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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
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The Consultative Committee for Space Data Systems

Recommendation for Space Data System Standards

ENCAPSULATION SERVICE

RECOMMENDED STANDARD

CCSDS 133.1-B-2

Note:
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BLUE BOOK

October 2009

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STATEMENT OF INTENT

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

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

- Whenever a member establishes a CCSDS-related **standard**, this **standard** will be in accord with the relevant **Recommended Standard**. Establishing such a **standard** does not preclude other provisions which a member may develop.
- Whenever a member establishes a CCSDS-related **standard**, that member will provide other CCSDS members with the following information:
  - -- The **standard** itself.
  - -- The anticipated date of initial operational capability.
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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

This document is a **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 Encapsulation Service described herein is intended for missions that are cross-supported between Agencies of the CCSDS.

This **Recommended Standard** specifies a communications service to be used by space missions to transfer protocol data units that are not directly transferred by the Space Data Link Protocols (references [1]-[4]) over a ground-to-space or space-to-space communications link. The data units transferred with this service are encapsulated in either Space Packets, defined in reference [5], or Encapsulation Packets, defined in this document.

This **Recommended Standard** is developed from the Encapsulation Service that was defined in the Advanced Orbiting Systems (AOS) Recommended Standard (reference [B2]). In this **Recommended Standard**, that service is re-defined so that it can be used with any of the Space Data Link Protocols (references [1]-[4]). Also, the Encapsulation Packet that was defined in references [B2]-[B4] is included in this **Recommended Standard** as an alternative packet structure for encapsulation.

In order to define all Space Data Link Protocols in a unified way, a few technical specifications of the Encapsulation Service in reference [B2] have been changed. Also, some technical terms in references [B2]-[B4] have been changed in order to unify the terminology used in all the CCSDS Recommended Standards that define space link protocols. These changes are listed in annex C of this **Recommended Standard**.

Through the process of normal evolution, it is expected that expansion, deletion or modification to this document may occur. This Recommended Standard is therefore subject to CCSDS document management and change control procedures, as defined in reference [B1]. Current versions of CCSDS documents are maintained at the CCSDS Web site:

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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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- Space and Upper Atmosphere Research Commission (SUPARCO)/Pakistan.
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DOCUMENT CONTROL

Document	Title and Issue	Date	Status
CCSDS 133.1-B-1	Encapsulation Service, Recommended Standard, Issue 1	June 2006	Original issue, superseded
CCSDS 133.1-B-2	Encapsulation Service, Recommended Standard, Issue 2	October 2009	Current issue: – adds corrections and clarifications to the specification
CCSDS 133.1-B-2 Cor.1	Technical Corrigendum 1	September 2012	Replaces reference to CCSDS 135.0-B-4, *Space Link Identifiers*, with reference to SANA.
CCSDS 133.1-B-2 Cor.2 EC 1	Technical Corrigendum 2 Editorial change 1	April 2014	Cor.2: – replaces reference to SANA with direct references to SANA registries; – expands range of reserved Space Packet APIDs to include CFDP. EC 1: – updates superseded references with current issues; – updates obsolescent style elements.

NOTE – Substantive changes from the previous issue are indicated with 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 Encapsulation Service. This service is to be used by space missions to transfer data units that are not directly transferred by the Space Data Link Protocols (references [1]-[4]) over a ground-to-space or space-to-space communications link.

1.2 SCOPE

This Recommended Standard defines the Encapsulation Service in terms of:

a) the service primitives provided to the users of this service;

b) the protocol data units employed by the service provider; and

c) the procedures performed by the service provider.

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 service.

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. The Recommended Standard includes comprehensive specification of the service 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 Recommended Standard 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 the 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.

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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. Concept and rationale behind the decisions that formed the basis for this Recommended Standard is documented in reference [B5].

1.5 DOCUMENT STRUCTURE

This document is divided into five numbered sections and three annexes:

a) Section 1 presents the purpose, scope, applicability and rationale of this Recommended Standard and lists the conventions, definitions, and references used throughout the document;

b) Section 2 provides an overview of the Encapsulation Service;

c) Section 3 defines the service primitives provided for this service;

d) Section 4 specifies the protocol data units and procedures employed by the service provider;

e) Section 5 lists the managed parameters associated with this service;

f) Section 6 is discussion of security considerations pertinent to the specification;

g) Annex A lists all acronyms used within this document;

h) Annex B provides a list of informative references;

i) Annex C lists the changes from older CCSDS Recommendations [B2]-[B4].

1.6 CONVENTIONS AND DEFINITIONS

1.6.1 DEFINITIONS

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

This Recommended Standard makes use of a number of terms defined in reference [6]. 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) connection;

c) entity;

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d) flow control;

e) protocol data unit;

f) real system;

g) segmenting;

h) service;

i) Service Access Point (SAP);

j) SAP address;

k) 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 [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 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 Terms Defined in This Recommended Standard

For the purposes of this Recommended Standard, the following definitions also apply. Many other terms that pertain to specific items are defined in the appropriate sections.

asynchronous: not *synchronous* (see below).

delimited: having a known (and finite) length; applies to data in the context of data handling.

Physical Channel: a stream of bits transferred over a space link in a single direction.

space link: a communications link between a spacecraft and its associated ground system, or between two spacecraft. A space link consists of one or more Physical Channels in one or both directions.

synchronous: of or pertaining to a sequence of events occurring in a fixed time relationship (within specified tolerance) to another sequence of events.

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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.

1.6.3 CONVENTIONS

In this document, the following convention is used to identify each bit in an N-bit field. The first bit in the field to be transmitted (i.e., the most left-justified when drawing a figure) is defined to be ‘Bit 0’; the following bit is defined to be ‘Bit 1’ and so on up to ‘Bit N-1’. When the field is used to express a binary value (such as a counter), the Most Significant Bit (MSB) shall be the first transmitted bit of the field, i.e., ‘Bit 0’ (see figure 1-1).

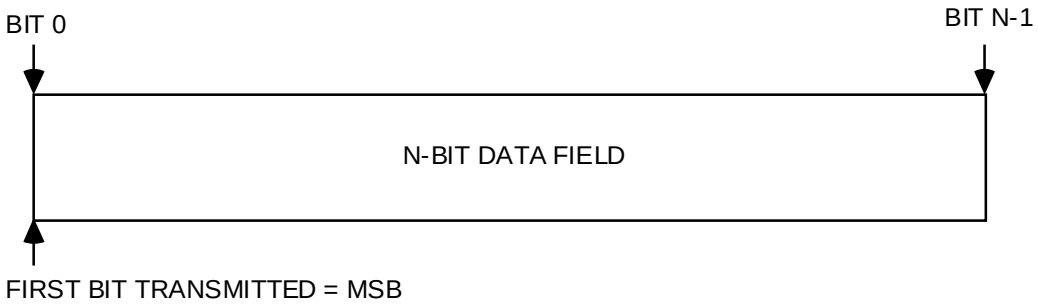


Figure 1-1: Bit Numbering Convention

In accordance with standard data-communications practice, data fields are often grouped into 8-bit ‘words’ which conform to the above convention. Throughout this Recommended Standard, such an 8-bit word is called an ‘octet’.

The numbering for octets within a data structure starts with 0.

By CCSDS convention, all ‘spare’ bits shall be permanently set to value ‘zero’.

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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] *TM Space Data Link Protocol*. Issue 1. Recommendation for Space Data System Standards (Blue Book), CCSDS 132.0-B-1. Washington, D.C.: CCSDS, September 2003.

[2] *TC Space Data Link Protocol*. Issue 2. Recommendation for Space Data System Standards (Blue Book), CCSDS 232.0-B-2. Washington, D.C.: CCSDS, September 2010.

[3] *AOS Space Data Link Protocol*. Recommendation for Space Data System Standards, CCSDS 732.0-B-2. Blue Book. Issue 2. Washington, D.C.: CCSDS, July 2006.

[4] *Proximity-1 Space Link Protocol—Data Link Layer*. Issue 5. Recommendation for Space Data System Standards (Blue Book), CCSDS 211.0-B-5. Washington, D.C.: CCSDS, December 2013.

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

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

[7] *Information Technology—Open Systems Interconnection—Basic Reference Model—Conventions for the Definition of OSI Services*. International Standard, ISO/IEC 10731:1994. Geneva: ISO, 1994.

[8] "Space Assigned Number Authority (SANA) Registry: Packet Version Number." Space Assigned Numbers Authority. Consultative Committee for Space Data Systems. http://sanaregistry.org/r/packet_version_number/.

[9] "Space Assigned Number Authority (SANA) Registry: Space Packet Protocol Application Process Identifier (APID)." Space Assigned Numbers Authority. Consultative Committee for Space Data Systems. http://sanaregistry.org/r/space_packet_protocol_application_process_id/.

[10] "Space Assigned Number Authority (SANA) Registry: Protocol Identifier for Encapsulation Service." Space Assigned Numbers Authority. Consultative Committee for Space Data Systems. http://sanaregistry.org/r/protocol_id/.

Cor. 2

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[11] “Space Assigned Number Authority (SANA) Registry: Extended Protocol Identifiers.” Space Assigned Numbers Authority. Consultative Committee for Space Data Systems. http://sanaregistry.org/r/extended_protocol_id/.

Cor. 2

NOTE – Informative references are listed in annex B.

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