

# Space Link Services Area

## Resolution SLS-R-2016-04-002

### Start of CWE Project for update of “CCSDS 211.2-B-2 Proximity-1 Space Link Protocol - Coding and Synchronization Sublayer” Blue Book

**8 April 2016**

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**The Space Link services Area,**

**CONSIDERING** that

- The Coding & Synchronization Working Group evaluated a NASA Concept Paper identifying the need for updating CCSDS 211.2-B-2 Proximity-1 Space Link Protocol - Coding and Synchronization Sublayer Blue Book in order to support the forthcoming Version 4 Transfer Frame being defined by the Unified Space Link Protocol (USLP)
- the WG has consensus on this need

# Space Link Services Area

**RECOGNISING** that required resources have been identified

**RESOLVES** to request CMC to approve starting a new CWE Project for update of “CCSDS 211.2-B-2 Proximity-1 Space Link Protocol - Coding and Synchronization Sublayer” Blue Book as per attached Concept Paper

**RECOMMENDS** that the CMC approve this resolution and, finally

**REQUESTS** that a CMC poll be conducted to accomplish this.

Introducing Version-4 Transfer Frame (USLP) into CCSDS 211.2-B-2  
(Proximity-1 C&S Sublayer)  
NASA Concept Paper

## **I. Introduction**

CCSDS agencies (NASA, UKSA, DLR, ESA, CNES) are actively developing the USLP Space Data Link Protocol Blue book, which is a project within the SLP WG. Currently, the CCSDS 211.2-B-2 is constrained to only accept Version 3 (Proximity-1) transfer frames. In order for the Proximity-1 C&S sublayer to support the USLP frame, it is necessary to modify CCSDS 211.2-B-2 to accommodate in addition to the Version 3 frame, the Version 4 transfer frame defined in the draft USLP Space data link white book, CCSDS 732.1-W-1.

The description of the key technical features of what is being proposed is in the Annex.

The expected benefit is that the existing Proximity-1 C&S sublayer defining Proximity-1 link coding will be able to support the USLP Space Data Link Protocol.

Requirements on prospective missions is described in the Annex.

The relationship to existing standards: USLP Space Data Link Protocol needs to be compatible with the CCSDS 211.2-B-2 in order for member agencies to use it over the Proximity link.

When this effort becomes a CCSDS Project, this work needs to be coordinated with the SLP WG USLP Project, so that the updated CCSDS 211.2 document is issued along with the release of the USLP Blue Book.

## **II. Schedule Impact**

Recommended Project Title: Proximity-1 Coding & Synchronization Sublayer Modification to support USLP Frame Format

Description: Modification of CCSDS 211.2-B-2 Proximity-1 Coding & Synchronization Sublayer to enable the additional use of the Version 4 transfer frame i.e., USLP transfer frame over the Proximity-1 Space Link.

There are no patent issues for this technology that are known by the CCSDS community.

This project is dependent upon the work being done by the SLP WG on the USLP Blue Book Project, in which the format of the USLP transfer frame is being defined.

Book Editor to be supplied by NASA at 0.1 full time equivalent for duration of project.

Prototype Description - Both NASA and DLR have said that they will provide resources for prototyping the USLP version 4 transfer frame. This work is currently underway in the USLP Blue Book project under SLP WG. The Proximity-1 link is one of several data link environments to be tested.

Proposed Schedule:

Project Approved	5/15/2016
Planned Project Start Date	5/25/2016
Internal WG Review	
- First draft circulated to WG	6/15/2016
- First draft comments due	7/15/2016
- Second draft circulated to WG	8/15/2016
- Second draft comments due	9/19/2016
- Final WB submitted to AD for further processing	11/14/2016
Secretariat Document Processing	12/12/2016
First Agency Review	1/25/2017
RID Resolution	2/22/2017
Secretariat Document Processing	3/21/2017
Final Agency Review	3/28/2017
RID Resolution	4/10/2017
First Prototype Development	9/26/2016
Second Prototype Development	3/8/2017
CMC Approval	7/24/2017

## ANNEX A - "Modifications to Existing CCSDS 211.2-B-2"

### A. *Locating the Frame Length Field in USLP Space Data Link Protocol* (Section A pertains to the USLP White Book specification)

In order for the C&S sublayer to function with Version 4 transfer frames, the C&S sublayer must be able to find the frame length field within the Version 4 transfer frame. The transfer frame length field in USLP is a 16-bit field defined in Section 4 in the Transfer Frame Header of CCSDS 732.1-W-1 as follows:

#### 4.1.2.7 Frame Length

- 4.1.2.7.1 Bits 32–47 of the Transfer Frame Primary Header shall contain the Frame Length.

- 4.1.2.7.2 This 16-bit field shall contain a length count  $C$  which equals one fewer than the total octets in the Transfer Frame.
- 4.1.2.7.3 The count shall be measured from the first bit of the Transfer Frame Primary Header to the last bit of the Frame Error Control Field (if present), or to the last bit of the Operational Control Field (if present), or to the last bit of the Transfer Frame Data Field (if both the FECF and the OCF is omitted).

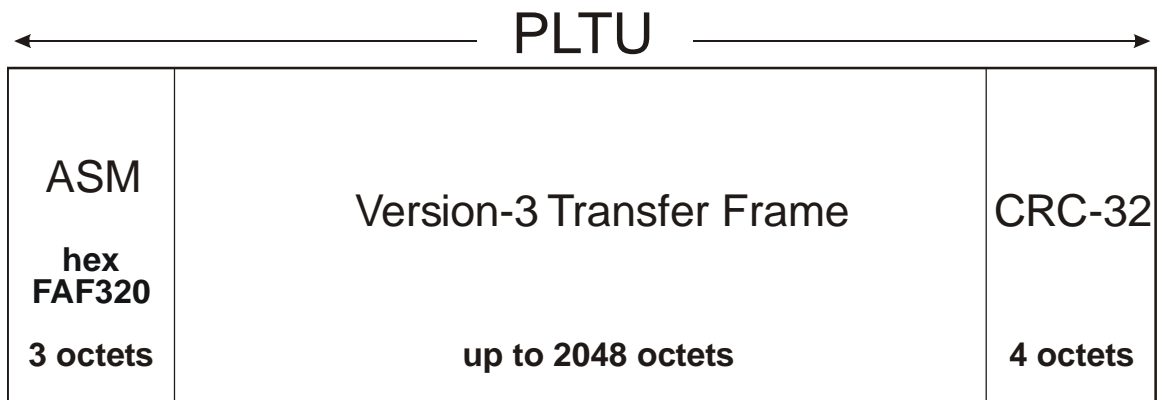
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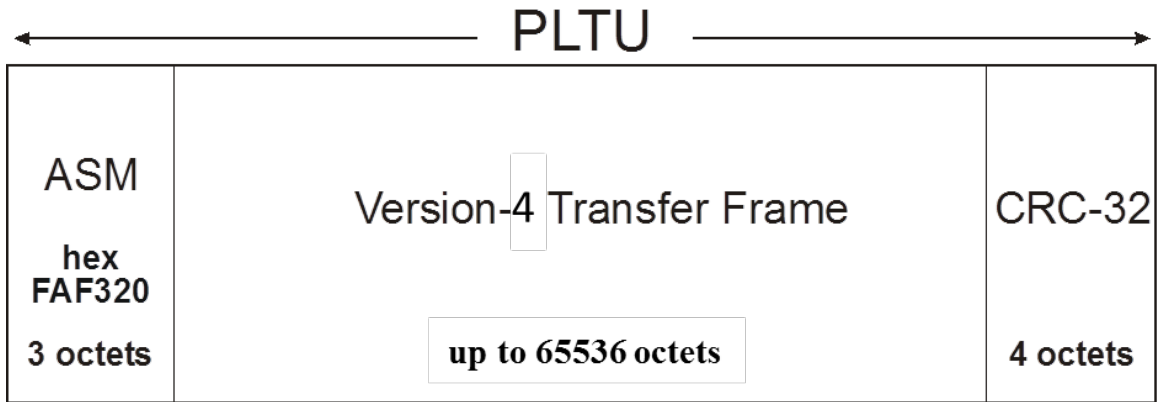
- 1 The length count  $C$  is expressed as:  
  
 $C = (\text{Total Number of Octets in the Transfer Frame}) - 1$
- 2 The size of this field limits the total number of octets in the Transfer Frame to 65536 octets.

Note – The USLP white book defines the Transfer Frame Version Number as a 4-bit field instead of the previous 2-bit Version number defined in AOS, TM, and TC. However, the previous 2-bit TFFNs are compatible with the new 4-bit field definition.

**B.** *Definition of the Proximity-1 PLTU Structure must be modified to work with Version-4 Frame (Sections B through G applies to CCSDS 211.2-B-2)*

Currently, CCSDS 211.2-B-2 only supports the Version-3 Transfer Frame whose maximum size is constrained to 2048 octets. However, the proposed Version-4 transfer frame can accommodate a maximum size of 65536 octets. This is shown in the figure below comparing the current PLTU and the additional change to the PLTU definition to accommodate the Version-4 transfer frame.





In addition, a new requirement (slightly modified from the existing one that defines the Version-3 Transfer Frame) will need to be added to CCSDS 211.2-B-2 in order to fully define the PLTU structure when supporting the USLP. A draft requirement is stated below:

#### VERSION-4 TRANSFER FRAME

The **Version-4** Transfer Frame in a PLTU shall immediately follow the ASM.

NOTE – The presence or absence of the FECF is specified by the Presence of Frame Error Control Managed Parameter in CCSDS 731.1-W-1. When using CCSDS 211.2-B-2, the Version-4 Transfer Frame does not include the FECF within the Transfer Frame. Specification of the Version-4 Transfer Frame is defined in CCSDS 731.1-W-1.

#### CYCLIC REDUNDANCY CHECK (CRC-32)

In order to complete the definition of the PLTU, the CRC-32 will need to immediately follow the Version-3 or **Version-4** Transfer Frame.

#### C. *Changes affecting Channel Coding*

#### CODING OPTIONS

The Coding & Synchronization Sublayer will also need to process **Version-4** Transfer Frames and produce a bit stream for encoding (including PLTUs and Idle Data) at data rate  $R_d$ , defined in the Proximity-1 Physical Layer book.

#### D. *Changes affecting Send Side Procedures*

The C&S Sublayer shall accept Version-3 or **Version-4** Transfer Frames from the Frame Sublayer.

When time tag collection is active **and LDPC coding is not employed**,

- a) before computing CRC, the C&S Sublayer shall store the values of the clock, frame sequence number, QOS Indicator, and direction (egress) of each outgoing Version-3 or **Version-4** Transfer Frame.

*E. Changes affecting Receive Side Procedures*

The C&S Sublayer shall use the ASM to locate the beginning of a PLTU, for frame synchronization with the Version-3 or **Version-4** Transfer Frame it contains.

The C&S Sublayer shall use the Frame Length field in the Transfer Frame Header of the Version-3 or **Version-4** Transfer Frame to locate the position of the CRC-32 field of the PLTU.

When time tag collection is active **and LDPC is not employed**,

- a) after decoding, the C&S Sublayer shall store the values of the clock, frame sequence number, QOS Indicator, and direction (ingress) of each received Version-3 or **Version 4** Transfer Frame.

*F. ANNEX B Service Changes*

Include Version-4 Transfer Frames in addition to Version-3 Transfer Frames.

*G. ANNEX C CRC-32 Coding Procedures Changes*

Include Version-4 Transfer Frames in addition to Version-3 Transfer Frames.