CanSat & Rocket Experiment(‘99～)

Hodoyoshi-1 ‘14

Water Quality/level Management by Micro/nano/pico-satellites

Team

University of Tokyo

CubeSat 03,05

PRISM ‘09

Nano-JASMINE ‘15

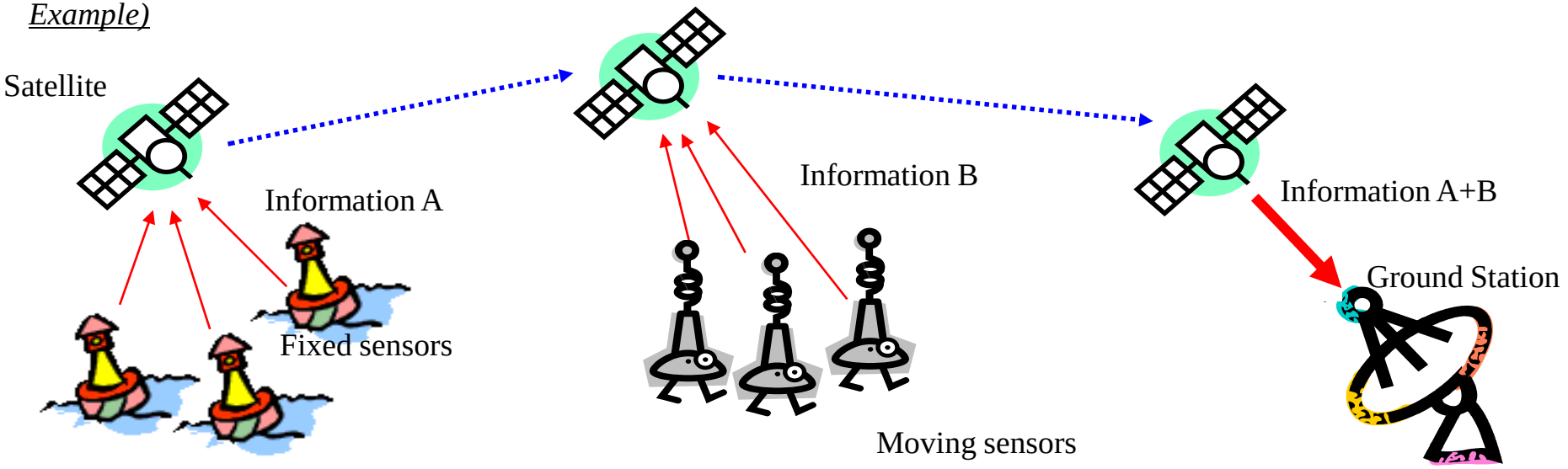
“Store & Forward” gets ground information

- UHF receiver onboard Hodoyohi-3 & 4 can collect data from ground Sensor Network (fixed points or mobile)

S&F mission outline

1. Fixed or mobile sensors on the earth get ground information and transmit them to Hodoyoshi-3&4 when they fly over the area
2. Hodoyoshi 3&4 receive and store the information, and forward (transmit) it to Ground Stations when it flies over them

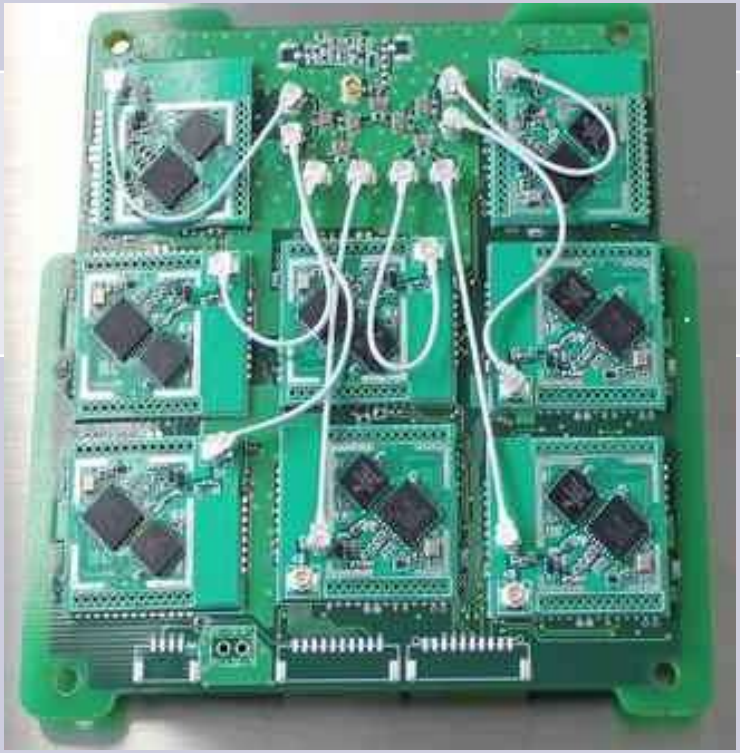
Example)



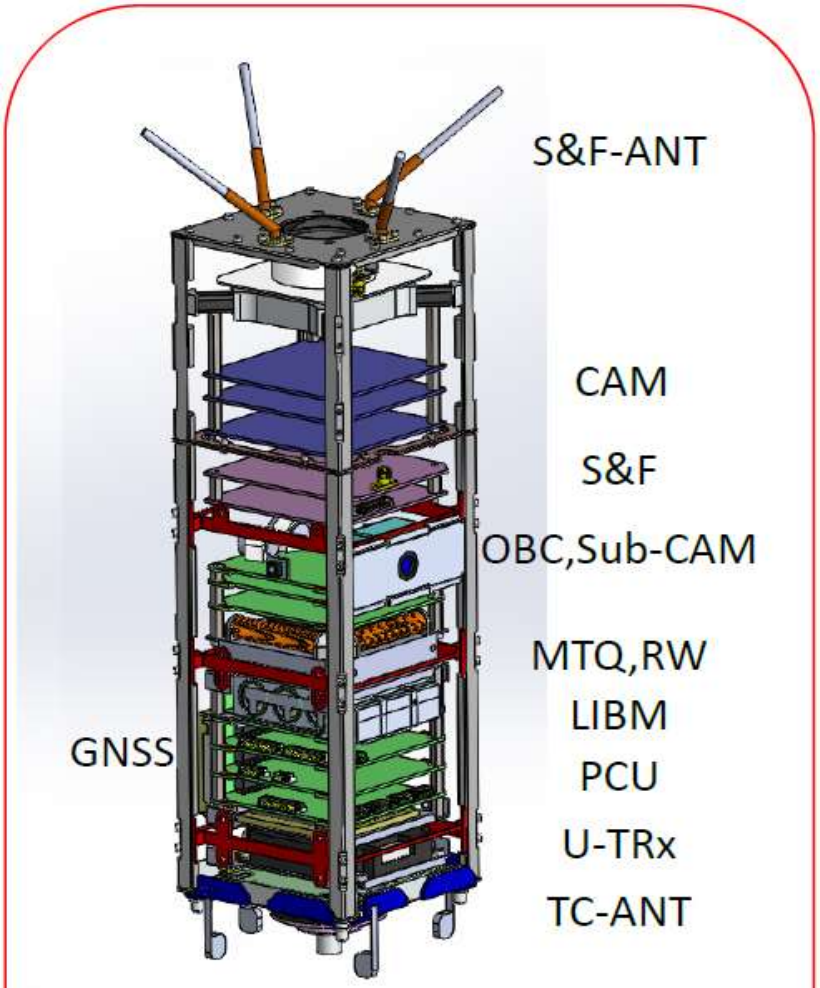
Application areas: disaster prediction, water level monitoring, forest data acquisition…..

Weak Signal Receiver for Data Collection Capability

Item	Specification
bit rate	100 bps, maximum 8 channels in parallel
Transmission duration	< 300 sec
Transmission power from ground	20 mW
Frequency band	920 MHz (no license of usage is required if using 20mW power)



3U CubeSat “TriCom-1R”
- Weak signal receiver from ground -



S&F: M2M technology for IoT

Items	Values	Miscellaneous
Size	10x10x30cm	3U size
Weight	< 3kg	
OBC	"Bocchan"board	Internal made
Power (average)	4W	AZUR GaAs cell
Battery	Li-Ion 41 wh	LIBM
Downlink (H/K&data)	W 1.2kbps	460MHz AFSK "U-TRx"
Uplink(H/K)	50W 9600bps	401MHz
Attitude	Simple 3 axis	B-dot law only
RF Receiver	20mW RF power from ground	920MHz no license required
Actuators	magnet torquer despun wheel	"MTQ" "RW"
Camera	GSD 314 m VGA @180km	"CAM"
Sub-Camera	GSD 67 m @600km	Five "Sub-CAM"

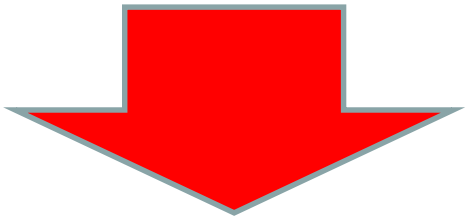
"Modified SS520"

Dedicated rocket for CubeSat by JAXA

Previous launch failed on Jan/2017 but will try it again !

Proposal of S&F Network

- One satellite only provides 4 x 10 min chance of data collection
- If the satellite fails, no backup is provided

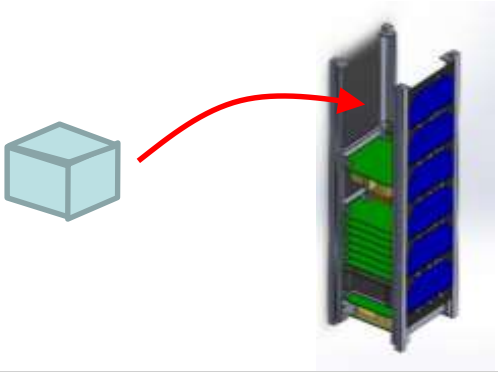


- How about making 2U or 3U by many UNISEC countries so that we can have more time to collect data from ground ?
  - Rule: the country who provides one satellite can use all the satellites for data collection.
  - Standardization of data protocol and communication system should be discussed

Options and Our Supports

- Any Collaboration : Your Idea **x** Our Experience
- All options can include capability building programs

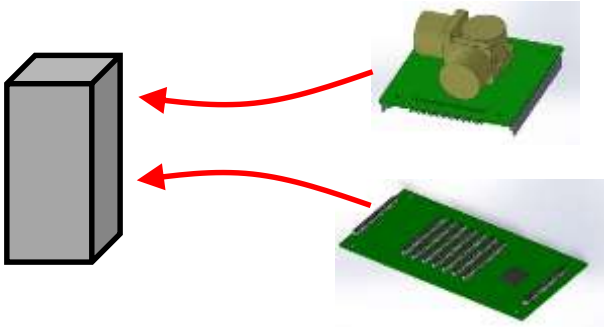
Your Mission × Our 2U/1U S&F BUS



Your Members × Our 3U/2U S&F Cubesat (build Together!)

Your Bus × Our S&F Mission Board

Your Bus × Our Heritage Components



Discussion Items

- Definition of Communication Protocol
  - Which frequency to use?
  - How we can make multiple use of frequency?
  - Standard data format, speed, packet length
- Managemental issues
  - Finance
  - Launch opportunity
  - Ground operation
  - Technological support
- How we can start the activities?
  - Experiment using TRICOM-1R

Technological Issues (1)

Specifications of transmitter from ground

i. RF power and input power, data rate, size of antenna, transmission intervals, etc.

- Considering “water quality management” mission
  - Water Quality Sensor is not chosen yet (TBD)
  - These factors will be decided after sensor/data are decided

Technological Issues (2)

Overall systems architecture

i. How to deal with transmission “collisions”?
   - CDMA, FDMA, TDMA ? ---- FDMA is suitable

ii. How the transmitter knows satellites’ coming?
   i. Beacon from satellite trigger transmission
      i. Ground receiver maybe turned on and off to reduce power consumption
   ii. Time based (clock error should be considered)
   iii. Transmitter turned on and off periodically
      i. Find suitable ON-OFF timing sequence
   iv. Hybrid (receiver ON just before satellite in vision)
   v. Future: Wireless power from satellite to the sensor, and trigger the sensor to transmit the signal back

iii. License of frequency usage: should be checked

Technological Issues (3)

Downlink from satellites

i. Ground station concept, number, frequency (UHF or S Band) and Cost & Performance should be traded off
ii. Collaborate with “Infosteller”
iii. Experimental frequency would be adequate
iv. Data storage and sharing way should be designed
v. Downlink radio transmitter should be standardize, housekeeping data also into standardized packets
vi. Encryption of data (example. Spain data to Ghana)
vii. Decided based on cost factor, either S Band or UHF
viii. Some countries can participate only with providing Ground Stations.
ix. Mass production and order of GS may reduce cost

Technological Issues (4)

Design of ground sensor/transmitter system

(Assuming 6 months without maintenance)

i. Power: Solar cell ? Screw ? Wind mil ?
   i. If used in river, use screw but requires maintenance
   ii. Solar cell is suitable due to less maintenance
   iii. Location based solution

ii. Antenna:
   i. Should be decided considering
      i. Coverage requirement
      ii. Communication speed
      iii. Communication frequency
      iv. User distribution
      v. Candidates: Omni, patch, horn, helical antenna

iii. Standard interface for various sensors
   i. Serial communication would be adequate

Technological Issues (5)

Water quality monitoring device

i. Should be small, cheap and low power
ii. Endurable for long time
iii. Accuracy requirement (specification)
iv. Application dependent (level, chemical, pH, heavy metal, oil detection, temperature, application selection based on user needs)
v. Possible information sources:
Tunisian University (Monastir), ANU, mailing list from Rei (UNISEC)

Other possible applications

i. Each member should study other possibilities

Managemental Issues (1)

Who (what organization) will lead this international collaboration?

- Conceptual study (feasibility study, plan generation, etc) should be lead by Mr. Rakesh Chandra Prajapati
- UNISEC providing info to students to participate in the project
- Team with geological scientist to find the user requirement (saves time to find the mission or application)
- Strong will and sustainable long-time effort are required as many issues should be solved

Managemental Issues (2)

Funding for the system development and operation

- Benefit to human being may appeal to ADB, WB or other banks or JICA (Japan)
- Connect with Hydro power (fund)

Launch opportunity

- May appeal to some governments to get opportunity such as Japanese H-IIA/ISS launch
- Contact for KiboCube
- Epsilon should be also contacted (to IHI person)

Timeline and Action Items

First milestone is a meeting in ISTS (June, 2017). Until then, we should;

- Work for 6 months
- Collect info, collect regions, people
- Find someone with Water quality knowhow
- Keep email contacts informed

Meeting on June 3 to 9, 2017 in ISTS

(with Skype with those who cannot come)

- At the meeting, we will define next phase work, discuss project feasibility