 | 69 | 2193 | 1392 | 991 | 790 | 659 |
| 448 | 64 | 8 | 2 | 225 | 0 | 223 | 1603 | 802 | 401 | 200 | 69 | 2193 | 1392 | 991 | 790 | 659 |
| 448 | 96 | 5 | 3 | 161 | 192 | 95 | 1643 | 822 | 411 | 205 | 70 | 2233 | 1412 | 1001 | 795 | 660 |
| 448 | 128 | 4 | 2 | 225 | 0 | 223 | 1603 | 802 | 401 | 200 | 69 | 2193 | 1392 | 991 | 790 | 659 |
| 480 | 60 | 9 | 3 | 209 | 240 | 31 | 1750 | 875 | 438 | 219 | 75 | 2340 | 1465 | 1028 | 809 | 665 |
| 480 | 64 | 8 | 2 | 225 | 0 | 255 | 1710 | 855 | 428 | 214 | 73 | 2300 | 1445 | 1018 | 804 | 663 |
| 480 | 96 | 6 | 3 | 161 | 192 | 127 | 1750 | 875 | 438 | 219 | 75 | 2340 | 1465 | 1028 | 809 | 665 |
| 480 | 128 | 4 | 2 | 225 | 0 | 255 | 1710 | 855 | 428 | 214 | 73 | 2300 | 1445 | 1018 | 804 | 663 |

ACF/NCP Release 2 to Terminal

| Max RU | BFRS | Num of Bufs | Num of Segs | Data Bytes Per Segment 1st | Mid | Nth | Using Land Facilities Milliseconds to Transmit — Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 | Using a Satellite Milliseconds to Transmit — Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 512 | 60 | 10 | 3 | 209 | 240 | 63 | 1857 | 928 | 464 | 232 | 80 | 2447 | 1518 | 1054 | 822 | 670 |
| 512 | 64 | 9 | 3 | 225 | 256 | 31 | 1857 | 928 | 464 | 232 | 80 | 2447 | 1518 | 1054 | 822 | 670 |
| 512 | 96 | 6 | 3 | 161 | 192 | 159 | 1857 | 928 | 464 | 232 | 80 | 2447 | 1518 | 1054 | 822 | 670 |
| 512 | 128 | 5 | 3 | 225 | 256 | 31 | 1857 | 928 | 464 | 232 | 80 | 2447 | 1518 | 1054 | 822 | 670 |
| 576 | 60 | 11 | 3 | 209 | 240 | 127 | 2070 | 1035 | 518 | 259 | 89 | 2660 | 1625 | 1108 | 849 | 679 |
| 576 | 64 | 10 | 3 | 225 | 256 | 95 | 2070 | 1035 | 518 | 259 | 89 | 2660 | 1625 | 1108 | 849 | 679 |
| 576 | 96 | 7 | 4 | 161 | 192 | 31 | 2110 | 1055 | 528 | 264 | 90 | 2700 | 1645 | 1118 | 854 | 680 |
| 576 | 128 | 5 | 3 | 225 | 256 | 95 | 2070 | 1035 | 518 | 259 | 89 | 2660 | 1625 | 1108 | 849 | 679 |
| 640 | 60 | 12 | 3 | 209 | 240 | 191 | 2283 | 1142 | 571 | 285 | 98 | 2873 | 1732 | 1161 | 875 | 688 |
| 640 | 64 | 11 | 3 | 225 | 256 | 159 | 2283 | 1142 | 571 | 285 | 98 | 2873 | 1732 | 1161 | 875 | 688 |
| 640 | 96 | 7 | 4 | 161 | 192 | 95 | 2323 | 1162 | 581 | 290 | 100 | 2913 | 1752 | 1171 | 880 | 690 |
| 640 | 128 | 6 | 3 | 225 | 256 | 159 | 2283 | 1142 | 571 | 285 | 98 | 2873 | 1732 | 1161 | 875 | 688 |
| 704 | 60 | 13 | 4 | 209 | 240 | 15 | 2537 | 1268 | 634 | 317 | 109 | 3127 | 1858 | 1224 | 907 | 699 |
| 704 | 64 | 12 | 3 | 225 | 256 | 223 | 2497 | 1248 | 624 | 312 | 107 | 3087 | 1838 | 1214 | 902 | 697 |
| 704 | 96 | 8 | 4 | 161 | 192 | 159 | 2537 | 1268 | 634 | 317 | 109 | 3127 | 1858 | 1224 | 907 | 699 |
| 704 | 128 | 6 | 3 | 225 | 256 | 223 | 2497 | 1248 | 624 | 312 | 107 | 3087 | 1838 | 1214 | 902 | 697 |
| 768 | 60 | 14 | 4 | 209 | 240 | 79 | 2750 | 1375 | 688 | 344 | 118 | 3340 | 1965 | 1278 | 934 | 708 |
| 768 | 64 | 13 | 4 | 225 | 256 | 31 | 2750 | 1375 | 688 | 344 | 118 | 3340 | 1965 | 1278 | 934 | 708 |
| 768 | 96 | 9 | 5 | 161 | 192 | 31 | 2790 | 1395 | 698 | 349 | 120 | 3380 | 1985 | 1288 | 939 | 710 |
| 768 | 128 | 7 | 4 | 225 | 256 | 31 | 2750 | 1375 | 688 | 344 | 118 | 3340 | 1965 | 1278 | 934 | 708 |
| 832 | 60 | 15 | 4 | 209 | 240 | 143 | 2963 | 1482 | 741 | 370 | 127 | 3553 | 2072 | 1331 | 960 | 717 |
| 832 | 64 | 14 | 4 | 225 | 256 | 95 | 2963 | 1482 | 741 | 370 | 127 | 3553 | 2072 | 1331 | 960 | 717 |
| 832 | 96 | 9 | 5 | 161 | 192 | 95 | 3003 | 1502 | 751 | 375 | 129 | 3593 | 2092 | 1341 | 965 | 719 |
| 832 | 128 | 7 | 4 | 225 | 256 | 95 | 2963 | 1482 | 741 | 370 | 127 | 3553 | 2072 | 1331 | 960 | 717 |
| 896 | 60 | 16 | 4 | 209 | 240 | 207 | 3177 | 1588 | 794 | 397 | 136 | 3767 | 2178 | 1384 | 987 | 726 |
| 896 | 64 | 15 | 4 | 225 | 256 | 159 | 3177 | 1588 | 794 | 397 | 136 | 3767 | 2178 | 1384 | 987 | 726 |
| 896 | 96 | 10 | 5 | 161 | 192 | 159 | 3217 | 1608 | 804 | 402 | 138 | 3807 | 2198 | 1394 | 992 | 728 |
| 896 | 128 | 8 | 4 | 225 | 256 | 159 | 3177 | 1588 | 794 | 397 | 136 | 3767 | 2178 | 1384 | 987 | 726 |
| 960 | 60 | 17 | 5 | 209 | 240 | 31 | 3430 | 1715 | 858 | 429 | 147 | 4020 | 2305 | 1448 | 1019 | 737 |
| 960 | 64 | 16 | 4 | 225 | 256 | 223 | 3390 | 1695 | 848 | 424 | 145 | 3980 | 2285 | 1438 | 1014 | 735 |
| 960 | 96 | 11 | 6 | 161 | 192 | 31 | 3470 | 1735 | 868 | 434 | 149 | 4060 | 2325 | 1458 | 1024 | 739 |
| 960 | 128 | 8 | 4 | 225 | 256 | 223 | 3390 | 1695 | 848 | 424 | 145 | 3980 | 2285 | 1438 | 1014 | 735 |

Figure 22. RU Analysis Estimate for ACF/NCP Release 2 (Part 2 of 5)

Figure 23. RU Analysis Estimate for ACF/NCP Release 2 (Part 3 of 5)

ACF/NCP Release 2 to Terminal

| | | | | Data Bytes Per Segment | | | Using Land Facilities Milliseconds to Transmit — Line Speed (bps) | | | | | Using a Satellite Milliseconds to Transmit — Line Speed (bps) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max RU | BFRS | Num of Bufs | Num of Segs | 1st | Mid | Nth | 2400 | 4800 | 9600 | 19200 | 56000 | 2400 | 4800 | 9600 | 19200 | 56000 |
| 1024 | 60 | 18 | 5 | 209 | 240 | 95 | 3643 | 1822 | 911 | 455 | 156 | 4233 | 2412 | 1501 | 1045 | 746 |
| 1024 | 64 | 17 | 5 | 225 | 256 | 31 | 3643 | 1822 | 911 | 455 | 156 | 4233 | 2412 | 1501 | 1045 | 746 |
| 1024 | 96 | 11 | 6 | 161 | 192 | 95 | 3683 | 1842 | 921 | 460 | 158 | 4273 | 2432 | 1511 | 1050 | 748 |
| 1024 | 128 | 9 | 5 | 225 | 256 | 31 | 3643 | 1822 | 911 | 455 | 156 | 4233 | 2412 | 1501 | 1045 | 746 |
| 1152 | 60 | 20 | 5 | 209 | 240 | 223 | 4070 | 2035 | 1018 | 509 | 174 | 4660 | 2625 | 1608 | 1099 | 764 |
| 1152 | 64 | 19 | 5 | 225 | 256 | 159 | 4070 | 2035 | 1018 | 509 | 174 | 4660 | 2625 | 1608 | 1099 | 764 |
| 1152 | 96 | 13 | 7 | 161 | 192 | 31 | 4150 | 2075 | 1038 | 519 | 178 | 4740 | 2665 | 1628 | 1109 | 768 |
| 1152 | 128 | 10 | 5 | 225 | 256 | 159 | 4070 | 2035 | 1018 | 509 | 174 | 4660 | 2625 | 1608 | 1099 | 764 |
| 1280 | 60 | 22 | 6 | 209 | 240 | 111 | 4537 | 2268 | 1134 | 567 | 194 | 5127 | 2858 | 1724 | 1157 | 784 |
| 1280 | 64 | 21 | 6 | 225 | 256 | 31 | 4537 | 2268 | 1134 | 567 | 194 | 5127 | 2858 | 1724 | 1157 | 784 |
| 1280 | 96 | 14 | 7 | 161 | 192 | 159 | 4577 | 2288 | 1144 | 572 | 196 | 5167 | 2878 | 1734 | 1162 | 786 |
| 1280 | 128 | 11 | 6 | 225 | 256 | 31 | 4537 | 2268 | 1134 | 567 | 194 | 5127 | 2858 | 1724 | 1157 | 784 |
| 1408 | 60 | 24 | 6 | 209 | 240 | 239 | 4963 | 2482 | 1241 | 620 | 213 | 5553 | 3072 | 1831 | 1210 | 803 |
| 1408 | 64 | 23 | 6 | 225 | 256 | 159 | 4963 | 2482 | 1241 | 620 | 213 | 5553 | 3072 | 1831 | 1210 | 803 |
| 1408 | 96 | 15 | 8 | 161 | 192 | 95 | 5083 | 2542 | 1271 | 635 | 218 | 6263 | 3722 | 2451 | 1815 | 1398 |
| 1408 | 128 | 12 | 6 | 225 | 256 | 159 | 4963 | 2482 | 1241 | 620 | 213 | 5553 | 3072 | 1831 | 1210 | 803 |
| 1536 | 60 | 27 | 7 | 209 | 240 | 127 | 5430 | 2715 | 1358 | 679 | 233 | 6020 | 3305 | 1948 | 1269 | 823 |
| 1536 | 64 | 25 | 7 | 225 | 256 | 31 | 5430 | 2715 | 1358 | 679 | 233 | 6020 | 3305 | 1948 | 1269 | 823 |
| 1536 | 96 | 17 | 9 | 161 | 192 | 31 | 5550 | 2775 | 1388 | 694 | 238 | 6730 | 3955 | 2568 | 1874 | 1418 |
| 1536 | 128 | 13 | 7 | 225 | 256 | 31 | 5430 | 2715 | 1358 | 679 | 233 | 6020 | 3305 | 1948 | 1269 | 823 |
| 1664 | 60 | 29 | 8 | 209 | 240 | 15 | 5937 | 2968 | 1484 | 742 | 254 | 7117 | 4148 | 2664 | 1922 | 1434 |
| 1664 | 64 | 27 | 7 | 225 | 256 | 159 | 5857 | 2928 | 1464 | 732 | 251 | 6447 | 3518 | 2054 | 1322 | 841 |
| 1664 | 96 | 18 | 9 | 161 | 192 | 159 | 5977 | 2988 | 1494 | 747 | 256 | 7157 | 4168 | 2674 | 1927 | 1436 |
| 1664 | 128 | 14 | 7 | 225 | 256 | 159 | 5857 | 2928 | 1464 | 732 | 251 | 6447 | 3518 | 2054 | 1322 | 841 |
| 1792 | 60 | 31 | 8 | 209 | 240 | 143 | 6363 | 3182 | 1591 | 795 | 273 | 7543 | 4362 | 2771 | 1975 | 1453 |
| 1792 | 64 | 29 | 8 | 225 | 256 | 31 | 6363 | 3182 | 1591 | 795 | 273 | 7543 | 4362 | 2771 | 1975 | 1453 |
| 1792 | 96 | 19 | 10 | 161 | 192 | 95 | 6443 | 3222 | 1611 | 805 | 276 | 7623 | 4402 | 2791 | 1985 | 1456 |
| 1792 | 128 | 15 | 8 | 225 | 256 | 31 | 6363 | 3182 | 1591 | 795 | 273 | 7543 | 4362 | 2771 | 1975 | 1453 |
| 1920 | 60 | 33 | 9 | 209 | 240 | 31 | 6830 | 3415 | 1708 | 854 | 293 | 8010 | 4595 | 2888 | 2034 | 1473 |
| 1920 | 64 | 31 | 8 | 225 | 256 | 159 | 6790 | 3395 | 1698 | 849 | 291 | 7970 | 4575 | 2878 | 2029 | 1471 |
| 1920 | 96 | 21 | 11 | 161 | 192 | 31 | 6910 | 3455 | 1728 | 864 | 296 | 8090 | 4635 | 2908 | 2044 | 1476 |
| 1920 | 128 | 16 | 8 | 225 | 256 | 159 | 6790 | 3395 | 1698 | 849 | 291 | 7970 | 4575 | 2878 | 2029 | 1471 |

ACF/NCP Release 2 to Terminal

| Max RU | BFRS | Num of Bufs | Num of Segs | Data Bytes Per Segment 1st | Mid | Nth | Using Land Facilities Milliseconds to Transmit — Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 | Using a Satellite Milliseconds to Transmit — Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2048 | 60 | 35 | 9 | 209 | 240 | 159 | 7257 | 3628 | 1814 | 907 | 311 | 8437 | 4808 | 2994 | 2087 | 1491 |
| 2048 | 64 | 33 | 9 | 225 | 256 | 31 | 7257 | 3628 | 1814 | 907 | 311 | 8437 | 4808 | 2994 | 2087 | 1491 |
| 2048 | 96 | 22 | 11 | 161 | 192 | 159 | 7337 | 3668 | 1834 | 917 | 314 | 8517 | 4848 | 3014 | 2097 | 1494 |
| 2048 | 128 | 17 | 9 | 225 | 256 | 31 | 7257 | 3628 | 1814 | 907 | 311 | 8437 | 4808 | 2994 | 2087 | 1491 |
| 2304 | 60 | 39 | 10 | 209 | 240 | 175 | 8150 | 4075 | 2038 | 1019 | 349 | 9330 | 5255 | 3218 | 2199 | 1529 |
| 2304 | 64 | 37 | 10 | 225 | 256 | 31 | 8150 | 4075 | 2038 | 1019 | 349 | 9330 | 5255 | 3218 | 2199 | 1529 |
| 2304 | 96 | 25 | 13 | 161 | 192 | 31 | 8270 | 4135 | 2068 | 1034 | 354 | 9450 | 5315 | 3248 | 2214 | 1534 |
| 2304 | 128 | 19 | 10 | 225 | 256 | 31 | 8150 | 4075 | 2038 | 1019 | 349 | 9330 | 5255 | 3218 | 2199 | 1529 |
| 2560 | 60 | 44 | 11 | 209 | 240 | 191 | 9043 | 4522 | 2261 | 1130 | 388 | 10223 | 5702 | 3441 | 2310 | 1568 |
| 2560 | 64 | 41 | 11 | 225 | 256 | 31 | 9043 | 4522 | 2261 | 1130 | 388 | 10223 | 5702 | 3441 | 2310 | 1568 |
| 2560 | 96 | 27 | 14 | 161 | 192 | 95 | 9163 | 4582 | 2291 | 1145 | 393 | 10343 | 5762 | 3471 | 2325 | 1573 |
| 2560 | 128 | 21 | 11 | 225 | 256 | 31 | 9043 | 4522 | 2261 | 1130 | 388 | 10223 | 5702 | 3441 | 2310 | 1568 |
| 2816 | 60 | 48 | 12 | 209 | 240 | 207 | 9937 | 4968 | 2484 | 1242 | 426 | 11117 | 6148 | 3664 | 2422 | 1606 |
| 2816 | 64 | 45 | 12 | 225 | 256 | 31 | 9937 | 4968 | 2484 | 1242 | 426 | 11117 | 6148 | 3664 | 2422 | 1606 |
| 2816 | 96 | 30 | 15 | 161 | 192 | 159 | 10097 | 5048 | 2524 | 1262 | 433 | 11867 | 6818 | 4294 | 3032 | 2203 |
| 2816 | 128 | 23 | 12 | 225 | 256 | 31 | 9937 | 4968 | 2484 | 1242 | 426 | 11117 | 6148 | 3664 | 2422 | 1606 |
| 3072 | 60 | 52 | 13 | 209 | 240 | 223 | 10830 | 5415 | 2708 | 1354 | 464 | 12010 | 6595 | 3888 | 2534 | 1644 |
| 3072 | 64 | 49 | 13 | 225 | 256 | 31 | 10830 | 5415 | 2708 | 1354 | 464 | 12010 | 6595 | 3888 | 2534 | 1644 |
| 3072 | 96 | 33 | 17 | 161 | 192 | 31 | 11030 | 5515 | 2758 | 1379 | 473 | 12800 | 7285 | 4528 | 3149 | 2243 |
| 3072 | 128 | 25 | 13 | 225 | 256 | 31 | 10830 | 5415 | 2708 | 1354 | 464 | 12010 | 6595 | 3888 | 2534 | 1644 |
| 3328 | 60 | 56 | 14 | 209 | 240 | 239 | 11723 | 5862 | 2931 | 1465 | 502 | 12903 | 7042 | 4111 | 2645 | 1682 |
| 3328 | 64 | 53 | 14 | 225 | 256 | 31 | 11723 | 5862 | 2931 | 1465 | 502 | 12903 | 7042 | 4111 | 2645 | 1682 |
| 3328 | 96 | 35 | 18 | 161 | 192 | 95 | 11923 | 5962 | 2981 | 1490 | 511 | 13693 | 7732 | 4751 | 3260 | 2281 |
| 3328 | 128 | 27 | 14 | 225 | 256 | 31 | 11723 | 5862 | 2931 | 1465 | 502 | 12903 | 7042 | 4111 | 2645 | 1682 |
| 3584 | 60 | 61 | 16 | 209 | 240 | 15 | 12697 | 6348 | 3174 | 1587 | 544 | 14467 | 8118 | 4944 | 3357 | 2314 |
| 3584 | 64 | 57 | 15 | 225 | 256 | 31 | 12657 | 6328 | 3164 | 1582 | 542 | 14427 | 8098 | 4934 | 3352 | 2312 |
| 3584 | 96 | 38 | 19 | 161 | 192 | 159 | 12817 | 6408 | 3204 | 1602 | 549 | 14587 | 8178 | 4974 | 3372 | 2319 |
| 3584 | 128 | 29 | 15 | 225 | 256 | 31 | 12657 | 6328 | 3164 | 1582 | 542 | 14427 | 8098 | 4934 | 3352 | 2312 |
| 3840 | 60 | 65 | 17 | 209 | 240 | 31 | 13590 | 6795 | 3398 | 1699 | 582 | 15360 | 8565 | 5168 | 3469 | 2352 |
| 3840 | 64 | 61 | 16 | 225 | 256 | 31 | 13550 | 6775 | 3388 | 1694 | 581 | 15320 | 8545 | 5158 | 3464 | 2351 |
| 3840 | 96 | 41 | 21 | 161 | 192 | 31 | 13750 | 6875 | 3438 | 1719 | 589 | 15520 | 8645 | 5208 | 3489 | 2359 |
| 3840 | 128 | 31 | 16 | 225 | 256 | 31 | 13550 | 6775 | 3388 | 1694 | 581 | 15320 | 8545 | 5158 | 3464 | 2351 |

Figure 24. RU Analysis Estimate for ACF/NCP Release 2 (Part 4 of 5)

ACF/NCP Release 2 to Terminal

| Max RU | BFRS | Num of Bufs | Num of Segs | Data Bytes Per Segment 1st | Mid | Nth | Using Land Facilities Milliseconds to Transmit, Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 | Using a Satellite Milliseconds to Transmit, Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4096 | 60 | 69 | 18 | 209 | 240 | 47 | 14483 | 7242 | 3621 | 1810 | 621 | 16253 | 9012 | 5391 | 3580 | 2391 |
| 4096 | 64 | 65 | 17 | 225 | 256 | 31 | 14443 | 7222 | 3611 | 1805 | 619 | 16213 | 8992 | 5381 | 3575 | 2389 |
| 4096 | 96 | 43 | 22 | 161 | 192 | 95 | 14683 | 7342 | 3671 | 1835 | 629 | 17043 | 9702 | 6031 | 4195 | 2989 |
| 4096 | 128 | 33 | 17 | 225 | 256 | 31 | 14443 | 7222 | 3611 | 1805 | 619 | 16213 | 8992 | 5381 | 3575 | 2389 |
| 4508 | 60 | 76 | 19 | 209 | 240 | 219 | 15897 | 7948 | 3974 | 1987 | 681 | 17667 | 9718 | 5744 | 3757 | 2451 |
| 4508 | 64 | 71 | 18 | 225 | 256 | 187 | 15857 | 7928 | 3964 | 1982 | 680 | 17627 | 9698 | 5734 | 3752 | 2450 |
| 4508 | 96 | 48 | 24 | 161 | 192 | 123 | 16137 | 8068 | 4034 | 2017 | 692 | 18497 | 10428 | 6394 | 4377 | 3052 |
| 4508 | 128 | 36 | 18 | 225 | 256 | 187 | 15857 | 7928 | 3964 | 1982 | 680 | 17627 | 9698 | 5734 | 3752 | 2450 |
| 5120 | 60 | 86 | 22 | 209 | 240 | 111 | 18097 | 9048 | 4524 | 2262 | 776 | 20457 | 11408 | 6884 | 4622 | 3136 |
| 5120 | 64 | 81 | 21 | 225 | 256 | 31 | 18017 | 9008 | 4504 | 2252 | 772 | 19787 | 10778 | 6274 | 4022 | 2542 |
| 5120 | 96 | 54 | 27 | 161 | 192 | 159 | 18297 | 9148 | 4574 | 2287 | 784 | 20657 | 11508 | 6934 | 4647 | 3144 |
| 5120 | 128 | 41 | 21 | 225 | 256 | 31 | 18017 | 9008 | 4504 | 2252 | 772 | 19787 | 10778 | 6274 | 4022 | 2542 |
| 5632 | 60 | 95 | 24 | 209 | 240 | 143 | 19883 | 9942 | 4971 | 2485 | 852 | 22243 | 12302 | 7331 | 4845 | 3212 |
| 5632 | 64 | 89 | 23 | 225 | 256 | 31 | 19843 | 9922 | 4961 | 2480 | 850 | 22203 | 12282 | 7321 | 4840 | 3210 |
| 5632 | 96 | 59 | 30 | 161 | 192 | 95 | 20163 | 10082 | 5041 | 2520 | 864 | 23113 | 13032 | 7991 | 5470 | 3814 |
| 5632 | 128 | 45 | 23 | 225 | 256 | 31 | 19843 | 9922 | 4961 | 2480 | 850 | 22203 | 12282 | 7321 | 4840 | 3210 |
| 6144 | 60 | 103 | 26 | 209 | 240 | 175 | 21670 | 10835 | 5418 | 2709 | 929 | 24030 | 13195 | 7778 | 5069 | 3289 |
| 6144 | 64 | 97 | 25 | 225 | 256 | 31 | 21630 | 10815 | 5408 | 2704 | 927 | 23990 | 13175 | 7768 | 5064 | 3287 |
| 6144 | 96 | 65 | 33 | 161 | 192 | 31 | 21990 | 10995 | 5498 | 2749 | 942 | 24940 | 13945 | 8448 | 5699 | 3892 |
| 6144 | 128 | 49 | 25 | 225 | 256 | 31 | 21630 | 10815 | 5408 | 2704 | 927 | 23990 | 13175 | 7768 | 5064 | 3287 |
| 6656 | 60 | 112 | 28 | 209 | 240 | 207 | 23457 | 11728 | 5864 | 2932 | 1005 | 25817 | 14088 | 8224 | 5292 | 3365 |
| 6656 | 64 | 105 | 27 | 225 | 256 | 31 | 23417 | 11708 | 5854 | 2927 | 1004 | 25777 | 14068 | 8214 | 5287 | 3364 |
| 6656 | 96 | 70 | 35 | 161 | 192 | 159 | 23777 | 11888 | 5944 | 2972 | 1019 | 26727 | 14838 | 8894 | 5922 | 3969 |
| 6656 | 128 | 53 | 27 | 225 | 256 | 31 | 23417 | 11708 | 5854 | 2927 | 1004 | 25777 | 14068 | 8214 | 5287 | 3364 |
| 7168 | 60 | 120 | 30 | 209 | 240 | 239 | 25283 | 12642 | 6321 | 3160 | 1084 | 28233 | 15592 | 9271 | 6110 | 4034 |
| 7168 | 64 | 113 | 29 | 225 | 256 | 31 | 25243 | 12622 | 6311 | 3155 | 1082 | 28193 | 15572 | 9261 | 6105 | 4032 |
| 7168 | 96 | 75 | 38 | 161 | 192 | 95 | 25643 | 12822 | 6411 | 3205 | 1099 | 29183 | 16362 | 9951 | 6745 | 4639 |
| 7168 | 128 | 57 | 29 | 225 | 256 | 31 | 25243 | 12622 | 6311 | 3155 | 1082 | 28193 | 15572 | 9261 | 6105 | 4032 |

Figure 25. RU Analysis Estimate for ACF/NCP Release 2 (Part 5 of 5)

## ACF/NCP Release 3 to Terminal

| Max RU | BFRS | Num of Bufs | Num of Segs | Data Bytes Per Segment 1st | Mid | Nth | Using Land Facilities Milliseconds to Transmit — Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 | Using a Satellite Milliseconds to Transmit — Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 256 | 72 | 5 | 1 | 256 | 0 | 0 | 923 | 462 | 231 | 115 | 40 | 1513 | 1052 | 821 | 705 | 630 |
| 256 | 84 | 4 | 1 | 256 | 0 | 0 | 923 | 462 | 231 | 115 | 40 | 1513 | 1052 | 821 | 705 | 630 |
| 256 | 88 | 4 | 1 | 256 | 0 | 0 | 923 | 462 | 231 | 115 | 40 | 1513 | 1052 | 821 | 705 | 630 |
| 256 | 96 | 4 | 1 | 256 | 0 | 0 | 923 | 462 | 231 | 115 | 40 | 1513 | 1052 | 821 | 705 | 630 |
| 256 | 128 | 3 | 1 | 256 | 0 | 0 | 923 | 462 | 231 | 115 | 40 | 1513 | 1052 | 821 | 705 | 630 |
| 288 | 72 | 5 | 2 | 241 | 0 | 47 | 1070 | 535 | 268 | 134 | 46 | 1660 | 1125 | 858 | 724 | 636 |
| 288 | 84 | 4 | 2 | 205 | 0 | 83 | 1070 | 535 | 268 | 134 | 46 | 1660 | 1125 | 858 | 724 | 636 |
| 288 | 88 | 4 | 2 | 217 | 0 | 71 | 1070 | 535 | 268 | 134 | 46 | 1660 | 1125 | 858 | 724 | 636 |
| 288 | 96 | 4 | 2 | 241 | 0 | 47 | 1070 | 535 | 268 | 134 | 46 | 1660 | 1125 | 858 | 724 | 636 |
| 288 | 128 | 3 | 2 | 209 | 0 | 79 | 1070 | 535 | 268 | 134 | 46 | 1660 | 1125 | 858 | 724 | 636 |
| 320 | 72 | 6 | 2 | 241 | 0 | 79 | 1177 | 588 | 294 | 147 | 50 | 1767 | 1178 | 884 | 737 | 640 |
| 320 | 84 | 5 | 2 | 205 | 0 | 115 | 1177 | 588 | 294 | 147 | 50 | 1767 | 1178 | 884 | 737 | 640 |
| 320 | 88 | 5 | 2 | 217 | 0 | 103 | 1177 | 588 | 294 | 147 | 50 | 1767 | 1178 | 884 | 737 | 640 |
| 320 | 96 | 4 | 2 | 241 | 0 | 79 | 1177 | 588 | 294 | 147 | 50 | 1767 | 1178 | 884 | 737 | 640 |
| 320 | 128 | 3 | 2 | 209 | 0 | 111 | 1177 | 588 | 294 | 147 | 50 | 1767 | 1178 | 884 | 737 | 640 |
| 352 | 72 | 6 | 2 | 241 | 0 | 111 | 1283 | 642 | 321 | 160 | 55 | 1873 | 1232 | 911 | 750 | 645 |
| 352 | 84 | 5 | 2 | 205 | 0 | 147 | 1283 | 642 | 321 | 160 | 55 | 1873 | 1232 | 911 | 750 | 645 |
| 352 | 88 | 5 | 2 | 217 | 0 | 135 | 1283 | 642 | 321 | 160 | 55 | 1873 | 1232 | 911 | 750 | 645 |
| 352 | 96 | 5 | 2 | 241 | 0 | 111 | 1283 | 642 | 321 | 160 | 55 | 1873 | 1232 | 911 | 750 | 645 |
| 352 | 128 | 4 | 2 | 209 | 0 | 143 | 1283 | 642 | 321 | 160 | 55 | 1873 | 1232 | 911 | 750 | 645 |
| 384 | 72 | 6 | 2 | 241 | 0 | 143 | 1390 | 695 | 348 | 174 | 60 | 1980 | 1285 | 938 | 764 | 650 |
| 384 | 84 | 6 | 2 | 205 | 0 | 179 | 1390 | 695 | 348 | 174 | 60 | 1980 | 1285 | 938 | 764 | 650 |
| 384 | 88 | 5 | 2 | 217 | 0 | 167 | 1390 | 695 | 348 | 174 | 60 | 1980 | 1285 | 938 | 764 | 650 |
| 384 | 96 | 5 | 2 | 241 | 0 | 143 | 1390 | 695 | 348 | 174 | 60 | 1980 | 1285 | 938 | 764 | 650 |
| 384 | 128 | 4 | 2 | 209 | 0 | 175 | 1390 | 695 | 348 | 174 | 60 | 1980 | 1285 | 938 | 764 | 650 |
| 416 | 72 | 7 | 2 | 241 | 0 | 175 | 1497 | 748 | 374 | 187 | 64 | 2087 | 1338 | 964 | 777 | 654 |
| 416 | 84 | 6 | 2 | 205 | 0 | 211 | 1497 | 748 | 374 | 187 | 64 | 2087 | 1338 | 964 | 777 | 654 |
| 416 | 88 | 6 | 3 | 217 | 176 | 23 | 1537 | 768 | 384 | 192 | 66 | 2127 | 1358 | 974 | 782 | 656 |
| 416 | 96 | 5 | 2 | 241 | 0 | 175 | 1497 | 748 | 374 | 187 | 64 | 2087 | 1338 | 964 | 777 | 654 |
| 416 | 128 | 4 | 2 | 209 | 0 | 207 | 1497 | 748 | 374 | 187 | 64 | 2087 | 1338 | 964 | 777 | 654 |
| 448 | 72 | 7 | 2 | 241 | 0 | 207 | 1603 | 802 | 401 | 200 | 69 | 2193 | 1392 | 991 | 790 | 659 |
| 448 | 84 | 6 | 2 | 205 | 0 | 243 | 1603 | 802 | 401 | 200 | 69 | 2193 | 1392 | 991 | 790 | 659 |
| 448 | 88 | 6 | 3 | 217 | 176 | 55 | 1643 | 822 | 411 | 205 | 70 | 2233 | 1412 | 1001 | 795 | 660 |
| 448 | 96 | 6 | 3 | 241 | 192 | 15 | 1643 | 822 | 411 | 205 | 70 | 2233 | 1412 | 1001 | 795 | 660 |
| 448 | 128 | 4 | 2 | 209 | 0 | 239 | 1603 | 802 | 401 | 200 | 69 | 2193 | 1392 | 991 | 790 | 659 |

Figure 26. RU Analysis Estimate for ACF/NCP Release 3 (Part 1 of 6)

Figure 27. RU Analysis Estimate for ACF/NCP Release 3 (Part 2 of 6)

ACF/NCP Release 3 to Terminal

| Max RU | BFRS | Num of Bufs | Num of Segs | Data Bytes Per Segment | | | Using Land Facilities Milliseconds to Transmit — Line Speed (bps) | | | | | Using a Satellite Milliseconds to Transmit — Line Speed (bps) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1st | Mid | Nth | 2400 | 4800 | 9600 | 19200 | 56000 | 2400 | 4800 | 9600 | 19200 | 56000 |
| 480 | 72 | 8 | 3 | 241 | 216 | 23 | 1750 | 875 | 438 | 219 | 75 | 2340 | 1465 | 1028 | 809 | 665 |
| 480 | 84 | 7 | 3 | 205 | 252 | 23 | 1750 | 875 | 438 | 219 | 75 | 2340 | 1465 | 1028 | 809 | 665 |
| 480 | 88 | 6 | 3 | 217 | 176 | 87 | 1750 | 875 | 438 | 219 | 75 | 2340 | 1465 | 1028 | 809 | 665 |
| 480 | 96 | 6 | 3 | 241 | 192 | 47 | 1750 | 875 | 438 | 219 | 75 | 2340 | 1465 | 1028 | 809 | 665 |
| 480 | 128 | 5 | 3 | 209 | 256 | 15 | 1750 | 875 | 438 | 219 | 75 | 2340 | 1465 | 1028 | 809 | 665 |
| 512 | 72 | 8 | 3 | 241 | 216 | 55 | 1857 | 928 | 464 | 232 | 80 | 2447 | 1518 | 1054 | 822 | 670 |
| 512 | 84 | 7 | 3 | 205 | 252 | 55 | 1857 | 928 | 464 | 232 | 80 | 2447 | 1518 | 1054 | 822 | 670 |
| 512 | 88 | 7 | 3 | 217 | 176 | 119 | 1857 | 928 | 464 | 232 | 80 | 2447 | 1518 | 1054 | 822 | 670 |
| 512 | 96 | 6 | 3 | 241 | 192 | 79 | 1857 | 928 | 464 | 232 | 80 | 2447 | 1518 | 1054 | 822 | 670 |
| 512 | 128 | 5 | 3 | 209 | 256 | 47 | 1857 | 928 | 464 | 232 | 80 | 2447 | 1518 | 1054 | 822 | 670 |
| 576 | 72 | 9 | 3 | 241 | 216 | 119 | 2070 | 1035 | 518 | 259 | 89 | 2660 | 1625 | 1108 | 849 | 679 |
| 576 | 84 | 8 | 3 | 205 | 252 | 119 | 2070 | 1035 | 518 | 259 | 89 | 2660 | 1625 | 1108 | 849 | 679 |
| 576 | 88 | 8 | 4 | 217 | 176 | 7 | 2110 | 1055 | 528 | 264 | 90 | 2700 | 1645 | 1118 | 854 | 680 |
| 576 | 96 | 7 | 3 | 241 | 192 | 143 | 2070 | 1035 | 518 | 259 | 89 | 2660 | 1625 | 1108 | 849 | 679 |
| 576 | 128 | 5 | 3 | 209 | 256 | 111 | 2070 | 1035 | 518 | 259 | 89 | 2660 | 1625 | 1108 | 849 | 679 |
| 640 | 72 | 10 | 3 | 241 | 216 | 183 | 2283 | 1142 | 571 | 285 | 98 | 2873 | 1732 | 1161 | 875 | 688 |
| 640 | 84 | 9 | 3 | 205 | 252 | 183 | 2283 | 1142 | 571 | 285 | 98 | 2873 | 1732 | 1161 | 875 | 688 |
| 640 | 88 | 8 | 4 | 217 | 176 | 71 | 2323 | 1162 | 581 | 290 | 100 | 2913 | 1752 | 1171 | 880 | 690 |
| 640 | 96 | 8 | 4 | 241 | 192 | 15 | 2323 | 1162 | 581 | 290 | 100 | 2913 | 1752 | 1171 | 880 | 690 |
| 640 | 128 | 6 | 3 | 209 | 256 | 175 | 2283 | 1142 | 571 | 285 | 98 | 2873 | 1732 | 1161 | 875 | 688 |
| 704 | 72 | 11 | 4 | 241 | 216 | 31 | 2537 | 1268 | 634 | 317 | 109 | 3127 | 1858 | 1224 | 907 | 699 |
| 704 | 84 | 9 | 3 | 205 | 252 | 247 | 2497 | 1248 | 624 | 312 | 107 | 3087 | 1838 | 1214 | 902 | 697 |
| 704 | 88 | 9 | 4 | 217 | 176 | 135 | 2537 | 1268 | 634 | 317 | 109 | 3127 | 1858 | 1224 | 907 | 699 |
| 704 | 96 | 8 | 4 | 241 | 192 | 79 | 2537 | 1268 | 634 | 317 | 109 | 3127 | 1858 | 1224 | 907 | 699 |
| 704 | 128 | 6 | 3 | 209 | 256 | 239 | 2497 | 1248 | 624 | 312 | 107 | 3087 | 1838 | 1214 | 902 | 697 |
| 768 | 72 | 12 | 4 | 241 | 216 | 95 | 2750 | 1375 | 688 | 344 | 118 | 3340 | 1965 | 1278 | 934 | 708 |
| 768 | 84 | 10 | 4 | 205 | 252 | 59 | 2750 | 1375 | 688 | 344 | 118 | 3340 | 1965 | 1278 | 934 | 708 |
| 768 | 88 | 10 | 5 | 217 | 176 | 23 | 2790 | 1395 | 698 | 349 | 120 | 3380 | 1985 | 1288 | 939 | 710 |
| 768 | 96 | 9 | 4 | 241 | 192 | 143 | 2750 | 1375 | 688 | 344 | 118 | 3340 | 1965 | 1278 | 934 | 708 |
| 768 | 128 | 7 | 4 | 209 | 256 | 47 | 2750 | 1375 | 688 | 344 | 118 | 3340 | 1965 | 1278 | 934 | 708 |
| 832 | 72 | 13 | 4 | 241 | 216 | 159 | 2963 | 1482 | 741 | 370 | 127 | 3553 | 2072 | 1331 | 960 | 717 |
| 832 | 84 | 11 | 4 | 205 | 252 | 123 | 2963 | 1482 | 741 | 370 | 127 | 3553 | 2072 | 1331 | 960 | 717 |
| 832 | 88 | 10 | 5 | 217 | 176 | 87 | 3003 | 1502 | 751 | 375 | 129 | 3593 | 2092 | 1341 | 965 | 719 |
| 832 | 96 | 10 | 5 | 241 | 192 | 15 | 3003 | 1502 | 751 | 375 | 129 | 3593 | 2092 | 1341 | 965 | 719 |
| 832 | 128 | 7 | 4 | 209 | 256 | 111 | 2963 | 1482 | 741 | 370 | 127 | 3553 | 2072 | 1331 | 960 | 717 |

## ACF/NCP Release 3 to Terminal

| | | | | Data Bytes Per Segment | | | Using Land Facilities Milliseconds to Transmit — Line Speed (bps) | | | | | Using a Satellite Milliseconds to Transmit — Line Speed (bps) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max RU | BFRS | Num of Bufs | Num of Segs | 1st | Mid | Nth | 2400 | 4800 | 9600 | 19200 | 56000 | 2400 | 4800 | 9600 | 19200 | 56000 |
| 896 | 72 | 14 | 5 | 241 | 216 | 7 | 3217 | 1608 | 804 | 402 | 138 | 3807 | 2198 | 1394 | 992 | 728 |
| 896 | 84 | 12 | 4 | 205 | 252 | 187 | 3177 | 1588 | 794 | 397 | 136 | 3767 | 2178 | 1384 | 987 | 726 |
| 896 | 88 | 11 | 5 | 217 | 176 | 151 | 3217 | 1608 | 804 | 402 | 138 | 3807 | 2198 | 1394 | 992 | 728 |
| 896 | 96 | 10 | 5 | 241 | 192 | 79 | 3217 | 1608 | 804 | 402 | 138 | 3807 | 2198 | 1394 | 992 | 728 |
| 896 | 128 | 8 | 4 | 209 | 256 | 175 | 3177 | 1588 | 794 | 397 | 136 | 3767 | 2178 | 1384 | 987 | 726 |
| 960 | 72 | 14 | 5 | 241 | 216 | 71 | 3430 | 1715 | 858 | 429 | 147 | 4020 | 2305 | 1448 | 1019 | 737 |
| 960 | 84 | 12 | 4 | 205 | 252 | 251 | 3390 | 1695 | 848 | 424 | 145 | 3980 | 2285 | 1438 | 1014 | 735 |
| 960 | 88 | 12 | 6 | 217 | 176 | 39 | 3470 | 1735 | 868 | 434 | 149 | 4060 | 2325 | 1458 | 1024 | 739 |
| 960 | 96 | 11 | 5 | 241 | 192 | 143 | 3430 | 1715 | 858 | 429 | 147 | 4020 | 2305 | 1448 | 1019 | 737 |
| 960 | 128 | 8 | 4 | 209 | 256 | 239 | 3390 | 1695 | 848 | 424 | 145 | 3980 | 2285 | 1438 | 1014 | 735 |
| 1024 | 72 | 15 | 5 | 241 | 216 | 135 | 3643 | 1822 | 911 | 455 | 156 | 4233 | 2412 | 1501 | 1045 | 746 |
| 1024 | 84 | 13 | 5 | 205 | 252 | 63 | 3643 | 1822 | 911 | 455 | 156 | 4233 | 2412 | 1501 | 1045 | 746 |
| 1024 | 88 | 13 | 6 | 217 | 176 | 103 | 3683 | 1842 | 921 | 460 | 158 | 4273 | 2432 | 1511 | 1050 | 748 |
| 1024 | 96 | 12 | 6 | 241 | 192 | 15 | 3683 | 1842 | 921 | 460 | 158 | 4273 | 2432 | 1511 | 1050 | 748 |
| 1024 | 128 | 9 | 5 | 209 | 256 | 47 | 3643 | 1822 | 911 | 455 | 156 | 4233 | 2412 | 1501 | 1045 | 746 |
| 1152 | 72 | 17 | 6 | 241 | 216 | 47 | 4110 | 2055 | 1028 | 514 | 176 | 4700 | 2645 | 1618 | 1104 | 766 |
| 1152 | 84 | 15 | 5 | 205 | 252 | 191 | 4070 | 2035 | 1018 | 509 | 174 | 4660 | 2625 | 1608 | 1099 | 764 |
| 1152 | 88 | 14 | 7 | 217 | 176 | 55 | 4150 | 2075 | 1038 | 519 | 178 | 4740 | 2665 | 1628 | 1109 | 768 |
| 1152 | 96 | 13 | 6 | 241 | 192 | 143 | 4110 | 2055 | 1028 | 514 | 176 | 4700 | 2645 | 1618 | 1104 | 766 |
| 1152 | 128 | 10 | 5 | 209 | 256 | 175 | 4070 | 2035 | 1018 | 509 | 174 | 4660 | 2625 | 1608 | 1099 | 764 |
| 1280 | 72 | 19 | 6 | 241 | 216 | 175 | 4537 | 2268 | 1134 | 567 | 194 | 5127 | 2858 | 1724 | 1157 | 784 |
| 1280 | 84 | 16 | 6 | 205 | 252 | 67 | 4537 | 2268 | 1134 | 567 | 194 | 5127 | 2858 | 1724 | 1157 | 784 |
| 1280 | 88 | 16 | 8 | 217 | 176 | 7 | 4657 | 2328 | 1164 | 582 | 200 | 5837 | 3508 | 2344 | 1762 | 1380 |
| 1280 | 96 | 14 | 7 | 241 | 192 | 79 | 4577 | 2288 | 1144 | 572 | 196 | 5167 | 2878 | 1734 | 1162 | 786 |
| 1280 | 128 | 11 | 6 | 209 | 256 | 47 | 4537 | 2268 | 1134 | 567 | 194 | 5127 | 2858 | 1724 | 1157 | 784 |
| 1408 | 72 | 21 | 7 | 241 | 216 | 87 | 5003 | 2502 | 1251 | 625 | 214 | 5593 | 3092 | 1841 | 1215 | 804 |
| 1408 | 84 | 18 | 6 | 205 | 252 | 195 | 4963 | 2482 | 1241 | 620 | 213 | 5553 | 3072 | 1831 | 1210 | 803 |
| 1408 | 88 | 17 | 8 | 217 | 176 | 135 | 5083 | 2542 | 1271 | 635 | 218 | 6263 | 3722 | 2451 | 1815 | 1398 |
| 1408 | 96 | 16 | 8 | 241 | 192 | 15 | 5083 | 2542 | 1271 | 635 | 218 | 6263 | 3722 | 2451 | 1815 | 1398 |
| 1408 | 128 | 12 | 6 | 209 | 256 | 175 | 4963 | 2482 | 1241 | 620 | 213 | 5553 | 3072 | 1831 | 1210 | 803 |
| 1536 | 72 | 22 | 7 | 241 | 216 | 215 | 5430 | 2715 | 1358 | 679 | 233 | 6020 | 3305 | 1948 | 1269 | 823 |
| 1536 | 84 | 19 | 7 | 205 | 252 | 71 | 5430 | 2715 | 1358 | 679 | 233 | 6020 | 3305 | 1948 | 1269 | 823 |
| 1536 | 88 | 18 | 9 | 217 | 176 | 87 | 5550 | 2775 | 1388 | 694 | 238 | 6730 | 3955 | 2568 | 1874 | 1418 |
| 1536 | 96 | 17 | 8 | 241 | 192 | 143 | 5510 | 2755 | 1378 | 689 | 236 | 6690 | 3935 | 2558 | 1869 | 1416 |
| 1536 | 128 | 13 | 7 | 209 | 256 | 47 | 5430 | 2715 | 1358 | 679 | 233 | 6020 | 3305 | 1948 | 1269 | 823 |

Figure 28. RU Analysis Estimate for ACF/NCP Release 3 (Part 3 of 6)

Figure 29. RU Analysis Estimate for ACF/NCP Release 3 (Part 4 of 6)

ACF/NCP Release 3 to Terminal

| Max RU | BFRS | Num of Bufs | Num of Segs | Data Bytes Per Segment 1st | Mid | Nth | Using Land Facilities Milliseconds to Transmit — Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 | Using a Satellite Milliseconds to Transmit — Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1664 | 72 | 24 | 8 | 241 | 216 | 127 | 5937 | 2968 | 1484 | 742 | 254 | 7117 | 4148 | 2664 | 1922 | 1434 |
| 1664 | 84 | 21 | 7 | 205 | 252 | 199 | 5857 | 2928 | 1464 | 732 | 251 | 6447 | 3518 | 2054 | 1322 | 841 |
| 1664 | 88 | 20 | 10 | 217 | 176 | 39 | 6017 | 3008 | 1504 | 752 | 258 | 7197 | 4188 | 2684 | 1932 | 1438 |
| 1664 | 96 | 18 | 9 | 241 | 192 | 79 | 5977 | 2988 | 1494 | 747 | 256 | 7157 | 4168 | 2674 | 1927 | 1436 |
| 1664 | 128 | 14 | 7 | 209 | 256 | 175 | 5857 | 2928 | 1464 | 732 | 251 | 6447 | 3518 | 2054 | 1322 | 841 |
| 1792 | 72 | 26 | 9 | 241 | 216 | 39 | 6403 | 3202 | 1601 | 800 | 274 | 7583 | 4382 | 2781 | 1980 | 1454 |
| 1792 | 84 | 22 | 8 | 205 | 252 | 75 | 6363 | 3182 | 1591 | 795 | 273 | 7543 | 4362 | 2771 | 1975 | 1453 |
| 1792 | 88 | 21 | 10 | 217 | 176 | 167 | 6443 | 3222 | 1611 | 805 | 276 | 7623 | 4402 | 2791 | 1985 | 1456 |
| 1792 | 96 | 20 | 10 | 241 | 192 | 15 | 6443 | 3222 | 1611 | 805 | 276 | 7623 | 4402 | 2791 | 1985 | 1456 |
| 1792 | 128 | 15 | 8 | 209 | 256 | 47 | 6363 | 3182 | 1591 | 795 | 273 | 7543 | 4362 | 2771 | 1975 | 1453 |
| 1920 | 72 | 28 | 9 | 241 | 216 | 167 | 6830 | 3415 | 1708 | 854 | 293 | 8010 | 4595 | 2888 | 2034 | 1473 |
| 1920 | 84 | 24 | 8 | 205 | 252 | 203 | 6790 | 3395 | 1698 | 849 | 291 | 7970 | 4575 | 2878 | 2029 | 1471 |
| 1920 | 88 | 23 | 11 | 217 | 176 | 119 | 6910 | 3455 | 1728 | 864 | 296 | 8090 | 4635 | 2908 | 2044 | 1476 |
| 1920 | 96 | 21 | 10 | 241 | 192 | 143 | 6870 | 3435 | 1718 | 859 | 294 | 8050 | 4615 | 2898 | 2039 | 1474 |
| 1920 | 128 | 16 | 8 | 209 | 256 | 175 | 6790 | 3395 | 1698 | 849 | 291 | 7970 | 4575 | 2878 | 2029 | 1471 |
| 2048 | 72 | 30 | 10 | 241 | 216 | 79 | 7297 | 3648 | 1824 | 912 | 313 | 8477 | 4828 | 3004 | 2092 | 1493 |
| 2048 | 84 | 25 | 9 | 205 | 252 | 79 | 7257 | 3628 | 1814 | 907 | 311 | 8437 | 4808 | 2994 | 2087 | 1491 |
| 2048 | 88 | 24 | 12 | 217 | 176 | 71 | 7377 | 3688 | 1844 | 922 | 316 | 8557 | 4868 | 3024 | 2102 | 1496 |
| 2048 | 96 | 22 | 11 | 241 | 192 | 79 | 7337 | 3668 | 1834 | 917 | 314 | 8517 | 4848 | 3014 | 2097 | 1494 |
| 2048 | 128 | 17 | 9 | 209 | 256 | 47 | 7257 | 3628 | 1814 | 907 | 311 | 8437 | 4808 | 2994 | 2087 | 1491 |
| 2304 | 72 | 33 | 11 | 241 | 216 | 119 | 8190 | 4095 | 2048 | 1024 | 351 | 9370 | 5275 | 3228 | 2204 | 1531 |
| 2304 | 84 | 28 | 10 | 205 | 252 | 83 | 8150 | 4075 | 2038 | 1019 | 349 | 9330 | 5255 | 3218 | 2199 | 1529 |
| 2304 | 88 | 27 | 13 | 217 | 176 | 151 | 8270 | 4135 | 2068 | 1034 | 354 | 9450 | 5315 | 3248 | 2214 | 1534 |
| 2304 | 96 | 25 | 12 | 241 | 192 | 143 | 8230 | 4115 | 2058 | 1029 | 353 | 9410 | 5295 | 3238 | 2209 | 1533 |
| 2304 | 128 | 19 | 10 | 209 | 256 | 47 | 8150 | 4075 | 2038 | 1019 | 349 | 9330 | 5255 | 3218 | 2199 | 1529 |
| 2560 | 72 | 37 | 12 | 241 | 216 | 159 | 9083 | 4542 | 2271 | 1135 | 389 | 10263 | 5722 | 3451 | 2315 | 1569 |
| 2560 | 84 | 32 | 11 | 205 | 252 | 87 | 9043 | 4522 | 2261 | 1130 | 388 | 10223 | 5702 | 3441 | 2310 | 1568 |
| 2560 | 88 | 30 | 15 | 217 | 176 | 55 | 9243 | 4622 | 2311 | 1155 | 396 | 11013 | 6392 | 4081 | 2925 | 2166 |
| 2560 | 96 | 28 | 14 | 241 | 192 | 15 | 9163 | 4582 | 2291 | 1145 | 393 | 10343 | 5762 | 3471 | 2325 | 1573 |
| 2560 | 128 | 21 | 11 | 209 | 256 | 47 | 9043 | 4522 | 2261 | 1130 | 388 | 10223 | 5702 | 3441 | 2310 | 1568 |
| 2816 | 72 | 40 | 13 | 241 | 216 | 199 | 9977 | 4988 | 2494 | 1247 | 428 | 11157 | 6168 | 3674 | 2427 | 1608 |
| 2816 | 84 | 35 | 12 | 205 | 252 | 91 | 9937 | 4968 | 2484 | 1242 | 426 | 11117 | 6148 | 3664 | 2422 | 1606 |
| 2816 | 88 | 33 | 16 | 217 | 176 | 135 | 10137 | 5068 | 2534 | 1267 | 434 | 11907 | 6838 | 4304 | 3037 | 2204 |
| 2816 | 96 | 30 | 15 | 241 | 192 | 79 | 10097 | 5048 | 2524 | 1262 | 433 | 11867 | 6818 | 4294 | 3032 | 2203 |
| 2816 | 128 | 23 | 12 | 209 | 256 | 47 | 9937 | 4968 | 2484 | 1242 | 426 | 11117 | 6148 | 3664 | 2422 | 1606 |

ACF/NCP Release 3 to Terminal

| Max RU | BFRS | Num of Bufs | Num of Segs | Data Bytes Per Segment 1st | Mid | Nth | Using Land Facilities Milliseconds to Transmit — Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 | Using a Satellite Milliseconds to Transmit — Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3072 | 72 | 44 | 15 | 241 | 216 | 23 | 10950 | 5475 | 2738 | 1369 | 469 | 12720 | 7245 | 4508 | 3139 | 2239 |
| 3072 | 84 | 38 | 13 | 205 | 252 | 95 | 10830 | 5415 | 2708 | 1354 | 464 | 12010 | 6595 | 3888 | 2534 | 1644 |
| 3072 | 88 | 36 | 18 | 217 | 176 | 39 | 11070 | 5535 | 2768 | 1384 | 474 | 12840 | 7305 | 4538 | 3154 | 2244 |
| 3072 | 96 | 33 | 16 | 241 | 192 | 143 | 10990 | 5495 | 2748 | 1374 | 471 | 12760 | 7265 | 4518 | 3144 | 2241 |
| 3072 | 128 | 25 | 13 | 209 | 256 | 47 | 10830 | 5415 | 2708 | 1354 | 464 | 12010 | 6595 | 3888 | 2534 | 1644 |
| 3328 | 72 | 47 | 16 | 241 | 216 | 63 | 11843 | 5922 | 2961 | 1480 | 508 | 13613 | 7692 | 4731 | 3250 | 2278 |
| 3328 | 84 | 41 | 14 | 205 | 252 | 99 | 11723 | 5862 | 2931 | 1465 | 502 | 12903 | 7042 | 4111 | 2645 | 1682 |
| 3328 | 88 | 39 | 19 | 217 | 176 | 119 | 11963 | 5982 | 2991 | 1495 | 513 | 13733 | 7752 | 4761 | 3265 | 2283 |
| 3328 | 96 | 36 | 18 | 241 | 192 | 15 | 11923 | 5962 | 2981 | 1490 | 511 | 13693 | 7732 | 4751 | 3260 | 2281 |
| 3328 | 128 | 27 | 14 | 209 | 256 | 47 | 11723 | 5862 | 2931 | 1465 | 502 | 12903 | 7042 | 4111 | 2645 | 1682 |
| 3584 | 72 | 51 | 17 | 241 | 216 | 103 | 12737 | 6368 | 3184 | 1592 | 546 | 14507 | 8138 | 4954 | 3362 | 2316 |
| 3584 | 84 | 44 | 15 | 205 | 252 | 103 | 12657 | 6328 | 3164 | 1582 | 542 | 14427 | 8098 | 4934 | 3352 | 2312 |
| 3584 | 88 | 42 | 21 | 217 | 176 | 23 | 12897 | 6448 | 3224 | 1612 | 553 | 14667 | 8218 | 4994 | 3382 | 2323 |
| 3584 | 96 | 38 | 19 | 241 | 192 | 79 | 12817 | 6408 | 3204 | 1602 | 549 | 14587 | 8178 | 4974 | 3372 | 2319 |
| 3584 | 128 | 29 | 15 | 209 | 256 | 47 | 12657 | 6328 | 3164 | 1582 | 542 | 14427 | 8098 | 4934 | 3352 | 2312 |
| 3840 | 72 | 54 | 18 | 241 | 216 | 143 | 13630 | 6815 | 3408 | 1704 | 584 | 15400 | 8585 | 5178 | 3474 | 2354 |
| 3840 | 84 | 47 | 16 | 205 | 252 | 107 | 13550 | 6775 | 3388 | 1694 | 581 | 15320 | 8545 | 5158 | 3464 | 2351 |
| 3840 | 88 | 45 | 22 | 217 | 176 | 103 | 13830 | 6915 | 3458 | 1729 | 593 | 16190 | 9275 | 5818 | 4089 | 2953 |
| 3840 | 96 | 41 | 20 | 241 | 192 | 143 | 13710 | 6855 | 3428 | 1714 | 588 | 15480 | 8625 | 5198 | 3484 | 2358 |
| 3840 | 128 | 31 | 16 | 209 | 256 | 47 | 13550 | 6775 | 3388 | 1694 | 581 | 15320 | 8545 | 5158 | 3464 | 2351 |
| 4096 | 72 | 58 | 19 | 241 | 216 | 183 | 14523 | 7262 | 3631 | 1815 | 622 | 16293 | 9032 | 5401 | 3585 | 2392 |
| 4096 | 84 | 50 | 17 | 205 | 252 | 111 | 14443 | 7222 | 3611 | 1805 | 619 | 16213 | 8992 | 5381 | 3575 | 2389 |
| 4096 | 88 | 48 | 24 | 217 | 176 | 7 | 14763 | 7382 | 3691 | 1845 | 633 | 17123 | 9742 | 6051 | 4205 | 2993 |
| 4096 | 96 | 44 | 22 | 241 | 192 | 15 | 14683 | 7342 | 3671 | 1835 | 629 | 17043 | 9702 | 6031 | 4195 | 2989 |
| 4096 | 128 | 33 | 17 | 209 | 256 | 47 | 14443 | 7222 | 3611 | 1805 | 619 | 16213 | 8992 | 5381 | 3575 | 2389 |
| 4508 | 72 | 64 | 21 | 241 | 216 | 163 | 15977 | 7988 | 3994 | 1997 | 685 | 17747 | 9758 | 5764 | 3767 | 2455 |
| 4508 | 84 | 55 | 19 | 205 | 252 | 19 | 15897 | 7948 | 3974 | 1987 | 681 | 17667 | 9718 | 5744 | 3757 | 2451 |
| 4508 | 88 | 52 | 26 | 217 | 176 | 67 | 16217 | 8108 | 4054 | 2027 | 695 | 18577 | 10468 | 6414 | 4387 | 3055 |
| 4508 | 96 | 48 | 24 | 241 | 192 | 43 | 16137 | 8068 | 4034 | 2017 | 692 | 18497 | 10428 | 6394 | 4377 | 3052 |
| 4508 | 128 | 36 | 18 | 209 | 256 | 203 | 15857 | 7928 | 3964 | 1982 | 680 | 17627 | 9698 | 5734 | 3752 | 2450 |
| 5120 | 72 | 72 | 24 | 241 | 216 | 127 | 18177 | 9088 | 4544 | 2272 | 779 | 20537 | 11448 | 6904 | 4632 | 3139 |
| 5120 | 84 | 62 | 21 | 205 | 252 | 127 | 18017 | 9008 | 4504 | 2252 | 772 | 19787 | 10778 | 6274 | 4022 | 2542 |
| 5120 | 88 | 59 | 29 | 217 | 176 | 151 | 18417 | 9208 | 4604 | 2302 | 789 | 21367 | 12158 | 7554 | 5252 | 3739 |
| 5120 | 96 | 54 | 27 | 241 | 192 | 79 | 18297 | 9148 | 4574 | 2287 | 784 | 20657 | 11508 | 6934 | 4647 | 3144 |
| 5120 | 128 | 41 | 21 | 209 | 256 | 47 | 18017 | 9008 | 4504 | 2252 | 772 | 19787 | 10778 | 6274 | 4022 | 2542 |

Figure 30. RU Analysis Estimate for ACF/NCP Release 3 (Part 5 of 6)

ACF/NCP Release 3 to Terminal

| Max RU | BFRS | Num of Bufs | Num of Segs | Data Bytes Per Segment 1st | Mid | Nth | Using Land Facilities Milliseconds to Transmit — Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 | Using a Satellite Milliseconds to Transmit — Line Speed (bps) 2400 | 4800 | 9600 | 19200 | 56000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5632 | 72 | 79 | 26 | 241 | 216 | 207 | 19963 | 9982 | 4991 | 2495 | 856 | 22323 | 12342 | 7351 | 4855 | 3216 |
| 5632 | 84 | 68 | 23 | 205 | 252 | 135 | 19843 | 9922 | 4961 | 2480 | 850 | 22203 | 12282 | 7321 | 4840 | 3210 |
| 5632 | 88 | 65 | 32 | 217 | 176 | 135 | 20243 | 10122 | 5061 | 2530 | 868 | 23193 | 13072 | 8011 | 5480 | 3818 |
| 5632 | 96 | 60 | 30 | 241 | 192 | 15 | 20163 | 10082 | 5041 | 2520 | 864 | 23113 | 13032 | 7991 | 5470 | 3814 |
| 5632 | 128 | 45 | 23 | 209 | 256 | 47 | 19843 | 9922 | 4961 | 2480 | 850 | 22203 | 12282 | 7321 | 4840 | 3210 |
| 6144 | 72 | 86 | 29 | 241 | 216 | 71 | 21830 | 10915 | 5458 | 2729 | 936 | 24780 | 13865 | 8408 | 5679 | 3886 |
| 6144 | 84 | 74 | 25 | 205 | 252 | 143 | 21630 | 10815 | 5408 | 2704 | 927 | 23990 | 13175 | 7768 | 5064 | 3287 |
| 6144 | 88 | 71 | 35 | 217 | 176 | 119 | 22070 | 11035 | 5518 | 2759 | 946 | 25020 | 13985 | 8468 | 5709 | 3896 |
| 6144 | 96 | 65 | 32 | 241 | 192 | 143 | 21950 | 10975 | 5488 | 2744 | 941 | 24900 | 13925 | 8438 | 5694 | 3891 |
| 6144 | 128 | 49 | 25 | 209 | 256 | 47 | 21630 | 10815 | 5408 | 2704 | 927 | 23990 | 13175 | 7768 | 5064 | 3287 |
| 6656 | 72 | 94 | 31 | 241 | 216 | 151 | 23617 | 11808 | 5904 | 2952 | 1012 | 26567 | 14758 | 8854 | 5902 | 3962 |
| 6656 | 84 | 80 | 27 | 205 | 252 | 151 | 23417 | 11708 | 5854 | 2927 | 1004 | 25777 | 14068 | 8214 | 5287 | 3364 |
| 6656 | 88 | 77 | 38 | 217 | 176 | 103 | 23937 | 11968 | 5984 | 2992 | 1026 | 27477 | 15508 | 9524 | 6532 | 4566 |
| 6656 | 96 | 70 | 35 | 241 | 192 | 79 | 23777 | 11888 | 5944 | 2972 | 1019 | 26727 | 14838 | 8894 | 5922 | 3969 |
| 6656 | 128 | 53 | 27 | 209 | 256 | 47 | 23417 | 11708 | 5854 | 2927 | 1004 | 25777 | 14068 | 8214 | 5287 | 3364 |
| 7168 | 72 | 101 | 34 | 241 | 216 | 15 | 25443 | 12722 | 6361 | 3180 | 1090 | 28393 | 15672 | 9311 | 6130 | 4040 |
| 7168 | 84 | 86 | 29 | 205 | 252 | 159 | 25243 | 12622 | 6311 | 3155 | 1082 | 28193 | 15572 | 9261 | 6105 | 4032 |
| 7168 | 88 | 82 | 41 | 217 | 176 | 87 | 25763 | 12882 | 6441 | 3220 | 1104 | 29303 | 16422 | 9981 | 6760 | 4644 |
| 7168 | 96 | 76 | 38 | 241 | 192 | 15 | 25643 | 12822 | 6411 | 3205 | 1099 | 29183 | 16362 | 9951 | 6745 | 4639 |
| 7168 | 128 | 57 | 29 | 209 | 256 | 47 | 25243 | 12622 | 6311 | 3155 | 1082 | 28193 | 15572 | 9261 | 6105 | 4032 |

Figure 31. RU Analysis Estimate for ACF/NCP Release 3 (Part 6 of 6)

## E.2 NCP TO NCP

### E.2.1 NCP TO NCP VIA NON-SATELLITE

NCP to NCP half duplex non-satellite (alternate send/receive) uses the same logic as NCP to terminal.

NCP to NCP full duplex non-satellite (concurrent send/receive) uses the same logic as defined in the next section for satellite service, but does not have the ground station to ground station delay.

### E.2.2 NCP TO NCP VIA SATELLITE

NCP to NCP half duplex (alternate send/receive) via satellite figures are the same as the NCP to terminal figures.

NCP to NCP full duplex (concurrent send/receive) via satellite figures are provided in the following material. The following figures assume an SDLC frame of six bytes plus a PIU including TH, RH, and RU. The TH size is 10 bytes for Release 2 and 26 bytes for Release 3. The RH size is 3 bytes. There are two sets of charts, with the release 2 to release 3 TH size difference of 16 bytes being the only difference.

The following examples have not been tested, but are examples of the logic as implemented for full duplex (concurrent send/receive) links between two NCPs.

The basic logic requires a relative line speed such that a response to the first frame of a group must be received before the seventh frame of a group has been sent. It also assumes that each frame in both directions is the first of a group of seven frames for a continuous frame transfer (see Figure 12 on page 37).

In the following example, an average frame size of 275 at 2400 bps requires .92 seconds to be transmitted. The next 6 frames require 5.50 seconds; .92 multiplied by 6 does not exactly match 5.50 because of rounding. The total for 7 frames at the sending station is 6.42 seconds.

There is an average satellite delay of .295 seconds, one way. For the receiving station, the time to receive is only .92 seconds of transmission time, the same as the transmitting station - but actually a .295 second delay must be added. When the receiving station has received the first transmitted PIU, the assumption is that an SDLC acknowledgement is immediately sent on a data frame. Therefore, the elapsed time from the original transmitters view is .295 delay to receiver, receiver frame transmit time to sender of .92 seconds, plus .295 seconds delay back to original transmitter. The total is 1.51 seconds (.295 + .92 + .295) for the response to the first frame from the original transmitters view.

If the time from the end of a frame (from the transmitters view) for satellite delay (.295) plus a response frame (.92) plus delay for the response frame (.295) is less than the time to send six additional frames (5.50), there is no delay in the transmitting NCP in continuous frame transmission. If there is a delay, a primary NCP polls for a response; a secondary NCP ends the outstanding poll. Therefore, in the following calculations, using the assumptions as given, when an NCP delay is indicated there will be additional overhead for polling.

The average frame size is in both directions and must be maintained over seven frames. If the average is not maintained then one or both of the NCPs will be delayed for frame acknowledgement. The assumption is the secondary is already polled (for concurrent transmit and receive to occur) and if the secondary is in PAUSE, either the primary or secondary may only delay while awaiting acknowledgement, and therefore does not necessarily require polling to occur.

ACF/NCP Release 2

| Avg. Frame Size | Line Speed | Time in Seconds: First Frame | Next 6 Frames | Total For 7 Frames | Respond First Frame | NCP Delay |
|---|---|---|---|---|---|---|
| 275 | 2400 | 0.92 | 5.50 | 6.42 | 1.51 | 0.000 |
| 275 | 4800 | 0.46 | 2.75 | 3.21 | 1.05 | 0.000 |
| 275 | 9600 | 0.23 | 1.37 | 1.60 | 0.82 | 0.000 |
| 275 | 19200 | 0.11 | 0.69 | 0.80 | 0.70 | 0.017 |
| 275 | 56000 | 0.04 | 0.24 | 0.27 | 0.63 | 0.394 |
| 307 | 2400 | 1.02 | 6.14 | 7.16 | 1.61 | 0.000 |
| 307 | 4800 | 0.51 | 3.07 | 3.58 | 1.10 | 0.000 |
| 307 | 9600 | 0.26 | 1.53 | 1.79 | 0.85 | 0.000 |
| 307 | 19200 | 0.13 | 0.77 | 0.90 | 0.72 | 0.000 |
| 307 | 56000 | 0.04 | 0.26 | 0.31 | 0.63 | 0.371 |
| 339 | 2400 | 1.13 | 6.78 | 7.91 | 1.72 | 0.000 |
| 339 | 4800 | 0.56 | 3.39 | 3.95 | 1.15 | 0.000 |
| 339 | 9600 | 0.28 | 1.69 | 1.98 | 0.87 | 0.000 |
| 339 | 19200 | 0.14 | 0.85 | 0.99 | 0.73 | 0.000 |
| 339 | 56000 | 0.05 | 0.29 | 0.34 | 0.64 | 0.348 |
| 371 | 2400 | 1.24 | 7.42 | 8.66 | 1.83 | 0.000 |
| 371 | 4800 | 0.62 | 3.71 | 4.33 | 1.21 | 0.000 |
| 371 | 9600 | 0.31 | 1.85 | 2.16 | 0.90 | 0.000 |
| 371 | 19200 | 0.15 | 0.93 | 1.08 | 0.74 | 0.000 |
| 371 | 56000 | 0.05 | 0.32 | 0.37 | 0.64 | 0.325 |
| 403 | 2400 | 1.34 | 8.06 | 9.40 | 1.93 | 0.000 |
| 403 | 4800 | 0.67 | 4.03 | 4.70 | 1.26 | 0.000 |
| 403 | 9600 | 0.34 | 2.01 | 2.35 | 0.93 | 0.000 |
| 403 | 19200 | 0.17 | 1.01 | 1.18 | 0.76 | 0.000 |
| 403 | 56000 | 0.06 | 0.35 | 0.40 | 0.65 | 0.302 |
| 435 | 2400 | 1.45 | 8.70 | 10.15 | 2.04 | 0.000 |
| 435 | 4800 | 0.72 | 4.35 | 5.07 | 1.31 | 0.000 |
| 435 | 9600 | 0.36 | 2.17 | 2.54 | 0.95 | 0.000 |
| 435 | 19200 | 0.18 | 1.09 | 1.27 | 0.77 | 0.000 |
| 435 | 56000 | 0.06 | 0.37 | 0.43 | 0.65 | 0.279 |
| 467 | 2400 | 1.56 | 9.34 | 10.90 | 2.15 | 0.000 |
| 467 | 4800 | 0.78 | 4.67 | 5.45 | 1.37 | 0.000 |
| 467 | 9600 | 0.39 | 2.33 | 2.72 | 0.98 | 0.000 |
| 467 | 19200 | 0.19 | 1.17 | 1.36 | 0.78 | 0.000 |
| 467 | 56000 | 0.07 | 0.40 | 0.47 | 0.66 | 0.256 |

Figure 32. Release 2 Estimate of NCP-to-NCP Using Satellite Transmission Facilities (Part 1 of 3)

ACF/NCP Release 2

| | | Time in Seconds | | | | |
|---|---|---|---|---|---|---|
| Avg. Frame Size | Line Speed | First Frame | Next 6 Frames | Total For 7 Frames | Respond First Frame | NCP Delay |
| 499 | 2400 | 1.66 | 9.98 | 11.64 | 2.25 | 0.000 |
| 499 | 4800 | 0.83 | 4.99 | 5.82 | 1.42 | 0.000 |
| 499 | 9600 | 0.42 | 2.49 | 2.91 | 1.01 | 0.000 |
| 499 | 19200 | 0.21 | 1.25 | 1.46 | 0.80 | 0.000 |
| 499 | 56000 | 0.07 | 0.43 | 0.50 | 0.66 | 0.234 |
| 531 | 2400 | 1.77 | 10.62 | 12.39 | 2.36 | 0.000 |
| 531 | 4800 | 0.88 | 5.31 | 6.19 | 1.47 | 0.000 |
| 531 | 9600 | 0.44 | 2.65 | 3.10 | 1.03 | 0.000 |
| 531 | 19200 | 0.22 | 1.33 | 1.55 | 0.81 | 0.000 |
| 531 | 56000 | 0.08 | 0.46 | 0.53 | 0.67 | 0.211 |
| 595 | 2400 | 1.98 | 11.90 | 13.88 | 2.57 | 0.000 |
| 595 | 4800 | 0.99 | 5.95 | 6.94 | 1.58 | 0.000 |
| 595 | 9600 | 0.50 | 2.97 | 3.47 | 1.09 | 0.000 |
| 595 | 19200 | 0.25 | 1.49 | 1.74 | 0.84 | 0.000 |
| 595 | 56000 | 0.08 | 0.51 | 0.59 | 0.68 | 0.165 |
| 659 | 2400 | 2.20 | 13.18 | 15.38 | 2.79 | 0.000 |
| 659 | 4800 | 1.10 | 6.59 | 7.69 | 1.69 | 0.000 |
| 659 | 9600 | 0.55 | 3.29 | 3.84 | 1.14 | 0.000 |
| 659 | 19200 | 0.27 | 1.65 | 1.92 | 0.86 | 0.000 |
| 659 | 56000 | 0.09 | 0.56 | 0.66 | 0.68 | 0.119 |
| 723 | 2400 | 2.41 | 14.46 | 16.87 | 3.00 | 0.000 |
| 723 | 4800 | 1.20 | 7.23 | 8.43 | 1.79 | 0.000 |
| 723 | 9600 | 0.60 | 3.61 | 4.22 | 1.19 | 0.000 |
| 723 | 19200 | 0.30 | 1.81 | 2.11 | 0.89 | 0.000 |
| 723 | 56000 | 0.10 | 0.62 | 0.72 | 0.69 | 0.074 |
| 787 | 2400 | 2.62 | 15.74 | 18.36 | 3.21 | 0.000 |
| 787 | 4800 | 1.31 | 7.87 | 9.18 | 1.90 | 0.000 |
| 787 | 9600 | 0.66 | 3.93 | 4.59 | 1.25 | 0.000 |
| 787 | 19200 | 0.33 | 1.97 | 2.30 | 0.92 | 0.000 |
| 787 | 56000 | 0.11 | 0.67 | 0.79 | 0.70 | 0.028 |
| 851 | 2400 | 2.84 | 17.02 | 19.86 | 3.43 | 0.000 |
| 851 | 4800 | 1.42 | 8.51 | 9.93 | 2.01 | 0.000 |
| 851 | 9600 | 0.71 | 4.25 | 4.96 | 1.30 | 0.000 |
| 851 | 19200 | 0.35 | 2.13 | 2.48 | 0.94 | 0.000 |
| 851 | 56000 | 0.12 | 0.73 | 0.85 | 0.71 | 0.000 |

Figure 33. Release 2 Estimate of NCP-to-NCP Using Satellite Transmission Facilities (Part 2 of 3)

ACF/NCP Release 2

| Avg. Frame Size | Line Speed | First Frame (Time in Seconds) | Next 6 Frames | Total For 7 Frames | Respond First Frame | NCP Delay |
|---|---|---|---|---|---|---|
| 915 | 2400 | 3.05 | 18.30 | 21.35 | 3.64 | 0.000 |
| 915 | 4800 | 1.52 | 9.15 | 10.67 | 2.11 | 0.000 |
| 915 | 9600 | 0.76 | 4.57 | 5.34 | 1.35 | 0.000 |
| 915 | 19200 | 0.38 | 2.29 | 2.67 | 0.97 | 0.000 |
| 915 | 56000 | 0.13 | 0.78 | 0.91 | 0.72 | 0.000 |
| 979 | 2400 | 3.26 | 19.58 | 22.84 | 3.85 | 0.000 |
| 979 | 4800 | 1.63 | 9.79 | 11.42 | 2.22 | 0.000 |
| 979 | 9600 | 0.82 | 4.89 | 5.71 | 1.41 | 0.000 |
| 979 | 19200 | 0.41 | 2.45 | 2.86 | 1.00 | 0.000 |
| 979 | 56000 | 0.14 | 0.84 | 0.98 | 0.73 | 0.000 |
| 1043 | 2400 | 3.48 | 20.86 | 24.34 | 4.07 | 0.000 |
| 1043 | 4800 | 1.74 | 10.43 | 12.17 | 2.33 | 0.000 |
| 1043 | 9600 | 0.87 | 5.21 | 6.08 | 1.46 | 0.000 |
| 1043 | 19200 | 0.43 | 2.61 | 3.04 | 1.02 | 0.000 |
| 1043 | 56000 | 0.15 | 0.89 | 1.04 | 0.74 | 0.000 |

Figure 34. Release 2 Estimate of NCP-to-NCP Using Satellite Transmission Facilities (Part 3 of 3)

ACF/NCP Release 3

| Avg. Frame Size | Line Speed | Time in Seconds: First Frame | Next 6 Frames | Total For 7 Frames | Respond First Frame | NCP Delay |
|---|---|---|---|---|---|---|
| 291 | 2400 | 0.97 | 5.82 | 6.79 | 1.56 | 0.000 |
| 291 | 4800 | 0.48 | 2.91 | 3.39 | 1.07 | 0.000 |
| 291 | 9600 | 0.24 | 1.45 | 1.70 | 0.83 | 0.000 |
| 291 | 19200 | 0.12 | 0.73 | 0.85 | 0.71 | 0.000 |
| 291 | 56000 | 0.04 | 0.25 | 0.29 | 0.63 | 0.382 |
| 323 | 2400 | 1.08 | 6.46 | 7.54 | 1.67 | 0.000 |
| 323 | 4800 | 0.54 | 3.23 | 3.77 | 1.13 | 0.000 |
| 323 | 9600 | 0.27 | 1.61 | 1.88 | 0.86 | 0.000 |
| 323 | 19200 | 0.13 | 0.81 | 0.94 | 0.72 | 0.000 |
| 323 | 56000 | 0.05 | 0.28 | 0.32 | 0.64 | 0.359 |
| 355 | 2400 | 1.18 | 7.10 | 8.28 | 1.77 | 0.000 |
| 355 | 4800 | 0.59 | 3.55 | 4.14 | 1.18 | 0.000 |
| 355 | 9600 | 0.30 | 1.77 | 2.07 | 0.89 | 0.000 |
| 355 | 19200 | 0.15 | 0.89 | 1.04 | 0.74 | 0.000 |
| 355 | 56000 | 0.05 | 0.30 | 0.35 | 0.64 | 0.336 |
| 387 | 2400 | 1.29 | 7.74 | 9.03 | 1.88 | 0.000 |
| 387 | 4800 | 0.64 | 3.87 | 4.51 | 1.23 | 0.000 |
| 387 | 9600 | 0.32 | 1.93 | 2.26 | 0.91 | 0.000 |
| 387 | 19200 | 0.16 | 0.97 | 1.13 | 0.75 | 0.000 |
| 387 | 56000 | 0.06 | 0.33 | 0.39 | 0.65 | 0.314 |
| 419 | 2400 | 1.40 | 8.38 | 9.78 | 1.99 | 0.000 |
| 419 | 4800 | 0.70 | 4.19 | 4.89 | 1.29 | 0.000 |
| 419 | 9600 | 0.35 | 2.09 | 2.44 | 0.94 | 0.000 |
| 419 | 19200 | 0.17 | 1.05 | 1.22 | 0.76 | 0.000 |
| 419 | 56000 | 0.06 | 0.36 | 0.42 | 0.65 | 0.291 |
| 451 | 2400 | 1.50 | 9.02 | 10.52 | 2.09 | 0.000 |
| 451 | 4800 | 0.75 | 4.51 | 5.26 | 1.34 | 0.000 |
| 451 | 9600 | 0.38 | 2.25 | 2.63 | 0.97 | 0.000 |
| 451 | 19200 | 0.19 | 1.13 | 1.32 | 0.78 | 0.000 |
| 451 | 56000 | 0.06 | 0.39 | 0.45 | 0.65 | 0.268 |
| 483 | 2400 | 1.61 | 9.66 | 11.27 | 2.20 | 0.000 |
| 483 | 4800 | 0.80 | 4.83 | 5.63 | 1.39 | 0.000 |
| 483 | 9600 | 0.40 | 2.41 | 2.82 | 0.99 | 0.000 |
| 483 | 19200 | 0.20 | 1.21 | 1.41 | 0.79 | 0.000 |
| 483 | 56000 | 0.07 | 0.41 | 0.48 | 0.66 | 0.245 |

Figure 35. Release 3 Estimate of NCP-to-NCP Using Satellite Transmission Facilities (Part 1 of 3)

ACF/NCP Release 3

| Avg. Frame Size | Line Speed | First Frame | Next 6 Frames | Total For 7 Frames | Respond First Frame | NCP Delay |
|---|---|---|---|---|---|---|
| | | Time in Seconds | | | | |
| 515 | 2400 | 1.72 | 10.30 | 12.02 | 2.31 | 0.000 |
| 515 | 4800 | 0.86 | 5.15 | 6.01 | 1.45 | 0.000 |
| 515 | 9600 | 0.43 | 2.57 | 3.00 | 1.02 | 0.000 |
| 515 | 19200 | 0.21 | 1.29 | 1.50 | 0.80 | 0.000 |
| 515 | 56000 | 0.07 | 0.44 | 0.51 | 0.66 | 0.222 |
| 547 | 2400 | 1.82 | 10.94 | 12.76 | 2.41 | 0.000 |
| 547 | 4800 | 0.91 | 5.47 | 6.38 | 1.50 | 0.000 |
| 547 | 9600 | 0.46 | 2.73 | 3.19 | 1.05 | 0.000 |
| 547 | 19200 | 0.23 | 1.37 | 1.60 | 0.82 | 0.000 |
| 547 | 56000 | 0.08 | 0.47 | 0.55 | 0.67 | 0.199 |
| 611 | 2400 | 2.04 | 12.22 | 14.26 | 2.63 | 0.000 |
| 611 | 4800 | 1.02 | 6.11 | 7.13 | 1.61 | 0.000 |
| 611 | 9600 | 0.51 | 3.05 | 3.56 | 1.10 | 0.000 |
| 611 | 19200 | 0.25 | 1.53 | 1.78 | 0.84 | 0.000 |
| 611 | 56000 | 0.09 | 0.52 | 0.61 | 0.68 | 0.154 |
| 675 | 2400 | 2.25 | 13.50 | 15.75 | 2.84 | 0.000 |
| 675 | 4800 | 1.12 | 6.75 | 7.87 | 1.71 | 0.000 |
| 675 | 9600 | 0.56 | 3.37 | 3.94 | 1.15 | 0.000 |
| 675 | 19200 | 0.28 | 1.69 | 1.97 | 0.87 | 0.000 |
| 675 | 56000 | 0.10 | 0.58 | 0.67 | 0.69 | 0.108 |
| 739 | 2400 | 2.46 | 14.78 | 17.24 | 3.05 | 0.000 |
| 739 | 4800 | 1.23 | 7.39 | 8.62 | 1.82 | 0.000 |
| 739 | 9600 | 0.62 | 3.69 | 4.31 | 1.21 | 0.000 |
| 739 | 19200 | 0.31 | 1.85 | 2.16 | 0.90 | 0.000 |
| 739 | 56000 | 0.11 | 0.63 | 0.74 | 0.70 | 0.062 |
| 803 | 2400 | 2.68 | 16.06 | 18.74 | 3.27 | 0.000 |
| 803 | 4800 | 1.34 | 8.03 | 9.37 | 1.93 | 0.000 |
| 803 | 9600 | 0.67 | 4.01 | 4.68 | 1.26 | 0.000 |
| 803 | 19200 | 0.33 | 2.01 | 2.34 | 0.92 | 0.000 |
| 803 | 56000 | 0.11 | 0.69 | 0.80 | 0.70 | 0.016 |
| 867 | 2400 | 2.89 | 17.34 | 20.23 | 3.48 | 0.000 |
| 867 | 4800 | 1.44 | 8.67 | 10.11 | 2.03 | 0.000 |
| 867 | 9600 | 0.72 | 4.33 | 5.06 | 1.31 | 0.000 |
| 867 | 19200 | 0.36 | 2.17 | 2.53 | 0.95 | 0.000 |
| 867 | 56000 | 0.12 | 0.74 | 0.87 | 0.71 | 0.000 |

Figure 36. Release 3 Estimate of NCP-to-NCP Using Satellite Transmission Facilities (Part 2 of 3)

ACF/NCP Release 3

| Avg. Frame Size | Line Speed | First Frame | Next 6 Frames | Total For 7 Frames | Respond First Frame | NCP Delay |
|---|---|---|---|---|---|---|
| | | Time in Seconds | | | | |
| 931 | 2400 | 3.10 | 18.62 | 21.72 | 3.69 | 0.000 |
| 931 | 4800 | 1.55 | 9.31 | 10.86 | 2.14 | 0.000 |
| 931 | 9600 | 0.78 | 4.65 | 5.43 | 1.37 | 0.000 |
| 931 | 19200 | 0.39 | 2.33 | 2.72 | 0.98 | 0.000 |
| 931 | 56000 | 0.13 | 0.80 | 0.93 | 0.72 | 0.000 |
| 995 | 2400 | 3.32 | 19.90 | 23.22 | 3.91 | 0.000 |
| 995 | 4800 | 1.66 | 9.95 | 11.61 | 2.25 | 0.000 |
| 995 | 9600 | 0.83 | 4.97 | 5.80 | 1.42 | 0.000 |
| 995 | 19200 | 0.41 | 2.49 | 2.90 | 1.00 | 0.000 |
| 995 | 56000 | 0.14 | 0.85 | 0.99 | 0.73 | 0.000 |
| 1059 | 2400 | 3.53 | 21.18 | 24.71 | 4.12 | 0.000 |
| 1059 | 4800 | 1.76 | 10.59 | 12.35 | 2.35 | 0.000 |
| 1059 | 9600 | 0.88 | 5.29 | 6.18 | 1.47 | 0.000 |
| 1059 | 19200 | 0.44 | 2.65 | 3.09 | 1.03 | 0.000 |
| 1059 | 56000 | 0.15 | 0.91 | 1.06 | 0.74 | 0.000 |

Figure 37. Release 3 Estimate of NCP-to-NCP Using Satellite Transmission Facilities (Part 3 of 3)

**Tuning and Problem Analysis for NCP SDLC Devices**

**D. L. Buckingham, Dept. 73G**

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