Leigh | Fisher

focus

February 2017

Workhorse aerial package delivery with drones

The Era of Small Drones

New Challenges for Airport Operators and the Aviation Industry

DHL Parcelcopter "last mile" deliveries using automated Skyports

Airbus uses drones to inspect aircraft

Innovations in drone technology, increasing numbers of small drones in operation, and expanding commercial uses of drones present new challenges for airport operations.

The Federal Aviation Administration (FAA) forecasts more than 7 million small Unmanned Aircraft Systems (sUAS), commonly referred to as drones, to be in operation by 2020, with hobbyists accounting for 61% and commercial users accounting for the remaining 39%. In December 2015, in response to strong growth in drone sales, the FAA began the requirement for all hobbyists to register small drones as a means to identify and educate owners about airspace operating restrictions. According to current FAA rules, hobbyists must always fly drones within line-of-sight and are not allowed to fly (1) within five miles of an airport without obtaining airport and air traffic control approval, (2) near manned aircraft, or (3) above 400 feet. In August 2016, the FAA released new rules for the commercial operation of sUAS, which require commercial users to obtain an FAA Remote Pilot Airman Certificate as well as comply with rules established for hobbyists. To operate outside of these rules, drone operators must apply to the FAA for a Certificate of Authorization or Waiver (COA) and/or a Section 333 exemption. This *focus* summarizes emerging trends in the use and operation of drones and the potential challenges for airport operators.

Photo credits: Workhorse Group Inc., Deutsche Post DHL Group, ©Airbus SAS 2016 – photo by R Gnecco/aircam

Planes, Trains, Automobiles, and Drones

As of January 2017, 670,000 small drones were registered with the FAA.

Decades from now, drones will likely be as much a part of life as planes, trains, and automobiles are today. Since December 2015, the FAA has required all sUAS weighing more than 0.55 pounds and less than 55 pounds to be registered using a new online system (unmanned aircraft weighing 55 pounds or more must be registered using the existing registration process for general aviation aircraft). Based on FAA registration data, hobbyist drone users accounted for 98% of registrations as of May 2016, while commercial users accounted for the remaining 2%. Of commercial users, the top five sUAS industries include real estate and aerial photography, insurance, agriculture, industrial inspection, and government.

Of the 50 states, California accounted for the largest share of registered drone users (hobby and commercial) with 13%, followed by Texas and Florida, each with 8%. California also accounted for the largest number of commercial drone users (1,212), including Menlo Park, the U.S. city with the most commercial registrations (176) and home to Silicon Valley companies such as Facebook and drone startup companies such as Matternet, Kespry, and Skydio. In addition, Los Angeles and Burbank together accounted for 136 commercial drone registrations, reflecting the increasing use of drones to produce Hollywood films.

FAA Registrations of Small Drone Users by State

As of May 12, 2016

		Number of registered drone users			
Ranking	State	Hobby	Commercial	Total	Percent of total
1	California	57,953	1,212	59,165	13%
2	Texas	36,705	616	37,321	8%
3	Florida	35,170	629	35,799	8%
4	New York	21,648	309	21,957	5%
5	Pennsylvania	17,145	252	17,397	4%
6	Illinois	15,713	235	15,948	3%
7	Ohio	15,596	245	15,841	3%
8	Michigan	14,193	192	14,385	3%
9	Washington	13,850	209	14,059	3%
10	Georgia	13,555	278	13,833	3%
	States listed	241,528	4,177	245,705	52%
	Other states	219,600	4,231	223,831	48%
	Total	**461,128**	**8,408**	**469,536**	**100%**

MKTG685

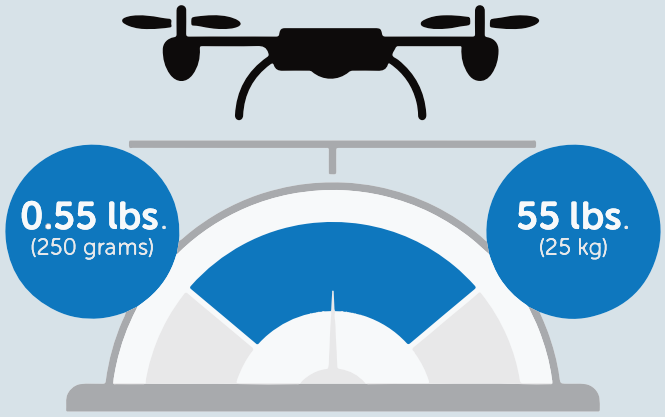
Note: Data are for drones weighing more than 0.55 pounds but less than 55 pounds. An additional 300 drones were registered to users outside the United States.

Source: Federal Aviation Administration, Drone Registration Location Data, www.faa.gov, accessed December 2016.

Partial Summary of FAA Small UAS Rule (Part 107) on Commercial Use

Effective August 29, 2016

- Register to fly drones weighing more than 0.55 pounds but less than 55 pounds (www.registermyuas.faa.gov)
- Obtain an FAA Remote Pilot Airman Certificate
- Maintain a visual line-of-sight with the drone by certified pilot in command
- Operate during daylight hours only
- Maintain a maximum altitude of 400 feet above ground level and a maximum speed of 100 mph
- Never fly over people and yield right of way to manned aircraft
- Fly within class G airspace (FAA approval required for operations in Class B, C, D, and E airspace)



Notes: See www.faa.gov/uas for complete rules.
U.S. military and government agency drones are operated under a Certificate of Waiver or Authorization (COA) issued by the FAA.

Drone Sightings Near Airports and Aircraft

The FAA receives more than 100 reports of drone sightings in the vicinity of airports and aircraft each month.

UAS sightings reported to the FAA by pilots, citizens, and law enforcement agencies have increased significantly since 2014. The FAA works closely with industry partners through the "Know Before You Fly" campaign to educate unmanned aircraft users about where they can legally operate and the law enforcement community to identify and investigate unauthorized unmanned aircraft operations.

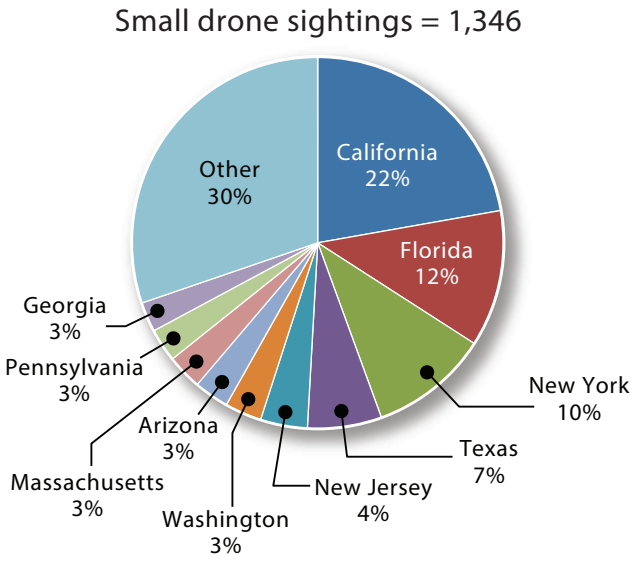
FAA's B4UFLY Smartphone App

Available for free download from the App Store for iOS and the Google Play store for Android

The United Kingdom's Civil Aviation Authority (CAA) is in the process of revising its rules on UAS operations in response to a fourfold increase in the number of near misses with aircraft and the collision of a drone and a British Airways A320 aircraft at 1,700 feet—well above the safe altitude to fly a drone in controlled airspace—on approach to London's Heathrow Airport in April 2016. The CAA's new UAS rules are expected to go into effect in April 2017 and would require the registration of all recreational drones weighing more than 250 grams (0.55 pounds).

Small Drone Sightings Reported to the FAA

November 2014 to January 2016



Note: Reports of sUAS sightings around airplanes, helicopters, and airports from pilots, citizens, and law enforcement.

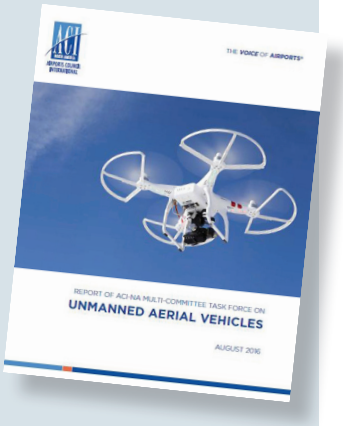
Source: Federal Aviation Administration, UAS Sightings Report, www.faa.gov, accessed December 2016.

Industry UAS Initiatives

ACI-NA Multi-Committee Task Force on Unmanned Aerial Vehicles

In January 2016, Airports Council International-North America (ACI-NA) convened an industry task force to evaluate the range of issues associated with the use of unmanned aerial vehicles (UAVs) at and near airports in the United States and Canada. A summary of its findings was published in August 2016 and is available at www.aci-na.org. Among the findings, the task force noted a number of potential sUAS applications for airport operators, including:

- Perimeter security
- Airfield and facility condition inspections
- Traffic management
- Parking surveillance
- Emergency response/ event management
- Surveying/capital project support
- Aerial photography
- Wildlife management



AAAE Digital Notice and Awareness System

In March 2016, the American Association of Airport Executives (AAAE) and AirMap, a leading provider of airspace information and services for unmanned aircraft, announced the release of the Digital Notice and Awareness System (D-NAS). More than 75 U.S. airport operators have already joined the D-NAS pilot program, created to allow UAS pilots to provide real-time information about the location of their drone flights that can be accessed by air traffic controllers. More information is available at www.aaae.org.

Drone Advisory Committee

In May 2016, FAA Administrator Michael Huerta announced the establishment of the Drone Advisory Committee (DAC) to work in partnership with the FAA to identify and propose actions to integrate UAS into the National Airspace System (NAS). DAC members include airport, government, university, private sector, and other aviation-related representatives. More information is available at www.rtca.org.

Drone Detection System Tests Are Underway at Airports

The use of proactive drone detection systems will be increasingly important with the continued proliferation of drones.

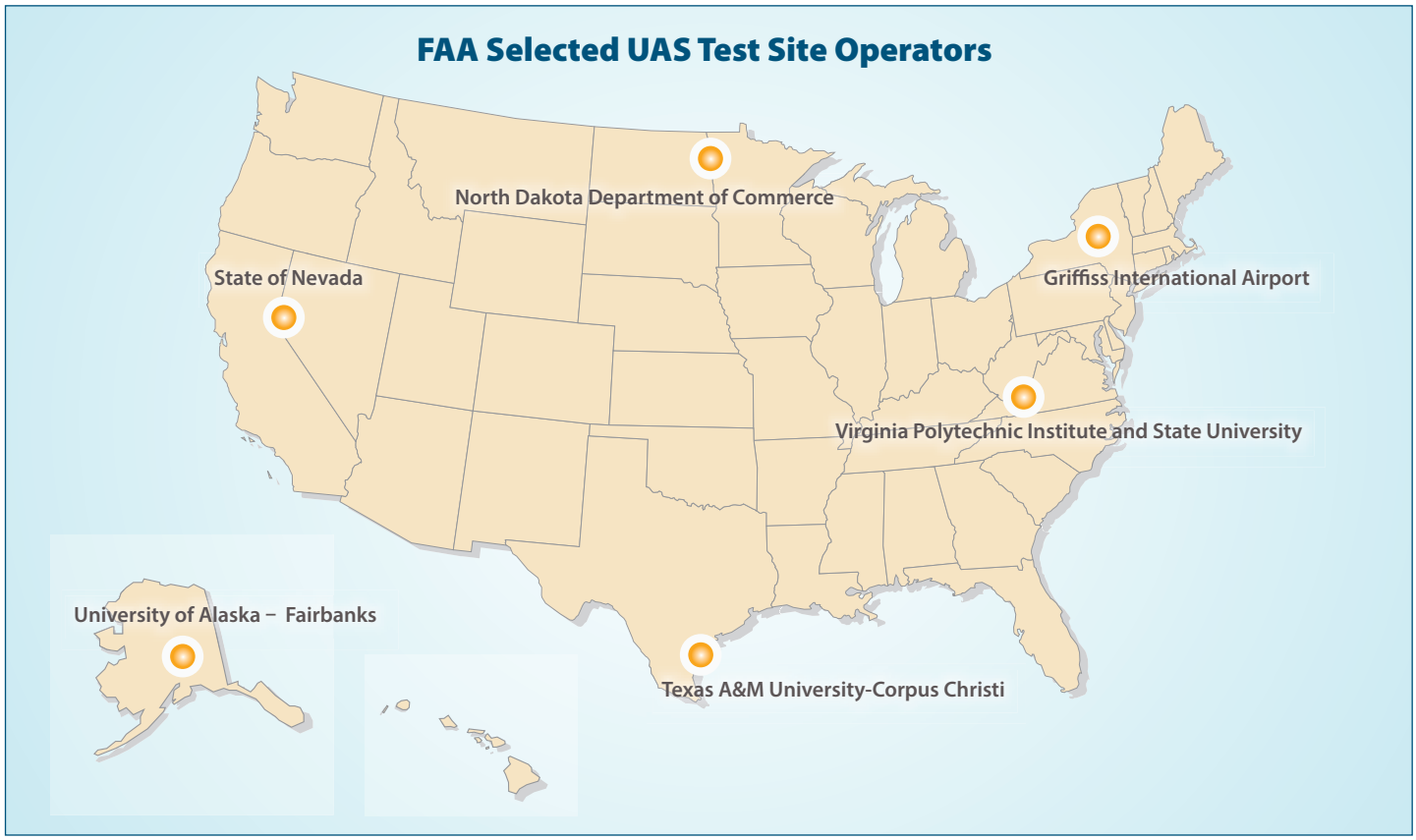
In June 2016, the FAA established the *Pathfinder Program* to explore the incremental expansion of UAS operations in the National Airspace System. In July 2016, the FAA expanded the program to include the *UAS Detection Initiative* to evaluate available technology to detect sUAS in airport vicinities. The FAA has partnered with U.S. agencies such as the Department of Homeland Security and the Federal Bureau of Investigation and private sector UAS technology companies to conduct tests at airports in Atlantic City, Dallas-Fort Worth, Denver, New York (JFK), and Valparaiso (Eglin Air Force Base). UAS detection tests were conducted at Atlantic City in January 2016 and Denver in November 2016.

The integration of UAS operations into the National Airspace System is also being supported by the FAA UAS Center of Excellence–the Alliance for System Safety of UAS through Research Excellence (ASSURE)–and six UAS test site operators selected by the FAA. ASSURE is led by Mississippi State University and consists of 23 of the world's leading institutions focused on research, education, and training to ensure the safe and successful integration of UAS into U.S. airspace. The FAA's test sites support UAS integration by providing an avenue for the UAS industry and stakeholder community to conduct more advanced research and operational concept validation.

In addition, drone manufacturers and software providers are developing technologies like geo-fencing and collision avoidance to make flying drones safer. The potential cost and funding sources of drone detection systems for airport operators are difficult to estimate and identify at this time, given the early stages of technology development and the FAA's ongoing tests of drone detection systems.

Photograph courtesy of Blighter Surveillance Systems

The Anti-UAV Defence System (AUDS) uses electronic scanning radar to detect drones up to 6 miles away and radio waves to disable them



Source: Federal Aviation Administration, https://www.faa.gov/uas/programs_partnerships/coe_test_sites/, accessed February 2017.

Keeping Up with the Drones

The FAA and NASA are testing an unmanned air traffic control system for drones.

The FAA and the National Aeronautics and Space Administration (NASA) are developing an unmanned aircraft system traffic management platform (referred to as UTM) that would allow for greater numbers of drones to fly simultaneously and prevent mid-air collisions with piloted aircraft and other drones. Tests of the platform began in 2016 and are scheduled to continue through 2019.

- April 2016: First drone air traffic control test, when pilots at multiple FAA drone test sites across the country flew a total of 22 drones simultaneously, each within the line-of-sight
- October 2016: Test to determine whether a mapping alert platform could track drones in real time, report flight paths, and alert pilots of unanticipated hazards, representing the first test of drones flying beyond the pilot line-of-sight
- January 2018: Test of the new drone air traffic control system over populated areas
- 2019: Final test, after which recommendations will be made for a national solution

In 2017, the FAA plans to develop a rule to extend commercial operations over populated areas and controlled airspace beyond visual line-of-sight (BVLOS) of the sUAS operator. To develop BVLOS rules, new detection and avoidance technologies must be developed and tested in safe but realistic environments. In December 2016, the FAA approved a COA for the Northern Plains UAS Test Site in North Dakota, which is slated to be the first test site in the United States to have BVLOS operations and will support the development, testing, and evaluation of new applications for UAS technology.

In Singapore, Nanyang Technological University and the Civil Aviation Authority are developing a drone traffic system that uses "virtual fences" to prevent crashes and expect the initial phase of conceptual design and software simulation to be complete in 2017.

Illustration courtesy of the National Aeronautics and Space Administration

UTM scenario showing many uses for small UAS

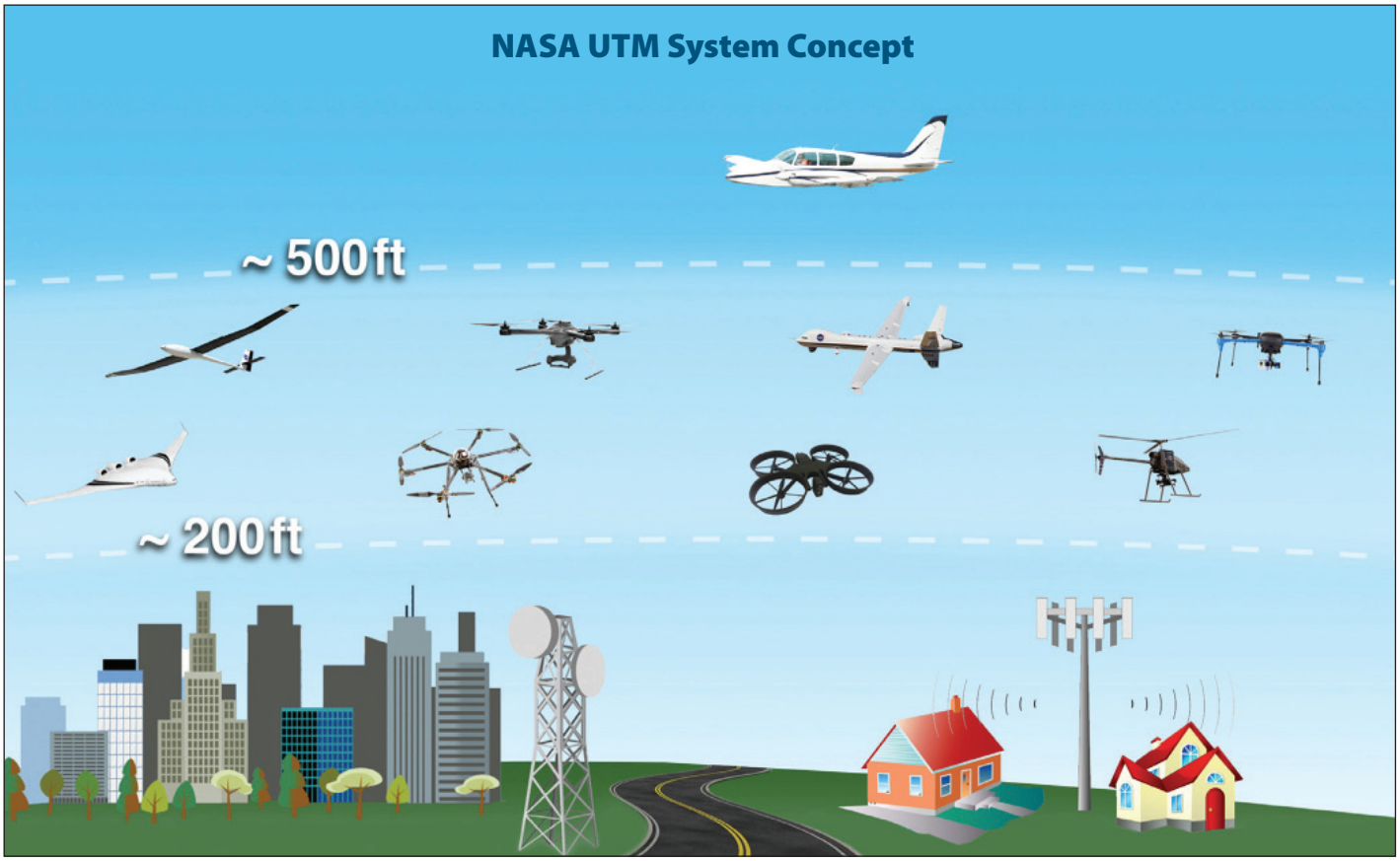


Illustration courtesy of the National Aeronautics and Space Administration

NASA's concept for a potential UTM system would safely manage diverse UAS operations in the airspace above buildings and below crewed aircraft operations in suburban and urban areas

The Future of Drone Package Delivery

The FAA predicts that drone package delivery is likely three or more years away from widespread commercial acceptance.

Although tests of drone package delivery are underway by companies such as Amazon, UPS, and Walmart, the integration of drones will depend on a number of factors, including:

- The development of further drone standards and technical guidelines for collision-avoidance technology
- The establishment of an unmanned air traffic control system for drones
- The continued advancement of drone technology
- The economic viability of drone delivery versus other modes

In 2013, Amazon announced plans to implement package delivery via drone in 30 minutes or less with a new service called "Amazon Prime Air." Since then, Amazon has been testing the ability to fly drones beyond the pilot's line-of-sight, sensors that identify and avoid obstacles, and a one person operation of a fleet of drones. According to Amazon, its drones are capable of delivering packages weighing up to five pounds, which comprises 80% to 90% of all products sold by Amazon. Amazon performed its first drone delivery test in the United Kingdom in December 2016 and has filed nearly 40 patents with the U.S. Patent and Trademark Office for drone related technology.

One of the largest obstacles to widespread drone package delivery in the United States is the requirement for drones to stay within a pilot's line-of-sight. Companies such as Mercedes-Benz and Workhorse, a U.S. firm that creates electric delivery vehicles for companies such as UPS and FedEx, have overcome this obstacle. Each company has developed an integrated van/drone delivery system which utilizes vehicles to launch drones carrying packaged goods for delivery. Mercedes-Benz's "Vision Van," developed in partnership with Silicon Valley drone startup Matternet, would employ two drones capable of delivering packages up to five pounds within a six mile radius. Workhorse plans to integrate its electric delivery trucks with its drone, which can travel at speeds up to 50 mph, carry a 10-pound package, and fly for 30 minutes.

Drone package delivery is also being tested outside the United States. The Directorate General of Civil Aviation, France's airspace regulator, has authorized drone package delivery in the southern region of Provence, where they will travel a limited, nine-mile route once per week. In November 2016, JD.com, a Chinese e-commerce company, started a trial of a drone delivery service in rural China during the country's "Singles' Day" shopping festival, testing drop-offs outside of Beijing and in Jiangsu, Shaanxi, and Sichuan provinces.

Send in the Drones

Airport operators are recognizing the value of drones in the operation, maintenance, and inspection of airport property.

Notwithstanding safety concerns about drone operations at airports, the successful use of drones for commercial purposes such as construction, insurance inspection, and mapping and surveying has provided a basis for similar uses at airports.

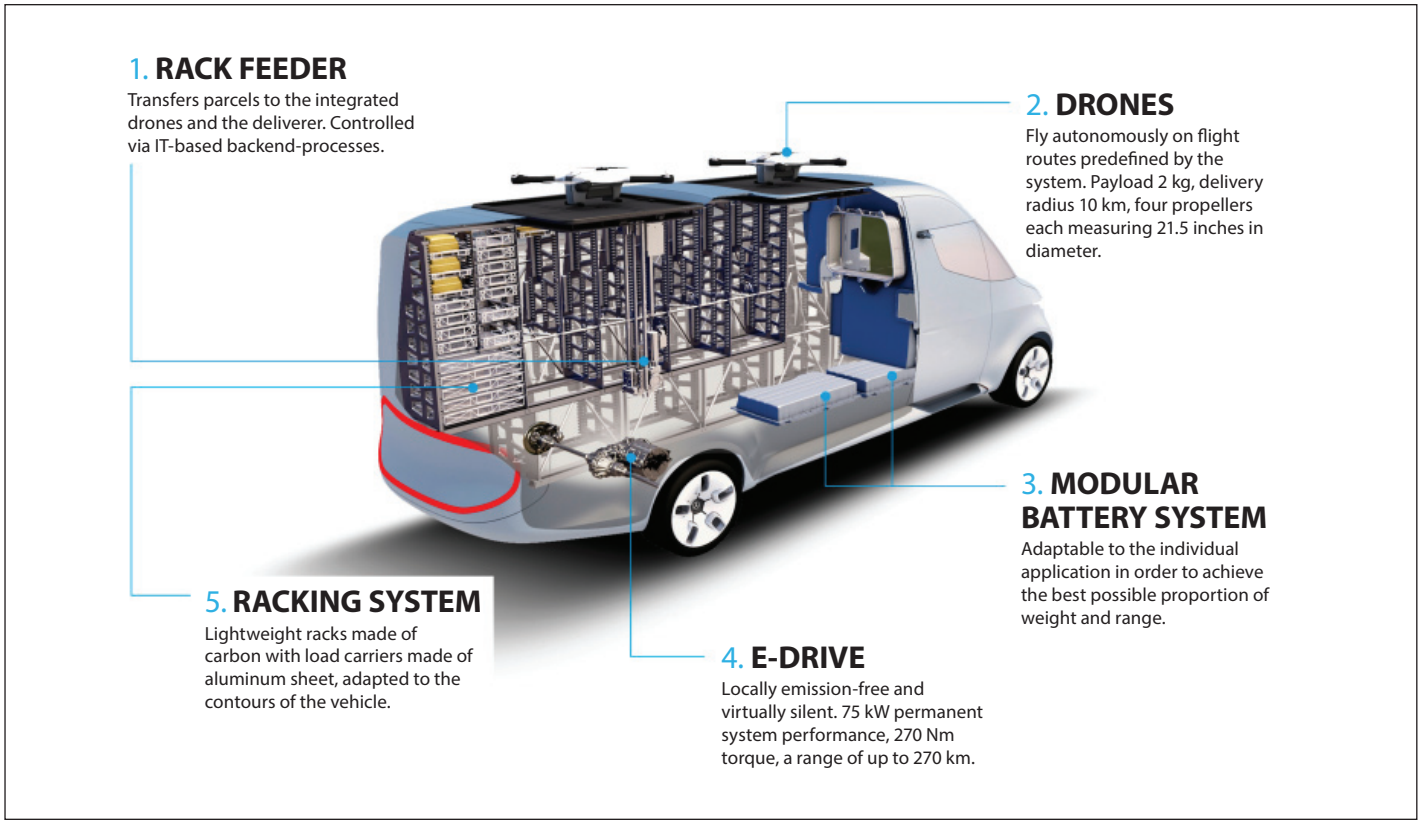
- In the United States, operators at general aviation airports, such as Southern Illinois Airport, received waivers from the FAA to use drones for wildlife management, perimeter security, and facility inspection. In January 2017, under the new commercial drone rules, the FAA granted the first waiver

Photograph courtesy of Domino's UK

Photograph courtesy of 7-Eleven and Flirtey

Source: UPS, "UPS and CyPhy Works Test Drone Delivery 3," September 23, 2016, https://pressroom.ups.com.

Drone delivery tests performed in 2016 by Dominos, 7-Eleven, and UPS



Mercedes-Benz Vision Van

Photo courtesy of Daimler

Drones Go the Last Mile

In supply chain management and transportation planning, the "last mile" refers to the last leg of a delivery to place a product in the hands of a consumer and typically accounts for 30% to 40% of total shipping costs. Strong growth in e-commerce and increased emphasis on the speed and convenience of delivery to the home are reshaping the last mile. Drones are expected to be an integral part of cost reduction of the last mile, particularly in countries with high labor costs such as the United States and when advanced technology allows a single pilot to operate multiple drones.

Illustration courtesy of Deutsche Post DHL Group

for the operation of drones in Class B airspace at Hartsfield-Jackson Atlanta International Airport, the busiest passenger airport in the world. Drones were used to collect data on two 4-story airport parking structures that were scheduled to be demolished.

- In Europe, at Charles de Gaulle and Paris-Le Bourget airports, drones are tethered by cords that provide power and communications as a safety precaution to inspect high jet bridges like those used for A380 aircraft and to calibrate air navigation assistance instruments.
- Airlines, aircraft manufacturers, and other aviation-related businesses such as Avianca, EasyJet, and Airbus have been using drones to inspect aircraft.

Drone On: Fast Forward to the Future

The development of new drone applications is likely to provide great benefits and, at the same time, challenge airport operators and the regulatory structure of the U.S. aviation industry.

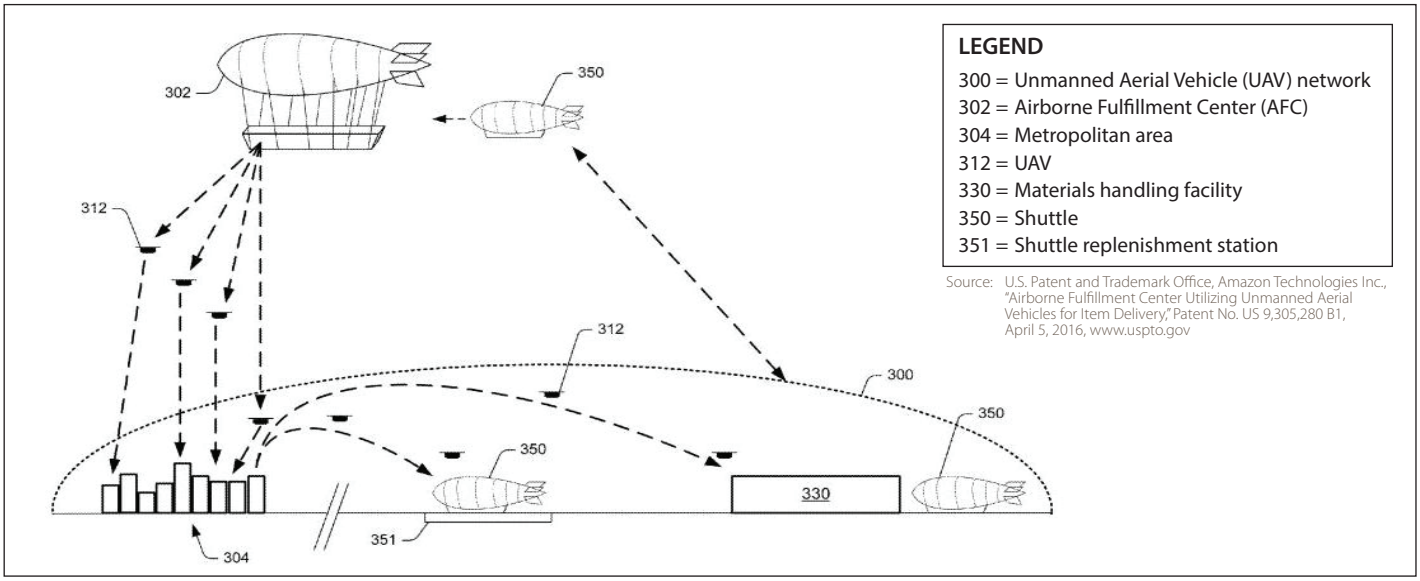
Drone technology continues to evolve. New proposed applications of drone technology highlight the innovative spirit of this industry and push the limits of what may be achieved.

The potential humanitarian applications are significant, including drone deliveries of blood and medical supplies to remote locations in the United States and developing countries such as Rwanda and Tanzania, drones that can record and stream high-definition video for search-and-rescue missions, or ambulance drones that can get medical equipment such as defibrillators to people quickly in rural areas.

Workplace safety could be improved by engaging drones equipped with high-definition and thermographic (infrared) cameras to safely inspect dangerous areas and locate energy leaks, damage, deterioration, or safety issues. The assessment of roof conditions with sUAS equipped with multispectral sensors that produce color infrared images is less expensive, safer, and more accurate than visual inspection.

The U.S. regulatory structure is likely to be challenged by drone technology innovations. In February 2017, the FAA granted a special waiver for a light show of 300 Intel Shooting Star drones at the stadium of Super Bowl LI, including permission to fly up to 700 feet in Class B airspace. Intel's drone light show was filmed prior to the Super Bowl because of FAA restrictions on drones flying within 34.5 miles of the stadium and over large numbers of people. In April 2016, Amazon received a patent for a conceptual "airborne fulfillment center," a flying warehouse such as an airship or blimp that would float at an approximate altitude of 45,000 feet.

The key to the future is the continued recognition of the economic and societal benefits of drones while simultaneously balancing operational and safety concerns at airports.



Amazon received a patent for its "Airborne Fulfillment Center" in April 2016

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