The Consultative Committee for Space Data Systems

Recommendation for Space Data System Standards

AOS SPACE DATA LINK PROTOCOL

ECSS MODIFIED VERSION

RECOMMENDED STANDARD

CCSDS 732.0-B-3

BLUE BOOK
September 2015

1 INTRODUCTION

1.1 PURPOSE

The purpose of this Recommended Standard is to specify the Advanced Orbiting Systems (AOS) Space Data Link Protocol. This protocol is a Data Link Layer protocol (see reference [1]) to be used over space-to-ground~~, ground-to-space,~~ or space-to-space communications links by space missions.

Commented [GPC1]: ECSS Change

1.2 SCOPE

This Recommended Standard defines the AOS Space Data Link Protocol in terms of:

a) the services provided to the users of this protocol;

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

c) the procedures performed by the protocol.

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 protocol.

1.3 APPLICABILITY

This Recommended Standard applies to the creation of Agency standards and to future data communications over space links between Consultative Committee for Space Data Systems (CCSDS) Agencies in cross-support situations. The Recommended Standard includes comprehensive specification of the services and protocol 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.

4.1.2.5 Signaling Field

4.1.2.5.1 General

4.1.2.5.1.1 Bits 40–47 of the Transfer Frame Primary Header shall contain the Signaling Field.

4.1.2.5.1.2 The Signaling Field shall be used to alert the receiver of the Transfer Frames with respect to functions that: (a) may change more rapidly than can be handled by management, or; (b) provide a significant cross-check against manual or automated setups for fault detection and isolation purposes.

4.1.2.5.1.3 This 8-bit field shall be subdivided into four sub-fields as follows:

a) Replay Flag (1 bit, mandatory);

b) Virtual Channel (VC) Frame Count Cycle Use Flag (1 bit, mandatory);

c) Reserved Spares (2 bits, mandatory);

d) Virtual Channel Frame Count Cycle (4 bits, mandatory).

4.1.2.5.2 Replay Flag

4.1.2.5.2.1 Bit 40 of the Transfer Frame Primary Header shall contain the Replay Flag.

4.1.2.5.2.2 The Replay Flag shall be set to '0'~~Recognizing the need to store Transfer Frames during periods when the space link is unavailable, and to retrieve them for subsequent replay when the link is restored, this flag shall alert the receiver of the Transfer Frames with respect to its 'realtime' or 'replay' status. Its main purpose is to discriminate between realtime and replay Transfer Frames when they both may use the same Virtual Channel.~~

NOTE – When the Replay Flag is '0' it indicates a Realtime Transfer Frame. CCSDS allows also the value '1' for this flag to indicate Replay Transfer Frames. ECSS does not allow this as there are alternative means of replaying Frames and there is an increase of complexity for processing at Receiving End.

Commented [GPC2]: ECSS Change

Commented [GPC3]: Note modified in Meeting 19 September 2017.

~~**4.1.2.5.2.2** The Replay Flag is interpreted as follows:~~

~~a) '0' = Realtime Transfer Frame;~~

~~b) '1' = Replay Transfer Frame.~~

~~NOTES~~

~~1 Owing to the wide spectrum of onboard storage and retrieval technology options, the exact interpretation of this Flag is necessarily the subject of negotiation between projects and cross-support organizations. For instance, it may be interpreted to~~

~~indicate that the value of the Virtual Channel Frame Count field on the replayed VC decreases, rather than increases, as a function of reverse playback.~~

~~2 If Transfer Frames are stored after encoding by the Channel Coding Sublayer, they must be re-encoded if the status of the Replay Flag is altered after retrieval.~~

4.1.2.5.3 Virtual Channel (VC) Frame Count Cycle Use Flag

4.1.2.5.3.1 Bit 41 of the Transfer Frame Primary Header shall contain the VC Frame Count Cycle Use Flag.

4.1.2.5.3.2 This one-bit field shall indicate whether the VC Frame Count Cycle field is used; its value shall be interpreted as follows:

a) '0' = VC Frame Count Cycle field is not used and shall be ignored by the receiver;

b) '1' = VC Frame Count Cycle field is used and shall be interpreted by the receiver.

4.1.2.5.4 Reserved Spare

4.1.2.5.4.1 Bits 42-43 of the Transfer Frame Primary Header shall contain the reserved spare.

4.1.2.5.4.2 This 2-bit field is reserved for future definition by CCSDS and shall be set to '00'.

4.1.2.5.5 Virtual Channel (VC) Frame Count Cycle

4.1.2.5.5.1 If used, bits 44-47 of the Transfer Frame Primary Header shall contain the Virtual Channel Frame Count Cycle field.

4.1.2.5.5.2 Each time the Virtual Channel Frame Count returns to zero, the VC Frame Count Cycle shall be incremented.

NOTE – The VC Frame Count Cycle effectively extends the Virtual Channel Frame Count from 24 to 28 bits.

4.1.2.5.5.3 If not used, bits 44 through 47 of the Transfer Frame Primary Header shall be set to 'all zeros'.

4.1.2.6 Frame Header Error Control

4.1.2.6.1 If implemented, Bits 48-63 of the Transfer Frame Primary Header shall contain the Frame Header Error Control.

NOTE 1 – The 10-bit Master Channel Identifier, the 6-bit Virtual Channel Identifier, and the 8-bit Signaling Field may all be protected by an optional error detecting and correcting code, whose check symbols are contained within this 16-bit field.

NOTE 2 – The use of the Frame Header Error Control may be restricted to Physical Channels where the AOS Transfer Frames are not protected by an error-correcting code in the Synchronization and Channel Coding Sublayer. For example, if the frames are protected by e.g. a Reed-Solomon code, the use of the Frame Header Error Control brings no benefit and is strongly discouraged.

Commented [GPC4]: ECSS Changes

4.1.2.6.2 The presence or absence of the optional Frame Header Error Control shall be established by management.

4.1.2.6.3 If present, the Frame Header Error Control shall exist in every Transfer Frame transmitted within the same Physical Channel.

4.1.2.6.4 Once set by management, the presence or absence of the Frame Header Error Control shall be static throughout a Mission Phase.

4.1.2.6.5 The mechanism for generating the Frame Header Error Control shall be a shortened Reed-Solomon (10,6) code. The parameters of the selected code are as follows:

a) 'J=4' bits per Reed-Solomon (R-S) symbol.

b) 'E=2' symbol error correction capability within an R-S code word.

c) The field generator polynomial shall be:

$F(X) = x^4 + x + 1$

over GF(2)

d) The code generator polynomial shall be:

$g(x) = (x + \alpha^6)(x + \alpha^7)(x + \alpha^8)(x + \alpha^9)$

over $GF(2^4)$

where $F(\alpha) = 0$,

$\alpha^6 = 1100$, $\alpha^7 = 1011$
$\alpha^8 = 0101$, $\alpha^9 = 1010$

also: