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Mission operations — MAL space packet transport binding and binary encoding

Opérations de mission - transport de paquets de l'espace MAL reliés et codage binaire

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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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ISO 21082 was prepared by the Consultative Committee for Space Data Systems (CCSDS) (as CCSDS 524.1-B-1, August 2015) 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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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.

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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.

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--   The anticipated date of initial operational capability.

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Questions relating to the contents or status of this document should be sent to the CCSDS Secretariat at the e-mail address indicated on page i.

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DOCUMENT CONTROL

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1 INTRODUCTION

1.1 PURPOSE

This Recommended Standard defines the binding between the Mission Operations (MO) Message Abstraction Layer (MAL) specified in reference [2] and the Space Packet Protocol specified in reference [1]. This binding allows MO Services to use the Space Packet Protocol as messaging technology in all situations where this may be required.

1.2 SCOPE

The scope of this Recommended Standard is the specification of the binding in terms of technology mapping to the Space Packet Protocol of:

 a) MAL message;

 b) MAL Transport Interface.

The MAL Blue Book (reference [2]) specifies the MAL protocol in an abstract way, i.e., without defining the concrete protocol data units. The MAL Space Packet Transport Binding and Binary Encoding specifies:

 a) a complete and unambiguous mapping of the MAL message to the Space Packet;

 b) a complete and unambiguous mapping of the MAL transport interface to the Space Packet Protocol interface;

 c) a complete and unambiguous mapping of the MAL data types to fixed and variable length binary encoding formats.

This Recommended Standard does not specify:

 a) individual implementations or products;

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

MO services defined in terms of MAL using the Space Packet Transport Binding as defined in this Recommended Standard are fully interoperable.

1.3 APPLICABILITY

This Recommended Standard specifies a technology mapping that enables different implementations of the MO service framework (see 2.2) to interoperate through the Space Packet Protocol.

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1.4 RATIONALE

The goal of this Recommended Standard is to specify how to translate the abstract MAL message model in an unambiguous way into a concrete message exchange protocol, namely the Space Packet Protocol.

This Recommended Standard defines a binary encoding format for the MAL data types that may be re-used by a MAL binding to a messaging technology that is not the Space Packet Protocol.

1.5 DOCUMENT STRUCTURE

This Recommended Standard is organized as follows:

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

b) section 2 presents an overview of the MAL Space Packet Transport Binding in relation with the MO service framework;

c) section 3 specifies the mapping of the MAL message to the Space Packet;

d) section 4 specifies the mapping of the MAL transport interface to the Space Packet Protocol interface;

e) section 5 specifies a generic encoding format for the MAL data types.

1.6 DEFINITIONS

The following definitions are from the MO Reference Model (reference [8]).

Protocol: The set of rules and formats (semantic and syntactic) used to determine the communication behaviour of a Protocol Layer in the performance of the layer functions. The state machines that operate and the protocol data units that are exchanged specify a protocol.

Protocol Layer: The implementation of a specific Protocol. It provides a Protocol Service Access Point to layers above and uses the Protocol Service Access Point of the layer below.

Protocol Service Access Point (SAP): The point at which one layer's functions are provided to the layer above. A layer may provide protocol services to one or more higher layers and use the protocol services of one or more lower layers.

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1.7   NOMENCLATURE

1.7.1   NORMATIVE TEXT

The following conventions apply for the normative specifications in 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.

NOTE – These conventions do not imply constraints on diction in text that is clearly
informative in nature.

1.7.2   INFORMATIVE TEXT

In the normative sections of this document, informative text is set off from the normative
specifications either in notes or under one of the following subsection headings:

    – Overview;

    – Background;

    – Rationale;

    – Discussion.

1.8   BIT NUMBERING CONVENTION

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 bit following 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'.
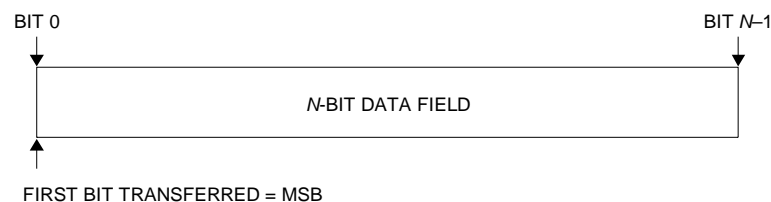

Figure 1-1: Bit Numbering Convention

In accordance with modern data communications practice, spacecraft data fields are often grouped into eight-bit 'words' which conform to the above convention. Throughout this Recommended Standard, the following nomenclature is used to describe this grouping:
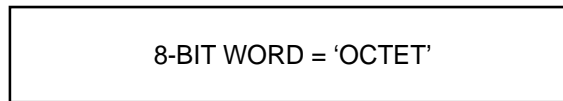
```
8-BIT WORD = 'OCTET'
```

Figure 1-2: Octet Convention

By CCSDS convention, all 'spare' or 'unused' bits shall be permanently set to value 'zero'.

1.9 REFERENCES

The following publications contain provisions which, through reference in this text, constitute provisions of this document. At the time of publication, the editions indicated were valid. All publications are subject to revision, and users of this document are encouraged to investigate the possibility of applying the most recent editions of the publications indicated below. The CCSDS Secretariat maintains a register of currently valid CCSDS publications.

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

[2] *Mission Operations Message Abstraction Layer*. Issue 2. Recommendation for Space Data System Standards (Blue Book), CCSDS 521.0-B-2. Washington, D.C.: CCSDS, March 2013.

[3] *IEEE Standard for Floating-Point Arithmetic*. 2nd ed. IEEE Std. 754-2008. New York: IEEE, 2008.

[4] F. Yergeau. *UTF-8, a Transformation Format of ISO 10646*. STD 63. Reston, Virginia: ISOC, November 2003.

[5] *Time Code Formats*. Issue 4. Recommendation for Space Data System Standards (Blue Book), CCSDS 301.0-B-4. Washington, D.C.: CCSDS, November 2010.

[6] *Data Elements and Interchange Formats—Information Interchange—Representation of Dates and Times*. 3rd ed. International Standard, ISO 8601:2004. Geneva: ISO, 2004.

[7] "Packet Version Number." Space Assigned Numbers Authority. http://sanaregistry.org/r/packet_version_number/.

[8] *Mission Operations Reference Model*. Issue 1. Recommendation for Space Data System Practices (Magenta Book), CCSDS 520.1-M-1. Washington, D.C.: CCSDS, July 2010.