INTERNATIONAL STANDARD

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Space data and information transfer systems — Space link extension (SLE) — Forward communications link transmission unit (CLTU) service specification

Systèmes de transfert des informations et données spatiales — Extension de liaisons spatiales (SLE) — Service de l'unité de transmission pour la liaison d'envoi de télécommande (CLTU)

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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 (see www.iso.org/directives).

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This document was prepared by the Consultative Committee for Space Data Systems (CCSDS) (as CCSDS 912.1-B-4, August 2016) and was adopted (without modifications) by Technical Committee ISO/TC 20, *Space vehicles,* Subcommittee SC 13, *Space data and information transfer systems*.

This fourth edition cancels and replaces the third edition (ISO 22671:2011), which has been technically revised.

The main changes compared to the previous edition are as follows:

— adds clarifications and corrections.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

CCSDS RECOMMENDED STANDARD FOR SLE FCLTU SERVICE

CONTENTS

CONTENTS (continued)

Section Page

Figure

Table

CONTENTS (continued)

1 INTRODUCTION

1.1 PURPOSE OF THIS RECOMMENDED STANDARD

This Recommended Standard defines the Communications Link Transmission Unit (CLTU) service in conformance with the transfer services specified in reference [1], *Cross Support Reference Model—Part 1: SLE Services*. The Forward CLTU service is a Space Link Extension (SLE) transfer service that enables a mission to send Communications Link Transmission Units (CLTUs) to a spacecraft.

1.2 SCOPE

This Recommended Standard defines, in an abstract manner, the Forward CLTU 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 data 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 Forward CLTU service.

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 Forward CLTU service. Implementation of the Forward CLTU service in a real system additionally requires the availability of a communications service to convey invocations and returns of Forward CLTU service operations between service users and

providers. This Recommended Standard requires that such a communications service ensure 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 Forward CLTU service user and the Forward CLTU service provider are disrupted, possibly resulting in a loss of data.

It is the specific intent of this Recommended Standard to define the Forward CLTU 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 Forward CLTU 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 or ground data handling systems of various agencies and the users of forward services.

1.5 DOCUMENT STRUCTURE

1.5.1 DOCUMENT ORGANIZATION

This Recommended Standard is organized as follows:

a) section 0 provides purpose, scope, applicability, and rationale of this Recommended Standard and lists definitions, nomenclature, conventions, and references used throughout the Recommended Standard;

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

c) section 3 specifies the operations of the Forward CLTU service;

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

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

f) annex B explains the relationship of the Forward CLTU service provisioning on the production status and its dependency on the status of the forward space link channel.

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

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

i) annex E lists all acronyms used within this document;

j) annex F contains examples of usage of the CLTU-THROW-EVENT operation;

k) annex G 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 SLE Mission User Entities (MUEs) and an SLE transfer service provider for the purpose of providing the Forward CLTU transfer service.

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.

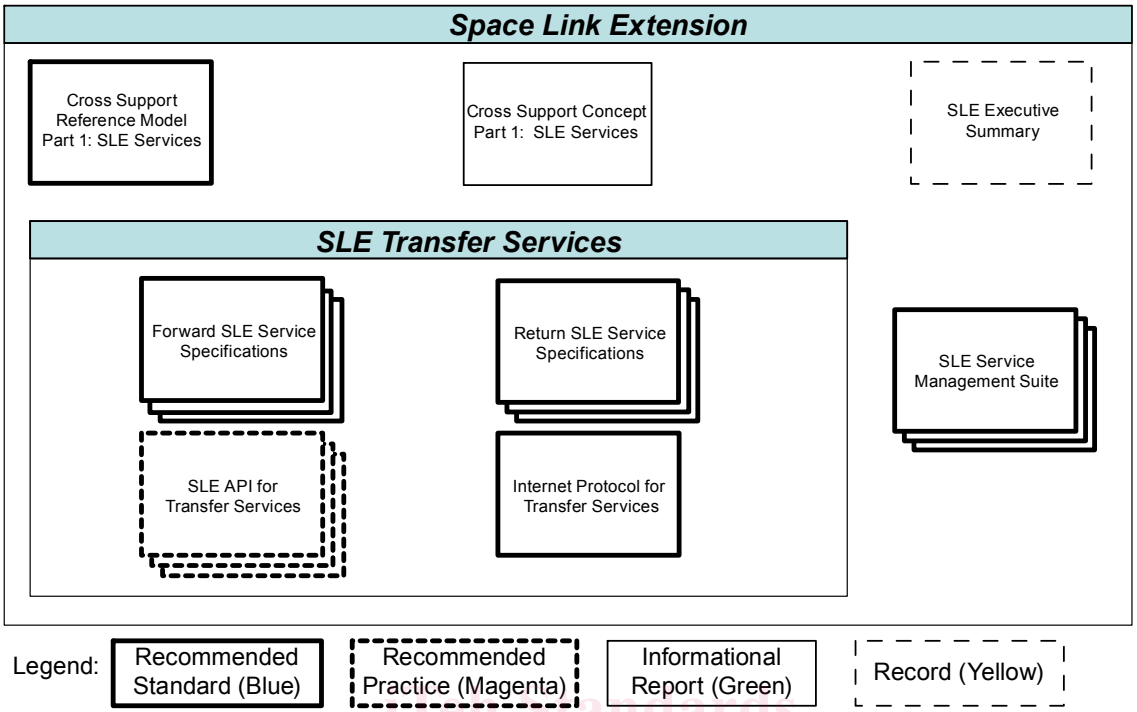

Figure 1-1: SLE Services Documentation

a) *Cross Support Concept – Part 1: Space Link Extension Services* (reference [G3]): 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 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);

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 [7]. 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 System 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 [6]:

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

b) object identifier;

c) (data) type;

d) (data) value.

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 Forward CLTU service. The use of ASN.1 as a descriptive language is intended to support the specification of the abstract Forward CLTU 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 Forward CLTU service.

1.6.1.3 Definitions from TC Synchronization and Channel Coding

This Recommended Standard makes use of the following terms defined in reference [2]:

a) acquisition sequence;

b) Communications Link Transmission Unit (CLTU);

c) Carrier Modulation Mode (CMM);

d) idle sequence;

e) Physical Layer operations procedure (PLOP).

1.6.1.4 Definitions from TC Space Data Link Protocol

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

Communications Link Control Word (CLCW).

1.6.1.5 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) CLTU channel;

f) Forward CLTU service;

g) invoker;

h) Mission Data Operation System (MDOS);

i) Mission User Entity (MUE);

j) offline delivery mode;

k) online delivery mode;

l) operation;

m) performer;

n) physical channel;

o) service agreement;

p) service provider (provider);

q) service user (user);

r) SLE Complex;

s) SLE Complex Management;

t) SLE data channel;

u) SLE functional group (SLE-FG);

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

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

x) SLE service package;

y) SLE transfer service instance;

z) SLE transfer service production;

aa) SLE transfer service provision;

bb) SLE Utilization Management;

cc) space link;

dd) space link data channel;

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

ff) space link session.

1.6.1.6 Additional Definitions

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

1.6.1.6.1 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 use of an underlying communications service.

1.6.1.6.2 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.

1.6.1.6.3 Confirmed Operation

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

1.6.1.6.4 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.

1.6.1.6.5 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.

1.6.1.6.6 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 production or provision of the service.

1.6.1.6.7 Performance

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

1.6.1.6.8 Port Identifier

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

NOTE – See 2.6.4.6 for more information.

1.6.1.6.9 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.