Building a 21st Century Infrastructure for America

Enabling Innovation in the National Airspace

Testimony of

Gregory S. McNeal, JD/PhD
Co-Founder, AirMap
Professor, Pepperdine University

AIRMAP

Mr. Chairman LoBiondo, ranking member Larsen, members of the committee. It's a pleasure to speak with you about the future of innovation in our national airspace system. To look forward and understand the challenges ahead of us, I think it's important to look back to the FAA Modernization and Reform Act of 2012 (FMRA 2012), which many of you participated in drafting. A mere five years ago, Congress directed the FAA to make plans for integrating drones into the National Airspace System. At the time, the drones many of us were thinking about were Predators and Reapers, flying above far off battlefields. In the 5 years since then, we've witnessed millions of small unmanned aircraft enter the national airspace system, a system that is struggling to handle this volume of new entrants. The drone ecosystem is growing exponentially: already, twice as many unmanned aircraft than manned aircraft are registered with the FAA, and we expect the trend to continue.

Without significant changes, two things are likely: first, America will no longer hold a preeminent place as a world leader in aviation, and our most innovative businesses will take their technology abroad. Second, the safety of the flying public will be jeopardized.

These issues of innovation and safety are closely intertwined. We cannot properly manage the complexity of unmanned aircraft sharing our skies without airspace automation and modernization. Because our airspace is one of the busiest and most complex in the world, our need for innovation and automation is most pressing. And yet, we are already seeing other nations move more quickly to develop infrastructure to automate traffic management and clear the way for unmanned aircraft, drone delivery, and the growth of the commercial drone industry. Japan will begin drone delivery in 2018 (Appendix A), while Europe expects to implement Unmanned Traffic Management, or UTM (Appendix B), in 2019 or 2020. The American UTM system will not be fully implemented until 2025, according to the latest NASA/FAA timelines (Appendix C).

Let's consider an example that illustrates the current system's inability to predict and anticipate future challenges. In 2015, the FAA published their proposed rule for Small Unmanned Aircraft (the rule that eventually became Part 107). In that proposed rule, the FAA declared that small unmanned aircraft could not operate in controlled airspace without prior authorization from Air Traffic Control. Despite writing a rule that required unmanned aircraft operators to obtain authorization for flights in controlled airspace, the FAA did not create a system to handle such requests. In fact, such a system will not be deployed until 2018 (See Appendix D, Appendix C), more than three years after the proposed rule was announced. This might not be a problem if the lack of systems for authorizing flights discouraged drones from flying in controlled airspace. But senior FAA officials have publicly admitted that they know or believe that individuals are already operating in controlled airspace, even without a system in place to ensure those individuals are accountable.

That system is not in place, but the technology to implement it already exists. Fourteen companies are participating in the Low Altitude Authorization and Notification Capability (LAANC) process (See Appendix D, E, F, G) and have told the FAA they are ready to deploy at no cost to the government. Many more want to do the same. If companies are ready to work with the FAA to deploy

automation at no charge to the agency, what accounts for the delays? First, the agency understands that they may need to rethink the way they do business – transitioning from their role as an acquirer of systems at a cost to the taxpayer, to a new one as the creator of frameworks, processes and standards that companies must meet, spurring competition and delivery of services by approved vendors. Second, numerous organizational problems hamper progress, including a lack of automation at ATC facilities (some of which even lack the internet), reliance on outdated modes of mapping (sometimes requiring facilities to hand draw grids with pen and paper and fax them back to headquarters), and a lack of coordination across business units within the agency. The FAA is an agency filled with hard working people who are doing their best to deal with 21st century challenges with outdated, 20th century ways of doing business.

If it sounds like I'm blaming FAA leadership or employees, let me make clear that I am not; these are organizational challenges that are inherent in a system that presumes that a government agency can move at the speed of innovation. The FAA was caught off guard by the pace of innovation and the rapid proliferation of this technology. In fact, in the FAA's economic analysis accompanying Part 107 regulations, published in February 2015, the FAA stated that, "The FAA estimates that approximately 7,550 commercial small UAS would be operating at the end of five years after the effective date of the final rule." That estimate was wildly off. By the time Part 107 was finalized, there were already 5,521 commercial operators, and within 5 days of the rule being finalized an additional 2,570 people took the Part 107 test. Assuming there is no double counting in those numbers, the FAA's prediction of 5 years to reach 7,550 operators was off by 4 years and 360 days and the volume of users has continued to increase.[1] In short, returning to the theme of this hearing, our government cannot always predict the future. When these predictions are wrong, they are difficult to remedy, because of the nature of budget planning and the challenges of keeping up with advances in technology.

At first blush, it may sound like these are structural problems that are extraordinarily hard to solve, and some are. But there is substantial room to make improvements. Looking back five years, we've learned an important lesson: that only Congressional action with clear direction and mandatory deadlines has ensured that our infrastructure and agencies keep pace with innovation. For example:

- In Section 332 of FMRA 2012, Congress called for UAS operations in the Arctic, operations that take place today.
- In Section 333 of FMRA 2012, Congress created an exemption process, which was implemented soon after.
- In Section 334 of FMRA 2012, Congress directed that public safety officials may operate unmanned aircraft weighing 4.4 lbs and below, operations that take place across America today.
- In Section 336 of FMRA 2012, Congress carved out protections for hobby and recreational use

1 Even if we set aside the 333 exempted operators, the number of Part 107 commercial operators exceeded the FAA's 7,550 estimate in a mere 33 days, 4 years and 332 days early.

of unmanned aircraft weighing up to 55 pounds, flights that also happen every day.

- In Section 2202 of the FAA Extension, Safety, and Security Act of 2016, Congress directed industry and the FAA to work together to create remote identification standards (appendix remote ID). Now, work has begun on that initiative.

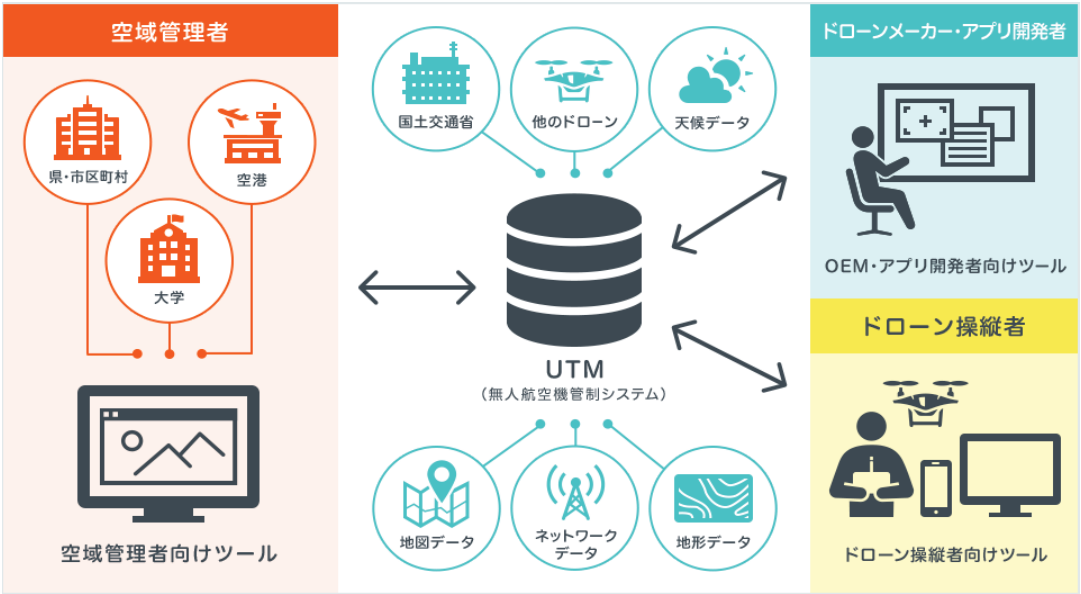
The trend line is clear: when Congress directs outcomes and provides concrete dates for when they must be achieved, innovation takes flight. So, what can Congress do to ensure innovation continues?

1) Congress must expand on Section 2208 of the FAA Extension, Safety, and Security Act of 2016 and ensure that the FAA operationalize and fully implement a UTM system by 2020. Otherwise, America will fall behind other nations and businesses will cast their eyes abroad. (See Appendix B, Appendix A, Appendix C, Appendix I.)
2) Congress should direct the agency to move beyond UAS test sites that move only at the pace of the FAA, and instead encourage the states to act as laboratories of democracy. A federalism approach to low risk operations in the very low altitude airspace will encourage competition and innovation amongst the states.
3) When Congress seeks to mandate a certain outcome from the FAA, Congress should continue to direct the agency to work with industry standards bodies, rather than through rulemaking. Industry standards are fast, flexible, and take account of the most recent advances in technology.
4) Congress should make clear the dividing line between reasonable time, manner and place restrictions that states may impose on unmanned aircraft and those areas that are the exclusive domain of the FAA. A failure to clarify this dividing line will result in a patchwork of judicial decisions that will doom the industry and state and local governments to a decade or more of litigation.
5) Congress should look to the success of the U.S. commercial space industry and the legislative frameworks that have worked for that industry, and adopt similar presumptions for advances in unmanned aircraft technology, especially for operations involving BVLOS flight (Appendix J), swarms, package delivery, autonomous passenger carrying VTOL aircraft, and electric aircraft.

American entrepreneurs, and the flying public have benefited from Congressional direction. History has proven that the best way to foster innovation is for Congress to take action to empower innovation and help the FAA hit key milestones. Now is the time for Congress to act again to keep the nation on track.

Appendix A: Rakuten AirMap, Inc.

OBJECTIVE: Bring Unmanned Traffic Management (UTM) solutions to Japan to support Prime Minister Abe's commitment to begin BVLOS flights in rural areas by October 2018, urban areas by 2020.
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 helps commercial drone operators fly safely and securely beyond visual line of sight – from automating waiver processes to providing tools for UTM and real-time flight planning and navigation.

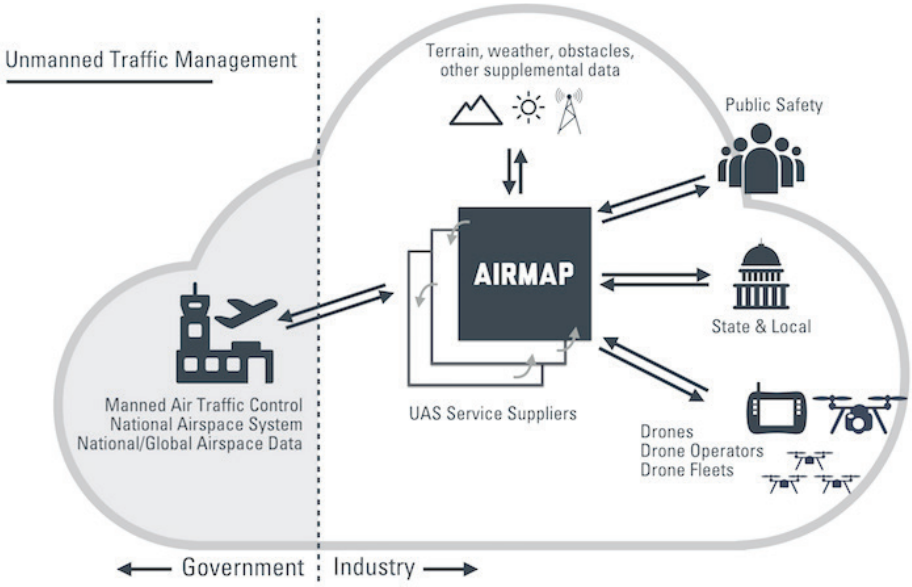
Drone Delivery
Rakuten launched its Sora Raku Rakuten Drone delivery service in April 2016, including a successful LTE-powered delivery to the mayor of Chiba City, Toshihito Kumagai, from over 40km away. Rakuten AirMap's UTM platform will support airspace managers seeking to open surrounding airspace 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 use the Rakuten AirMap UTM platform to learn about the rules and conditions in their flight area, create flight plans, and share them with nearby airports and authorities.

Appendix B: 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.



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

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.

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.

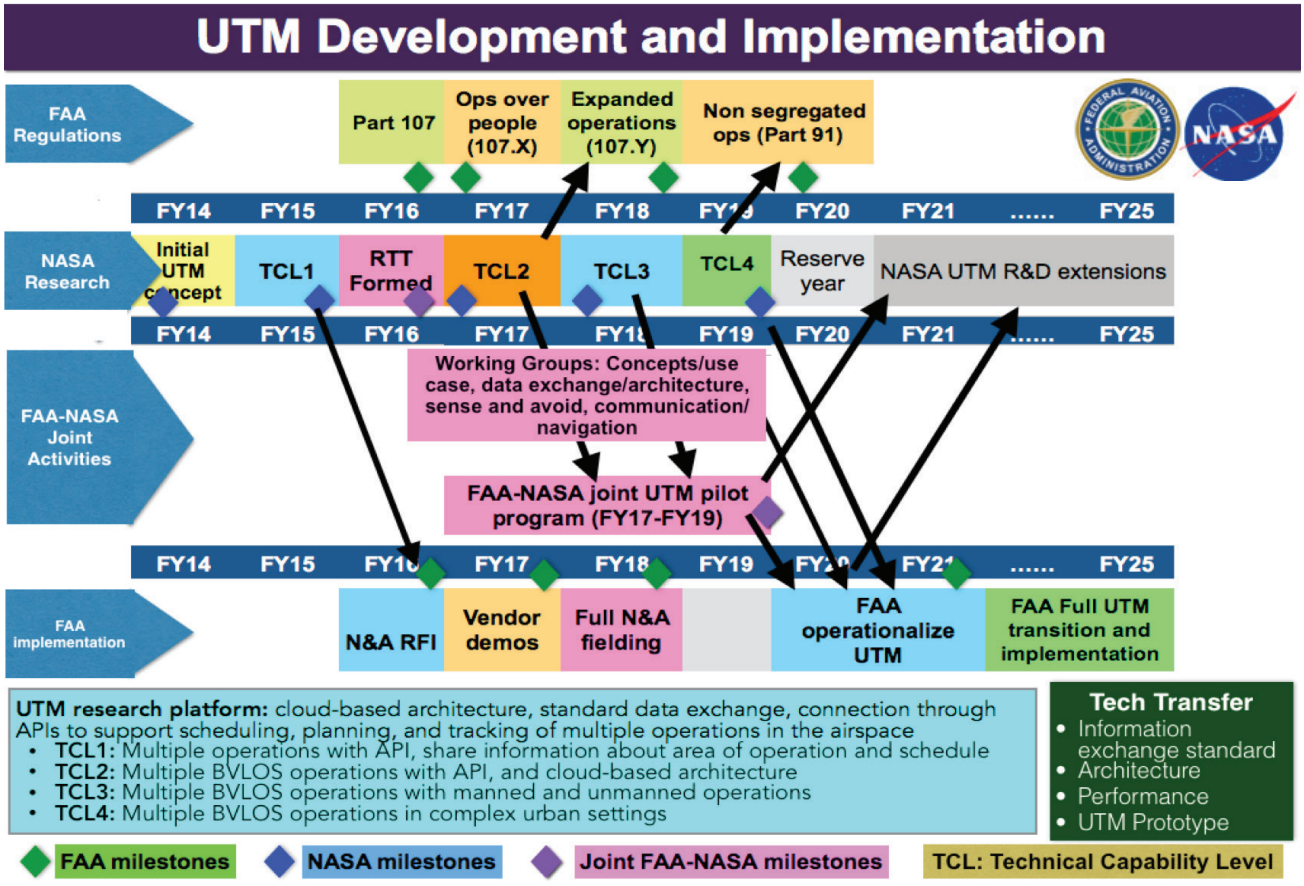
Dynamic Geofencing
AirMap makes it easy for drone manufacturers to incorporate geofencing and authorized unlocking directly into a drone's firmware. For example, the DJI GEO flight control app is powered by AirMap to provide the safest operating environment possible.

Appendix C: 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



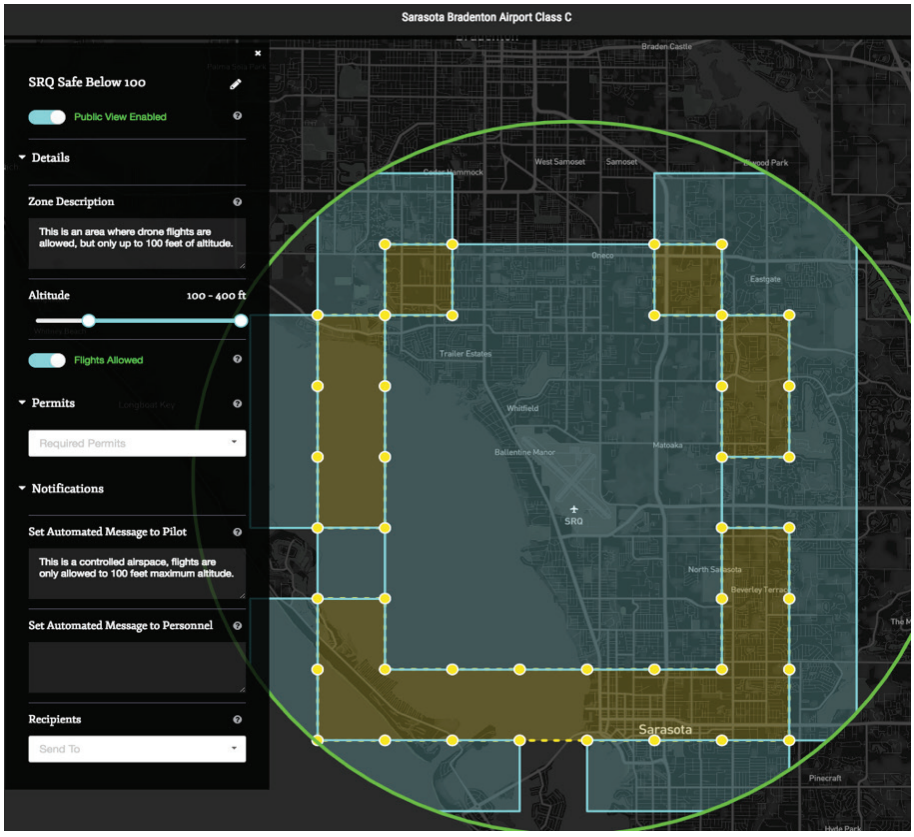
The diagram above outlines NASA and the FAA's proposed timeline for the full development and implementation of Unmanned Traffic Management (UTM), with complete UTM implementation planned for 2025.

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 D: 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 drone operations in controlled airspace by third party UTM Service Suppliers (USS) like AirMap. The system is 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

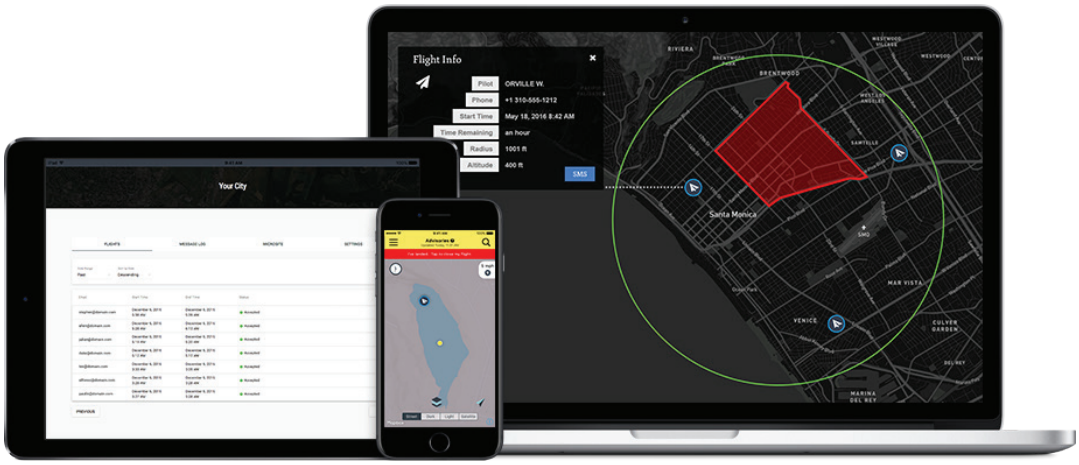
LAANC streamlines and digitizes the current authorization process for drone operations in controlled airspace. Today, FAA authorization is a manual process that takes up to 90 days. With LAANC, authorization is automatic and instantaneous. LAANC drives efficiency while removing the need for administrative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

Appendix E: Airports

OBJECTIVE: Connect drone operators with airport managers to give notice of flight, per Section 336 of FMRA 2012.

IN COLLABORATION WITH: American Association of Airport Executives (AAAE)

STATUS: Deployed at 125 airports, including Los Angeles Int'l, Houston Airport System, and others.



Airspace Authorization

Designate sensitive areas requiring airspace authorization before flight. Specify digital authorization requirements to streamline flight planning and approval protocol. Communicate safety-critical airspace information directly to drones and drone operators in real-time.

Digital Notification

A drone operator files an encrypted digital flight notice, which is shared on the airport's secure dashboard of ongoing operations in that airspace. Airspace authorities can choose to automate responses or interact directly with the operator in the event of authorization requests.

Flight Logs Archive

AirMap facilitates easy and automated record-keeping for current and past drone operations in authorized airspace. Access details including path, altitude, speed, distances, and duration.

Situational Awareness

The AirMap 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.

Deployed at 125 airports, including:

Asheville Regional Airport
Charlotte Douglas Int'l Airport
Camarillo/Oxnard Airports
Minneapolis-St. Paul Int'l
Cincinnati/N. Kentucky Int'l
Moffett Federal Airport
Fort Wayne Airport
Los Angeles Int'l Airport
Houston Airport System
Boulder City Municipal
Reno Stead Airport
Boston Logan Int'l Airport
San Gabriel Valley Airport
John Wayne Airport
Portland Int'l Airport
Franklin Field
Truckee-Tahoe Airport
Columbus Air Force Base

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Appendix F: Manufacturer Integrations

OBJECTIVE: Power the world's drones with global, robust, and trustworthy airspace data for efficient, safe, intelligent, and secure operations at scale with AirMap's easy-to-use APIs and SDKs.
IN COLLABORATION WITH: DJI, Intel, Sensefly, Yuneec, AeryonLabs, and more
STATUS: Millions of drones have the most up-to-date information about low-altitude airspace.

Situational Awareness
The AirMap platform allows drone manufacturers like DJI, Sensefly, Intel, and others, to make AirMap's airspace information and services, including RTCA DO-200A data, available to end users.

Real-Time Deconfliction
AirMap has partnered with the FAA, PASSUR, and uAvionix to deliver location-based information of nearby aircraft directly to drone operators and drones for real-time collision avoidance.

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.

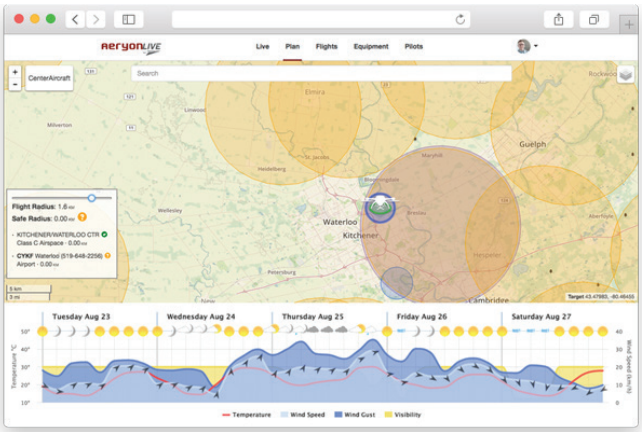
Dynamic Geofencing
AirMap makes it easy for drone manufacturers to use AirMap's airspace services to prevent drones from inadvertently operating amid hazards like wildfires or temporary flight restrictions.

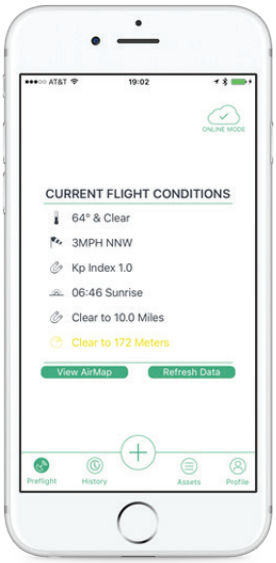
User Authentication
AirMap and DigiCert partnered to deliver Drone ID, a publicly-trusted SSL/TLS certificate that facilitates instant verification of a drone's identity via digital certificate for drone authentication and encryption.

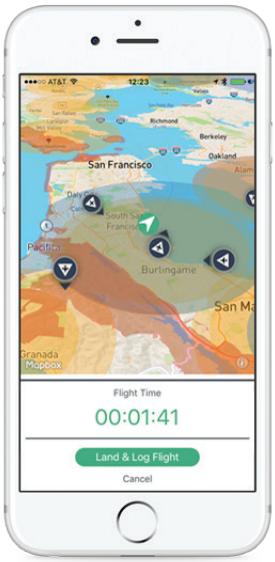
Notice and Authorization
AirMap's notice and authorization technology enables drone operators to send encrypted digital flight notices or requests for authorization from an AirMap-integrated drone directly to airspace authorities.

Appendix G: 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.

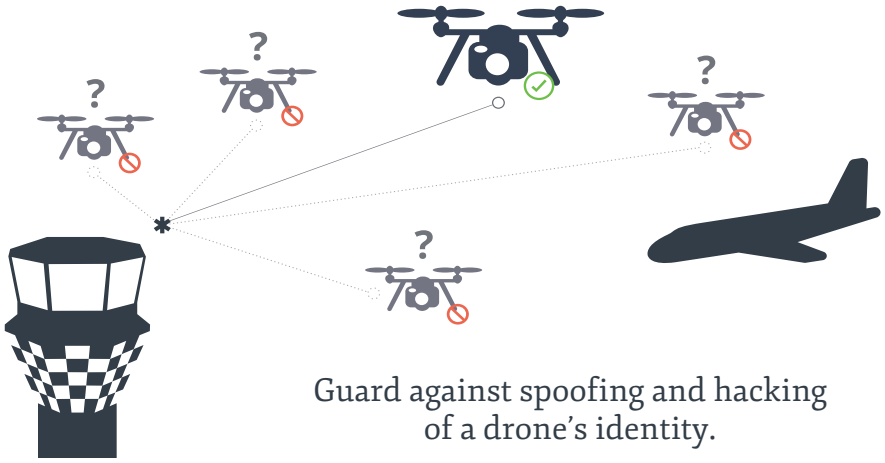
Appendix H: Remote Identification

OBJECTIVE: Propose a reliable method of identifying a drone in-flight – enabling accountability for operations in a wide range of flying environments, especially near people, property, and critical infrastructure.

STATUS: Drone ID, first-ever digital certificate for drones, is available to the drone industry today.

ADVANTAGES:

- Activated with a simple firmware/software update
- No additional hardware requirements
- Information is exchanged using existing broadcast capabilities, such as WiFi, Bluetooth, LTE
- Low-cost, highly secure, and easily scalable
- Supported by existing and competitive ecosystem of more than 1,480 certificate authorities
- Prevents spoofing/hacking of identifying information and ensures that a drone's identity can be trusted



Guard against spoofing and hacking of a drone's identity.

SSL/TLS certificates are a digital technology commonly used to secure communications on the internet and in the Internet of Things (IoT) ecosystem. Today, a competitive ecosystem of more than 1,480 certificate authorities provides SSL/TLS certificates to millions of websites and IoT devices. Each SSL/TLS certificate establishes a pair of digital "keys" that are used to encrypt and/or digitally sign information shared with others. On the Internet, this is information shared between websites and their users (for example, your data is protected by a SSL/TLS certificate when you use an online banking site). When an individual sends data to a website with https, it is encrypted with a public key, designated by a lock next to web link in the address bar. Only the web page visited has the private key needed to decipher the message.

Certificates can be used to provide a range of benefits to drones. If a drone broadcasts information about itself or its flight without a digital signature, that information is unverified, and the recipient cannot tell if this information has been modified or spoofed. If this information is "digitally signed" by an SSL/TLS certificate, the authenticity and integrity of the message can be verified, and it can be confirmed as belonging to a specific drone. The SSL/TLS certificate helps to ensure that the drone's identity can be trusted and has not been spoofed or hacked.

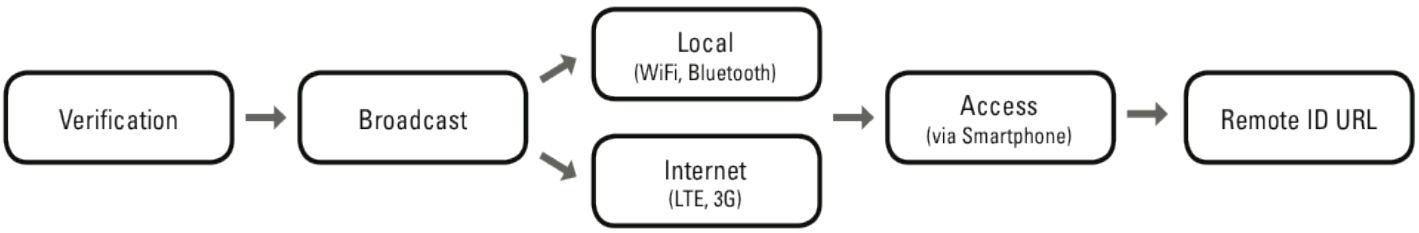
Appendix H: Remote Identification (cont.)

SSL/TLS certificates can also enable three steps of trusted remote identification for drones:

1. Verification
A Certificate Authority validates the drone operator's email address, phone number, name, and address and issues a x509 certificate SSL/TLS certificate. The certificate includes a unique identifying number for the drone, akin to a car's license plate, and a Remote ID URL, where authorities can learn how to access more detailed information in the case of an investigation.

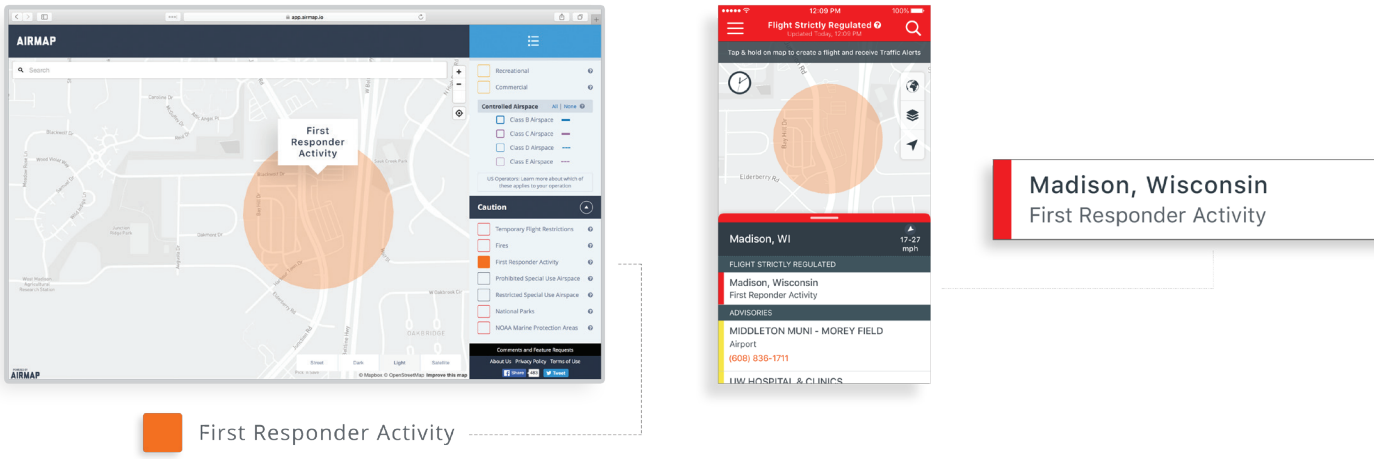
2. Broadcast
The drone securely broadcasts its identifying number and Remote ID URL to those on the ground. Broadcast is available via technologies already on board most drones, or that require a firmware upgrade, such as WiFi Aware or Bluetooth Smart. An internet connection, such as LTE, can also be used, but local broadcast allows for data exchange in areas with limited or no data coverage.

3. Access
Authorities and others on the ground view the drone's ID number and Remote ID URL via a mobile app on their smartphone, tablet, or other device. The drone's position is visualized on a map; users tap to view the drone's ID number and Remote ID URL. Members of the public can use the drone's ID number to report issues to authorities, but cannot access personally identifying operator details.



Appendix I: 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.



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 partnered with AirMap to publish 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 software application.

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.

Appendix J: Beyond Visual Line-of-Sight (BVLOS)

OBJECTIVE: Equip drones with the technology necessary to fly safe and efficient routes, react and adapt to changes in real time, and exchange critical information with others.
IN COLLABORATION WITH: NASA, FAA, Rakuten
STATUS: AirMap works with NASA-FAA to test technical capabilities to support U.S. BVLOS operations. Rakuten AirMap, Inc., supports BVLOS operations in Japan, with regular deliveries expected in 2018.

NASA-FAA UTM BVLOS Trials

In the future, millions of drones will fly billions of flights. These drones will need a complex universe of data to understand the environment around them – and tools to communicate and deconflict with others in low-altitude airspace. The majority of drone operations will be beyond the visual line-of-sight of an operator, or without an operator at all in the case of autonomous drones.

AirMap is a partner in the NASA-FAA UTM project, a collaboration between regulators and private industry that is testing and harmonizing technologies needed to realize UTM in the United States.

Rakuten AirMap, Inc.

E-commerce company Rakuten leads the way in efforts to realize BVLOS drone delivery in Japan. Rakuten launched Sora Raku drone delivery service in April 2016. Since then, Rakuten has flown several ground-breaking test flights, including a successful LTE delivery flight to the mayor of Chiba City, Toshihito Kumagai, over 40km away.

Rakuten AirMap, Inc. is a joint venture with the goal of bringing AirMap's technology solutions for Unmanned Traffic Management (UTM) to Japan for BVLOS operations at scale.

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