SPACE LINK SERVICES (SLS) AREA

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Spring 2015 Meeting CalTech (Pasadena, CA, USA)

CURRENTLY ACTIVE WGs, BOFs & SIGs WITHIN AREA

1. **RFM WG**   Radio Frequency & Modulation

2. **C&S WG**   Coding & Synchronization

3. **SLP WG**   Space Link Protocols

4. **MHDC WG**   Multi/Hyperspectral Data Compression

5. **SDLS WG**   Space Data Link Security **(Joint with SEA)**

6. **OPT WG**   Optical Communications

SLS Area Report
B. Meeting Demographics

	Plenary	C/S	SLP	RFM	Optical	OPT+C&S+RFM+SLP	SDLS	MHDC
ASI								
CNES	5	3	3	2	4	4	1	2
CNSA		1	1	1				
CSA								
DLR	1	4	3	3	5	3	1	1
ESA	3	3	2	3	6	3	3	4
INPE								
JAXA					4			
NASA	5	7	5	7	11	6	4	3
RFSA	2	3	3	2		2	1	
UKSA	1		1			1	1	
Other*			1					
TOTAL	17	21	19	18	30	19	11	10
			*South Korea					telecon: 1 NASA
Meeting Duration	0.5	1,5	1.5	0.5	4	0.5	2	2.5
Agency Diversity	6	6	8	6	5	6	6	4

SLS AREA REPORT

Radio Frequency and Modulation (RFM) WG – Progress Summary

1. Recommendations for Simultaneous High Rate Telemetry and Ranging

- Draft GREEN Book on GMSK+PN ranging was delayed until next meeting due to absence of key personnel and inputs. A new telemetry-based ranging technique that could be suitable for simultaneous high rate telemetry and ranging was presented to the WG.

2. New Recommendation on 26 GHz modulations for EESS

- Draft Recommendation 401 (2.4.23) for 26 GHz modulations for EESS was discussed and edited during the pre-meeting Webex teleconference. Some issues remain and the recommendation will remain White until the next meeting.

3. Update of Recommendation 401 (2.4.18) on 8 GHz modulation for EESS

- Work on revision of Rec 401 (2.4.18) to include higher order modulations for 8 GHz EESS is pending an SFCG response to a CCSDS liaison statement regarding spectrum homogeneity. The SFCG reply is expected by August 2015. Revision to Rec 401 (2.4.18) will be conducted in synch with development of the 26 GHz EESS recommendation Rec 401 (2.4.23).

4. Uplink Idle Sequence for (O)QPSK

- Input presented on the need for a new uplink idle sequence for future (O)QPSK in 231.0-B "TC Coding & Synchronization" (Book joint with C&S WG).

5. PCOM Green Book

- PCOM GB project has been suspended as a consequence of the answers to CMC Action.

RFM WG Summary

status:	OK	CAUTION	PROBLEM
comment:	Good progress		

Problems and Issues:

- **None**

Planning:

- **Revision to Rec 401 (2.4.18) will be conducted in Fall 2015 Meeting.**

- **Green Book on GMSK+PN Ranging expected to be ready for approval by Fall 2015 or Spring 2016**

- **Red Rec 401 (2.4.23) on 26 Ghz EESS modulations is expected by Spring 2016**

- **5-year review of Efficient Modulation Green Book (413.0-G-2) planned to start in Spring 2016 and complete by Fall 2016**

Resolutions:

- **WG consensus to appoint a deputy chair for RFM**

C&S: Coding & Synchronization WG - Working Group Summary progress (1 of 3)

Uplink codes

> ➢ Discussions still on-going on start sequence and CLTU termination needs, possibly converging

> ➢ Target to close the technical work by Fall 2015 and then move to Agency Review

Sliced data transfer in 131.0 Blue Book

> ➢ Good progress in the preparation of the pink sheet for 131.0

> ➢ Few actions pending before starting Agency Review

Erasure coding

> ➢ Progress in discussion between interested Agencies

> ➢ Decision for a new CWE Project for BB deferred based on the choices of intended users, i.e. optical comms

C&S: Coding & Synchronization WG - Working Group Summary progress (2 of 3)

VCM Magenta Book

- ➢ Further progress on the Magenta book for VCM, based on agreement from the London (Fall 2014) meeting

- ➢ Detailed comments from the WG expected in the coming months, well in time for Fall 2015.

Architecture for high data rate coded QPSK modulation

- ➢ Material to be included in the Green Book 130.1-G agreed at WG level
- ➢ A new project for the formal justification of the Green Book revision is still needed

SLS AREA REPORT

C&S: Coding & Synchronization WG - Working Group Summary progress (3 of 3)

Sync markers

- ➢ Definition of markers for frame vs. codewords vs. … discussed

- ➢ Possible need of harmonization in nomenclature.

➢ ### *DVB-S2*

- ➢ Update of GB based on comments received since last meeting

- ➢ Some disagreement on the content expressed by WG members

- ➢ New version will be circulated and commented in the coming months

➢ ### *SLS-C&S General Status*

status:	OK	CAUTION	PROBLEM
comment:	Good progress		

SLS AREA REPORT

SLS Space Link Protocols (SLP) WG

Goals:

1. Address the action: CMC-A-2014-11-19 on assigning the same SCID to multiple spacecraft and craft procedures for SANA.
2. Hold the reconfirmation review of CCSDS 133.1-B-2 Encapsulation Service
3. Ensure consistency between transfer frame definitions in TM, TC, AOS, Prox-1
4. Review the Unified Space Data Link Protocol White book with a focus on coming to consensus on the frame format and field values including interfaces to existing data link layer blue books.
5. Confirm the release of version 3 of the Space Data Link Protocols Green Book, CCSDS 130.2-G-2.
6. Determine if there is a need to issue a resolution to publish the updates to TM, TC, AOS blue books coincident with SDLS protocol release.
7. Discussion of need or no need for SLP WG Co-Chair

status:	OK	CAUTION	PROBLEM
comment:	Good progress		

SLS AREA REPORT

SLP WG Summary Progress:

- Consensus was achieved in publishing the updates to the TM, AOS, and TC Space Data Link Protocol books in sync with the 1st release of the SDLS blue book. Checking with the secretariat to ensure all updates have been included to these books.

- Consensus was achieved in publishing the next version of CCSDS 130.2-G-2 Space Data Link Protocols update. To be published (with release of SDLS and TM, AOS, TC updates above.

- WG created a set of procedures for SANA to utilize for future SCID assignments. WG representatives will meet with SANA to ensure good cooperation and understanding. These procedures require confirmation and enforcement by CMC.

- Update on the frame format and field assignments for the USLP including the interface requirements with COP-1/-P were discussed. A plan for interoperability testing between NASA and DLR was drafted.

- To ensure all agencies are in agreement with the Reconfirmation of the Encapsulation Service, CCSDS 133.1-B-2 all agencies will be asked to review the current document and will be polled at the next meeting. SIS area will also be notified.

- WG did not demonstrate a need at this time for a co-chair position.

SLS-SLP WG (cnt'd)

Planning:

- Expect joint publication of TM/TC/AOS and SDLS protocols after this meeting.
- Issue updated version of CCSDS 130.2-G-2 Space Data Link Protocols GB.
- Before Fall 2015 meeting:
  - ➢ Issue Red-1 of USLP book.
  - ➢ Issue 2nd draft version of USLP Green Book.

Resolutions:

- Request that the Area Director forward to CESG a resolution to publish the updated TM, TC, AOS Space Link Protocols based upon both approved SDLS changes and the already CMC approved changes accumulated over the years.
- Request the AD forward a resolution to CESG to publish version 3 of CCSDS 130.2-G-2 Space Data Link Protocols Green Book

SLS AREA REPORT

Multispectral & Hyperspectral Data Compression (MHDC) WG

1. **New 120.2-G** *Lossless Multispectral & Hyperspectral Image Compression* **Green Book:**

   - **Thorough review: nearly all rewritten text agreed on and nearly all comments resolved**

   - **Action items assigned to clean up remaining minor issues**

   - **Expect to deliver completed Green Book to SLS Area Director on June 1**

2. **New 122.1-B: Spectral pre-processing transform stage to extend 122.0-B to support multispectral & hyperspectral images**

   - **Cross-verification of transform specifications complete**

   - **Reviewed and resolved several comments on latest draft White Book**

3. **Issue 2 of CCSDS-120.1-G "Image Data Compression" was released in February**

4. **WG participants unanimously agreed to request approval of CCSDS-123.1-B project to extend the existing CCSDS-123.0-B to provide near-lossless multi- & hyper-spectral compression**

Working Group Status: Active X   Idle _____

status:	OK	CAUTION	PROBLEM
comment:	Good progress		

MHDC WG (con't)

Problems and Issues:

- **None**

Planning:

- **120.2-G Lossless Multispectral & Hyperspectral Image Compression: Plan to deliver completed Green Book to SLS Area Director June 1 with publication poll to follow**

- **122.1-B: Cross-verification of coding stage expected June. Expect to request promotion to Red Book shortly after Fall 2015 meeting.**

- **123.1-B: Work to begin at Fall 2015 meeting if this project is approved (see Resolution below)**

Chair & Deputy:

- **WG currently has a Chair (JPL) and [informally] a Deputy (GSFC). WG participants indicated that they are happy with this arrangement and propose Englin (Mark) Wong to be appointed formally.**

Resolution:

- **Request approval of new project CCSDS-123.1-B to provide Near Lossless extension of the CCSDS-123.0-B "Lossless Multispectral & Hyperspectral Image Compression."   This leverages the existing CCSDS-123.0-B standard to provide a very low complexity compressor for missions in need of lossy but high fidelity compression.**

Space Data Link Security (SDLS) WG

Working Group Status: Active - Progress report:

1. SDLS <u>core</u> protocol

- SDLS red-4 book: includes all RIDs dispositions from Agency Review-3. Final version delivered to CCSDS editor in May 2014. Since then, awaiting completion of interoperability testing

- Interoperability testing completed between CNES, ESA and NASA independent implementations. Test report (yellow book) reviewed and finalized.

- *<u>Proposed resolution by the WG to request publication of SDLS core protocol Blue Book</u>*.

- SDLS <u>core</u> protocol green book : review of the complete book. Discussion and drafting of several missing subsections. Target: finalization of GB at fall 2015 meeting

2. SDLS <u>extended</u> procedures

- Review of all inputs. Identification of missing specifications and related text.

- Discussion and finalization of M&C, SA management and key management services/procedures/directives

- Agreed on Frame Security Report (FSR – type-2 OCF) to real-time reporting of SDLS On-Board Security Unit

- Discussion and agreement on scenario, definition and parameters for baseline mode

- Target: finalize white book at next fall meeting.

Space Data Link Security (SDLS) protocol (cont'd)

Problems and Issues:

- SDLS Green Book issue 2 "pending" project dealing with SDLS extended procedures should be reclassified as draft. Should be submitted to CMC approval later when resources are available to start the work. Premature for the time being.

status:	OK	CAUTION	PROBLEM
comment:	Good progress		

Planning:

SDLS core protocol:

- **Interoperability testing completed – Test report (yellow book) finalized.**
- **Proposed resolution for SLS area, by the WG, to request publication of Blue Book simultaneously with Space Data Link Protocols Blue Books revisions (integrating SDLS)**

- **SDLS extended procedures:**
  - **White book V1 completion : fall 2015**
  - **Red book 1 (including baseline mode): spring 2016**

Space Data Link Security (SDLS) protocol (cont'd)

Resolution for SDLS Protocol BB publication:

Considering:

- **Integration in the document of agreed dispositions of all RIDs raised against this SDLS protocol book in the course of the 3 agency reviews performed**

- **Successful completion of interoperability testing of SDLS over TC, TM and AOS**

- **Pending revisions of TC, TM and AOS Space Data Link Protocols blue books integrating SDLS function**

Request:

- **publication of SDLS protocol (355.0-B-1) blue book issue 1**

- **This publication to be made in conjunction with TC, TM and AOS Space Data Link BB pending revisions.**

SLS-OPT: Optical Communications Working Group (1 of 3)

Summary of Progress:

- **Deep Space Scenario: Input received for High Photon Efficiency Uplink and Downlink for Coding and Synchronization. Physical Layer White Book material will uploaded to CWE**
  - **Working Group agrees to proposal**
- **Near Earth Scenario for Low Complexity Systems: Input received for Low Complexity Coding and Synchronization and Physical Layer.**
  - **General agreement on the concept; need for a refined definition of what "low complexity" is.**
- **Reviewed and processed the comments on the first draft of the Green Book on Real-Time Weather and Atmospheric Data; second draft planned for Summer 2015**
  - **Continuing discussion on several of the atmospheric seeing parameters**
- **General agreement on a common set of terminology based on existing CCSDS definitions, with some specific amendments.**
- **Working Group also held presentations on current and planned optical demonstrations (Sentinel-to-AlphaSat, SOTA, OSIRIS)**

SLS-OPT: Optical Communications Working Group (2 of 3)

OPT Blue Books Issue for Near Earth Scenario

- For the "High Data Rate" there are still two proposals, each with distinct Coding and Synch and Physical Layer specifications.
- In seeking a single standard, NASA propose to study a dual options physical layer combined with a common coding and synchronization layer allowing physical frame switching at relay spacecraft.
  - ESA and DLR agree to consider the common Coding and Synchronization layer approach
  - NASA has not committed to the details presented in the proposal above, but would like to further explore the complexity of the dual physical layer approach to understand the implications to the relay spacecraft
    - NASA proposed that the WG try to reach agreement on common Coding and Synchronization prior to Fall 2015 meeting
    - NASA will complete its evaluation of this proposal and the OPT WG could produce a first draft of the White Book as input to the Spring 2016 meeting
  - JAXA and CNES agree to the above proposal for dual physical layer combined with a common coding and synchronization layer
- It was agreed to cooperate with the Coding and Synchronization WG to study a common Coding and Synchronization layer for the high data rate. A joint meeting was held between the two Working Groups.

SLS-OPT: Optical Communications Working Group (3 of 3)

Problem and Issues:

status:	OK	CAUTION	PROBLEM
comment:	**Green Book for Real-Time Weather and Atmospheric Data, and White Book material for High Photon Efficiency, and Low Complexity are progressing well**		**Blue Books Issue:** • **No agreed approach for the High Data Rate regime** • **This will delay production of the Blue Books**

Planning:

- **The schedule for the Blue Books will be delayed by about one year with respect to the planning done at the Fall 2014 meeting (CWE to be updated)**
- **The Optical Communications Working Group holds monthly video teleconference meetings; Coding and Synchronization WG will be invited to these meetings**

Planning for Fall 2015 Face-to-Face Meeting:

- **Coding and Synchronization and Physical Layer inputs will be updated to be consistent with the common terminology definitions**
- **High rate Coding and Synchronization Layer proposal in the form of a White Book**

CESG Chair check against SLS WGs Project resources

- **SLP WG**   **No issue**
- **OPT WG**   **No issue**
- **MHDC WG**   **No issue**
- **C&S WG**   **No issue**
- **RFM WG**   **PLACOM GB:** **SLS Area propose that CWE Project status changes to Draft to be re-approved when more resources are available. <u>CMC to confirm</u>.**
- **SDLS WG**   **Concept of Ops GB Issue 2:**   **SLS Area propose that CWE Project status changes to Draft to be -approved when project will really start and resources are available. <u>CMC to confirm</u>.**

Missing WG Co-chairs and AD/DAD as WG Chair

- **RFM WG**   **Consensus to appoint Dennis Lee (NASA/JPL) as deputy**
- **SLP WG**   **WG did not demonstrate a need at this time for a co-chair position**
- **MHDC WG**   **Consensus to appoint Englin (Mark) Wong (NASA/GSFC) as deputy**
- **C&S WG**   **Investigation for a candidate to be confirmed.**

CWE (Editing) Issues

- **SLP WG**   **Charter cannot be updated. Same issue for a few projects,**
- **OPT WG**   **No issue**
- **MHDC WG**   **No issue**
- **C&S WG**   **No issue**
- **RFM WG**   **No issue**
- **SDLS WG**   **No issue**

Almost **No "Projects behind schedule"; i.e. either non editable or to be fixed soon.**

Strategic Plan – SLS Part (http://cwe.ccsds.org/fm/sp/default.aspx)

- **No issue identified**

SLS Area candidate Project for Interoperability

- **Candidate project has been identified in the SDLS WG**

ICPA Check for SLS Projects (http://cwe.ccsds.org/fm/Lists/Projects/IOAG.aspx)

- **401.0 Evolutions of CCSDS recommendations for RF & Modulation systems, part 1**
- **355.0 Space Data Link Security Protocol**
- **355.1 Space Data Link Security (SDLS) protocol : extended procedures**
- **141.0 Optical Communications Physical Layer**
    Delayed: it may get closer/pass IOAG required date of December 2018.
- **142.0 Optical Communications Coding & Synchronization**
    Delayed: it may get closer/pass IOAG required date of December 2018.
- **140.0 Optical Communications Concepts and Terminologies**
- **140.1 Real-Time Weather and Atmospheric Characterization Data**

No OTHER issues

CCSDS Document Status (http://cwe.ccsds.org/cesg/docs/CCSDS%20Document%20Status.pdf)
The CCSDS Document status has been checked and proper actions either for reconfirmation or periodic review have been performed.

Action CMC-A-2014-11-19

The SLP WG is requested to do an analysis and create procedures (if applicable) for assigning SCIDs to multiple spacecraft (this is needed for V1 and V2 but most critical for V2). Provide recommendations to the Secretariat for forwarding to the CMC and SANA Steering Group.

Recommendations for Future SANA SCID Assignments (1 of 2)

Pending Action Item on Agencies to free up SCIDs no longer in use
Immediate Action: Each agency to determine which of their SCIDs are no longer in use and return these IDs back to CCSDS (action given to each Agency representative). Note that some agencies have already responded to this action.
Long Term Solution
CCSDS adopts the emerging Unified Space Link Protocol (USLP) which envisions a SCID space of at least 8192 SCIDs.

Recommendations for Future SANA SCID Assignments (2 of 2)

SANA SCID Assignment Procedures (requires CMC approval and enforcement)use

- In order for SANA to assign the same SCID to multiple users, we recommend SANA solicit the <u>frequency band (e.g., S, X, Ka)</u> to be used by the mission <u>by mission phase</u> (since frequency may change by mission phase).
- For each new SCID assignment, recommend SANA solicit an expiration date for the SCID based upon the expected mission termination date.
  - SANA to notify the mission at least 6 months before mission termination to ensure termination date has not changed.
  - Burden is upon the Project to request an extension of the SCID from SANA. If no response received from the project, SANA has the right to recycle the SCID.
- Recommend SANA will only assign <u>SCIDs for use on the Space Link only</u> i.e., not for test, simulation, etc.
- Recommend SANA will make it clear to the user community that there is no expectation that a contiguous set of SCIDs will be provided by SANA when multiple SCIDs are requested at a time.
- Recommend SANA suggest the user utilize virtual channel IDs as an extension of SCID for constellations of spacecraft (more than 4 spacecraft at a time). Version 2 is most appropriate for this approach (64 VCs available) and very much in need (only 256 SCIDs available).

RFM WG   Radio Frequency & Modulation

- GMSK+PN Ranging Green Book expected to be ready for publication by Fall 2015 or Spring 2016
- Recommendation 401 (2.4.23) on 26 GHz modulations for EESS expected RED for Spring 2016.
- Scheduled 5-year review of 413.0-G-2 Efficient Modulation Green Book will start in Spring 2016, after ongoing work on high order modulation recommendations for 8 GHz and 26 GHz EESS are completed.
- Work on PCOM GB has been frozen.
- Issue with uplink idle sequence in 231.0-B-2 when used with (O)QPSK was identified.

C&S WG   Coding & Synchronization

- New uplink codes selected, work for CLTU delimitation procedures continues.
- Progress for draft pink sheets to 131.0-B (TM Coding) to introduce LDPC slicing toward Agency Review in 2015.
- Further progress on VCM Magenta book, detailed discussion planned for Fall 2015.
- No new project for Blue Book for Long Erasure Codes yet, scenario investigations ongoing.
- DVB-S2 draft green book updated, new draft before Fall 2015.

SLP WG   Space Link Protocols

- Resolution to publish the updated TM, TC, AOS Space Link Protocols based upon both approved SDLS changes and the already CMC approved changes accumulated over the years.
- Resolution to publish version 3 of CCSDS 130.2-G-2 Space Data Link Protocols Green Book
- Update on the frame format and field assignments for the USLP including the interface requirements with COP-1/-P were discussed. A plan for interoperability testing between NASA and DLR was drafted.

MHDC WG Multispectral & Hyperspectral Data Compression

- **New 122.1-B: Spectral pre-processing transform stage to extend 122.0-B to support multispectral & hyperspectral images: Complete cross-verification expected June 2015. Expect to request Red Book shortly after Fall 2015 meeting.**
- **New 120.2-G Lossless Multispectral & Hyperspectral Image Compression Green Book: expect to deliver completed Green Book June 2015.**
- **New project proposal CCSDS-123.1-B: Near-Lossless extension of CCSDS-123.0-B "Lossless Multispectral & Hyperspectral Image Compression" leveraging existing CCSDS-123.0-B standard to provide a very low complexity compressor for missions in need of lossy but high fidelity compression**

OPT WG Optical Communications

- **Blue Book for Optical Communications (Physical Layer; Coding & Synchronization):**
  - **2 competing proposals for the Near Earth "High Data Rate" mission profile. Possible way forward by dual option physical layer combined with common coding and synchronization layer is considered. Consensus in the WG for Deep Space high photon efficiency and Near Earth low complexity proposals.**
- **Green Book for Real Time Weather and Atmospheric Characterization Data: 2nd draft planned for Jun 2015.**

SDLS WG   Space Data Link Security

- **SDLS core protocol**
  - **Interoperability testing complete between ESA, CNES and NASA. Test report finalized.**
  - **Consequently, resolution proposal by the WG to publish Blue Book**
  - **SDLS core protocol green book: new inputs reviewed. Priority work for the next 6-month period. Publication expected end 2015.**
- **SDLS extended procedures**
  - **Agreed on formatting rules for SDLS directives and reports messages**
  - **Agreed on Monitoring & Control, SA and key management services, directives & reports**
  - **A baseline configuration has been agreed to allow interoperability at bit level for extended procedures.**
  - **Objective: Complete white book – fall 2015; Red-1 for Agency Review - mid 2016**

- **SLS Area want to thank CalTech and NASA/JPL for the excellent accommodation and facilities.**