Introduction to HEPTA-Sat training

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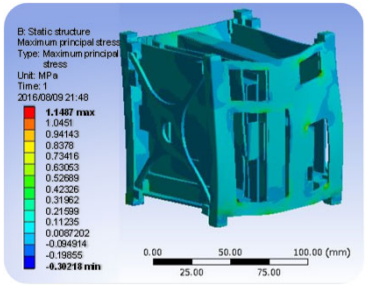
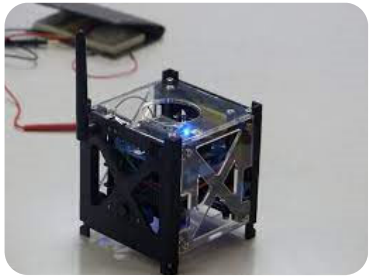
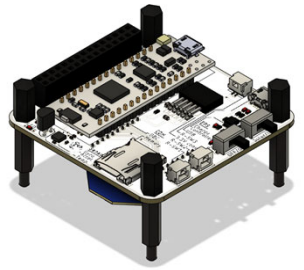
Challenges of CubeSat Program Knowledge Transfer

- The space industry needs radical collaborations among more diverse sectors (e.g., other fields such as software, disaster management, etc.) in this “new space” era.
  - It is difficult for engineers and non-engineers outside the space field to understand space systems engineering itself. Without practical experience and a common language (a common model), it is difficult to consider why and how to integrate new elements with space systems.
- Most university programs cannot sustain permanent professionals. Documentation and its handling is also not sufficient. It is difficult to pass on the concept and management methods of design development.

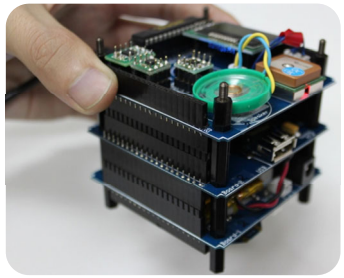


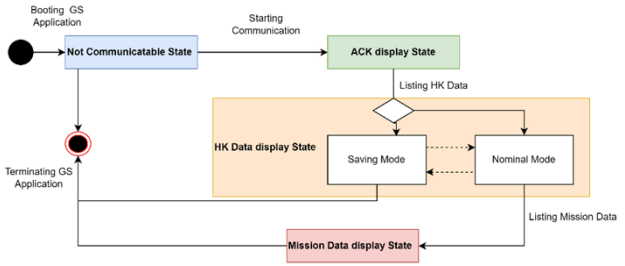




Project start(2012) **HEPTA-Sat-II(2016)** **HEPTA-Sat-Lite(Online, 2021)**

HEPTA-Sat-I(2012) **HEPTA-Sat-III with Model Based Systems Engineering(2019)**

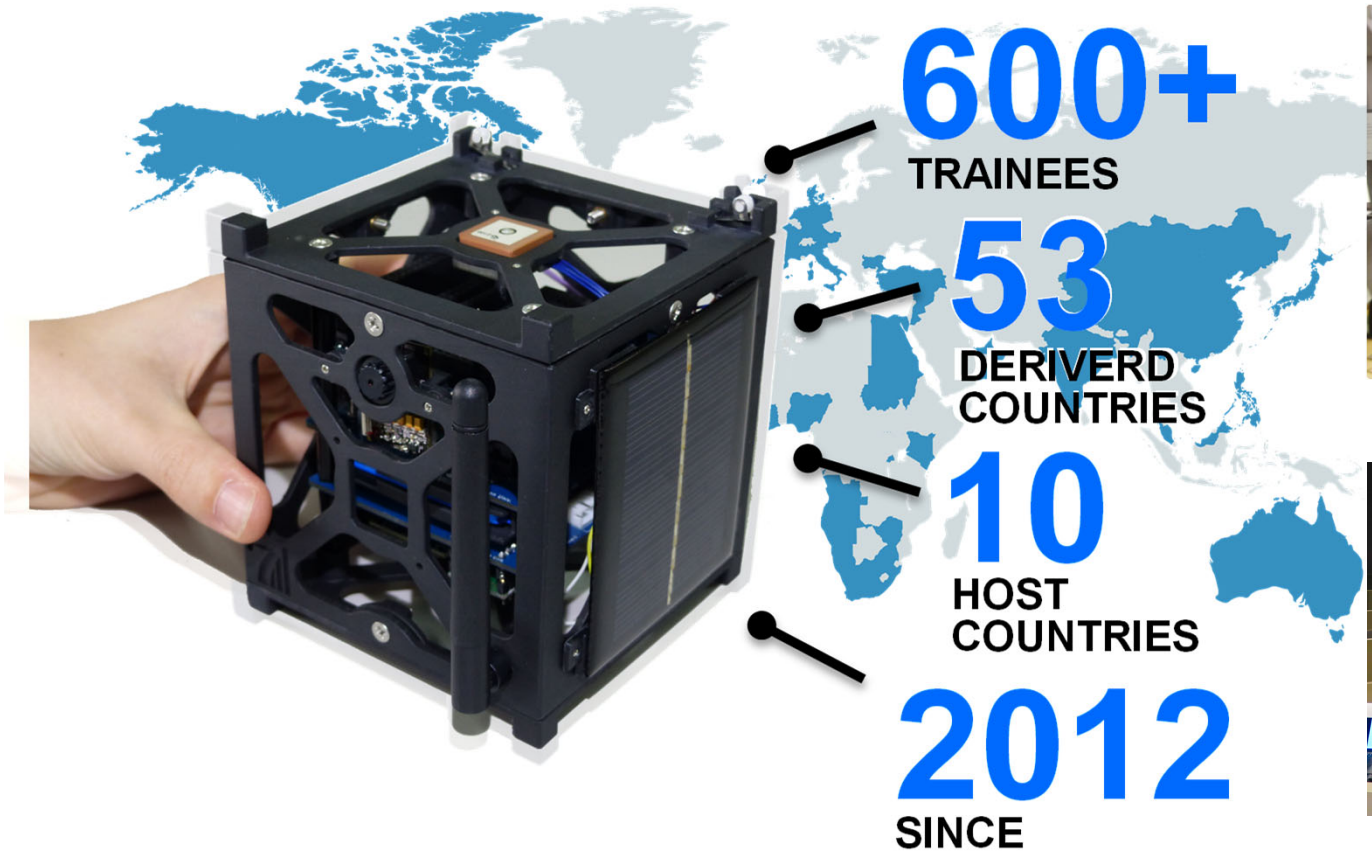




CubeSat Engineering Education by Hands-on Activity

- Education to gain the knowledge necessary to think about satellite-based services with people from various background through hands-on experience for new entrants with limited prerequisite knowledge of space systems.

CubeSat Engineering Education by Hands-on Activity



Annual Training Program(CLTP)

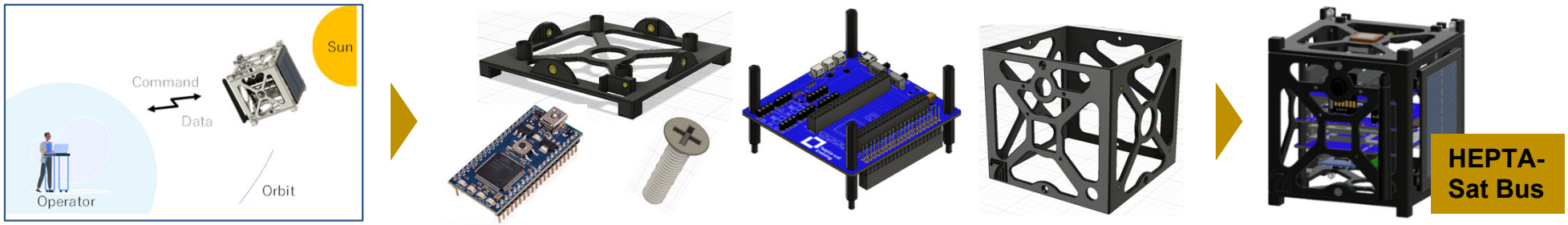
International Space University

Online Workshop(UNISEC Academy)

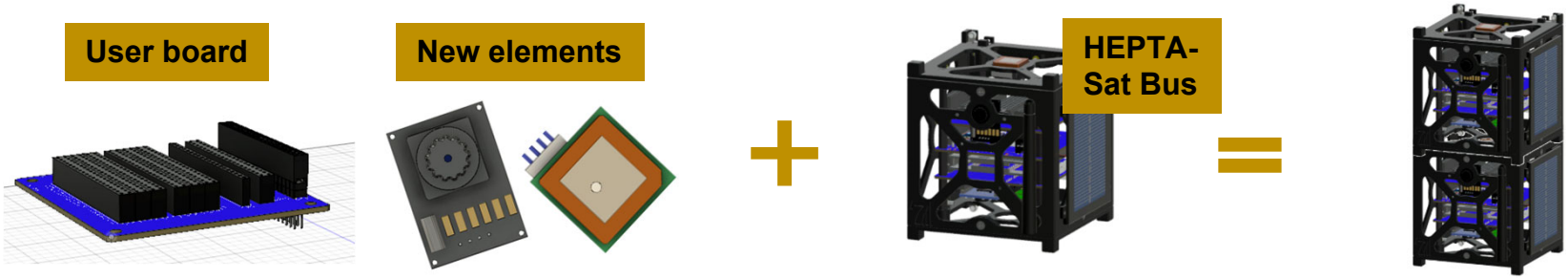
- Annual Training Program for Instructors(CLTP)
- International Space University (France)
  - SHSSP(2019,2020), SSP(2019, 2021)
- Japan International Cooperation Agency(JICA) (Japan)
- Space and Space related Agency (Kenya, Oman, etc.)
- University (UAE University, Titech, etc.)
- United Nation Workshop (South Africa)
- Online Hands-on Workshop (UNISEC Academy)

Three Steps of HEPTA-Sat Training Program

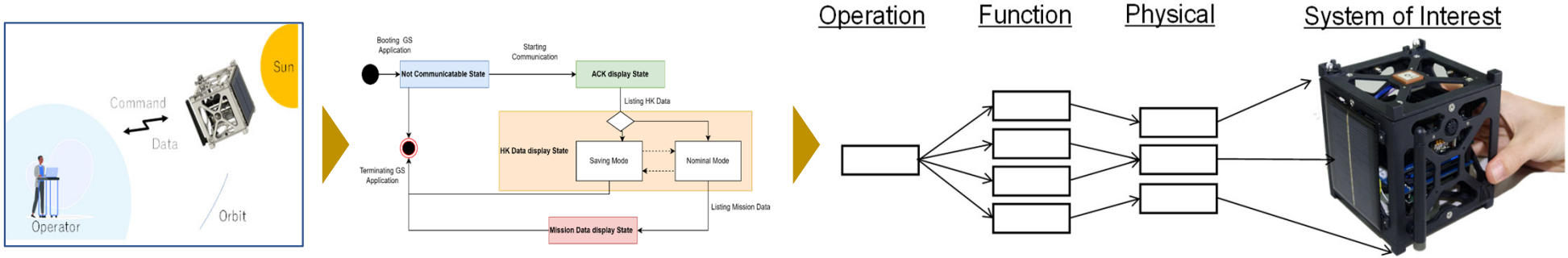
- **Step1：CubeSat System Assembly, Integration and Test with Textbook.**
  - Understand the functional and physical elements and their relationships.



- **Step2：Problem and Project based learning with HEPTA-Sat Bus**
  - Understand the relationship between operational, functional, physical point of view and there relation with design & development.



- **Step3： Visualization of system design and development (MBSE)**



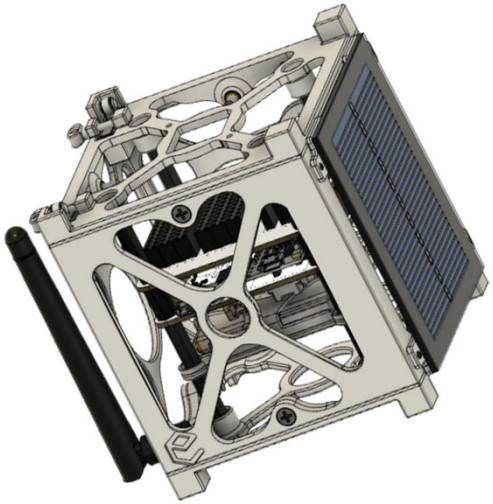
HEPTA-Sat Training Kit > HEPTA-Sat Bus

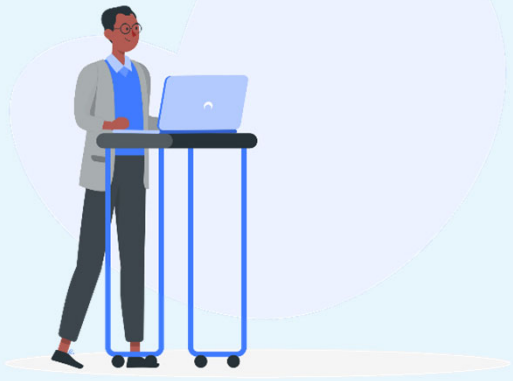
- Simulates the actual satellite-to-ground station communication experience.

Sun

Command

Data



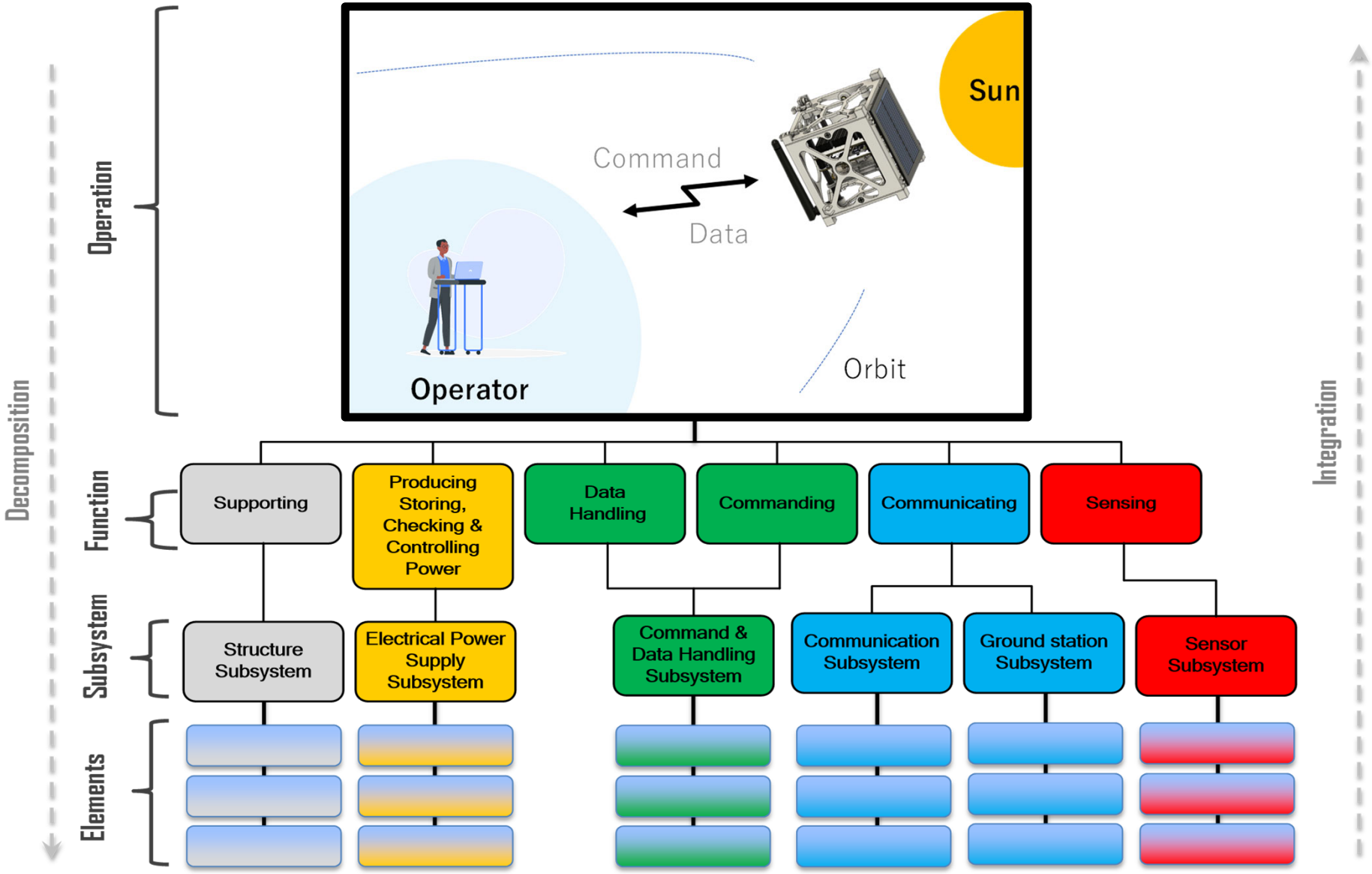


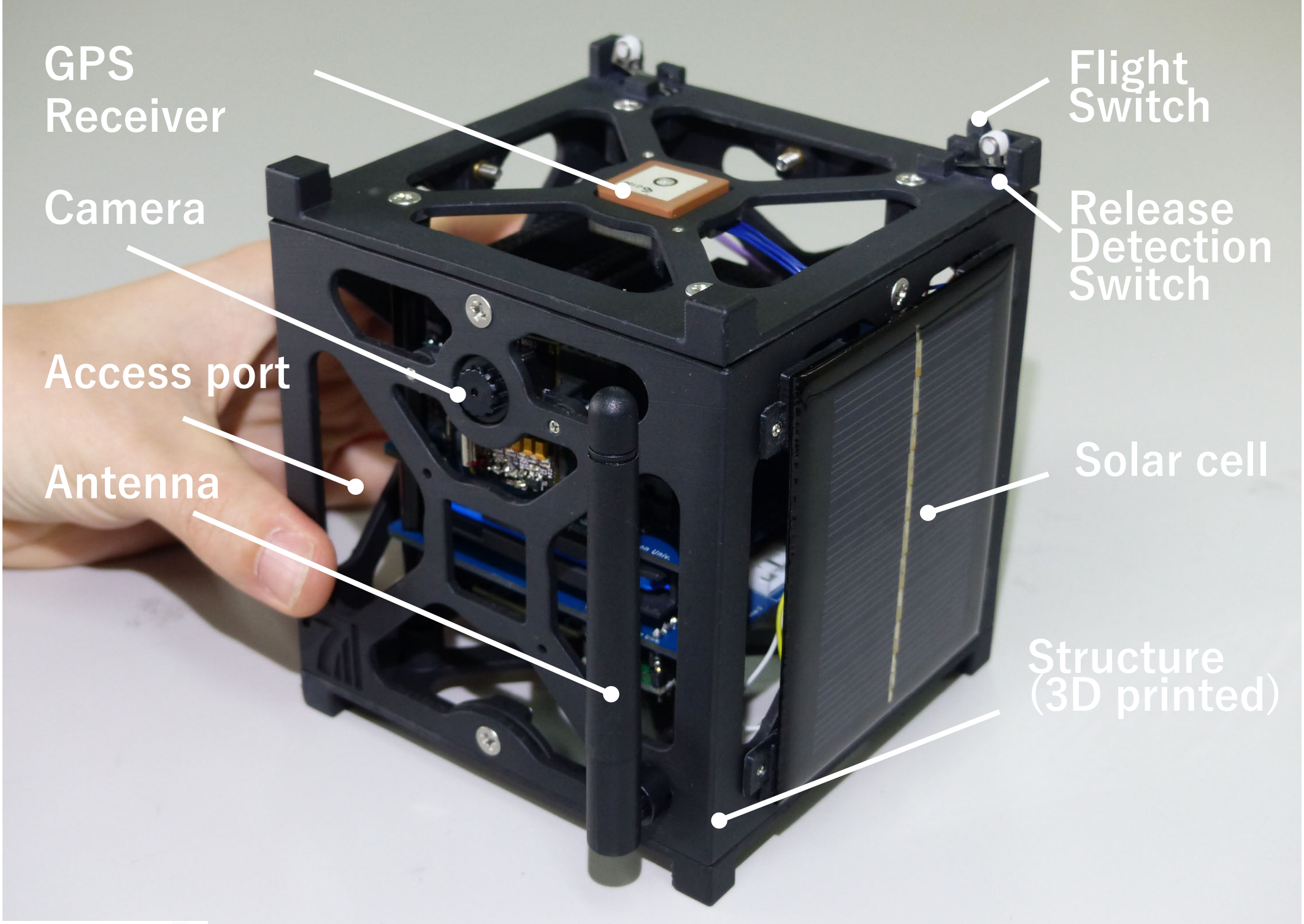
Operator

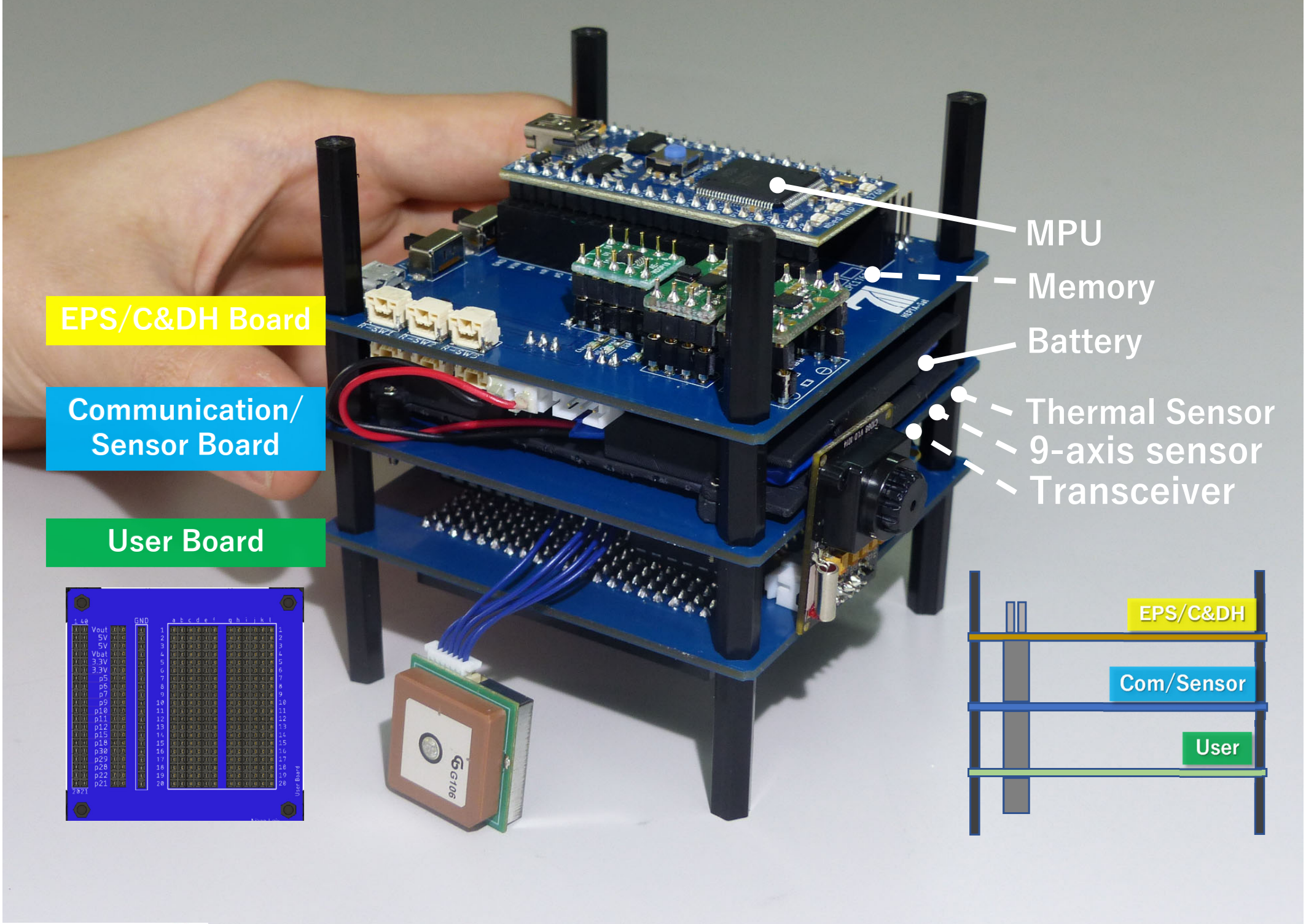
Orbit

HEPTA-Sat Training Kit > HEPTA-Sat Bus

- Experience how a system is composed of elements and sub-elements (understand the relationship between the whole system and the elements.)

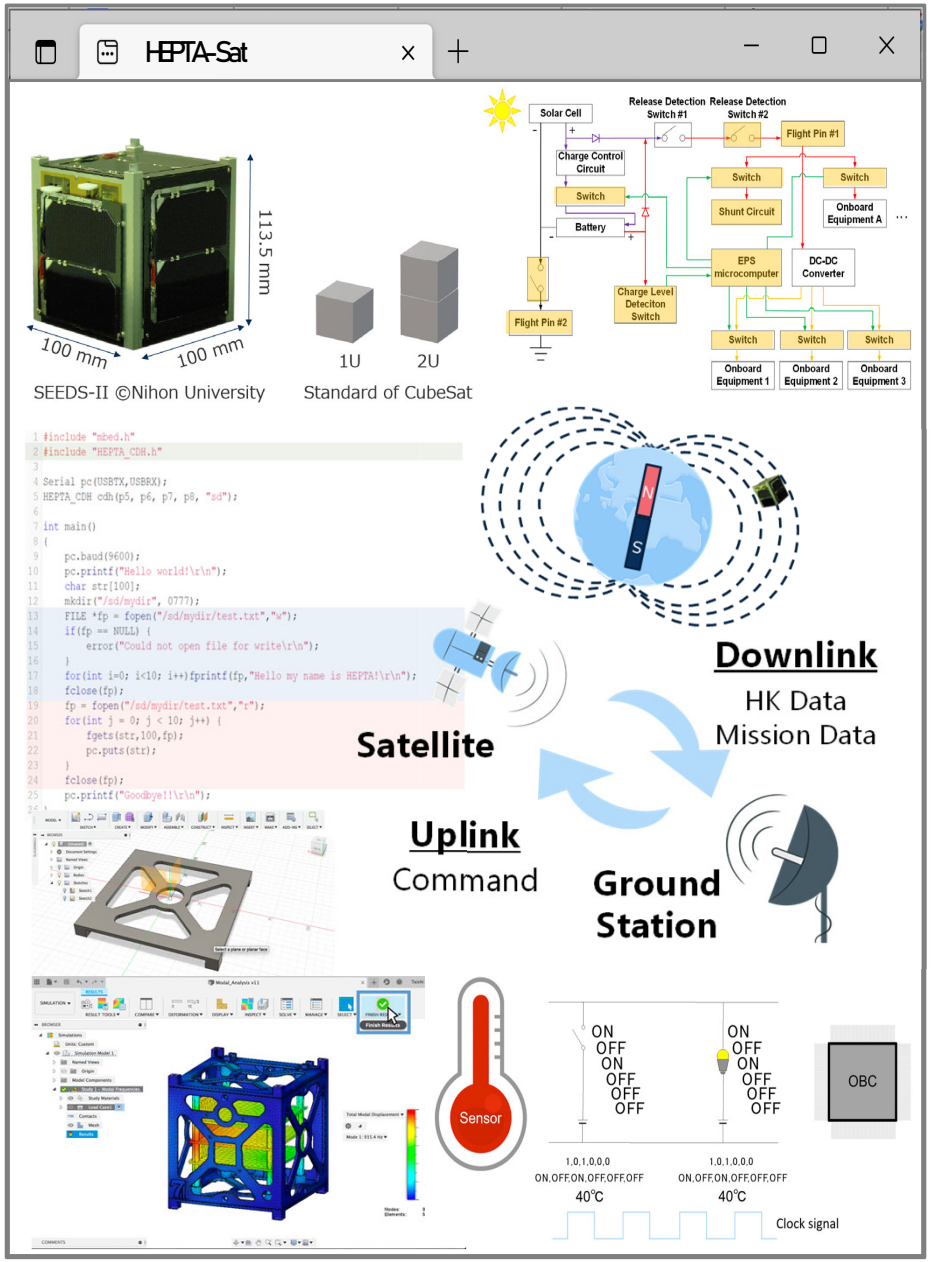



GPS Receiver
Camera
Access port
Antenna
Flight Switch
Release Detection Switch
Solar cell
Structure (3D printed)

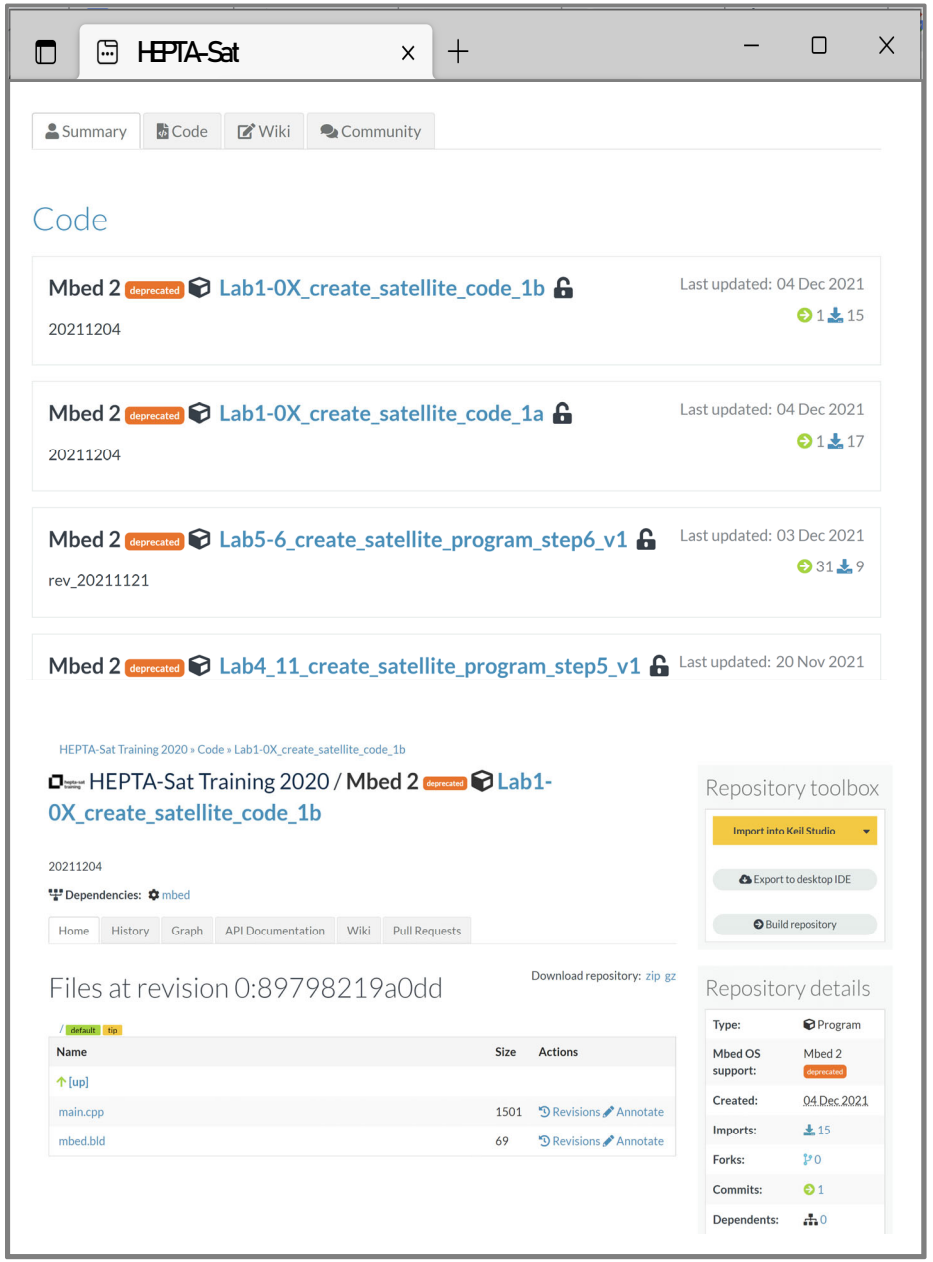

EPS/C&DH Board
Communication/
Sensor Board
User Board
MPU
Memory
Battery
Thermal Sensor
9-axis sensor
Transceiver
EPS/C&DH
Com/Sensor
User

HEPTA-Sat Training Kit > Self-learning Environment

Textbook

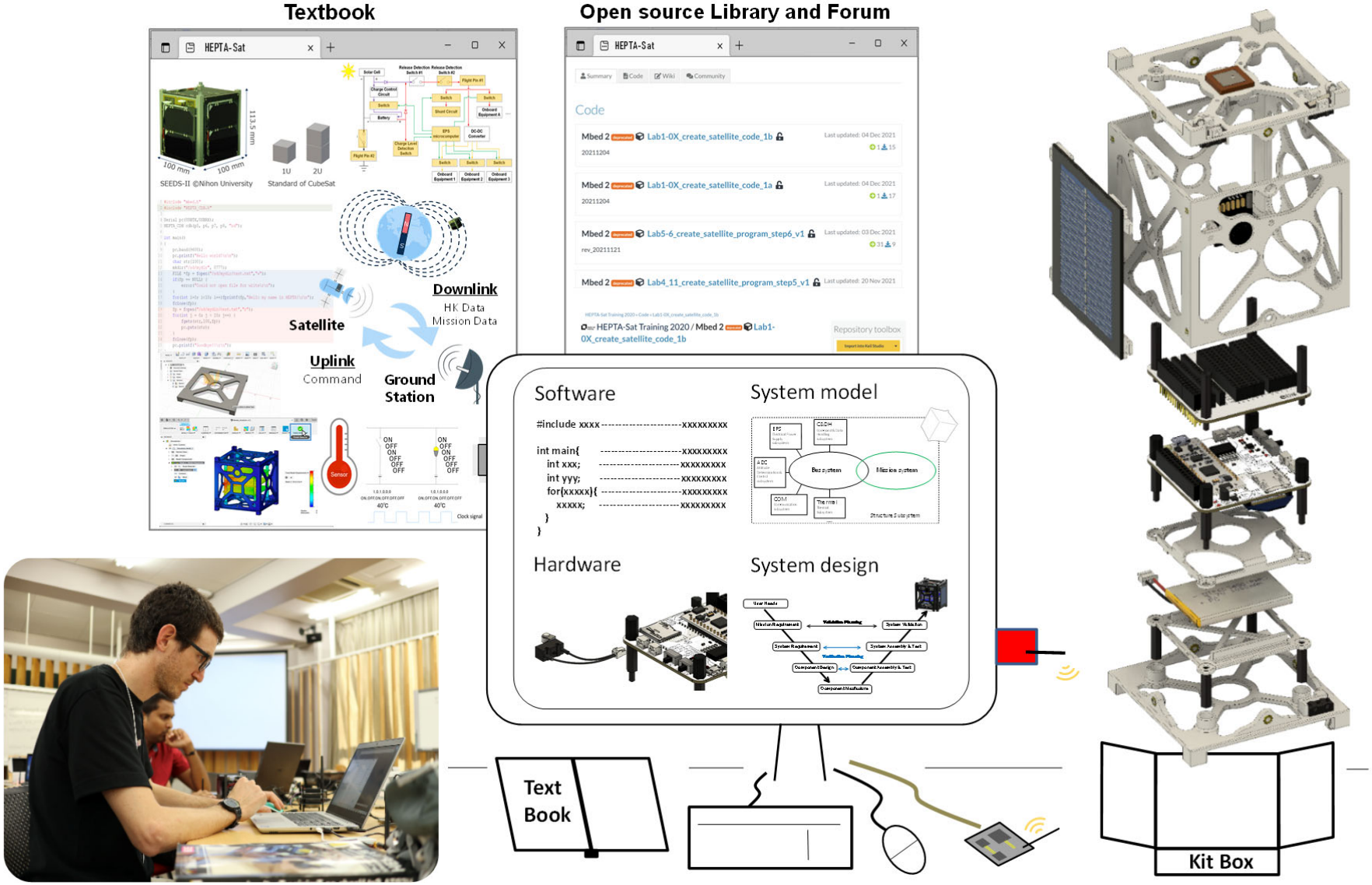


Open source Library and Forum



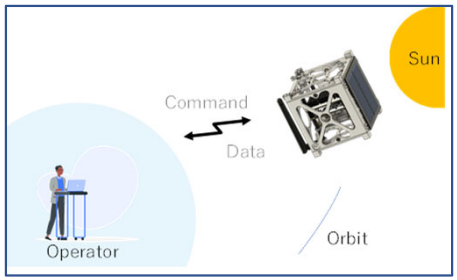
HEPTA-Sat Training Kit > Training Package

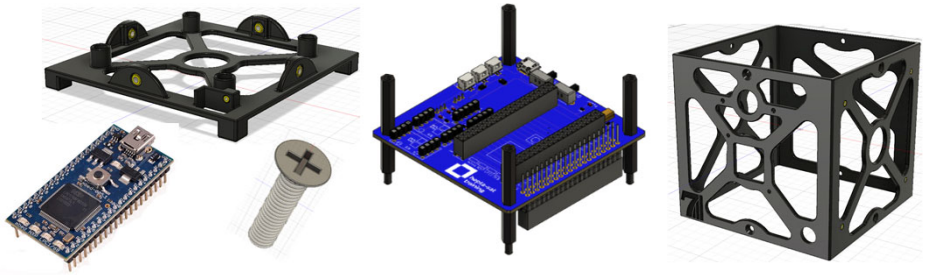
- Easy access to space for newcomers, requiring only an Internet environment and a laptop computer.



Three Steps of HEPTA-Sat Training Program

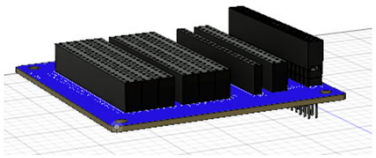
- **Step1：CubeSat System Assembly, Integration and Test with Textbook.**
  - Understand the functional and physical elements and their relationships.



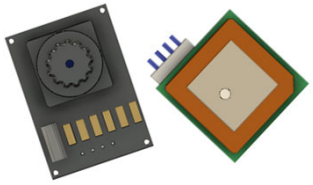


- **Step2：Problem and Project based learning with HEPTA-Sat Bus**
  - Understand the relationship between operational, functional, physical point of view and there relation with design & development.

User board



New elements



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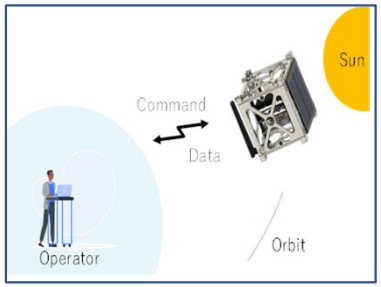
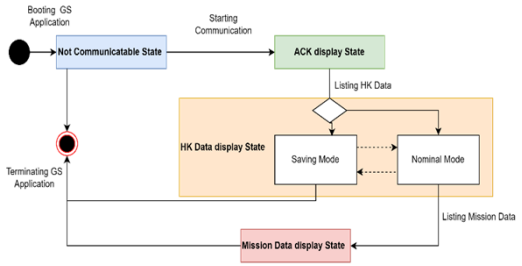
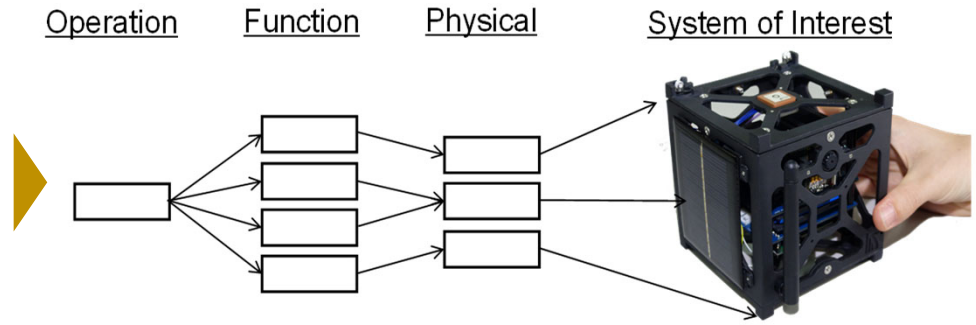
- **Step3： Visualization of system, design and development process(MBSE)**

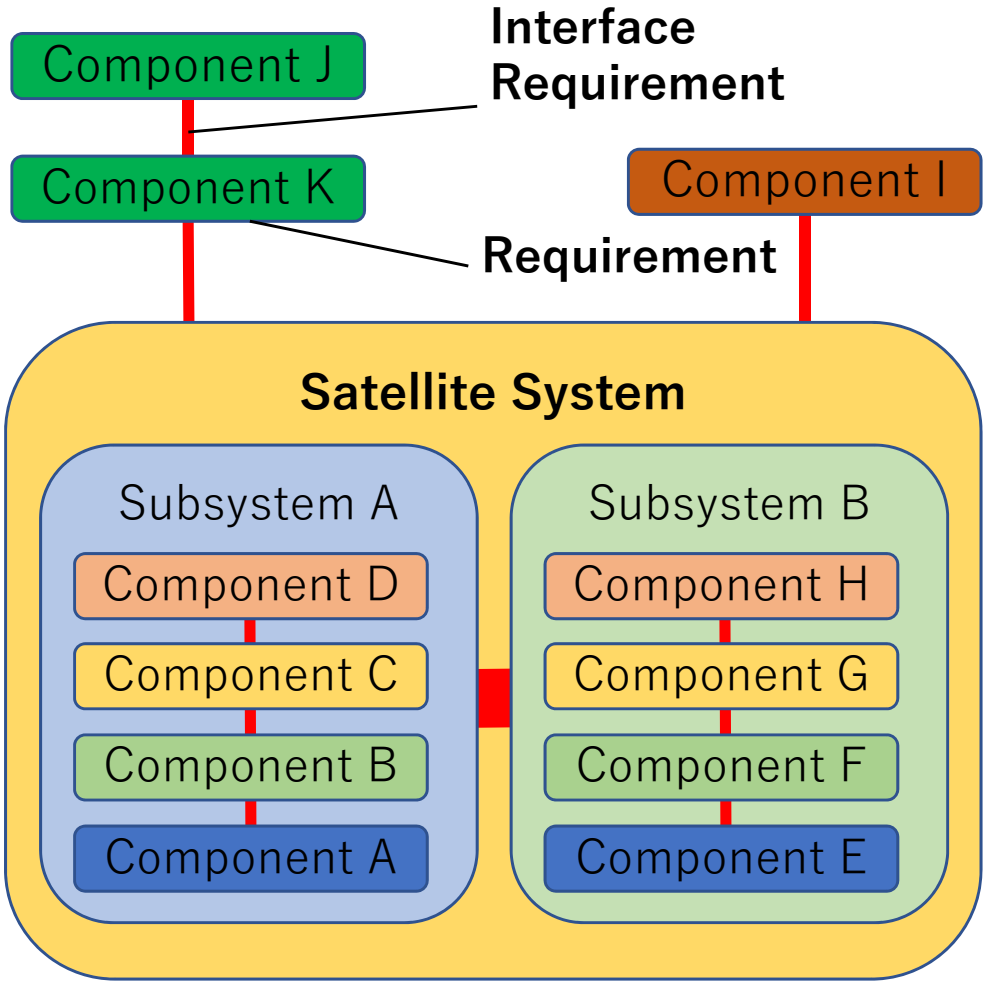


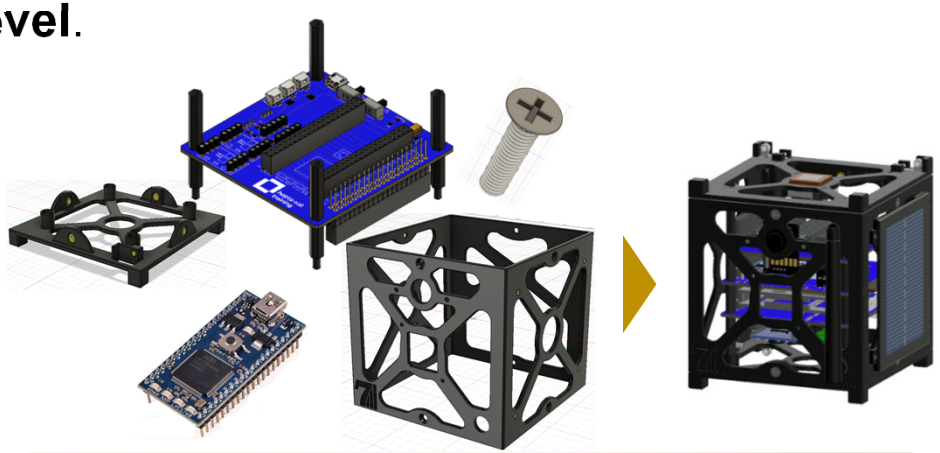


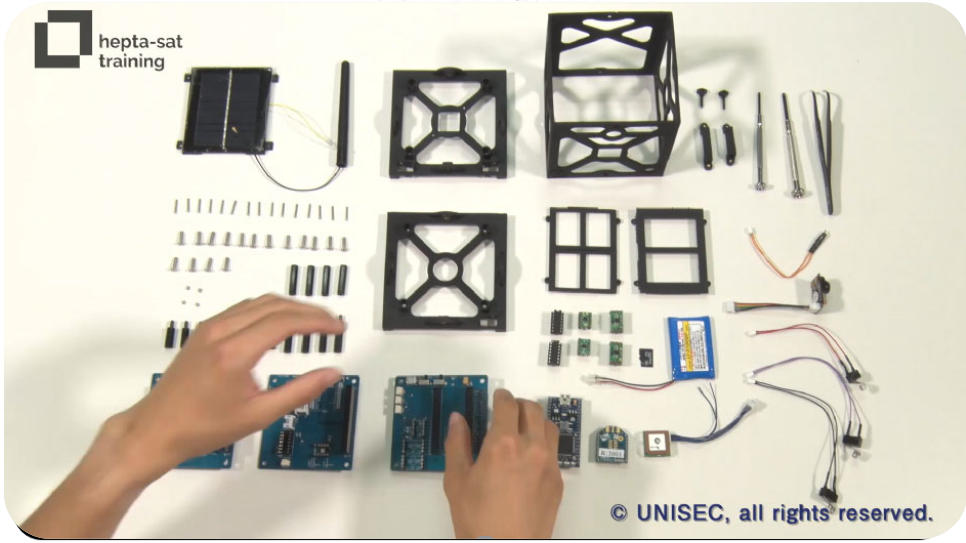


Step1 : CubeSat System A, I & T with Textbook

- Understand the functional and physical elements and their relationships.
- Focuses mainly on understanding, assembling, integrating, and testing the function of the CubeSat Kit and carrying out it in a hands-on manner step by step **form components level to the system level**.







Assembly videos without testing and understanding process

Step2 : Problem and Project based learning with HEPTA-Sat Bus

- Understand the relationship between operational, functional, physical point of view and there relation with design & development.

Mission definition

System definition

Concept design

Bread Board Model

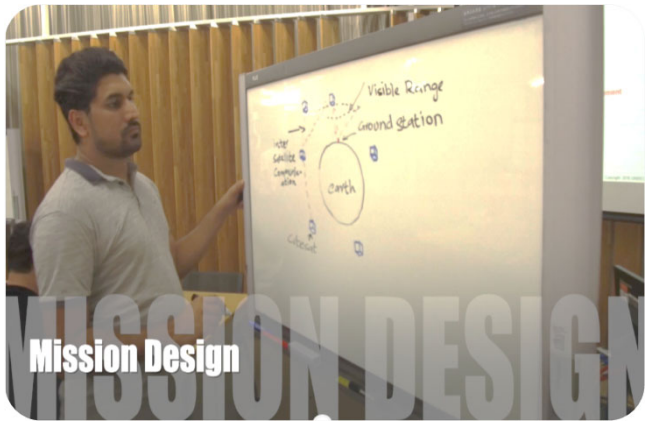
Basic design

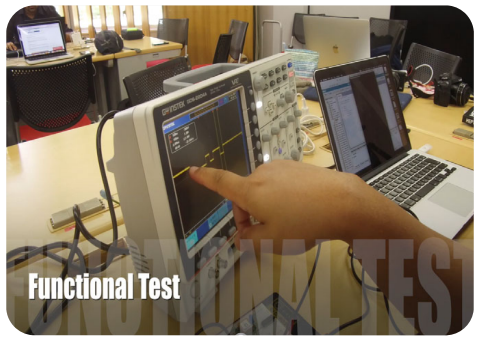
Engineering Model

Detailed design

Flight Model

Launch

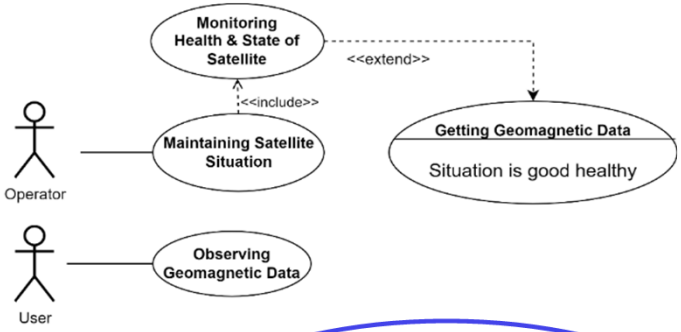




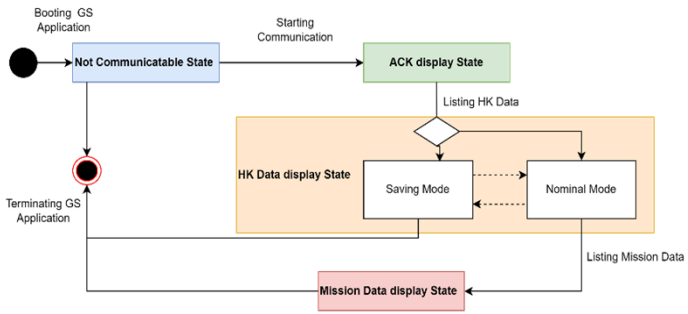
Step3 : Visualization of system design and development process

- After reflecting on the first PBL, visualize and apply the next PBL.

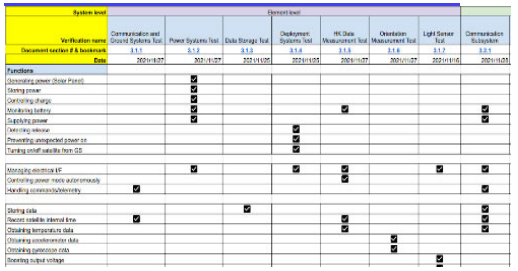
Use case scenario

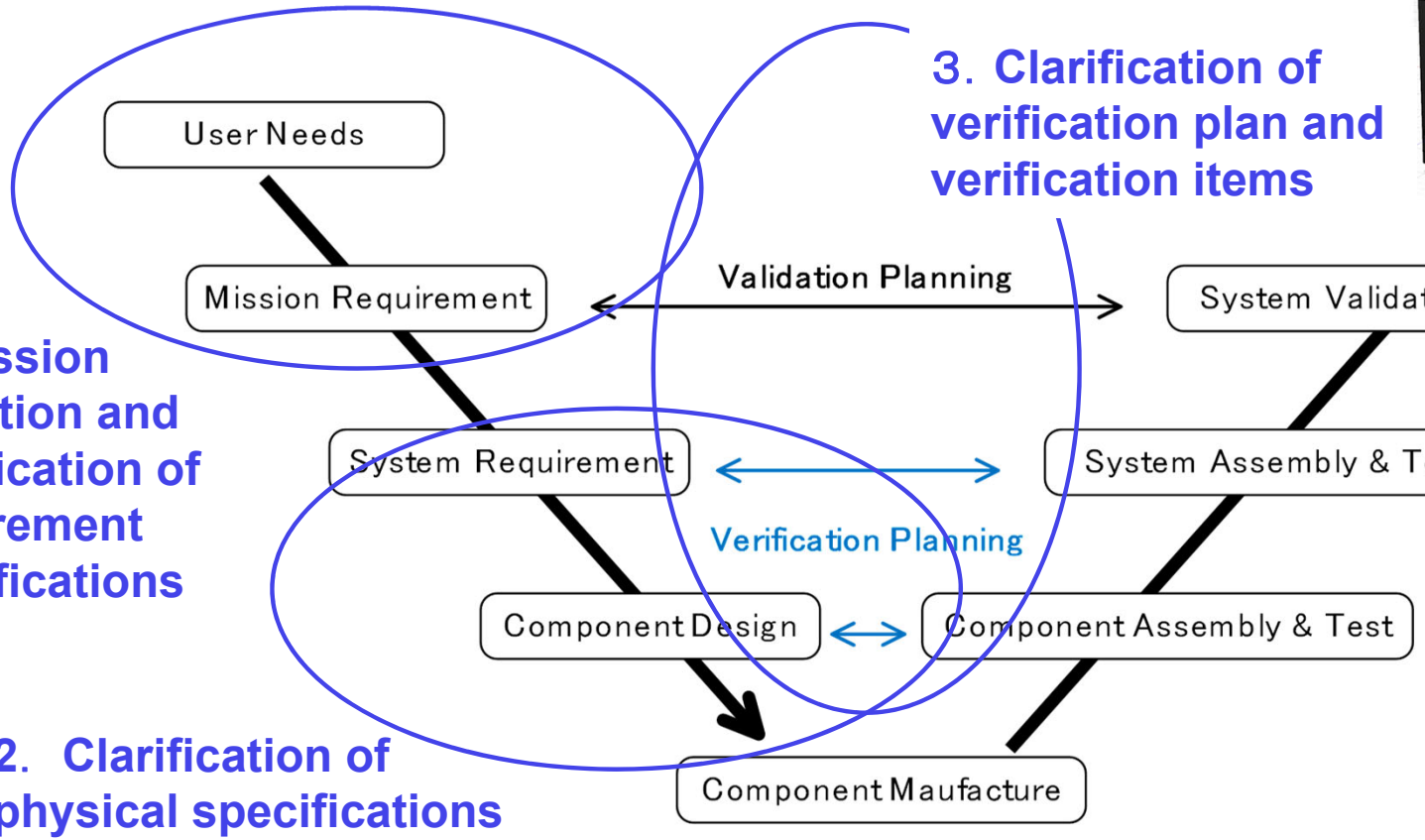


State Machine Diagram



Verification Matrix





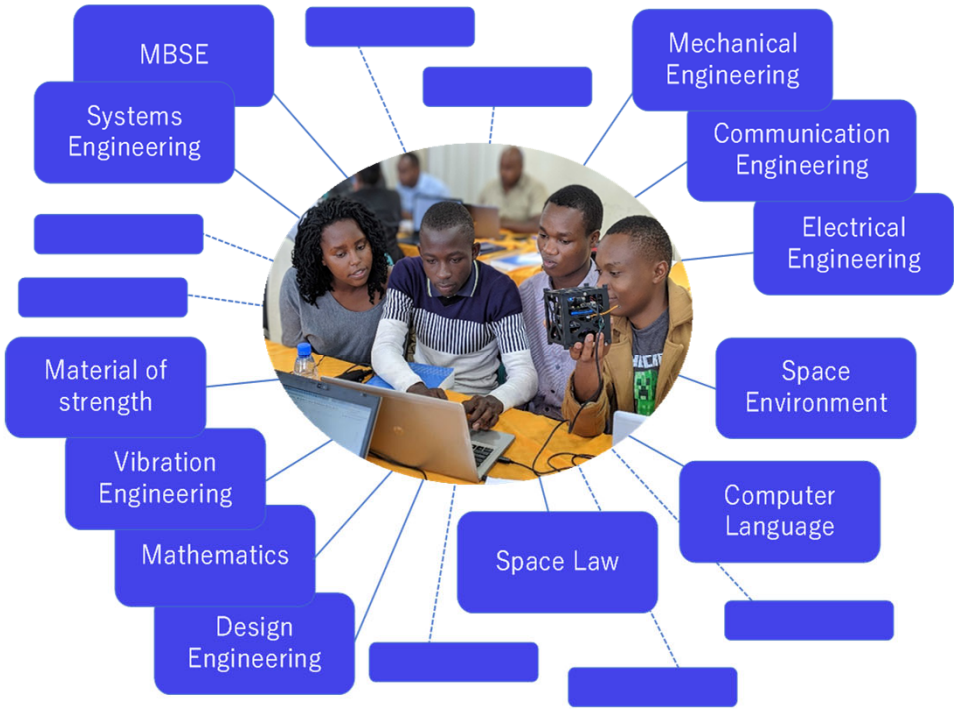
3. Clarification of verification plan and verification items

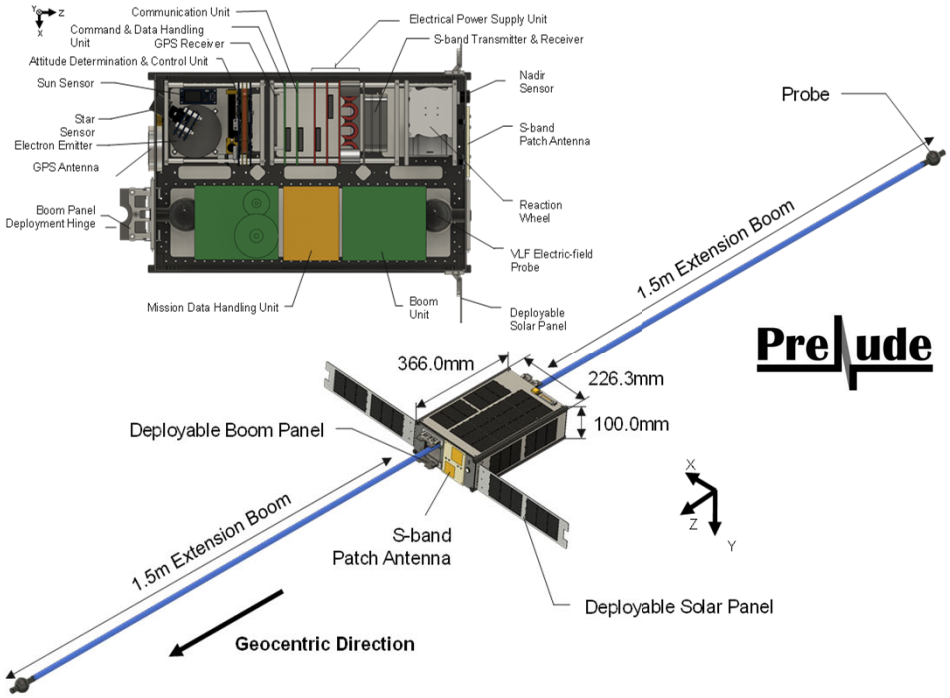
1. Mission definition and Clarification of requirement specifications

2. Clarification of physical specifications

Summary and Future work

- The HEPTA-Sat training program provides a practical space engineering education platform for engineers and non-engineers that can be learned in a short period of time to support radical collaborations among more diverse sectors.
- The Hands-on experience with some level of complexity and expansibility is a good hub/interface for connecting students with current and future disciplines.
- We would like to conduct earthquake prediction and tsunami early warning missions in the near future by using an open-design CubeSat like HEPTA-Sat, which enables the transfer of knowledge and technology, and university-originated satellite swarm observation.





Annual Training > CanSat Leader Training Program (CLTP)

- CLTP is a training program for professors/instructors to learn how to conduct CanSat (or HEPTA-Sat) training by experience. Participants are expected to teach their students after training
- **CLTP 11 Date: August 17-31, 2022 (TBD)**

http://cltp.info/

Please take the course!
And together with us, let's create a sustainable development educational platform!

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