The Consultative Committee for Space Data Systems

CCSDS FILE DELIVERY PROTOCOL (CFDP)—

NOTEBOOK OF COMMON INTER-AGENCY TESTS FOR EXTENDED PROCEDURES

CCSDS RECORD

CCSDS 720.5-Y-1

YELLOW BOOK

September 2007

The Consultative Committee for Space Data Systems

CCSDS FILE DELIVERY PROTOCOL (CFDP)—

NOTEBOOK OF COMMON INTER-AGENCY TESTS FOR EXTENDED PROCEDURES

CCSDS RECORD

CCSDS 720.5-Y-1

YELLOW BOOK

September 2007

FOREWORD

Through the process of normal evolution, it is expected that expansion, deletion, or modification of this document may occur. This document is therefore subject to CCSDS document management and change control procedures, which are defined in the *Procedures Manual for the Consultative Committee for Space Data Systems*. Current versions of CCSDS documents are maintained at the CCSDS Web site:

http://www.ccsds.org/

Questions relating to the contents or status of this document should be addressed to the CCSDS Secretariat at the address indicated on page i.

At time of publication, the active Member and Observer Agencies of the CCSDS were:

Member Agencies

- Agenzia Spaziale Italiana (ASI)/Italy.
- British National Space Centre (BNSC)/United Kingdom.
- Canadian Space Agency (CSA)/Canada.
- Centre National d'Etudes Spatiales (CNES)/France.
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)/Germany.
- European Space Agency (ESA)/Europe.
- Federal Space Agency (FSA)/Russian Federation.
- Instituto Nacional de Pesquisas Espaciais (INPE)/Brazil.
- Japan Aerospace Exploration Agency (JAXA)/Japan.
- National Aeronautics and Space Administration (NASA)/USA.

Observer Agencies

- Austrian Space Agency (ASA)/Austria.
- Belgian Federal Science Policy Office (BFSPO)/Belgium.
- Central Research Institute of Machine Building (TsNIIMash)/Russian Federation.
- Centro Tecnico Aeroespacial (CTA)/Brazil.
- Chinese Academy of Sciences (CAS)/China.
- Chinese Academy of Space Technology (CAST)/China.
- Commonwealth Scientific and Industrial Research Organization (CSIRO)/Australia.
- Danish National Space Center (DNSC)/Denmark.
- European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)/Europe.
- European Telecommunications Satellite Organization (EUTELSAT)/Europe.
- Hellenic National Space Committee (HNSC)/Greece.
- Indian Space Research Organization (ISRO)/India.
- Institute of Space Research (IKI)/Russian Federation.
- KFKI Research Institute for Particle & Nuclear Physics (KFKI)/Hungary.
- Korea Aerospace Research Institute (KARI)/Korea.
- MIKOMTEK: CSIR (CSIR)/Republic of South Africa.
- Ministry of Communications (MOC)/Israel.
- National Institute of Information and Communications Technology (NICT)/Japan.
- National Oceanic and Atmospheric Administration (NOAA)/USA.
- National Space Organization (NSPO)/Taiwan.
- Naval Center for Space Technology (NCST)/USA.
- Space and Upper Atmosphere Research Commission (SUPARCO)/Pakistan.
- Swedish Space Corporation (SSC)/Sweden.
- United States Geological Survey (USGS)/USA.

DOCUMENT CONTROL

Document	Title	Date	Status
CCSDS 720.5-Y-1	CCSDS File Delivery Protocol (CFDP)—Notebook of Common Inter-Agency Tests for Extended Procedures, CCSDS Record, Issue 1	September 2007	Current issue

CONTENTS

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 four 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. Section 4 contains a standardized survey of the capabilities of each of the implementations known to date.

1.4 REFERENCES

[1] *CCSDS File Delivery Protocol (CFDP)—Notebook of Common Inter-Agency Tests for Core Procedures*. Space Data System Standards, CCSDS 720.4-Y-1. Yellow Book. Issue 1. Washington, D.C.: CCSDS, September 2007.

[2] *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 the Extended Procedures portion 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.

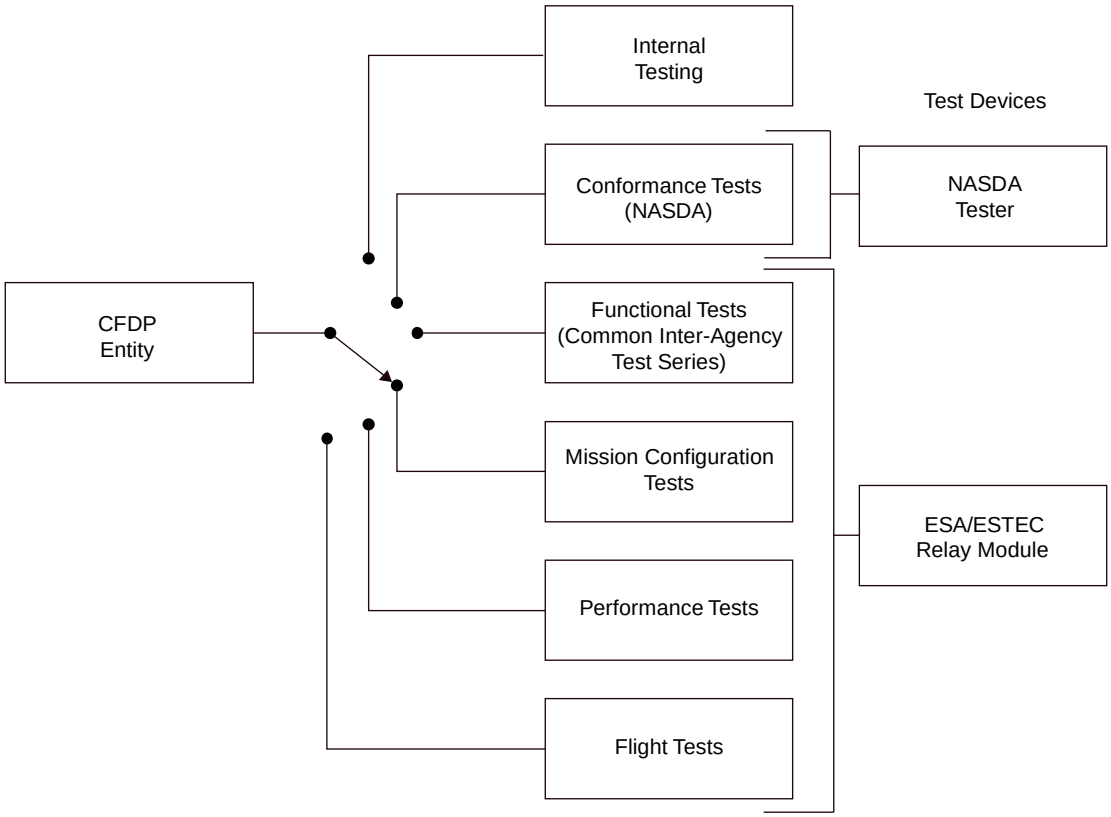

Figure 2-1: Testing Progression

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 interoperating implementations. This establishes a high level of confidence in interoperability for follow-on testing specifically oriented toward the planned application.

The tests in this document are for the Extended Procedures of an implementation. Prior to the tests described in this document, the Core Procedures of an implementation must first be tested as described in the *CCSDS File Delivery Protocol (CFDP)—Notebook of Common Inter-Agency Tests for Core Procedures* (reference [1]).

Testing aids available to implementers include the various CFDP Notebooks of Common Inter-Agency Tests, 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.

2.2 TEST SERIES OVERVIEW

The Test Series in this document are numbered as a continuation of the tests for the Core Procedures, as described in *CCSDS File Delivery Protocol (CFDP)—Notebook of Common Inter-Agency Tests for Core Procedures* (reference [1]). It is necessary that those tests be performed on the entities before attempting the tests described in this document.

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

Test Series F6 demonstrates the basic functioning of the Extended procedures in order to establish a confidence baseline for Series F7 tests, which will initiate thorough checking of the Extended procedures. Test Series F6 utilizes one Waypoint. Demonstrations are made of Unacknowledged and Acknowledged modes, of canceling an ongoing transaction, and of user messages. These tests are in CFDP Service Classes 4 and 5 (see reference [2]). They are examples of the original requirements defining Scenario 2.

Test Series F7 initiates thorough checking of the Extended procedures (utilizing one Waypoint) in 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, and also simulation of an extremely noisy link in which every PDU except the EOF in each direction is dropped once. The Deferred Transmission Procedure operation, and handling of a fault are demonstrated. These tests are in CFDP Service Class 4 (see reference [2]). They are examples of the original requirements defining Scenario 2.

Test Series F8 checks the functioning of the forwarding methods (*Incremental and Immediate* and *In Total Upon Custody Acquisition*) of the Waypoint. Test Series F8 utilizes one Waypoint.

Test Series F9 demonstrates the functioning of a Waypoint that is positioned between two other Waypoints. Test Series F9 utilizes three Waypoints. As yet, there is no Service Class defined for this configuration. It is an example of the original requirements defining Scenario 3 (see reference [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
F6	4-Unreliable Transfer via One Waypoint, and 5-Reliable Transfer via One Waypoint.
F7	5-Reliable Transfer via One Waypoint.
F8	5-Checks the functioning of the forwarding methods (*Incremental and Immediate* and *In Total Upon Custody Acquisition*) of the Waypoint. Utilizes one Waypoint.
F9	Currently Undefined-Unreliable Transfer via Multiple Waypoints in Series, and Currently Undefined-Reliable Transfer via Multiple Waypoints in Series.

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

Table 2-2: Functional Test Series versus Function Tested

CFDP Extended Procedures Interoperability Tests	Test Series Segment Number	One-way (Unreliable)	Two-way (Reliable)	Recovery from Lost PDU(s)	Number of Waypoints (incl. Agent)	Simultaneous End-to-End Connectivity	Time Disjoint End-to-End Connectivity	Fwd Mode - Incr. and Immed.	Fwd Mode - In Total Upon Custody Acquisition
	TEST SERIES F6								
Single File Data PDU	**1**	X			1	X		X	
Multiple File Data PDUs	**2, 3**	X	X		1	X		X	
File Data PDU Loss	**4, 7**		X	X	1	X		X	
Duplicate Data	**5, 8**		X	X	1	X		X	
Out of Order Data	**6, 9**		X	X	1	X		X	
User Message	**10**		X		1	X		X	
Cancel Function (Source init.)	**11, 14**	X	X		1	X		X	
Cancel Function (Dest. Init.)	**12, 15**	X	X		1	X		X	
Cancel Function (Waypoint init.)	**13, 16**	X	X		1	X		X	
	TEST SERIES F7								
Metadata PDU lost	**1**		X	X	1	X		X	
EOF PDU lost	**2**		X	X	1	X		X	
ACK (Finished) PDU lost	**3**		X	X	1	X		X	
ACK (EOF) PDU lost	**4**		X	X	1	X		X	
Finished PDU lost	**5**		X	X	1	X		X	
Gross data loss	**6**		X	X	1	X		X	
ACK Limit Reached error	**7**		X	X	1	X		X	
NAK Limit Reached error	**8**		X	X	1	X		X	
Inactivity Timer limit reached	**9**		X	X	1	X		X	
Multiple Open Transactions	**10**		X		1	X		X	

CFDP Extended Procedures Interoperability Tests	Test Series Segment Number	One-way (Unreliable)	Two-way (Reliable)	Recovery from Lost PDU(s)	Number of Waypoints (incl. Agent)	Simultaneous End-to-End Connectivity	Time Disjoint End-to-End Connectivity	Fwd Mode - Incr. and Immed.	Fwd Mode - In Total Upon Custody Acquisition
Multiple Open Transactions	**11**		X	X	1	X		X	
	TEST SERIES F8								
Incremental and Immediate	**1, 3**		X		1	X	X	X	
In Total Upon Custody Acquisition	**2, 4**		X		1	X	X		X
	TEST SERIES F9								
Unacknowledged	**1**	X			3	X		X	
Acknowledged	**2**		X		3	X		X	
Metadata PDU lost	**3**		X	X	3	X		X	
EOF PDU lost	**4**		X	X	3	X		X	
ACK (Finished) PDU lost	**5**		X	X	3	X		X	
ACK (EOF) PDU lost	**6**		X	X	3	X		X	
Finished PDU lost	**7**		X	X	3	X		X	
Gross data loss	**8**		X	X	3	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.***
Extended Transaction Waypoint Option	
Forwarding Method	**Effect**
Incremental and Immediate	***Sends received PDUs to next entity as soon as received.***
In Total Upon Complete Custody Acquisition	Sends FDU to next entity only when entire FDU has been received.

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 receipt of Suspend PDU.
False	No action.
Resumed.indication	**Effect**
True	Issues Resume.indication to local user on receipt of Resume PDU.
False	No action.

3.1 TEST SERIES F6

3.1.1 OBJECTIVE OF TEST

This Test Series checks the basic functioning of the Extended procedures in order to establish a confidence baseline for Series F7 tests, which will initiate thorough checking of the Extended procedures. It utilizes one Waypoint. 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

File transfers are from Entity A via Entity B to Entity C.

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 F6 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		Multiple File Data PDUs
3	Establish two-way connectivity	Acknowledged	M	0		
4	Check reliable mode operation	Acknowledged	M	~1% of data dropped on Source/Waypoint link		
5	Check elimination of duplicate data	Acknowledged	M	~1% of data duplicated on Source/Waypoint link		
6	Check reordering of data	Acknowledged	M	~1% of data out of order on Source/Waypoint link		
7	Check reliable mode operation	Acknowledged	M	~1% of data dropped on Waypoint/Destination link		
8	Check elimination of duplicate data	Acknowledged	M	~1% of data duplicated on Waypoint/Destination link		
9	Check reordering of data	Acknowledged	M	~1% of data out of order on Waypoint/Destination link		
10	Check user (application) messages functioning	Acknowledged	Zero	0		Two Messages to User
11	Check cancel functioning	Acknowledged	M	0	Source initiated about mid-file	
12	Check cancel functioning	Acknowledged	M	0	Destination initiated about mid-file	
13	Check cancel functioning	Acknowledged	M	0	Waypoint initiated about mid-file	
14	Check cancel functioning	Unacknowledged	M	0	Source initiated about mid-file	
15	Check cancel functioning	Unacknowledged	M	0	Destination initiated about mid-file	
16	Check cancel functioning	Unacknowledged	M	0	Waypoint initiated about 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 F6 Subtests

Subtest	Entity A (Source) provided by	Entity B (Waypoint) provided by	Entity C (Destination) provided by	A to B to C Connection	Notes
F6.1	Agency A	Agency B	Agency A	Simultaneous	
F6.2	Agency B	Agency A	Agency B	Simultaneous	

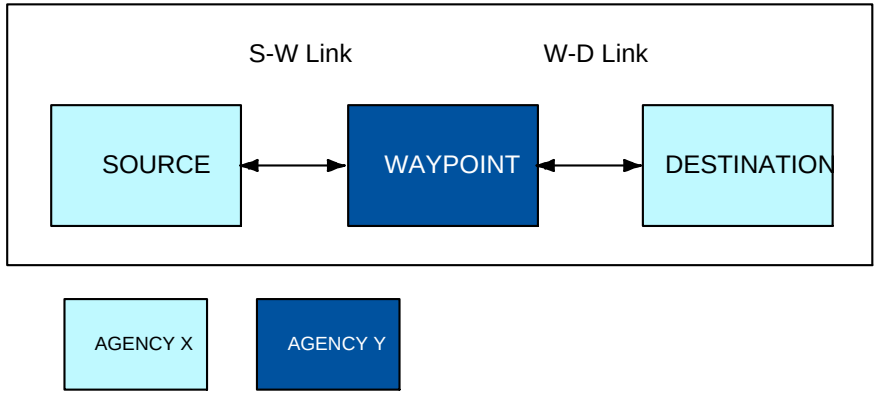

Figure 3-1: Test Series F6 Configuration

3.1.5 TEST RESULTS

3.2 TEST SERIES F7

3.2.1 OBJECTIVE OF TEST

This Test Series initiates thorough checking of the protocol procedures of the Extended procedures (utilizing one Waypoint) in 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, and also simulation of an extremely noisy link in which every PDU except the EOF in each direction is dropped once. Suspend and Resume propagation are checked. The simulation of a fault is checked, as is operation with multiple simultaneously open Transactions.

3.2.2 TEST PARTICIPANTS

AGENCY A

AGENCY B

3.2.3 TEST DESCRIPTION

File transfers are from Entity A via Entity B to Entity C.

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 F7 Segments

Seg. Nmbr	Purpose	PDU loss	Notes
1	Check recovery from loss of Metadata PDU	First Metadata PDU dropped on S-W link	
2	Check recovery from loss of EOF PDU	First EOF PDU dropped on S-W link	
3	Check recovery from loss of ACK (Finished) PDU	First ACK (Finished) PDU dropped on S-W link	
4	Check recovery from loss of ACK (EOF) PDU	First ACK (EOF) PDU dropped on W-D link	
5	Check recovery from loss of Finished PDU	First Finished PDU dropped on W-D link	
6	Check Waypoint operation in extremely noisy environment	On each link, every PDU except EOF in each direction dropped once	
7	Check Waypoint response to ACK Limit Reached	Drop all ACK and Finished PDUs on S-W link	Waypoint entity needs to set Inactivity Timer appropriately.
8	Check Waypoint response to NAK Limit Reached	Drop all NAK PDUs to Source (S-W link)	Waypoint entity needs to set Inactivity Timer appropriately.
9	Check Inactivity Timer at Waypoint	After file copy procedure starts, block all further traffic on the S-W link.	Waypoint entity needs to set Inactivity Timer appropriately.
10	Check Multiple Open Transactions (clean)		Open Transactions in a sequence that causes five Transactions to be open at the same time.
11	Check Multiple Open Transactions (w/ data loss)	~5% of data dropped	Open Transactions in a sequence that causes five Transactions to be open at the same time.

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 F7 Subtests

Subtest	NAK Mode	Entity A (Source) provided by	Entity B (Waypoint) provided by	Entity C (Destination) provided by	Notes
F7.1	Deferred	Agency A	Agency B	Agency A	
F7.2	Deferred	Agency B	Agency A	Agency B	

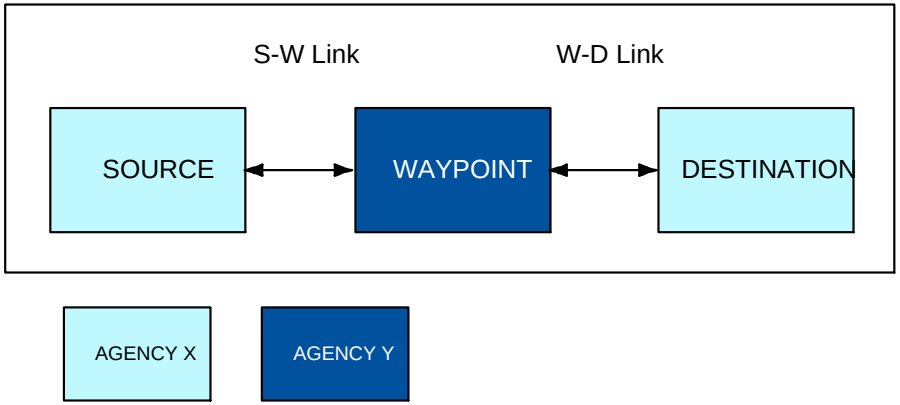

Figure 3-2: Test Series F7 Configuration

3.2.5 TEST RESULTS

3.3 TEST SERIES F8

3.3.1 OBJECTIVE OF TEST

This Test Series checks the functioning of the forwarding methods of the Waypoint. It utilizes one Waypoint.

3.3.2 TEST PARTICIPANTS

AGENCY A

AGENCY B

3.3.3 TEST DESCRIPTION

File transfers are from Entity A via Entity B to Entity C.

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 3-9: Test Series F8 Segments

Seg. Nmbr	Purpose	Mode	A to B to C Connectivity	Entity B (Waypoint) Forwarding Method	Notes
1	Check 'Incremental and Immediate' method of forwarding in Waypoint	Acknowledged	Simultaneous	Incremental and Immediate	
2	Check 'In Total Upon Custody Acquisition' method of forwarding in Waypoint	Acknowledged	Simultaneous	In Total Upon Custody Acquisition	
3	Check 'Incremental and Immediate' method of forwarding in Waypoint	Acknowledged	B to C only after A to B transfer is complete	Incremental and Immediate	
4	Check 'In Total Upon Custody Acquisition' method of forwarding in Waypoint	Acknowledged	B to C only after A to B transfer is complete	In Total Upon Custody Acquisition	

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 F8 Subtests

Subtest	Entity A (Source) provided by	Entity B (Waypoint) provided by	Entity C (Destination) provided by	Notes
F8.1	Agency A	Agency B	Agency A	
F8.2	Agency B	Agency A	Agency B	

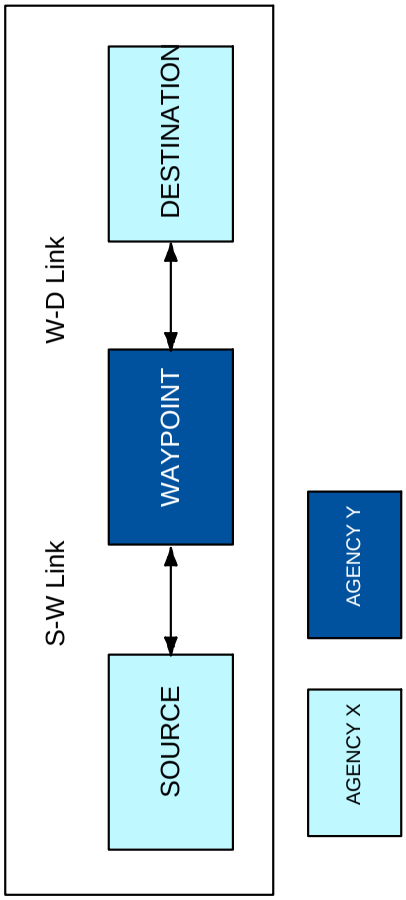

Figure 3-3: Test Series F8 Configuration

3.3.5 TEST RESULTS

3.4 TEST SERIES F9

3.4.1 OBJECTIVE OF TEST

This Test Series checks the functioning of the Extended procedures through multiple Waypoints in series. This Test Series utilizes three Waypoints. The previous Test Series in this document tested the interoperability of a Waypoint with Source and Destination entities from a different Agency. This Test Series tests the interoperability of a Waypoint with Waypoints from a different Agency. In theory, there is almost no difference in requirements on the Waypoints for this configuration, but this Test Series is provided simply to provide increased confidence.

3.4.2 TEST PARTICIPANTS

AGENCY A

AGENCY B

Optionally, AGENCY C

3.4.3 TEST DESCRIPTION

File transfers are from Entity A to Entity B to Entity C to Entity D to Entity E. An interesting and worthwhile variation of this test is to have the Source and Destination entities provided by a third Agency (Agency C).

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 3-11: Test Series F9 Segments

Seg. Nmbr	Purpose	Mode	PDU loss
1	Transfer one medium file	Unacknowledged	None
2	Transfer one medium file	Acknowledged	None
3	Check recovery from loss of Metadata PDU	Acknowledged	First Metadata PDU dropped on W1-W2 link
4	Check recovery from loss of EOF PDU	Acknowledged	First EOF PDU dropped on W1-W2 link
5	Check recovery from loss of ACK (Finished) PDU	Acknowledged	First ACK (Finished) PDU dropped on W1-W2 link
6	Check recovery from loss of ACK (EOF) PDU	Acknowledged	First ACK (EOF) PDU dropped on W2-W3 link
7	Check recovery from loss of Finished PDU	Acknowledged	First Finished PDU dropped on W2-W3 link
8	Check Waypoint operation in extremely noisy environment	Acknowledged	On W1-W2 link and on W2-W3 link, every PDU except EOF in each direction dropped once

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 F9 Subtests

Subtest	Entity A (Source) provided by	Entity B (Waypoint-1) provided by	Entity C (Waypoint-2) provided by	Entity D (Waypoint-3) provided by	Entity E (Destination) provided by	PDU Losses To Occur Between	Notes
F9.1	Agency A	Agency A	Agency B	Agency A	Agency A	Entity B and Entity C	
F9.2	Agency B	Agency B	Agency A	Agency B	Agency B	Entity C and Entity D	

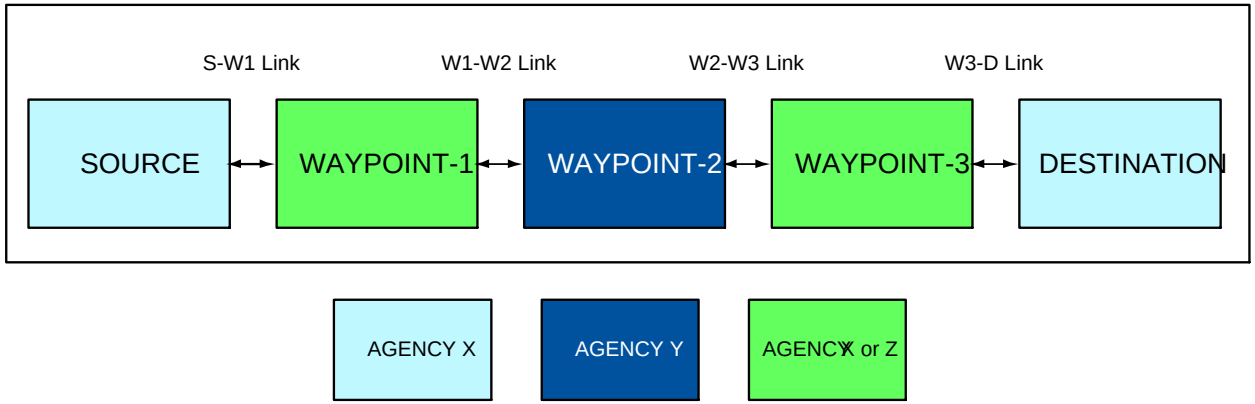

Figure 3-4: Test Series F9 Configuration

3.4.5 TEST RESULTS