



From High Schools to High Altitude: Advancing High-School-Level Engineering through Stratospheric Balloon Platforms for CubeSat Development and Scientific Exploration

**Vivatsathorn Thitasirivit, Krin Kawewongsunthorn, Chayanin Uthanpathumros,
Suvijak Piyanophaioj, Anonphat Thanasawangkul, Phachara Phumiprathet**

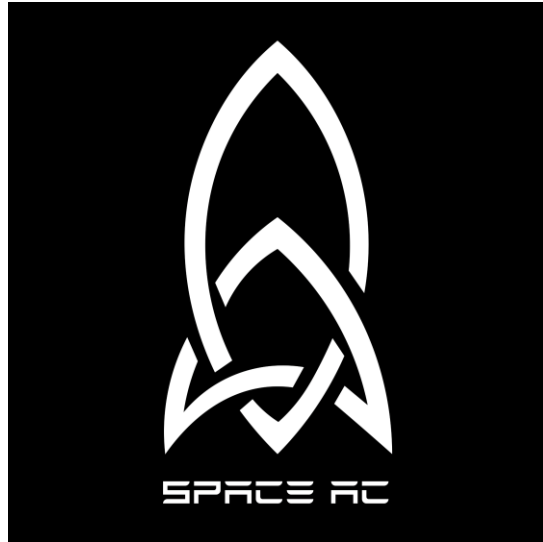
Chulalongkorn University

SPACE AC Institute of Technology

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Outlines

- Backgrounds and Introduction
- Project Showcase
- Results
- Future Projects



SPACE AC Institute of Technology:
Thailand's premier project-based space
technology education institute.



Who are we?

SPACE AC Institute of Technology

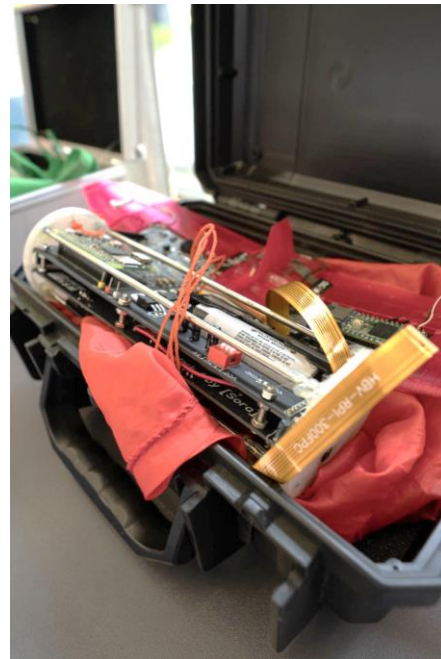
Sounding Rocket

Nanosatellite
and CanSat

UAV Development

Space Science
and Research

Outreach, STEM
and Public Events



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The **"Passenger"** Project:
Thailand's first high-school HAB project aiming
to provide opportunity and develop students
using accessible space technology.



“Passenger”: Project-Based Learning

Objective Expectations

- Advance our technological capabilities through student-led projects.
- Provide a high-altitude balloon platform for space-related research across partnered institutions.
- Inspire the youth interested in space technologies by making “space” more accessible and reachable.

Human Resource Development

- Enhance both technical skills and transferrable skills through advanced space projects.
- Deliver skillful manpower to engineering and space technology community.

“Passenger”: Project-Based Learning

Key Activities

1. Research: Investigate current HAB technologies and applications.
2. Project Planning: Develop detailed plans for project execution.
3. Design: Create design drafts, technical designs, component and hardware selection, and programming for the HAB.
4. Prototype: Build and test prototypes of the balloon and payload.
5. Implementation & Deployment: Integrate and launch the HAB and collect data for analysis.

“Passenger”: Project-Based Learning

Assessment Criteria

- Primary Mission
 1. Be able to collect basic atmospheric data.
 2. Be able to launch the payload to the apogee of 20 to 45 km AGL.
 3. Be able to reliably track the payload location in real time.
 4. Be able to successfully recover the payload.
- Skills
 1. Innovation and Creativity: Originality and practicality of the HAB design.
 2. Technical Accuracy: Precision and reliability of the prototypes and final deployment.
 3. Research Depth: Comprehensive understanding and application of HAB technologies.
 4. Team Collaboration: Effectiveness of teamwork and communication among students.
 5. Community Engagement: Level of involvement and impact on the local community and educational institutions.

Development Phases of “Passenger”

Technological Infrastructure Development (2019 – 2021)

- Introduces Passenger Project specialization for each mission from different agencies.

- Focuses on developing basic knowledge and foundations of HAB experiments.

Balloon Platform as a Service (BPaaS) (2022 – 2024)

- Aimed at creating a model for the development of youth engineers through Passenger Project.

Outreach and Networking (2023 – Present)

2019

Future

Our HAB Project Iterations

- **Passenger-I (2021)**
 - coop. with LESA, National Institute of Measurement Thailand, Chulalongkorn University, and KMITL
- **Passenger-II (2021)**
 - coop. with LESA, National Institute of Measurement Thailand, Chulalongkorn University, and Suranaree University of Technology
- **Passenger-III (2022)**
 - coop. with LESA and Mahidol University
- **SG CubeSat-Balloon Camp (2023)**
 - coop. with EECi, Wangchan Valley Project by PTT and Mahidol University
- **Passenger-IV (2023)**
 - coop. with Bangkok Christian College and KVIS
- **Passenger-V (2024)**
 - coop. with Mahidol University

- *Many more future projects*



Project Showcase Passenger-I



- Our Projects

- Our first nanosatellite to go to near-space environment.
- Testing of Digital FPV camera transmission.
- Testing of LoRa, RFD900x (FHSS) wireless radio communication for data telemetry.

- Partners' Projects

- Testing of self-calibrated BME280 atmospheric sensor in troposphere and stratosphere environments
- Comparison of monopole antenna and Yagi-Uda antenna in long-range communication.



Project Showcase

Passenger-I



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Project Showcase

Passenger-I



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Project Showcase Passenger-II



- Our Projects

- Custom-built automated antenna tracking system
- 1W long-range communication system with redundancy transmitter

- Partners' Projects

- Testing of self-calibrated BME280 atmospheric sensor in troposphere and stratosphere environments
- Testing of Lithium titanate battery in troposphere and stratosphere environment



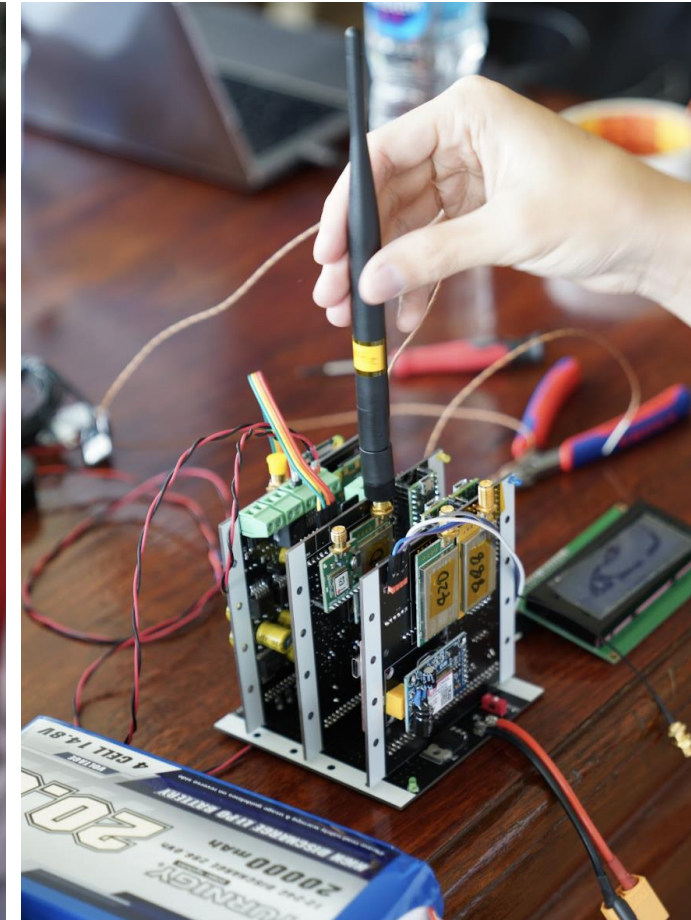
Project Showcase

Passenger-II



Project Showcase

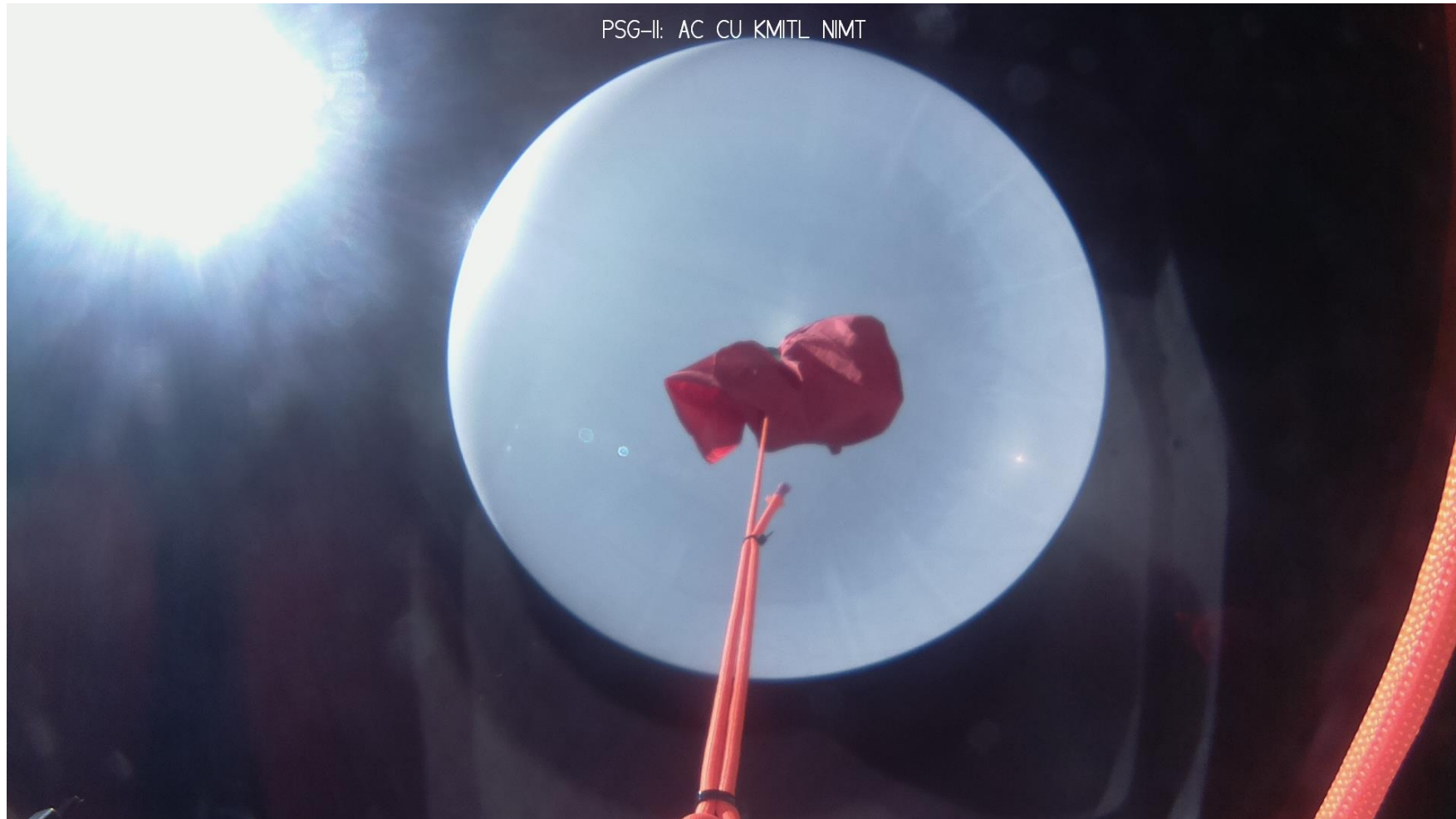
Passenger-II



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Project Showcase

Passenger-II



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Project Showcase Passenger-III



- Our Projects
 - Re-evaluation of 1W long-range communication system with redundancy transmitter
- Partners' Projects
 - Biological response of living organisms in near-space environment



Project Showcase

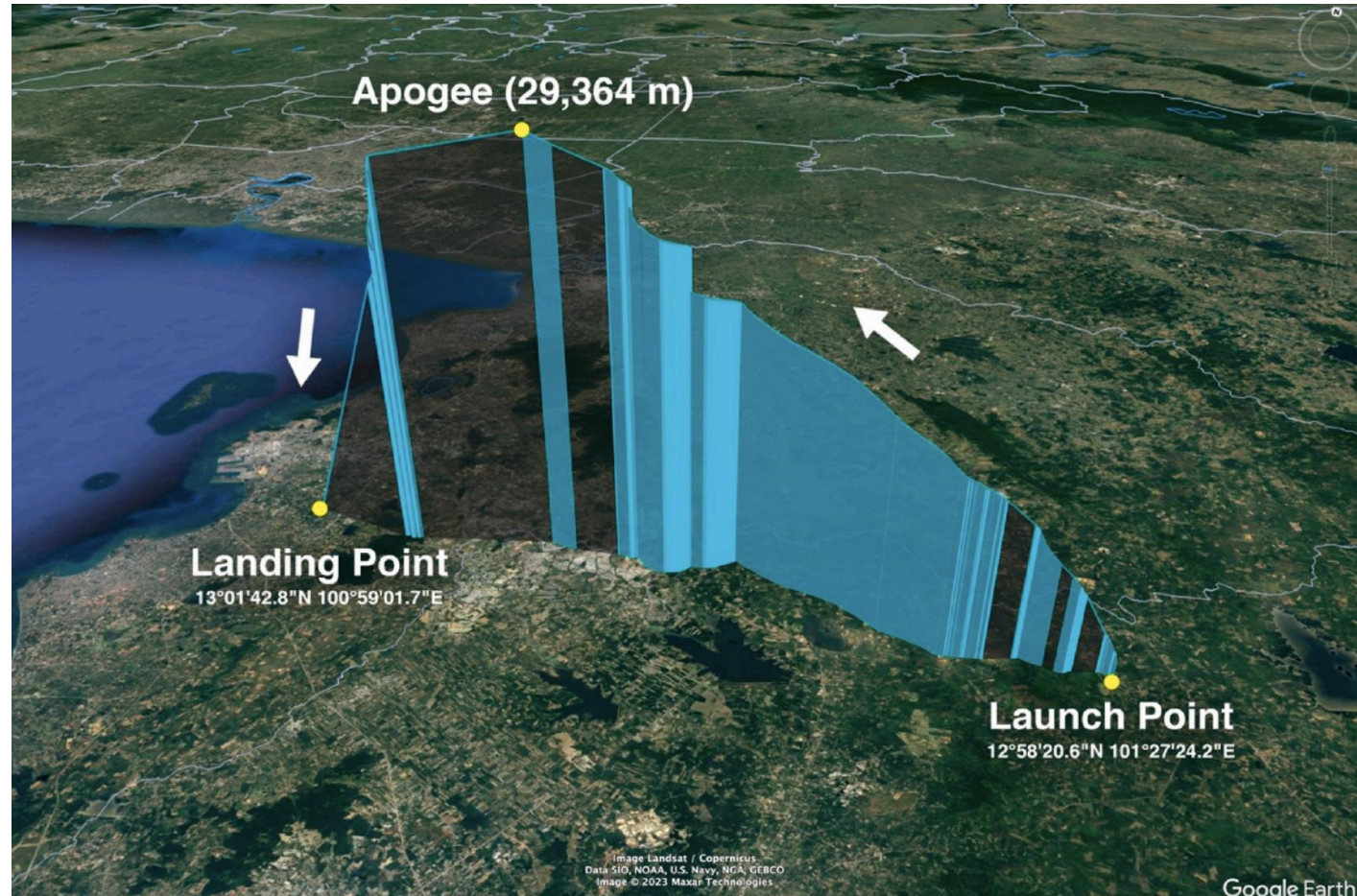
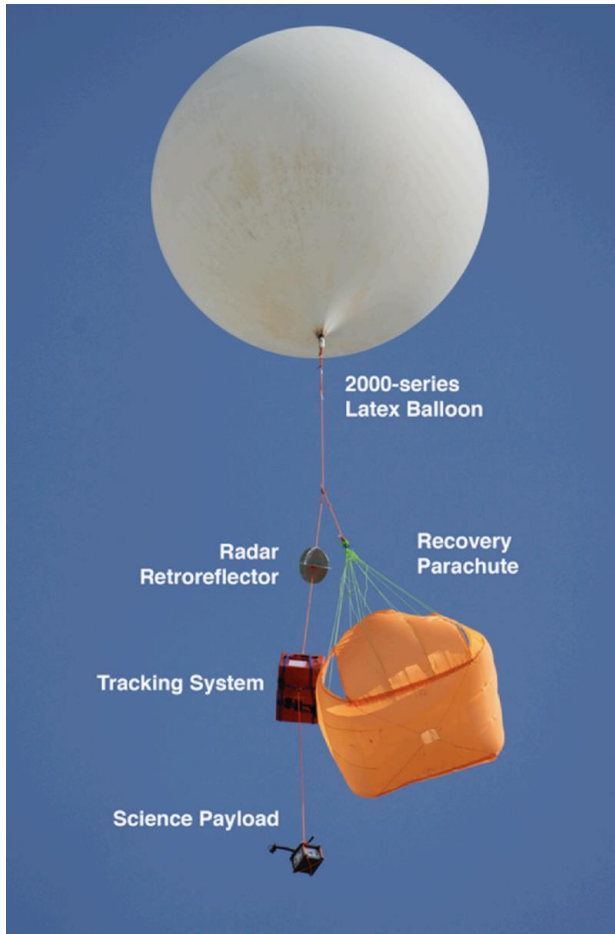
SG CubeSat-Balloon Camp

- Thailand's first and only HAB workshop camp
- Prototype learning model
- Provide workshop and DIY CubeSat kit to schools.
- More than 50 students from 5 schools with total of more than 100 people have participated.
- Collaborated with more than 20 agencies.



Project Showcase

SG CubeSat-Balloon Camp



Project Showcase

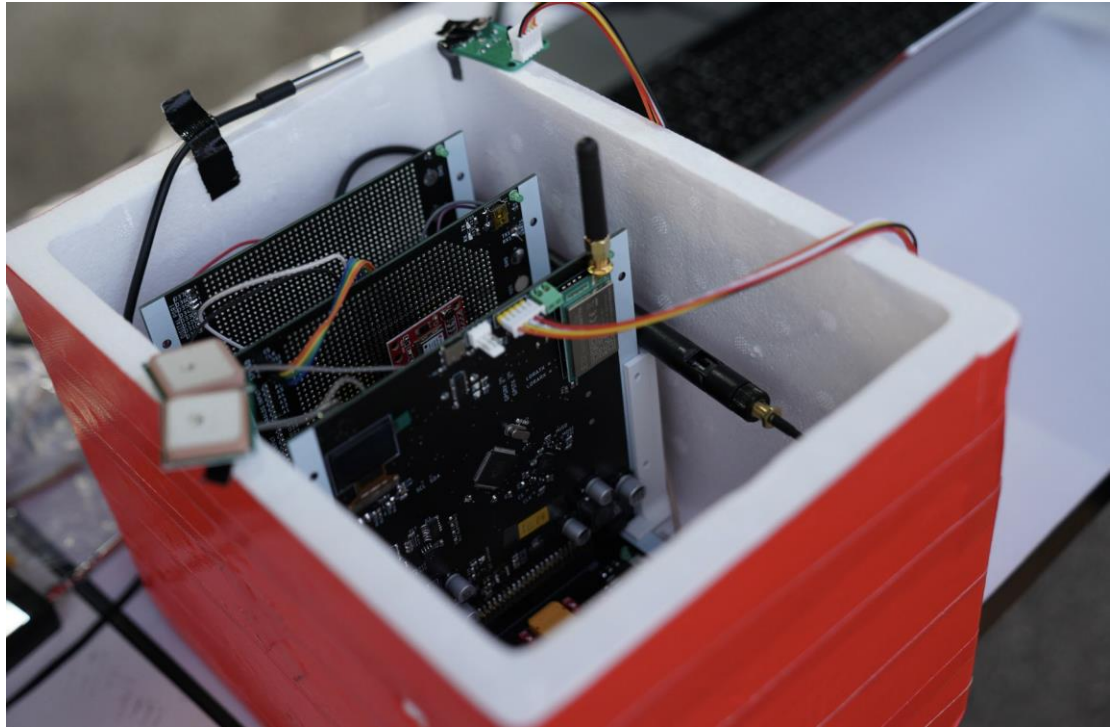
SG CubeSat-Balloon Camp



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Project Showcase

SG CubeSat-Balloon Camp



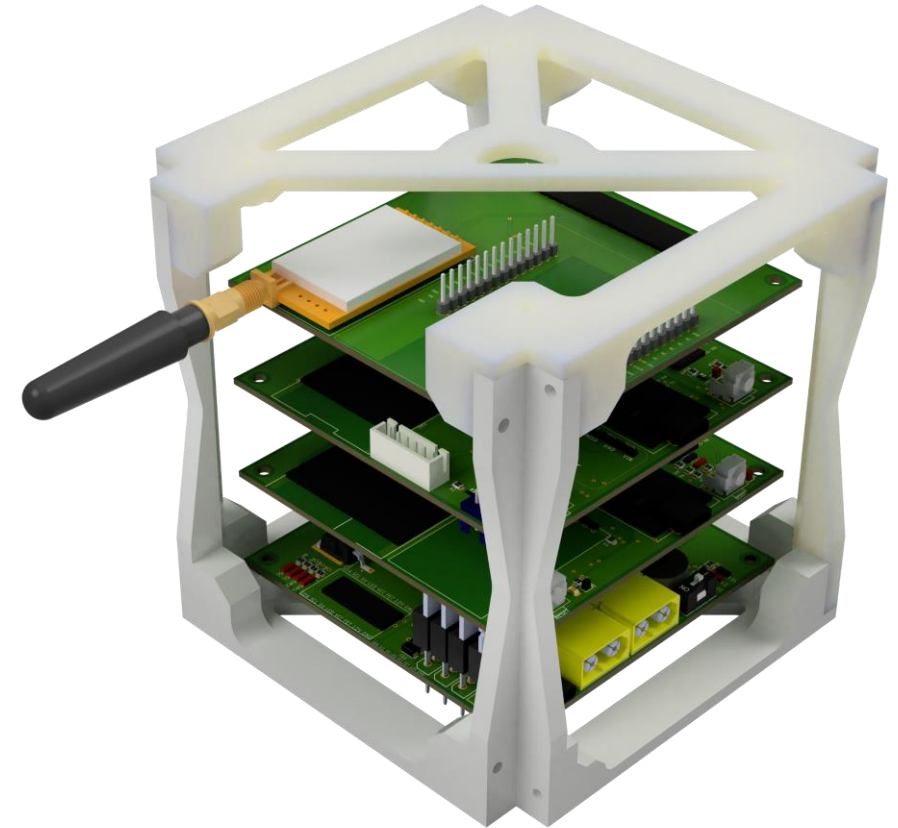
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Project Showcase

Passenger-IV



- Our Projects
 - 5-Watt long-range wireless communication (LoRa)
 - High-power Electrical Power Subsystem and full-scale system redundancy
- Partners' Projects
 - Application of commercial automatic antenna tracking system
 - Commercial grade sensor range and reliability test in near-space environment

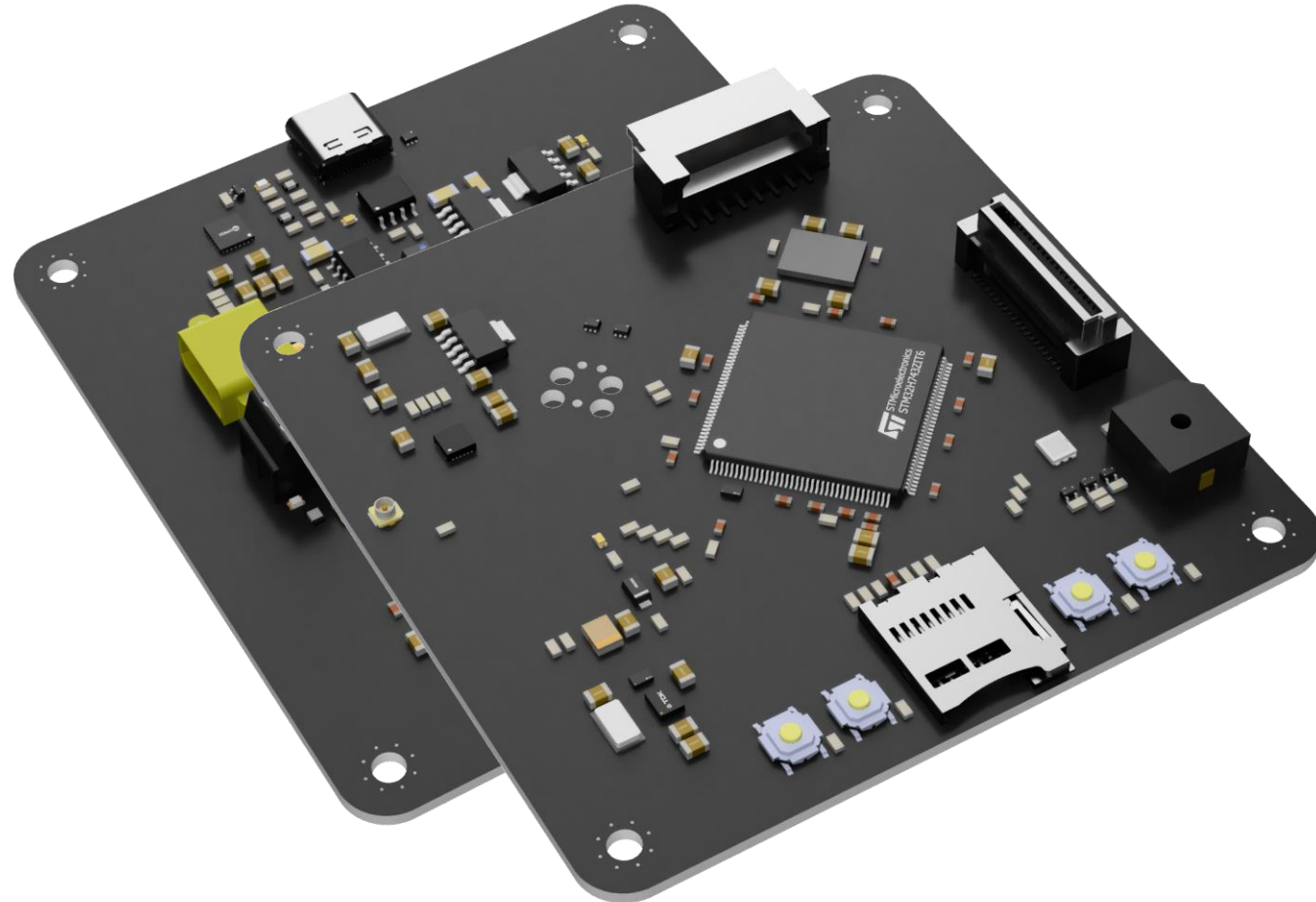


Project Showcase

Passenger-VI (To be launched this August)

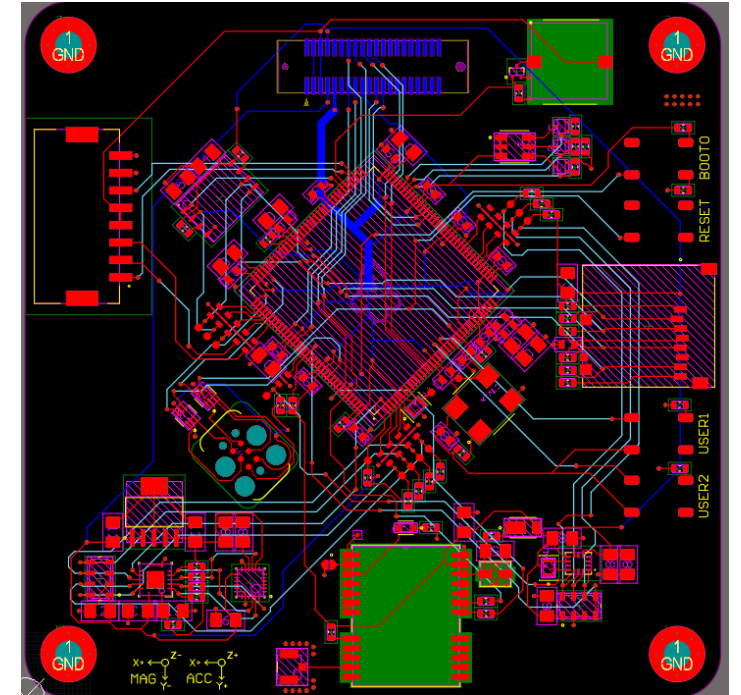


- Our Project Goals
 - To create most reliable and power efficient nano-satellite with ultra long-range data transmitter fully design and build inhouse using all SMD components
 - Aiming to be our most compact and versatile nano-satellite platform



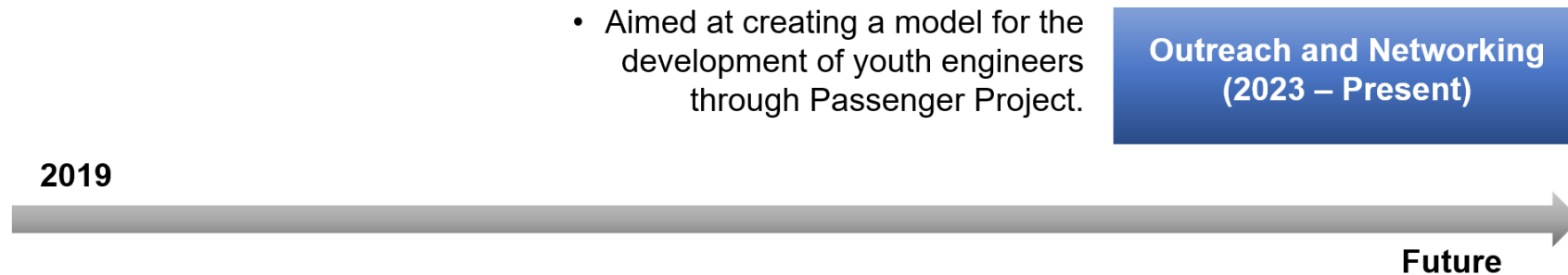
By-products from “Passenger” Project

- Reliable long range wireless communication system design
- High efficiency Electricity Power Subsystem design
- Recovery Harness Model
- Microcontroller programming libraries
- In-house open-source software
- Electronics Design footprints
- Experiences gained from the project
- Tentative problem-solving and critical problem-solving skills
- And much more!



Future Projects (2024 onwards)

- Advance our technological capabilities to support more technically challenging projects
- Partner up with science and engineering institutions
- Scale the project to remote communities at national level and international level
- Scale the project to higher altitude, higher payload mass, and longer flight time



Thank You!