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TN3270 Extensions for LUname and Printer Selection

Status of this Memo

This memo provides information for the Internet community. This memo does not specify an Internet standard of any kind. Distribution of this memo is unlimited.

Abstract

This document describes protocol extensions to TN3270. There are two extensions outlined in this document. The first defines a way by which a TN3270 client can request a specific device (LUname) from a TN3270 server. The second extension specifies how a TN3270 printer device can be requested by a TN3270 client and the manner in which the 3270 printer status information can be sent to the TN3270 server. Discussions and suggestions for improvements to these enhancements should be sent to the TN3270E Working Group mailing list TN3270E@list.nih.gov . These extensions will be called TN3287 in this document. This information is being provided to members of the Internet community that want to support the 3287 data stream within the TELNET protocol.

1. INTRODUCTION

The need to communicate with IBM mainframe systems has a number of unique requirements associated with it. This document addresses those needs in a TCP/IP communications network.

IBM terminals are generically referred to as 3270’s which includes a broad range of terminals and devices,not all of which actually begin with the numbers 327x.

The 3270 family of terminals and the IBM mainframe applications systems are VERY closely coupled and it is the nature of the way the 3270s and the applications interact which require that this document be available to provide a consistent way for the TCP/IP environment to interact effectively with the 3270 applications of the IBM mainframe world.

IBM mainframe applications systems have existed for almost two decades now and are used to serve tens of thousands of users daily. For this reason it is usually the need of a mainframe environment to add TCP/IP network support WITHOUT writing new applications to run with the TCP network. The TN3270 series of documents addresses how this can be done and maintain compatibility with those mainframe application systems.

One of the unique characteristics of the 3270 terminals is their ability to communicate status information in an out-of-band data flow. These status's are in turn used by the applications systems to support error recovery, and conflict resolutions, examples of these are printer out of paper, and terminal powered up. The terminals are also half duplex and block mode in their operations, which results in the need to communicate when blocks are being sent, when they end, and when they cannot be sent. This document describes these characteristics in IBM VTAM/SNA terms. Some VM mainframe application systems do not use VTAM, so for those systems these terms don't apply. For any systems which use VTAM these terms apply and are dealt with in some way by the TCP/IP to VTAM interface.

VTAM/SNA is a hierarchical network and some of that hierarchy needs to be addressed by the TCP network attaching to it if the applications systems are to continue to provide the same applications support that they have provided to the 3270 terminals.

The 3270 terminal environment consists of a terminal controller with terminals attached to that controller. In VTAM/SNA this controller is called a PU (Physical Unit) and the terminals called LUs (Logical Units). The PU is used to communicate management information to the VTAM/SNA system, and the LU is used by the application to communicate with the terminal. VTAM/SNA identifies each LU and PU in a network by a unique name. These names are referred to as LUnames and PUnames, and is how the network is managed and the applications identify what terminals are being communicated with in the network. The actual connection between a terminal and the applications is referred to as a session, and it is this session which has both in-band and out-of-band information flows sent between the applications and the terminals.

VTAM/SNA 3270 terminals actually have two sessions when communicating with the applications. One session is directly connected with the application and the other session is connected directly to VTAM. It is the session with VTAM, also called the SSCP, that is used to communicate the out-of-band information flows. This session is called the SSCP-LU session, and the session with the application is called the LU-LU session (in VTAM an applications is just another Logical Unit).

One such out-of-band flow is the LUSTAT message which tells the application that the status of the terminal has changed, and is how a printer or screen tells the application that it is ready, or is not ready to receive data.

There are also flows which must be able to flow in the LU-LU session to help control the use of the terminal by applications. The block of information sent in a session is called an RU (Request Unit) and it tells what type of data this block contains, how long it is and if more data (RUs) is coming along. This is a gross over simplification of what RUs are and do, but it should help understand their use in the TN3270 documents. Some of the VTAM/SNA terms used to describe what an RU is requesting are: Chains/chaining which tell a session partner that another RU is being sent or not being sent in this transmission. Brackets which are used to indicate that a unit of work is complete, such as when a printout of a file is complete.

The determination of what part of the VTAM/SNA protocols such as brackets and chaining are to be used are managed by VTAM tables called LOGMODE tables. These tables are selected when an LU-LU session is started and set up such things as bracket, and/or chaining protocols; and the type of terminal data contained in the RUs, such as printer data without screen formatting data (LU type 1), 3270 screen formatted data (LU type 2) and 3270 screen formatted data for a printer (LU type 3). The LOGMODE tables also contain the size of the RU to be sent and received. These tables also communicate the screen size of 3270 terminals such as 24X80 (Model 2), 27X132 (Model 5), etc. Each LU has a LOGMODE table entry hard assigned to it as part of the VTAM configuration (often called a GEN). The selection of these table entries can’t be controlled by the terminal LU or PU. They can only be selected by the user at connection/logon time or by the application when the connection is established. The actual LOGMODE entries to be used during a session are sent at session logon time, in a special type of RU called a BIND. Once the bind has been sent then the rules for the use of the session have been set, can’t be changed, and must be followed.

The purpose of the TN3287 protocol is to provide a general IBM 3270 host printer communications facility. Its primary goal is to allow a method of connecting printer devices and printer-oriented processes to each other. This protocol will allow a TN3270 Client to process 3287 print data streams.

This memo supplements and extends the STD 8, RFC 854, TELNET Protocol Specification. This memo also presents an example of the correct implementation.

2. GENERAL CONSIDERATIONS

A TELNET connection is a Transmission Control Protocol (TCP) connection used to transmit data with interspersed TELNET control information.

The companion document, STD 8, RFC 854 -- "TELNET Protocol Specification" should be consulted for further information about the TELNET command, codes and code sequences referenced in this specification.

3. CLIENT-SERVER NEGOTIATION

The TN3270 Client and Server require a specific negotiation protocol. After the negotiation is complete, all transmission between the Client and Server is in TELNET Binary format with a TELNET "End-Of-Record(EOR)" sequence at the end of each data stream.

Support for the TN3287 data stream requires that both sides:

A. Are able to exchange binary data.

B. Can establish the agreement between client and server on the terminal type that will be used.

C. Agree to use the TELNET IAC EOR as a delimiter for inbound and outbound TN3287 data streams

This implementation requires the options: TERMINAL-TYPE and BINARY be successfully negotiated between the Client and Server before processing of any print data streams.

This implementation supports host applications that can mix LU 1 and LU 3 type data in the data stream.

3.1 TN3287 SERVER

The maximum Request Unit (RU) size is server specific, but should not exceed 4 kilobytes.

The LU type is determined by the bind from the mainframe application. The server, when bound, must remember LU 1 or LU 3 type.

The server will automatically unbind the session upon receipt of a TELNET CLOSE command. The printer will be reported to VTAM as powered down until a new TELNET connection is established.

3.2 TN3287 CLIENT

The TN3287 Client is a TN3270 client created specifically to print mainframe 3270 print data. The client emulates the IBM device type that it identifies itself to the TN3270 server as, in this case, an IBM 3287 model 1 type printer. The design of this printer protocol is aligned with the way printing occurs in the IBM host and how 3270 printers function. These printer extensions DO NOT support a 3270 printer client that cannot accept both types LU 1 and LU 3 printer streams. No IBM printer operates in this fashion, and as a result, no TN3270 server could function properly with mainframe applications if it didn't allow for a mixing of LU 1 and LU 3 data streams. The common way in which this can occur is printer sharing between multiple IBM host applications, such as CICS and JES. Since there is no restriction, the JES can be configured to output LU 1 data streams, and the CICS can be configured for LU 3 data streams. Therefore, the server will identify what LU type the current application connected to the server is using. If that type is LU 1, ALL message records sent to the Client will be preceded by one byte of binary zeros (0x00). If the first byte is not zeros, then that byte will be a valid LU type 3 Write-Command-Code(WCC), which can NEVER be zeros. Thus, the client can tell the LU type of data as each record is received.

This protocol does allow for the client to shutdown if the client does not wish to support both LU types. This is accomplished by detecting an invalid data type from the received record, and notifying the user that the mainframe application has sent LU type x print data and should be configured for LU type y printing.

4. COMMAND STRUCTURE

1. All TELNET commands consist of at least a two-byte sequence: the "Interpret-as-Command(IAC)" escape character followed by the code for the command.

NOTE: Since the TELNET IAC character (255 decimal) is used as a delimiter (together with EOR) in the inbound and outbound data streams, a data byte within the data stream itself that has the same value as the IAC command is sent as two bytes (255, 255) and one byte is discarded.

4.1 TELNET COMMANDS

Command meaning - WILL and DO commands are used to obtain and grant permission for the subsequent subnegotiation. Both sides must exchange WILL TERM-TYPE and DO TERM-TYPE before subnegotiation.

The actual exchange of information is done within the option subcommand.

<IAC DO TERMINAL-TYPE> Sender requests that the other party begin terminal-type sub-negotiation.

<IAC WILL TERMINAL-TYPE> Sender is willing to send terminal-type information in a subsequent sub-negotiation.

<IAC SB TERMINAL-TYPE SEND IAC SE> Sender requests the receiver to transmit his terminal-type.

<IAC SB TERM TYPE IS IBM-3287-1 IAC SE> Sender is stating the name of his terminal-type. The code for <IS> is 0. Optionally, a specific Logical Unit (LU) can be requested by using the TERMINAL-TYPE string below. If no LUname is specified, the first available 3287 LU is selected.

IAC SB TERM-TYPE IS IBM-3287-1 @ LUNAME IAC SE

<IAC DO BINARY> Sender requests that sender of the data starts transmitting or confirms that the sender of data is expected to transmit characters that are to be interpreted as 8 bits of binary data by the receiver.

<IAC WILL BINARY> Sender requests permission to begin transmitting, or confirms it will now begin transmitting binary data.

An <EOR> is sent at the end of each SNA Request Unit (RU) end of chain, in either direction. The first byte following the <EOR> is a Write-Command-Code(WCC) for LU 3 data streams.

An <AO> is sent at the end of the SNA RU and end of bracket. This signifies the end of the print output or file by the IBM host application and possibly a change of LU type.

4.2 COMMAND VALUES

TELNET COMMAND	CODE
IAC Interpret as Command	255
DO	253
WILL	251
SB SuBnegotiation option	250
SE Subnegotiation End	240
TERMINAL-TYPE	24
SEND	1
IS	0

EOR End-Of-Record	25
BINARY	0
AO Abort Output	245
IP Interrupt Process	244
AYT Are You There	246
BREAK	243

NOTE: The above codes and code sequences have the indicated meaning only when immediately preceded by an "Interpret as Command (IAC)".

5. TN3270 Printer Status Message

The status message can be sent at any time. It must be sent every time the TN3270 Server sends an End-of-Record(EOR) indicator to the TN3270 Client, or when a printing error occurs at the Client. The Printer Status Message is only sent by the TN3270 Client. Once the End-Of-Record IAC is processed, the TN3270 Client sends the status message to the server when it is ready to receive more print data.

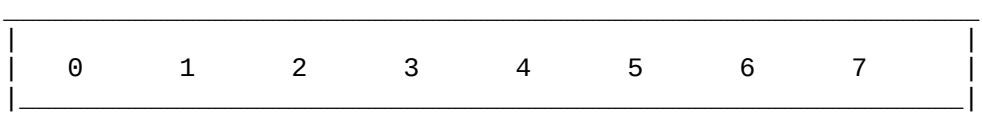
MESSAGE DESCRIPTION: SOH % R S1 S2 IAC EOR

SOH = 0X01
% = 0X6C
R = 0XD9
S1 = Status/Sense Byte 0
S2 = Status/Sense Byte 1
IAC = Telnet IAC Character
EOR = Telnet EOR Character

5.1 Status/Sense Byte description

5.1.1. S/S Byte 0:

High Order Low Order



Bit Number:	Bit Definition:
0	Always Zero
1	Always Zero

2	Always Zero
3	Always Zero
4	Always Zero
5	Unit Specify - is set due to an error condition. The reason for the error condition will be indicated in S/S Byte 1. See Note 1*.
6	Device End - when this bit sent in response to a data message it indicates the client has successfully processed the data message from the server and notifies the server to send a new data message to the client when available. See Note 2*.
7	Always Zero

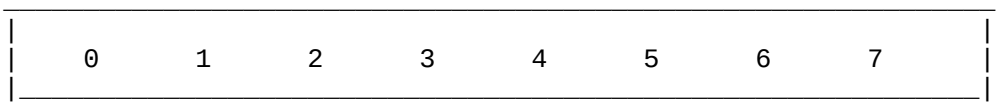
Note 1*: A negative response to the Server's data message would be S/S Byte 0 Bit 5 "Unit Specify condition". The possible Unit Specify conditions are listed below. (See Section 3.2 for bit settings for the Unit Specify conditions listed below.)

Unit Specify Condition:	SNA Sense Code sent to host:
Command Rejected	0X10030000
Intervention Required	0X08020000
Data Check	0X10010000
Operation Check	0X10050000
Component Disconnected (LU)	0X08020000

Note 2*: Device End - A positive response to the Server's data message would be the "Device End" bit (S/S Byte 0 Bit 6) to indicate a ready to receive data from the host condition. This will also be sent after clearing a previous Unit Specify condition of "Intervention Required".

5.1.2. S/S Byte 1:

High Order Low Order



Bit Number:	Bit Definition:
0	Always Zero
1	Always Zero
2	Command Rejected (CR) -- This bit indicates an invalid 3270 command generated.
3	Intervention Required - Printer Not Ready. See Note 3*.
4	Component Disconnected - Printer is powered off or printer cable not connected. See Note 4*.
5	Data Check - Invalid print data
6	Always Zero
7	Operation Check - An illegal buffer address or incomplete order sequence

Note 3*: The Intervention Required is cleared by sending an S/S message with the "Device End" bit (Bit 6 of S/S byte 0). The LUSTAT sent to the host is 0X00010000. The IBM host interprets this as a "printer now ready" condition.

Note 4*: The Component disconnected is cleared by sending an S/S message with the "Device End" bit (Bit 6 of S/S byte 0). The LUSTAT sent to the host is 0X082B0000. The IBM host interprets this as a "printer now ready -- presentation space integrity may be lost" condition.

6. The following is an example of the Client-Server negotiation process.

```
Server:   IAC DO TERMINAL-TYPE
Client:        IAC WILL TERMINAL-TYPE
Server:   IAC SB TERMINAL-TYPE SEND IAC SE
Client:        IAC SB TERMINAL-TYPE IS IBM-3287-1 IAC SE
```

Note: To request a specific LU the TERMINAL-TYPE string would be:
IAC SB TERMINAL-TYPE IS IBM-3287-1 @ LUNAME IAC SE
(The client has specified its terminal type is an IBM-3287-1)

```
Server:   IAC DO END-OF-RECORD
Client:        IAC WILL END-OF-RECORD
Server:   IAC WILL END-OF-RECORD
Client:        IAC DO END-OF-RECORD
```

(The Server and Client have both agreed to transmit End-Of-Record (EOR)).

```
Server:   IAC DO TRANSMIT-BINARY
Client:        IAC WILL TRANSMIT-BINARY
Server:   IAC WILL TRANSMIT-BINARY
Client:        IAC DO TRANSMIT-BINARY
```

(The Server and Client have both agreed to use binary transmission)

```
Server:   0x00 (3270 PRINT DATA)
Client:        (S/S with DEV END) IAC EOR
Server:   0x00 (3270 PRINT DATA) IAC EOR
```

NOTE: LU 1 type data is prefaced with a 0x00 character. LU 3 type data is not prefaced with a special character. This character will precede print data in each chain, and should be discarded before the print data is processed. An <IAC EOR> must be received before changing to LU 1 or LU 3 type data.

```
Client:        (S/S with IR) IAC EOR (This indicates a paper jam
               at printer.)
Client:        (S/S with DE) IAC EOR (This indicates the clearing
               of above condition.)
Server:  0x00 (3270 PRINT DATA) (This indicates start of LU 1
         data)

Server:   (3270 PRINT DATA)
```

```
Server:   (3270 PRINT DATA)
Server:   (3270 PRINT DATA) IAC EOR
Client:        (S/S with DE) IAC EOR
Server:   0x00 (LAST 3270 PRINT DATA) IAC EOR


Client:        (S/S with DE) IAC EOR
Server:   IAC AO
(The Abort Output <AO> signifies the end-of-bracket -- end of
print job)
```

7. SECURITY CONSIDERATIONS

This document does not specify a security methodology to insure that the client requesting a printer LU name is authorized to access that LU. Currently, this is left up to individual server implementations. The design of the protocols described in this document allow for the future incorporation of the RFCs regarding encryptions and authentication protocols and services. However, before this may occur, certain extensions may be required to the protocols defined in this document or to the encryptions and authentication services and protocols.

8. ERROR CONDITIONS

After a client and server have successfully completed negotiation, a number of potential error conditions may be detected by the server which require notifying the client and aborting the connection.

When an error condition is detected by the server, the client must be negotiated back into NVT mode by the server sending a "WONT/DONT BINARY" TELNET sequence and the client responding with the appropriate "DONT/WONT BINARY" TELNET sequence.

The server should immediately send the appropriate error message to the client as an ASCII string and then close the connection. The error message should be prefixed by a numeric identifier to precisely notify the client of the specific error condition. The error message sent to the client should be routed to the proper console or log for corrective action.

Below is a list of error conditions identified by numeric value, error text, meaning of the error and recovery procedure.

Message: "01 No LU's of the type configured"

Meaning: The configuration definition on the server does not include the LU type requested.

Recovery: Notify your Systems Administrator as this is a permanent error condition.

Message: "02 Requested LU unavailable"

Meaning: The requested LU is not available at this time.

Recovery: This may be a temporary error and may be retried periodically. If the condition persists contact your Systems Administrator.

Message: "03 Requested LU type is inconsistent with configuration"

Meaning: The LU requested does not match the terminal type in the server configuration.

Recovery: Notify your Systems Administrator as this is a permanent error condition.

Message: "04 Requested LU is not configured"

Meaning: The LU is not defined in server configuration.

Recovery: Notify your Systems Administrator as this is a permanent error condition.

When a client receives a message not defined in the above list, the message should be displayed to a console or log and the connection to the server should be closed. No other recovery should be attempted as this is most likely a fatal error condition. (Notify your Systems Administrator.)

9. REFERENCES

[1] Postel, J., and J. Reynolds, "TELNET Protocol Specification", STD 8, RFC 854, USC/Information Services Institute, May 1983.

[2] VanBokkeln, J., "TELNET Terminal-Type Option" RFC 1091, FTP Software Inc., February 1989.

[3] Postel, J., and J. Reynolds, "TELNET Binary Transmission", STD 27, RFC 856, USC/Information Services Institute, May 1983.

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