ICAO DRONE ENABLE 2023, December 5th, 2023
RFI Session: What solutions are needed or are being developed to address CNS requirements in low-level airspace?

Manned Aircraft Surveillance in Low-Level Airspace for UTM

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NEDO ReAMo Project, Japan

- ✓ **ReAMo (Realization of Advanced Air Mobility) project** promoted by **NEDO (New Energy and Industrial Technology Development Organization)**, October 2022 – March 2027
- ✓ One of the sub-projects aims to achieve integrated traffic management technologies for **AAM (UAS and eVTOL) and conventional VFR aircraft flying in low-altitude airspace**, including;
  - ✓ Development and demonstration of a protype of integrated traffic management system operable in near future (late 2020's);
  - ✓ Development of advanced technologies about autonomous flight and CNS at low-altitude airspace (2030's and beyond).

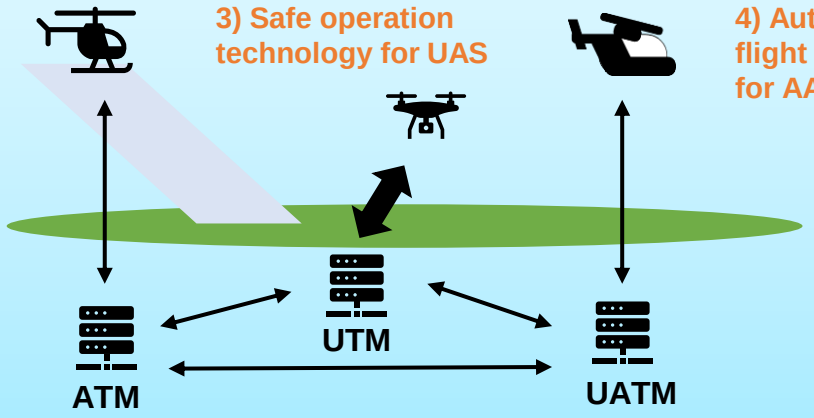
https://reamo.nedo.go.jp/en/

Performance evaluation methods for drone

Conformity certificate methods for multiple small UAS operations controlled by a single pilot

R&D of optimal sharing of airspace among drone, advanced air mobility, and existing aircraft

R&D on AAM Traffic Management Technologies for Low-Altitude Airspace Harmonization



Project members:

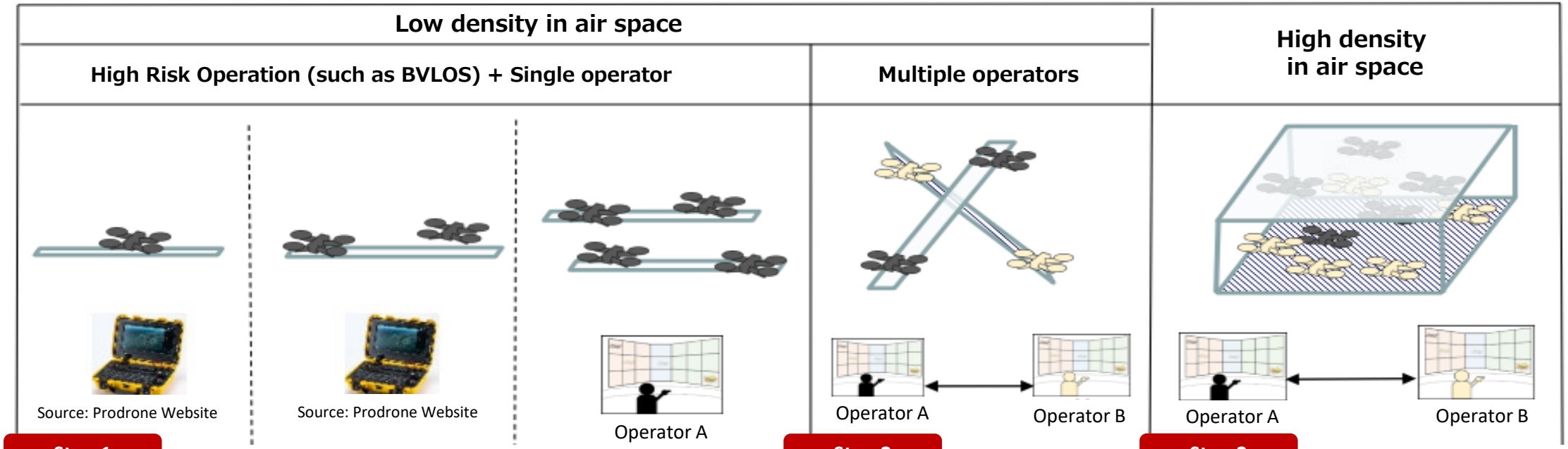
- **NEC Corporation**
- **JAXA**
- **KDDI Corporation**
- **NTT Data Corp.**
- **Intent Exchange, Inc.**
- **Japan Airlines Co., Ltd.**
- **ORIX Corporation**

Low Level Airspace Surveillance: Manned and Unmanned, Urgent Matter

- ✓ The traditional aviation communication (like VHF) and surveillance (like SSR) do not cover low-level airspace.
- ✓ For low level airspace safety today, **a mid-air collision risk reduction between traditional VFR aircraft and small UAS is an urgent issue**.
- ✓ Manned aviation: medical, crop-spraying, and external load sling helicopters, gliders, and sky sports
- ✓ Unmanned aviation: VLOS crop-spraying drones, aerial photographing drones, and infrastructure inspection, and so on. **BVLOS drones like package delivery will increase from now on.**

UTM Implementation Roadmap in Japan

UTM Including Manned Aircraft Information Sharing



Step 1

Recommendation of UTM usage

For high-risk flight, such as BVLOS,
risk mitigation measures by operators are evaluated through JCAB-approval of each flight.

Step 2

2025 -

UTM Service Providers certified by JCAB, multiple UAS operators can conduct high risk operation in the same air space.

Step 3

JCAB-designated air space, all UAS operators are required to use UTM service by JCAB-certified UTM Service Providers.

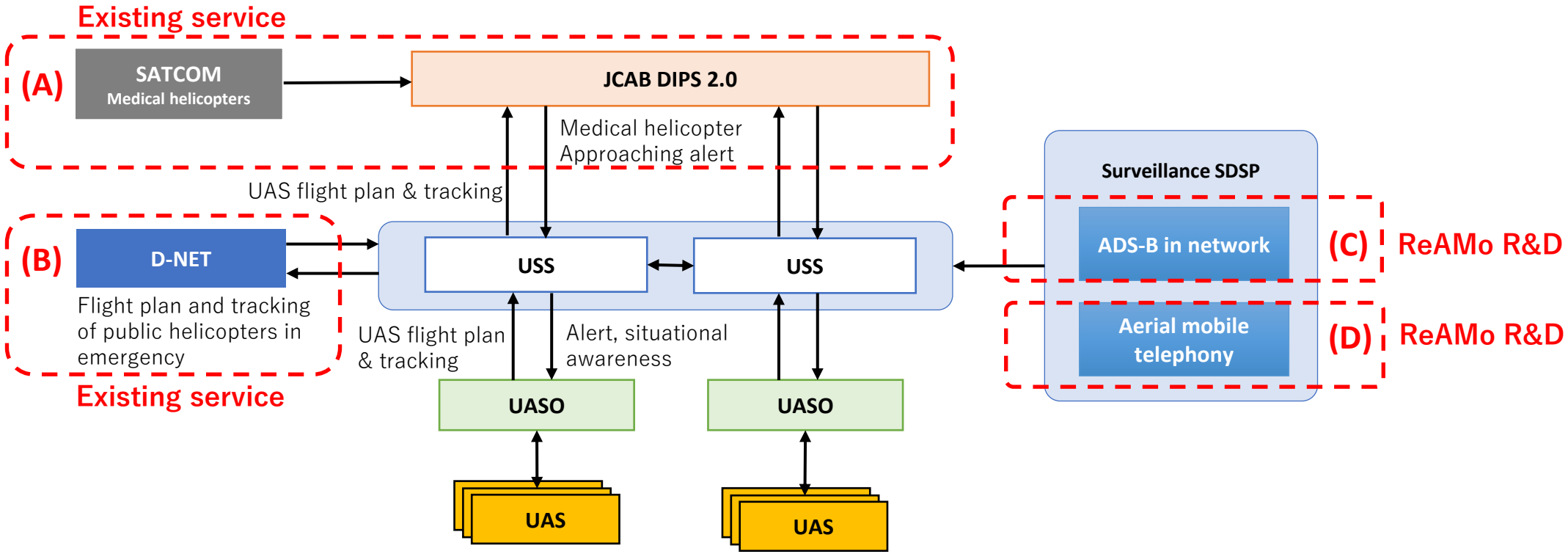
Manned aircraft should also share their position information in the designated low level airspace.

Source (in Japanese) : https://www.kantei.go.jp/jp/singi/kogatamujinki/kanminkyougi_dai18/siryou1.pdf

Manned Aircraft Position Info., Multiple Source

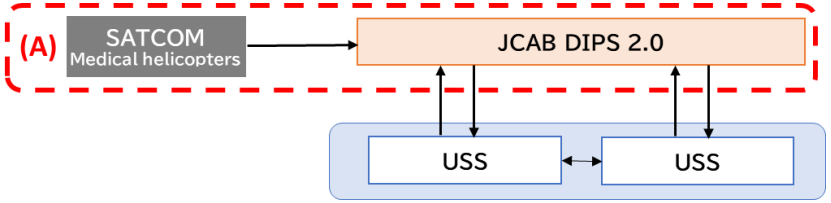
UTM Architecture for Flight Info. Sharing Assumed in ReAMo Project

- Existing JCAB's drone information platform **(DIPS 2.0) provides SATCOM based alerting service** which notify approaching manned aircraft to drone operators.
- **D-NET** is also SATCOM system in disasters and national security activities
- **ReAMo R&D scope: other lower cost solutions must be introduced for comprehensive flight information sharing**



Manned Aircraft Position Info., Multiple Source

(A) DIPS 2.0, SATCOM based Approaching Alert



Position information

SATCOM satellite

SATCOM earth station

Fleet management

Company radio

FOSTER
Co-Pilot

Ground server

Dispatcher

Conflict prevention

Drone operator

DIPS 2.0

Approaching alert message

DIPS server

This service is originally intended to support air carrier's efficient operations of their aircraft, not for flight safety itself.

Industry service

ANSP service

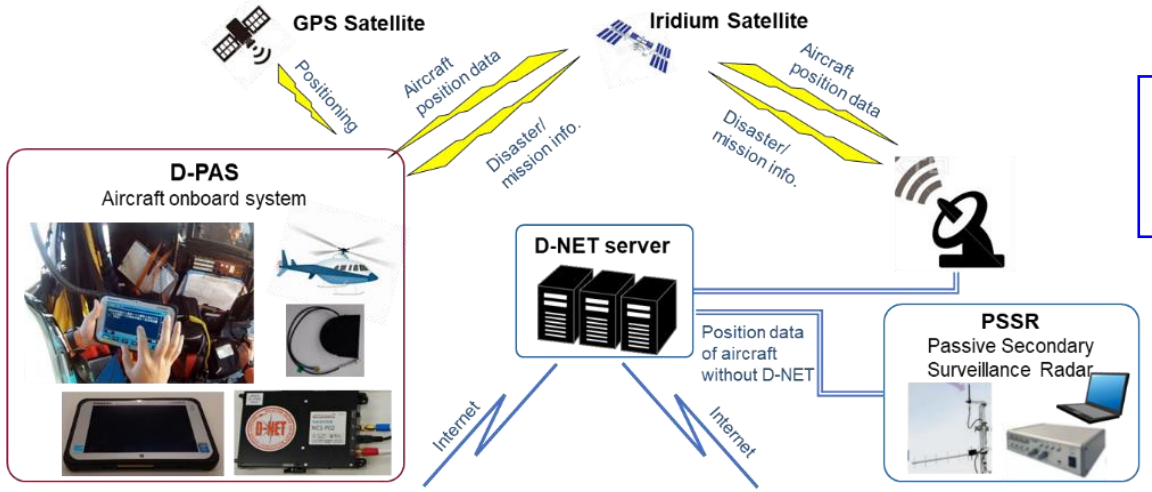
Abstracted approaching alert are send to UAS operators, "a helicopter in the vicinity."

Alert information image

Manned Aircraft Position Info., Multiple Source

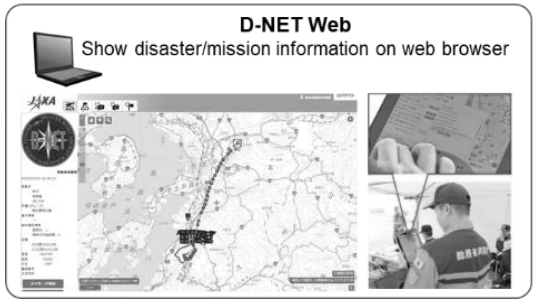
(B) D-NET, Public Helicopter Position Info. Sharing

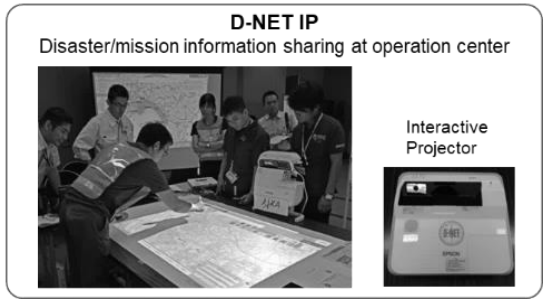
- ✓ To enable safer and more efficient disaster relief aircraft operations, **JAXA has developed "Disaster Relief Aircraft Information Sharing Network (D-NET)"**.
- ✓ All firefighting helicopters in Japan have introduced D-NET compatible systems.
- ✓ D-NET systems are gradually being introduced to other disaster-relief related agencies including National Police Agency.
- ✓ Real-time **position and mission information sharing** among aircraft involved in relief activities and emergency operation centers on the ground.
- ✓ **D-NET system will be connected to UTM (USS) and share flight information** of public aircraft **in disasters and national security activities.**



D-NET Surveillance Function

Aircraft reports its position to ground station via satellite link.



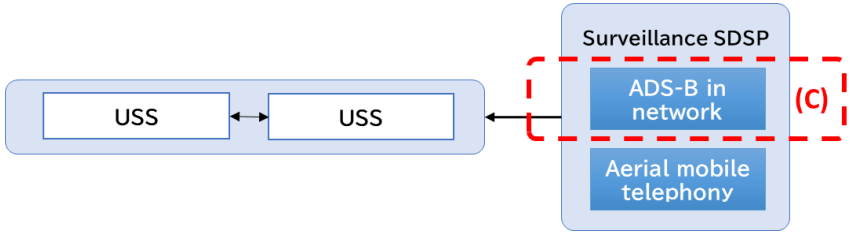


D-NET mission information sharing and management function

Aircraft, ground center and ground staff share disaster information via satellite link and internet.

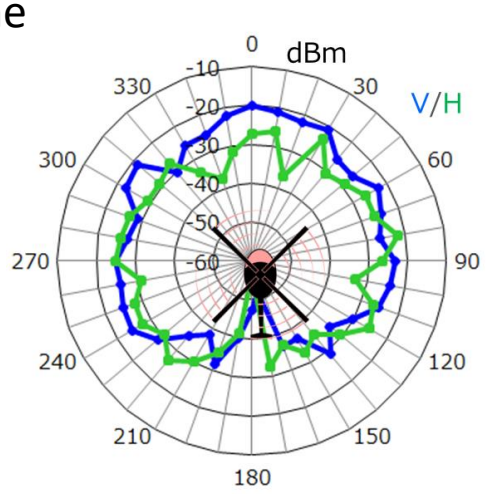
Manned Aircraft Position Info., Multiple Source

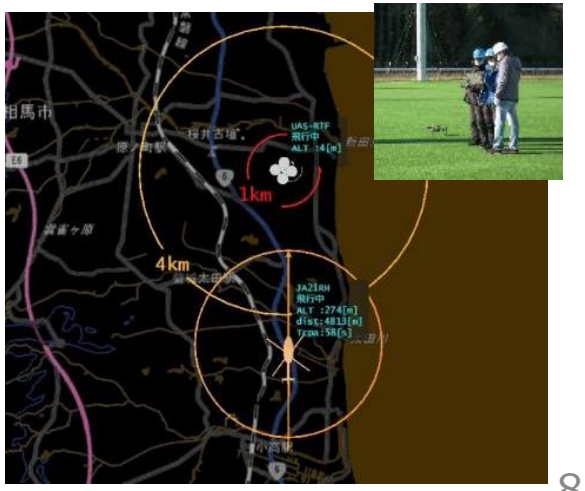
(C) Portable ADS-B as an Electronic Conspicuity



- ✓ SATCOM based position sharing system has been widely introduced in Japan, more than half of helicopters equipped them.
- ✓ To extend position information sharing to other aircraft, **lower-cost solutions must be needed, and the candidate is electronic conspicuity.**
- ✓ FLARM is the most popular e-conspicuity solution in the world, however, FLARM frequency is not available in Japan because the frequency is assigned to major cellular phone companies.
- ✓ Instead, **1090MHz portable ADS-B out** (UK CAA CAP1391) is one of the candidate for electronic conspicuity in Japan.
- ✓ Technical issues;
  - ✓ **Blocking radio waves by airframe**
  - ✓ Multi-pass phasing especially low altitude
  - ✓ Polarization
  - ✓ Lack of guidelines for separation for UAS

CAP1391
Portable
ADS-B out

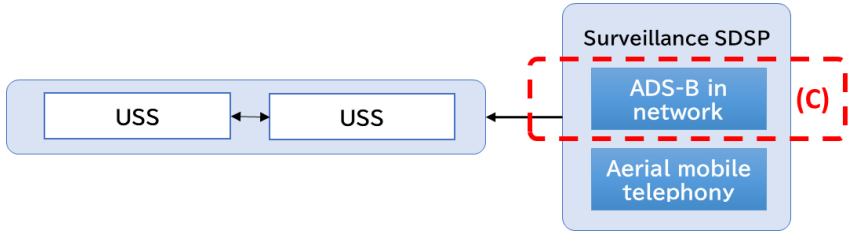


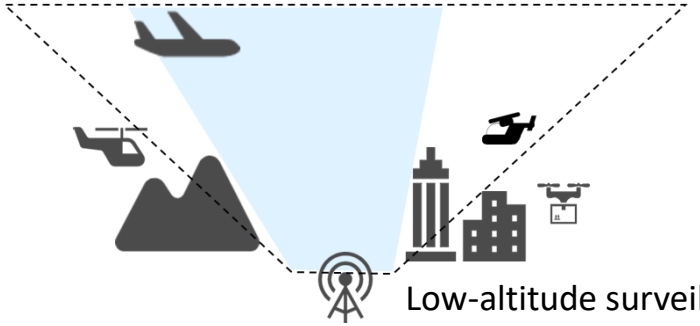


Manned Aircraft Position Info., Multiple Source

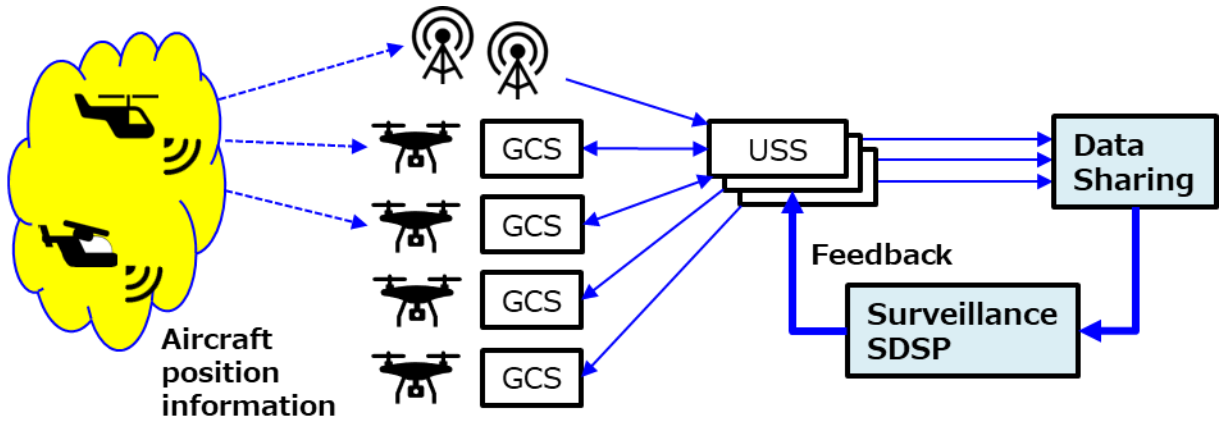
(C) ADS-B in Ground Infrastructure

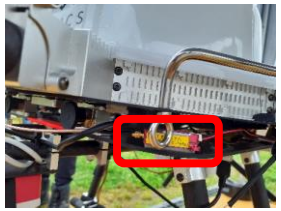
- ✓ In low-altitude over urban areas and mountainous areas, there will be areas where manned aircraft could not be monitored by traditional surveillance infrastructure because of **shadow of obstacles such as buildings and terrains**.
- ✓ **UAS can carry small ADS-B IN receiver onboard**. Sharing received information by multiple flying UAS and ground receivers, low-level surveillance blind area can be reduced.
- ✓ **UTM network could be available to share the multiple ADS-B IN receiving information and the integration and distribution**.





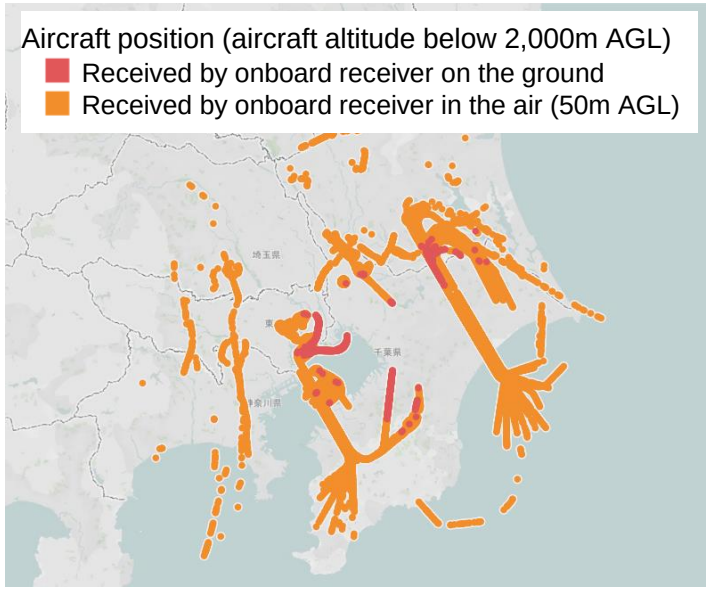
Low-altitude surveillance coverage





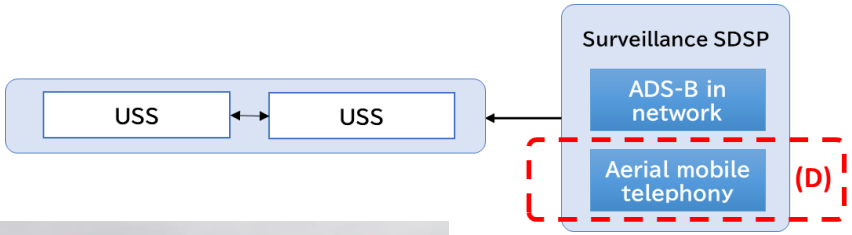
Receiver on drone

Receiver on ground



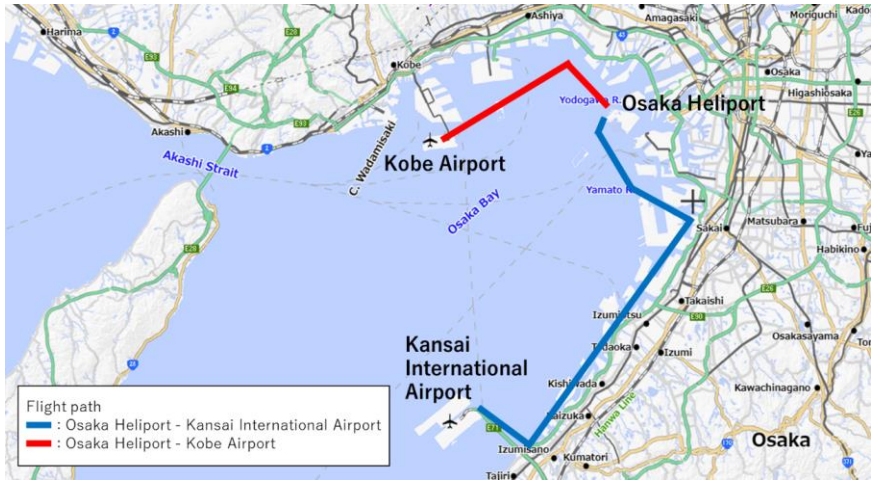
Manned Aircraft Position Info., Multiple Source

(D) Aerial Mobile Telephony



- ✓ **The use of aerial mobile telephony network has been permitted** since 2020 for small UAS flying at altitudes of less than 150 meters AGL, and it is also permitted including altitude above 150 meters AGL since this year for both small UAS and manned aircraft.
- ✓ In ReAMo project, **the integrity and availability of 4G/5G aerial mobile telephony for aircraft communications is under evaluation through flight tests over urban areas**.
- ✓ **Commercial 4G/5G are sufficient for conventional VFR operation** efficiency improvement and position reporting **for advisory purposes**.
- ✓ However, for reliable safety measures, such as AAM C2 and traffic management purpose, we have still **technical challenges from a viewpoint of the integrity and availability.**

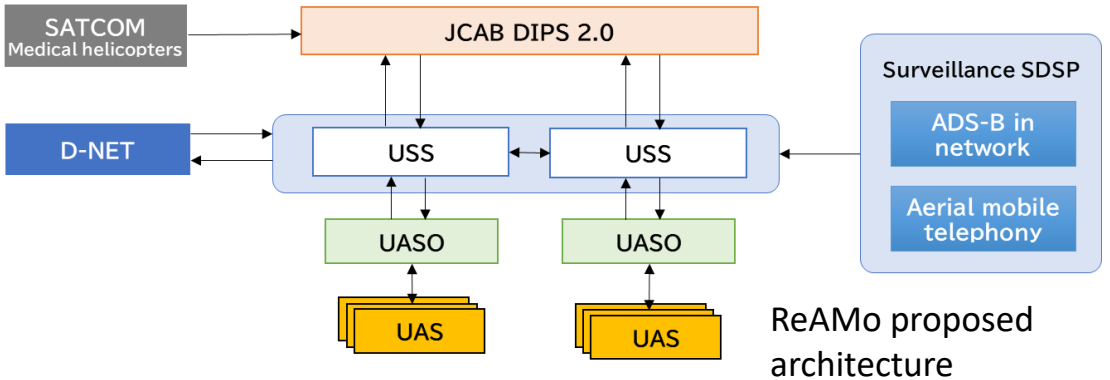
4G/5G aerial mobile telephony evaluation over urban areas



Summary and Discussion

1. Low altitude Surveillance Technologies;

- ✓ ReAMo project is exploring multiple manned aircraft position information sources for UTM considering the institutional and environmental conditions in Japan.
  - ✓ **Existing SATCOM based position reporting system, Japanese unique point**
  - ✓ **Electronic conspicuity, frequency issue and 1090MHz portable ADS-B**
  - ✓ **Aerial mobile telephony, 4G/5G**



ReAMo proposed architecture

2. Multiple position information sources approach has advantages;

- ✓ Robustness and mitigation of limited spectrum issue

3. Surveillance Performance Requirement Considerations;

- ✓ Since these information sources are **not certified equipment, the information is just advisory**.
- ✓ However, it would be **sufficient for low to middle level of risk airspace from a viewpoint of risk-based approach**.
- ✓ In the future, for **higher risk airspace application, integrity and availability of these system must be improved**.