CCSDS Fall 2023 meetings

SLS C&S Working Group Minutes of the Meeting

Because of unavailability of C&S chair and deputy for CCSDS Fall 2023 technical meetings in CW45, the C&S convened by teleconference on October 30th.
Agenda is provided in Annex 1, and this MoM shall be intended as record of the teleconference only.

Joint meetings of C&S WG with RFM and SLP WGs, were instead held as physical meetings in The Hague, chaired by the D. Lee/RFM WG chair.
For the minutes of these meetings, please refer to RFM WG MoM.

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1 C&S MEETING

The C&S meeting was held on October 30th.

1.1 Update of 131.0 to include Turbo channel interleaver (SLS-CS_23-14)

Presentation of J. Quintanilla/ESA for showing the proposed changes to 131.0-B (TM BB), for including a Turbo Channel interleaver as per AI_23_03.

For the reader convenience, it is reminded that the Turbo Channel interleaver does a row-column interleaving of the bits of a single Turbo-coded transfer frame, for avoiding the issues found in the scenario of a tumbling spacecraft and in that of communication link subject to solar scintillations (see SLS-CS_21-05 for a summary).
An ESA HW prototype was also developed in the framework of the VIRTUDE project (see SLS-CS_22-14).

From the input presentation and its discussion, the following points are highlighted:
- In the VIRTUDE project, testing was done by placing the interleaver after the pseudo randomizer. However, since the original WG intention was to make the interleaver part of the Turbo-encoding function, C&S preference is to swap the order and thus perform the interleaving before the pseudo-randomization. In this way, it is ensured that:
  - the sub-layer structure is not modified (see Figure 2-2 in BB);
  - the cross-correlation properties of the pseudo-randomizer are not altered.
  C&S WG does not expect that the swapping will cause any change of performance as seen in the VIRTUDE project. For confirmation, J. Quintanilla/ESA took action to perform a SW simulation for replicating VIRTUDE results when the interleaving is done before the pseudo-randomization (**AI_23_07**).
- During the drafting of the BB update, it was observed that the:
  - Turbo Code chapter (Section 6 of the current BB) has an editorial organization that is not well harmonized with the remainder of the book, in particular for the normative clauses headings. Thus, it was proposed to re-organize the headings in the numerical format C.S.SS.P as adopted throughout the book (where letters refers to the number of Chapter, Section, Subsection, Paragraph, e.g., 6.1.1.1). As part of normal work, J. Quintanilla/ESA will check with Tom Gannett/CCSDS Secretariat if there are specific recommendations.
  - The BB requires a full revision of the terminology, to ensure that is aligned with RFM BB 401.0-B and (possibly) SFCG reccomendations. In particular, J. Quintanilla/ESA identified that the 'Frame Synchronization' chapter in the TM BB often refers to 'channel symbols', while it was probably meant 'coded symbols'. This revision will be carried out as part of the WG review (see AIs in next section).

Finally, it was noted that 130.1-G (TM GB) will need to be updated for being aligned with the current BB for the following items:
- Use of TM codes in Ground-to-space links;
- Compatibility with USLP frames

- 17-cell randomizer
- Turbo channel interleaver
- Transfer Frame slicing.

The WG agreed to tackle this update as part of the GB re-confirmation required by 2025 (**AI_23_08**), with book captain J. Quintanilla/ESA and contributions of A. Modenini, N. Maturo/ESA, and K. Andrews/NASA.

1.2 Update of 131.0 to include TF slicing (SLS-CS_23-15)

Presentation of K. Andrews/NASA for showing the proposed changes to 131.0-B (TM BB), for including a TF slicing, as per AI_23_02, in line with the agreements taken in CCSDS Spring 2023 (see Section 1.3 of C&S MoM).

For the WG's convenience, proposed changes were included in the same Word file of previous input.

It was noted that the draft did not include a clause about the ASM bypass, as recommended by SLS DAD proposal (see page 6 of of C&S Spring 2023 MoM), since it was intended as non-normative. Following discussion, the WG eventually agreed to include at least a non-normative note for providing an explicit reference.

During the presentation, the WG noticed also some discrepancies (e.g., SMTFs to be removed from Figure 2-2 and 2-3 in the draft document). On the other hand, it was recognized that the draft (including the Turbo channel interleaver) is mature enough for starting a detailed WG review, in which all possible discrepancies can be tackled.

In this respect, it was agreed as way forward:
- WG to review the document in CWE and provide comments to K. Andrews/NASA and J. Quintanilla/ESA by end of November (**AI_23_09**)
- During the same time period, A. Modenini/ESA to check the terminology of coded/channel bit/symbol and eventually provide a harmonized terminology to be adopted in the 131.0-B (**AI_23_10**)
- K. Andrews/NASA and J. Quintanilla/ESA, following AI_23_09 and AI_23_10, to provide an updated draft of 131.0-B suitable for SLS AD Review (**AI_23_11**).

1.3 C&S WG status

Presentation of C&S chair reporting the status of WG activities. See presentation in CWE and Section 3 of this MoM.

2   JOINT C&S/SLP/RFM MEETINGS

Joint meetings were held in The Hague, during Fall 2023 technical meetings during CW45, and chaired by D. Lee/NASA.

Please refer to RFM MoM.

3 C&S WG STATUS

This section provides highlights of C&S activities. An executive summary can be found in the presentation in CWE.

3.1 Projects

Currently C&S WG is working on the following projects:
- *TM synchronization and coding – new channel interleaver for Turbo codes.*

and has three project proposals (still pending CMC approval):
- *Proximity-1 extension (with activities already started)*
- *Slicing of Transfer Frames (with activities already started)*
- *VCM Greenbook*
- *Erasure correcting codes for NE and DS*

With respect to Spring 2023 it is highlighted that:
- *TM synchronization and coding – new Randomizer* was completed (BB published in September 2023)
- *VCM Greenbook* was created as proposal, but is pending an additional iteration (**AI_23_12**, see Annex)
- It was found that CWE has a draft for *Erasure correcting codes for NE and DS* since 2015. Based on preliminary inquiring with member agencies, it appears and old for which there is no longer interest. During Spring 2023, C&S chair asked member agencies to raise the interest (if any) no later than Spring 2024, otherwise the project will be withdrawn.

3.2 Resolutions

No resolution were raised during C&S meetings.

3.3 Action Items status

AIs list was reviewed. Latest status is reported in Annex.

ANNEX 1: AGENDA

C&S meeting
Location: MS Team

Date/Time:
- **October 30th, 09:00 (Los Angeles),**
- **October 30th, 12:00 (Washington DC),**
- **October 30th, 17:00 (Amsterdam),**
- **October 31st, 01.00 (Tokyo)**

N°	Author	Agenda Topic C&S meeting	Estimated time allocation in minutes	REMARKS
1	ESA	Update of 131.0 to include Turbo channel interleaver	30	SLS-CS_23-14
2	NASA	Update of 131.0 to Include Transfer Frame Slicing	30	SLS-CS_23-15
3	Chair	C&S Status: • Project status review • Review of AIs (up to this meeting) • AoB	30	N/A
		TOTAL hours	1.5	

NOTES:
- Agenda for joint meetings (with discussion of all other inputs as reported in the list) was provided by RFM Chair (see RFM WG MoM).
- Inputs are available at https://tinyurl.com/CCSDS2023Fall.

ANNEX 2: ACTION ITEM LIST

Open action items are listed in the table below.
AIs closed during this meeting are cancelled out in the table below (with traceability about their closure).

The new AIs are those starting from AI_23_07. Those actions starting from AI_23_12 were raised during joint meetings (see RFM MoM) and re-traced also in the C&S WG AI list.

Latest version of AI list can be found on CWE (private folder, requires login): https://tinyurl.com/jyrjpz6a

AI#	Action	Actionee	Due date	Status	Traceability
AI_22_08	To implement a SW prototype for the Turbo Channel Interleaver	K. Andrews/NASA	Spring 2024	Open	
AI_22_09	To prepare C&S resolution for AOS max length technical corrigendum, and possibly inject changes as part of TF slicer ~~TM BB randomizer Agency Review~~ Edited between Fall 2022 and Spring 2023: SLS AD recommended as part of TF slicer	A. Modenini/ESA	Spring 2024	Open	
~~AI_23_01~~	~~To draft CWE project for a VCM Green Book that provides system results of using VCM (SCCC, DVB, or LDPC)~~	~~A. Modenini/C&S Chair~~	~~Fall 2023~~	~~Closed~~	SLS-CS_23-09, See RFM MoM
~~AI_23_02~~	~~To prepare draft Blue Book (pink sheets) of 131.0-B with transfer frame slicing as agreed in Spring 2023 (see Spring 2023 MoM for technical details), including technical corrigendum for AOS length~~	~~K. Andrews/NASA~~	~~Fall 2023~~	~~Closed~~	SLS-CS_23-15

~~AI_23_03~~	~~To update Channel interleaver description in 131.0-B making it 'optional' (with possible Note about the implications of not using it) and make it applicable only to Turbo Codes (and not as an independent function in a dedicated chapter)~~	~~J. Quintanilla/ESA~~	~~Fall 2023~~	~~Closed~~	SLS-CS_23-14
~~AI_23_04~~	~~to comment SLP WG proposal for Proximty-1 extension and provide a default table of modcods to be adopted~~	~~C&S chair + WG~~	~~Sep-23~~	~~Closed~~	SLS-CS_23-08, See RFM MoM
~~AI_23_05~~	~~to provide latest outcomes of SFCG 2023 about the definition of channels (frequency assignments and polarizations) in S-Band (and possible in K-Band) for Proximity-1 extension~~	~~D. Lee/NASA~~	~~Fall 2023~~	~~Closed in favor of AI_23_17~~	See RFM MoM
~~AI_23_06~~	~~To provide update of pink sheets for Proximty-1 211.2-B (c&s layer) and 211.1-B (phy layer), implementing the changes agreed in Spring 2023~~ ~~NOTE: related action items for 211.o-B (data link layer) is tracked in SLP WG.~~	~~N. Maturo/ESA~~	~~Fall 2023~~	~~Closed~~	SLS-CS_23-12 and SLS-CS_23-13, See RFM MoM
AI_23_07	to perform a SW simulation to see if VIRTUDE results can be replicated when Turbo-Code interleaving is done before pseudo-randomization	J. Quintanilla/ESA	Spring 2024	Open	
AI_23_08	Provide an update of 130.1-G (TM GB), in preparation of 2025 reconfirmation, for including the following: • Use of TM codes in Ground-to-space links; • Compatibility with USLP; • 17-cell randomizer; • Turbo channel interleaver;	J. Quintanilla/ESA, A. Modenini/ESA, N. Maturo/ESA, K. Andrews/NASA	Spring 2025	Open	

	• Transfer frame slicing. Book captain: J. Quintanilla/ESA				
AI_23_09	To review proposed changes to 131.0-B (TM BB) and send comments to K. Andrews/NASA and J. Quintanilla/ESA (with CC C&S Chair)	C&S WG	30th November 2023	Open	
AI_23_10	to check the terminology of coded/channel bit/symbol in 131.0-B and eventually provide a proposal for harmonizing the book with RFM and SFCG recommendations.	A. Modenini/C&S Chair	30th November 2023	Open	
AI_23_11	following AI_23_09 and AI_23_10, to provide an updated draft of 131.0-B suitable for SLS AD Review, with the target of having the 'start Agency Review' resolution by Spring 2024	K. Andrews/NASA, J. Quintanilla/ESA	1st February 2024	Open	
AI_23_12	Provide draft ToC for proposed new VCM green book	A. Modenini	December 2023	Open	See RFM MoM, AI_23-11
AI_23_13	Review draft VCM GB ToC and provide feedback to C&S chair on whether to proceed with development of the GB	All	January 2023	Open	See RFM MoM, AI_23-12

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AI_23_14	Provide draft Orange book on link budget data exchange format	A. Modenini, A. Miraglia	Spring 2024	Open	See RFM MoM, AI_23-13
AI_23_15	Provide analysis or measurements of the link performance degradation as a function of the carrier suppression for 16APSK/32APSK/64APSK modulation	A. Modenini	Spring 2024	Open	See RFM MoM, AI_23-14
AI_23_16	Provide draft revision of Recommendation (401) 2.4.17A to include high order modulations	A. Modenini	Spring 2024	Open	See RFM MoM, AI_23-15
AI_23_17	Liaise to the SFCG that the hailing channel in SFCG Rec 42-1 should be specified as a frequency rather than a frequency range.	D. Lee	Next SFCG in June 2024	Open	See RFM MoM, AI_23-16
AI_23_18	Modify text in the draft 211.2 Prox-1 Data Link Layer Blue Book to explicitly indicate that slicing will be used, instead of partitioning as stated in the current draft.	N. Maturo	Spring 2024	Open	See RFM MoM, AI_23-17
AI_23_19	Consider the number of mod indices that should be recommended for Prox-1 S-band and Ka-band.	RFM WG members	Spring 2024	Open	See RFM MoM, AI_23-18

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AI_23_20	Include specification of the filtering of the bi-phase signal in the draft update of 211.1 Prox-1 Physical Layer Blue Book based on the pink Recommendation 2.4.7A	N. Maturo	Spring 2024	Open	See RFM MoM, AI_23-19
AI_23_21	Perform analysis to determine if the Prox-1 S-band phase noise mask in Figure 5-2 of the draft 211.1 Prox-1 Physical Layer Blue Book is appropriate for low symbol rates.	W. Lee	Spring 2024	Open	See RFM MoM, AI_23-20
AI_23_22	Update the spurious emissions mask in Figure 5-3 of the draft 211.1 Prox-1 Physical Layer Blue Book to be in-line with the spurious lines resulting from filtering of the bi-phase signal	N. Maturo	Spring 2024	Open	See RFM MoM, AI_23-21
AI_23_23	Confirm the S-band Doppler frequency range and rate in Section 5.2.5	N. Maturo	Spring 2024	Open	See RFM MoM, AI_23-22

ANNEX 3: LIST OF PARTICIPANTS

NOTE: for joint meetings attendance, see RFM WG MoM.

Name	Affiliation
Amanuel Geda	DLR
Andrea Modenini	ESA
Antonio Miraglia	ESA
Gunther Sessler	ESA
Jorge Quintanilla	ESA
Kenneth Andrews	NASA
Nicola Maturo	ESA
Shannon Rodriguez	NASA
Stefan Veit	DLR
Victor Sank	NASA
Wai Fong	NASA
Wing-Tsz Lee	NASA
Xavier Enrich	Eumetsat
Jose David Ferris Gomez	ESA