＝Drones Flying Together: Our Aims for Society＝

Drones and Robots for Ecologically Sustainable Societies Project

March 14, 2019

National Research and Development Agency
New Energy and Industrial Technology Development Organization （ＮＥＤＯ）
Robots/AI Division

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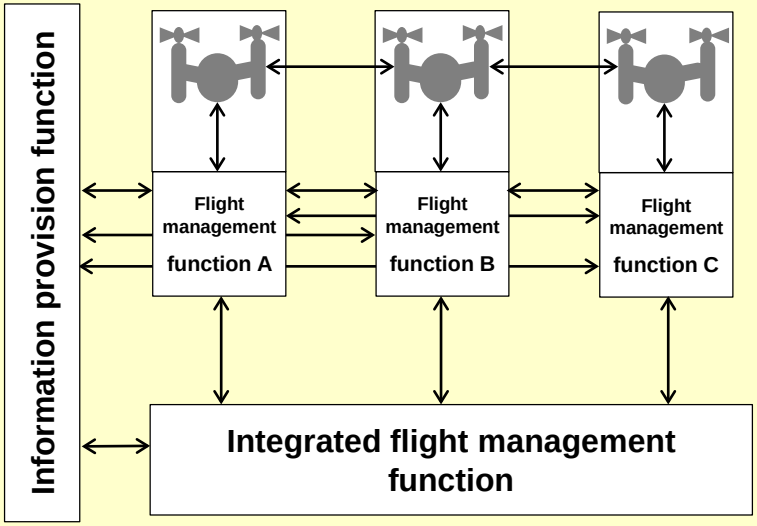
Project Overall Outline

Project Overview
(2017-2022: 5 years, 2018 budget: 3.2 billion yen)

- The use of drones and robots is expected to help conserve energy, particularly in the logistics sector where there is a priority on energy-efficiency from the increase in transportation of small deliveries and lighter load ratios, as well as the infrastructure inspection sector where there is an urgent need to reduce the use of resources by ensuring a longer operating life through effective and efficient inspections.
- This project aims to encourage the development of drones and robots that can be used in sectors and fields such as logistics, infrastructure inspections and disaster response, while also establishing systems and running test flights in preparation for utilization in society.



Conceptual image of drone flight control system

[1] Development of performance evaluation methods for robot and drone devices

(1) R&D of performance evaluation methods (2016 - 2017 + (2018 - 2019)

Establish performance evaluation methods for each sector and robot type, for various types of robots (including drones, land-based robots and underwater robots).

(2) R&D to improve energy-saving performance (2017 - 2019)

Develop technology for efficient energy systems required for increasing the continuous operating time of various robots.

[2] Development of drone flight control systems and collision avoidance technology

(1) Development of drone flight control systems (2017 - 2019)

Develop various functions and systems to ensure that drones can be operated safely, based on the project's flight control systems comprised of information provision functions, flight control functions and integrated flight control functions.

(2) Development of drone collision avoidance technology (2017 - 2019)

Develop technology that enables drones to detect objects and other items on land and in the midair, so that they can fly by avoiding collisions with those objects in real time.

[3] Promotion of international standards related to robots and drones

(1) De jure standards (2017 - 2021)

Gain an understanding of the workings of international organizations promoting standardization, continue research and development at an international level, and carry out the activities needed to link the results of this project to international standardization.

(2) De facto standards (2017 - 2020)

Promote methods to increase competition in development, with Japan-based rules, by gathering information on global trends in the newest technology and bringing it to Japan.

Project Overall Schedule

R&D Item			2016	2017	2018	2019	2020	2021
[R&D Item [1]] Development of performance evaluation standards for robot and drone devices	(1) R&D of performance evaluation methods							
	(2) R&D to improve energy-saving performance							
[R&D Item [2]] Development of drone flight control systems and collision avoidance technology	(1) Development of drone flight control systems	1) Development of integrated flight control function						
		2) Development of flight control function (for logistics and disaster response)						
		3) Development of flight control function (for remote islands)						
		4) Development of information provision function						
		5) R&D of overall design of flight control systems						
	(2) Development of drone collision avoidance technology	1) Non-collaborative SAA						
		2) Collaborative SAA						
[R&D Item [3]] Promotion of international standards related to robots and drones	(1) De jure standards							
	(2) De facto standards (World Robot Summit)							

Overall coordination including training of human resources and industry-academia cooperation at the core of the NEDO project, special courses related to the “Robots performance evaluation methods”.

Flight Management System Development Agencies/Flight Management Functions

【Overall Planning】Japan Aerospace Exploration Agency

Information Providers

Zenrin Co.

Japan Weather Association

Flight Management

NTT DOCOMO, INC.

Rakuten, Inc.

Flight Management

KDDI Corporation

Terra Drone Corporation

Flight Management

Hitachi, Ltd.

National Institute of Information and Communications Technology

Flight Management

SKY Perfect JSAT Corporation

Flight Management

SUBARU

JRC Nihon Musen

Mitsubishi Electric Corporation

Nippon Avionics Co.

Autonomous Control Systems Laboratory, Ltd.

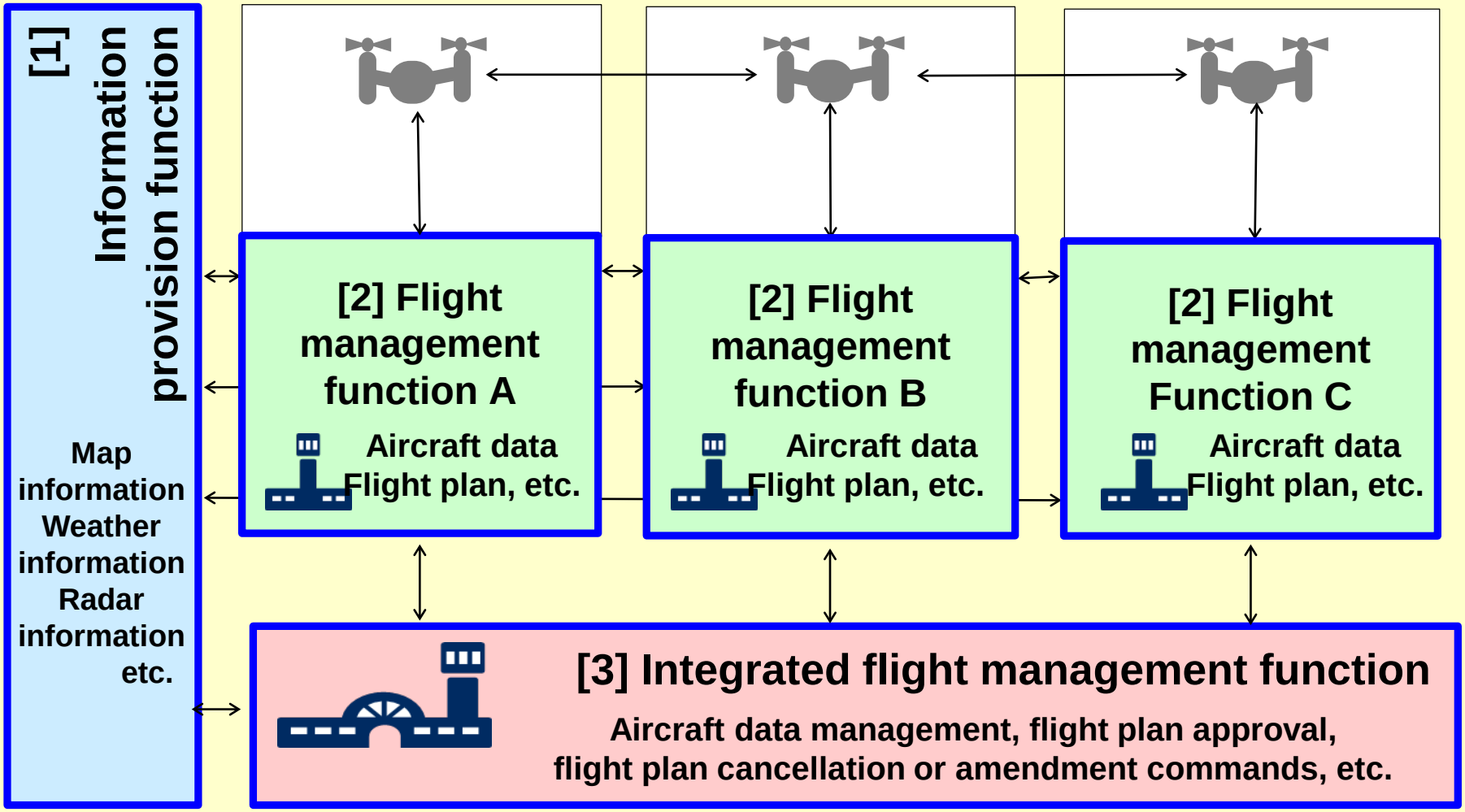
Integrated Flight Management

NEC Corp./NTT Data Corporation/Hitachi, Ltd.

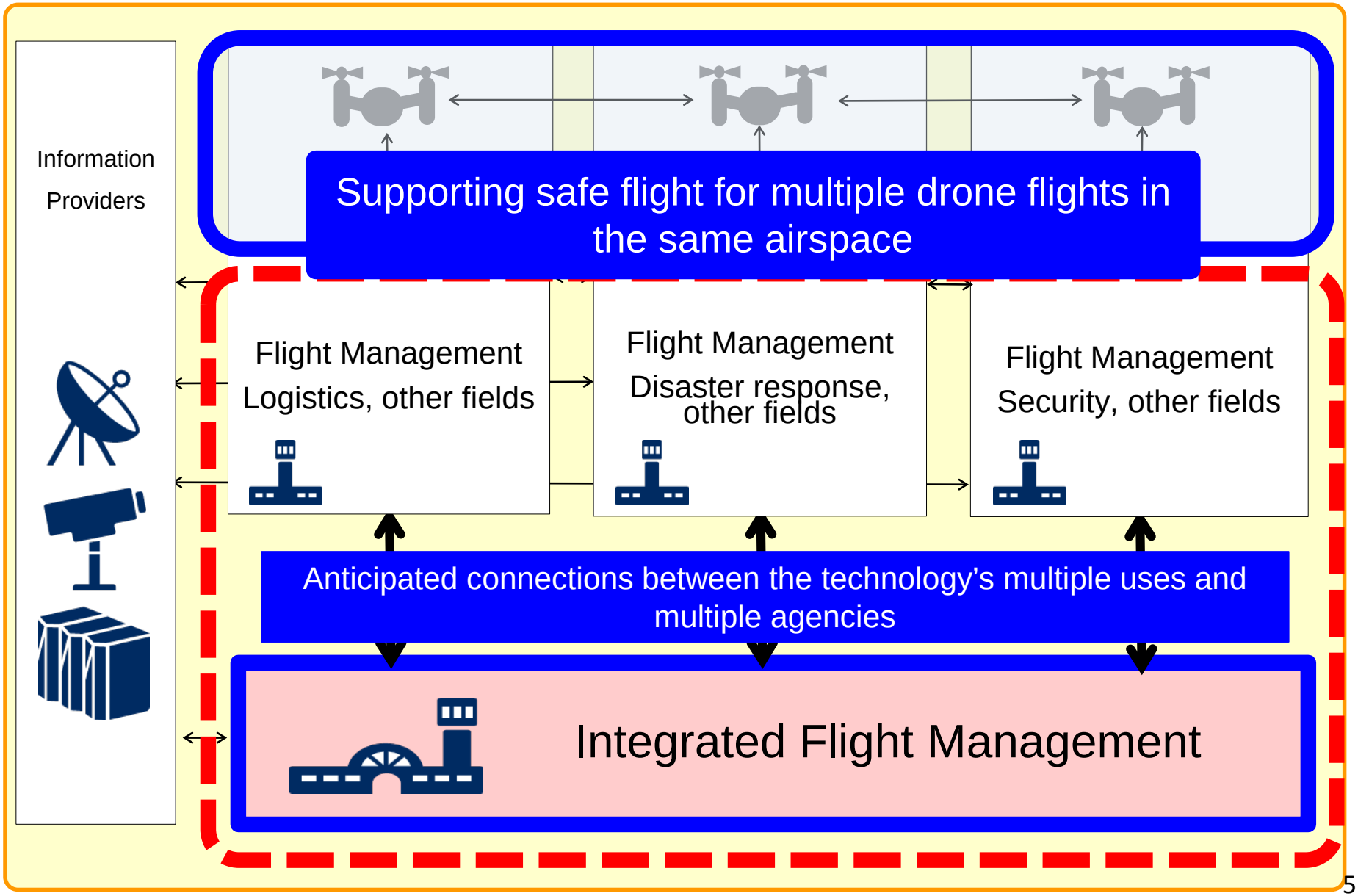
Providing Safe, Secure and Efficient Services

Key concern: If there are so many drones flying around in the air at the same time, "won't they hit each other?"

Multiple drones in the same airspace: development of flight control systems



Connecting the Multiple Uses of This technology with Multiple Agencies / Flight Management Integration



Introduction to Project Initiatives

Preliminary Test of Long-Distance Drone Flight

Long-distance package delivery with a fully autonomously-controlled drone
January 12, 2017　Namie – Minamisoma, Fukushima

A drone for the test

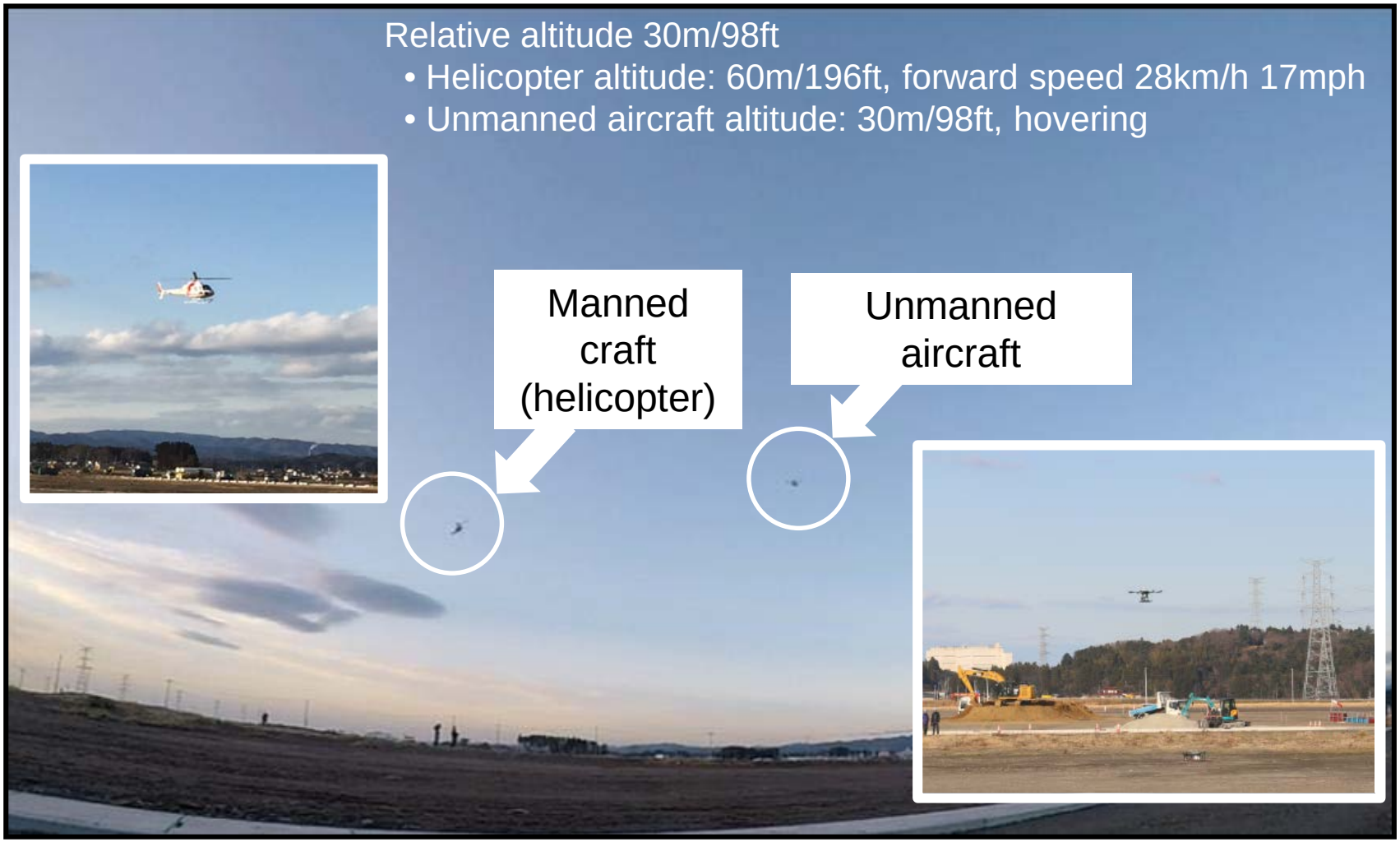
During the test (altitude: 50m/164ft)

http://www.nedo.go.jp/news/press/AA5_100704.html

Delivered the package (soup)

Japan's first safety performance test with a helicopter and an unmanned aircraft in the same airspace

December 11-22, 2017 at Fukushima Robot Test Field



http://www.nedo.go.jp/news/press/AA5_100887.html

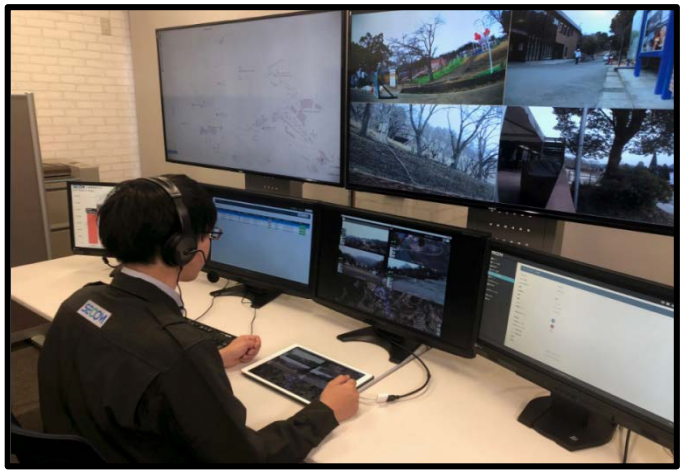
R&D for remote security patrol using multiple drones

Using multiple drones which are operated autonomously using 4G LTE for wide-area security patrol

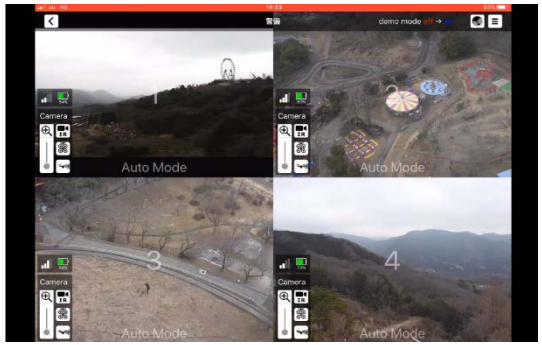
March 15, 2018 at an amusement park in Kanagawa

Base Station　Flight Management System

Sagami Lake Resort Pleasure Forest



Flight Management System



Security software

Night security

Drone

http://www.nedo.go.jp/news/press/AA5_100928.html

Developing collision avoidance technology for unmanned aircraft

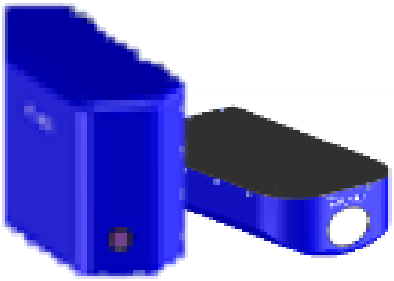
We are developing autonomous dynamic rerouting technology for unmanned aircraft using the Quasi-Zenith Satellite System

June 13-15, 2018 at Location Business Japan 2018 (exhibit)

Quasi-Zenith Satellite corresponding receiver

Configuration of autonomous dynamic rerouting technology

Radio wave sensor



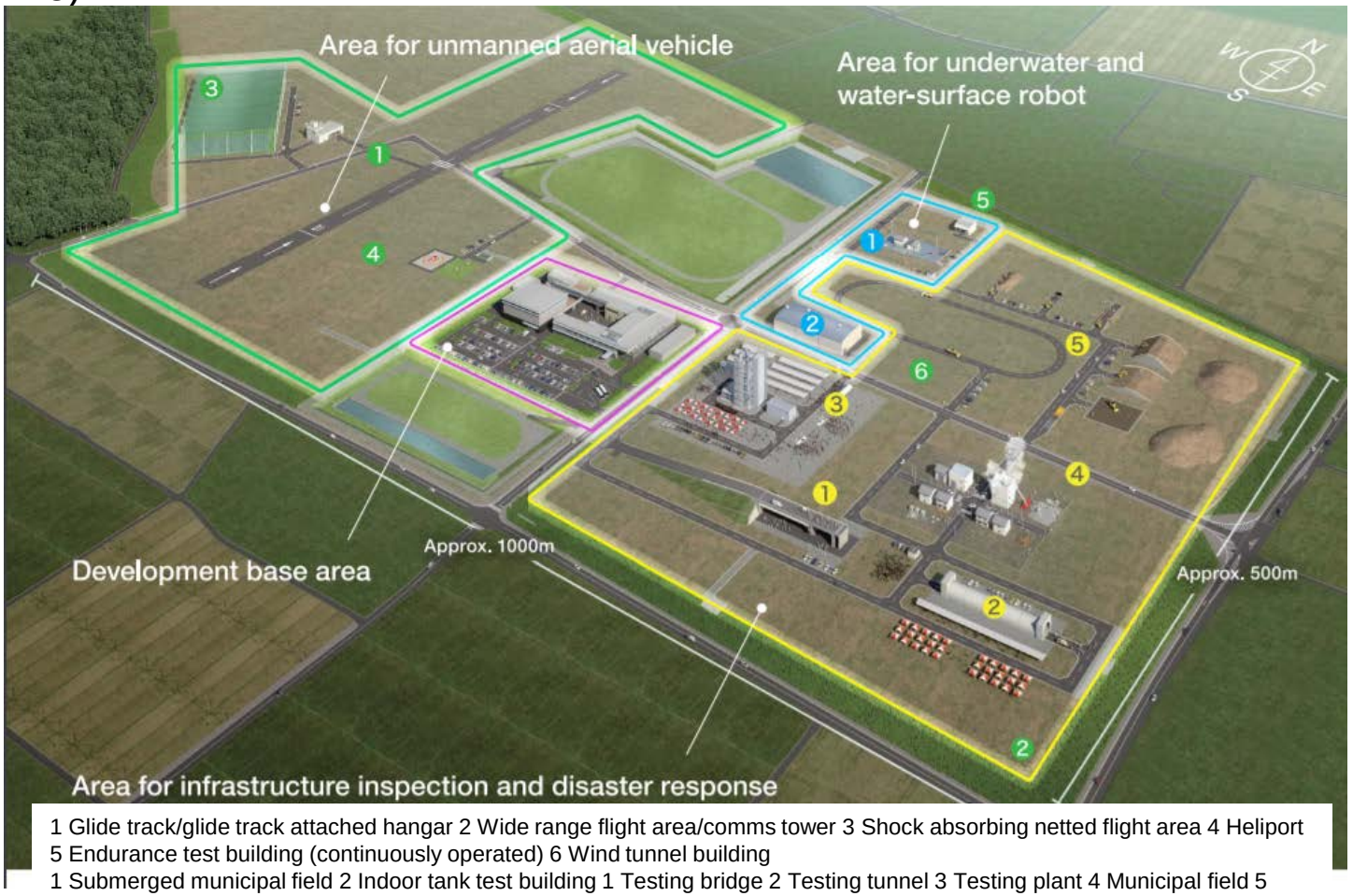
Light wave sensor

Autonomous management device

Our Cooperation with the Fukushima Robot Test Field

Fukushima Robot Test Field Overview

- Construction period: 2016-2019 (opening sequentially beginning in 2018)
- 1000m east-west x 500m north-south of the Reconstruction (Fukko) Industrial Park (50ha/123acre) in Minamisoma
- Long-Distance Flight Test Glide Track in the Tanashio Industrial Park in Namie (approx. 13km/8mile)



1 Glide track/glide track attached hangar 2 Wide range flight area/comms tower 3 Shock absorbing netted flight area 4 Heliport 5 Endurance test building (continuously operated) 6 Wind tunnel building
1 Submerged municipal field 2 Indoor tank test building 1 Testing bridge 2 Testing tunnel 3 Testing plant 4 Municipal field 5 Rubble/collapsed sediment field

https://www.pref.fukushima.lg.jp/site/robot/about.html

Main Facilities: unmanned aircraft area

Wide-range flight area / comms tower
(Planned opening in 2018)

Glide track/glide track attached hangar
(Planned opening in 2019)

Shock absorption netted flight area
(Planned opening in 2019)

Heliport
(Planned opening in 2018)

Project Implementation

Application

[1] Develop performance evaluation methods for robot and drone devices

- Logistics, infrastructure inspections, and disaster area surveys / performance evaluation of land, underwater and aerial robots
- Propose evaluation and testing methods as well as facility specifications to the Fukushima Robot Test Field
- Conduct various tests at sites planned for construction of test fields (FY2016 - FY2017)

Utilization

[2] Development of drone flight control systems and collision avoidance technology

- Accelerate R&D of flight control systems + R&D of collision avoidance technology
- R&D with Japanese advanced knowledge x ensure coordination and conformity with Japanese and international systems and policies
- Conduct test flights utilizing the Fukushima Robot Test Field (FY2019)

Releasing information globally

[3] Promotion of international standards related to robots and drones

- Global drone market x propose standardization and analysis of technology pros/cons
- Organize the World Robot Summit competition, a showcase of robot excellence from around the world, through a combination of robot challenges and exhibitions

Future Project Initiatives

Project vision

Brush-up on individual optimizations / proposed technology (2017)

① Development of flight management systems and collision avoidance technology for unmanned aircraft
• Repair of functions that provide information / provision of space information, radio wave environment measurements, and weather information
• Concretization of individual flight management functions / setting business model targets
• Development of information integration functions / architectural design

Overall optimization / integration of results back into the project (2018)

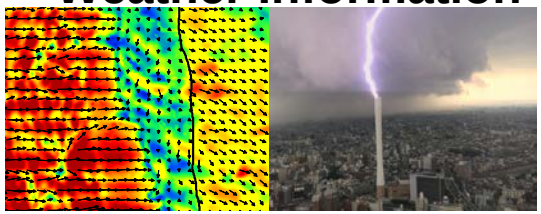
② Integration of functions that provide information / flight management and integration functions / collision avoidance technology
• Concretization of integrated functions that provide information
• Introduction of partial flight management functions + flight management integration functions on a test basis
• Development of a fuselage equipped with full-spec collision avoidance technology

Pre-implementation / actual operation & open flight test (2019)

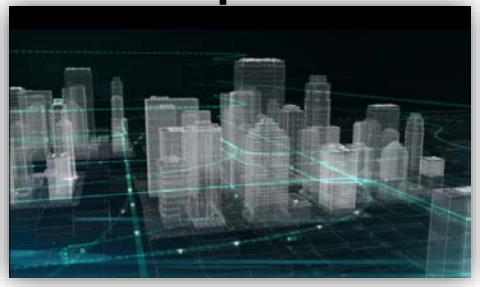
③ Flight test / connection inspection at Fukushima Robot Test Field
• Operation of flight management integration functions at Fukushima Robot Test Field
• Connected flight test for each field / multiple flight management functions

Supporting drone flight planning / flight management
Providing a shared interface (API) with integrated spatial information

Weather Information



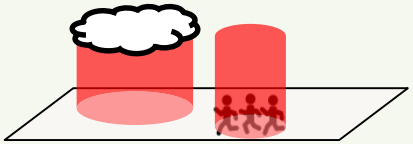
2D/3D Map Information



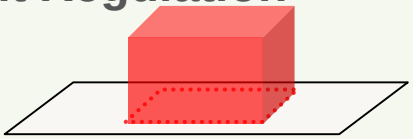
Integration System

<Elements of Info>

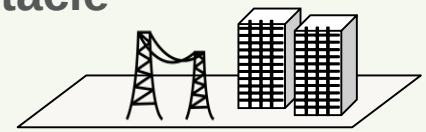
- Dynamic



- Flight Regulation



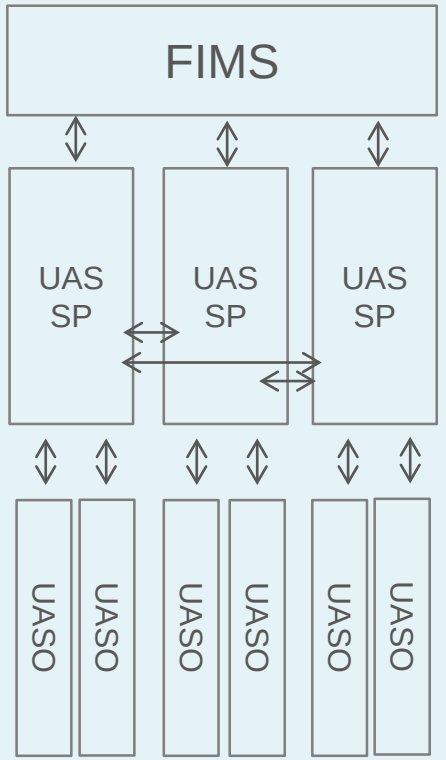
- Obstacle



- Landscape

API

UTM



Currently promoting this model as an international standard（ISO TC20 SC16）

Towards a future where drones fly together!

Gathering wisdom from the DRESS project,
we aim for a flying world!