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Mind Your Drone Business: Allowing Drones in Controlled Airspace

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Part I: Introduction

The technology that has led to present day advancements in unmanned aerial vehicle ("UAV") operations – what are more commonly referred to as drones – dates back over one hundred years.[1] During World War I, simple UAVs relying on gyroscopic guidance were used for aerial target practice.[2] In 1940, Edward Sorensen patented a radio-based, ground control system which allowed UAVs to fly beyond the operator's line of sight ("LoS").[3]

Within the last decade, the capabilities and utilization of commercial and recreational drones has exploded. Using drones to supplement our infrastructure could have incredible benefits.[4] A wide range of companies, from start-ups to multinational conglomerates, are currently testing and have received authorization to use drones which could impact a wide range of industries. For example, Alphabet's Project Wing is currently testing using drones for domestic commercial delivery.[5] Similarly, UPS has also demonstrated capabilities in medical supply

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[1] DEPT. OF HOMELAND SECURITY, UNMANNED AIRCRAFT SYSTEM (UAS) SEARCH AND RESCUE ADDENDUM TO THE INTERNATIONAL AERONAUTICAL AND MARITIME SEARCH AND RESCUE MANUAL (2016), https://connect.ncdot.gov/resources/Aviation%20Resources%20Documents/SAR_UAS_Addendum(July2016_Vers_1-0)-Final.pdf
[2] *Id.*
[3] *Id.*
[4] Admittedly, drones also present many threats. While this paper will not discuss these concerns, for illustration the most pressing issues are privacy and national security; drones could be used by both private users or government actors to surveil others, or rogue actors could use their drones as weapons. *See* Tom Farrier, *Drones Are Here To Stay, But These Four Key Concerns Still Need To Be Addressed*, FORBES (2017), https://www.forbes.com/sites/quora/2017/10/04/drones-are-here-to-stay-but-these-four-key-concerns-still-need-to-be-addressed/#6cd121ab177d
[5] Luke Dormehl, *When it Comes to Delivery Drones, Google's Wing is Miles Above the Competition*, DIGITAL TRENDS, (Jan. 27, 2020), https://www.digitaltrends.com/cool-tech/google-wing-drone-deliveries/

transport, delivering time-sensitive blood samples via drones.[6] After Hurricane Harvey in 2017, telecom giants and insurance companies used drones for infrastructure inspection.[7] Additionally, those searching for a new home could soon have easy access to aerial imagery, surveys, and neighborhood information via drone photography.[8] And SenseFly is developing drones for humanitarian ends, including search and rescue and aerial mapping for water and land use management.[9] In total, PricewaterhouseCoopers forecasts that the potential market value of all drone activity could be up to $127.3 billion[10]

For reference, in 2019 the Federal Aviation Administration ("FAA") reported an average of 44,000 daily manned flight operations handled by the FAA.[11] Yet as recently as March 2020, the FAA has also reported that they forecast that the daily number of UAVs operations, both commercial and recreational, could reach into the millions in the near future.[12] This presents challenges for both the FAA and the users of UAVs. The FAA recognizes that the current national airspace system ("NAS")[13] cannot scale to meet this forecast growth.[14] Further, without a clear regulatory structure, a problem arises for operators: to operate in a meaningful way, these

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6 UPS FLIGHT FORWARD, https://www.ups.com/us/en/services/shipping-services/flight-forward-drones.page

7 Nicole Friedman, *Insurers Are Set to Use Drones to Assess Harvey's Property Damage*, THE WALL STREET JOURNAL (August 30, 2017), https://www.wsj.com/articles/insurers-are-set-to-use-drones-to-assess-harveys-property-damage-1504115552

8 Kyle Wiggers, *Trulia Neighborhoods Gives Homebuyers a Drone's Eye View on Their New Neighborhood*, VENTUREBEAT (Aug. 14, 2018), https://venturebeat.com/2018/08/14/trulia-neighborhoods-gives-homebuyers-a-drones-eye-view-on-their-new-neighborhood/.

9 Why Use Humanitarian Drones? SENSEFLY, https://www.sensefly.com/industry/humanitarian-drones/

10 Brad Silver et. al., *Communications Review / July 2017*, PRICEWATERHOUSECOOPERS (2017), https://www.pwc.com/gx/en/communications/pdf/communications-review-july-2017.pdf.

11 Air Traffic by The Numbers, FEDERAL AVIATION ADMINISTRATION https://www.faa.gov/air_traffic/by_the_numbers/

12 Concept of Operation, v2.0, FEDERAL AVIATION ADMINISTRATION, (Mar. 2, 2020), https://www.faa.gov/uas/research_development/traffic_management/media/UTM_ConOps_v2.pdf

13 The NAS is the common network of U.S. airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations and procedures, technical information, and manpower and material. U.S. DEPT. OF TRANSPORTATION, AERONAUTICAL INFORMATION MANUAL (2019).

14 *Id.*

companies have to contend with an ad-hoc system of petitioning the FAA for exemptions to current aviation regulations (which are designed with manned aircraft in mind).

On October 25, 2017, President Trump issued an executive order directing the FAA to promote and enable the development of UAV technologies through an integration pilot program ("IPP").[15] The IPP created no deadline for a new and complete regulatory regime to integrate drones, but rather mandates that the FAA ensure that regulatory framework be "sufficiently flexible to keep pace with the advancement of UAV technology."[16] However, this current conflict between emerging technology and ill-fitting regulatory structure risks preventing UAV use within the United States from reaching its full potential. Comparisons between the current state of UAV technology and past advancements illuminate a path forward for the FAA.[17] But, more action must be quickly taken to standardize regulations, because as it stands, the current system of exempting UAVs from only a handful of regulations designed for manned aircraft is hindering progress on drones.[18]

This paper will focus on the application of UAV technology to the commercial delivery application specifically – such as is being developed by Alphabet's Project Wing[19] – and the unique regulatory problem that this application faces: how can drones ultimately operate safely within the nation's busiest airspace, where the most populated areas are? The main question here is whether UAVs will be integrated into the current system of airspace and flight rules, used by

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[15] Presidential Memorandum for the Secretary of Transportation, No. 2017-23746, 82 Fed. Reg. 50301 (Oct. 30, 2017) (https://www.federalregister.gov/d/2017-23746).
[16] *Id.*
[17] Although outside the scope of this paper – and likely not an issue due to the fact that the FAA is actively researching integration methods – many cite to England's "red flag" laws when discussing stifling innovation through legislation. *See* ADRIAN J. SMITH, PRIVATIZED INFRASTRUCTURE: THE ROLE OF GOVERNMENT, 36 (1999) ("The [Red Flag] Act required at least three persons to be employed in driving the machine, one of whom was to walk not less than 60 yds in front of the vehicle carrying a red flag.").
[18] Steve Calandrill et. al., *Deadly Drones? Why FAA Regulations: Miss the Mark on Drone Safety*, 23 STAN. TECH. L. REV. P182, 185 (2020)
[19] *See* PROJECT WING, https://x.company/projects/wing/.

everything from gliders to airliners, or whether there will need to be a separate system to manage UAVs. The answer to this is not an easy one; while aviation safety is the main objective of the FAA, "[t]he Federal Aviation Act requires a delicate balance between safety and efficiency, and the protection of persons on the ground."[20]

In Part II, this paper will look at the specific technology used by Project Wing. Then, this paper will provide an overview of current airspace and general flight rules, and the current regulatory structure surrounding UAV operations. Then, it will review how Project Wing has navigated the current framework of laws to achieve limited testing capabilities. Finally, in Part III, this paper will consider whether drones operating within the airspace over populous cities can safely and effectively coexist within the NAS.

Part II: Background

The FAA's mission is to "provide the safest, most efficient aerospace system in the world."[21] Their goal of safety is achieved through regulation, and this section will review Project Wing's technology and review the current unmanned and manned flight regulations to which they are held.

A. The Technology

Alphabet's Project Wing company focuses on developing their UAV technology for commercial delivery. From the end-user's perspective, one can order items using their phone and within a few hours a drone will pick up their order from the retailer and deliver it to the user's home.[22] Ultimately, Project Wing hopes that their system will be able to pick up packages from

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[20] *Burbank v. Lockheed Air Terminal Inc.*, 411 U.S. 624, 638-39 (1973).
[21] Mission, FEDERAL AVIATION ADMINISTRATION, https://www.faa.gov/about/mission/
[22] Nick Heath, *Project Wing: A Cheat Sheet on Alphabet's Drone Delivery Project*, TECHREPUBLIC (April 4, 2018), https://www.techrepublic.com/article/project-wing-a-cheat-sheet/.

any retailer, without any specialized staff or training.[23] While some of their operational structure is proprietary, and thus not publicly available, some information can be gleaned from their public petitions to the FAA.[24] As compared to manned aircraft which operate to and from airports, Project Wing is developing the ability to house multiple UAVs in a single "nest," which would fly autonomously to a merchant location to pick up a package, then deliver it to the end consumer.[25] The UAVs never land during this process, instead using a winch system to raise and lower the packages.[26] The drone itself is of Project Wing's own design, the Hummingbird V2, which weighs less than 12lbs, and can carry packages up to 3.3lbs.[27] Unlike a traditional manned aircraft, the pilot-in-command ("PIC")[28] makes no control inputs to the UAV during normal operations.[29] Instead, they act as a monitor as the UAV relays continuous information about its route and flight profile.[30]

Project Wing has documented extensive safety testing and analysis in their requests for exemptions to the FAA. The safety analysis portion of their research details the calculated risk to the exposed public. They have concluded, based on the probability of a drone failure and the concurrent probability of a fatal collision with a person on the ground, that their operation is two orders of magnitude safer than existing chartered aircraft operations.[31] Further, while Project Wing's current operations are self-limited to geographic areas generally not used by manned

[23] *Id*.
[24] *See, e.g.* Letter from James Burgess, Chief Exec. Officer of Wing Aviation, LLC, to Dept. of Transportation, (Aug. 31, 2018) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0001&attachmentNumber=1&contentType=pdf).
[25] *Id.*
[26] *Id.*
[27] *Id.*
[28] Pilot-in-command is a legal term, defined as the individual "who is directly responsible for, and has the final authority as to, the operation of the aircraft." 14 C.F.R. § 91.3.
[29] Letter from James Burgess, Chief Exec. Officer of Wing Aviation, LLC, to Dept. of Transportation, (Aug. 31, 2018) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0001&attachmentNumber=1&contentType=pdf).
[30] *Id.*
[31] *Id.*

aircraft, their UAVs are still designed to be able to detect and give way to any manned flights which might be operating at low altitude.[32] However, despite this designed ability to avoid traffic autonomously, Project Wing admits that these UAVs are not, and will not, be equipped for integration into the general flow of manned traffic.[33]

Whereas pilots of typical manned flights use a combination of different navigational aids to maintain a safe altitude above terrain, including charts, ground-based guidance, and global positioning satellite ("GPS"), Project Wing's UAVs use only GPS as the primary means of navigation and obstacle avoidance. Instead of seeing-and-avoiding obstacles on the ground in real time, flight paths for these UAVs are pre-determined by reviewing obstacle databases and digital surface models to avoid ground structures, and then the UAV uses its GPS to navigate waypoint to waypoint. Further, Project Wing's UAVs do not fully utilize the types of technology used by manned aircraft to see and avoid other aerial traffic. Finally, whereas pilots of manned aircraft can always resort to manual control to avoid other traffic, Project Wing's UAVs are designed to only allow its pilots the control authority to abort a takeoff or initiate a landing sequence.[34] This lack of traditional equipment will make UAV integration into traditional airspace more difficult, as will be explained below.

B. Airspace and Equipment Requirements

The most obstructive element of the regulatory scheme is the fact that UAVs are operating in, and therefore currently abiding by, a plethora of airspace restrictions and equipment

[32] *Id.* While manned flights generally do not operate at 400 feet and below unless landing or taking off, they are not always legally prohibited from doing so. There are possible scenarios where an aircraft or helicopter might conflict with a drone in a rural area, such as crop-dusting operations or medical evacuation by helicopter.
[33] *Id.* Manned aircraft follow standardized routes between airports and standardized procedures near airports while communicating with ATC or each other via voice radio. The "general flow of traffic" refers to these standardized operations combined with the ability to communicate.
[34] Letter from James Burgess, Chief Exec. Officer of Wing Aviation, LLC, to Dept. of Transportation, at 19 (Aug. 31, 2018) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0001&attachmentNumber=1&contentType=pdf).

requirements designed to accommodate and separate manned flights, not UAVs. The FAA has exclusive authority to regulate United States airspace, and thus has the authority to regulate that airspace as necessary to "ensure the safety of aircraft and efficient use of airspace."[35] The primary purpose of these different airspace rules and classifications is to safely separate the air traffic contained within. In the words of Supreme Court Justice Robert H. Jackson, "[p]lanes do not wander about in the sky like vagrant clouds. They move only by federal permission, subject to federal inspection, in the hands of federally certified personnel and under an intricate system of federal commands."[36] Therefore, thorough FAA regulation is vitally necessary to permit the smooth and safe operation of aircrafts in United States airspace.

i. Division of Airspace

The airspace over the United States is primarily divided into separate classes, depending on the amount of traffic and availability of air traffic control ("ATC") services.[37] The "controlled" classes of airspace are designated as Class A through Class E, while "uncontrolled" airspace is designated as Class G.[38] Each class of airspace has its own requirements for aircraft equipment and capabilities prior to allowing entry, with Class A the most restrictive and Class G the least restrictive.[39] Class A airspace extends upwards from an altitude of 18,000 feet[40] across the entire United States,[41] which, for now, will not be an issue for UAVs because they are limited to 400 feet

[35] 49 U.S.C. § 40103.
[36] *Northwest Airlines v. State of Minnesota*, 322 U.S. 292, 303 (1944) (Jackson, R., concurring).
[37] U.S. DEPT. OF TRANSPORTATION, AERONAUTICAL INFORMATION MANUAL, at Chapter 3-1-1 (2019) [hereinafter "AIM"] (This does not include military operations and "special use airspace," which are generally restricted to manned flights as well).
[38] *Id.* Note, there is no airspace designated as Class F in the United States.
[39] *Id.*
[40] There are two methods of referring to altitude within aviation: by reference to height above sea level (called mean sea level, or "MSL" altitude), and height above the ground (called above ground level or "AGL"). Unless specifically identified as AGL in this paper, altitudes used are MSL.
[41] *Id.*

and below.[42] Classes B, C, and D surround airports where traffic landing and taking off is managed by a local air traffic controller.[43] Class B airspace surrounds the busiest airports in the nation and generally extends from the surface up through 10,000 feet.[44] Each manned aircraft wanting to enter Class B airspace must, at a minimum, have a radio capable of two-way radio communication with the air traffic controller and a transponder (which relays aircraft identification and three-dimensional position);[45] and it must receive an individualized, explicit clearance to enter that airspace.[46] This is contrasted with the less-busy Class C and D airports, where the pilot must be able to establish and maintain radio communications with the controller, but does not necessarily need an individualized, explicit clearance to enter the airspace.[47] The difference between Class C and D being that a transponder is required to operate within class C, but not Class D.[48] Class E airspace surrounds uncontrolled airports and the airspace between airports, where a wider-area controller using radar will be able to see the aircraft.[49] Class G airspace is low-level airspace (generally 700 feet AGL and below) away from airports and does not require any specific on-board equipment or ability to contact air traffic control.[50] Aircraft operating in Class G will not be able to be detected by ATC using radar, since radar is limited by terrain—hence the term "uncontrolled" airspace. Currently, UAV regulations only allow drone operations within Class G airspace, unless

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[42] *See* 14 C.F.R. § 107.51.
[43] *Id.* For example, New York City's major airports, Newark, LaGuardia, and JFK, are all Class B while airports in places such as Albany, NY, Providence, RI, and Richmond, VA are Class C airports. For a complete list of airports which are Class B or Class C, *see* AIM at Chapter 3-2-1.
[44] AIM at Chapter 3-2-3.
[45] Aircraft transponders interface with ATC through ground-based radar returns. The transponder does not continuously transmit information to ATC, rather the transponder will only transmit in response to an "interrogation," or an encoded request signal that accompanies the transmission from a radar. Lester A. Reingold, *How Things Work: Aircraft Identification*, AIR & SPACE MAGAZINE (Nov. 2006) https://www.airspacemag.com/flight-today/how-things-work-aircraft-identification-12752594/.
[46] *Id.*
[47] AIM at Chapter 3-2-4, AIM at Chapter 3-2-5.
[48] *Id.*
[49] AIM at Chapter 3-2-6.
[50] AIM at Chapter 3-3-1.

the operator receives authorization to enter one of the controlled airspaces from the controlling authority. However, the controlled airspace surrounding airports also encompass most of the more densely populated areas of the country.[51]

ii. Mid-Air Collision Avoidance

Despite the fact that last two decades have been the safest years ever for commercial aviation,[52] there were still a total of 42 mid-air collisions between 2009 and 2013.[53] More recently, in 2015 there were two separate mid-air collisions, one in South Carolina and one in San Diego, California, killing a total of seven people; in 2019 two chartered aircraft collided while approaching Ketchikan, Alaska, killing six.[54] Notwithstanding these airspace rules and the functions of ATC, the final authority for avoiding collisions rests with the pilots of each aircraft when the pilots of those manned flights are able to see and avoid other traffic;[55] this applies to all levels of aviation operating within the NAS, from gliders to large airliners.[56] However, to further mitigate the risk of mid-air collisions, there are various kinds of detection and avoidance equipment which are utilized by manned aircraft to further aid in real-time collision avoidance.

All aircraft operating within Class A, Class B, or Class C airspace must be equipped with Automatic Dependent Surveillance-Broadcast ("ADS-B") equipment.[57] ADS-B works by continuously and automatically transmitting each aircraft's GPS information, which includes both

[51] 14 C.F.R. § 107.41.
[52] Steve Creedy, *2019 Still One of Aviation's Safest Years Despite 737 Max*, AIRLINERATINGS (Jan. 2, 2020), https://www.airlineratings.com/news/2019-still-one-aviations-safest-despite-737-max/ (2017 was the safest year ever in terms of fatalities, and 2019 was the third safest in terms of fatalities).
[53] U.S. DEPT. OF TRANSPORTATION, ADVISORY CIRCULAR 90-48D, PILOTS' ROLE IN COLLISION AVOIDANCE (Apr. 19, 2016), https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_90-48D_CHG_1.pdf.
[54] *See* NATIONAL TRANSPORTATION SAFETY BOARD, Safety Recommendation Report ASR-16-006 (Nov. 14, 2016); *and* NATIONAL TRANSPORTATION SAFETY BOARD, Aviation Accident Preliminary Report, CEN19MA141B (May 13, 2019).
[55] 14 C.F.R. § 91.113.
[56] *See Id.* "regardless of whether an operation is conducted under instrument flight rules or visual flight rules, vigilance shall be maintained by each person operating an aircraft so as to see and avoid other aircraft."
[57] 14 C.F.R. § 91.225.

altitude and position, to a ground station which can then be used by both ATC and other aircraft to see a real-time map of each aircraft's location, altitude, and speed.[58] This is a newly-implemented technology, required as of January 2020, which is designed to replace the primary ground-based radar method of traffic control.[59] Because traditional transponders interface with ground-based radar signals, the slow speed of the radar's sweep and return beam means that transponder information is slightly delayed and air traffic controllers must space aircraft further apart.[60] However, using ADS-B, aircraft are able to transmit their position and altitude information directly to ATC, which means that ATC has much more precise location information about each aircraft.[61] Yet, the regulation only requires these aircraft to equip an ADS-B "out" transmitter, which means that without additional equipment, they will not being able to receive, or "see," other aircrafts' ADS-B signals in flight.[62] For an aircraft's systems to be able to "see" other ADS-B equipped traffic, they need "ADS-B in" capabilities, which can pick up directly other aircraft's "out" signals.

Furthermore, all aircraft equipped with over 30 seats must have Traffic Alert and Collision Avoidance System ("TCAS"),[63] a last-line-of-defense system that communicates between aircraft independently to calculate closure rates – the speed of two aircraft on a converging course relative to each other – and determine if a risk of collision is imminent.[64] The TCAS interfaces with the pilots of each equipped aircraft by displaying the relative position of any nearby so-equipped

[58] Ins and Outs, FEDERAL AVIATION ADMINISTRATION, https://www.faa.gov/nextgen/equipadsb/capabilities/ins_outs/.
[59] *See* 14 CFR § 91.225, *see also* What is NextGen?, FEDERAL AVIATION ADMINISTRATION, https://www.faa.gov/nextgen/what_is_nextgen/.
[60] Introduction to ADS-B, TRIG AVIONICS, https://www.trig-avionics.com/knowledge-bank/ads-b/introduction-to-ads-b/.
[61] *Id.*
[62] *See* 14 C.F.R. § 91.225.
[63] FEDERAL AVIATION ADMINISTRATION, *Introduction to TCAS II Version 7.1* (Feb 28, 2011) https://www.faa.gov/documentlibrary/media/advisory_circular/tcas%20ii%20v7.1%20intro%20booklet.pdf
[64] *Id.*

aircraft, and, if a collision is likely within 15-30 seconds, the system will coordinate corrective action between the two aircraft and display these instructions to each pilot as a "resolution advisory."[65] A resolution advisory commands the pilots, both audibly and visually, to manually start either a climb or descent; the FAA dictates that compliance with these instructions is mandatory, even if in contravention of a previous ATC clearance.[66] For example, if two aircraft are converging at the same altitude, the systems will coordinate and automatically determine which aircraft should climb and which should descend to avoid a collision.[67]

The FAA is still concerned with the potential for mid-air collisions between manned aircraft – despite their relative rarity – as evinced by the plethora of requirements that manned aircraft employ robust detection and avoidance equipment. Yet, there is an emerging risk of collision between manned aircraft and UAVs which could be just as hazardous as a collision between two aircraft. As the 2009 "miracle on the Hudson" immortalizes, even a flock of geese can destroy an airliner's engines.[68] In response to the emergence of UAVs, The University of Dayton tested the effects of an impact between a drone and an aircraft[69] and found that a two-pound drone hitting an airplane's wing at 240 miles per hour created enough force to damage the main spar of the aircraft's wing.[70] The wing spar is the main structural support of the wing, and carries both the weight of the wing on the ground and the lift forces in flight.[71] Thus, the risk of

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[65] *Id.*
[66] U.S. DEPT. OF TRANSPORTATION, ADVISORY CIRCULAR 120-55, AIR CARRIER OPERATIONAL APPROVAL AND USE OF TCAS II, at 9, (Mar. 18, 2013) https://www.faa.gov/documentlibrary/media/advisory_circular/ac_120-55c_chg_1.pdf.
[67] *Id.*
[68] *See* Final Report, US Airways Flight 1549, NATIONAL TRANSPORTATION SAFETY BOARD, https://www.ntsb.gov/investigations/AccidentReports/Reports/AAR1003.pdf.
[69] Pamela Gregg, *Impact Tests Prove Large Aircraft Won't Always Win in Collision with Small Drones*, UNIV. OF DAYTON RESEARCH INSTITUTE (Sept. 13, 2018), https://udayton.edu/udri/news/18-09-13-risk-in-the-sky.php.
[70] *Id.*
[71] Parthasarathy Garre, *Modeling and Analysis of a RIBS and Spars of An Airplane Wing for Bending and Shear Loads*, INT'T JOURNAL FOR RESEARCH IN APPLIED SCIENCE & ENGINEERING TECH., Vol. 5 Issue 27 (Feb. 2017).

damage to manned aircraft is substantial, and could cause the aircraft to break apart in the event of a collision with a drone.[72] Hence we see why the eventual integration of UAVs into the NAS presents a potential safety issue.

C. The Regulations: Part 107

The current regulatory structure provides some specific operating rules for small UAV use.[73] These rules, referred to as "Part 107," govern all UAVs under 55lbs. However, the restrictions imposed by Part 107 prohibit what would likely be the most advantageous types of operations for those companies looking to capitalize on and maximize UAV capabilities. For example, Part 107 requires that the UAVs do not operate over people,[74] and that the UAVs remain within LoS of the PIC or a visual observer ("VO") who is in communication with the PIC.[75] A PIC may only operate one UAV at a time,[76] and the UAV may not be operated within the controlled airspace surrounding an airport without prior approval from that airspace's ATC.[77] Additionally, all UAV operations, whether recreational or commercial, must remain below 400 feet AGL. These restrictions, along with the airspace rules outlined above, mean that currently drones are prevented from performing deliveries in more densely populated areas, and those areas that are within a five- to ten-mile radius of a controlled airport.

The FAA has a process in place to allow operators to apply for waivers from some of the Part 107 restrictions,[78] but some commentators have noted the burdensome nature of this process.[79]

[72] *See* Brandon Specktor, *When a Drone Crashes into an Airplane, Everyone Has a Bad Time*, LIVESCIENCE (Oct. 15, 2018).
[73] *See* 14 C.F.R. § 107, et. seq.
[74] 14 C.F.R. § 107.39.
[75] 14 C.F.R. § 107.31.
[76] 14 C.F.R. § 107.35.
[77] 14 C.F.R. § 107.41.
[78] 14 C.F.R. § 107.200.
[79] Steve Calandrillo et. al., *Deadly Drones? Why FAA Regulations: Miss the Mark on Drone Safety*, 23 STAN. TECH. L. REV. P185, 192 (2020) ("While these waivers are sometimes granted, the time and red tape involved in obtaining one makes them impractical for most immediate drone technology applications.").

Further, there are specific sections of Part 107 from which UAV operators may not receive a waiver. For example, for UAV operators wanting to deliver packages by UAV, the requirement that the UAV remain within LoS of the operator may not be waived.[80]

D. The Regulations: Part 135

The only path forward for a UAV operator who wants to be able to deliver packages by drone beyond line of sight is through certification as a commercial air carrier. [81] The FAA has issued to Project Wing the authority to act as a commercial air carrier because the FAA recognizes that Project Wing's delivery systems will eventually outgrow the scope of operations allowed by Part 107.[82]

With respect to regulating manned aircraft operations, the FAA draws a distinction between recreational flying ("flying private") and flying for compensation or hire ("flying charter").[83] To the general public, flying private and flying charter might be synonymous. However, when a pilot or operator begins providing aerial transportation for compensation as a service to the public, they are operating a charter and must receive "air carrier" certification from the FAA and abide by additional, more stringent sets of safety and operational requirements.[84] The additional operating rules for these charter flights are contained within Title 14 of the Code of Federal Regulations Part 135 ("Part 135").[85] If conducting charters, a Part 135 certificate is required for those operators with

[80] FEDERAL AVIATION ADMINISTRATION, Certificated Remote Pilots including Commercial Operators (Jan. 28, 2020), https://www.faa.gov/uas/commercial_operators/.
[81] *Id.*
[82] *See* FEDERAL AVIATION ADMINISTRATION, Package Delivery by Drone (Oct 1, 2019), https://www.faa.gov/uas/advanced_operations/package_delivery_drone/.
[83] *See generally* 14 C.F.R. §§ 91, 121, 135.
[84] 14 C.F.R. § 119.1, ("Air carrier" is defined as one who undertakes directly by lease, or other arrangement, to engage in air transportation.") 14 C.F.R. § 1.1.
[85] *See generally* 14 C.F.R. § 135, *et. seq.*

aircraft containing less than 30 seats. However, until a complete UAV regulatory regime is created, Project Wing, must also abide by the additional rules contained within Part 135.[86]

To be certified under Part 135, for either manned flight or UAV operations, an applicant must go through a five-phase certification process.[87] This process can be time-consuming; for instance, Project Wing's certification took nearly a year and a half with communication occurring at least biweekly between Project Wing and the FAA throughout that time.[88] In addition to the certification to operate under Part 135, the FAA has issued several waivers from Part 135 requirements to Project Wing because these rules were designed specifically for manned flight. For example, a manned flight operating under Part 135 would need to remain at least 500 feet above the surface, and the PIC of that flight must hold a commercial pilot certificate.[89] Yet, Project Wing is allowed to operate their UAVs at altitudes below over people and their remote pilots can operate the UAVs without the normally required commercial pilot license.[90]

Part 135 rules further differ from those governing private flight in that there needs to be more thorough recordkeeping, more robust equipment onboard aircraft, and increased training and currency for pilots. If one were to pilot their own aircraft for personal reasons, they would only need to abide by the general flight rules listed in 14 C.F.R. Part 91, and they would only need a private pilot's license.[91] But, for example, to act as PIC of a Part 135, the pilot needs to not only

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86 Package Delivery by Drone (Part 135), FEDERAL AVIATION ADMINISTRATION (2019), https://www.faa.gov/uas/advanced_operations/package_delivery_drone/
87 14 CFR Part 135 Certification Process, FEDERAL AVIATION ADMINISTRATION (2020), https://www.faa.gov/licenses_certificates/airline_certification/135_certification/cert_process/
88 FEDERAL AVIATION ADMINISTRATION, GRANT OF EXEMPTION TO WING AVIATION, LLC, EXEMPTION NO. 18163 (Mar. 28, 2019) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0020&attachmentNumber=1&contentType=pdf).
89 14 C.F.R § 135.203, § 135.243. Here we start to see the conflict between the Part 107 rules, e.g. restricting operations below 400 feet AGL, and Part 135 rules.
90 FEDERAL AVIATION ADMINISTRATION, AMENDED GRANT OF EXEMPTION TO WING AVIATION, LLC, EXEMPTION NO. 18163A (Oct. 11, 2019) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0034&attachmentNumber=1&contentType=pdf).
91 *See* 14 C.F.R §§ 91, 61 (the minimum flight experience required to achieve a private pilot's license is 40 hours.).

hold a commercial pilot's license, but also have at least 1,200 hours of previous flight experience.[92] PICs under Part 135 must also receive yearly recurrent checks on certain procedures and be checked every six months on other procedures.[93] The operator must keep a written record of which aircraft are used for charter operations, which pilots are used in their charter operations, and the PIC must prepare a load manifest for each flight which includes, *inter alia*, the names of passengers and the weight and balance calculations for each chartered flight.[94] Pilots and flight attendants working under Part 135 must also receive hazardous materials training when hired and at least once every 24 months thereafter.[95]

Part III: Analysis

Project Wing is a good example of how far the FAA is currently willing to go to exempt UAVs from current regulations; to that end, Project Wing's case will also show us how applying manned aviation regulations to UAVs is hampering their progress. In addition to the grant of a Part 135 operating certificate, the FAA has also exempted Project Wing from many of the operational requirements described above, including pilot licensure and some operational requirements such as requiring a load manifest for each flight. In understanding this regulatory framework, we can look to where Project Wing has been granted relief and where the process does not support them. Project Wing currently operates in a limited capacity, both geographically and in the number of operations they undertake. Project Wing has tested their technology by making actual deliveries in both rural Australia, and Christiansburg, Virginia.[96] But without further action, Project Wing is unlikely to be able to achieve more complex operations beyond this limited operation. Notably,

[92] 14 C.F.R. § 135.243 (though there is a reduced requirement for charter flights that operate exclusively under visual conditions, which most charter operators do not).
[93] 14 C.F.R. §§ 135.293, 135.297, 135.299.
[94] 14 C.F.R. § 135.63.
[95] 14 C.F.R. § 135.501.
[96] Miriam McNabb, *Wing Launches Drone Delivery Service in Virginia*, DRONELIFE (Oct. 21, 2019), https://dronelife.com/2019/10/21/wing-launches-drone-delivery-service-in-viriginia/.

the FAA has recognized when granting exemptions to Project Wing that the agency is still in the information gathering process relating to UAV integration, and as such, policy will have to be adjusted going forward.[97] Further, notwithstanding the issues with finding a fitting regulatory scheme, drones will still have to find a way to integrate with an airspace and ATC system which cannot scale to meet the forecast number of UAV operations in the future.

A. Relief from Licensure of Pilots

Licensure of pilots is one of the few areas of relief via regulatory exemptions that the FAA granted Project Wing. As stated above, one of the requirements to operate as a PIC for a Part 135 operation is to hold a commercial pilot certificate. This license requires, at a minimum, 250 hours of logged manned flight time.[98] Additionally, to act as a PIC of a Part 135 flight, the pilot must have logged 1200 hours.[99]

In their petition for exemption, Project Wing argued that the flight time and licensure requirements for PICs under Part 135 should not apply to UAV operations.[100] First, as explained above, Project Wing's pilots primarily act as a monitor of the autonomous UAV – not a direct control role – with only limited abilities to command the UAV to auto-land in the event of a mishap. Therefore, Project Wing argued that they have their own comprehensive training program and that experience manipulating the controls of a manned aircraft is less relevant to experience monitoring their UAVs.[101] Further, Project Wing stated that "Wing's training and checking

[97] FEDERAL AVIATION ADMINISTRATION, GRANT OF EXEMPTION TO WING AVIATION, LLC, EXEMPTION NO. 18163 (Mar. 28, 2019) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0020&attachmentNumber=1&contentType=pdf).

[98] 14 C.F.R. § 61.129.

[99] 14 C.F.R. § 135.243(b).

[100] Letter from James Burgess, Chief Exec. Officer of Wing Aviation, LLC, to Dept. of Transportation, (Aug. 31, 2018) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0001&attachmentNumber=1&contentType=pdf).

[101] Letter from James Burgess, Chief Exec. Officer of Wing Aviation, LLC, to Dept. of Transportation, (Aug. 31, 2018) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0001&attachmentNumber=1&contentType=pdf).

program is designed to provide an equivalent level of safety specific to the unique operations involved in the use of [UAVs] for cargo delivery."[102] Their training program ensures each PIC is qualified for operations only after "demonstrating the necessary knowledge, skills, and experience to safely operate Wing's unique aircraft and under its approved operations."[103]

The FAA ultimately granted the relief from this licensure requirement but issued some caveats. Specifically, the FAA mandated that (1) the PIC operating the UAV must still hold a remote pilot certificate under Part 107,[104] (2) Project Wing's pilots must complete a line check, which is an evaluation from an in-house FAA-designated check pilot, every three months,[105] and (3) Project Wing's pilots must comply with the FAA-approved training program which Project Wing has implemented.[106] The FAA made a point to emphasize that a commercial pilot license holder has a certain level of foundational knowledge of aeronautical decision making and how to operate within the NAS;[107] however, Project Wing's training incorporates these knowledge items to the FAA's satisfaction.[108]

Project Wing was not successful in receiving an exemption from all elements of the licensure requirement, however. A commercial pilot is typically also required to receive a bi-yearly medical examination and be issued a medical certificate. Project Wing attempted to receive exemption from this medical examination requirement, but the FAA decided against relief here,

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[102] *Id.*
[103] *Id.*
[104] A Part 107 license is a "Remote Pilot Certificate," and required for UAV users operating under Part 107 rules. There is not a requisite amount of flight time to qualify for this license, but rather requires only passing a written knowledge exam. *See* Become a Drone Pilot, FEDERAL AVIATION ADMINISTRATION, https://www.faa.gov/uas/commercial_operators/become_a_drone_pilot/.
[105] This is compared with the requirement for manned flight PIC who must pass a line check every twelve months. 14 C.F.R. §§ 135.293, *et. seq.*
[106] FEDERAL AVIATION ADMINISTRATION, AMENDED GRANT OF EXEMPTION TO WING AVIATION, LLC, EXEMPTION NO. 18163A (Oct. 11, 2019) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0034&attachmentNumber=1&contentType=pdf).
[107] *Id.*
[108] *Id.*

stating that the UAV PICs need the medical certificate because the "pilot is still conducting operations under Part 135 for compensation or hire. . . . [Passing a medical exam would] provide some assurance the pilot does not have a condition that would affect the safety of an operation."[109]

B. Operational Rules

Another Part 135 requirement, as discussed above, is the requirement for a load manifest for each flight.[110] With a manned flight, there are a number of ways that the aircraft could be loaded with passengers, cargo, and fuel; this loading affects the total weight and longitudinal balance of the aircraft in flight.[111] The load manifest serves as a written record that the proper weight and balance calculations were completed and that the flight was safe to operate. However, Project Wing's UAV, as described in its petition for relief, only carries one package at a time and will be able to balance itself through its own loading and vertical propulsion design, so Project Wing argued UAVs lacked the same need for a load manifest.[112] The FAA determined here that the UAV's balance is insensitive to properly attached packages, and an equivalent level of safety can be attained without a manifest and therefore granted the exemption.[113]

In addition to the aforementioned rejections, Project Wing did not receive the waiver it requested as to limits on required visibility. It is easy to imagine a completely autonomous UAV being unaffected by low visibility: the UAV would still navigate its predetermined path, avoiding known obstacles via GPS. Project Wing argued for relief from the requirement that aircraft and helicopters under Part 135 cannot operate in less than two miles or one-half miles of visibility, respectively. Their first contention was that their UAVs are more akin to helicopters, and second

[109] *Id.*
[110] 14 C.F.R. § 135.63(c).
[111] *See* U.S. DEPT OF TRANSPORTATION, PILOT'S HANDBOOK OF AERONAUTICAL KNOWLEDGE, Chapter 10 (2016), https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak/media/12_phak_ch10.pdf.
[112] *Id.*
[113] *Id.*

that their navigation systems do not require a certain visibility to remain effective.[114] However, the FAA did not agree with Project Wing's reasoning for relief in this area, as the FAA was not as concerned with the UAV technology as it was with the possibility of drones conflicting with other traffic.[115] Therefore, the FAA decided not to allow this visibility exemption because helicopters could still be operating in that area down to 300 feet AGL, and, when combined with the fact that Project Wing's UAVs do not have any of the commonly used traffic avoidance technology (such as ADS-B), an exemption would create too great a risk of collisions.[116]

Notwithstanding the airspace restrictions still facing Project Wing, there are also regulation-created personnel restrictions limiting their operational capacity. Ideally, Project Wing's technology would enable multiple UAVs to autonomously make deliveries without direct individual oversight of each UAV.[117] Yet at this stage, the FAA has only allowed Project Wing to operate one UAV per PIC, and only one VO may communicate with one PIC at a time.[118] Additionally, Part 135 regulations specifically state that once a PIC has been designated for a flight, that PIC must remain as PIC for its duration.[119] Project Wing had envisioned the ability to change and relieve the remote PIC operators during multiple UAV deliveries.[120] Project Wing

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[114] Letter from James Burgess, Chief Exec. Officer of Wing Aviation, LLC, to Dept. of Transportation, (Aug. 31, 2018) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0001&attachmentNumber=1&contentType=pdf).
[115] FEDERAL AVIATION ADMINISTRATION, GRANT OF EXEMPTION TO WING AVIATION, LLC, EXEMPTION NO. 18163, at 28 (Mar. 28, 2019) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0020&attachmentNumber=1&contentType=pdf).
[116] *Id.*
[117] Letter from James Burgess, Chief Exec. Officer of Wing Aviation, LLC, to U.S. Dept. of Transportation, (Aug. 31, 2018) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0001&attachmentNumber=1&contentType=pdf).
[118] *See* FEDERAL AVIATION ADMINISTRATION, AMENDED GRANT OF EXEMPTION TO WING AVIATION, LLC, EXEMPTION NO. 18163A, at 2-3 (Oct. 11, 2019) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0034&attachmentNumber=1&contentType=pdf).
[119] 14 CFR Part 135.109(b).
[120] Letter from James Burgess, Chief Exec. Officer of Wing Aviation, LLC, to U.S. Dept. of Transportation, at 13 (Aug. 31, 2018) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0001&attachmentNumber=1&contentType=pdf).

thought that this rule would not be as important to their drone operators because they are primarily performing monitoring duties.[121] However, the FAA identified multiple safety issues with crew changes which it felt have not yet been adequately addressed. First, the lack of proximity between the PIC and VO means that there is an increased risk of loss of common knowledge[122] between the two if one were to change mid-operation.[123] Second, there is a lack of demonstrated ability by Project Wing to prove that they are capable of performing crew changes without a loss of equivalent level of safety.[124] However, the FAA did not foreclose the possibility of future waivers from these regulations: the FAA specifically identified that Project Wing's internal checklists and procedures manuals lack detail and do not actually support changing PICs mid-flight.[125] This reasoning from the FAA leaves at least a hope that with proper procedures Project Wing may be able to change PICs mid-flight. Finally, it should be noted that these exemption grants are specific to Project Wing only, and while they portray the current possibilities for UAV systems, they are not automatically granted to other operators.

C. Integration into Controlled Airspace

Project Wing has stated in its petitions that it voluntarily operates in rural areas, exclusively within uncontrolled airspace. But if this technology is to be scaled to reach most Americans, UAVs will have to be allowed to operate within controlled airspace. For illustration, a joint Class B airspace surrounds the surface at New York City's LaGuardia and John F. Kennedy International

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[121] *Id.* at 13-14.
[122] "Common knowledge" here means any pertinent information discussed in a preflight briefing between the crew members – such as weather or obstacle information along the intended route – or ongoing information such as previously identified traffic or other hazards identified by the VO. *See* FEDERAL AVIATION ADMINISTRATION, AMENDED GRANT OF EXEMPTION TO WING AVIATION, LLC, EXEMPTION NO. 18163A, at 3 (Oct. 11, 2019) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0034&attachmentNumber=1&contentType=pdf).
[123] *Id.*
[124] *Id.*
[125] *Id.* at 4

("JFK") airports; this surface airspace's lateral limits extend to eight miles north of LaGuardia – covering most of the Bronx borough – and eight miles east and west of JFK, which further covers most of Brooklyn and Queens. The combined population of these three boroughs is 3.6 million, and as of now none of them would be able to participate in delivery by drone.[126] Even considering areas which are covered by Class C airspace – Allentown, PA, for example – populations within the bounds of such airspace reach into the hundreds of thousands.

Nonetheless, the FAA is not currently granting UAV operators direct regulatory exemptions from airspace entry and equipment rules.[127] Instead, in Project Wing's exemption grant, the FAA explains that it defers to a waiver process which is to be agreed upon between the operators and each air traffic control facility.[128]

As stated previously, the integration of UAV traffic into controlled airspace will be the most difficult portion of drone authorization. To that end, the FAA is still in the exploratory stage – collaborating with NASA, other federal agencies, and industry representatives – to develop an Unmanned Aircraft System Traffic Management ("UTM") to separate UAVs within controlled airspace.[129] As previously noted, most UAVs, such as the Hummingbird developed by Project Wing, do not utilize all of the required communication or traffic avoidance technologies currently in use by manned aircraft. As a result, the FAA's vision for a UTM system differs from the current system because it would facilitate cooperation between UAV users within the same airspace, while

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126 *See* QuickFacts Bronx County, UNITED STATES CENSUS BUREAU, https://www.census.gov/quickfacts/bronxcountybronxboroughnewyork, *and* QuickFacts Queens County, UNITED STATES CENSUS BUREAU, https://www.census.gov/quickfacts/fact/table/queenscountyqueensboroughnewyork/

127 *See* FEDERAL AVIATION ADMINISTRATION, GRANT OF EXEMPTION TO WING AVIATION, LLC, EXEMPTION NO. 18163, at 9 (Mar. 28, 2019) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0020&attachmentNumber=1&contentType=pdf).

128 *Id.*

129 Concept of Operation, v2.0, FEDERAL AVIATION ADMINISTRATION, (Mar. 2, 2020), https://www.faa.gov/uas/research_development/traffic_management/media/UTM_ConOps_v2.pdf.

placing real-time spatial restrictions on those UAVs to possibly obviate the need to communicate with – and receive instructions from – air traffic controllers.[130] While this system is still theoretical, the FAA has released a "Concept of Operations" in which it states that the purpose of these ideas are not specific implementation methods but rather conceptual elements meant to inform the later development of solutions.[131] The UTM architecture, in theory, would use application programming interfaces ("API") and automated systems to coordinate between these users and the FAA.[132] This system, according to the FAA, would be complimentary to – and not a replacement for – traditional air traffic control services; this is because while the UAVs may not need to – or be able to – receive direct communication from ATC, other manned flights in the area may still need to be diverted by ATC to avoid a conflicting UAV.[133]

There are two components within the UTM that an operator would need to satisfy before flight: (1) a performance authorization, and (2) an airspace authorization. A performance authorization would be obtained by users through demonstrating that their UAVs capabilities, as well as their personnel, training, and procedures, are sufficient to maintain the UAV within the requested operation area.[134] This is essentially an individualized assessment in lieu of traditional regulations pertaining to required equipment capabilities for manned flight – for example, the navigation, terrain, and traffic avoidance systems described above.[135] The FAA is exploring individualized assessments because it recognizes that UAV operators will vary greatly in their performance abilities based on their UAV's model and type of operation.[136] Put simply, a

[130] *Id.*
[131] *Id.*
[132] *Id.*
[133] *Id.* at 18.
[134] Concept of Operation, v2.0, FEDERAL AVIATION ADMINISTRATION, at 27 (Mar. 2, 2020), https://www.faa.gov/uas/research_development/traffic_management/media/UTM_ConOps_v2.pdf.
[135] *Id.*
[136] *Id.* at 26.

performance authorization request would contain the operation area, which would be a four-dimensional[137] path, which subsequently could be cross-checked with other requests or ongoing operations in the area before the authorization is granted to facilitate UAV traffic avoidance.[138] If there is a traffic conflict between two UAV operators, the system would initially deny the performance authorization, and instead facilitate coordination between the two operators to de-conflict their intended routes.[139] Interestingly, the FAA predicts that the UTM may be able to alter parameters pertaining to the allowable risk of UAV-on-UAV collision based on the area over which the operation is taking place, if the risk to life on the ground is lower.[140] There are also provisions for allowing necessary manned flights, such as medical evacuations or law enforcement, to participate in the UTM and be granted priority if their operation conflicted with a previous performance authorization.[141]

The airspace authorization, on the other hand, can be thought of as the actual "clearance" to fly through controlled airspace.[142] The FAA is in the process of beta-testing an app-based airspace authorization method, referred to as the Low Altitude Authorization and Notification Capability ("LAANC"), currently in use at about 600 airports.[143] This system currently allows Part 107 UAV users to make a request for authorization to enter controlled airspace, thereafter checking the requested route against a database of airspace maps and data, as well as checking for temporary

[137] Four-dimensional in the sense that it not only depicts the flight path geographically, but also temporally at each position.
[138] *Id.* at 50.
[139] *Id*. at 49.
[140] *Id.* at 40.
[141] Concept of Operation, v2.0, FEDERAL AVIATION ADMINISTRATION, at 52 (Mar. 2, 2020), https://www.faa.gov/uas/research_development/traffic_management/media/UTM_ConOps_v2.pdf.
[142] *Id.* at 28.
[143] *See* UAS Data Exchange (LAANC), FEDERAL AVIATION ADMINISTRATION, https://www.faa.gov/uas/programs_partnerships/data_exchange/, *see also id.*

flight restrictions.[144] If approved, LAANC can then relay an authorization in near real time to the operator, which allows the UAV to enter the airspace without the normally-required equipment.[145] In contrast to airspace regulations vis-à-vis manned flight, the UAV operator does not need to communicate with the air traffic controller for that airspace once granted a clearance through the LAANC system.[146]

Non-essential manned flights will also be able to participate in UTM.[147] There are two possible methods by which manned flights could participate in UTM: they could either be passive or active participants.[148] A passive participant would simply utilize the UTM service to request relevant information regarding nearby UAV activity to incorporate into their own operation planning.[149] The UAV operators would not be aware of the intent or flight path of the passively-participating manned flight operation. This is contrasted with active participation, where the manned operator would provide information – flight path, times, aircraft type, etc. –about their own operation to the UTM. This would allow UAV operators to become aware of the manned flight and give the UAV the ability to alter their planned flight path.[150] Yet, while manned flights are being considered within this nascent UTM system, the current responsibility for traffic avoidance still rests on the UAV operators.[151]

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[144] UAS Data Exchange (LAANC), FEDERAL AVIATION ADMINISTRATION, https://www.faa.gov/uas/programs_partnerships/data_exchange/.
[145] *See Id.*
[146] *Id.*
[147] Concept of Operation, v2.0, FEDERAL AVIATION ADMINISTRATION, at 56 (Mar. 2, 2020), https://www.faa.gov/uas/research_development/traffic_management/media/UTM_ConOps_v2.pdf.
[148] *Id.*
[149] *Id.*
[150] *Id.*
[151] *Id.*

D. Future Integration

While there has been much research into developing new UTM systems, there are still more considerations that need to be addressed going forward to completely integrate UAVs into the NAS. For example, the FAA predicts that manned aircraft will need to begin to share some of the responsibility with UAVs for traffic avoidance.[152] However, there are a number of issues that need to be addressed for this shared responsibility to come to fruition. First, there has to be the ability for manned aircraft to be able to detect nearby UAVs. As stated above, most UAVs – Project Wing, for example – do not utilize most of the traditional equipment with which manned aircraft use to coordinate with and avoid other aircraft. Second, there should be established procedures for UAVs of which manned operators will be aware. Currently, predictability of standardized procedures aids manned aircraft operators in knowing where to look for other traffic, and this predictability would also be of benefit to future UAV integration.

In addition to the work done with industry partners and other federal agencies, the FAA has convened a drone advisory committee ("DAC") made up of individual stakeholders and representatives of UAV interests to produce recommendations on some of these integration issues.[153] In February 2020, the DAC made recommendations pertaining to additional UAV equipment, specifically that UAV manufacturers should voluntarily equip not only ADS-B "out" transmitters, but also ADS-B "in" receivers to aid in traffic detection and avoidance.[154] Further, the DAC recommends that a collision avoidance system – similar to TCAS – should be developed and equipped on UAVs.[155] The benefits of ADS-B "in" for UAVs would be that the operators

[152] *Id.*, at 37, n. 23.
[153] Drone Advisory Committee, FEDERAL AVIATION ADMINISTRATION, https://www.faa.gov/uas/programs_partnerships/drone_advisory_committee/.
[154] FEDERAL AVIATION ADMINISTRATION, DRONE ADVISORY COMMITTEE MEMBER EBOOK, at 18 (Feb. 27, 2020) (https://www.faa.gov/uas/programs_partnerships/drone_advisory_committee/media/Public_Ebook_v3a.pdf).
[155] Id.

would be alerted to nearby aircraft, and would have the opportunity to adjust their flight path.[156] ADS-B would further help protect UAVs against, according to the DAC, " careless and clueless pilots operating within the broader NAS."[157] Project Wing is a participant in UTM testing, having developed their own system for maintaining separation between their own fleet of UAVs.[158] Project Wing further demonstrates that ADS-B can be used by drones, as Project Wing incorporates ADS-B "in" receivers on their drones to help detect manned traffic.[159] Yet the incorporation of ADS-B "in" alone still does not provide a method of assistance to manned flights in detecting and avoiding the UAVs.

The additional TCAS-like system would provide an added layer of safety to UAV operations by providing the operator with a set of commands to avoid a conflict. According to the DAC, a "[UAV] operator without this type of warning might make a flight control input that increases the potential for a collision."[160] However, the FAA responded to these recommendations by stating that ADS-B "out" equipage was considered for UAVs but is unsuitable to the platform because of a greater potential for saturation interference.[161] Further, the FAA is preferring the development of new technologies and procedures to address the unique challenges posed by UAV integration.[162] On the issue of implementing a TCAS-like system, the FAA commented that they are not against this proposal but that any traffic avoidance capabilities "must be based on overarching, default requirement that [UAV] operators ensure that their aircraft remain clear of

[156] *Id.*
[157] *Id.*
[158] Letter from James Burgess, Chief Exec. Officer of Wing Aviation, LLC, to U.S. Dept. of Transportation, (Aug. 31, 2018) (https://www.regulations.gov/contentStreamer?documentId=FAA-2018-0835-0001&attachmentNumber=1&contentType=pdf).
[159] *Id.*
[160] FEDERAL AVIATION ADMINISTRATION, DRONE ADVISORY COMMITTEE MEMBER EBOOK, at 18 (Feb. 27, 2020) (https://www.faa.gov/uas/programs_partnerships/drone_advisory_committee/media/Public_Ebook_v3a.pdf).
[161] *Id.* at 23.
[162] *Id.*

manned aircraft, not vice versa."[163] Thus, the FAA does not yet appear ready to begin considering shared responsibility for traffic avoidance.

Manned aircraft use standard procedures, such as navigating between airports via established airways and "traffic patterns" when approaching an airport for landing. While these solutions are inapposite to typical UAV operations because UAVs will likely take a hub-and-spoke flight path rather than airport to airport,[164] there are other operational standards which could be applied to drones. For instance, there still could be standardized operational limitations on UAVs so that manned aircraft can know where to expect the UAVs will be operating. The DAC recommended two possible solutions, for example: either enabling "geofencing" capabilities for UAVs, or automated performance limiting systems.[165] Geofencing refers to establishing a virtual boundary and, in the case of UAVs, creating pre-determined areas, such as busier airspace, airport runways, and national security areas, into which the UAV is not capable of flying.[166] Geofencing technology is readily available, as the Chinese drone manufacturer DJI has recently implemented airport geofencing measures for their drones after a drone flying near London's Gatwick Airport grounded hundreds of flights.[167] The benefits of geofencing, according to the DAC, include the fact that it is an immediate and easily scalable technology solution to prevent careless UAV operations.[168]

The FAA, in response, explained that they have considered georeferencing in terms of limiting drones to 400 feet AGL or less, but it encourages other stakeholders to develop capabilities

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[163] *Id.*
[164] As with Project Wing's planned "nest" system, the UAVs would be centrally located and fly to back-and-forth to random points to either pick up or drop off a delivery.
[165] FEDERAL AVIATION ADMINISTRATION, DRONE ADVISORY COMMITTEE MEMBER EBOOK (Feb. 27, 2020) (https://www.faa.gov/uas/programs_partnerships/drone_advisory_committee/media/Public_Ebook_v3a.pdf).
[166] *Id.*
[167] https://www.theverge.com/2019/2/13/18223184/dji-geofencing-airport-gatwick-disruption
[168] FEDERAL AVIATION ADMINISTRATION, DRONE ADVISORY COMMITTEE MEMBER EBOOK, at 17 (Feb. 27, 2020) (https://www.faa.gov/uas/programs_partnerships/drone_advisory_committee/media/Public_Ebook_v3a.pdf).

regarding geographical restrictions.[169] Specifically, the FAA asked that any developed geofencing technology support future coordination with the FAA to allow for geofencing of potential short-term or dynamic airspace changes, such as when a temporary flight restriction goes into effect.[170] A less-restrictive alternative to geofencing is the possibility of manufacturer-installed performance limiting features.[171] These limitations could include decreasing speed abilities in certain areas or a default "return to home" feature.[172] The FAA supports these features, though it noted that development of such technology must be coordinated with the FAA to prevent safety issues, such as limiting the ability of the PIC to maneuver the UAV.[173] Thus, there have not yet been any meaningful standardized operational procedures developed for UAVs.

Part IV: Conclusion

Air travel is already a highly regulated facet of our economy, and UAVs will require a broad set of new regulations to allow them to reach their full potential by safely assisting us in our daily lives. However, UAV integration into the NAS will not only require a new field of regulations but also utilization of new forms of technology. While there are many current traffic avoidance technologies that can used by UAVs, there will need to be a new system of managing and separating the UAV traffic from each other and from manned flights. Thankfully, the FAA is engaging many interested parties for input to develop sensible solutions.

[169] *Id.* at 20.
[170] *Id.*
[171] *Id.* at 19.
[172] *Id.*
[173] *Id.* at 23.