ACC HDLC-NRM (SLDC) User's Guide

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Notices

HEWLETT-PACKARD COMPANY 3000 Hanover Street Palo Alto, California 94304 U.S.A.

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Preface

The HDLC Normal Response Mode (NRM) Protocol Product is used in conjunction with Hewlett-Packard's Advanced Communications Controller (ACC) product.

This manual applies to the ACC Protocols for Application Developers product.This manual provides installation and configuration information that is specific to the HDLC Normal Response Mode (NRM) protocol.

Organization

This manual contains the following chapters and appendixes:

Chapter 1	**Overview -** presents an overview of the features provided by the HDLC-NRM(SDLC) Protocol product.
Chapter 2	**Software Installation and Verification -** describes how to install the protocol module software. It describes how to verify that the protocol software is correctly installed and is functional.
Chapter 3	**Using HDLC-NRM(SDLC) Protocol -** contains information about using the HDLC Normal Response Mode protocol.
Chapter 4	**Protocol Specific Configuration -** contains HDLC-NRM(SDLC) specific configuration information.
Appendix A	**Sample Configuration Files -** contains a listing of the sample configuration files provided with this product.
Appendix B	**SDLC Loop Mode Option -** describes the subset of standard GA27-3093 which has been implemented and how it operates.

Related Documentation

The documentation available for the Multiprotocol ACC family of products includes the following hardware and software manuals:

Hardware Manuals

- *8 Channel HP-PB ACC Multiplexer Hardware Installation and Reference Manual*
- *8 Channel EISA ACC Multiplexer Hardware Installation and Reference Manual*
- *8 Channel PCI ACC Multiplexer Hardware Installation and Reference Manual*
- *2 Channel (HP-PB) ACC Multiplexer Hardware Installation and Reference Manual*
- *4-Chan. T1/E1 (HP-PB) ACC Multiplexer Hardware Installation and Reference Manual*

Software Manuals

- *ACC Installation and Configuration Guide*
- *ACC Utilities Reference Guide*
- *ACC Programmer's Reference Guide*
- *ACC Error Guide*
- *HDLC Frame Protocol User's Guide*
- *ACC X.25 Protocol User's Guide*
- *ACC X.25/ISDN Data Analyzer User's Guide*
- *ACC HDLC/LAP-B (ABM) Protocol User's Guide*
- *ACC HDLC/LAP-D Protocol User's Guide*
- *HDLC-NRM (SDLC) Protocol User's Guide*
- *X.25/ACC Installation and Configuration Guide*
- *X.25/ACC Update Guide*
- *X.25/9000 User's Guide*
- *X.25/9000 Programmer's Guide*

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1 Overview

The HDLC-NRM (SDLC) Protocol product is used in conjunction with the Advanced Communications Controller (ACC) product. This chapter provides an overview of the HDLC-NRM (SDLC) protocol product.

Product Features

NOTE This protocol is not available on the ACC 4-port E1/T1 cards.

The HDLC-NRM (SDLC) protocols are polled protocols, supporting both a primary and secondary station. Multiple stations may be defined on a line. However, stations on a line must be either all primary or all secondary.

The HDLC protocols are fully defined in three standards documents published by the International Standards Organization (ISO). These standards are ISO 3309, 7809 and 4335, full references to which are given at the end of this chapter.

The HDLC Normal Response Mode protocols product implements both the primary and secondary station procedures for the Unbalanced operation Normal response mode class, as defined in ISO 7809.

The frame types supported are those for the basic repertoire, as defined in ISO 7809 clause 3.2.2.1. These frames are as follows:

Commands	**Responses**
I	I
RR	RR
RNR	RNR
SNRM	UA
DISC	DM
	FRMR

Three optional extended features are provided in addition to the defined standard features. These features are:

- Remote Power Control
- Broadcast Facility
- SDLC Loop Mode Primary

The first two features are more fully described in Chapter 4 , “Protocol Specific Configuration,” while the third feature is covered in Appendix B , “SDLC Loop Mode Option,”.

Supported Devices

The HDLC-NRM (SDLC) protocol implementation supports either primary or secondary stations conforming to the above published standards. Both point-to-point and multipoint configurations are supported.

Modes of Operation

The HDLC-NRM (SDLC) implementation supports two normal response modes of transmission:

- Two Way Simultaneous (TWS) transmission
- Two Way Alternate (TWA) transmission

Within TWA mode, both half duplex and full duplex options are supported.

There is also a restricted implementation of SDLC Loop Mode operation (see Appendix B). This mode is not available on the 2-Channel ACC Multiplexer interface.

Data Rates

This release of the HDLC-NRM (SDLC) protocol product is qualified for use at line speeds from 4800 bits per second to 19,200 bits per second on the 8-Channel EISA and HP-PB ACC Multiplexer interfaces. When the HDLC-NRM (SDLC) protocol is used on an 8-Channel EISA or HP-PB interface in a mode where there is only a single primary or secondary broadcast terminal configured on a line, the operation of the protocol is supported at speeds up to 64,000 bits per second.

On the 2-Channel interface, operation of the protocol is supported at speeds up to 128,000 bits per second.

Files Provided

The HDLC-NRM (SDLC) Protocol product provides a pre-loaded firmware file that can be used directly in network configuration files.

The HDLC-NRM (SDLC) protocol may also be used on the same ACC Mux as other protocols. If this is the case, a new *.zabs* file can be built to contain all of the protocols that will be used on that Mux. This product provides the relocatable firmware files and a sample Link command file for use in this case.

The files provided with the HDLC-NRM (SDLC) product are:

/opt/acc/<card-type>/hdlcnrm.zabs	This is a pre-loaded file that contains the *frame.zrel* and *hdlcnrm.zrel* relocatables. It can be referenced directly from the network configuration file.
/opt/acc/<card-type>/hdlcnrm.zlnk	This link file is used to create the *hdlcnrm.zabs* file using the *frame.zrel*, *hdlcnrm.zrel* and *nrment.zrel* files.
/opt/acc/protocol/hdlcnrm.zrel	This module implements the HDLC Normal Response Mode Level-2 protocol for both primary and secondary stations. It provides all of the polling, response, timeout control and error recovery, as well as the sending and receiving of information frames.
/opt/acc/cfg/hdlcnrm_sample.answ	This is a sample *ttgen* configuration file.

References

For information on installing the ACC product, how to load the relocatable firmware, files, and how to start up the ACC Subsystem, refer to the *ACC Installation and Configuration Guide*.

For information on using the utilities related to the ACC products, refer to the *ACC Utilities Reference Manual*.

For information on using the ZCOM Programmatic Interface, refer to the *ACC Programmers' Reference Guide*.

For error recovery and log messaging information, refer to the *ACC Error Guide*.

The ISO standards documents describing the HDLC protocols are as follows:

ISO 3309 HDLC Procedures - Frame Structure
Fifth edition 1993-12-15
Reference number ISO/IEC 3309:1993(E)

ISO 7809 HDLC Procedures - Classes of procedures
Third edition 1993-12-15
Reference number ISO/IEC 7809:1993(E)

ISO 4335 HDLC Procedures - Elements of procedures
Fifth edition 1993-12-15
Reference number ISO/IEC 4335:1993(E)

References

2 Software Installation and Verification

Introduction

The HDLC NRM (SDLC) protocol is included in the ACC Developer Software Suite product. This chapter describes how to install the product using the *swinstall* utility. It also describes how to verify that the protocol has been successfully installed and is functional.

Software Removal

CAUTION

If a previous version of the HDLC-NRM (SDLC) protocol product is already installed on the HP-UX system, it should first be removed. It is very important to follow the instructions provided with the software that is currently installed in the system to shutdown and remove that software. This procedure may change between major releases of the product.

Step 1. Log in to the system as superuser.

Step 2. Terminate the ACC Mux Subsystem by typing:

```
% zmasterd kill
```

Step 3. Run *swremove* to remove the HDLC-NRM (SDLC) protocol product.

```
% swremove
```

NOTE

The *swremove* will fail if any ACC daemon is still active. Terminate any active ACC daemon indicated in the log file and try again.

Any of the ACC related products can be removed by selecting them and then marking them for removal. (Both the terminal interface and the GUI interface for *swremove* behave the same; only the means for selecting items differs.)

Step 4. Select the HDLC-NRM (SDLC) protocol product (and any other items to be removed) in the “Software Selection Window” and mark for removal, using the “Mark for Remove” function under the “Actions” menu. When all items are marked, select the “Remove(analysis)” action.

Open “Logfile” to view running status of the removal process, and follow any screen prompts until the removal process is done.

Software Installation

Running Swinstall

The ACC software is read from the HP Application Software CD-ROM, in superuser mode, using the *swinstall* utility. The steps are listed below.

Step 1. Log in to the system as “root”.

Step 2. Place the media in a local or remote CD-ROM drive.

Step 3. Run *swinstall*, which behaves the same in the GUI interface as for the terminal interface. When the “Specify Source” box opens, select “Source Depot Type” to “Local CDROM”, or for a remote CD-ROM driver, select for “Network Directory/CDROM” and set “Source Host Name...”. Select “OK”.

Step 4. Select the ACC Developer Software Suite product and any other ACC items to be installed, from the list of software bundles; open the “Actions” menu and select “Mark for Install”.

Step 5. When all items have been marked, select “Install (analysis)”; select “OK” and proceed.

The “Install (analysis)” window allows you to track summary progress of the installation process. Use the “Logfile” feature to display a detailed status, which is logged to */var/adm/sw/swagent.log*.

Product Identification

The **what** utility can be run on */opt/acc/protocol/hdlcnrm.zrel* and */opt/acc/<card-type>/hdlcnrm.zabs* to show what version of the protocols is installed.

Installation Verification

A sample configuration file */opt/acc/cfg/hdlcnrm_sample.answ* file is provided with the ACC Protocols for Application Developers product. This sample file can be used to verify that the HDLC-NRM (SDLC) protocol module has been properly installed and is functional. Note that you need to customize this file, to reflect the location of the mux card(s) and to reflect the mux ports to be used. (The *hdlcnrm_sample.answ* file is shown in Appendix A of this manual.)

The steps in the verification process are listed below. It is assumed that the ACC Protocols for Application Developers product is installed on the system, and that the ACC base product has already been installed and the system has been regenerated and rebooted. It is also assumed that there is at least one ACC Mux card installed, and that it has a cable and mux panel attached.

At least one loopback cable should be used to connect two of the ports on the mux panel. For the configuration file provided, it is assumed that the first two ports of the mux card are connected with an RS-232 loopback cable, and that the end of the cable marked “Int” is connected to port 0.

Using the HDLC-NRM (SDLC) Protocol Module

The *ACC Installation and Configuration Guide* contains the general procedure for configuring the ttgen configuration file, creating customized downloadable firmware files, and starting up the ACC subsystem with the new protocol and new configuration. To add HDLC-NRM (SDLC) to a firmware file, see “Download Linkage” on page 59 in Appendix A , “Sample Configuration Files,”.

Refer to Chapter 4 , “Protocol Specific Configuration,” of this manual for HDLC-NRM (SDLC) specific configuration requirements when building the network configuration file.

Verification Procedure

The procedure described involves using the *zmlog*, *ttgen*, *zmntr*, and *zterm* utilities. These utilities are described in the *ACC Utilities Reference Guide*.

Step 1. Modify the *Bus:Slot[slot]* terms in the Interface-Definition statement in the /op*t/acc/cfg/hdlcnrm_sample.answ* file if necessary, to reflect the actual location of the ACC Mux cards. Also modify the <*card-type*> term to reflect your specific card type (replace <card-type> with z7400a, for example.) Refer to Chapter 4 , “Protocol Specific Configuration,” of this manual for information on how to modify these statements.

Step 2. The sample file only configures the first two ports of one mux card. If desired, expand the configuration file to include additional ports.

NOTE For the test described here, the ports that will be connected together via a loopback cable must have one port configured with primary stations, and the other with secondary stations. The mux ports must also have one set to internal clocking and the other to external clocking.

In the sample configuration file, the even ports are set to internal clocking and the odd ports are set to external clocking. (Note that the ports are numbered 0 to 7.) Also note that the loopback cable must be connected so that the end marked “Int” is connected to the port configured for internal clocking.

Step 3. Run *ttgen* on the modified .answ file.

```
% ttgen -o hdlcnrm_sample.answ hdlcnrm_sample.tmem
ttgen: END$  0 Disasters, 0 Errors, 0 Warnings
%
```

Step 4. Bring up the ZCOM subsystem:

```
% zmasterd cold /opt/acc/cfg/hdlcnrm_sample.tmem
```

It is suggested that the system console (or the appropriate */var/opt/acc/log/*.tlog* file, e.g. *mon.tlog*, *tue.tlog*, etc.) be monitored to make sure the ZCOM subsystem comes up. The following *zmlog* messages should be seen:

```
-------------------------------------------------------------------
Tue Mar 14 13:10:22 2000: zmlog: message logging resumed
-------------------------------------------------------------------
13:10:22 znode 00109   ZCOM system down, exiting
13:10:22 zmast 00129   Stopping zmlog daemon.
13:10:22 zmon  00049   End of ZMON request, program terminated
13:10:22 zmon  00075   ZCOM system stopped
13:12:06 zmast 00101   Launched daemon zmlog, pid 1350.
13:12:06 zmast 00117   Zmasterd daemon start running ...
13:12:06 zmast 00101   Launched daemon zmon, pid 1351.
13:12:07 zmon  00002   Resource manager (Rev 1.32) for ZCOM 6.2.0.0
13:12:07 zmon  00003   Cold start with: hdlcnrm_sample.tmem
13:12:07 zmon  00100   Card 0 starting up ...
13:12:15 zmon  00110   Card 0 startup successful, card READY
13:12:15 zmon  00020   Cold start completed, ZCOM system ready
13:12:15 zmon  00004   Waiting for ZMON requests ...
13:12:15 zmast 00101   Launched daemon znode, pid 1372.
13:12:15 zcom  00165   Node 123 is now UP
```

Step 5. Use the *zmntr* utility to display the original state of the HDLC-NRM (SDLC) terminals:

```
% zmntr
ZMNTR> tt 1 20
ZLU# Mx p:sc Terminal Description.....  Rx.Mes Tx.Mes  Error  E.Rate State.
0001 00 0:00  HDLC/NRM Primary A             0      0      0  0.00% Disabled
0002 00 0:00  HDLC/NRM Primary B             0      0      0  0.00% Disabled
0011 00 1:00  HDLC/NRM Secondary A           0      0      0  0.00% Disabled
0012 00 1:00  HDLC/NRM Secondary B           0      0      0  0.00% Disabled
**** ** ** Message totals                    0      0      0  0.00% *******

ZMNTR> ex
```

Step 6. Use the *zterm* utility to enable and activate the HDLC-NRM (SDLC) terminals:

```
% zterm
13:13:43 ZCOM Interactive command utility
13:13:43 Primary ZLU is  801
ZTERM> rc 1 20
ZTERM> cn 1 20 en
ZTERM> cn 1 20 ac
ZTERM> rx
13:14:03 Stat chg (UP) rspns from ZLU#00011(00123) No error detected
13:14:03 Stat chg (UP) rspns from ZLU#00001(00123) No error detected
13:14:03 Stat chg (UP) rspns from ZLU#00012(00123) No error detected
13:14:03 Stat chg (UP) rspns from ZLU#00002(00123) No error detected
<CNTRL-C>
13:14:06 Error on ZREAD: Interrupt occurs while waiting
13:14:06 Messages received         4,    Messages sent          0
13:14:06 Elapsed time secs         3,    Messages/sec           1
13:14:06 Data in KBytes            0,    Data rate (KB/s)       0
13:14:06 Sys CPU   0%, User CPU   1%,    Total CPU   1%
13:14:06 Mux   0 utilization      5%

ZTERM> ex
```

Step 7. You can now use the *zmntr* utility to observe the state of the link:

```
% zmntr
ZMNTR> tt 1 20
ZLU# Mx p:sc Terminal Description....  Rx.Mes Tx.Mes Error  E.Rate State.
0001 00 0:00  HDLC/NRM Primary A            0      0     0  0.00% Up
0002 00 0:00  HDLC/NRM Primary B            0      0     0  0.00% Up
0011 00 1:00  HDLC/NRM Secondary A          0      0     0  0.00% Up
0012 00 1:00  HDLC/NRM Secondary B          0      0     0  0.00% Up
**** ** ** Message totals                   0      0     0  0.00% *******

ZMNTR> ex
```

Step 8. Data can now be sent over the established links between primary and secondary terminals. In this example, one 40 byte message is sent to one of the two primary terminals and another to one of the two secondary terminals:

```
% zterm
13:49:07 ZCOM Interactive command utility
13:49:07 Primary ZLU is  801
ZTERM> rc 1 20
ZTERM> tx 1 40 0 1
13:49:55 TX test complete!!!
ZTERM> tx 12 40 0 1
13:50:04 TX test complete!!!
```

Step 9. The data sent can now be received and displayed. Note that the message sent to ZLU 1 is received from ZLU 11, and similarly the message sent to ZLU 12 is received from ZLU 2, because of the loopback configuration.

```
ZTERM> rx li
13:50:12 Msg from tmnl ZLU#00011(00123) len    40 No error detected
Lcn .00. .01. .02. .03. .04. .05. .06. .07. .08. .09.  ASCII.....ASCII.....
000 5A74 3031 3532 3500 206D 6573 7361 6765 206E 6F2E  Zt01525  message no.
010 2030 3030 3031 206C 656E 6774 6820 2020 2034 3024   00001 length    40$
13:50:12 Msg from tmnl ZLU#00002(00123) len    40 No error detected
Lcn .00. .01. .02. .03. .04. .05. .06. .07. .08. .09.  ASCII.....ASCII.....
000 5A74 3031 3532 3500 206D 6573 7361 6765 206E 6F2E  Zt01525  message no.
010 2030 3030 3031 206C 656E 6774 6820 2020 2034 3024   00001 length    40$

<CNTRL-C>

13:51:13 Error on ZREAD: Interrupt occurs while waiting
13:51:13 Messages received         2,    Messages sent            0
13:51:13 Elapsed time secs        61,    Messages/sec             0
13:51:13 Data in KBytes            0,    Data rate (KB/s)         0
13:51:13 Sys CPU   0%, User CPU   0%,    Total CPU   0%
13:51:13 Mux   0 utilization      7%
ZTERM> ex
```

NOTE The *zterm rx* command must be terminated by using a <cntrl-c> command.

3 Using HDLC-NRM (SDLC) Protocols

Introduction

For a complete description of the communications formats and protocol disciplines, the reader is referred to the ISO standards mentioned in the first chapter of this manual.

The HDLC-NRM (SDLC) protocol is a polled, bit oriented protocol. Each unit transmitted over an HDLC-NRM (SDLC) link is termed a frame. A frame consists of the following components:

- Opening flag (one byte binary 01111110)
- Address (one byte)
- Control field (one byte)
- Information field (optional depending on frame type)
- Frame check sequence (2 bytes)
- Closing flag (one byte binary 01111110).

The frame type is encoded in the control field. There are three types of frames:

- Unnumbered frames
- Supervisory frames
- Information frames.

Each line used for HDLC-NRM (SDLC) protocol has a primary and secondary end. The primary station (end) polls the secondary stations. The primary station sends frames to the secondary station. When a frame with the “poll bit” is sent to a secondary station, this station is allowed to send information frames to the primary station. When it has no more frames to send, the secondary sends a frame with the “final bit” set. The primary can then send a frame containing the poll to another secondary station on the line.

A number of parameters can be configured to control the operation of primary and secondary stations defined via the HDLC-NRM (SDLC) protocol. These parameters are fully described in Chapter 4 , “Protocol Specific Configuration.”

Application Message Headers

The HDLC-NRM (SDLC) protocol does not use application message headers. Both transmitted and received messages contain only the information field of information frames sent across the link. The protocol adds communications header and trailer to transmitted messages, and removes the same from received messages.

Timeout Processing

Timers are used to control several mechanisms in this implementation of the HDLC-NRM (SDLC) protocol.

Response Timer

The principal timer used to control the polling cycle is the T1 timer, which is a parameter for each primary station. Its value is configured as described in the next chapter. When the primary station sends a frame with the Poll bit set to the secondary, the T1 timer is started. It is restarted when an I-frame is received without the Final bit. The timer is stopped when a frame is received from the secondary station with the Final bit set. If the T1 timer expires, the primary station will issue another poll (to the same or another secondary station).

If timeouts continue to occur, up to the configured retry limit, without a good response being received, the primary will send a mode setting command (Set Normal Response Mode or SNRM) with the Poll bit set to the secondary to cause a reset. The SNRM command also uses the T1 timer to ensure that it receives a response. If no response is received to the SNRM command for the configured retry limit, the terminal is marked down, and an unsolicited status message is sent to the application.

When down, the primary protocol software will conserve line time by polling the station only once in every slow poll cycle, unless the 'No Slow Poll' option is set for the terminal. The slow poll interval for the HDLC-NRM (SDLC) protocol is 33 seconds. Once the secondary station responds to a poll, it will be reinstated to the normal poll cycle. At the time when it successfully responds to a SNRM command after being down, the protocol software will issue an unsolicited status message to the application with reason code “No error detected”, indicating that the terminal is now operational.

Poll Timer

The secondary station has a timer configured to allow the protocol software to detect and inform the application when it is no longer receiving a poll from the primary. This timer is started when the terminal is enabled, and restarted whenever a poll is received by a particular secondary station. When this timer expires, the protocol software will mark the secondary station down and inform the application program with an unsolicited status message indicating that the “Host has stopped polling”.

Terminal Busy Timer

When a terminal is busy (responds to polls or other frames with a Receiver Not Ready or RNR frame and is unable to accept messages), a timer known as the terminal busy timer is started. The value of this timer is approximately 30 to 40 seconds. The timer is stopped when the terminal is no longer busy. If the timer expires, any transmit messages which have not been transmitted to the terminal and acknowledged will be rejected with an error “Terminal busy for too long”.

Error Handling

Several mechanisms are used to detect and recover from error conditions.

Checkpoint Recovery

The principal method of error recovery used by the HDLC-NRM (SDLC) protocol is known as *checkpointing*. This technique, which is more fully described in ISO 4335, ensures that a received frame with the poll or final bit set acknowledges all frames sent prior to or including the last frame sent with the final or poll bit (respectively) set. If this is not the case, then there is a need for re-transmission of the unacknowledged frames. If this condition occurs more times than the configured retry limit, then the protocol software will attempt to either request a reset of the link (if a secondary) or reset the mode with SNRM (if a primary), to recover from the error condition.

Transmit Blockage

Another error which can occur is the inability to transmit frames. This is usually because of a hardware exception condition. Such a condition is usually caused by a cable problem between the mux panel and the Data Communications Equipment (DCE). However, there are several other conditions which can cause such an error, such as an absent or slow transmit clock signal, or no Clear to Send signal. Because this condition is detected by a timer expiring, it can also be detected because a very low line speed is being used. When this error occurs, an immediate exception condition is sent to the application via an unsolicited status message with reason code “Cable or local modem fault”.

Command/Response Reject Conditions

In accordance with the ISO standards, a number of error conditions associated with frames are detected and handled. Short frames (less than Address and Control field) are discarded. Frames ending in an abort sequence, or frames received with FCS errors are also discarded.

If frames pass the above checks, then they are also checked for various command/response exception conditions as follows:

- Unrecognized or unimplemented control field;
- Frame too long (longer than maximum configured I-field);
- Invalid receive sequence number, N(R).

If any of these command/response exception conditions are detected, different recovery actions will be taken, depending on whether the receiving station is primary or secondary. The ISO 4335 standard in section 7.3.2.2 defines a three byte information field which is used to convey information about the command response reject condition. The format of the reason code is given in a later section of this chapter.

If the receiving station is a primary station, the station will:

- Notify the application program with an unsolicited status message indicating “Invalid terminal response”. This unsolicited message will contain the three byte reject reason code.
- Reset the mode of the station, using the SNRM command.

If the receiving station is a secondary, the station will:

- Notify the application program with an unsolicited status message indicating “Frame reject transmitted”. This message will contain three bytes of reject reason code.
- The secondary station will request the resetting of the mode, by sending a Frame Reject (FRMR) frame to the primary, whenever it is polled.

When a primary station receives a Frame Reject frame, it will:

- Notify the application program with an unsolicited status message indicating “Frame reject received”. This message will contain the three bytes of reason code, as received in the FRMR frame from the remote secondary station.
- Reset the mode of the station, using the SNRM command.

Application Control Requests

All HDLC-NRM (SDLC) terminals must be enabled prior to sending and receiving of messages.

The enable request will cause the primary station to initialize the mode for the terminal by sending a Set Normal Response Mode (SNRM) command to the terminal. After the appropriate (UA) response, normal polling will commence.

The enable request will cause the secondary terminal to respond to commands from the primary station, such as SNRM and polls.

The activate request is used to allow the receiving of messages on a terminal. Normally, an application will issue an activate request at the same time it is enabled. The initial enabled state of the terminal will also be activated. A deactivate request can be used to mark a terminal busy, so that it is unable to receive messages. When a terminal is busy, it will acknowledge polls and other frames with a Receiver Not Ready (RNR) frame rather than the usual Receiver Ready (RR) frame.

Status and Error Messages

Error and other conditions are reported to the application program through two kinds of status codes.

The defines for these status codes are located in *zcomstatus.h* and *zx25status.h*.

Buffer Completion Statuses

Buffer completion statuses are generated by the protocol on all transmit messages. Depending on the *mode* parameter selected when using the *zsend* call, the application will see either no transmit response messages, error responses only, or all transmit response messages. The status code in these messages indicate either the successful transmission of the message, or the reason why it could not be transmitted.

The buffer completion statuses listed in the following table may be generated by the HDLC-NRM (SDLC) protocol.

Table 3-1 **Buffer Completion Status**

Status Code Value	Description
IO_OK (0)	No error detected. This message was successfully transmitted to and acknowledged (if appropriate) by the receiving station.
IO_DSBL (1)	Terminal disabled. Messages cannot be transmitted to a disabled terminal.
IO_TX_TMOUT (2)	Cable or local modem fault. This message cannot be sent or acknowledged because a “transmit blockage” condition exists.
IO_BUSY (3)	Terminal busy for too long. Messages cannot be sent to the remote station because it is busy.

Table 3-1 Buffer Completion Status

Status Code Value	Description
IO_TX_RETRY (4)	Too many retransmissions. There were too many retransmissions needed to send this message or to obtain an acknowledgment for this message.
IO_TERM_TMOUT (6)	No terminal response. There is no response from this terminal for this message or a request for acknowledgment.
IO_PROT_REJ (10)	Protocol rejects request. This status code is used for messages which are attempted to be transmitted to a secondary broadcast terminal.
IO_DOWN (20)	Terminal down. Messages cannot be successfully transmitted because the terminal is down.
IO_LNK_RST (23)	Link reset. Messages which were outstanding and unacknowledged at the time when the link is reset with a SNRM/UA sequence are completed with this status code. These messages have been transmitted, but not properly acknowledged. In Loop mode the link may also be reset due to the secondary station sending an RIM frame.
ST25RXFR (70)	Received frame reject. Messages which were outstanding and unacknowledged at the time when the link is reset due to a received frame reject are completed with this status code. These messages have been transmitted, but not acknowledged.

Unsolicited Status Messages

The unsolicited status messages are used to inform the application program of events which occur affecting communications with the remote station. The status code "No error detected" is used to inform the application that the remote station is communicating normally, either after an enable request, or some error condition.

The status codes marked with a † contain command/response reason code information, in the format described in Table 3-2.

The unsolicited status codes listed in following table may be sent to an application program by the HDLC-NRM (SDLC) protocol.

Table 3-2 Unsolicited Status Codes

Unsolicited Status Code Value	Description
IO_OK (0)	No error detected. Normal communications have been established or resumed.
IO_DSBL (1)	Terminal Disabled. The processing for the disable request has completed.
IO_TX_TMOUT (2)	Cable or local modem fault. A transmit blockage exception condition exists.
IO_TX_RETRY (4)	Too many retransmissions. There were too many retransmissions required to obtain a successful acknowledgment or response.
IO_INV_RESP (9) †	Invalid terminal response. A command/response reject condition has been detected by a primary station.
IO_POLL (13)	Host has stopped polling. For a secondary station, a poll has not been received for the duration of the configured poll timer.

Table 3-2 Unsolicited Status Codes

Unsolicited Status Code Value	Description
IO_LNK_DSC (22)	Link disconnected. The link has been disconnected, either by the transmission or receiving of a DISC command.
IO_LNK_RST (23)	Link reset. In Loop mode, indicates that an RIM frame was received from the secondary station, resetting the link.
ST25TXFR (69) †	Frame reject transmitted. A command/response reject condition was detected by this secondary station causing it to send a FRMR frame.
ST25RXFR (70) †	Frame reject received. A frame reject response has been received by this primary station. (Reason code is from received frame.)

Command/Response Reject Reason Codes

The format of the command/response reject reason information is given below. This data is passed to the application in the data portion of the indicated unsolicited status messages, as described under the Error Recovery section. This information is summarized from ISO 4335 standard, section 7.3.3.2. Please refer to the standard for a more detailed description.

Byte 1	Byte 2				Byte 3							
Rej. frame control field	N(r)	C/R	N(s)	0					z	y	x	w

Of primary interest here are the four one bit flags named w, x, y and z. The meanings are as follows:

w — when set to “1” indicates that the rejected control field was undefined or not implemented.

x — when set to “1” indicates that the rejected frame contains an I-field when it is illegal for this type of frame. w is also set to “1” in this case.

y — when set to “1”indicates that the rejected frame was too long.

z — when set to “1” indicates that the rejected control field contains an invalid receive sequence number N(R).

NOTE ISO 4335 Section 7.3.3.2 describes the format of this information field for a Frame Reject response in modulo 8 using bit numbers from 1 (for the first transmitted bit) to 20. This I-field is padded with 4 extra bits to make 3 whole octets, as allowed in the standard. The above diagram uses the more usual convention of showing the most significant bit of each byte on the left, and the least significant bit of each byte on the right. When data is transmitted over the wire, the least significant bit is transmitted first beginning at byte 1.

4 Protocol Specific Configuration

Introduction

This chapter provides specific information on preparing the network configuration (ttgen) file when HDLC-NRM (SDLC) is to be used.

The parts of the network configuration answer file (.answ) relevant to HDLC-NRM (SDLC) are:

- Interface-Definition
- Port-Definition
- Terminal-Definition

For additional details on general configuration, see the TTGEN chapter of the *ACC Utilities Reference Manual*.

Interface-Definition

An Interface-Definition line appears in the sample configuration file for each Multiplexer that will have HDLC-NRM (SDLC) connections configured.

The firmware file that is used for products using HDLC-NRM (SDLC) is different from the firmware files that are used for other protocols. It is possible, however, to use other protocols with HDLC-NRM (SDLC) on a single card, provided the firmware file has been customized to include those other protocols. (Refer to the *ACC Installation and Configuration Guide* and the *ACC Utilities Reference Guide* Sections on *zlink* for more information on creating firmware files for multiple protocols.)

A sample Interface-Definition is as follows:

```
z7200a 00   56:36      /opt/acc/z7200a/hdlcnrm.zabs
```

The “z7200a” part will be different depending on the ACC card used. It should be set to “z7400a” for EISA cards, for example.

Port-Definition

The ports used must be defined as operating in SDLC mode. They may be defined with either an external (modem supplied) clock, or an internal (supplied by the ACC card) clock. With an external clock, the speed is for documentation purposes only, and will not be used by the ZCOM system.

The clock multiplier should be x1, and the encoding mode will normally be NRZ.

A sample Port-Definition is as follows:

```
Port 01:04 RS232       9600   Ext    SDLC  x1     NRZ
```

Refer to the *ACC Utilities Reference Guide* Section on *ttgen* for details.

Terminal-Definition

Each port which is to be used with the HDLC-NRM (SDLC) protocol must have one or more HDLC-NRM (SDLC) terminals defined on it. Each port must have either all primary terminals defined or all secondary terminals defined. They cannot be mixed on a line.

Some example HDLC-NRM (SDLC) Terminal-Definition lines follow:

```
Term 120  1:6  HDLCNRM.P 0041H    4024H    1000 0 0 0 0 ″HDLC/NRM   Primary A″
```

The first Terminal-Definition defines an HDLC primary terminal with ZLU of 120 on Mux 1 Port 6 with poll address 0x41 (ASCII “A”).

```
Term 120  1:6  HDLCNRM.S 0042H    0824H    1000 0 0 0 0 ″HDLC/NRM Secondary B″
```

The second definition defines a secondary terminal with address 0x42 (“B”).

```
Term 120  1:6  HDLCNRM.P 0041H    4024H    1000 0 0 0 0  ″HDLC/NRM TWS Primary A″
Option 02H
```

The third definition is the same as the first except that the Option keyword is used to override the predefined option definition for the HDLCNRM.P device to specify the TWS option (see later sections for details).

The Terminal-Definition takes the following format:

```
Term  zlu  card:port type poll select application_data  name  <option>
```

More specific information on the parameters in the HDLC-NRM (SDLC) terminal definition follows:

ZLU This number (120 in the example) assigns a unique reference number for this terminal.

Card:port The port assigned must be configured as above and the Card must have the appropriate HDLC-NRM (SDLC) firmware configured.

type This name defines a device type which is used with the HDLC-NRM (SDLC) protocol. There are a number of predefined devices which may be used with the HDLC-NRM (SDLC) protocol. These are described in a later section of this chapter.

poll This parameter, which is normally specified in hexadecimal, is used to specify the secondary station address. Its format is described in a later section of this chapter.

select This parameter is used to define a number of parameters which govern the operation of the protocol. The value is normally specified in hexadecimal. The individual parameters contained in the select word are defined and described in a later section of this chapter.

appl.no. Application number (Application dependent - has no effect on protocol, see *Note*).

inst.no. Institution number (Application dependent - has no effect on protocol, see *Note*).

brch.no. Branch number (Application dependent - has no effect on protocol, see *Note*).

wkst.no. Workstation number (Application dependent - has no effect on protocol, see *Note*).

area no. Area no (Application dependent - has no effect on protocol, see *Note*).

NOTE The five parameters above are for the use of the application and can be set to any value desired. They can be accessed by the application from the Logical Terminal Table using ZINFO.

name Choose a meaningful description of the HDLC-NRM (SDLC) terminal, preferably including a reference to the location of the remote end of the link. This field will be used in some ZMNTR displays. It may also be accessed programmatically using the ZINFO call.

option This parameter may be specified to override the predefined options for a device type. It is not normally used, as it would be more useful to define a new device type. (See later section on HDLC-NRM (SDLC) device types.)

Protocol Configuration Values

Poll Word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Unused (0)					Loop Pacing			Secondary Station Address							

Loop Pacing

NOTE Applicable only in Loop Mode; default value is 100 ms.

This parameter is used to configure an extra delay in the poll cycle when Loop Mode is in use. The parameter values currently supported are as shown below.

000	100 ms	100	300 ms
001	150 ms	101	350 ms
010	200 ms	110	400 ms
011	250 ms	111	450 ms

Secondary Station Address

This parameter defines the address which is used to communicate with a secondary station. This parameter is required for both primary and secondary HDLC-NRM (SDLC) terminals. For a primary terminal, it is still referred to as the secondary station address, because the address belongs to the secondary station.

This secondary station address has a valid range of 0x00 to 0xFF. The broadcast terminal address (if defined) should be set to 0xFF. Each terminal defined on a line requires a different address.

Select Word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TIR	T1					Frame size			Window			N2			

T1R - T1 Timer Resolution

In the case of a primary station this bit determines the resolution which applies to the T1 parameter as follows:

T1R Bit clear (0) - 100 Millisecond units

T1R Bit set (1) - 1 Second units

In the case of a secondary station this bit becomes the top bit of the “Poll Timeout” parameter.

T1 - Poll Timeout

This parameter is used to set the T1 response timer for a primary configuration or the Poll Timeout for a secondary configuration.

For a primary terminal, the T1 response timer value is set by a combination of the T1R timer resolution parameter and the T1 poll timeout value. The value of the timer should be chosen so that it is longer than the time taken to transmit the longest I-frame. The T1 timer is started after a frame with the poll is transmitted and is restarted after each I-frame that does not contain the final bit is received. A detailed explanation of the T1 timer processing is given in Chapter 3, “Response Timer”.

The user may choose a value for the T1 parameter between 2 and 31. A value of 1 is not recommended as it can lead to an arbitrarily low timeout value. The default value for the poll timeout value (if both T1 and T1R parameters are zero) is one second.

When choosing a value for the timer, care should be taken to ensure that the internal rounding down of the timer value, which occurs at run time, does not lead to a shorter than expected timer value. This can be achieved by either choosing a higher resolution (100ms), if possible, or by choosing a value of the T1 parameter which is one unit larger than the minimum desired timer value.

Table 4-1 shows the minimum and maximum actual timeout values which will be achieved with various combinations of T1R and T1 parameters.

Table 4-1 Timeout Values

T1R Timer Resolution	T1 Poll Timeout Value	Minimum Timeout	Maximum Timeout
100ms	1 (not recommended)	0	100ms
100ms	2	100ms	200ms
100ms	3	200ms	300ms
100ms	4	300ms	400ms
100ms	5	400ms	500ms
.	.	.	.
100ms	19	1800ms	1900ms
100ms	20	1900ms	2000ms
.	.	.	.
100ms	31	3000ms	3100ms
1 sec	1 (not recommended)	0	1 sec
1 sec	2	1 sec	2 sec
1 sec	3	2 sec	3 sec
.	.	.	.
1 sec	31	30 sec	31 sec

For the secondary Poll Timeout, the configured units are 1 second, but this timer has a 10 second resolution. The default (if the parameter is set to zero) is 20 seconds. This parameter is used to detect a disconnected condition for the secondary station, where a poll is not received for the duration of this timer. For the secondary, the allowable values for this timer are 1 to 63 seconds.

Frame Size

This parameter is used to set a limit on the size of the received I-field of a frame that will be allowed. This parameter does not restrict the size of I-frames which may be transmitted.

This limit does not include the Address byte, Control byte or FCS characters. The parameters correspond to byte lengths as follows:

Frame size parameter	Max I-field size (bytes)
0	1024
1	2048
2	3072
3	4096
4	5120
5	6144
6	7168
7	8192

Window - Transmit Window Size

This is the maximum number of unacknowledged transmitted I-frames allowed. Allowable values are 1 to 7 inclusive. The default (if this parameter is set to zero) is one (1). This parameter is applicable to both the primary and secondary stations.

For the primary broadcast terminal, this parameter can be set to govern the number of broadcast messages that will be sent on a poll cycle.

Increasing this parameter will allow for higher throughput where there are multiple messages to send, because acknowledgments are not required for every message transmitted. This parameter is normally set in conjunction with the capabilities of the receiving station to receive multiple messages. On a line with many terminals defined, or with large messages sizes to transmit, the use of a large window size will require large numbers of transmit buffers to be used. When configuring a large window size, the terminal unacknowledged queue limit may need to be increased in order to take advantage of the window.

N2 - Retransmission Limit

This is the retransmission retry limit. The default (if this parameter is set to zero) is seven (7).

This parameter governs the number of times the protocol will attempt to retry after an error condition, before resorting to a higher level recovery action.

Protocol Option Word

The option word enables various options to be configured for each terminal. Usually, these options are defined for a certain device type in the *zcomdevice.txt* file (see later section on predefined device types). The option word can be overridden for a particular terminal by use of the *Option* keyword following the Terminal-Definition. Refer to the *ACC Utilities Reference Guide* for further information.

Each of the individual options is controlled by a single bit flag within the option word. The option word is configured as follows:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Unused (0)								NSP	SLM	BCT	RTS	HDX	RPC	TWS	SEC

NSP - No Slow Poll

Set to disable the normal slow poll facility for a primary station when the terminal is down. When set for a primary station, the station will be polled once during each normal poll cycle, even when down. For further discussion of the slow poll mechanism, refer to the “Response Timer” section of Chapter 3. This option is only applicable for a primary station.

SLM - SDLC Loop Mode

Set to enable loop mode operation. Refer to Appendix B , “SDLC Loop Mode Option.” If this option bit is set (1), then the HDX (half duplex) bit should also be set (1), and all other option bits clear (0).

BCT - Broadcast terminal (Extension feature)

Set to make a terminal the broadcast terminal for the port. A single broadcast terminal may be configured on either a primary or secondary port. A broadcast terminal’s address should be set to 0xFF.

The broadcast facility is an extension feature of the HDLC-NRM (SDLC) basic procedures as described in ISO 4335. The broadcast facility allows the primary control station to send messages without acknowledgment to all secondary addresses on a line (if these are capable of receiving such messages).

For a line configured for secondary operation, a secondary broadcast terminal may be configured to allow the reception of any broadcast messages sent by the primary control station. In this implementation, the secondary broadcast terminal only will receive broadcasts, and not any of the other secondary stations.

For operation with the broadcast facility, a terminal ZLU should be configured with the all stations address “11111111”, (0xFF) in addition to the real terminals. Messages to be broadcast should be sent to this virtual terminal ZLU by an application program. On the secondary line, all broadcast messages will be received by the secondary broadcast terminal.

The virtual broadcast terminal is distinguished by this BCT option setting which will change the way in which this terminal will be handled by the protocol as follows:

- No RPC
- No SNRM
- No polling

A broadcast message will be sent as an unnumbered information (UI) command with P bit set to zero (0). No response is expected to the broadcast message from any secondary station.

RTS - Controlled RTS

This option flag may be set to enable the control of the RTS signal as frames are transmitted. This option must be set the same for all terminals on the port.

If set to zero, the RTS control signal is left permanently ON after the port is enabled.

HDX - Half Duplex

This option is only applicable for the primary stations. The setting of this option for a primary terminal will prevent the transmission of frames to ANY SECONDARY TERMINAL while the poll is outstanding to a terminal configured as half duplex.

If the half duplex option flag for a primary terminal is zero (0), then the terminal will operate in full duplex mode.

RPC - Remote Power Control (Extension feature)

Set to invoke support for the remote power control feature for the station. Stations do not support remote power control by default. This procedure is outside of the standard procedure for HDLC-NRM (SDLC), as defined in ISO 4335.

This option is only applicable for primary stations. Secondary stations will respond as expected to the RPC sequence if received, without setting this configuration option.

The RPC command is defined as a UI command frame, with empty I-field and P bit equal to “1”. The RPC procedure operates outside of the normal mode setting procedure using the SNRM command.

When the RPC is enabled, the primary station will initiate the RPC command for a station when the terminal is enabled. The primary station will continue to send the RPC command until either a DM or FRMR response is received. The primary station will then proceed to set the mode using the SNRM command.

TWS - Two Way Simultaneous

Set to enable two way simultaneous operation of a station. This option is only configurable for primary stations. Primary stations operate in two way alternate mode if this option is set to zero (0). Secondary stations will operate in TWS if permitted by the discipline enforced by the corresponding primary station.

The setting of the TWS option will allow frames to be sent to the secondary station while the poll is outstanding to that station.

NOTE Use of the TWS option is not recommended when there are multiple polled primary terminals configured on the line (i.e. multipoint rather than point-to-point). This is for the reason that, when a secondary terminal has high volumes of data to send, the primary station keeps acknowledging received frames, consequently allowing the secondary an arbitrarily long time to return the final bit to the poll. Since in the TWS mode the interval between polls is indeterminate, using the TWS option under these conditions is not recommended.

SEC - Secondary Station

Set to make the terminal a secondary station. If this option flag is set to zero (0), then this terminal is configured as a primary station. Primary and Secondary terminals cannot be mixed on a single port.

HDLC-NRM (SDLC) Device Types

Table 4-2 lists devices that have been added to the "zcomdevice.txt" file to allow HDLC primary and secondary terminals to be configured with a selected range of options.

Table 4-2 Devices Added to the "zcomdevice.txt" File

Device Name	Option	Comments
HDLCNRM.P	0x00	HDLC/NRM Primary TWA
HDLCNRM.PT	0x02	HDLC/NRM Primary TWS
HDLCNRM.S	0x11	HDLC/NRM Secondary
HDLCNRM.PBT	0x22	HDLC/NRM Primary, broadcast, TWS
HDLCNRM.PRT	0x06	HDLC/NRM Primary, TWS, RPC
HDLCNRM.SBT	0x23	HDLC/NRM Secondary broadcast
NRMLOOP	0x48	SDLC Loop Mode device

Other devices may be added to the zcomdevice.txt file for site specific configuration options. Refer to the section on *zdgen* in the *ACC Utilities Reference Guide* for more information on defining new devices.

A Sample Configuration Files

Sample Network Configuration File

The file shown is the sample network configuration file *hdlcnrm_sample.answ* which is provided with the HDLC/NRM protocol.

```
ttgen

   Configuration
      system-name     "ACC HDLC/NRM Sample Configuration"
      Program-Zlu     100
      TERMINAL-zlu    800
      LOGICAL-TERM    400
      Physical-Term   400
      BUFFER-POOL     3000000
      logical-size    252
      Queue-Limit     200
      Transmit-Limit  200
      Unack-Limit     5000
      Port-Limit      20000
      E1T1-Port-Limit 100000
      Node-Entry      1

  Interface-Definition
*         mx#    bus#:slot#    Download file name
   z7200a   0      56:36       /opt/acc/z7200a/hdlcnrm.zabs
*    The "z7200a" part will be different depending on the
*    ACC card used.  It should be set to z7400a for EISA cards.

  Port-Definition
Port 00:00   RS232    9600   Int   SDLC x1 NRZ
Port 00:01   RS232    9600   Ext   SDLC x1 NRZ
Port 00:02   RS232    9600   Int   SDLC x1 NRZ
Port 00:03   RS232    9600   Ext   SDLC x1 NRZ
Port 00:04   RS232    9600   Int   SDLC x1 NRZ
Port 00:05   RS232    9600   Ext   SDLC x1 NRZ
Port 00:06   RS232    9600   Int   SDLC x1 NRZ
Port 00:07   RS232    9600   Ext   SDLC x1 NRZ

  Terminal-Definition
Term 0001 0:0 HDLCNRM.P   0041h 4024h 1000 0 0 0 0 "HDLC/NRM Primary A"
Term 0002 0:0 HDLCNRM.P   0042h 4024h 1000 0 0 0 0 "HDLC/NRM Primary B"

Term 0011 0:1 HDLCNRM.S   0041h 0824h 1000 0 0 0 0 "HDLC/NRM Secondary A"
Term 0012 0:1 HDLCNRM.S   0042h 0824h 1000 0 0 0 0 "HDLC/NRM Secondary B"

  Node-Definition
     Local-Node     123
End$
```

Download Linkage

This file is the example Link command file that is provided for the 8-Channel HP-PB (NIO) Multiplexer interface, and is typical for other interfaces as well. (Z7200A denotes the 8-Channel HP-PB interface hardware.)

```
ma z7200a/hdlcnrm.zmap
xr
nam HDLCNRM Download file HDLC/NRM distribution
sn sys/z7200_rom.zsnp
org,vmux1org,vmux1lim
re sys/wmux1.zrel
org,vmux3org,vmux3lim
re sys/wmux3.zrel
org,progorg,proglim
re sys/wmux4.zrel
re protocol/level1.zrel
****************  Protocol Modules  ***********************
re protocol/hdlcnrm.zrel
**************  End of Protocol Modules  ****************

re protocol/monitor.zrel
re protocol/testprot.zrel
org,eptable
re sys/pmenttab.zrel
org,preptbl
re sys/umuxent.zrel
ab z7200a/hdlcnrm.zabs
end
```

If any of the other ACC multiplexers which support the HDLC NRM level 2 protocol are in use, a different Link command file is provided.

When customizing download files, use whichever files have been provided with your configuration.

B SDLC Loop Mode Option

Introduction

The SDLC loop mode of operation is described in the IBM document "Synchronous Data Link Control General Information" GA27-3093. A subset of this standard has been implemented. Only the primary station is supported in loop mode. The "turn-around" signal described in the SDLC document is not used.

NOTE The SDLC loop mode is not available for use on the 2-Channel ACC interface.

Frame Types Supported

In loop mode the HDLC/NRM protocol supports the use of the following additional commands and responses:

Commands	Responses
SIM	RIM
TEST	TEST
UP	

Request to Send Control

In Primary/Loop mode the HDLC/NRM protocol maintains the RTS signal in the ON condition.

Unnumbered Poll

In Primary/Loop mode the HDLC/NRM protocol will poll the secondary stations with the Unnumbered Poll (UP) command with the P bit set to '0' and with the address field set to 0xFF.

TEST Command and Response

In Primary/Loop mode the HDLCNRM protocol will periodically issue a TEST command with the P bit set to ‘0’ to each secondary station. If the correct response (TEST response with the F bit set to ‘0’) is not received within the T1 timeout period, the TEST command will be repeated. After N2 repeat transmissions of the TEST command with no response received the secondary station will be considered to be in the disconnected mode.

The default value for the contents of the TEST command I-field is six ASCII characters as follows:

“U TEST”

The test pattern can be modified to any sequence of up to 6 bytes by the use of a control write request to the terminal. The format of the control write request is as follows:

Bytes
Request Type (=1)
Data length (less than 7 bytes)
TEST data

This request should be the first request to the terminal after it is enabled.

TEST commands are transmitted to secondary stations in the “up” state (i.e. after a successful SNRM/UA exchange) at 60 second intervals.The Information field of the TEST response is not verified.

SDLC Frame Types Not Supported

The following commands and responses defined in the IBM SDLC specification are not supported:

Commands	Responses
CFGR	BCN
XID	CFGR
REJ	RD
	XID
	REJ

Modulo-128 sequence numbering is also not supported.

Operation

When one terminal on a port is enabled, then polls (UP frame) with the go-ahead signal will be transmitted. When all terminals are disabled no more polls will be transmitted.

Once a terminal is enabled SNRM command frames will be transmitted to that terminal at 10 second intervals until a UA response is received.

When a terminal is disabled, no more frames will be transmitted with that terminal's address (there is no disconnect procedure).

Response Timers

The T1 timer is used as in normal HDLC/NRM operation, to time the response to a frame transmitted with the P-bit set to 1.

Because in loop mode there are usually no frames transmitted with the P-bit set to 1 (other than TEST), there is an additional 1 second timer which is started each time an I-frame is transmitted.

If no acknowledgment has been received when this timer expires, an RR frame with the P-bit set to 1 is transmitted to solicit a response from the secondary station.