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Space data and information transfer systems — Communications operation procedure-1

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The UK participation in its preparation was entrusted to Technical Committee ACE/68/-/7, Space systems and operations - Space data and information transfer systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

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INTERNATIONAL STANDARD

BS ISO 22667:2013

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Second edition
2013-06-01

Space data and information transfer systems — Communications operation procedure-1

*Systèmes de transfert des données et informations spatiales —
Procédure 1 pour les opérations de communication*



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Foreword

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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.

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ISO 22667 was prepared by the Consultative Committee for Space Data Systems (CCSDS) (as CCSDS 232.1-B-2, September 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 22667:2005), which has been technically revised.

Space data and information transfer systems — Communications operation procedure-1

1 Scope

1.1 This International Standard specifies the communications operation procedure-1 (COP-1). This procedure is used with the telecommand (TC) space data link protocol (as defined in ISO 22664:2013) to enable the delivery of service data units to the receiving end of the layer above, correct and without omission or duplication, and in the same sequential order in which they were received from the layer above at the sending end.

1.2 This International Standard defines the COP-1 in terms of

- a) the interfaces with the other procedures,
- b) the internal variables used by the protocol entity,
- c) the actions performed by the protocol entity, and
- d) the state transitions of the protocol entity.

1.3 It does not specify

- a) individual implementations or products,
- b) the implementation of service interfaces within real systems,
- c) the methods or technologies required to perform the procedures, or
- d) the management activities required to configure and control the protocol.

1.4 The scope and field of application are furthermore detailed in subclauses 1.1, 1.2 and 1.3 of the enclosed CCSDS publication.

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 232.1-B-2, September 2010, *Communications operation procedure-1*.

For the purposes of international standardization, the modifications outlined below shall apply to the specific clauses and paragraphs of publication CCSDS 232.1-B-2.

Pages i to vi

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

Page 1-5

Add the following information to the reference indicated:

[3] Document CCSDS 232.0-B-2, July 2010, is equivalent to ISO 22664:2013.

3 Revision of publication CCSDS 232.1-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 232.1-B-2. To this end, NASA will act as a liaison body between CCSDS and ISO.

Recommendation for Space Data System Standards

COMMUNICATIONS OPERATION PROCEDURE-1

RECOMMENDED STANDARD

CCSDS 232.1-B-2

BLUE BOOK
September 2010

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AUTHORITY

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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:

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Washington, DC 20546-0001, USA

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:

- o 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.
- o 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.
- o 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.

FOREWORD

This document is a technical Recommended Standard for use in developing flight and ground systems for space missions and has been prepared by the Consultative Committee for Space Data Systems (CCSDS). The Communications Operation Procedure-1 (COP-1) described herein is intended for missions that are cross-supported between Agencies of the CCSDS.

This Recommended Standard specifies an automatic retransmission procedure to be used by space missions to transfer space application data over a ground-to-space or space-to-space communications link. This Recommended Standard has been developed from an existing CCSDS Recommended Standard that specifies Command Operation Procedure-1 (reference [B2]), which defines essentially the same procedure but in a slightly different context.

This Recommended Standard does not change the basic technical contents defined in reference [B2], but the name of the procedure and the presentation of the specification have been changed so that:

- a) COP-1 can be used to transfer any data over any space link in either direction;
- b) the specification matches the Open Systems Interconnection (OSI) Basic Reference Model (references [2] and [3]).

The most notable change in presentation is that COP-1 is defined as a procedure in the Data Link Layer of the OSI Model in this Recommended Standard, whereas it is defined as a procedure in the Transfer Layer (a sublayer of the Data Link Layer) in reference [B2].

Together with the change in presentation, a few technical details in reference [B2] have been changed based upon experience in using this procedure. Also, some technical terms in reference [B2] have been changed in order to unify the terminology used in all CCSDS Recommended Standards that define space link protocols. These changes are listed in annex D of this Recommended Standard.

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.

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

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- United States Geological Survey (USGS)/USA.

DOCUMENT CONTROL

Document	Title	Date	Status
CCSDS 232.1-B-1	Communications Operation Procedure-1, Issue 1	September 2003	Original issue
CCSDS 232.1-B-2	Communications Operation Procedure-1, Recommended Standard, Issue 2	September 2010	Current issue: – adds text concerning a new systematic retransmission option (note).

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

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1 INTRODUCTION

1.1 PURPOSE

The purpose of this Recommended Standard is to specify the Communications Operation Procedure-1 (COP-1). This procedure is used with the Telecommand (TC) Space Data Link Protocol (reference [3]) to enable the delivery of service data units to the receiving end of the layer above, correct and without omission or duplication, and in the same sequential order in which they were received from the layer above at the sending end.

It is assumed that the reader of this document is familiar with the data structures and terminology contained in reference [3].

1.2 SCOPE

This Recommended Standard defines the COP-1 in terms of:

- a) the interfaces with the other procedures;
- b) the internal variables used by the protocol entity;
- c) the actions performed by the protocol entity; and
- d) the state transitions of the protocol entity.

It does not specify:

- a) individual implementations or products;
- b) the implementation of service interfaces within real systems;
- c) the methods or technologies required to perform the procedures; or
- d) the management activities required to configure and control the protocol.

In case of conflict between reference [3] and this Recommended Standard, this Recommended Standard will take precedence.

1.3 APPLICABILITY

This Recommended Standard applies to the creation of Agency standards and to the future data communications over space links between CCSDS Agencies in cross-support situations. This Recommended Standard includes comprehensive specification of the procedure for inter-Agency cross support. It is neither a specification of, nor a design for, real systems that may be implemented for existing or future missions.

The recommendation specified in this document is to be invoked through the normal standards programs of each CCSDS Agency, and is applicable to those missions for which

cross support, based on capabilities described in this Recommended Standard, is anticipated. Where mandatory capabilities are clearly indicated in sections of this Recommended Standard, they must be implemented when this document is used as a basis for cross support. Where options are allowed or implied, implementation of these options is subject to specific bilateral cross support agreements between the Agencies involved.

This Recommended Standard is applicable only to those Projects that implement the TC Space Data Link Protocol (reference [3]).

1.4 RATIONALE

The CCSDS believes it is important to document the rationale underlying the recommendations chosen, so that future evaluations of proposed changes or improvements will not lose sight of previous decisions.

1.5 DOCUMENT STRUCTURE

This document is divided into seven numbered sections and four annexes:

- a) section 1 presents the purpose, scope, applicability and rationale of this Recommended Standard and lists the conventions, definitions, and normative references used throughout the Recommended Standard;
- b) section 2 provides an overview of the COP-1;
- c) section 3 describes the interfaces between COP-1 and the other procedures used in the TC Space Data Link Protocol;
- d) section 4 describes the detailed service definition related to COP-1, and complements the service definition of reference [3];
- e) section 5 specifies the Frame Operation Procedure-1 (FOP-1), which is the procedure used at the sending side of COP-1;
- f) section 6 specifies the Frame Acceptance and Reporting Mechanism-1 (FARM-1), which is the procedure used at the receiving side of COP-1;
- g) section 7 specifies the managed parameters used by COP-1;
- h) annex A lists all acronyms used within this document;
- i) annex B provides a list of informative references;
- j) annex C shows the format of the state tables used in sections 5 and 6;
- k) annex D lists the changes contained in this Recommended Standard as compared to the previously issued CCSDS COP Recommended Standard (reference [B2]).

1.6 CONVENTIONS AND DEFINITIONS

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 [1]. 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 any of a variety of technologies that provide for the exchange of information between real systems. Those terms are:

- a) blocking;
- b) Data Link Layer;
- c) entity;
- d) flow control;
- e) real system;
- f) segmenting;
- g) service;
- h) Service Access Point (SAP);
- i) service data unit.

1.6.1.2 Definitions from OSI Service Definition Conventions

This Recommended Standard makes use of a number of terms defined in reference [2]. 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 any of a variety of technologies that provide for the exchange of information between real systems. Those terms are:

- a) indication;
- b) primitive;
- c) request;
- d) service provider;
- e) service user.

1.6.1.3 Definitions from TC Space Data Link Protocol

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

- a) Communications Link Control Word (CLCW);
- b) Control Command;
- c) Frame Data Unit (FDU);
- d) Global Virtual Channel Identifier (GVCID);
- e) Transfer Frame;
- f) Type-A Service;
- g) Type-A Transfer Frame;
- h) Type-AD Transfer Frame;
- i) Type-B Service;
- j) Type-B Transfer Frame;
- k) Type-BC Transfer Frame;
- l) Type-BD Transfer Frame;
- m) Virtual Channel Identifier (VCID);
- n) Virtual Channel (VC).

1.6.2 NOMENCLATURE

The following conventions apply 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.

1.7 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.

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

- [2] *Information Technology—Open Systems Interconnection—Basic Reference Model—Conventions for the definition of OSI services*. International Standard, ISO/IEC 10731:1994. Geneva: ISO, 1994.
- [3] *TC Space Data Link Protocol*. Recommendation for Space Data System Standards, CCSDS 232.0-B-2. Blue Book. Issue 2. Washington, D.C.: CCSDS, July 2010.

NOTE – Informative references are listed in annex B.

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2 OVERVIEW

2.1 CONCEPT OF COP-1

The Communications Operation Procedure-1 (COP-1) is a closed-loop procedure executed by the sending and receiving ends of the TC Space Data Link Protocol (reference [3]). COP-1 utilizes an Automatic Request for Retransmission (ARQ) procedure of the ‘go-back-n’ type to retransmit Transfer Frames that were rejected by the receiving end of the protocol. COP-1 allows Type-A Transfer Frames to be accepted by the receiving end only if they are received in strict sequential order. This enables the service data units to be delivered correctly to the layer above at the receiving end, without omission or duplication, and in the same sequential order in which they were received from the layer above at the sending end.

COP-1 consists of a pair of synchronized procedures for each Virtual Channel: a Frame Operation Procedure-1 (FOP-1) that executes within the sending entity, and a Frame Acceptance and Reporting Mechanism-1 (FARM-1) that executes within the receiving entity. The FOP-1 transmits Transfer Frames of a particular Virtual Channel to the FARM-1 of the same Virtual Channel. The FARM-1 returns reports of the status of Transfer Frame acceptance to the FOP-1 using the Communications Link Control Words (CLCWs).

NOTE – This Recommended Standard states that COP-1 handles ‘Transfer Frames’; however, these are actually partial Transfer Frames made up of Frame Data Units (FDUs) plus some parameters in the Transfer Frame Primary Header generated by COP-1. The Transfer Frame will be generated by the Frame Generation Procedure, as defined in reference [3]. The Frame Data Unit consists of the data to be inserted in the Transfer Frame Data Field.

Within COP-1, control of sequentiality is maintained using the Frame Sequence Number, which must be present in each Type-A Transfer Frame. Type-A Transfer Frames are transmitted by the FOP-1 with their Frame Sequence Numbers arranged in strict up-counting order. The FARM-1 permits Type-A Transfer Frames to be accepted only if they are received bearing Frame Sequence Numbers in the proper up-counting sequential order. Upon detection of the first sequence error, the FARM-1 will reject all subsequent Type-A Transfer Frames on that Virtual Channel which do not contain the expected Frame Sequence Number. FOP-1 initiates retransmission either in response to a ‘Retransmit’ Flag in the CLCW or by detecting a timeout. FOP-1 performs retransmission by re-sending all unacknowledged Type-A Transfer Frames on that Virtual Channel. FOP-1 and FARM-1 also have a window mechanism to prevent a new Transfer Frame with the same Frame Sequence Number as that of a missing Transfer Frame from being transmitted or accepted.

Valid Type-B Transfer Frames will always be accepted by FARM-1, and processed only to the extent of incrementing a counter for Type-B Transfer Frames in the CLCW. Type-B Transfer Frames are also used to send Control Commands from the FOP-1 to the FARM-1.

Both Type-A and Type-B Transfer Frames are protected by the error correction/detection capability of the underlying Channel Coding Sublayer and also must pass the Frame

Validation Check defined in reference [3]. Therefore, Type-B Transfer Frames accepted by FARM-1 have a very high probability of being error-free. However, their sequentiality is not controlled by COP-1.

2.2 SERVICE TYPES

NOTE – The TC Space Data Link Protocol provides two service types (Sequence-Controlled and Expedited) that determine how reliably service data units supplied by the sending user are delivered to the receiving user. COP-1 provides two services (Sequence-Controlled Service and Expedited Service) to support these service types, as described in 2.2.1 and 2.2.2.

2.2.1 SEQUENCE-CONTROLLED SERVICE (AD SERVICE)

The Sequence-Controlled Service (AD Service) is realized by an automatic ARQ procedure of the 'go-back-n' type, with sequence-control mechanisms of both sending and receiving ends and a standard report returned from the receiving end to the sending end.

For the AD Service, COP-1 ensures with a high probability of success that:

- a) no FDU is lost;
- b) no FDU is duplicated;
- c) no FDU is delivered out of sequence.

Two types of Transfer Frames are used for providing the AD Service:

- a) Type-AD Transfer Frames, for carrying FDUs;
- b) Type-BC Transfer Frames, for carrying Control Commands for configuring COP-1 ('Unlock' and 'Set V(R)').

The AD Service is initiated by means of four distinct 'Initiate AD Service' Directives. Two of these Directives result in the transmission of one of the two Control Commands (Type-BC Transfer Frames). Each of the two Control Commands causes a well-defined action in FARM-1, which is then reflected in the CLCW. A timer is used to cause retransmission of the Control Command if the expected response is not received, with a limit on the number of automatic retransmissions allowed before it is declared that there is a problem in initiating the AD Service. The other two Directives allow the AD Service to be started without waiting for an action by the receiving end (although one requires receiving a good CLCW).

Once COP-1 for a particular Virtual Channel has been initialized for AD Service, FDUs are inserted into Transfer Frames and transmitted on that Virtual Channel in the order in which they are presented to COP-1.

The AD Service guarantees in-order delivery of FDUs on a single Virtual Channel. Because of the possibility of retransmission on only a single Virtual Channel, there is no guarantee that FDUs on separate Virtual Channels, each using the AD Service, will be delivered in the order initially transmitted.

For the Type-AD Transfer Frames, the automatic retransmission procedure makes use of several variables, the most notable being the Receiver_Frame_Sequence_Number, $V(R)$; the Transmitter_Frame_Sequence_Number, $V(S)$; the Next Expected Frame Sequence Number contained in the CLCW, $N(R)$; and the Frame Sequence Number in the Transfer Frame Primary Header, $N(S)$ (see figure 2-1). These variables are explained in more detail in subsections 5.1 and 6.1.

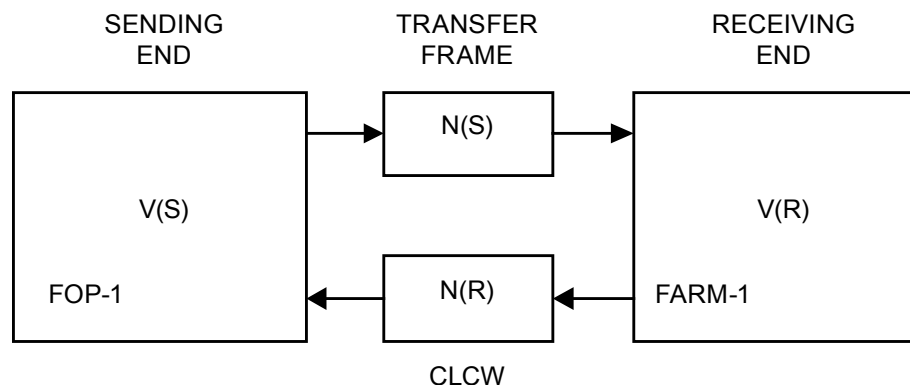


Figure 2-1: COP-1 Variables, Frame and Report Values

For transferring Type-AD Transfer Frames, if required, a flow control mechanism ('Wait' mechanism) is provided that permits the receiving end to signal that it does not have enough resources to cope with incoming data.

For Type-BC Transfer Frames, COP-1 makes use of a very small number of variables, the most notable being the 'Lockout' Flag in the CLCW for the 'Unlock' Control Command, and the value ' $N(R)$ ' in the CLCW for the 'Set $V(R)$ ' Control Command.

2.2.2 EXPEDITED SERVICE (BD SERVICE)

The Expedited Service (BD Service) is normally used either in exceptional operational circumstances, typically during spacecraft recovery operations, or when a higher layer protocol provides a retransmission capability.

Type-BD Transfer Frames are used for carrying FDUs of the BD Service. Type-BD Transfer Frames are transmitted only once (i.e., no retransmission). There is no guarantee that all Type-B FDUs are delivered.

In the FOP-1 at the sending end, Type-BD Transfer Frames are given immediate access in so far as is permitted by delays in the lower layers and procedures by other traffic on the

communications link. At the receiving end, the FDUs carried by Type-BD Transfer Frames will be passed to the next procedure immediately.

NOTES

- 1 Some implementations of FARM-1 may use the same buffer to deliver FDUs carried by either Type-AD or Type-BD Transfer Frames in order to provide increased reliability through reduced complexity and lower resource consumption. In this case, when a Type-BD Transfer Frame is received, an FDU in the process of being delivered or 'waiting' to be delivered will be erased, without any indication to the sending end in the CLCW. For this implementation, the sending end should terminate any ongoing AD Service before starting a BD Service on the same Virtual Channel.
- 2 Although the BD mode of transmission carries the name 'Expedited', BD mode is neither a required method nor a faster method for inserting a Transfer Frame for immediate delivery into a stream of Transfer Frames. If the link currently supports a reliable AD service, then AD mode is recommended in such cases. Regardless of whether AD or BD mode is used, the inserted Transfer Frame must not use the same MAP address as an unfinished, multi-segment packet delivery process (a possible exception would be delivering a control command to the Packet Assembly Process).

2.3 HOW TO READ THIS DOCUMENT

COP-1 is one of the procedures performed by the protocol entity of the TC Space Data Link Protocol (reference [3]). Section 3 of this document defines the interfaces between COP-1 and other procedures of the protocol entity that are used to define COP-1 in the succeeding sections of this document.

COP-1 processes requests submitted by the users of the protocol with request primitives and generates information to be given to the users with notification primitives (these interactions with the users are performed indirectly through the Higher Procedures as explained in 3.2.2 and 3.3.2). Section 4 of this document defines details of the request and notification primitives and complements the service definition of reference [3].

Each end of COP-1 (FOP-1 or FARM-1) is defined as a state machine. A state machine is an abstract model of a machine that is in a state at a particular instance and transitions to a new state performing certain actions when an event occurs. Sections 5 and 6 define the state machine of FOP-1 and FARM-1, respectively. In each of these sections, internal variables used by the state machine, actions performed by the state machine, and the state table of the state machine are defined in this order.

Finally, the parameters used for managing COP-1 are specified in section 7.

3 INTER-PROCEDURE INTERFACES

3.1 DEFINITIONS

COP-1 is one of the procedures performed by the protocol entity of the TC Space Data Link Protocol (reference [3]). In order to define the operations of COP-1 completely and clearly, it is necessary to define some of the characteristics of the interfaces between COP-1 and other procedures of the protocol entity. This subsection defines the interfaces between COP-1 and other procedures of the protocol entity that are used to define COP-1 in the succeeding sections of this document.

The inter-procedure interfaces are defined only for the purpose of specifying the operations of COP-1 completely and clearly, and are not intended to imply any implementation technology or hardware/software configuration in a real system.

The inter-procedure interfaces are specified in the form of inter-procedure signals, which present an abstract model of the logical exchange of data and control information between procedures. The parameters of the primitives are specified in an abstract sense and specify the information to be made available to the procedure that uses the signal. The way in which a specific implementation makes this information available is not constrained by this specification. In addition to the parameters specified here, an implementation may provide other parameters (e.g., parameters for controlling activities, monitoring performance, facilitating diagnosis, and so on).

3.2 INTER-PROCEDURE INTERFACES AT THE SENDING END

3.2.1 INTERNAL ORGANIZATION OF PROTOCOL ENTITY

NOTE – Figure 3-1 shows the internal organization of the TC Space Data Link Protocol entity at the sending end, together with the interfaces with the other protocols used with the TC Space Data Link Protocol. The set of procedures performed above FOP-1 is collectively called the Higher Procedures, and the set of procedures performed below FOP-1 is collectively called the Lower Procedures.

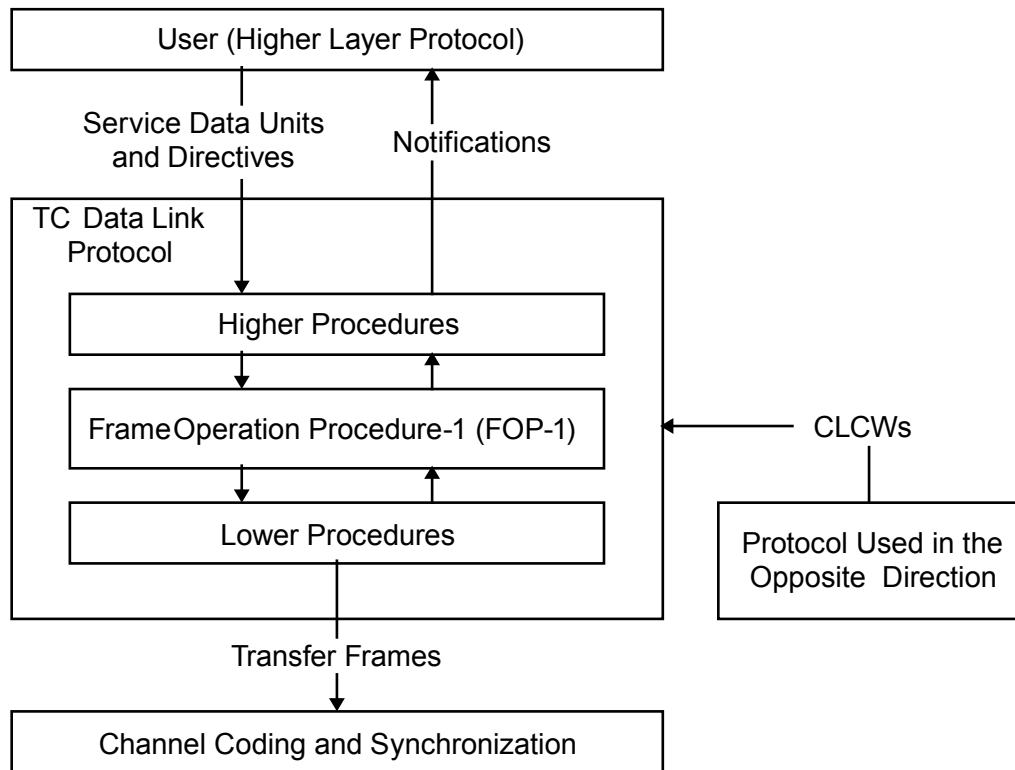


Figure 3-1: Internal Organization of Protocol Entity (Sending End)

3.2.1.1 The users of the TC Space Data Link Protocol shall interact with the protocol entity through Service Access Points (SAPs) using service primitives defined in reference [3]. The users shall request the protocol entity to transfer service data units, and shall receive from the protocol entity notifications associated with the transfer of service data units. The users may also request the protocol entity to perform Directives defined in section 4.

3.2.1.2 The Higher Procedures shall perform blocking and/or segmentation if necessary, and shall deliver Frame Data Units (FDUs) to the entities of FOP-1 (there is an entity of FOP-1 for each Virtual Channel). FOP-1 shall: generate some parameters of the Transfer Frame Primary Header; control transmission and retransmission of FDUs by examining the CLCWs received from the receiving end; and deliver FDUs with the generated parameters to the Lower Procedures. FOP-1 shall receive CLCWs using a protocol used in the opposite direction. The Lower Procedures shall generate Transfer Frames from the data received from FOP-1, multiplex Transfer Frames, and deliver Transfer Frames to the underlying entity of Channel Coding and Synchronization.

3.2.2 FOP-1 INTERFACE TO HIGHER PROCEDURES

3.2.2.1 Inter-procedure Signals

FOP-1 shall interact with the Higher Procedures using inter-procedure signals. These inter-procedure signals are related to service primitives exchanged between users of the protocol and the protocol entity, and it is assumed in this Recommended Standard that the Higher