The Consultative Committee for Space Data Systems

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The Consultative Committee for Space Data Systems

Recommendation for Space Data System Standards

SPACE LINK IDENTIFIERS

RECOMMENDED STANDARD

CCSDS 135.0-B-4

BLUE BOOK
October 2009

CCSDS HISTORICAL DOCUMENT

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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:

- 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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- 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.

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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).

This Recommended Standard documents the identifiers used by the space link protocols developed by CCSDS, shows how these identifiers are managed, and lists the identifiers that are defined or reserved by CCSDS as part of the specification of the space link protocols.

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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CCSDS HISTORICAL DOCUMENT

DOCUMENT CONTROL

Document	Title and Issue	Date	Status
CCSDS 135.0-B-1	Space Link Identifiers, Issue 1	January 2002	Original issue, superseded.
CCSDS 135.0-B-2	Space Link Identifiers, Recommended Standard, Issue 2	November 2005	Issue 2 (superseded): – adds Proximity-1 port ID assignments.
CCSDS 135.0-B-3	Space Link Identifiers, Recommended Standard, Issue 3	October 2006	Issue 3 (superseded): – adds a security subsection (2.5); – adds protocol IDs for IPv4, Encapsulation Service, and Encapsulation Service Extended Protocol IDs; – expands, clarifies meaning of Proximity-1 port ID for Packets.
CCSDS 135.0-B-4	Space Link Identifiers, Recommended Standard, Issue 4	October 2009	Current issue: – adds Internet Protocol Extension (IPE) specification as annex A; – removes identifier for direct multiplexing of IPv4 in transport frames.

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

CONTENTS

CONTENTS (continued)

1 INTRODUCTION

1.1 PURPOSE

The purpose of this Recommended Standard is to document the identifiers used by the space link protocols developed by CCSDS, to show how these identifiers are managed, and to list the identifiers that are defined or reserved by CCSDS as part of the specification of the space link protocols.

1.2 SCOPE

This Recommended Standard documents the identifiers currently used by the space link protocols and shows how these identifiers are managed at the CCSDS level. It does not specify how these identifiers are managed in individual data systems of space projects.

1.3 APPLICABILITY

This Recommended Standard constitutes provisions of the CCSDS Recommended Standards that refer to this Recommended Standard as a normative reference, to the extent that is specified in those Recommended Standards.

1.4 RATIONALE

The goal of this Recommended Standard is to enable management of identifiers used by the space link protocols independently of management of protocol specifications themselves.

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 definitions and references used throughout the document;

b) section 2 summarizes the methods used for managing space link identifiers;

c) sections 3 through 7 list the identifiers used by each of the space link protocols, show how these identifiers are managed, and list the identifiers that are defined or reserved by CCSDS;

d) annex A contains the CCSDS IP Extension (IPE) specification;

e) annex B lists all acronyms used within this document;

f) annex C provides a list of informative references;

g) annex D summarizes the location of the length field of the packets for which Packet Version Numbers are defined by CCSDS.

1.6 DEFINITIONS

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

Assigned by CCSDS: values of the identifier are assigned by CCSDS upon request by Agencies.

Defined by CCSDS: values of the identifier are defined by CCSDS as part of the specification of protocol.

Managed by projects: values of the identifier are managed independently by the projects that use the protocol.

space link: a communications link between a spacecraft and its associated ground system, or between two spacecraft.

space link protocol: a communications protocol designed to be used over a space link (see above). A space link protocol is not necessarily a protocol of the Data Link Layer of the OSI Basic Reference Model (reference [1]).

1.7 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).

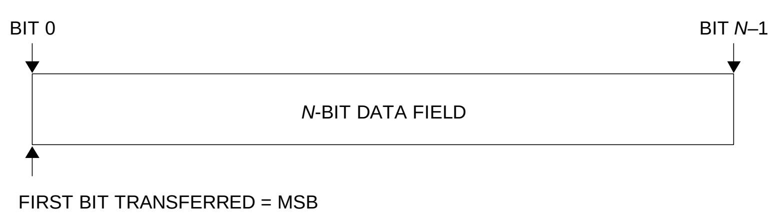

Figure 1-1: Bit Numbering Convention

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

The numbering for octets within a data structure starts with zero. By CCSDS convention, all 'spare' bits shall be permanently set to '0'.

1.8 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 7498-1:1994. 2nd ed. Geneva: ISO, 1994.

[2] *Lossless Data Compression*. Recommendation for Space Data Systems Standards, CCSDS 121.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, May 1997.

[3] *Space Communications Protocol Specification—File Protocol (SCPS-FP)*. Recommendation for Space Data Systems Standards, CCSDS 717.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, May 1999.

[4] *CCSDS File Delivery Protocol (CFDP)*. Recommendation for Space Data System Standards, CCSDS 727.0-B-4. Blue Book. Issue 4. Washington, D.C.: CCSDS, January 2007.

[5] *Space Communications Protocol Specification—Transport Protocol (SCPS-TP)*. Recommendation for Space Data Systems Standards, CCSDS 714.0-B-2. Blue Book. Issue 2. Washington, D.C.: CCSDS, October 2006.

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

[7] *Space Communications Protocol Specification—Network Protocol (SCPS-NP)*. Recommendation for Space Data Systems Standards, CCSDS 713.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, May 1999.

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

[9] *TC Space Data Link Protocol*. Recommendation for Space Data System Standards, CCSDS 232.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[10] *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.

[11] *Proximity-1 Space Link Protocol—Data Link Layer*. Recommendation for Space Data System Standards, CCSDS 211.0-B-4. Blue Book. Issue 4. Washington, D.C.: CCSDS, July 2006.

[12] *CCSDS Global Spacecraft Identification Field Code Assignment Control Procedures*. Recommendation for Space Data System Standards, CCSDS 320.0-B-5. Blue Book. Issue 5. Washington, D.C.: CCSDS, September 2007.

[13] *Encapsulation Service*. Recommendation for Space Data System Standards, CCSDS 133.1-B-2. Blue Book. Issue 2. Washington, D.C.: CCSDS, October 2009.

[14] *TM Synchronization and Channel Coding*. Recommendation for Space Data System Standards, CCSDS 131.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[15] *TC Synchronization and Channel Coding*. Recommendation for Space Data System Standards, CCSDS 231.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[16] *Information Technology—Protocol for Providing the Connectionless-Mode Network Service: Protocol Specification*. International Standard, ISO/IEC 8473-1:1998. 2nd ed. Geneva: ISO, 1998.

[17] J. Postel. *Internet Protocol*. STD 5. Reston, Virginia: ISOC, September 1981.

[18] S. Deering and R. Hinden. *Internet Protocol, Version 6 (IPv6) Specification*. RFC 2460. Reston, Virginia: ISOC, December 1998.

[19] M. Degermark, B. Nordgren, and B. Nordgren. *IP Header Compression*. RFC 2507. Reston, Virginia: ISOC, February 1999.

[20] S. Casner and V. Jacobson. *Compressing IP/UDP/RTP Headers for Low-Speed Serial Links*. RFC 2508. Reston, Virginia: ISOC, February 1999.

[21] George Wilkie, ed. Frame Relay IP Header Compression Implementation Agreement. FRF.20. Fremont, CA: The Frame Relay Forum, June 2001.

NOTE – Informative references are listed in annex C.

2 MANAGEMENT OF SPACE LINK IDENTIFIERS

2.1 GENERAL

The space link protocols developed by CCSDS use identifiers to identify protocols, addresses, and data formats. Even though some of these identifiers are defined in the Recommended Standards that specify the protocols, management of identifiers should be performed independently of management of protocol specifications so that values of the identifiers can be defined (or re-defined) without changing the protocol specifications themselves.

With the aim described above, this document lists the identifiers currently used by the space link protocols developed by CCSDS, shows how these identifiers are managed, and lists the identifiers that are defined or reserved by CCSDS as part of the specification of the space link protocols.

NOTE – Since no identifier is used by the following CCSDS space link protocols, these protocols are not included in the following sections:

a) Lossless Data Compression (reference [2]);

b) SCPS-FP (reference [3]);

c) TM Synchronization and Channel Coding (reference [14]);

d) TC Synchronization and Channel Coding (reference [15]).

Each identifier is managed by one of the three methods listed below depending on its characteristics:

a) defined by CCSDS as part of protocol specification;

b) assigned by CCSDS upon request by Agencies;

c) managed by individual projects.

The following subsections briefly describe these management methods.

2.2 IDENTIFIERS DEFINED BY CCSDS

The values of some identifiers are defined by CCSDS as part of the specification of protocols. This method for managing identifiers is denoted ‘Defined by CCSDS’ in this document.

The values of the identifiers of this category that are currently defined by CCSDS are listed in the following sections of this document.

2.3 IDENTIFIERS ASSIGNED BY CCSDS

The values of some identifiers are assigned by CCSDS upon request by Agencies. This method for managing identifiers is denoted 'Assigned by CCSDS' in this document.

The procedure for assigning values of each of the identifiers of this category is defined by a separate CCSDS Recommended Standard, which is referred to in the following sections of this document.

2.4 IDENTIFIERS MANAGED BY INDIVIDUAL PROJECTS

The values of some identifiers are managed independently by the projects that use the protocols. CCSDS does not specify how to manage these identifiers. This method for managing identifiers is denoted 'Managed by projects' in this document.

Some values of the identifiers in this category may be reserved by CCSDS to be used for some specific purposes across Agencies. The values of the identifiers reserved by CCSDS are listed in the following sections of this document.

2.5 SECURITY ASPECTS OF THE SPACE LINK IDENTIFIERS

2.5.1 SECURITY BACKGROUND/INTRODUCTION

The Space Link Identifiers Blue Book documents the identifiers used by the CCSDS space link protocols, CFDP, SCPS-TP and SCPS-NP, CCSDS space packet protocol, and the CCSDS encapsulation service. It documents how these identifiers are managed and provides a list of these identifiers along with their defined and/or reserved values.

2.5.2 STATEMENTS OF SECURITY CONCERNS

2.5.2.1 General

This subsection identifies Space Link Identifiers support for capabilities responding to security concerns in the areas of data privacy, data integrity, authentication, access control, availability of resources, and auditing.

2.5.2.2 Data Privacy (also known as Confidentiality)

This Space Link Identifiers specification does not define explicit data privacy requirements or capabilities to ensure data privacy. Data privacy is expected to be ensured either by encryption techniques applied at the data link layer or at a higher layer. For example, mission application processes might apply end-to-end encryption to the contents of the CCSDS space link data units carried as data by the applicable CCSDS data transfer service. Alternatively or in addition, the network connection between communicating entities might be encrypted to provide data privacy in the underlying communication network.

2.5.2.3 Data Integrity

The Space Link Identifiers specification does not define explicit data integrity requirements or capabilities to ensure data integrity. See the individual protocol specifications listed in the References subsection (1.7) for such requirements.

2.5.2.4 Authentication

The Space Link Identifiers specification does not define explicit authentication requirements or capabilities to ensure authentication. See the individual protocol specifications listed in the References subsection (1.7) for such requirements.

2.5.2.5 Access Control

The Space Link Identifiers specification does not define access control requirements or capabilities for access control. See the individual protocol specifications listed in the References subsection (1.7) for such requirements.

2.5.2.6 Availability of Resources

This Space Link Identifiers specification does not define explicit capabilities to prevent denial of service. See the individual protocol specifications listed in the References subsection (1.7) for such requirements.

2.5.2.7 Auditing

This Space Link Identifiers specification does not define explicit security auditing requirements or capabilities.

2.5.3 POTENTIAL THREATS AND ATTACK SCENARIOS

The Space Link Identifiers specification does not define potential threats and attack scenarios.

2.5.4 CONSEQUENCES OF NOT APPLYING SECURITY

The consequences of not applying security to the list of protocols whose identifiers are defined in the Space Link Identifiers Blue book is an issue covered by each individual protocol specification.

3 IDENTIFIERS USED BY CCSDS FILE DELIVERY PROTOCOL (CFDP)

Table 3-1 shows the identifier used by the CCSDS File Delivery Protocol (CFDP) (reference [4]) and how it is managed.

Table 3-1: Identifier Used by CCSDS File Delivery Protocol

Identifier	Management Method	Note
Entity ID	Managed by projects	No value is reserved

4 IDENTIFIERS USED BY SCPS-TP

Table 4-1 shows the identifier used by SCPS-TP (reference [5]) and how it is managed.

Table 4-1: Identifier Used by SCPS-TP

Identifier	Management Method	Note
Connection Identifier	Managed by projects	No value is reserved

5 IDENTIFIERS USED BY SPACE PACKET PROTOCOL

5.1 APPLICATION PROCESS IDENTIFIER

Table 5-1 shows the identifier used by the Space Packet Protocol (reference [6]) and how it is managed.

Table 5-1: Identifier Used by Space Packet Protocol

Identifier	Management Method	Note
Application Process Identifier (APID)	Managed by projects	See 5.2 for reserved values

5.2 RESERVED APPLICATION PROCESS IDENTIFIERS

Some values of the Application Process Identifier (APID) defined by the Space Packet Protocol (reference [6]) are reserved by CCSDS for special uses. Table 5-2 lists the APIDs currently reserved by CCSDS.

Table 5-2: Reserved Application Process Identifiers

APID (decimal)	Utilization	Reference
2040 - 2044	Reserved for possible future use	
2045	CFDP	[4]
2046	ISO 8473	[16]
2047	Idle Packet	[6]

6 IDENTIFIERS USED BY SCPS-NP

Table 6-1 shows the identifiers used by SCPS-NP (reference [7]) and how they are managed.

Table 6-1: Identifiers Used by SCPS-NP

Identifier	Management Method	Note
Domain Identifier (D-ID)	Assigned by CCSDS	See NOTE below the table
End System Identifier (ES-ID)	Managed by projects	No value is reserved
Path Identifier (P-ID)	Managed by projects	No value is reserved
Transport Protocol Identifier (TP-ID)	Defined by CCSDS	See table 3-2 of reference [7] for defined values

NOTE – No procedure is defined for assigning values of the Domain Identifier. If SCPS-NP is intended to be used globally, one must be developed.

7 IDENTIFIERS USED BY SPACE DATA LINK PROTOCOLS

7.1 GENERAL

Table 7-1 shows the identifiers used by the Space Data Link Protocols (references [8]-[10]) and Proximity-1 Space Link Protocol (reference [11]), and how they are managed.

Table 7-1: Identifiers Used by Space Data Link Protocols

Identifier	Used by	Management Method	Note
Transfer Frame Version Number	TM [8], TC [9], AOS [10], Prox [11]	Defined by CCSDS	See 7.2 for defined values
Spacecraft Identifier (SCID)	TM [8], TC [9], AOS [10], Prox [11]	Assigned by CCSDS	See reference [12] for assignment procedure
Virtual Channel Identifier (VCID)	TM [8], TC [9], AOS [10], Prox [11]	Managed by projects	See 7.3 for reserved values
Frame Secondary Header Version Number	TM [8]	Defined by CCSDS	See 7.4 for defined values
MAP Identifier (MAP ID)	TC [9]	Managed by projects	No value is reserved
Port Identifier (Port ID)	Prox [11]	Defined by CCSDS	See tables 7-8a and 7-8b for defined values
CLCW Version Number	TC [9]	Defined by CCSDS	See 7.5 for defined values
Packet Version Number	TM [8], TC [9], AOS [10], Prox [11]	Defined by CCSDS	See 7.6 for defined values
Protocol Identifier	Encapsulation Packet [13]	Defined by CCSDS	See 7.7 for defined values

7.2 DEFINED TRANSFER FRAME VERSION NUMBERS

In the Transfer Frames defined by the Space Data Link Protocols (references [8]-[10]) and Proximity-1 Space Link Protocol (reference [11]), there is a field called the Transfer Frame Version Number to identify the Transfer Frame. This is a two-bit field and its values are defined by CCSDS as part of the protocol specifications.

Table 7-2 lists the Transfer Frame Version Numbers currently defined by CCSDS.

Table 7-2: Defined Transfer Frame Version Numbers

Version Number	Binary Encoded Version Number	Transfer Frame	Reference
1	00	TM Transfer Frame	[8]
1	00	TC Transfer Frame	[9]
2	01	AOS Transfer Frame	[10]
3	10	Version 3 Transfer Frame	[11]

NOTES

1 Version Number ‘1’ is assigned to both TM Transfer Frame and TC Transfer Frame. These two Transfer Frames are distinguished by the Attached Sync Marker defined in reference [14] or the Start Sequence defined in reference [15].

2 In the field of Transfer Frame Version Number in the Transfer Frames, the Binary Encoded Version Number listed above must be used.

7.3 RESERVED VIRTUAL CHANNEL IDENTIFIERS

A value of the Virtual Channel Identifier (VCID) is reserved by CCSDS for special use in the AOS Space Data Link Protocol (reference [10]). Table 7-3 lists the VCID currently reserved by CCSDS.

No value of VCID is reserved by CCSDS for the other Space Data Link Protocols.

Table 7-3: Reserved Virtual Channel Identifiers (AOS Space Data Link Protocol Only)

VCID (binary)	Utilization	Reference
111111	Idle Transfer Frames	[10]

7.4 DEFINED FRAME SECONDARY HEADER VERSION NUMBERS

In the optional Transfer Frame Secondary Header defined by the TM Space Data Link Protocol (reference [8]), there is a field called the Frame Secondary Header Version Number to identify the Transfer Frame Secondary Header. This is a two-bit field and its values are defined by CCSDS as part of the protocol specification.

Table 7-4 lists the Frame Secondary Header Version Number currently defined by CCSDS.

Table 7-4: Defined Frame Secondary Header Version Numbers

Version Number	Binary Encoded Version Number	Frame Secondary Header	Reference
1	00	Version 1 Frame Secondary Header	[8]

NOTE – In the field of Frame Secondary Header Version Number in the Transfer Frame Secondary Header, the Binary Encoded Version Number listed above must be used.

7.5 DEFINED CLCW VERSION NUMBERS

In the CLCW defined by the TC Space Data Link Protocol (reference [9]), there is a field called the CLCW Version Number to identify the CLCW. This is a two-bit field and its values are defined by CCSDS as part of the protocol specification.

Table 7-5 lists the CLCW Version Number currently defined by CCSDS.

Table 7-5: Defined CLCW Version Numbers

Version Number	Binary Encoded Version Number	CLCW	Reference
1	00	Version 1 CLCW	[9]

NOTE – In the field of CLCW Version Number in the CLCW, the Binary Encoded Version Number listed above must be used.

7.6 DEFINED PACKET VERSION NUMBERS

In the Packets carried by the Space Data Link Protocols, there is a field called the Packet Version Number to identify the Packets. This is a three-bit field (see NOTE 2 below) and its values are defined by CCSDS as part of the protocol specifications.

Table 7-6 lists the Packet Version Numbers currently defined by CCSDS.

Table 7-6: Defined Packet Version Numbers

Version Number	Binary Encoded Version Number	Packet	Reference
1	000	Space Packet	[6]
2	001	SCPS-NP	[7]
8	111	Encapsulation Packet	[13]

NOTE – In the field of Packet Version Number in the Packets, the Binary Encoded Version Number listed above must be used.

7.7 PROTOCOL IDENTIFIERS

The Encapsulation Packet (reference [13]) is a data structure to encapsulate data units of some protocols so that they can be carried by a CCSDS Space Data Link Protocol. In the Encapsulation Packet, there is a field called the Protocol Identifier to identify the protocol whose data units are encapsulated. This is a three-bit field and its values are defined by CCSDS as part of the specification of the Encapsulation Packet.

When all of the values of the Protocol Identifier have been assigned, CCSDS has provided a mechanism for extending the Protocol Identifier: This is done by setting the Protocol Identifier field in the Encapsulation Packet header to '110', which signals that the 4-bit Extended Protocol ID field within the Encapsulation Packet header (see table 7-7b) is used to define the protocol encapsulated by the Encapsulation Packet.

Table 7-7a lists the Protocol Identifiers currently defined by CCSDS.

Table 7-7a: Defined Protocol Identifiers

Protocol Identifier (binary)	Protocol	Reference
000	Fill (the encapsulation data field, if present, contains no protocol data)	N/A
001	Reserved by CCSDS	N/A
010	Internet Protocol Extension (IPE)	annex A
011	CFDP	[4]
100	Reserved by CCSDS	N/A
101	Reserved by CCSDS	N/A
110	Extended Protocol ID for Encapsulation Service	[13]
111	Arbitrary Aggregations of Octets	N/A

Table 7-7b lists the Extended Protocol Identifiers defined for the Encapsulation Service by CCSDS.

Table 7-7b: Extended Protocol Identifiers

Protocol Identifier (binary)	Protocol	Reference
0000 through 1111	Reserved by CCSDS	N/A

7.8 RESERVED PROXIMITY-1 PORT IDENTIFIERS

The Proximity-1 Port Identifier (reference [11]) provides the means to route user data internally (at the transceiver's output interface) to specific logical ports, such as applications or transport processes, or to physical ports, such as on-board buses or physical connections (including hardware command decoders) on either the forward and/or return proximity links.

Table 7-8a: Proximity-1 Port ID Assignments for the Forward Link for Both Physical Channels

Port Identifier (binary)	Usage	Reference
000	Bitstream	N/A
001	Hardware Commands	N/A
010	Packets	[6], [7], [13], [17]
011	Reserved by CCSDS	N/A
100	Reserved by CCSDS	N/A
101	Reserved by CCSDS	N/A
110	Reserved by CCSDS	N/A
111	Reserved by CCSDS	N/A

Table 7-8b: Proximity-1 Port ID Assignments for the Return Link for Both Physical Channels

Port Identifier (binary)	Usage	Reference
000	Bitstream	N/A
001	Reserved by CCSDS	N/A
010	Packets	[6], [7], [13], [17]
011	Reserved by CCSDS	N/A
100	Reserved by CCSDS	N/A
101	Reserved by CCSDS	N/A
110	Reserved by CCSDS	N/A
111	Reserved by CCSDS	N/A

ANNEX A

CCSDS IP EXTENSION (IPE)

(NORMATIVE)

A1 PURPOSE AND SCOPE

This annex specifies the CCSDS Internet Protocol Extension (IPE) convention.

A2 OVERVIEW

A2.1 GENERAL

The primary purpose of the CCSDS Internet Protocol Extension (IPE) convention is to provide an interoperable way of identifying the Internet protocols being encapsulated by the CCSDS Encapsulation Service (reference [13]) when this service is being used to provide a data link layer for the Internet Protocol (IP). The IPE header uses one and optionally more than one shim byte to logically extend the CCSDS Encapsulation Packet header. Table A-1 lists the CCSDS recommended protocols to be encapsulated and their enumerations for the content of the IPE header.

Using this convention, the Encapsulation service provides a data link layer for the IP protocols shown in table A-1. IPE uses the Encapsulation service primitives defined and the service described in reference [13]. The additional service provided through the IPE is a protocol multiplexing/demultiplexing capability.

The IPE convention allows demultiplexing of subprotocols used in IP. It offers a sizable protocol identifier space while not impacting the protocol ID space used by the Encapsulation Service itself. This abstracts, and allows the separation of, protocols originally supported by the Encapsulation Service and IP data transfer over it. No additional processing is performed at the multiplexing/demultiplexing layer affiliated with the IPE convention. The multiplexing/demultiplexing services know nothing of the formats or conventions of the protocols they are multiplexing or demultiplexing.

NOTE – The Relationship of IPE to the Encapsulation Service is shown in figure A-1.

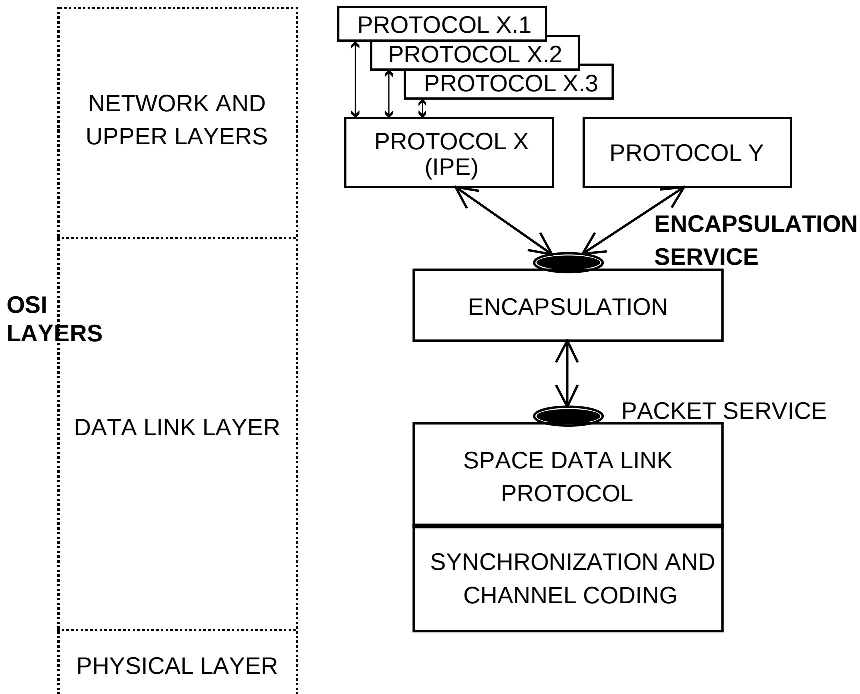

Figure A-1: Relationship of IPE to the Encapsulation Service

A2.2 IPE HEADER ENUMERATIONS AND MAPPINGS

There often are many IP data types that require encapsulation. The exact number of protocols depends on the mission and its requirements. These protocols are fully defined in other data standards. Thus the intent here is to identify only auxiliary Protocol Data Unit (PDU) formats that are often used in support of IP. As a comparison, serial links between routers often carry the 16-bit PPP protocol field, and the Ethernet protocol data units carry a 16-bit Ethernet type field. In these cases, the enumerations of the protocols are defined by the Internet Assigned Numbers Authority (IANA) and the Institute of Electrical and Electronics Engineers (IEEE) respectively. The tables containing the enumerations then point to the standards that define the protocols themselves.

The alternate approach would have been to encapsulate a conventional link layer, such as Multiprotocol over Frame Relay, and use its methods for identifying the auxiliary PDU formats.

Auxiliary protocols nominally identified at the data link layer in support of IP include IPv4, IPv6, IP compressed header formats, the address resolution protocol for multi-access link layers, link layer control protocols including link metrics exchange and link health monitoring, various link and network layer configuration protocols, and authentication protocols.

Addressing and routing protocols often tie into these protocols via initial configuration exchanges and link state up/down information. It should be noted, however, that routing protocols such as Open Shortest Path First (OSPF), Protocol-Independent Multicast (PIM), and Border Gateway Protocol (BGP) also maintain their own adjacency or state via hello exchanges or refreshes at the network layer.

Most of these protocols are built around bi-directional links and require bi-directional exchanges. Since in the space environment it is expected that network layer protocols will have to be able to use one-way links, it is not recommended that these protocols be required. It is believed that if fairly simple networks are involved, and they are monitored in a transparent manner, it is possible to use pre-arranged static settings rather than dynamic exchanges to verify and maintain correct configuration. However, if appropriate for the mission, use of these protocols is not prohibited.

A3 INTERNET PROTOCOL EXTENSION SPECIFICATION

A3.1 GENERAL

A3.1.1 The IP PDU to be encapsulated shall follow, without gap, the IPE header.

A3.1.2 The concatenation of IPE header and IP PDU shall be the Data Unit parameter of the Encapsulation Service (see reference [13], section 3).

NOTES

1 The Encapsulation Packet length field in the Encapsulation Packet header consists of the sum of the sizes of the Encapsulation Packet header, the IPE header, and the PDU to be encapsulated.

2 The format and placement of the IPE header are shown in figure A-2.

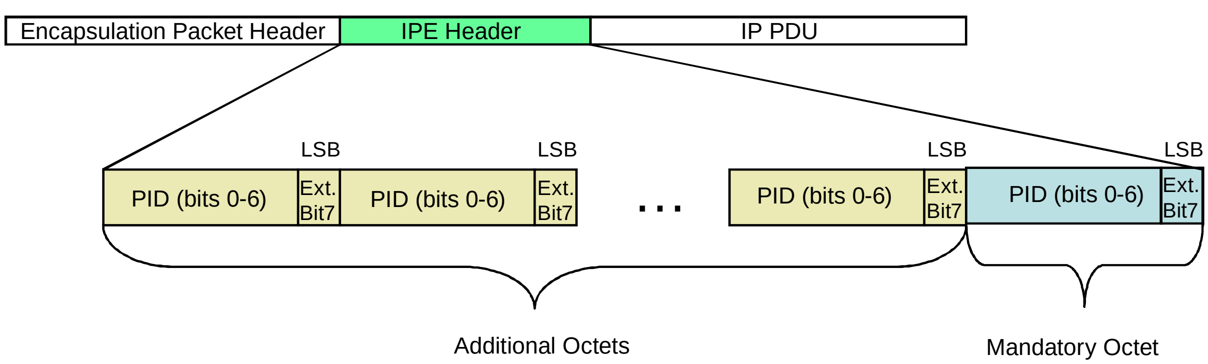

Figure A-2: IPE Header Format and Placement

A3.2 INTERNET PROTOCOL EXTENSION HEADER

A3.2.1 The IPE header shall be an integral number of octets in length, with a minimum length of one octet.

A3.2.2 Bit and octet ordering of the IPE header shall follow the conventions given in 1.7.

A3.2.3 The IPE header shall be extendable by adding more significant octets to the first octet. The use of one or more additional octets is signaled by setting the LSB of each octet of the header except the final (least significant) octet to '0'; the LSB of the IPE header shall be set to '1'.

EXAMPLE – For an IPE header value of 33 (decimal) for a two octet header, the most significant octet would contain all zeros.

A3.2.4 The IPE header shall be interpreted as an unsigned integer value, per the convention given in 1.7.

A3.2.5 The IPE header shall contain one of the values given in table A-1.

A3.2.6 The IPE header value shall be the decimal value of the contents of the entire IPE header.

NOTE – Only the odd IPE header values are valid, since the LSB of the least significant octet must have a value of '1'.

If the IPE header consists of a single octet, then only odd IPE header values from 1 to 255 are valid.

If the IPE header consists of two or more octets, then

- odd IPE header values from 1 to 255 are valid;
- no IPE header values from 256 to 511 are valid (since the value of the LSB in the second least significant octet must have a value of '0');
- odd IPE header values from 513 to 767 are valid;
- no IPE header values from 768 to 1023 are valid (since the value of the LSB in the second least significant octet must have a value of '0').

This pattern continues across the entire IPE header space.

Table A-1: Enumerations for the IPE Header Values

IPE Header Value	Protocol Encapsulated	Reference
33	IPv4 datagram	[17]
35	Frame Relay IP Header Compression Control Protocol (NOTE 1)	[21], section 4
87	IPv6 datagram	[18]
97	FULL_HEADER	[19]
99	COMPRESSED_TCP	[19]
101	COMPRESSED_TCP_NO_DELTA	[19]
103	COMPRESSED_NON_TCP	[19]
105	COMPRESSED_RTP_8	[20]
107	COMPRESSED_RTP_16	[20]
109	COMPRESSED_UDP_8	[20]
111	COMPRESSED_UDP_16	[20]
113	CONTEXT_STATE	[19], [20]

NOTES

1 Per this standard, the Frame Relay IP Header Compression Control Protocol exchange is not required for header compression to take place on the link. The alternative is that the use of header compression is by prior arrangement and the associated parameters have been preconfigured. This is the only option for header compression on a one way link. If header compression options are misconfigured between sender and receiver, the link will not successfully pass IP packets, as is true with any misconfiguration (e.g. Virtual Channel number used for IP over AOS). For this reason, use of IP header compression negotiation is useful and recommended where feasible.

2 The IPE Header is an extension to the Encapsulation Packet header in that it effectively expands the number of IP protocols that can have a standardized definition for transport over CCSDS space data links.

3 Since the most significant octets occur first, octets with the value of zero are effectively fill octets.

4 All IPE header numbers will by definition be odd. A consequence of signaling additional octets in the IPE Header by setting the extension bit to ‘0’, results in discontinuities in the IPE header value as discussed in the note at A3.2.6.

5 To support the IPE header, processing and parsing of the header is required. Besides multiplexing and demultiplexing, which can subsequently involve stateless mapping between link layer conventions used on other link layers, no additional processing is intended. Such processing would be considered to be specific to the protocols that are identified via this header.

ANNEX B

ACRONYMS

(INFORMATIVE)

This annex lists the acronyms used in this Recommended Standard.

AOS	Advanced Orbiting Systems
APID	Application Process Identifier
BGP	Border Gateway Protocol
CCSDS	Consultative Committee for Space Data Systems
CFDP	CCSDS File Delivery Protocol
CLCW	Communications Link Control Word
D-ID	Domain Identifier
ES-ID	End System Identifier
IANA	Internet Assigned Numbers Authority
ID	Identifier
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
ISO	International Organization for Standardization
MAP	Multiplexer Access Point
N/A	Not Applicable
OSPF	Open Shortest Path First
PDU	Protocol Data Unit
P-ID	Path Identifier
PIM	Protocol-Independent Multicast
Prox	Proximity-1 Space Link Protocol
SCID	Spacecraft Identifier
SCPS	Space Communications Protocol Standards
SCPS-FP	Space Communications Protocol Standards File Protocol
SCPS-NP	Space Communications Protocol Standards Network Protocol
SCPS-SP	Space Communications Protocol Standards Security Protocol
SCPS-TP	Space Communications Protocol Standards Transport Protocol

TC	Telecommand
TM	Telemetry
TP-ID	Transport Protocol Identifier
VC	Virtual Channel
VCID	Virtual Channel Identifier

CCSDS HISTORICAL DOCUMENT

ANNEX C

INFORMATIVE REFERENCES

(INFORMATIVE)

[C1] *Procedures Manual for the Consultative Committee for Space Data Systems*. CCSDS A00.0-Y-9. Yellow Book. Issue 9. Washington, D.C.: CCSDS, November 2003.

NOTE – Normative references are listed in 1.8.

ANNEX D

LOCATION OF PACKET LENGTH FIELD

(INFORMATIVE)

Table C-1 summarizes the location of the length field of Packets for which Packet Version Numbers are defined by CCSDS.

NOTE – This information is used by the Space Data Link Protocols (reference [8]-[10]) and Proximity-1 Space Link protocol (reference [11]) to extract Packets from the Data Field of Transfer Frames.

Table D-1: Location of Packet Length Field

Version Number	Binary Encoded Version Number	Packet	Location of Length Field (See NOTE)	Interpretation of Length	Refer-ence
1	000	Space Packet	32-47	Binary count of number of octets in Packet Data Field minus 1. Must add 7 to get full packet length.	[6]
2	001	SCPS-NP	3-16	Binary count of total octets in Packet, including header. Shortest legal length is 4 (= 4 octets).	[7]
8	111	Encapsulation Packet	8-15, 16-31, or 32-63	Binary count of total octets in Packet, including header.	[13]

NOTE – Counted in bits, from beginning of packet; first bit is numbered zero.