The Consultative Committee for Space Data Systems

CCSDS FILE DELIVERY PROTOCOL (CFDP)—

NOTEBOOK OF COMMON INTER-AGENCY TESTS FOR CORE PROCEDURES

CCSDS RECORD

CCSDS 720.4-Y-1

YELLOW BOOK

September 2007

The Consultative Committee for Space Data Systems

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1 INTRODUCTION

1.1 PURPOSE

This document is a notebook intended to help those planning, participating in, and/or evaluating inter-Agency testing of the CFDP Protocol. It is a 'living' document and will be updated, modified, and reissued as needed.

The CFDP testing program has four distinct purposes. These are:

- to verify the correctness of the protocol specification by creating multiple implementations according to that specification and thoroughly testing those implementations;
- to provide measurements of the performance of the protocol and the resources required by the protocol from its hosting system, including the size of the software implementations;
- to demonstrate the interoperability of independent implementations by inter-implementation testing; and
- to make available the tested implementations as reference implementations for the use of projects and programs which wish to use the CFDP.

1.2 SCOPE

This document is not a part of any CCSDS Recommended Standard.

1.3 ORGANIZATION OF THIS REPORT

This notebook is divided into three parts. Section 1 (this section) presents the purpose and organization of the notebook. Section 2 is a short overview of the Test Series and the place of the series in an overall testing program. Section 3 contains the descriptions of each of the functional Test Series, including the objective, configuration, and procedures.

1.4 REFERENCES

[1] *CCSDS File Delivery Protocol (CFDP)—Part 2: Implementers Guide*. Report Concerning Space Data System Standards, CCSDS 720.2-G-3. Green Book. Issue 3. Washington, D.C.: CCSDS, April 2007.

2 OVERVIEW

2.1 THE OVERALL PLACE OF THESE TESTS

The Test Series in this document are suggested for initial inter-Agency compatibility testing of implementations of the CFDP. The tests described in this document are intended to be a part of a progressive set of tests, proceeding from initial internal software development testing to whatever level of testing is appropriate for the intended use of the implementations. An example of such a progression of tests is shown in figure 2-1.

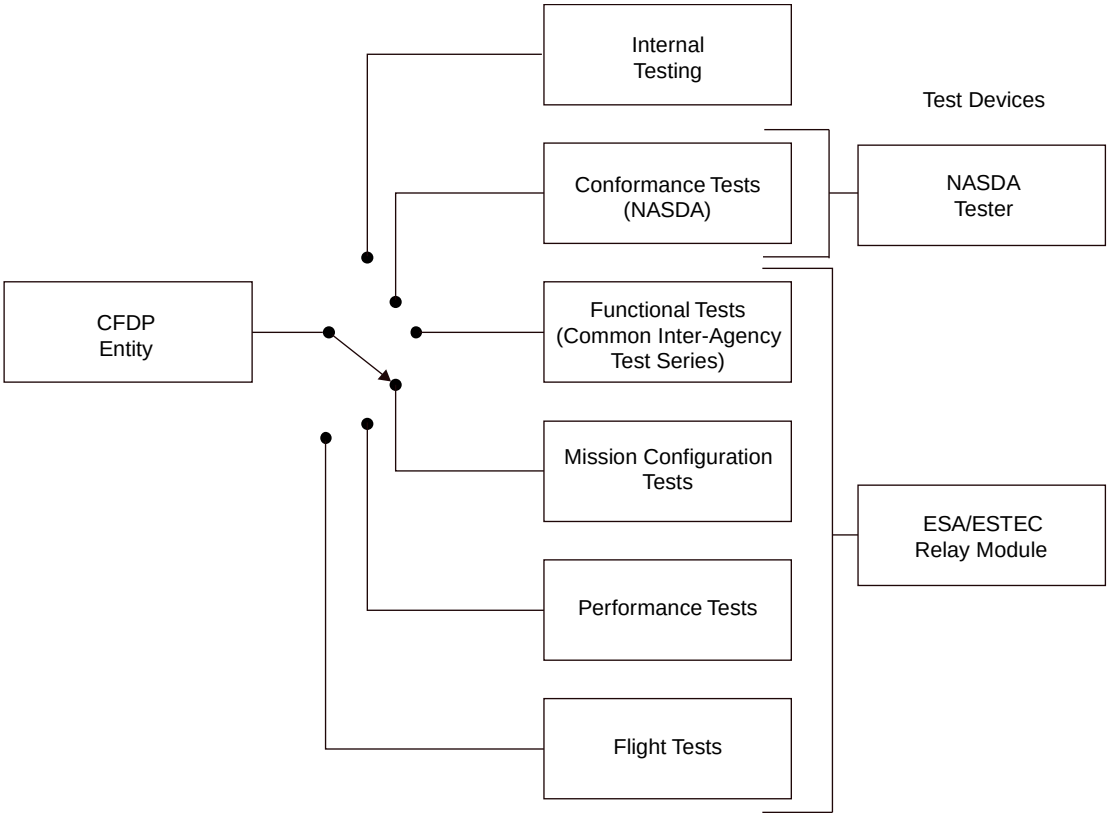

Figure 2-1: Testing Progression

The tests described in this document are not totally comprehensive and are not conformance tests. However, they do test the various procedures and options of the CFDP and provide a set of performance measurements of the interoperating implementations. This establishes a high level of confidence in interoperability for follow-on testing specifically oriented toward the planned application.

Testing aids are available to implementers, including this document, a Conformance Tester and associated tests scripts contributed by NASDA/NEC, and testing software, called a 'Relay Module', contributed by ESA/ESTEC. The latter is a general purpose CFDP testing item that is especially useful in executing the tests described in this document.

Figure 2-2: CFDP Operations View—Things to be Tested

2.2 TEST SERIES OVERVIEW

The primary purpose of the Functional Test Series is to provide a high level of confidence that the two separately developed implementations under test will interoperate correctly.

Test Series F1 is simple in order to expedite testing and to establish a confidence baseline for Series F2 tests, which initiate thorough checking of protocol procedures. Demonstrations are made of Unacknowledged and Acknowledged modes, of canceling an ongoing transaction, and of user messages. These tests are in CFDP Service Classes 1 and 2. They are examples of the original requirements defining Scenario 1 (see reference [1], CFDP Green Book Part 2).

Test Series F2 initiates thorough checking of protocol procedures of the Acknowledged mode, including automatic recovery from dropping of the metadata PDU, of each of the positively acknowledged PDUs (EOF and Finished), of the positive acknowledgements to those PDUs, as well as simulation of an extremely noisy link in which every PDU in each direction is dropped once, and simulation of a fault. These tests are in CFDP Service Class 2. They are examples of the original requirements defining Scenario 1 (see reference [1], CFDP Green Book Part 2).

Test Series F3 demonstrates the functioning of the two party Remote Put (Proxy) functions, which acts as a 'Get', and the operation of the Filestore Procedures and of the Directory Listing Request. Each file store directive is exercised. These tests are in CFDP Service Class 2. They are examples of the original requirements defining Scenario 1 (see reference [1], CFDP Green Book Part 2).

Test Series F4 demonstrates the operation of each of the options not demonstrated in a previous Test Series. (Options between an Entity and its User are not tested as they are not interoperability issues.) These tests are in CFDP Service Class 2. They are examples of the original requirements defining Scenario 1 (see reference [1], CFDP Green Book Part 2).

Test Series F5 demonstrates the functioning of the three party Remote Put (Proxy) functions. These tests are in CFDP Service Class 3. They are examples of the original requirements defining Scenario 2 (see reference [1], CFDP Green Book Part 2).

The CFDP Functional Test Series versus CFDP Service Class is shown in table 2-1.

Table 2-1: Functional Test Series versus Service Class

CFDP Functional Test Series	CFDP Service Class(es) Exercised
F1	1-Unreliable Transfer, and 2-Reliable Transfer
F2	2-Reliable Transfer
F3	2-Reliable Transfer
F4	2-Reliable Transfer
F5	3-Reliable Transfer by Proxy (three party)

A matrix showing the Test Series and Segments by functions tested is shown in table 2-2.

Table 2-2: Functional Test Series versus Tested Functions

CFDP Core Procedures Interoperability Tests	Test Series Segment Number	One Way (Unreliable)	Two Way (Reliable)	Recovery from lost PDU	Deferred NAK mode	Immediate NAK mode	Prompted NAK mode	Asynchronous NAK mode
	TEST SERIES F1							
Single File Data PDU	**1**	X						
Multiple File Data PDUs	**2, 3**	X	X		X			
File data PDU loss	**4**		X	X	X			
Duplicate data	**5**		X		X			
Out of order data	**6**		X		X			
User messages	**7**		X		X			
Cancel sender initiated	**8**		X		X			
Cancel receiver initiated	**9**		X		X			
Cancel sender initiated	**10**	X						
	TEST SERIES F2							
Metadata PDU	**1**		X	X	X			
EOF PDU	**2**		X	X	X			
Finished PDU	**3**		X	X	X			
ACK (EOF) PDU	**4**		X	X	X			
ACK (Finished) PDU	**5**		X	X	X			
Extremely noisy environment	**6**		X	X	X			
ACK Limit Reached	**7**		X	X	X			
NAK Limit Reached	**8**		X	X	X			
Inactivity Timer at sender	**9**		X	X	X			
Inactivity Timer at receiver	**10**		X	X	X			
	TEST SERIES F3							
Two party Remote Put	**1**		X		X			
Create File directive	**2**		X		X			
Delete File directive	**3**		X		X			
Rename File directive	**4**		X		X			
Append File directive	**5**		X		X			

Replace File directive	**6**	X		X				
Create Directory directive	**7**	X		X				
Remove Directory directive	**8**	X		X				
Deny File Directive	**9**	X		X				
Directory Listing Request	**10**	X		X				
	TEST SERIES F4							
Deferred NAK mode	**1**	X	X	X				
Immediate NAK mode	**2**	X	X		X			
Prompted NAK mode	**3**	X	X			X		
Asynchronous NAK mode	**4**	X	X					X
Segmentation Control (record boundaries observed)	**5**	X		X				
No Segmentation Control (record boundaries not observed).	**6**	X		X				
Sender initiated Suspend and Resume	**7**	X		X				
Receiver initiated Suspend and Resume	**8**	X		X				
Unbounded file type	**9**	X		X				
File Data PDU CRC mode	**10**	X	X	X				
Keep Alive function	**11**	X		X				
Prompt (Keep Alive)	**12**	X		X				
Multiple Open Transactions (clean)	**13**	X		X				
Multiple Open Transactions (w/ data loss)	**14**	X	X	X				

	TEST SERIES F5		
Remote Put Order (2 Party)	**1**	**X**	**X**
Remote Put Cancel	**2**	**X**	**X**
Remote Fault Handler Override, Remote Transmission Mode, Remote Flow Label, and Remote Segmentation Control	**3**	**X**	**X**
Remote Message to User	**4**	**X**	**X**
Remote File Store Request	**5**	**X**	**X**
Remote Status Report Request	**6**	**X**	**X**
Remote Suspend/Resume	**7**	**X**	**X**
Exercise three party Remote Put (Proxy) operation	**8**	X	X

3 INTER-AGENCY FUNCTIONAL TEST SERIES

Default settings of Protocol Options are as shown in ***bold italic*** in the following table. When a test or subtest requires a deviation from one or more of the default settings, the different setting is noted in the test description.

Table 3-1: Interoperability Options

Put Modes	**Effect**
UnACK	Selects Unreliable mode of operation
NAK	***Selects Reliable mode of operation***
Put NAK Modes	**Effect**
Deferred	***NAK is sent when EOF is received.***
Immediate	NAKs are sent as soon as missing data is detected.
Prompted	NAK is sent when a Prompt (NAK) is received
Asynchronous	NAK is sent upon a local (implementation specific) trigger at the receiving entity
Put PDU CRC	**Effect**
True	Requires that a CRC be calculated and inserted into each File Data PDU.
False	***No CRC is inserted in File Data PDUs.***
Put File Types	**Effect**
Bounded	***Sends a normal file, i.e., one in which the file is completely known before transmission.***
Unbounded	Sends a file the length of which is not known when transmission is initiated (intended primarily for real-time data).
Segmentation Control	**Effect**
Yes	Causes each File Data PDU to begin at a record boundary.
No	***Ignores record structure when building PDUs.***

Note that testing of the timers and counters is a local matter. However settings of the timers and counters must be appropriate in order to attain successful interoperations testing.

Suggested settings for the ACK and Inactivity Timers are shown in table 3-2. These settings assume that the entities are connected in a manner in which the one way light time delay is essentially zero (as via a LAN) and that the link rate is in the region of 10 Kb/sec to 1 Mb/sec. If the links used in a test operate significantly differently (e.g., via the Internet) it may be necessary to adjust the Timer settings appropriately. These settings are not optimal and should not be used either operationally or for protocol performance tests. They are simply a convenience for these functional tests.

Table 3-2: Timers

TIMER NAME	Setting (seconds)
NAK Retry Timer	For file sizes up to 300 Kbytes – 25 For file sizes from 300 Kbytes to 1 Mbyte – 45 For file sizes from 1 Mbyte to 2 Mbytes – 90
ACK Retry Timer	2
Inactivity Timer	60

Table 3-3: Counters

COUNTER NAME	Counter Limit
NAK Timer Expiration Limit	5
ACK Timer Expiration Limit	3

The following options affect the *local* behavior of a CFDP entity and therefore are not a part of interoperability testing. If an implementer wishes to test these options it is suggested that it be done as a local matter during the execution of the interoperability tests, or as separate tests outside the scope of the interoperability tests.

Table 3-4: Local Options

Action on Detection of a Fault	**Effect**
Cancel	Cancels subject transaction.
Suspend	Suspends subject transaction.
Ignore	Ignores error (but sends Fault.indication to local user).
Abandon	***Abandons transaction with no further action.***
Put Primitives (Receiving End)	**Effect**
EOF-sent.ind	Indicates to User at source entity that the EOF for the identified transaction was sent.
Transaction-finished.ind	Mandatory at source entity, optional at destination entity.
File-segment-receive.ind	Indicates to the user at destination entity that a File Data PDU has been received.
Action on Cancel At Receiving End	**Effect**
Discard data	Discards all data received in the transaction.
Forward incomplete	Forwards all data received to the local destination.
Put Report Modes (Sending End)	**Effect**
Prompted Rpt	Returns report on Prompt from local user.
Periodic	Returns report to local user at specified intervals.
Release of Retransmission Buffers	**Effect**
Incremental and Immediate	Releases local retransmission buffer as soon as sent.
In total When 'Finished' Received	Releases local retransmission buffer only when Finished PDU is received.
Suspended.indication	**Effect**
True	Issues Suspend.indication to local user on Notice of Suspension of a file transmission procedure.
False	No action.
Resumed.indication	**Effect**
True	Issues Resume.indication to local user in response to Resume.request**.**
False	No action.

3.1 TEST SERIES F1

3.1.1 OBJECTIVE OF TEST

This first Test Series is simple in order to expedite testing and to establish a confidence baseline for Series F2 tests, which initiate thorough checking of protocol procedures. Demonstrations are made of Unacknowledged and Acknowledged modes, of canceling an ongoing transaction, and of user messages.

3.1.2 TEST PARTICIPANTS

AGENCY A

AGENCY B

3.1.3 TEST DESCRIPTION

In the File Size column, ‘S’ designates a short file with a file length equal to 20 bytes (therefore requiring only a single File Data PDU). ‘M’ designates a medium file with a file length of 50 Kbytes, and ‘L’ designates a long file with a file length of 5000 Kbytes. Note that the actual file lengths used in the Test Segments are not of great importance in themselves, except where specifically noted (as in the single File Data PDU test). The file lengths should, however, provide a reasonable number of File Data PDUs, perhaps greater than 200. Other than that, file lengths appropriate and convenient for the data rates used in the tests should be selected.

Default settings of Protocol Options are as shown in bold italic in table 3-1. When a test or subtest requires a deviation from one or more of the default settings, the different setting is noted in the appropriate Test Series Segment table.

Table 3-5: Test Series 1 Segments

Seg. Nmbr	Purpose	Mode	File size	File data loss	Cancel	Notes
1	Establish one-way connectivity	Unacknowledged	S	0		Single File Data PDU
2	Exercise multiple File Data PDUs	Unacknowledged	M	0		
3	Establish two-way connectivity and establish performance baseline	Acknowledged	M	0		
4	Check recovery of dropped data	Acknowledged	M	~1% of data dropped		
5	Check deletion of duplicate data	Acknowledged	M	~1% of data duplicated		
6	Check reordering of data	Acknowledged	M	~1% of data out of order		
7	Check user (application) messages functioning	Acknowledged	Zero	0		Two Messages to User in Metadata
8	Check cancel functioning	Acknowledged	M	0	Sender initiated approximately mid-file	
9	Check cancel functioning	Acknowledged	M	0	Receiver initiated approximately mid-file	
10	Check cancel functioning	Unacknowledged	M	0	Sender initiated approximately mid-file	

3.1.4 TEST PROCEDURE

For each subtest execute all Test Segments with test setup configured as shown in table 3-6.

Table 3-6: Test Series F1 Subtests

Subtest	Execute Test Segments From	Execute Test Segments To	Notes
F1.1	Agency A Entity	Agency B Entity	
F1.2	Agency B Entity	Agency A Entity	

3.1.5 TEST RESULTS

3.2 TEST SERIES F2

3.2.1 OBJECTIVE OF TEST

The second Test Series initiates thorough checking of protocol procedures of the Acknowledged mode, including automatic recovery from dropping of the metadata PDU, of each of the positively acknowledged PDUs (EOF and Finished), of the positive acknowledgements to those PDUs, as well as simulation of an extremely noisy link in which every PDU in each direction is dropped once, and simulation of a fault.

3.2.2 TEST PARTICIPANTS

AGENCY A

AGENCY B

3.2.3 TEST DESCRIPTION

In this Test Series all files are of medium size with an approximate file length of 50 Kbytes. Note that the actual file lengths are not of great importance in themselves. The file lengths should, however, provide a reasonable number of File Data PDUs, perhaps greater than 200. Other than that, file lengths appropriate and convenient for the data rates used in the tests should be selected.

Default settings of Protocol Options are as shown in bold italic in table 3-1. When a test or subtest requires a deviation from one or more of the default settings, the different setting is noted in the appropriate Test Series Segment table.

Table 3-7: Test Series F2 Segments

Seg. Nmbr	Purpose	PDU loss	Notes
1	Check recovery from loss of Metadata PDU	First Metadata PDU dropped	
2	Check recovery from loss of EOF PDU	First EOF PDU dropped	
3	Check recovery from loss of Finished PDU	First Finished PDU dropped	
4	Check recovery from loss of ACK (EOF) PDU	First ACK (EOF) PDU dropped	
5	Check recovery from loss of ACK (Finished) PDU	First ACK (Finished) PDU dropped	
6	Check operation in extremely noisy environment	every PDU except EOF in each direction dropped once	
7	Check response to ACK Limit Reached at sender	Drop all ACK and Finished PDUs to cause fault at sender	
8	Check response to NAK Limit Reached at receiver	Drop all NAK PDUs to cause fault at receiver	Rcvng entity needs to set Inactivity Timer appropriately.
9	Check Inactivity Timer at sender	Drop all Finished PDUs from receiver	
10	Check Inactivity Timer at receiver	After file copy procedure starts, block all transmissions from sender	

3.2.4 TEST PROCEDURE

For each subtest execute all Test Segments with test setup configured as shown in table 3-8.

Table 3-8: Test Series F2 Subtests

Subtest	Execute Test Segments From	Execute Test Segments To	Notes
F2.1	Agency A Entity	Agency B Entity	
F2.2	Agency B Entity	Agency A Entity	

3.2.5 TEST RESULTS

3.3 TEST SERIES F3

3.3.1 OBJECTIVE OF TEST

The third Test Series checks the functioning of the two party Remote Put (Proxy) functions and checks the operation of the Filestore Procedures and Directory Listing Request.

3.3.2 TEST PARTICIPANTS

AGENCY A

AGENCY B

3.3.3 TEST DESCRIPTION

In this Test Series all files are either of medium size with an approximate file length of 50 Kbytes, or of zero length, as noted. Note that the actual file lengths are not of great importance in themselves. The file lengths should, however, provide a reasonable number of File Data PDUs, perhaps greater than 200. Other than that, file lengths appropriate and convenient for the data rates used in the tests should be selected.

Default settings of Protocol Options are as shown in bold italic in table 3-1. When a test or subtest requires a deviation from one or more of the default settings, the different setting is noted in the appropriate Test Series Segment table.

Table 3-9: Test Series F3 Segments

Seg. Nmbr	Purpose	File size	Notes
1	Check two party Remote Put (acts as a 'Get')	M	
2	Check Create File directive	Zero	
3	Check Delete File directive	Zero	
4	Check Rename File directive	Zero	
5	Check Append File directive	M	
6	Check Replace File directive	M	
7	Check Create Directory directive	Zero	
8	Check Remove Directory directive	Zero	
9	Check Deny File Directive	Zero	
10	Check Directory Listing Request	Zero	

3.3.4 TEST PROCEDURE

For each subtest execute all Test Segments with test setup configured as shown in table 3-10.

Table 3-10: Test Series F3 Subtests

Subtest	Execute Test Segments From	Execute Test Segments To	Notes
F3.1	Agency A Entity	Agency B Entity	
F3.2	Agency B Entity	Agency A Entity	

3.3.5 TEST RESULTS

3.4 TEST SERIES F4

3.4.1 OBJECTIVE OF TEST

The fourth Test Series checks the operation of each of the options not checked in a previous Test Series. (Options between an Entity and its User are not tested as they are not interoperability issues.)

3.4.2 TEST PARTICIPANTS

AGENCY A

AGENCY B

3.4.3 TEST DESCRIPTION

In this Test Series all files are of medium size with an approximate file length of 50 Kbytes. Note that the actual file lengths are not of great importance in themselves. The file lengths should, however, provide a reasonable number of File Data PDUs, perhaps greater than 200. Other than that, file lengths appropriate and convenient for the data rates used in the tests should be selected.

Default settings of Protocol Options are as shown in bold italic in table 3-1. When a test or subtest requires a deviation from one or more of the default settings, the different setting is noted in the appropriate Test Series Segment table.

NOTES

1 If the default settings specified in table 3-1 have been used in the preceding tests, Segments 1 and 6 may be skipped, as those configurations will have already been exercised.

2 The implementation-specific triggers for Prompt (NAK) and Asynchronous NAK transmissions should be such that the appropriate PDU is issued approximately one third of the way through the file transmission and then a second one approximately two thirds of the way through the file transmission.

3 The implementation-specific triggers for Keep Alive and Prompt (Keep Alive) transmissions should be such that the appropriate PDU is issued approximately one third of the way through the file transmission and then a second one approximately two thirds of the way through the file transmission. Note that the senders response to a Keep Alive PDU in which the Keep Alive Limit Reached value is exceeded is not an interoperational item, and therefore testing of the Keep Alive Limit Reached is a local testing matter.

Table 3-11: Test Series F4 Segments

Seg. Nmbr	Purpose	Lost Segment Detection Mode	Segmentation	File Type	File Data PDU CRC	Data Errors	Notes
1	Check Deferred NAK mode (See Note 1 above.)	Deferred	No Segmentation Control	Bounded	Off	~5% of data dropped	See Note 1 above
2	Check Immediate NAK mode	Immediate	No Segmentation Control	Bounded	Off	~5% of data dropped	
3	Check Prompted NAK mode	Prompted	No Segmentation Control	Bounded	Off	~5% of data dropped	See Note 2 above.
4	Check Asynchronous NAK mode	Asynchronous	No Segmentation Control	Bounded	Off	~5% of data dropped	See Note 2 above.
5	Check Segmentation Control (record boundaries observed)	Deferred	With Segmentation Control	Bounded	Off	0	Participants must have4 agreed-upon record structure.
6	Check no Segmentation Control (record boundaries not observed). (See Note 1 above.)	Deferred	No Segmentation Control	Bounded	Off	0	See Note 1 above.
7	Check Sender initiated Suspend and Resume functioning	Deferred	No Segmentation Control	Bounded	Off	0	Sender executes Suspend about mid-file. Waits two minutes and executes Resume.
8	Check Receiver initiated Suspend and Resume functioning	Deferred	No Segmentation Control	Bounded	Off	0	Receiver executes Suspend about mid-file. Waits two minutes and executes Resume.
9	Check Unbounded file type	Deferred	No Segmentation Control	Unbounded	Off	0	
10	Check File Data PDU CRC mode	Deferred	No Segmentation Control	Bounded	On	In one File Data PDU, after CRC is generated, cause error in data field.	Check that CRC error is detected at receiver.
11	Check Keep Alive function	Deferred	No Segmentation Control	Bounded	Off	0	See Note 3 above.
12	Check Prompt (Keep Alive)	Deferred	No Segmentation Control	Bounded	Off	0	See Note 3 above.

13	Check Multiple Open Transactions (clean)	Deferred	No Segmentation Control	Bounded	Off	0	Open Transactions in a sequence that causes five Transactions to be open at the same time.
14	Check Multiple Open Transactions (w/ data loss)	Deferred	No Segmentation Control	Bounded	Off	~5% of data dropped	Open Transactions in a sequence that causes five Transactions to be open at the same time.

3.4.4 TEST PROCEDURE

For each subtest execute all Test Segments with test setup configured as shown in table 3-12.

Table 3-12: Test Series F4 Subtests

Subtest	Execute Test Segments From	Execute Test Segments To	Notes
F4.1	Agency A Entity	Agency B Entity	
F4.2	Agency B Entity	Agency A Entity	

3.4.5 TEST RESULTS

3.5 TEST SERIES F5

3.5.1 OBJECTIVE OF TEST

The fifth Test Series checks the functioning of the three party Remote Put (Proxy) functions.

3.5.2 TEST PARTICIPANTS

AGENCY A

AGENCY B

3.5.3 TEST DESCRIPTION

File transfers are requested by Entity A and take place from Entity B to Entity C.

In this Test Series the file is of medium size with an approximate file length of 50 Kbytes. Note that the actual file lengths are not of great importance in themselves. The file lengths should, however, provide a reasonable number of File Data PDUs, perhaps greater than 200. Other than that, file lengths appropriate and convenient for the data rates used in the tests should be selected.

Default settings of Protocol Options are as shown in bold italic in table 3-1. When a test or subtest requires a deviation from one or more of the default settings, the different setting is noted in the appropriate Test Series Segment table.

Table 3-13: Test Series F5 Segments

Seg. Nmbr	Purpose	Mode	Notes
1	Check Remote Put Order (2 Party)	Acknowledged	Execute a Remote Put with Destination set to originator of request. (If Test Series F3 Segment 1 has already been executed, this test may be skipped.)
2	Check Remote Put Cancel	Acknowledged	Execute a Remote Put with Destination set to originator of request. Approximately half way through file execute Remote Put Cancel.
3	Check Remote Fault Handler Override, Remote Transmission Mode, Remote Flow Label, and Remote Segmentation Control	Acknowledged	Check default Fault Handler, Transmission Mode, Flow Label, and Segmentation Control settings at receiver before sending. Verify that Remote requesting message contains different values. After transmission verify that all have been changed to requested values.
4	Check Remote Message to User	Acknowledged	
5	Check Remote File Store Request	Acknowledged	
6	Check Remote Status Report Request	Acknowledged	
7	Check Remote Suspend/Resume	Acknowledged	Execute Suspend about mid-file. Wait two minutes and execute Resume.
8	Exercise three party Remote Put (Proxy) operation	Acknowledged	Execute a Remote Put with Destination set to an entity other than originator of request.

3.5.4 TEST PROCEDURE

For each subtest execute all Test Segments with test setup configured as shown in table 3-14.

Table 3-14: Test Series F5 Subtests

Subtest	Entity A provided by	Entity B provided by	Entity C provided by	Notes
F5.1	Agency A	Agency B	Agency A	
F5.2	Agency B	Agency A	Agency B	

3.5.5 TEST RESULTS