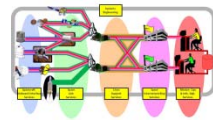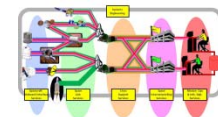# SPACE LINK SERVICES (SLS) AREA

Gian Paolo Calzolari (AD)

Gilles Moury (DAD)

**Version presented at SLS Area Plenary Meeting: Issue 1.0 (Statistics to be confirmed)**

## A. CURRENTLY ACTIVE WGs, BOFs & SIGs WITHIN AREA

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

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

3. **SLP WG**      Space Link Protocols

4. **NGU WG**      Next Generation Uplink

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

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

7. **OCM SIG**     Optical Coding and Modulation **(Did not meet)**

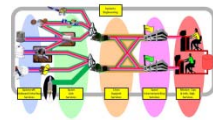8. **PlaCom SIG**  Planetary Communications

## B. Meeting Demographics

To be Checked

| | Plenary | C&S | SLP | NGU | RFM | NGU+C&S+ RFM | NGU+C&S | SDLS | PLACOM BoF | MHDC | OCM SIG |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ASI | | | | | | | | | | | |
| CNES | 3 | 3 | 1 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | |
| CNSA | | 1 | 1 | | 2 | 1 | | | | 2 | |
| CSA | | | | | | | | 1 | | 1 | |
| DLR | 2 | 3 | | 3 | 2 | 3 | 3 | 3 | 3 | 1 | |
| ESA | 5 | 5 | | 5 | 4 | 5 | 5 | 2 | 5 | 1 | |
| INPE | | | | | | | | | | | |
| JAXA | | | | | | 1 | | | | | |
| NASA | 2 | 10 | 3 | 7 | 6 | 8 | 7 | 5 | 2 | 2 | |
| RFSA | | 3 | 3 | 3 | | 3 | 3 | | 3 | | |
| UKSA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | | |
| Other* | | | | | | | | | | 1 | |
| TOTAL | 13 | 26 | 9 | 22 | 17 | 24 | 22 | 12 | 17 | 10 | 0 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Meeting Duration | 1 | 1.5 | 1 | 0.5 | 1.5 | 0.5 | 0.5 | 1.5 | 0.5 | 2.5 | 0 |
| Agency Diversity | 5 | 7 | 5 | 6 | 6 | 8 | 6 | 4 | 7 | 6 | 0 |

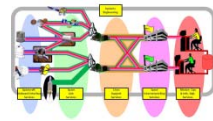# SLS REPORT

## C. SUMMARY TECHNICAL STATUS

**1. RFM WG**

**Goal vs status:**

**Recommendation on high rate telemetry and PN ranging**
Additional mission requirements considered – additional work
in progress, draft recommendation **NOW** expected at
Spring 2012

**Recommendation on 22 and 26 GHz modulations**
No inputs for this meeting – 22 GHz is future activity

**Recommendation on 2 GHz (CDMA) modulation missions
supported by data relay satellites**
Blue book published, Green book being drafted

**Recommendation on 32 GHz modulations**
Work started, Pink sheets expected at Spring 2012

## RFM WG

**Goal vs status (continued):**

**Revised recommendation 2.2.8 as per NGU requirements**
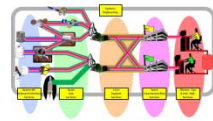**Blue book published**

**Pink sheets to Prox-1 PL BB**
**Review terminated and agreement reached for RFM related modifications also in other two Prox-1 books**
**Ready for submission to Agency review**
**Charter will be updated with related Project**
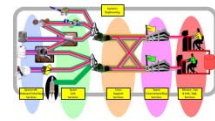
**Recommendation on 4D-8PSK TCM impairments**
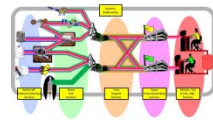**No input for this meeting – Deferred to Spring 2012**

## RFM WG Summary

**Some activities (CDMA blue book, CDMA green book, rec. 2.2.8, high rate TLM and PN RNG,) are approximately on schedule;**

**Some activities (26 GHz modulations, 4D-8PSK TCM impairments, emergency communications) are behind schedule since required effort could not be made available and no inputs were submitted.**

## RFM WG Resolutions

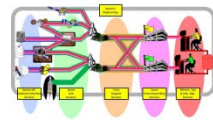**SLS AD to request Agency review of pink sheets to the Prox-1 BB**

# RFM WG

**Working Group Status: Active**

**Working Group Summary Situation:**

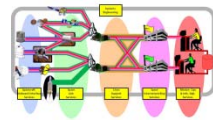| status: | OK | CAUTION | PROBLEM |
|---|---|---|---|
| comment: | | Some delays experienced due to technical issues and missing resources | |

# SLS Area Report

1. *RFM WG*
2. *RNG WG*
3. **C&S WG**
4. *LEC BOF*
5. *SLP WG*
6. *HRU WG*
7. *MHDC WG*
8. *SDLS BOF*

## 3. C&S: Coding & Synchronization WG

- **Working Group Status: Active**

- **Working Group Summary Situation:**

| status: | OK | CAUTION | PROBLEM |
|---------|----|---------|---------|
| comment: | X | | |

- **Working Group Summary progress :**

  ➢ **See next slides**

- **Achievements before this meeting:**

  - **Published CCSDS 131.0-B-2 TM Synchronization and Channel Coding (LDPC Codes, etc.)**

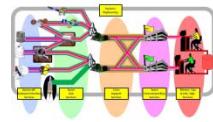  - **Published CCSDS 131.4-M-1 TM Channel Coding Profiles**

## C&S: Coding & Synchronization WG  - **Working Group Summary progress (1 of 5)**

Revision of CCSDS 131.2-R-2 SCCC Coding (*)

- ➢ Agency Review 2 terminated with a few RIDs.

- ➢ RIDs were produced by ESA (7 accepted + 1 rejected), NASA (3 accepted +1 rejected), ECSS (4 accepted + 5 Rejected) and CNES (1 accepted).

- ➢ WG reached consensus on a version implementing the RID dispositions and asked to issue a WG resolution for publication.

- ➢ ESA Yellow Book on Interoperability Reports is considered acceptable to WG Member with the request of a few modifications.

- ➢ Three patented technologies are affecting this book:

  - ➢ Two US Patents by ESA on APSK modulation (ISO Form available).

  - ➢ US Patent by CalTech licensed to Intellectual Ventures (ISO Form in progress).

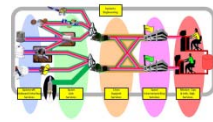(*) Really: FLEXIBLE ADVANCED CODING AND MODULATION SCHEME FOR HIGH RATE TELEMETRY APPLICATIONS

# SLS Area Report

**Resolution SLS-C&S-2011-11-001**

➢ The Coding & Synchronization Working Group

➢ CONSIDERING that the Working Group has reached consensus on

  ➢ an updated version of the Flexible Advanced Coding and Modulation Scheme for High Rate Telemetry Applications,

➢ **RESOLVES** to request the AD to issue a SLS resolution for

  ➢ Publication of 131.2 Blue Book.

DVB-S2 Standardization

  ➢ In Berlin, WG reached consensus on a version implementing the RID dispositions and asked to issue a WG resolution for starting Agency Review.
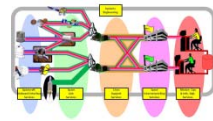
  ➢ CNES editorial update pending.

# SLS Area Report

## C&S: Coding & Synchronization WG  - Working Group Summary progress (3 of 5)

TC Green Book 230.1-G Green Book Update

- ➤ After the Introduction of TC Repeated Transmission in coordination with the Space Link Protocol WG, a few additional improvements and corrections have been approved in this meeting. (Similar SLP activity ongoing for updating 130.2-G Space Data Link Protocols Summary of Concept and Rationale Green Book)

- ➤ **Resolution** for publication will be issued after update (before end of 2011)

Short (64, 128, 256 bit ) LDPC codes for uplink - Orange Book

- ➤ NASA announced the intention of producing an Orange Book on "Short-Blocklength LDPC Codes" suitable for emergency and low data rate uplink. They would provide improvement over the existing BCH codes.

- ➤ WG consensus in supporting its review according to Orange Book rules.

- ➤ New project has be created. New goal to be added to charter for CMC approval.
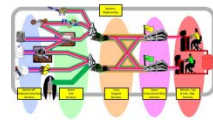
## C&S: Coding & Synchronization WG  - **Working Group Summary progress (4 of 5)**

### TM Coding Green Book

- ➢ Work in progress  with several changes agreed in this meeting

- ➢ Agreement for issuing Green 2  deferring to Green 3 the SCCC and DVB-S2 material

- ➢ Actionees identified for finalization of changes (excluding SCCC and DVB-S2)

- ➢ Resolution for publication of Green 2 will be issued after update (hopefully before end of 2011)
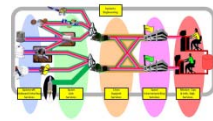
### Long Erasures Codes

- ➢ DLR presented an updated draft Orange Book On the use of Erasure Coding for CCSDS space missions. Still a few empty sections in this version.

- ➢ New version will be discussed at Spring 2012 Meeting with increased level of detail.

## C&S: Coding & Synchronization WG - **Working Group Summary progress (5 of 5)**

### Proximity-1 Review & Upgrade

➢ Further progress on Five Year Review of Proximity-1 C&S Standard

➢ Important agreements at Joint Meeting with RFM+SLP.

➢ C&S Version including LDPC Codes submitted for WG Review

➢ Current GOAL is to start Agency Review of the 3 Pink Books at the beginning of 2012 with delivery to CCSDS Editor by

  ➢ 1st December for DLL Book

  ➢ 15th December for C&S and PL Books.

➢ This would allow discussing RIDs in the Spring 2012 Meeting in Darmstadt.

➢ Resolution of the C&S WG will be polled after updating the relevant book (specially with respect to LDPC Codes addition) and before submission to CCSDS Editor.
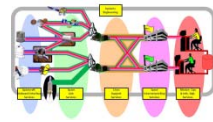
## 3. SLS-SLP WG

### Goal:

1) To complete the 5-year review of the Proximity-1 Space Data Link Protocol Blue Book, CCSDS 211.0-B-4 (along with Physical layer and C&S sublayer books)
2) Impact of 5-year review on Proximity-1 Green Book
3) Review the NASA proposal of future Proximity-2 protocol capabilities

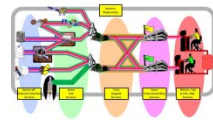**WG Status: Active  X   Idle _____**

### WG Summary Situation:

| status: | OK | CAUTION | PROBLEM |
|---|---|---|---|
| comment: | Good progress | | |

**SLP WG Summary progress:**

- **Continued the review of Prox-1 Space Data Link Layer Protocol. Three significant outcomes:**
  - **Agreement reached on the C&S and DLL Time Tagging Requirements**
  - **Discussion of Prox-1 data rates vs symbol rates – conclusion eventually achieved at Joint RF&MOD/C&S/SLP/NGU meeting**
  - **Next step is to compare clean copies of Physical layer, C&S sublayer, and Data Link layer books as a result of Boulder meeting to be delivered by each chairman to ensure all inconsistencies have been addressed**
  - **Goal of this meeting is to deliver all 3 Proximity books to Editor starting Dec 1 as a result of the Boulder meeting. Agency Review would then be at beginning of 2012 with RID resolution to take place at the Spring 2012 meeting.**
- **There was insufficient time to generate a comprehensive list of proposed updates to the existing Prox-1 GB. This topic was only briefly discussed.**
  - **Plan is to address this topic by telecon between now and the Spring 2012 meeting in association with the updated Prox-1 Blue books**
  - **The update will be jointly discussed in Darmstadt**
- **NASA presented a proposal for a future Prox-2 protocol at the brainstorming level containing forward looking capabilities**
  - **Area Director suggested that NASA is welcome to submit future desired capability proposals to the appropriate WGs in SLS for study and charter submission**
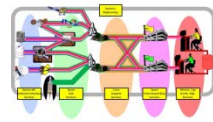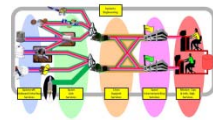
## SLS-SLP WG (cnt'd)

**Problems and Issues:**

- **NRZ, supressed carrier, FSK, PSK, etc NASA MRO specific capabilities are to be described and handled in a dedicated Annex in DLL book. Exceptional use of these capabilities is currently allowed only for interoperability with NASA MRO.**
- **The evolution of future Mars missions will be monitored for possible impact; e.g. Russian involvement, etc.**
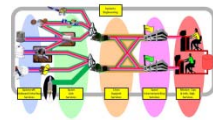
## SLS-SLP WG (cnt'd)

**Planning :**

- **Generate clean copies of PL, C&S, and DLL books to hand off to CCSDS Secretariat for editing starting Dec 1, 2011 to allow eventual start of Agency Review.**
- **SLP+C&S+RFM WGs to propose sections in Prox-1 GB that require updating – for presentation at Spring 2012 meeting**

## SLS-SLP WG (cnt'd)

**Resolutions :**

**Prox-1 DLL book to go for agency review including LDPC information (along with Physical Layer and C&S sublayer books)**

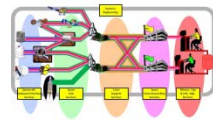## 4. Next Generation Uplink WG/C&S WG Joint Session

### Goal:

- Produce Green Book on requirements, profiles, trade offs, etc. for Next Generation Uplink
- NASA proposal for a new Telecommand Standard-2 – NASA/JPL
- Reliability aspects associated with using LTP for reliable Telecommand – NASA/JPL
- Short Non-Binary Turbo Codes based on Memory-1 Recursive Convolutional Codes - DLR
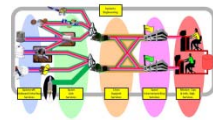
WG Status: Active  X   Idle _____

WG Summary Situation: Good progress.

| status: | OK | CAUTION | PROBLEM |
|---|---|---|---|
| comment: | Good progress | | |

# SLS Area Report

## NGU WG Summary Progress

- **Discussion on replacement of the Current TC Standard**

    - **Focus is on enhancing capabilities for Deep Space**

    - **Use of LTP most advantageous for long distance and high error rate links when supporting single uplinks with multiple downlinks (where latencies are increased between uplink and downlink i.e., TDRSS multiple access and DSN MSPA)**

- **DLR (Tomaso de Cola) presented a short non-binary turbo code for emergency uplink use**

- **Fabrizo Pollara/Ken Andrews NASA/JPL provided the rational and use cases for the LDPC codes including a discussion of the performance of the short (64,128, 256) codes.**

- **Concurrence on Updated 230.1-G Green book "TC Sync and Channel Coding – Summary of Concept and Rationale" – audio report from Marco Baldi – ESA**

- **Outline for NGU Green Book provided to WG for further discussion.**

## Next Generation Uplink WG (cnt'd)
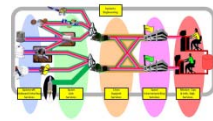
**Problems and Issues:**

- **None**

**Planning :**

- **Comments are welcome from Agencies on NGU GB outline provided at this meeting. Draft GB with draft populated sections to be reviewed at Spring 2012 meeting**

- **NASA to submit potential impact of short LDPCC to RF&MOD WG – in particular Mode A (emergency profile)**

**Resolutions :**
**None at this time.**

## 5. Multispectral & Hyperspectral Data Compression (MHDC) WG

### Goals:

1. 123.0-B *Lossless Multispectral & Hyperspectral Image Compression* (Red Book): Disposed of all RIDs

2. Lossy Compression: Review of proposed approaches and plans for selection process

3. 5-year review of 121 (Universal Lossless Compression) ongoing
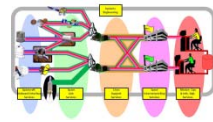
**Working Group Status: Active  X   Idle _____**

**Working Group Summary Situation:**

Disposed of all RIDs on 123.0-B.

Reviewed progress of proposed lossy compressors.

**Problems and Issues: none**

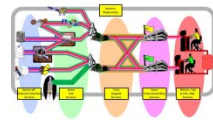| status: | OK | CAUTION | PROBLEM |
|---|---|---|---|
| comment: | Good progress | | |

## MHDC WG (con't)

**Planning :**

- **123.0 (Lossless): consolidated RID dispositions to be delivered to area director – mid November 2011**

- **120.2 Lossless Green Book – Fall 2012**

- **Lossy:**

  - **Spring 2012 – Final Concept Paper and performance results required for all candidate algorithms; WG to select algorithm for standardization**

**Resolutions :**

- **WG requests promotion of 123 to Blue Book (pending delivery of consolidated RID dispositions) – but requests that release be synchronized with release of 121B Issue 2 (because new Issue 2 features are used as part of 123)**

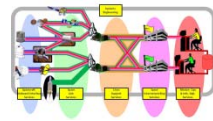## 6. Space Data Link Security (SDLS) WG (cross-area SEA/SLS)

### Goals:

- **Develop standard protocol for security at the data link layer. This includes authentication and/or encryption both uplink and downlink. This protocol will be independent from crypto algorithm and compatible with CCSDS TM/TC/AOS data link protocols.**

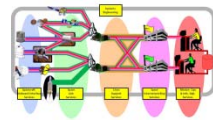**WG Status: Active  X  (4 agencies, 12 participants)          Idle _____**

**WG Summary Situation:**

- **Final dispositions of RIDs for Red-1 SDLS Agency Review #1. All inputs for red-2 SDLS book preparation discussed. Second agency review will be necessary : anticipated date : mid-January**

- **SDLS green book progressing : detailed structure finalized, content 75% completed**

- **Discussion of the "SDLS protocol extended procedures" project that aims at specifying : Security Association management, key management, SDLS protocol Monitoring & Control**

  - **Development of User Requirements and Cross-support scenarios**

# SLS Area Report

## Space Data Link Security WG

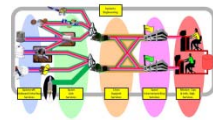| status: | OK | CAUTION | PROBLEM |
|---|---|---|---|
| comment: | good progress (red-1 agency review #1 completed, green book 75 % completed, SDLS extension project started by the WG) | | |

## Space Data Link Security WG

**Planning :**

- **Red-2 (SDLS core protocol) Agency Review #2 : feb 2012**

- **First complete draft SDLS core protocol Green Book : April 2012**

- **Draft SDLS Core protocol BB : April 2012**

- **SDLS core protocol prototype testing : April-June 2012**

- **Interoperability testing SDLS core : Sept 2012**

- **Publication BB and GB SDLS core protocol : Oct 2012**

- **White book for SDLS extended procedures :  April 2012**

- **Red-1 SDLS extended procedures : Dec 2012**

- **BB SDLS extended procedures : June 2013**

**Potential future New Work Item (SLS/SEA) :**
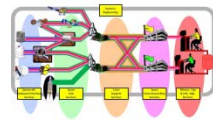
- **Protection against denial of service at physical and data link layer**

## 7. SLS-OCM: Optical Coding & Modulations (SIG)

- **Goal:**

    - **Provide a discussion forum for cooperation and cross-support**

    - **On the long term, create a WG**

- **SIG Status : OK**

- **SIG Summary Situation:**

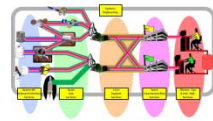| status: | OK | CAUTION | PROBLEM |
|---------|-----|---------|---------|
| comment: | Less active but OK | | |

## SLS-OCM SIG (cont'd)

**SIG Summary progress:**

- **In June 2011, DLR and CNES provided information papers to the SFCG meeting following the SFCG resolution RES 20-2R2 on optical communications: "the characteristics of member agency optical communication systems be maintained in a SFCG data base"**

- **The OCM-SIG waits for the IOAG/OLSG recommendations on optical communications to be provided in the beginning of 2012**

- **Concept paper is left open for future possible updates**

- **Discussion on link-budget conventions is still open.**

**Planning :**

- **Next OCM meeting in spring 2012 (in Darmstadt)**
- **Update of agencies' activities on optical communications.**
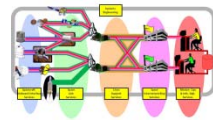- **Review of the IOAG/OLSG recommendations for WG chartering.**

## 9. PLACOM SIG

### Goal:

- Survey and report on agencies needs and planning for lunar and Martian local communications/navigation infrastructure (surface coms/nav and surface-orbit coms/nav)

- Establish a preliminary coarse inventory of communications/navigation requirements (URD)

- Identify the way forward, e.g. proposal for the creation of a WG, type of book needed (recommended standard, recommended practice, …)

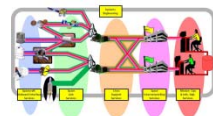**SIG Status: Active  X   Idle _____**

**SIG Summary Situation:**

| status: | OK | CAUTION | PROBLEM |
|---------|----|---------|---------|
| comment: | X | Difficult to gather information | |

## PLACOM SIG

**SIG Summary progress:**

- **Programmatic environment**

    - **Member agencies lunar/martian exploration plans on hold or under redefinition; No new input provided**
    - **Actions taken to Report on agencies plans**

- **Report provided on lessons learnt from PROX-1**

- **Report provided on SFCG work on communications/navigation requirements and frequency allocation for lunar missions**

- **PLACOM SIG kept active. Development of a standard deemed premature given the uncertainties on the current agencies plans**

- **SIG profiting of members of other WGs to focus on the assigned topic.**
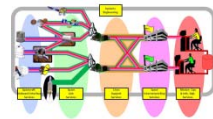
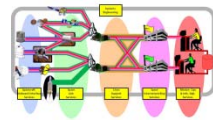| | Mon. AM | Mon. PM | Tue. AM | Tue. PM | Wed. AM | Wed. PM | Thu. AM | Thu. PM |
|---|---|---|---|---|---|---|---|---|
| SLS | | | | | | | | SLS Plenary |
| RFM | | | RFM | RFM | RFM | | Joint RFM+ C&S+ SLP+NGU | |
| C&S | | C&S+ | | | | C&S | | |
| NGU | NGU | NGU | | | | | | |
| OCM | OCM | OCM | | | | | | |
| SLP | | | SLP | SLP | | | | |
| MHDC | | MHDC | MHDC | MHDC | MHDC | MHDC | | |
| SDLS | | | | | SDLS | SDLS | SDLS | |
| PlaCom | PlaCom | | | | | | | |
| Required Rooms | 3 | 3 | 3 | 3 | 4 | 3 | 2 | 1 |

- **This is SLS proposal. Thursday PM some WG may have some spill over. SDLS shall arrange the schedule with the security WG, however the global requirement SEC+SDLS would not change.**

Risk of impact on technical work due to reduced meeting duration. The following is proposed to cope with this:

1. The CCSDS wide opening plenary shall be avoided to allow Monday morning to be completely usable for WG Meeting

2. Logistic and other information should be made available on web before the meeting and be available to collect at registration.

3. With Area Plenary just after WG Meeting in the same day, the time for **WG Reports** to AD is drastically reduced. WG Chairs ask to avoid usual reporting, what about the AREA reporting to CESG then? BTW, the template is a nightmare…

4. Shall really <u>both</u> yearly meetings co-locate all Areas?

- **There is a general worry for resource reduction and implied delays**