**Concept Paper for introducing the slicing of transfer frames**

# Purpose

The purpose of the proposed work is to create a new book that documents transfer frames slicing in one place, such that it can be adopted in combination with synchronization and coding books (CCSDS 131.0-B, 131.2-B, 131.3-B, and 142.0-B).

# Key Technical Features

The new Blue Book will document an optional slicer that allows decoupling of the transfer frame length from the codeword/codeblock length, and replaces the transfer frame interface specifications in CCSDS 131.0-B, 131.2-B, 131.3-B, and 142.0-B.

This will be done by using the same slicing strategy that was adopted in CCSDS 131.0-B for LDPC encoding of a stream of synch-marked transfer frames (SMTFs).

# Benefits

Currently all of the CCSDS Link Layer documents assume that the selected Coding & Synchronization layer standards set the data link layer frame lengths. This couples the data link layer and the coding sub-layer and constrains the frame length options. At the same time the CCSDS 131.0-B foresees that all block codes, except LDPC of a SMTFs stream, shall perform the encoding of a single complete transfer frame. Thus, the transfer frame length depends directly on the selected codeword/codeblock length and both are delimited by the same Attached Synch Marker (ASM). For instance, for RS(223,255), I=5, the transfer frame length shall be fixed to 8920 bits.

This approach of separating slicing from the frame length will instead allow to have a transfer frame length that is independent of the codeword/codeblock length, hence introducing an additional degree of freedom. Additionally, although not part of this project, it is an enabler for the introduction of

* CCSDS variable length frames, that could be potentially enable in future CCSDS C&S standards, or,
* other standards (e.g., ITU GFP), or,
* enabling data link frame sizes to be tuned for the data requirements separate from the codeblock length which can be tuned for error correction and the link characteristics.

# Requirements of prospective missions

Space-to-Earth links in future space missions could require multiple coding options depending on the mission phases. For instance, a spacecraft orbiting around a Lagrange point, transmitting in X-Band, could require high-rate coding options during nominal phases, with the aim of maximizing the spectral efficiency, and low-rate coding options during safe and emergency modes. Such kind of coding profiles require that the transfer frame encapsulation is always adapted to the selected codes. On the other hand, the transfer frame formatting is often driven by the on-board computer implementation, that has less flexibility w.r.t. TM transmitters.

Thus, the objective of this activity is to provide an additional degree of freedom that allows to decouple the transfer frame length, allowing to better optimize the data rates for future missions.

Additionally, the slicing is an enabler for variable length frames, that could be adopted in future lunar and Martian missions, for which link directionality among local links and inter-satellite links is not a discriminating concept.

**ANNEX 1 – Proposed Charter Modifications**

The charters of C&S do not require any update.

**ANNEX 2 – Proposed CWE Projects**

**Title: Transfer frame slicing for TM synchronization and coding**

**Document Number:** To be assigned.

**Document Type:** Red Book + Pink Books

**Description of Document:** The new blue book is going to provide an optional slicer, that can be adopted by 131.0-B (TM coding and synch), 131.2-B (SCCC), 131.3-B (DVB-S2), and 142.0-B (optical coding & synch).

The current 131.0-B, 131.2-B, 131.3-B, and 142.0-B will need to be updated to remove some current text and add the reference to this new document. Similarly the current data link protocol documents (TC, TM, AOS, and USLP) will need to be reviewed and updated to reflect that the frame data length may be selected based of data handling requirements and separate from the limitations of the C&S codeblock sizes.

**Applicable Patents:** -

**Patents Comments:** -

**Book Editor (estimated resources + Agency Volunteering):** Total resources 3 mm in ESA and 3 mm in NASA. Book editor ESA and NASA

**Prototype 1 (estimated resources + Agency Volunteering):** 3 mm ESA

**Prototype 2 (estimated resources + Agency Volunteering):** 3 mm NASA

**Expected Contributing Agencies:** ESA, NASA

**Expected Monitoring Agencies:** CNES, DLR

**Schedule**

**December 2022 – February 2024**

**Total time to complete: 14 months**

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| **Schedule Milestones** | **Forecast** | **Comments** |
| Project Approved | 15 December 2022 |  |
| First draft circulated to WG | April 2023 | Before Spring 23 Meeting |
| First draft comments due | May 2023 | At Spring 23 Meeting |
| Second draft circulated to WG | N/A | Not expected |
| Second draft comments due | N/A | Not expected |
| Final WB Submitted to AD for further processing | June 2023 | After Fall 23 Meeting |
| Secretariat Document Processing | September 2023 |  |
| First Prototype Development  | N/A |  |
| Second Prototype Development | N/A |  |
| First Agency review | October 2023 |  |
| RID Resolution | November 2023 |  |
| Second Agency Review | Not expected |  |
| CMC Approval | February 2024 | Approved by CMC Poll  |