SLS C&S Working Group
Minutes of the Meeting

CCSDS Spring 2024 technical meetings were held from November 4th to 8th in London, UK.

The C&S WG convened two days, on November 6th and 7th, for the following meetings: C&S, joint C&S/SLP/RFM, joint C&S/SLP/RFM/SDLS, and joint C&S/RFM.

1 C&S MEETING

The C&S meeting was held on November 6th.

1.1 Opening of C&S activities

Reference	N/A
Presenter	C&S chair
Inputs	• agenda • C&S status presentation
Minutes	Agenda was presented. Issue of the limited manpower and travel budget of ESA/ESTEC (see Spring 2024 MoM) for CCSDS activities is still present and monitored. As done for the past meeting, ESA-ESTEC representatives in C&S and RFM will inform immediately in case they are unable to attend Spring 2025, for ensuring that WGs can continue activities as planned.

1.2 Final edits to add TF slicing to the "TM coding" blue book

Reference	SLS-CS_24-17
Presenter	K. Andrews/NASA
Inputs	• presentation • pink sheets of 131.0-B (TM BB)
Minutes	Input for AI_24_01 and to reply comments received by SLS AD, following request for Agency review. Comments were reviewed, agreed, and implemented during meeting directly in the Pink sheets. The WG resolved that pink sheets (**RES#1**) can be sent for Agency review.

Outputs
- **RES#1**, to send Pink Sheets of 131.0-B for Agency Review.
- [Pink Sheets](#) of 131.0-B

2   JOINT C&S/SLP/RFM MEETING

The meeting was held on November 7th.

2.1 CCSDS 211.1 Pink Sheet (Proximity-1 RFM) and CCSDS 211.2 Pink Sheet (Proximity-1 C&S)

Reference	SLS-CS_24-13, SLS-CS_24-14
Presenter	N. Maturo/ESA
Inputs	• RFM supporting presentation • RFM pink sheets • C&S supporting presentation • C&S pink sheets

Minutes	Presentations gave latest updates in Proximity-1 C&S and RFM pink sheets for introducing S-Band extension. During meeting:
	
	• ESA confirmed (AI_24_14) that phase noise mask is considered at RF output. As such, it was agreed to remove the word "oscillator" from the specification in 4.2.3, and rephrase it as "transmitter phase noise";
	• Hailing modulation index was set to pi/3 rad-pk (60 degrees). It was also agreed to specify all modulation indexes in rad-pk instead of degrees;
	• Modulation index 0.2 was removed from the list of possible indexes, in favor of 0.0 rad-pk. The latter allows a "No-modulation mode" (carrier only when w/o ranging) that can be commanded through the Directive;
	• Differently from Spring 2024 agreements it was decided to apply filtering to Bi-Phase-L data format also for when doing Hailing (for meeting the SFCG mask when Bi-Phase-L/PM is used). In particular:
	  o The Spring 2024 agreement was initially due to ESA Lunar Pathfinder (LPF), with the intention of minimizing the loss on the hailing channel;
	  o ESA performed a second check with LPF and confirmed that filtering is actually acceptable also for the hailing.
	• the 255-bit pseudo-randomizer was made normative, since already adopted by LPF, while the usage of the 17-cell randomizer was excluded (since deemed as not required);
	• Maximum symbol rate was increased to 4096 ksps, in harmonization with UHF, and in favor that is a power of 2 of the minimum symbol rate (1 ksps);

- Upon CNES proposal, it was agreed to add a figure that clarifies the '1' and '0' voltage transitions versus advance/delay of the modulated-signal phase.

As follow up it was agreed:
- NASA (D. Lee and S. Rodriguez, **AI_24_17**) to provide a proposal for including PN ranging parameters in the RFM Blue Book (if feasible with the current status of PN ranging activities for space-to-space);
- N. Maturo/ESA to provide an update of the Pink sheets based on the meeting discussion (**AI_24_18**);
- By mid-December, the two pink sheets to be distributed to the WGs, and to have a meeting by mid-February for possibly releasing the sheets for Agency Review.

Output
- **AI_24_17**
- **AI_24_18**
- Agreement to have a mid-February progress meeting (remotely)

2.2 Byte alignment ambiguity in Prox-1 with LDPC coding

Reference   SLS-CS_24-18

Presenter   K. Andrews/NASA

Inputs
- Presentation

Minutes   With reference to 211.2-B-3, when using LDPC coding, the standard is not sufficiently clear if TF must be byte-aligned with LDPC codewords or not. As such industry is building HWs for lunar missions that can prevent inter-operability

Two possible corrigenda were given, for ensuring or preventing byte alignment.

The WGs eventually resolved to have a technical corrigendum (**RES#2**) for including byte alignment in the 211.2-B-3.

Chair will prepare technical corrigendum for SLS AD (**AI_24_19**).

Outputs
- **RES#2**, technical corrigendum for byte alignment in 211.2-B-3;
- **AI_24_19.**

2.3 Recap on S-Band proximity-1 activities, AoB

Reference	N/A
Presenter	A. Modenini/C&S Chair G. Kazz/SLP Chair

Inputs
- C&S status of activities presentation
- SLP default session control and directives word files

Minutes

Recap of S-Band proximity-1 activities was given:
- It was emphasized the target of having the Proximity-1 blue books published by January 2026, that requires an Agency Review by February 2025;
- Since there was no work on possible Ka-Band extension for Proximity-1, this will be dealt as separated project if required. Interested member agencies can send inputs in future CCSDS technical meetings.

G. Kazz/SLP chair presented latest version of SLP default session control and directives. Minor discrepancies with Proxy-1 RFM and C&S pink sheets were corrected directly in the word files.

A major concern was raised M. Cosby/UKSA about the inter-operability between Proximity-1 and LunaNet: it was observed that Directives cover only Proximity-1, and that SFCG allocations differentiate between S-Band proximity-1 and other kind of links, thus preventing the inter-operability, target of LunaNet.

Issue and way forward was discussed in SLS plenary: reader can refer to SLS plenary MoM.

Member agencies are also invited to coordinate with LunaNet representatives in their organizations.

Outputs
- Updated Default Session Access control and Directives for S-Band proximity-1.

3   JOINT SLP/C&S/RFM/SDLS MEETING

The meeting was held on November 7th.

3.1 Security risk of adaptive coding and modulation in Space systems

Reference	N/A
Presenter	Oxford University via SDLS WG
Inputs	• Presentation • Other supporting documents
Minutes	Presentation from Oxford University about potential vulnerability in ACM system was given. The results presented are derived from the study in the paper "Security Risks of Adaptive Coding and Modulation in Space Systems", of Edd Salkeld et al, presented at the ESA security conference in 2024. The CCSDS WGs recognize the potential flaws of ACM, and will investigate the following levels of protection: • Uplink of TCs for changing the ACM; • Protection of SNR estimator for deriving the channel condition; • Replay of downlink. Activities will be coordinated by SDLS WG.
Outputs	• SDLS will review the VCM, SCCC, and DVB-S2 blue books, and report to C&S, RFM, and SLP on required changes for protecting the ACM from potential attacks.

3.2 Joint C&S/RFM

The meeting was held on November 7th.

3.3 Link Budget Digital Format – status update (with demonstration)

Reference	SLS-CS_24-16
Presenter	A. Modenini\ESA N. Maturo\ESA A. Mourglia\TAS-I via ESA
Inputs	• [Presentation](#) • [UML and XSD files](#)
Minutes	Status of activities was presented. Demo, for showing the benefits of having a LBDF, was given.
Outputs	• Esa will continue activities as normal work, with target of having draft Orange Book in Spring 2025.

3.4 Demonstration of new link budget method based on random draws

Reference	SLS-CS_24-15
Presenter	H. Guillon/CNES
Inputs	• [Presentation](#)
Minutes	Topic is re-called from [Spring 2025 presentation](#) where an alternative method for computing statistical link budget was given. Presentation is informative, no proposal to change currents standards. Demo was provided. Member agencies interested in using the tool can contact CNES.

4 C&S WG STATUS

This section provides highlights of C&S activities, based on the presentation given at end of meeting, that can be found in CWE.

4.1 Projects

Currently C&S WG is working on the following projects:
- *TM synchronization and coding – new channel interleaver for Turbo codes*
- *Proximity-1 extension*
- *Slicing of Transfer Frames*
- *Link Budget Digital Format (LBDF).*

and has one project proposal on hold (due to limited manpower):
- *VCM Greenbook.*

4.2 Resolutions

The WG had two resolutions:
- **RES#1**, to send Pink Sheets of 131.0-B for Agency Review;
- **RES#2**, technical corrigendum for byte alignment in 211.2-B-3.

4.3 Action Items status

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

ANNEX 1: 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_24_17**.

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_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; • Transfer frame slicing. Book captain: J. Quintanilla/ESA	J. Quintanilla/ESA, A. Modenini/ESA, N. Maturo/ESA, K. Andrews/NASA	Spring 2025	Open	
AI_23_13	Review draft VCM GB ToC and provide feedback to C&S chair on whether to proceed with development of the GB NOTE: during Spring 2024 project was decided to be put on-hold, and action kept open for Fall 2025.	All	Fall 2025	Open	
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~~	Closed	SLP latest doc

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~~	Closed	SLS-CS_24-13
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~~	Closed	SLS-CS_24-13
AI_24_01	~~To provide consolidated pink sheets for Agency Review of 131.0-B with following editorial edits (on top of those already presented at Spring 2024):~~ • ~~Note about codeblock (for RS only) under figure 3-1 and 3-3~~ • ~~Review title of Section 3.3~~ • ~~Reinstate CADU~~ • ~~Make randomization mandatory (Review Figure 2-2, 2-3, and Sections 4.2.2, 5.2.1, 7.2.1, 8.2.2, and 10.x).~~	~~K. Andrews~~	~~June 2024~~	Closed	SLS-CS_24-17
AI_24_02	To provide Draft Yellow Book for the two prototypes of the Turbo channel interleaver	J. Quintanilla	Spring 2025	Open	
AI_24_03	ESA/NASA to: • cross check results about CLTU termination performance (with tail and idle sequence) for identifying the reason of the discrepancy between the two analyses • in case issue is confirmed, to check if also LDPC(256,512) has same problematic	K. Andrews A. Modenini N. Maturo	Spring 2025	Open	

AI_24_05	~~To check the need of having an EVM requirement in the Proximity 1 211.1 B, or if this can be considered a specification at unit level~~	~~C&S/RFM WGs~~	~~July 2024 (intermediate C&S meeting)~~	Closed	No inputs in favour
AI_24_06	~~To draft CWE project for an update of 414.0-B (PN ranging), with the objective of adding space-to-space and one-way ranging~~	~~D. Lee~~	~~July 2024 (intermediate C&S Meeting)~~	Closed	CWE project
AI_24_07	~~To check rationale in LNIS for having modulation index range 0.2-1.4, since 0.2 and 1.4 appears not practicable cases~~	~~S. Rodriguez~~	~~May 2024 (before intermediate C&S meeting)~~	Closed	SLS-CS_24-13
AI_24_08	~~To provide an updated list of modulation index (in deg) to be supported, taking into account that LPF uses pi/3, and (possibly) input by LNIS (see AI_24_06)~~	~~N. Maturo~~	~~July 2024 (intermediate C&S Meeting)~~	Closed	SLS-CS_24-13
AI_24_11	~~To assess possible incompatibilities of the current S-Band directives for a possible extension to Ka-Band~~	~~M. Cosby~~	~~July 2024 (intermediated C&S meeting)~~	~~Closed~~	Superseded by inter-operability activities discussed at SLS plenary (see SLS MoM)
AI_24_12	~~To review UML diagram for LBDF for checking parameters to add/remove.~~ ~~NOTE: Member agencies can contact ESA as needed since there is not yet documentation available, with the exception of Section 1,2,3 in the draft Orange Book.~~	~~C&S WG~~	~~Fall 2024~~	Closed	SLS-CS_24-16

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AI_24_13	To add non-normative note about having as input bitstream instead of TFs, as will be done in 131.0-B-6	C&S chair	After Agency Review of 131.0-B-6 for TF slicing	Closed	Superseded, note was removed in agreement with SLS AD
AI_24_14	To verify that: • S-Band phase noise mask provided was measured at RF output of LPF, • Doppler dynamics of 75 Hz/sec is the worst-case scenario of a lander.	N. Maturo A. Modenini	Fall 2024	Closed	SLS-CS_24-13
AI_24_15	To repeat analysis for UHF taking into account mask an Doppler as provided in 211.1-B, with the objective to see if same challenges in the synchronization are also for UHF links at low rates	W. Lee	Fall 2024	Closed	Email A. Modenini on 30rd July 2024 to NASA – note will be added as part of AI_24_18
AI_24_16	ESA (and other member agencies) interested in contributing to the project of space-to-space and one-way ranging (with activities or a prototype) to inform RFM Chair	ESA and other member agencies	Fall 2024	Closed	See RFM MoM
AI_24_17	To provide a proposal for including PN ranging parameters in the Proxy-1 RFM Blue Book (if feasible at current status of PN ranging activities	D. Lee S. Rodriguez	**2nd December 2024**	New	
AI_24_18	To update draft pink sheets of Proxy-1 RFM/CS with the following: • Add default parameters for hailing (including UHF), by setting MI=pi/3 rad-pk (both) and 8 ksps uncoded (for UHF); • To enforce 255-bit randomizer;	N. Maturo	**15th December 2024**	New	

	• To enforce filtering for Bi-phase-L for S-Band in all cases (including hailing) • To add figure for clarifying '1' and '0' voltage transitions; • to remove MI 0.2 rad-pk, and add MI 0 rad-pk, in the list of S-Band MIs; • to increase S-Band max sps to 4096 ksps • to add note about issues in synchronization at low rate also for UHF (as done for S-Band)				
AI_24_19	To prepare technical corrigendum for 211.2-B-3 for having byte alignment, and send to SLS AD	A. Modenini	**2ⁿᵈ December 2024**	New	

ANNEX 2: LIST OF PARTICIPANTS

NOTE: participation list is only for C&S members. It does not account additional participants from RFM, OPT, SLP WGs in joint meetings.

Name	Affiliation
Amanuel Geda	DLR
Andrea Domenica Mourglia	ESA
Andrea Modenini	ESA
Clement Leclerc	CNES
Daniel Pettitt	ESA
Dennis Lee	NASA
Eric Pitts	NASA
Greg Kazz	NASA
Gunther Sessler	ESA
Herve Guillon	CNES
Jean-Luc Issler	CNES
Jorge Quintanilla	ESA
Kenneth Andrews	NASA
Klaus-Juergen Schulz	ESA
Marie Vialard	CNES
Massimo Capozzi	ASI
Nicola Maturo	ESA
Romina Fenker	ASI
Shannon Rodriguez	NASA
Stefano Petri	ESA
Victor Sank	NASA
Wai Fong	NASA
Wing-Tsz Lee	NASA
Xavier Enrich	Eumetsat