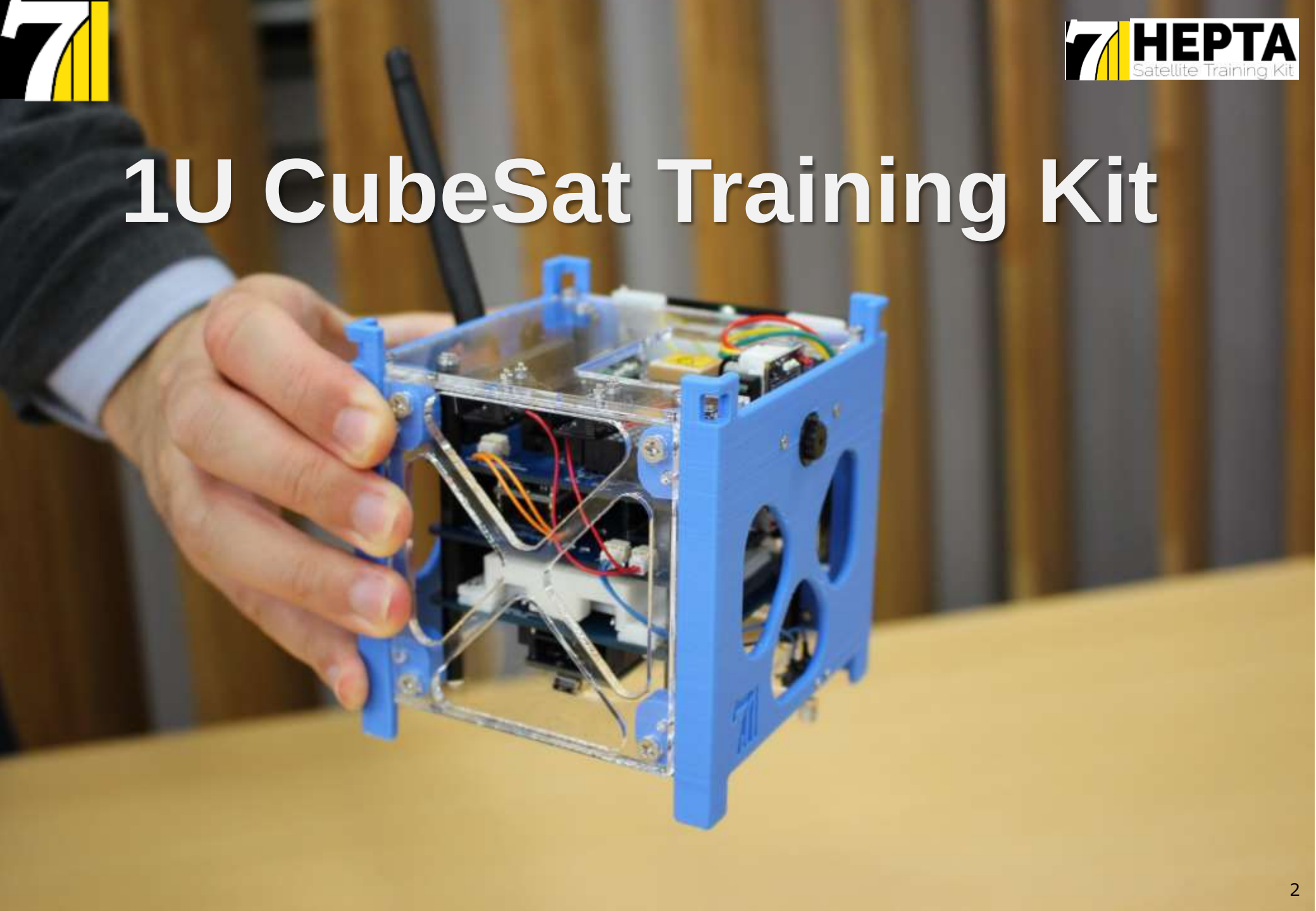
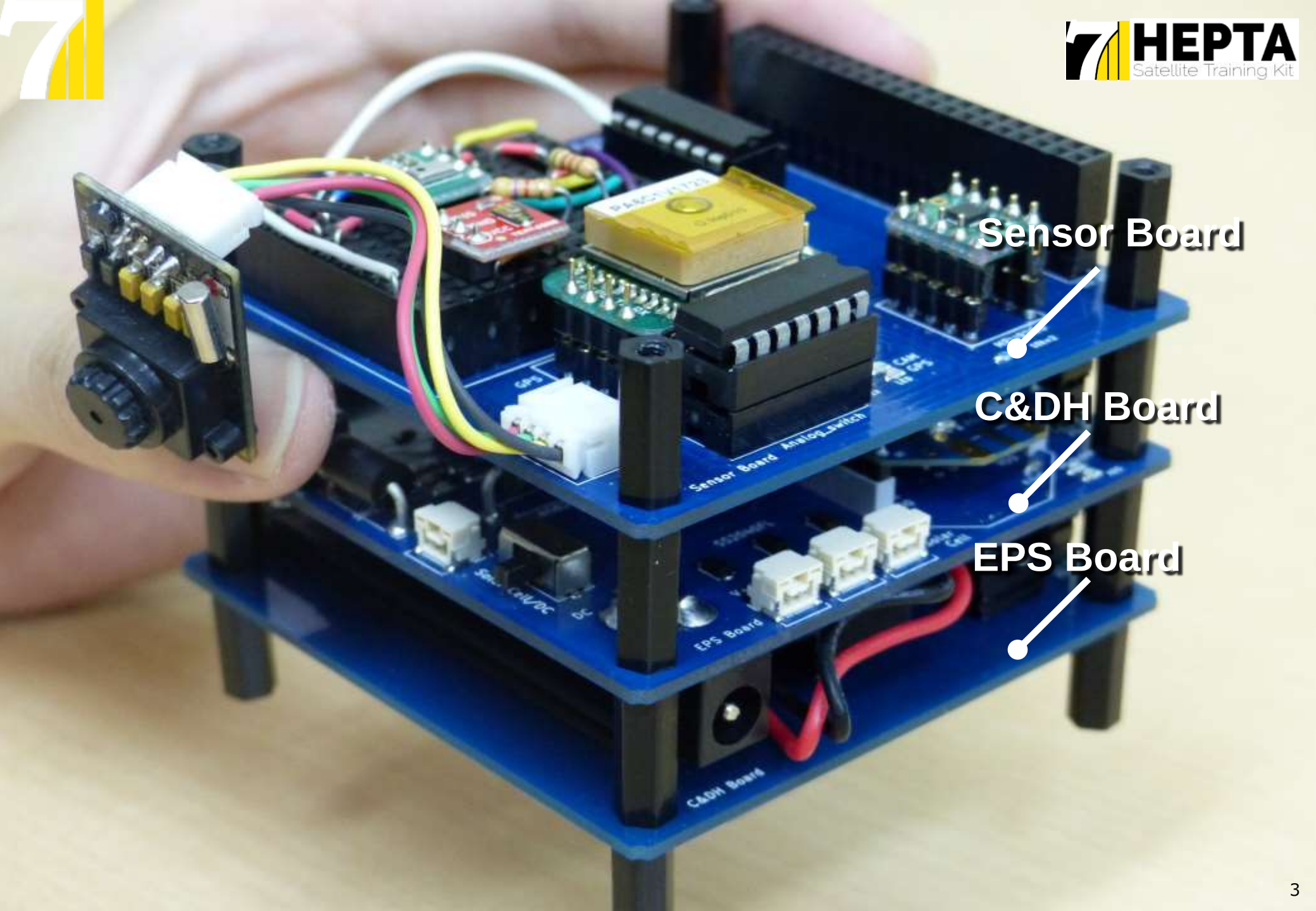
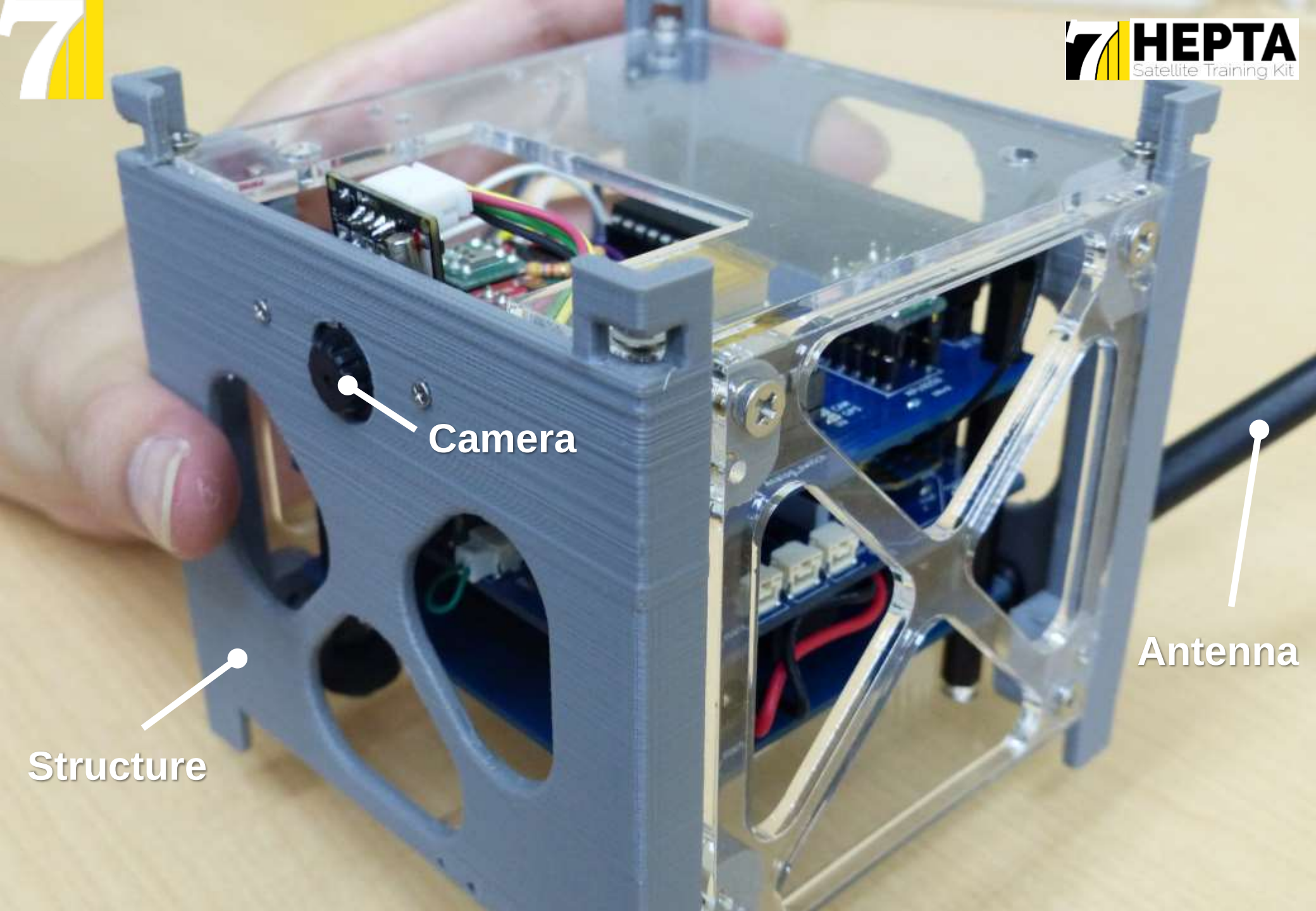
Hands-On Space Systems Engineering Education Using Pico-Satellite Training Kit HEPTA-Sat

1U CubeSat Training Kit

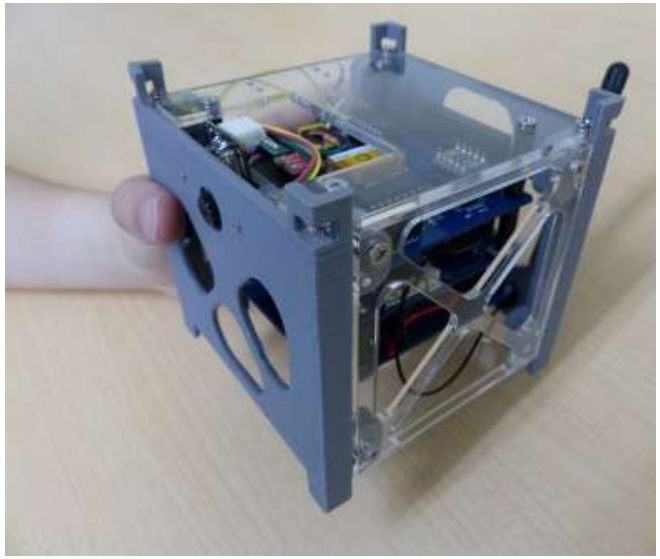



Sensor Board
C&DH Board
EPS Board


HEPTA
Satellite Training Kit
Camera
Antenna
Structure

HEPTA-Sat Training Program

Concept: "Understand basic satellite system architecture & experience pico-satellite development process"
Objective: "To gain hands-on experience in the pico-satellite development process with a constrained schedule and acquire basic knowledge of space engineering"

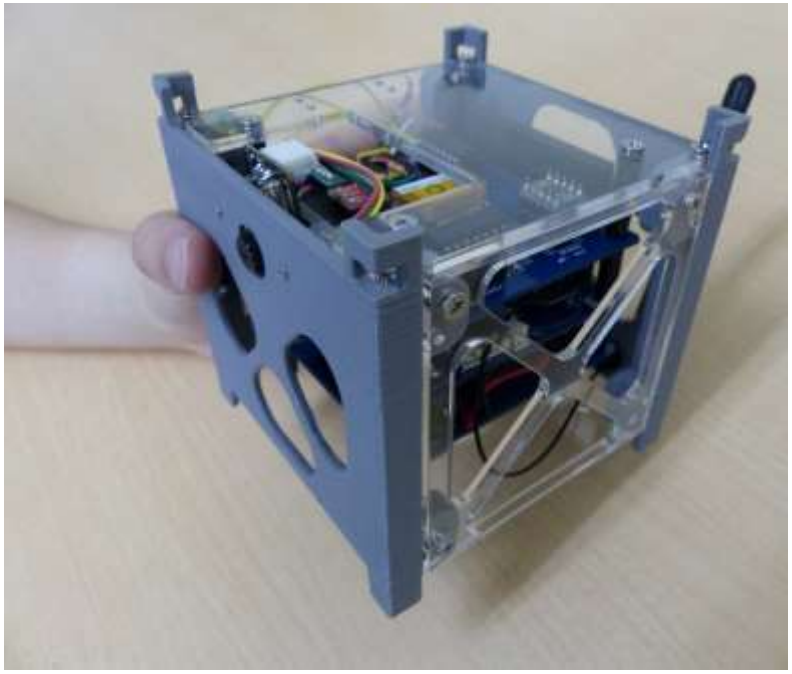


HEPTA-Sat & HEPTA-Sat Training Workshop

- Target audience of the workshop is anyone who is interested in space.
- We hope HEPTA-Sat will be widely adopted as an opportunity "to understand space engineering" or a tool "to learn pico-satellite engineering."

HEPTA-Sat Training Program

- Understand basic satellite system architecture
  & experience pico-satellite development process.

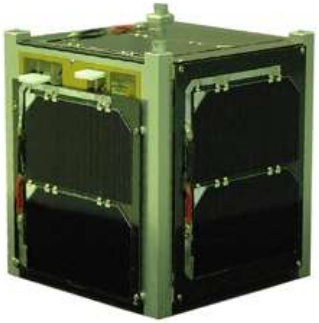


Development

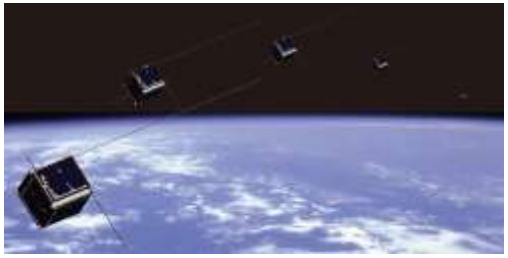
Launch

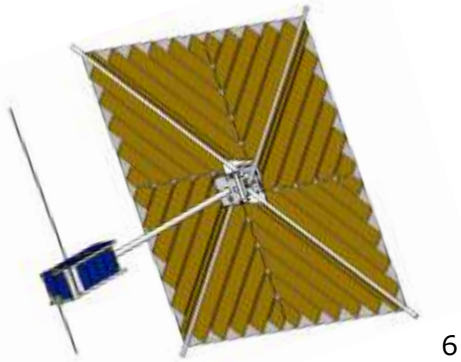
Operation

1U CubeSat



Future Missions

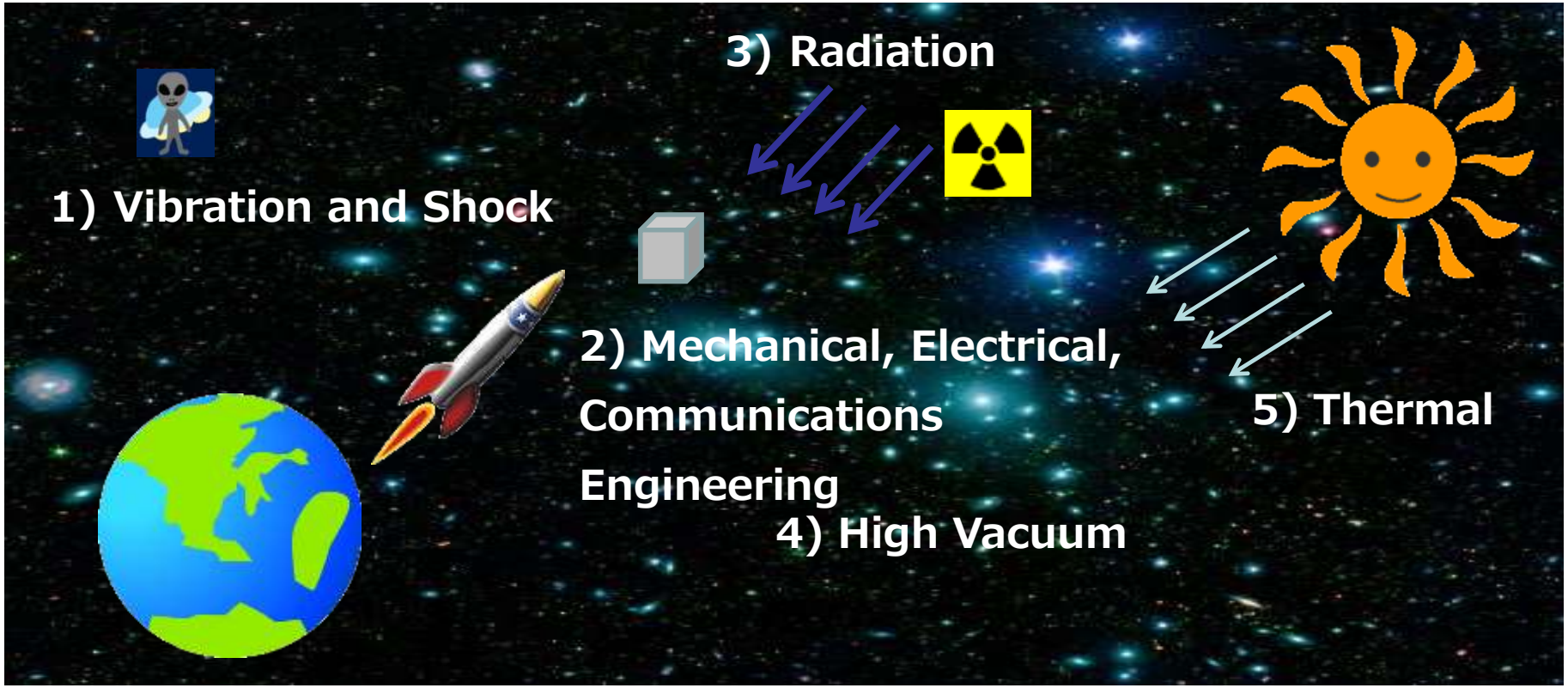




*HEPTA-Sat **Training***

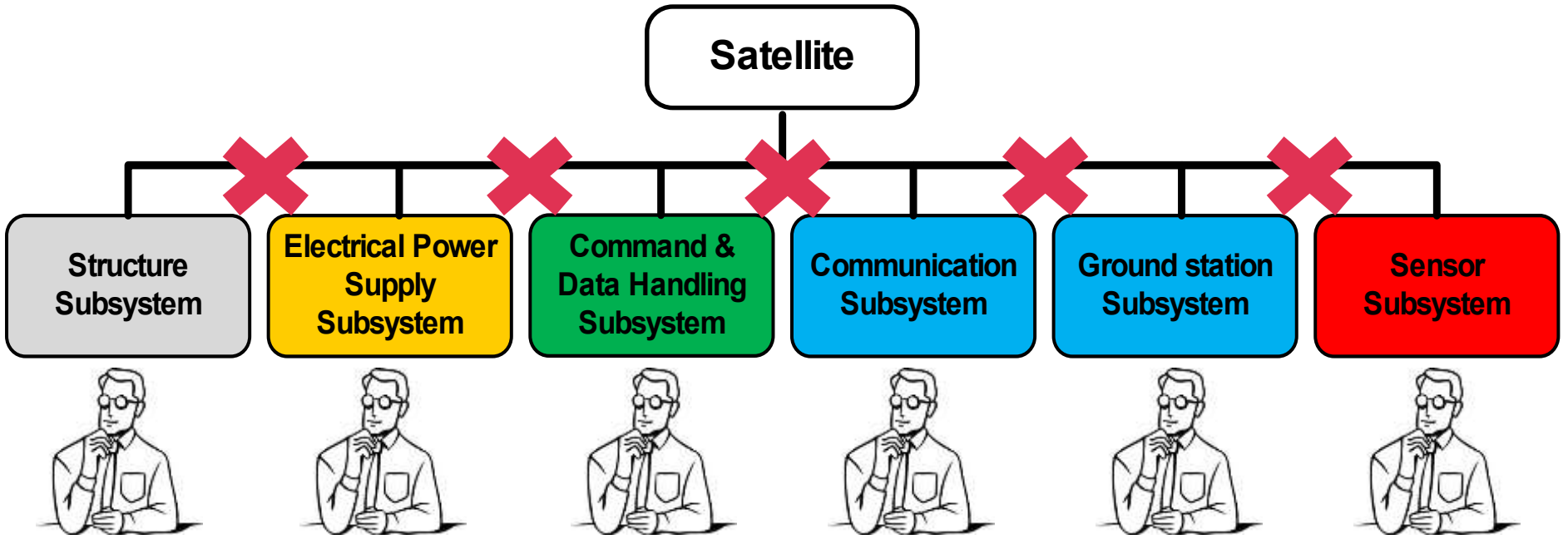
Background

- Satellite projects enable learning of **many foundational technologies**
  - Mechanical engineering, electrical engineering, communications engineering, and system integration.
  - CubeSat development project based learning is a very effective training method for learning space systems engineering.



Background

- Satellite projects enable learning of **many foundational technologies**
  - Mechanical engineering, electrical engineering and communications engineering, and system integration.
  - CubeSat development project based learning is a very effective training method for learning space systems engineering.
- Usually, it is **difficult to gain a breadth of knowledge or experience** across domains because the roles are siloed in separate subsystem teams.



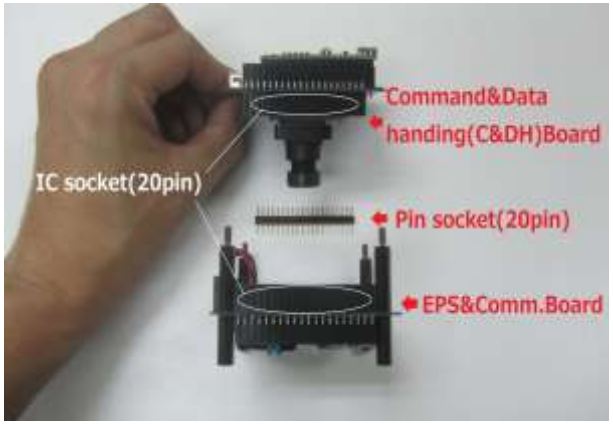
Background

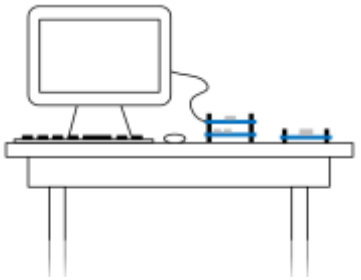
Features

- Effective and low-cost tool that enables space systems engineering education within a short period of time.
- It can be used either by an individual or team.
- Most major components are removable and can be integrated repeatedly.
- Users can design, build, and integrate their own circuit board to run an original mission.
- The textbook allows efficient and systematic self-study of the software, hardware, and pico-satellite, even for a beginner.

Self-education

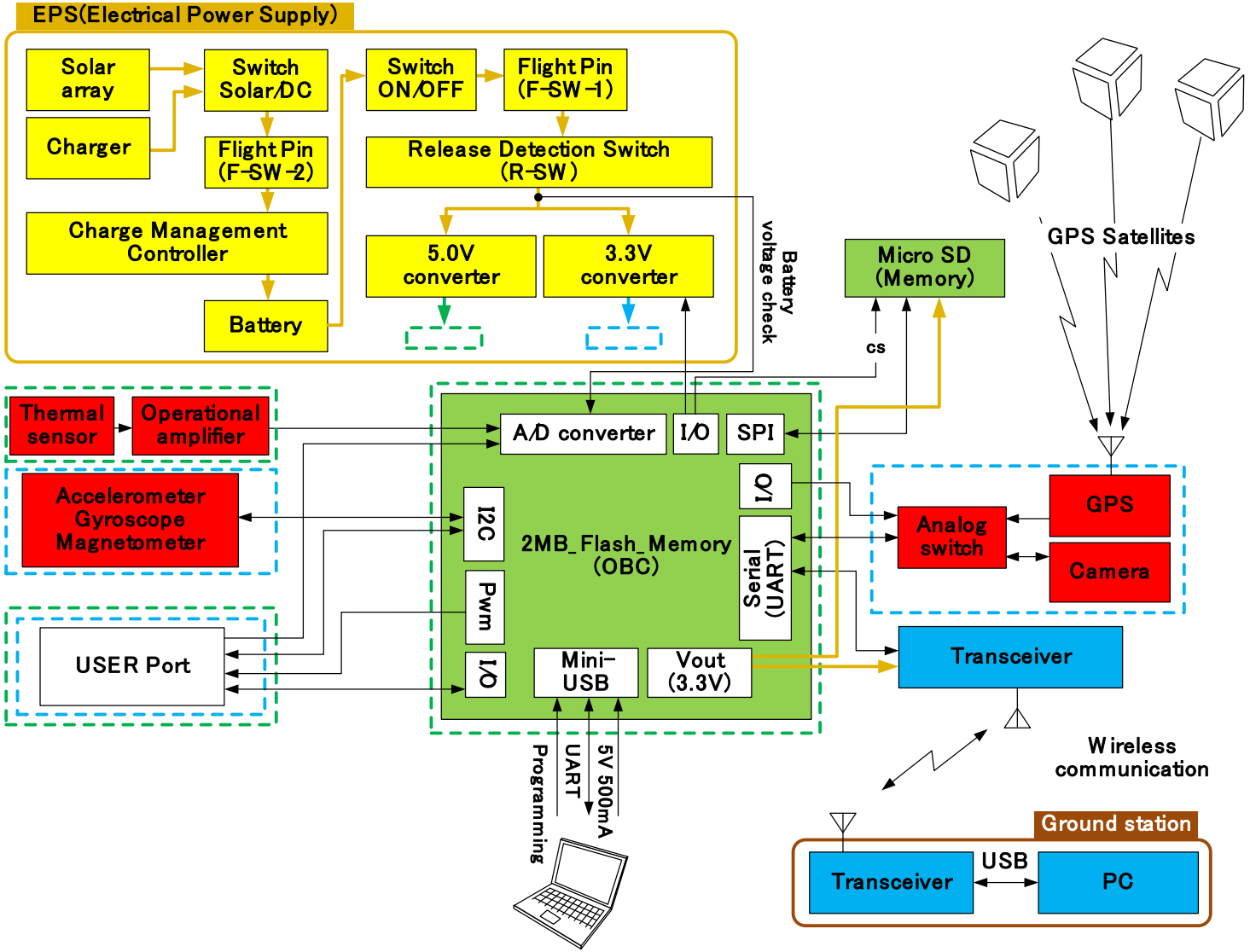
Group-education





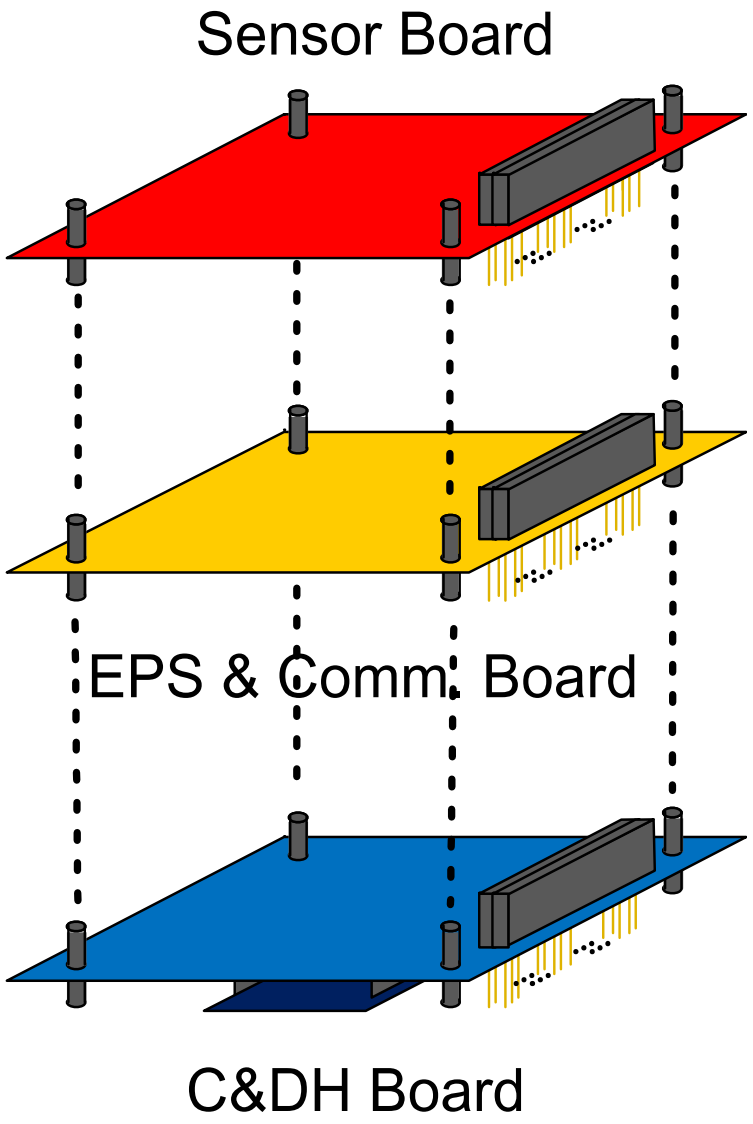
Design Overview

- Composed of 6 function and 6 primary subsystems.



Additional Information

Design Overview



Pin socket

- Electrically connected through pin-sockets. Every board has same electrical interface.

Spacer

- Physically connected and fixed with spacer.

Electrical Interface

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Upper Surface	GND	VIN	VB	nR	I/O	I/O	I/O	I/O	tx	rx	mosi	miso	sck	rx	I/O	ADC	I/O	I/O	I/O	I/O
Lower Surface	GND	VIN	VB	nR	I/O	I/O	I/O	I/O	tx	rx	mosi	miso	sck	rx	I/O	ADC	I/O	I/O	I/O	I/O

	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21
Upper Surface	VOut	VU	IF−	IF+	RD−	RD+	TD−	TD+	D−	D+	I/O	I/O	sda	scl	I/O	I/O	I/O	I/O	I/O	I/O
Lower Surface	VOut	VU	IF−	IF+	RD−	RD+	TD−	TD+	D−	D+	I/O	I/O	sda	scl	I/O	I/O	I/O	I/O	I/O	I/O

Design Overview

- A 40-pin electrical interface between the boards. Each pin has its own role.

OBC Electrical Interface Table									
Pin No.	Interface Type		Component-1		Pin No.	Interface Type		Component-1	
1	GND	0V	–	–	40	Vout	3.3V	VDD	XBee
								VDD	SD Card
2	VIN	5V	Vout	5V Converter	39	Vu	5V	Cathode	Zenerdiode
3	VB	3.3V	Vout	3.3V Converter	38	–	–	–	–
4	nR	–	–	–	37	–	–	–	–
5	mosi	SPI	CMD	SD Card	36	–	–	–	–
6	miso		DAT0		35	–	–	–	–
7	sck		CLK		34	–	–	–	–
8	Digital I/O	O	DAT3		33	–	–	–	–
9	tx	UART-1	Din	Xbee	32	–	–	–	–
10	rx		Dout		31	–	–	–	–
11	mosi	–	–	–	30	Digital I/O	I/O	–	–
12	miso	–	–	–	29	Digital I/O	I/O	–	–
13	tx	Serial	RxD	CAM	28	sda	I2C	sda	9-axis
								sda	user
14	rx	Serial	1O/I	Analog Switch	27	scl		scl	9-axis
			2O/I	Analog Switch				scl	user
15	Analog In	I	–	–	26	Digital I/O	O	EN	3.3V Regulator
16	Analog In	I	V+	Battery	25	Digital I/O	I	2C	Analog Switch
17	Analog In	I	OUTD	OP Amplifer	24	Digital I/O	I	1C	Analog Switch
18	Analog I/O	I/O	I/O	user	23	Digital I/O	I	–	–
19	Analog In	I	I	user	22	Digital I/O	I	pwm	user
20	Analog In	I			21	Digital I/O	I	pwm	user

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