

HEPTA-Sat Program: International **Knowledge and Technology Transfer** for **CubeSat Development**

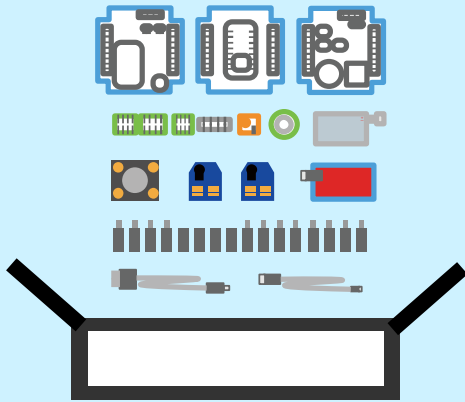
Masahiko Yamazaki (Director, HEPTA Training Program @ Unisec-global)



Southern Hemisphere Space Studies Program 2019
Collaboration with International Space University(ISU)

Key Features

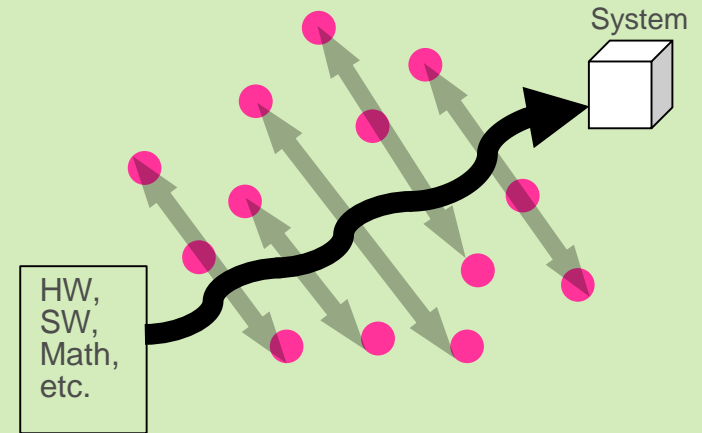
1. Training Kit



2. Text Book



3. Training Program



4. Hands-on

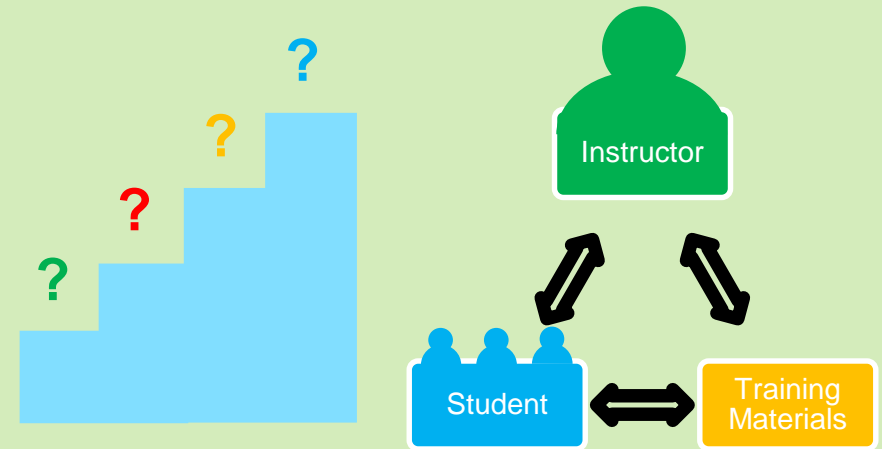


5. Self-directed

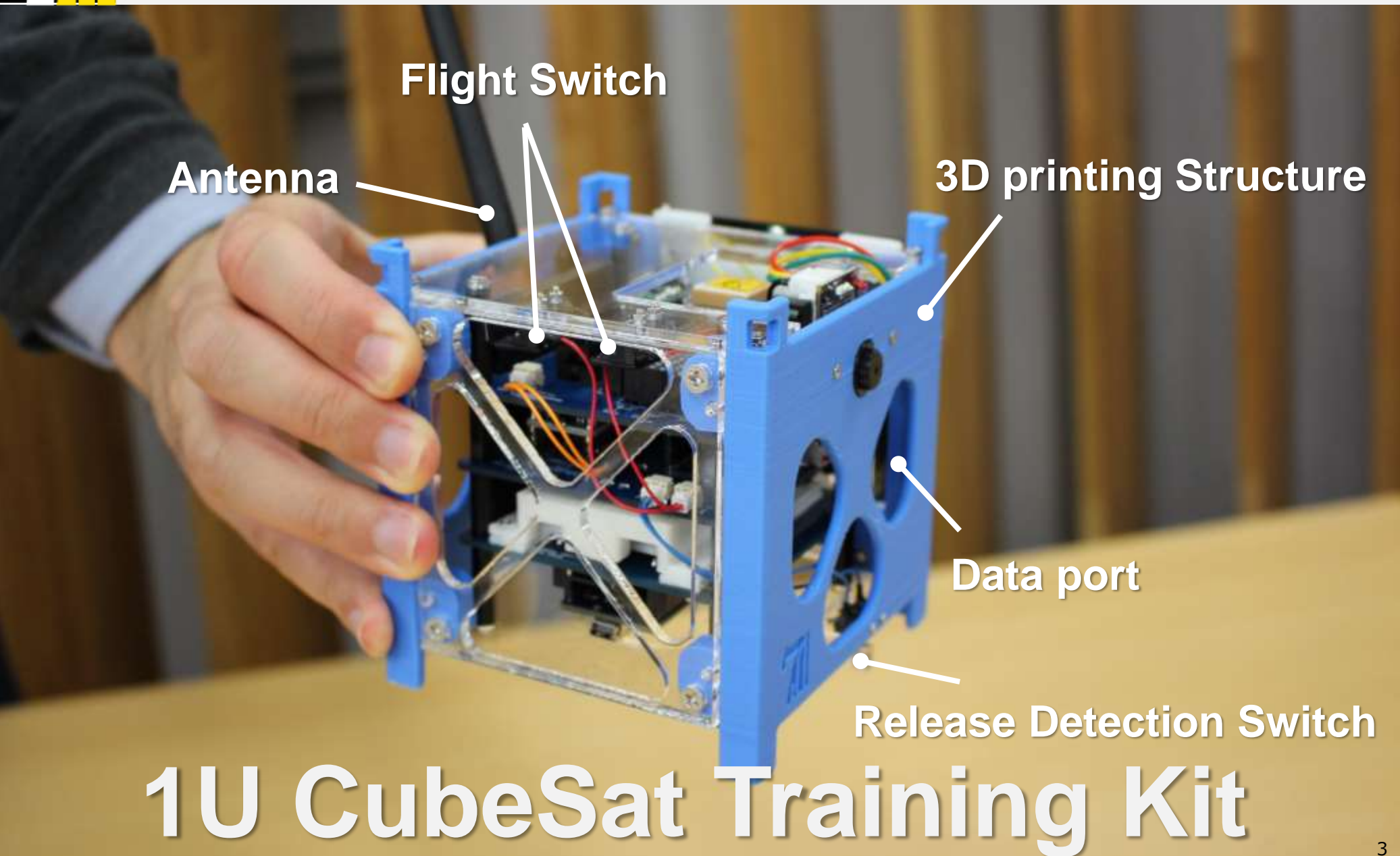


6. Step by Step

7. Interactive Communication

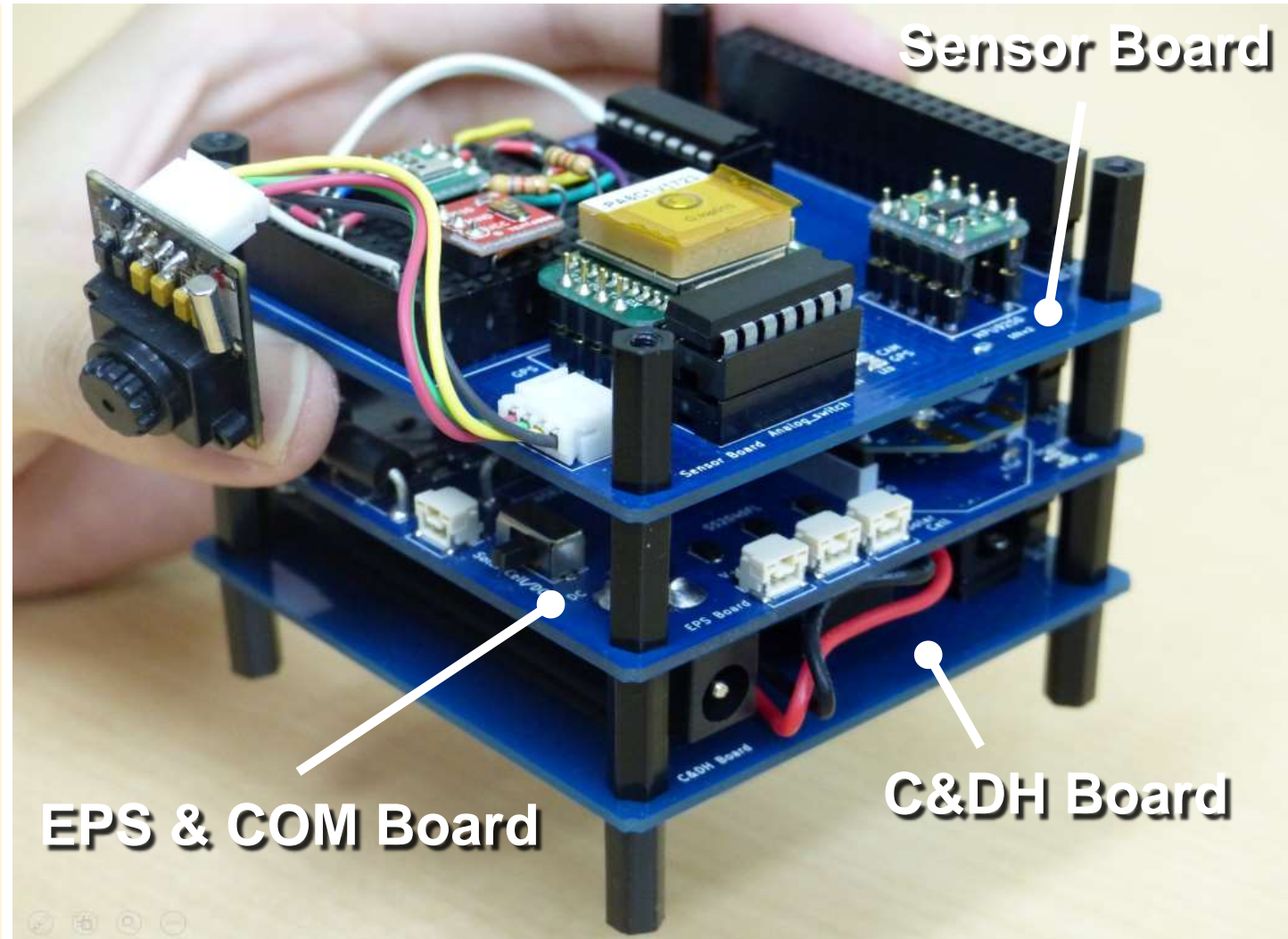
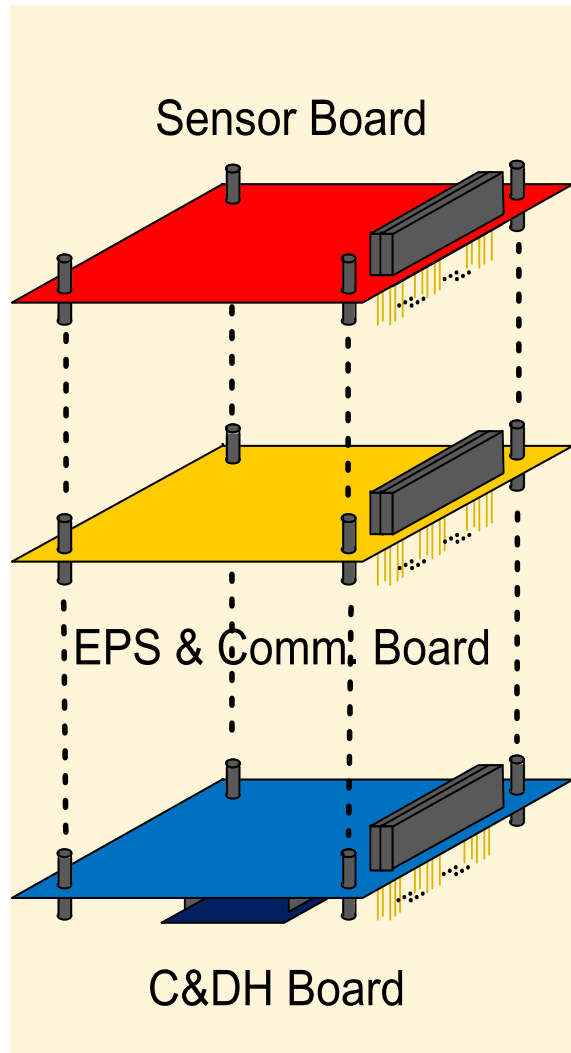


What is HEPTA-Sat kit ?



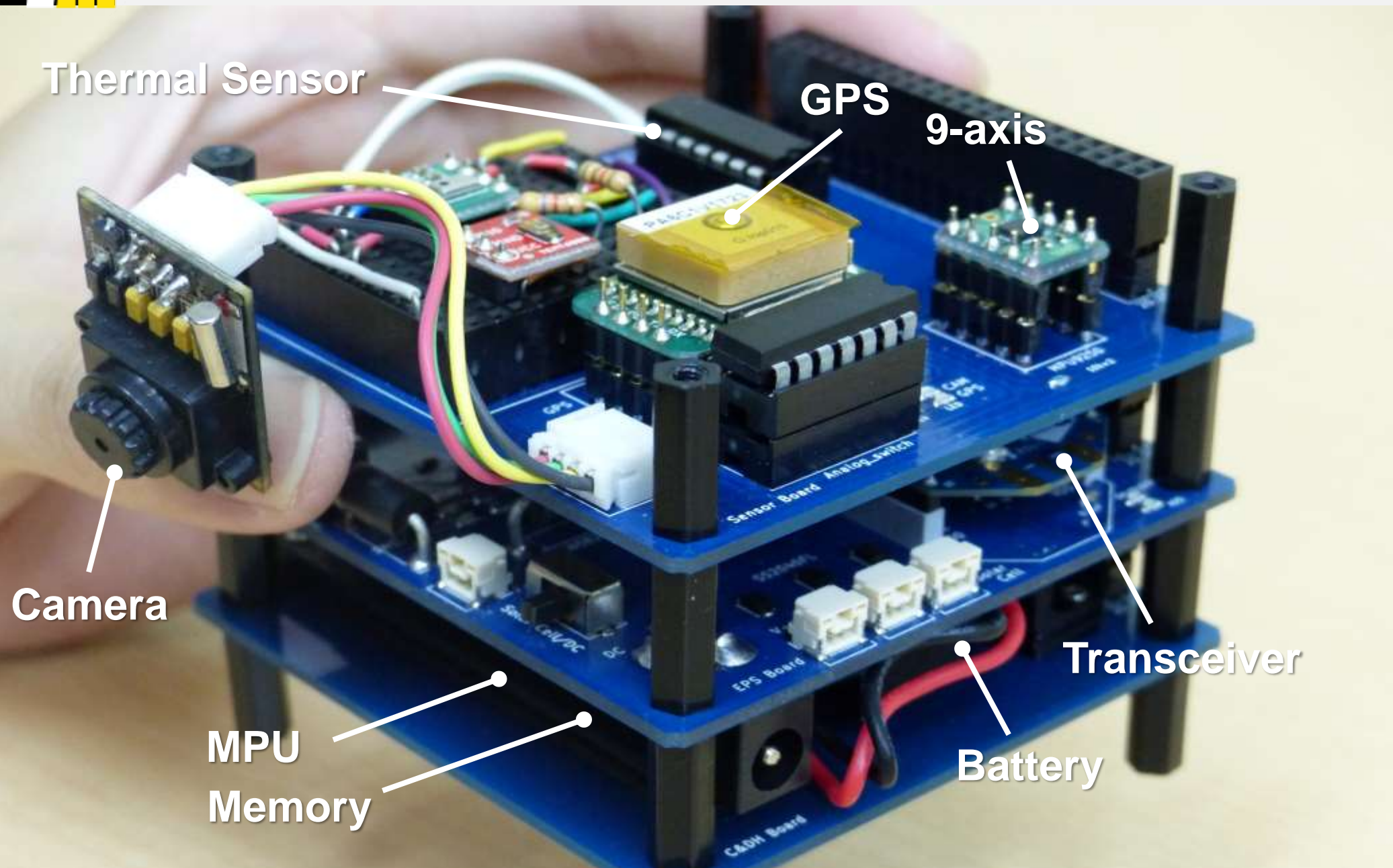


What is HEPTA-Sat kit ?



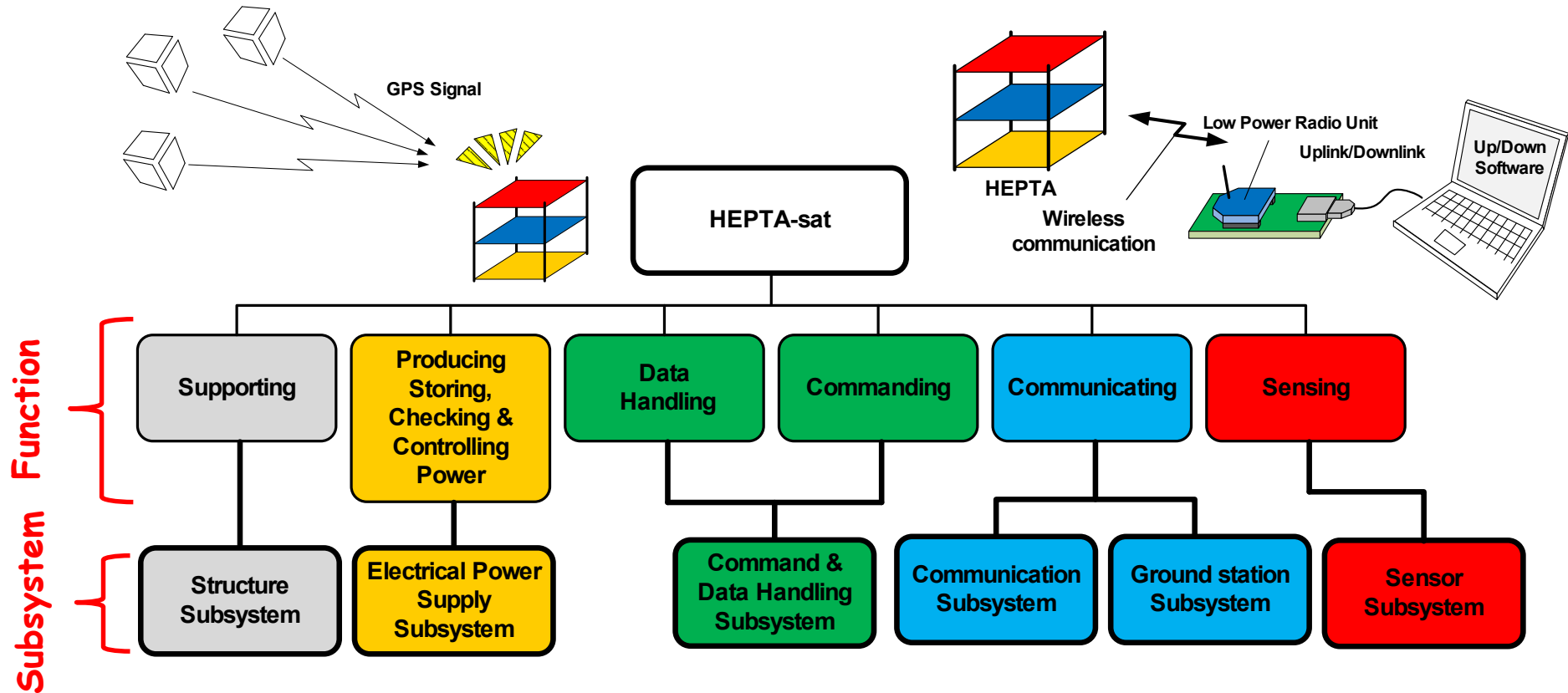


What is HEPTA-Sat kit ?



What is HEPTA-Sat kit ?

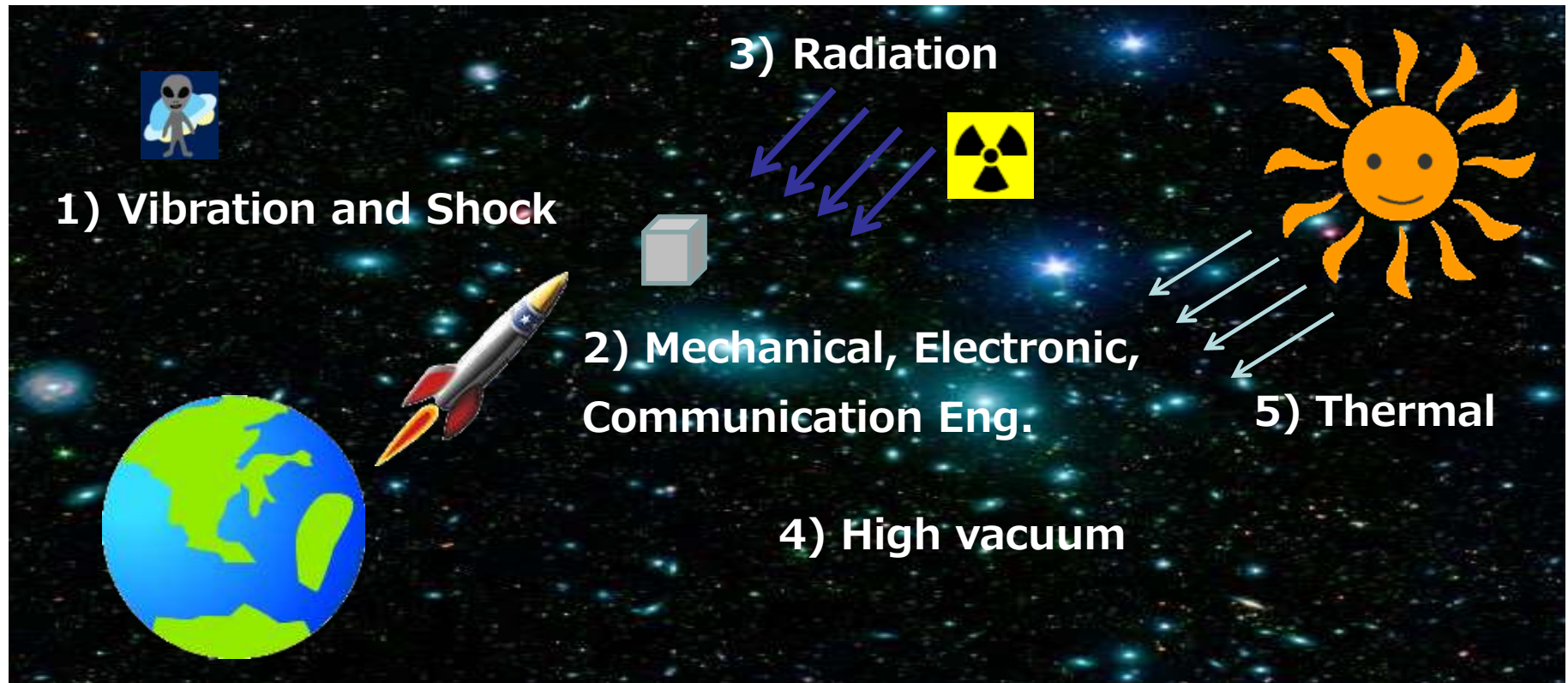
- Composed of 6 function and 6 primary sub-systems.



- You can learn how each subsystem functions and how to integrate subsystems into a satellite through experiencing the process of **assembly**, **integration** including programming & system implementation and **test**.

Why CubeSat Training?

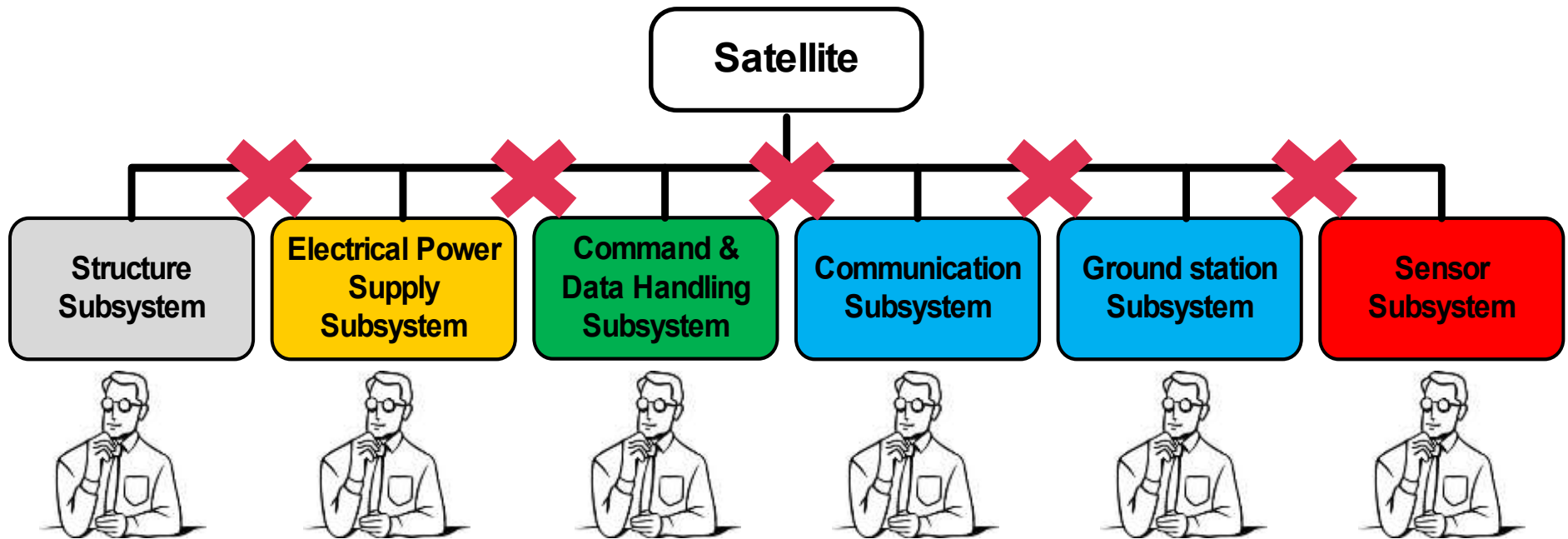
- Satellite is possible to learn **variety of elemental technologies**
 - Mechanical engineering, electronic engineering and communication engineering and it's system integration.
 - To learn the space systems engineering, CubeSat development project based learning is a very effective training way.





Why HEPTA-Sat kit ?

- It is sometimes **hard to gain knowledge or experience** of the **whole development process** because the roles are divided into team members.



- Not only a **local optimization insight** but also **global optimization insight** for developing the system.
- The training program offer a such kind of experience before starting real satellite in a **short time and low cost**.

What is HEPTA-Sat Training Program ?

- 1) Understanding basic satellite system architecture.
- 2) Experiencing the pico-satellite development process in a short time.
- 3) Acquiring the basic knowledge of space engineering.

Step 1:
Lecture



Step 2:
Hardware Assembly



Step 5:
Field test



Congratulations!



Step 3:
Hardware & Software
Integration



Step 4:
Mission Design

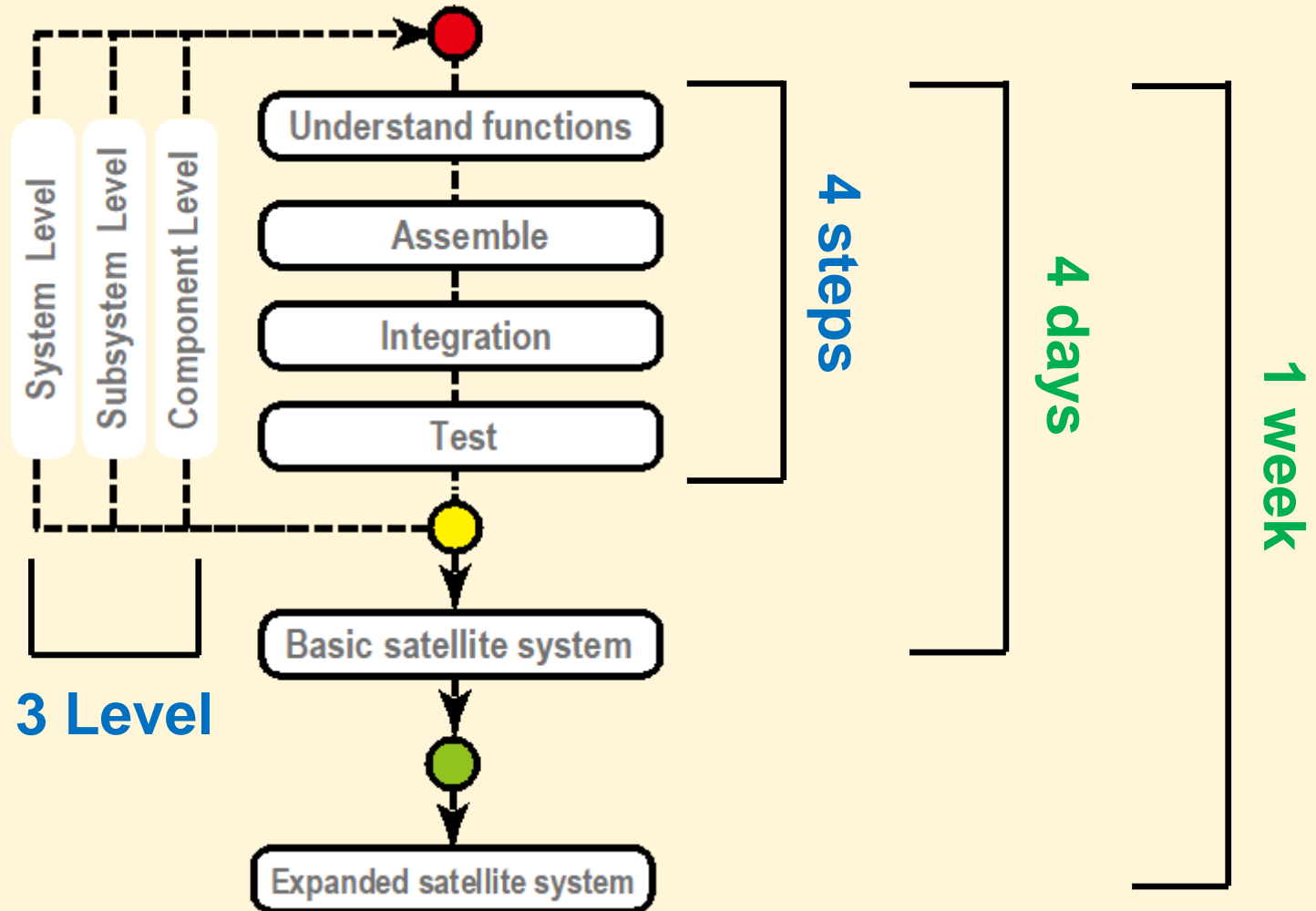


Step 6:
Review & Presentation



from Scratch to Satellite System

- Focuses mainly on **understanding**, **assembling**, **integrating**, and **testing** the function of the CubeSat model and carrying out it in a **hands-on manner** step by step from the **component level to the system level**.



Training TEXT book Examples

- Satellite needs a separation system that deploys the satellite from the launch vehicle to the orbit.

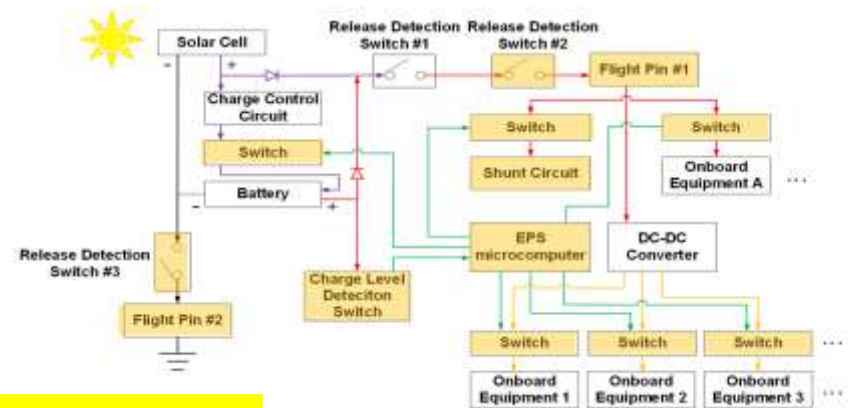


Introduction

System Architecture

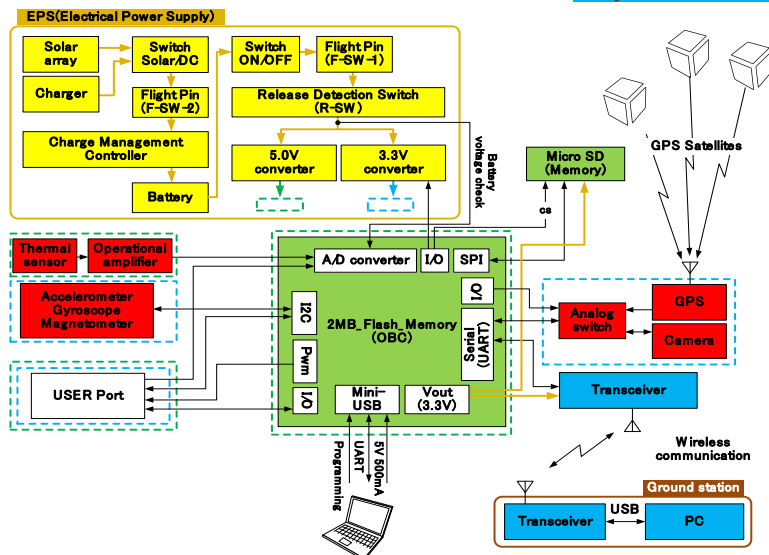
1. Check Function and architecture of EPS Subsystem

- An example of EPS subsystem that considers reliable and secure electric power supply, management of proper power supply, and safety assurance.



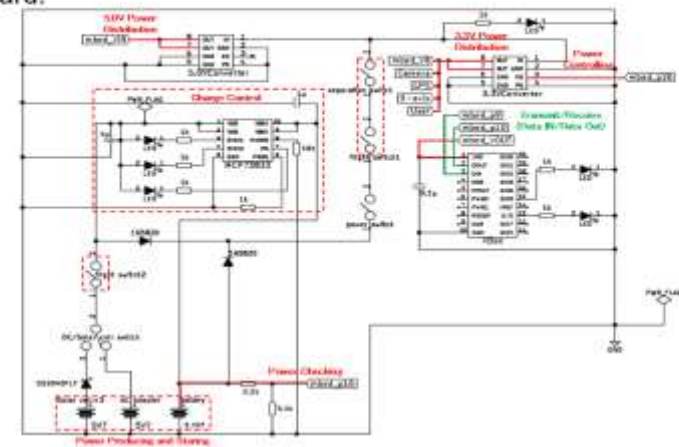
EPS Architecture

Circuit Diagram



1. Check Function and architecture of EPS Subsystem

- The circuit diagram of HEPTA-Sat's EPS and communication board.

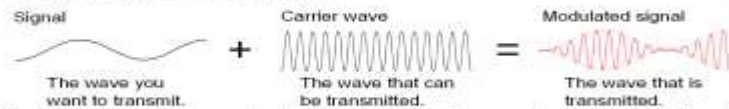




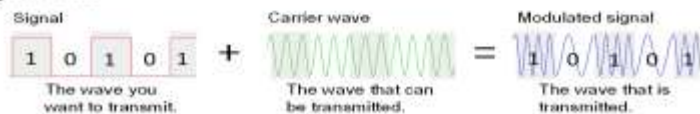
Training TEXT book Examples

2. Check of function and architecture of Communication Subsystem

- There are variations in the modulation and demodulation scheme.
- Amplitude Modulation (AM) or Frequency Modulation (FM) are ways of broadcasting radio signals. Both transmit the information in the form of electromagnetic waves.
- AM works by modulating (varying) the amplitude of the signal or the carrier to be transmitted according to the information being sent, while the frequency remains constant.



- Digital data is also conducted by modulation and demodulation. The following figure is the schematic diagram of frequency modulation of digital data.

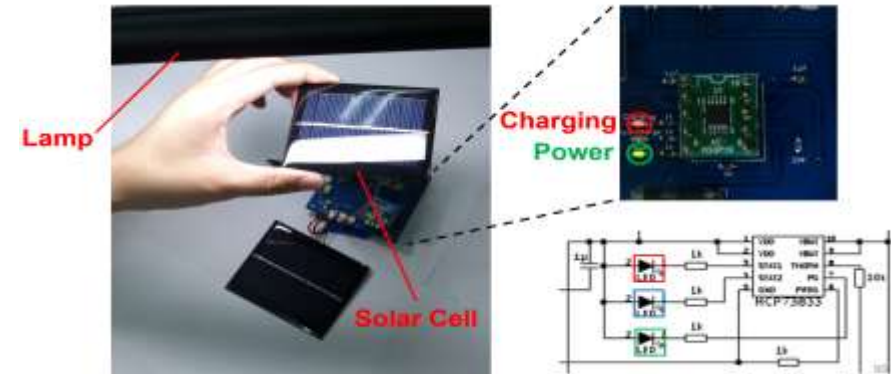


Technical Term

Integration

14. Installation of Solar Cells

- Set the switch "DC / Solar cell" on the board to "Solar cell".
- Charge with desktop lighting!
- It can be confirmed that charging is possible.



Test

Assembly

10. Software & Hardware Integration: Detect acceleration by using 9-axis Sensor

- Software and hardware integration of EPS & communication board and C&DH board are conducted

- Acquire the acceleration sensor data.

File name : Detect_Acceleration

```
#include "mbed.h"
#include "Hepta9axis.h"

Serial pc(USBTX,USBRX);
Hepta9axis n_axis(p28,p27,0xD0,0x18);

int main()
{
    pc.baud(9600);
    float ax,ay,az;
    pc.printf("Accel Sensor Mode\r\n");
    for(int i = 0; i<50; i++) {
        n_axis.get_acc(&ax,&ay,&az);
        pc.printf("%f,%f,%f\r\n",ax,ay,az);
        wait(1.0);
    }
}
```

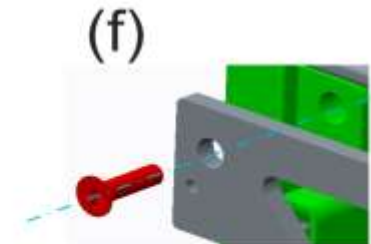
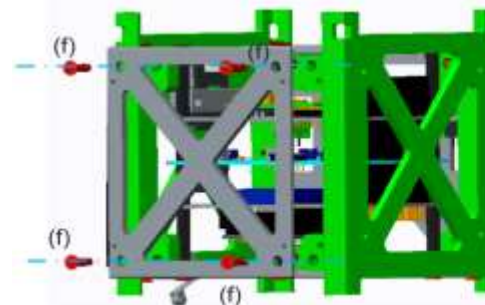
include mbed library
include Hepta9axis library
serial class declaration
Hepta9axis class declaration
main loop start
set communication rate
variable definition
display 'Accel Sensor Mode' on PC
loop 50 times
get Accel value
display 'Accel value' on PC
1.0 second wait
loop end
main loop end



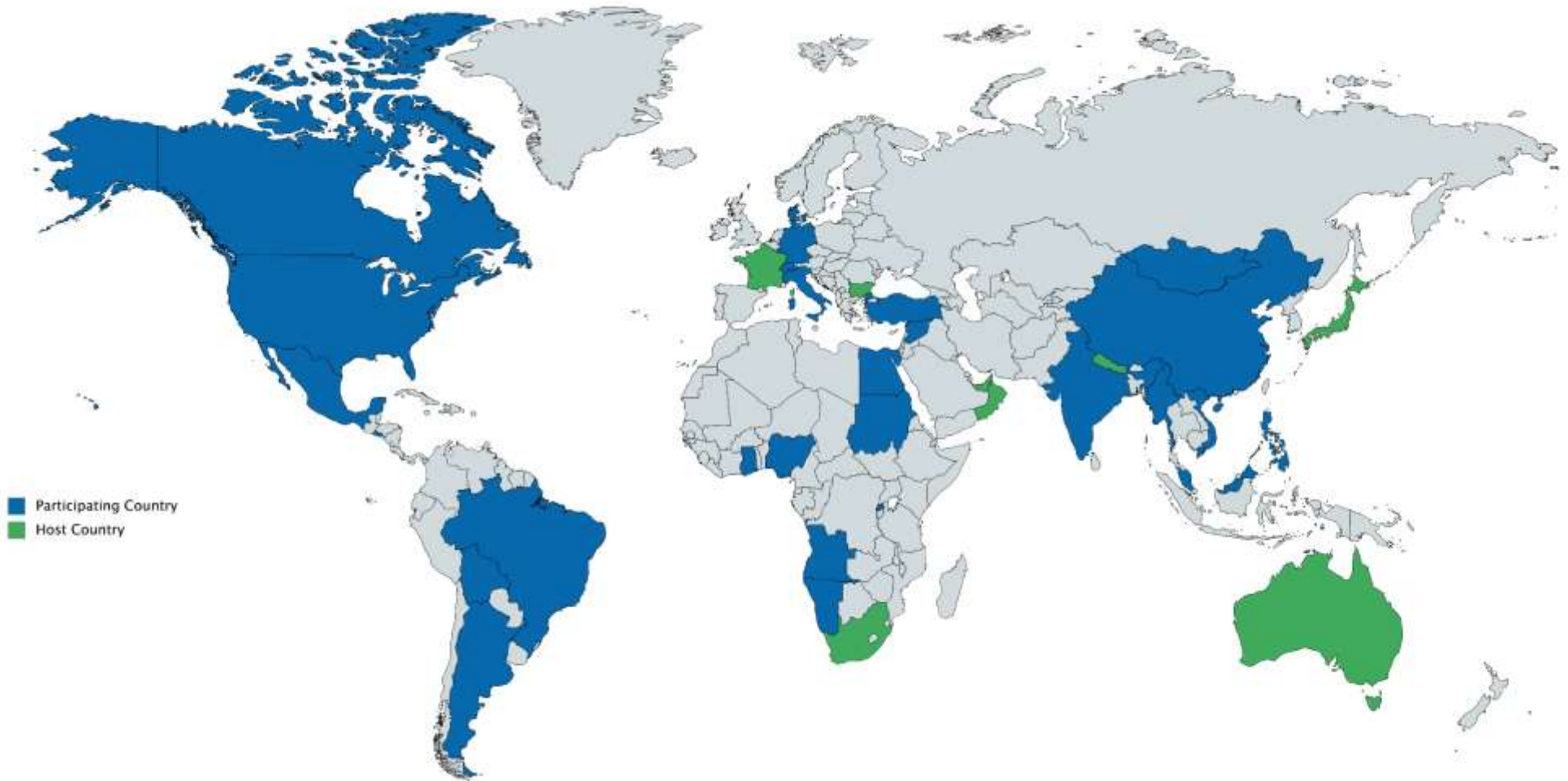
3. The structure of HEPTA-Sat

Fabrication and Assembly of the structure subsystem of HEPTA-Sat

- Next, assemble the trusses.



- Altogether, 211 participated from 37 countries from 2017 to 2019.





Host Countries / Organizations

- All Nations University (Ghana): 2015
- GGPEN (Angola): 2016
- Katmandu University (Nepal): 2017
- Sofia University (Bulgaria): 2017
- CNES(France): 2017-2019
- Stellenbosch University (South Africa): 2017
 - UN/South Africa Symposium on Basic Space Technology
"Small Satellite Missions for Scientific and Technological Advancement" 2017
- United Arab Emirates University (UAE): 2018
- International Space University (France): 2018
- Oman Astronomical Society (Oman): 2018
- Japan International Cooperation Agency (Japan): 2018
- Luxembourg University (Luxembourg): 2018
- South Australia University (Australia) and International Space University (France): 2019
 - Southern Hemisphere Space Studies Program 2019

■ Participating Country

■ Host Country

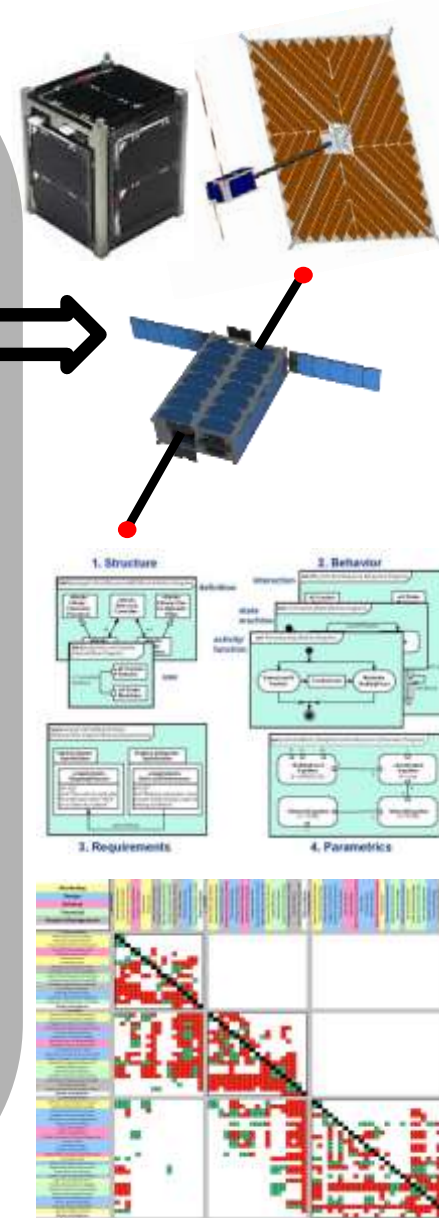
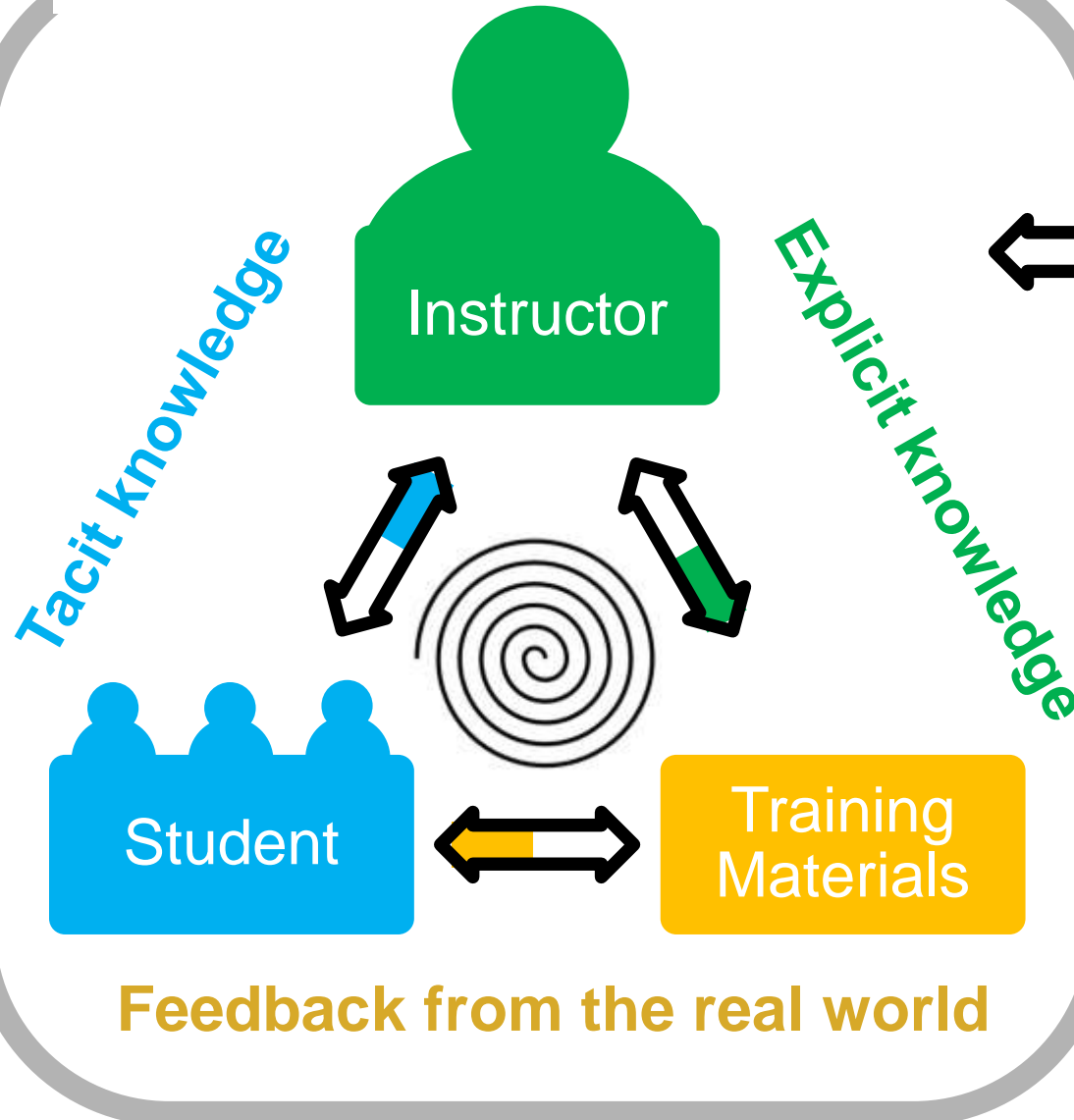


Interactive Communication

Version Up



Class Room



Various fields
Engineer, Scientist,
Lawyer, Artist, Manager

HEPTA-Sat Program:
International Knowledge and Technology
Transfer for CubeSat Development

Masahiko Yamazaki(UNISEC-global, Nihon University)

**Thank you for your Attention
Questions?**

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Email: yamazaki.masahiko@unisec-global.org

The 10th CanSat Leader Training Program:

CLTP10



**August 19-30, 2019, Nihon Univ.,
Japan**