BIRDS Project Newsletter

Springtime Wisteria in Japan
春は藤の季節

Issue No. 3 (15 April 2016)

Project website: http://birds.ele.kyutech.ac.jp/

Edited by:
G. Maeda, Tejumola Taiwo, M. Cho,
Laboratory of Spacecraft Environment Interaction Engineering (LaSEINE),
Kyushu Institute of Technology,
Kitakyushu, Japan.

Bangladesh

Nigeria

Mongolia

Ghana

Japan

The nations of the BIRDS Project

Contents of this Issue

More subsystems and more ground stations will be covered in future issues of the newsletter.

1. Subsystem Summary #5

Communication Subsystem

April 12, 2016

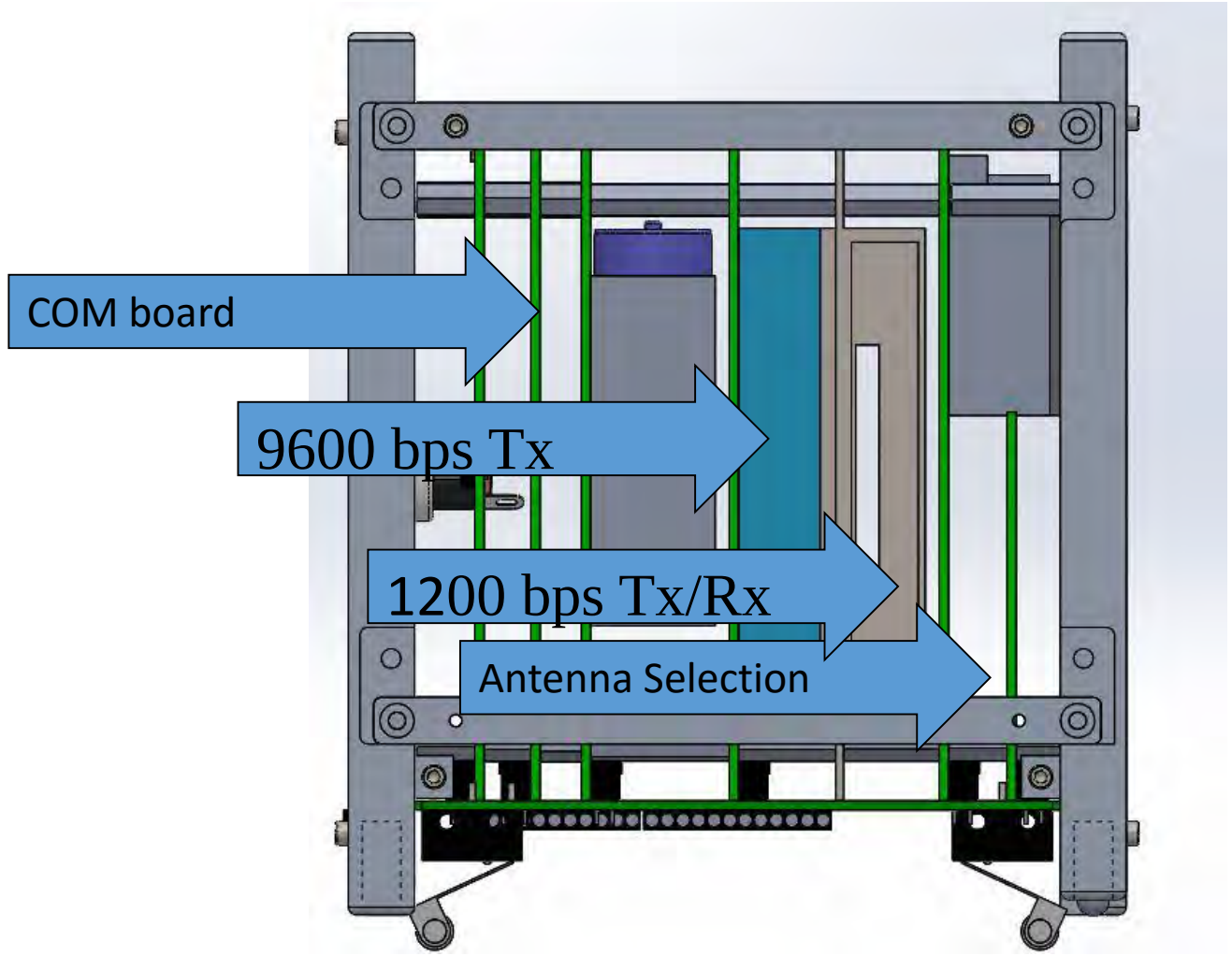
Team Members
Maisun Ibn MONOWAR
TURTOGTOKH Tumenjargal
ERNEST Matey
TOKUNAGA Yasuhiro

Background

Purpose of COM:

To build a reliable communication subsystem so that the BIRDS satellite can communicate with ground stations

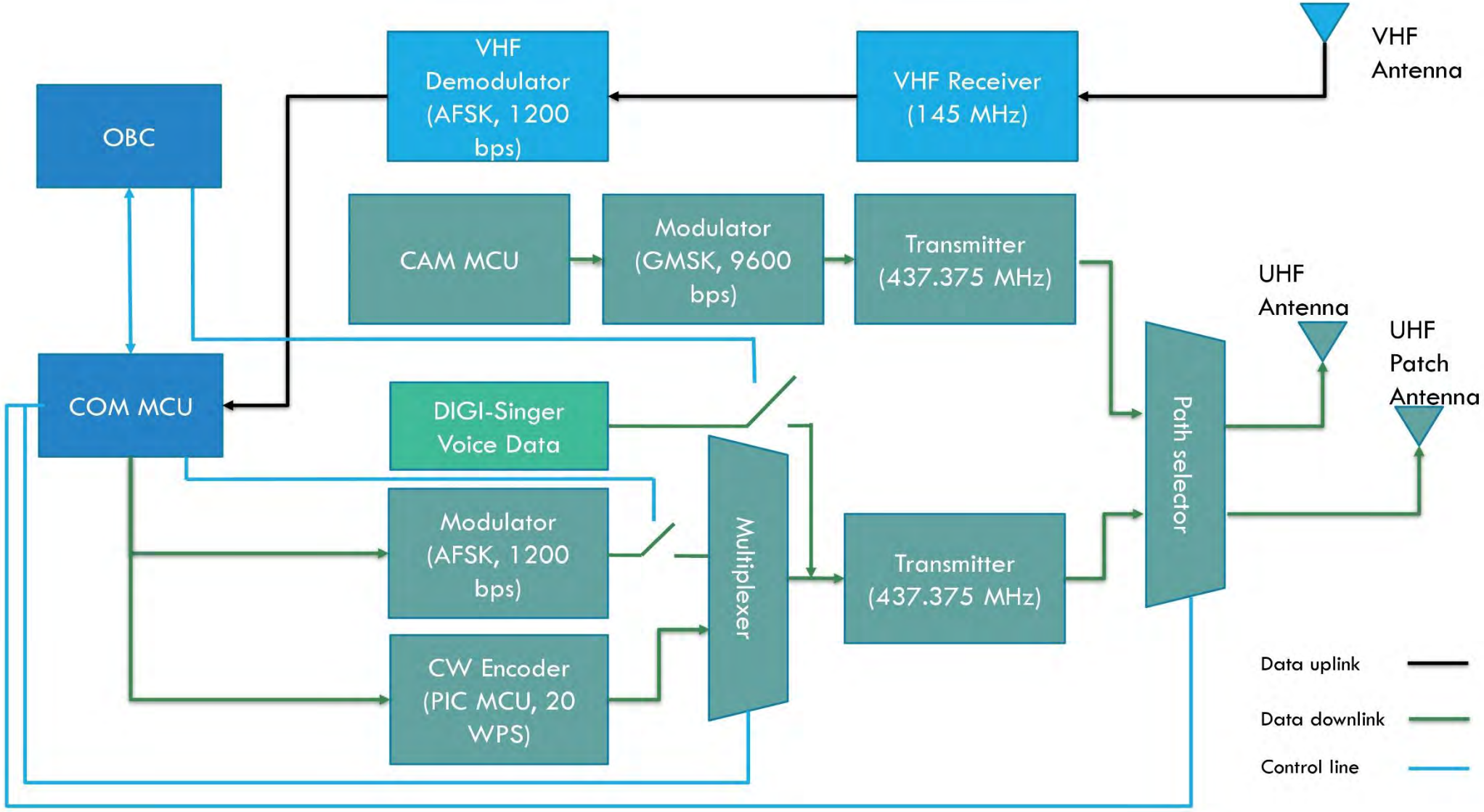
We will use amateur radio bands in order to realize communication between BIRDS satellite and ground stations.



Sub-system Objectives

- Satellite uplink shall be made through VHF band (145 MHz ~ 146 MHz).
- Satellite downlink shall be made through UHF band (435 MHz ~ 438 MHz).
- Files for the SNG (Digi Singer) mission can be uploaded to satellite.
- COM shall transmit mission data packets processed by OBC to GS.
- Use 9600 bps transmitter for faster downloading of high resolution image data from satellite to ground stations.
- Use of FM transmitter (UHF band) to carry out “Digi-Singer Mission”.

Block Diagram of COM

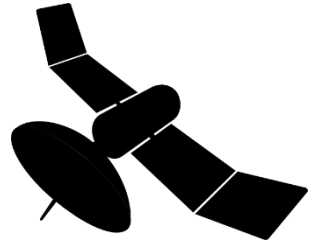


Telemetry & Mission data

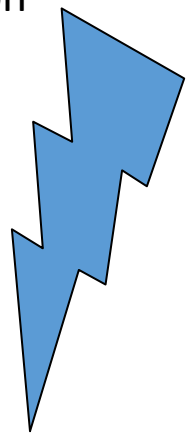
BIRDS satellites will use Amateur radio bands for all of its communication functions. Data uplink and downlink will be done through methods that are commonly used by the amateur radio community.

That means, if you are an amateur radio operator (which is a common hobby for many) and have access to handheld radios shown below, you can listen to BIRDS satellite's CW signals, digi-singer, maybe even decode telemetry data once the satellite is in space.

[Image from Wikipedia]



FM Transmission
"70 cm" band
AX.25 packets



2. Subsystem Summary #6

On-Board Computer Subsystem (OBC)

This summary prepared by:
TURTOGTOKH Tumenjargal
TOKUNAGA Yasuhiro
Maisun Ibn MONOWAR
11 April 2016

OBC Objectives

The main objectives of the OBC

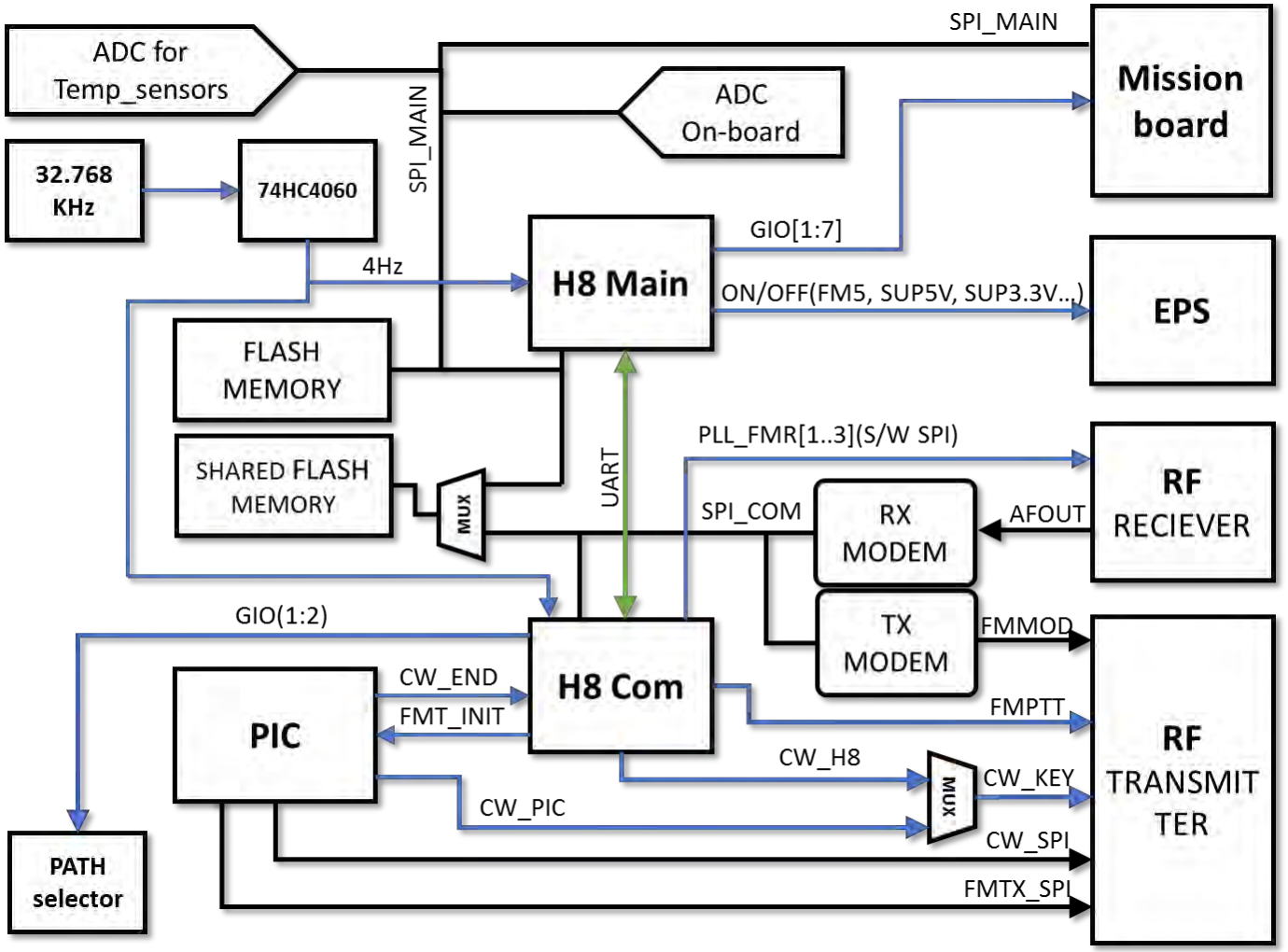
- To receive Telecommand from Ground Station through COM. Then verify and execute it
- To manage (collect, process and store) and transmit Housekeeping data and Mission data
- To monitor satellite health parameter and withstand space radiation

OBC Design Specifications

BIRDS OBC is built around the flight-proven Renesas H8 microprocessors, which were used for the HORYU-II and HORYU-IV satellites of Kyutech.

Two H8 microcontrollers that have the capability to watch over and reset each other shall be use for the purpose of OBC and COM, the OBC H8 is the main H8 and act as the master and control satellite's mission modes and communicate with all subsystems using Serial Peripheral Interface (SPI) bus through their dedicated flash memories. Flash memories are also used by missions through a multiplexer (MUX) to exchange command and data.

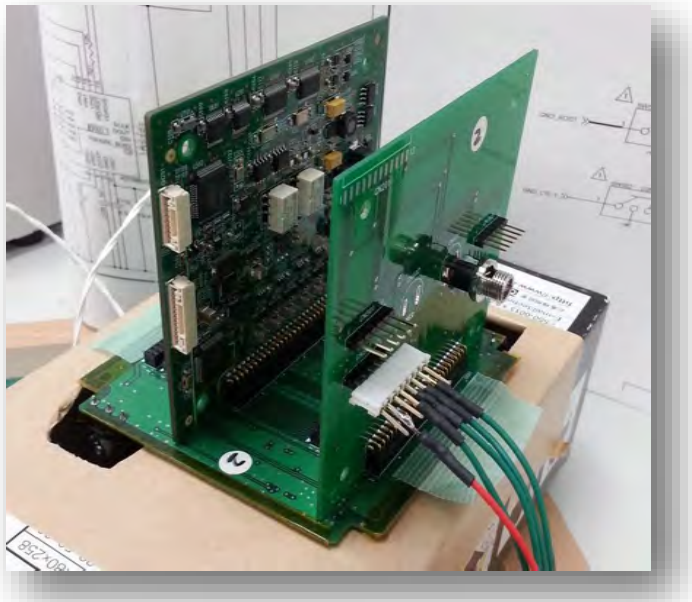
OBC block diagram



Development process

Our OBC bus system is based on good heritage of Horyu-2 and Horyu-4 satellites.
We made OBC BBM (Bread board module) version for a software and hardware development. Thanks to Sagami Tsushin Co., Ltd manufactured PCB (Printed Circuit Board). And we have done functional test using that PCB board. Development is in progress.

BBM board in the OBC work area



PCB (Printed Circuit Board) of OBC, EPS and COM

(Manufactured by Sagami Tsushin Co., Ltd)

相模通信工業株式会社

Functional Tests

Functional tests have been performed under various space and launch conditions. The following are tested conditions and tested parts. For the OBC team, it is a relief to discover that all test results have been good.

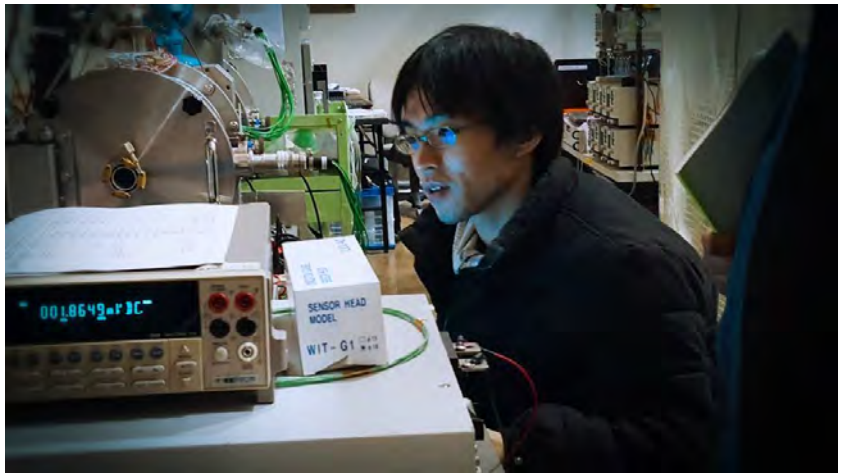
Thermal Vacuum Test	• -15 °C ~ 50 °C • 2 cycles • Hot start (70 °C)
Thermal Cycle Test	• -25 °C ~ 60 °C • 25 cycles
Vibration Test	• 13.3G – Random Vibration • 1 minutes
Shock Test	• SRS 100Hz – 545.21 m/s^2 2600Hz – 4145.50 m/s^2 5000Hz – 4145.50 m/s^2 • One shot

Tested parts of OBC

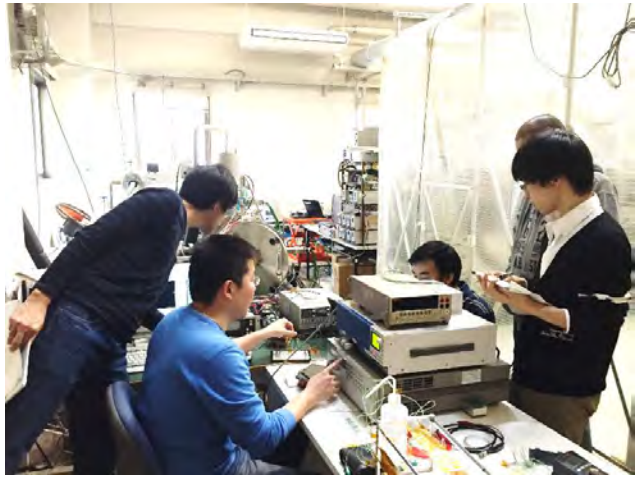
- ✓ Main and Com H8 operation
- ✓ UART Communication,
- ✓ Flash memories and multiplexers
- ✓ Clock Generation
- ✓ ADC for EPS and ADCs for sensors
- ✓ EPS output controls from Main H8
- ✓ Reset from Main/Com H8
- ✓ GPIO to Mission board
- ✓ CW PIC

Activities in the lab

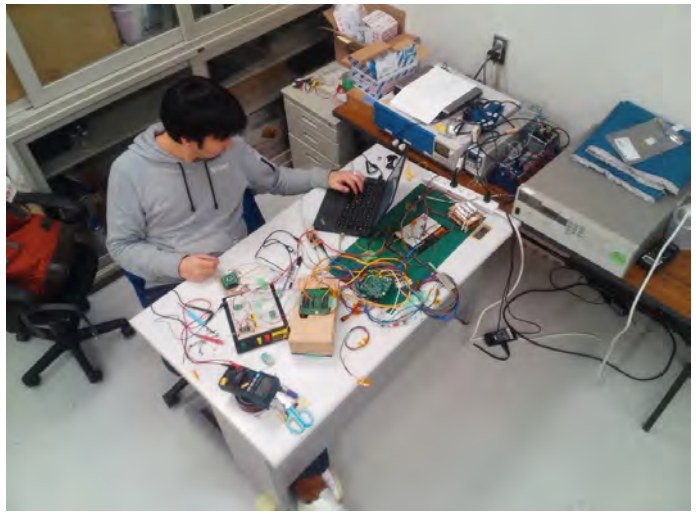
Setting our boards into thermal vacuum chamber. Photo taken by Apiwat



Functional test process. Photo taken by Antara



Functional test process. Photo taken by Dr. Masui



Software development process. Photo taken by Amara

3. Subsystem Summary #7

Camera Subsystem (CAM)

This summary prepared by:
AMARTUVSHIN Dagvasumberel
SHIGYO
13 April 2016

CAM Subsystem Objectives

The purpose of including a digital camera on the BIRDS satellite is to photograph the Earth from the Low Earth Orbit (LEO) position and transmit the captured images to Earth. The current payload idea is to photograph the participating countries from space, and use these images for verifying attitude estimation algorithm data in comparison with camera data for ADCS. Camera mission images shall be downlinked at 9600bps through a dedicated COM 9.6k transmitter. This receives camera image data inside the memory from COM9.6k microcontroller via the UART. As a low-speed backup, SCAMP data will be also stored in a flash memory to share with OBC and the low resolution image can be sent via 1200bps through the COM1.2k transmitter.

- OV5642 OmniVision 5MPixels resolution camera
- SCAMP 0.3MPixels VGA resolution backup camera
- CAM subsystem will operate in one of three possible modes:
  - Timer mode
  - Normal mode
  - Target mode

CAM Design Specifications

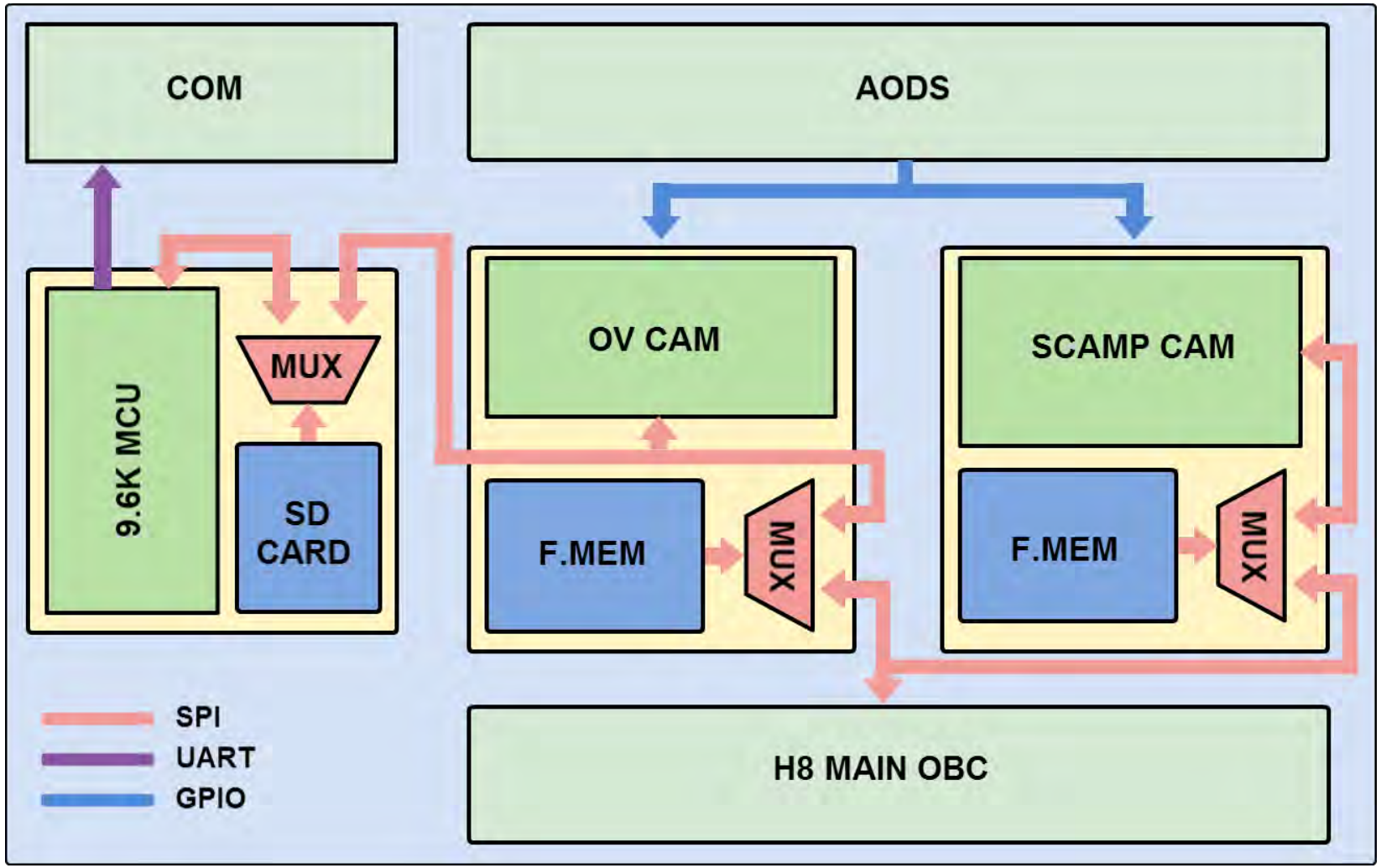


Image Verification Test

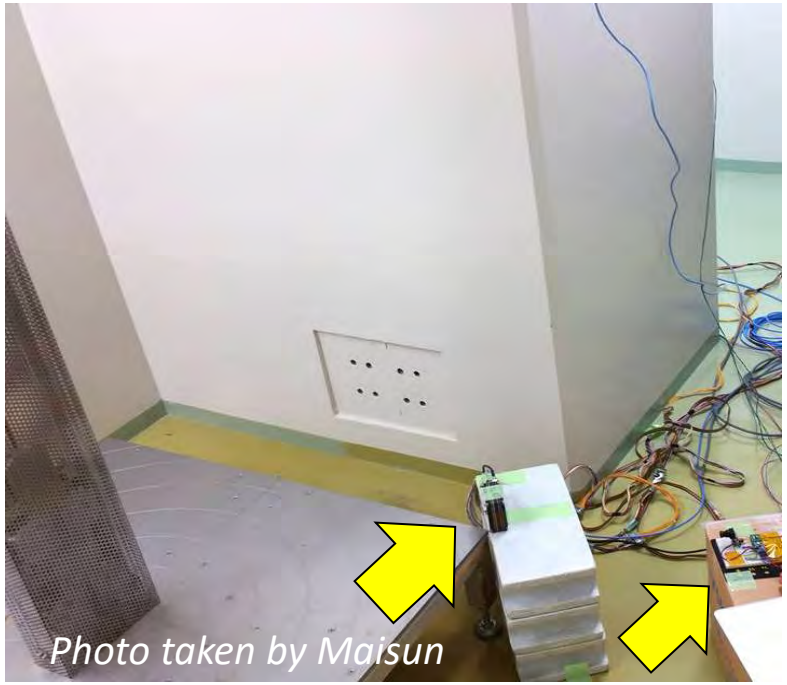
- OV CAM's image format and parameters

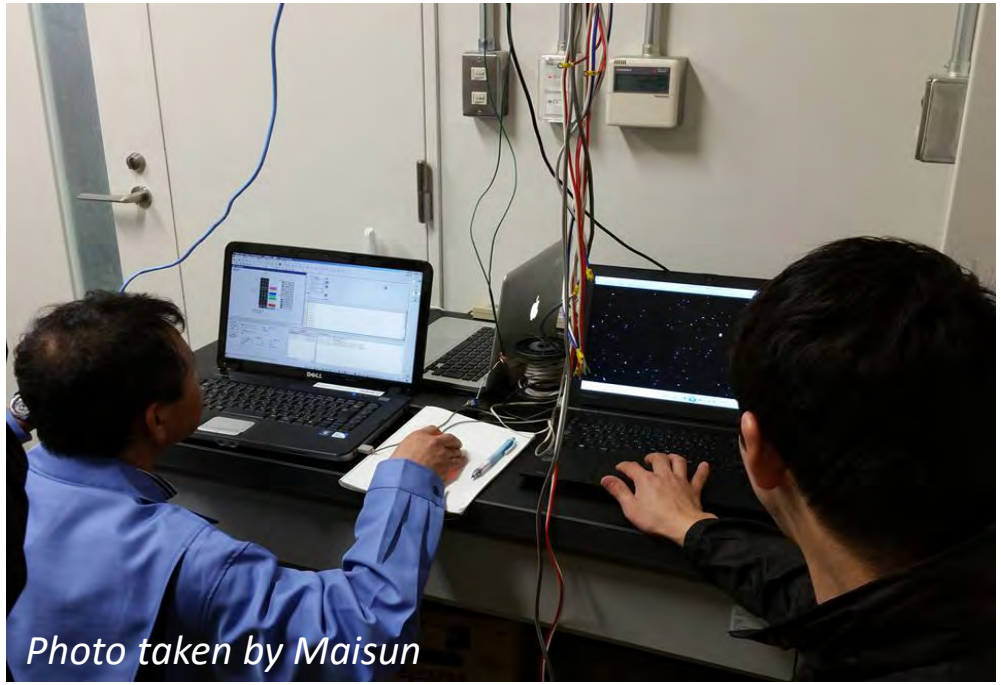
Resolution	Data size (kb)	Frame rate
2592x1944	318 – 512	15 fps
1980x1080	200 – 350	30 fps
640x480	40 – 50	60fps
320x240	12 – 40	120 fps

Resolution	Data size (kb)	CAM delay (sec)
2592x1944	318 – 512	4-8
320x240	12 – 40	0.4 – 1

Camera undergoing radiation tests

Electronic hardware in space must be able to withstand a fair amount of radiation. Our satellite's camera board and communication board have been tested at 15Krad radiation levels – as shown here:



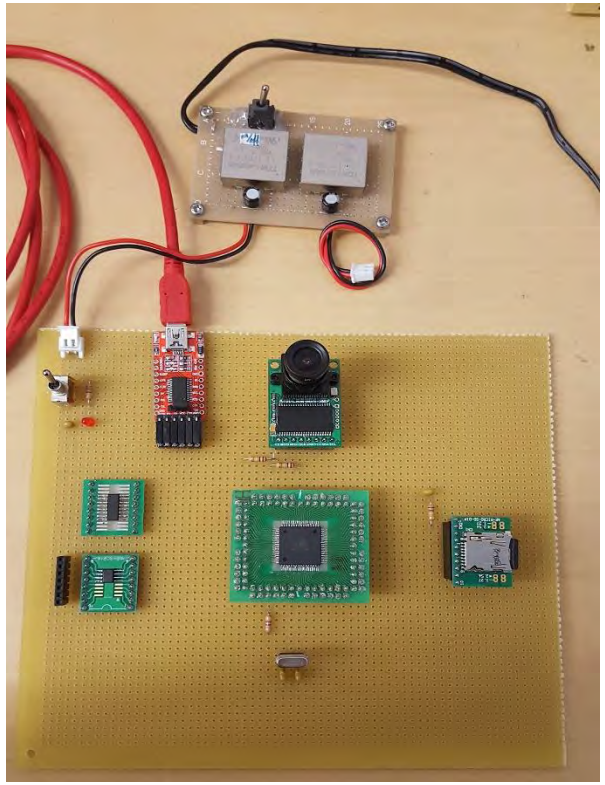


OV CAM BBM board during a radiation test

Development process

OV Camera system is based on AVR chip and is designed to compress, save, delete and list up images that have been captured. It is also possible to store images in the external memory up to 2GB.

Test photo taken by OV CAM



BBM development board

4. The ground station of Thailand

KMUTNB Ground Station

King Mongkut's University of Technology North Bangkok (KMUTNB)

Bangkok, Thailand.

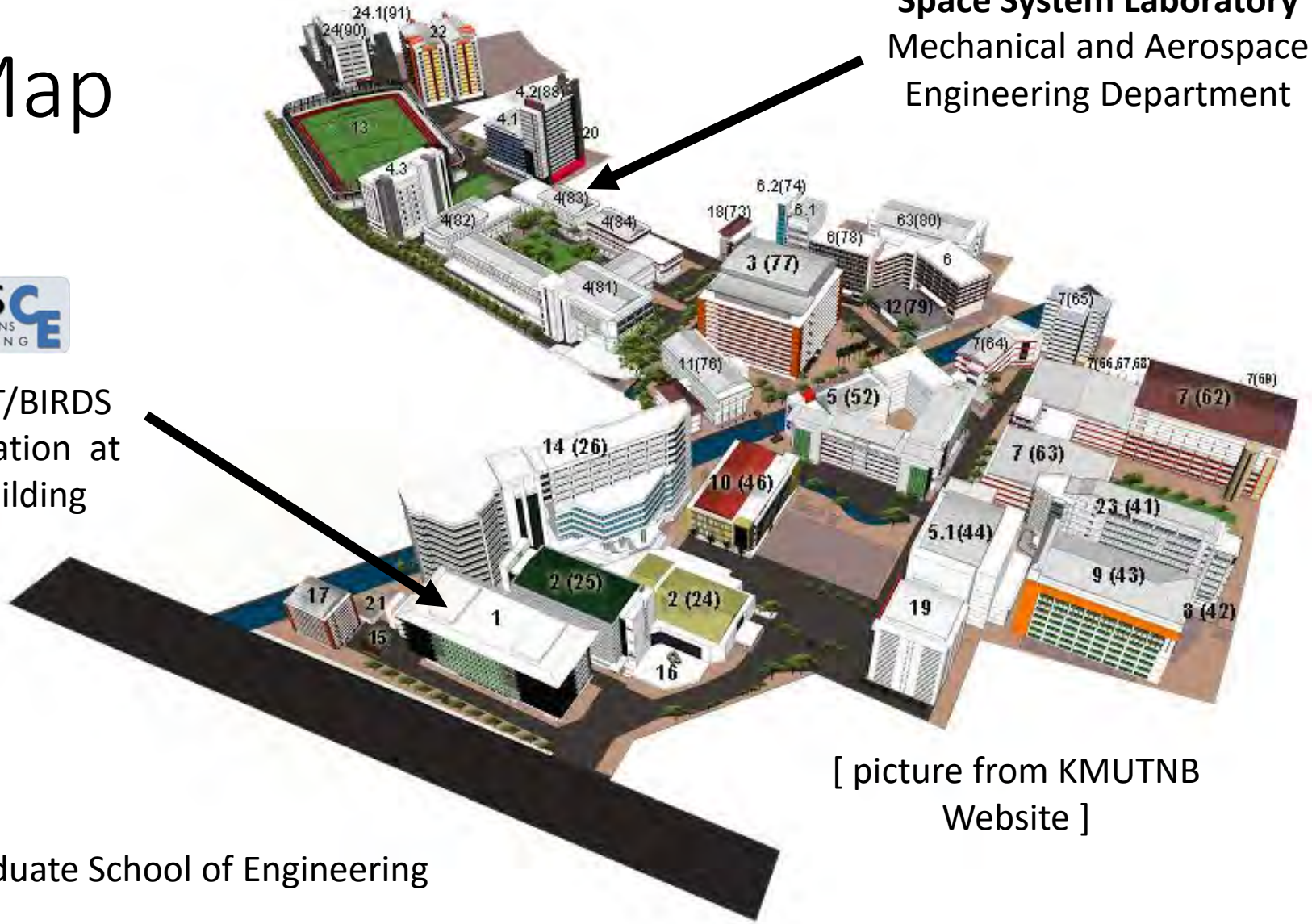
This photo report was prepared by Apiwat, SEIC Grad Student at Kyutech, Japan.

13 April 2016

KMUTNB Campus Map

Space System Laboratory
Mechanical and Aerospace Engineering Department

KNACKSAT/BIRDS Ground Station at TGGS Building

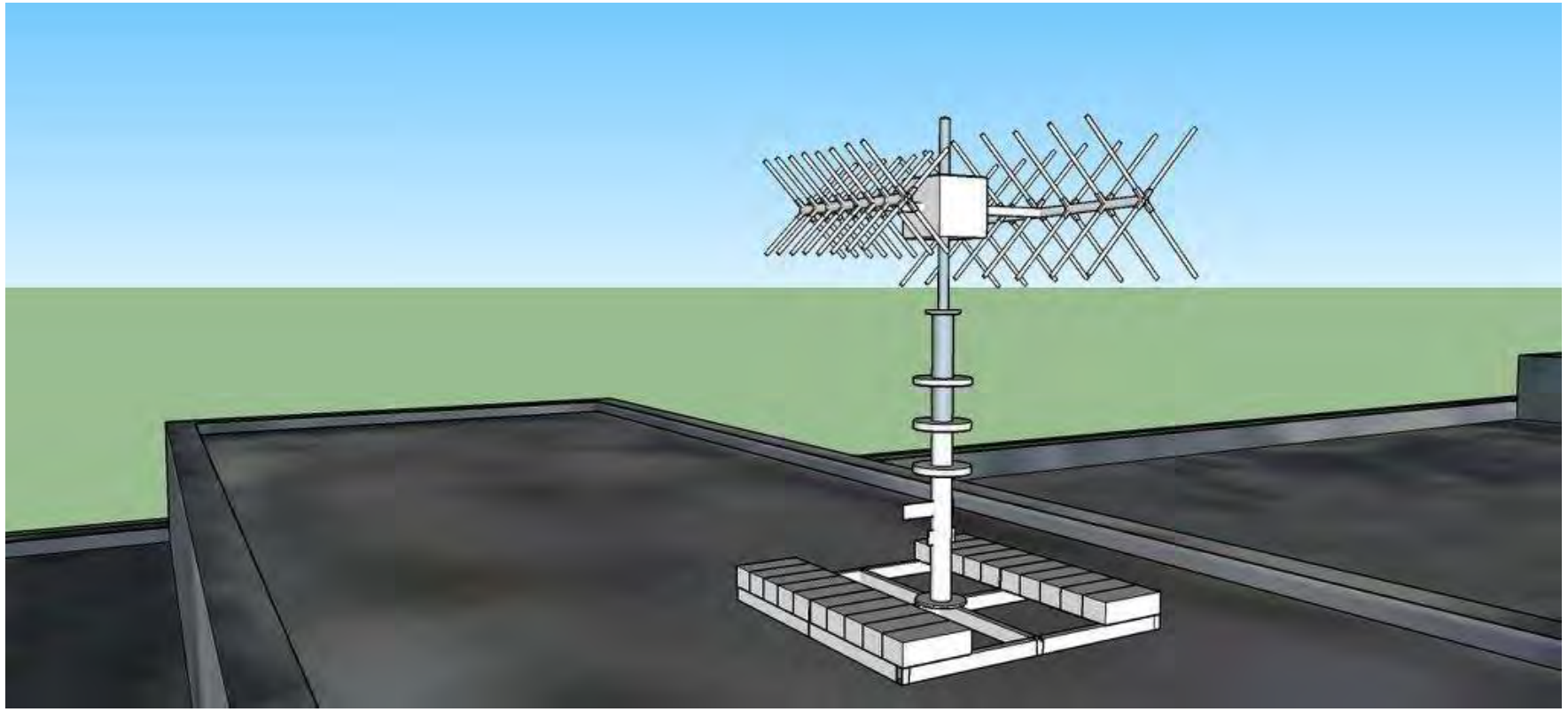


[picture from KMUTNB Website]

TGGS : Thai-German Graduate School of Engineering

Proposed Ground Station (artist conception)

– to be installed in 2016



Drawing by Prof. Suramate Chalermwisutkul

KMUTNB Ground Station parameters

- Transceiver: ICOM IC-9100
- Antenna: cross Yagi-Uda
- Antenna Polarization: Circular (RCHP, LCHP)
- Rotator: Yaesu G-5500
- Station Callsign: HS0AK
- Altitude: 55 m above ground
- Latitude: 13.819091
- Longitude 100.513775
- Installation goal: June 2016

KNACKSAT/BIRDS Team

Communication Sub-Team

Staff member
Asst. Prof. Dr.-Ing. Suramate Chalermwisutkul

PhD student (Sub leader)
Mr. Vasan Jantarachote

Master Students
Ms. Syifa Hersista
Mr. Bhaskar Shivanna
Mr. Nonthapat Teerasuttakorn
Mr. Chodok Daraphan
Mr. Jirasin Tanglukchai
Ms. Thipamas Phakaew

Roof top of TGGS Building

Activities

Team members survey the new location for KMUTNB ground station -- and use handheld antenna to receive the satellite signal.

5. The ground station of Ghana

ALL NATIONS UNIVERSITY COLLEGE
– SPACE SCIENCE TECHNOLOGY LABORATORY
(ANUC-SSTL) GROUND STATION OVERVIEW

BIRDS Ground Station in Ghana

This Photo Report prepared by:

Benjamin Bonsu

Joseph N.K.K Quansah

Ernest Teye Matey

[All graduate students of SEIC]

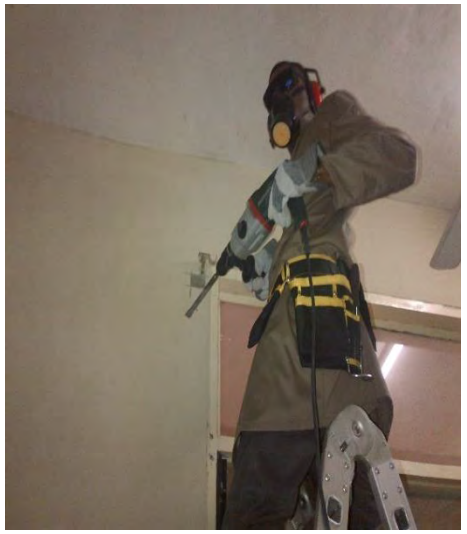
12/April/2016

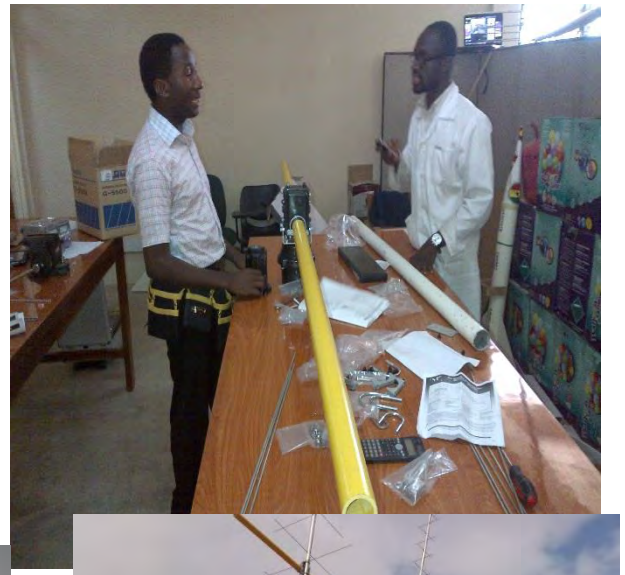
ALL NATIONS
UNIVERSITY COLLEGE

ANUC GROUND STATION PARAMETERS (QTH)

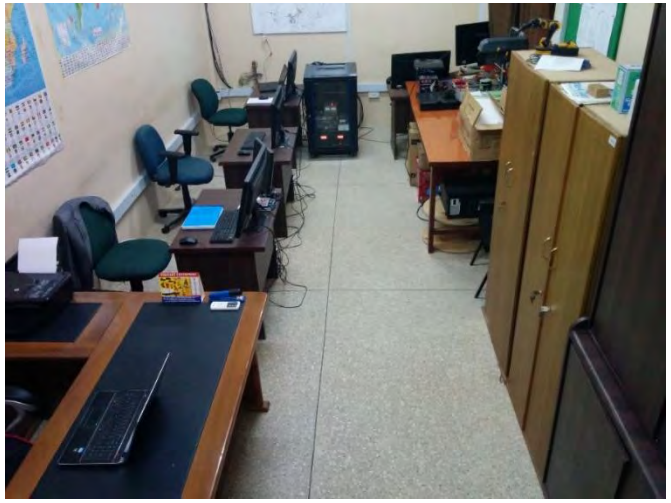
- Name: All Nations University College
- CALL SIGN : 9G2-AA
- Latitude : 6^{O} 6^{I} 33.87N
- Longitude : 0^{O} 18^{I} 7.41W
- Grid Location : 1J96UC
- Altitude above sea level: 162m

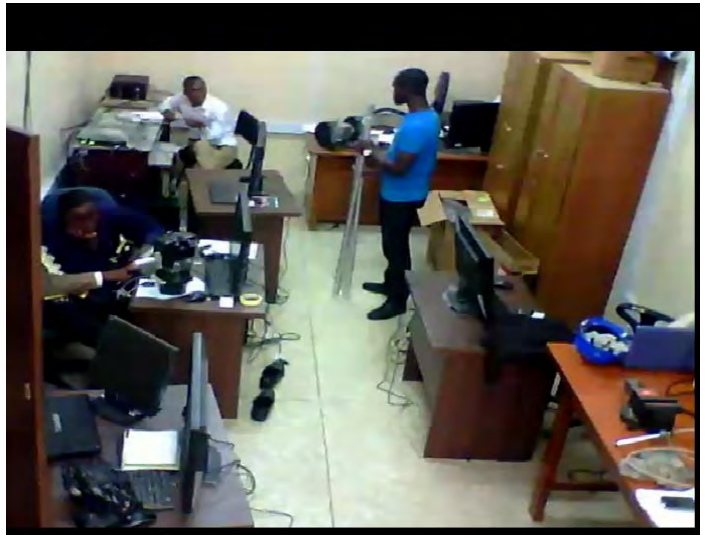
DEVELOPMENT PHASES (EQUIPMENT INSTALLATION)





INDOOR EQUIPMENT





RECEPTION OF STTV IMAGE FROM *ISS*

The International Space Station (ISS) is sponsored by **Canada, Japan, Russia, the USA and many nations in Europe.** ISS crews hail from these and other nations. Major hardware elements are:

- Zarya , Zvezda, Pirs, research modules Poisk and MRM-1 Rassvet built by Russia
- Science lab Destiny, Unity, Quest, Harmony and Tranquility modules provided by the US
- Canadian Mobile Servicing System, a 55-foot mobile robotic arm used for assembly and maintenance
- Columbus module, a science laboratory provided by ESA
- Kibo module, a science laboratory provided by Japan.

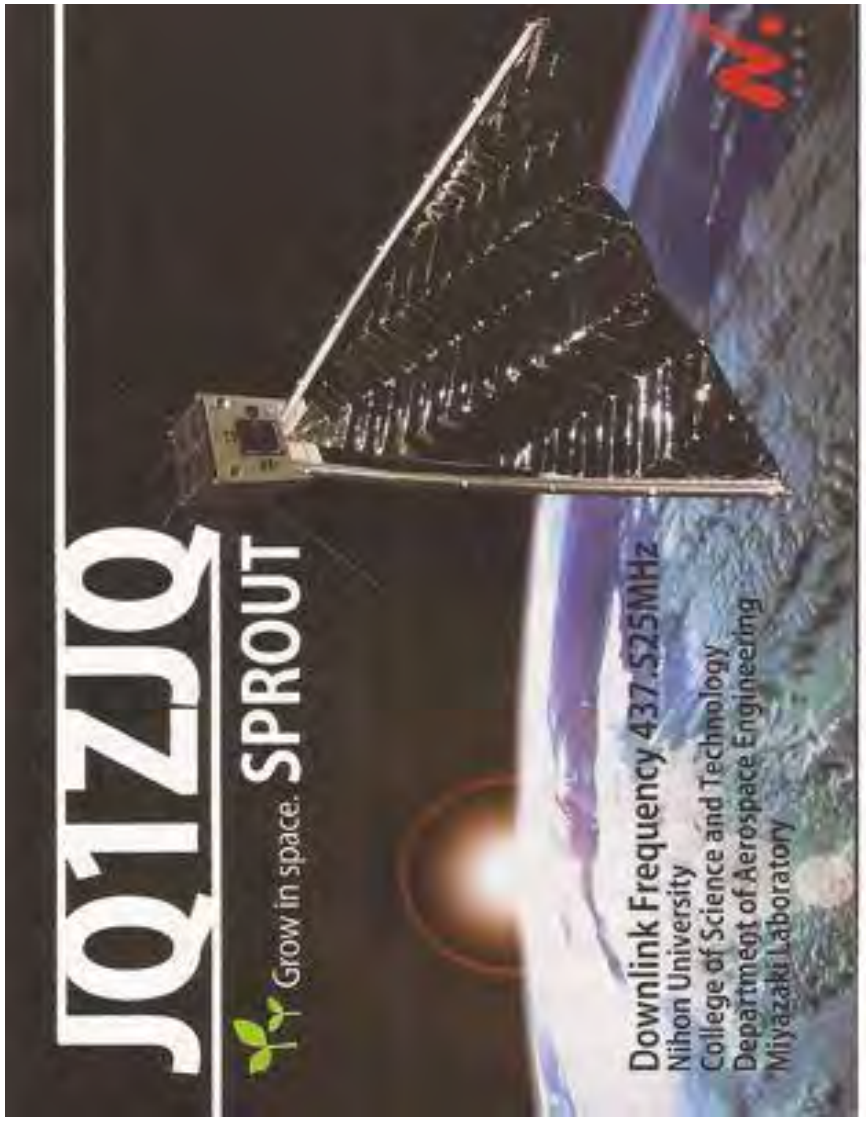
ISS crews and visitors often use their Amateur Radio station, first set up in Zarya and then Zvezda, t talk with school students to aid in their education, plus chat with fellow radio amateurs around the world. The ARISS Team continually works to extend ISS Amateur Radio station capability with new operation modes and, more recently, equipment placement in the Columbus module.

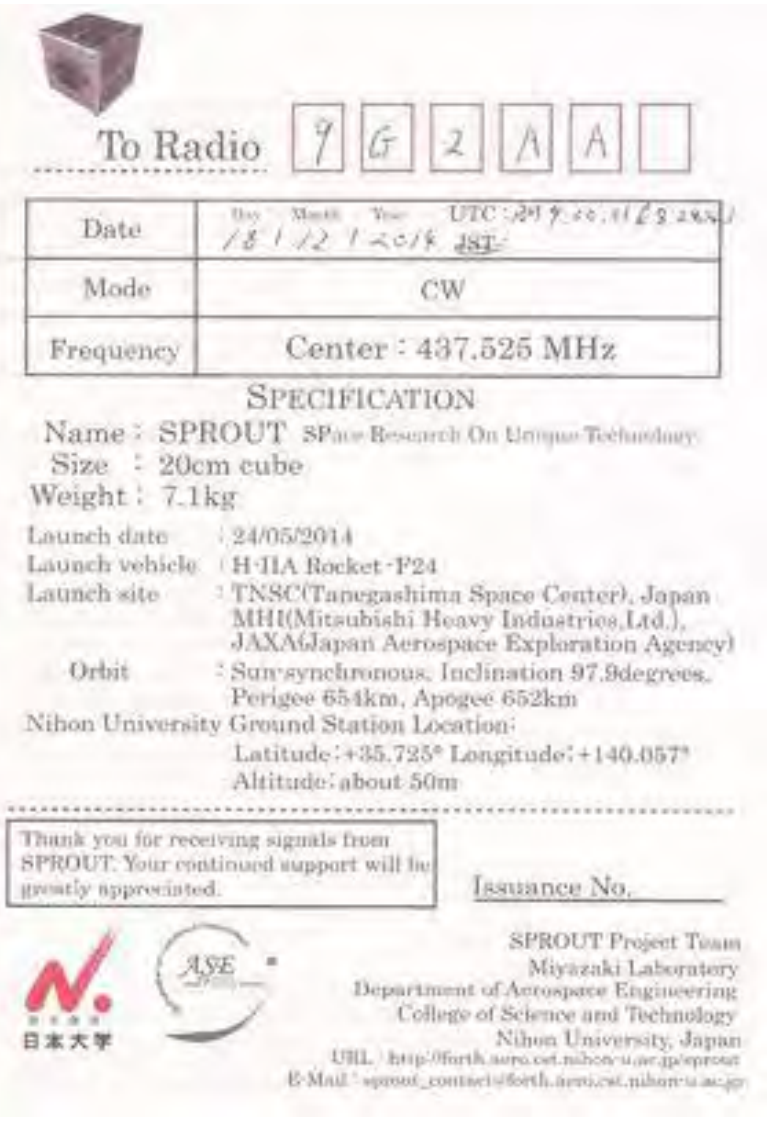
To 9G2AA

From	Day	Month	Year	UTC	MHz
☐ NA1SS					
☒ RS0ISS	18	12	2014	12h38	145.
☐ OR4ISS	20			12h34	800

Mode : ☐ Voice ☐ Packet ☒ SSTV ☐ APRS ☐ Repeater ☒ SWL

FIRST ISS QSL CARD RECEIVED FROM AMATEUR RADIO ON INTERNATIONAL SPACE STATION (*ARISS*)





To Radio 9G2AA

Date	Day Month Year UTC : 2019.00.11 23:28 /8 / 12 / 2019 JST
Mode	CW
Frequency	Center : 437.525 MHz

SPECIFICATION

Name : SPROUT SPace Research On Unique Technology
Size : 20cm cube
Weight : 7.1kg

Launch date : 24/05/2014
Launch vehicle : H-IIA Rocket-F24
Launch site : TNSC(Tanegashima Space Center), Japan
MHI(Mitsubishi Heavy Industries,Ltd.),
JAXA(Japan Aerospace Exploration Agency)
Orbit : Sun-synchronous, Inclination 97.9degrees,
Perigee 654km, Apogee 652km
Nihon University Ground Station Location:
Latitude: +35.725° Longitude: +140.057°
Altitude: about 50m

Thank you for receiving signals from SPROUT. Your continued support will be greatly appreciated.

Issuance No.

日本大学

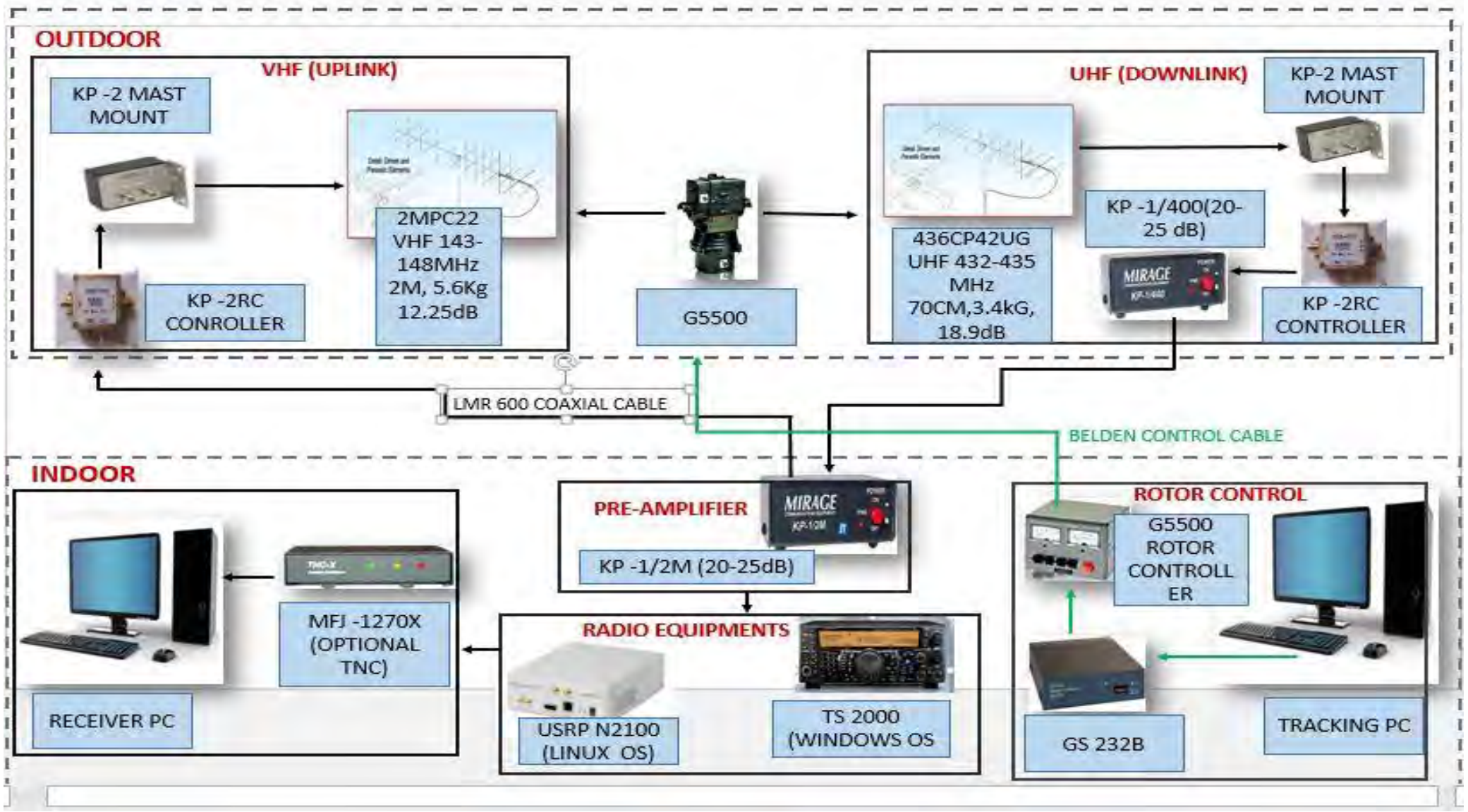
ASE

SPROUT Project Team
Miyazaki Laboratory
Department of Aerospace Engineering
College of Science and Technology
Nihon University, Japan
URL : http://forth.aero.cst.nihon-u.ac.jp/eprout
E-Mail : sprout_contact@forth.aero.cst.nihon-u.ac.jp

QSL CARD RECEIVED FROM *SPROUT* SATELLITE

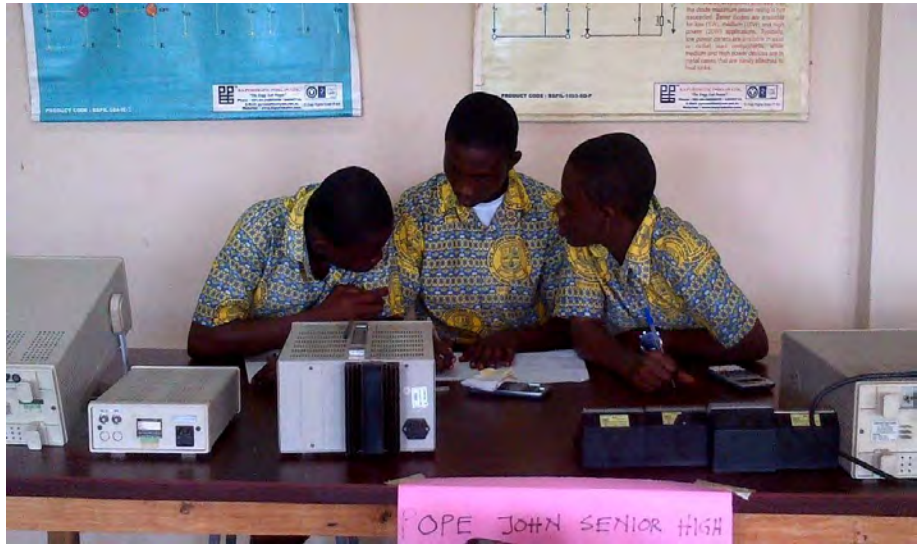
自主創造
日本大学
NIHON UNIVERSITY

ANUC GROUND STATION BLOCK DIAGRAM OVERVIEW



ANUC-SSTL GS ANTENNA ATOP THE UNIVERSITY's ENGINEERING BLOCK

ANUC- SSTL OUTREACH PROGRAMS (NATIONAL EDUCATION ON SATELLITE TECHNOLOGY)



HIGH SCHOOL QUIZ COMPETITION ON SATELLITE TECHNOLOGY AND INTRODUCTION TO AMATEUR GROUND STATION OPERATION

(World Space Week Celebration)

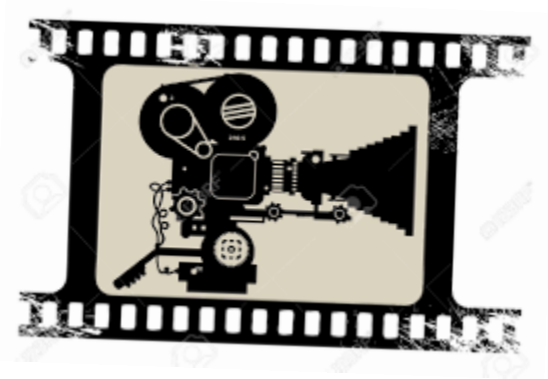
World Space Week

The largest public space event on Earth

ANNUAL COMFERENCES ON SATELLITE TECHNOLOGY ORGANIZED BY ANUC-SSTL

6. Great Videos by our Bangladesh team

Our Bangladesh team of Kafi, Antara, and Maisun (shown below) produced seven videos about the BIRDS Project. Check them out using the link shown below.



https://www.youtube.com/playlist?list=PLvBDuyuOQnC0GvRKPW91TwgL89ijlbAZL

7. More pics of ANUC-九工大 signing ceremony

More photos of the signing ceremony between ANUC (Ghana) and Kyutech (Japan) on 6 January 2016. For details, please see **Page 24** of *Issue No. 1 of the BIRDS Project Newsletter.*

END OF ISSUE NO. 3