THAILAND YOUTH INNOVATION INTERNSHIP PROGRAM : SATELLITE TELECOMMUNICATION ENGINEER

Warinthorn Kiadtikornthaweeyot (1), Natthawat Hongkarnjanakul (1), Thanchanok Khlongkhlaew (1), Prayat Puangjaktha (2), Peerapong aramsoontornsuk (3),

[1]Geo-Informatics and Space Technology Development Agency (GISTDA) Bangkok, Thailand
[2] Chiang mai University, Chiang mai , Thailand
[3] Mahanakorn university of technology, Bangkok, Thailand
Email: warinthorn@gistda.or.th; natthawat@gistda.or.th; thanchanok@gistda.or.th; prayat_pu@cmu.ac.th; 5811140006@mutacth.com

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ABSTRACT: Geo-Informatics and Space Technology Development Agency (GISTDA) has initiated a program named the Innovation Internship program, for university students who are interested in space technology, especially telecommunication engineering. The program is also called Ignite star. The aim of the project is for young university students to gain more experience on CubeSat satellites expectedly on VHF/UHF Transceivers.

The Student Small Satellite project has been established by APSCO since 2016. There are 3 constellation satellites, which consist of one micro-satellite with the name of SSS-1 at 30 kg and two CubeSats. The two CubeSats have been given the names of SSS-2A and SSS-2B, which are both 3U CubeSats at about 4 kg each. The SSS-2B is led by Turkey and the Thailand team supports the development. These satellites are designed and manufactured by guidance from the space agency and cooperation of the APSCO members. The objective of this program is to promote cooperation, joint development and share the achievements among the members in space technology via hands on satellite development.

In this paper presents the Ignite star program, which is an internship student program. The procedure to select the students is described. There are 4 students will have this opportunity to join this training short course. Furthermore, only 2 students, who get the highest score at the end of the ignite star program will participate the SSS-2B satellite testing and training at Turkey about the end of 2019. The program started at the beginning of June and finished at the end of July. The students have been assigned to design their own project in the satellite communication field. There are 4th oral presentations in front of the external examiners, who are the specialist from difference universities. Therefore, GISTDA engineers involve along the project as personal instructors for each student. Moreover, these students are preparing to understand and gain knowledge in satellite communication, SSS-2B specification and satellite testing procedure.

GISTDA perceives this as an opportunity for Thailand to gain experience in space technology for students and co-operation with APSCO members. This project will be the great step moving forward to build up the space technology capacity for Thailand.

1. INTRODUCTION

Now a day, it can be said that satellites are an important part of the extra information to monitoring the Earth, included disaster, communication, transportation and other field related to space technology. Generally, people feel that the satellite is too far away and cannot be recognize or perceive. As a result of the currently of the new space technology makes new generation of the satellite smaller, cheaper and easier.

These small satellites that mentioned above are called “CubeSat” which is classified in nanosatellites. CubeSat are built to standard dimensions of 10 cm x 10 cm x 10 cm (1U). There are CubeSat in the size of 2U, 3U, 6U and some 12U [1]. CubeSat has been popular since the start from the universities and many organizations due to it is very small size, which related to less weight and lead to lower budget for launcher [1]. The standard deployment system was developed to ensures that the CubeSat can be built in the physical requirement. It is the standard shape interface between launcher and CubeSat. [2]

The smaller satellite gives the team the shorter development time. Therefore, there are many COTs equipment flight proven ready to use in the industry. All these features put together created CubeSat to be the satellite that is accessible easier and open the larger satellite development community. There are many benefits in terms of education, experiments on space technology and science education. CubeSat development projects makes students, professors and team members get more understanding and skill in the satellites technology.

There is more need to use the benefit of the satellite in Thailand for many different areas, such as natural disaster. Recently, the small satellite system is one of the tools that very important to support Thailand to develop the country. Thailand 4.0 is released recently as the direction of the country to use the big data and Internet of Thing to be able to

support the Thai government. GISTDA as the space agency for Thailand created many channels to bring the space data to be benefit on Earth.

This paper presents the innovation internship program in the area of telecommunication engineer, which is the program to promote space technology to the university students. Also it is the process to select the students to join the satellite hand on testing at Turkey. This program gives GISTDA more experience for the satellite technology. It is very important to integrate the space technology knowledge to be able to support space technology capability for the future of Thailand [3]. The rest of the paper is organized as follows: Section II describes the Student Small Satellite by APSCO. The next section details of the Ignite Star program. Section 4 describes the program activities and section 5 describes the small satellite projects. Section 5 describes the evaluation and competition criteria to select the students and the final section is conclusion and future work.

2. STUDENT SMALL SATELLITE BY APSCO

Student Small Satellite (SSS) was initiated by Asia-Pacific Space Cooperation Organization (APSCO) since 2016. The main objective is to train the students from the member states of APSCO to be able to understand more space technology through hand on built the small satellite. APSCO has provided not only the budget to do the satellites design but also contribute to the development of the space education for the APSCO member states. Therefore, the hands-on training is very important for this project with the concept that the most efficient means of training is based on hands-on practical training. It is a very power full procurer to gain the experience and technical skill to the trainees by open more the opportunity to design, build, integration and testing [4].

The SSS APSCO system consists of 3 satellites, which will operate in the orbit as the satellite consternation as demonstrates in Figure 1 [6]. There is one micro-satellite with the name of SSS-1, two CubeSats SSS-2A and SSS-2B. The SSS-1 led by Beihang University in China. Iran and Pakistan support the development. The SSS-2A led by Shanghai Jiaotong University in China. Pakistan is the support team for SSS-2A. Whereas, the SSS-2B is led by TUBITAK-UZAY, Turkey and the Thailand team supports the development. These satellites are designed and manufactured by guidance from the space agency and cooperation of the APSCO members [6].

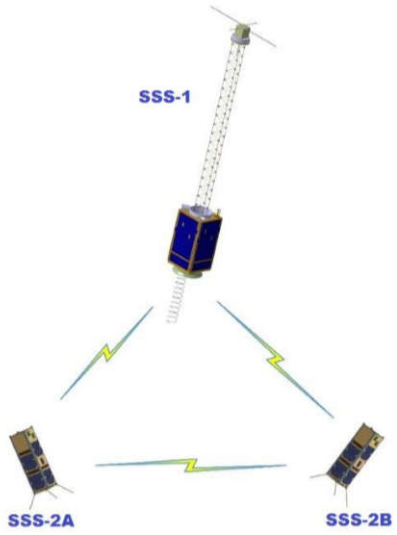


Figure 1 APSCO SSS project [6]

Therefore, the requirement of APSCO Council is that the SSS project shall involve the universities, institutes or companies from many different countries from the member states. All the participant shall be able to gain hands on practice in such as;

- Satellite system design and system engineering
- Satellite payload and sub-system design and development
- Satellite assembly, integration, and testing (AIT)
- Satellite launch and operation
- In-orbit technology demonstration
- Space scientific experiments
- Ground station network for operating a group of satellites for a joint mission

3. IGNITE STAR PROGRAM

Innovation Internship Program: Satellite telecommunication Engineer or Ignite star. It is the first program to select the top quality internship student to join the testing of the SSS-2B at Turkey. The objective for this program is for;

- To encourage the university student interesting in the SSS-2B project.
- To encourage the young student looking into the benefit of the SSS-2B project and create the ideal to be able to use the SSS-2B for Thailand.
- To support the university student who interesting in satellite communication to be able to hand on testing and training in the real testing with the international laboratory.
- To extend the capability in space technology for Thailand as the Thai nation development plan.

The intention of who can join this program is the university student who is interesting in telecommunication satellite and who that would like to gain more experience on CubeSat satellites and VHF/UHF Transceivers. The program was based on GISTDA at Siracha, Choburi. It is the mail place for GISTDA to operate the satellite control center, receiving station and development centers.

The time line of the program activities is demonstrated in Figure 2. The schedule is firstly advertising the program to the universities these have the faculty related to such as engineering or science technology. The road show was started about February 2019. The application starts from March until mid of May. Mid of May. The committee decide on the students using the interview and the essay. The topic for the essay is "CubeSat 3U technology and its benefits for Earth", with size maximum 1 page A4. The internship program began the beginning of June and finished the end of July, the program duration is about 2 months.

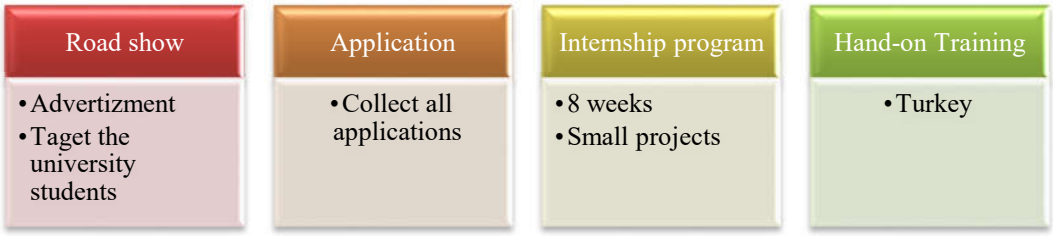


Figure 2 The Ignite star main activities time line

GISTDA performed the orientation for all the student to give all the information about the project, the schedule for this 2 months. Beside they will know the principle in GISTDA and the rule that need to follow. Moreover, on the orientation the personal trainer (instructor) was introducing to the student. Also during this program each student has the individual small project that created by themselves about the communication system. This small project is advised by the instructors that lead the small project archive the goal of the project. The only top quality intership student will join the Hand on training at Turkey.

4. PROGRAM ACTIVITIES

On the job training is the recommended method to transfer specialist skills and knowledge through hands on activities to the engineers. Moreover, the academic education is also very important for providing the fundamental knowledge to the team. During these 2 months there are many activities going on such as, short course training, review technology, onside training and small telecommunication projects.

4.1 SHORT COURSES TRAINING

The team project had been set up the schedule for internship student. There are many courses for the internship students. There are the courses from GISTDA engineers and the specialist that are invited to give the talk and training at GISTDA site. The short courses are demonstrating in Figure 3, which consist of APSCO training, Link Budget analysis, VHF/UHF Transceiver, Mission design, Orbit Fundamental, Spacecraft technology and English skill. Moreover, the onside review and training are included such as GISAVIA project, Satellite control center, Galaxy Laboratory, Hand on Testing laboratory and CubeSat Demonstration session etc.

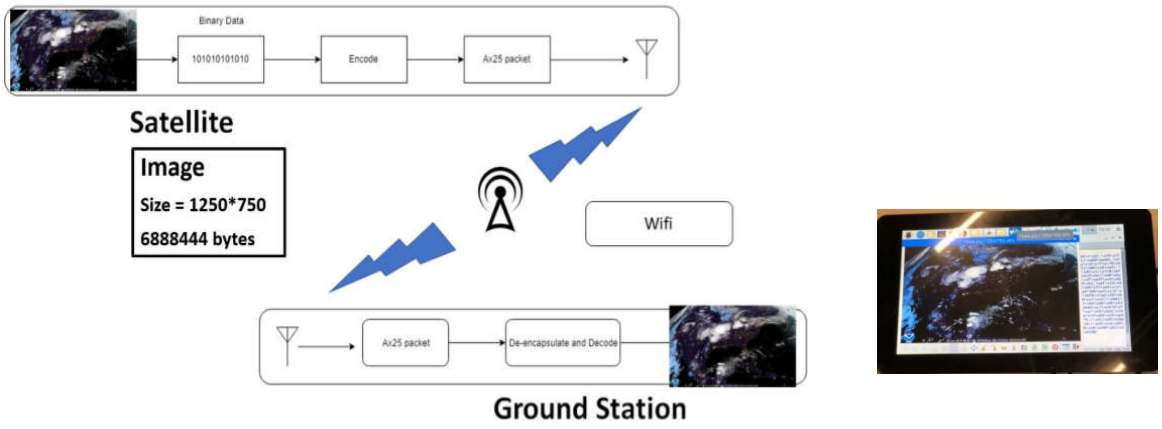
Figure 3 Short courses training at GISTDA site.

5. SMALL TELECOMUNICATION PROJECTS

The internship students have been assigned to finish the small project individual. GISTDA engineers involve along the project as personal instructors for each student. Moreover, these students are preparing to understand and gain knowledge in satellite communication, SSS-2B specification and satellite testing procedure. There are 4 small projects in satellite telecommunication.

5.1 PROJECT 1

The first project is "Protocol satellite communication". The project objective is to study about the communication system between the satellite and the ground station. There are two protocols had been studied, AX.25 and Auto Transmission picture (APT). AX.2 is usually use with CubeSat satellite to be able to communicate between the ground station and the CubeSat itself. The topic to learn consists of Communication system, Protocol, Modulation, Amateur Packet Radio (AX.25) and Encrypted Data. The procedure starts with understanding the work flow before implement the procedure of the protocol using python. The Raspberry pi has been use to simulate the function of the design. Figure 4(a) demonstrates the overall AX.25 protocol simulation. For this project the internship student uses 2 Raspberry pi, camera, the computer and use python to implement the designed. Also the testing and debug the program are performed. Figure 4(b) demonstrates the final hardware development in this project.

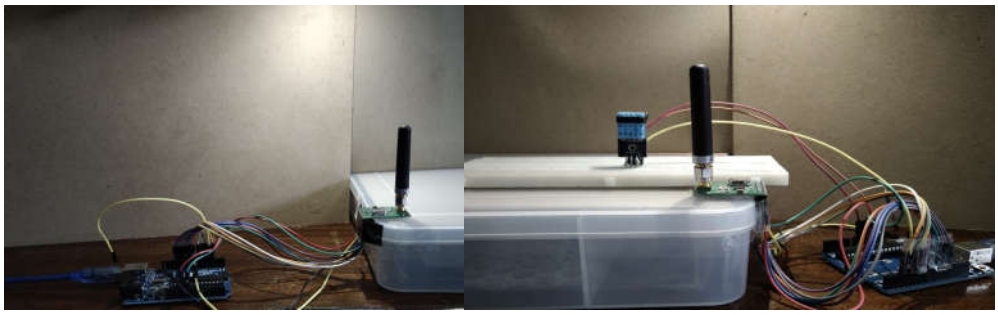


(a). (b).

Figure 4 (a) The overall AX.25 protocol for satellite communication.
(b) The simulation result of the transmitted image at the ground station.

5.2 PROJECT 2

The project 2 is “RF Communication for CubeSat”. The project focuses on the prototype design of RF communication system of CubeSat to transmit data between ground station and CubeSat. The main objective of this project is learning about the behavior in part of the RF communication. The project has divided into three parts: (1) Research about Nano-satellites and circuits for communication system, (2) Experimental, (3) Design circuit and PCB. Therefore, the Requirement hardware consist of two microcontrollers, two RF modules, One RF amplifier or LNA, wires and connect, antenna, program Arduino and easyEDA. The final result that the designed system can transmit and receive the signal using SPI protocol control between the ICs as demonstrates in Figure 5.

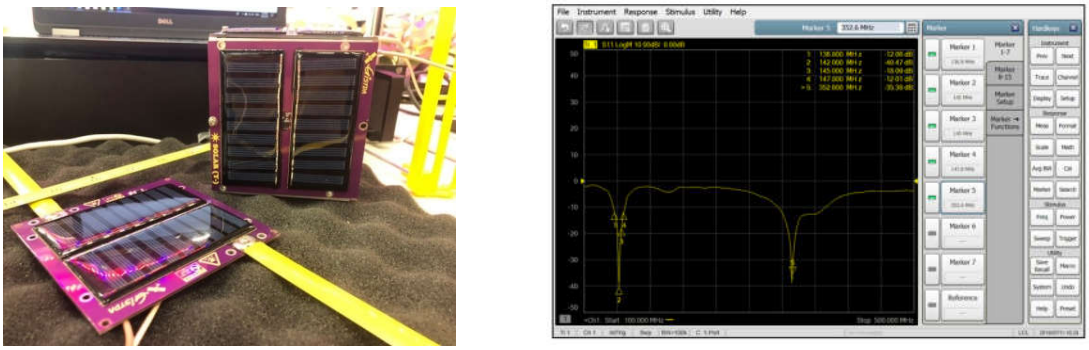


Receiver Transmitter

Figure 5 The final product for the RF communication for CubeSat project

5.3 PROJECT 3

The project 3 is “Dipole Antenna for CubeSat”. These objectives are to study, design and built the small antenna that possible to use for receive and transmitting the signal on the satellite. The ANSYS HFSS was use for skittering the simulation. The dipole antenna is use for this project and VHF/UHF frequencies also apply using for the test. The design and built testing result are compared with the result from the simulation model. From this project student learn more about the parameters that need to consider to design and simulate the dipole antenna. The design limitation and constrain have been learn for the compatible simulation design. The project was beginning with the technical information, after that learn about all the necessary parameter and how to use the ANSYS HFSS, design and test. Figure 6(a) demonstrates the final hardware development in this project. Figure 6 (b) shows the example of the simulation result.



(a) (b)

Figure 6 (a) The final hardware development.
(b)The example of the simulation result using the design antenna in VHF frequency band

5.4 PROJECT 4

The project 4 is “Basics communication system: Smart box”. This project is designed the real time temperature monitoring from control room. The objective is to control the appropriate temperature to stop any risk from the higher or lower temperature in the ground station control room. The idea is built the temperature sensor and

install in the control room, which given the name smart box. The smart box has the temperature sensor and transmitting system. The smart box sends the sensor data to the Wi-Fi and this data will board case out to the operator automatically via application LINE, which is free to use on PC and smart phone. The equipment has been used in the project consist of controller Arduino board, temperature sensor. The internship student learns to use the Arduino and programming also understand the communication concept as the final hardware is demonstrates in Figure 7.

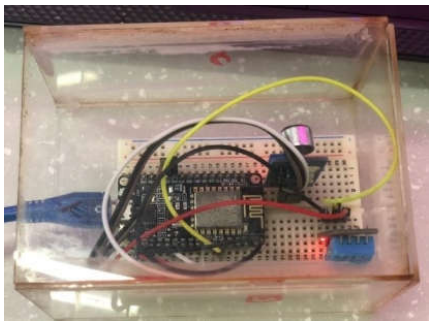


Figure 7 The final hardware for “Basics communication system: Smart box”

6. EVALUATION AND COMPETITION

During these 2 months, there are 4 times oral presentations for students to collect the point. The last poster presentation demonstrates their final result of each project. Figure 8 demonstrates the final Poster presentation and project demonstration. The evaluation measurement consists of:

- The understanding in space technology
- The understanding in TT&C UHF/VHF Transceiver
- The understanding of the data from space apply using for human and planet
- The English communication skill
- The communication project, new, technology, logic and the results.
- The principle and references
- The idea of the project and the development procedure.

The students who get the top score for this competition will acquire: Firstly, on the job training for testing the CubeSat satellite with the international laboratory from professional space technology organization on the beginning of November 2019. Secondly, the scholarship and the certification from GISTDA.

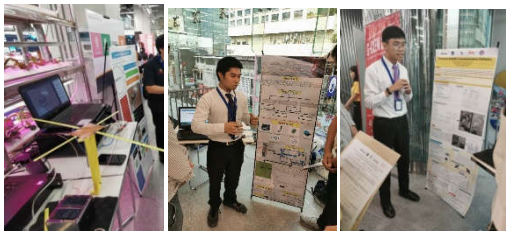


Figure 8 Poster presentation and project demonstration

7. CONCLUSION AND FUTURE WORK

The Innovation Internship program in the communication engineer has been described in this paper. The program is established due to GISTDA join the project SSS-2B, which is the 3U satellite supported by APSCO. The objective is to gain more experiences to the students in the member countries by using the hand on practice thought the real satellite. There are 2 students from the ignite start project will have the opportunity to join the on the job training on testing the SSS-2B satellite at Turkey. The expecting time to join this training is about November 2019. This program is under the support from GISTDA and the APSCO with the cooperation with TUBITAK UZAY Turkey. It is the small part to build the new platforms of space technology for sustainable technology in Thailand.

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