Proposed updates to 401.0-B (policy recommendations) and 413.0-G

Andrea Modenini

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Scope

- The scope of this input is to propose activities for updating BB 401.0-B, RF modulations, and GB 413.0-G, Bandwidth efficient modulations (in parallel to the other on-going updates in RFM WG)

- In particular, during a review of the books, it was noticed that:
  - **401.0-B-31**, Section 3.0 (titled *Policy recommendations*) has several frequency management recommendations that are covered by SFCG resolutions/recommendations (RES/REC)
  - **413.0-G-3** is pending the 5y reconfirmation, and missing latest information from 401.0-P-32 pink sheets (in particular, Bi-phase-L filtering and HoM minimum supressed carrier, discussed in last years)

- As such, it is proposed to exploit the on-going publication cycles (pink sheets of 401.0-P-32, and re-confirmation review of 413.0-G) for doing such additional updates

Policy recommendations in 401.0-B

Current content of Section 3, 401.0-B

- **There are several recommendations that are reflections of SFCG RES/REC**. In particular:
  - **3.1.1**, Efficient use of 2 GHz
    - It is replica of SFCG 4-3R3, and is up-to-date
  - **3.1.2A/B**, Max Cat A/B telemetry bandwidth in 8 GHz
    - For Cat A, it is replica of SFCG 5-1R7, and is up-to-date
    - For Cat B, it is replica of SFCG 23-1R4, and is not up-to-date
  - **3.1.4A**, Cat A constraints of use of 14-17 GHz
    - It is replica of SFCG 12-2, up-to-date
  - **3.1.6B**, channel frequencies
    - It is seems covered by SFCG 7-1R6, but tailored for CCSDS (TBC)
  - **3.2.1A**, Limitation on Earth-to-space links
    - It is seems an envelope of SFCG 12-5R3 and 39-2
  - **3.6.1A, 3.6.2A**, interference reduction
    - It appears not up-to-date since it refers to S-Band only, but it could be included as general *recommends* for limiting EIRP using proper coding

How to update 401.0-B, Section 3?

- **At time of writing, all CCSDS members are also SFCG members.** Thus, it is expected that CCSDS standards are aligned with SFCG REC/RES.

- As such, for Section 3, **it is proposed to adopt one of the following strategy**:
    1. To update Section 3 recommendations in line with latest SFCG REC/RES:
        - Pro: decision is done on a case-by-case basis, and a easy operation
        - Cons: requires “to chase” SFCG

    2. To delete from Section 3 the recommendations mentioned in previous slide, and to write a new single recommendations that “adopts” directly the SFCG REC/RES
        - Pro: easier to update in case of future SFCG REC/RES, and makes applicable also future SFCG revisions
        - Cons : limited space for tailoring, and somehow mandates such policies completely to SFCG

    3. Other ideas?

ESA proposal for option 2

- In case the WG decides to go for option 2, ESA has drafted a recommendation that allows to cover all SFCG regulations related to the CCSDS recommendations indicated in previous slide (that could be then deleted)

(*see attached word file – Annex 1*)

3.X.Z INTERFERENCE REDUCTION AND EFFICIENT USAGE OF THE RF SPECTRUM RESOURCES

The CCSDS,

considering

(a) that efficient use of RF spectrum resources is imperative with the increasing congestion of the frequency bands;

(b) that the SFCG has recommendations and resolutions which express technical agreements that may be used by CCSDS member agencies to make best use of allocated bands and to avoid interference;

noting

(i) that the effectiveness of SFCG recommendations and resolutions depends upon voluntary acceptance and use by member agencies;

(ii) There is no formal process by which agencies formally agree to accept and be bound by SFCG recommendations;

recommends

(1) that CCSDS agencies comply with the SFCG regulations reported in Table I (or later version);

(2) that frequency selection be coordinated with an appropriate organization, such as SFCG, to ensure the orderly use of available allocations;

(3) that the power spectral density of space radiocommunication (Earth-to-space, space-to-Earth, space-to-space) links be reduced by using appropriate modulation and channel coding in accordance with CCSDS Recommendations, in order to reduce the potential for harmful interference.

Number	Title	Applicability
REC 4-3R3	Utilization of 2 GHz Band by Space operations	Fully applicable
REC 5-1R7	Use of the 8450-8500 MHz for Space Research, Category A	Fully applicable
REC 12-2	Use of the 14.0 - 15.35 GHz and 16.6 - 17.1 GHz Bands for Space Research, Category A	Fully applicable
REC 23-1R4	Efficient Spectrum Utilization for Space Research Service, Deep Space (Category B), in the Space-to-Earth Link	Fully applicable
7-1R6	Transponder Turnaround Frequency Ratios and Radio Frequency Channel Plans for Space Research, Category B	Limited to Recommends 2) and Table II[1]
12-5R3	Limitations on Earth-Space Link Power Levels in the 2025-2110 MHz Band	Fully applicable
39-2	Limitations on Earth-Space Link Power Levels in the EESS 7190-7250 MHz Band	Fully applicable

[1] Turnaround ratios reported in REC 7-1R6 are covered by recommendations 2.6.1 – 2.6.15)

Proposed changes to 413.0-G

Proposed changes to 413.0-G

- The 413.0-G-3 seems pending the 5y reconfirmation review

- Beyond normal review work, **ESA identified the following updates**:
  - To include simulation results and design of the Bi-phase-L filtering for meeting the SFCG mask;
  - To include simulation results and justification for the minimum carrier suppression required for HoM (>30 dBc)

- In light of this, ESA has prepared a possible concept paper for updating the Green Book (if required)

  (*see word file attached – Annex 2*)

Concept Paper for updating CCSDS 413.0-G-3
"Bandwidth-efficient modulations"

European Space Agency

1. Purpose

The purpose of the proposed work is to update the existing Green Book that documents the definition, implementation and performance about Bandwidth-efficient modulations, CCSDS 413.0-G-3.

2. Key Technical Features

The Green Book will include two new (sub)sections concerning:

- Description and performance of Bi-phase-L filtering, for meeting SFCG mask
- Justification for the need of a high carrier suppression (>30 dBc) when using high-order modulation

Additionally, minor technical and editorial updates will be done, for alignment of content with latest references, SFCG recommendations, and latest issues of bandwidth-efficient 401.0-B recommendations (2.4.17A, 2.4.18, 2.4.23) since its last issue in 2018.

3. Benefits

Since 2018, the RFM blue book 401.0-B evolved from issue 28 to issue 32 (with issue 33 planned by end of 2024). The updates concerned aspects of bandwidth-efficient modulations as GMSK, SRRC-PSK/APSK, and filtered Bi-phase-L.

Thus the benefit is to have an up-to-date alignment between blue book and green book.

4. Requirements of prospective missions

Spectral-efficient modulations are widely used for high-rate links in the domain of Earth Observation, Science, human/robotic exploration, and space operations applications.

ANNEX 1 – Proposed Charter Modifications

The charters of RFM do not require any update.

ANNEX 2 – Proposed CWE Projects

Title: Transfer frame slicing for TM synchronization and coding

Document Number: 413.0-G-4

Document Type: Draft informational report + CCSDS Information report (Green Book)

Description of Document: unchanged with respect Section 1 of 413.0-G-3 (with exception of possible minor updates to be done during activity)

Conclusions

- **ESA proposed to**:
  - Update Section 3 – policy recommendations, of the 401.0-B, presenting some options;
  - To update the 413.0-G with latest from pink sheets, for covering also the 5y re-confirmation, by presenting a concept paper.

- The **WG is invited to assess the ESA proposals** and decide the way forward for the two books