

The First Meeting of APSCO Small Student Satellite Project

1- 4 November, 2011

Beijing, China

MINUTES OF MEETING

A. GENERAL

1. The project of APSCO Small Student Satellite (SSS) initiated by the Asia-Pacific Space Cooperation Organization (APSCO) is aimed at training students and faculties from Member States (MS) for satellite engineering through hands-on practical training until the flight model is made, and thus to contribute significantly for developing space education system in MS. The 1st Meeting of APSCO SSS project held on Nov 1-4, 2011, was aimed at developing overall plan for implementation of the project, and get agreement on some details of the project up to sufficient details only. The following Distinguished Professors those who are from Universities in Member States and nominated by their respective countries attended in the meeting. Countries are namely People's Republic of Bangladesh, People's Republic of China, Republic of Indonesia, Islamic Republic of Iran, Mongolia, Islamic Republic of Pakistan, Republic of Peru, and the Kingdom of Thailand. A list of all the Participants is placed at Attachment-1 these minutes.
2. On the 1st November 2011, the opening session for the meeting was held. Distinguished Professors from MS and some officials from APSCO attended the opening ceremony. The opening was addressed by Dr. Zhang Wei, SG of the APSCO. He stressed out that the target of the first meeting is to establishing core group for the project, and emphasized on the following topics: the objective and mission definition, the system architecture design, the payload design, and the implementation plan. The core group should be composed of University Professors and students from member states. He highlighted that one can not finish things through single attempt, instead he asked participants to focus more on developing the implementation plan up to sufficient details only.
3. During the opening session, Mr. Tsoodol Nyamkhuu, the Director General of the Education, Training and Database Management Department of APSCO, made a brief introduction to the APSCO and SSS project as an introductory to the participants.
4. Based on the agenda of the meeting, each member states of APSCO made a 15 minutes country presentation as to the project. They shared information on available resources and facilities in their home country, and the experiences as well.

5. In 3rd session, Professor Cao from BUAA made a keynote presentation on the small student satellite design. His presentation based on the example of 3 satellite constellation proposed by Chinese side.
6. In discussion session, the participants are invited for discussion on general about the project features. And some MS suggested as follows:
 - **Indonesia:** The common interest of MS for this project should be focused on earth-quake monitoring, global warming, inter-sats communication etc. Industry should be involved.
 - **Iran:** Different MS have different standards, so we do have to set the standard at first. To start from the small scale and build up gradually as one ground principle for the project. We should have a project manager who should organize all member states work efficiently. Systematic approach for meeting and for discussion, all the member states should monitor the progress of the project. Emphasized on Teamwork and Synergy.
 - **Thailand:** How can we involve the University students and Professors to work together?
 - **Bangladesh:** Leading country should have good industry background.
 - **Peru:** Better to have good relation with launcher.
 - **Pakistan:** Capacity building for all MS.

Conclusions: Different member states have different standards, so we have to set the common standard first. The role and responsibility of leading university should be as follows:

- Good facility for training and education.
- Having good relation with industries and launcher.
- Centralized management structure through single body for an effective coordination with all MS.

B. OBJECTIVE DEFINITIONS

7. Member States have discussed the Objectives and agreed as follows for overall objective:
 - The project is aimed at creating a platform for educational cooperation among participating Universities of MS targeting for enhancing a capacity of Universities in space technology development for senior undergraduates and above levels in both aspects of knowledge and engineering practices.
 - In light of the educational purposes for senior undergraduates and above levels, the proposed satellite system (constellation) should not be too complicated and be designed and developed through the collaborative efforts between participating Universities from MS within the reasonable timeframe, funding, and taking into account potential risks. The proposed satellite system payloads can be the Earth Observation, Communication, and Space Science Experimental modules.

- The continuity and sustainability of the project are the important priorities for the project, and the overall purpose of the project for training should not be abandoned at any stages of project.
- This project shall provide a platform for collaboration and teamwork among Universities from MS, and every participating MS in the project shall accept responsibility for at least one part of the project.

C. MISSION AND FUNCTION DEFINITIONS

8. After rigorous discussions among MS, it has been agreed as follows for mission and functions:

9.1 As to number of satellites, MS suggested as follows:

- **Indonesia:** Two satellites constellation with expandable capability is preferable.
- **China:** Six satellites constellation including 3 by Beihang University of China, which should be built by postgraduate and above level students. For other 3 Satellites, suggested to define it through consultation with other MS.
- **Iran:** That six satellite constellation should be under APSCO leadership.
- **Peru:** More than two satellites.
- **Thailand:** Two is preferable.
- **Pakistan:** Two with expandable capability is preferable.
- **Bangladesh:** Two is preferable.
- **Mongolia:** More than one satellite.

Conclusion: All MS agreed on having satellite constellation under name of APSCO SSS constellation. APSCO Constellation shall consist of 6 satellites including 3 satellites as it has been defined by China in advance and plus other 3 satellites by other MS, which shall be defined the configurations at later stage. Since those 3 satellites defined by China are in same orbit, other 3 satellites by MS should be put in different altitude orbit taking into consideration the timeframe for implementation. And as to the organizational structure for the project, MS agreed on having two-tier management structure for the project and to choose Beihang University of China as Top level leader for the project, and at the same time as sub-tier project leaders are Universities from Pakistan, Indonesia, Iran, and Thailand. Beihang University shall be sub-tier leader for 3 satellites proposed by China at the same time. The APSCO agreed to take care for coordinating the launching and providing associated trainings accordingly.

9.2 As to the Primary and secondary payloads, MS suggested as follows:

- **Iran:** RS and Communication as primary payload, and plus new technology demonstration payload as secondary payload.

- **Indonesia:** RS payload as primary and Inter satellite Communication as secondary payload.
- **China:** RS plus Communication payload as primary and inter sat& sat/ground payload as secondary. Plus having experimental payloads for space science is also preferable.
- **Bangladesh:** RS plus Communication as primary, and some Experimental payload as secondary.
- **Thailand:** RS payload as primary and Inter sat communication payload as secondary.
- **Pakistan:** RS payload as primary and Inter sat communication payload as secondary.
- **Peru:** RS and Communication payload as primary and Inter sat communication payload as secondary. Plus having experimental payload is preferable.
- **Mongolia:** RS and Communication (including Inter Sat& Sat/Ground) as primary and Experimental payloads for space science and research technology as secondary.

Conclusion: MS agreed on having RS payload plus Inter satellite & Sat to Ground communication transceivers as primary payload for APSCO constellation and Experimental payloads for space science and research as secondary payloads.

9.3 As to designed lifetime of system, MS suggested as follows:

- **Iran:** 2-3 years
- **Indonesia:** 3-5 years
- **China:** 1-3 years
- **Bangladesh:** 3 Years
- **Thailand:** 3 years
- **Pakistan:** 3 years
- **Peru:** 3 years
- **Mongolia:** 2-3 years

Conclusion: 2-3 Years

9.4 As to the timeframe for project implementation, MS suggested as follows:

- **Iran:** 2-3 years
- **Indonesia:** 3 years (Launching in 2014)
- **China:** 3-4 years (Launching in 2014/2015)
- **Bangladesh:** 3-4 years (Launching in 2014/2015)
- **Thailand:** 3-4 years (Launching in 2014/2015)
- **Pakistan:** 3 years launching should by 2014.
- **Peru:** 3-4 years (Launching in 2014/2015)

- **Mongolia:** 3-4 years (Launching in 2014/2015)

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Conclusion: 3-4 years

D. PAYLOAD DEFINITIONS

10. As to the payload definitions in details, MS suggested as follows:

- **Iran:** RS and Communication payloads should have at least one camera and store and forward capability. And as secondary Payloads, the testing the manufactured sensors and actuators are preferable.
- **Pakistan:** RS Payload: Pan/Multi-spectral Imager.
- **Thailand:** RS Payload: Multi-spectral Imager. Secondary: Inter Satellite Transceiver.
- **China:** RS Payload: Multi-spectral Camera/Spectrometer. Communication payloads. Secondary payload: Radiation belt particle detector.
- **Indonesia:** NIR and MSI. Communication FX.25 for data communication.
- **Peru:** Primary: MSI + Inter Satellite Transceiver. Secondary Payload: Experimental attitude controller.
- **Bangladesh:** no suggestion.
- **Mongolia:** no suggestion.

Conclusion for primary payload: After rigorous discussions among MS, it has been agreed as follows for Minimum requirements for primary payloads:

10.1 RS Payload:

- a) *MSI (Multi-spectral Camera)*
 - **GSD:** less than 200m,
 - **Swath:** 30-40 Km,
 - **Bands Requirements:** 0.45um-1um,
 - **Data transmission rate:** TBD,
 - **Storage req.:** TBD.
- b) *Spectrometer:*
 - **Band freq:** 0.45-0.9um,
 - **Bands:** 32 bands,
 - **GSD:** 100m,
 - **Swath:** 50km,
 - **Mass:** 10 kg.

10.2 Communication Payload:

- a) *Inter Satellite Communication Transceiver:*
 - **Frequency band:** S-band (Shall follow ITU allocation)

- **Data rate:**
 - 1) Inter Sat: 128Kbps,
 - 2) Sat downlink: 2Mbps,
 - 3) Uplink: 9.6kbps,
 - 4) Protocol: CCSDS.

b) *Satellite to Ground Transceivers*

- VHF/UHF Transceiver for TT&C and store and forward,
- X-band transmitter for image transmission,
- Frequency coordination should be coordinated by APSCO.

10.3 Summary table for the APSCO 3 Satellites by China:

	APSCO Satellite A	APSCO Satellite B1	APSCO Satellite B2
Payloads	Micro-camera, CMG, Space Environment Exploration Package Inter Sat communication transceiver	Space Environment Exploration Package Inter Sat communication transceiver	Space Environment Exploration Package Inter Sat communication transceiver
Specifications	<ul style="list-style-type: none"> - Three axis - ACS - Platform Stability: 0.001deg/s - Pointing Accuracy:0.1deg - Agility: 2-5deg/s - GSD:2.5m - Swath:15Km - Mass: 150Kg 	<ul style="list-style-type: none"> - Spinning - 10-20rpm - Attitude determination: 0.5 deg - Pointing to north of ecliptic: 5 deg - Mass: 50Kg 	<ul style="list-style-type: none"> - Spinning - 10-20rpm - Attitude determination: 0.5 deg - Pointing to north of ecliptic: 5 deg - Mass: 50Kg
Leading country	China (Sub-tier leader for the satellites proposed by China and at the same time Top leading University for the project)		
Participating countries	<ul style="list-style-type: none"> - Pakistan - Iran (subsystem level) - Thailand (Subsystem Level) - Indonesia (Subsystem Level) - Peru(Subsystem Level) 		

10.4 Summary table for the APSCO 3 satellites by other MS:

	APSCO Sat 3	APSCO Sat 4	APSCO Sat 6
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Payloads	R.S Payloads Inter Sat Communication Transceiver	R.S Payloads Inter Sat Communication Transceiver	R.S Payloads Inter Sat Communication Transceiver
Specifications	- See above mentioned	- See above mentioned	-See above mentioned
Leading country (sub-tier leaders)	Iran	Pakistan	Indonesia
Participating countries	<ul style="list-style-type: none"> - China (Payload level) - Thailand (Sub-system Level) - Peru (Sub-system Level) - Bangladesh (Sub-system Level) - Mongolia (Sub-system Level) - Indonesia (Sub-system Level) 	<ul style="list-style-type: none"> - China (Payload level) - Iran (Sub-system level) - Thailand (Sub-system Level) - Peru (Sub-system Level) - Bangladesh (Sub-system Level) - Mongolia (Sub-system Level) - Indonesia (Sub-system Level) 	<ul style="list-style-type: none"> - China (Payload level) - Iran (Sub-system level) - Thailand (Sub-system Level) - Peru (Sub-system Level) - Bangladesh (Sub-system Level) - Mongolia (Sub-system Level)

Conclusion for secondary payload (optional): TBD

E. SYSTEM REQUIREMENT DEFINITIONS

11. MS have discussed system requirements and then agreed on as follows:

11.1 As to the Orbit range:

- **Iran:** Circular Repeating SSO or Frozen repeating SSO 500km-800km.
- **China:** SSO 686 Km altitude same orbit for three Sats, 576km for others. The orbit should be defined by the launcher.
- **Bangladesh:** APSCO satellite shall be in line with Chinese launcher definition.
- **Thailand:** SSO 600km-800km.

- **Pakistan:** 550km-800km polar or SSO.
- **Peru:** 500km-700km around 600km.
- **Mongolia:** No comments.

Conclusion: The leading university shall coordinate with the launcher on this issue

Ideal orbit: Circular Repeating SSO
Acceptable orbit: Polar orbit

11.2 As to the Mass Requirements for each satellite to be defined.

- **Indonesia:** 30-100kg
- **Peru:** Less than 100Kg
- **Pak:** 60kg-80kg
- **Iran:** 50kg
- **Thailand:**50-100kg
- **Bangladesh:** 80kg
- **China:** 50-100kg not include Chinese satellites
- **Mongolia:** less than 100kg

Conclusion: 30-100Kg

11.3 As to the system functional/performance requirements:

- **Pakistan:** Pointing accuracy, three axis stability. Two satellites should be with same payloads, the other one should be different.
- **Indonesia:** The payloads have to be defined before the system definition.
- **Iran:** Pointing accuracy, Imaging bands, Coverage, Image Resolution. The principle on whether the satellites shall be identical shall be decided.
- **Pakistan: China:** Leading country should decide on the payloads.

Conclusion: It is agreed that three satellites to be defined by MS would be identically configured for the time being. After detailed study, the detailed configuration would be given. However, the study should examine following requirements, which have been agreed tentatively.

System Requirements:

- **Attitude control:** 3 Axis Bus
- **Pointing Accuracy:** Less than 3 deg
- **Power for payloads:** More than 30% of the total power consumption
- **Platform stability:** 0.01 deg/s
- **Maneuver:** No stereo imaging TBD
- **Real time imaging:** Off time imaging TBD
- **Revisiting time:** TBD until the orbit and No. satellite determined
- **Mass of payload:** Maximally using the capacity of the BUS (TBD)
- **Launcher requirements:** To meet the requirements of the launcher

- **Reliability of the space segment:** More than 80% over the designed Lifetime

F. ACTION PLAN/ROAD MAP

12. MS agreed on action plan for next steps as follows:

- Sub-tier leaders of the satellite system shall be responsible for developing the Feasibility Study (FS). It is asked sub-tier leaders to make their respective part for particular satellite, and submit them to the APSCO by end of Jan, 2012.
- Funding plan shall be finalized by sub-tier leaders of satellite system by Jan 31, 2012, then to submit to the APSCO.
- APSCO will share all proposals and information on funding plan by sub-tier leading Universities to the Top leading University (China). Top leader shall finalize the report including the overall funding plan for the project, then to submit to the APSCO for reviewing, and to distribute to all participating Universities in MS by end of March, 2012.
- The second meeting of APSCO SSS project and Admin Heads meeting shall be held and to finalize the FS report by April 2012.
- The final report will be submitted to APSCO Council Meeting in May, 2012 for approval.

G. OTHERS

13. Focal points from each leading country are shown as attached.

14. Technical meetings would be called on request and coordinated by Project leader.

H. OVERALL CONCLUSION

15. The meeting was successfully concluded, and all participants from MS agreed on this Minutes of meeting. APSCO thanks to all participants from MS for active participation, inputs, efforts, and dedication for the meeting. Participants from MS thank to APSCO for organizing this meeting and Beihang University of China for hosting as well. Participants expressed also that their pleasure for sharing information, knowledge, and experiences to each others toward for developing collaboration between MS and man power development in MS.