INTERNATIONAL STANDARD

ISO 22672

Second edition
2011-11-15

Space data and information transfer systems — Space link extension (SLE) — Forward space packet service specification

Systèmes de transfert des informations et données spatiales — Extension de liaisons spatiales (SLE) — Spécification d'envoi de données spatiales par paquets

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

Reference number
ISO 22672:2011(E)

© ISO 2011

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

COPYRIGHT PROTECTED DOCUMENT

© ISO 2011

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

© ISO 2011 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 22672 was prepared by the Consultative Committee for Space Data Systems (CCSDS) as CCSDS 912.3-B-2, July 2010 and was adopted without modifications except those stated in Clause 2 of this International Standard by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 13, *Space data and information transfer systems*.

This second edition cancels and replaces the first edition (ISO 22672:2006), which has been technically revised.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

Space data and information transfer systems — Space link extension (SLE) — Forward space packet service specification

1 Scope

1.1 This International Standard defines the Forward Space Packet (FSP) service in conformance with the transfer services specified in CCSDS 910.4-B-2 (equivalent to ISO 15396). The FSP service is a Space Link Extension (SLE) transfer service that enables a mission to send Space Packets to a spacecraft in sequence-controlled or expedited mode.

1.2 This International Standard defines, in an abstract manner, the FSP service in terms of

a) the operations necessary to provide the transfer service,

b) the parameter data associated with each operation,

c) the behaviors that result from the invocation of each operation, and

d) the relationship between, and the valid sequence of, the operations and resulting behaviors.

1.3 It does not specify

a) individual implementations or products,

b) the implementation of entities or interfaces within real systems,

c) the methods or technologies required to radiate Space Packets to a spacecraft and to acquire telemetry frames from the signals received from that spacecraft for extraction of the Operational Control Field,

d) the methods or technologies required for communications, or

e) the management activities necessary to schedule, configure, and control the FSP service.

1.4 The scope and field of application are furthermore detailed in subclauses 1.2 and 1.3 of the enclosed CCSDS publication.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

2 Requirements

Requirements are the technical recommendations made in the following publication (reproduced on the following pages), which is adopted as an International Standard:

CCSDS 912.3-B-2, July 2010, *Space link extension — Forward space packet service specification.*

For the purposes of international standardization, the modifications outlined below shall apply to the specific clauses and paragraphs of publication CCSDS 912.3-B-2.

Pages i to vi

This part is information which is relevant to the CCSDS publication only.

© ISO 2011 – All rights reserved

Page 1-14

Add the following information to the reference indicated:

[1] Document CCSDS 910.4-B-2, October 2005, is equivalent to ISO 15396:2007.

[2] Document CCSDS 301.0-B-3, January 2002, is equivalent to ISO 11104:2003.

[3] Document CCSDS 231.0-B-1, September 2003, is equivalent to ISO 22642:2005.

[4] Document CCSDS 232.0-B-1, September 2003, is equivalent to ISO 22664:2005.

[5] Document CCSDS 232.1-B-1, September 2003, is equivalent to ISO 22667:2005.

[6] Document CCSDS 133.0-B-1, September 2003, is equivalent to ISO 22646:2005.

[7] ISO/IEC 8824-1:2002 has been cancelled and withdrawn. It has been replaced by ISO/IEC 8824-1:2008, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation*.

[9] Document CCSDS 912.1-B-3, July 2010, is equivalent to ISO 22671:2011.

Page I-1

Add the following information to the reference indicated:

[I4] Document CCSDS 201.0-B-3, June 2000, is equivalent to ISO 12171:2002.

[I5] Document CCSDS 202.0-B-3, June 2001, is equivalent to ISO 12172:2003.

[I6] Document CCSDS 202.1-B-2, June 2001, is equivalent to ISO 12173:2003.

[I7] Document CCSDS 203.0-B-2, June 2001, is equivalent to ISO 12174:2003.

3 Revision of publication CCSDS 912.3-B-2

It has been agreed with the Consultative Committee for Space Data Systems that Subcommittee ISO/TC 20/SC 13 will be consulted in the event of any revision or amendment of publication CCSDS 912.3-B-2. To this end, NASA will act as a liaison body between CCSDS and ISO.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

The Consultative Committee for Space Data Systems

Recommendation for Space Data System Standards

SPACE LINK EXTENSION—FORWARD SPACE PACKET SERVICE SPECIFICATION

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

RECOMMENDED STANDARD

CCSDS 912.3-B-2

BLUE BOOK

July 2010

© ISO 2011 – All rights reserved

(Blank page)

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

CCSDS RECOMMENDED STANDARD FOR SLE FSP SERVICE

AUTHORITY

Issue:	Recommended Standard, Issue 2
Date:	July 2010
Location:	Washington, DC, USA

This document has been approved for publication by the Management Council of the Consultative Committee for Space Data Systems (CCSDS) and represents the consensus technical agreement of the participating CCSDS Member Agencies. The procedure for review and authorization of CCSDS documents is detailed in the *Procedures Manual for the Consultative Committee for Space Data Systems*, and the record of Agency participation in the authorization of this document can be obtained from the CCSDS Secretariat at the address below.

This document is published and maintained by:

CCSDS Secretariat
Space Communications and Navigation Office, 7L70
Space Operations Mission Directorate
NASA Headquarters
Washington, DC 20546-0001, USA

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

STATEMENT OF INTENT

The Consultative Committee for Space Data Systems (CCSDS) is an organization officially established by the management of its members. The Committee meets periodically to address data systems problems that are common to all participants, and to formulate sound technical solutions to these problems. Inasmuch as participation in the CCSDS is completely voluntary, the results of Committee actions are termed **Recommended Standards** and are not considered binding on any Agency.

This **Recommended Standard** is issued by, and represents the consensus of, the CCSDS members. Endorsement of this **Recommendation** is entirely voluntary. Endorsement, however, indicates the following understandings:

- Whenever a member establishes a CCSDS-related **standard**, this **standard** will be in accord with the relevant **Recommended Standard**. Establishing such a **standard** does not preclude other provisions which a member may develop.
- Whenever a member establishes a CCSDS-related **standard**, that member will provide other CCSDS members with the following information:
  - The **standard** itself.
  - The anticipated date of initial operational capability.
  - The anticipated duration of operational service.
- Specific service arrangements shall be made via memoranda of agreement. Neither this **Recommended Standard** nor any ensuing **standard** is a substitute for a memorandum of agreement.

No later than five years from its date of issuance, this **Recommended Standard** will be reviewed by the CCSDS to determine whether it should: (1) remain in effect without change; (2) be changed to reflect the impact of new technologies, new requirements, or new directions; or (3) be retired or canceled.

In those instances when a new version of a **Recommended Standard** is issued, existing CCSDS-related member standards and implementations are not negated or deemed to be non-CCSDS compatible. It is the responsibility of each member to determine when such standards or implementations are to be modified. Each member is, however, strongly encouraged to direct planning for its new standards and implementations towards the later version of the Recommended Standard.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

FOREWORD

Through the process of normal evolution, it is expected that expansion, deletion, or modification of this document may occur. This Recommended Standard 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.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

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

Member Agencies

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

Observer Agencies

- Austrian Space Agency (ASA)/Austria.
- Belgian Federal Science Policy Office (BFSPO)/Belgium.
- Central Research Institute of Machine Building (TsNIIMash)/Russian Federation.
- China Satellite Launch and Tracking Control General, Beijing Institute of Tracking and Telecommunications Technology (CLTC/BITTT)/China.
- Chinese Academy of Sciences (CAS)/China.
- Chinese Academy of Space Technology (CAST)/China.
- Commonwealth Scientific and Industrial Research Organization (CSIRO)/Australia.
- CSIR Satellite Applications Centre (CSIR)/Republic of South Africa.
- Danish National Space Center (DNSC)/Denmark.
- Departamento de Ciência e Tecnologia Aeroespacial (DCTA)/Brazil.
- European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)/Europe.
- European Telecommunications Satellite Organization (EUTELSAT)/Europe.
- Geo-Informatics and Space Technology Development Agency (GISTDA)/Thailand.
- 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.
- Ministry of Communications (MOC)/Israel.
- National Institute of Information and Communications Technology (NICT)/Japan.
- National Oceanic and Atmospheric Administration (NOAA)/USA.
- National Space Agency of the Republic of Kazakhstan (NSARK)/Kazakhstan.
- National Space Organization (NSPO)/Chinese Taipei.
- Naval Center for Space Technology (NCST)/USA.
- Scientific and Technological Research Council of Turkey (TUBITAK)/Turkey.
- Space and Upper Atmosphere Research Commission (SUPARCO)/Pakistan.
- Swedish Space Corporation (SSC)/Sweden.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

– United States Geological Survey (USGS)/USA.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

DOCUMENT CONTROL

Document	Title	Date	Status
CCSDS 912.3-B-1	Space Link Extension—Forward Space Packet Service Specification	November 2004	Original issue, superseded
CCSDS 912.3-B-2	Space Link Extension—Forward Space Packet Service Specification, Recommended Standard, Issue 2	July 2010	Current issue: – corrects/clarifies/ updates text and adds the option of picosecond resolution to parameters containing a time value

NOTE – Substantive changes from the previous issue are indicated by change bars in the inside margin.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

CCSDS RECOMMENDED STANDARD FOR SLE FSP SERVICE

CONTENTS

Section Page

1 INTRODUCTION 1-1

1.1 PURPOSE OF THIS RECOMMENDED STANDARD 1-1
1.2 SCOPE 1-1
1.3 APPLICABILITY 1-2
1.4 RATIONALE 1-2
1.5 DOCUMENT STRUCTURE 1-3
1.6 DEFINITIONS, NOMENCLATURE, AND CONVENTIONS 1-5
1.7 REFERENCES 1-14

2 DESCRIPTION OF THE FORWARD SPACE PACKET SERVICE 2-1

2.1 OVERVIEW 2-1
2.2 SPACE LINK EXTENSION REFERENCE MODEL 2-1
2.3 SERVICE MANAGEMENT 2-3
2.4 ARCHITECTURE MODEL—FUNCTIONAL VIEW 2-3
2.5 ARCHITECTURE MODEL—CROSS SUPPORT VIEW 2-8
2.6 FUNCTIONAL DESCRIPTION 2-9
2.7 OPERATIONAL SCENARIO 2-16
2.8 SECURITY ASPECTS OF THE SLE FORWARD SPACE PACKET (FSP) TRANSFER SERVICE 2-17

3 FSP SERVICE OPERATIONS 3-1

3.1 GENERAL CONSIDERATIONS 3-1
3.2 FSP-BIND 3-10
3.3 FSP-UNBIND 3-16
3.4 FSP-START 3-20
3.5 FSP-STOP 3-24
3.6 FSP-TRANSFER-DATA 3-27
3.7 FSP-ASYNC-NOTIFY 3-38
3.8 FSP-SCHEDULE-STATUS-REPORT 3-52
3.9 FSP-STATUS-REPORT 3-56
3.10 FSP-GET-PARAMETER 3-63
3.11 FSP-THROW-EVENT 3-69
3.12 FSP-INVOKE-DIRECTIVE 3-74
3.13 FSP-PEER-ABORT 3-79

4 FSP PROTOCOL 4-1

4.1 GENERIC PROTOCOL CHARACTERISTICS 4-1

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

4.2 FSP SERVICE PROVIDER BEHAVIOR..... 4-4

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

CONTENTS (continued)

Section Page

ANNEX A DATA TYPE DEFINITIONS (NORMATIVE) A-1
ANNEX B FSP QUEUES AND MULTIPLEXING BEHAVIOR DEFINITION (NORMATIVE) B-1
ANNEX C PRODUCTION STATUS (NORMATIVE) C-1
ANNEX D FUNCTIONAL GROUP PRODUCTION REQUIREMENTS FOR FSP (NORMATIVE) D-1
ANNEX E CONFORMANCE MATRIX (NORMATIVE) E-1
ANNEX F INDEX TO DEFINITIONS (INFORMATIVE) F-3
ANNEX G ACRONYMS (INFORMATIVE) G-1
ANNEX H THROW EVENT DEFINITIONS (INFORMATIVE) H-1
ANNEX I INFORMATIVE REFERENCES (INFORMATIVE) I-1

Figure

1-1 SLE Services Documentation 1-4
2-1 Forward Telecommand Functional Groups 2-4
2-2 FSP Service Production and Provision 2-7
2-3 Example of the Management and Provision of FSP Service 2-8
2-4 Simplified FSP Service Provider State Transition Diagram 2-11
2-5 Communications Realization of FSP Service 2-14
B-1 FSP MAP and TC Frame Multiplexing B-1
B-2 MAP and VC Multiplexing B-2
B-3 FSP Queues B-5
C-1 FSP Production Status Diagram C-1

Table

2-1 FSP Service Operations 2-10
3-1 Setting of FSP Service Operation Parameters 3-6
3-2 FSP-BIND Parameters 3-11
3-3 FSP-UNBIND Parameters 3-17
3-4 FSP-START Parameters 3-20
3-5 FSP-STOP Parameters 3-24
3-6 FSP-TRANSFER-DATA Parameters 3-28
3-7 FSP-ASYNC-NOTIFY Parameters 3-38
3-8 FSP-SCHEDULE-STATUS-REPORT Parameters 3-52
3-9 FSP-STATUS-REPORT Parameters 3-56
3-10 FSP-GET-PARAMETER Parameters 3-63
3-11 FSP Service Parameters 3-64
3-12 FSP-THROW-EVENT Parameters 3-70

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

CONTENTS (continued)

Table Page

3-13 FSP-INVOKE-DIRECTIVE Parameters 3-74
3-14 FSP-PEER-ABORT Parameters 3-79
4-1 Provider Behavior 4-6
4-2 Event Description References 4-10
4-3 Predicate Definitions 4-11
4-4 Boolean Flags 4-11
4-5 Compound Action Definitions 4-12
C-1 Production Status Transitions C-2
C-2 Effects of Production Status on Operations C-4
D-1 Forward CLTU Generation Aggregate Production Status D-3
D-2 Forward TC VC Data Insertion Aggregate Production Status D-5
E-1 Conformance Matrix for FSP Service (Operations) E-1
E-2 Conformance Matrix for FSP Service (Other Requirements) E-2
H-1 Throw Event Examples H-1

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

1 INTRODUCTION

1.1 PURPOSE OF THIS RECOMMENDED STANDARD

This Recommended Standard defines the Forward Space Packet (FSP) service in conformance with the transfer services specified in reference [1], *Cross Support Reference Model—Part 1: SLE Services*. The FSP service is a Space Link Extension (SLE) transfer service that enables a mission to send Space Packets to a spacecraft in sequence-controlled or expedited mode.

1.2 SCOPE

This Recommended Standard defines, in an abstract manner, the FSP service in terms of:

a) the operations necessary to provide the transfer service;

b) the parameter data associated with each operation;

c) the behaviors that result from the invocation of each operation; and

d) the relationship between, and the valid sequence of, the operations and resulting behaviors.

It does not specify:

a) individual implementations or products;

b) the implementation of entities or interfaces within real systems;

c) the methods or technologies required to radiate Space Packets to a spacecraft and to acquire telemetry frames from the signals received from that spacecraft for extraction of the Operational Control Field;

d) the methods or technologies required for communications; or

e) the management activities necessary to schedule, configure, and control the FSP service.

NOTE – While the FSP service as described in reference [1] is conceived to handle a variety of packet data structures, this version of the FSP Recommended Standard is restricted to the handling of Space Packets as defined in reference [6].

This version of the FSP Recommended Standard is specific to the transfer of Space Packets to be transmitted via the Telecommand protocol stack as defined in references [3], [4], and [5]. The Cross Support Reference Model (reference [1]) specifies that the FSP service may also be used in conjunction with the Advanced Orbiting System protocol stack, but that mode of operation is outside the scope of this version of the Recommended Standard.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

The FSP service is provided in the online delivery mode, as defined in reference [1]. The offline delivery mode is the subject of further study.

1.3 APPLICABILITY

1.3.1 APPLICABILITY OF THIS RECOMMENDED STANDARD

This Recommended Standard provides a basis for the development of real systems that implement the FSP service. Implementation of the FSP service in a real system additionally requires the availability of a communications service to convey invocations and returns of FSP service operations between FSP service users and providers. This Recommended Standard requires that such a communications service ensures that invocations and returns of operations are transferred:

a) in sequence;

b) completely and with integrity;

c) without duplication;

d) with flow control that notifies backpressure to the application layer in the event of congestion; and

e) with notification to the application layer in the event that communications between the FSP service user and the FSP service provider are disrupted, possibly resulting in a loss of data.

It is the specific intent of this Recommended Standard to define the FSP service in a manner that is independent of any particular communications services, protocols, or technologies.

1.3.2 LIMITS OF APPLICABILITY

This Recommended Standard specifies the FSP service that may be provided by an SLE System for inter-Agency cross support. It is neither a specification of, nor a design for, real systems that may be implemented for the control and monitoring of existing or future missions.

1.4 RATIONALE

The goal of this Recommended Standard is to create a standard for interoperability between the tracking stations and/or ground data handling systems of various agencies and the users of forward services.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

1.5 DOCUMENT STRUCTURE

1.5.1 ORGANIZATION

This Recommended Standard is organized as follows:

a) section 1 provides the purpose, scope, applicability, and rationale of this Recommended Standard and lists definitions, nomenclature, conventions, and references used throughout the Recommended Standard;

b) section 2 provides an overview of the FSP service including a functional description, the service management context, and protocol considerations;

c) section 3 specifies the operations of the FSP service;

d) section 4 specifies the dynamic behavior of the FSP service in terms of the state transitions of the FSP service provider;

e) annex A provides a formal specification of FSP service data types, using the Abstract Syntax Notation One (ASN.1);

f) annex B provides a specification of the multiplexing between concurrent FSP service instances sharing the same TC Virtual Channel (VC) as well as the multiplexing between TC VCs sharing the same physical space link data channel;

g) annex C presents the FSP production status and its transitions;

h) annex D defines the production requirements the FSP service imposes on the forward Functional Groups;

i) annex E provides a conformance matrix that defines what capabilities must be provided for an implementation to be considered compliant with this Recommended Standard;

j) annex F lists all terms used in this document and identifies where they are defined;

k) annex G lists all acronyms used within this document;

l) annex H contains examples of usage of the FSP-THROW-EVENT operation;

m) annex I contains a list of informative references.

1.5.2 SLE SERVICES DOCUMENTATION TREE

This Recommended Standard is based on the architectural model for cross support defined in reference [1]. It expands upon the concept of an SLE Transfer Service as interactions between an SLE Mission User Entity (MUE) and an SLE Transfer Service provider for the purpose of providing the FSP Transfer Service.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

This Recommended Standard is part of a suite of documents specifying the SLE services. The SLE services constitute one of the three types of Cross Support Services:

a) Part 1: SLE Services;

b) Part 2: Ground Communications Services;

c) Part 3: Ground Domain Services.

The basic organization of the SLE services documentation is shown in figure 1-1. The documents are described in the following paragraphs.

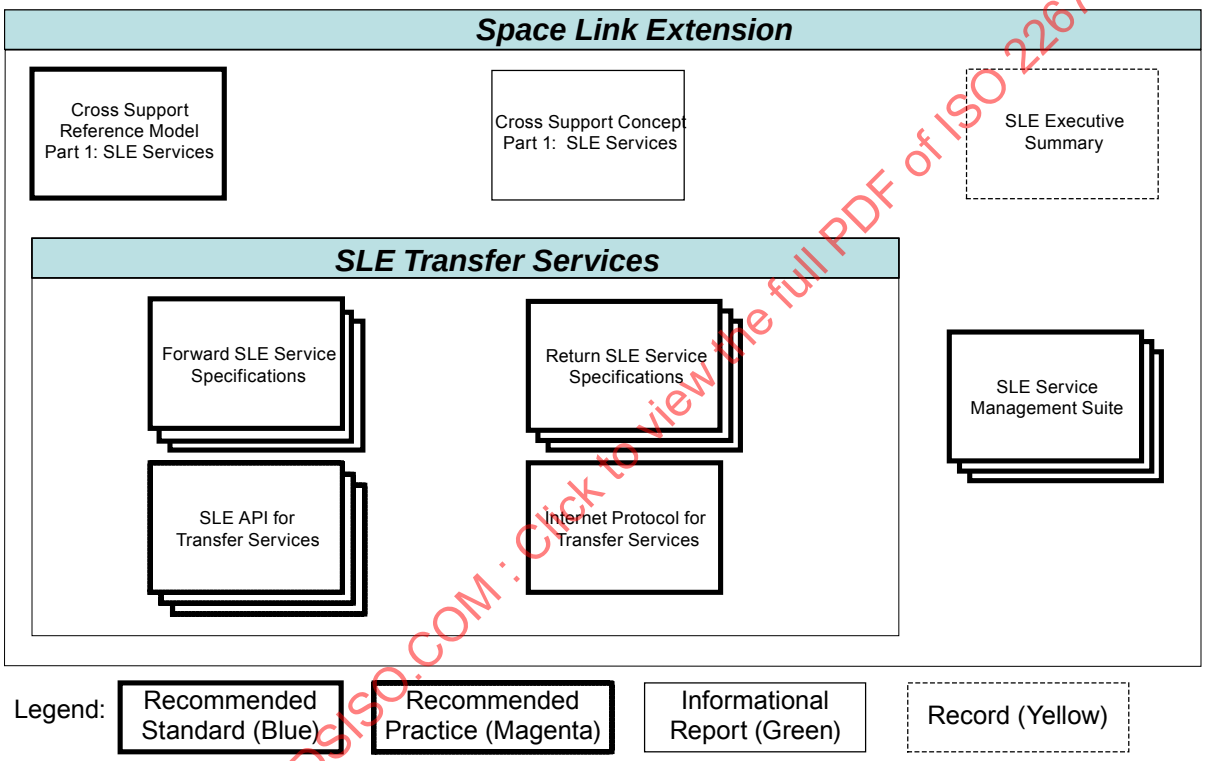

Figure 1-1: SLE Services Documentation

a) *Cross Support Concept — Part 1: Space Link Extension Services* (reference [I3]): a Report introducing the concepts of cross support and SLE services;

b) *Cross Support Reference Model — Part 1: Space Link Extension Services* (reference [1]): a Recommended Standard that defines the reference model that provides a common framework and terminology for the specification of SLE services;

c) *Return SLE Transfer Service Specifications:* a set of Recommended Standards that will provide specification of all return link SLE transfer services.

d) *Forward SLE Transfer Service Specifications:* a set of Recommended Standards that will provide specification of all forward link SLE transfer services (this Recommended Standard is one of the specifications in that set);

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

e) *SLE API for Transfer Services Specifications:* a set of Recommended Practices that provide specifications of an Application Program Interface; a set of Recommended Standards that provide specifications of an Application Program Interface and a mapping to TCP/IP as underlying communications service for SLE services;

f) *Internet Protocol for Transfer Services:* defines a protocol for transfer of SLE Protocol Data Units using TCP/IP as underlying communications service for SLE services;

g) *SLE Service Management Specification Suite*: a set of Recommended Standards that establish the basis for SLE service management.

1.6 DEFINITIONS, NOMENCLATURE, AND CONVENTIONS

1.6.1 DEFINITIONS

1.6.1.1 Definitions from Open Systems Interconnection (OSI) Basic Reference Model

This Recommended Standard makes use of a number of terms defined in reference [8]. The use of those terms in this Recommended Standard shall be understood in a generic sense, i.e., in the sense that those terms are generally applicable to technologies that provide for the exchange of information between real systems. Those terms are:

a) abstract syntax;

b) application entity;

c) application layer;

d) flow control;

e) Open Systems Interconnection (OSI);

f) real system;

g) service access point (SAP).

1.6.1.2 Definitions from Abstract Syntax Notation One

This Recommended Standard makes use of the following terms defined in reference [7]:

a) Abstract Syntax Notation One (ASN.1);

b) object identifier;

c) (data) type;

d) (data) value.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

NOTE – In annex A of this Recommended Standard, ASN.1 is used for specifying the abstract syntax of the invocations and returns of the operations of the FSP service. The use of ASN.1 as a descriptive language is intended to support the specification of the abstract FSP service; it is not intended to constrain implementations. In particular, there is no requirement for implementations to employ ASN.1 encoding rules. ASN.1 is simply a convenient tool for formally describing the abstract syntax of the invocations and returns of the FSP service.

1.6.1.3 Definitions from TC Synchronization and Channel Coding

This Recommended Standard makes use of the following term defined in reference [3]:

Communications Link Transmission Unit (CLTU).

1.6.1.4 Definitions from TC Space Data Link Protocol

This Recommended Standard makes use of the following terms defined in reference [4]:

a) AD, BD, BC;

b) Communications Link Control Word (CLCW);

c) Communications Operation Procedure (COP);

d) Control Word Type;

e) Frame Operation Procedure (FOP);

f) Frame Sequence Number;

g) Multiplexer Access Point (MAP);

h) Operational Control Field (OCF);

i) Segment;

j) Telecommand Transfer Frame (TC Transfer Frame or TC frame);

k) Virtual Channel (VC).

1.6.1.5 Definitions from Communications Operation Procedure-1

This Recommended Standard makes use of the following terms defined in reference [5]:

a) FOP_Sliding_Window_Width;

b) Receiver_Frame_Sequence_Number V(R);

c) Timeout_Type;

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

d) Transmitter_Frame_Sequence_Number V(S);

e) T1_Initial.

1.6.1.6 Definitions from Space Packet Protocol

This Recommended Standard makes use of the following terms defined in reference [6]:

a) Application Process Identifier (APID);

b) Space Packet.

1.6.1.7 Definitions from SLE Reference Model

This Recommended Standard makes use of the following terms defined in reference [1]:

a) abstract binding;

b) abstract object;

c) abstract port;

d) abstract service;

e) Forward CLTU SLE data channel (Forward CLTU data channel);

f) Forward Space Packet channel (FSP channel);

g) Forward Space Packet service (FSP service);

h) Forward Telecommand Frame SLE data channel (Forward TC Frame data channel);

i) invoker;

j) Mission Data Operation System (MDOS);

k) Mission User Entity (MUE);

l) offline delivery mode;

m) online delivery mode;

n) operation;

o) Operational Control Field SLE data channel (OCF data channel);

p) performer;

q) physical channel;

r) service agreement;

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

s) service provider (provider);

t) service user (user);

u) SLE Complex;

v) SLE Complex Management;

w) SLE data channel;

x) SLE Functional Group (SLE-FG);

y) SLE protocol data unit (SLE-PDU);

z) SLE service data unit (SLE-SDU);

aa) SLE service package;

bb) SLE transfer service instance;

cc) SLE transfer service production;

dd) SLE transfer service provision;

ee) SLE Utilization Management;

ff) space link;

gg) space link data channel;

hh) space link data unit (SL-DU);

ii) space link session.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

1.6.1.8 Additional Definitions

For the purposes of this Recommended Standard, the following definitions also apply.

1.6.1.8.1 Acknowledged (Space Packet)

A Space Packet is said to be acknowledged when evaluation of the CLCWs returned by the space element shows that all TC frames containing parts of the Space Packet reported have been acknowledged by the space element.

NOTE — This status applies only to the sequence-controlled transmission mode (AD). Although a Space Packet is 'acknowledged', packet re-assembly and/or execution may still fail. This can only be determined by examining telemetry.

© ISO 2011 – All rights reserved

1.6.1.8.2 Association

An association is a cooperative relationship between an SLE service-providing application entity and an SLE service-using application entity. An association is formed by the exchange of SLE protocol data units through the use of an underlying communications service.

1.6.1.8.3 CLTU Transfer Data SLE-SDU

A CLTU Transfer Data SLE-SDU contains a CLTU plus information (see D1.2.2.2) required by the Forward TC Space Link Processing SLE Functional Group (see 2.4.1.4) to process that CLTU. In the context of the FSP SLE transfer service, the CLTU Transfer Data SLE-SDU is generated by the Forward CLTU Generation SLE Functional Group (see 2.4.1.3).

NOTE – When the F-CLTU transfer service is used, the CLTU Transfer Data SLE-SDU is carried (along with other information) in the CLTU-TRANSFER-DATA invocation.

1.6.1.8.4 Communications Service

A communications service is a capability that enables an SLE service-providing application entity and an SLE service-using application entity to exchange information.

NOTE – If an SLE service user and an SLE service provider are implemented using different communications services, then interoperability between them is possible only by means of a suitable gateway. Adherence to this Recommended Standard ensures, at least in principle, that it is possible to construct such a gateway.

1.6.1.8.5 Confirmed Operation

A confirmed operation is an operation that requires the performer to return a report of its outcome to the invoker.

1.6.1.8.6 Initiator

The initiator is the object that issues the request to bind to another object (the responder).

NOTE – In other words, the initiator is always the invoker of the request to bind to another object. Therefore, in the context of the request to bind, the terms ‘initiator’ and ‘invoker’ refer to the same object and are synonyms.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

1.6.1.8.7 Invocation

The invocation of an operation is the making of a request by an object (the invoker) to another object (the performer) to carry out the operation.

1.6.1.8.8 Parameter

A parameter of an operation is data that may accompany the operation's invocation or return.

NOTE – The term parameter is also used to refer to mission-dependent configuration information used in the production or provision of the service.

1.6.1.8.9 Performance

The performance of an operation is the carrying out of the operation by an object (the performer).

1.6.1.8.10 Port Identifier

A port identifier identifies a source or a destination in a communications system.

NOTE – See 2.6.4.5 for more information.

1.6.1.8.11 Radiated (Space Packet)

A Space Packet is said to be radiated when, based on the ground equipment monitoring, the FSP production process can assume that all the CLTUs containing parts of the Space Packet reported have been transmitted to the spacecraft.

1.6.1.8.12 Responder

The responder is the object that receives a request to bind and completes the binding (if possible) with the initiator in order for a service association to exist between the two objects.

NOTE – In other words, the responder is always the performer of the binding. Therefore, in the context of binding, the terms 'responder' and 'performer' refer to the same object and are synonyms.

1.6.1.8.13 Return

The return of an operation is a report, from the performer to the invoker, of the outcome of the performance of the operation.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

1.6.1.8.14 Service Instance Provision Period

A service instance provision period is the time during which a service instance (i.e., the capability to transfer one or more SLE data channels of a given type) is scheduled to be provided.

1.6.1.8.15 TC Frame Transfer Data SLE-SDU

A TC Frame Transfer Data SLE-SDU contains a TC Frame plus information (see D1.3.2.2) required by the Forward CLTU Generation SLE Functional Group (see 2.4.1.3) to process that TC frame. In the context of the FSP SLE transfer service, the TC Frame Transfer Data SLE-SDU is generated by the Forward TC VC Data Insertion SLE Functional Group (see 2.4.1.2).

1.6.1.8.16 Unconfirmed Operation

An unconfirmed operation is an operation that does not require a report of its outcome to be returned to the invoker by the performer.

1.6.2 NOMENCLATURE

The following nomenclature applies throughout this Recommended Standard:

a) the words ‘shall’ and ‘must’ imply a binding and verifiable specification;

b) the word ‘should’ implies an optional, but desirable, specification;

c) the word ‘may’ implies an optional specification;

d) the words ‘is’, ‘are’, and ‘will’ imply statements of fact.

1.6.3 CONVENTIONS

1.6.3.1 Specification of Operations

1.6.3.1.1 General

Section 3 of this Recommended Standard specifies the operations that constitute the FSP service. The specification of each operation is divided into subsections as follows:

1.6.3.1.2 Purpose Subsection

The Purpose subsection briefly describes the purpose and functioning of the operation. Additionally, it indicates whether the operation may be invoked by the user, provider, or

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

both; whether the operation is confirmed or unconfirmed; and whether there are any constraints on when the operation may be invoked.

1.6.3.1.3 Invocation, Return, and Parameters Subsection

The Invocation, Return, and Parameters subsection describes the parameters associated with each operation, including their semantics. A table accompanying the description of each operation lists all parameters associated with the operation and, for both the invocation and return, whether the parameter is always present, always absent, or conditionally present.

For parameters that are conditionally present, the parameter description specifies the conditions for the presence or absence of the parameter. The condition is generally based on the value of another parameter in the same invocation or return; for example, in the return of an operation, the `diagnostic` parameter is present if and only if the value of the `result` parameter is 'negative result'. For a conditional parameter in a return, the condition may be based on the value of a parameter in the corresponding invocation.

In the table, the following convention is used to indicate whether a parameter is always present, always absent, or conditionally present:

M	always present (mandatory)
C	conditionally present
Blank	always absent

NOTE – Even though a parameter may be characterized as always present, its description may specify that its value is permitted to be 'null' or 'unused' or the like.

1.6.3.1.4 Effects Subsection

The Effects subsection describes the effects an operation has on the invoker, the performer, the association between them, or any combination thereof. The details of how those effects occur or the mechanisms used are outside the scope of this Recommended Standard.

1.6.3.2 Typographic Conventions

Typographic conventions used in this Recommended Standard are described in the following subsections.

1.6.3.2.1 Operation Names

Names of FSP service operations appear in uppercase and begin with the characters 'FSP-' (e.g., FSP-TRANSFER-DATA).

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

1.6.3.2.2 Parameter Names

In the main text, names of parameters of FSP service operations appear in lowercase and are typeset in a fixed-width font (e.g., `responder-port-identifier`). In annex A, the corresponding name is formed by omitting any hyphens contained in the name and using mixed-case (e.g., `responderPortIdentifier`).

1.6.3.2.3 Value Names

The values of many parameters discussed in this Recommended Standard are represented by names. In the main text, these names are shown in single quotation marks (e.g., 'no such service instance'). The corresponding name in annex A is formed by omitting any hyphens or white space contained in the name and using mixed-case (e.g., `noSuchServiceInstance`). The actual value associated with the name is constrained by the type of the parameter taking on this value. Parameter types are specified in annex A of this Recommended Standard.

NOTE – The name of a value does not imply anything about its type. For example, the value 'no such service instance' has the appearance of a character string but might be assigned to a parameter whose type is integer.

1.6.3.2.4 State Names

This Recommended Standard specifies the states of FSP service providers. States may be referred to by number (e.g., state 3) or by name. State names are always shown in single quotation marks (e.g., 'active').

1.6.3.2.5 SLE-PDU Names

The names of SLE-PDUs appear in mixed-case (e.g., fspBindInvocation).

1.6.3.2.6 Data Type Definitions

Data type definitions for the FSP service are presented in annex A in the form of a set of ASN.1 modules. Regardless of the conventions used elsewhere in this Recommended Standard, the text of the ASN.1 modules is typeset entirely in a fixed-width font.

1.6.3.3 Other Conventions

This Recommended Standard uses the conventions specified in reference [1].

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

1.7 REFERENCES

The following documents contain provisions which, through reference in this text, constitute provisions of this Recommended Standard. At the time of publication, the editions indicated were valid. All documents are subject to revision, and users of this Recommended Standard 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 Recommended Standards.

NOTES

1 A list of informative references is provided in annex I.

2 This document takes advantage of the harmonized terminology introduced by restructured documentation of the space link protocols (references [3], [4], [5], and [6]). From an interoperability point of view, they do not introduce any incompatibilities with respect to the original set of space link protocol documents (references [I4], [I5], [I6], and [I7]).

[1] *Cross Support Reference Model—Part 1: Space Link Extension Services*. Recommendation for Space Data System Standards, CCSDS 910.4-B-2. Blue Book. Issue 2. Washington, D.C.: CCSDS, October 2005.

[2] *Time Code Formats*. Recommendation for Space Data System Standards, CCSDS 301.0-B-3. Blue Book. Issue 3. Washington, D.C.: CCSDS, January 2002.

[3] *TC Synchronization and Channel Coding*. Recommendation for Space Data System Standards, CCSDS 231.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[4] *TC Space Data Link Protocol*. Recommendation for Space Data System Standards, CCSDS 232.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[5] *Communications Operation Procedure-1*. Recommendation for Space Data System Standards, CCSDS 232.1-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[6] *Space Packet Protocol*. Recommendation for Space Data System Standards, CCSDS 133.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[7] *Information Technology—Open Systems Interconnection—Specification of Abstract Syntax Notation One (ASN.1)*. International Standard, ISO/IEC 8824-1:2002. 3rd ed. Geneva: ISO, 2002.

[8] *Information Technology—Open Systems Interconnection—Basic Reference Model: The Basic Model*. International Standard, ISO/IEC 7498-1:1994. 2nd ed. Geneva: ISO, 1994.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

[9] *Space Link Extension—Forward CLTU Service Specification*. Recommendation for Space Data System Standards, CCSDS 912.1-B-3. Blue Book. Issue 3. Washington, D.C.: CCSDS, July 2010.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

(Blank page)

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

2 DESCRIPTION OF THE FORWARD SPACE PACKET SERVICE

2.1 OVERVIEW

The FSP service enables the user of the service to send Space Packets (reference [6]) to a spacecraft. The FSP service user submits Space Packets encapsulated in SLE-SDUs by means of the FSP-TRANSFER-DATA operation.

The FSP service provider checks the Packet Primary Header to determine if the Packet sent by the user complies with the applicable constraints, e.g., that the Packet has an Application Process Identifier (APID) that falls into the set of APIDs the user is authorized to access. The FSP service provider does not otherwise interpret, interrogate, or modify the content of the Packet. Telecommand Packets having valid Packet Primary Header information are transmitted bit for bit as received from the service user.

The FSP service passes its Space Packets to a production process that collectively encapsulates the Space Packets into TC Transfer Frames (i.e., one or more frames), encodes the frames into Communication Link Transmission Units (CLTUs), and radiates the CLTUs to the receiving spacecraft.

The operations defined in section 3 of this Recommended Standard enable an FSP service user to interact with an FSP service provider to:

a) establish an association between the user and the provider;

b) send annotated Space Packets to the provider;

c) obtain notifications and reports regarding status, configuration, and performance of the service;

d) temporarily stop and later re-start the sending of Space Packets;

e) change the values of certain parameters (such as `transmission-mode`) that affect the behavior of the service; and

f) release an association.

The provision of FSP service for access to one or more TC VCs by one or more MUEs service users is permitted. Each pairing of TC VC and MUE constitutes a separate service instance.

2.2 SPACE LINK EXTENSION REFERENCE MODEL

2.2.1 INTRODUCTION

The FSP service is specified within the framework defined by the SLE Reference Model (reference [1]). The following subsections summarize selected concepts from the SLE Reference Model.

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

2.2.2 ABSTRACT OBJECT

An abstract object is a functional entity that interacts with other abstract objects. Objects are of different types, which determine their function and behavior. An object is characterized by its interfaces (one or more), which are called abstract ports, and the operations that are made available through those interfaces.

2.2.3 ABSTRACT SERVICE

An abstract service is the capability provided by a set of operations that an abstract object exposes at one or more of its abstract ports.

NOTE – The concept of an abstract service is to be distinguished from the concept of an (N)-service as defined in the OSI Basic Reference Model (reference [8]). The definition of (N)-service is in terms of the capability provided by one layer in the OSI architecture to the layer above it. The definition of abstract service is in terms of the capability provided by one abstract object to another abstract object. In a cross support scenario, where one Agency is providing an SLE service to another Agency, the object that provides the service typically is associated with one Agency, and the object that uses the service typically is associated with the other Agency.

2.2.4 ABSTRACT BINDING

When two abstract ports have an association established between them, they are said to be bound. The act of establishing such an association is called abstract binding. One object (the initiator) invokes a bind operation, which is accepted (or rejected) by another object (the responder).

2.2.5 SERVICE USER/PROVIDER

An object that offers a service to another by means of one or more of its ports is called a service provider (provider). The other object is called a service user (user). An object may be a provider of some services and a user of others.

The terms user and provider are used to distinguish the roles of two interacting objects. In this Recommended Standard, when two objects are involved in provision of a service, the object closer to the space link is considered to be the provider of the service, and the object further from the space link is considered to be the user.

2.2.6 OPERATION

An operation is a procedure or task that one object (the invoker) can request of another (the performer) through a bound port pair.

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

The terms invoker and performer are used to describe the interaction between two objects as the operations that constitute the service occur. One object invokes an operation that is performed by the other. For most services, each object invokes some operations and performs others.

2.3 SERVICE MANAGEMENT

SLE service management determines the number and schedule of FSP service instances to be provided, the resources required to enable those service instances, and the initial configuration of all service instances and their supporting resources. SLE service management is the subject of separate CCSDS Recommended Standards.

The SLE Reference Model (reference [1]) distinguishes between service provision and service production:

a) Service provision makes available to the user the operations necessary to obtain the service;

b) Service production transforms the SLE Forward Space Packet channel to the RF channel.

Certain configuration parameters are associated with the provision of FSP service, while others are associated with production (see 2.4.1). Changes to FSP provision configuration parameters (e.g., the frequency at which status reports shall be generated) affect only a single service instance; the values of such parameters are initialized by service management when the service instance is created but may be modified subsequently by the user through FSP operations specified in this Recommended Standard. Changes to FSP production configuration parameters (e.g., maximum Packet Data Length, VC multiplexing scheme) potentially affect multiple service instances or potentially impact SLE Complex resources and other concurrent service instances; consequently, with one exception outlined below those parameters may be modified only through service management.

For each VC, one service instance can invoke Frame Operation Procedure (FOP) directives, even though FOP directives will in general affect multiple service instances. Some FOP directives also affect the space element and are therefore regarded to be integral part of a telecommand service and not part of the management of such service.

2.4 ARCHITECTURE MODEL—FUNCTIONAL VIEW

2.4.1 FORWARD TELECOMMAND FUNCTIONAL GROUPS

2.4.1.1 General

As defined in reference [1], the production of the FSP service involves three SLE-FGs: the Forward TC Space Link Processing SLE-FG, the Forward Communications Link Transmission Unit (CLTU) Generation SLE-FG, and the Forward TC VC Data Insertion

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

SLE-FG. Figure 2-1 illustrates these three Functional Groups and their interconnections in support of the FSP service.

NOTES

1 Figure 2-1 shows two types of connections for transporting data channels between the SLE Functional Groups. If a data channel is transported between Functional Groups that are implemented by different Complexes, the transfer is accomplished via an SLE transfer service, as indicated by the Transfer User (T-U) and Transfer Provider (T-P) port pairs. If a data channel is transported between Functional Groups that are implemented by the same Complex, the transfer is accomplished via a locally-defined connection within the Complex, as indicated by the unlabeled port pairs with smaller port icons.

2 Figure 2-1 shows a Fwd TC Frame (for Forward Telecommand Frame) SLE transfer service between the Forward CLTU Generation SLE-FG and the Forward TC VC Data Insertion SLE-FG. The Forward TC Frame (FTCF) SLE transfer service is formally identified in reference [1], As of this version of the FSP Recommended Standard there is no Recommended Standard for the FTCF SLE transfer service. Unless and until a Forward TC Frame Recommended Standard is published by CCSDS, the Forward CLTU Generation and the Forward TC VC Data Insertion SLE-FGs must be assumed to be implemented by the same Complex and exchange the Forward TC Frame SLE data channel via locally-defined means.

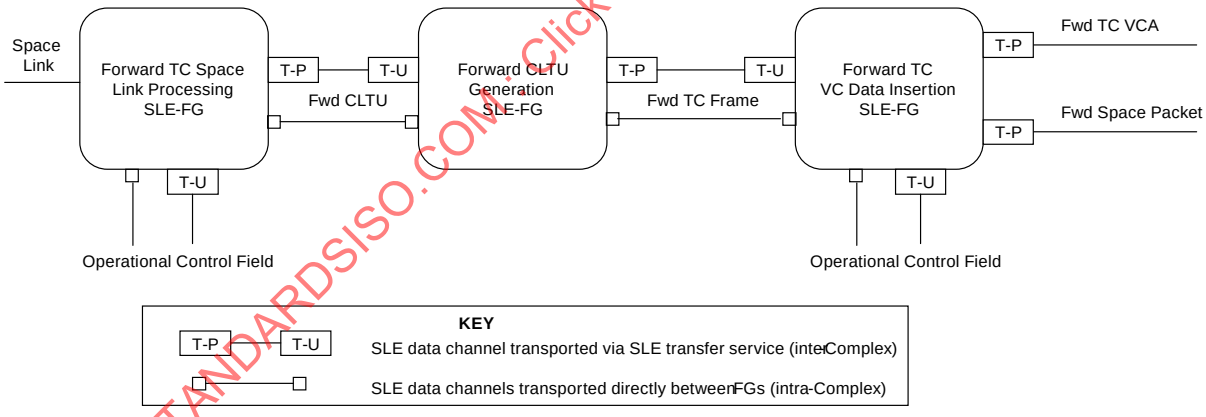

Figure 2-1: Forward Telecommand Functional Groups

2.4.1.2 Forward TC VC Data Insertion SLE Functional Group

The Forward TC-VC Data Insertion SLE Functional Group (SLE-FG) shown in figure 2-1 provides and produces the FSP service and the Forward Telecommand Virtual Channel Access (TC VCA) service. The latter service is not addressed by this Recommended Standard, but is defined in reference [1].

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

As described in reference [1], the Forward TC VC Data Insertion SLE-FG consumes one or more FSP data channels consisting of a stream of FSP SLE-SDUs and supplies the Forward Telecommand Frame SLE data channel.

The Forward TC VC Data Insertion SLE-FG performs the following functions with respect to the FSP service (see references [4], [5], and [6]):

a) For each FSP service instance, the Forward TC VC Data Insertion SLE-FG consumes one FSP data channel, extracts the Space Packets from the FSP SLE-SDUs in each data channel, blocks or segments the Space Packets into TC frames, and supplies the Forward TC Frame SLE data channel in the form of individual TC frames. The FSP service does not support blocking of TC frames. If the TC frame is to be sent using the sequence-controlled service option of the Communications Operation Procedure (COP), the TC VC Data Insertion SLE-FG sets the Frame Sequence Number and buffers a copy of the TC frame.

b) The Forward TC VC Data Insertion SLE-FG consumes Operational Control Field (OCF) SLE data channels (Control Word Type 0 only) and extracts the Communications Link Control Words (CLCWs). Based on the values in the CLCW, the Forward TC VC Data Insertion SLE-FG retransmits or deletes buffered TC frames.

c) The Forward TC VC Data Insertion SLE-FG supplies the Forward TC frame SLE data channels to the Forward CLTU Generation SLE-FG through a locally-defined connection (if both FGs are implemented by the same Complex) or an online instance of the FTCF SLE transfer service (if the FGs are implemented by different Complexes – however, see NOTE 2 under 2.4.1).

In addition to encapsulating the Space Packets, the SLE-SDUs contain control and annotation data that specify production time and other parameters to aid in processing the data. The SLE-SDUs containing Space Packets are described in 3.6, which defines the FSP-TRANSFER-DATA operation.

2.4.1.3 Forward CLTU Generation SLE Functional Group

As defined in reference [1], the Forward CLTU Generation SLE-FG shown in figure 2-1 provides the FTCF SLE transfer service (see NOTE 2 under 2.4.1).

As defined in reference [1], the Forward CLTU Generation SLE-FG performs the following production functions with respect to the FSP service (see reference [3]):

a) The Forward CLTU Generation SLE-FG consumes Forward Telecommand Frame SLE data channels supplied as blocks of one or more TC Frames for transmission via a single CLTU.

b) The Forward CLTU Generation SLE-FG optionally randomizes the block of TC frames to ensure a sufficient bit transition density.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

c) The Forward CLTU Generation SLE-FG BCH-encodes each block of TC frames into a set of BCH Codeblocks.

d) The Forward CLTU Generation SLE-FG forms a CLTU by appending Start and Tail sequences to the BCH Codeblocks representing the block of TC frames.

e) The Forward CLTU Generation SLE-FG injects the resulting CLTU into its respective CLTU SLE data channel.

f) The Forward CLTU Generation SLE-FG supplies the CLTU SLE data channels to the Forward TC Space Link Processing SLE-FG either through a locally-defined connection (only if both FGs are implemented by the same Complex) or through an online instance of the Forward CLTU SLE transfer service [9] (if the FGs are implemented by different Complexes and optionally if both FGs are implemented by the same Complex).

2.4.1.4 Forward TC Space Link Processing SLE Functional Group

As defined in reference [1], the Forward TC Space Link SLE-FG shown in figure 2-1 provides the Forward CLTU SLE transfer service.

As defined in reference [1], the Forward TC Space Link SLE-FG performs the following production functions with respect to the FSP service (see reference [3]):

a) The Forward TC Space Link SLE-FG consumes a CLTU SLE data channel.

b) The Forward TC Space Link SLE-FG consumes OCF SLE data channels (Control Word Type 0 only) and extracts the CLCWs. Based on the values in the CLCW, the Forward TC Space Link SLE-FG determines whether the physical channel is available.

c) The Forward TC Space Link SLE-FG generates Acquisition and Idle Sequences on the asynchronous physical channel in accordance with the Physical Link Operations Procedure (PLOP) in effect.

d) The Forward TC Space Link SLE-FG injects the CLTUs into the asynchronous physical channel.

e) The Forward TC Space Link SLE-FG utilizes the underlying antenna steering capabilities provided by the Complex.

f) The Forward TC Space Link SLE-FG modulates the resulting stream of bits to RF and radiates the signal to the spacecraft.

2.4.2 FSP SERVICE PRODUCTION AND PROVISION

One instance of FSP service production (or, one instance of the TC-VC Data Insertion SLE FG) may be associated with multiple FSP service instances. FSP **production** is concerned

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

with the extraction of Space Packets from concurrent streams of the SLE-SDUs and their multiplexing onto the space link according to the Space Packet control and annotation information in the SLE-SDU and the configuration set up by service management. This process is independent of any particular instance of service and is specified in detail in annex B. FSP service **provision** is concerned with receiving one stream of SLE-PDUs from an FSP service user. Service provision addresses such matters as when service is provided (e.g., service start and stop times), and how service is provided (e.g., which events are notified to the user).

The SLE-SDUs consumed by FSP service production are sent by the service user by means of the FSP service operations defined in section 3. These operations also provide additional functionality to facilitate the provision of FSP service, i.e. enabling the exchange of SLE-SDUs across a remote interface. The FSP service operations are realized as SLE protocol data units (SLE-PDUs), which are exchanged between the FSP service provider and the FSP service user by means of an underlying communications service. The general relationship between SL-DUs, SLE-SDUs, and SLE-PDUs is illustrated in figure 2-2. This figure assumes that as in the example shown in figure 2-3 all forward service production is implemented within a single SLE Complex. This may or may not be the case. For instance, one SLE Complex could host the FSP and TC Frame production process and use the Forward CLTU service provided by another SLE Complex. In that case, the latter SLE Complex would generate the SL-DUs while the two SLE Complexes would exchange Forward CLTU SLE-PDUs.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

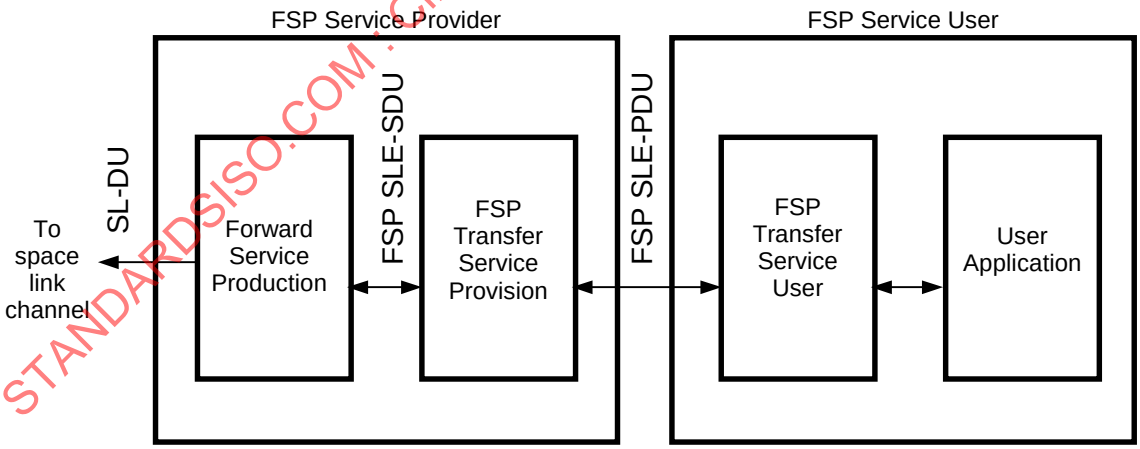

Figure 2-2: FSP Service Production and Provision

Production of the FSP service by the provider occurs during the space link session. It will in general largely overlap with service provisioning. Production status affects the provision of the service, as specified in sections 3 and 4, and reviewed in annex C.

© ISO 2011 – All rights reserved

2.5 ARCHITECTURE MODEL—CROSS SUPPORT VIEW

The management and control of the production and provisioning of the SLE transfer services is described in general terms in reference [1]. Figure 2-3 shows an example operational scenario and the related binding of the transfer and management ports. This example shows an SLE Complex with one Forward TC VC Data Insertion SLE-FG instance providing two instances of FSP service to MUEs in a Mission Data Operations System (MDOS). The Forward TC VC Data Insertion SLE-FG transfers the TC frames to the Forward CLTU Generation SLE-FG, which in turn transfers the CLTUs to the Forward TC Space Link Processing SLE-FG.

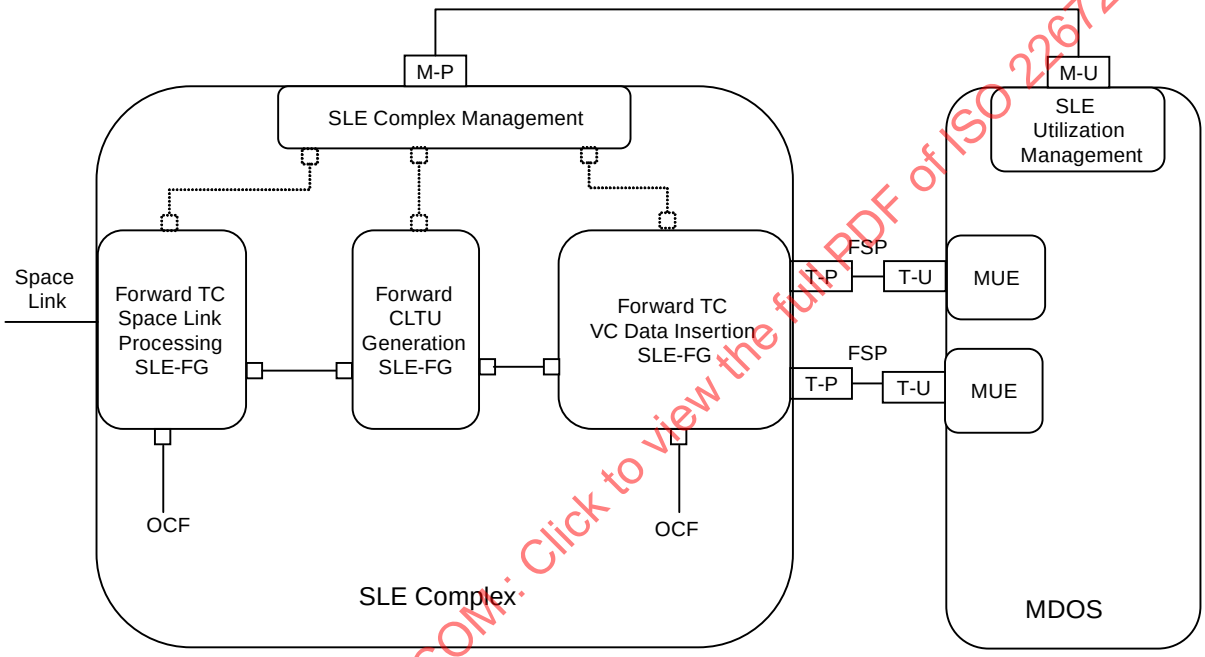

Figure 2-3: Example of the Management and Provision of FSP Service

NOTES

1 The FSP service occurs between the MDOS T-U ports and the SLE Complex T-P ports.

2 Although not shown in this scenario, many other combinations are possible. For example, it is also possible to have several SLE-FG instances, each supplying a different SLE data channel and each providing one or more instances of service. The different SLE-FGs shown in the scenario may also belong to different SLE Complexes.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

2.6 FUNCTIONAL DESCRIPTION

2.6.1 GENERAL

This subsection describes the FSP service with respect to scheduling, configuration, underlying services, provider states, and protocol considerations.

2.6.2 SCHEDULING AND CONFIGURATION

SLE Utilization Management negotiates with SLE Complex Management to establish mutually agreed upon SLE service packages. Among other things, SLE service packages specify what service instances are to be provided, when those services are to be provided, and what resources are needed to enable those services.

Service packages also specify the initial values of the mission-dependent parameters required for service production and provision. FSP service production parameters include such things as the TC VC to be used, the multiplexing schemes applicable at TC frame and MAP level, maximum Packet Data Length TC Transfer Frame length, and configuration information associated with the service production performed by the Forward CLTU Generation and Forward TC Space Link Processing SLE-FGs. Provision parameters include such things as the scheduled start and stop times of the FSP service instance.

Service production is guaranteed to occur only as needed to support service packages that have been scheduled and mutually agreed upon by SLE Complex Management and SLE Utilization Management. Service provision occurs only within the bounds of the agreed upon schedule of service instances and only during those periods when there is an association between the service provider and the service user.

2.6.3 UNDERLYING SERVICES

If the production of an FSP service instances involves more than one Complex, the FSP service relies on one or both of the following SLE services, depending on which Functional Groups are implemented by which Complexes:

a) Forward TC Frame (see NOTE 2 under 2.4.1);

b) Forward CLTU.

Provision of FSP service depends on service management for scheduling, resources, and configuration. If the Forward CLTU Generation SLE-FG and/or Forward TC Space Link Processing SLE-FG are implemented by a Complex (or Complexes) other than the Complex that is providing the FSP service, the schedule for an FSP service instance must be compliant with the schedule of the underlying FTCF service and/or Forward CLTU service.

The FSP service also depends on the availability of a suitable communications service to enable the exchange of information between the FSP service user and provider.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

2.6.4 PROTOCOL DESCRIPTION

2.6.4.1 FSP Operations

The operations that constitute the FSP service are listed in table 2-1. Section 3 of this Recommended Standard contains the detailed specification of these operations.

Table 2-1: FSP Service Operations

Operations	Invoked By	Purpose	Con-firmed
FSP-BIND	Initiator (User)	To establish an association with the provider	Yes
FSP-UNBIND	Initiator (User)	To release an association previously established by an FSP-BIND operation	Yes
FSP-START	User	To request that the SLE service provider prepare to accept FSP-TRANSFER-DATA operations	Yes
FSP-STOP	User	To request that the provider stop service production for the Space Packets associated with this service instance and not yet passed to the segment queues and discard these Space Packets	Yes
FSP-TRANSFER-DATA	User	To transfer a Space Packet to the service provider	Yes
FSP-ASYNC-NOTIFY	Provider	To notify the user of an event affecting production or provision of the FSP service	No
FSP-SCHEDULE-STATUS-REPORT	User	To request that the provider send a status report immediately or periodically, or stop reporting	Yes
FSP-STATUS-REPORT	Provider	To send a status report to the user	No
FSP-GET-PARAMETER	User	To ascertain the value of an SLE service parameter (see tables 3-1 and 3-11)	Yes
FSP-THROW-EVENT	User	To forward an event that requires Complex Management to take the actions defined for this event	Yes
FSP-INVOKE-DIRECTIVE	User	To invoke TC-Directives as specified in reference [5]. TC directives are required to (re-)establish the commanding capability on a given VC	Yes
FSP-PEER-ABORT	User or Provider	To notify the peer that the local SLE application detected an error that requires the association to be terminated	No

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

2.6.4.2 States of the Service Provider

Once an FSP service instance is created, the FSP service provider is in one of three states, as follows:

a) State 1 (‘unbound’): In state 1, all resources required to enable the provision of the FSP service have been allocated, and all objects required to provide the service have been instantiated. However, no association yet exists between the user and the provider (i.e., the FSP transfer service provider port is not bound).

b) State 2 (‘ready’): In state 2, an association has been established between the user and the provider, and they may interact by means of the operations described in section 3 of this Recommended Standard. However, sending of Space Packets from the user to the provider (by means of the FSP-TRANSFER-DATA operation) is not permitted. The user may enable the delivery of Space Packets by means of the appropriate service operation (FSP-START), which, in turn, will cause the provider to transition to state 3 (‘active’).

c) State 3 (‘active’): State 3 resembles to state 2 (‘ready’), except that now the user can send Space Packets. The service continues in this state until the user invokes the FSP-STOP operation to cause the provider to discard any Space Packets belonging to the given service instance and not yet having been passed to the segment queues and to transition back to state 2.

A simplified FSP service provider state transition diagram is shown in figure 2-4. A detailed state transition matrix is provided in 4.2.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

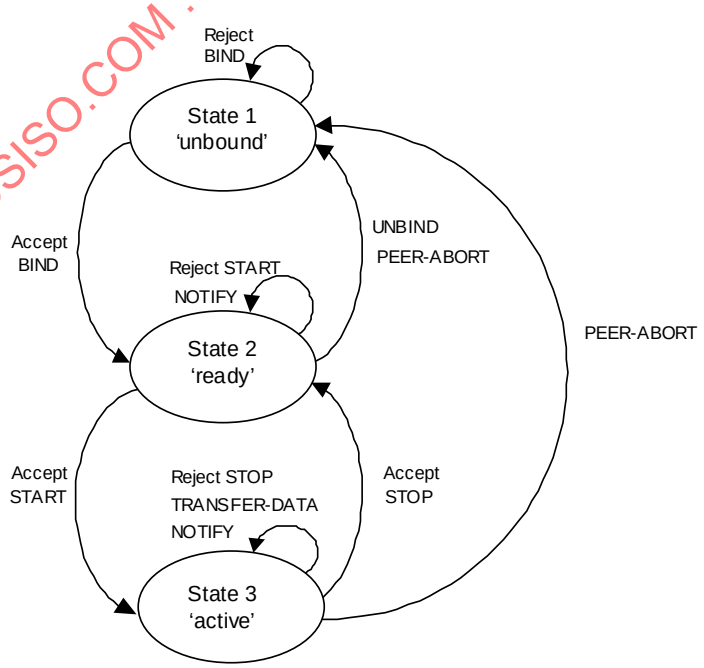

Figure 2-4: Simplified FSP Service Provider State Transition Diagram

© ISO 2011 – All rights reserved

2.6.4.3 Terminating an Association

An association is released normally when an FSP-UNBIND is issued by the user (the initiator of the association) and accepted by the provider (the responder). An association may be aborted by either the user or the provider by means of the FSP-PEER-ABORT operation. An association may also be aborted because of a failure in the underlying communications system. Such failures are signaled to the local application entity by the 'protocol abort' event described in 4.1.5.

2.6.4.4 Effects of Association Termination

Following the termination of an association, the provider immediately discards all Space Packets buffered for this service instance except any Space Packets that are already in the production process, i.e. that have already been converted to Frame Data Units and passed to the segment queues (see annex B).

When an association is released or aborted, no further operations can be exchanged between the user and the provider. The systems may re-establish an association via a new FSP-BIND operation if that is consistent with the service instance provision period. However, status information from the prior association is not preserved and is not available to the new association except that:

a) all accounting information, such as number of Space Packets processed, is persistent during the service instance provision period;

b) parameters that serve to relate notifications on an activity to operations that triggered this activity will not be altered when the association is released or aborted;

c) COP parameters, i.e. parameters that are set by invoking directives (see 3.12), will not be altered.

2.6.4.5 Technology-specific Aspects

This Recommended Standard defines the FSP service. Provision of the FSP service in a real system also requires a specification of how the FSP service defined here is mapped to a communications service such that all invocations and returns of the FSP service operations can be conveyed between the user and the provider. In order not to restrict the applicability of this Recommended Standard to a specific communications technology, as few assumptions as possible have been made about the characteristics of the underlying communications service (see 1.3.1).

The FSP service interface between the user and the provider is specified in this Recommended Standard in terms of the operations that the service provides. Those operations are realized by mapping the service operation invocations and returns to protocol data units that can be conveyed by means of the underlying communications service. This Recommended Standard conceptualizes such mapping in two parts:

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

a) FSP service operation invocations and returns (defined in section 3) are mapped to SLE-PDUs (defined in annex A);

b) SLE-PDUs are mapped to protocol data units that can be conveyed by means of the underlying communications service.

The mapping of FSP service operation invocations and returns to SLE-PDUs is specified by this Recommended Standard. In the FSP case, an SLE-PDU corresponds to the invocation or return of an FSP operation. Other services may opt to map multiple TRANSFER-DATA invocations to a single SLE-PDU. From the point of view of the provider or user application, the interaction between the user and provider is in terms of operations, but from the point of view of the application entities that implement the FSP protocol, what is exchanged are SLE-PDUs.

The mapping of SLE-PDUs to an underlying communications service is intentionally outside the scope of this Recommended Standard (e.g., so that the FSP service may be mapped to more than one communications technology). In order to achieve interoperability, the user and provider must conform not only to this Recommended Standard but also to an agreed upon specification of the mapping of the FSP service to the underlying communications service. The specification of a mapping of the FSP service onto a particular communications service must address such points as:

a) selection of communications network(s) to ensure connectivity;

b) compatible configuration of protocol stacks (e.g., timeout values);

c) specification of port-identifiers, and their translation onto the communications technology;

d) specification of security related information.

Figure 2-5 illustrates a communications realization of the FSP service that results from such a mapping. The specification of such mappings is the subject of separate CCSDS Recommended Standards.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

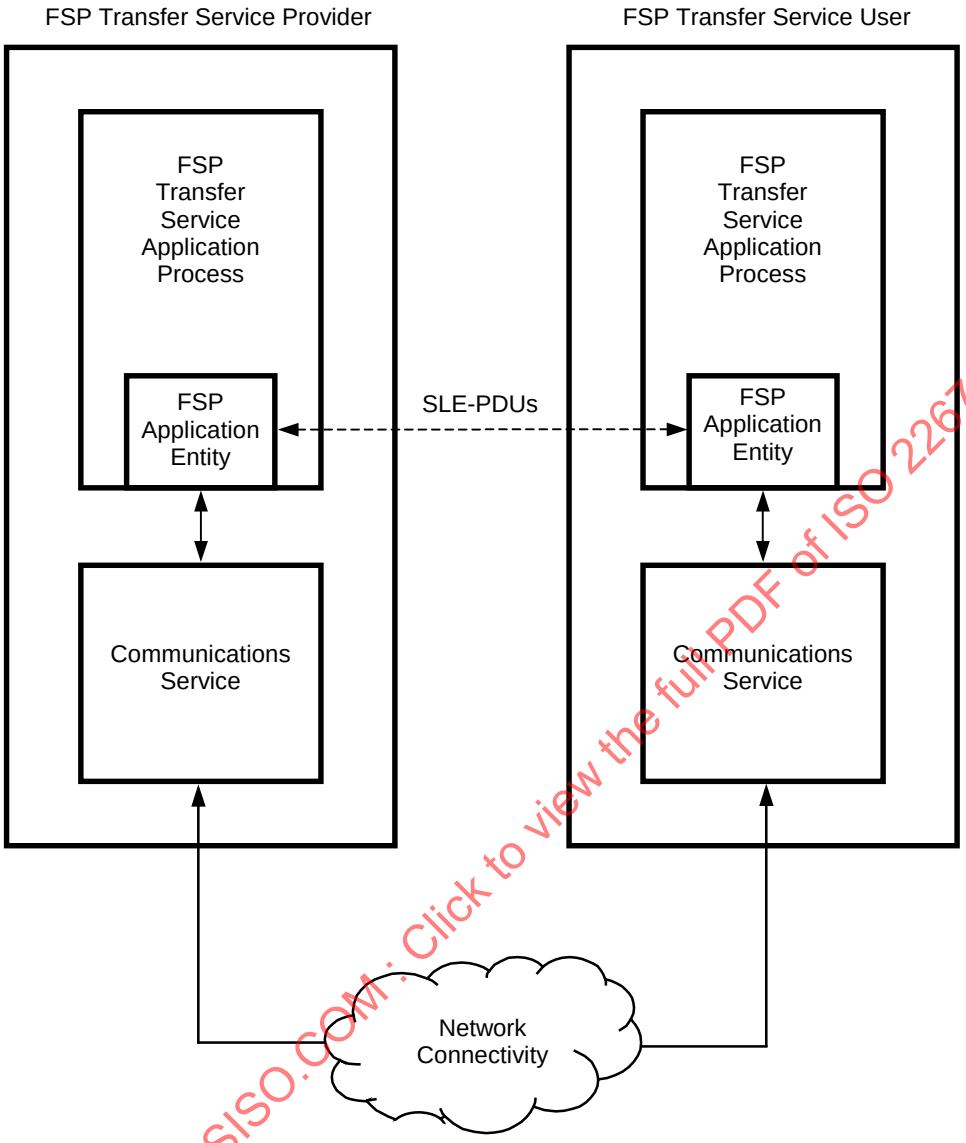

Figure 2-5: Communications Realization of FSP Service

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

Because the operations of the FSP service are relatively simple, once an association is in place between the service user and the service provider, the technology specific elements involved in the exchange of SLE-PDUs are generally minor. However, the way an association is established (i.e., the binding) tends to vary significantly depending on the communications technology in use. Nonetheless, the FSP-BIND and FSP-UNBIND operations as specified in this document are intended to be 'technology neutral'. This neutrality is achieved as described in the following paragraphs.

For purposes of the communications mapping, the endpoints of an SLE association are identified by port identifiers, namely, an 'initiator port identifier' and a 'responder port identifier'. The port identifiers represent all the technology-specific addressing information needed to establish communications between the user and provider and to route SLE-PDUs

© ISO 2011 – All rights reserved

between them. The initiator port identifier identifies the endpoint that will invoke the FSP-BIND operation (initiator). The responder port identifier identifies the endpoint that will perform the FSP-BIND operation (responder). Generally speaking, the information represented by a port identifier consists of:

a) information needed to route data between two real systems over a communications channel or network; and

b) information needed to route data within a real system to a particular application entity.

For example, the information represented by a port identifier might be the combination of an Internet Protocol (IP) network address and a Transmission Control Protocol (TCP) port number or the combination of an OSI network address and an associated set of service access points (SAPs).

The exact relationship between SLE port identifiers and communications ports provided by the underlying communications service must be specified by the mapping of the FSP service to the underlying communications service.

One possible mapping of the SLE transfer service to the TCP/IP communications service is specified in [I8]. As part of this mapping, also issues such as sizing of TCP buffers in accordance with the bandwidth-delay product of the communication link and ways to manage relative priority of transfer services concurrently using the same connectivity are to be addressed.

In order for an SLE association to be established, SLE Complex Management and SLE Utilization Management must agree beforehand on the responder port identifier for the association. The responder needs the information represented by the responder port identifier to ensure that resources are allocated to recognize and respond to an FSP-BIND invocation for that association. The initiator needs the information to ensure that the FSP-BIND invocation will be communicated to the appropriate responder.

In general, it is not necessary for SLE Complex Management and SLE Utilization Management to agree beforehand on the initiator port identifier for the association. Rather, the initiator should communicate that information to the responder in conjunction with the FSP-BIND invocation. The exact means by which the initiator port identifier is provided to the responder is technology-specific and must be specified by the mapping of the FSP service to the underlying communications service.

The responder port identifier is included as a parameter of the FSP-BIND operation. While it is only necessary that the SLE application entity communicate the information represented by the port identifiers to the underlying communications service, the responder port identifier is provided as a parameter of the FSP-BIND operation to allow for the possible simplification of the implementation of a gateway.

The information represented by the responder port identifier is technology-specific. In order to define the FSP-BIND operation in a way that is not technology-specific, the

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

`responder-port-identifier` parameter of the FSP-BIND operation is defined to be a logical name. A logical name is an arbitrary identifier that has an appropriately chosen and agreed upon translation to technology-specific information. Prior to the start time of a service instance, SLE Complex Management and SLE Utilization must mutually agree upon the value of the responder port identifier (and its translation) applicable to that service instance. The actual process of translating logical names to technology-specific information is considered a local matter. The translation methodology may rely on simple techniques such as look-up tables or may use more elaborate mechanisms such as naming or directory services.

The above discussion describes the case that both the user and provider applications are implemented using the same communications service. It is possible to achieve interoperability even if the user and provider use different communications services. However, in that case interoperability requires the use of an appropriate gateway.

2.6.4.6 Buffering

The FSP service buffers the Space Packets for the purpose of multiplexing concurrent FSP data channels in accordance with the applicable multiplexing scheme and for maintaining a steady output stream of TC frames despite variable latency over the ground communications links. Annex B specifies the applicable buffering mechanisms in detail. All Space Packets transfers from the service user to the service provider must occur within the scheduled service instance provision period.

2.7 OPERATIONAL SCENARIO

Prior to the actual provision of service, start and stop times for both the space link session and the associated FSP service instance are negotiated between SLE Complex Management and SLE Utilization Management. Configuration and other information needed to enable the service are also agreed.

Some time before the scheduled start time of the FSP service instance, the service instance is created by SLE Complex Management. Initially, the service provider is in state 1 (‘unbound’). At the scheduled start time of the space link session, the SLE Complexes involved establish the forward link to the spacecraft and initiate the production of FSP service and, if applicable, of the underlying FTCF service (see NOTE 2 under 2.4.1) and Forward CLTU service. Typically (but not necessarily) the start time of the service instance will precede by a small margin the start time of the space link session to allow the user to bind to the service before the start of the space link session.

The following illustrates a typical sequence of operations between the user and the provider of the FSP service. A complete definition of the operations is found in section 3; the formal specification of provider behavior is presented in section 4.

a) The user invokes the FSP-BIND operation to establish an association.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

b) The provider monitors the status of the underlying services. If the production status permits, it transitions from state 1 (‘unbound’) to state 2 (‘ready’) and returns a report of the successful completion of the bind operation to the user.

c) The provider continuously monitors the production status. When the production status changes and the user might be affected by this change, the provider sends FSP-ASYNC-NOTIFY to the user.

d) The user may check parameters that control service provision by means of the FSP-GET-PARAMETER operation.

e) A user interested in obtaining periodic status reports may invoke the FSP-SCHEDULE-STATUS-REPORT operation to configure status reporting.

f) The user invokes the FSP-START operation to enable the submission of Space Packets.

g) The provider transitions from state 2 (‘ready’) to state 3 (‘active’) and confirms the start operation to the user.

h) The user next submits a Space Packet by invoking the FSP-TRANSFER-DATA operation. The provider verifies the Packet, and if acceptable, buffers it until the earliest transmission start time specified in the FSP-TRANSFER-DATA invocation is reached. In addition, notifications may be delivered by means of FSP-ASYNC-NOTIFY operations, and requested status reports are delivered by means of FSP-STATUS-REPORT operations.

i) The user sends additional Space Packets by repeated invocation of FSP-TRANSFER-DATA operations.

j) The user checks if radiation or acknowledgement of all Space Packets is completed by inspecting the notifications or reports sent by the provider via the FSP-ASYNC-NOTIFY or FSP-STATUS-REPORT operations. If all Space Packets have been radiated or acknowledged, the user will invoke the FSP-STOP operation, which will cause the provider to transition to the ‘ready’ state.

k) If the service instance provision period has not expired, the user may initiate the radiation of another set of Space Packets by invoking another FSP-START operation. If there are no more Packets to be uplinked, the user terminates the association by invoking the FSP-UNBIND operation.

2.8 SECURITY ASPECTS OF THE SLE FORWARD SPACE PACKET (FSP) TRANSFER SERVICE

2.8.1 SECURITY BACKGROUND/INTRODUCTION

The SLE transfer services explicitly provide authentication and access control. Additional security capabilities, if required, are levied on the underlying communication services that

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

support the SLE transfer services. The SLE transfer services are defined as layered application services operating over underlying communication services that must meet certain requirements but which are otherwise unspecified. Selection of the underlying communication services over which real SLE implementations connect is based on the requirements of the communicating parties and/or the availability of CCSDS-standard communication technology profiles and proxy specifications. Different underlying communication technology profiles are intended to address not only different performance requirements but also different security requirements. Missions and service providers are expected to select from these technology profiles to acquire the performance and security capabilities appropriate to the mission. Specification of the various underlying communication technologies, and in particular their associated security provisions, are outside the scope of this Recommended Standard.

The SLE FSP transfer service transfers data that is destined for a mission spacecraft. As such, the SLE FSP transfer service has custody of the data for only a portion of the end-to-end data path between MDOS and mission spacecraft. Consequently the ability of an SLE transfer service to secure the transfer of mission spacecraft data is limited to that portion of the end-to-end path that is provided by the SLE transfer service (i.e., the terrestrial link between the MDOS and the ground termination of the ground-space link to the mission spacecraft). End-to-end security must also involve securing the data as it crosses the ground-space link, which can be provided by some combination of securing the mission data itself (e.g., encryption of the mission data within CCSDS space packets) and securing the ground-space link (e.g., encryption of the physical ground-space link). Thus while the SLE FSP transfer service plays a role in the end-to-end security of the data path, it does not control and cannot ensure that end-to-end security. This component perspective is reflected in the security provisions of the SLE transfer services.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

2.8.2 STATEMENTS OF SECURITY CONCERNS

This section identifies SLE FSP transfer service support for capabilities that responds to these security concerns in the areas of data privacy, data integrity, authentication, access control, availability of resources, and auditing.

2.8.2.1 Data Privacy (also known as Confidentiality)

This SLE FSP transfer service specification does not define explicit data privacy requirements or capabilities to ensure data privacy. Data privacy is expected to be ensured outside of the SLE transfer service layer, by the mission application processes that communicate over the SLE transfer service, in the underlying communication service that lies under the SLE transfer service, or some combination of both. For example, mission application processes might apply end-to-end encryption to the contents of the CCSDS space link data units carried as data by the SLE transfer service. Alternatively or in addition, the network connection between the SLE entities might be encrypted to provide data privacy in the underlying communication network.

© ISO 2011 – All rights reserved

2.8.2.2 Data Integrity

The SLE FSP service requires that each transferred space packet be accompanied by a sequence number, which must increase monotonically. Failure of a space packet to be accompanied by the expected sequence number causes the space packet to be rejected (see 3.6.2.18.1 d)). This constrains the ability of a third party to inject additional command data into an active FSP transfer service instance.

The SLE FSP transfer service defines and enforces a strict sequence of operations that constrain the ability of a third party to inject operation invocations or returns into the transfer service association between a service user and provider (see 4.2.2). This constrains the ability of a third party to seize control of an active FSP transfer service instance without detection.

The SLE FSP transfer service requires that the underlying communication service transfer data in sequence, completely and with integrity, without duplication, with flow control that notifies the application layer in the event of congestion, and with notification to the application layer in the event that communication between the service user and the service provider is disrupted (see 1.3.1). No specific mechanisms are identified, as they will be an integral part of the underlying communication service.

2.8.2.3 Authentication

This SLE FSP transfer service specification defines authentication requirements (see 3.1.5), and defines `initiator-identifier`, `responder-identifier`, `invoker-credentials`, and `performer-credentials` parameters of the service operation invocations and returns that are used to perform SLE transfer service authentication. The procedure by which SLE transfer service operation invocations and returns are authenticated is described in annex F of the Cross Support Concept Green Book (reference [I3]). The SLE transfer service authentication capability can be selectively set to authenticate at one of three levels: authenticate every invocation and return, authenticate only the BIND operation invocation and return, or perform no authentication. Depending upon the inherent authentication available from the underlying communication network, the security environment in which the SLE service user and provider are operating, and the security requirements of the spaceflight mission, the SLE transfer service authentication level can be adapted by choosing the SLE operation invocations and returns that shall be authenticated. Furthermore, the mechanism used for generating and checking the credentials and thus the level of protection against masquerading (simple or strong authentication) can be selected in accordance with the results of a threat analysis.

2.8.2.4 Access Control

This SLE FSP transfer service specification defines access control requirements (see 3.1.4), and defines `initiator-identifier` and `responder-identifier` parameters of the service operation invocations and returns that are used to perform SLE transfer service

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

access control. The procedure by which access to SLE transfer services is controlled is described in annex F of the Cross Support Concept Green Book (reference [I3]).

2.8.2.5 Availability of Resources

The SLE transfer services are provided via communication networks that have some limit to the resources available to support those SLE transfer services. If these resources can be diverted from their support of the SLE transfer services (in what is commonly known as 'denial of service') then the performance of the SLE transfer services may be curtailed or inhibited. This SLE FSP transfer service specification does not define explicit capabilities to prevent denial of service. Resource availability is expected to be ensured by appropriate capabilities in the underlying communication service. The specific capabilities will be dependent upon the technologies used in the underlying communication service and the security environment in which the transfer service user and provider operate.

2.8.2.6 Auditing

This SLE FSP transfer service specification does not define explicit security auditing requirements or capabilities. Security auditing is expected to be negotiated and implemented bilaterally between the spaceflight mission and the service provider.

2.8.3 POTENTIAL THREATS AND ATTACK SCENARIOS

The SLE FSP transfer service depends on unspecified mechanisms operating above the SLE transfer service (between a mission spacecraft application process and its peer application process on the ground), underneath the SLE transfer service in the underlying communication service, or some combination of both, to ensure data privacy (confidentiality). If no such mechanisms are actually implemented, or the mechanisms selected are inadequate or inappropriate to the network environment in which the mission is operating, an attacker could read the command data contained in the FSP protocol data units as they traverse the WAN between service user and service provider.

The SLE FSP transfer service constrains the ability of a third party to seize control of an active SLE transfer service instance, or to inject extra command data into a service instance, but it does not specify mechanisms that would prevent an attacker from intercepting the protocol data units and replacing the contents of the `data` parameter. The prevention of such a replacement attack depends on unspecified mechanisms operating above the SLE transfer service (between a mission spacecraft application process and its peer application process on the ground), underneath the SLE transfer service in the underlying communication service, in bilaterally-agreed extra capabilities applied to the SLE transfer service (e.g., encryption of the `data` parameter) or some combination of the three. If no such mechanisms are actually implemented, or the mechanisms selected are inadequate or inappropriate to the network environment in which the mission is operating, an attacker could 'hijack' an established SLE

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

FSP transfer service instance and overwrite the commands in the protocol data units to subvert or destroy the operation of the spacecraft.

If the SLE transfer service authentication capability is not used and if authentication is not ensured by the underlying communication service, attackers may somehow obtain valid `initiator-identifier` values and use them to initiate SLE transfer service instances by which they could subvert or destroy the mission.

The SLE FSP transfer service depends on unspecified mechanisms operating in the underlying communication service to ensure that the supporting network has sufficient resources to provide sufficient support to legitimate users. If no such mechanisms are actually implemented, or the mechanisms selected are inadequate or inappropriate to the network environment in which the mission is operating, an attacker could prevent legitimate users from communicating with their spacecraft, causing degradation or even loss of the mission.

If the provider of SLE FSP transfers service provides no security auditing capabilities, or if a user chooses not to employ auditing capabilities that do exist, then attackers may delay or escape detection long enough to do serious (or increasingly serious) harm to the mission.

2.8.4 CONSEQUENCES OF NOT APPLYING SECURITY

The consequences of not applying security to the SLE FSP transfer service are possible degradation and loss of ability to command the spacecraft, and even loss of the spacecraft itself.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

(Blank page)

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3 FSP SERVICE OPERATIONS

NOTE – This section (3) specifies the processing of valid SLE-PDUs (i.e., those that are recognized as the invocation or return of an FSP service operation). Subsection 3.1 specifies behaviors that are generally applicable to all operations. Subsections 3.2 through 3.13 specify individual operations. Handling of invalid SLE-PDUs is specified in subsection 4.1.

3.1 GENERAL CONSIDERATIONS

3.1.1 RESULT OF OPERATIONS

3.1.1.1 All confirmed operations shall report on the outcome of the operation in a return, except as specified otherwise in section 4.

3.1.1.2 All returns shall include a `result` parameter that indicates whether the outcome of the operation was successful ('positive result') or unsuccessful ('negative result').

3.1.1.3 In the event of a 'negative result', the return shall also include a `diagnostic` parameter, the value of which is descriptive of the reason for the 'negative result'.

NOTE – Possible values of the `diagnostic` parameter are listed in the description of each operation.

3.1.1.4 A `diagnostic` parameter value of 'other reason' shall be returned only if no other value in the list adequately describes the reason for the 'negative result'.

3.1.2 PARAMETER TYPES

The types of all parameters shall conform to the abstract syntax specified in annex A.

NOTE – Some parameter types in annex A are chosen such that possible future extensions of the range of allowed values of a parameter will not cause a type mismatch. For example, parameters that logically are of the 'enumerated' type are specified as being of the 'named integer' type.

3.1.3 PARAMETER CHECKING

3.1.3.1 Validity checks shall be performed on the values of parameters associated with an operation.

NOTE – Rules governing the validity of parameter values are included in the specification of individual operations. General reasons for regarding a parameter value as invalid are specified in the following subsections.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.1.3.2 A parameter shall be treated as invalid if its value is outside the range or not in the set of values currently permitted by service management for the given parameter.

NOTE – A conformant implementation shall be capable of supporting the full range or set as specified in annex A.

3.1.3.3 A parameter shall be treated as invalid if its value is in conflict with the value of another parameter in the same invocation.

NOTE – For example, in the FSP-TRANSFER-DATA invocation the time specified in the `earliest-production-time` parameter is later than the time specified in the `latest-production-time` parameter.

3.1.3.4 If a parameter value is not valid, the operation shall not be performed, and, for confirmed operations, a report of 'negative result' shall be returned to the invoker.

3.1.3.5 Except as noted in 3.2.2.11, checks for invalid parameters or for other conditions that can cause a report of 'negative result' should be performed in the order in which diagnostics are listed in the descriptions of the operations, and the `diagnostic` parameter should be set to the value defined for the first problem found.

3.1.3.6 In the case that an implementation does not adhere to the sequence of checks as specified by the sequence of diagnostics values, such implementation shall specify the sequence in which the checks are actually performed.

3.1.4 ACCESS CONTROL

3.1.4.1 The FSP service shall implement access control based on the identity of the initiator and responder. Access control is performed at two levels:

a) the initiator must be registered at the responder and the responder must be registered at the initiator;

b) the initiator and responder must be authorized for the given service instance.

3.1.4.2 The initiator shall have access to a registry of authorized responders and the responder shall have access to a registry of authorized initiators. These registries shall be maintained by SLE Complex Management and SLE Utilization Management, respectively.

3.1.4.3 Service management shall specify the authorized initiator and responder for each service instance.

3.1.4.4 The initiator and responder shall indicate their identity by setting the parameters `initiator-identifier` and `responder-identifier` in the FSP-BIND operation to the values assigned by service management.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.1.5 AUTHENTICATION

NOTE – Requirements for security depend on the application and the environment of the SLE Complexes and the MDOS (e.g., whether closed or public networks are used or if access is only from physically restricted areas). In many environments, security may be provided by the communications service, transparently to the SLE application. This Recommended Standard does not preclude the use of security features that are provided by the communications service or the local environment, nor does it assume the availability of such features.

3.1.5.1 The FSP service shall provide the following options with respect to level of authentication of invocations and returns of operations:

a) 'all': all FSP invocations and returns, except the invocation of FSP-PEER-ABORT, shall be authenticated;

b) 'bind': only the FSP-BIND invocation and return shall be authenticated;

c) 'none': no FSP invocations or returns shall be authenticated.

3.1.5.2 SLE Complex Management and SLE Utilization Management shall agree on the level of authentication to be required for an association between a service user and a service provider and shall configure both entities accordingly.

3.1.5.3 SLE Complex Management and SLE Utilization Management shall agree on the algorithm used to generate and check credentials parameters and make this algorithm known to the service user and service provider, together with associated parameters such as passwords or keys as necessary for the selected algorithm.

NOTES

1 The specification of the algorithms themselves is outside the scope of this Recommended Standard.

2 The `initiator-identifier` and `responder-identifier` parameters of the FSP-BIND operation identify the user and provider, respectively, and therefore the applicable authentication level and algorithm necessary to generate and check credentials.

3.1.5.4 For operations for which authentication is required by the terms of the agreement between SLE Complex Management and SLE Utilization Management:

a) invocations shall include an `invoker-credentials` parameter to permit the performer to authenticate the invocation; and

b) returns shall include a `performer-credentials` parameter to permit the invoker to authenticate the return.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.1.5.5 For operations for which authentication is not required, the `invoker-credentials` or `performer-credentials` parameter should be set to the value 'unused' to signify that the invocation or return does not carry credentials.

3.1.6 BLOCKING AND NON-BLOCKING OPERATIONS

3.1.6.1 To support applications that may need to invoke several operations concurrently, the `invoke-ID` parameter is specified for all confirmed operations except FSP-BIND and FSP-UNBIND.

NOTES

1 The `invoke-ID` parameter allows the invoker to correlate a particular return to the invocation that prompted it.

2 Confirmed operations that include the `invoke-ID` parameter are non-blocking operations; those that do not are blocking operations. Unconfirmed operations are always non-blocking.

3.1.6.2 After invoking a blocking operation, the invoker shall not invoke another operation for the same service instance until the return from the blocking operation is received; if the return from a blocking operation is not received in a timely manner, the invoker may invoke FSP-PEER-ABORT to terminate the association.

3.1.6.3 After invoking a non-blocking operation, the invoker may invoke another operation without waiting for the return from the first invocation.

3.1.6.4 The value of the `invoke-ID` parameter shall be an invoker-supplied arbitrary integer value that shall be returned, unchanged, by the performer.

3.1.6.5 The invocation of a non-blocking operation shall be rejected with the `diagnostic` 'duplicate invoke id' if it includes an `invoke-ID` whose value is the same as that of another invocation that is awaiting confirmation within the context of the same service instance.

3.1.6.6 To ensure that the FSP service behaves in a predictable manner, the effects of operations shall be as though the operations were performed in the order that their invocations were received by the performer.

3.1.6.7 The invoker may choose not to exploit the non-blocking capability and always wait for the return from a non-blocking operation before invoking another operation.

NOTE – An invoker wishing to operate in blocking mode, i.e., to invoke a new operation only after the return from the previous operation has been received, may use a constant value for the `invoke-ID` parameter. As long as a return is still outstanding, the performer will reject any further invocations.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.1.6.8 Compliance with this Recommended Standard does not require the performer to process invocations concurrently; however, the performer must accept invocations from a non-blocking invoker and buffer and serialize them by local means not visible externally.

3.1.7 TIME

3.1.7.1 The time reference for all parameters containing a time value shall be based on Coordinated Universal Time (UTC).

3.1.7.2 The type of parameters containing a time value shall be the CCSDS Day Segmented (CDS) time code format (reference [2]) with an epoch of 1958-01-01 and a 16-bit day segment. Depending on the FSP service provider capabilities and/or the supported mission requirements, the time tag may have either a resolution of microseconds or a resolution of picoseconds.

3.1.7.3 All time values shall be expressed to a precision of at least one-tenth (0.1) of a second.

3.1.7.4 All time value shall be accurate to within one-tenth (0.1) of a second or better.

3.1.8 DELIVERY MODES

3.1.8.1 Forward Online Delivery

3.1.8.1.1 Forward online delivery service provisioning shall occur at the same time as service production, i.e., during a space link session.

3.1.8.1.2 Space Packets supplied by the service user are buffered by the service provider until they are processed.

3.1.8.1.3 The buffer used by the service provider exists only during service provisioning.

3.1.8.1.4 The timing of Packet processing is determined by the order of Packets in the buffer and any annotation data provided with the Packets (see annex B).

3.1.8.1.5 Two transmission modes shall be available to the service user:

a) sequence-controlled (AD);

b) expedited (BD).

Sequence-controlled transmission mode means that there is a high probability of complete delivery of the Space Packet, that no Packet is duplicated, and that no Packet is delivered out of sequence. Expedited mode delivers Space Packets in the sequence specified but does not guarantee complete delivery.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

NOTE – The forward online delivery mode is defined in this Recommended Standard.

3.1.8.2 Forward Offline Delivery

The forward offline delivery mode is not defined in this version of this Recommended Standard.

3.1.9 SETTING OF PARAMETERS

3.1.9.1 An FSP provider shall permit setting of the parameters as specified in table 3-1.

3.1.9.2 The range or set of values a parameter may assume is constrained by specification of its data type (see annex A).

3.1.9.3 Service management may further constrain the allowed values for a given service instance.

NOTES

1 Further details on these parameters are presented in 3.10.

2 Table 3-1 contains only parameters for which the user can ascertain the current value by means of the FSP-GET-PARAMETER operation. A complete list of parameters that may affect service production is to be found in the service management suite of documents (see 1.5.2).

Table 3-1: Setting of FSP Service Operation Parameters

Parameter	Service Management	FSP-START Operation	FSP-SCHEDULE-STATUS-REPORT Operation	FSP-INVOKE-DIRECTIVE Operation
Parameters applicable to all FSP service instances:				
maximum-packet-data-length	X			

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

Parameter	Service Management	FSP-START Operation	FSP-SCHEDULE-STATUS-REPORT Operation	FSP-INVOKE-DIRECTIVE Operation
vc-multiplexing-control	X			
vc-multiplexing-scheme	X			
Parameters applicable to all FSP service instances using a given Physical Channel:				
bit-lock-required (see NOTE)	X			
clcw-physical-channel	X			
clcw-global-VCID	X			
rf-available-required (see NOTE)	X			
Parameters applicable to all FSP service instances using a given VC:				
blocking-timeout-period	X			
blocking-usage (blocking performed by the provider)	X			
directive-invocation-enabled	X			
fop-sliding-window	X			X
fop-state	read-only			
map-multiplexing-control	X			X

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

Parameter	Service Management	FSP-START Operation	FSP-SCHEDULE-STATUS-REPORT Operation	FSP-INVOKE-DIRECTIVE Operation
map-multiplexing-scheme	X			
maximum-frame-length	X			
segment-header	X			
timeout-type	X			X
timer-initial	X			X
transmission-limit	X			X
transmitter-frame-sequence-number	X			X
Parameters applicable to a given service instance:				
apid-list	X			
delivery-mode	X			
expected-packet-identification		X		
map-list	X			
maximum-reporting-cycle	X			
minimum-reporting-cycle	X			
permitted-transmission-mode	X			
reporting-cycle			X	

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

Parameter	Service Management	FSP-START Operation	FSP-SCHEDULE-STATUS-REPORT Operation	FSP-INVOKE-DIRECTIVE Operation
return-timeout-period	X			
service-instance-provision-period	X			
service-version-number	X			
virtual-channel	X			

NOTE – Strictly speaking, the parameters `bit-lock-required` and `rf-available-required` are not part of the FSP service, as processing of the associated lock flags in the CLCW is delegated to the Forward TC Space Link Processing FG (see 2.4.1.4). Nonetheless these parameters are listed here to underline that the processing of these lock flags is identical for all FSP service instances sharing the same physical channel. Furthermore, the uplink lock status has a significant impact on the FSP service behavior exposed to the user.

3.1.10 PROVIDER BUFFERING REQUIREMENTS

3.1.10.1 The service package shall specify the amount of buffering the provider must maintain.

3.1.10.2 The amount of buffer space shall be specified in terms of the number of octets that can be stored.

3.1.10.3 The service provider shall buffer only complete Space Packets.

3.1.11 ACCOUNTING SUMMARY

3.1.11.1 Statistical information to be collected over a period of time shall always refer to the service instance provision period.

3.1.11.2 Separate information shall be kept for AD and BD modes (see 3.9.2.9 to 3.9.2.11).

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.2 FSP-BIND

3.2.1 PURPOSE

3.2.1.1 The initiator shall invoke the FSP-BIND operation to establish an association between the initiator and responder as defined in 1.6.1.8.2.

3.2.1.2 The responder shall return a report of the outcome of the performance of the FSP-BIND operation to the initiator.

3.2.1.3 Except as provided in 3.2.1.4, the initiator shall not invoke any further FSP operations for this service instance until the return from the responder is received.

3.2.1.4 If the return from the invocation of FSP-BIND is not received after a sufficiently long time, the initiator may attempt to recover by invoking the FSP-PEER-ABORT operation (see 3.13) followed by another FSP-BIND.

NOTE – The length of the duration that constitutes 'a sufficiently long time' is determined by service management.

3.2.1.5 The FSP-BIND operation is valid only in state 1 ('unbound') and shall be invoked only by the user.

3.2.2 INVOCATION, RETURN, AND PARAMETERS

3.2.2.1 General

The parameters of the FSP-BIND operation shall be present in the invocation and return as specified in table 3-2.

3.2.2.2 `invoker-credentials`

The **`invoker-credentials`** parameter shall provide information that enables the performer to authenticate the FSP-BIND invocation (see 3.1.5).

3.2.2.3 `performer-credentials`

The **`performer-credentials`** parameter shall provide information that enables the invoker to authenticate the return from the performance of FSP-BIND (see 3.1.5).

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.2.2.4 `initiator-identifier`

The **`initiator-identifier`** parameter shall identify the authority on whose behalf the SLE application entity is initiating an association.

Table 3-2: FSP-BIND Parameters

Parameter	Invocation	Return
`invoker-credentials`	M	
`performer-credentials`		M
`initiator-identifier`	M	
`responder-identifier`		M
`responder-port-identifier`	M	
`service-type`	M	
`version-number`	M	C
`service-instance-identifier`	M	
`result`		M
`diagnostic`		C

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

NOTES

1 The `initiator-identifier` parameter permits the responder to determine if the initiator is registered at this responder and if the FSP-BIND operation is being invoked by the authorized initiator for this service instance.

2 Each value of the `initiator-identifier` parameter is associated with exactly one authentication level and exactly one authentication scheme.

3 If authentication based on credentials is used, this parameter may be redundant since the `initiator-identifier` value may be one constituent of the `invoker-credentials` parameter. However, the encoding may differ, and it may be convenient to have this parameter also available in ‘clear text’ form.

3.2.2.5 `responder-identifier`

The **`responder-identifier`** parameter shall identify the authority on whose behalf the responding SLE application entity is acting.

© ISO 2011 – All rights reserved

NOTES

1 The `responder-identifier` parameter permits the initiator to determine if the responder from which the FSP-BIND return originates is registered at this initiator.

2 The initiator uses this parameter, if applicable, after having successfully authenticated the FSP-BIND return to determine if this return originates from the intended responder.

3.2.2.6 `responder-port-identifier`

The **`responder-port-identifier`** parameter shall specify the port identifier of the responding SLE application entity with which the initiator seeks to establish an association.

NOTES

1 The value of the `responder-port-identifier` parameter is a logical name that can be translated into the technology-specific addressing information required to establish a connection with the responder using the agreed upon communications service (see 2.6.4.5).

2 SLE Complex Management and SLE Utilization Management must have previously agreed on the `responder-port-identifier` and its translation that is applicable to a particular instance of service.

3 The `responder-port-identifier` parameter is included in the FSP-BIND invocation to support its possible use by particular kinds of gateways.

3.2.2.7 `service-type`

The **`service-type`** parameter shall specify the type of service that will be provided if the bind operation succeeds.[1]

3.2.2.8 `version-number`

3.2.2.8.1 The **`version-number`** parameter shall identify the version number of the FSP service specification that is to govern this association if the FSP-BIND succeeds.

---

1 For the FSP-BIND operation, the `service-type` parameter is redundant, because the only valid value of `service-type` is 'fwdTcSpacePkt'. However, it is anticipated that future work by CCSDS will result in FSP-BIND being superseded by a generic SLE-BIND operation that is invoked with any one of several SLE service types as specified `ApplicationIdentifier` in annex A. The FSP-BIND `service-type` parameter is provided in an attempt to facilitate such a change.

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

3.2.2.8.2 `version-number` is conditionally present in the return based on the `result` parameter:

a) if the value of `result` is 'positive result', `version-number` shall be present in the return;

b) if the value of `result` is 'negative result', `version-number` shall not be present in the return.

3.2.2.8.3 If a provider does not support version negotiation, the `version-number` value it will accept during the BIND operation is configured by means of the managed parameter `service-version-number` (see table 3-1).

3.2.2.8.4 If the value of `result` is 'positive result', the responder shall either:

a) accept the version proposed by the initiator by putting the same version number into the positive return; or

b) if the responder supports version negotiation, propose a lower (earlier) version number by putting the lower version number into the return.

3.2.2.8.5 If the responder implementation does not support the requested version and does not support a lower version (or does not support version negotiation), the responder shall reject the bind with the `diagnostic` parameter set to 'version not supported'.

3.2.2.8.6 If the responder proposes a lower version in the return and the initiator does not support version negotiation or does not support the version proposed by the responder, the initiator shall unbind the association.

3.2.2.8.7 The `version-number` value of the FSP service defined by this issue of this Recommended Standard shall be '4'.

NOTE – The version negotiation process as outlined above is only feasible as long as future versions of the FSP service retain the specification of the FSP-BIND operation.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

3.2.2.9 `service-instance-identifier`

The **`service-instance-identifier`** parameter shall uniquely identify this service instance within the scope of the service-providing SLE Complex.

3.2.2.10 `result`

The **`result`** parameter shall specify the result of the FSP-BIND invocation and shall contain one of the following values:

© ISO 2011 – All rights reserved

a) ‘positive result’—the FSP-BIND operation has been performed by the responder and the association is established;

b) ‘negative result’—the FSP-BIND operation has not been performed by the responder for the reason specified in the `diagnostic` parameter, and the association is not established.

3.2.2.11 `diagnostic`

3.2.2.11.1 If `result` is ‘negative result’, **`diagnostic`** shall be present and its value shall be one of the following:

a) ‘access denied’—an initiator with the `initiator-identifier` value presented in the FSP-BIND invocation is not registered at the responder;

b) ‘service type not supported’— the value of the `service-type` parameter of the FSP-BIND invocation does not identify a service type supported by the responder;

c) ‘version not supported’—the responder does not support the requested version and the responder implementation does not permit version negotiation; or the responder does not support any version of the service lower than the one requested by the initiator;

d) ‘no such service instance’—the requested service instance is not defined by any agreed upon service package known to the responder;

e) ‘already bound’—the service instance is already bound via a different association;

f) ‘service instance not accessible to this initiator’— the initiator specified by the `initiator-identifier` parameter of the FSP-BIND invocation does not match the authorized initiator for the service instance identified by the `service-instance-identifier` parameter;

g) ‘inconsistent service type’—the value of the `service-type` parameter of the FSP-BIND invocation is not ‘fwdTcSpacePkt’, or the value of the `service-type` parameter does not match the service type of the service instance identified by the `service-instance-identifier` parameter;

h) ‘invalid time’—the FSP-BIND operation was invoked outside the service instance provision period of the service instance identified by the `service-instance-identifier` parameter;

i) ‘out of service’— the responder has been taken out of service for an indefinite period by management action, i.e., `production-status` is ‘halted’;

j) ‘other reason’—the reason for the negative result will have to be found by other means.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

NOTES

1 In some implementations, under some circumstances, it may not be possible for the intended performer to provide a return in the event of the conditions indicated by `diagnostic` d), h) or i).

2 Initiators should consider that, under some conditions, FSP-BIND may fail with no return, e.g., if the value of the `responder-port-identifier` parameter is incorrect.

3.2.2.11.2 If `result` is 'positive result', the `diagnostic` parameter shall not be present in the return.

3.2.3 EFFECTS

3.2.3.1 If `result` is 'positive result', the FSP-BIND operation shall have the following effects:

a) an association between the user and the provider shall be established;

b) the provider shall transition from state 1 ('unbound') to state 2 ('ready');

c) upon receipt of the positive return, the user may proceed to invoke other FSP service operations, e.g., to initialize the service and enable the Space Packet transfer.

3.2.3.2 If `result` is 'negative result', the FSP-BIND operation shall have the following effects:

a) an association between the user and the provider shall not be established;

b) the provider shall remain in state 1 ('unbound');

c) upon receipt of the negative return:

1) the initiator should examine the `diagnostic` parameter for the cause;

2) the initiator may attempt to re-invoke the FSP-BIND.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.3 FSP-UNBIND

3.3.1 PURPOSE

3.3.1.1 The initiator shall invoke the FSP-UNBIND to release an association previously established by FSP-BIND (see 3.2).

3.3.1.2 The responder shall return a report of the outcome of the performance of the FSP-UNBIND operation to the initiator.

3.3.1.3 Except as provided in 3.3.1.4, the initiator shall not invoke any further FSP operations for this service instance until the return from FSP-UNBIND is received; nor shall it perform any further operations invoked by the responder; nor shall it return to the responder any further reports of the outcome of operations invoked by the responder.

NOTE – The initiator may invoke the FSP-UNBIND operation even if it did not yet receive all returns from previously invoked operations. The initiator should be aware that the responder may choose not to send any further returns as soon as it has received the FSP-UNBIND invocation. It may then happen that the FSP-UNBIND return is not received before one of the missing returns causes a 'missing return' timeout (see 4.1.3).

3.3.1.4 If the return from FSP-UNBIND invocation is not received after a sufficiently long time, the initiator should invoke the FSP-PEER-ABORT operation (see 3.13) to abort the association.

NOTES

1 The length of the duration that constitutes 'a sufficiently long time' is determined by service management.

2 Following receipt of the return from FSP-UNBIND or following the invocation of FSP-PEER-ABORT, the initiator may issue another FSP-BIND if otherwise permitted (e.g., if the end of the service instance provision period has not been reached).

3.3.1.5 The FSP-UNBIND operation is valid only in state 2 ('ready').

3.3.1.6 The FSP-UNBIND operation shall be invoked only by the initiator (i.e., the invoker of the FSP-BIND operation that established this association).

3.3.2 INVOCATION, RETURN, AND PARAMETERS

3.3.2.1 General

The parameters of the FSP-UNBIND operation shall be present in the invocation and return as specified in table 3-3.

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

Table 3-3: FSP-UNBIND Parameters

Parameter	Invocation	Return
`invoker-credentials`	M	
`performer-credentials`		M
`unbind-reason`	M	
`result`		M

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

3.3.2.2 `invoker-credentials`

The **`invoker-credentials`** parameter shall provide information that enables the performer to authenticate the FSP-UNBIND invocation (see 3.1.5).

3.3.2.3 `performer-credentials`

The **`performer-credentials`** parameter shall provide information that enables the invoker to authenticate the return from the performance of FSP-UNBIND (see 3.1.5).

3.3.2.4 `unbind-reason`

The **`unbind-reason`** parameter shall indicate the reason for which the FSP-UNBIND operation is being invoked and shall contain one of the following values:

a) ‘end’—the initiator has completed the transfer of its data and is releasing the association normally: the provider may delete the service instance and release all resources associated with it;

NOTE — If `unbind-reason` is ‘end’, any subsequent attempt to invoke FSP-BIND may fail even if the service instance provision period has not expired, since the service provider may release the resources allocated to that service instance.

b) ‘suspend’—the initiator is suspending usage of this service instance for an unspecified period of time; the user may or may not re-bind to the provider to continue data transfer at some time prior to the end of the service instance provision period;

c) ‘version not supported’—the initiator does not support the version of the FSP service proposed by the provider in the return from FSP-BIND or does not support version negotiation; this value of `unbind-reason` shall be used only if the FSP-UNBIND is the first operation invoked following the FSP-BIND;

d) ‘other reason’—the reason for the release will have to be found by other means.

© ISO 2011 – All rights reserved

3.3.2.5 `result`

The **`result`** parameter shall specify the result of the FSP-UNBIND invocation, and shall always contain the following value:

'positive result'—the FSP-UNBIND operation has been performed by the responder and the association is released.

NOTES

1 If FSP-UNBIND is invoked while the provider is not in the 'ready' state, the responder invokes FSP-PEER-ABORT; if the authentication level is 'all' and the invocation of FSP-UNBIND cannot be authenticated, the responder ignores it; there is no situation in which the response to the invocation of FSP-UNBIND is to return 'negative result'.

2 The `result` parameter is returned for the FSP-UNBIND operation, even though the only permitted value is 'positive result', for consistency with other confirmed operations.

3 FSP-UNBIND is a confirmed operation in order to provide a definite indication to the initiator that the responder has performed the operation and the association is released.

3.3.3 EFFECTS

The FSP-UNBIND operation shall have the following effects:

a) the association between the initiator and the responder shall be released, and the initiator and the responder shall cease to communicate with each other;

b) the provider shall transition to state 1 ('unbound');

c) if `unbind-reason` is 'end', the provider may delete the service instance and release its resources;

d) if `unbind-reason` is not 'end', the initiator may attempt to re-bind at any time prior to the end of the service instance provision period.

NOTES

1 The performance of FSP-UNBIND for a particular service instance does not necessarily terminate FSP production since other service instances might be dependent on the production.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

2 COP parameters, i.e. parameters that can be set by means the FSP-INVOKE-DIRECTIVE operation, are not altered when the association for the service with the capability to invoke directives is released.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.4 FSP-START

3.4.1 PURPOSE

3.4.1.1 The user shall invoke the FSP-START operation to request that the provider prepare to receive FSP-TRANSFER-DATA invocations (see 3.6).

3.4.1.2 The provider shall return a report of the outcome of the performance of the FSP-START operation to the user.

3.4.1.3 The FSP-START operation shall allow the FSP service provider to return to the user the times scheduled for start and stop of service production.

3.4.1.4 The FSP-START operation is valid only in state 2 (‘ready’) and shall be invoked only by the user.

NOTE – The COP-1 protocol will be set up in accordance with the parameter values supplied by service management. The user may modify these parameter values by invoking any necessary FSP-INVOKE-DIRECTIVE operations, provided the FSP-INVOKE-DIRECTIVE operation is enabled for the given service instance (see 3.12).

3.4.2 INVOCATION, RETURN, AND PARAMETERS

3.4.2.1 General

The parameters of the FSP-START operation shall be present in the invocation and return as specified in table 3-4.

Table 3-4: FSP-START Parameters

Parameter	Invocation	Return
`invoker-credentials`	M	
`performer-credentials`		M
`invoke-ID`	M	M
`first-packet-identification`	M	
`start-production-time`		C
`stop-production-time`		C
`result`		M
`diagnostic`		C

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.4.2.2 **`invoker-credentials`**

The **`invoker-credentials`** parameter shall provide information that enables the performer to authenticate the FSP-START invocation (see 3.1.5).

3.4.2.3 **`performer-credentials`**

The **`performer-credentials`** parameter shall provide information that enables the invoker to authenticate the return from the performance of FSP-START (see 3.1.5).

3.4.2.4 **`invoke-ID`**

The FSP service provider shall return unchanged the user-supplied value of the **`invoke-ID`** parameter (see 3.1.6).

3.4.2.5 **`first-packet-identification`**

The **`first-packet-identification`** parameter shall contain the Packet identification value the FSP service provider shall expect to receive in the first FSP-TRANSFER-DATA invocation after the FSP-START.

NOTE – Further to certain exceptions (e.g. 'sldu expired', see 3.7.2.3), it is necessary to invoke FSP-STOP followed by FSP-START. Any Packets that were already being processed when FSP-STOP was invoked, may still cause notifications be invoked after the new FSP-START invocation. The value of the `first-packet-identification` parameter in the new FSP-START invocation and the values of the `packet-identification` parameter in subsequent FSP-TRANSFER-DATA invocations should be chosen such that all Packets for which the production process did not yet complete can be uniquely identified.

3.4.2.6 **`start-production-time`**

3.4.2.6.1 If the `production-status` is not yet 'operational':

a) **`start-production-time`** parameter value shall be the estimated time at which the FSP service provider will be able to start processing buffered Space Packets;

b) in this case `start-production-time` shall be determined from the production schedule, with allowance for subsequent production steps and completion of the uplink acquisition sequence.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.4.2.6.2 If the `production-status` is 'operational' and the provider is ready to start the processing of Space Packets, `start-production-time` shall contain the time the `production-status` changed to 'operational'.

3.4.2.6.3 If there is a subsequent FSP-START operation within the same service instance, the `start-production-time` parameter shall contain the latest time the provider became ready to process Space Packets; i.e., the most recent time the `production-status` changed to 'operational'.

3.4.2.6.4 The `start-production-time` parameter shall be returned only if the value of the `result` parameter is 'positive result'.

3.4.2.7 `stop-production-time`

3.4.2.7.1 The **`stop-production-time`** shall be the estimated time at which the provider will stop the service production.

NOTE – The value of the `stop-production-time` may be a time later than the end of the service instance provision period.

3.4.2.7.2 If the estimated stop time is not available to the provider, the `stop-production-time` parameter shall contain a value of 'null'.

3.4.2.7.3 The `stop-production-time` parameter shall be returned if the value of the `result` parameter is 'positive result'.

3.4.2.8 `result`

The **`result`** parameter shall specify the result of the FSP-START operation and shall contain one of the following values:

a) 'positive result'—the FSP-START operation has been performed by the provider and the user may start invoking FSP-TRANSFER-DATA operations;

b) 'negative result'—the FSP-START has not been performed by the provider for the reason specified in the `diagnostic` parameter; and the provider cannot accept FSP-TRANSFER-DATA invocations.

3.4.2.9 `diagnostic`

3.4.2.9.1 If `result` is 'negative result', the **`diagnostic`** parameter shall be present in the return, and its value shall be one of the following:

a) 'duplicate invoke-ID'— the value of the `invoke-ID` parameter is the same as the `invoke-ID` value of a previous, outstanding operation;

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

b) ‘out of service’—the provider has been taken out of service for an indefinite period by management action, i.e., `production-status` is ‘halted’;

c) ‘unable to comply’—the provider is unable to accept data at this time because of a possibly temporary fault condition affecting the provider, i.e., `production-status` is ‘interrupted’;

d) ‘production time expired’—the time period scheduled for service production, i.e., the processing of Space Packets, is already past;

e) ‘other reason’—the reason for the negative result will have to be found by other means.

3.4.2.10 If `result` is ‘positive result’, the `diagnostic` parameter shall not be present in the return.

3.4.3 EFFECTS

3.4.3.1 If `result` is ‘positive result’, the FSP-START operation shall have the following effects:

a) the provider shall transition to state 3 (‘active’);

b) in the ‘active’ state, the provider shall accept FSP-TRANSFER-DATA invocations.

3.4.3.2 If `result` is ‘negative result’, the FSP-START operation shall have the following effects:

a) the provider shall remain in state 2 (‘ready’);

b) If `diagnostic` is ‘unable to comply’:

1) the user may re-invoke the FSP-START operation at a later time, within the constraints of the service instance provision period;

2) if the provider’s complex management determines that being ‘unable to comply’ is more than a transient problem, the provider may invoke the FSP-PEER-ABORT operation.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.5 FSP-STOP

3.5.1 PURPOSE

3.5.1.1 The user shall invoke the FSP-STOP operation to request that the provider stop the processing of Space Packets already received from this user.

NOTE – Within the constraints of the service instance provision period, the user may re-enable the reception and processing of Space Packets on the provider side by invoking the FSP-START operation.

3.5.1.2 The provider shall provide a report of the outcome of the performance of the FSP-STOP operation to the user.

3.5.1.3 The FSP-STOP operation is valid only in state 3 (‘active’) and shall be invoked only by the user.

3.5.2 INVOCATION, RETURN AND PARAMETERS

3.5.2.1 General

The parameters of the FSP-STOP operation shall be present in the invocation and return as specified in table 3-5.

Table 3-5: FSP-STOP Parameters

Parameters	Invocation	Return
`invoker-credentials`	M	
`performer-credentials`		M
`invoke-ID`	M	M
`result`		M
`diagnostic`		C

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

3.5.2.2 `invoker-credentials`

The **`invoker-credentials`** parameter shall provide information that enables the performer to authenticate the FSP-STOP invocation (see 3.1.5).

3.5.2.3 `performer-credentials`

The **`performer-credentials`** parameter shall provide information that enables the invoker to authenticate the return from the performance of FSP-STOP (see 3.1.5).

© ISO 2011 – All rights reserved

3.5.2.4 **invoke-ID**

The FSP service provider shall return unchanged the user-supplied value of the **invoke-ID** parameter (see 3.1.6).

3.5.2.5 **result**

The **result** parameter shall specify the result of the FSP-STOP operation and shall contain one of the following values:

a) 'positive result'—the FSP-STOP operation has been performed by the provider, and the user may invoke an FSP-UNBIND operation or a new FSP-START operation;

b) 'negative result'—the FSP-STOP operation has not been performed by the provider for the reason specified by the `diagnostic` parameter.

3.5.2.6 **diagnostic**

3.5.2.6.1 If `result` is 'negative result', the **diagnostic** parameter shall be present in the return, and its value shall contain one of the following:

a) 'duplicate invoke-ID'—the value of the `invoke-ID` parameter is the same as the `invoke-ID` value of a previous, outstanding operation;

b) 'other reason'—the reason for the negative result will have to be found by other means.

3.5.2.6.2 If `result` is 'positive result', the `diagnostic` parameter shall not be present in the return.

3.5.3 EFFECTS

3.5.3.1 If `result` is 'positive result', the FSP-STOP operation shall have the following effects:

a) the provider shall transition to state 2 ('ready') and shall no longer accept FSP-TRANSFER-DATA invocations;

b) for Space Packets queued for this service instance:

1) the provider shall discard any Packets that have not yet been passed to the segment queue;

2) the provider shall not discard, but shall complete processing, of Packets that have been converted to Frame Data Units and passed to the segment queues;

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

c) if a radiation or transfer report has been requested by the user for a Space Packet that is already being processed, the report shall be generated and sent to the user by means of an FSP-ASYNC-NOTIFY operation.

3.5.3.2 If `result` is 'negative result':

a) processing shall continue;

b) the provider state shall remain unchanged;

c) any buffered Space Packets shall not be discarded.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.6 FSP-TRANSFER-DATA

3.6.1 PURPOSE

3.6.1.1 The user shall invoke the FSP-TRANSFER-DATA operation to transfer Space Packets to the provider.

3.6.1.2 The provider shall provide a report of the outcome of the performance of the FSP-TRANSFER-DATA operation to the user.

3.6.1.3 The FSP-TRANSFER-DATA operation is valid only in state 3 ('active') and shall be invoked only by the user.

3.6.2 INVOCATION, RETURN, AND PARAMETERS

3.6.2.1 General

The parameters of the FSP-TRANSFER-DATA operation shall be present in the invocation and return as specified in table 3-6.

3.6.2.2 `invoker-credentials`

The **`invoker-credentials`** parameter shall provide information that enables the performer to authenticate the FSP-TRANSFER-DATA invocation (see 3.1.5).

3.6.2.3 `performer-credentials`

The **`performer-credentials`** parameter shall provide information that enables the invoker to authenticate the return from the performance of FSP-TRANSFER-DATA (see 3.1.5).

3.6.2.4 `invoke-ID`

The FSP service provider shall return unchanged the user-supplied value of the **`invoke-ID`** parameter (see 3.1.6).

3.6.2.5 `packet-identification`

3.6.2.5.1 The **`packet-identification`** parameter shall contain a monotonically increasing sequence number and shall be:

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

a) set for the first FSP-TRANSFER-DATA invocation after a successful FSP-START invocation to the value of the `first-packet-identification` parameter of that FSP-START invocation;

b) incremented for each FSP-TRANSFER-DATA invocation accepted by the provider.

Table 3-6: FSP-TRANSFER-DATA Parameters

Parameters	Invocation	Return
`invoker-credentials`	M	
`performer-credentials`		M
`invoke-ID`	M	M
`packet-identification`	M	M
`earliest-production-time`	M	
`latest-production-time`	M	
`delay-time`	M	
`transmission-mode`	M	
`MAP-identifier`	M	
`blocking`	M	
`processing-started-notification`	M	
`radiated-notification`	M	
`acknowledged-notification`	M	
`data`	M	
`packet-buffer-available`		M
`result`		M
`diagnostic`		C

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

3.6.2.5.2 The provider shall set the value of the `packet-identification` parameter to the sequence number expected in the next FSP-TRANSFER-DATA invocation:

a) if the invocation is accepted, the `packet-identification` in the return shall be one greater than the value in the invocation;

b) if the invocation is rejected, the `packet-identification` in the return shall contain the value expected by the FSP service provider:

1) in the case of the first FSP-TRANSFER-DATA operation following an FSP-START, it is the value specified in the `first-packet-identification` parameter of the FSP-START operation;

© ISO 2011 – All rights reserved

2) otherwise, the value is one greater than the value of the `packet-identification` parameter of the last accepted FSP-TRANSFER-DATA operation;

NOTE – It is assumed that the supported range of this parameter is sufficiently large that no two Packets buffered and/or being processed by the FSP service provider on behalf of a given service instance have the same `packet-identification` value. Should that be the case, then the FSP provider rejects the FSP-TRANSFER-DATA with the `diagnostic` parameter value set to 'duplicate packet identification', but the value of the `packet-identification` parameter in the return is nevertheless set as specified in 3.6.2.5.2.

3.6.2.6 `earliest-production-time`

3.6.2.6.1 The **`earliest-production-time`** parameter shall be used to specify the earliest time that the provider shall start processing this Packet.

3.6.2.6.2 The `earliest-production-time` parameter shall either be unspecified (i.e., contain a value of 'null'), or shall specify the earliest time that the provider shall start processing this Packet.

3.6.2.6.3 If the `earliest-production-time` parameter is unspecified, the provider shall begin processing this Space Packet immediately as long as

a) `production-status` is 'operational' and the transmission mode required for the packet is available; or

b) `latest-production-time` is unspecified (i.e., contains a value of 'null').

3.6.2.6.4 The time specified in `earliest-production-time` shall not be earlier than the time specified for any preceding Space Packet.

3.6.2.7 `latest-production-time`

3.6.2.7.1 The **`latest-production-time`** parameter shall be used to specify the latest time at which the provider shall start processing this Packet.

3.6.2.7.2 The `latest-production-time` parameter shall either be unspecified (i.e., contain a value of 'null'), or shall specify the latest time at which the provider shall start processing this Packet.

3.6.2.7.3 If the `latest-production-time` parameter is unspecified, the provider shall process the Space Packet as long as the service instance is in state 3 ('active') and the production process is not halted.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.6.2.7.4 The time specified in `latest-production-time` shall not be earlier than the time specified for any preceding Space Packet.

3.6.2.7.5 If the time specified in the `latest-production-time` parameter has passed before the Packet is removed from the packets queue (see annex B for details), the 'sldu expired' exception shall occur (see 3.7.2.3) and the Packet shall not be processed.

NOTES

1 As described in annex B, the time necessary for the processing steps (such as packet blocking) taken from the time where processing of the Packet starts (as controlled by the `earliest-production-time` parameter) and the point in time when conformance with the `latest-production-time` parameter is checked is not negligible. As a consequence, setting the `latest-production-time` parameter to the same time as `earliest-production-time` will generally cause the 'late sldu' exception (see 3.7.2.3).

2 Depending on the applied multiplexing scheme, the actual radiation of the frame(s) encapsulating the given Packet may happen later than specified in the `latest-production-time` parameter. Related details are discussed in annex B. Therefore, once a Packet has been multiplexed into a TC Frame, the `latest-production-time` parameter value for that Packet no longer has any effect on the subsequent processing of the TC Frame or the CLTU into which it the frame is encoded.

3 If `latest-production-time` is specified, i.e., it is not 'null', the provider will defer the processing of a Packet if the current `production-status` value is 'interrupted' or if the required transmission mode is currently not available. Processing is deferred until either recovery from a temporary problem is accomplished, i.e., the `production-status` value changes to 'operational', or otherwise the `latest-production-time` would expire (see B3.3). If `latest-production-time` is unspecified, the provider does not defer the processing of the packet.

3.6.2.8 `delay-time`

3.6.2.8.1 The **`delay-time`** parameter shall contain the minimum radiation delay, in microseconds, between the CLTU(s) bearing this Space Packet and the next CLTU.

3.6.2.8.2 The **`delay-time`** parameter shall also apply in case the packet is radiated embedded in a frame that needs to be retransmitted as per COP-1.

3.6.2.8.3 The delay shall be measured from the trailing edge of the last radiated bit of the last CLTU encapsulating (part of) this Space Packet to the leading edge of the first bit of the next CLTU.

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

3.6.2.8.4 If `delay-time` contains a value of zero, radiation of the next CLTU may occur immediately.

3.6.2.8.5 If `blocking` is 'yes' (see 3.6.2.11) and more than one Space Packet has been inserted into the frame that is encapsulated in the CLTU, the maximum of the `delay-time` values specified for all Space Packets in that CLTU shall be applied.

3.6.2.8.6 The `delay-time` shall be applied regardless of the VC to which the next TC frame is sent.

NOTE – The `delay-time` value is passed via the Forward CLTU Generation FG to the Forward TC Space Link Processing FG. Unacceptable values will be detected by the Forward TC Space Link Processing FG. The Forward TC Space Link Processing FG reports rejection of any CLTU to the source Forward CLTU Generation FG, which in turn reports it to the source Forward TC VC Space Link Processing FG, ultimately causing the corresponding FSP-TRANSFER-DATA invocations to be rejected with a negative return.

3.6.2.9 `transmission-mode`

3.6.2.9.1 The **transmission-mode** parameter shall specify the mode in which the Space Packet shall be transmitted to the spacecraft, and shall contain one of the following values:

a) 'sequence-controlled'—the Space Packet shall be transmitted in the sequence-controlled (AD) mode;

b) 'sequence-controlled and unblock AD mode'—the AD service shall be unblocked and the Space Packet shall be transmitted in the sequence-controlled (AD) mode;

NOTE – The AD mode will be blocked when a 'packet transmission mode mismatch' notification is sent to the affected user. Any subsequent FSP-TRANSFER-DATA invocation requesting the sequence-controlled transmission mode will be rejected until the AD mode is unblocked. Taking into account the packets that were discarded as a consequence of the transmission mismatch, the user needs to identify the packets that need to be transferred again in order for the commands to arrive to the spacecraft completely and in the intended sequence. When the user is ready to transfer AD packets again, he should unblock the AD mode by sending an FSP-TRANSFER-DATA invocation with `transmission-mode` set to 'sequence-controlled and unblock AD mode'. Invocations with `transmission-mode` parameter set to 'sequence-controlled and unblock AD mode' while the AD mode is not blocked will be rejected.

c) 'expedited'—the Space Packet shall be transmitted without sequence control (BD mode).

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.6.2.9.2 If the `transmission-mode` is set to 'sequence-controlled and unblock AD mode', the FSP-TRANSFER-DATA invocation shall be accepted only if the AD mode is currently blocked.

3.6.2.9.3 If an FSP-TRANSFER-DATA invocation with the parameter `transmission-mode` set to 'sequence-controlled and unblock AD mode' is accepted, the AD mode is unblocked.

NOTE – AD Packets will be accepted again as soon as the AD mode is unblocked regardless of the current transmission mode capability. If the submitted packet requires AD mode and the production time is specified such that production of that packet has to be started before the sequence-controlled transmission mode was re-established, a further 'transmission mode mismatch' event will occur and AD mode will be blocked again.

3.6.2.10 `MAP-identifier`

3.6.2.10.1 The **`MAP-identifier`** parameter shall specify the Multiplexer Access Point (MAP) to be used for the transmission of the Space Packet contained in the `data` parameter.

NOTE – If the MAP multiplexing scheme (see table 3-11) is set to 'polling vector' and the `MAP-identifier` associated with the Space Packet transferred by the user is not an element of the polling vector, but an element of the list of MAP-ID permitted for the given Service Instance (see parameter `map-list` in table 3-11), the packet will be queued, but not processed as long as the multiplexing scheme is not modified such that the given `MAP-identifier` would be processed.

3.6.2.10.2 If the service instance is configured to not generate Segment Headers, this parameter must be set to 'none'.

3.6.2.11 `blocking`

3.6.2.11.1 The **`blocking`** parameter shall specify whether the Space Packet may be blocked with other Space Packets into one TC frame.

3.6.2.11.2 If `blocking` is set to 'yes', depending on the availability of other Space Packets on the same MAP and the space left in the frame being built, the Packet may be merged with other Packets into one TC frame.

3.6.2.11.3 If `blocking` is set to 'no', the Space Packet shall be inserted into a frame carrying that Packet only.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

NOTE – Service management may elect to set the blocking-usage parameter to 'not permitted' (see table 3-11). In that case, the provider will ignore the `blocking` parameter and each frame will encapsulate at most one Space Packet.

3.6.2.12 `processing-started-notification`

The **`processing-started-notification`** parameter shall specify whether the provider shall invoke the FSP-ASYNC-NOTIFY operation upon forwarding of the Packet from the packets queue to the segments queue (see annex B for the definition of these queues), and shall contain one of the following values:

a) 'produce notification'—invoke an FSP-ASYNC-NOTIFY operation upon forwarding of the Packet to the segments queue;

b) 'do not produce notification'—do not invoke the FSP-ASYNC-NOTIFY operation.

3.6.2.13 `radiated-notification`

The **`radiated-notification`** parameter shall specify whether the provider shall invoke the FSP-ASYNC-NOTIFY operation upon completion of the radiation of the Space Packet, and shall contain one of the following values:

a) 'produce notification'—invoke an FSP-ASYNC-NOTIFY operation upon completion of the radiation;

b) 'do not produce notification'—do not invoke the FSP-ASYNC-NOTIFY operation.

3.6.2.14 `acknowledged-notification`

The **`acknowledged-notification`** parameter shall specify whether the provider shall invoke an FSP-ASYNC-NOTIFY operation upon completion of the transfer of the Space Packet, i.e., when all Segments of the Packet have been acknowledged by the spacecraft in the CLCW, and shall contain one of the following values:

a) 'produce notification'—invoke an FSP-ASYNC-NOTIFY operation upon completion of the transfer; this value is allowed only when `transmission-mode` is 'sequence-controlled';

b) 'do not produce notification'—do not invoke the FSP-ASYNC-NOTIFY operation.

3.6.2.15 `data`

The **`data`** parameter shall contain a Space Packet for transfer to the space element of a mission.

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

3.6.2.16 `packet-buffer-available`

The **`packet-buffer-available`** parameter shall specify the remaining number of octets available to this service instance for buffering of Space Packets in the request queue.

3.6.2.17 `result`

The **`result`** parameter shall specify the result of the FSP-TRANSFER-DATA operation and shall contain one of the following values:

a) 'positive result'—the FSP-TRANSFER-DATA operation has been performed by the provider, and the Space Packet will be queued until processing is due;

b) 'negative result'—the FSP-TRANSFER-DATA operation has not been performed by the provider, for the reason specified by the `diagnostic` parameter, and the Space Packet has not been queued.

3.6.2.18 `diagnostic`

3.6.2.18.1 If `result` is 'negative result', the **`diagnostic`** parameter shall be present in the return and its value shall be one of the following:

a) 'duplicate invoke-ID'—the value of the `invoke-ID` parameter is the same as the `invoke-ID` value of a previous, outstanding operation;

b) 'unable to process'—the provider cannot process Space Packets for one of the following reasons:

1) the provider cannot process Space Packets because the `production-status` parameter is not 'operational'; this has been reported to the user via an FSP-ASYNC-NOTIFY operation containing the `notification-type` value 'production interrupted' or 'production halted';

2) the `production-status` is 'operational' but the provider is blocked due to an earlier fault: the provider has reported the fault condition to the user by a CLTU-ASYNC-NOTIFY operation containing the `notification-type` value 'production interrupted' and has reported the recovery from the fault condition to the user by a CLTU-ASYNC-NOTIFY operation containing the `notification-type` value 'production operational';

3) the provider cannot process Space Packets because the service instance is blocked following a condition which has been reported to the user via an FSP-ASYNC-NOTIFY operation containing the `notification-type` value 'sldu expired';

4) the `production-status` is 'operational', but the provider has temporarily suspended production to process a FSP-THROW-EVENT invocation: no fault condition has been reported to the user;

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

c) ‘unable to store’—there is not enough buffer space available in the request queue of this service instance to store this Space Packet;

d) ‘out of sequence’—the value of the `packet-identification` parameter is not equal to the value expected by the provider, which is one of the following:

   1) in the case of the first FSP-TRANSFER-DATA operation following an FSP-START, the value specified in the `first-packet-identification` parameter of the FSP-START operation;

   2) otherwise, one greater than that of the value of the `packet-identification` parameter of the last accepted FSP-TRANSFER-DATA operation;

e) ‘duplicate packet identification’—the value of the `packet-identification` parameter is equal to that of a Packet buffered and/or being processed by the FSP service provider on behalf of this service instance;

NOTE – This error condition can only be encountered after FSP-STOP and FSP-START operations have been successfully performed setting the `first-packet-identification` parameter value such that such duplication is not excluded.

f) ‘inconsistent time range’—the time specified in the `earliest-production-time` parameter is later than the time specified in `latest-production-time`;

g) ‘invalid time’—the production time window is invalid, for one of the following reasons:

   1) the period from `earliest-production-time` to `latest-production-time` does not overlap with the range of times for which service production is scheduled;

   2) the period from `earliest-production-time` to `latest-production-time` does not overlap with the service instance provision period;

NOTE – The production may be scheduled to terminate earlier than the service instance provision period ends. An SLE Complex may do so to have the production engine available for support of a different mission as soon as possible, but permitting the users of the previous production period some extra time to retrieve for example a status report reflecting the final accounting information.

h) ‘conflicting production time intervals’—the time specified in the `earliest-production-time` and/or `latest-production-time` parameter for this Space Packet is earlier than the corresponding time(s) specified for an already accepted Space Packet;

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

NOTE – A Space Packet is rejected if its production time interval starts or terminates earlier than the production time interval of a Space Packet already accepted. Although this condition does not necessarily lead to the 'sldu expired' exception (see 3.7.2.3), it may. As a precaution, the FSP-TRANSFER-DATA operation is rejected. This permits the user to correct the problem by changing the conflicting time specification to 'unspecified' and to avoid the 'sldu expired' exception and the associated loss of the already buffered Space Packets at production time.

i) 'late sldu'—the `latest-production-time` is earlier than the time the FSP-TRANSFER-DATA invocation is received by the provider;

j) 'invalid delay time'—the specified delay time is outside the range supported by the given configuration of the Forward TC Space Link Processing FG;

k) 'invalid transmission mode'—a transmission mode has been invoked which is not allowed for that particular service instance or the AD mode is currently blocked and the requested `transmission-mode` value is 'sequence-controlled' or the AD mode is not blocked and the requested `transmission-mode` is 'sequence-controlled and unblock AD mode';

l) 'invalid MAP'—the value in the `MAP-identifier` parameter is invalid for one of the following reasons:

   1) the `MAP-identifier` parameter value is not part of the set of MAP identifiers permitted for this service instance;

   2) the `MAP-identifier` value is not 'null' although no Segment Headers shall be generated;

m) 'invalid notification request'—the parameter `acknowledged-notification` is set to 'produce notification', but the `transmission-mode` parameter is set to 'expedited';

n) 'packet too long'—the Space Packet contained in `data` exceeds the maximum Packet Data Length allowed for this service instance;

o) 'unsupported packet version'—the packet version is either not supported by CCSDS or is supported by CCSDS but not specified for this the service instance;

p) 'incorrect packet type'—the Packet Type does not specify telecommand;

q) 'invalid packet apid'—the Application Process Identifier (APID) in the Packet Primary Header is not one specified for this service instance;

NOTE – The apid-list list parameter (see table 3-1) may be set to 'any', in which case any Space Packet will be accepted regardless of the APID.

r) 'other reason'—the reason for the negative result will have to be found by other means.

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

3.6.2.18.2 If `result` is 'positive result', the `diagnostic` parameter shall not be present in the return.

3.6.3 EFFECTS

3.6.3.1 If `result` is 'positive result', the FSP-TRANSFER-DATA operation shall have the following effects:

a) the provider shall queue the Space Packet until it is due to be processed;

b) the provider shall process Space Packets in the sequence received and according to the production and delay time parameters;

c) the provider shall remain in state 3 ('active').

3.6.3.2 If `result` is 'negative result', the FSP-TRANSFER-DATA operation shall have no effect, i.e.:

a) the Packet contained in the FSP-TRANSFER-DATA invocation shall not be buffered;

b) the provider shall remain in state 3 ('active').

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.7 FSP-ASYNC-NOTIFY

3.7.1 PURPOSE

3.7.1.1 The FSP service provider shall invoke the FSP-ASYNC-NOTIFY operation to notify the user of an event affecting the production of the FSP service.

NOTE – Notification of events may be of value to the user in understanding specific provider behavior, such as an interruption of the command radiation.

3.7.1.2 The FSP-ASYNC-NOTIFY operation shall be an unconfirmed operation.

NOTE – Notifications from the provider are delivered to the user asynchronously to the flow of FSP-TRANSFER-DATA operations from the user to the provider.

3.7.1.3 The FSP-ASYNC-NOTIFY operation is valid only in states 2 (‘ready’) and 3 (‘active’) and shall be invoked only by the provider.

3.7.2 INVOCATION AND PARAMETERS

3.7.2.1 General

The parameters of the FSP-ASYNC-NOTIFY operation shall be present in the invocation as specified in table 3-7.

Table 3-7: FSP-ASYNC-NOTIFY Parameters

Parameters	Invocation
invoker-credentials	M
notification-type	M
directive-executed-identification	C
event-thrown-identification	C
packet-identification-list	C
fop-alert	C
packet-identification-last-processed	M
production-start-time	C
packet-status	C
packet-identification-last-ok	M
production-stop-time	C
production-status	M

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.7.2.2 `invoker-credentials`

The **`invoker-credentials`** parameter shall provide information that enables the performer to authenticate the FSP-ASYNC-NOTIFY invocation (see 3.1.5).

3.7.2.3 `notification-type`

The **`notification-type`** parameter shall indicate the event that the user is being notified of, and its value shall be one of the following:

a) 'packet processing started'—the Space Packet whose identification is contained in the `packet-identification-list` parameter was extracted from the requests queue and forwarded to the packets queue. This value of `notification-type` shall be used only if the value of `processing-started-notification` in the associated FSP-TRANSFER-DATA invocation was 'produce notification'. This event shall only be notified to the user who submitted the affected Space Packet.

NOTE – When the `notification-type` parameter value is 'packet processing started', the `packet-identification-list` parameter will contain a single entry. The value of this entry will always be the same as the value of the `packet-identification-last-processed` parameter.

b) 'packet radiated'—the Space Packet whose identification is contained in the `packet-identification-list` parameter successfully completed radiation. For sequence-controlled packet transmission this may imply that at least one acknowledgement via a CLCW is still outstanding. This value of `notification-type` shall be used only if the value of `radiated-notification` in the associated FSP-TRANSFER-DATA invocation was 'produce notification'. This event shall only be notified to the user who submitted the affected Space Packet.

NOTE – When the `notification-type` parameter value is 'packet radiated', the `packet-identification-list` parameter will contain a single entry.

c) 'packet acknowledged'—the Space Packet whose identification is contained in the `packet-identification-list` parameter successfully completed transfer. This applies only to sequence-controlled transmission mode and signifies that all Packet components have been acknowledged by the space element via the associated stream of CLCWs. This value of `notification-type` shall be used only if the value of `acknowledged-notification` in the associated FSP-TRANSFER-DATA invocation was 'produce notification'. This event shall only be notified to the user who submitted the affected Space Packet.

NOTES

1 When the `notification-type` parameter value is 'packet acknowledged', the `packet-identification-list` parameter will contain a single entry.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

The value of this entry will always be the same as the value of the `packet-identification-last-ok` parameter.

2 The Space Packet is guaranteed to have been received by the space element, but not necessarily accepted. Packet assembly or execution may not have been carried out correctly. This can only be determined by examining telemetry.

d) 'sldu expired'—processing of the Packet identified by the value of the first entry in the `packet-identification-list` parameter did not begin by the time specified in the `latest-production-time` parameter of this Space Packet. This event shall only be notified to the user who submitted the affected Space Packet.

NOTES

1 After the 'sldu expired' event, Space Packets belonging to this service instance and not yet having been passed to the segment queues in the form of Frame Data Units will be discarded. The identifications of these discarded Packets are entered in the `packet-identification-list` parameter. The user should resend all Packets referenced in the `packet-identification-list` parameter to the provider.

2 Further FSP-TRANSFER-DATA invocations will be blocked, i.e., rejected with an 'unable to process' `diagnostic`. The user has to clear the blocking by invoking an FSP-STOP operation. In order to resume the transfer and processing of Space Packets, after confirmation of the FSP-STOP, the user must invoke FSP-START.

e) 'packet transmission mode mismatch'—the current provider configuration prevents the transmission of Space Packets in the requested mode, but `production-status` is still 'operational'. The requested mode may be disabled by service management, or the provider configuration in effect, resulting from FSP-INVOKE-DIRECTIVE invocations or FOP alerts, does not permit the transmission of Space Packets in the requested mode. All Space Packets with a currently not supported transmission mode for which production did not yet complete and belong to the given user shall be identified in the `packet-identification-list` parameter and shall be discarded by the provider. This means that also Frame Data Units derived from Space Packets requiring the no longer supported transmission mode have to be discarded (see B3.14). This event shall only be notified to users with Space Packets that were discarded because of the not available sequence-controlled transmission mode.

NOTES

1 If the current `packet-identification-last-processed` value is also an entry in `packet-identification-list`, and the `packet-status` value of that packet was 'packet processing started', then the `packet-status` value will be updated to 'unsupported transmission mode' and the

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

`production-stop-time` parameter value will indicate the time when the transmission mode capability changed. If the `packet-status` value of that packet was 'radiated', then the `packet-status` value is left unchanged.

2 All users of the affected VC connected at the time when a change of the transmission mode capability occurs will receive a 'transmission mode capability change' notification. Users with Space Packets, for which processing is starting or has started but did not complete yet and require a currently not supported transmission mode, will receive in addition the 'packet transmission mode mismatch' notification.

3 After the 'packet transmission mode mismatch' event, service production and processing of Space Packets continues, but all Space Packets requiring the no longer supported transmission mode and belonging to a service instance with at least one Space Packet requiring the sequence-controlled transmission mode and being processed are discarded. The AD mode for this service instance is blocked and FSP-TRANSFER-DATA invocations requesting the sequence-controlled transmission mode will be rejected until an FSP-TRANSFER-DATA invocation requesting the unblocking of the sequence-controlled mode has been received (see 3.6.2.9). The user should retransmit to the provider all Packets identified in the `packet-identification-list` parameter when the desired transmission mode is available again.

f) 'transmission mode capability change'—a change in the capability to handle AD packets occurred. This event shall be notified to a given user:

1) only if the `production-status` is still 'operational'; or

2) if `production-status` changed from 'operational' with a sub-state different from 'BD' to 'interrupted', but the given user is not notified of this production status transition because this user has no Packets for which processing has started but did not yet complete; i.e., no Packets of this user are currently in the packets queues and no Frame Data Units generated from Packets of this user are in the segment queues.

NOTE – This event occurs as a result of FOP alerts, the successful completion of certain directives and when the allowed number of transmissions specified in the transmission-limit parameter (see table 3-1) has been completed. The parameter `production-status` indicates the current capability. A FOP alert may cause a 'packet transmission mode mismatch' event that will then be notified separately (see 3.7.2.3e)). B3.14 specifies which packets are discarded in such case.

g) 'buffer empty'—the provider has no further Space Packets buffered for this service instance. This event shall:

1) only be notified to the user of the given service instance;

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

2) not be notified if it is the result of an FSP-STOP operation or an 'sldu expired', 'packet transmission mode mismatch', 'production interrupted', 'VC aborted', or 'production halted' event.

h) 'no invoke directive capability on this VC'—the service instance for which the FSP-INVOKE-DIRECTIVE is enabled is no longer connected to the service provider because of an FSP-UNBIND, FSP-PEER-ABORT, or 'protocol abort' event for that instance. This event shall be notified to all users currently connected to the service provider and using the affected VC.

NOTE – This notification is not applicable to the service instance that has been enabled to invoke the FSP-INVOKE-DIRECTIVE operation.

i) 'invoke directive capability established on this VC'—the service instance for which the FSP-INVOKE-DIRECTIVE is enabled just bound to the service provider by means of a successful FSP-BIND operation. This event shall be notified to all users currently connected to the service provider and using the affected VC.

NOTE – This notification is not applicable to the service instance that has been enabled to invoke the FSP-INVOKE-DIRECTIVE operation.

j) 'positive confirm response to directive'—the directive identified in the `directive-executed-identification` parameter completed successfully. This notification indicates that COP-1 (including FARM-1 for directives requiring receiving-end action) was able to complete the execution of the directive. This event shall only be notified to the user who invoked the FSP-INVOKE-DIRECTIVE operation.

k) 'negative confirm response to directive'—the directive identified in the `directive-executed-identification` parameter did not complete successfully.

NOTE – The 'negative confirm response to directive' notification does not carry a parameter giving the reason for the failure to confirm performance of the actions invoked by the directive. However, a 'transmission mode capability change' notification together with the `fop-alert` parameter may arise independently and may explain why the directive was not implemented.

l) 'VC aborted'—this event occurs as a result of successful execution of the 'abort VC' directive (see 3.12.2.6). This event shall be notified to all currently connected users of the affected VC.

NOTES

1 All Space Packets belonging to this VC are discarded. This also applies to packets already converted to Frame Data Units and passed to the segment queues. For each user, all discarded Space Packets, for which production did not yet complete, are identified in the `packet-identification-list` parameter.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

The user should retransmit to the provider all Packets listed in the `packet-identification-list` parameter.

2 The `packet-identification-list` will not contain any entry if no Packets of the given user were buffered and/or being processed when the 'abort VC' directive was invoked.

m) 'production interrupted'—processing aborted for the Packets belonging to this service instance and the Packets identified in the `packet-identification-list` parameter were discarded. This also applies to packets already converted to Frame Data Units and passed to the segment queues. This event occurs when `production-status` is 'interrupted' and at least one Packet belonging to this service instance has the `packet-status` 'production started' or, in case of an AD Packet, 'radiated' or the processing of a Packet has to be started based on the specified `earliest-production-time` and `latest-production-time` parameters. The production process is stopped; however, it may still be functional. This event shall be notified to all users affected by the interruption of the production process, i.e. to all users with Packets for which processing has started but did not yet complete.

NOTES

1 If at the time where the `production-status` changes to 'interrupted' no Space Packets of a given user are being processed, no 'production interrupted' notification is sent to this user and no Packets belonging to this user are discarded. If the `production-status` is still 'interrupted' when, according to the `earliest-production-time` and/or `latest-production-time` parameters, the next Space Packet of this user starts to be processed, the notification will be sent at that time to this user.

2 The production process is currently interrupted due to a (possibly transient) problem affecting the production process. The processing of Space Packets of the notified user is stopped and all Space Packets identified in the `packet-identification-list` parameter have been discarded. This also applies to packets already converted to Frame Data Units and passed to the segment queues. Further FSP-TRANSFER-DATA invocations will be blocked, i.e., rejected with 'unable to process' `diagnostic`. The user has to clear the blocking by invoking an FSP-STOP operation and wait for a positive FSP-STOP return. When the production problem is cleared, the user will be notified of the 'production operational' event. In order to resume the transfer and processing of Space Packets, the user must invoke FSP-START. The user should retransmit to the provider all Space Packets listed in the `packet-identification-list` parameter.

n) 'production halted'—the production process has been stopped and `production-status` changed to 'halted'; this event shall be notified to all users connected to the

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

service provider at the point in time when the `production-status` change occurred.

NOTES

1 The production process enters the halted status by service management decision, for example in case of malfunctioning equipment.

2 The production process is stopped and all buffered Space Packets are discarded. This also applies to packets already converted to Frame Data Units and passed to the segment queues. For each user, all discarded Space Packets are identified in the `packet-identification-list` parameter. Further FSP-TRANSFER-DATA invocations will be blocked, i.e., rejected with 'unable to process' `diagnostic`. The user has to clear the blocking by invoking an FSP-STOP operation and wait for a positive FSP-STOP return. When service management decides that production will be resumed, the user is notified of this `production-status` transition by the 'production operational' event. In order to resume the transfer and processing of Space Packets, the user must invoke FSP-START. The user should retransmit to the provider all Packets listed in the `packet-identification-list` parameter.

3 The `packet-identification-list` will not contain any entry if no Packets of the given user were buffered and/or being processed when `production-status` changed to 'halted'.

o) 'production operational'—the production process is ready to process Space Packets and `production-status` has changed to 'operational'. This event shall be notified to all users who did not yet receive any notification regarding the current production- status or had been notified of any production-status different from 'operational'.

NOTES

1 This event occurs when the forward space link has been successfully established or following actions to restore production to operational status after a halt or interrupt.

2 It is permissible to send this notification also to users if the most recent notification received by them was 'production operational'.

3 After this transition, the initial sub-state of the `production-status` is 'BD';

p) 'action list completed'—all actions associated with the event triggered by an FSP-THROW-EVENT operation identified by the `event-thrown-identification` parameter have successfully completed. This event shall only be notified to the user who invoked the FSP-THROW-EVENT operation.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

q) ‘action list not completed’—at least one of the actions of the action list associated with the event triggered by the FSP-THROW-EVENT operation identified by the `event-thrown-identification` parameter did not complete. This event shall only be notified to the user who invoked the FSP-THROW-EVENT operation.

r) ‘event condition evaluated to false’—a required condition was false for the event that the FSP-THROW-EVENT operation identified by the `event-thrown-identification` parameter, attempted to trigger. The actions associated with this event have not been performed. This event shall only be notified to the user who invoked the FSP-THROW-EVENT operation.

3.7.2.4 `directive-executed-identification`

3.7.2.4.1 If `notification-type` is ‘positive confirm response to directive’ or ‘negative confirm response to directive’, the **`directive-executed-identification`** parameter shall be present and identify the `directive-identification` value in the FSP-INVOKE-DIRECTIVE invocation.

3.7.2.4.2 For all other notifications, this parameter shall not be present.

3.7.2.5 `event-thrown-identification`

3.7.2.5.1 If `notification-type` is ‘action list completed’, ‘action list not completed’, or ‘event condition evaluated to false’, the **`event-thrown-identification`** parameter shall be present and indicate the `event-invocation-identification` value of the FSP-THROW-EVENT invocation that triggered the actions whose results are reported.

3.7.2.5.2 For all other notifications, this parameter shall not be present.

3.7.2.6 `packet-identification-list`

3.7.2.6.1 If `notification-type` is ‘packet processing started’, ‘packet radiated’, ‘packet acknowledged’, or ‘sldu expired’, the **`packet-identification-list`** parameter shall be present and comprise the `packet-identification` value of the FSP-TRANSFER-DATA invocation that contained the affected Packet.

3.7.2.6.2 If `notification-type` is ‘packet transmission mode mismatch’, ‘production interrupted’, ‘VC aborted’, or ‘production halted’, the `packet-identification-list` parameter shall be present and comprise the list of `packet-identification` values of the FSP-TRANSFER-DATA invocations that contained the Packets that were discarded following the reported event.

3.7.2.6.3 For all other notifications, this parameter shall not be present.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.7.2.7 `fop-alert`

3.7.2.7.1 The **`fop-alert`** parameter shall contain the FOP alert as generated by the FSP production process in accordance with reference [5] as indication of the termination of the sequence-controlled service guarantee. It shall have one of the following values:

a) 'no FOP alert'—this value is used when the notified transmission mode capability change does not imply the termination of the sequence-controlled service guarantee.

b) 'FOP alert-limit'—this alert is generated when:

1) the allowed number of transmissions was exhausted for a Type-AD frame; or

2) the allowed number of transmissions was exhausted for a Type-BC frame derived from a directive (e.g., 'Initiate AD Service' directive with 'Unlock' or with 'Set V(R)');

c) 'FOP alert-lockout'—lockout detected;

d) 'FOP alert-synch'—this alert is generated when:

1) CLCW with 'Retransmit' Flag = 0 and N(R) = NN(R) has arrived, when last CLCW showed 'Retransmit' Flag = 1;

2) all frames sent are acknowledged but 'Retransmit' Flag = 1; or

3) an attempt to acknowledge frames is made during the initializing phase corresponding to FOP State (S4);

e) 'FOP alert-NN(R)'—CLCW with invalid N(R) has arrived;

f) 'FOP alert-CLCW'—this alert is generated when:

1) a CLCW with = 'Wait' Flag = 1 and 'Retransmit' Flag = 0 has arrived; or

2) a CLCW with invalid pattern of bits has arrived;

g) 'FOP alert-LLIF'—FOP-1 and Lower Layer are out of synchronization;

h) 'FOP alert-term'—a 'Terminate AD Service' directive has arrived.

3.7.2.7.2 If `notification-type` is 'transmission mode capability change' or 'negative confirm response to directive', the `fop-alert` parameter shall be present.

3.7.2.7.3 For all other notifications, this parameter shall not be present.

3.7.2.8 `packet-identification-last-processed`

For all notifications, the **`packet-identification-last-processed`** parameter shall be present; its value shall be set as follows:

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

a) if no Space Packets belonging to the given service instance have been processed, the value of the `packet-identification-last-processed` parameter shall be set to 'null';

b) otherwise, the parameter shall specify the identification of the Space Packet belonging to the given service instance that most recently started to be processed.

NOTE – A Packet starts to be processed when it is transferred from a packets queue to a segments queue (see annex B).

c) The value of the `packet-identification-last-processed` parameter shall not be altered when the association is released or aborted.

NOTE – The most recently processed Space Packet may be the same as that identified in `packet-identification-last-ok`.

3.7.2.9 `production-start-time`

3.7.2.9.1 Whenever `packet-identification-last-processed` is not 'null', the **`production-start-time`** parameter shall be present and shall contain the time at which the provider started to process the Space Packet identified by `packet-identification-last-processed`.

3.7.2.9.2 For all notifications, if `packet-identification-last-processed` is 'null', the `production-start-time` parameter shall not be present.

3.7.2.10 `packet-status`

3.7.2.10.1 Whenever the value of the `packet-identification-last-processed` parameter is not 'null', the **`packet-status`** parameter shall be present and shall contain one of the following values representing the processing state of the Space Packet identified by `packet-identification-last-processed`:

a) 'acknowledged'—(applies only to sequence-controlled transmission mode) all Space Packet components have been acknowledged by the space element via the associated stream of CLCWs.

NOTE – If `packet-status` is 'acknowledged', the Space Packet whose identifier is contained in the parameter `packet-identification-last-processed` is guaranteed to have been *received* by the space element, but not necessarily *accepted* by the space segment. Packet assembly or execution may not have been carried out correctly. This can only be determined by examining telemetry.

b) 'radiated'—the radiation of the Space Packet components completed without aborting: the Space Packet is guaranteed to have been radiated nominally.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

NOTE – The packet status is not changed to 'radiated' until all CLTUs containing parts of the Space Packet reported have been transmitted to the spacecraft (see 1.6.1.8.11). For sequence-controlled packet transmission the Packet status 'radiated' may imply that at least one acknowledgement via a CLCW is still outstanding.

c) 'production started'—the Space Packet has been removed from the service instance's request queue (see annex B) and has been inserted into the packets queue.

d) 'production not started'—at the time when Space Packet had to be removed from the service instance's request queue for insertion into the appropriate Packets queue, production-status was not 'operational' and therefore production could not be started for this packet.

e) 'expired'—the `latest-production-time` of the Space Packet was reached before beginning processing: the Space Packet is guaranteed not to have been radiated.

f) 'unsupported transmission mode'—the transmission mode requested for the Packet was not supported when production for this Packet began: the Space Packet is guaranteed not to have been radiated.

g) 'interrupted'—processing of the Space Packet was aborted when the `production-status` changed from 'operational' to 'interrupted' or 'halted' or when the directive 'abort VC' was executed: the Space Packet is guaranteed to have started being processed, and to have aborted prior to nominal completion.

NOTE – Earlier Space Packets may also have been affected. Packets with sequence-controlled transmission mode may have completed radiation before their status changed to 'interrupted'.

3.7.2.10.2 For all notifications, if the value of the `packet-identification-last-processed` parameter is 'null', the `packet-status` parameter shall not be present.

3.7.2.11 `packet-identification-last-ok`

For all notifications, the **`packet-identification-last-ok`** parameter shall be present; its value shall be set as follows:

a) if no Space Packets belonging to the given service instance have been successfully processed, the value of the `packet-identification-last-ok` parameter shall be set to 'null';

b) otherwise, the parameter shall specify the identification of the Space Packet belonging to the given service instance that most recently was successfully processed.

c) the value of the `packet-identification-last-ok` parameter shall not be altered when the association is released or aborted.

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

3.7.2.12 `production-stop-time`

3.7.2.12.1 Whenever `packet-identification-last-ok` is not 'null', the **`production-stop-time`** parameter shall be present and shall contain the time at which processing of the Space Packet identified by `packet-identification-last-ok` completed, subject to the following stipulations:

a) for expedited (BD) transmission mode, the `production-stop-time` parameter shall contain the time at which radiation of the Space Packet identified by `packet-identification-last-ok` was completed;

b) for sequence-controlled (AD) transmission mode, it shall contain the time at which the last Space Packet component was acknowledged via a received CLCW.

3.7.2.12.2 For all notifications, if the `packet-identification-last-ok` parameter is 'null', the `production-stop-time` parameter shall not be present.

3.7.2.13 `production-status`

The **`production-status`** parameter shall describe the current status of the production process and shall contain one of the following values:

a) 'configured'—equipment has been assigned to support the given service instance, but the production process is not yet capable of processing Space Packets;

NOTE – Users may connect in accordance with the scheduled service provision periods and submit Packets with a production time interval that fits with the expected space link session.

b) 'operational'—the production process is capable of and possibly currently processing Space Packets; it shall have the following sub-states:

1) 'BD'—Packets can only be handled in BD transmission mode. The AD service may have been terminated for the reason indicated by the FOP alert or none of the directives initiating the AD service has been invoked or did not complete successfully yet;

2) 'AD and BD'—Packets can be handled in any transmission mode. The AD service is available further to the successful completion of one of the directives that initiate or resume the AD service;

3) 'AD suspended'—this status is entered when the allowed number of transmissions specified in the transmission-limit parameter (see table 3-1) has been completed and the service has been suspended. A subsequent 'resume AD service' directive will then cause FOP-1 to resume service in the same state it was in when it was suspended.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

NOTE – The `production-status` 'operational' occurs: when the production equipment is configured for support and has completed the acquisition sequence; when a problem that caused the `production-status` 'interrupted' is cleared; when service management restarts the production process after the `production-status` was 'halted'.

c) 'interrupted'—the production process has detected a problem that prevents it from processing Space Packets; the problem may be transient and may be cleared for instance by automatic equipment reconfiguration;

NOTE – When `production-status` changes from 'operational' to 'interrupted', the transmission mode capability may change as well, but the notification with `notification-type` 'transmission mode capability change' is suppressed (see 3.7.2.3), if the sub-state of the `production-status` was 'BD' before the transition to 'interrupted' occurred or if the given user is immediately notified of the transition of the `production-status` to 'interrupted' because Packets of this user are discarded since processing of them had been started, but did not yet complete.

d) 'halted'—service management has taken the production process out of service for instance because the problem that caused the `production-status` to change to 'interrupted' is more severe and not of transient nature or because the resources have to be re-assigned.

NOTES

1 Reassignment of resources may become necessary e.g. because of a spacecraft emergency.

2 When production-status changes from 'operational' to 'halted', the transmission mode capability may change as well, but the notification with notification-type 'transmission mode capability change' will be suppressed (see 3.7.2.3), since the change of the production-status to 'halted' is notified to all users anyway.

3.7.3 EFFECTS

3.7.3.1 If `notification-type` indicates 'sldu expired':

a) all Space Packets queued for this service instance and not yet passed to the segment queues in the form of Frame Data Units shall be discarded; and

b) further FSP-TRANSFER-DATA invocations shall be rejected.

3.7.3.2 If `notification-type` indicates 'production interrupted', or 'production halted':

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

a) all Space Packets belonging to this service instance shall be discarded including those converted already to Frame Data Units and passed to the segment queues; and

b) further FSP-TRANSFER-DATA invocations shall be rejected.

3.7.3.3 If `notification-type` indicates 'packet transmission mode mismatch': all Space Packets currently being processed or buffered and requiring the not supported transmission mode shall be discarded including those already converted to Frame Data Units and passed to the segment queues.

3.7.3.4 If `notification-type` indicates 'VC aborted': all Space Packets shall be discarded including those converted already to Frame Data Units and passed to the segment queues.

3.7.3.5 There shall be no effect for any other values of `notification-type`.

3.7.3.6 The provider shall remain in its original state, i.e., state 2 ('ready') or state 3 ('active').

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.8 FSP-SCHEDULE-STATUS-REPORT

3.8.1 PURPOSE

3.8.1.1 The user shall invoke the FSP-SCHEDULE-STATUS-REPORT operation to request that the provider do one of the following:

a) send a status report immediately (see 3.9);

b) send periodic status reports (see 3.9); or

c) stop sending periodic status reports.

3.8.1.2 The provider shall return a report of the outcome of the performance of the FSP-SCHEDULE-STATUS-REPORT operation to the user.

3.8.1.3 Initially (i.e., whenever the FSP-BIND operation is performed and the provider transitions from state 1 to state 2), periodic reporting shall be inactive.

3.8.1.4 For periodic reporting, the user may change the reporting period by invoking another FSP-SCHEDULE-STATUS-REPORT operation.

3.8.1.5 The FSP-SCHEDULE-STATUS-REPORT operation is valid only in states 2 (‘ready’) and 3 (‘active’) and shall be invoked only by the user.

3.8.2 INVOCATION, RETURN, AND PARAMETERS

3.8.2.1 General

The parameters of the FSP-SCHEDULE-STATUS-REPORT operation shall be present in the invocation and return as specified in table 3-8.

Table 3-8: FSP-SCHEDULE-STATUS-REPORT Parameters

Parameters	Invocation	Return
invoker-credentials	M	
performer-credentials		M
invoke-ID	M	M
report-request-type	M	
reporting-cycle	C	
result		M
diagnostic		C

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.8.2.2 `invoker-credentials`

The **`invoker-credentials`** parameter shall provide information that enables the performer to authenticate the FSP-SCHEDULE-STATUS-REPORT invocation (see 3.1.5).

3.8.2.3 `performer-credentials`

The **`performer-credentials`** parameter shall provide information that enables the invoker to authenticate the return from the performance of FSP-SCHEDULE-STATUS-REPORT (see 3.1.5).

3.8.2.4 `invoke-ID`

The performer shall return unchanged the invoker-supplied value of the **`invoke-ID`** parameter (see 3.1.6).

3.8.2.5 `report-request-type`

3.8.2.5.1 The **`report-request-type`** parameter shall specify how reporting shall be done, and its value shall be one of the following:

a) 'immediately'—send a single status report immediately;

b) 'periodically'—send a status report every `reporting-cycle` seconds;

c) 'stop'—do not send further status reports.

3.8.2.5.2 If `report-request-type` is 'immediately',

a) the provider shall send a status report immediately;

b) stop sending status reports after the immediate status report has been sent.

NOTE – Periodic reporting may be (re-)started by means of another FSP-SCHEDULE-STATUS-REPORT invocation.

3.8.2.6 `reporting-cycle`

3.8.2.6.1 If the value of the `report-request-type` parameter is 'periodically', then the **`reporting-cycle`** parameter shall be present and shall specify the requested interval between status reports in seconds.

3.8.2.6.2 If the value of the `report-request-type` parameter is not 'periodically', the `reporting-cycle` parameter shall not be present.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.8.2.7 **`result`**

The **`result`** parameter shall specify the result of the FSP-SCHEDULE-STATUS-REPORT operation, and its value shall be one of the following:

a) 'positive result'—the FSP-SCHEDULE-STATUS-REPORT operation has been performed, and the provider will send the requested status report(s) or stop sending periodic status reports;

b) 'negative result'—the FSP-SCHEDULE-STATUS-REPORT operation has not been performed for the reason specified in the `diagnostic` parameter; the previous setting for status reporting remains in effect.

3.8.2.8 **`diagnostic`**

3.8.2.8.1 If `result` is 'negative result', the **`diagnostic`** parameter shall be present in the return and its value shall be one of the following:

a) 'duplicate invoke-ID'—the value of the `invoke-ID` parameter is the same as the `invoke-ID` value of a previous, outstanding operation;

b) 'already stopped'—the provider is not currently providing periodic reports (applicable only when `report-request-type` is 'stop');

c) 'invalid reporting cycle'—the `reporting-cycle` value is outside the range agreed upon by service management;

d) 'other reason'—the reason for the negative result will have to be found by other means.

3.8.2.8.2 If `result` is 'positive result', the `diagnostic` parameter shall not be present.

3.8.3 EFFECTS

3.8.3.1 If `result` is 'positive result', the FSP-SCHEDULE-STATUS-REPORT operation shall have the following effects, depending on the value of the `report-request-type` parameter:

a) if the value of `report-request-type` is 'immediately':

   1) a status report shall be sent immediately;

   2) the sending of any previously requested periodic status reports shall cease.

b) if the value of `report-request-type` is 'periodically':

   1) a status report shall be sent immediately;

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

2) subsequent status reports shall be sent at the interval specified in the `reporting-cycle` parameter, i.e., whenever the reporting cycle timer expires.

c) if the value of `report-request-type` is 'stop', periodic reporting shall cease.

3.8.3.2 If `result` is 'negative result', the FSP-SCHEDULE-STATUS-REPORT operation shall have no effect, and the previous setting for status reporting shall not change.

3.8.3.3 The provider shall remain in its original state, i.e., state 2 ('ready') or state 3 ('active').

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.9 FSP-STATUS-REPORT

3.9.1 PURPOSE

3.9.1.1 The provider shall invoke the FSP-STATUS-REPORT operation to send a status report to the user.

3.9.1.2 FSP-STATUS-REPORT shall be an unconfirmed operation.

3.9.1.3 Status reports shall be sent (or not sent) in accordance with user requests conveyed by means of the FSP-SCHEDULE-STATUS-REPORT operation (see 3.8).

3.9.1.4 The FSP-STATUS-REPORT operation is valid only in states 2 (‘ready’) and 3 (‘active’) and shall be invoked only by the provider.

3.9.2 INVOCATION AND PARAMETERS

3.9.2.1 General

The parameters of the FSP-STATUS-REPORT operation shall be present in the invocation as specified in 3-9.

Table 3-9: FSP-STATUS-REPORT Parameters

Parameters	Invocation
invoker-credentials	M
packet-identification-last-processed	M
production-start-time	C
packet-status	C
packet-identification-last-ok	M
production-stop-time	C
production-status	M
number-of-packets-received	M
number-of-packets-processed	M
number-of-packets-radiated	M
number-of-packets-acknowledged	M
packet-buffer-available	M

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.9.2.2 `invoker-credentials`

The **`invoker-credentials`** parameter shall provide information that enables the performer to authenticate the FSP-STATUS-REPORT invocation (see 3.1.5).

3.9.2.3 `packet-identification-last-processed`

3.9.2.3.1 If the provider has processed at least one Space Packet belonging to the given service instance, the **`packet-identification-last-processed`** parameter shall specify the identification of the Space Packet belonging to the given service instance that most recently started to be processed regardless whether it was successfully processed or an exception occurred.

NOTE – A Packet starts to be processed when it is transferred from the requests queue to a packets queue (see annex B).

3.9.2.3.2 If the provider has processed no Space Packet belonging to the given service instance, the `packet-identification-last-processed` parameter shall be set to 'null'.

3.9.2.3.3 The value of the `packet-identification-last-processed` parameter shall not be altered when the association is released or aborted.

NOTE – The most recently processed Space Packet may be the same as that identified in `packet-identification-last-ok`.

3.9.2.4 `production-start-time`

3.9.2.4.1 If the value of `packet-identification-last-processed` is not 'null', the **`production-start-time`** parameter shall be present and shall contain the time at which the provider started to process the Space Packet identified in `packet-identification-last-processed`.

3.9.2.4.2 If the `packet-identification-last-processed` parameter is 'null', the `production-start-time` parameter shall not be present.

3.9.2.5 `packet-status`

3.9.2.5.1 Whenever the `packet-identification-last-processed` parameter is not 'null', the **`packet-status`** parameter shall be present and shall contain one of the following values representing the processing state of the Space Packet identified by `packet-identification-last-processed`:

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

a) 'acknowledged'—(applies only to sequence-controlled transmission mode) all Space Packet components have been acknowledged by the space element via the associated stream of CLCWs.

NOTE – If `packet-status` is 'acknowledged', the Space Packet whose identifier is contained in the parameter `packet-identification-last-processed` is guaranteed to have been *received* by the space element, but not necessarily *accepted* by the space segment. Packet assembly or execution may not have been carried out correctly. This can only be determined by examining telemetry.

b) 'radiated'—the radiation of the Space Packet components completed without aborting: the Space Packet is guaranteed to have been radiated nominally.

NOTE – The packet status is not changed to 'radiated' as long as not all CLTUs containing parts of the Space Packet reported have been transmitted to the spacecraft (see 1.6.1.8.11). For sequence-controlled packet transmission the Packet status 'radiated' may imply that at least one acknowledgement via a CLCW is still outstanding.

c) 'production started'—the Space Packet has been removed from the service instance's request queue (see annex B) and has been inserted into the packets queue.

d) 'production not started'—at the time when Space Packet had to be removed from the service instance's request queue for insertion into the appropriate Packets queue, production-status was not 'operational' and therefore production could not be started for this packet.

e) 'expired'—the `latest-production-time` of the Space Packet was reached before beginning processing: the Space Packet is guaranteed not to have been radiated.

f) 'unsupported transmission mode'—the transmission mode requested for the Packet was not supported when production for this Packet began: the Space Packet is guaranteed not to have been radiated.

h) 'interrupted'—processing of the Space Packet was aborted when the `production-status` changed from 'operational' to 'interrupted' or 'halted' or when the directive 'abort VC' was executed: the Space Packet is guaranteed to have started being processed, and to have aborted prior to nominal completion.

NOTE – Earlier Space Packets may also have been affected. Packets with sequence-controlled transmission mode may have completed radiation before their status changed to 'interrupted'.

3.9.2.5.2 If the `packet-identification-last-processed` parameter value is 'null', the `packet-status` parameter shall not be present.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.9.2.6 **packet-identification-last-ok**

3.9.2.6.1 If the provider has successfully completed the processing of at least one Space Packet belonging to the given service instance, the **packet-identification-last-ok** parameter shall specify the identification of the last Space Packet belonging to the given service instance that was successfully processed.

3.9.2.6.2 If the provider has processed no Space Packets belonging to the given service instance, the packet-identification-last-ok parameter shall be set to 'null'.

3.9.2.6.3 The value of the packet-identification-last-ok parameter shall not be altered when the association is released or aborted.

3.9.2.7 **production-stop-time**

3.9.2.7.1 Whenever packet-identification-last-ok is not 'null', the **production-stop-time** parameter shall be present and shall contain the time at which processing of the Space Packet identified by packet-identification-last-ok completed, subject to the following stipulations:

a) for expedited (BD) transmission mode, the production-stop-time parameter shall contain the time at which radiation of the Space Packet identified by packet-identification-last-ok was completed;

b) for sequence-controlled (AD) transmission mode, it shall contain the time at which the last Space Packet component was acknowledged via a received CLCW.

3.9.2.7.2 If the packet-identification-last-ok parameter is 'null', the production-stop-time parameter shall not be present.

3.9.2.8 **production-status**

The **production-status** parameter shall describe the current status of the production process and shall contain one of the following values:

a) 'configured'—equipment has been assigned to support the given service instance, but the production process is not yet capable of processing Space Packets.

NOTE – Users may connect in accordance with the scheduled service provision periods and submit Packets with a production time interval that fits with the expected space link session.

b) 'operational'—the production process is capable of and possibly currently processing Space Packets; it shall have the following sub-states:

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

1) ‘BD’—Packets can only be handled in BD transmission mode. The AD service may have been terminated for the reason indicated by the FOP alert or none of the directives initiating the AD service has been invoked or did not complete successfully yet;

2) ‘AD and BD’—Packets can be handled in any transmission mode. The AD service is available further to the successful completion of one of the directives that initiate or resume the AD service;

3) ‘AD suspended’—this status is entered when the allowed number of transmissions specified in the transmission-limit parameter (see table 3-1) has been completed and the service has been suspended. A subsequent ‘resume AD service’ directive will then cause FOP-1 to resume service in the same state it was in when it was suspended.

NOTE – The `production-status` ‘operational’ occurs: when the production equipment is configured for support and has completed the acquisition sequence; when a problem that caused the `production-status` ‘interrupted’ is cleared; when service management restarts the production process after the `production-status` was ‘halted’.

c) ‘interrupted’—the production process has detected a problem that prevents it from processing Space Packets; the problem may be transient and may be cleared for instance by automatic equipment reconfiguration;

d) ‘halted’—service management has taken the production process out of service for instance because the problem that caused the `production-status` to change to ‘interrupted’ is more severe and not of transient nature or because the resources have to be re-assigned e.g. due to a spacecraft emergency.

3.9.2.9 `number-of-packets-received`

3.9.2.9.1 The **`number-of-packets-received`** parameter shall specify the number of Space Packets received during this service instance.

3.9.2.9.2 Only Packets that are checked successfully and buffered shall be counted in the total.

3.9.2.9.3 This parameter shall include separate values for AD packets and BD packets.

3.9.2.9.4 If no Space Packets have been received, this parameter shall be set to zero (‘0’).

3.9.2.10 `number-of-packets-processed`

3.9.2.10.1 The **`number-of-packets-processed`** parameter shall specify the number of Space Packets that the provider attempted to process during this service instance, including:

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

a) Space Packets that were acknowledged;

b) Space Packets that radiated successfully, but were not (yet) acknowledged;

c) Space Packets that aborted;

d) Space Packets currently being processed.

3.9.2.10.2 This parameter shall include separate values for AD packets and BD packets.

3.9.2.10.3 If no Space Packets have been processed, this parameter shall be set to zero ('0').

3.9.2.11 `number-of-packets-radiated`

3.9.2.11.1 The **`number-of-packets-radiated`** parameter shall specify the number of Space Packets successfully radiated during this service instance.

3.9.2.11.2 A Space Packet in the process of being radiated shall not be included in this count.

3.9.2.11.3 For a given Space Packet, only its first radiation shall be counted; retransmission of frames in accordance with COP-1, which may imply retransmission of complete Packets, shall not cause this parameter to be updated.

3.9.2.11.4 This parameter shall include separate values for AD packets and BD packets.

3.9.2.11.5 If no Space Packets have been radiated, this parameter shall be set to zero ('0').

3.9.2.12 `number-of-packets-acknowledged`

3.9.2.12.1 The **`number-of-packets-acknowledged`** parameter only applies to sequence-controlled transmission mode and shall specify the number of Space Packets that during this service instance were successfully transferred to the space element as determined by evaluation of CLCWs.

3.9.2.12.2 If Space Packets have been acknowledged, this parameter shall be set to zero ('0').

3.9.2.13 `packet-buffer-available`

3.9.2.13.1 The **`packet-buffer-available`** parameter shall specify the number of octets available in the request queue of this service instance for Packet storage.

NOTE – This parameter shall reflect the free storage space in the request queue belonging to the given service instance (see annex B).

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.9.2.13.2 Once the provider starts to process a Space Packet, it shall be considered removed from the buffer.

3.9.3 EFFECTS

The FSP-STATUS-REPORT operation shall have the following effects:

3.9.3.1 Status information shall be delivered to the user.

3.9.3.2 The provider shall remain in its original state, i.e., state 2 (‘ready’) or state 3 (‘active’).

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.10 FSP-GET-PARAMETER

3.10.1 PURPOSE

3.10.1.1 The user shall invoke the FSP-GET-PARAMETER operation to ascertain the value of an FSP service parameter.

3.10.1.2 The provider shall return a report of the outcome of the performance of the FSP-GET-PARAMETER operation to the user.

3.10.1.3 If the operation is successful, the current value of the specified FSP service parameter shall be provided to the user in the return from the operation.

3.10.1.4 The FSP-GET-PARAMETER operation is valid only in states 2 (‘ready’) and 3 (‘active’) and shall be invoked only by the user.

3.10.2 INVOCATION, RETURN, AND PARAMETERS

3.10.2.1 General

The parameters of the FSP-GET-PARAMETER operation shall be present in the invocation and return as specified in table 3-10.

Table 3-10: FSP-GET-PARAMETER Parameters

Parameters	Invocation	Return
`invoker-credentials`	M	
`performer-credentials`		M
`invoke-ID`	M	M
`fsp-parameter`	M	C
`parameter-value`		C
`result`		M
`diagnostic`		C

3.10.2.2 `invoker-credentials`

The **`invoker-credentials`** parameter shall provide information that enables the performer to authenticate the FSP-GET-PARAMETER invocation (see 3.1.5).

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.10.2.3 `performer-credentials`

The **`performer-credentials`** parameter shall provide information that enables the invoker to authenticate the return from the performance of FSP-GET-PARAMETER (see 3.1.5).

3.10.2.4 `invoke-ID`

The performer shall return unchanged the invoker-supplied value of the **`invoke-ID`** parameter (see 3.1.6).

3.10.2.5 `fsp-parameter`

3.10.2.5.1 The **`fsp-parameter`** parameter shall specify the FSP service parameter whose value is to be returned to the user, and its value shall be one of the values listed in table 3-11.

Table 3-11: FSP Service Parameters

Parameter	Description
apid-list	List of APIDs the given service instance is authorized to access.
bit-lock-required	If the value is 'yes', the 'No bit lock' flag in the CLCW must be false in order for the provider to set `production-status` to 'operational'.
blocking-timeout-period	Period from inserting the first Packet into the Frame Data Unit until this unit is passed to the FOP regardless of the number of Packets contained; this timeout period is applicable to all blocking regardless of the specific MAP.
blocking-usage	'permitted' if the provider may block multiple Space Packets into a single frame, 'not permitted' otherwise; the permission to block Space Packets applies to all MAPs in use on the given VC.
delivery-mode	'fwd online'
directive-invocation-online	'yes', if the service instance that is permitted to invoke directives for the given VC if any is in the state 'ready' or 'active', 'no', if that service instance is in the state 'unbound'.
directive-invocation-enabled	'enabled' if this service instance is authorized to invoke the FSP-INVOKE-DIRECTIVE operation, 'disabled' otherwise.
expected-directive-identification	The `directive-identification` parameter value the provider expects in the next FSP-INVOKE-DIRECTIVE invocation.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

Parameter	Description
expected-event-invocation-identification	The `event-invocation-identification` parameter value the provider expects in the next FSP-THROW-EVENT invocation. The initial value of this parameter is zero.
expected-sldu-identification	The `packet-identification` parameter value the provider expects in the next FSP-TRANSFER-DATA invocation; If no FSP-START operation has been performed, zero shall be returned as the default value of this parameter.
fop-sliding-window	Number of frames that can be transmitted on the given VC before an acknowledgement is required.
fop-state	State of the FOP on the given VC: 'ACTIVE', 'RETRANSMIT WITHOUT WAIT', 'RETRANSMIT WITH WAIT', 'INITIALIZING WITHOUT BC FRAME', 'INITIALIZING WITH BC FRAME', 'INITIAL'.
map-list	List of MAPs permitted to be used by the given service instance if MAPs are used, 'null' otherwise.
map-multiplexing-control	MAP priority list or MAP polling vector; if the map-multiplexing-scheme is 'FIFO' or if MAPs are not used, this parameter is 'null'. This parameter applies to the given VC.
map-multiplexing-scheme	MAP multiplexing scheme in effect on the given VC: 'FIFO', 'absolute priority', 'polling vector'. If no MAP multiplexing is used, this parameter must be set to 'FIFO'.
maximum-frame-length	Mission maximum TC transfer frame length in octets (see NOTE).
maximum-packet-length	Mission maximum Packet Data Length in octets (see NOTE).
permitted-transmission-mode	Specifies the transmission mode permitted for the given service instance; it may be 'expedited' or 'sequence-controlled' or 'any'.
reporting-cycle	The current setting of the reporting cycle for status reports (see 3.8 and 3.9): the value is 'null' if cyclic reporting is off, otherwise it is the time (in seconds) between successive FSP-STATUS-REPORT invocations (see 3.8).
return-timeout-period	The maximum time period (in seconds) permitted from when a confirmed FSP operation is invoked until the return is received by the invoker (see 4.1.3).

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

Parameter	Description
rf-available-required	If the value is 'yes', the 'No RF available' flag in the CLCW must be false in order for the provider to set `production-status` to 'operational'.
segment-header	Specifies if a Segment Header is 'present' or 'absent' in the TC transfer frames (see NOTE).
timeout-type	Specifies FOP behavior (either 'Alert' or 'AD service suspension').
timer-initial	Initial value for countdown timer when an AD or BC frame is transmitted.
transmission-limit	Maximum number of times the first frame on the Sent_Queue may be transmitted (see [5]).
transmitter-frame-sequence-number	After a transmission mode capability change event, the parameter Transmitter_Frame_Sequence_Number, V(S), contains the value of the Frame Sequence Number, N(S), to be put in the Transfer Frame Primary Header of the next Type-AD frame to be transmitted.
vc-multiplexing-control	VC priority list or the VC polling vector; if the vc-multiplexing scheme is 'FIFO', this parameter is 'null'.
vc-multiplexing-scheme	VC multiplexing scheme in effect: 'FIFO', 'absolute priority', 'polling vector'.
virtual-channel	VC being used by this service instance.

NOTE – Service Management has to ensure that the chosen values of the parameters maximum-frame-length, maximum-packet-length and segment-header are consistent. An example of an inconsistent parameter setting would be a maximum-frame-length of 100 octets, a maximum-packet-length of 1024 octets and segment-header 'absent'. In such case a packet of say 250 octets could not be processed as it does not fit into the frame, but due to the absence of the segment header the packet cannot be segmented either. Any inconsistent combination of parameter values shall be rejected at configuration time. FSP is not designed to deal with such inconsistencies at run time.

3.10.2.5.2 `fsp-parameter` is conditionally present in the return based on the `result` parameter:

a) if the value of `result` is 'positive result', `fsp-parameter` shall be present in the return;

b) if the value of `result` is 'negative result', `fsp-parameter` shall not be present in the return.

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

3.10.2.6 `parameter-value`

3.10.2.6.1 The **`parameter-value`** parameter shall contain the value of the FSP service parameter indicated by `fsp-parameter` (see 3.10.2.5).

3.10.2.6.2 The `parameter-value` parameter is conditionally present in the return based on the `result` parameter:

a) if the value of `result` is 'positive result', `parameter-value` shall be present;

b) if the value of `result` is 'negative result', `parameter-value` shall not be present.

3.10.2.7 `result`

The **`result`** parameter shall specify the result of the FSP-GET-PARAMETER operation and shall contain one of the following values:

a) 'positive result'—the FSP-GET-PARAMETER operation has been performed, and the value of the specified FSP service parameter is provided in the return to the user;

b) 'negative result'—the FSP-GET-PARAMETER operation has not been performed for the reason specified in the `diagnostic` parameter.

3.10.2.8 `diagnostic`

3.10.2.8.1 If `result` is 'negative result', **`diagnostic`** shall be present and shall contain one of the following values:

a) 'duplicate invoke-ID'—the value of the `invoke-ID` parameter is the same as the `invoke-ID` value of a previous, outstanding operation;

b) 'unknown parameter'—the value of `fsp-parameter` does not identify an FSP service parameter that is recognized by the service provider;

c) 'other reason'—the reason for the negative result will have to be found by other means.

3.10.2.8.2 If `result` is 'positive result', the `diagnostic` parameter shall not be present in the return.

3.10.3 EFFECTS

3.10.3.1 If `result` is 'positive result', the value of the FSP service parameter specified in the invocation shall be provided to the user in the return.

3.10.3.2 If `result` is 'negative result', no FSP service parameter shall be returned to the user;

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.10.3.3 The provider shall remain in its original state shall, i.e., state 2 (‘ready’) or state 3 (‘active’).

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.11 FSP-THROW-EVENT

3.11.1 PURPOSE

3.11.1.1 The user shall invoke the FSP-THROW-EVENT operation in order to cause the provider to forward to SLE Complex Management an event that requires management action.

NOTES

1 An example of such an event is change of the uplink bit rate. This will typically require sending a telecommand that reconfigures the onboard commanding system to the new bit rate. When this command is executed, the uplink bit rate can be changed by throwing the associated event. Another example is the release of the uplink bit pattern that will cause a reset of the selected Packet Assembly Controller.

2 The event is considered to occur when the user invokes the FSP-THROW-EVENT operation, i.e., the provider is expected to react to the receipt of a FSP-THROW-EVENT invocation with minimal delay. It is therefore asynchronous with the radiation of SL-DUs.

3 If synchronism is required between the event and the radiation of a specific SL-DU, it is the user's responsibility to ensure that, e.g. by means of controlling the production time of the critical Space Packet or by means of the notification capabilities provided by the FSP service.

4 In cases where the Forward TC Space Link Processing production functions are performed by a separate SLE Complex, the Forward TC VC Data Insertion FG and/or Forward CLTU Generation FG invokes the FTCF-THROW-EVENT or CLTU-THROW-EVENT operations on this separate Complex as necessary to achieve the desired updates of service management parameters.

3.11.1.2 The provider shall return a report of the outcome of the performance of the FSP-THROW-EVENT operation to the user.

NOTES

1 The return will only show whether the invocation itself has been accepted or rejected, but not if the actions associated with the event have been performed successfully. The provider will invoke an FSP-ASYNC-NOTIFY operation to inform the user on the outcome of the actions triggered by the event.

2 In cases where the Forward TC Space Link Processing production functions are performed by a separate SLE Complex, the Forward TC VC Data Insertion FG and/or Forward CLTU Generation FG translates the CLTU-ASYNC-NOTIFY or FTCF-ASYNC-NOTIFY invocations containing FSP thrown-event outcome information into appropriate FSP-ASYNC-NOTIFY invocations as specified in annex D.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.11.1.3 The FSP-THROW-EVENT operation is valid only in states 2 (‘ready’) and 3 (‘active’) and shall be invoked only by the user.

3.11.2 INVOCATION, RETURN, AND PARAMETERS

3.11.2.1 General

The parameters of the FSP-THROW-EVENT operation shall be present in the invocation and return as specified in table 3-12.

Table 3-12: FSP-THROW-EVENT Parameters

Parameters	Invocation	Return
`invoker-credentials`	M	
`performer-credentials`		M
`invoke-ID`	M	M
`event-identifier`	M	
`event-qualifier`	M	
`event-invocation-identification`	M	M
`result`		M
`diagnostic`		C

3.11.2.2 `invoker-credentials`

The **`invoker-credentials`** parameter shall provide information that enables the performer to authenticate the FSP-THROW-EVENT invocation (see 3.1.5).

3.11.2.3 `performer-credentials`

The **`performer-credentials`** parameter shall provide information that enables the invoker to authenticate the return from the performance of FSP-THROW-EVENT (see 3.1.5).

3.11.2.4 `invoke-ID`

The performer shall return unchanged the invoker-supplied value of the **`invoke-ID`** parameter (see 3.1.6).

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.11.2.5 `event-identifier`

The **`event-identifier`** parameter shall identify the event to be forwarded to Complex Management by the service provider.

3.11.2.6 `event-qualifier`

The **`event-qualifier`** parameter may be used to provide additional data constraining the actions to be performed by Complex Management in response to the event specified in `event-identifier` and shall be forwarded together with the event.

NOTES

1 For example, `event-identifier` may be 'bit-rate-change'. Then `event-qualifier` may specify the new bit rate.

2 The **actual** type and any constraints applicable to the data contained in the `event-qualifier` parameter depend on the event. These have to be checked by Complex Management. The FSP provider only checks that the **formal** type (octet string) and the length of this parameter are in line with the specification in annex A.

3.11.2.7 `event-invocation-identification`

3.11.2.7.1 The **`event-invocation-identification`** parameter shall contain a monotonically increasing sequence number and shall be:

a) set to '0' for the first FSP-THROW-EVENT invocation following the first successful FSP-BIND to the service instance;

b) incremented for each FSP-THROW-EVENT invocation accepted by the provider.

3.11.2.7.2 The provider shall set the value of the `event-invocation-identification` parameter to the sequence number expected in the next FSP-THROW-EVENT invocation:

a) if the invocation is accepted, the `event-invocation-identification` in the return shall be one greater than the value in the invocation;

b) if the invocation is rejected, the `event-invocation-identification` in the return shall contain the value expected by the FSP service provider:

1) in the case of the first FSP-THROW-EVENT operation following a successful FSP-BIND operation, it is zero ('0');

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

2) otherwise, the value is one greater than the value of the `event-invocation-identification` parameter of the last accepted FSP-THROW-EVENT operation.

3.11.2.7.3 The user shall set the value of `event-invocation-identification` in the next FSP-THROW-EVENT invocation to the value returned by the provider.

3.11.2.7.4 The value expected by the provider for the given service instance shall not be altered when the association between user and provider is reestablished after being released or aborted.

3.11.2.7.5 The provider shall use the user-supplied value of `event-invocation-identification` to reference the respective event in all subsequent reports.

3.11.2.8 `result`

The **`result`** parameter shall specify the result of the FSP-THROW-EVENT invocation and shall contain one of the following values:

a) 'positive result'—the FSP-THROW-EVENT operation has been performed, and the event together with the associated qualifier will be forwarded to Complex Management;

b) 'negative result'—the FSP-THROW-EVENT operation has not been performed for the reason specified in the `diagnostic` parameter. The provider will not forward an event to Complex Management.

3.11.2.9 `diagnostic`

3.11.2.9.1 If `result` is 'negative result', the **`diagnostic`** parameter shall be present in the return, and its value shall be one of the following:

a) 'duplicate invoke-ID'—the value of the `invoke-ID` parameter is the same as the `invoke-ID` value of a previous, outstanding operation;

b) 'operation not supported'—the FSP-THROW-EVENT operation is not supported by the provider;

c) 'out of sequence'—the value of the `event-invocation-identification` parameter is not equal to the value expected by the provider;

d) 'no such event'—the value of the `event-identifier` parameter in the FSP-THROW-EVENT invocation is not in the set of `event-identifier` values recognized by Complex Management;

e) 'other reason'—the reason for the negative result will have to be found by other means.

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

3.11.2.9.2 If `result` is 'positive result', the `diagnostic` parameter shall not be present in the return.

3.11.3 EFFECTS

3.11.3.1 If `result` is 'positive result', the FSP-THROW-EVENT operation shall have the following effects:

a) the event shall be forwarded to Complex Management;

b) the FSP provider shall pass notifications received from the Forward TC VC Data Insertion FG to the user by invoking the FSP-ASYNC-NOTIFY operation.

NOTES

1 In order for the FSP-THROW-EVENT to have an effect, there must be prior agreement between SLE Complex Management and SLE Utilization Management regarding the definition of event identifiers and the interpretation of any accompanying qualifying parameter.

2 The effects of the event thrown may consist of preparations made for a change to be triggered by a later FSP-THROW-EVENT invocation.

3 Checking of the `event-qualifier` parameter may be performed within SLE Complex Management. If an error is found, FSP-ASYNC-NOTIFY is sent to the user with the notification 'action list not completed'.

3.11.3.2 If `result` is 'negative result', the event shall not be forwarded to Complex Management.

3.11.3.3 The provider shall remain in its original state, i.e., state 2 ('ready') or state 3 ('active').

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.12 FSP-INVOKE-DIRECTIVE

3.12.1 PURPOSE

3.12.1.1 The user shall invoke the FSP-INVOKE-DIRECTIVE operation to invoke the TC directives as necessary in order to (re-)establish the commanding capability.

NOTE – TC directives cause a (re-)configuration of the TC protocol entities. TC directives are specified in reference [5].

3.12.1.2 For a given telecommand VC, at most one FSP service instance shall be configured to allow invocation of the FSP-INVOKE-DIRECTIVE operation.

3.12.1.3 The provider shall return a report of the outcome of the performance of the FSP-INVOKE-DIRECTIVE operation to the user.

3.12.1.4 The FSP-INVOKE-DIRECTIVE operation is valid only in state 3 ('active') and shall be invoked only by the user.

3.12.2 INVOCATION, RETURN AND PARAMETERS

3.12.2.1 General

The parameters of the FSP-INVOKE-DIRECTIVE operation shall be present in the invocation and return as specified in table 3-13.

Table 3-13: FSP-INVOKE-DIRECTIVE Parameters

Parameters	Invocation	Return
`invoker-credentials`	M	
`performer-credentials`		M
`invoke-ID`	M	M
`directive-identification`	M	M
`directive`	M	
`result`		M
`diagnostic`		C

3.12.2.2 `invoker-credentials`

The **`invoker-credentials`** parameter shall provide information that enables the performer to authenticate the FSP-INVOKE-DIRECTIVE invocation (see 3.1.5).

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

3.12.2.3 `performer-credentials`

The **`performer-credentials`** parameter shall provide information that enables the invoker to authenticate the return from the performance of FSP-INVOKE-DIRECTIVE (see 3.1.5).

3.12.2.4 `invoke-ID`

The performer shall return unchanged the invoker-supplied value of the **`invoke-ID`** parameter (see 3.1.6).

3.12.2.5 `directive-identification`

3.12.2.5.1 The **`directive-identification`** parameter shall contain a monotonically increasing sequence number and shall be:

a) set to '0' for the first FSP-INVOKE-DIRECTIVE invocation following the first successful FSP-BIND to the service instance;

b) incremented for each FSP-INVOKE-DIRECTIVE invocation accepted by the provider.

3.12.2.5.2 The value of `directive-identification` returned shall be the sequence number expected in the next FSP-INVOKE-DIRECTIVE invocation:

a) if the invocation is accepted, the `directive-identification` in the return shall be one greater than the value in the invocation;

b) if the invocation is rejected, the `directive-identification` in the return shall contain the value expected by the FSP service provider:

   1) in the case of the first FSP-INVOKE-DIRECTIVE operation following a successful FSP-BIND operation, it is zero ('0');

   2) otherwise, the value is one greater than the value of the `directive-identification` parameter of the last accepted FSP-INVOKE-DIRECTIVE operation.

3.12.2.5.3 The user shall set the value of `directive-identification` in the next FSP-INVOKE-DIRECTIVE invocation to the value returned by the provider.

3.12.2.5.4 The value expected by the provider for the given service instance shall not be altered when the association between user and provider is reestablished after being released or aborted.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.12.2.5.5 The performer shall use the user-supplied value of `directive-identification` to reference the respective event in all subsequent reports.

3.12.2.6 `directive`

3.12.2.6.1 The **`directive`** parameter shall contain the directive code and, where applicable, the associated parameter.

NOTE – The directive codes and, where applicable, the associated parameter are specified in annex A.

3.12.2.6.2 The directives supported are:

a) 'Initiate AD Service (without CLCW check)';

b) 'Initiate AD Service (with CLCW check)';

c) 'Initiate AD Service (with Unlock)';

NOTE – This directive causes a BC Segment to be transmitted to the space element.

d) 'Initiate AD Service (with Set V(R))';

NOTE – This directive causes a BC Segment to be transmitted to the space element.

e) 'Terminate AD Service';

NOTE – This directive selectively deletes all AD packets currently buffered for transmission on the service instance's VC, but does not delete BD packets (see annex B).

f) 'Resume AD Service';

g) 'Set V(S) to V*(S)';

h) 'Set FOP_Sliding_Window_Width';

i) 'Set T1_Initial';

j) 'Set Transmission_Limit';

k) 'Set Timeout_Type';

l) 'Abort VC';

NOTES

1 This directive implies 'Terminate AD Service'. It causes the frames that resulted from the segmentation and MAP multiplexing processes and queued for

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

forwarding to the Forward CLTU Generation SLE FG to be deleted. This directive will affect all Space Packets, including BD packets.

2 After successful execution of the directive, Packets with BD transmission mode can be handled. AD transmission mode requires the AD service be initiated by one of the directives a) to d).

m) 'Modify map-multiplexing-control'.

NOTE – This directive allows the user to change the priority with which the concurrent MAPs are multiplexed into the service instance's VC. Depending on the applicable multiplexing scheme, either the priority list identifying the priority applicable to each MAP being used or a polling vector is sent.

3.12.2.7 `result`

The **`result`** parameter shall specify the result of the FSP-INVOKE-DIRECTIVE operation and shall contain one of the following values:

a) 'positive result'—the FSP-INVOKE-DIRECTIVE operation has been performed, and the directive will be passed to the relevant protocol entity for implementation;

b) 'negative result'—the FSP-INVOKE-DIRECTIVE operation has not been performed for the reason specified in the `diagnostic` parameter.

3.12.2.8 `diagnostic`

3.12.2.8.1 If `result` is 'negative result', the **`diagnostic`** parameter shall be present in the return, and its value shall be one of the following:

a) 'duplicate invoke-ID'—the value of the `invoke-ID` parameter is the same as the `invoke-ID` value of a previous, outstanding operation;

b) 'directive invocation not allowed'—the operation FSP-INVOKE-DIRECTIVE is not enabled for this service instance;

c) 'directive identification out of sequence'—`directive-identification` is not set to the value expected by the provider;

d) 'directive error'—the provider has found an error in the `directive` parameter: the directive may be unknown or the parameter associated with the invoked directive is in error (e.g. out of range);

e) 'other reason'—the reason for the negative result will have to be found by other means.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.12.2.8.2 If `result` is 'positive result', the `diagnostic` parameter shall not be present in the return.

3.12.3 EFFECTS

3.12.3.1 If `result` is 'positive result', the FSP-INVOKE-DIRECTIVE shall have the following effects:

a) the provider shall forward the TC directive for processing by the FSP production engine;

b) the provider shall use the FSP-ASYNC-NOTIFY operation to relay information to the user concerning completion of the directive.

3.12.3.2 If `result` is 'negative result', the FSP-INVOKE-DIRECTIVE shall have no effect, i.e., the provider shall not forward the TC directive to the FSP production engine.

3.12.3.3 The provider shall remain in its original state shall, i.e., state 3 ('active').

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

3.13 FSP-PEER-ABORT

3.13.1 PURPOSE

3.13.1.1 The user or provider shall invoke the FSP-PEER-ABORT operation to notify the peer system that the local application entity detected an error that requires that the association between them be terminated abnormally.

3.13.1.2 FSP-PEER-ABORT shall be an unconfirmed operation.

3.13.1.3 The FSP-PEER-ABORT operation should be truly abortive, i.e., the transfer of the SLE-PDU carrying this invocation should not be delayed by other invocations submitted earlier and possibly being buffered by the underlying communication service.

3.13.1.4 The FSP-PEER-ABORT operation is valid only in states 2 (‘ready’) and 3 (‘active’) and may be invoked by either the user or the provider.

3.13.2 INVOCATION AND PARAMETERS

3.13.2.1 General

The parameters of the FSP-PEER-ABORT operation shall be present in the invocation as specified in table 3-14.

Table 3-14: FSP-PEER-ABORT Parameters

Parameters	Invocation
diagnostic	M

3.13.2.2 `diagnostic`

The **`diagnostic`** parameter shall specify why the FSP-PEER-ABORT is being issued and shall contain one of the following values:

a) ‘access denied’—a responder with an identity as presented in the `responder-identifier` parameter of the FSP-BIND return is not registered at the initiator.

b) ‘unexpected responder ID’—the value of the `responder-identifier` parameter in the FSP-BIND return does not match the identity the authorized responder for this service instance as specified by service management.

c) ‘operational requirement’—the local system had to terminate the association to accommodate some other operational need;

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

d) ‘protocol error’—the local application entity detected an error in the sequencing of FSP service operations;

e) ‘communications failure’—the communications service on the other side of a gateway was disrupted.

NOTE – This `diagnostic` value is only applicable when the SLE application entities are communicating via a gateway.

f) ‘encoding error’—the local application detected an error in the encoding of one or more operation parameters or did not recognize the operation;

g) ‘return timeout’—the local application entity detected that the return from a confirmed operation was not received within the time specified by the return-timeout-period parameter (see 4.1.3).

h) ‘end of service instance provision period’—the local application entity detected that the service instance provision period has ended and the initiator has not invoked the FSP-UNBIND operation;

i) ‘unsolicited invoke-ID’—the local application entity received a return with an `invoke-ID` that does not match the `invoke-ID` of any of the operations for which the return is pending;

j) ‘other reason’—the local application entity detected an unspecified error during the processing of one or more operations.

NOTE – FSP-PEER-ABORT does not carry an `invoker-credentials` parameter. It is conceivable that an intruder might use the FSP-PEER-ABORT operation for a denial-of-service attack. If an intruder has the required capability of breaking into an existing connection, then a denial-of-service attack can be much more easily accomplished by disrupting communications at a lower than the application layer. Therefore, authentication of the FSP-PEER-ABORT operation would not provide improved protection against such attacks.

3.13.3 EFFECTS

The FSP-PEER-ABORT operation shall have the following effects:

a) the association shall be aborted and the provider shall transition to state 1 (‘unbound’);

b) all Space Packets buffered for this service instance by the provider that have not yet been converted to Frame Data Units and passed to the segment queues shall be discarded;

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

c) COP parameters, i.e. parameters that can be set by means the FSP-INVOKE-DIRECTIVE operation, shall not be altered when the association for the service with the capability to invoke directives is aborted;

d) the values of other service provision parameters shall return to the initial values set by service management, including the values of any parameters changed by the service user;

e) statistical information required for the generation of status reports shall be retained throughout the service instance provision period;

f) parameters that serve to relate notifications on an activity to operations that triggered that activity shall not be altered when the association is aborted.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

(Blank page)

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

4 FSP PROTOCOL

4.1 GENERIC PROTOCOL CHARACTERISTICS

NOTE – This section specifies the handling of invalid SLE-PDUs and other failures affecting the protocol.

4.1.1 UNEXPECTED SLE PROTOCOL DATA UNIT

If the peer application entity sends an invocation or return not allowed in the current state of the performer, the performer shall abort the association by invoking the FSP-PEER-ABORT operation with the `diagnostic` parameter set to 'protocol error'.

4.1.2 INVALID SLE PROTOCOL DATA UNIT

If the application entity receives an invocation or return that contains an unrecognized operation type, contains a parameter of a wrong type, or is otherwise not decodable, the application entity shall aborted the association by invoking the FSP-PEER-ABORT operation with the `diagnostic` parameter set to 'encoding error'.

4.1.3 MISSING RETURN

For confirmed operations, if the invoker does not receive the return from the performer within the return-timeout-period specified by service management, the invoker shall abort the association by invoking the FSP-PEER-ABORT operation with the `diagnostic` parameter set to 'return timeout'.

NOTES

1 The return-timeout-period shall be chosen taking into account performance of user and provider applications as well as the delays introduced by the underlying communications service.

2 In order to provide responsive service and short return-timeout-periods, the generation of the return from an operation must not depend on any human interaction.

3 After invoking the FSP-UNBIND operation, the initiator must not invoke any further operations with the exception of the case addressed in 3.3.1.4 nor send any returns. The responder is not required to send any pending returns after having received the FSP-UNBIND invocation. Therefore, following an FSP-UNBIND invocation, the 'missing return' event may occur.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

4.1.4 UNSOLICITED RETURN

If the application entity receives a return with an `invoke-ID` parameter value that does not correspond to any invocation for which the return is still pending, the application entity shall abort the association by invoking the FSP-PEER-ABORT operation with the `diagnostic` parameter set to 'unsolicited invoke-ID'.

4.1.5 COMMUNICATIONS FAILURE

4.1.5.1 Every SLE entity (i.e., every SLE user or provider) that is in an association (bound) with a peer SLE entity shall maintain knowledge of the health of the communications interface with the peer.

4.1.5.2 If an SLE entity is informed by its underlying communications service that communications with the peer entity have been disrupted (e.g., due to a communications failure), then this entity shall consider that the association with the peer entity has been aborted. Occurrence of such communications failure event shall be referred to as a 'protocol abort'.

NOTE – The exact criteria for determining when communications have been disrupted may depend on the characteristics of the communications technology used and may be specific to a given implementation. However, it is a firm requirement on any communications service underlying an SLE transfer service that it includes suitable means to ascertain the status of the connection (see 1.3.1). In the case of communications protocols that do not intrinsically provide such a capability, the transmission of a periodic 'heartbeat' indicator or equivalent may need to be implemented.

4.1.5.3 Subsequent to a 'protocol abort' event:

a) the FSP provider shall transition to state 1 ('unbound');

b) neither the user nor the provider shall attempt further communications with the peer except that the user may attempt to re-establish the association by invoking the FSP-BIND operation;

c) the provider shall discard all Space Packets buffered for this service instance except those already converted to Frame Data Units and passed to the segment queues;

d) the values of FSP service provision parameters shall return to the initial values set by service management for that service instance;

e) statistical information required for the generation of status reports shall be retained throughout the service instance provision period; and

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

f) parameters that serve to relate notifications on an activity to operations that triggered that activity (such as `directive-executed-identification`) shall not be altered.

4.1.6 ACCESS CONTROL

4.1.6.1 The initiator of an association shall present its own identity in the `initiator-identifier` parameter of the FSP-BIND invocation.

4.1.6.2 If the initiator is not registered at the responder, i.e., the initiator-identity value presented in the FSP-BIND invocation is not part of the responder's initiators registry, the responder shall deny access to this initiator by sending a negative FSP-BIND return with `diagnostic` set to 'access denied' and `performer-credentials` set to 'unused'.

4.1.6.3 If the initiator is registered at the responder, the responder shall attempt to authenticate the FSP-BIND invocation (see 3.1.5) as required for the given initiator. If authentication succeeds, but the initiator is not authorized for the service instance indicated in the `service-instance-identifier` parameter of the FSP-BIND invocation, the responder shall generate an FSP-BIND return with `result` set to 'negative result' and `diagnostic` set to 'service instance not accessible to this initiator'.

NOTE – If authentication fails, the responder shall behave as specified in 4.1.7. If authentication is not required for the given initiator, it shall be as if authentication was successful.

4.1.6.4 If the initiator receives an FSP-BIND return with a `responder-identifier` value that does not correspond to the identity of any responder registered at this initiator, the initiator shall abort the association by invoking FSP-PEER-ABORT with `diagnostic` set to 'access denied'.

4.1.6.5 If the responder is registered at the initiator, the initiator shall attempt to authenticate the FSP-BIND return (see 3.1.5) as required for the given responder. If authentication succeeds, but the `responder-identifier` value is different from the expected responder identity, the initiator shall abort the association by invoking FSP-PEER-ABORT with `diagnostic` set to 'unexpected responder ID'.

NOTE – If authentication fails, the initiator shall behave as specified in 4.1.7. If authentication is not required for the given responder, it shall be as if authentication was successful.

4.1.7 FAILING AUTHENTICATION

4.1.7.1 An incoming invocation or return shall be ignored if the credentials parameter cannot be authenticated when, by management arrangement, credentials are required.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

4.1.7.2 If an invocation is ignored, the operation shall not be performed, and a report of the outcome shall not be returned to the invoker.

4.1.7.3 If a return is ignored, it shall be as if no report of the outcome of the operation has been received.

4.2 FSP SERVICE PROVIDER BEHAVIOR

4.2.1 GENERAL REQUIREMENTS

4.2.1.1 The behavior of the FSP service provider shall conform to the state transition matrix specified in table 4-1.

4.2.1.2 All actions including state transitions specified for given state and a given event shall be performed before a subsequent event is considered.

4.2.1.3 SLE-PDUs shall be sent in the sequence specified in table 4-1.

4.2.1.4 Implementations shall ensure that events are not lost while an earlier event is being processed but are buffered in first-in first-out order for processing as soon as processing of the earlier event has completed.

4.2.1.5 The state transition matrix specified in table 4-1 represents one instance of service and thus one association. Once the association is established, if an FSP-BIND invocation for a different association but for the same service instance is received, it shall be rejected with an FSP-BIND return with the `result` parameter set to 'negative result' and the `diagnostic` parameter set to 'already bound'. This event shall not affect the association already in place.

4.2.2 STATE TABLE

NOTES

1 The first column simply numbers the rows of the table.

2 The second column lists all incoming events. Where these events correspond to the arrival of an incoming SLE-PDU, the ASN.1 type defined for this SLE-PDU in annex A is indicated in parentheses, ( ).

3 Where an event is internal to the provider, its description is put in quotation marks, ' '. These events are defined in table 4-2.

4 The three columns (one column per state) on the right side of the table specify the behavior the provider will exhibit depending on the current state and the incoming event. In some cases, the behavior in addition depends on Boolean conditions, also referred to as predicates. Such predicates are put in double quotation marks, " ". The

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

predicates are defined in table 4-3. Predicates that are simple Boolean variables set only by the state machine itself are referred to as Boolean Flags and specified in table 4-4. The dependency on a predicate is presented in the form of an 'IF <condition> THEN <action> [ELSEIF <condition> THEN <action>] ELSE <action>' clause.

5 If the action given in the table is simply to send a specific SLE-PDU, that is indicated by the appearance of the name of the ASN.1 type of the SLE-PDU to be sent in parentheses, ( ). If that SLE-PDU is a return, the name is preceded by the plus symbol ('+') to indicate that `result` is 'positive result', or by the negative symbol ('-') to indicate 'negative result'. Where several actions are to be taken (referred to as a 'compound action'), the name of the compound action is put in curly braces { }. The individual actions making up each compound action are identified in table 4-5.

6 'Not applicable' is stated where the given event can only occur in the given state because of an implementation error on the provider side.

7 Where the consequences of an incoming event are not visible to the user because the provider does not send any SLE-PDU in reaction to the given event, the action is put in square brackets, [ ].

8 State transitions are indicated by an arrow and the number of the state that will be entered; for example, → 1 indicates the transition to state 1.

9 Whenever the provider invokes a confirmed operation with `invoke-ID` set to <n>, it shall start an associated return <n> timer. Should this timer expire before the return <n> is received, the provider shall invoke the FSP-PEER-ABORT operation.

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

Table 4-1: Provider Behavior

No.	Incoming Event	Unbound (State 1)	Ready (State 2)	Active (State 3)
1)	(fspBindInvocation)	IF "positive result" .AND. "production configured" THEN {accept bind} → 2 ELSE IF "positive result" THEN (+fspBindReturn) → 2 ELSE (-fspBindReturn)	{peer abort 'protocol error'} → 1	{peer abort 'protocol error'} → 1
2)	'end of service instance provision period'	[ignore]	{peer abort 'end of service instance provision period'} → 1	{peer abort 'end of service instance provision period'} → 1
3)	(fspUnbindInvocation)	[ignore]	(fspUnbindReturn) → 1 stop reporting-cycle timer stop all return-timeout-period timers set "notify production operational" to FALSE IF "end" THEN release resources ELSE [ignore]	{peer abort 'protocol error'} → 1
4)	(fspStartInvocation)	[ignore]	IF "positive result" → 3 THEN (+fspStartReturn) ELSE IF "production off" THEN {reject start} ELSE (-fspStartReturn)	{peer abort 'protocol error'} → 1
5)	(fspStopInvocation)	[ignore]	{peer abort 'protocol error'} → 1	IF "positive result" → 2 THEN {initiate stop} ELSE (-fspStopReturn)

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

No.	Incoming Event	Unbound (State 1)	Ready (State 2)	Active (State 3)
6)	(fspTransferDataInvocation) with BD Packet	[ignore]	{peer abort 'protocol error'} → 1	IF "positive result" .AND. (.NOT. "service instance blocked") THEN queue packet (+fspTransferDataReturn) ELSE discard packet (-fspTransferDataReturn)
7)	(fspTransferDataInvocation) with AD Packet and unblock AD	[ignore]	{peer abort 'protocol error'} → 1	IF "positive result" .AND. (.NOT. "service instance blocked") .AND. ("AD blocked") THEN queue packet Set "AD blocked" to FALSE (+fspTransferDataReturn) ELSE discard packet (-fspTransferDataReturn)
8)	(fspTransferDataInvocation) with AD Packet and .NOT. unblock AD	[ignore]	{peer abort 'protocol error'} → 1	IF "positive result" .AND. (.NOT. "service instance blocked") .AND. (.NOT. "AD blocked") THEN queue packet (+fspTransferDataReturn) ELSE discard packet (-fspTransferDataReturn)
9)	(fspScheduleStatusReportInvocation)	[ignore]	IF "positive result" THEN (+fspScheduleStatusReportReturn) IF "immediately" THEN {immediate report} ELSE IF "periodically" THEN {periodic report} ELSE stop reporting-cycle timer ELSE (-fspScheduleStatusReportReturn)	IF "positive result" THEN (+fspScheduleStatusReportReturn) IF "immediately" THEN {immediate report} ELSE IF "periodically" THEN {periodic report} ELSE stop reporting-cycle timer ELSE (-fspScheduleStatusReportReturn)
10)	'reporting-cycle timer expired'	Not applicable	{periodic report}	{periodic report}
11)	'return-timeout-period timer <n> expired'	Not applicable	{peer abort 'return timeout'} → 1	{peer abort 'return timeout'} → 1

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

No.	Incoming Event	Unbound (State 1)	Ready (State 2)	Active (State 3)
12)	(fspGetParameterInvocation)	[ignore]	IF "positive result" THEN (+fspGetParameterReturn) ELSE (-fspGetParameterReturn)	IF "positive result" THEN (+fspGetParameterReturn) ELSE (-fspGetParameterReturn)
13)	(fspThrowEventInvocation)	[ignore]	IF "positive result" THEN (+fspThrowEventReturn) forward event to Complex Management ELSE (-fspThrowEventReturn)	IF "positive result" THEN (+fspThrowEventReturn) forward event to Complex Management ELSE (-fspThrowEventReturn)
14)	(fspInvokeDirectiveInvocation)	[ignore]	{peer abort 'protocol error'} → 1	IF "positive result" THEN queue directive (+fspInvokeDirectiveReturn) ELSE (-fspInvokeDirectiveReturn)
15)	'packet processing started'	Not applicable	Not applicable	IF "report processing" THEN {notify 'packet processing started'} ELSE [ignore]
16)	'packet acknowledged'	Not applicable	IF "report acknowledgement" THEN {notify 'packet acknowledged'} ELSE [ignore]	IF "report acknowledgement" THEN {notify 'packet acknowledged'} ELSE [ignore]
17)	'packet radiated'	Not applicable	IF "report radiation" THEN {notify 'packet radiated'} ELSE [ignore]	IF "report radiation" THEN {notify 'packet radiated'} ELSE [ignore]
18)	'sldu expired'	Not applicable	Not applicable	{notify 'sldu expired' and block}
19)	'packet transmission mode mismatch'	Not applicable	Not applicable	{notify and block AD}
20)	'transmission mode capability change'	Not applicable	{notify 'transmission mode capability change'}	{notify 'transmission mode capability change'}
21)	'VC aborted'	Not applicable	{notify 'VC aborted'}	{notify 'VC aborted'}
22)	'production interrupted'	Not applicable	Not applicable	{notify 'production interrupted' and block} set "notify production operational" to TRUE

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

No.	Incoming Event	Unbound (State 1)	Ready (State 2)	Active (State 3)
23)	'production halted'	Not applicable	{notify 'production halted'} set "notify production operational" to TRUE	{notify 'production halted' and block} set "notify production operational" to TRUE
24)	'production operational'	Not applicable	IF "notify production operational" THEN {notify 'production operational'} set "notify production operational" to FALSE	IF "notify production operational" THEN {notify 'production operational'} set "notify production operational" to FALSE
25)	'buffer empty'	Not applicable	{notify 'buffer empty'}	{notify 'buffer empty'}
26)	'no invoke directive capability on this VC'	Not applicable	{notify 'no invoke directive capability on this VC'}	{notify 'no invoke directive capability on this VC'}
27)	'invoke directive capability on this VC'	Not applicable	{notify 'invoke directive capability established on this VC'}	{notify 'invoke directive capability established on this VC'}
28)	'positive confirm response to directive'	Not applicable	{notify 'positive confirm response to directive'}	{notify 'positive confirm response to directive'}
29)	'negative confirm response to directive'	Not applicable	{notify 'negative confirm response to directive'}	{notify 'negative confirm response to directive'}
30)	'action list completed'	Not applicable	{notify 'action list completed'}	{notify 'action list completed'}
31)	'action list not completed'	Not applicable	{notify 'action list not completed'}	{notify 'action list not completed'}
32)	'event condition evaluated to false'	Not applicable	{notify 'event condition evaluated to false'}	{notify 'event condition evaluated to false'}
33)	(fspPeerAbortInvocation)	[ignore]	{clean up} → 1	{clean up} → 1
34)	'protocol abort'	[ignore]	{clean up} → 1	{clean up} → 1
35)	'unsolicited invoke-ID'	[ignore]	{peer abort 'unsolicited invoke-ID'} → 1	{peer abort 'unsolicited invoke-ID'} → 1
36)	'invalid SLE-PDU'	[ignore]	{peer abort 'encoding error'} → 1	{peer abort 'encoding error'} → 1
37)	'unexpected SLE-PDU'	[ignore]	{peer abort 'protocol error'} → 1	{peer abort 'protocol error'} → 1
38)	'not authenticated SLE-PDU'	[ignore]	[ignore]	[ignore]

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

Table 4-2: Event Description References

Event	Reference
‘action list completed’	3.7.2.3
‘action list not completed’	3.7.2.3
‘buffer empty’	3.7.2.3
‘end of service instance provision period’	3.13.2.2
‘event condition evaluated to false’	3.7.2.3
‘invalid SLE-PDU’	4.1.2
‘invoke directive capability established on this VC’	3.7.2.3
‘negative confirm response to directive’	3.7.2.3
‘no invoke directive capability on this VC’	3.7.2.3
‘not authenticated SLE-PDU’	4.1.7
‘packet acknowledged’	3.7.2.3
‘packet processing started’	3.7.2.3
‘packet radiated’	3.7.2.3
‘packet transmission mode mismatch’	3.7.2.3
‘positive confirm response to directive’	3.7.2.3
‘production halted’	3.7.2.3
‘production interrupted’	3.7.2.3
‘production operational’	3.7.2.3
‘protocol abort’	4.1.5
‘reporting-cycle timer expired’	3.8.3
‘return-timeout-period timer <n> expired’	4.1.3
‘sldu expired’	3.7.2.3
‘transmission mode capability change’	3.7.2.3
‘unexpected SLE-PDU’	4.1.1
‘unsolicited invoke-ID’	3.13.2.2
‘VC aborted’	3.7.2.3

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

Table 4-3: Predicate Definitions

Predicate	Evaluates to TRUE if
"end"	all checks on the (fspUnbindInvocation) PDU are passed and the `unbind-reason` parameter value is 'end'
"immediately"	all parameter checks on the (fspScheduleStatusReportInvocation) PDU are passed and the `report-request-type` parameter value is 'immediately'
"periodically"	all parameter checks on the (fspScheduleStatusReportInvocation) PDU are passed and the `report-request-type` parameter value is 'periodically'
"positive result"	all checks on the given invocation PDU are passed
"production configured"	The current value of `production-status` is 'configured'
"production off"	The `diagnostic` parameter value in the (–fspStartReturn) is either 'out of service' or 'unable to comply'
"report processing"	the `processing-started-notification` parameter value was 'produce notification' in the (fspTransferDataInvocation) PDU for the Space Packet associated with the processing event
"report radiation"	the `radiated-notification` parameter value was 'produce notification' in the (fspTransferDataInvocation) PDU for the Space Packet associated with the radiation event
"report acknowledgement"	the `acknowledged-notification` parameter value was 'produce notification' in the (fspTransferDataInvocation) PDU for the Space Packet associated with the transfer event

Table 4-4: Boolean Flags

Flag Name	Initial Value
"AD blocked"	FALSE
"notify production operational"	FALSE
"service instance blocked"	FALSE

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

Table 4-5: Compound Action Definitions

Name	Actions Performed
{accept bind}	(+fspBindReturn) set “notify production operational” to TRUE
{clean up}	stop reporting-cycle timer stop all return-timeout-period timers set “notify production operational” to FALSE clear Packets relating to the service instance from the packet queues reset service provision parameters
{immediate report}	(fspStatusReportInvocation) stop reporting-cycle timer
{initiate stop}	clear Packets relating to the service instance from the packet queues set “service instance blocked” to FALSE set “AD blocked” to FALSE (+fspStopReturn)
{notify ‘xxxx’}	(fspAsyncNotifyInvocation) with `notification-type` set to ‘xxxx’, i.e., to the value corresponding to the incoming event
{notify ‘xxxx’ and block}	(fspAsyncNotifyInvocation) with `invoke-ID` value <n> and `notification-type` set to ‘xxxx’, i.e., to the value corresponding to the incoming event clear Packets relating to the service instance from the requests and packets queues set “service instance blocked” to TRUE
{notify ‘xxxx’ and block AD}	(fspAsyncNotifyInvocation) with `invoke-ID` value <n> and `notification-type` set to ‘xxxx’, i.e., to the value corresponding to the incoming event clear AD Packets relating to the service instance from the requests and packets queues set “AD blocked” to TRUE
{peer abort ‘xxxx’}	(fspPeerAbortInvocation) with `diagnostic` set to ‘xxxx’ stop reporting-cycle timer stop all return timers set “notify production operational” to FALSE clear Packets relating to the service instance from the packet queues

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

Name	Actions Performed
{periodic report}	(fspStatusReportInvocation) set reporting-cycle timer to the `reporting-cycle` value in the most recent (fspScheduleStatusReportInvocation) start reporting-cycle timer
{reject start}	(-fspStartReturn) set “notify production operational” to TRUE

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

(Blank page)

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

ANNEX A

DATA TYPE DEFINITIONS

(NORMATIVE)

A1 INTRODUCTION

A1.1 This annex defines the data types that are used by the FSP service. It is intended to provide a clear specification of these data types and to avoid ambiguity. It is not intended to constrain how these data types are implemented or encoded. These definitions are suitable for inclusion in any type of ASN.1 based protocol that implements the FSP service.

A1.2 The data type definitions are presented in seven ASN.1 modules.

A1.3 Subsection A2.1 contains basic data types that are common with other SLE transfer services. As additional services are specified by CCSDS, further data types may be added to this module or existing types may be extended. This does, however, not invalidate the module in its present form because an implementation compliant with a future extended version of this module will be still fully interoperable with an implementation based on its present version.

A1.4 Subsection A2.2 specifies the SLE-PDUs exchanged between an SLE user and an SLE provider application entity in order to establish, release or abort an association. They are common among SLE transfer service types.

A1.5 Subsection A2.3 specifies SLE-PDUs related to invocations and returns that are common to SLE transfer service types.

A1.6 Subsection A2.4 specifies the format of the Service Instance Identifiers.

A1.7 Subsection A2.4 specifies data types specific to the FSP service. In part, these specific types are derived from types specified in A2.1 by means of subtyping.

A1.8 Subsection A2.6 specifies all incoming (from a provider point of view) SLE-PDUs of the FSP service. Where applicable, these SLE-PDUs are mapped to the generic SLE-PDUs defined in A2.2 and A2.3.

A1.9 Subsection A2.7 specifies in the same way all outgoing SLE-PDUs.

A1.10 Although subsections A2.2, A2.3, A2.6 and A2.7 define the SLE-PDUs that will be exchanged between the SLE provider and user application entities, they shall not be interpreted as requiring that these PDUs shall be completely mapped to the user data field of the underlying communications protocol. Depending on the communications protocol(s) used, part of the SLE-PDUs may be used to determine the appropriate setting of protocol control information.

© ISO 2011 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

A2 FSP DATA TYPE SPECIFICATION

A2.1 SLE TRANSFER SERVICE COMMON TYPES

```
CCSDS-SLE-TRANSFER-SERVICE-COMMON-TYPES

{  iso identified-organization(3)
   standards-producing-organization(112) ccsds(4)
   space-link-extension(3) sle-transfer-services(1)
   modules(1) common-modules(99) version-four(4) asn1-common-types(1)
}

DEFINITIONS
IMPLICIT TAGS
::=   BEGIN

EXPORTS  ConditionalTime
,        Credentials
,        DeliveryMode
,        Diagnostics
,        Duration
,        ForwardDuStatus
,        IntPosLong
,        IntPosShort
,        IntUnsignedLong
,        IntUnsignedShort
,        InvokeId
,        ParameterName
,        SlduStatusNotification
,        SpaceLinkDataUnit
,        Time
;

ConditionalTime         ::=   CHOICE
{  undefined         [0]   NULL
,  known             [1]   Time
}

-- If credentials are used, it will be necessary that
-- the internal structure of the octet string is known
-- to both parties. Since the structure will depend on
-- algorithm used, it is not specified here. However,
-- the peer entities may use ASN.1 encoding to make the
-- internal structure visible.
Credentials             ::=   CHOICE
{  unused            [0]   NULL
,  used              [1]   OCTET STRING (SIZE (8 .. 256))
}

DeliveryMode            ::=   INTEGER
{  rtnTimelyOnline               (0)
,  rtnCompleteOnline             (1)
,  rtnOffline                    (2)
,  fwdOnline                     (3)
,  fwdOffline                    (4)
}
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
Diagnostics             ::=   INTEGER
{  duplicateInvokeId              (100)
,  otherReason                    (127)
}

-- The Duration is expressed in microseconds
Duration                ::=   IntUnsignedLong

ForwardDuStatus         ::=   INTEGER
{  radiated                       (0)
,  expired                        (1)
,  interrupted                    (2)
,  acknowledged                   (3)   -- FSP
,  productionStarted              (4)   -- CLTU: 'radiation started'
,  productionNotStarted           (5)   -- CLTU: 'radiation not started'
,  unsupportedTransmissionMode    (6)   -- FSP
}

-- 1 to (2^32)-1
IntPosLong              ::=   INTEGER (1 .. 4294967295)

-- 1 to (2^16)-1
IntPosShort             ::=   INTEGER (1 .. 65535)

-- 0 to (2^32)-1
IntUnsignedLong         ::=   INTEGER (0 .. 4294967295)

-- 0 to (2^16)-1
IntUnsignedShort        ::=   INTEGER (0 .. 65535)

InvokeId                ::=   IntUnsignedShort
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
ParameterName                          ::=   INTEGER
{  acquisitionSequenceLength                 (201)
,  apidList                                  (2)
,  bitLockRequired                           (3)
,  blockingTimeoutPeriod                     (0)
,  blockingUsage                             (1)
,  bufferSize                                (4)
,  clcwGlobalVcid                            (202)
,  clcwPhysicalChannel                       (203)
,  deliveryMode                              (6)
,  directiveInvocation                       (7)
,  directiveInvocationOnline                 (108)
,  expectedDirectiveIdentification           (8)
,  expectedEventInvocationIdentification     (9)
,  expectedSlduIdentification                (10)
,  fopSlidingWindow                          (11)
,  fopState                                  (12)
,  latencyLimit                              (15)
,  mapList                                   (16)
,  mapMuxControl                             (17)
,  mapMuxScheme                              (18)
,  maximumFrameLength                        (19)
,  maximumPacketLength                       (20)
,  maximumSlduLength                         (21)
,  minimumDelayTime                          (204)
,  modulationFrequency                       (22)
,  modulationIndex                           (23)
,  notificationMode                          (205)
,  permittedControlWordTypeSet               (101)
,  permittedGvcidSet                         (24)
,  permittedTcVcidSet                        (102)
,  permittedTransmissionMode                 (107)
,  permittedUpdateModeSet                    (103)
,  plop1IdleSequenceLength                   (206)
,  plopInEffect                              (25)
,  protocolAbortMode                         (207)
,  reportingCycle                            (26)
,  requestedControlWordType                  (104)
,  requestedFrameQuality                     (27)
,  requestedGvcid                            (28)
,  requestedTcVcid                           (105)
,  requestedUpdateMode                       (106)
,  returnTimeoutPeriod                       (29)
,  rfAvailable                               (30)
,  rfAvailableRequired                       (31)
,  segmentHeader                             (32)
,  subcarrierToBitRateRatio                  (34)
,  timeoutType                               (35)
,  timerInitial                              (36)
,  transmissionLimit                         (37)
,  transmitterFrameSequenceNumber            (38)
,  vcMuxControl                              (39)
,  vcMuxScheme                               (40)
,  virtualChannel                            (41)
}

SlduStatusNotification  ::=   INTEGER
{  produceNotification           (0)
,  doNotProduceNotification      (1)
}
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
SpaceLinkDataUnit       ::=   OCTET STRING (SIZE (1 .. 65536))

Time                    ::=   CHOICE
{  ccsdsFormat       [0]   TimeCCSDS
,  ccsdsPicoFormat   [1]   TimeCCSDSpico
}

TimeCCSDS               ::=   OCTET STRING (SIZE(8))
-- P-field is implicit (not present, defaulted to 41 hex
-- T-field:
-- 2 octets: number of days since 1958/01/01 00:00:00
-- 4 octets: number of milliseconds of the day
-- 2 octets: number of microseconds of the millisecond
--        (set to 0 if not used)
-- This definition reflects exactly the format of the CCSDS defined
-- time tag as used in spacelink data units (see Time Code Formats.
-- Recommendation for Space Data Systems Standards, CCSDS 301.0-B-3.
-- Blue Book. Issue 3. Washington, D.C.: CCSDS, January 2002).

TimeCCSDSpico           ::=   OCTET STRING (SIZE(10))
-- P-field is implicit (not present, defaulted to 42 hex
-- T-field:
-- 2 octets: number of days since 1958/01/01 00:00:00
-- 4 octets: number of milliseconds of the day
-- 4 octets: number of picoseconds of the millisecond
--        (set to 0 if not used)
-- This definition reflects exactly the format of the CCSDS defined
-- time tag as used in spacelink data units (see Time Code Formats.
-- Recommendation for Space Data System Standards, CCSDS 301.0-B-3.
-- Blue Book.  Issue 3.  Washington, D.C.: CCSDS, January 2002).

END
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

A2.2 SLE TRANSFER SERVICE BIND TYPES

```
CCSDS-SLE-TRANSFER-SERVICE-BIND-TYPES

{  iso identified-organization(3)
   standards-producing-organization(112) ccsds(4)
   space-link-extension(3) sle-transfer-services(1)
   modules(1) common-modules(99) version-four(4) asn1-bind-types(2)
}

DEFINITIONS
IMPLICIT TAGS
::=   BEGIN

EXPORTS  SleBindInvocation
,        SleBindReturn
,        SlePeerAbort
,        SleUnbindInvocation
,        SleUnbindReturn
;

IMPORTS  Credentials
,        IntPosShort
   FROM CCSDS-SLE-TRANSFER-SERVICE-COMMON-TYPES

         ServiceInstanceIdentifier
   FROM CCSDS-SLE-TRANSFER-SERVICE-SERVICE-INSTANCE-ID
;

-- ================================================================
-- The first part of the module definition contains the SLE-PDUs
-- ================================================================

SleBindInvocation          ::=   SEQUENCE
{  invokerCredentials         Credentials
,  initiatorIdentifier        AuthorityIdentifier
,  responderPortIdentifier    PortId
,  serviceType                ApplicationIdentifier
,  versionNumber              VersionNumber
,  serviceInstanceIdentifier  ServiceInstanceIdentifier
}

SleBindReturn              ::=   SEQUENCE
{  performerCredentials      Credentials
,  responderIdentifier       AuthorityIdentifier
,  result                    CHOICE
   {  positive          [0]   VersionNumber
   ,  negative          [1]   BindDiagnostic
   }
}

SlePeerAbort               ::=   PeerAbortDiagnostic

SleUnbindInvocation        ::=   SEQUENCE
{  invokerCredentials        Credentials
,  unbindReason              UnbindReason
}
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
SleUnbindReturn         ::=   SEQUENCE
{  responderCredentials    Credentials
,  result                  CHOICE
   {  positive          [0]   NULL
   }
}

-- ================================================================
-- The second part of the module definition contains the types
-- used by the SLE-PDUs declared in the first part.
-- ================================================================

ApplicationIdentifier      ::=   INTEGER
{  rtnAllFrames               (0)
,  rtnInsert                  (1)
,  rtnChFrames                (2)
-- rtnChFrames includes rtnMcFrames and rtnVcFrames
,  rtnChFsh                   (3)
-- rtnChFsh includes rtnMcFsh and rtnVcFsh
,  rtnChOcf                   (4)
-- rtnChOcf includes rtnMcOcf and rtnVcOcf
,  rtnBitstr                  (5)   -- AOS
,  rtnSpacePkt                (6)
,  fwdAosSpacePkt             (7)
,  fwdAosVca                  (8)
,  fwdBitstr                  (9)
,  fwdProtoVcdu               (10)
,  fwdInsert                  (11)
,  fwdCVcdu                   (12)
,  fwdTcSpacePkt              (13)  -- conventional telecommand
,  fwdTcVca                   (14)  -- conventional telecommand
,  fwdTcFrame                 (15)
,  fwdCltu                    (16)
}

AuthorityIdentifier     ::=   IdentifierString (SIZE (3 .. 16))

BindDiagnostic                 ::=   INTEGER
{  accessDenied                   (0)
,  serviceTypeNotSupported        (1)
,  versionNotSupported            (2)
,  noSuchServiceInstance          (3)
,  alreadyBound                   (4)
,  siNotAccessibleToThisInitiator (5)
,  inconsistentServiceType        (6)
,  invalidTime                    (7)
,  outOfService                   (8)
,  otherReason                    (127)
}

IdentifierString        ::=   VisibleString (FROM (ALL EXCEPT " "))

LogicalPortName         ::=   IdentifierString (SIZE (1 .. 128))
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
PeerAbortDiagnostic           ::=   INTEGER
{  accessDenied                  (0)
,  unexpectedResponderId         (1)
,  operationalRequirement        (2)
,  protocolError                 (3)
,  communicationsFailure         (4)
,  encodingError                 (5)
,  returnTimeout                 (6)
,  endOfServiceProvisionPeriod   (7)
,  unsolicitedInvokeId           (8)
,  otherReason                   (127)
-- The range of this INTEGER shall be (0 .. 255).
-- (128 .. 255) is reserved for diagnostic codes
-- that are specific to the communications technology used.
}

PortId              ::=   LogicalPortName

UnbindReason        ::=   INTEGER
{  end                  (0)
,  suspend              (1)
,  versionNotSupported  (2)
,  other                (127)
}

VersionNumber       ::=   IntPosShort

END
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

A2.3 SLE TRANSFER SERVICE COMMON PDUS

```
CCSDS-SLE-TRANSFER-SERVICE-COMMON-PDUS

{  iso identified-organization(3)
   standards-producing-organization(112) ccsds(4)
   space-link-extension(3) sle-transfer-services(1)
   modules(1) common-modules(99) version-four(4) asn1-common-pdu(3)
}

DEFINITIONS
IMPLICIT TAGS
::=   BEGIN

EXPORTS  ReportingCycle
,        SleAcknowledgement
,        SleScheduleStatusReportInvocation
,        SleScheduleStatusReportReturn
,        SleStopInvocation
;

IMPORTS  Credentials
,        Diagnostics
,        InvokeId
   FROM CCSDS-SLE-TRANSFER-SERVICE-COMMON-TYPES
;

-- ================================================================
-- The first part of the module definition contains the SLE-PDUs
-- ================================================================

SleAcknowledgement      ::=   SEQUENCE
{  credentials             Credentials
,  invokeId                InvokeId
,  result                  CHOICE
   {  positiveResult    [0]   NULL
   ,  negativeResult    [1]   Diagnostics
   }
}

SleScheduleStatusReportInvocation   ::=   SEQUENCE
{  invokerCredentials                  Credentials
,  invokeId                            InvokeId
,  reportRequestType                   ReportRequestType
}

SleScheduleStatusReportReturn ::=   SEQUENCE
{  performerCredentials          Credentials
,  invokeId                      InvokeId
,  result                        CHOICE
   {  positiveResult          [0]   NULL
   ,  negativeResult          [1]   DiagnosticScheduleStatusReport
   }
}
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
SleStopInvocation       ::=   SEQUENCE
{  invokerCredentials      Credentials
,  invokeId                InvokeId
}

-- ================================================================
-- The second part of the module definition contains the types
-- used by the SLE-PDUs declared in the first part.
-- ================================================================

DiagnosticScheduleStatusReport   ::=   CHOICE
{  common                     [0]   Diagnostics
,  specific                   [1]   INTEGER
   {  notSupportedInThisDeliveryMode   (0)   -- not used for
                                             -- version 1 forward transfer
                                             -- services
   ,     alreadyStopped                (1)
   ,     invalidReportingCycle         (2)
   }
}

-- The cycle duration is expressed in seconds
ReportingCycle          ::=   INTEGER (2 .. 600)

ReportRequestType       ::=   CHOICE
{  immediately       [0]   NULL
,  periodically      [1]   ReportingCycle
,  stop              [2]   NULL
}

END
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

A2.4 SERVICE INSTANCE IDENTIFIER DEFINITION

```
CCSDS-SLE-TRANSFER-SERVICE-SERVICE-INSTANCE-ID

{  iso identified-organization (3) standards-producing-organization(112)
   ccsds(4) space-link-extension(3) sle-transfer-services(1)
   modules(1) common-modules(99) version-four(4)
   asn1-service-id-type(4)
}

DEFINITIONS
IMPLICIT TAGS
::= BEGIN

EXPORTS ServiceInstanceIdentifier
;

-- Object Identifiers definition
sagr     OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 52}
spack    OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 53}
fsl-fg   OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 14}
rsl-fg   OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 38}
cltu     OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 7}
fsp      OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 10}
raf      OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 22}
rcf      OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 46}
rcfsh    OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 44}
rocf     OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 49}
rsp      OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 40}
tcf      OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 12}
tcva     OBJECT IDENTIFIER    ::=   {iso 3 112 4 3 1 2 16}
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
-- ++++++++++++++++++++++++++++++++++
-- ++++++++++++++++++++++++++++++++++
-- The Service Instance Identifier is a concatenation of Attributes.
-- Each Attribute is composed of a name and a value.
-- Note that the Attribute names are not specified by the ASN.1 proper,
-- but by means of comments in this module.
-- The following Attributes identify the Service Instance:
-- Service agreement
--    the name of which is:   "sagr",
--    the value of which is to be agreed between the user and the provider;
-- Service package
--    the name of which is:   "spack",
--    the value of which is to be agreed between the user and the provider;
-- Forward/Return Service Functional Group
--    the name of which is:
--       "fsl-fg" for the forward services,
--    or:
--       "rsl-fg" for the return services,
--    the value of which is to be agreed between the user and the provider;
-- Service Name identifier,
--       the name of which is:   "cltu"
--       the value of which is:  "cltu" plus an instance number;
--    or:
--       the name of which is:   "fsp",
--       the value of which is:  "fsp" plus an instance number;
--    or:
--       the name of which is:   "tcva",
--       the value of which is:  "tcva" plus an instance number;
--    or:
--       the name of which is:   "tcf",
--       the value of which is:  "tcf" plus an instance number;
--    or:
--       the name of which is:   "raf",
--       the value ofwhich is:  "onlc" or "onlt" or "offl" plus an
--       instance number;
--    or:
--       the name of which is:   "rcf",
--       the value of which is:  "onlc" or "onlt" or "offl" plus an
--       instance number;
--    or:
--       the name of which is:   "rocf",
--       the value of which is:  "onlc" or "onlt" or "offl" plus an
--       instance number;
--    or:
--       the name of which is:   "rcfsh",
--       the value of which is:  "onlc" or "onlt" or "offl" plus an
--       instance number;
--    or:
--       the name of which is:   "rsp",
--       the value of which is:  "onlc" or "onlt" or "offl" plus an
--       instance number.
--
-- To obtain the string correponding to the instance identifier, one must
-- concatenate the Attributes values and Names as follows:
-- 'Atribute Name"="Attrbute value'.
-- Two Attributes must be separated by a ".".
--
-- Example: 'sagr=xyz.spack=abcdef.rsl-fg=gfjdy.raf=onlc2'
-- Note that the quotes are not part of the string.
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
ATTRIBUTE            ::=   CLASS
{  &id                  OBJECT IDENTIFIER UNIQUE
}
WITH SYNTAX { ID  &id }

GeneralAttributes ATTRIBUTE   ::=
{  serviceAgreement
|  servicePackage
|  forwardService
|  returnService
}

ServiceInstanceAttribute   ::=   SET SIZE(1) OF SEQUENCE
{  identifier                       ATTRIBUTE.&id
                                    ({ServiceInstanceAttributes})
,  siAttributeValue                 VisibleString (SIZE (1 .. 256))
}

ServiceInstanceAttributes ATTRIBUTE ::=
{  GeneralAttributes
|  ServiceNames
}

ServiceInstanceIdentifier  ::=   SEQUENCE OF ServiceInstanceAttribute

ServiceNames ATTRIBUTE  ::=
{  rafService
|  rcfService
|  rcfshService
|  rocfService
|  rspServiceId
|  cltuService
|  fspService
|  tcfServiceId
|  tcvaServiceId
}

-- ++++++++++++++++++++++++++++++++++
-- CLTU Service Definition
-- The cltu Service Id starts with "onlc" or "onlt" or "offl" and is
-- followed by the instance number.
cltuService ATTRIBUTE      ::=   {  ID cltu  }

-- ++++++++++++++++++++++++++++++++++
-- Forward Service Definition
forwardService ATTRIBUTE   ::=   {  ID fsl-fg   }

-- ++++++++++++++++++++++++++++++++++
-- FSP Service Definition
-- The fsp Service Id starts with "onlc" or "onlt" or "offl" and is
-- followed by the instance number.
fspService ATTRIBUTE       ::=   {  ID fsp   }

-- ++++++++++++++++++++++++++++++++++
-- RAF Service Definition
-- The raf Service Id starts with "onlc" or "onlt" or "offl" and is
-- followed by the instance number.
rafService ATTRIBUTE       ::=   {  ID raf   }
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
-- ++++++++++++++++++++++++++++++++++++
-- RCF Service Definition
-- The rcf Service Id starts with "onlc" or "onlt" or "offl" and is
-- followed by the instance number.
rcfService ATTRIBUTE       ::=   {  ID rcf   }

-- ++++++++++++++++++++++++++++++++++++
-- RCFSH Service Definition
-- The rcfsh Service Id starts with "onlc" or "onlt" or "offl" and is
-- followed by the instance number.
rcfshService ATTRIBUTE     ::=   {  ID rcfsh }

-- ++++++++++++++++++++++++++++++++++++
-- Return Service Definition
returnService ATTRIBUTE    ::=   {  ID rsl-fg   }

-- ++++++++++++++++++++++++++++++++++++
-- ROCF Service Definition
-- The rocf Service Id starts with "onlc" or "onlt" or "offl" and is
-- followed by the instance number.
rocfService ATTRIBUTE      ::=   {  ID rocf  }

-- ++++++++++++++++++++++++++++++++++++
-- RSP Service Definition
-- The rocf Service Id starts with "onlc" or "onlt" or "offl" and is
-- followed by the instance number.
rspServiceId ATTRIBUTE     ::=   {  ID rsp   }

-- ++++++++++++++++++++++++++++++++++++
-- Service Agreement Definition
serviceAgreement ATTRIBUTE ::=   {  ID sagr  }

-- ++++++++++++++++++++++++++++++++++++
-- Service Package Definition
servicePackage ATTRIBUTE   ::=   {  ID spack }

-- ++++++++++++++++++++++++++++++++++++
-- TCF Service Definition
-- The tcf Service Id starts with "onlc" or "onlt" or "offl" and is
-- followed by the instance number.
tcfServiceId ATTRIBUTE     ::=   {  ID tcf   }

-- ++++++++++++++++++++++++++++++++++++
-- TCVA Service Definition
-- The tcva Service Id starts with "onlc" or "onlt" or "offl" and is
-- followed by the instance number.
tcvaServiceId ATTRIBUTE    ::=   {  ID tcva  }

END
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

A2.5 FSP TRANSFER STRUCTURES

```
CCSDS-SLE-TRANSFER-SERVICE-FSP-STRUCTURES

{  iso identified-organization(3)
   standards-producing-organization(112) ccsds(4)
   space-link-extension(3) sle-transfer-services(1)
   modules(1) forward-space-packet-service(24) version-four(4)
   asn1-fsp-structures(1)
}

DEFINITIONS
IMPLICIT TAGS
::=   BEGIN

EXPORTS  BlockingUsage
,        BufferSize
,        DiagnosticFspGet
,        DiagnosticFspInvokeDirective
,        DiagnosticFspStart
,        DiagnosticFspThrowEvent
,        DiagnosticFspTransferData
,        FspData
,        FspGetParameter
,        FspNotification
,        FspPacketCount
,        FspPacketLastOk
,        FspPacketLastProcessed
,        FspParameterName
,        FspProductionStatus
,        Map
,        MapMuxControl
,        PacketIdentification
,        ProductionTime
,        TransmissionMode
;

IMPORTS  DeliveryMode
,        Diagnostics
,        ForwardDuStatus
,        IntPosLong
,        IntUnsignedLong
,        ParameterName
,        SpaceLinkDataUnit
,        Time
   FROM CCSDS-SLE-TRANSFER-SERVICE-COMMON-TYPES

         ReportingCycle
   FROM CCSDS-SLE-TRANSFER-SERVICE-COMMON-PDUS
;

AbsolutePriority        ::=   SEQUENCE
{  vcOrMapId               VcOrMapId
,  priority                Priority
}

Apid                    ::=   INTEGER (0 .. 2047)
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
-- The entries shall be in ascending order.
ApidList                ::=   CHOICE
{  any                  [0]   NULL
,  apidList             [1]   SEQUENCE SIZE (1 .. 2048) OF Apid
}

BlockingUsage           ::=   INTEGER
{  permitted               (0)
,  notPermitted            (1)
}

-- measured in milliseconds
BlockingTimeoutPeriod      ::=   INTEGER (100 .. 100000)

-- The minimum Telecommand size is 7 octets.
-- The maximum Telecommand size is 64 K-Octets + overhead.
BufferSize              ::=   INTEGER (7 .. 66560)

CurrentReportingCycle   ::=   CHOICE
{  cyclicReportOff   [0]   NULL
,  cyclicReportOn    [1]   ReportingCycle
}

DiagnosticFspGet        ::=   CHOICE
{  common            [0]   Diagnostics
,  specific          [1]   INTEGER
   {  unknownParameter        (0)
   }
}

DiagnosticFspInvokeDirective                ::=   CHOICE
{  common                              [0]   Diagnostics
,  specific                            [1]   INTEGER
   {  directiveInvocationNotAllowed          (0)
   ,  directiveIdentificationOutOfSequence   (1)
   ,  directiveError                         (2)
   }
}

DiagnosticFspStart      ::=   CHOICE
{  common            [0]   Diagnostics
,  specific          [1]   INTEGER
   {  outOfService            (0)
   ,  unableToComply          (1)
   ,  productionTimeExpired   (2)
   }
}

DiagnosticFspThrowEvent          ::=   CHOICE
{  common                        [0]   Diagnostics
,  specific                      [1]   INTEGER
   {  operationNotSupported               (0)
   ,  eventIdentificationOutOfSequence    (1)
,  noSuchEvent                            (2)
   }
}
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
DiagnosticFspTransferData           ::=   CHOICE
{  common                          [0]   Diagnostics
,  specific                        [1]   INTEGER
   {  unableToProcess                        (0)
   ,  unableToStore                          (1)
   ,  packetIdentificationOutOfSequence      (2)
   ,  duplicatePacketIdentification          (3)
,  inconsistentTimeRange                     (4)
   ,  invalidTime                            (5)
   ,  conflictingProductionTimeIntervals     (6)
   ,  lateSldu                               (7)
   ,  invalidDelayTime                       (8)
   ,  invalidTransmissionMode                (9)
   ,  invalidMap                             (10)
   ,  invalidNotificationRequest             (11)
   ,  packetTooLong                          (12)
   ,  unsupportedPacketVersion               (13)
   ,  incorrectPacketType                    (14)
   ,  invalidPacketApid                      (15)
   }
}

DirectiveExecutedId     ::=   IntUnsignedLong

EventInvocationId       ::=   IntUnsignedLong

FopAlert                ::=   INTEGER
{  noAlert                        (0)
,  limit                          (1)
,  lockOutDetected                (2)
,  synch                          (3)
,  invalidNR                      (4)
,  clcw                           (5)
,  lowerLayerOutOfSync            (6)
,  terminateADService             (7)
}

FspData                 ::=   SpaceLinkDataUnit

FspDeliveryMode         ::=   DeliveryMode
(  fwdOnline
)
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
FspGetParameter            ::=   CHOICE
{  parApidList             [0]   SEQUENCE
   {  parameterName        ParameterName (apidList)
   ,  parameterValue       ApidList
   }
,  parBitLockRequired      [27]  SEQUENCE
   {  parameterName        ParameterName  (bitLockRequired)
   ,  parameterValue       INTEGER
      {  yes                        (0)
      ,  no                         (1)
      }
   }
,  parBlockingTimeout      [1]   SEQUENCE
   {  parameterName           ParameterName(blockingTimeoutPeriod)
   ,  parameterValue          CHOICE
      {  blockingOff          [0]   NULL
      ,  blockingOn           [1]   BlockingTimeoutPeriod
      }
   }
,  parBlockingUsage        [2]   SEQUENCE
   {  parameterName        ParameterName (blockingUsage)
   ,  parameterValue       BlockingUsage
   }
,  parDeliveryMode         [3]   SEQUENCE
   {  parameterName        ParameterName (deliveryMode)
   ,  parameterValue       FspDeliveryMode
   }
,  parDirectiveInvoc       [4]   SEQUENCE
   {  parameterName        ParameterName (directiveInvocation)
   ,  parameterValue       INTEGER
      {  enabled              (0)
      ,  disabled             (1)
      }
   }
,  parDirInvocOnl          [5]   SEQUENCE
   {  parameterName        ParameterName (directiveInvocationOnline)
   ,  parameterValue       INTEGER
      {  yes                  (0)
      ,  no                   (1)
      }
   }
,  parExpectDirectiveId    [6]   SEQUENCE
   {  parameterName        ParameterName  (expectedDirectiveIdentification)
   ,  parameterValue       IntUnsignedLong
   }
,  parExpectEventInvId     [7]   SEQUENCE
{  parameterName           ParameterName
                           (expectedEventInvocationIdentification)
   ,  parameterValue       IntUnsignedLong
   }
,  parExpectSlduId         [8]   SEQUENCE
   {  parameterName        ParameterName  (expectedSlduIdentification)
   ,  parameterValue       PacketIdentification
   }
,  parFopSlidWindow        [9]   SEQUENCE
   {  parameterName        ParameterName (fopSlidingWindow)
   ,  parameterValue       INTEGER (1 .. 255)
   }
,  parFopState             [10]  SEQUENCE
   {  parameterName        ParameterName (fopState)
   ,  fopState             INTEGER
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved

```
      {  active                     (0)
      ,  retransmitWithoutWait      (1)
      ,  retransmitWithWait         (2)
      ,  initialisingWithoutBCFrame (3)
      ,  initialisingWithBCFrame    (4)
      ,  initial                    (5)
      }
   }
,  parMapList           [11]  SEQUENCE
   {  parameterName     ParameterName (mapList)
   ,  mapList           MapList
   }
,  parMapMuxControl     [12]  SEQUENCE
   {  parameterName     ParameterName (mapMuxControl)
   ,  parameterValue    MuxControl
   }
,  parMapMuxScheme      [13]  SEQUENCE
   {  parameterName     ParameterName (mapMuxScheme)
   ,  parameterValue    MuxScheme
   }
,  parMaxFrameLength    [14]  SEQUENCE
   {  parameterName     ParameterName (maximumFrameLength)
   ,  parameterValue    INTEGER (12 .. 1024) -- octets
   }
,  parMaxPacketLength   [15]  SEQUENCE
   {  parameterName     ParameterName (maximumPacketLength)
   ,  parameterValue    INTEGER (7 .. 65542)
   }
,  parPermTransMode     [16]  SEQUENCE
   {  parameterName     ParameterName (permittedTransmissionMode)
   ,  parameterValue    PermittedTransmissionMode
   }
,  parReportingCycle    [17]  SEQUENCE
   {  parameterName     ParameterName (reportingCycle)
   ,  parameterValue    CurrentReportingCycle
   }
,  parReturnTimeout     [18]  SEQUENCE
   {  parameterName     ParameterName (returnTimeoutPeriod)
   ,  parameterValue    TimeoutPeriod
   }
,  parRfAvailableRequired  [28]  SEQUENCE
   {  parameterName        ParameterName  (rfAvailableRequired)
   ,  parameterValue       INTEGER
      {  yes                        (0)
      ,  no                         (1)
      }
   }
,  parSegmHeader        [19]  SEQUENCE
   {  parameterName     ParameterName (segmentHeader)
   ,  parameterValue    INTEGER
      {  present           (0)
      ,  absent            (1)
      }
   }
,  parTimeoutType       [20]  SEQUENCE
   {  parameterName     ParameterName (timeoutType)
   ,  parameterValue    INTEGER
      {  generateAlert              (0)
      ,  suspendSequenceControlled  (1)
      }
   }
```

STANDARDSISO.COM : Click to view the full PDF of ISO 22672:2011

© ISO 2011 – All rights reserved