Testimony of

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Subcommittee on Aviation

Hearing on

"Unmanned Aircraft Systems: Emerging Uses in a Changing National Airspace"

November 29, 2017

Chairman LoBiondo, Ranking Member Larsen, and Members of the Committee, it is a pleasure to speak with you about the emerging uses of unmanned aircraft systems (UAS) in the changing national airspace.

I am the General Counsel of AirMap, the world's leading airspace management platform for drones. We are building and improving unmanned traffic management solutions that currently help millions of drones fly safely.

To realize the full economic benefit and efficiencies that drones can provide we must continue to challenge our own assumptions about airspace and airspace management. Leaders within the Administration, such as Michael Kratsios, Elaine Chao, Michael Huerta, Earl Lawrence and Parimal Kopardekar (PK), are working as change agents promoting a spirit of innovation and collaboration between government and business.

See Appendix A (UTM)

Internationally, countries are competing with the United States to integrate drones into their airspace more quickly. Other countries' openness to experimentation has accelerated into regulatory action and standards-setting that threatens to leave American businesses behind. We have no choice but to work harder and faster to safely integrate drones into the U.S. national airspace.

In this testimony, I will provide you with 1) examples of how the U.S. national airspace is evolving to accommodate drones, 2) AirMap's experience in other countries that are accelerating drone integration, and 3) recommendations for U.S. policy to build on recent progress in the United States.

U.S. Airspace Innovations

In the United States, AirMap has been working at the federal, state, local, and tribal government levels to help adapt the airspace to safely integrate drones.

Low Altitude Authorization and Notification Capability

Recently, the Federal Aviation Administration (FAA) certified AirMap and Skyward as LAANC providers to grant instant authorizations to operate in restricted airspace that has been identified as safe for low-altitude drone operations. This program is called the Low Altitude Authorization and Notification Capability or LAANC program. Prior to LAANC, it could take up to 90 days to secure an authorization to operate in restricted airspace. The AirMap LAANC solution is active at 49 airports through 10 FAA air traffic control facilities. AirMap has already granted more than 500 approved authorizations in the U.S. national airspace. LAANC creates the first building block to a full UTM network.

> **Learn more at airmap.com/laanc or see Appendix B (LAANC)**

Kansas UTM Pilot

Another example of AirMap's work to enable expanded drone operations in U.S. airspace is our partnership with the State of Kansas, a leader in aerospace innovation. We worked closely with the Kansas Department of Transportation to develop and deploy UTM technology across the state to speed the integration of drones. As a part of this project, Kansas will use AirMap's platform to communicate local, safety-critical information to drone operators, including other drone operations, manned aircraft operations, wildfire locations, and major events on the ground.

> **Learn more at airmap.com/kansas or see Appendix C (Kansas Case Study) and Appendix D (First Responder Activity)**

Hurricane Response

AirMap technology also assisted in managing the U.S. national airspace in the response to Hurricanes Harvey and Irma. In the aftermath of each hurricane, the FAA restricted drone operations in the recovery area. AirMap supported vital hurricane response efforts by providing the local Emergency Operations Center (EOC) with a dashboard that allowed incident commanders to plan and observe their missions, deconflict manned and unmanned air assets, and communicate directly with their teams. AirMap provided essential airspace intelligence services including weather data, infrastructure locations, and manned traffic alerts, to ensure emergency operators' manned and unmanned assets remained safe while conducting search and rescue and surveying efforts.

> **See Appendix E (Hurricane Response)**

Drone Integration Pilot Program

Finally, the UAS Integration Pilot Program announced by President Trump and implemented by FAA on November 2nd is expected to open the floodgates to expanded drone operations. By

leveraging the insights and expertise of state, local, and tribal governments into their low-altitude airspace, the UAS Integration Pilot Program will create numerous laboratories of innovation. This program is expected to enable package delivery, beyond visual line of sight operations, and flights over people, as well as accelerate the testing of enhanced human mobility. AirMap is assisting state, local, and tribal governments prepare applications that manage the safety of expanded operations in their areas of jurisdiction, while providing solutions to commercial partners through our developer platform and manufacturer integrations.

Learn more at airmap.com/ipp/ or see Appendix F (Developer Platform)

International Airspace Innovations

Outside the United States, other countries are working hard to integrate drones at a faster rate and, in some cases, are succeeding. Unfortunately, there are still reasons that companies need to go overseas to conduct transformative drone work today. AirMap is working with other international partners to deliver UTM solutions next year that may take the United States until 2021 or later to achieve, absent Congressional action.

See Appendix G (Timeline)

Japan

Two years ago, Japanese Prime Minister Shinzo Abe committed the Japanese government to enabling drone deliveries as early as November 2018. To enable these deliveries, he directed his government to form public-private councils to collaborate and review drone regulations. Thanks in part to his leadership, commercial drone delivery already exists in limited form and is expected to expand over the course of next year. In a joint venture with Rakuten, Japan's largest e-commerce company, AirMap is providing airspace management capabilities to enable expanded drone operations.

Learn more at airmap.com/rakuten or see Appendix H (Rakuten)

Switzerland

In September 2017, in Geneva, Switzerland, AirMap participated in a robust demonstration of U-space. Defined by SESAR J.U., the Single European Sky ATM program, U-space is a collaborative effort to enable situational awareness, data exchange, and digital communication for the drone ecosystem, much like the UTM initiative in the United States In partnership with skyguide, SITAONAIR, senseFly, Intel, px4, and AirMap, and with support from FOCA and GUTMA, Switzerland demonstrated an operational UTM system, including registration, authentication, ATC integration and approval, dynamic flight planning, and real-time geofencing.

In missions flown by senseFly's albris and eBee Plus drones and a drone with a pre-programmed Intel / PX4 flight controller, partners demonstrated how drones can be easily announced to the air navigation service provider through e-registration and e-identification. AirMap provided integration with air traffic control, managed flight plans and enabled electronic airspace authorizations. Additional technology was used to transmit live telemetry of drones and

manned-aviation over LTE through the ground control stations to inform drones and drone pilots of manned aviation traffic as well as dynamic updates of airspace restrictions related to rescue helicopter missions. Finally, ATM radar feeds were made available to the UTM system though technology powered by AirMap. This has since enabled BVLOS missions for package-delivery over densely populated areas.

The entire demonstration occurred over and around Lake Geneva, in close proximity to Geneva Airport in some of the most complex and sensitive airspace in Switzerland. This successful U-space demonstration is a model for UTM around the world, proving that the air navigation services are available today and ready for the next stage of drone integration worldwide.

Learn more at airmap.com/u-space or see Appendix I (U-space)

Recommendations

There are three things Congress can do to accelerate the safe integration of drones into the complex U.S. national airspace:

First, Congress should expedite and prioritize the establishment of an operational UTM system by 2020. UTM is necessary for expanded operations, such as package delivery and beyond visual line of sight operations. Congress should expand on Section 2208 of the FAA Extension to support the leaders within NASA and FAA that are developing a national, federated UTM network. Congressional action with clear direction, mandatory deadlines, and consistent oversight is the only way to ensure that our infrastructure and agencies keep pace with innovation. Without Congressional action, America will fall behind other nations and businesses will cast their eyes abroad.

Second, Congress should apply support and resources towards the FAA's UAS Integration Pilot Program to leverage state, local, and tribal governments to enable expanded drone operations. Congress should ensure that FAA has all the necessary authority to waive regulations to allow local authorities to authorize expanded operations that can be conducted safely within geographically defined areas. Congress should ensure that the UAS Integration Pilot Program serves as a permanent pathway for the United States to enable an unlimited number of expanded operations by using state, tribal, and local governments as laboratories of innovation.

Third, Congress should ensure that a remote identification and tracking system based on licensed spectrum is established to enable nationwide expanded drone operations. Remote identification and tracking is an essential component to ensure responsible operations and serves as another building block to an operational UTM network.

Thank you again for convening this hearing to discuss the exciting emerging uses of drones across the United States and abroad. We appreciate the committee's leadership on these critical issues and believe that working together we will ensure that the United States remains a leader in drone innovation.

Appendix A: Unmanned Traffic Management (UTM)

OBJECTIVE: AirMap is a UTM Service Supplier (USS), collaborating with regulators and industry partners to develop the infrastructure to enable the safe integration of drones into the national airspace system.

IN COLLABORATION WITH: NASA, the Federal Aviation Administration, Rakuten

STATUS: AirMap is part of NASA and the FAA's ongoing research in data exchange, remote command control, beyond visual line-of-sight operations, telemetry, and deconfliction.
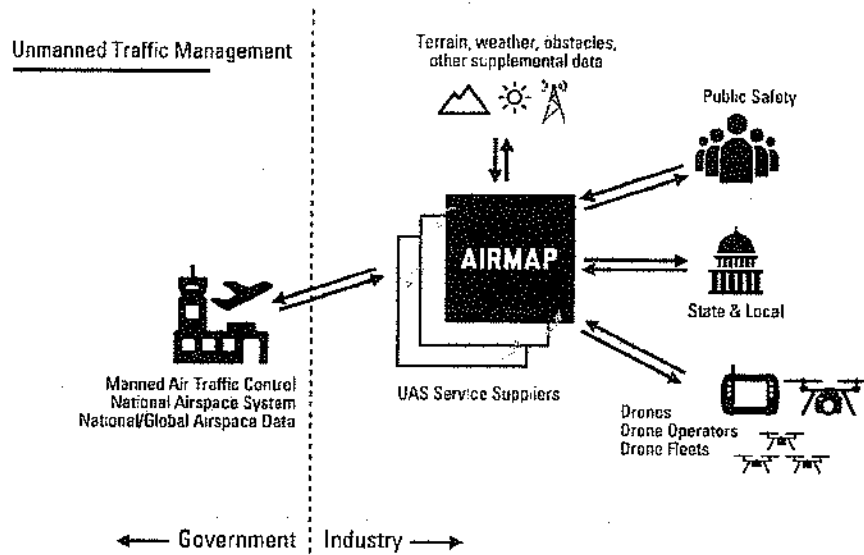
Situational Awareness

The AirMap UTM platform allows drone manufacturers like DJI, Sensefly, and Intel to deliver AirMap's airspace information and services to their end users directly from the drone's flight control software.

Real-Time Deconfliction

AirMap partners with the FAA for RTCA DO-200A aviation data and PASSUR, the aviation intelligence provider trusted by airlines and airports worldwide, to deliver real-time collision avoidance capabilities to drones.

Remote Identification

The AirMap platform includes a suite of security solutions for remote identification, encrypted communications, and the protection of critical infrastructure for the safe integration of drones worldwide.

Route Optimization

Today, millions of drones rely on AirMap's airspace data to navigate safe and efficient routes, including controlled airspace, nearby traffic, temporary flight restrictions, local weather, and more.

Automated Airspace Authorization

AirMap's notice and authorization technology empowers airspace authorities to automate authorization when conditional requirements are met and to interact directly with operators in real time.

Dynamic Geofencing

AirMap makes it easy for drone manufacturers to incorporate geofencing and authorized unlocking directly into a drone's firmware. For example, the DJI GEO flight control app is powered by AirMap to provide the safest operating environment possible.

AIRMAP
www.airmap.com

Appendix B: Low-Altitude Authorization & Navigation Capability (LAANC)

OBJECTIVE: Propose and develop an easy and reliable digital system for providing authorized access to controlled airspace areas for commercial drone operations.

IN COLLABORATION WITH: The Federal Aviation Administration

STATUS: AirMap is one of the selected industry partners working directly with the FAA to demonstrate operational LAANC to advance commercial drone operations and decrease administrative workload.
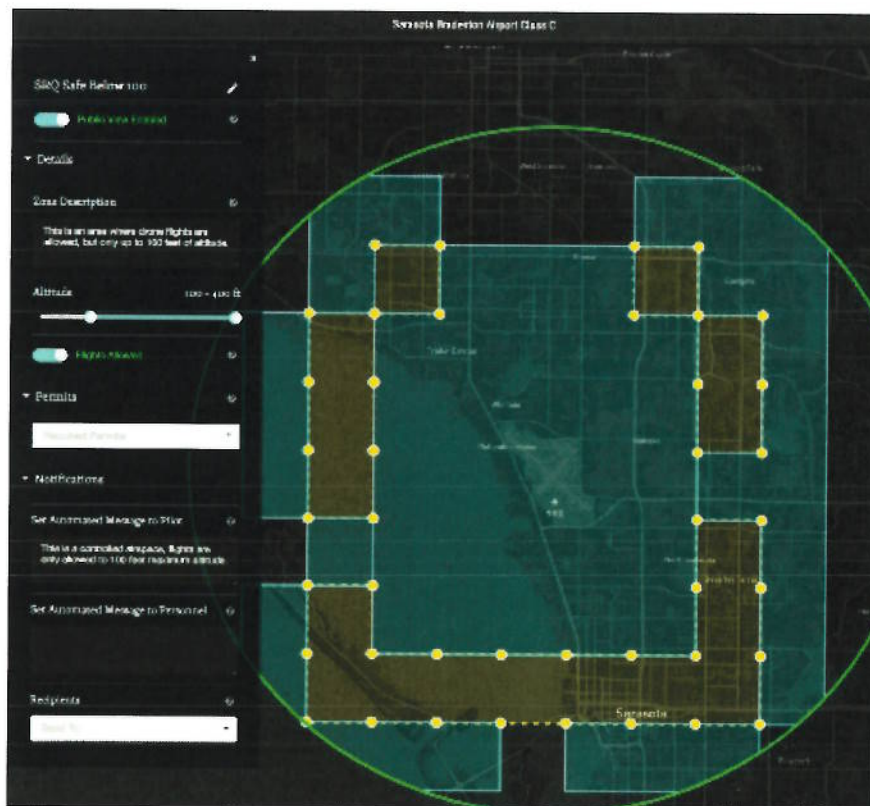
Low-Altitude Authorization and Notification Capability (LAANC) describes a digital system that allows for the instant authorization of commercial drone operations in controlled airspace by third party UTM Service Suppliers (USS) like AirMap based on contextual airspace rules designated by the Federal Aviation Administration. LAANC authorizes commercial flight plans taking place in controlled airspace that match up to ATC-approved airspace grids that are identified as low-risk or pre-approved for drone flight

LAANC streamlines and digitizes the current authorization process for commercial operations in controlled airspace. Today, FAA authorization is a manual process that takes up to 90 days. With LAANC, authorization is automatic and instantaneous. LAANC drives efficiency while removing the need for administrative work by human resources.

CASE STUDY

Kansas Department of Transportation launches statewide "unmanned traffic management" initiative to support commercial drone operations

A new collaboration between the **Kansas Department of Transportation (KDOT)** and airspace management platform **AirMap** is deploying technology for unmanned traffic management, or UTM, across the state of Kansas.

The initiative will create a digital infrastructure capable of communicating local, safety-critical information to drone operators about conditions in the surrounding airspace and on the ground. By implementing technologies that will one day be part of a nationwide UTM framework, Kansas is the first U.S. state to take a proactive approach to protecting the privacy, safety, and security of Kansas residents - while empowering drone entrepreneurship statewide.

According to PricewaterhouseCoopers, commercial drones will create more than $127 billion in economic benefits and 100,000 jobs over the next several years – presenting tremendous opportunities for Kansas and other U.S. states. The KDOT-AirMap partnership will foster a thriving drone economy with the potential to contribute billions in economic impact and create thousands of jobs in the state.

The KDOT-AirMap partnership will make the AirMap platform available to state agencies, airports, and colleges and universities, deploying technology that is capable of:

- Delivering safety-critical information from state and local agencies to drones for situational awareness and flight planning
- Facilitating collaboration, communication, and data exchange between state and local authorities and drones and their operators
- Fostering public awareness about drone regulations and airspace requirements
- Automating airspace notification and authorization at Kansas airports
- Demonstrating sophisticated solutions that safeguard public safety and personal privacy, including technologies for geofencing and remote identification
- Enabling high-scale and complex operations beyond visual line of sight

The UTM initiative represents the next step in Kansas' long history of aviation innovation, allowing the state to mobilize drones for disaster recovery, search and rescue, agriculture, construction, package delivery, and other community benefits.

By opening Kansas skies for sophisticated drone operations and deploying AirMap airspace management technology across the state, Kansas will be uniquely positioned to capture a significant share of the drone opportunity.

AIRMAP

Appendix D: First Responder Activity

OBJECTIVE: Empower drone operators to plan safer routes and ensure that flights do not interfere with the efforts of firefighters and emergency responders.

IN COLLABORATION WITH: U.S. Department of the Interior and 2,100 U.S. Communities

STATUS: Thousands of drone operators receive real-time information about nearby first responder activities today through the AirMap app for Android, and iOS.
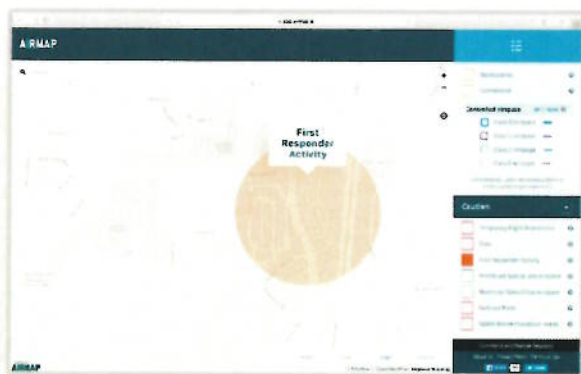
First Responder Activity

Madison, Wisconsin
First Responder Activity

Wildfires

AirMap makes FAA-published temporary flight restrictions available to millions of drone operators. However, the vast majority of wildfires start and spread faster than the time it takes to communicate and post the hazard.

In July 2016, the U.S. Department of the Interior partner with AirMap to wildfire information from the Department's s incident command system as it happens and immediately push it to drone pilots through AirMap's iOS, Android and web apps, AirMap's API, and the GEO geofencing system in the DJI GO flight control app.

First Responder Activity

AirMap also enhances situational awareness for drone pilots and safety for everyone through the availability of First Responder Activity, which provides data about fires, electrical and gas hazards, medical emergencies, tornados, tsunamis, rescue operations, and more.

Drone operators can see first responder activity from more than 2,100 U.S. communities. For safety and security of first responders, the exact location and category of emergency is not disclosed to drone pilots. Drone operators use this information to plan safer routes that won't interfere with the efforts of firefighters and emergency responders – prohibited by law in most states.

AIRMAP
www.airmap.com/first-responder-activity
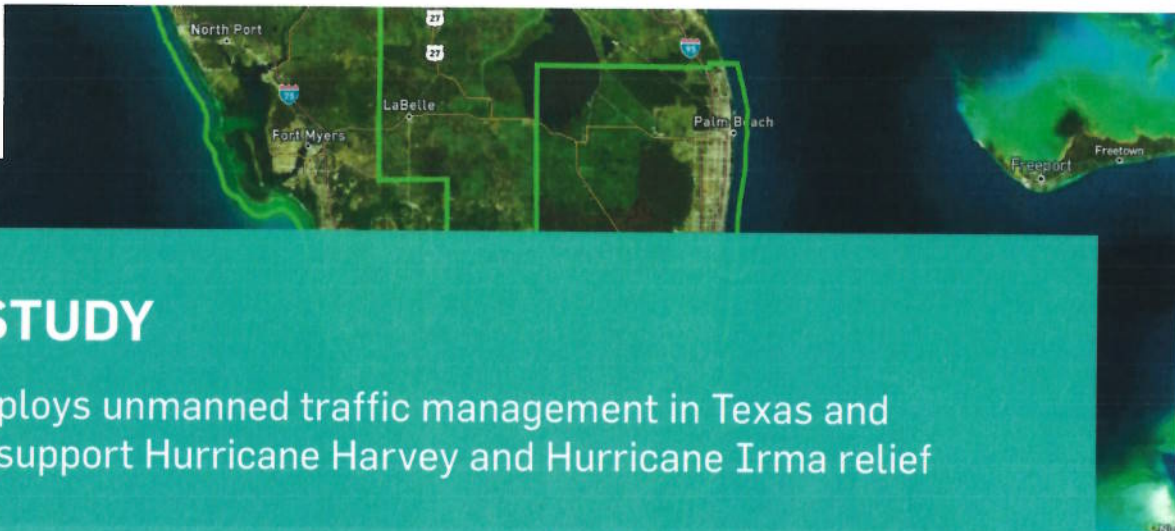
CASE STUDY

AirMap deploys unmanned traffic management in Texas and Florida to support Hurricane Harvey and Hurricane Irma relief efforts

The United States experienced one of the most devastating hurricane seasons on record in 2017. Hurricanes Harvey and Irma were category four storms that left destruction across communities in Texas and Florida.

In the aftermath of Hurricane Harvey, the FAA issued a disaster TFR (temporary flight restriction), charging the Texas Emergency Operations Center (EOC) with managing the local airspace during disaster relief efforts. Both manned and unmanned (drones) aircraft became essential components to these efforts. AirMap supported vital response efforts by providing a dashboard that allowed incident commanders to visualize and manage their airspace.

In the wake of Hurricane Irma, AirMap worked with the same team of emergency operators deployed on behalf of the State of Florida and provided them with the same airspace management services.

AirMap provided essential airspace intelligence services including weather data, infrastructure locations, and manned traffic alerts, to ensure emergency operators' manned and unmanned assets remained safe while conducting search and rescue and surveying efforts. This intelligence was visualized on a screen which allowed the EOCs to monitor and manage where their teams were operating. AirMap's technology provided the Florida and Texas EOCs with the information required to plan and observe their missions, deconflict manned and unmanned air assets, and communicate directly with their teams.

How did AirMap help?

AirMap provided the Texas and Florida teams with an airspace management dashboard and airspace

intelligence services that allowed them to:

- Create flights and provide notice of intended flight to command centers

- Accept flight notices by relief operators active in disaster TFR areas

- Visualize and monitor hundreds of flights being conducted by the EOC to support relief efforts

- Remain abreast of manned aircraft traffic and unmanned flights submitted through AirMap within the TFR

- Notify drone operators logging flights with AirMap that they had entered airspace covered by a disaster TFR managed by the EOC

- Contact drone operators who were flying in violation of the TFR and urge them to keep their UAS grounded until the TFR was lifted

By providing the EOCs with a suite of tools and and an airspace management dashboard, AirMap helped support safe and efficient relief efforts that we hope to replicate for emergency operators across the country.

"Essentially, every drone that flew meant that a traditional aircraft was not putting an additional strain on an already fragile system. I don't think it's an exaggeration to say that the hurricane response will be looked back upon as a landmark in the evolution of drone usage in this country."

FAA Administrator Michael Huerta
"InterDrone" Speech, Las Vegas, NV
September 6, 2017

Appendix F: Developer Platform

OBJECTIVE: Empower the hundreds of innovators that are building software for drones, apps, and the Web with easy-to-use APIs and SDKs for complete airspace intelligence.

IN COLLABORATION WITH: Hangar, Kittyhawk, DroneLogbook, KnowBeforeYouFly, DroneDeploy, ANRA Technologies, Hover, NVDrones, the Intel Aero Platform, AeryonLabs, and more.

STATUS: More than 300 developers are building tools for drones on the AirMap platform.

Status API
Is it safe to fly? Integrate AirMap's low-altitude airspace intelligence platform into third party software to inform end users of airspace requirements, including advisories, and notice requirements.

Airspace API
Bring AirMap's robust, trustworthy, and accurate low-altitude airspace intelligence to your software. Includes RTCA DO-200A data as well as information about critical infrastructure, obstacles, weather, TFRs, and more.

Flight API
Empower end users to create and query flights, verify that flight requirements are met, and provide digital notice to or request authorization from designated airspace authorities.

Pilot API
Let end users manage their pilot profile, including contact details, registration number, and preferences, and verify pilot identity for added security.

Aircraft API
Includes metadata about a pilot's drone, including manufacturer, model, weight, speed, performance, and type.

Maps API
Customize the look/style of your AirMap-powered application with a TileJSON spec for use with Mapbox GL.

Platform SDKs
AirMap makes it easy for software developers to get up and running with interactive airspace data for applications built for Javascript, Android, iOS, & Apple Watch.
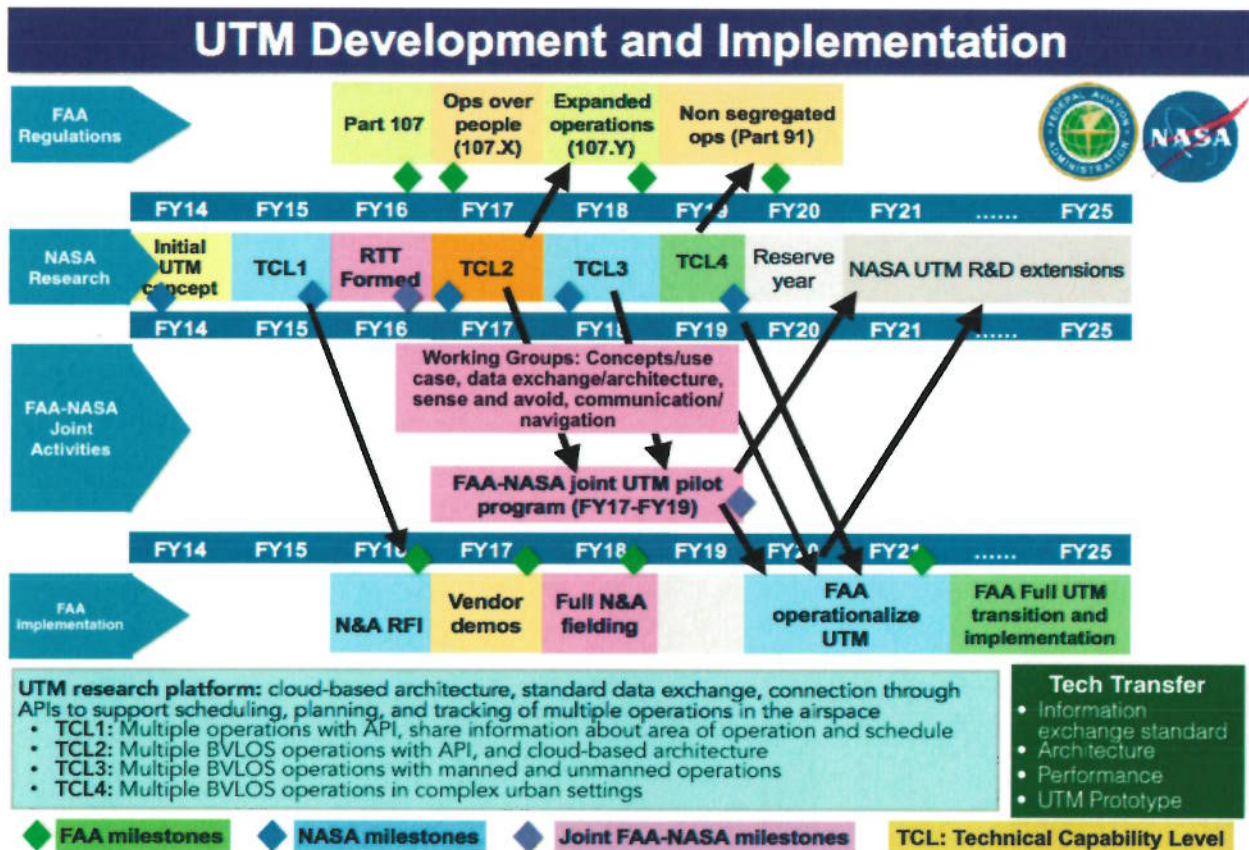
AIRMAP
www.airmap.com/developers

Appendix G: Timeline

OBJECTIVE: Develop and operationalize a complete UTM infrastructure for the safe integration of drones for VLOS and BVLOS operations into the national airspace system.

STATUS:
- 2017: Airbus to begin flying car trials.
- 2018: Rakuten Sora Raku to begin regular drone deliveries in Japan.
- 2025: Federal Aviation Administration to complete UTM transition and implementation.

UTM Development and Implementation

FAA Regulations		Part 107	Ops over people (107.X)	Expanded operations (107.Y)	Non segregated ops (Part 91)				

	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	......	FY25
NASA Research	Initial UTM concept	TCL1	RTT Formed	TCL2	TCL3	TCL4	Reserve year	NASA UTM R&D extensions		

	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	......	FY25

FAA-NASA Joint Activities

Working Groups: Concepts/use case, data exchange/architecture, sense and avoid, communication/navigation

FAA-NASA joint UTM pilot program (FY17-FY19)

	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	......	FY25
FAA implementation			N&A RFI	Vendor demos	Full N&A fielding		FAA operationalize UTM	FAA Full UTM transition and implementation		

UTM research platform: cloud-based architecture, standard data exchange, connection through APIs to support scheduling, planning, and tracking of multiple operations in the airspace
- **TCL1:** Multiple operations with API, share information about area of operation and schedule
- **TCL2:** Multiple BVLOS operations with API, and cloud-based architecture
- **TCL3:** Multiple BVLOS operations with manned and unmanned operations
- **TCL4:** Multiple BVLOS operations in complex urban settings

Tech Transfer
- Information exchange standard
- Architecture
- Performance
- UTM Prototype

◆ **FAA milestones**   ◆ **NASA milestones**   ◆ **Joint FAA-NASA milestones**   **TCL: Technical Capability Level**

The diagram above outlines NASA and the FAA's proposed timeline for the full development and implementation of Unmanned Traffic Management (UTM), with complete UTM implementation planned for 2025.

Important progress has been made towards critical UTM milestones, and AirMap continues to be a partner in the NASA-FAA UTM project, testing UTM technologies and participating in the development of UTM standards.

Airbus is projected to begin flying car trials in 2017 and companies across the drone ecosystem, including AirMap, are already offering technologies for UTM. U.S. regulators have the opportunity to harness innovation to realize a fully operational UTM system in alignment with progress industry-wide.

Appendix H: Rakuten AirMap, Inc.

OBJECTIVE: Bring Unmanned Traffic Management (UTM) solutions to Japan to support and empower drone ecosystem for economic development.
IN COLLABORATION WITH: Rakuten
STATUS: Launched Rakuten AirMap, Inc., joint venture in March 2017 to serve Japan's growing drone ecosystem.
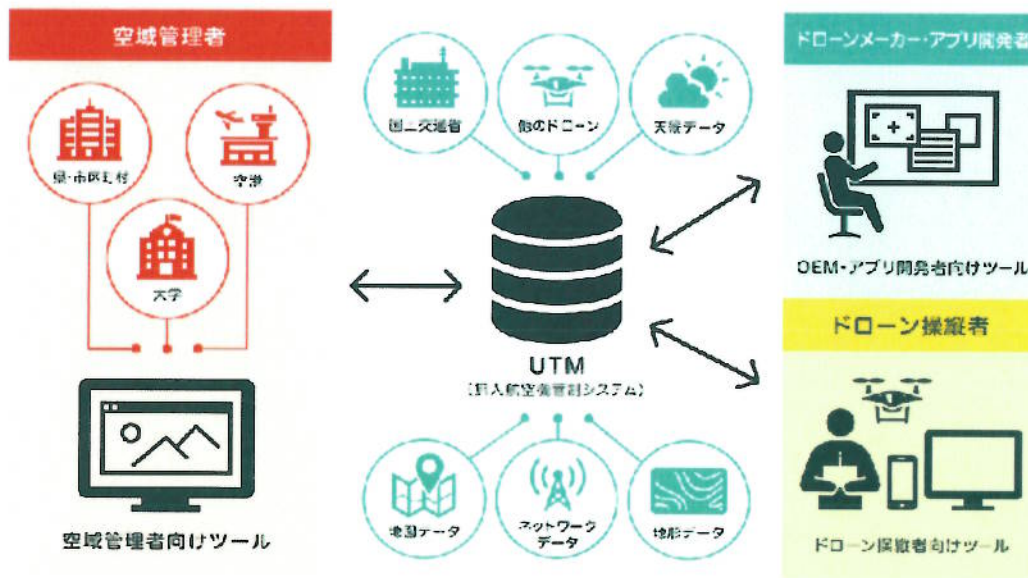
BVLOS Flights

Solutions to help Japan's regulators open the skies for drones, even in "densely inhabited districts" where drone flight is currently prohibited. Rakuten AirMap Inc. helps commercial drone operators fly safely and securely beyond visual line of sight in a variety of environments, from rural agricultural sites to densely populated urban areas in major cities.

Drone Delivery

Rakuten launched its Sora Raku Rakuten Drone delivery service in April 2016, including a successful LTE-powered test with support from Chiba City and NTT Docomo. Rakuten AirMap's UTM platform will support airspace managers seeking to open surrounding airspace for drones and innovations like drone delivery by 2018.

Airspace Authorization

Designate sensitive areas requiring authorization before flight. Airspace managers – which in Japan includes owners of critical infrastructure, universities, airports, municipal governments, and other stakeholders – can specify digital authorization requirements, accept digital flight notices, and communicate safety-critical information directly to drones and drone operators in real time.

Situational Awareness

Delivering real-time airspace intelligence to recreational and commercial drone operators in Japan. Drone pilots rely on the Rakuten AirMap UTM platform to learn about the rules and condition in their flight area, create flight plans, and share them with nearby airports, authorities, and other stakeholders.

AIRMAP

www.airmap.com/rakuten

Appendix I: U-space Demonstration

OBJECTIVE: Provide U-space (UTM) services, including flight planning, geofencing before and during flight, tracking, and live telemetry, during three live drone missions in Europe's first live demonstration of U-space (UTM) capabilities.

STATUS: In September 2017, Skyguide, AirMap, SITAONAIR, senseFly, Intel, and PX4 demonstrated how drones can be safely, efficiently integrated into existing airspace infrastructure in urban environments.

ADVANTAGES:
- U-space (UTM) capabilities are available today, ahead of SESAR's anticipated 2019 delivery.
- U-space (UTM) can be replicated in other cities and countries worldwide.
- Supported by existing and competitive ecosystem of hardware and software providers.
- Provides dynamic situational awareness of low-altitude airspace in urban environments.
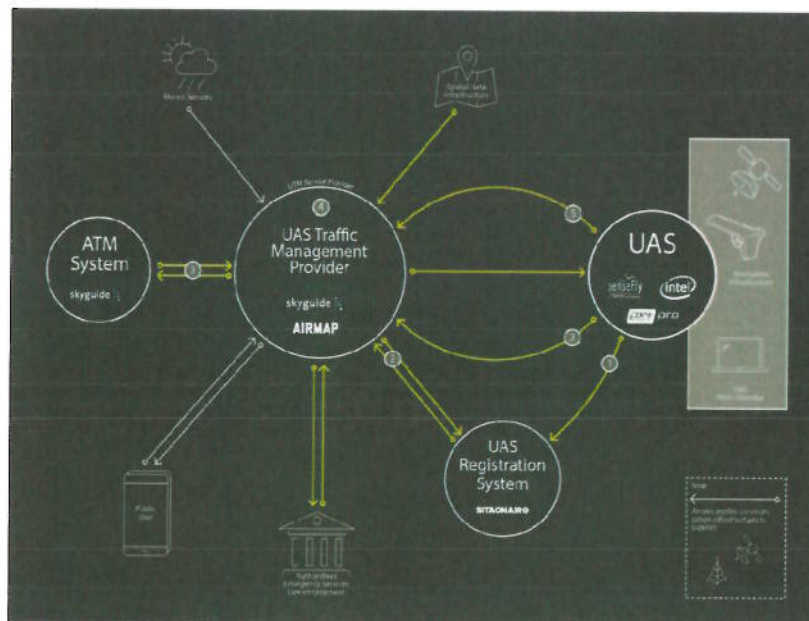
The European Commission expects that the global marketplace for unmanned aircraft or drones will create more than 10 billion Euros in economic impact each year by 2035. U-space is a set of new services and procedures designed to support safe, efficient, and secure access to airspace for a large numbers of drones.

Defined by SESAR J.U., the Single European Sky ATM program, U-space ensures the smooth operations of all categories of drones, all types of missions and all drones users in all operating environments. Much like the U.S. "Unmanned Traffic Management" initiative, U-space is a collaborative effort to enable situational awareness, data exchange, and digital communication for the drone ecosystem. U-space provides not only the framework for routine drone operations, but also an effective interface to manned aviation, ATM/ANS service providers, and authorities. The services are based on a high level of digitilization and automation, on board the drone itself or on the ground.

AIRMAP
www.airmap.com/u-space

Appendix I: U-space Demonstration (cont.)
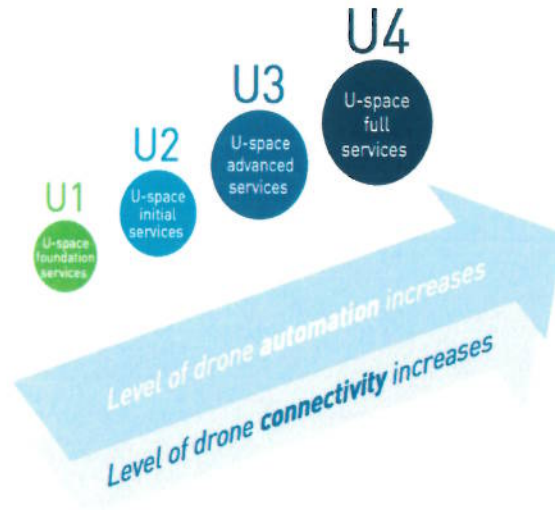
Levels of U-space services based on increasing levels of technological capability are as follows:

U1: U-space foundation services provide e-registration, e-identification and geofencing.

U2: U-space initial services support the management of drone operations and may include flight planning, flight approval, tracking, airspace dynamic information, and procedural interfaces with air traffic control.

U3: U-space advanced services support more complex operations in dense areas and may include capacity management and assistance for conflict detection. The availability of automated DAA functionalities, in addition to more reliable means of communication, will lead to a significant increase of operations in all environments.

U4: U-space full services, particularly services offering integrated interfaces with manned aviation, support the full operational capability of U-space and will rely on very high level of automation, connectivity, and digitalization for both the drone and the U-space system.

In September 2017, project partners performed a live demonstration of **U1** and **U2** services. In three live missions flown by senseFly's albris and eBee Plus drones and a drone with pre-programmed Intel / PX4 flight controller, partners demonstrated how drones can be easily announced to the air navigation service provider through e-registration and e-identification. AirMap provided integration with ATC, managed flight plans and enabled electronic airspace authorizations. Additional technology was used to transmit live telemetry of drones and manned-aviation over LTE through the ground control stations to inform drones and drone pilots of manned aviation traffic as well as dynamic updates of airspace restrictions related to rescue helicopter missions. ATM radar feeds were made available to the UTM-system though technology powered by AirMap. This enabled BVLOS missions for package delivery over densely populated areas.

The successful U-space demonstration in Geneva, Switzerland, is a model for UTM around the world, proving that the air navigation services are available today and ready for the next stage of drone integration worldwide.