**Extension of downlink channel codes to uplink and interface with USLP**

**SLS C&S WG workplan**

# Motivation

CCSDS 131.3 “Space link protocols over ETSI DVB-S2 standard” blue book issue 2 pink sheets have been submitted to CESG poll for agency review, following a C&S WG / SLS Area resolution. This CESG poll has been blocked by SEA AD on the ground that the extension of this originally downlink DVB-S2 code to uplink and space-to-space links and usage with USLP should also be applicable to the TM channel codes specified in CCSDS 131.0. This paper summarizes the sequence of events, the current objectives and the workplan of the SLS/C&S WG regarding the extension of usage of downlink channel codes to uplink and USLP.

# A bit of history

The topic of extending the usage of CCSDS recommended downlink codes (TM (131.0), SCCC (131.2), DVB-S2 (131.3)) has been discussed during the 3 preceding C&S WG meeting. The sequence of debates, actions and resolution is the following:

## CCSDS Fall 2018 meeting

Extract of the C&S WG minutes of meeting:

“**2.1 Modifications to 131.0-B to add AOS and USLP Uplink (NASA)**

… the working group agreed to the text, “Prepare a concept paper to 1) rename, remove link directions and protocols from TM C&S Blue Book, 2) same with SCCC, 3) same with DVB-S2, 4) prepare Profiles Blue Book to enumerate combinations”. During preparation of the meeting minutes, it became clear that ESA and NASA understood these words differently. One solution to achieve this is, “all three C&S books should be harmonized to describe that the coding schemes there described apply to fixed-length CCSDS Transfer Frames over various communication links (ground-to-space, space-to-space, and space-to-ground) but omitting the specification of the allowed combinations, as a new “Profiles” book would be written to specify the recommended combinations of coding schemes, communication links, and space link protocols (TM, AOS, or USLP).” Another solution to achieve this is: “the specifications about both communications link direction (e.g. space-to-ground) and supported space link protocols (e.g. TM, AOS, or USLP) should be deleted from all three C&S books, the TM Coding and Synchronization Blue Book should be renamed to avoid the term “TM”, and a new “Profiles” book should be written to specify the recommended combinations of codes, link directions, and protocols.” The meeting did not explore the two solutions in detail.

While nobody present would speak with authority about the colour of the Profiles book to be written, many knew that Peter Shames believed it should be a Blue Book. All of these activities will be captured in a single concept paper (AI\_18\_16), to initiate new projects for each of the books to be edited.

**AI\_18\_16** - Prepare a concept paper to: 1) rename, remove link directions and protocols from TM C&S Blue Book, 2) same with SCCC, 3) same with DVB-S2, 4) prepare Profiles Blue Book to enumerate combinations [Note: see paragraph 2.1 of the minutes for further explanation]

## CCSDS Spring 2019 meeting

Extract from the C&S WG minutes of meeting:

**“2.4 AOS and USLP uplink (NASA)**

Presentation SLS-CS\_19-05 given by K. Andrews/NASA, about the support of ground to space and space to space links with the coding options out of the TM Coding Blue Book. NASA proposal is to add a short chapter specifying which coding options may be used for this purpose. A concept paper has been prepared to address the work required. NASA acknowledges that other Agencies may be interested in pushing different options as well, i.e. SCCC/DVB-S2 and would support the relevant charter addition when requested by relevant Agency. Among the changes, the proposal would introduce referencing to USLP protocol in addition to AOS and TM already cited in the book. M. di Giulio/ESA stressed how the change should be limited to fixed frame length, once USLP is used. G.P. Calzolari/ESA underlined how the CRC may change with USLP (CRC-32 allowed in that case) and this should be signalled somehow (e.g. managed parameter).

A possible new name of the modified book was debated, but no consensus was achieved during the meeting. Consensus on the concept paper was formally recorded with WG resolution to submit it to CMC approval to initiate the work required to implement this update in CCSDS 131.0-B.

**AI\_18\_16** - Prepare a concept paper to: 1) rename, remove link directions and protocols from TM C&S Blue Book, 2) same with SCCC, 3) same with DVB-S2, 4) prepare Profiles Blue Book to enumerate combinations [Note: see paragraph 2.1 of the minutes of the Fall 2018 MOM for further explanation]”

This spring 2019 meeting enabled to reach a consensus within the C&S WG on the scope and content of the NASA concept paper (AI\_18\_16) and therefore issue a resolution to start 3 projects in parallel with the same objectives: extending usage of CCSDS downlink codes to uplink and space-to-space links, using AOS or USLP protocols. The 3 projects started following this meeting are summarized in the table hereafter:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Project title** | **Recommendation reference** | **Description of the project** | **CMC approval date** | **Book editor Agency** |
| “TM Synchronization and Channel Coding” Issue 4 | 131.0-B Issue 4 | The Recommended Standard for TM Synchronization and Channel Coding contains specifications to be used by space missions on synchronous communications links. This update to the Blue Book will produce issue 4, and will add a short chapter that specifies a subset of codes to be used in ground-to-space links. Input of USLP frames will also be addressed. | 6/5/2019 | NASA |
| Flexible Advanced Coding and Modulation Scheme for High Rate Telemetry Applications, Issue 2 | 131.2-B Issue 2 | This update to the Blue Book will produce issue 2, enabling the use USLP frames as well as allowing space-to-space and ground-to-space links applications. | 7/22/2019 | ESA |
| Space link protocols over ETSI DVB-S2 standard, Issue 2 | 131.3-B Issue 3 | This update to the Blue Book will produce issue 2, enabling the use USLP frames as well as allowing space-to-space and ground-to-space links applications. | 7/22/2019 | CNES |

## CCSDS Fall 2019 meeting

Extract from the C&S WG minutes of meeting:

**“2.1 General (AIs etc.)**

The WG reviewed the AI list, closing actions when possible based on inputs received since the previous meeting. In discussing AI\_18\_16 (for which point 4 (prepare Profiles Blue Book to enumerate combinations ) is open), the WG agreed that the profile book referred to in this action should be Magenta and not Blue as originally proposed in previous meeting, and that the closure of the action (i.e. delivery of concept paper) should reflect this decision.

**2.6 Update of DVB-S2 BB (CNES)**

Presentation SLS-CS\_19-18 given by C. Dudal/CNES on the update of the existing Blue Book 131.3-B to include USLP and extend the applicability to ground-to-space and space-to-space. Among the changes, applicability to SRS services was included (on top of the existing applicability to EESS). The WG agreed to ask the AD to issue the area resolution for submitting DVB-S2 BB pink sheets to Agency Review (AI\_19\_22, M. Bertinelli/ESA).”

**At this meeting, among the 3 projects started at the preceding meeting (listed in 2.2), only one input was provided by CNES for the DVB-S2 Issue 2 pink sheets.** Those pink sheets were discussed and approved by the WG for submission to Agency Review.

The two other projects did not submit any material.

The so-called “Profiles” magenta book was agreed to list all recommended combinations of channel codes, type of links and data link protocols.

# Current situation

CESG poll for approving Agency Review of DVB-S2 BB pink sheets has been blocked by SEA AD on the ground that the extension of this originally downlink DVB-S2 code to uplink and space-to-space links and usage with USLP should also be applicable to the TM channel codes specified in CCSDS 131.0.

As already stated by SLS area representative during the CESG telecon on March 10:

* There are 3 C&S projects on going aiming at extending the use of downlink codes to uplink using AOS/USLP as requested by SEA AD. Those 3 projects are fully coherent technically in terms of objectives. Each project is going at its own pace because they depend on the input of their lead agency to provide drafts to the WG. In the end, all the downlink codes suitable for uplink and space-to-space links will be allowed in combination with AOS and USLP data link protocols. A so-called “Profiles” magenta book will be developed if necessary to list all recommended combinations of channel codes, type of links and data link protocols.
* making the Agency Review conditional on input for a different book (agreed by C&S & SLS but) not provided by other Agency is illegitimate.
* There is no reason to synchronize the agency reviews of the resulting 3 pink sheets.
* No comment/PID was raised on the document submitted to CESG poll for Agency Review.

For all these reasons, if the CESG poll cannot be concluded positively, SLS area will ask for escalation to CMC.