NBSIR 84-2855

Proceedings of the Fifth LAN-Transport Workshop

Report of the Fifth Workshop for Local Area Network
Implementors of the NBS Specifications of the
International Standards Organization Transport
Class 4 Protocol

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Institute for Computer Sciences and Technology
Systems and Network Architecture Division
Washington, DC 20234

March 8 - 9, 1984

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ABSTRACT

The National Bureau of Standards Institute for Computer
Sciences and Technology (ICST) has prepared specifications
for the International Organization for Standardization's
(ISO) Class 4 Transport Protocol. At the request of a number
of companies, ICST organized a workshop series for implementors
of these specifications using local area networking technology.
The first workshop focused on implementation techniques and
strategies so that a multivendor demonstration of these
protocols can occur at a major computer conference in 1984
targeted for the NCC 1984. Primarily the details of CSMA/CD
and Transport Class 4 were discussed and parameters were
selected. A second workshop focused on token bus LANs and
file transfer applications to be run at the trageted 1984
demonstration. Agreements on the specifics of the file
transfer protocol were reached at the third workshop. The
fourth workshop covered futher refinements to the file transfer
protocol, testing procedures, and demonstration details.
This report documents the fifth workshop in the series of
LAN/Transport workshops. The fifth workshop defined the
File Transfer Protocol (FTP) testing schedule and minimum
vendors tests, and made minor adjustments to the FTP specification.

Keywords: communication protocols, computer networks, transport protocol,
file transfer protocol, local area networks.

SUMMARY

This report documents the fifth workshop of the LAN-Transport Workshop
series for implementors of the ICST specification of the ISO Class
4 Transport Protocol over IEEE 802 compatible LANs.

At the fifth workshop vendor dependent minimum FTP tests were
agreed to and an FTP schedule was set. All vendors agreed to
implement the FCOPY utility and supply disk space so that
they can participate in the FTP demonstrations. Refinements to the
file transfer protocol were approved and transport protocol testing
experiences were covered. It was announced that a news worthy
event for the business press would be held in the U.S. and ICL
would make a press release in Europe, both events will be in April.

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2. Opening Remarks

Dr. John Heafner opened the meeting and acted as chairman for Mr. Maris Graube who did not attend. The agenda was reviewed. An FTP test schedule and status report of transport testing was added and FTP problems and FTP differences were merged.

3. Sub-Group Status Reports

3.1 Mr. Ron Yara of Intel presented the CSMA/CD status report. In the CSMA/CD meeting of March 7 (also attended by GM), both the vendor for constructing the booth and the style of the booth at the NCC were selected. The style of the brochure was also selected; fifty thousand copies of the brochure will be printed. NCR is coordinating this effort. The logo will be reviewed by NCR and CRDS on April 2.

It was noted that the common cable could not run outside of the booths. A vendor could, however, act as a gateway and run a separate cable if desired. The separate cable would be the responsibility of the vendor.

3.2 Mr. Ed Deenihan of GM presented the token bus status report. The vendor testing schedule, shown as Attachment A, was presented as a proposed schedule. Vendors must test with NBS before testing with GM (Telenet encouraged). Confusion as to the number of required NBS test scenarios was clarified: There are 139 required transport protocol test scenarios and several optional ones. The complete list is given in Attachment B. The transport CR and CC were reviewed and it was decided to allow data in these PDUs. Hence, six tests were added to the 139 test set.

DEC will supply the reference FTP and IBM the reference MSG implementations.

At this point the question of who could be included in the press release was raised. The final determination was only those participating in the booth.

4. FTP Problems and Protocol Refinements

4.1 Ms. Pat Amaranth representing GM spoke on three topics: GM FTP agreements, open issues and DEC's replies to FTP implementations issues. John Heafner stated that if there are any changes to the existing FTP specification, a new document would have to be generated.

4.1 GM FTP Agreements

A copy of Attachment G "Current GM FTP Agreements" was made available to all attendees. These are agreements to make the FTP implementations on all machines easier. The following points were brought out in the ensuing discussion:

    o Only one TSAP id for FTP,
    o File type not in CC Transport PDU,
    o Only two file types,
    o FTP document is more current than Proceedings of the 4th LAN-
       Transport Workshop,

o   One FPDU is one TSDU - clarification of document not a change,
o   Text file types will have .TXT in filename,
o   Buffering is a local issue for TSDU interface does not require it
    DEC is buffering but should have enough memory to avoid problems.

It was agreed that items two through seven of Attachment C, would be adhered to by both groups. Logging (item number eight) was left as an option for the CSMA/CD group.

4.1.B   Open Issues

The error id, error code and diagnostic fields in the open, close and release are now mandatory and in the order presented. Success or warning are assumed to have worked properly. The diagnostic field may have a length code of zero.

The question of data in the T_DISC was debated. It was decided that transport will accept data in the T_DISC (not a protocol violation) but what it does with it is optional. The data, however, must be an ASCII string.

The error codes defined under the Error Header Item (p. 35 of FTP Final Report) overlap.   It will, therefore, be up to the implementor to find out what each means as debugging progresses.

It was agreed that the receipt of an F_CANCEL Request after issuing an F_CANCEL Request would be treated as a confirm (just as transport handles crossing T.DISC's).

The transport sequence space is assumed to be 31 bits but may be negotiated to seven bits. Participants will use the NBS not ISO specification. It has been agreed that 31-bit sequence space will be used in the demonstration. Implementation of the seven bit sequence space is only being provided for conformance to the specification.

4.1.C   DEC Replies to FTP Implementation Issues

All issues discussed are shown in Attachment D. There is a need to solicit questions from implementors, find answers to those questions and distribute results. Distribution will be through Jerry Linn of NBS (see section 11).

5.   NAPLPS Demo and Files

Mr. Kern Hardman of BCS described the NAPLPS demo (see Attachment E).

BCS will use the HP protocol implementations. The demo will be menu driven. The data base will be expanded to include all CSMA/CD vendors.

The database will be filled in with current (e.g., what is playing at the hotels) and graphic (e.g., maps) information. NAPLPS files will be retrieved from the system on which they are stored and displayed on the NAPLPS terminal. Each vendor's logo and one frame of company information can be displayed. The company information frame will be a statement already done by each vendor. The frame is limited to fifteen rows of eighty characters and is needed by April 2. Company information frames and logos should be sent to Mr. Kern Hardman, Boeing Computer Services, P.O. Box 24346, MS 7A-05, Seattle, WA 98124. DEC, Intel, ICL, and Honeywell volunteered to house the BCS and NBS frames.

The biggest problem envisioned was getting the data files on the appropriate hosts. BCS had a problem with added carriage return line feeds when they moved a NAPLPS file from one host to another. This should be cured by FCOPY (see section 6).

6. FCOPY

Mr. Allen Rochkind of Intel presented a solution to the file loading problem, the FCOPY utility. FCOPY, which would use FTP in read-mode, would provide the needed functionality to overcome incompatible media. It would work like the following (underlined are user supplied);

> FCOPY
>
> FTP File Copy Utility
> Remote File Owner Name: BCS
> FTP File Name: XYZ.Bin.BCS
> Local Pathname: /aw0/ncc/xyzbb

The file type would come from the FTP File Name. All CSMA/CD vendors agreed to implement FCOPY.

7. HIS Demo and Files

Mr. Bruce Carlson of Honeywell presented a preliminary proposed application (see Attachment F). The trivia quiz (e.g., sports, movies, history) would have each set of questions and answers on a different host.

The problem of the expanding number of file names that would appear, mostly unneeded, in a FILE.DIR was debated. The resolution was that FILE.DIR would supply all names and it is up to the requestor to display them.

ICL will implement the menu described at the Seattle meeting.

8. FTP Testing and Schedule

8.1 DEC FTP Implementation and Tools

Mr. Keven Miles of DEC described the status of two software packages; the FTP reference implementation and the Test PDU Sender (see Attachment G).

The FTP implementation comes with full logging, multiple concurrent transfers (multiple copies) and no write/create. The implementation is

due at GM on April 9. This is a conforming implementation and does not inject errors.

The Test PDU Sender can generate incorrect or out of order FPDUs with full logging. There are no scenario command files at present. DEC will make available whatever is used to test their FTP. Volunteers were solicited to expand this set. GM will coordinate the collection of scenarios and generate some. Ken Aird of HP will generate some scenarios (see Attachment H). Gould will also do some for state transitions including write create.

8.2 FTP Testing

Ms. Pat Amaranth described the GM FTP Testing Agreement (see Attachment I). The GM tape will be in TAR format.

A discussion of minimum FTP testing was resolved by vendors agreeing to meet various testing requirements. The testing requirements were:

1. send, receive and compare one file (to DEC and return),

2. send, receive and compare all files in agreed upon set, algorithms published by James Berets of BBN, "N" lines,

3. send, receive and compare GM file set "N" times,

4. ten concurrent connections of type 3,

5. Test PDU Sender.

The vendors agreed to do the following tests:

TYPE	VENDOR
1	Intel, Gould, ICL, NCR, HP, DEC, HIS, ACC
2	Intel, Gould, ICL, NCR, HP
3	Intel, Gould, ICL, NCR, HP, DEC, HIS
4	Intel, Gould, ICL, HP, DEC, HIS
5	Intel, Gould, ICL NCR, HP, DEC, HIS

An FTP test schedule, at NBS, was agreed to as follows:

April 16-20	DEC
May 7-11	HIS
May 14-18	ICL, NCR
May 21-25	Intel, HP, BCS
May 28-June 1	ACC/CRDS
June 4-8	Full System Tests
June 11-15	Full System Tests
June 18-22	Ship Out

When testing at NBS, vendors will be given a five meter cable which can then be connected to the long cable. Multiplexing of testing has worked out best.

9. Common Business

The press day scheduled for April 25 is cancelled. In its place a news
worthy event will be created by having the Secretary of Commerce, Malcolm
Baldrige, the Director of NBS, Ernest Ambler, the President of BCS, Mr.
Robert Dryden and a Vice President of General Motors sign agreements for
the NCC demo. ICL will issue a press release in Europe like the original
release after checking with NBS and after signing. Vendors who want to
make minor revisions should go through NBS for technical review. Mr.
Robert Blanc is the contact point.

10. Arbitration of Technical Points

NBS was selected as the focal point to arbitrate technical issues and
disseminate answers. Mr. Jerry Linn is the contact point for both
Transport and FTP. Telex is acceptable (Telex number 898493).

11. Transport Testing Experiences

11.1 HP

Mr. Ken Aird's major problems were porting the scenario interpreter and
addressing in the NISL. HP used a 3COM transceiver. The ICL monitor box
was useful but couldn't be used for master scenarios (run all scenarios).
Mr. Stephen Nightingale of NBS was specifically commended for providing
assistance.

11.2 Gould

Gould's major problem was getting TELENT link service. A line monitor
was useful to see that invalid PDU's came across when expected. Mr.
Jeff Gura of NBS was cited for outstanding service and being available
any hours needed.

Other vendors have completed transport testing with NBS, but did not
provide comments at the workshop.

VENDOR TESTING

	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY
IBM	N B S	HDLC 3-12 TRANSPORT	FTP MSG		FULL	N C C
DEC		N B S, HDLC 4-2 TRAN, FTP, MSG			MULTI -	J
MOTOROLA	N B S		HDLC 4-9 TRAN, FTP TEST DATE TO BE DEFINED		VENDOR	U L Y
HP		N B S	HDLC 4-16 TRAN, FTP, MSG		TESTING	9
GOULD		N B S	HDLC 4-23 TRAN, FTP, MSG			
A-B		N B S	HDLC 4-30 TRAN, MSG			

8

To: Bill Kauffman, G"
From: Jerry Linn, NBS

Subject: Update to your list of scenarios

Per our conversation, I have reviewed your list of required
scenarios. The footnotes indicate changes.

You had some scenarios missing -- those provided last fall
to you and the vendors replacing graceful close with disconnect.
We have been doing the tests as noted below. Those noted with
one or more asterisks indicate variance with either your original
list or that proposed by Stephen as required tests. Hopefully,
this will address any outstanding questions about "what is the
kernal set."

    Transport Scenarios to be Tested with NBS

                  Mar. 2, 1984

tc_4.1.104	tc_4.4.204	tc_4.5.011
tc_4.1.107	tc_4.4.300	tc_4.5.012
tc_4.1.109	tc_4.4.301	tc_4.5.013
tc_4.1.112	tc_4.4.302	tc_4.5.014
tc_4.1.118	tc_4.4.303	tc_4.5.015
tc_4.1.120	tc_4.4.304	tc_4.5.016
tc_4.1.251	tc_4.4.305	----------
tc_4.1.252	tc_4.4.306	tc_4.5.101 ***
tc_4.1.263	tc_4.4.311	tc_4.5.102 ***
tc_4.2.107 *	tc_4.4.312	tc_4.5.103
tc_4.2.108 *	tc_4.4.313	tc_4.5.104
tc_4.2.207 *	tc_4.4.500	----------
tc_4.2.208 *	tc_4.4.501	----------
tc_4.2.305 *	tc_4.4.502	tc_4.5.107
tc_4.2.306 *	tc_4.4.504	tc_4.5.108
tc_4.2.602 *	tc_4.4.505	tc_4.5.109
tc_4.2.603 *	tc_4.4.506	tc_4.5.110
tc_4.3.600 **	tc_4.4.507	tc_4.5.111
tc_4.3.601 **	tc_4.4.700	tc_4.5.112
tc_4.3.602 **	tc_4.4.701	tc_4.5.114
tc_4.3.603 **	tc_4.4.702	----------
tc_4.3.604 **	tc_4.4.704	----------
tc_4.3.605 **	tc_4.4.705	----------
tc_4.4.000	tc_4.4.706	tc_4.5.202 ***
tc_4.4.001	tc_4.4.707	tc_4.5.203
tc_4.4.002	tc_4.4.900	tc_4.5.204
tc_4.4.003	tc_4.4.901	tc_4.5.301 ***
tc_4.4.004	tc_4.4.902	tc_4.5.302 ***
tc_4.4.009	tc_4.4.903	tc_4.5.303
tc_4.4.010	tc_4.4.904	tc_4.5.304
tc_4.4.011	tc_4.4.905	tc_4.5.504
tc_4.4.012	tc_4.4.906	tc_4.5.706
tc_4.4.100	tc_4.4.911	tc_4.6.001
	tc_4.4.912	tc_4.6.002

```
      tc_4.4.101              tc_4.4.913              tc_4.6.203
      tc_4.4.102              tc_4.4.914              tc_4.6.204
      tc_4.4.103              tc_4.5.001    ***       tc_4.6.205
      tc_4.4.104              tc_4.5.002    ***       tc_4.6.206
      tc_4.4.105              tc_4.5.003              tc_4.6.207
      tc_4.4.110              tc_4.5.004              tc_4.6.208
      tc_4.4.111              tc_4.5.005              tc_4.6.209
      tc_4.4.112              tc_4.5.006              tc_4.6.211
      tc_4.4.113              tc_4.5.007              tc_4.6.212
      tc_4.4.200              tc_4.5.008              tc_4.6.216
      tc_4.4.201              tc_4.5.009              tc_4.6.217
      tc_4.4.202              tc_4.5.010              tc_4.6.218
      tc_4.4.203              ---------               tc_4.6.219
```

```
      *     optional -- deals with implementation issue
      **    optional -- data on DR TPDU (GM requirement)
      ***   optional -- change length indicator on TPDU:
                        results of test are not deterministic--
                        action of parser should be to discard NSDU
                        but it is not in the specification.
```

```
      Test missing from the list -- use disconnect rather than
                                graceful close

      tc_4.3.350            tc_4.3.351            tc_4.3.352
            353                  355                  356
            357                  358
      Note: tc_4.3.354 is deliberately ommitted

      also missing
      tc_4.5.105            tc_4.5.106   (variation of parameters)
```

```
      This list should not be considered as a set of "exhaustive tests";
      it is a "MINIMUM" which will demonstrate potential interoperability.
      Others may be added from time to time as needed.
```

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CURRENT GM FTP AGREEMENTS
MARCH 7, 1984

1.   Maximum file size will be limited to 8K octets.

2.   File content is limited to ASCII text characters.
     Each variable length line of text is terminated by
     a CRLF (ASCII carriage return, line feed pair). A
     single line of text is 2 to 82 octets in length (0
     - 80 text chars + CRLF).

3.   A file may be transmitted as one or more FDATA
     requests.

4.   Each FDATA request contains an arbitrary partition
     of the complete file data and may contain multiple
     or partial text lines.

5.   Each FDATA request becomes a single FDR PDU sent as
     a TDATA request.

6.   Only one file read should be done for each file
     connection.

7.   Filenames for FSELECT PDUs and local FILEDIRs are
     in the format: filetitle.filetype.fileowner (eg.
     FABLE.TXT.MOT)

8.   Each vendor will keep an FTP LOG of connects (CR
     and CC) and disconnects with reason code

DEC REFERENCE REPLIES TO FTP IMPLEMENTATION QUESTIONS

Q: Will the reference support more than one concurrent
FTP incoming and/or outgoing connection?

Yes, but not multiplexed within the FTP code.

Q: Will the reference be using FTP response timers in
addition to event timers provided in Transport?

If we have time we may implement timers.

Q: What is the reference behavior if a filename other
than the filename specified in the FSELECT is
returned in the FSELECT confirm? Is this an error
resulting in an FABORT, does it result in an
FDESELECT and retry, or is it not an error detected
by the protocol machine?

The reference implementation will ignore this condition, and will not generate
this condition. In any case, I would not regard this as an error since the
returned name may the the full filename, e.g., after defaults have been
applied.

Q: Is it an error to select a file that does exist but
is not contained in the local FILEDIR? (see clause
6.1.1 of the GM agreements document for description
of FILEDIR)

The reference implementation will not generate an error for this.

Q: re: INTEL's "NOTE ABOUT IMPLEMENTING MULTIVENDOR
FTP"; January 3, 1984 Does the reference intend to
send DT TPDU's with EOT? Does it expect to receive
only DT TPDU's with EOT? If not, in the case where
an FDR PDU is sent as a series of DT TPDU's, will
only the first DT TPDU be expected to have an FPDU
header or will all of the DT TPDU's have an FPDU
header inserted as in INTEL's description?

I havn't seen Intel's document. However, segmentation of TSDUs is a Transport
Protocol issue and is NOT a Transport Service issue. The Transport Service
provides for the transfer of complete TSDUs. An FDR PDU is a complete TSDU.
The fact that a complete TSDU may be transferred as a number of separate TPDUs
should not normally be reflected at the Service interface. Thus, if an FPDU is
transferred as a number of DT TPDUs, the responder should only see the arrival
of the concatenated FPDU. However, this depends upon the Transport
implementation at the responder.

Q: How many times will the reference retry
establishing a connection?

The File Transfer Protocol does not include retries. Thus, it will try once.
The Transport Service will send up to 4 CRs before it gives up.

HONEYWELL

~~PROPOSED~~
APPLICATION

NBS / NCC MULTI VENDOR DEMONSTRATION

PRELIMINARY

SUBJECT
TO
CHANGE

MENU: 1. DEMO EXPLANATION
          2. LIST OF FILES @ ANOTHER SYSTEM
          3. DISPLAY FILE ___ FROM ___
          4. CREATE FILE
          5. QUIZ / TRIVIA

          File Display

REMOTE "READ" REPORTS, e.g.
'SENDING FILE ___ TO DEC DISPLAY, HH:MM:SS

QUIZ   MENU
SUBJECTS:

     1. SPORTS TRIVIA   - QUESTIONS FROM
                          DEC
     2. MOVIES TRIVIA   - Q's FROM HP
     3. HISTORY TRIVIA - Q's FROM INTEL
          : etc

SPORTS TRIVIA: QUESTION FROM
   Q: _____   DEC SYSTEM.
      ~~~~~~~~
      ~~~~~~~~
      ~~~~~~~~

ANSWER FROM ICL SYSTEM
HIT (CR) WHEN READY FOR ANSWER.

Need to: — Identify other Vendors who will
              store Qs + As

           — Arrange to "Transfer" files to
              Vendor's

                  QUIZ-01. TXT. ???
                  ANSW01. TXT. ???

    ⟹ — "Blind" ? (non-filedir) files.

14

MULTI-VENDOR DEMONSTRATION FILE TRANSFER PROTOCOL

TEST PROTOCOL DATA UNIT SENDER

1.0 INTRODUCTION

The Test PDU Sender (TPS) is a program that sends and receives FPDUs to and from a remote FTP implementation. An Event Logger is used to log all Transport events and data received and transmitted. For testing purposes TPS can be instructed to send many types of invalid FPDU.

TPS is designed to emulate a FTP implementation, and is transparent to the FTP implementation being tested. The significant difference between TPS and FTP is that TPS sends and expects to receive a pre-determined sequence of FPDUs and it aborts the connection if the received FPDUs are not what was expected.

2.0 GENERAL DESCRIPTION

TPS is a substitute for the FTP Responder or Initiator. It runs on a
Digital Equipment Corporation VAX computer system under the VAX/VMS
operating system. The VAX computer is connected to the Local Area
Network (LAN) via appropriate hardware.

TPS is run by issuing a DCL (Digital Command Language) command to the
VAX system.   When running as the FTP Responder the command is issued
by a DCL command procedure which is invoked by the OSI Transport
implementation.   The DCL command to run TPS is described in section
2.1 of this document.

TPS operates with an Event and Data Logger and communicates directly
with the OSI Transport implementation to send and receive FPDUs.
Commands to control transmission and reception of FPDUs are stored in
a file called the Scenario Command file. The commands used in the
Scenario Command File are described in section 2.2 of this document.

The Scenario Command File is accessed either by a name supplied by the
command to run TPS or, if no name is specified, from the same source
as the command was issued from.

Transport events and all received and transmitted FPDUs are logged to
a Logfile.   In the Logfile FPDUs are formatted into the fields that
they contain and are analyzed for some types of error. Bad FPDUs are
flagged in the Logfile and their contents are printed in hexadecimal
for further analysis.

The Logfile is accessed either by a name supplied with the command to
run TPS or, if no name was specified, it is written to the terminal or
batch log for the job that issued the command.

2.1 DCL Command For TPS

Invokes the Test PDU Sender (TPS).

TPS runs until either the end of the Scenario Command File is
encountered, or, when executing a scenario, an error is detected. If
a Transport Connection is established by the scenario and it has not
been disconnected when TPS has completed the scenario or the error is
detected, an implicit DISCONNECT command (see section 2.2.2) is issued
to release the Transport Connection.

Format:

        TPS [file-spec]

        Command Qualifiers   Defaults

        /LOG[=file-spec]   (see text)
        /[NO]EXECUTE   /EXECUTE
        /[NO]TIMEOUT[=value]   /TIMEOUT=15

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Command Parameters:

file-spec

> Specifies the scenario command file to be executed. If not
> specified the scenario commands are read from SYS$INPUT: (by
> default this is either the terminal or the DCL command procedure
> that issued the TPS command). If the file specification does not
> contain a file type, TPS uses a default file type of COM.

Command Qualifiers:

/LOG[=file-spec]

> Specifies the file the FTP log output is to be sent to. If this
> qualifier is not specified the log output is written to
> SYS$OUTPUT: (by default this is the terminal or batch log of the
> job that issued the TPS command). If you omit the file
> specification, TPS gives the log file the same file name as the
> scenario command file and a file type of LOG.

/EXECUTE
/NOEXECUTE

> Controls whether the scenario commands are executed or only a
> syntax check of the scenario commands is made. By default the
> scenario is executed. If the commands are being executed a bad
> command will terminate the scenario. If only a syntax check is
> being carried out, bad commands will be flagged and processing
> the scenario will continue.

/TIMEOUT[=value]
/NOTIMEOUT

> Specifies a timeout to be applied to all network read (receive)
> operations. The value is given in seconds. If /NOTIMEOUT is
> specified, the timeout period is infinite. The default timeout
> period is 15 seconds. The /TIMEOUT qualifier is ignored if the
> /NOEXECUTE qualifier is specified.

Examples:

> 1. $ TPS
>
>   Execute the scenario which is read from the same source as
>   the command is issued from. The log file is written to the
>   terminal or batch log of the job that issued the TPS command.
>   The default timeout of 15 seconds is applied to all network
>   read operations.

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2. $ TPS/NOEXECUTE TEST1/LOG

     Performs a syntax check of the scenario file TEST1.COM,
     writing the log to TEST1.LOG. As no network read operations
     are performed, no timeout is applied to anything.

3. $ TPS/TIMEOUT=2/LOG=FTPLOG.DAT TEST1

     Execute the scenario command file TEST1.COM, writing the log
     to FTPLOG.DAT. A timeout of 2 seconds is applied to network
     read operations.

2.2 TPS Scenario Commands

The Test PDU Sender uses a series of scenario commands to control its
operation. These commands are described in this section. The
commands are stored in a file.

Each command consists of keywords and parameter values which are
separated by one or more spaces or tabs. Commands may be continued
over multiple lines by placing a hyphen as the last non-comment
character on the line to be continued.

An exclamation point (!) is used to designate a comment. A comment
extends from the exclamation point to the end of the line. A comment
cannot be continued on to the next line. Comments may also be placed
at the end of a line after a command (or part of a continued command).

Command names and keywords may be abbreviated to the fewest unique
letters. Also some keywords may be left out. In the command
descriptions these words are enclosed by brackets ([]).

Certain parameter values are specified as quoted strings. These
strings may be quoted with either apostrophes (') or quotation marks
("), but the starting and ending quotes must match. A quoted string
may not be continued over more than one line of the scenario command
file.

Scenario command files may contain as many blank lines as required
between commands for formatting purposes. Also any Form Feed
characters at the beginning of a line are discarded.

2.2.1 Connect To Remote FTP

Establishes a transport connection to a remote FTP implementation. No FPDUs are transmitted.

Format:

CONNECT remote-id   PDU [SIZE] max-pdu-size

remote-id   Identification   of   the   remote   FTP
                           implementation   the   connection   is to be made
                           to.   It is specified as a string.   The   format
                           is *TBS*.

PDU [SIZE] max-pdu-size   Specifies the maximum length of an FPDU to be
                           transmitted   over   this   connection.   It   is
                           specified as a decimal number greater than 10.
                           The default value is 256.

2.2.2 Disconnect From Remote FTP

Disconnects the transport connection to a remote FTP implementation.
No FPDUs are transmitted.

Format:

DISCONNECT

2.2.3   Send FPDUs To The Remote FTP

Builds a FPDU and transmits it to the remote FTP. If data is to be
transmitted, multiple FPDUs may be transmitted, depending on the
amount of data to be sent, and the maximum PDU size set up with the
CONNECT command.

The send command allows any header fields to be transmitted in any
type of PDU. This facility is provided in order that invalid PDUs may
be transmitted. The header fields are placed in the header in the
order in which they were specified in the command.

If data is transmitted in a PDU and the data type id is specified as
ASCII text;   the data consists of the ASCII code sequence from "!"
through "~", and is offset one character into the sequence after every
<CR><LF> pair. If the data type id is any other, the data consists of
octets containing the values 0 through 255 decimal, and is offset one
octet into the sequence in every consecutive PDU. Both these
sequences are repeated if the end of the sequence is reached.

Format:

SEND   pdu-type-id   SERVICE [SUBSET] service-subset-id
                            FILENAME filename
                            ERROR error-id
                            ERROR TYPE error-type-id
                            DIAGNOSTIC [STRING] diag-string
                            DATA TYPE data-type-id
                            DATA data-octet-count   DATA LENGTH data-length

pdu-type-id   Defines the PDU-type id in the header of the
                            PDU to be transmitted. It is specified as one
                            of the following strings or as a decimal
                            number in the range 0 to 255.

                                  FCR   file connect request
                                  FCC   file connect confirm
                                  FRLR   file release request
                                  FRLC   file release confirm
                                  FSR   file select request
                                  FSC   file select confirm
                                  FDSR   file deselect request
                                  FDSC   file deselect confirm
                                  FOR   file open request
                                  FOC   file open confirm
                                  FCLR   file close request
                                  FCLC   file close confirm
                                  FRR   file read request
                                  FRC   file read confirm
                                  FDR   file data request
                                  FDER   file data end request
                                  FTER   file transfer end request

FTEC	file transfer end confirm
FCANR	file cancel request
FCANC	file cancel confirm
FWR	file write request
FWC	file write confirm
FCRR	file create request
FCRC	file create confirm

SERVICE [SUBSET]
service-subset-id

Specifies the subset service id in the service subset header item. It is specified as a decimal number in the range 0 to 15.

FILENAME filename

Specifies the filename string in the filename header item. It is specified as a quoted string.

ERROR TYPE
error-type-id

Specifies the error type id in the error type header item. It is specified as a decimal number in the range 0 to 15.

ERROR error-id

Specifies the error id in the error header item. It is specified as a decimal number in the range 0 to 15.

DIAGNOSTIC [STRING]
diag-string

Specifies the diagnostic string in the diagnostic string header item. It is specified as a quoted string.

DATA TYPE
data-type-id

Specifies the data type id in the data type header item. It is specified as a decimal number in the range 176 to 191. The following values are defined:

176	ASCII text
191	binary data

any other values are interpreted as specifying binary data. The default value is ASCII text.

DATA data-octet-count

Specifies that data is to be transferred in this PDU. It is specified as a decimal number in the range 1 to 65535. If the specified number of octets cannot be transferred in one PDU, multiple PDUs are transmitted. The data transmitted is generated internally and depends on the data type being transmitted.

DATA LENGTH
data-length

Specifies the length of the data field in the individual FPDUs transmitted. TPS will attempt to put data-length octets of user data into each FPDU. Less data will be put in the FPDU if either the maximum FPDU size specified in the CONNECT command (see section 2.2.1) would be exceeded, or more data than that specified by data-octet-count would be transmitted. IF the data type for the FPDU is ASCII text, then a <CR><LF> pair is inserted

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at the end of the data in each FPDU after data-length octets of text data. It is specified as a decimal number greater than or equal to 1.

2.2.4   Receive FPDUs From The Remote FTP

Receives the next FPDU and checks its pdu-type-id, or receives FDR
FPDUs until the next FPDU received has a specified pdu-type-id.

Format:

RECEIVE pdu-type-id-1   UNTIL pdu-type-id-2

pdu-type-id-1   Defines the PDU-type id of the PDU to be
                            received. If the PDU is not of the specified
                            type the scenario is terminated and an
                            implicit DISCONNECT is performed. It is
                            specified as one of the following strings or
                            as a decimal number in the range 0 to 255.

                                FCR   file connect request
                                FCC   file connect confirm
                                FRLR   file release request
                                FRLC   file release confirm
                                FSR   file select request
                                FSC   file select confirm
                                FDSR   file deselect request
                                FDSC   file deselect confirm
                                FOR   file open request
                                FOC   file open confirm
                                FCLR   file close request
                                FCLC   file close confirm
                                FRR   file read request
                                FRC   file read confirm
                                FDR   file data request
                                FDER   file data end request
                                FTER   file transfer end request
                                FTEC   file transfer end confirm
                                FCANR   file cancel request
                                FCANC   file cancel confirm
                                FWR   file write request
                                FWC   file write confirm
                                FCRR   file create request
                                FCRC   file create confirm

UNTIL pdu-type-id-2   Specifies that PDUs of pdu-type-id-1 are to be
                            received until a PDU with a PDU type id of
                            pdu-type-id-2 is received. If the PDU
                            received is neither type the scenario is
                            terminated and an implicit DISCONNECT is
                            performed. It is specified either as a string
                            or a decimal number in the range 0 to 255.
                            See above for the possible PDU-type id names.

2.2.4.1   Example Scenario Command File

```
!
! FTP Responder Test  (TPS runs as FTP Initiator)
!
! This scenario command file first sets up a transport
! connection, then selects, opens and reads the file TEST.
! When the transfer is complete the file is closed and
! deselected and finally the transport connection is
! disconnected.
!

CONNECT TESTNODE -        ! Establish Transport Connection to
           -             !  TESTNODE and use a
        PDU SIZE 384     !  maximum PDU size of 384 octets.

SEND FCR SERVICE 1       ! File Connect Request - service
                         !  subset code is 1 (file transfer)

RECEIVE FCC              ! File Connect Confirm

SEND FSR -               ! File Select Request
        FILENAME "TEST"  !  filename is TEST

RECEIVE FSC              ! File Select Confirm
SEND FOR                 ! File Open Request
RECEIVE FOC              ! File Open Confirm
SEND FRR                 ! File Read Request
RECEIVE FRC              ! File Read Confirm

RECEIVE FDR UNTIL FDER   ! Receive FDR PDUs up to and including
                         !  a FDER PDU (File Data End Request).

SEND FTER -              ! File Transfer End Request
        ERROR TYPE 0 -   !  Error Type = 0 - Success
        ERROR 0 -        !  Error = 0 - Success
        DIAG STRING ""   !  Null Diagnostic String

RECEIVE FTEC             ! File Transfer End Confirm
SEND FCLR                ! File Close Request
RECEIVE FCLC             ! File Close Confirm
SEND FDSR                ! File Deselect Request
RECEIVE FDSC             ! File Deselect Confirm
SEND FRLR                ! File Release Request
RECEIVE FRLC             ! File Release Confirm
DISCONNECT               ! Release Transport Connection
!
! End of example scenario
!
```

[End of description]

FTP Test Scenarios

1. State transition tests
   extended service set negotiation
   out of order PDUs
   cancels

2. Invalid PDUs
   Duplicate parameter
   Missing parameter
   Illegal parameter
   Out of order "
   Bad parameter encoding
   Bytes reversed

3. Boundary testing

4. Crash testing
   FTP hangs without losing transport connection

5. Error testing
   send all possible error codes
   cause errors in system under test

FTP TESTING

GM vendors have agreed to the testing outline prepared by Jim Berets of BBN and distributed as Annex D of the MULTIVENDOR DEMONSTRATION FILE TRANSFER PROTOCOL FINAL REPORT REVISED, December 1983, with the following modifications:

1. Section 1 - Tests of Normal Operation
   Test 1 - "Transfer file between like machines" offsite before coming on-site at GM.

2. Test 2 - "Transfer file between different machines" Steps 3 and 4 "Comparison" will be accomplished in the following manner.

   - GM will distribute test file tape

   - vendor --> ref test: DEC reference will request the test file suite and compare against its copy of the test masters.

   - ref --> vendor test: DEC reference will transmit the test file suite. Testing vendor will compare against its local copy of the test masters.

   - Above tests will be repeated for a specified number of trials.

3. Section 3 - Tests of Robustness will be accomplished with the error-injecting facilities provided by the DEC reference implementation.

4. A multi-vendor "full loading" test period will be added to simulate NCC conditions.

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10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant
bibliography or literature survey, mention it here)

The National Bureau of Standards Institute for Computer Sciences and Technology (ICST)
has prepared specifications for the International Organization for Standardization's
(ISO) Class 4 Transport Protocol. At the request of a number of companies, ICST orga-
nized a workshop series for implementors of these specifications using local area
networking technology. The first workshop focused on implementation techniques and
strategies so that a multivendor demonstration of these protocols can occur at a major
computer conference in 1984 targeted for the NCC 1984. Primarily the details of CSMA/CD
and Transport Class 4 were discussed and parameters were selected. A second workshop
focused on token bus LANs and file transfer applications to be run at the targeted 1984
demonstration. Agreements on the specifics of the file transfer protocol were reached at
the third workshop. The fourth workshop covered further refinements to the file transfer
protocol, testing procedures, and demonstration details. This report documents the fifth
workshop in the series of LAN/Transport workshops. The fifth workshop defined the File
Transfer Protocol (FTP) testing schedule and minimum vendors tests, made minor adjust-
ments to the FTP and reached agreements on participation in the HIS and BCS demonstra-
tions.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

communication protocols; computer networks; file transfer protocol; local area
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