

CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS

FINAL REPORT OF JOINT CCSDS SUBPANEL 1A/B/E/J MEETING

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The joint panel1A, 1B, 1E, 1J meeting of CCSDS took place on 20 Oct., 2000 in Villafranca, Spain chaired by the Panel 1A chairman, Greg Kazz.

The purpose of the joint meeting was to discuss issues on the Physical Layer of the Proximity-1 Space Link Protocol, (CCSDS 211.0-R-3, Pre-Red 3 Interim Draft, Oct. 11, 2000). This issue of the document is internal to the CCSDS subpanels and was distributed by the Panel 1A chairman by email on 11 Oct. 2000. All references to "Proximity-1" in these minutes refer to this version.

The main goals for this meeting were:

1. PHYSICAL LAYER CHANGES. To review the changes made to the Proximity-1 Physical Layer since the Spring 2000 CCSDS Panel 1 meetings in Annapolis.
2. ENHANCED FREQUENCY ALLOCATION. To discuss and approve the NASA proposal for an enhanced forward and return sub-band with a 30 MHz separation.
3. CHANNEL ASSIGNMENTS. To discuss and approve a plan to define specific channels within the agreed to frequency allocation for the Proximity-1 link.
4. IDLE & ACQUISITION SEQUENCE DEFINITION. To come to consensus on the definition of the idle and acquisition sequences.
5. RANGING & TIMING SERVICES. To discuss the proposed NASA plan for proximity-1 ranging and timing services based upon the coupled non-coherent ranging technique.

6. PHASE NOISE SPECIFICATION FOR PROXIMITY-1. To determine an acceptable recommendation for the phase noise specification for the Proximity-1 Recommendation.
7. TRANSMITTER SPURIOUS MASK. For specification of Section 3.3.5 Out of Band Spurs.
8. RESOLUTIONS. Provide resolutions if applicable, for the CCSDS management council to consider for approval.
9. ACTION ITEMS. Status of action items, assignees, and due dates assigned during this and previous related joint meetings.
10. ACKNOWLEDGEMENT/FUTURE MEETINGS
11. LIST OF ATTACHMENTS AND REFERENCES

The following is a summary of the discussions at the meeting:

1. PHYSICAL LAYER CHANGES

David Hansen of NASA/JPL reported on the changes to the Proximity-1 Physical Layer since the CCSDS Spring 2000 meeting. The changes made were either a) clarifications, b) responses to approved RIDs, or c) TBDs which have now been filled in. See attachment 1 for further details.

2. ENHANCED FREQUENCY ALLOCATION

David Hansen presented the NASA proposal to increase the UHF frequency allocation for the physical layer to 60 MHz (390 to 450 MHz). The forward frequency band is defined from 435 to 450 MHz. The return band is defined from 390 to 405 MHz. There is a 30 MHz deadband in-between them. After discussing the pros and cons of this approach, the subpanels decided to accept this new frequency allocation. See attachment 1 for more details.

3. CHANNEL ASSIGNMENTS

David Hansen presented a proposal (See attachment 1) for a Proximity-1 channelization scheme, given the approved 60 MHz UHF bandwidth. David pointed out the need to reassign a hailing channel for the Proximity-1 link since it needed to be 1) separate from the (437.1, 401.585) operational channel in use by the first set of UHF Mars Missions and 2) as close to the 30 MHz deadband as possible, since hailing will be done at a low data rate. The second fixed channel assignment, (437.1, 401.585) is necessary to grandfather

the existing Mars operational channel. During the meeting, CNES brought up their need to include the 4 Netlander return frequencies into the channelization scheme. These return frequencies are: 401.4, 401.7, 402.0, and 402.3 MHz. The subpanels agreed that these return frequencies can be used with any forward frequency within the forward frequency band operationally. Moreover, these return frequencies may be used coherently with 437.1 MHz. In summary, the subpanels agreed to the following Proximity-1 channelization scheme (all frequencies given in MHz):

Channel 1: Forward 437.1

Channel 1: Return 401.585625

Channel 2 (Hailing): Forward 435.6

Channel 2 (Hailing): Return 404.4

Channel 3: Forward: Selectable (At a minimum: 437.1) within the forward frequency band

Channel 3: Return: 401.4

Channel 4: Forward: Selectable (At a minimum: 437.1) within the forward frequency band

Channel 4: Return: 401.7

Channel 5: Forward: Selectable (At a minimum: 437.1) within the forward frequency band

Channel 5: Return: 402.0

Channel 6: Forward: Selectable (At a minimum: 437.1) within the forward frequency band

Channel 6: Return: 402.3

Channel 7: Forward: 439.2

Channel 7: Return: 397.5

Channel 8: Forward: 444.6

Channel 8: Return: 393.9

4. IDLE & ACQUISITION SEQUENCE DEFINITION

Dave Hansen presented how the NASA/JPL Mars Surveyor Project 2001 Odyssey orbiter defines its acquisition and idle sequences. See attachment 1. There was no report from ESA on what type of sequences are planned to be used on the Mars Express orbiter. Andre Ribes of CNES proposed the use of a Pseudo-Noise (PN) sequence instead of the alternating '1010...' pattern currently defined in Proximity-1 for both sequences. The rationale for this proposal follows. Andre raised the concern that if the data is convolutionally encoded or uncoded, spikes will appear in the frequency domain such that the receiver may lock up to one of them instead of to the carrier. Proximity-1 currently states that for acquisition, the transmitter shall transmit carrier only and then modulation with the acquisition/idle pattern. However, the CNES Netlanders transmit with modulation present. Hence, the '1010...' acquisition sequence presents a potential problem for their acquisition and if the currently defined acquisition sequence is used, a periodic spike can appear in the data in a repeatable way such that the receiver may lock up to it instead of on the carrier. A method of mitigating the risk of locking up to the data instead of the carrier is accomplished by using a PN code for both sequences. The subpanels agreed to Andre's proposal to use the same PN code and PN generator (which Andre has been tasked to supply, see New Action Items) for both the acquisition and the idle sequences for both coded and uncoded links. A requirement was levied on this PN generator to ensure that the PN code does not autocorrelate with either the 24 bit or 32 bit Proximity-1 link attached synchronization markers.

5. RANGING AND TIMING SERVICES

Greg Kazz presented the concepts and process whereby the coupled non-coherent ranging technique is used to generate round trip light time (RTLTL) and once determined, in applying that calculation in setting remote (UTC) time. See attachment 2. Attachment 3 contains the text that describes the time tagging carried out in the transceiver and how the process is used for setting remote time (UTC). The joint subpanels agreed that this proposal for ranging and timing service be added to the Proximity-1 specification.

6. PHASE NOISE SPECIFICATION FOR PROXIMITY-1

Andre Ribes made a presentation (see attachment 4) and provided a white paper (see attachment 5) on the phase noise specification for Proximity-1. These attachments provide the evidence for Andre's conclusion of specifying a performance curve for the transmitter defining the relationship between phase noise in dBc/Hz vs. frequency.

7. TRANSMITTER SPURIOUS MASK

Andre Ribes supplied his answer to Action item 00-1A1E-08 providing the characteristics of the transmitter spurious mask used on the ESA ROSETTA mission. See attachment 7. The rationale for this input is to provide the basis for the specification of Section 3.3.5 Out of Band Spurs of Proximity-1. Unfortunately, there wasn't enough time at the meeting to discuss this proposal. However, since this material has been available for review to the agencies, this matter shall be resolved outside of the panel meeting expeditiously.

8. RESOLUTIONS

The subpanels made no resolutions for Management Council approval.

9. ACTION ITEMS

ACTION ITEMS CLOSED AT THE MEETING:

00-1A1E-04 Provide rationale for and technical description of NASA proposed new frequency plan for forward and return links.

Action: D. Hansen
Due: 2000-06-15
Status: CLOSED

00-1A1E-05 Provide comments to D. Hansen & G. Kazz on outcomes of action 00-1A1E-04.

Action: A. Ribes
J.L. Gerner
Due: 2000-07-31
Status: CLOSED

00-1A1E-06 Extend in Proximity-1 Red Book the data rate range in section 3.2.5 with: inclusion of 1 Kbps data rate and indication that 4 data rates are 'reserved'.

Action: G. Kazz
Due: 2000-10-19
Status: CLOSED

00-1A1E-07 Provide G. Kazz description of the idle and acquisition sequences used for MSP-01, Mars Relay, and Mars Express in view of updating section 3.2.4 of Proximity-1 Red book.

Action: A. Barbieri (NASA/JPL); A. Ribes (CNES); A. Winton (ESA)

Due: 2000-05-30

Status: CLOSED By joint panel decision to use a PN sequence for both acquisition and idle sequences.

00-1A1E-08 Provide characteristics of transmitter spurious mask used on ROSETTA proximity link.

Action: A. Ribes

Due: 2000-06-15

Status: CLOSED

NEW ACTION ITEMS FROM THIS MEETING:

00-1ABEJ-01 Define a new directive for Annex B, to expand on the frequency options.

Action: E. Greenberg/G.Kazz

Due: 2001-01-15

Status: OPEN

00-1ABEJ-02 To the current Set Transmitter Parameters directive, add 401.4, 401.7, 402.0, 402.3 MHz as return frequencies. These can be used with any given forward frequencies operationally. These frequencies may be capable of being used coherently with 437.1 MHz.

Action: E. Greenberg/G.Kazz

Due: 2001-01-15

Status: OPEN

00-1ABEJ-03 The length of the acquisition sequence in octets shall be 512. In addition, remove the acquisition_sequence_length MIB parameter from Annex D.

Action: G. Kazz

Due: 2001-01-15

Status: OPEN

00-1ABEJ-04 To provide the detailed write-up on the phase noise specification for Proximity-1.

Action: A. Ribes
Due: 2001-01-30
Status: OPEN

00-1ABEJ-05 Update diagram 2-1 in Proximity-1 based upon the CNES comments in attachment 5.

Action: G. Kazz
Due: 2001-1-15
Status: OPEN

00-1ABEJ-06 Redefine the priority of transmission of Proximity-1 Frames in the document.

Action: G. Kazz
Due: 2001-01-15
Status: OPEN

00-1ABEJ-07 Provide Ed Greenberg/Greg Kazz with the specification of the PN generator for both acquisition & idle sequences for the Proximity-1 specification.

Action: A. Ribes
Due: 2001-01-30

00-1ABEJ-08 Modify the Proximity-1 specification to incorporate the PN code for use as the idle and acquisition sequences. Note: the PN code cannot autocorrelate with 24 and 32 bit ASMs.

Action: G. Kazz
Due: 2001-02-15
Status: OPEN

00-1ABEJ-09 Define in the Proximity-1 specification the SET MODE directive.

Action: E. Greenberg
Due: 2001-01-15
Status: OPEN

00-1ABEJ-10 Add to Section 3.2.6, a statement that says both idle and acquisition sequences shall be convolutionally encoded, when convolutional encoding is applied.

Action: G. Kazz
Due: 2001-01-15
Status: OPEN

00-1ABEJ-11 Clarify the validation & verification parts of the frame acceptance procedure (both transmit and receive).

Action: E. Greenberg
Due: 2001-01-30
Status: OPEN

00-1ABEJ-12 Add a note to 4.3.2 as a reference to the MIB parameters for Persistence defined in Annex D.

Action: G. Kazz
Due: 2001-01-15
Status: OPEN

10. ACKNOWLEDGEMENT/NEXT MEETING

ACKNOWLEDGEMENT. The chair and members of Subpanel 1A sincerely thank our hosts, Mr. Valeriano Claros and Ms. Fany Pena of ESA/Vilspa for the gracious accommodations and services provided.

NEXT MEETING. The next P1A meeting will take place in May 2001, most likely on the U.S. West Coast in the vicinity of JPL. Further details on meeting logistics will be provided to you by e-mail.

11. LIST OF ATTACHMENTS AND REFERENCES

[1] D. Hansen, "CCSDS Proximity-1 Physical Layer" (Presentation to CCSDS Panels 1A,B,E, J, Oct. 20, 2000). See filename: R2toR3_DMH.pdf.

- [2] G. Kazz, “CCSDS Proximity-1 Standard Timing Services Proposal”, May 23, 2000. (Timing_Services1ppt.pdf)
- [3] G. Kazz, “Coupled Non-coherent Proximity Timing Service (for ranging and UTC Time Transfer”. (Timing_process.pdf)
- [4] Andre Ribes, Presentation : “Proximity Link Standard Contribution to the specification of phase noise for the oscillators”, 20 Oct. 2000. (Phase_Noise_Slides.pdf)
- [5] Andre Ribes, White Paper: “Proximity Link Standard: Contribution to the determination of the specification of the phase noise of the different oscillators”, 20 Oct. 2000. (PL1_Phase_Noise.pdf)
- [6] Andre Ribes – J. Benoist, “Comments & Remarks on PL-1 CCSDS Standard Pre-Red 3 Interim Draft Issue”, 20 Oct. 2000. (PL1_Comments.pdf)
- [7] Andre Ribes, “Proposal for a Specification for the discrete lines spurious at the output of the power amplifier and out-of-band noise for Proximity Link Standard.”, 23 May 2000.