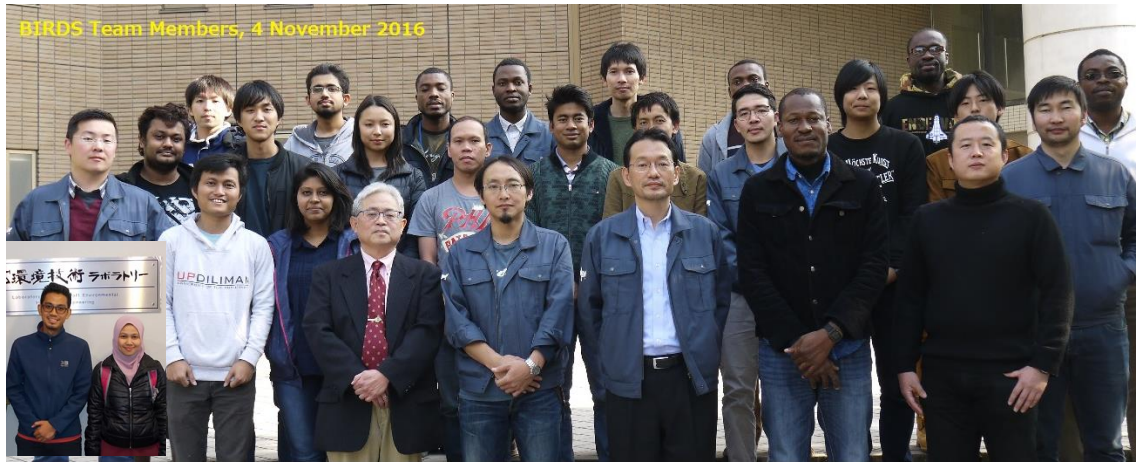
BIRDS Project Newsletter

Issue No. 15 (30 April 2017)



Members of BIRDS-1 and BIRDS-2 Teams (Tobata Campus)

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

Project website: http://birds.ele.kyutech.ac.jp/
All back issues are archived at this website.

La SEINE

SEIC Space Engineering International Course

All back issues of this newsletter can be easily downloaded. Go to here: **http://birds.ele.kyutech.ac.jp/**
At the top, click on the tab called NEWSLETTER. You will get a menu for all back issues.

Contents of this Issue

Additional subsystem reports will appear in the newsletter next month.

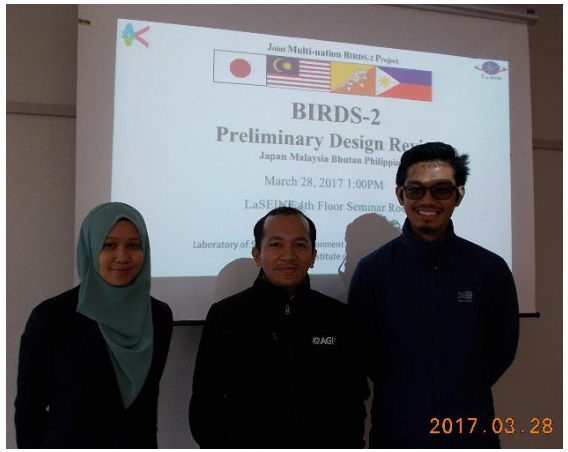
Video Conference between UiTM and BIRDS-2 members on 3 March 2017

1. BIRDS-2 PDR (Preliminary Design Review) --- 13:00 to 18:00 on 28 March 2017

Joven (Project Manager)

Yeshey

Cheki



Syazana Dr Huzaimy Azami (UiTM Team)

Each BIRDS-2 student delivered a presentation on his or her subsystem – each did a great job.

Adrian

山口さん

Photo taken by G. Maeda

Members of the BIRDS-2 PDR -- *a job well done*

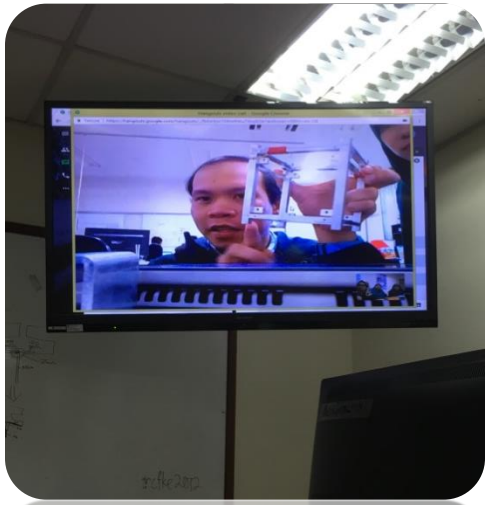
Special thanks to Dr Huzaimy (UiTM), Dr Marc (UPD) and Mr Alvin (DOST) for coming to our PDR.
Also, special thanks to **BIRDS-1 members** who contributed to the review.

2. Video conference between Antenna Team (UiTM) and BIRDS-2 Representatives

Prepared by: Dr. Nurul Huda of UiTM

Date : 3 March 2017 (16:00 JST)

Venue : Kyutech & Antenna Research Group (ARG) Lab, UiTM



Pic: Joven showing the allocated position for UHF and VHF antennas on chassis

A video conference has been conducted to discuss specific issues related to UHF and VHF antennas that are going to be mounted on BIRDS-2. During the discussion, UiTM was represented by Dr Huda (lead), Nadiah (Degree student) and Fatihah (Degree student), and the BIRDS-2 representatives were Joven (lead), Syazana (antenna) & Adrian (ground station).

Among the topics that we discussed were:

- link budget (Uplink, downlink, APRS)
- Antenna specifications with respect to link requirements
- Antenna position and space allocation
- Trade-offs between size and performance
- Critical issues with respect to VHF link

3. Progress presentation at UiTM

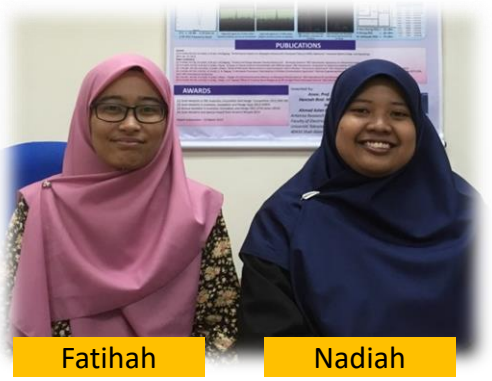
Prepared by: Dr. Nurul Huda of UiTM

Date :22 March 2017 (14:30 MST)

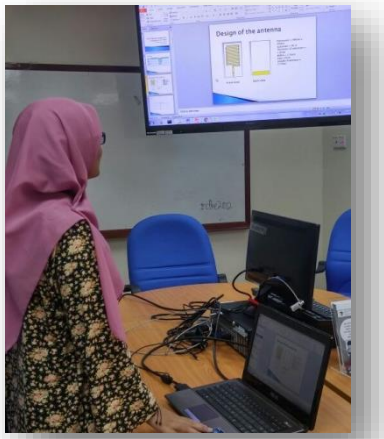
Venue : Antenna Research Group (ARG) Lab, UiTM

A small colloquium was held in our lab, with the purpose to observe the progress of the degree students in delivering their final-year projects. In this session, two students (Nadiah and Fatihah) who have been working on designing UHF and VHF antennas for BIRDS-2 were also invited to present their progress. All issues related to their designs have been presented in front of the students and the ARG staff (as the internal panels). Useful suggestions and ideas have been discussed between the students and the expert panels during this session.

Pic: Discussion between ARG panels.



Pic: Nadiah (VHF antenna) and Fatihah (UHF antenna)



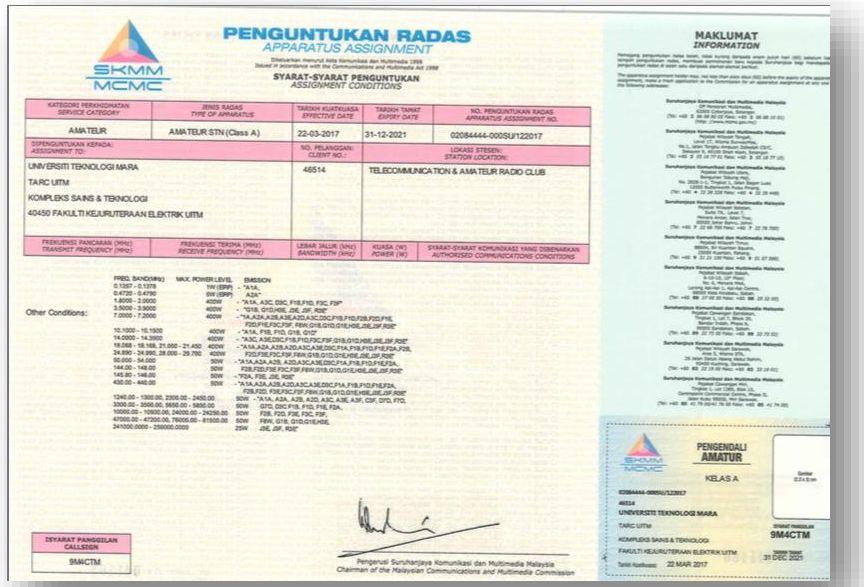
Pic: Presentations by students

4. Call sign for UiTM Ground Station

Prepared by: Dr. Nurul Huda of UiTM

9M4CTM

Finally UiTM has obtained a Class A license to operate our ground station. The license has been obtained from the Malaysian Communications And Multimedia Commission (MCMC), which has a validity of 5 years from 22 March 2017. Our application has been reviewed and supported by the Malaysian Amateur Radio Transmitters' Society (MARTS).


PENGUNTUKAN RADAS
APPARATUS ASSIGNMENT
SYARAT-SYARAT PENGUNTUKAN
ASSIGNMENT CONDITIONS
MAKLUMAT
INFORMATION
AMATEUR
AMATEUR STN (Class A)
22-03-2017
31-12-2021
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UNIVERSITI TEKNOLOGI MARA
TARC UITM
KOMPLEKS SAINS & TEKNOLOGI
40450 FAKULTI KEJURUTERAAN ELEKTRIK UITM
46514
TELECOMMUNICATION & AMATEUR RADIO CLUB
PENGENDALI AMATUR
KELAS A
9M4CTM
31 DEC 2021
22 MAR 2017

Pic: Class A Apparatus Assignment License, allowing UiTM to operate at full Class A spectrum

Pic: Rooftop at Level 21 – the location of where the ground station will be installed.

Many thanks to Dr Huda for providing three informative reports from UiTM. Excellent.

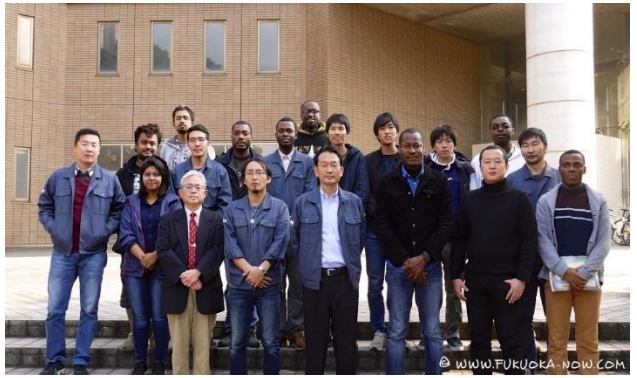
G. Maeda

5. Taiwo interviewed by “Fukuoka Now” (the following was published by “Fukuoka Now”)

Interview by Oscar Boyd. Interview on Feb. 21, 2017. Released on March. 27, 2017. Reprinted with permission.

Taiwo Tejumola is a Systems Engineer operating out of KyuTech. More specifically, he is helping to build nextgen satellites whilst also heading up a program to encourage space exploration and research by students from developing world countries. Taiwo currently has plans to launch five satellites planned on a Space X rocket in April under KyuTech’s Birds Project. Taiwo kindly joined us in the Fukuoka Now offices to discuss satellites, space junk, and his dreams of bringing his skills back to his home country of Nigeria.

In Japan: 3 years
Nationality: Nigerian
Identity:
Systems Engineer specialising in Space Engineering



Photos from this *Fukuoka News* article

You help make satellites for a living, how did that come about?
I grew up in Nigeria and, and when I was very young, I loved to see what was up there. I always wanted to know more about space. Technology in Africa is kind of primitive though, so I had to figure out how to make my dream possible. I studied sciences in high school and then did a Bachelor's degree in Electrical Engineering. After that, I worked for the Nigerian Space Agency for about six years. But I felt if I was to do a postgraduate degree in Nigeria, I wouldn't get to where I wanted. I knew I had to go abroad and luckily in 2013 I had the opportunity to come to the Kyushu Institute of Technology in Kitakyushu.

How did that opportunity arise?
I came to Japan first in 2012 for the Cansat Leader Training Program, a program for people from the developing world to learn how satellites are made. I spent three weeks at Tokyo Metropolitan University, and got to know how technology is taught in Japan. Here, it's very open, the professor won't tell you 'don't touch this, don't open that door'. You do everything yourself.

So I talked to my Professor at the Cansat Program and told him I wanted to come to Japan for a Master's Degree, and he suggested the program at KyuTech. KyuTech is a great university because you can do the course entirely in English, though this is now probably a disadvantage for me, my Japanese is very bad for three years living here. The course I'm on is the Space International Space Engineering course.

How was it for you arriving in Japan for the first time? For me, coming from the UK to Japan was a big leap, how was it for you coming from Nigeria?
It was a huge shock. I'd travelled abroad with my job at the Nigerian Space Agency for conferences and training, but I'd never stayed anywhere long. The biggest shock is having to think of Japan as your home, really learning about the food, the culture, the way people behave. All of that has now influenced me to change and improve my life, but it was still a shock. **Continued next column.**

And you're studying as part of the Birds Project to champion students from the developing world?
Yes, during my Master's I was working on a satellite payload to measure plasma density. The satellite is called Horyu-IV and was launched last year from Tanegashima. Then, during the transition from my Master's to my Doctorate course, my professor included me on this initiative called the Birds Project. It aims to help promote space faring for developing nations and he made me project manager. The initiative kicked off in October 2015 and we now have 15 students from six countries: Japan, Ghana, Mongolia, Bangladesh, Nigeria and Thailand. Between us we've made 5 satellites: 1kg, 10cm cubed satellites. They're only small, but there's a lot of ambition in the box.
Those satellites have actually been shipped to JAXA (the Japan Aerospace Exploration Agency) and are now on their way to be launched in the U.S. They should be launched in late April on a Space X rocket to the International Space Station and they'll be deployed from there.

What are the practical uses of the satellites?
The satellites can do things like taking pictures of the earth, others can broadcast national anthems, emergency broadcasts and other information to receivers on the ground. But basically it's training for these students. We hope they will go back to their countries and work for their own space organizations, or create new space organizations.

What are you researching personally?
My research is in system engineering. System engineering isn't just electronics, or making structures or making software. It encompasses everything, and is about making decisions about how things should work.
Your computer for example. There will be a designer, who will have come up with the exterior design, a mechanical engineer would have come up with the layout, an electrical engineer the power. After all that, a system engineer has to think about how all of those different elements come together to create the final product. That's my research. **Continued next page.**

So what kind of things do you have to consider when engineering satellites?
In terms of satellites, you have to think about the materials you use; materials that work well on Earth might not work well in space. You have to think about the electronics and whether they can survive in space. Then there's the communication; how to achieve good communication at huge distances. And then you have to work out how to bring the whole satellite together at the lowest possible weight and cost. My research is very hands on.

What do you see as the future of satellite technology
Before, satellites used to be a Lockheed Martin job, or something done by Boeing, big companies. But now there are a lot of startups, small companies doing fantastic work. I think the future's very bright, there will be more companies launching small satellites. Last week, Planet Labs launched 84 satellites from India. Each satellite is only 3kg and will provide real time imaging of the Earth.

But what about space junk?
It's a big problem. I'm currently taking a class on space policy and law. It's taught by a member of the United Nations Office for Outer Space Affairs. We talk about topics like space sustainability and it's definitely a problem that needs international cooperation. I know there's a couple of organizations in Japan and in KyuTech working on solving these problems.

What do you like about your life as a researcher here in Japan?
I actually spend most of the time in my lab. It's basically home, lab, lab, home. So I haven't had much time to explore Japan.

But what's the difference between say, your Japanese lab, and your work at the Nigerian Space Agency?
Well the main thing is how personal work in a university is. If I have an idea I can just email my professor and then get on with it. But in a company there's no direct link between you and the top of the company and its harder to get started on ideas because of the bureaucracy.

Here, you also really have to work. You have to get results. No complaints, no excuses, you have to get it done. But that's what drives this society. I come from Nigeria, where if things go wrong, people give up. In Japan, you have to work. There are times when we have fun, but work is first. It's a challenge, but it's also very important and rewarding.

What do friends and family back home say when you tell them you're working to build satellites in Japan?
They are very interested. A couple of times, Nigerian newspapers have published articles on me. My friends and family are very proud.

Do you see yourself continuing your research in Japan? Or bringing your expertise to Nigeria?
Eventually, I want to go back. There are a lot of challenges in Nigeria and in Africa, and I see myself as being able to bridge a gap. I'd like to be able to bring my skills to my country, because there's a brain drain.
People often don't want to go back. Take communication. Here, if I want to talk to my boss I send him an email and he answers in real time. Back in Nigeria, internet is very poor in places, and it's harder to communicate. Here, I don't have to pay for research materials, I take my university ID, login and then can download the papers I need. It's not the same back in my country and in many developing countries. So we need to bridge this gap.

What do you hope to achieve with your expertise in the long term?
In the long term I want to work in science and technology policy. That's my dream. There are lots of problems making policy in Africa. Many African countries simply copy policy from abroad, from countries like the U.S., without fully understanding it. Policy needs to be locally rooted, not copied from abroad. I want to bring my expertise to that area, and make policy with local content. Maybe someday I'll go into parliament.

Quick Fire!

Where do you go when you want a taste of home?
Most of the time I just cook for myself at home. But whenever I go to Tokyo I make sure I go to African restaurants. There aren't so many here.

Where's your favorite place in Fukuoka Pref.?
Kitakyushu

What's your favorite Japanese word or expression?
Oishisou

Do you have any advice to newly arrived non-Japanese in Fukuoka?
Everyone has culture shock, but Japanese culture is very open. So just be open, and it will be fine.

When's your favorite time of the year in Fukuoka?
Summer. It's hot like home!

END OF INTERVIEW.

Distributed all throughout Fukuoka Prefecture in a paper version.

6. Kyutech-UiTM business meeting

Ms. Chika Ward
International Contract Specialist
Legal Affairs & Contracts, Kyutech

On 28 March, before the PDR, there was a special business meeting (affairs of BIRDS-2) between Kyutech (Ward, Maeda) and UiTM (Dr Huzaimy, shown at the left wearing an AGU jacket).

Dr Huzaimy is a deputy dean at UiTM and received his Phd at Kyushu University. It was related to space weather.

7. SEIC/BIRDS students do farewell lunch for Dr Werner Balogh on 28 March 2017

Dr Balogh, from the United Nations Office for Outer Space Affairs, taught the space law and policy course during January and February. The course was highly popular and successful. The students say good-bye with this lunch at the Kyutech cafeteria.

(left)
Gathering at the lobby of the building of LaSEINE

Ian Ruxton, English instructor for SEIC

8. Interview with Dr. Joel Joseph S. Marciano, Jr., of DOST in the Philippines

As the editor of the **BIRDS Project Newsletter**, I reprint this interview for the following two reasons:

① Dr Marciano is the head of the Philippines team of BIRDS-2 – he is a well-established professor of electrical engineering at UPD in Manila.

② His comments beautifully capture what BIRDS is trying to do with capacity building.

To become a space-faring nation, you need to master the skills of building satellites. This is crucial. So I endorse his comments.

Interview with Dr. Joel Joseph S. Marciano Jr.

Program Leader of the PHL-MICROSAT
Acting Director, Advanced Science and Technology Institute (ASTI)
Department of Science and Technology (DOST)
Space Technology Working Group Co-Chair

DIWATA-1, THE FIRST PHILIPPINE-MADE SATELLITE, WAS SUCCESSFULLY DEPLOYED FROM THE "KIBO" IN INTERNATIONAL SPACE STATION (ISS) ON APRIL 27, 2016. THE APRSAF SECRETARIAT INTERVIEWED DR. JOEL JOSEPH S. MARCIANO JR., PROGRAM LEADER OF THE PHL-MICROSAT, ON THE OCCASION OF APRSAF-23.

Would you tell me how The Philippines Microsatellite Project started in 2014?

In 2013, the Philippines was hit by a super typhoon "Haiyan" which prompted the Philippines Government to start thinking more about a way of sustaining capability in remote sensing and having on-demand access to information from satellites. I think the decision was made by the DOST to try and vigorously pursue our space technology development, particularly in the area of small satellites.

Prior to this, Professor Yukihiro Takahashi of Hokkaido University had been pitching the idea and had visited the Philippines a few times. In February 2014, we were invited to Hokkaido University and there were substantive discussions on microsatellite development. After that, when we came back to the Philippines, we learned enough about it to write the proposal. So I led a team in writing the proposal, which we submitted to the DOST for funding, and it officially started in January 2015.

Continued on the next page.

This interview comes from Issue No. 25 of the **APRSAF Newsletter** (of JAXA)

The participation of young engineers or students from the Philippines involved in the building satellite is unique.

Well, it may seem unique, but actually it's an approach that has been taken by Japanese universities when engaging with other countries in the ASEAN; for example, in Vietnam and I guess even in Indonesia, the idea is to get young people from these countries to learn about this technology in Japan. In order to do so, they are enrolled as graduate students.

The same idea was proposed to the Philippines by Japanese professors. I guess it is a good idea because we have to rely on our young people to be future leaders. We are not really considering sending mature engineers, or very old engineers, to build these things and to learn about these things. We were relying on the younger generation. They are very eager to learn and, of course, they will receive their master's and advanced degrees.

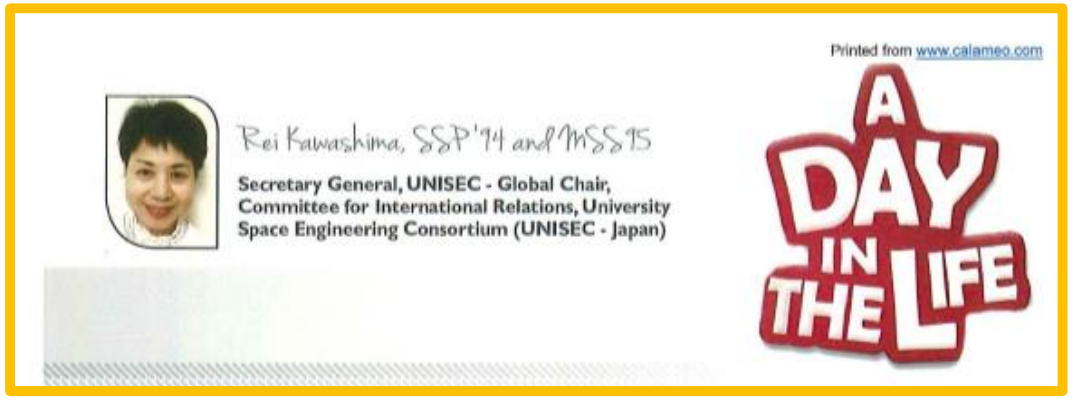
So, in that sense, is this project kind of a nice example or a success story among APRSAF community?

I think, yes, there are successes. Of course, there are challenges, several lessons learned certainly. The Philippines is truly new in terms of space technology. So, you have probably heard the expression "learning curve". Thankfully, because of Japan's experience working with other countries before the Philippines, the steep slope of this learning curve has been less steep. Many innovations are taking place: space heritage is continually being built every time a rocket is launched and a satellite is deployed. There are many lessons being shared within the space community. I think the Philippines is really taking advantage of this opportunity to learn from other countries and to try to make the most of the investment in space technology.

There has been a relatively mature community in space applications and particularly in remote sensing. There is a vibrant community using images and products on space. However, in terms of the space technology, components, and the actual hardware- and software-embedded systems that go into these small satellites, the initial effort has been made by the Philippines. So yes, it is a combination: new in some things and then you use your experience in other things.

I think the Philippines is realizing also that there is a need, as I mentioned, to build capacity, which will sustain this effort. So, it is not just about acquiring capability but also putting in place the elements in the Philippines, starting with the universities and the academy, which will help promote these efforts in the future. I think the government has been supportive, they are even pushing for the creation of a space agency. I think the project is getting some support from the legislators.

Hopefully, it will be sustained. In the future, apart from addressing the Disaster Risk Management concerns of the country, it can also translate to downstream benefits for industry. Some new industries will be created or current industries will be better equipped to deal with these new markets in space technology.



9. Interview with Rei Kawashima, Secretary General, UNISEC

calaméo

http://www.calameo.com/read/0047295678057f2b0ec52

As the editor of the **BIRDS Project Newsletter**, I reprint this interview from ***Calameo (Space Talk)*** because there are several references in the interview to Dr Balogh, Prof Cho, PNST, Kyutech, and the BIRDS Project.

If your university is not yet a part of UNISEC activities, please become involved. For example, you can be the **MIC Regional Coordinator** for your country.

INTRODUCTION

Please list your ISU affiliation - Program & Year

SSP1994 and MSS 1995 - 1996

Tell us a little about yourself - Personal Background (Social, Economic, Educational)

Let me talk about my childhood first. I was born and raised in a small town called Akabira, which is located in the centre of Hokkaido, Japan. Akabira's main industry was coal-mining which was destined to decline. It was a painful experience to see my classmates leave the town one by one as their fathers lost their jobs.Knowing "efforts and results may not be directly related to each other sometimes…. especially when circumstances are changing" during my childhood gave me a chance to contemplate the meaning of life.

The movie "October Sky" reminded me of my childhood, and realised that similar stories were everywhere…. Unlike Homer Hickam in October Sky, I was not attracted by space when I was a kid. I wanted to become a writer and studied Chinese literature at university. I had nothing to do with "space".

My first encounter with "space" was in the English training programme for three newly selected Japanese astronauts, at a language service company where I worked in Japan. I was assigned as an assistant, taking care of the training. It is an interesting coincidence that the name of the company was "ISS". The second encounter occurred in my English conversation class. I took the class to survive in the company as the main target of business was English, not Chinese. In the class, one question from the teacher of the class changed my life. It was "Do you think the World War III will happen or not." I was naïve enough to believe that it will never happen, but the teacher who was a political scientist showed many reasons why it may happen. When I felt totally hopeless, a word of "space" came into my heart. I just believed my intuition, "Key to peace is space" and, since then, I have been searching for how I can contribute to a peaceful world through space. When I heard news of the ISU permanent campus, I thought that it would be my first destination. All three words of "International, Space and University" sounded attractive. This is the beginning of my journey in the space field.

Do you still work in the space sector?

Yes, I am happy to be able to contribute to the space sector.

Please summarise your role in 2 sentences

Promote and facilitate practical space projects/ activities at university level and manage and develop an international NGO called "UNISEC-Global" UNISEC stands for University Space Engineering Consortium.

ISU INVOLVEMENT

How did ISU influence or assist you in your career & current role/function?

ISU provided me with basic knowledge of various space fields, space friends from all over the world, and opportunities to think deeply about "roles and meanings of space exploration and development."

Have you maintained contact with many of your ISU classmates?

Yes, it iswonderful that we can keep such a close relationship after graduation.

In 2015, MSS classmates got together in Strasbourg,

Continued on the next page.

with a kind invitation from ISU, and really enjoyed celebrating the 20th anniversary of the Masters together.

SSP1994 classmates are also keeping in touch, and still have a strong bond.

How often do you leverage your ISU network to achieve your role/function objectives?

Some important contacts that support our activities were given by my ISU experience. I have many ISU people whom I want to appreciate, but here I would like to mention three people.
Werner Balogh was a classmate in both SSP and MSS. The Basic Space Technology Initiative (BSTI) that he created under the United Nations Programme on Space Applications, and that he has been implementing since 2009 as Programme Officer in the United Nations Office for Outer Space Affairs, gave me lots of hints and network.

Mengu Cho was a TA during my MSS. Kyushu Institute of Technology, where he worked after ISU, joined UNISEC in 2005. His contribution for non-space faring countries has been outstanding. He created a scholarship programme called United Nations/Japan Long-term Fellowship Programme "Post-graduate study on Nano-Satellite Technologies (PNST)", in cooperation with UNOOSA. He also launched a new CubeSat project called BIRDS with university students from non-space faring countries such as Mongolia, Bangladesh, Ghana and Nigeria.

John Mugwe was also my classmate both in SSP and MSS. He has contributed to the Nano-satellite Mission Idea Contest as regional coordinator in Kenya since 2010. His inputs were very helpful when I considered how we can promote collaboration worldwide to involve non-space faring countries. I am pleased to see that Kenyan students are currently building their CubeSat in cooperation with an Italian university.

In the future, I think the ISU worldwide network will help to achieve "Vision 2020-100" which is described as "By the end of 2020, let's create a world where university students can participate in practical space projects in more than 100 countries."

CAREER PATH

How has your career developed to arrive where you are?

Whenever I met something / somebody whom I got inspiration from, I tried to keep and deepen it. For example, in 1999, I was introduced to a totally new approach in space engineering education with "CanSat" by Prof Shinichi Nakasuka of the University of Tokyo. The Coke-can sized model satellites proposed by Prof Bob Twiggs of Stanford University were being developed by students at the University of Tokyo and the Tokyo Institute of Technology. I saw promising futures in their activities because they were trying to make it by themselves without any textbook or instructor. In the next year, the students started to develop "CubeSat" which was also proposed by Prof Twiggs. UNISEC was established to support the activities.

Such relationships with people and things led me to a new stage/world, where I tried to seek an opportunity in any difficult situation and did my best there. For example, UNISEC did not have enough financial resources for promotion. Then, I published two books that introduced CanSat and CubeSat through commercial publishers. My desire to become a "writer" was also fulfilled somehow. The publishers promoted our activities through advertising the book. The same cycle happened again and again…

5 years ago, where did you see yourself today?

In 2012, I had already started to work towards realising Vision 2020-100. I knew it was an ambitious goal and I was not very sure what to do, and did not know where I would be 5 years later. I am quite happy to see where I am now because I am still working on it and more and more people are joining our activities.

5 years from now, where do you see yourself?

In 2022, I hope UNISEC-Global will be a successful international NGO in the space field. It will provide training programs, conferences, competitions, seminars, etc. Also, various collaborative space projects which are being proposed, such as the Earthquake Precursor Investigation project or Water quality monitoring with Nano-satellites, will be pursued with international participants in a sustainable way. I hope I'll be promoting and facilitating the activities worldwide by writing and talking.

Why?

Sustainable management and continuous new challenges for local chapters are important. If I can contribute to effective management of local chapters (UNISEC-xxx) with my experiences, I would be more than happy.

What does this mean to you?

When I studied at ISU, I was wondering whether human beings, as a species, were qualified to explore deep space yet. Gaps between nations are huge, and only people from rich countries can join space exploration and development. If the world could become a place where university students in more than half of the countries on Earth can join practical space projects, then the human species would be eligible to explore beyond their solar system? It seems to be a paradox, but the premise of such a world, where university students in more than 100 countries can participate in space projects, is that the world is peaceful and that people can collaborate.

- **Personally** My goal is to contribute to makin a peaceful world. There must be infinite paths to that goal. I think that one of the paths could be to ensure space engineering education can be acquired everywhere.
- **Professionally** I want to contribute to the world with my knowledge, skills and experiences. I hope I can write a book to encourage and inspire readers.

CURRENT JOB

What do you most love about your job/ business? (What gets you up in the morning?)

I can help others explore and uncover their real power and potential through creating a platform for practical space activities at university level worldwide. I am happy when I can serve others an feel that I am making others happy.

What are you working on now?

I am working on behalf of my organisation to become a permanent UNCOPUOS observer with points of contact in the local chapters, hoping to get it this year. Also, I am working on promoting and preparing the 8th CanSat Leader Training Program (CLTP) which is a training program for professors and instructors to learn how to conduct CanSat hands-on training by experiencing. <http://www.CLTP.info>

In 2017, we will organise two competitions related to nano/micro satellites:
The Pre-5th Mission Idea Contest workshop plus local competitions http://www.spacemic.net and the 2nd Debris Mitigation Competition http://unisec-global.org/dmc/.

Final presentations of both competitions will be held in the 5th UNISEC-Global Meeting held in Rome, in Dec 2-4, 2017. Efforts to enrol new local chapters and raise funding are being made continuously. I'm also working towards publishing a new International Academy of Astronautics (IAA) book (collection of 4th Mission Idea Contest and Deorbit Device Competition), and I'm also trying to write a book on UNISEC history so that the original intention will be understood by the future generations.

Why does this matter to you?

All of them are related to our Vision 2020-100 which is based on peaceful applications. My aspiration is to contribute towards creating a peaceful world. Both inner peace and outer peace are important as I think they are influencing each other.

How do you measure success personally?

How many universities/regions join the activities and can go to the next stage in a sustainable way. Also, how many individuals I can build trustworthy relationships with.

What are the most important changes happening in the Space industry from your perspective and how do you think they'll affect your present role?

Non-governmental organisations' contribution to space industry is getting bigger. Small private companies are becoming especially important to the space industry. Due to this new trend, university students have more options in their future plans. It is also good news for nano-satellite developers, as more companies are producing parts so they have more options.

What was you most significant Success

- **What was it?** Establish UNISEC-Global

Continued on the next page.

- **Why did it work?** 10-year experience in Japanese UNISEC and given budget for international activities (2010-2014). I met nice, motivated people worldwide.
- **What did you learn from it?** Keep mind clear and treat all things that happen seriously, focus on solutions not problems

What was you most significant Failure

- **What was it?** Couldn't manage financial matters properly leading to staff redundancies.
- **Why didn't it work?** A big project (and the funding) ceased in 2014, and couldn't get enough new funding.
- **What did you learn from it?** Careful planning and continuous efforts for fund raising are necessary.

UNISEC SPECIFIC QUESTIONS

UNISEC places a great deal of interest in cubesats. UNOOSA together with Kyutech offer a fully sponsored Master's degree which places emphasis on cubesat engineering. However, what this program does not currently do is to assist the specific developing nation establish a cubesat engineering laboratory – without which the knowledge gained via the UNOOSA/Kyutech program is difficult to utilise. Has UNISEC considered assisting with the establishment of cubesat engineering laboratory's?
I think Kyutech is assisting the specific developing nations establish a CubeSat. (BIRDS project) Their CubeSats will be launched soon.

The European Space Agency, NASA and the Canadian Space Agency all offer opportunities for students to fly experiments on board parabolic flight aircraft. Has UNISEC, with JAXA funding, considered supporting microgravity science?

Of course, if there are any opportunities to support students' space activities, we would love to explore the possibility. (Always need to consider the finance, though.)

Do participants of UNISEC ever experience complications associated with ITAR, i.e. the export of cubesat technology made partly of components/subsystems developed in the United States?

I have not heard about such a case. I think Japanese universities manage building satellites with mostly Japanese parts these days. Some universities purchase components from Europe.

The Mission Idea Contest is a superb opportunity for institutions, primarily in emerging space nations, to gain prominence but even so, such projects can be very costly. In order to foster international cooperation, has UNISEC every considered presenting a project where each partner contributes to a larger project where the entire team collectively works towards developing a microsatellite? Each partner nation would have its own ground receiving station and thus be able to acquire data on its own country.

Thank you for your nice suggestion. Yes, we would love to do it. Again, we need to consider the financial resources at the same time.

Actually, Kyutech is realising it through the BIRDS project.
http://birds.ele.kyutech.ac.jp/

Yes, Kyutech is doing it with the BIRDS Project.

Anything Else You'd Like to Say?

I think that support for education could be the most beneficial investment. It is the key to a better future. It seems almost everybody is interested in talking about education as they are able to contribute to education in some way. That's why I believe it should be possible to make a collaborative platform among universities beyond national boundaries, and to discuss among executives who represent governments and/or companies.
What I want to see is that governments and industries compete to contribute to space education through various ways such as providing free launch slots, supporting travel funding, offering technical support and monetary contributions for meaningful missions.

Thank You very much for your participation!

Thank you for giving me such opportunity.

End of interview.

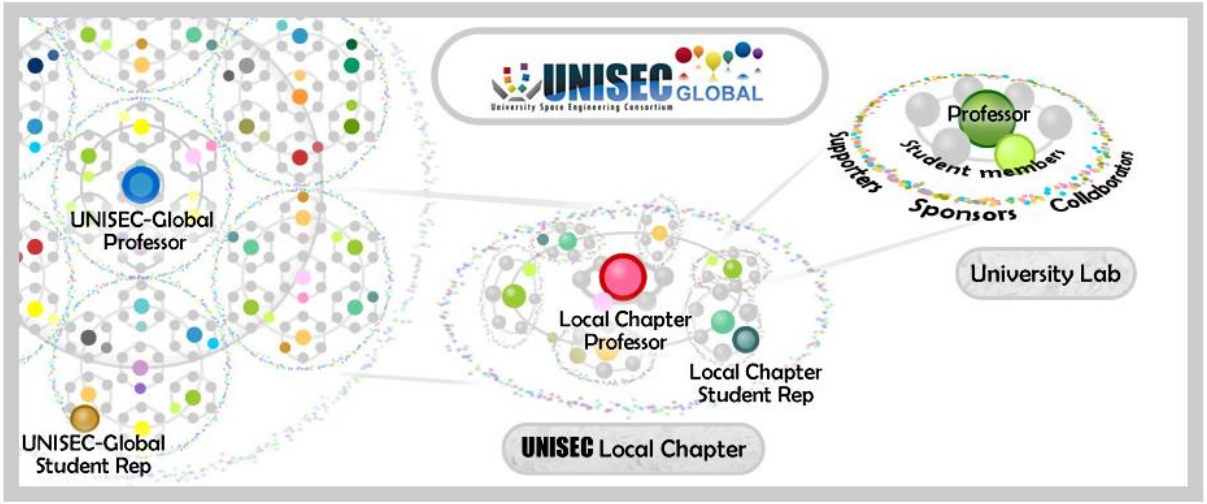
Organize a MIC in your country – become a coordinator. Contact:

Rei Kawashima
University Space Engineering Consortium (UNISEC)
Central Yayoi 2F, 2-3-2 Yayoi, Bunkyo-ku, Tokyo
113-0032, Japan
Email: info@spacemic.net
Tel: +81-3-5800-6645, Fax:+81-3-3868-2208

http://www.unisec-global.org/index.html

"By the end of 2020, let's create a world where university students can participate in practical space projects in more than 100 countries"

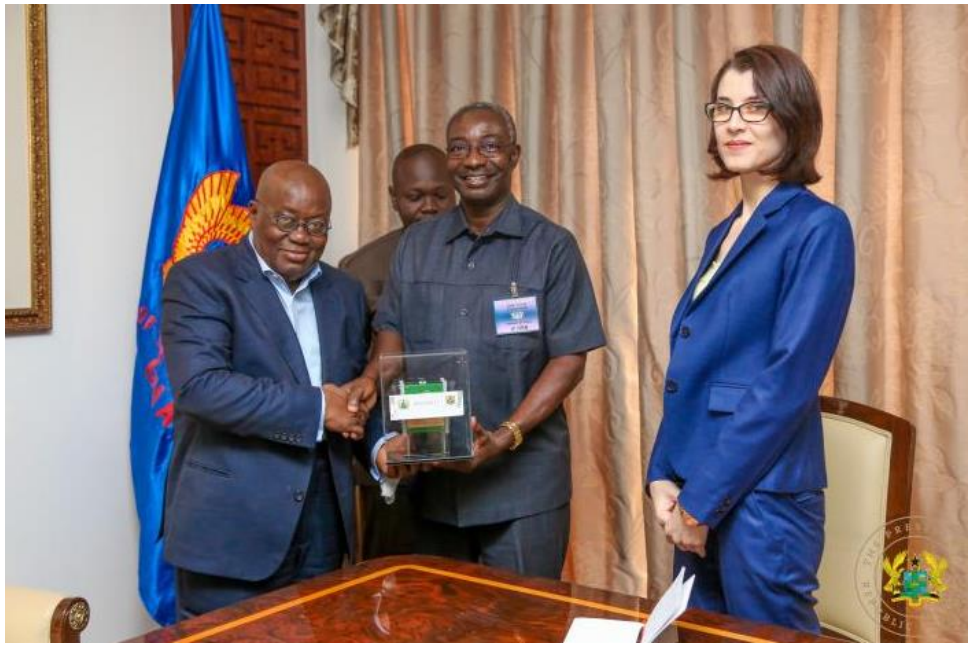
Vision of UNISEC-Global



10. The President of Ghana is presented with a mock-up of GhanaSat 1 (a BIRDS-1 cubesat)

On 23 February 2017, Dr S. Donkor (the president of *All Nations University* in Ghana) presented a mock-up (shown at the left) of **GhanaSat 1** to the president of Ghana, *His Excellency Nana Addo Dankwa Akufo-Addo*. When on orbit, it will be Ghana's first foray into space. This photo op was also an opportunity to explain to Ghana's head of state the current status of their satellite.

These photos are courtesy of Dr Donkor.



His Excellency, Dr Donkor, Rev. Adriana Ion (Registrar of ANUC)

GhanaSat 1 and a handshake

11. Cherry blossoms are in bloom – the most beautiful time of the year in Japan

From Rei Kawashima
(Facebook)

桜

sakura

All of Japan is spectacularly beautiful during the early part of April when more or less in unison *sakura* (cherry blossoms) burst into bloom.

If you are able to pick the time of the year to visit Japan, then sakura time is the best choice. Winter is over and the oppressive heat and humidity of summer are not around.

Sakura – Tobata Campus of Kyutech – near student cafeteria

12. Dr Suvdaa publishes capacity building paper in *Mongolian Journal of Strategic Studies*

МОНГОЛ УЛСЫН САНСРЫН ТЕХНОЛОГИЙН ХӨГЖИЛ БА ЦААШДЫН ЧИГ ХАНДЛАГА

ДОКТОР Б.СУВДАНЦЭЦЭГ

Nowadays, leading countries are giving urgent role in space science development because of its huge benefits on countries information technology development, national security, disaster risk reduction and environmental protection. This study aims to describe the trends of space science and government roles in space technology development in Mongolia. The study concludes that we need to develop the human capacity on space engineering, enhance basic technology, participate in international constellation satellite projects and ground station networks, and launch the communication satellite to improve information technology and national security.

НЭГ. ИХ ГҮРНҮҮДИЙН САНСРЫН ТӨЛӨӨХ ӨРСӨЛДӨӨН ЭРЧИМЖИЖ БАЙНА

This paper was the result of Dr Suvdaa staying at Kyutech for a few weeks early in 2016. Prof Cho provided advice and guidance for this paper. It is a policy paper for helping to form the policy for Mongolian space science development.

As a first step, this paper was presented as a lecture before the national security council of Mongolia.

If you have questions, please contact the author directly.

SEE THE NEXT PAGE FOR AN ENGLISH SUMMARY OF THIS PAPER.

DATE OF PUBLICATION: *25 SEPTEMBER 2016*
NAME OF PUBLICATION:
THE MONGOLIAN JOURNAL OF STRATEGIC STUDIES
NAME OF AUTHOR: *SUVDANTSETSEG BALT*
TITLE:
THE TRENDS OF MONGOLIAN SPACE SCIENCE DEVELOPMENT

Summary [original document is written in Mongolian language]

Nowadays, leading countries are giving urgent role in space science development because of its huge benefits on countries information technology development, national security, disaster risk reduction and environmental protection. This study aims to describe the trends of space science and government roles in space technology development in Mongolia.

Broadcasting services in Mongolia are still expensive but users are expanding in coming years. We are paying 5 billion dollars per year for its renting and uses of Chinese, Russian, Korea and other countries communication satellite. Thus, Mongolia needs to launch a communication satellite in near future to reduce a broadcasting services cost. The other side each country has a higher priority over an amount of spectrum at a particular orbital position and to cover its national territory. These rights attributed to each country are the National allotments from ITU region. **Cont'd next column.**

The Mongolian satellite location is become very narrow where we need to make a coordination with adjacent networks and countries which are planning to launch satellites at near our allocated location. This is strategically very important issue in Mongolia where we need to institute a space agency with professional researchers and engineers in near future.

Mongolia have some advantages of huge territory, large steppe, no raining season and a serene sky. In this case, we need to install some ground station networks in parallel positions of latitude to downlink a remote sensing data from polar orbital earth observation satellites. Here we have to expand our international collaboration with countries to help them a data downloading and get benefits from them.

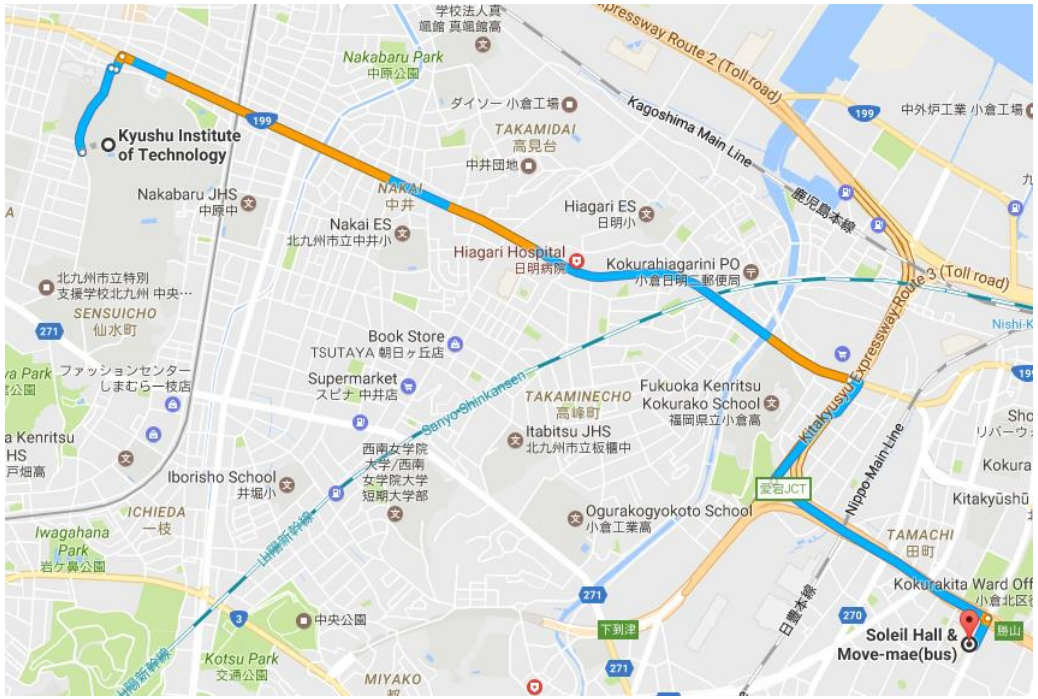
The one of the requirement to enter this science field, we have to capacity human resources and young space engineers through collaborating with best engineering universities from space science developed countries to work together on Nano and micro satellite real projects and joint research or study program.

The study concludes that we need to develop the human capacity on space engineering, enhance basic technology, participate in international constellation satellite projects, to join ground station networks for remote sensing, and launch the communication satellite to improve information technology and national security. **End of summary.**

13. Bhutan students are formally admitted in Kyutech

Report by Cheki Dorji

Kyutech Entrance Ceremony, Date: 5th April 2017 @ 2 p.m.
Venue: Kitakyushu Soleil Hall (15 minutes bus ride from University)



Students leaving after the ceremony

Kiran and Yeshey posing for a photo at the ceremony

Kyutech held entrance ceremony to congratulate and welcome new students to the Kyutech family. President of Kyutech addressed the gathering. Although the address was in Japanese, international students received a translated copy in English. Three students from Bhutan under BIRDS-2 project are now enrolled in the *SEIC Masters* course. Up until April 2017, they were on research-student status.

14. ITU issues IFIC (Int'l Frequency Info Circular) for BIRDS-1; hence NASA can launch all five BIRDS-1

Your query : / IFIC = 2843

Complete list - Explanations - Export in txt format - Export in Excel format

Issued on 18-April-2017

Total line = 200/211

ID number (SNS)	adm	ORG or Geo.area	Satellite name	Earth station	long_nom	Date of receipt	ssn_ref	ssn_no	ssn rev/ Sup	ssn rev no	removal	Part/ Art.	WIC/IFIC (ific.mdb)	WIC/IFIC date
up down	up down	up down	up down	up down	up down	up down	up down	up down					up down	
108552010	HOL		NSS-BSS 108.2E		108.2	20.06.2016	AP30/E	469				B	2843	18.04.2017
108552013	HOL		NSS-BSS 113.5E		113.5	11.07.2016	AP30/E	472				B	2843	18.04.2017
108554010	HOL		NSS-BSS 108.2E		108.2	20.06.2016	AP30A/E	469				B	2843	18.04.2017
108554013	HOL		NSS-BSS 113.5E		113.5	11.07.2016	AP30A/E	472				B	2843	18.04.2017
116554018	G		UKDIGISAT-4C		-33.5	07.07.2016	AP30A/E	753				A	2843	18.04.2017
116559022	F		F-SAT-30B-12.5W		-12.5	06.06.2016	AP30B/A6A	458					2843	18.04.2017
116559023	F		F-SAT-30B-36E		36	17.06.2016	AP30B/A6A	459					2843	18.04.2017
116559024	F		F-SAT-30B-7W		-7	29.06.2016	AP30B/A6A	460					2843	18.04.2017
108559011	GRC		HELLAS-SAT-3G		39	01.06.2016	AP30B/A6B	106					2843	18.04.2017
110559018	CYP		KYPROS-SAT-3		39	03.06.2016	AP30B/A6B	107					2843	18.04.2017
113559013	LAO		LAOSAT-FSS-128.5E		128.5	08.07.2016	AP30B/A6B	108					2843	18.04.2017
107540013	USA		LRO		N-GSO	05.12.2016	API/A	4479	M	2			2843	18.04.2017
116545194	NOR		SE-6-HEO-1A		N-GSO	14.12.2016	API/A	9958	M	2			2843	18.04.2017
115545072	I		EAGLET		N-GSO	22.12.2016	API/A	10954	M	1			2843	18.04.2017
115545074	F		JFDSAT-LEO-A-C		N-GSO	27.11.2015	API/A	11126	M	1			2843	18.04.2017
115545075	F		JFDSAT-LEO-B-C		N-GSO	27.11.2015	API/A	11127	M	1			2843	18.04.2017
115545076	F		JFDSAT-LEO-C-C		N-GSO	27.11.2015	API/A	11128	M	1			2843	18.04.2017
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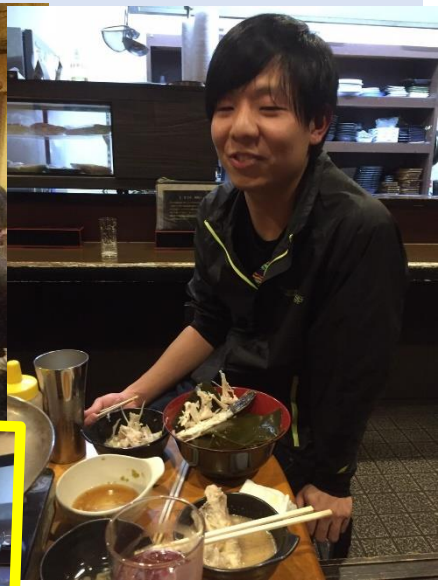
115545087	ARG		ALEPH-1-C		N-GSO	13.01.2017	API/A	11254	M	1			2843	18.04.2017
116545126	USA		LEMUR-2		N-GSO	05.12.2016	API/A	11743	M	1			2843	18.04.2017
116545229	USA		OSNSAT-1		N-GSO	21.11.2016	API/A	11943					2843	18.04.2017
116545247	USA		PROMETHEUS-B2		N-GSO	08.12.2016	API/A	11956					2843	18.04.2017
116545248	USA		HARP		N-GSO	08.12.2016	API/A	11957					2843	18.04.2017
116545249	CHN		TY-1		N-GSO	09.12.2016	API/A	11958					2843	18.04.2017
116545252	CHN		CATON-1		N-GSO	13.12.2016	API/A	11959					2843	18.04.2017
116545238	J		BIRDS		N-GSO	30.11.2016	API/A	11960					2843	18.04.2017

From ITU website on 24 April 2017

https://www.itu.int/net/ITU-R/space/snl/bresult/radvance.asp?sel_ific=2843&ie=y

15. BIRDS-2 Team celebrates completion of their PDR



Joint Multi-nation BIRDS-2 Project

BIRDS-2

PDR Dinner Celebration

Japan Malaysia Bhutan Philippines

April 10, 2017 Monday

Cherry blossom petals on the ground

Editor's Note: From here to the end of this document (Issue No. 15) we present BIRDS-2 subsystem reports (01 thru 10) derived from BIRDS-2 PDR presentations. More will be presented next month in Issue No. 16.

16. Subsystem Report-01: ADCS - Attitude Determination and Control System (ADCS)

ADCS

Attitude Determination and Control System

by: Cheki Dorji (Bhutan)

Attitude Determination & Control Subsystem (ADCS)

Attitude is described as an angular rotation with respect to its body-centered coordinate frame (body frame). Hence, attitude defines a satellite's orientation in space.
This subsystem is expected to fulfill 3 broad functions:

1. Attitude Determination

For attitude determination of BIRDS 2 CubeSat, following sensors are used.

- Gyroscope (L3GD20)
  - 3-axis angular rate sensor
- AMR Magnetometer (HMC5883)
  - Magnetic field strength and Earth's magnetic field vector
- Solar Cell
  - Sun position vector - voltage and current data

From the data from above sensors, an algorithm will be used for determining attitude of CubeSat on board as well as on ground after downloading the data. Since the CubeSat has camera mission for taking pictures of homeland of each participating countries, it is important that the side of CubeSat that has camera faces the Earth.

2. Passive Stabilization of CubeSat

Once the CubeSat is deployed from International Space Station (ISS), it will experience varying angular velocities. This tumbling of CubeSat should be brought to minimum.

For this function, following system will be used:

- Permanent Magnets – To align CubeSat with Earth's magnetic fields
- Hysteresis Dampers – To reduce oscillations of CubeSat

Main advantages of using this system for BIRDS 2 CubeSat are:

- No system power required
- Light weight

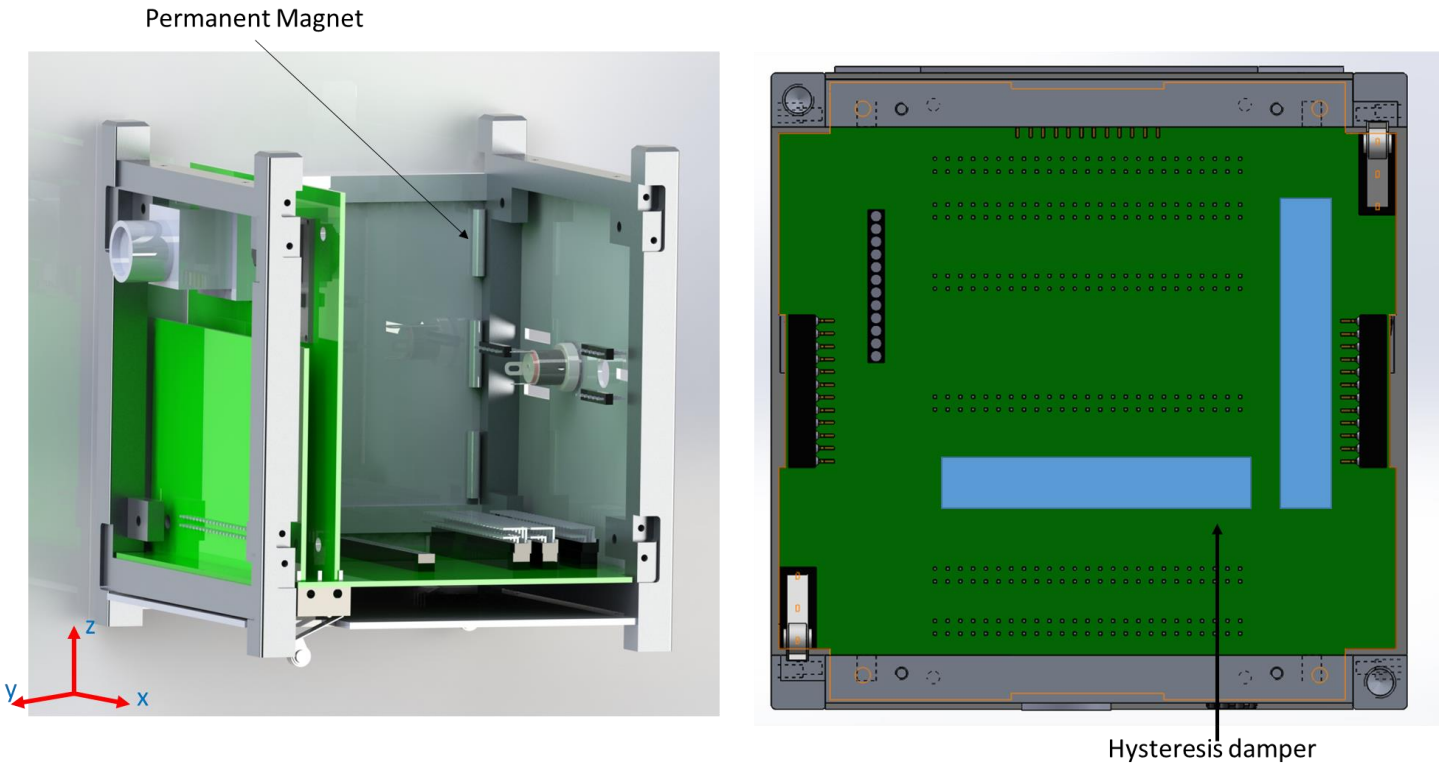
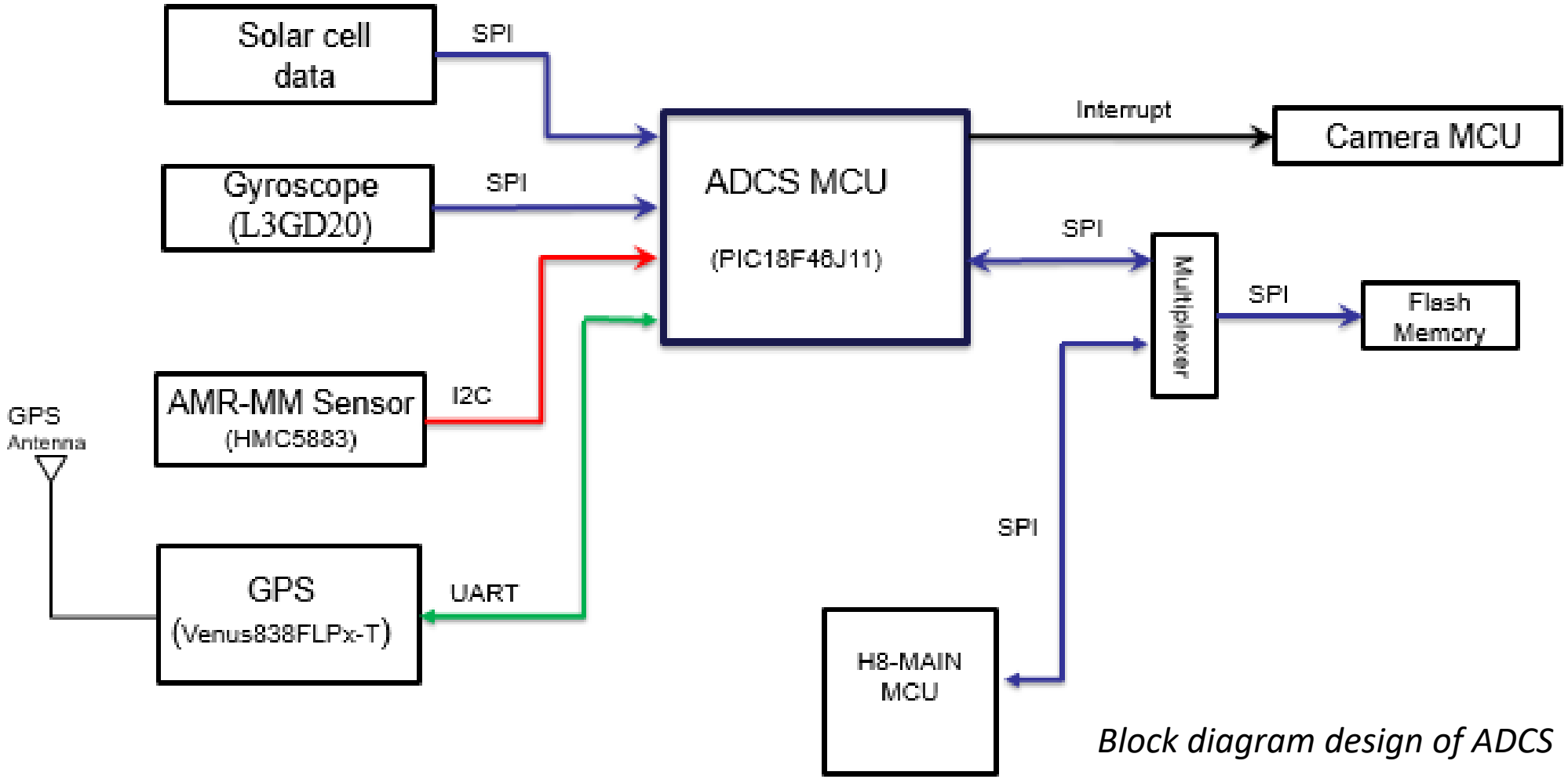


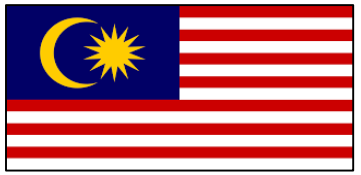
Figure 1:
Placement of permanent magnets and hysteresis damper – both are inherited from BIRDS-1 design.

3. Provide Attitude Information to Camera Subsystem

After it is determined that the camera is facing Earth, ADCs will give an interrupt to camera subsystem for taking pictures.



Block diagram design of ADCS



AMR-MM Mission

Anisotropic Magneto Resistance MagnetoMeter

by: Syazana Basyirah (Malaysia)

AMR-MM Objectives

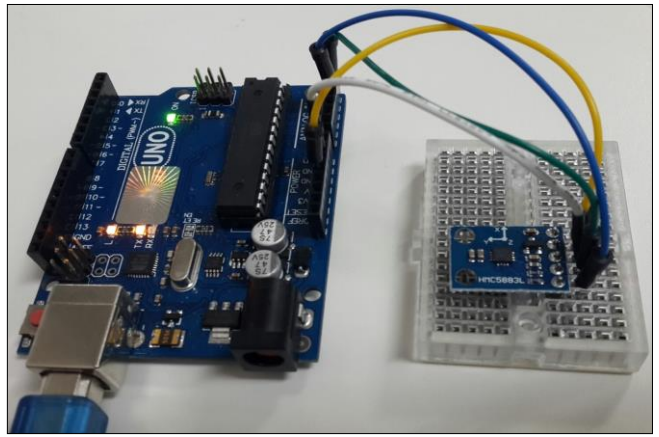
■To conduct measurement of magnetic field in space.

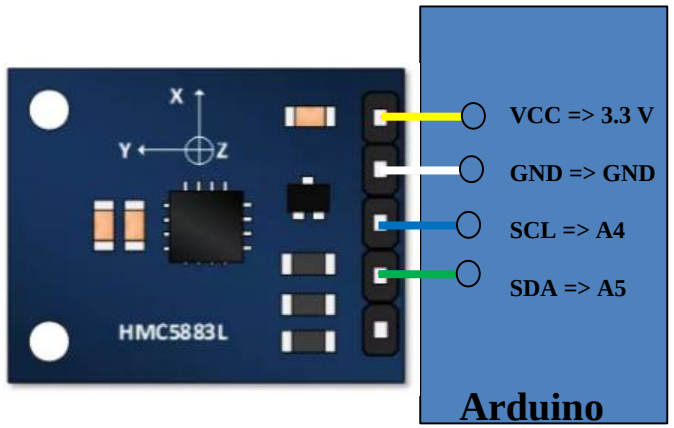
■To provide an alternative method of magnetic field measurement in space which work as a support data for geomagnetic mapping of South Asian region.

■To store and send the magnetic field data downlink to be able compare it with the existing geomagnetic field data.

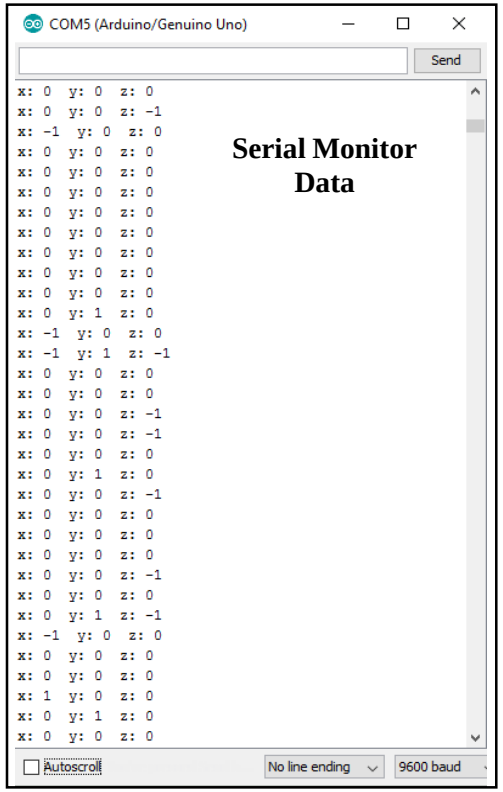
AMR-MM Verification Test

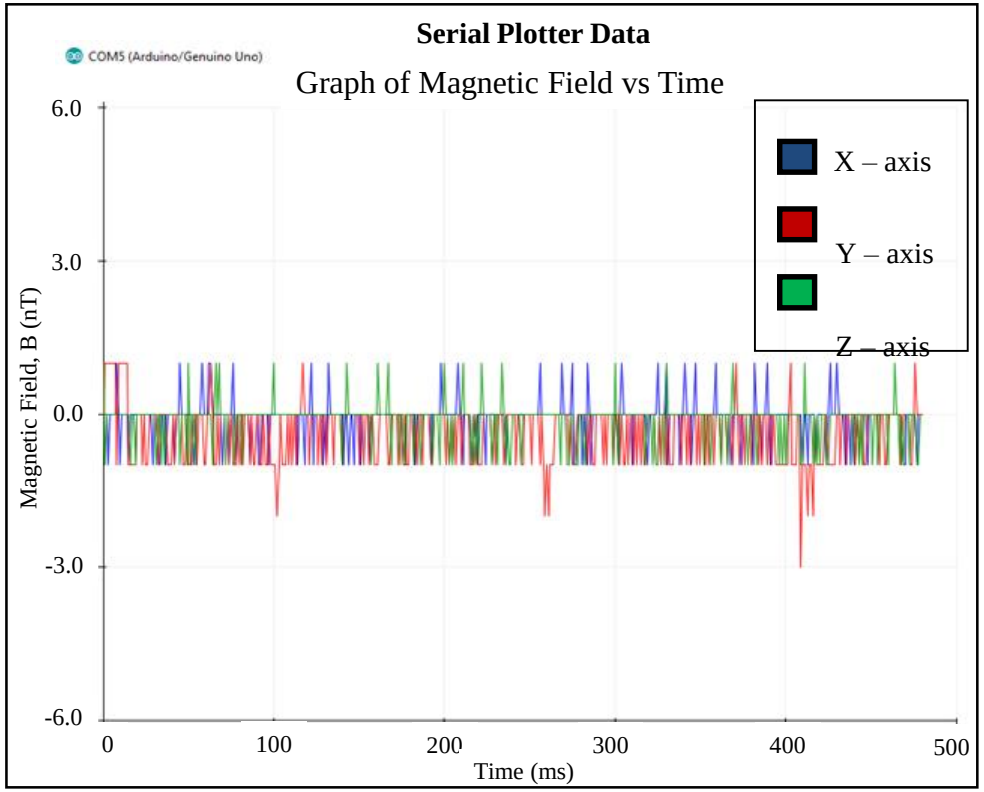
1. Calibration: AMR Magnetometer (GY-273 Module)
Connection Diagram





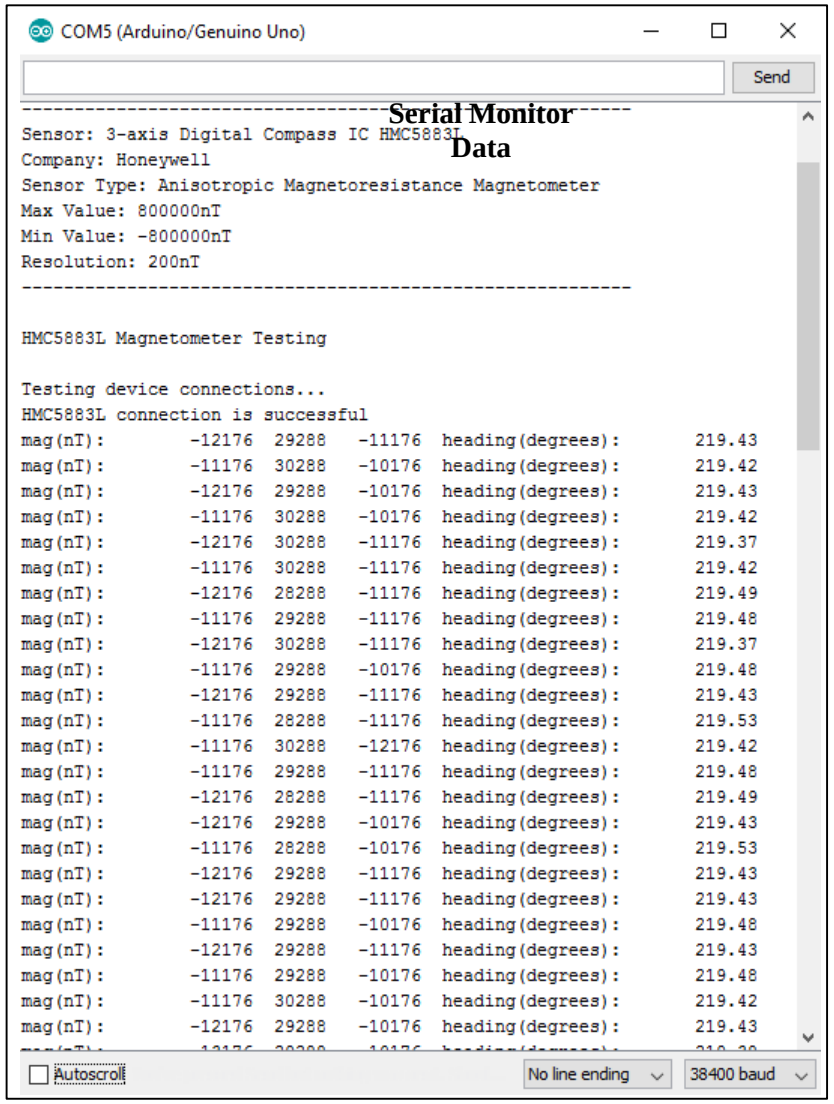
1.1. Calibration Result: GY-273 Module

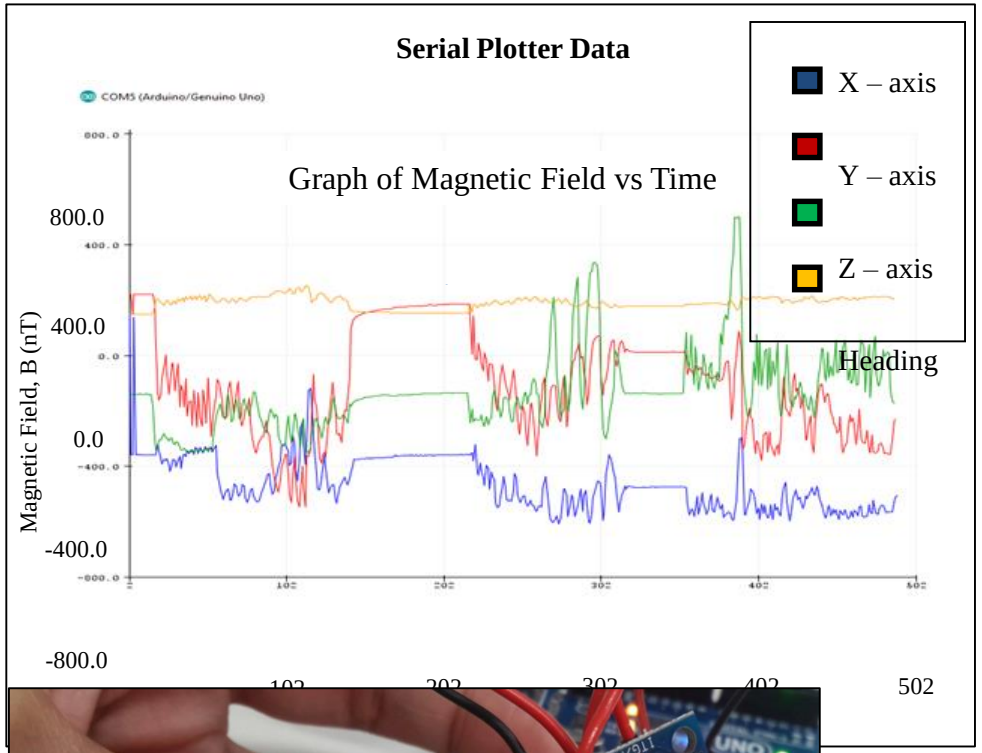


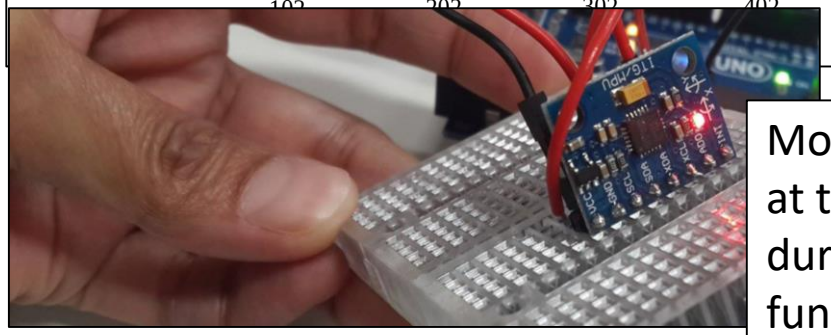


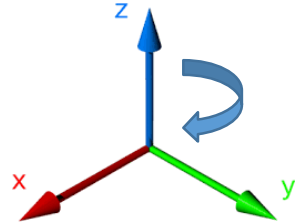
AMR-MM Verification Test

2. Functionality Test: AMR Magnetometer (GY-273 Module)





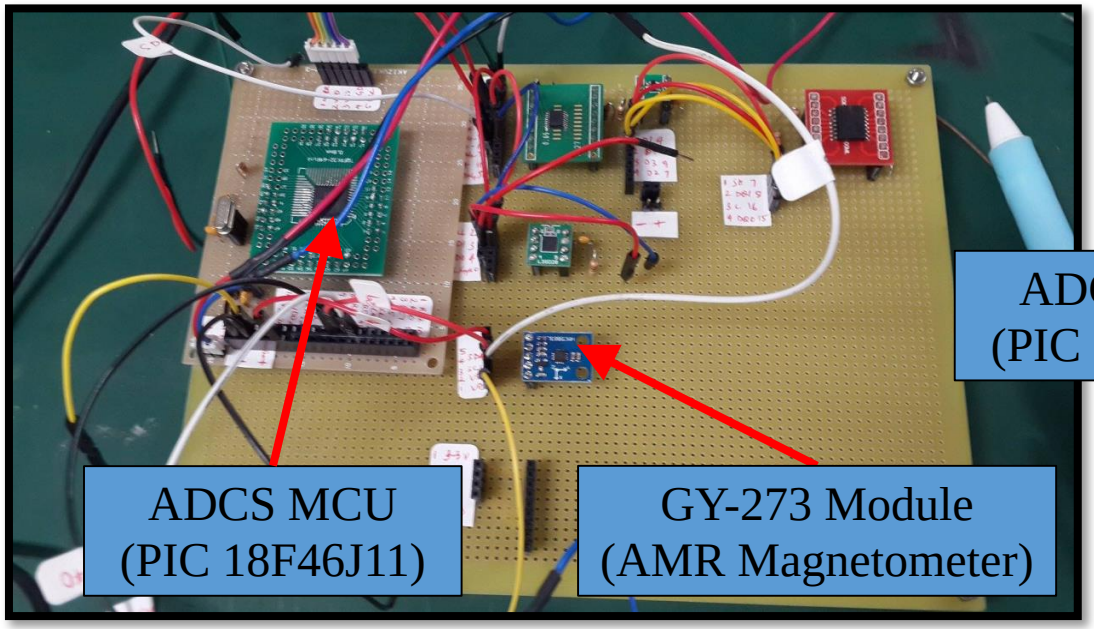




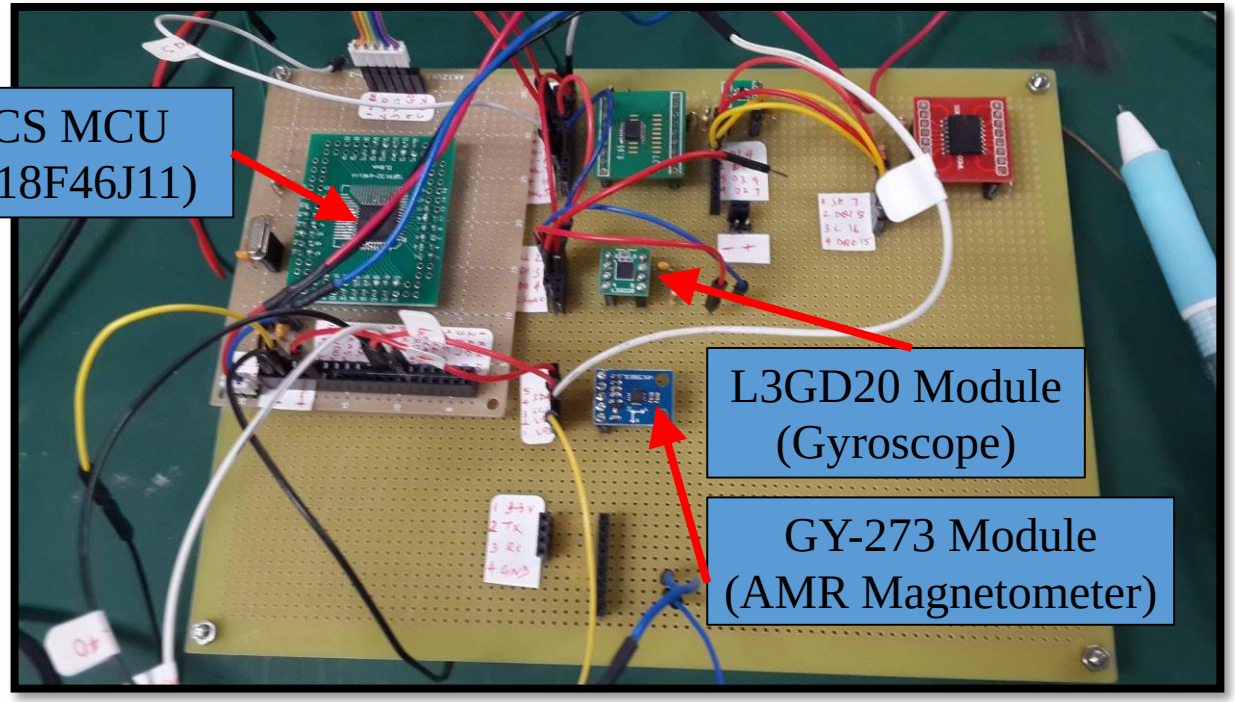
Module was rotated at the triple axes during the functional test.

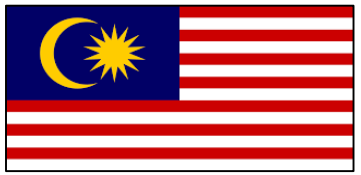
AMR-MM Verification Test

3. BBM Test: GY-273 Module integration with ADCS MCU



4. BBM Test Result: GY-273 Module integration with ADCS MCU and Gyroscope





Antenna Design

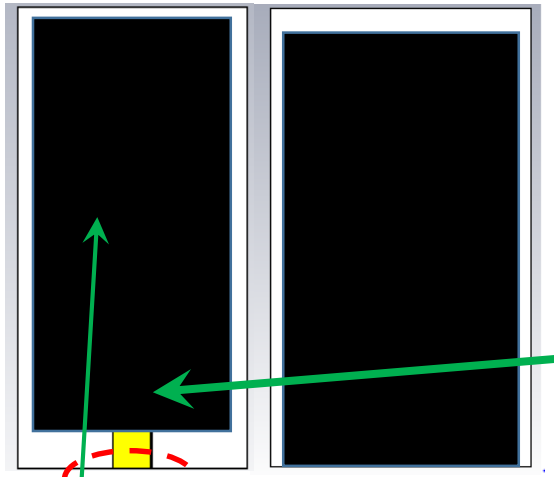
UHF Patch Antenna by UiTM

VHF Deployable Monopole Antenna by Syazana Basyirah

Antenna Objectives

- To achieve uplink and downlink communication with the ground stations in multiple countries, successfully.
- To design two antennas within the range frequency of 435 – 438 MHz (UHF) and 145 – 147 MHz (VHF).

UHF Patch Antenna Simulation Design

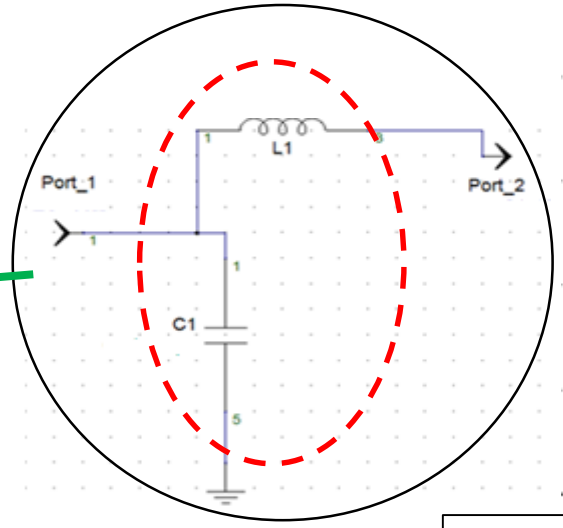


Top view

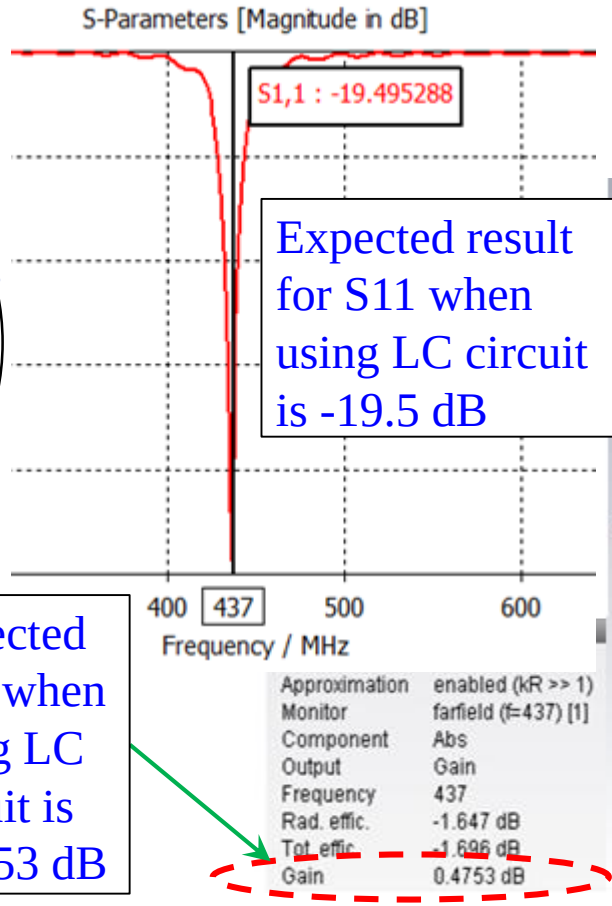
Bottom view

Radiating element (actual antenna design is not shown)

MMCX connector

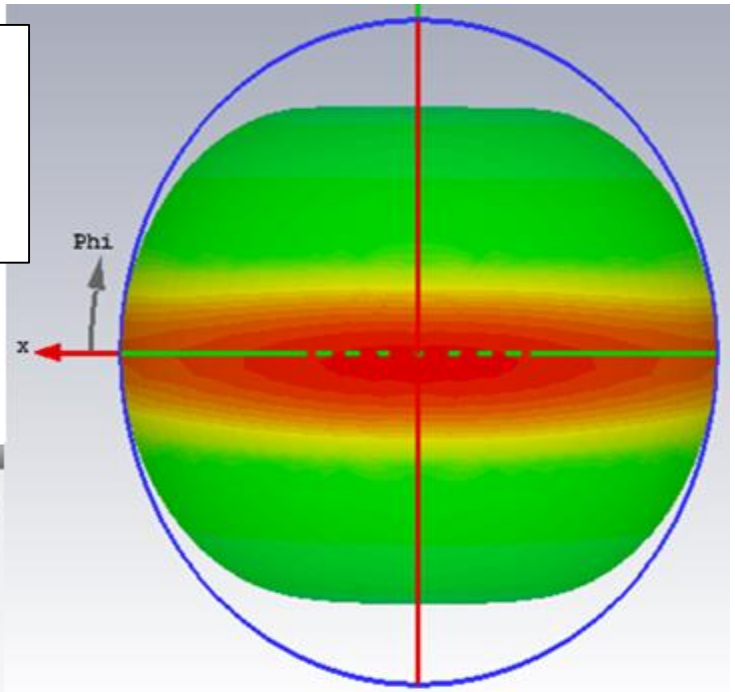


Equivalent LC circuit is connected here to solve impedance mismatch (and for efficient use of space)



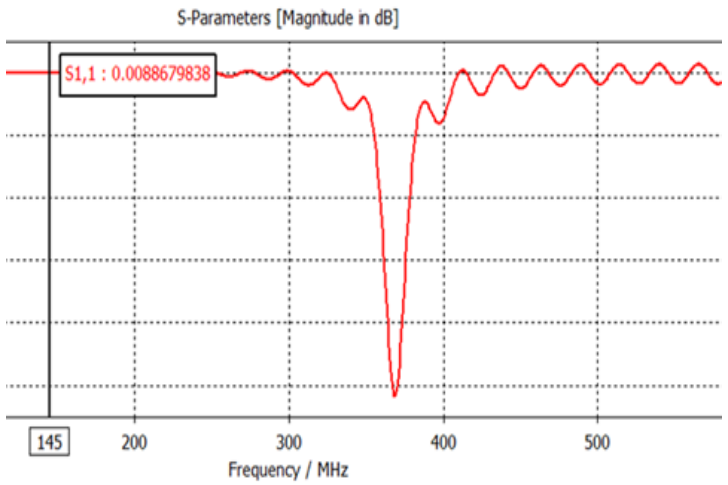
Expected result for S11 when using LC circuit is -19.5 dB

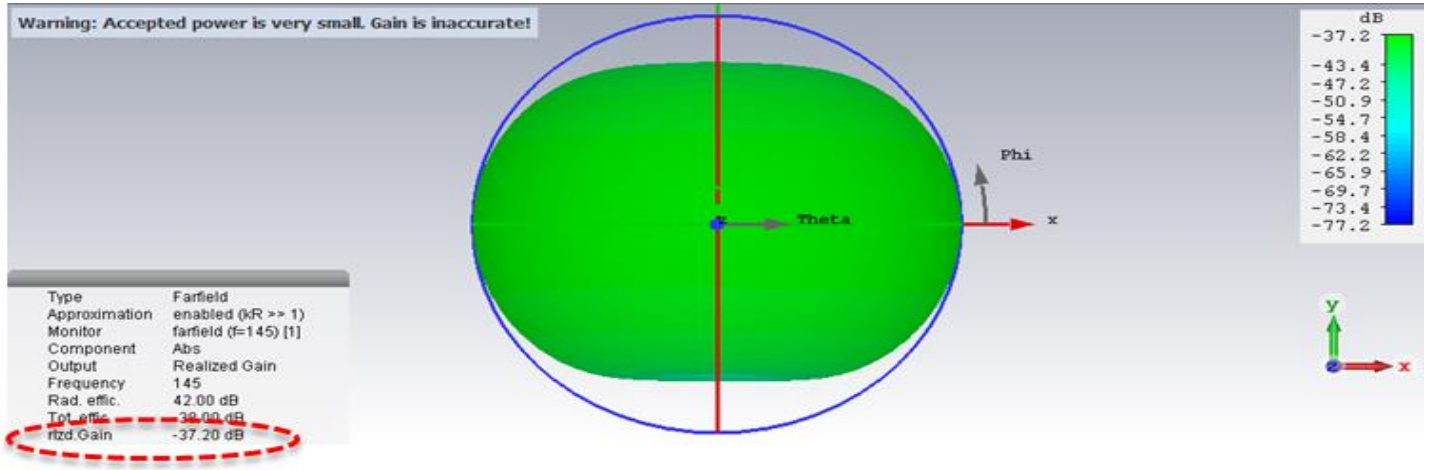
Expected gain when using LC circuit is 0.4753 dB



VHF Patch Antenna Simulation Design

A patch antenna was initially proposed for VHF operation, however, due to high GAIN requirement of the satellite mission, patch antenna with sufficient gain cannot be produced without having to increase the antenna size (which would be an issue due to the limited size of the satellite to accommodate both antennas and solar panels).



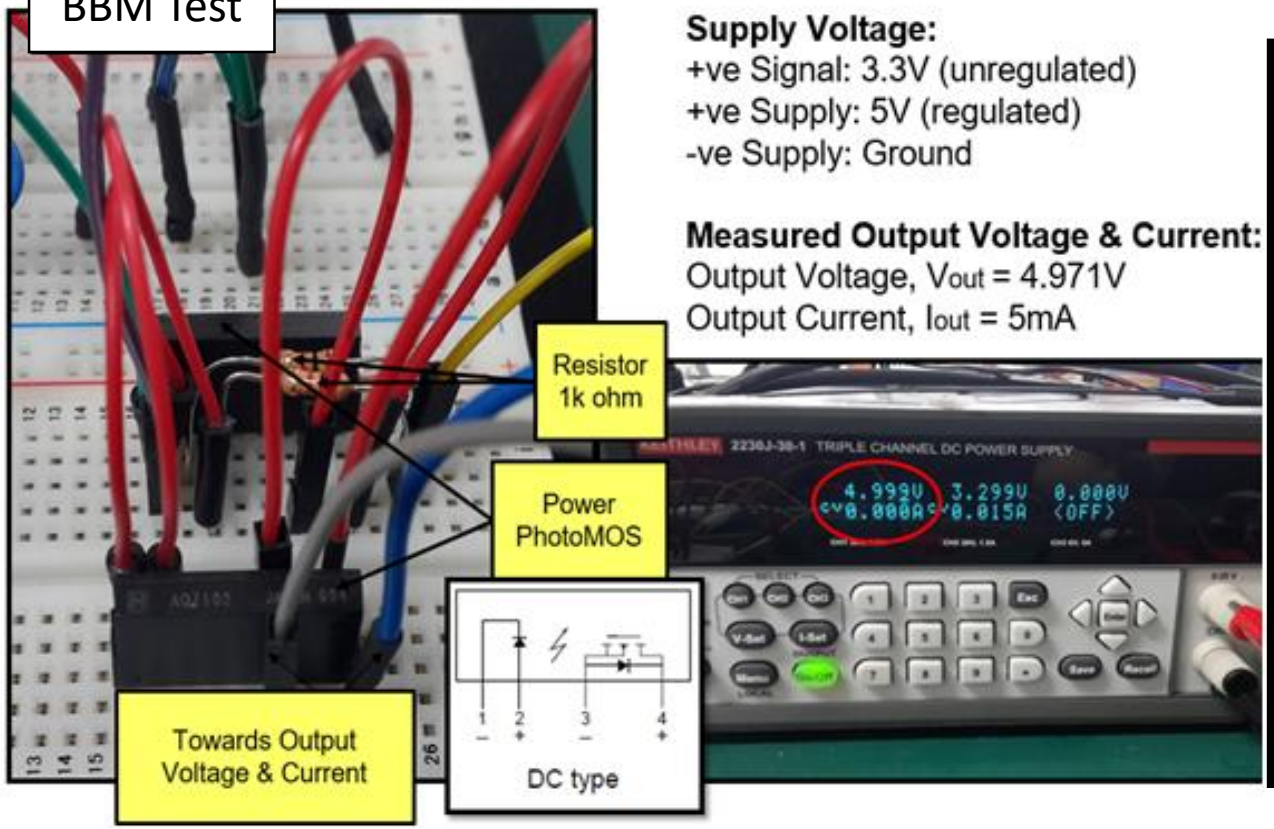


#Issue 1: Return loss (S11) does not resonate at 145 MHz. If the width of the ground plane (Wg) increases, S11 will resonate at lower frequency. If length of ground plane (Lg) decreases, a good S11 can be obtained. Reducing this further however will not bring the resonant frequency to 145 MHz, unless the size of the radiating patch is increase, which would result in bigger antenna size.

#Issue 2: Gain is low (-37.20 dB). This happens due to the low efficiency of the design resulted from miniaturization of the design based on the space limitation. Impedance also shall be optimized further to obtain correct matching.

VHF Deployable Monopole Antenna
BBM and Functionality Test

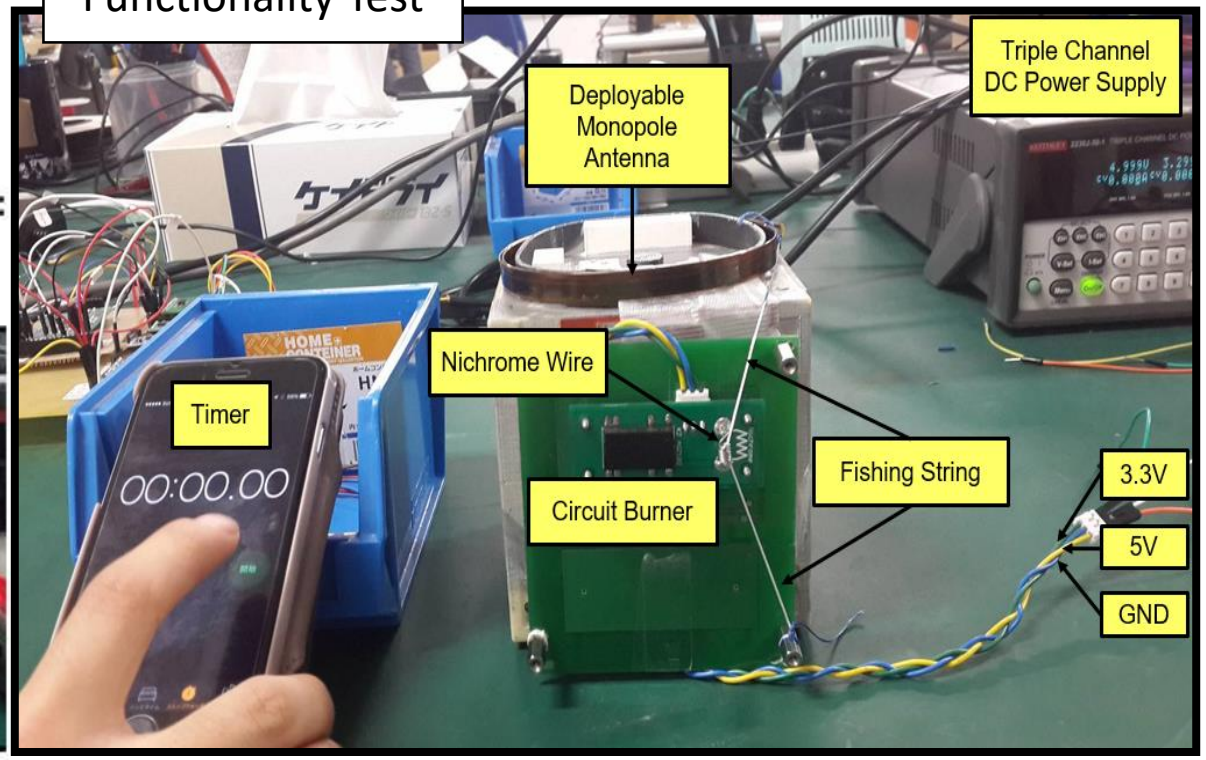
BBM Test

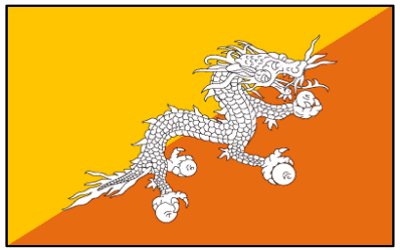


Supply Voltage:
+ve Signal: 3.3V (unregulated)
+ve Supply: 5V (regulated)
-ve Supply: Ground

Measured Output Voltage & Current:
Output Voltage, V_{out} = 4.971V
Output Current, I_{out} = 5mA

Functionality Test





APRS-DP Mission

Automatic Packet Reporting Service DigiPeater

by: Yeshey Choden (Bhutan)

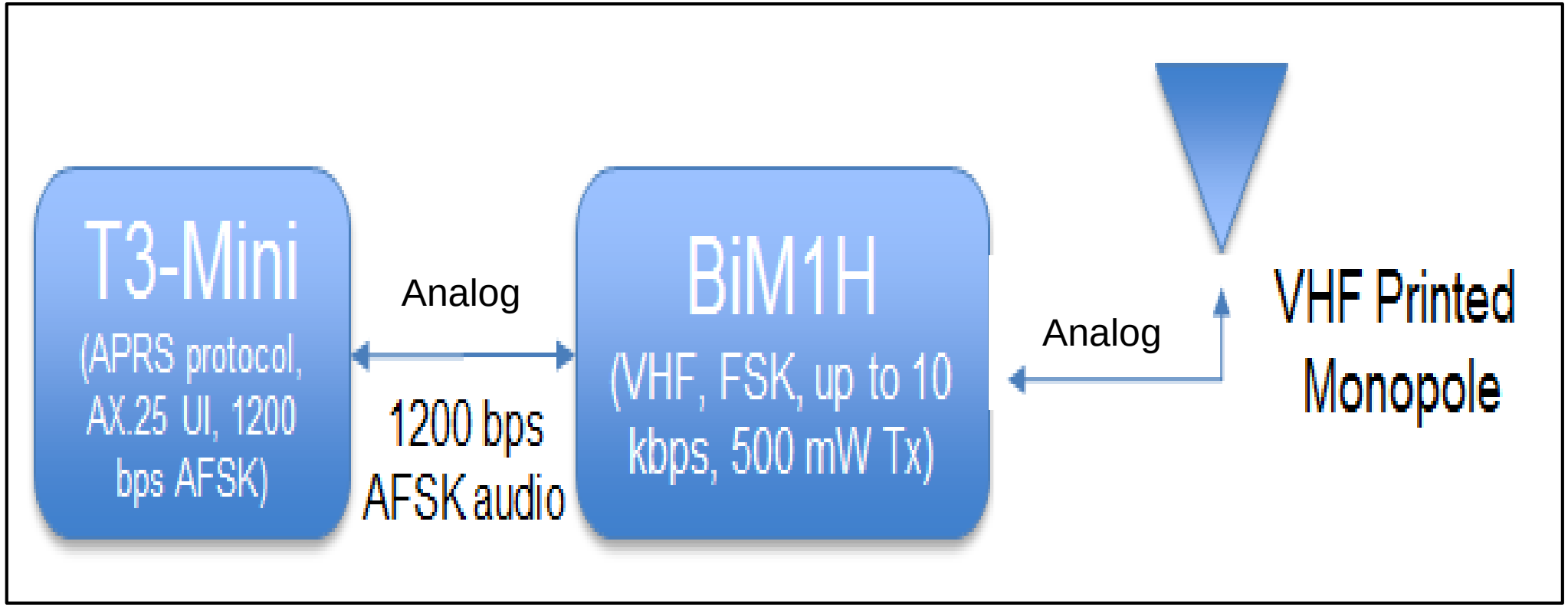
Objectives

- Primary mission of BIRDS-2 Project
- To **demonstrate functionality** of low cost COTS APRS DP payload on 1U cubesat in space

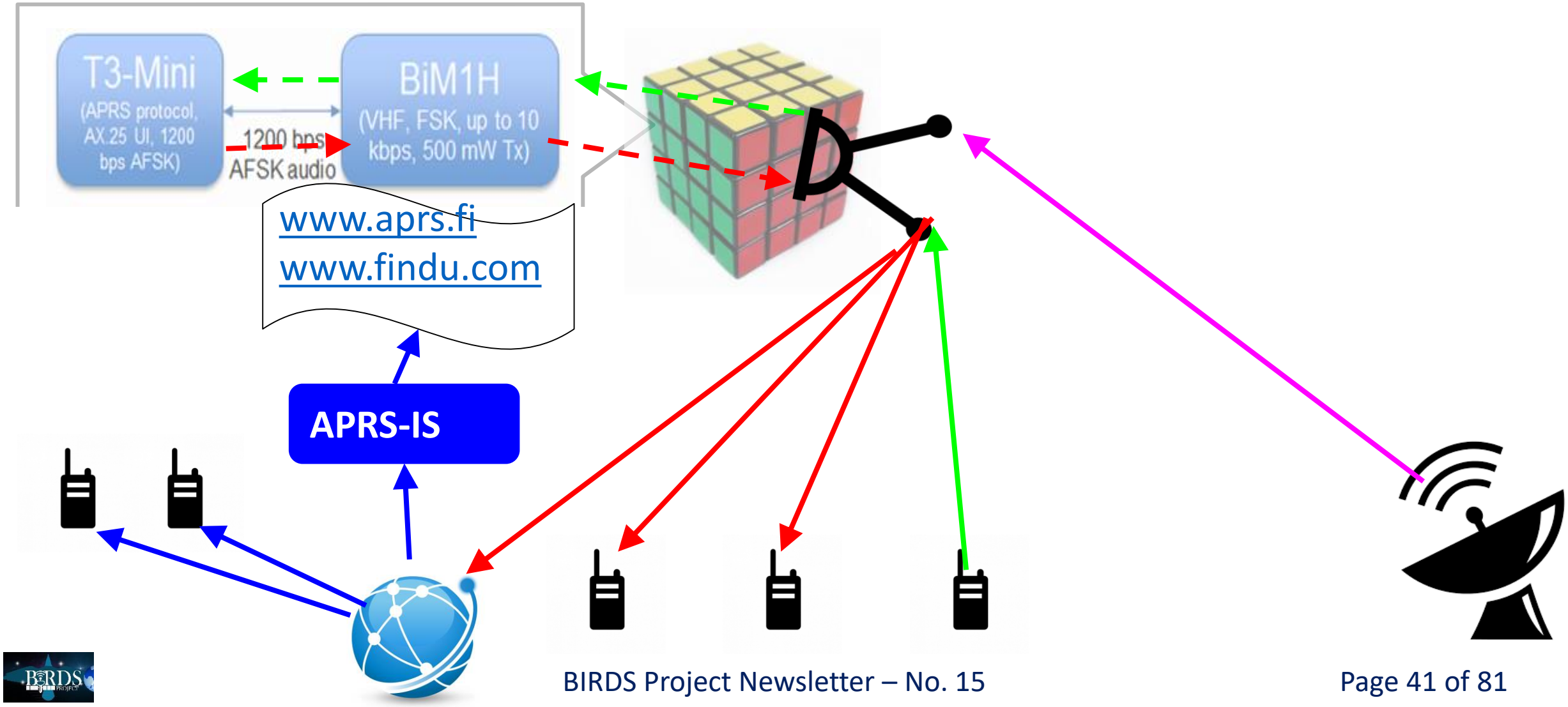
Potential Applications

- Provide real time digital communication service to amateur community
- Provide alternative communication services during emergencies
- Use as a tool to educate general public and young people about amateur and radio communication

Block Diagram



Design Mechanism



Comments / Discussions

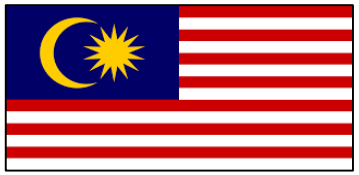
- What kind of data can be exchanged using APRS?
- E.g. text messages, GPS coordinates/location, telemetry, etc.

Can video be supported? Answer is No

- How many users can be simultaneously accommodated by the payload?

Answer: Need to perform an experiment/test on this

Consider how to handle collisions, can the payload handle this?



Camera Mission

by: Muhammad Hasif Bin Azami (Malaysia)

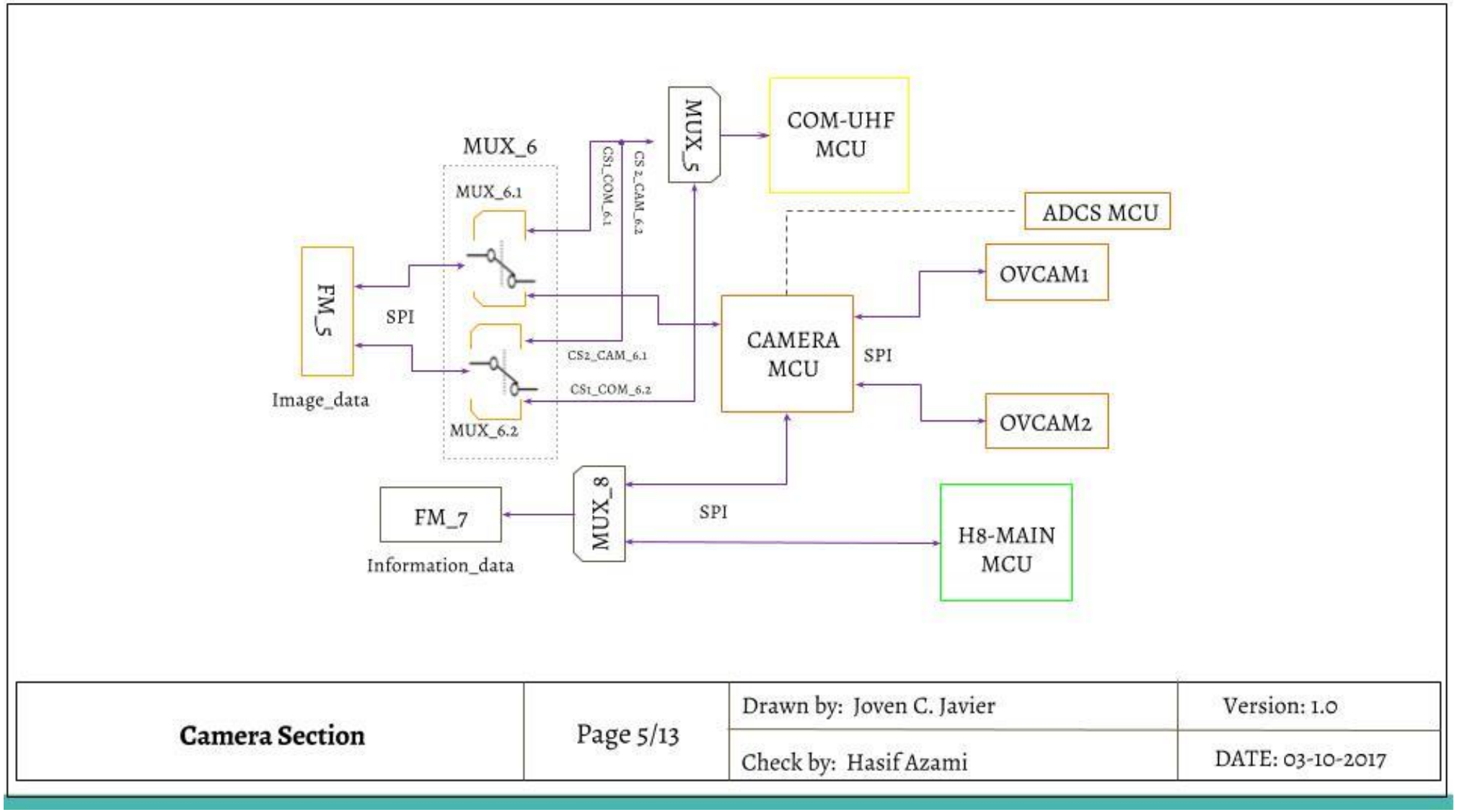
Introduction

- The purpose of the CAM mission is able to capture images of each country (Japan, Philippines, Bhutan and Malaysia)
- We divided the mission into three success levels;
  I. Minimum – Capture images from the Earth's surface
  II. Full – Take picture of the 4 countries homelands in desired high resolution
  III. Extra – Take short video
- Use 2 separate OVCAM cameras as payload; a primary camera (narrow-angle lens), and a secondary camera (wide-angle lens; also, video)
- Have four modes;
  I. Normal mode
  II. Timer mode
  III. Continuous mode
  IV. Target mode

  I, II, III: Command from OBC
  IV: Trigger from ADCS

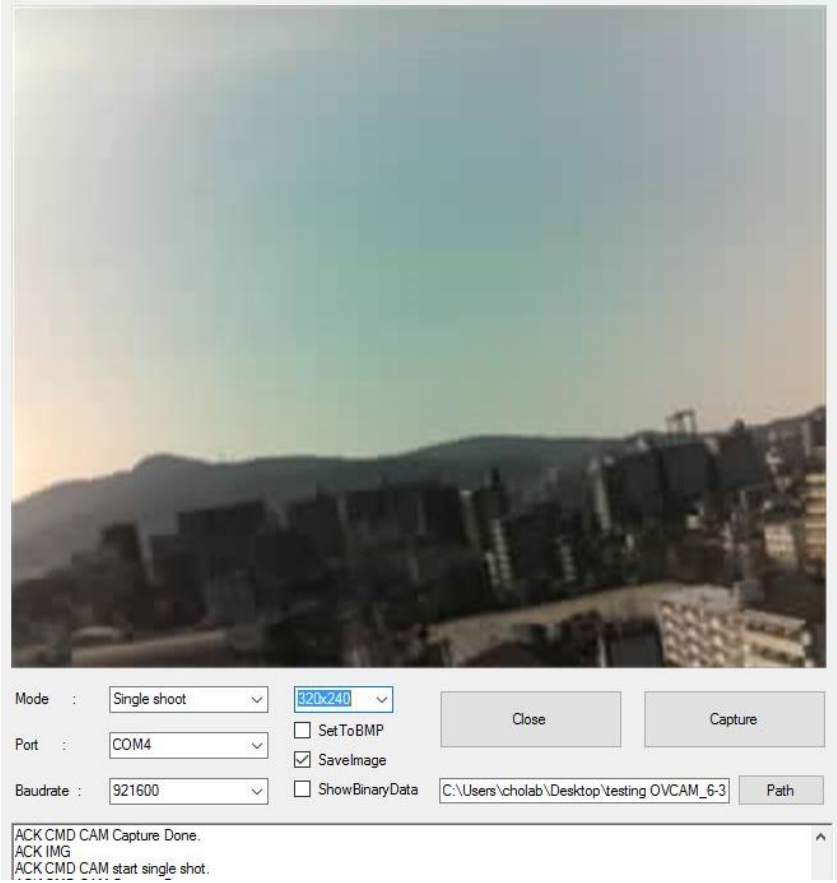
"OV"=OmniVision (brand name)

CAM System Block Diagram



JPEG Format Verification Test

❑OVCAM image's format and parameter



Array Resolution	Processing Time (sec)	Size (kB)
320 x 240	2.1	4.80
640 x 480	1.45	22.88
1024 x 768	2.52	49.08
1280 x 960	2.97	69.8
1600 x 1200	3.65	100.10
2048 x 1536	5.08	154.66
2592 x 1944	7.44	250.28

•We did the test at the roof top of General Research Building 1
•We target the camera to Wakato Bridge (~2.39km)

JPEG Format Verification Test

(using wide-angle lens)

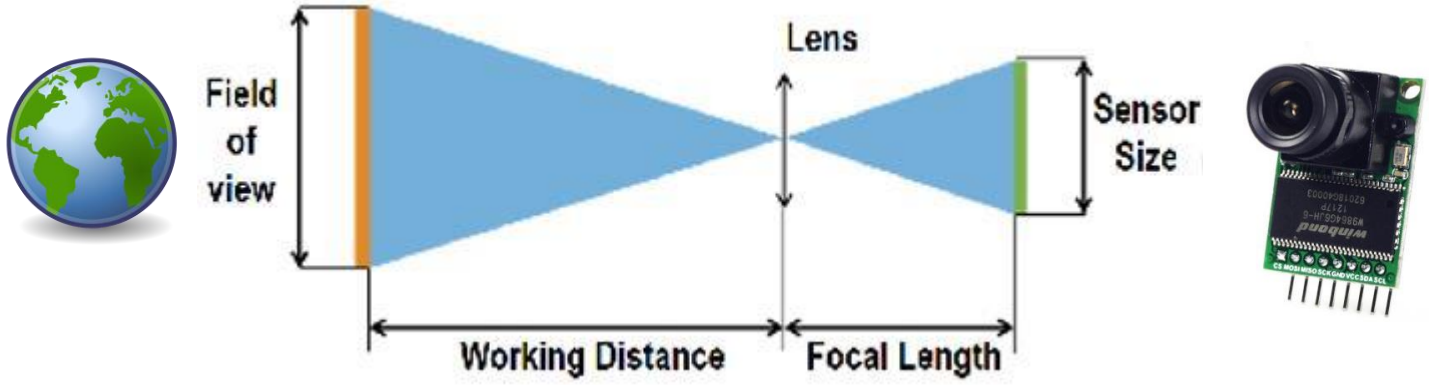
Quality image	320x240
Image data size	4.80kB

With this verification test (this page and the one before), we wanted to verify the adequacy of the resolution, and to see how long it takes to get image data from the camera module to the micro-controller unit of the OVCAM.

Quality image	2592 x 1944
Image data size	250.28kB

Resolution Verification Test

❑Measure OVCAM system's HFOV, VFOV, and focus length.
(HFOV=Horizontal Field of View, VFOV=Vertical Field of View)



	Wide Angle Lens	Narrow Angle Lens
Pixel size	1.4um	1.4um
H_pixel x V_pixel	2592x1944 (5MP)	2592x1944 (5MP)
Focal length (f)	8mm	25mm
Altitude of satellite	450km	450km
Resolution	81.58m	25.29m
H_coverage x V_coverage	211.46 x 156.12km	65.55 x 49.09km

The last row is about the terrestrial foot print – the region snapped as a photo of the Earth.

Communication Subsystem and Ground Station Network

by: Adrian C. Salces (Philippines)

Functions of Communication Subsystem

■ Receive uplink command from the ground station.
■ Send telemetry, image and other mission data to the ground station.
■ Transmit Morse coded CW beacon generated by the OBC.

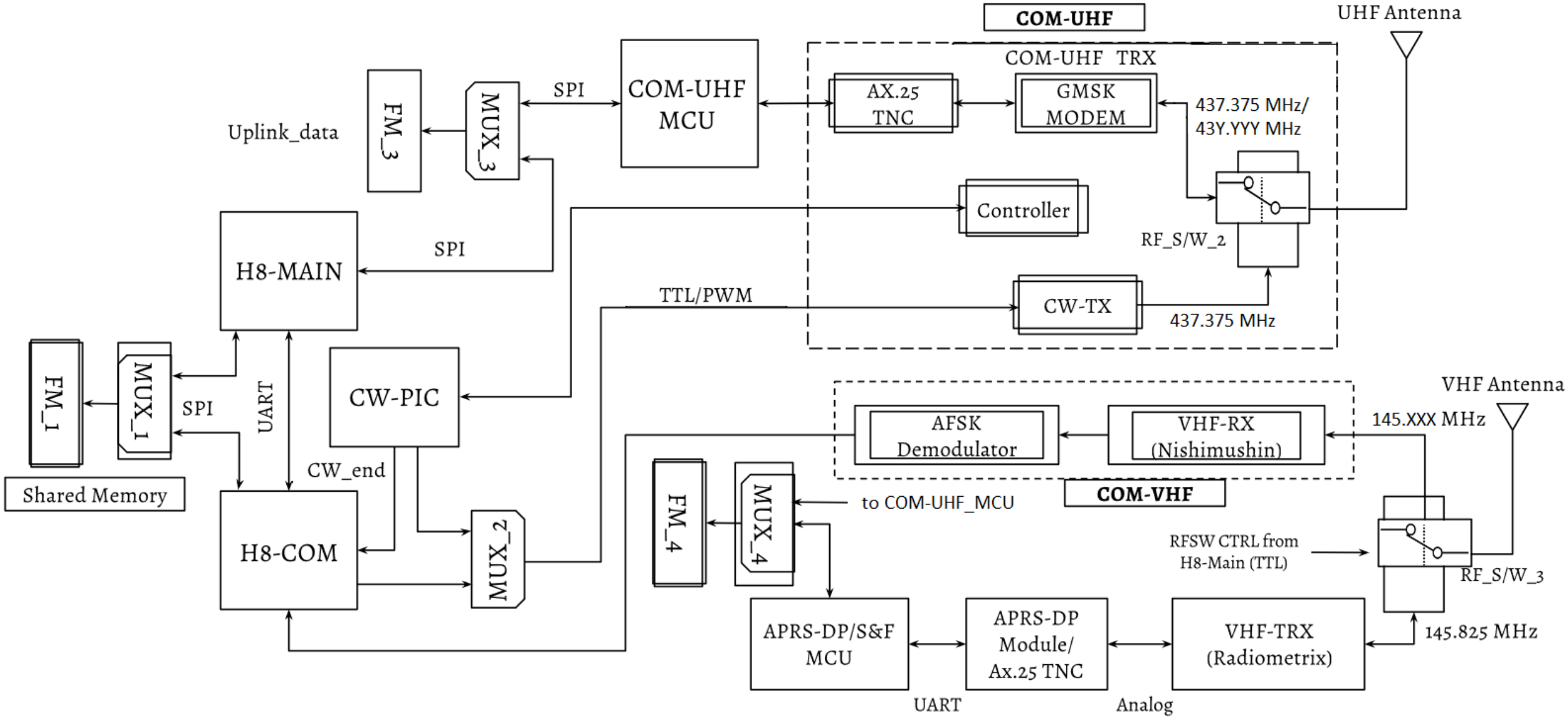
Functions of Ground Station Network

■ Send uplink command to the satellite.
■ Receive telemetry, image and other mission data from the satellite.
■ Receive Morse coded CW beacon from the satellite.

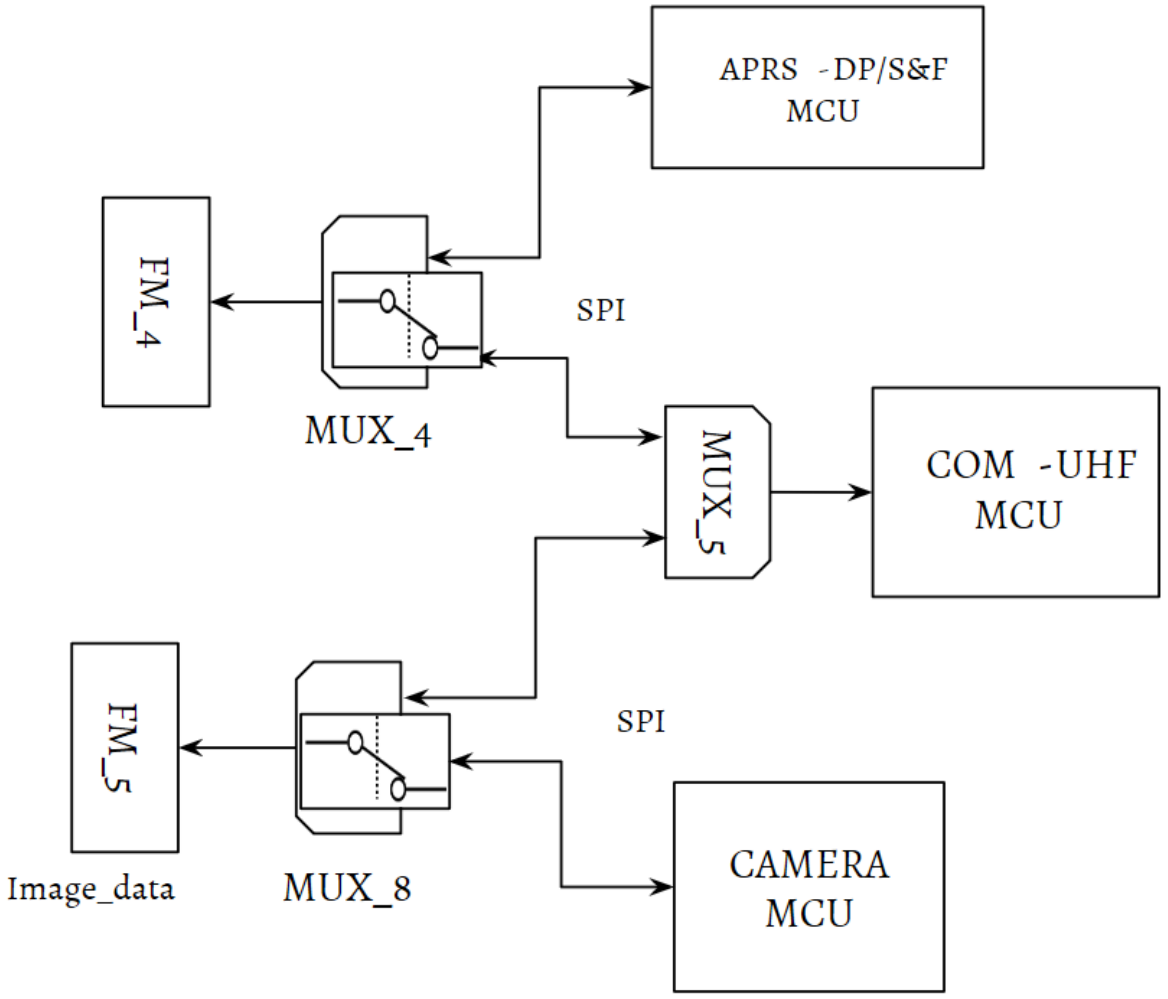
Communication Protocols and Modulation

- Command uplink
  - VHF band, 1200 bps AFSK, AX.25 protocol
  - UHF band, 9600 bps GMSK, AX.25 protocol
- Telemetry, image and other mission data downlink
  - 435.375 MHz, 9600 bps GMSK, AX.25 protocol
- Morse coded CW beacon
  - 435.375 MHz, ON/OFF keying, 20 words/min Morse Code

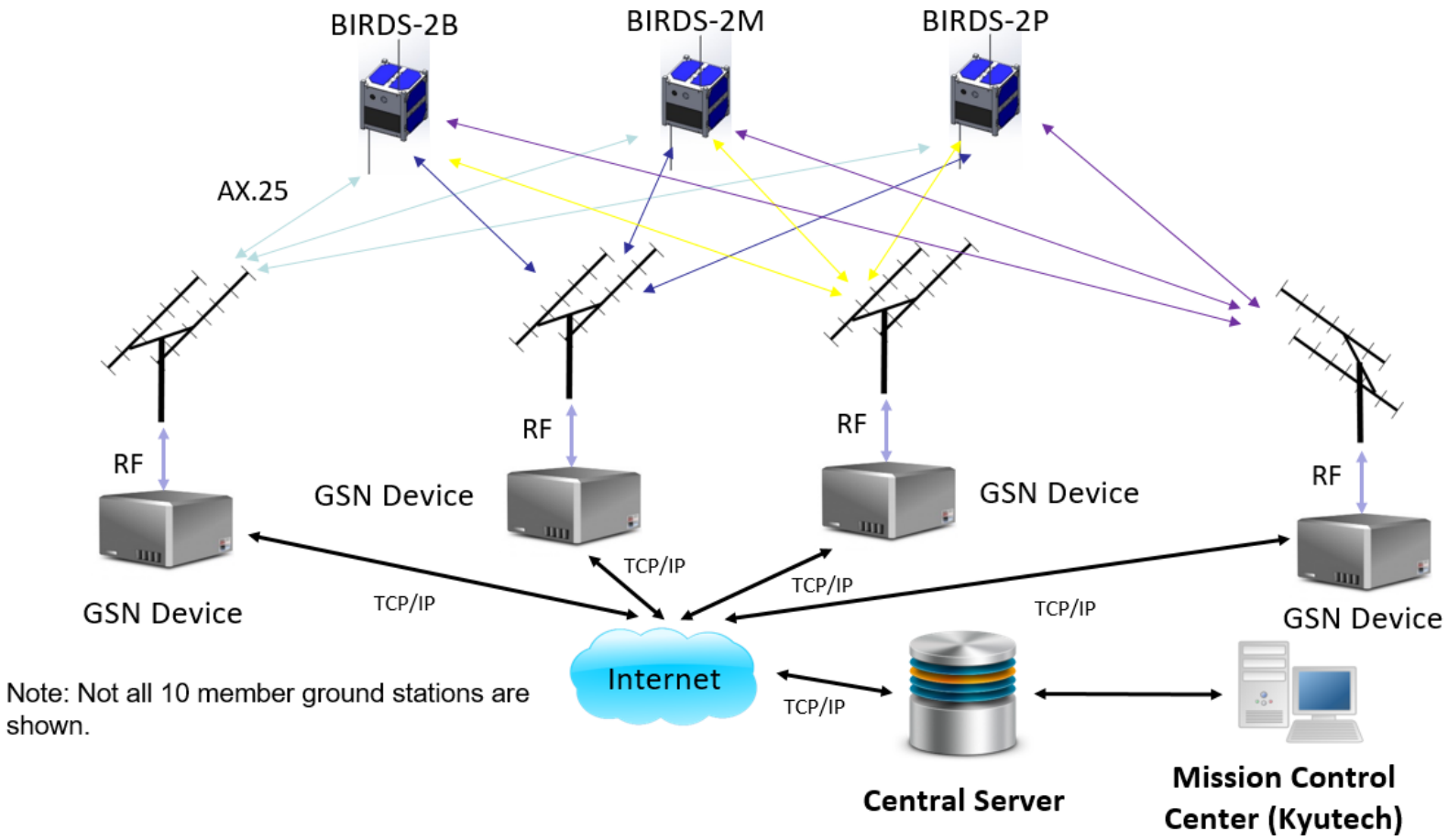
Block Diagram of Communication Subsystem



Block Diagram of Communication Subsystem (cont.)



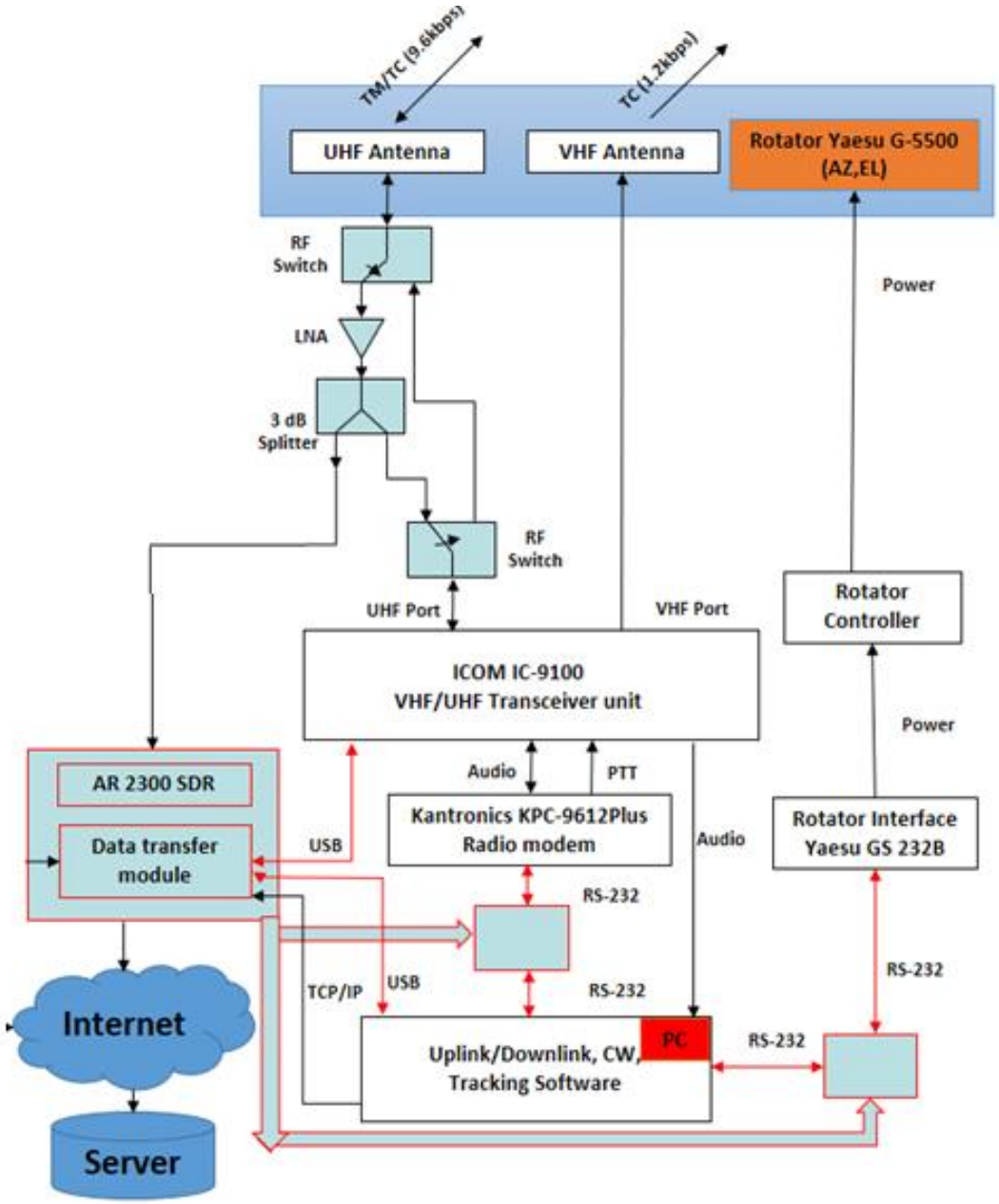
Overview of BIRDS Ground Station Network



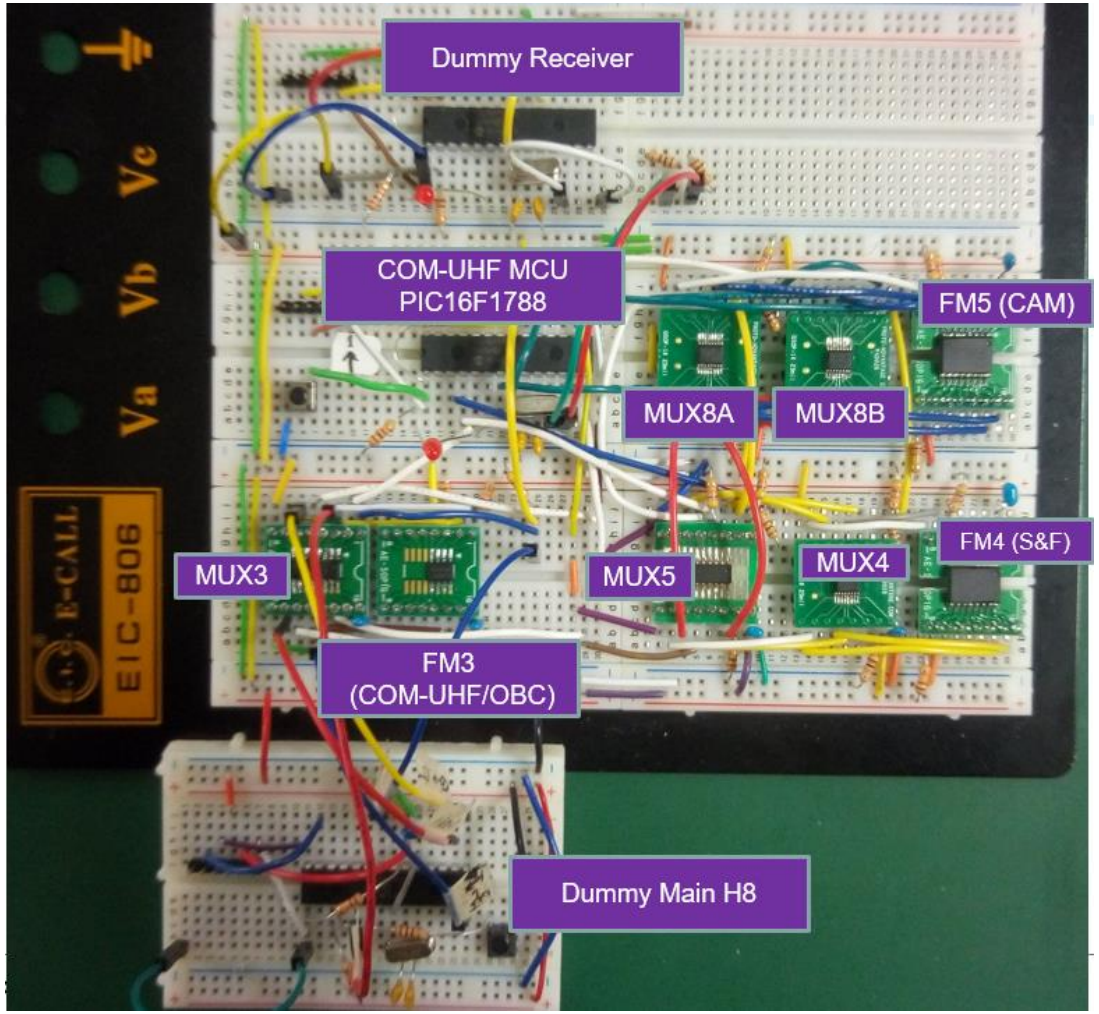
Ground Stations of BIRDS Project

- Kyutech (Japan)
- BRAC University (Bangladesh)
- All Nations University College (Ghana)
- Federal University of Technology (Nigeria)
- National University of Mongolia (Mongolia)
- King Mongkut's University of Technology - North Bangkok (Thailand)
- NCKU (Taiwan)
- Dept. of IT & Telecom (Bhutan)
- University Technology MARA (Malaysia)
- University of the Philippines – Diliman (Philippines)

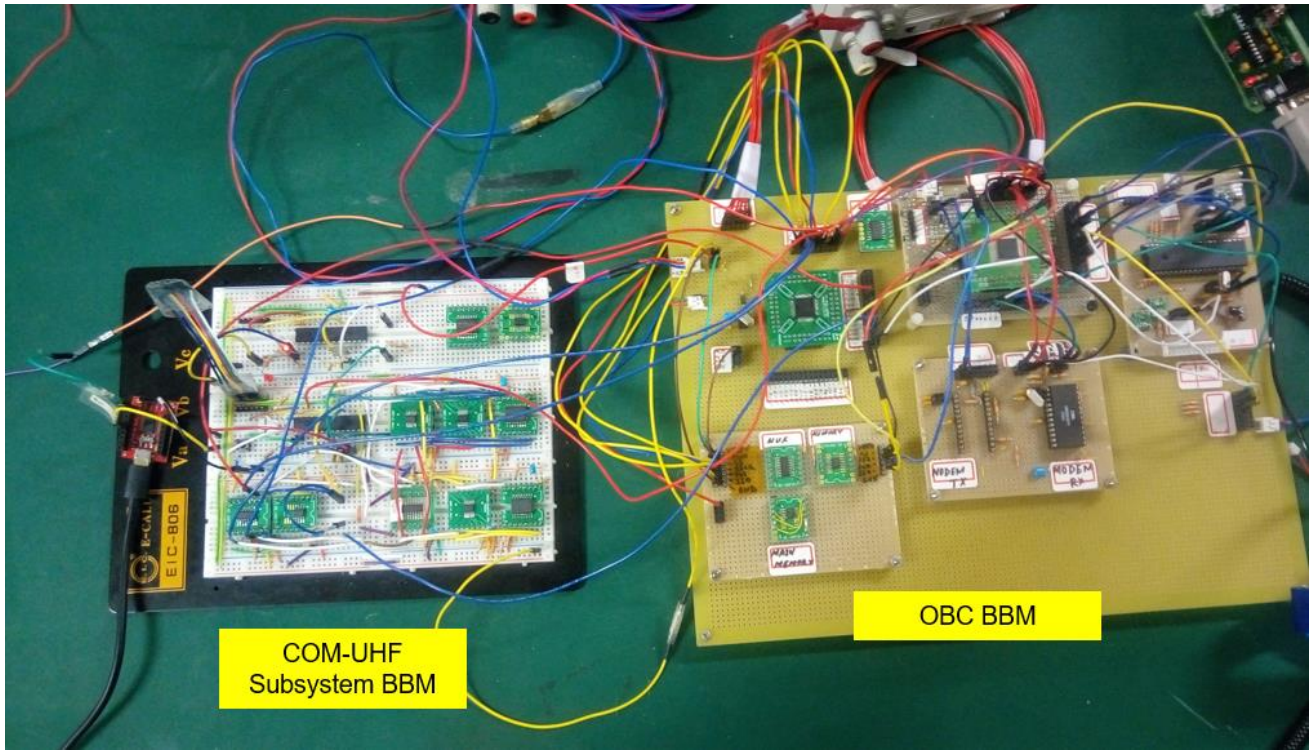
Block Diagram of Ground Station



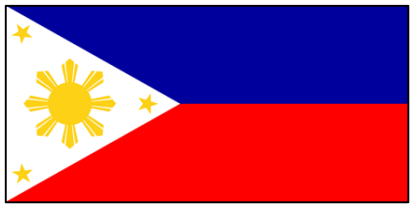
Communication Subsytem Breadboard Model



Communication subsystem breadboard model. COM-UHF_MCU has been loaded with partial C program, which is currently being developed.



Integration with OBC and checking functionality. For downlink, COM-UHF_MCU reads instructions stored by MainH8 into flash memory upon interrupt. For uplink, COM-UHF_MCU saves uplink data received from ground station into flash memory and prompts MainH8.



COTS GPS Mission

Commercial Off The Shelf

by: Joven Javier (Philippines)

Introduction

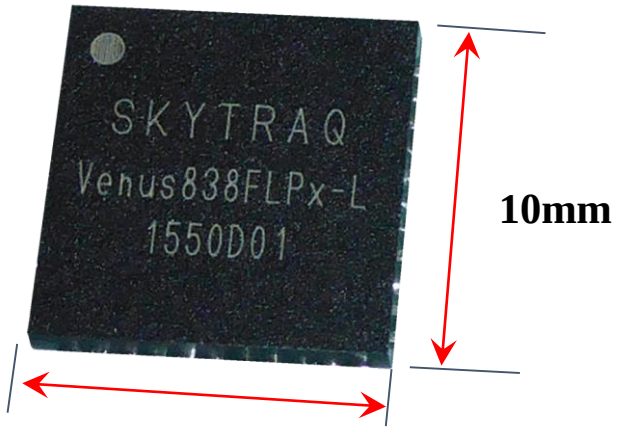
- Mission Objective is to use the GPS COTS for technology demonstration for BIRDS-2 cubesat.

- The Success of proven GPS chip for space application which is low power, cheap, small, COTS and reliable will benefit by future cube satellite development.

- It will set up in such a way the GPS satellite and BIRDS-2 cubesat should lock of at least 4 satellites to calculate position & clock deviation.

GPS Chip

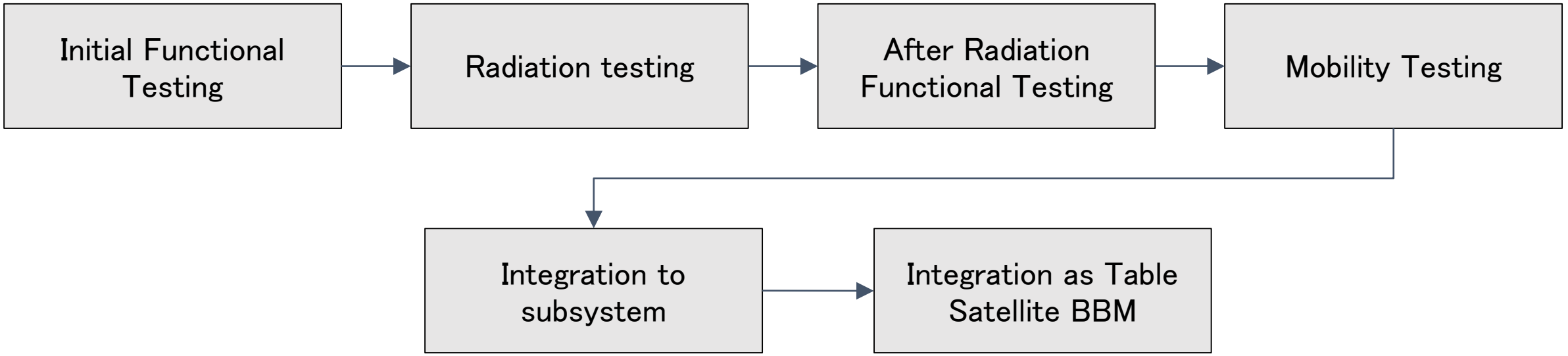
Venus838FLPx-L



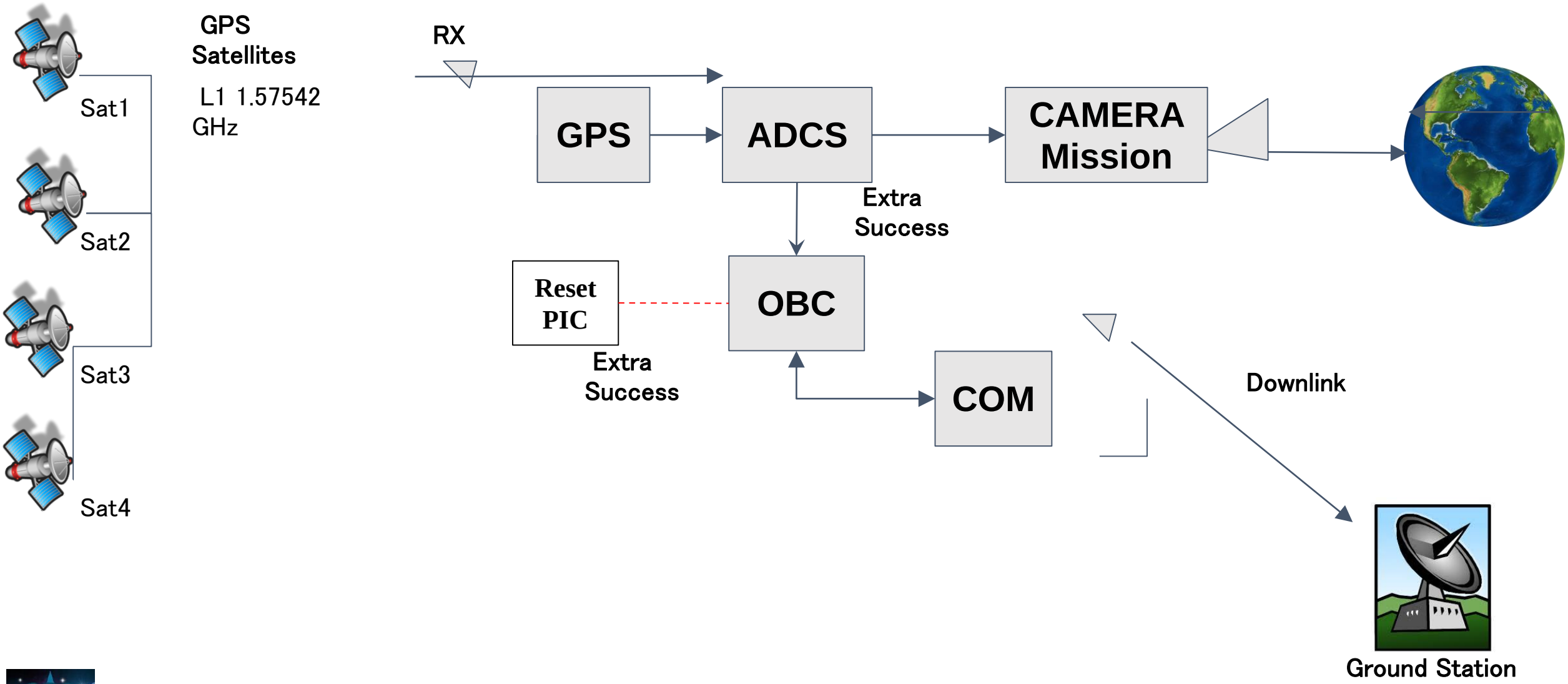
Technical Specifications

- Cost = $99.00
- Size = 10mm x 10mm x 1.3mm
- Weight = 0.3 g
- Tracking = 16mA (52.8mW)
- Acquisition (4 satellites) = 23mA (75.9mW)
- Main Supply voltage = 3.3 V
- Interface: UART TTL
- Data message format NMEA
- Baud rate = 9600 (default)
- Operating Temperature -40 C to 80 C
- **Can withstand radiation level within?**
- **Doppler shift of satellite mobility?**

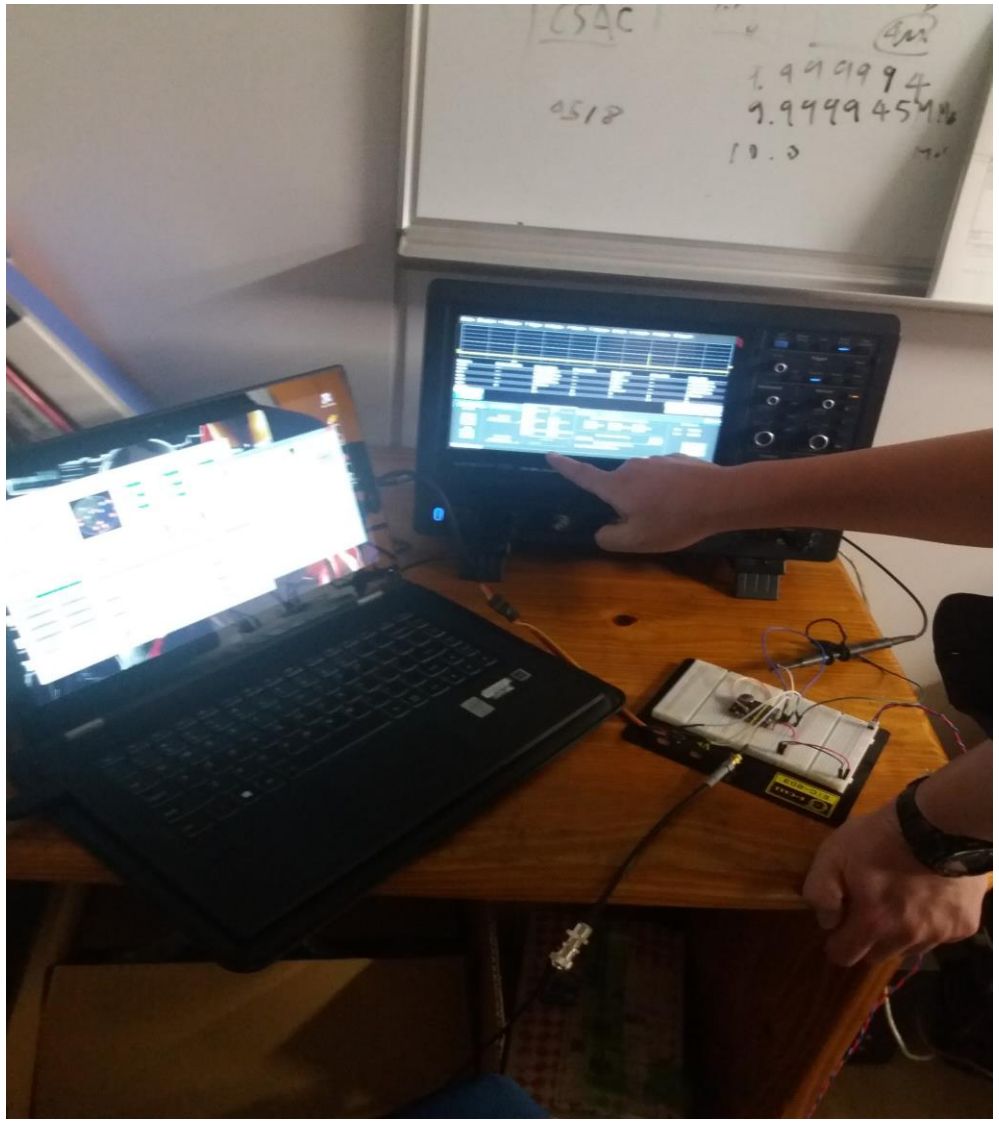
Work to during PDR Stage

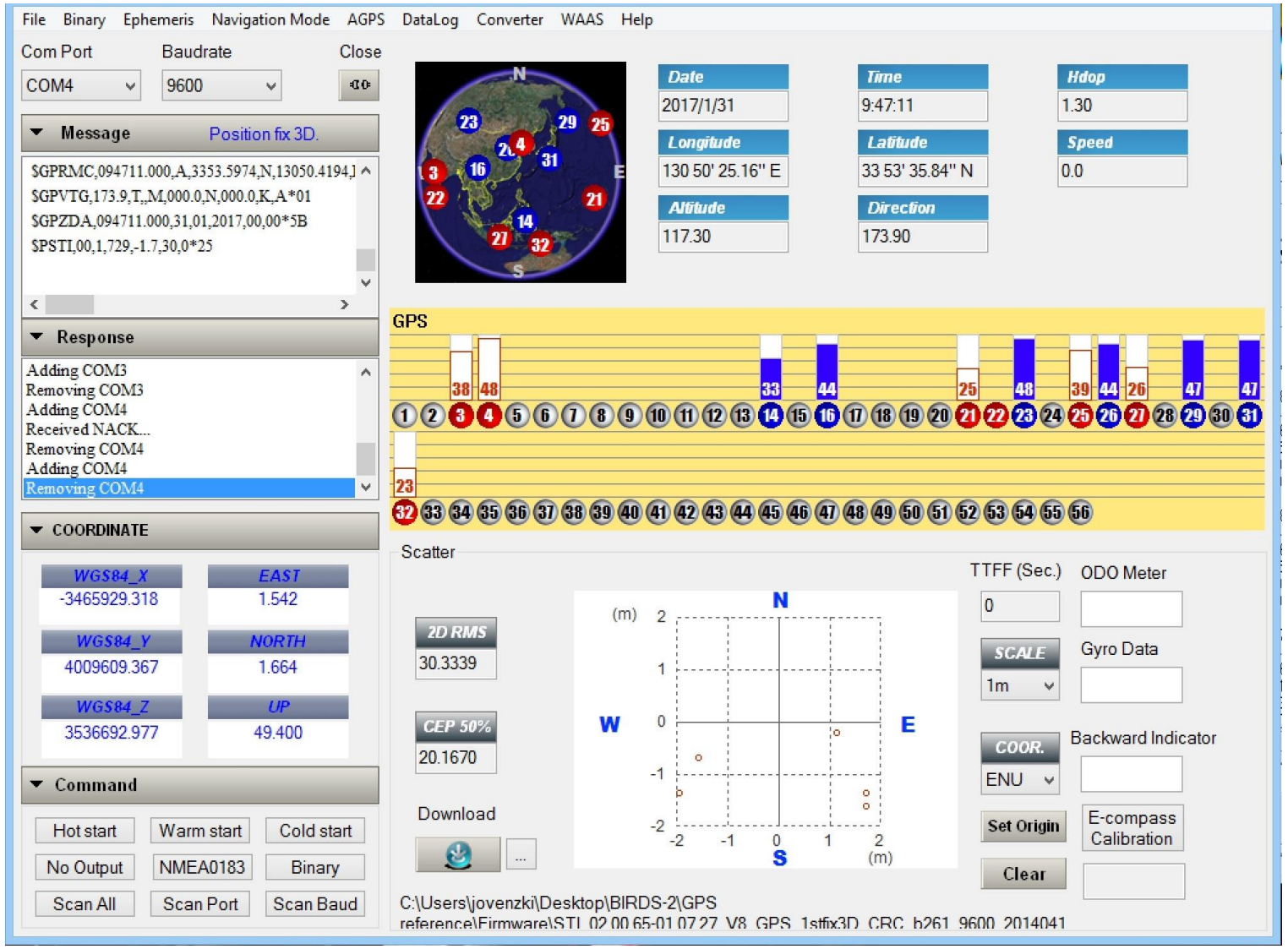


GPS Functional Overview

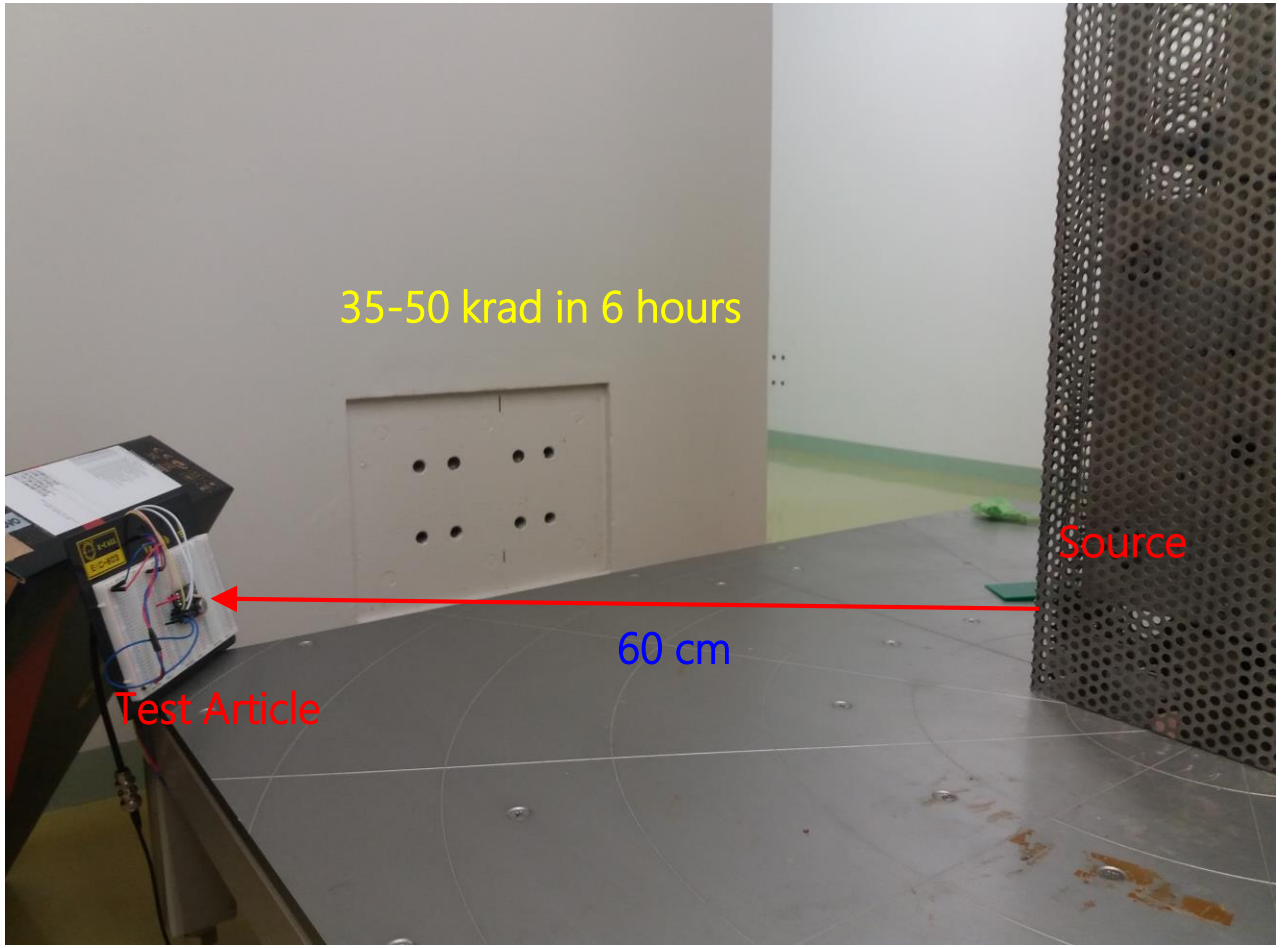


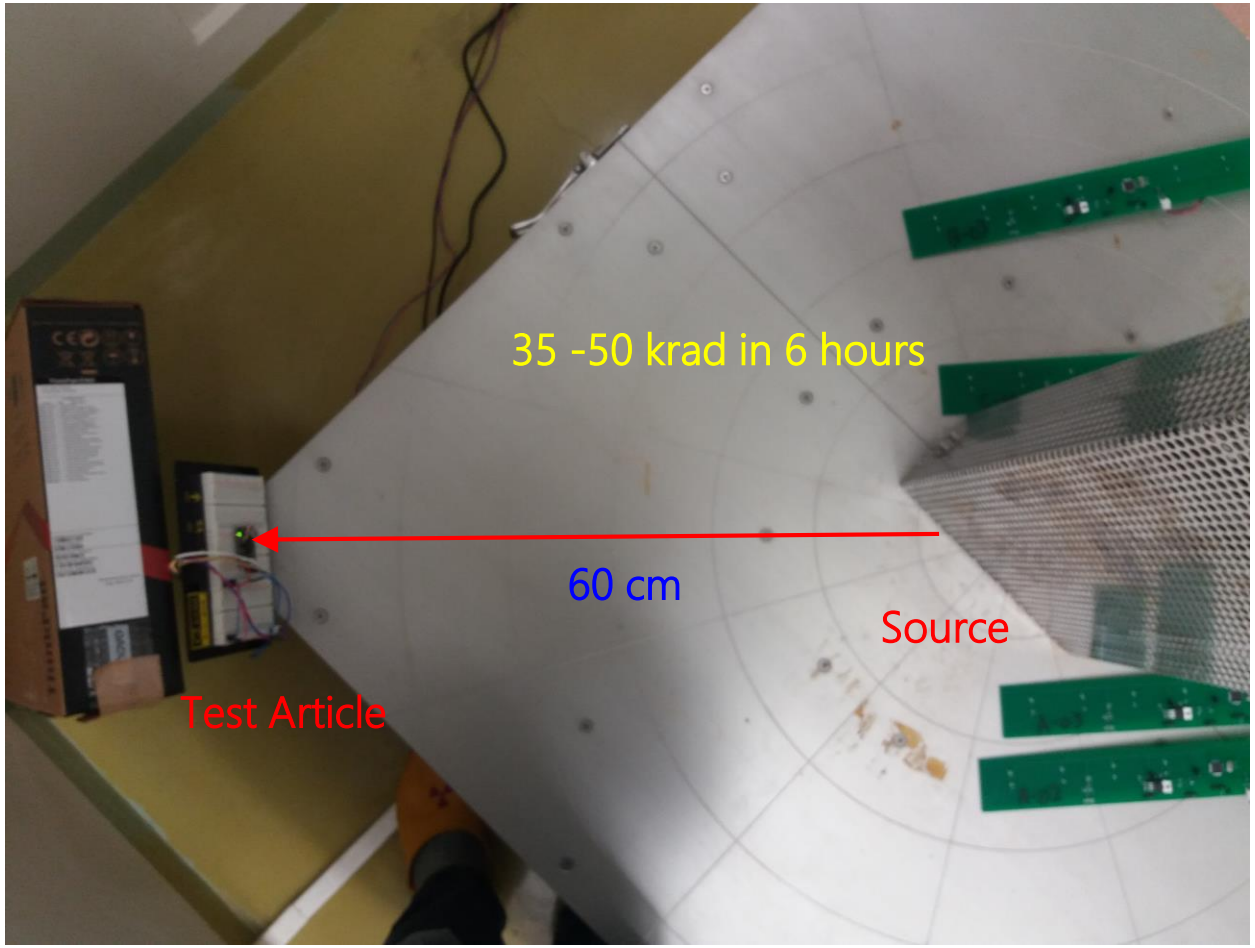
GPS Functional Testing



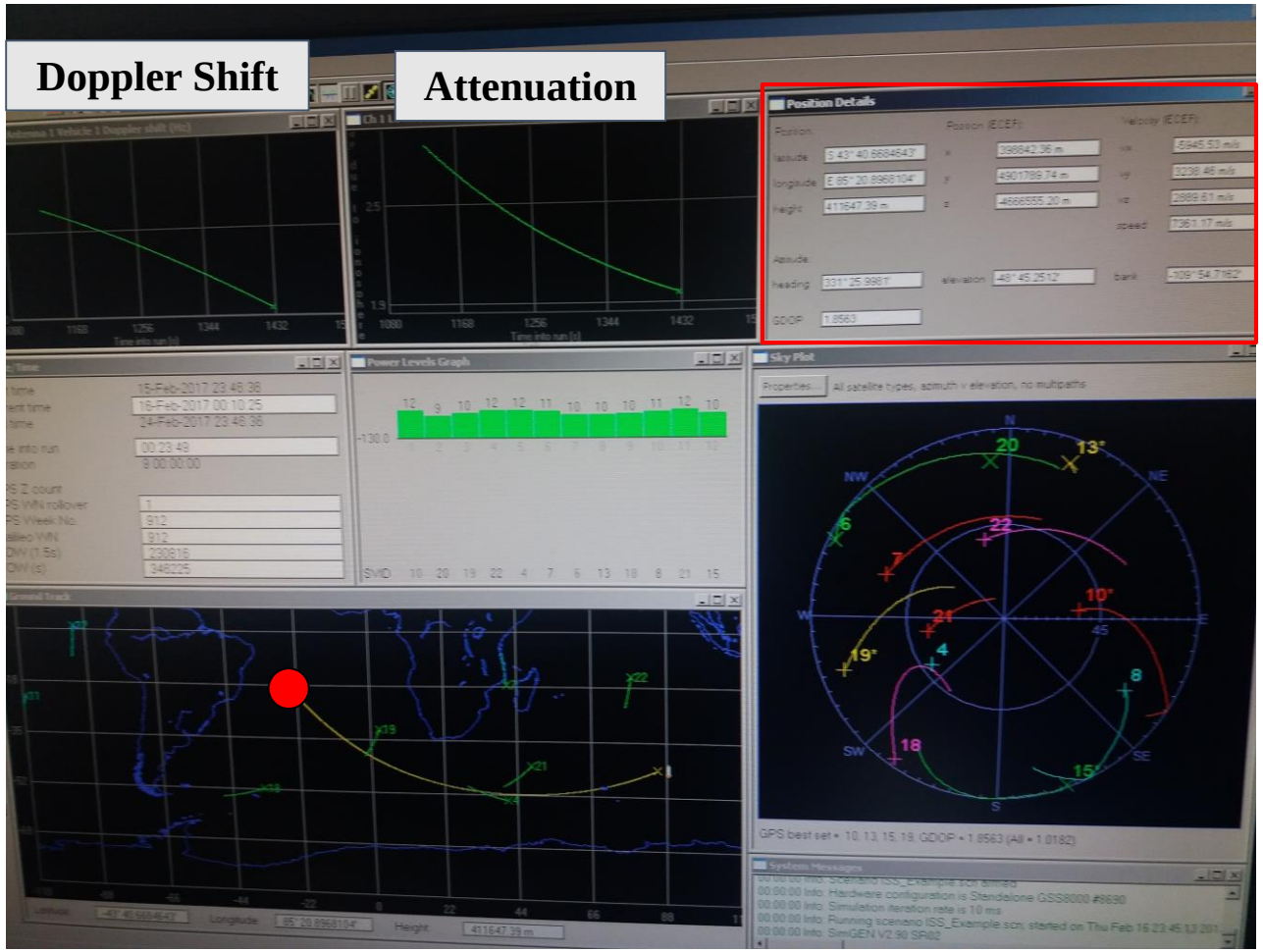


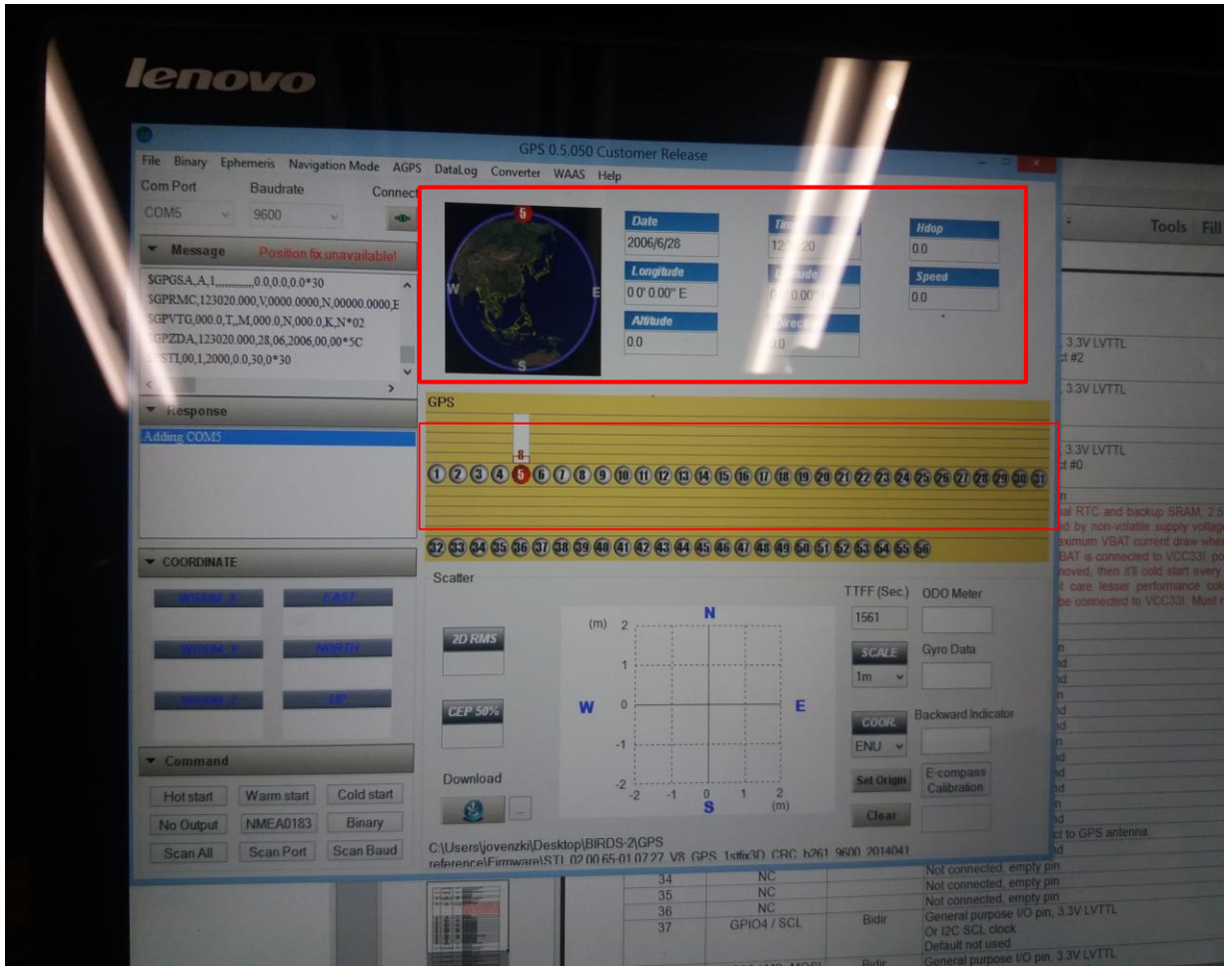
TID Radiation Testing





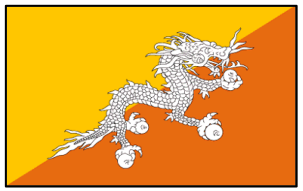
GPS Mobility Testing





Simulation Speed = 7361.17 m/s

Test Result = Failed



OBC Subsystem

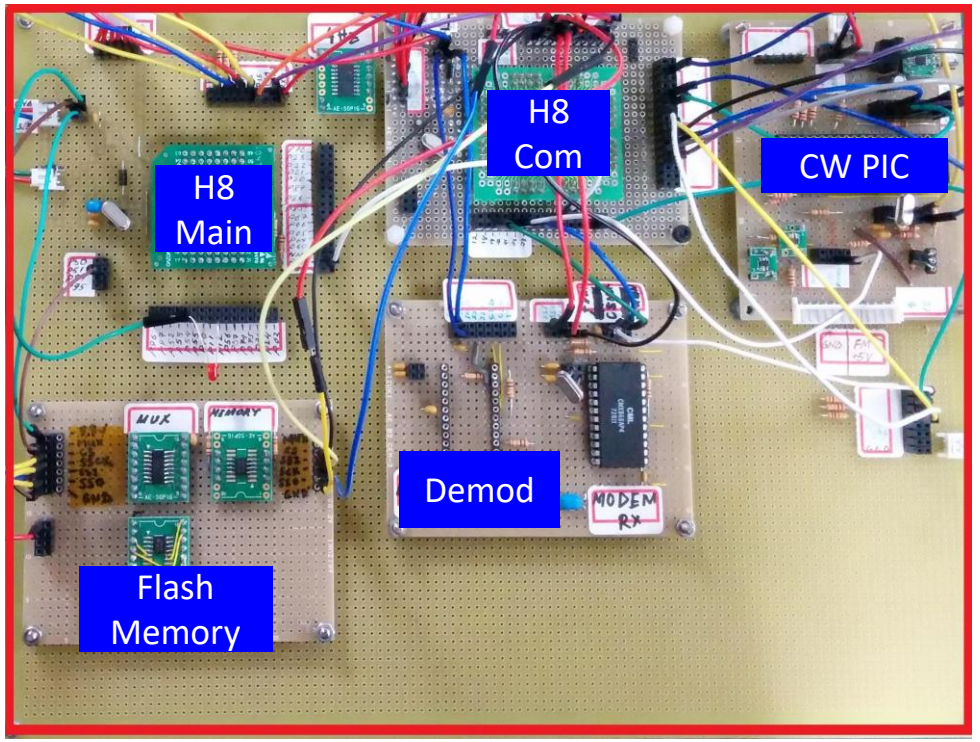
On Board Computer

by: Kiran Kumar Pradhan (Bhutan)

Overview

The main objective of the OBC is:

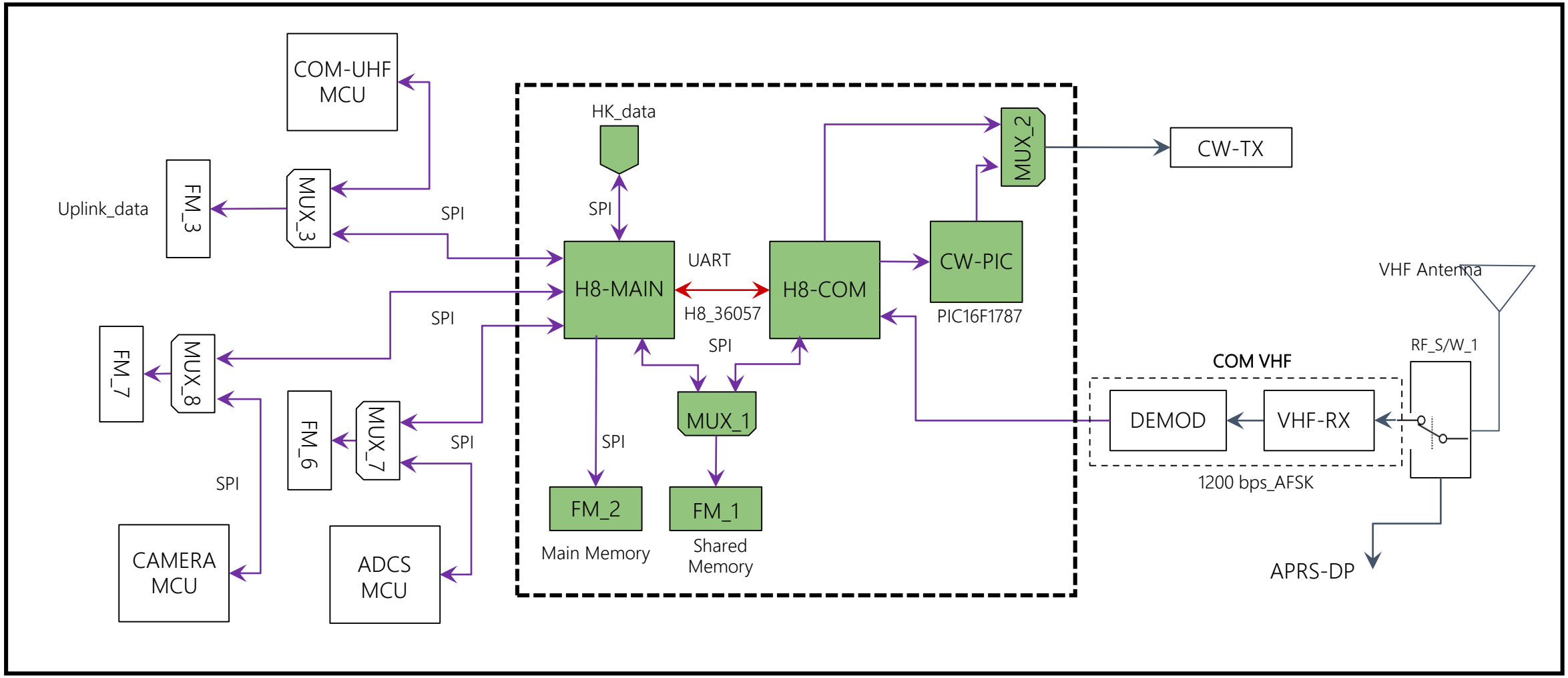
- ❑ Generate Beacon signal (callsign+HK data)
- ❑ Receive, Analyze and Execute Telecommands
- ❑ Handle Telemetry data
- ❑ Monitor satellite health parameters



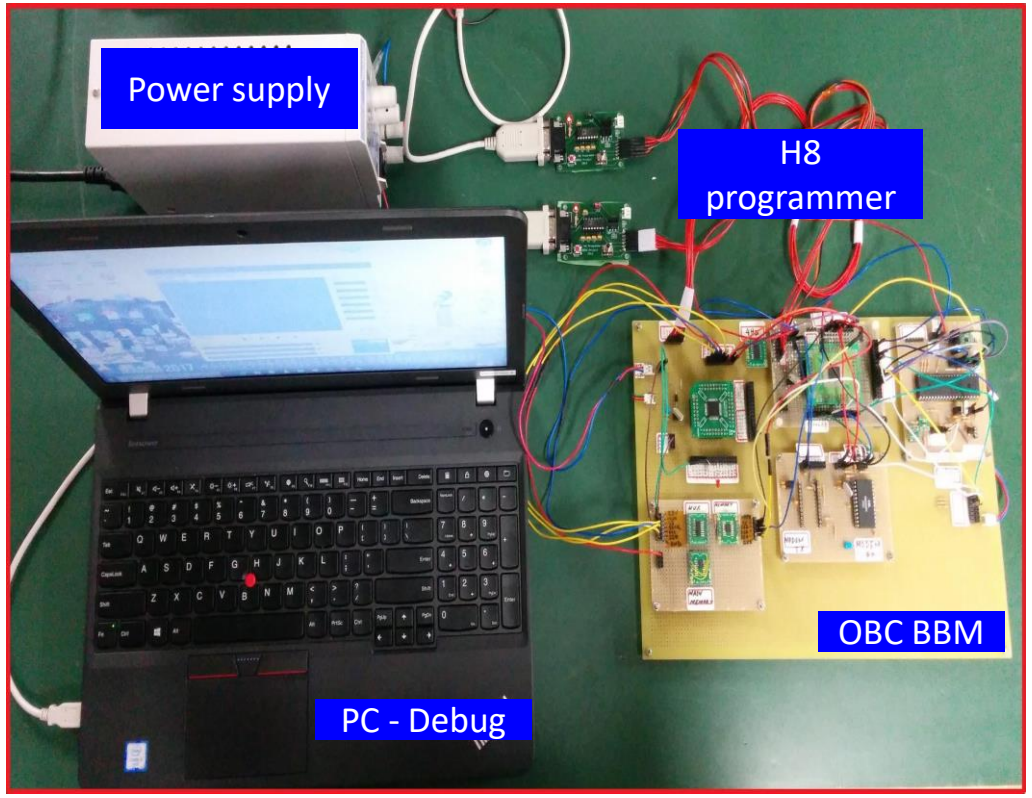
• Design Specification:

➢ The design for the BIRDS-2 OBC is inherited from the flight proven design of HORYU-II, HORYU-IV and BIRDS-1 satellites of Kyutech. The Renesas microcontroller (H8 Main) is the master controlling all other subsystems and the missions of the satellite.

Block Diagram

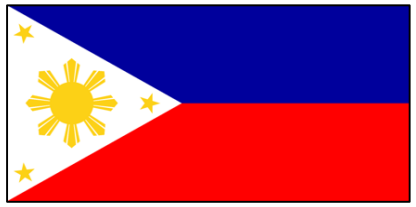


Function



Functional test set up

- The H8 Main communicates with other subsystems through Serial Peripheral Interface (SPI) bus via dedicated flash memories.
- Flash memories for each subsystem is used for exchange of command and data.
- H8 Com is responsible for transmission of House Keeping (HK) data for the beacon signal and receive the Uplink Command through VHF receiver.
- CW PIC is responsible for transmission of call sign for the beacon signal and control the transmitter radio of the satellite.
- H8 main keeps the time information for the satellite.



SEL Mission

Single Event Latch up

by: Joven Javier (Philippines)

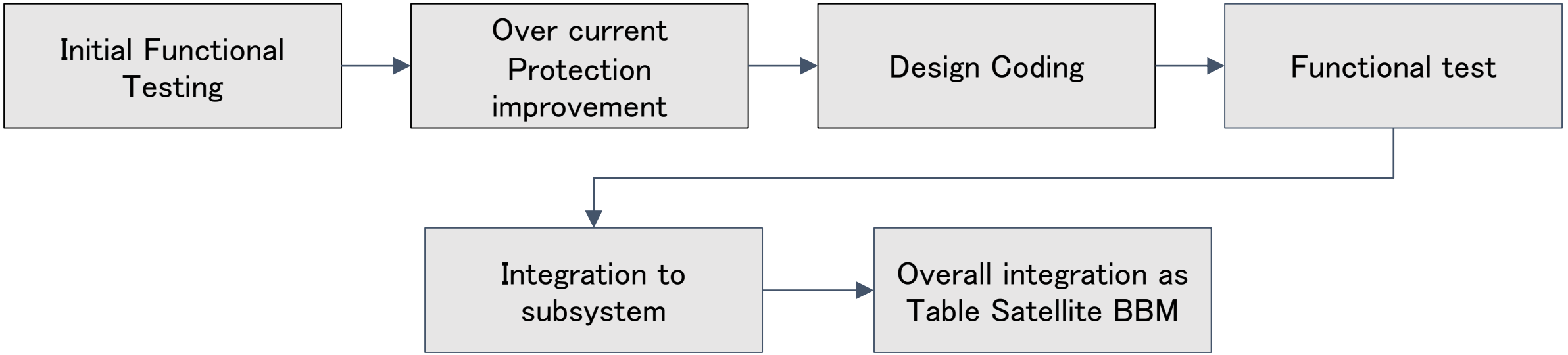
Introduction

- Identify any correlation of SEL occurrence with satellite locations, time and space weather etc. by using GPS chip on board

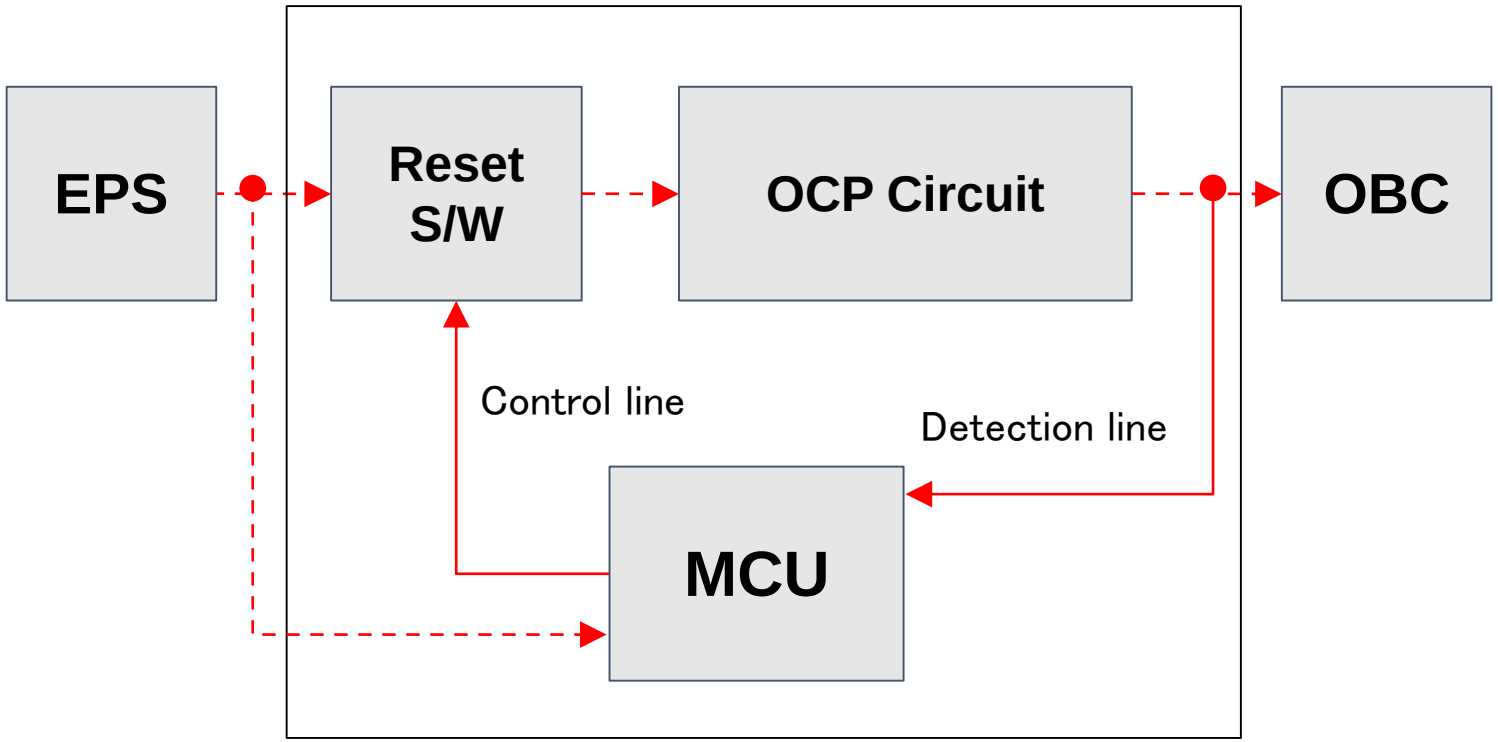
- Continue the database that will Horyu IV and BIRDS-1 on SEL occurrence rate of microprocessor that can be compared with laboratory data.

- In future, we can predict SEL rate in orbit using the database as scientific merit of developing better or less radiation risk cubesat.

SEL Development and Functional Test



SEL Functional Diagram



S&F Mission

Demonstration and Investigation of a Cubesat Constellation

Store-and-Forward (S&F) System

by: Adrian C. Salces (Philippines)

S&F Mission Objectives

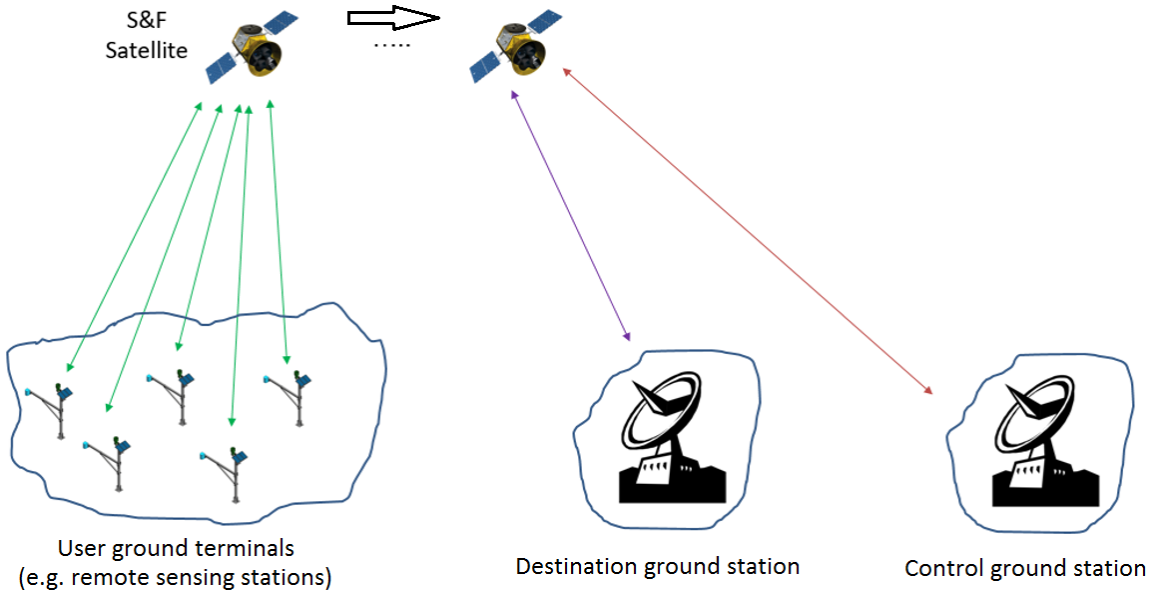
- To demonstrate a store-and-forward system involving cubesat constellation.
  - An application of the mission is to collect sensor data from ground terminals through the cubesats, store onboard and download them to any BIRDS ground station.
- To investigate communication and other technical challenges of such a system.
  - Data format, multiple access scheme, file handling
  - Limited visibility time, size and power constraints of the system

Background on the S&F Mission

The process of planning and defining the missions for BIRDS-2 cubesats was a very challenging task. In spite of spatial, electrical power, and safety compliance issues inherent in a 1U cubesat (10cm x 10cm x 10cm satellite), as well as other technical, schedule and cost constraints, we aimed for missions which have potential scientific/technological merits and can serve the needs and demands of our stakeholders. Personally, I preferred one that is unique, challenging, with practical applications and can contribute to the state-of-the-art in cubesat technology. Demonstration and investigation of a store-and-forward (S&F) system involving a cubesat constellation fits well into these criteria and the capacity-building aspect of the project. In this article, I will discuss about BIRDS-2's S&F mission.

Store-and-forward (S&F) satellite can be described as a spacecraft that "receives and stores messages while over one part of the earth and downloads them later over another part of the globe." [1]. In a basic S&F system, each user ground terminal uploads data to the satellite; the data is stored in an onboard memory and downloaded later to a destination ground station,

Continued next page



Basic components of a satellite store-and-forward system

[1] K. Martin, V. Venkatesan and U.N. Das, "Data Link Control in the LEO Satellite Store and Forward Network", IEEE, 2003.

Background on the S&F Mission

which can be another user in a different part of the world. In the general case, in uploading or downloading data to/from the satellite, user terminals bid for access based on satellite moving coverage, visibility and an arbitration scheme (either purely random, priority-based, schedule- or sequence-based, etc.). As in other satellites, the control ground station monitors satellite status and manages its operation.

In the early 1980s, amateur radio researchers and experimenters pioneered the design and development of simple, small-size, efficient and low-cost digital S&F communication satellites, with UoSAT-2 launched on March 1984 being the first of its kind. It was then followed by amateur or experimental satellites with greater capabilities in the 1990s, including PACSAT-1, UoSAT-3, UoSAT-5, S-80/T, KITSAT-1 and PoSAT-1 among others [2][3]. These were characterized as 50 kg. microsatellites in low Earth orbits, enabling non-real-time communication (due to limited visibility), low to medium data transfer speeds (from few to tens of kbps, due to small allocated bandwidth) and small data volume (hundred kilobytes to a few megabytes per day). During that time when the Internet was not yet widely available as today, these systems provided personal communication services such as email and file forwarding especially to the radio amateurs [2]. Later on, they "form[ed] the basis of the communication links for both of experimental and operational microsatellite missions and perform a

Continued next page

[2] R. Diersing and G. Jones, "Low Earth-Orbit Store-And-Forward Satellites in the Amateur Radio Service", IEEE AES Systems Magazine, January 1993.
[3] M.N. Allery, H.E. Price, J.W. Ward, and R.A. Da Silva Curiel, "Low Earth orbit microsatellites for data communications using small terminals",

Background on the S&F Mission

range of missions from remote sensing data transfer and experimental data downlinks to *remote site data collection* and messaging [3].” Innovative work that dealt with unique communication characteristics of LEO S&F systems tackled data and file handling protocols [4-6], data link layer and multiple access schemes [1][7-9] among others.

Commercial communication satellites that offer similar services have since been developed, providing significantly higher data capacity to support niche markets such as tele-learning, data transfer to/from remote sites (e.g., for remote environment monitoring purposes, automatic meter reading and transmission of documentary films from remote zones), tele-control of remote instrumentation, etc.[10].

Since the past decade, we have seen a significant shift toward increasing activity among research and educational institutions in the development of even smaller classes of satellites, nanosatellites (1 to <10 kg) and picosatellites (0.1 to <1 kg), particularly cubesats, due to their substantially cheaper cost, shorter development cycle and little barrier to entry. In spite of their inherent very tight constraints in physical size, power and communications, cubesats have been proven as effective platform not only for student training but also for various technology demonstrations and scientific experiments. Recently people have begun to also explore

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[4] J.W. Ward and H.E. Price, “Protocols for Store-and-Forward Message Switching via Microsatellites”, ___
[5] R.J. Diersing, “Characterization of the PACSAT File Broadcast System”, IEEE, 1993.
[6] H.E. Price and J. Ward, “PACSAT Protocol Suite – An Overview”, _____
[7] C. Ward, C. Choi and T. Hain, “A Data Link Control Protocol for LEO Satellite Networks Providing a Reliable Datagram Service”, IEEE/ACM Transactions on Networking, Vol. 3, No. 1, Feb. 1995.

Background on the S&F Mission

potential practical applications for cubesats, bringing its use outside the domain of research.

While it is true that cubesats are not expected to surpass their microsatellite counterparts in terms of optical imaging remote sensing purposes, a larger number of cubesats at the same or lower cost can be launched in LEO to serve as digital data relay; in other words, store-and-forward (S&F) cubesat constellation. Such will be instrumental for collecting data from ground sensor terminals deployed in remote sites – places with lack of communications infrastructure (e.g. Antarctica, desserts, jungles, etc.), or where terrestrial radio frequency networks are not optimal (e.g. seas) or wherein direct human operation would be dangerous. Ground sensor terminals are usually installed for environmental or weather monitoring where direct ground measurements are more suitable than satellite imagery data, or will be complementary to the latter. Many of these systems involve low data volume and real-time data delivery is not critical, thus nanosatellite constellation S&F system could be a viable cost-effective solution.

As of writing, although there have been a few work which tackled the utilization of nanosatellites for S&F systems [11-13], this idea has not been considerably explored and demonstrated in literature and actual missions. In particular, it is worthwhile to demonstrate this idea by deploying a cubesat constellation S&F system in LEO

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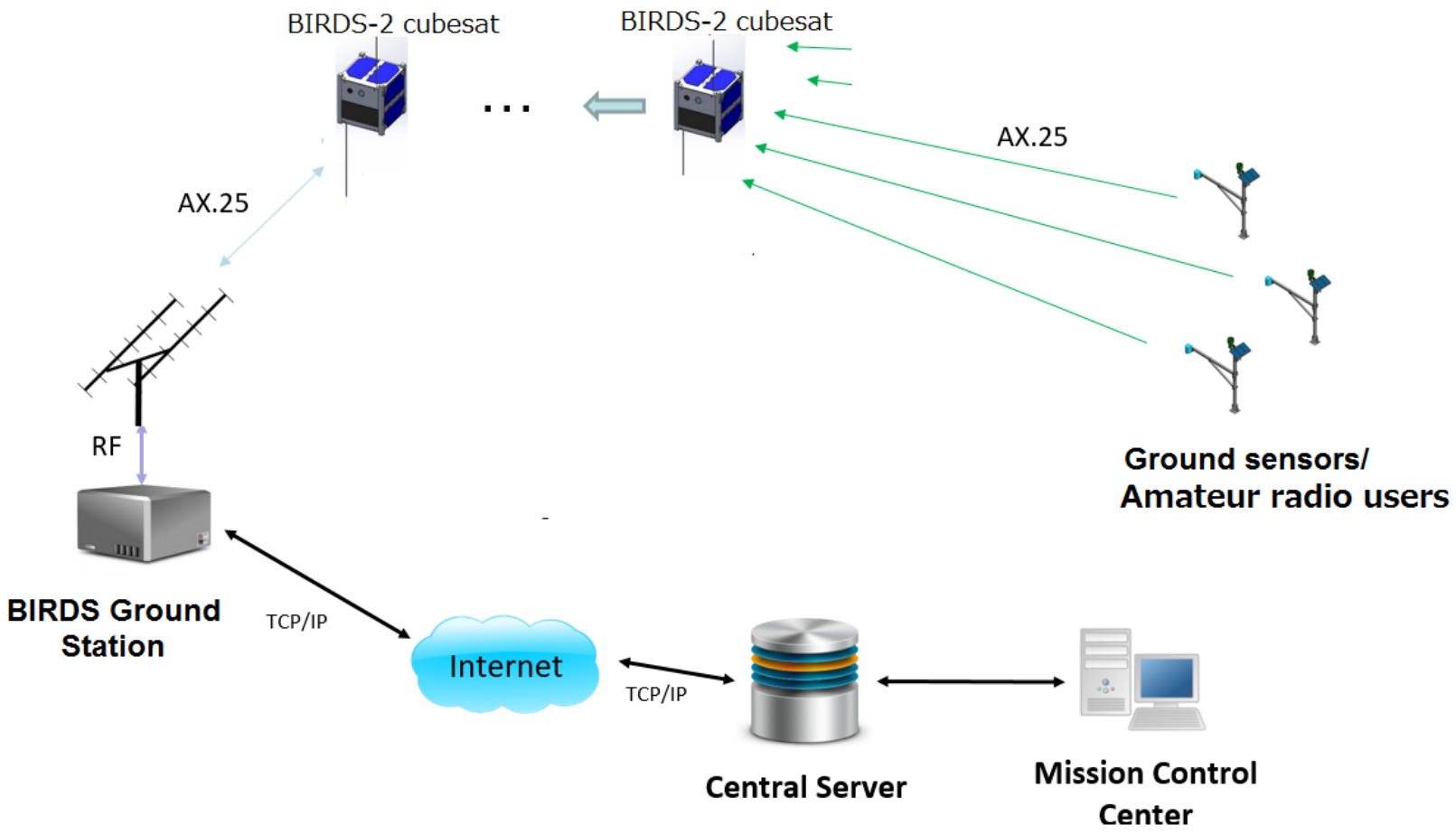
[8] T. Nakayama, “Link Control Method for Improving Packet Transmission Efficiency for Store and Forward Communications by LEO Satellites”, Electronics and Communication in Japan, Part 1, Vol. 79, No. 9, 1996.
[9] W. Ren, “A Control-Centralized Framed-ALOHA with Capture for LEO Satellite Communications”, IEEE, 2005.
[10] M. Antonini, et. al., “Satellite Data Collection & Forwarding Systems”, IEEE A&E Systems Magazine, September 2005.

Background on the S&F Mission

and investigate the actual system performance and technical challenges. The three-member BIRDS-2 cubesat constellation is a good opportunity to achieve this and this is the objective of the BIRDS-2 S&F mission. We hope that the results can provide practical experience and engineering insights that may guide similar experimental or operational nanosatellite missions in the future. In this mission, our aim is to investigate communication and other technical challenges of such a system (e.g. experiments on appropriate data format, multiple access scheme, file-handling protocol, as well as operational limited operational time and power constraints). BIRDS-2 S&F payload will be experimental only and will be used to collect data from remote ground sensor terminals, store them onboard and download them to any BIRDS ground stations. Some stakeholders have notified their intent to support the mission by building ground terminals and one is exploring to integrate them to existing weather stations. Amateur enthusiasts who want to build ground sensors to collect data of their choice (temperature, humidity, wind speed, etc.) are also welcome to join. The data format, sample ground sensor implementation and data collected by the satellites will be posted in BIRDS-2 Project website.

[11] A. Addaim, E.B. Zantou and A. Kherras, “DSP implementation of integrated store-and-forward APRS payload and OBDH subsystems for low-cost small satellite”, Aerospace Science and Technology, June 2008.
[12] A. Addaim, “Design of WSN with Relay Nodes Connected Directly with a LEO Nanosatellite”, International Journal of Computer and Communication Engineering, Vol. 3, No. 5, Sept. 2014.
[13] T. Koritza and J.M. Bellardo, “Increasing cubesat downlink capacity with store-and-forward routing and data mules”,

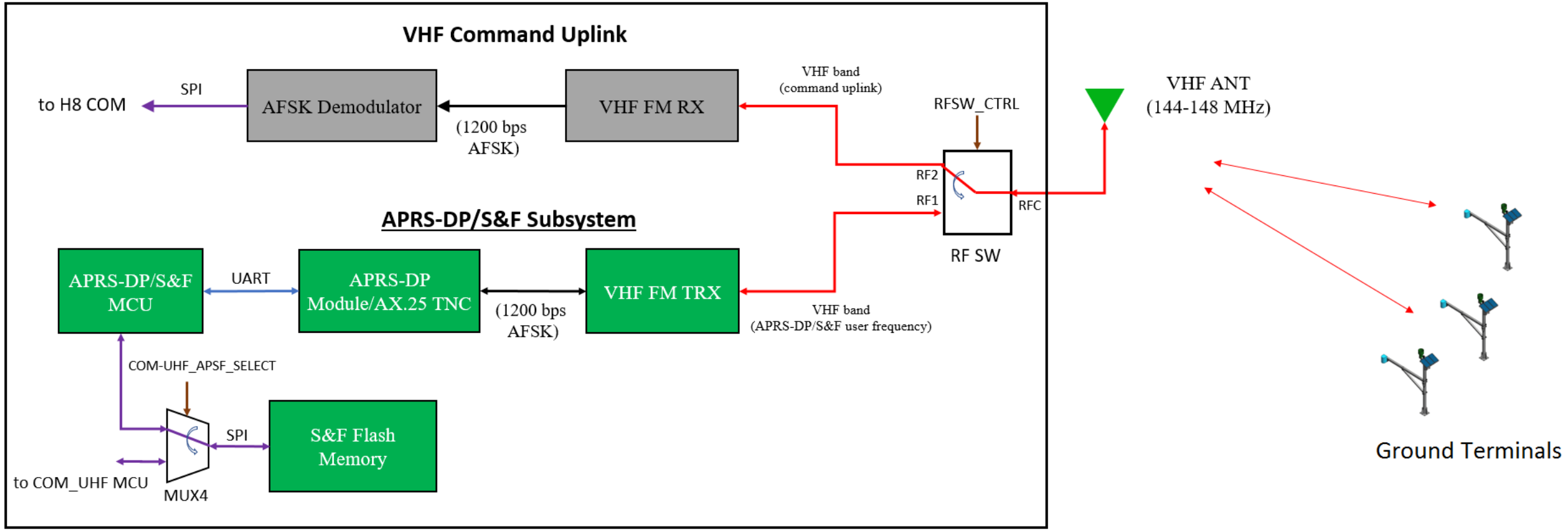
Overview of Proposed BIRDS-2 S&F System



Overview of proposed BIRDS-2 S&F system

- Any *licensed amateurs* with ground terminals operating in the VHF band may upload sensor data to the satellite.
- Sensor data are *user-defined*. Users can decide the kind of parameters they want to monitor (e.g., temperature, pressure, wind velocity, humidity, etc.)
- Ground terminals shall send their monitored data to the satellite *following the data format* that will be announced to the amateur community.
- Collected data will be downloaded to any BIRDS ground stations through the satellite's UHF downlink and will be posted in BIRDS-2 Project website.
- System operation is *unguaranteed best effort*. *Technical experimentation* rather than offering an operational system.

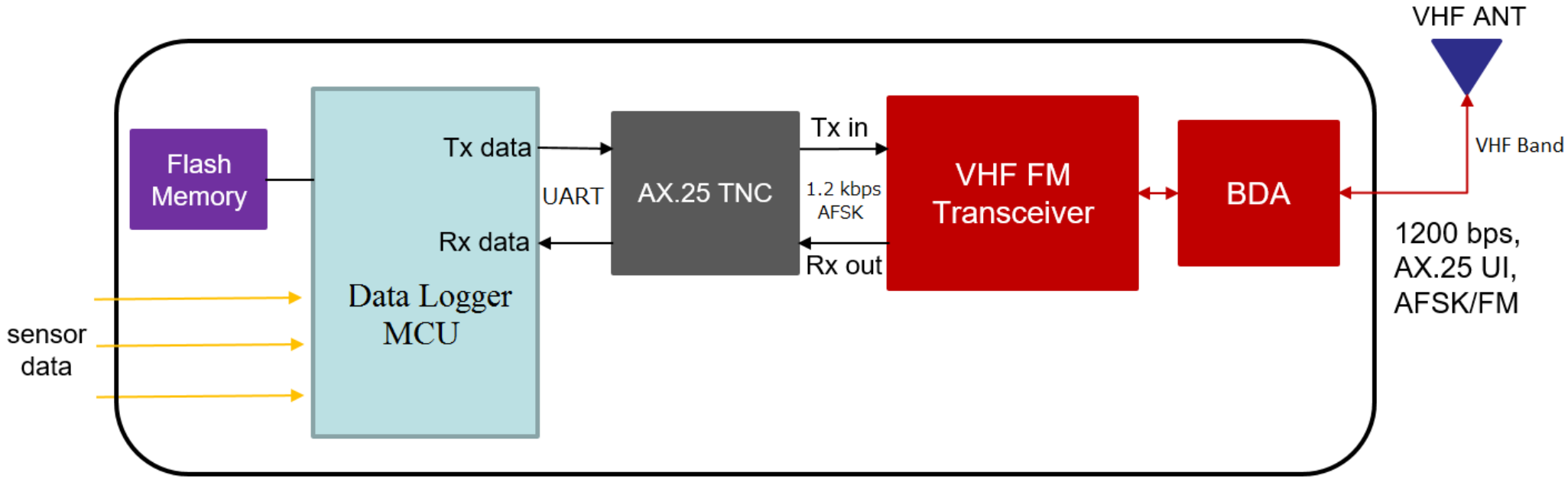
Block Diagram of S&F Subsystem Onboard BIRDS-2 Cubesat



Block diagram of S&F subsystem onboard BIRDS-2 cubesat

Note: VHF downlink path is only for triggering the ground terminals and is currently an option being considered. Collected data will be downloaded to a BIRDS ground station at UHF band (see Communication Subsystem).

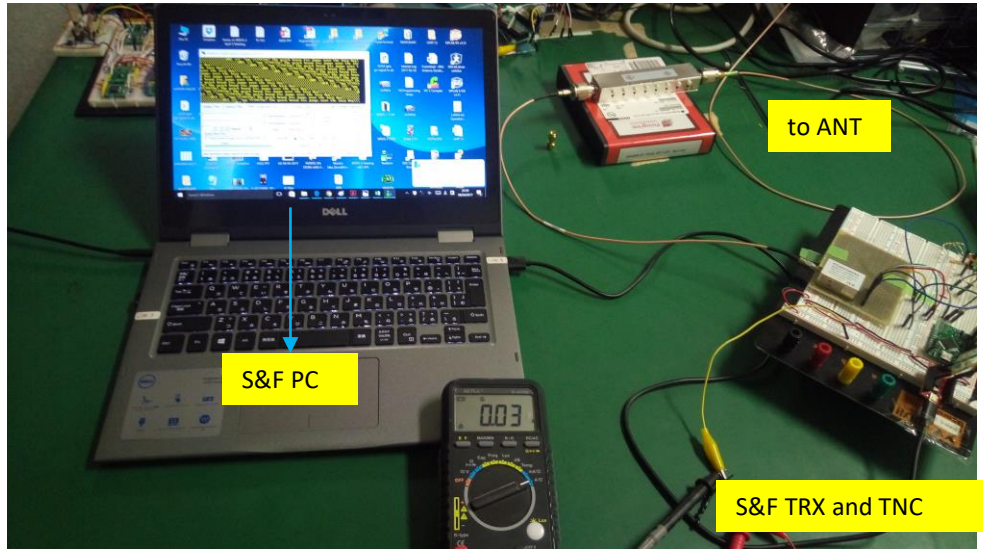
Sample Implementation of Ground Terminals



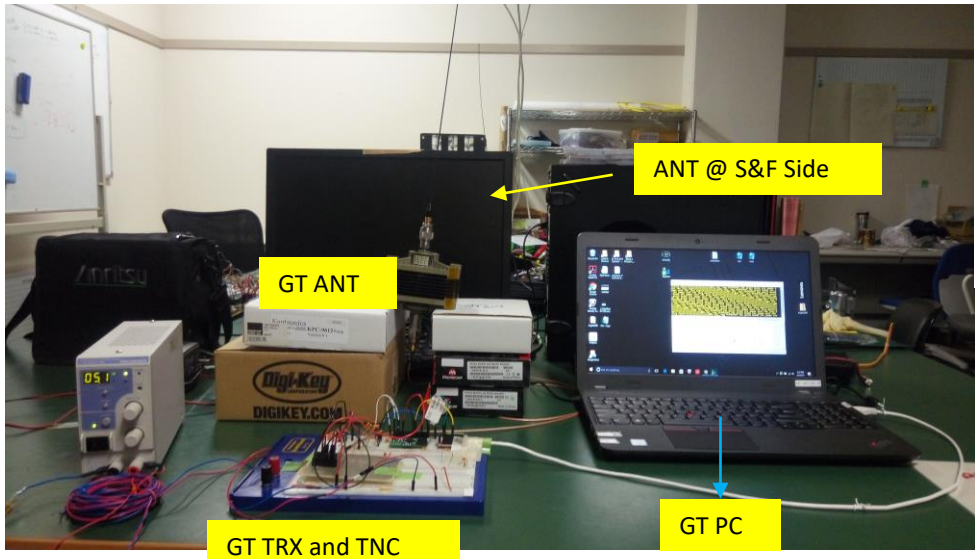
Block diagram of ground terminals

- For the ground terminals to properly communicate with the S&F subsystem onboard BIRDS-2 cubesat, it must support AX.25 protocol, AFSK/FM modulation, 1200 bps data rate, and follow a specific data format that can be implemented in software by the data logger MCU.
- Following this functional block diagram and same communication protocol, users may implement their ground terminals using the hardware components of their choice.

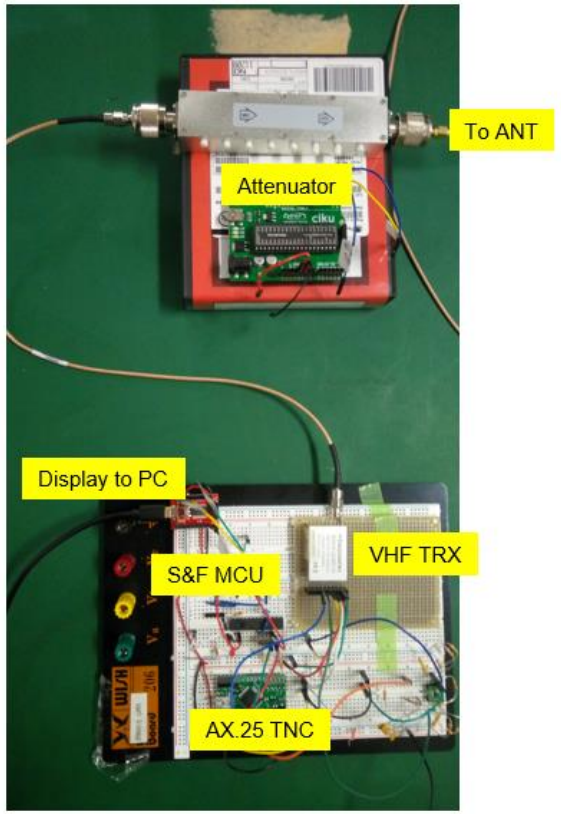
Functionality Tests on Breadboard Model (BBM)



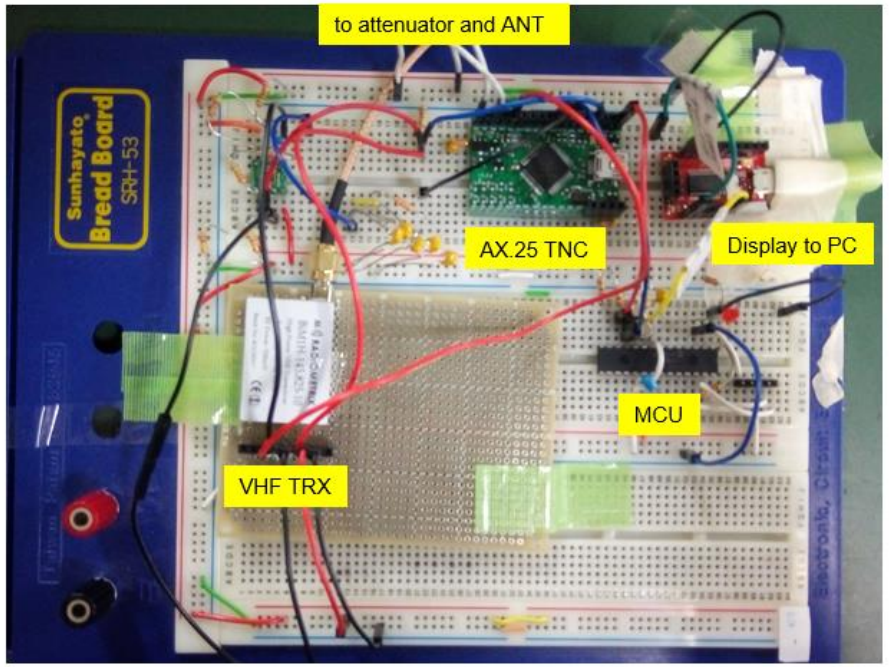
Satellite S&F Side



Dummy Ground Terminal Side



Satellite S&F Side



Dummy Ground Terminal Side

These pictures show the breadboard model of the BIRDS-2 cubesat S&F subsystem and a dummy ground terminal built at Kyutech. Functionality tests were done to verify that the subsystem configuration and selected components would work based on system and design requirements. It was also done to demonstrate communication between the S&F subsystem and a dummy ground terminal.

End of Newsletter Issue No. 15