BS ISO 18439:2013

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Space data and information transfer systems — Space Communication Cross Support — Service Management — Service Specification

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National foreword

This British Standard is the UK implementation of ISO 18439:2013.

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.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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INTERNATIONAL STANDARD

ISO 18439

First edition
2013-06-01

Space data and information transfer systems — Space Communication Cross Support —Service Management — Service Specification

Systèmes de transfert des informations et données spatiales — Support croisé pour les communications spatiales — Gestion des services — Spécification des services

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Case postale 56 • CH-1211 Geneva 20
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

ISO 18439 was prepared by the Consultative Committee for Space Data Systems (CCSDS) (as CCSDS 910.11-B-1, August 2009) 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*.

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INTERNATIONAL STANDARD ISO 18439:2013(E)

Space data and information transfer systems — Space Communication Cross Support —Service Management — Service Specification

1 Scope

It is common practice for management information to be exchanged between space mission management and a space link service provider for the purposes of negotiating, configuring, and executing the Tracking, Telemetry, and Command (TT&C) functions and cross support transfer services that are provided to the space mission. The various processes that generate, exchange, ingest, and act upon this management information are collectively referred to as *service management*.

This International Standard defines a set of *Space Communication Cross Support Service Management (SCCS-SM) services* by which space link service providers and space missions exchange information needed to arrange spacecraft contact periods and establish the operating parameters of the space link services and cross support transfer services during those contact periods.

The SCCS-SM services reflect the common practices of the space operations community and the contents of the SLE transfer specifications. Four SCCS Management Services are defined:

a) Service Agreement service, which addresses the information that needs to be agreed before a cross support service can be established;

b) Configuration Profile service, which addresses the establishment of sets of data concerning the space link and ground station configuration;

c) Trajectory Prediction service, which addresses the transfer and updating of spacecraft trajectory data;

d) Service Package service, which addresses the arrangement of spacecraft space link session times and execution of the transfer services.

This International Standard deals with only three of the SLE transfer services defined in the *Cross Support Reference Model*:

a) Forward Communications Link Transmission Unit (FCLTU);

b) Return All Frames (RAF);

c) Return Channel Frames (RCF).

The management of other SLE transfer services, including Return Operations Control Field (ROCF), Forward Space Packet (FSP), supported by the Communications Operation Procedure-1, and a radiometric data transfer service, will be addressed in future versions of this International Standard.

This International Standard addresses the management of both online and offline return SLE transfer services. In this International Standard, online return services are part of a larger class of services referred to as Space Link Session Transfer Services (because they are concurrent with an active space link), and offline services are part of a larger class of services referred to as Retrieval Transfer Services (because they are the mechanism by which data are retrieved from intermediate storage).

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This International Standard addresses the management of user-initiated transfer services only. Although some of the SLE transfer service specifications permit provider initiation, all implementations of SLE transfer services are user-initiated as of the time of the writing of this International Standard. Therefore, under this version of SCCS-SM, the initiator is always the user, and the responder is always the provider.

This International Standard provides a mechanism for defining and scheduling non-CCSDS transfer services that are bilaterally defined between the Complex and MDOS. RF and ModuLAtion Systems and Space Link Services Addressed in this Recommended Standard

This International Standard supports the exchange of information used in scheduling of services that employ radio frequency (RF) and modulation systems that are conformant with the CCSDS Recommended Standard 401.0, *Radio Frequency and Modulation Systems—Part 1: Earth Stations and Spacecraft*. Space link service providers that provide RF links that conform to CCSDS 401.0 can implement the full set of capabilities specified herein. However, the capabilities provided by this International Standard for space communication service scheduling information exchange are not strictly limited to those recommended in CCSDS 401: for example, this International Standard supports the use of additional forward subcarrier frequencies beyond those specified in CCSDS 401.

Space link service providers that provide RF links that *do not* conform to CCSDS 401.0 or the extended parameters and values supported by this International Standard may use bilaterally defined space link service information, or may simply implement a subset of the capabilities specified herein.

This version of the International Standard contains the following limitations, constraints, exclusions and qualifications:

a) The concept of *staging* in the *Cross Support Reference Model*—distributing the provision of transfer services across two or more Complexes that progressively process and transform a data stream—is not addressed in this document.

b) This International Standard does not address the mechanism for exchanging authentication and access control information associated with the creation of transfer service credentials.

c) Ground systems and services that are not directly concerned with the transport of transfer frames and communications link transmission units compliant to CCSDS Recommended Standards are not described. Processing of data held within the data fields of source packet Protocol Data Units (PDUs) is outside the scope of this document.

d) The initial establishment of a service relationship and the negotiation of a mission-length Service Agreement are not covered by this International Standard.

e) This International Standard does not define the operations and messages required to perform execution-time monitoring and control of transfer services.

f) The specification of systems to generate information required by SCCS-SM, such as mission planning (scheduling), flight dynamics (trajectory), mission monitoring and control, and ground station selection are outside the scope of this document. It is assumed that these systems will provide the data needed in the required format at the required times.

g) SCCS-SM does not define the way in which Complex Management (CM) interfaces with the equipment that is used to provide the space link and transfer services, so the users in the MDOS do not need to be concerned about the internal workings of the Complex. In other words, Complex Management provides an interface to the user that hides the complexity of the provider's Complex.

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

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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 910.11-B-1, August 2009, Space Communication Cross Support — Service Management — Service Specification.

For the purposes of international standardization, the modifications outlined below shall apply to the specific clauses and paragraphs of publication CCSDS 910.11-B-1.

Pages i to v

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

Page 1-19 and 1-20

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 132.0-B-1, September 2003, is equivalent to ISO 22645:2005.

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

[4] Document CCSDS 131.0-B-1, September 2003, is equivalent to ISO 22641:2012.

[5] Document CCSDS 732.0-B-2, July 2006, is equivalent to ISO 22666:2007.

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

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

[8] Document CCSDS 911.1-B-2, December 2004, is equivalent to ISO 22669:2007.

[9] Document CCSDS 911.2-B-2, December 2004, is equivalent to ISO 22670:2006.

[10] Document CCSDS 911.5-B-2, December 2004, is equivalent to ISO 26143:2007.

[11] Document CCSDS 912.1-B-2, December 2004, is equivalent to ISO 22671:2011.

[12] Document CCSDS 912.3-B-1, December 2004, is equivalent to ISO 22672:2011.

[13] Document CCSDS 502.0-B-1, September 2004, is equivalent to ISO 22644:2006.

3 Revision of publication CCSDS 910.11-B-1

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 910.11-B-1. To this end, NASA will act as a liaison body between CCSDS and ISO.

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The Consultative Committee for Space Data Systems

Recommendation for Space Data System Standards

SPACE COMMUNICATION CROSS SUPPORT— SERVICE MANAGEMENT— SERVICE SPECIFICATION

RECOMMENDED STANDARD

CCSDS 910.11-B-1

BLUE BOOK

August 2009

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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.

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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.

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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.

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1 INTRODUCTION

1.1 PURPOSE OF THIS RECOMMENDED STANDARD

It is common practice for management information to be exchanged between space mission management and a space link service provider for the purposes of negotiating, configuring, and executing the Tracking, Telemetry, and Command (TT&C) functions and cross support transfer services that are provided to the space mission. The various processes that generate, exchange, ingest, and act upon this management information are collectively referred to as *service management*.

This Recommended Standard defines a set of *Space Communication Cross Support Service Management (SCCS-SM) services* by which space link service providers and space missions exchange information needed to arrange spacecraft contact periods and establish the operating parameters of the space link services and cross support transfer services during those contact periods.

1.2 RELATION TO CROSS SUPPORT REFERENCE MODEL

The *Cross Support Reference Model* (reference [1]) establishes a model for space mission data exchange as illustrated in figure 1-1. Space mission users and mission management are represented by the Mission Data Operations System (MDOS), which sends data to and receives data from the Space Element. The Space Link Extension (SLE) System transfers these data using SLE transfer services between the SLE System and the MDOS, and using space link services between the SLE System and the Space Element. In addition, the MDOS and the SLE System exchange management data for managing the space link services and SLE transfer services.

NOTE – The management data exchanged between the Space Element and the MDOS are illustrated for the sake of completeness. However, they are outside the scope of the Cross Support Reference Model and this SCCS-SM Service Specification. Also, although this management data exchange is illustrated as a direct link between Space Element and MDOS, it is actually accomplished via the space link and SLE transfer services.

The *Cross Support Reference Model* provides the framework for defining SLE transfer service specifications (references [8] to [12]) and an SLE-SM service specification. It defines the functional and management components of the MDOS and SLE System. It identifies the SLE transfer services which are used to extend space link services (references [2], [4], [5], and [6]) across the ground segment. It specifies the time spans of various management information entities used in SLE-SM.

This SCCS-SM Service Specification expands the scope of SLE-SM as identified in the Cross Support Reference Model to include management of space communication services and cross support transfer services in general, not just those directly related to the transfer of command and telemetry data (i.e., the scope of Space Link Extension).

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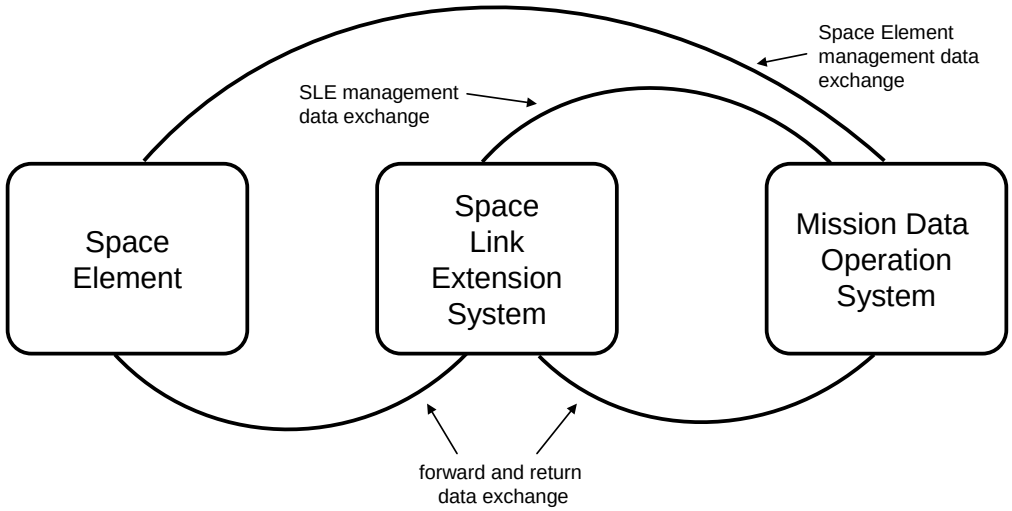

Figure 1-1: Cross Support Reference Model Space Mission Data Exchange

1.3 SCOPE

1.3.1 SCCS-SM SERVICES

The SCCS-SM services reflect the common practices of the space operations community and the contents of the SLE transfer specifications. Four SCCS Management Services are defined:

a) Service Agreement service, which addresses the information that needs to be agreed before a cross support service can be established;

b) Configuration Profile service, which addresses the establishment of sets of data concerning the space link and ground station configuration;

c) Trajectory Prediction service, which addresses the transfer and updating of spacecraft trajectory data;

d) Service Package service, which addresses the arrangement of spacecraft space link session times and execution of the transfer services.

1.3.2 SCCS-SM SERVICE PROCEDURES, OPERATIONS, AND MESSAGES

The SCCS-SM services are implemented by procedures, operations, and messages that effect the negotiation and commitment of resources for the provision of space link and transfer services. This establishes the mechanism by which a user requests services from a provider for individual spacecraft space link sessions (also known as contacts, passes, and tracks).

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1.3.3 TRANSFER SERVICES ADDRESSED IN THIS RECOMMENDED STANDARD

This Recommended Standard deals with only three of the SLE transfer services defined in the *Cross Support Reference Model*:

a) Forward Communications Link Transmission Unit (FCLTU, reference [11]);

b) Return All Frames (RAF, reference [8]);

c) Return Channel Frames (RCF, reference [9]).

The management of other SLE transfer services, including Return Operations Control Field (ROCF, reference [10]), Forward Space Packet (FSP, reference [12], supported by the Communications Operation Procedure-1, reference [7]) and a radiometric data transfer service, will be addressed in future versions of this Recommended Standard.

This Recommended Standard addresses the management of both online and offline return SLE transfer services. In this Recommended Standard, online return services are part of a larger class of services referred to as Space Link Session Transfer Services (because they are concurrent with an active space link), and offline services are part of a larger class of services referred to as Retrieval Transfer Services (because they are the mechanism by which data are retrieved from intermediate storage).

This Recommended Standard addresses the management of user-initiated transfer services only. Although some of the SLE transfer service specifications permit provider initiation, all implementations of SLE transfer services are user-initiated as of the time of the writing of this Recommended Standard. Therefore, under this version of SCCS-SM, the initiator is always the user, and the responder is always the provider.

This Recommended Standard provides a mechanism for defining and scheduling non-CCSDS transfer services that are bilaterally defined between the Complex and MDOS.

1.3.4 RF AND MODULATION SYSTEMS AND SPACE LINK SERVICES ADDRESSED IN THIS RECOMMENDED STANDARD

This Recommended Standard supports the exchange of information used in scheduling of services that employ radio frequency (RF) and modulation systems that are conformant with the CCSDS Recommended Standard 401.0, *Radio Frequency and Modulation Systems—Part 1: Earth Stations and Spacecraft* (reference [14]). Space link service providers that provide RF links that conform to CCSDS 401.0 can implement the full set of capabilities specified herein. However, the capabilities provided by this Recommended Standard for space communication service scheduling information exchange are not strictly limited to those recommended in CCSDS 401: for example, this Recommended Standard supports the use of additional forward subcarrier frequencies beyond those specified in CCSDS 401.

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NOTE – The specific set of RF and modulation parameters and associated values that are fully supported by this Recommended Standard are specified in section 5.

Space link service providers that provide RF links that *do not* conform to CCSDS 401.0 or the extended parameters and values supported by t his Recommended Standard may use bilaterally defined space link service information, or may simply implement a subset of the capabilities specified herein, as described in annex B.

1.3.5 LIMITATIONS, CONSTRAINTS, EXCLUSIONS AND QUALIFICATIONS

This version of the Recommended Standard contains the following limitations, constraints, exclusions and qualifications:

a) The concept of *staging* in the *Cross Support Reference Model*—distributing the provision of transfer services across two or more Complexes that progressively process and transform a data stream—is not addressed in this document.

b) This Recommended Standard does not address the mechanism for exchanging authentication and access control information associated with the creation of transfer service credentials.

c) Ground systems and services that are not directly concerned with the transport of transfer frames (references [2] and [5]) and communications link transmission units (reference [6]) compliant to CCSDS Recommended Standards are not described. Processing of data held within the data fields of source packet Protocol Data Units (PDUs) (reference [3]) is outside the scope of this document.

d) The initial establishment of a service relationship and the negotiation of a mission-length Service Agreement are not covered by this Recommended Standard.

e) This Recommended Standard does not define the operations and messages required to perform execution-time monitoring and control of transfer services.

f) The specification of systems to generate information required by SCCS-SM, such as mission planning (scheduling), flight dynamics (trajectory), mission monitoring and control, and ground station selection are outside the scope of this document. It is assumed that these systems will provide the data needed in the required format at the required times.

g) SCCS-SM does not define the way in which Complex Management (CM) interfaces with the equipment that is used to provide the space link and transfer services, so the users in the MDOS do not need to be concerned about the internal workings of the Complex. In other words, Complex Management provides an interface to the user that hides the complexity of the provider's Complex.

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1.4 APPLICABILITY

1.4.1 APPLICABILITY OF THIS RECOMMENDED STANDARD

This Recommended Standard serves as the basis for the development of compatible Agency standards for space communication service management systems. This Recommended Standard is applicable to space communication service management systems that are involved in cross support.

Although sharing ground systems between multiple space missions or between multiple spacecraft of the same space mission is not explicitly modeled, this Recommended Standard in no way precludes sharing ground systems.

1.4.2 LIMIT OF APPLICABILITY

This Recommended Standard is not a design for real space communication service management systems that may be implemented for the control and monitoring of existing or future missions.

1.5 RATIONALE

The primary goal of CCSDS is to increase the level of interoperability among Agencies. This Recommended Standard furthers that goal by establishing the means to manage the provision of space link and transfer services to be used in the area where most cross support activity occurs: between the tracking stations or ground data handling systems of various Agencies and the mission-specific components of a mission ground system. Reference [G1], *Cross Support Concept*, provides further discussion of the rationale for this Recommended Standard.

1.6 DOCUMENT STRUCTURE

1.6.1 ORGANIZATION

This document is organized as follows:

a) Section 1 provides the purpose, scope, applicability, and rationale of this Recommended Standard and identifies the conventions and references used throughout the document. This section also describes how this document is organized. A brief description is provided for each section and annex so that the reader will have an idea of where information can be found in the document. It also identifies terminology that is used in this document but is defined elsewhere.

b) Section 2 provides an overview of SCCS-SM, places it in its context, introduces some basic service management concepts, and identifies the SCCS-SM services specified in this Recommended Standard.

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c) Section 3 defines the SCCS-SM document exchange protocol.

d) Section 4 defines the Service Package service.

e) Section 5 defines the Configuration Profile service.

f) Section 6 defines the Trajectory Prediction service.

g) Section 7 defines the Service Agreement service.

h) Annex A provides the definitions of the data types used in this Recommended Standard.

i) Annex B identifies the minimum set of operations that are required for an implementation of SCCS-SM to be compliant with this Recommended Standard.

j) Annex C contains a list of acronyms.

k) Annex D lists the SCCS-SM parameters in alphabetical order, presented in tabular form.

l) Annex E provides an overview of the Unified Modeling Language (UML) Version 2.0 diagramming notation, semantics, and conventions that are used in this Recommended Standard.

m) Annex F lists the time parameters associated with the various information entities that are managed through SCCS-SM, and specifies the interrelationships between these terms.

n) Annex G is a list of informative references.

1.6.2 HOW TO READ THIS DOCUMENT

It is important for readers of this document to have a basic understanding of:

a) CCSDS Space Link Services (see references [2], [4], [5], and [6]);

b) CCSDS-compliant radio frequency and modulation systems (reference [14]);

c) CCSDS SLE services, as d escribed in the *Cross Support Concept* document (reference [G1]) and the *Cross Support Reference Model* (reference [1]);

d) SLE-SM concepts, as d escribed in *Cross Support Concept* (reference [G1]). The SLE-SM concepts described in reference [G1] are essentially the same as, or a subset of, the concepts that are applicable to SCCS-SM. In the future, reference [G1] is expected to be updated to have SLE-SM replaced by SCCS-SM.

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1.7 DEFINITIONS AND NOMENCLATURE

1.7.1 DEFINITIONS

1.7.1.1 Definitions from the Cross Support Reference Model

This Recommended Standard makes use of the following terms that are defined in the *Cross Support Reference Model*, reference [1]:

a) Invoker;

b) Mission Data Operations System (MDOS);

c) Operation;

d) Performer;

e) Service Agreement;

f) Service Agreement Period;

g) Service Management;

h) Service Package Utilization Phase;

i) (SLE) Complex;

j) (SLE) Complex Management (CM);

k) (SLE) Service Package;

l) (SLE) Utilization Management (UM);

m) (SLE) Transfer Service Instance;

n) Space Link Session;

o) Utilization Phase.

1.7.1.2 Definitions from the RAF, RCF, and CLTU Service Specifications

This Recommended Standard makes use of the following terms that are defined in references [8], [9] and [11]:

a) Active (State);

b) Association;

c) Communication Service;

d) Delivery Mode (`delivery-mode`) (references [8] and [9] only);

e) Invocation;

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f) Latency Limit (`latency-limit`) (references [8] and [9] only);

g) Master Channel;

h) Parameter;

i) Performance;

j) Port Identifier;

k) Reporting Cycle (`reporting-cycle`);

l) Return;

m) Service Instance Provision Period;

n) Spacecraft Identifier;

o) Transfer Frame Version Number;

p) Virtual Channel;

q) Virtual Channel Identifier.

1.7.1.3 Definitions from TM Synchronization and Channel Coding

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

a) Attached Sync Marker;

b) Convolutional Code;

c) Pseudo-Randomization;

d) Reed-Solomon Check Symbols;

e) Reed-Solomon Code;

f) Turbo Code.

1.7.1.4 Definitions from TC Synchronization and Channel Coding

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

a) Communications Link Control Word (CLCW);

b) bit lock;

c) RF availability.

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1.7.1.5 Additional Definitions

1.7.1.5.1 Introduction

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

1.7.1.5.2 Two-Phase Operation Procedure Pattern

The pattern that is common to all SCCS-SM two-phase operation procedures; that is, operation procedures involving only an invocation and a single return (either a successful or failed return).

1.7.1.5.3 Two-Phase Operation

An SCCS-SM operation that conforms to the two-phase operation procedure pattern.

1.7.1.5.4 Three-Phase Operation Procedure Pattern

The pattern that is common to all SCCS-SM three-phase operation procedures; that is, operation procedures involving an invocation, an acknowledged return, and either a successful or failed return.

1.7.1.5.5 Three-Phase Operation

An SCCS-SM operation that conforms to the three-phase operation procedure pattern.

1.7.1.5.6 Notify Operation Procedure Pattern

The pattern that is common to all SCCS-SM notify operation procedures; that is, procedures involving performance of a locally invoked operation, the issuance of a notification, and subsequent confirmation of receipt of that notification.

1.7.1.5.7 Notify Operation

An SCCS-SM operation that conforms to the Notify operation procedure pattern.

1.7.1.5.8 Sender and Receiver

Entities that participate in the exchange of messages. The SCCS-SM document exchange protocol is described in terms of transmitting an SM Message Set from a Sender to a Receiver. On the occurrence of certain exception conditions, the Receiver sends SM Exception Responses (see 1.7.1.5.11) to the Sender.

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1.7.1.5.9 SM Document

A standard-content communiqué exchanged between SM Sender and Receiver entities, containing either an SM Message Set (see 1.7.1.5.10) or an SM Exception Response (see 1.7.1.5.11).

1.7.1.5.10 SM Message Set

An ordered collection of one or more SM messages sent from a Sender to a Receiver in a single SM Document.

1.7.1.5.11 SM Exception Response

A standard-content communiqué that is returned from the Receiver to the Sender when the processing of a received document results in exception conditions.

1.7.1.5.12 SM Message

A standard-content component of an SM Message Set that is one of the four generic SM message types: invocation, operation return, notification, and confirmation.

1.7.1.5.13 Syntactic Validation

Determination that a received document is a properly formed SM document of a version that is supported by the Receiver.

1.7.1.5.14 Authorization Validation

The validation of an SM Message Set to ensure that the Sender of the message set is authorized to send messages in the context of the Service Agreement and that the Service Agreement is supported by the Receiver.

1.7.1.5.15 Service Management Validation

The validation of an SM message to ensure that the values of the parameters of the message are consistent among themselves, that the contents of the message are within the scope of the controlling Service Agreement, that all service management information that is prerequisite to the successful performance of the operation is in place, and that all resources required to successfully perform the operation are available (or expected to be available).

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1.7.1.5.16 Space Link Session Transfer Service

A transfer service that is active concurrent with a space link session, such that all data sent via a forward transfer service is transmitted across the forward space link with minimal delay, and data that is received via a return space link is transferred with minimal delay. The standard Space Link Session (SLS) Transfer Services include the forward SLE transfer services and the return SLE transfer services operating in timely online delivery mode. The MDOS and the Complex may also bilaterally define and implement non–CCSDS-standard SLS transfer services.

NOTE – The standard SLS Transfer Services will also include forward Cross Support Transfer Services (CSTSes) and return CSTSes operating in the timely delivery mode.

1.7.1.5.17 Retrieval Transfer Service

A return transfer service that retrieves space link data from a data store. The data may be retrieved anytime from the beginning of the associated space link session until the end of the scheduled service period of the retrieval transfer service instance, which may be any specified time period up to the end of the Service Agreement period. The standard Retrieval Transfer Services include the forward SLE transfer services and the return SLE transfer services operating in complete online and offline delivery modes. The MDOS and the Complex may also bilaterally define and implement non–CCSDS-standard retrieval transfer services.

NOTE – The standard Retrieval Transfer Services will also include return Cross Support Transfer Services (CSTSes) operating in the complete delivery mode.

1.7.1.5.18 Rule-based Scheduling

A mode of scheduling in which the MDOS and the Complex are able to define a generic set of scheduling rules that CM uses to routinely schedule tentative space link session Service Packages on behalf of the mission. CM proposes each tentative Service Package to UM, which in turn accepts or declines it. Rule-based scheduling is a viable approach when a mission's requirements can be generically stated (e.g., two return link contacts per day, between 10 and 15 minutes each in duration) and the Complex is able to perform rule-based scheduling. When used appropriately, rule-based scheduling can result in higher efficiency in the utilization of a Complex's resources by allowing CM to fit the most contacts into a given schedule period. Rule-based scheduling, sometimes known as *generic scheduling* or *standing order* scheduling, is the primary scheduling mode for several TT&C networks.

1.7.1.5.19 Scenario

A collection of space communication services that are scheduled to support an anticipated set of spacecraft activities during the execution of a Service Package. In some cases, it is possible to anticipate that one of several sets of spacecraft activities might occur during the

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execution of a given Service Package, but specifically which of those sets will occur cannot be known at the time that the Service Package is scheduled. For example, for a planned spacecraft maneuver, it may be possible to anticipate ahead of time two outcomes (the maneuver executes as planned, or the maneuver is aborted, possibly at the last minute), each of which may have different space communication service requirements.

The Service Package is capable of specifying more than one scenario, each of which specifies the communications services required for each outcome. When a Service Package with more than one scenario is scheduled, the resources are reserved to support all of the scenarios in the Service Package, so that the scenario can be changed with minimal delay via the SELECT_ALTERNATE_SCENARIO operation.

NOTE – Support for multiple scenarios in a single Service Package is optional and depends on the ability of a Complex to reserve multiple sets of space communication resources and switch among them with small delay.

1.7.2 NOMENCLATURE

The following conventions apply throughout this Recommended Standard:

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

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

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

d) the words ‘is,’ ‘are,’ and ‘will’ indicate statements of fact;

e) when applied to tables contained within normative sections of this Recommended Standard, the phrase ‘is(are) defined in’ indicates normative requirements or message structure and content.

1.8 CONVENTIONS

1.8.1 THE UNIFIED MODELING LANGUAGE

The Unified Modeling Language (UML) diagrams used in this Recommended Standard (including class diagrams, sequence diagrams, activity diagrams, and state machine diagrams) follow the notation, semantics, and conventions imposed by the Version 2.0 UML specification of the Object Management Group (OMG). Annex E provides an overview of the UML 2.0 diagramming conventions that are used in this Recommended Standard.

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1.8.2 SPECIFICATION OF SERVICE OPERATIONS

1.8.2.1 General

The typographical convention for a service operation is specified in 1.8.4.2, 'Operation Names'. The specification of each operation is divided into subsections as follows:

1.8.2.2 Purpose Subsection

The Purpose subsection provides a brief text description of the purpose of the operation.

1.8.2.3 Procedure Subsection

The Procedure subsection specifies the sequencing and behavior of an operation. It defines the associated messages and describes the relationship of these messages to the operation. UML activity and sequence diagrams are used to describe procedural logic between the UM and CM. The typographical convention for a message is specified in 1.8.4.3, 'Message Names'.

1.8.2.4 Requirements Subsection

1.8.2.4.1 General

The Requirements subsection specifies the requirements for UM and/or CM in executing the operation. This subsection will reference messages, parameters, data sets, and composition requirements. The typographical conventions for these references are listed in 1.8.3.

1.8.2.4.2 Identification of Service Management Validation and Operation Performance Requirements

All UM and CM operations conform to operation procedure patterns, as defined in section 3. These operation procedure patterns contain abstractly defined activities for performing service management validation and performing the operation itself. The concrete definition of these activities is operation-specific and therefore deferred to the specification of the operation itself as defined in sections 4 to 7.

A UM or CM requirement that constitutes part or all of the service management validation activity for an operation includes the text '[service management validation]' at the end of the requirement.

A UM or CM requirement that constitutes part or all of the performance of an operation includes the text '[perform operation]' at the end of the requirement.

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1.8.2.5 Message Subsection(s)

1.8.2.5.1 General

Each message of an operation has subsections that define the message structure, the parameters of the message, and the rules and requirements for UM and/or CM in composing, validating, or processing them. The typographical convention for a message is specified in 1.8.4.3, 'Message Names'.

1.8.2.5.2 Class diagram

1.8.2.5.2.1 General

A UML class diagram illustrates the structure of a message, its parts, and how those parts interrelate. Class diagram conventions that are used for SM messages include composition, generalization, multiplicity, and constraints. Enumeration notation is also used but only when it is involved in a composition constraint. Subsection E2 of annex E provides an overview of composition, generalization, multiplicity constraints, and enumeration in UML class diagrams.

1.8.2.5.2.2 Data Set Classes

A message is decomposed into logical components called data sets, which contain associated parameters. The composition of one or more data sets is an instantiated message. Data sets are reusable and may be contained in more than one message class. Each data set is represented in the UML class diagram as a UML class, which is illustrated as a box with a line separating the name of the data set class from the list of parameters for that data set class. The typographical convention for the names of data set classes in class diagrams is specified in 1.8.4.4, 'Data Set Names'. The typographical convention for the names of the parameters in data set classes in class diagrams is specified in 1.8.4.6, Parameter Names.

1.8.2.5.2.3 Abstract Data Set Classes

An abstract data set is a data set that encapsulates common parameters that are inherited by multiple data sets. Abstract data sets adhere to the rules and conventions of an abstract class. The typographical convention for the names of abstract data sets in class diagrams is specified in 1.8.4.5, 'Abstract Data Set Names'. The typographical convention for the names of the parameters in abstract data set classes in class diagrams is specified in 1.8.4.6, Parameter Names.

NOTE – Abstract data set classes appear only in the UML class diagrams. In the data set tables in the Parameter Subsection (see 1.8.2.6.1), the parameters of an abstract class are explicitly included in the tables of the data sets that inherit from that abstract class.

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1.8.2.6 Parameters Subsection

1.8.2.6.1 Data Set Tables

Each data set is presented in a table that includes a table name and, for each parameter in the data set: the parameter name, definition/description, data type, units, and an applicable Service Agreement parameter (if any). The list of parameters in a data set table includes the parameters from the corresponding data set class in the UML class diagram, plus the parameters that the corresponding data set class inherits from any abstract classes. The typographical convention for the names of data set tables is specified in 1.8.4.4, 'Data Set Names'. The typographical convention for parameter names in data set tables is specified in 1.8.4.6, 'Parameter Names'.

1.8.2.6.2 Nullable Parameters

Some parameters may be optional or meaningful only in certain contexts. Such parameters are identified in the data type column of the data set table by the notation '<data type> OR NULL', where <data type> is the data type that the parameter assumes when it is meaningful, and NULL indicates that the parameter is absent. For each nullable parameter, one or more data set composition and relationship requirements identify the conditions under which the parameter is NULL.

1.8.2.6.3 Applicable Service Agreement Parameter

Many SM message parameters are constrained to be within ranges or sets of values that are specified as part of the Service Agreement under the context of which the messages are exchanged. A data set parameter value will be constrained to be consistent with its Applicable Service Agreement Parameter (if present) in order for the message containing the parameter to pass service management validation.

An Applicable Service Agreement Parameter is normally identified simply by the parameter name as it appears in the appropriate Service Agreement data set. However, if the parameter name alone is ambiguous (e.g., the same parameter name is used in several data sets), the parameter name is distinguished by also identifying the associated data set.

The typographical conventions for an Applicable Service Agreement Parameter are specified in 1.8.4.6, 'Parameter Names'.

1.8.2.7 Data Set Composition and Relationship Requirements Subsection

1.8.2.7.1 General

To complement the class diagram, data set composition and relationship requirements are indexed and listed in tables. These requirements will reference messages, parameters, abstract data sets and data sets. The typographical conventions for these references are listed in 1.8.4.

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1.8.2.7.2 Identification of Syntactic Validation and Service Management Validation Requirements

All UM and CM operations conform to operation procedure patterns, as defined in 3.3.4.1. These operation procedure patterns contain abstractly defined activities for performing syntactic validation (i.e., ensuring conformance to message format) and service management validation (ensuring conformance to relationship requirements among parameter values within the message and parameters of other related data sets) on SM messages. The concrete definition of the syntax of a message and the service management requirements on the message content are operation-specific and therefore deferred to the specification of the operation-specific messages (see section 3).

A data set composition and relationship requirement that is to be validated as part of the syntactic validation activity for that message includes the text '[syntactic validation]' at the end of the requirement.

A data set composition and relationship requirement that is to be validated as part of the service management validation activity for that message includes the text '[service management validation]' at the end of the requirement.

1.8.3 STEREOTYPES

Common patterns in the specification are expressed as stereotypes. Stereotypes are defined using the UML stereotype conventions, which define the pattern, identify where context-specific data apply, and provide a name for the stereotype. UML stereotype conventions are also used to handle the application of a defined stereotype. When a stereotype is applied to a model element, which could be a sequence, activity, or data set in the specification, the element is referred to as an instance of the stereotype. Structurally, the element is extending that stereotype, i.e., using the pattern and adding traits and/or behavior to it. The typographical conventions for stereotypes and their usage are listed in 1.8.4.8, 'Stereotype Names'.

1.8.4 TYPOGRAPHIC CONVENTIONS

1.8.4.1 New Terms and Key Concepts

Italic font in textual description is used to introduce to the reader a new term or phrase that represents a key concept of the specification. Subsequent usage of the term or phrase is in regular non-italicized font.

1.8.4.2 Operation Names

The typographical convention for an operation name is to use non-proportional font, Courier New, uppercase and with underscores between the words (e.g., `CREATE_SERVICE_PACKAGE`). The shorthand convention is to use the first character of each word in uppercase. For example, `CSP` is the shorthand representation of `CREATE_SERVICE_PACKAGE`.

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1.8.4.3 Message Names

A message name will appear in non-proportional font, Courier New, camel-case, bold, with first letter capitalized (e.g., **`CreateServicePackageInvocation`**). The shorthand convention is to use the first character of each word in the operation name and add the first character of the message type with a hyphen between the operation and message type. For example, **`CSP-I`** is shorthand for **`CreateServicePackageInvocation`**.

Hyphens may appear in message names in order to facilitate readability. The hyphens are not part of the message names.

1.8.4.4 Data Set Names

Names of data set classes in UML class diagrams appear in proportional font, camel-case with first character capitalized, and in bold (e.g., **ReturnCarrierRequestType**).

Names of data set tables appear in non-proportional font, Courier New, camel-case with first character capitalized, and in bold (e.g., **`ReturnCarrierRequestType`**).

Hyphens may appear in data set class and table names in order to facilitate readability. The hyphens are not part of the data set names.

1.8.4.5 Abstract Data Set Names

Conventionally, abstract data set class names in UML class diagrams are similar to data set class names but distinguished by italics. Thus, abstract data set class names appear in proportional font, camel-case with first character capitalized, in bold, and in italics (e.g., ***CarrierRequestType***).

Hyphens may appear in abstract data set class names in order to facilitate readability. The hyphens are not part of the abstract data set class names.

1.8.4.6 Parameter Names

Names of parameters in data set classes and abstract data set classes in UML class diagrams appear in proportional font, and camel-case with the first character in lower-case (e.g., `pcmWaveform`).

Names of parameters in data set tables appear in non-proportional font, Courier New, and camel-case with the first character in lower-case (e.g., `pcmWaveform`).

Some parameters may specify a data type or data set to further distinguish the parameter. The convention for including a data type is to list the parameter name using the font and camel-case conventions mentioned above and append the name of the data type, separated by a colon (e.g., `reason: <<Denial>>`). The convention for including a data set is to prepend

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