

RECORD FOR SPACE DATA SYSTEM STANDARDS

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| Terrestrial Generic File Transfer (TGFT)Prototype testPlan and Report |

Draft CCSDS Record

CCSDS 927.1-Y-0.3

Draft Yellow Book

December 2017

FOREWORD

This document records the prototype test plan and results for the Terrestrial Generic File Transfer (TGFT),CCSDS 927.1-W-0.00,White Book. As a record of prototype testing, it is expected that expansion, deletion, or modification of this document will **not** occur. This document is subject to CCSDS document management and change control procedures, which are defined in the *Organization and Processes for the Consultative Committee for Space Data Systems*. Current versions of CCSDS documents are maintained at the CCSDS Web site:

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E-mail: secretariat@mailman.ccsds.org

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# INTRODUCTION

## PURPOSE

This test plan and report provides a record of the interoperability testing that will occur in support of the production of the Consultative Committee for Space Data Systems (CCSDS) recommendation Terrestrial Generic File Transfer (TGFT) Blue Book.

## SCOPE

This record addresses the formal prototype testing that will occur between CNES and CNSA against the White book version of the draft Terrestrial Generic File Transfer (TGFT)[reference 1] and focuses on a standard mechanism for transferring files and associated metadata between space agencies required in the context of the CCSDS Service Management. Prototype testing shall incorporate modifications to the TGFT document and ongoing working group activity as applicable.

## RATIONALE

The CCSDS Procedures Manual states that for a Recommendation to become a Blue Book, the draft standard must be tested in an operational manner. The following requirements for an

implementation exercise were excerpted from reference [2]:

“At least two independent and interoperable prototypes or implementations

must have been developed and demonstrated in an operationally relevant

environment, either real or simulated.”

This document outlines the Cross Support Services-Service Management Working Group’s(CSS-SMWG’s) approach to meeting this requirement for the TGFT Blue Book.

## DOCUMENT STRUCTURE

A brief description is provided for each section and annex so the reader will have an idea of where information can be found within the document. This document is organized as follows:

1. Section 1 provides the purpose, scope, rationale and references of this test plan and report. This section also describes how this document is organized.
2. Section 2 provides the test plan description including the test goals, overview and details of each test case.
3. Section 3 provides the summary of test result conclusions and a recommendation for the supported Blue Book.
4. Section 4 describes the test results and provides test reports for each use case and test run.
5. Annex A lists the abbreviations and acronyms used within this document
6. Annex B lists the XML formatted files, Interface Control Documents (ICDs) and Interpretation of each test run.

## References

The following documents are referenced in this document. At the time of publication, the editions indicated were valid. All documents are subject to revision, and users of this document are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below. The CCSDS Secretariat maintains a register of currently valid CCSDS documents.

[1] Terrestrial Generic File Transfer (TGFT)*,* CCSDS927.1-W-0.00, Draft Recommended Standard.

[2] *Organization and Processes for the Consultative Committee for Space Data Systems*. CCSDS A02.1-Y-4. Yellow Book. Issue 4. Washington, D.C.: CCSDS, April 2014.

# Terrestrial Generic File Transfer (TGFT) TEST Plan

## TEST GOALS

The prototype testing shall be performed to demonstrate that the proposed standard has been written with enough clarity to be used to transfer files and the associated metadata between various Space Agencies and commercial or governmental spacecraft operators.

## Test approach

Two sets of tests will be implemented, to validate the nominal use cases on one hand, and to validate error cases on the other hand.

### Nominal test cases

Two independant implementations of the standard will be used to transfer a set of files and their associated metadata back and forth between two systems. Input data will be defined by the agency A and transformed as an XFDU package, which will then be transferred to the system B using the first implementation and deployment of TGFT. The XFDU package will then be interpreted by the agency B to retrieve the set of files and their metadata. The agency B will then retransform the set of files it has just rebuilt into a new XFDU package, and transfer it to the system A using the second implementation and deployment of TGFT. The XFDU package will then be interpreted by the agency A to retrieve the set of files and their metadata. The output will then be compared to the input, and should be equivalent.

The two agencies performing the tests, CNES and CNSA, will play in turn the role of agency A and agency B. Each agency will initiate half of the nominal test cases.



The format of the set of input files and metadata is not defined by the TGFT standard. TGFT only defines the format of the XFDU archive to be transferred. However it is required for the validity of the test procedure that each agency defines its own format of expanded files and metadata. It is actually essential for the validity of the test procedure that the XFDU archive is completely interpreted on the system B prior to be reencoded into a new archive. It is notably important that the metadata associated with a particular file be identified as such in the format (for example as a separate file with the same name and another suffix, or as a separate XML entity in an XML formatted file).

The format of expanded files need not be the same on both sides.

Each agency should also develop an automated tool to transform the data from/to the expanded format to/from the XFDU format. However the test procedure could still be valid with a manual transformation, as long as the person performing the transformation follows a well established procedure (to be defined if required).

### Error test cases

Error test cases are used to validate the understanding of the assertions in the standard. Assertions are identified by the use of the "shall" or "must" keywords. All of them concern the input TGFT/XFDU archive.

Invalid input files will be designed by each agency, and pushed to the other agency using TGFT. When unpacking the file, the receiving agency should signal the violation of an assertion, and identify the violated assertion.



The two agencies performing the tests, CNES and CNSA, will play in turn the role of agency A and agency B. Each agency will initiate the error test cases it has designed.

## TEST PLAN OVERVIEW

### Nominal test cases

The nominal use cases will be performed according to the procedure described above.

#### Configuration

Each agency will install its own implementation of TGFT, including an HTTP server over TLS as this is a mandatory feature required by the standard.

A bidirectional service agreement will be established, according to the template provided in Annex A of the specification. A special care should be taken during this step to validate if the provided template is sufficient to enable the operations of the TGFT implementations. Any additional point of agreement should be explicitely noted in the test report.

#### TGFT-using service conventions

The standard has been designed as an extensible base. A number of rules actually are delegated to the TGFT-using service.

It is not the purpose of the tests to validate those rules. However one rule at least needs to be known to the test, that is the naming convention of the XFDU manifest file in the archive.

For the scope of the tests, we decide to apply the following rule:

The XFDU Manifest file shall be named manifest.xfdu, and be located on the top level of the file hierarchy in the archive.

#### Test input

Each use case will be defined by:

* a set of files, including data and metadata files
* the archive level metadata, all optional except otherwise noted, i.e.

|  |  |  |  |
| --- | --- | --- | --- |
| TGFT metadata | originator | Annex D |  |
| recipient | Annex D |  |
| crossSuportServiceType | Annex D |  |
| packageType | 4.2.6.1.a | identifier of the TGFT-using service with which the XFDU is associated |
| Generic service level metadata | packageId | 4.2.5.1.a | TGFT-using service dependant |
| textInfo | 4.2.3.a | TGFT-using service dependant |
| sequenceInformation | 4.2.5.5 | TGFT-using service dependantprovided as an XML String formatted as a sequenceInformation element the content is not interpreted |
| Specific service level metadata | environmentInfo | 4.2.5.6.2 | TGFT-using service dependantprovided as an XML String formatted as environmentInfo elements the content is not interpreted |

* the file level metadata for each metadata file, i.e.

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| --- | --- | --- | --- |
| TGFT metadata | ID | 4.2.7.2.1.a | unique ID of the metadata file |
| url | 4.2.7.3.1.c.2 | required if the metadata file is not to be added to the archive |
| Generic service level metadata | classification | 4.2.7.2.1.d | TGFT-using service dependant |
| category | 4.2.7.2.1.e | TGFT-using service dependant |
| textInfo | 4.2.7.3.1.a | TGFT-using service dependant |
| vocabularyName | 4.2.7.3.1.d | TGFT-using service dependant |
| mimeType | 4.2.7.3.1.e | TGFT-using service dependant |

* the file level metadata for each data file, i.e.

|  |  |  |  |
| --- | --- | --- | --- |
| TGFT metadata | creationDate | Annex D |  |
| ID | 4.2.8.2.1.a | unique ID of the data file |
| contentUnitID | 4.2.6.3.1.a | unique ID of the contentUnit which will hold the data file |
| checksum | 4.2.8.2.3 | provided as an XML string formatted as a checksumInformation elementthe content is not interpreted |
| metadata files |  | list of associated metadata files, identified by their file name if present in the archive, or their URL if not |
| Generic service level metadata | order | 4.2.6.3.1.b | TGFT-using service dependant |
| unitType | 4.2.6.3.1.c | TGFT-using service dependant |
| textInfo | 4.2.6.3.1.d | TGFT-using service dependant |
| mimeType | 4.2.8.2.1.b | TGFT-using service dependant |
| fileInfo | 4.2.8.4.1.a | additional textInfo string associated with the data file |
| Specific service level metadata | serviceSpecificContentUnitExt | 4.2.6.6.1 | TGFT-using service dependantprovided as an XML String formatted as a serviceSpecificContentUnitExt element the content is not interpreted |

How the metadata are produced is not part of this document. A separate action of the working group aims at identifying the metadata required by the actual use cases and producing the metadata for the test cases. Only the result of this action is described in the present document.

#### Preparation

A TGFT archive will be built from the input.

All metadata required by the specification will be either retrieved from the provided test metadata, or constructed from the test input (e.g. file size).

#### Execution

Five tests will be performed, based on actual use cases.

The identified use cases are:

* DDOR Data
* Radiometric Observables
* Trajectory Predictions
* NW Utilisation Schedules
* Pass Report.

#### Validation

The nominal test cases will be validated when:

* the files undergo the round trip through the two independant implementations successfully
* the returning data and metadata files are identical, including their names and hierarchy
* the metadata for which a value was given as input can be found with the same value in the returning archive

### Error test cases

#### Configuration

The error test cases reuse the configuration established for the nominal test cases. The only difference is that the file on the remote side (System B) should raise an error when being disassembled.

#### Test input

The archive may be built manually as it should be invalid. Each test input will be designed to violate one of the specification assertions.

Not all the assertions require a specific test. This may be true for three different reasons:

* the assertion actually exists in the original XFDU standard. The XFDU standard has already been validated so there is no need to question the potential misunderstanding of it. Example of this can be found in section 4.2.6.4.1.a:
	+ The dataObjectID attribute shall contain the value of the ID attribute of the dataObject element (4.2.8.2.1 (a)) to which the contentUnit corresponds.
* the assertion concerns the possible extension of the standard by a TGFT-using service. It is not the purpose of this work to validate specific rules. Example of this can be found in section 4.2.5.1.a:
	+ The ID attribute of the packageHeader element shall have the default value of “pkgHdr”. However, TGFT-using service may define their own values for the ID attribute.
* the assertion can be enforced by the specific XSD schema provided with the specification and named TGFTXFDUschema.xsd. As the XML schema technology is a standard, and as the conformance of the archive manifest to this schema may be verified by a standard tool, there is no need to question the potential misunderstanding of such assertions. We furthermore assume that the conformance of the archive manifest to this schema will be verified on each end of the TGFT deployment, when archives are assembled and disassembled.

#### Execution

#### Validation

The error test cases will be validated when:

* unpacking the archive on the remote node (System B) signals an error identifying a violated assertion
* the assertion is the one expected to be violated

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## TEST PLAN DETAILS

### Nominal test cases

#### DDOR Data

input description

#### Radiometric Observables

input description

#### Trajectory Predictions

input description

#### NW Utilisation Schedules

input description

#### Pass Report

input description

### Error test cases

The assertions to check are quoted from the specification.

The actual input files built to violate the assertion are provided in annex B.

More than one test file may be provided for the various ways of violating the assertion.

#### assertion 3.2.1.1

##### specification quote

The original package name part shall consist of the file name and file type of the XFDU Package: *file\_name.file\_type.* where file.type is either “zip’ or “tar”.

The rules for forming the original package name part of the XFDU package file name shall be defined by the application using TGFT, with the constraint that the original package name part shall be limited to the following character set:

* [a-z], lower case alphabetic characters
* [0-9], numeric characters
* -, the “dash”(or minus) character
* \_, the underscore character
* ., the dot character

To minimise the risk of overwriting files of the same name that are still present in the target directory of the TGFT Receiver, the original package name of the XFDU Package shall be post-fixed on the sending side with the Zulu time at which the transfer of the file was started.

The format of the timestamp part shall be a modified version of the CCSDS ASCII Time Code B that is specified in reference [11]:

*YYYY-DDDThh-mm-ssZ,*

where (as per reference [11])

YYYY Year in four-character subfield with values 0001-9999

DDD Day of year in three-character subfield with values 001-365 or -366

T Calendar-Time separator

hh Hour in two-character subfield with values 00-23

mm Minute in two-character subfield with values 00-59

ss Second in two-character subfield with values 00-59 (-58 or -60 during leap seconds)

Z time code terminator,

but contrary to using colons (‘:”) to delimit the *hh*, *mm*, and *ss* fields (as per reference [11]), the modified time code uses dashes (“-“) because colons are illegal file name characters in many file systems.

##### details

All "shall" concern the XFDU package file name. They are collected under the single assertion name 3.2.1.1.

#### assertion 3.2.1.2

##### specification quote

The file type (extension) “.xfdu” shall be used to uniquely identify it as the XFDU Manifest and to differentiate it from any other XML-formatted file that might be in XFDU Package.

#### assertion 4.2.3.b

##### specification quote

The optional version attribute shall be absent when the XFDU schema defined in Issue 1 (September 2008) of reference [9] is used as the schema for TGFT XFDUs.

#### assertion 4.2.5.6.1

##### specification quote

One environmentInfo element shall contain one extension element for the TGFT XFDU extension parameters that are applicable to the XFDU as a whole.

The extension element for the TGFT XFDU extension parameters shall contain one tgftXfduExtension element, cast as an instance of the TgftXfduExtensionType complex schema type, which is registered in the “urn:ccsds:schema:tgft:xfdu\_extensions” namespace (TBD) in the file TgftXfduExtensionParameters.xsd (TBD).

#### assertion 4.2.6.2

##### specification quote

The informationPackageMap element shall contain one contentUnit element for each Data Object (i.e., payload data file) contained within the XFDU Package.

#### assertion 4.2.6.3.1.e

##### specification quote

The optional anyMdID attribute of the contentUnit element shall be present if the XFDU Manifest contains a metadataSection element (4.2.7) (i.e., if there are any metadata files contained within the XFDU Package or referenced by the XFDU Manifest). If present, this attribute shall contain the IDREF values of the ID attributes of the corresponding metadataObject elements (see 4.2.7.2.1 (a)).

#### assertion 4.2.6.5.1

##### specification quote

The extension element of the contentUnit shall contain one tgftContentUnitExtension element.

#### assertion 4.2.7.1

##### specification quote

The metadataSection element shall contain one metadataObject element for each Metadata Object (i.e., metadata file) associated with the payload data file(s) being transferred in the XFDU Package.

#### assertion 4.2.7.3.1.c

##### specification quote

If the metadata file is contained within the same XFDU Package as the XFDU Manifest, the URL of the file shall be of the form

 “file:”+<XFDU Package original package name part> + ”/” + <metadata file name (with extension>,

where the original package name part of the XFDU file name is defined in 3.2.1.1.1.

#### assertion 4.2.8.1

##### specification quote

The dataObjectSection element shall contain one dataObject element for each payload data file in the XFDU Package.

#### assertion 4.2.8.2.1.c

##### specification quote

The size attribute shall be present and contain the size of the Data Object.

#### assertion 4.2.8.4.1.c

##### specification quote

The href attribute shall contain the URL of the file, which shall be of the form

 “file:”+<XFDU Package original package name part> + ”/” + <payload file name (with extension>.

where the original package name part of the XFDU file name is defined in 3.2.1.1.1.

#### assertion 4.5.2

##### specification quote

The TGFT XFDU package shall contain one enclosed payload data file for every dataObject element in the dataObjectSection of the XFDU manifest.

#### assertion 4.5.3

##### specification quote

The TGFT XFDU package shall contain one enclosed metadata file for every metadataObject element in the metadataSection of the XFDU manifest for which the metadataReference element has an href value that begins “file:”.

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## TEST REPORTing

The test report conclusions and recommendation shall be sumarized in Section 3 and the test details shall be documented in Section 4. The summary test report will be available to the CCSDSEngineering Steering Group (CESG) and CCSDS Management Council (CMC), along with results of the agency reviews. At that time, a formal data shall be submitted to the CMCfor progression of the TGFT to CCSDS Blue Book status.

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# Test Results Summary, CONCLUSIONs &RECOMMENDATION

## Test summary and Conclusion

[When the testing is complete, this section will be updated:]

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In order to validate the TGFT standard, two implementations have been designed independantly from the specifications by CNES and CAS. Both implementations have undergone a series of tests to check that:

* the objective of the standard is fulfilled (i.e. transfer data files and their metadata)
* the standard is described clearly enough so that it cannot be interpreted in two different ways.

A first series of five tests have been designed to validate the nominal behaviour. Input data has been defined based on actual expected use cases of the standard. Data files and their metadata have been successfully transferred from one agency to the other, in both ways.

A second series of 17 tests have been designed to validate the proper expression and understanding of assertions in the standard. Voluntary violation of those assertions have been successfully detected by the receiving agency.

Details of the Test Plan are presented in Chapter 2. The Test Report details can be found in Chapter 4.

## Recommendation{If Successful with minor changes to book, use the following paragraphs}

One of the key considerations for any CCSDS recommended standard is whether or not it is sufficiently specific to enable two or more parties to develop implementations and achieve interoperability by reading and following what the recommendation states. When viewed collectively, the test results indicate that the TGFT recommendation does indeed supply sufficient specificity to enable interoperability. This is evident as the independently developed implementations at CNES and CAS achieving successful interoperability over a variety of tests.

Another key consideration for any CCSDS recommended standard is whether or not it is feasible for implementation. A key finding of the set of prototype testing involved is that computing technology could sufficiently be developed to support feasible implementation of the CCSDS TGFT recommendation with operational data.

The prototype development and testing did not require the use of patented technology other than required by the specification.

Although the prototype tests did produce minor corrections to the draft recommendation, in total number they were not significant, as relatively few errors and/or ambiguities were found with the document and schema; those found were corrected. Accordingly, it is the express recommendation of this report that the draft TGFT recommendation is sufficiently mature to be a CCSDS Blue Book.

# TGFT Test report

## Nominal test cases{Insert File in ANNEX and Edit Hyperlinks for “Click Here”}

### Configuration

description of the test framework

service agreement

additional points of agreement

### DDOR DATA

Test Run XML formatted input file [click here](#XML1A)

Test Run XML formatted output file [click here](#Tran1A)

#### Test Run Description

{Describe Test Run here}

#### Test Run Results

### Radiometric Observables

### Trajectory Predictions

### NW Utilisation Schedules

### Pass Report

## Error test cases

### Assertion 3.2.1

Test Run XML formatted file [click here](#XML2A)

#### Test Run Description

{Describe Test Run here}

#### Test Run Results

{Continue for additional Test Runs}

1. ABBREVIATIONS AND ACRONYMS[Add as needed]

CAS Chinese Academy of Sciences (CAS)/China

CCSDS ConsultativeCommitteefor Space Data Systems

CESG CCSDS EngineeringSteering Group

CMC CCSDS Management Council

CSS Cross Support Services

CSSS Cross Support Service System

CSS-SM WG Cross Support Services-Service Management Working Group

CWE CCSDSWorking Environment

FTP File Transfer Protocol

ICD Interface Control Document

ID Identifier

i.e. That is; in other words; that is to say

MOC Mission Operations Center

NASA NationalAeronauticsand Space Administration

NEN Near Earth Network

NOAA National Oceanic and Atmospheric Administration

SN Space Network

SM Service Management

TGFT Terrestrial Generic File Transfer

UML Unified Modeling Language

WG Working Group

XML Extensible Markup Language

1. Test Run input and output