

# **RFM Meeting**

## **PCOM Project Session**

**London, 12 November 2014, AM**

### **Minutes**

#### **Participants**

Jean-Luc Gerner, chair	CNES
Ricard Abello	ESA
Massimo Bertinelli	ESA
Edward Christov	FSA
Xavier Enrich	ESA
Wai Fong	NASA
Amanuel Geda	DLR
Marina Gourtovaia	ESA
Jean-Luc Issler	CNES
Irina Kalininskaia	FSA
Alexander Kuzovnikov	FSA
Dennis Lee	NASA
Wu Ling	BITTT China
Jean-Pierre Millerieux	CNES
Alexander Rusanov	FSA
Victor Sank	NASA
Gunther Sessler	ESA
Vladimir Shuchev	FSA
Valery Vorontsov	FSA
Weiming Xiong	CAS
Takahiro Yamada	JAXA/ISAS
Xiujuan Yao	CAS

#### **Background**

The Spring 2014 PCOM meeting took place in Noordwijkerhout, The Netherlands and the following actions were raised:

##### **1. Agenda**

The agenda for this meeting was as follows:

12 November 2014 8:45 – 12:30		
1.	8:45	Approval of Agenda
2.	8:50	Review of Actions
3.	9:00	SLS-RFM_14-18 Lunar Relay Satellite Orbits (NASA)
4.	9:30	SLS-RFM_14-19 Hayabusa-2 Proximity Links (JAXA)
5.	10:00	SLS-RFM_14-21 Inputs proposed for the PCOM Green Book
6.	10:30	SLS-RFM_14-16 PCOM GB Issue 6 (chairman)
7.	11:50	Decisions. Next steps and actions
8.	12:20	AOB
	12:30	End of meeting

The agenda was approved.

## 2. Review of Actions

AI #	AI description	Actionee	Due date	Status
AI_PCOM14-1	Add indication of timeframe in section 2.1 and rework section 3.2 (Lunar Missions Requirements) of the PCOM draft GB	J.L. Gerner	8 weeks prior to Fall 2014 meeting	CLOSED PCOM GB Issue 6
AI_PCOM14-2	Provide glossary of acronyms	J.L. Gerner	8 weeks prior to Fall 2014 meeting	CLOSED PCOM GB Issue 6
AI_PCOM14-3	Provide text for rationale for the selection of bands in section 3.2.2	J.L. Gerner	8 weeks prior to Fall 2014 meeting	CLOSED PCOM GB Issue 6
AI_PCOM14-4	Add conventional modulations in table of section 4.2.1.1	J.L. Gerner	8 weeks prior to Fall 2014 meeting	CLOSED PCOM GB Issue 6
AI_PCOM14-5	Investigate complexity of an OFDM management system to assess its relevance for local lunar links	J.L. Issler	2 weeks prior to Fall 2014 meeting	CLOSED Input doct 14-21
AI_PCOM14-6	Review table of contents for sections 5 and 6 and develop these two sections	W. Fong	2 weeks prior to Fall 2014 meeting	DELETED
AI_PCOM14-7	Provide report(s) on study(ies) of lunar orbit design	V. Sank	2 weeks prior to Fall 2014 meeting	CLOSED Input doct 14-18
AI_PCOM14-8	Investigate the possibility of placing lunar orbiters at orbit altitudes high enough so that there is always an orbiter that sees a	J.L. Issler	2 weeks prior to Fall 2014	CLOSED Input doct 14-21

	lunar surface element and the Earth (so as to avoid orbiter-to-orbiter links)		meeting	
AI_PCOM14-9	In continuation to AI_PCOM13-2/ Devise a preliminary system architecture for communications in the vicinity of the moon, exploiting terrestrial systems technologies wherever practicable and propose a methodology for system design. Continuation of document SLS-RFM_14-10	J.L. Issler	2 weeks prior to Fall 2014 meeting	CLOSED Input doct 14-21
AI_PCOM14-10	Include lunar propagation material into the PCOM GB and check with the authors of the two articles whether their lunar propagation models could be made available to the CCSDS community	J.L. Gerner	8 weeks prior to Fall 2014 meeting	CLOSED PCOM GB Issue 6 Annex B
AI_PCOM14-11	Review the draft PCOM GB and provide comments no later than <u>four weeks</u> prior to the Fall'2014 meeting.	All	4 weeks prior to Fall 2014 meeting	CLOSED

All (but one) actions were closed. One was deleted.

### **3. Review of SLS-RFM\_14-18 Orbital Considerations For A Lunar Comm Relay (NASA)**

The document highlights the major influence of the Earth's gravitational effect on moon orbits. High altitude orbits (>1200 km) are inherently unstable while low altitude moon orbits gradually lose their circularity. The document refers to an article which proposes a stable moon orbit with eccentricity of 0.6, an inclination of 51 degrees and a periapsis of around 700 km at the north pole.

### **4. Review of SLS-RFM\_14-19 Hayabusa-2 Proximity Links (JAXA)**

This document reports of the technical characteristics of the JAXA satellite Hayabusa-2, due to be launched end of November 2014. The objectives of Hayabusa-2 are to capture samples from the asteroid 1999ju3 and bring them back to Earth. The spacecraft carries three small rovers and a lander. The spacecraft communicates with these four detached payloads through a proximity link radio system designed to minimize mass and cost. For that reason it is not compatible with CCSDS standards and operates in TDMA around 950 MHz.

### **5. Review of SLS-RFM\_14-21 Inputs proposed for the PCOM Green Book (CNES)**

The document is responding to several actions from last meeting.

The proximity link for the Rosetta mission is presented: S-band, full duplex, TC at 16 kbps.

Mascot is one of the Hayabusa-2 (JAXA) payloads. The radio link was provided by JAXA (see section 4).

Lessons learnt from these two missions are that future such missions would benefit from ranging capabilities of the proximity links. The point was discussed but not all agencies agreed on the need for accurate ranging in future missions.

Two agencies (ESA, UKSA) suggested that the PCOM GB should include a section on lessons learnt from Prox-1. The proposal was agreed by the group and UKSA took the action to elaborate on this.

**AI\_PCOM14-12 (M. Cosby UKSA) Provide comments on the GB architecture and a proposal for the introduction of lessons learnt**

The document addresses also the lunar orbits design and the gravitational influence of the Earth. It refers to the same publication as document SLS-RFM\_14-18 (section 3). The proposed elliptical orbit in two planes, with 3 satellites each, offers a global coverage of the moon surface. CNES and NASA took the action to propose an annex on the subject of lunar orbit selection.

**AI\_PCOM14-13 (J.L. Issler CNES, V. Sank NASA) Propose a text for an annex on lunar orbit design issues: constraints and possible solutions for lunar orbits**

The document investigates also the relevance of OFDM in terms of complexity of the management system for local lunar links. The system would be much simpler than that used for the mobile satellite service (MSS), as the number of users will be far less. Discussion went on where the resource management system should be: on Earth or in a lunar outpost. The question would need to be studied. The complexity of such system would also have to be traded-off against other systems such as CDMA.

**6. Review of SLS-RFM\_14-16 PCOM GB Issue 6**

The main changes with regard to the previous issue were presented and discussed.

The requirement for continuity of communication was discussed. Its need was recognized for EVA for safety issues but no conclusion as to whether it would be also required for unmanned rovers.

The requirement for a navigation accuracy of 1 meter was found too demanding by some participants; it was agreed to leave a TBD instead.

The Mars mission and system requirements sections are still empty. No participant volunteered to help filling-up the sections.

Link parameters for the bands 2483.5-2500 MHz and 1610 -1626.5 MHz are still incomplete. CNES took the action to provide the needed information.

**AI\_PCOM14-14 (J.L. Issler CNES) Propose updates to tables 10 and 14 on link parameters for the 2.5 and 1.6 GHz bands**

The chairman will complete link parameters data at 25-27 GHz.

**AI\_PCOM14-15 (J.L. Gerner CNES) Updates table 17 on link parameters at 25-27 GHz**

The group agreed that no optical link parameters data should be provided in the PCOM GB on optical links, as the OPT WG is currently working at the definition of CCSDS standards for optical links.

**AI\_PCOM14-16 (J.L. Gerner CNES) Leave only TBDs in table 21 on optical links and add an explanatory footnote**

It was agreed that the OPT WG and other SLS WGs shall be made aware of PCOM GB status and plans at the joint meeting Friday 14/11. The chairman will also update the PCOM GB and circulate it for comments.

**AI\_PCOM14-17 (J.L. Gerner CNES) Update PCOM GB and distribute to PCOM members**

**AI\_PCOM14-18 (All) Review the latest issue of the PCOM GB and provide comments**

**7. Decisions. Next steps and actions**

The project plan in the CWE foresees a completion of the GB by Fall 2015. This implies that the PCOM GB should be 'complete' by Spring 2015, the time remaining between Spring and Fall being dedicated to the fin tuning. With the limited participation from agencies, this objective appears difficult to meet.

**8. AOB**

No other points were raised. The meeting was adjourned.

**SUMMARY ACTIONS**

<b>AI #</b>	<b>AI description</b>	<b>Actionee</b>	<b>Due date</b>
AI_PCOM14-12	Provide comments on the GB architecture and a proposal for the introduction of lessons learnt	M. Cosby	8 weeks prior to Spring 2015 meeting
AI_PCOM14-13	Propose a text for an annex on lunar orbit design issues: constraints and possible solutions for lunar orbits	J.L. Issler V. Sank	8 weeks prior to Spring 2015 meeting
AI_PCOM14-14	Propose updates to tables 10 and 14 on link parameters for the 2.5 and 1.6 GHz bands	J.L. Issler	8 weeks prior to Spring 2015 meeting
AI_PCOM14-15	Updates table 17 on link parameters at 25-27 GHz	J.L. Gerner	8 weeks prior to Spring 2015 meeting
AI_PCOM14-16	Leave only TBDs in table 21 on optical links and add an explanatory footnote	J.L. Gerner	8 weeks prior to Spring 2015 meeting
AI_PCOM14-17	Update PCOM GB and distribute to PCOM members	J.L. Gerner	6 weeks prior to Spring 2015

			meeting
AI_PCOM14-18	Review the latest issue of the PCOM GB and provide comments	All	2 weeks prior to Spring 2015 meeting