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Rethinking the Highway: Integrating Delivery Drones into Airspace Above Highways

DANIEL THOMPSON*

ABSTRACT

It is no secret that drones are occupying the skies, but where are they supposed to fly? Drones will need to share airspace with other aircraft, and, eventually, other drones. Considering that drones come in different shapes and sizes and serve different functions, businesses and lawmakers should coordinate to propose creative solutions. This Note proposes one such solution: municipal, state, and federal governments should lease the airspace above roads and highways to develop an infrastructure capable of supporting the unique characteristics of delivery drones.

INTRODUCTION

Necessity is the mother of invention. When it was necessary to travel in automobiles, Americans developed and regulated highways.¹ To travel in trains, Americans developed and regulated railroads.² To travel in manned aircraft, Americans developed and regulated navigable airspace.³ To travel with unmanned aerial vehicles (UAVs), commonly referred to as drones, Americans need to develop and regulate a new airspace infrastructure. But sharing that airspace with a developed and regulated manned aircraft infrastructure poses new and difficult challenges for America's policymakers and businesses. Officially tasked with regulating commercial drones in 2012,⁴ the Federal Aviation Administration (FAA) has been working tirelessly to manage drone integration into national airspace.⁵ Considering that the FAA's top priority is safety,⁶ the agency's recent attempt at regulating drones

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1. See generally Chad D. Emerson, *All Sprawled Out: How the Federal Regulatory System Has Driven Unsustainable Growth*, 75 TENN. L. REV. 411, 430–37 (2008). Congress adopted the nation's first highway law in 1916, which laid the foundation for sustainable infrastructure growth. Federal-Aid Road Act of 1916, Pub. L. No. 64-156, 39 Stat. 355.

2. See Pacific Railroad Act of 1862, ch. 120, 12 Stat. 489.

3. See Federal Aviation Act of 1958, Pub. L. No. 85-726, 72 Stat. 731.

4. FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, § 332(a)(3), 126 Stat. 11, 73 (codified at 49 U.S.C. § 44802(a)(3) (2018)).

5. One of the FAA's most promising regulations allows commercial drone operators to obtain a specialized license to operate in national airspace, but those flights are still heavily restricted. 14 C.F.R. pt. 107 (2016). Part II will discuss these restrictions in more detail. See *infra* Part II.

6. U.S. DEP'T OF TRANSP., FED. AVIATION ADMIN., INTEGRATION OF CIVIL UNMANNED AIRCRAFT SYSTEMS (UAS) IN THE NATIONAL AIRSPACE SYSTEM (NAS) ROADMAP (2013).

has restricted businesses from fully launching an operational commercial drone delivery service.⁷ Unable to operate drones that carry more than fifty-five pounds, fly over human beings, or break visual line of sight,⁸ commercial delivery drones are paralyzed on the ground.

One major challenge the FAA expects in its endeavor to regulate drones is the volume of drones entering a relatively unoccupied infrastructure. Already, drone sales are expected to surpass twelve billion dollars in 2021, which is about thirty million drone shipments.⁹ Scholars, lawmakers, and businesses are predicting the myriad of problems that will arise with this volume of drones entering into airspace designed for manned aircraft.¹⁰ Chief among these concerns is figuring out which pockets of airspace would best support drone integration. Businesses like Amazon have proposed a segregated airspace system, which would establish a drone-focused airspace below 400 feet.¹¹ Taking a different approach, a California lawyer has proposed a drone highway above railroads.¹² Making room for drones in the airspace is not necessarily the challenge; instead, the challenge is figuring out how to divide up the existing airspace to create an infrastructure capable of integrating drones. Part III will explore some of the different airspace pockets above ground level and how some of those pockets may be transferred to drone delivery companies.¹³

In particular, Congress seems to have established transferrable airspace above highways,¹⁴ which would be a major step towards a workable drone infrastructure if that airspace could be transferred to drone delivery companies. Grappling with legacy airspace laws poses unique problems because Congress could not have

7. See 14 C.F.R. pt. 107; see also Roderick O'Dorisio, *The Current State of Drone Law and the Future of Drone Delivery*, 94 DENV. L. REV. ONLINE 59, 61–64 (2016) (discussing how the restrictions in Part 107 affect commercial drone operators).

8. See 14 C.F.R. pt. 107.

9. Andrew Meola, *Drone Market Shows Positive Outlook with Strong Industry Growth and Trends*, BUS. INSIDER (July 13, 2017, 10:42 AM), <https://www.businessinsider.com/drone-industry-analysis-market-trends-growth-forecasts-2017-7> [<https://perma.cc/LVP4-CGVP>].

10. See, e.g., Andrew M. Anderson, Comment, *Look, Up in the Sky!: Regulating Drone Use to Protect Our Safety and Privacy*, 88 TEMP. L. REV. ONLINE 48, 48–49 (2017) (discussing safety and privacy concerns arising from increasing drone usage); Andy Pasztor, *FAA Projects Fourfold Increase in Commercial Drones by 2022*, WALL STREET. J. (Mar. 18, 2018, 5:05 PM), <https://www.wsj.com/articles/faa-projects-fourfold-increase-in-commercial-drones-by-2022-1521407110> [<https://perma.cc/C5YE-VNBT>] (discussing FAA's response to rapid increases in drone usage).

11. See Ed Pilkington, *Amazon Proposes Drones-Only Airspace to Facilitate High-Speed Delivery*, GUARDIAN (July 28, 2015, 12:30 PM), <https://www.theguardian.com/technology/2015/jul/28/amazon-autonomous-drones-only-airspace-package-delivery> [<https://perma.cc/Q5V8-YZ7K>].

12. Jonathan Kathrein, *The Future of Drones is the Railroad*, 21 INTELL. PROP. & TECH. L.J. 127 (2017).

13. See *infra* Part III.

14. See *infra* Part III.

considered how the “drone age”¹⁵ would interact with its legislation. At the same time, drone delivery companies could—and are trying to—advocate for new laws and regulations to get drones delivering packages sooner rather than later.¹⁶ Nothing suggests that drone companies should forfeit these efforts, but this Note argues that they should also pursue a workable drone infrastructure above highways that employs existing laws and regulations to create a more expansive and efficient drone delivery system.

Harmonizing federal, state, and local airspace property laws will be one of the most frustrating obstacles for this integrated drone infrastructure above highways. Interstate highways would comprise most of this drone infrastructure because of its broad reach and substantial size. Drone delivery companies would also need to navigate state highways and local roads to effectuate their delivery operation, but interstate highway airspace would provide a substantial drone infrastructure by itself. Even if drone delivery companies cannot secure harmonized airspace rights above state and local roads, securing airspace rights above interstate highways could substantially assist in developing a long-term super drone highway due to the interstate’s established connections and direct routes to the most populated areas in America.

This Note addresses how lawmakers and businesses should consider using federal and state highway airspace to initiate America’s drone infrastructure. Part I explores commercial drone delivery services and how companies operate drones to meet consumer expectations. Part II navigates the restrictions and possibilities that federal agency law establishes for commercial drone operations in the national airspace. Part III examines how state and federal government can transfer airspace rights to commercial drone operators to provide them with a usable infrastructure to begin commercial drone flights. Part IV lays out how municipal governments can establish a frontier infrastructure that could connect with a larger super drone highway, which most companies would need to efficiently operate in the commercial drone delivery industry.

I. COMMERCIAL DRONE DELIVERY SERVICES

Tapping into the commercial drone industry has come to the forefront of several businesses. Consumers are increasingly expecting faster delivery times,¹⁷ and commercial delivery drones offer businesses like Amazon and Project Wing the opportunity to meet that expectation. As drones are capable of delivering packages between fifteen and thirty minutes, consumers could often receive a product faster through drone delivery than if they drove to the store themselves.¹⁸ In fact, some of

15. See *Welcome to the Drone Age*, ECONOMIST (Sept. 26, 2015), <https://www.economist.com/science-and-technology/2015/09/26/welcome-to-the-drone-age> [<https://perma.cc/NYR4-KMGD>].

16. See Pilkington, *supra* note 11.

17. See James Henderson, *Consumers Want Their Deliveries to Be Free and Fast*, SUPPLY CHAIN DIGITAL (Mar. 17, 2018, 1:00 AM), <https://www.supplychaindigital.com/distribution/consumers-want-their-deliveries-be-free-and-fast> [<https://perma.cc/LXX7-JXAW>].

18. See Amit Regev, *Drone Deliveries Are No Longer Pies in the Sky*, FORBES

these businesses are already delivering packages with drones in countries like Australia with remarkable success.¹⁹ In addition to the convenience and speed that drone deliveries offer, the service is more environmentally friendly than traditional delivery methods.²⁰ Nonetheless, Americans have also expressed their concerns about drone malfunction and misuse.²¹ Malfunctioning drones and theft are two of the most commonly expressed concerns.²² Nonetheless, drone delivery companies are working to develop solutions to these problems to implement a feasible, safe, and practical drone delivery system.

On December 7th, 2016, Amazon completed its first fully autonomous drone delivery in thirteen minutes.²³ Regulations aside, Amazon is prepared to launch its program, but details like a functioning air traffic management system are not yet fully developed.²⁴ Sharing a common goal with federal regulators, Amazon wants to prioritize safety.²⁵ Some of these features include a universal traffic management system and drone identification systems, both of which will be discussed further below.²⁶ In the meantime, Amazon continues to invest in this tremendous opportunity.²⁷ With delivery speeds of up to one hundred miles per hour, a target cost of one dollar per delivery, and a growing demand for faster deliveries, the drone delivery industry promises to return a large investment for Amazon.²⁸ Even culturally, delivery drones promise to provide impact: the Smithsonian Museum will display an Amazon Prime Air drone in 2021 as part of its “We All Fly” exhibition.²⁹

(Apr. 10, 2018, 1:36 AM), <https://www.forbes.com/sites/startupnationcentral/2018/04/10/drone-deliveries-are-no-longer-pie-in-the-sky/#7507d9bd4188> [https://perma.cc/44XW-RT9H].

19. *Wing Australia: Canberra*, WING, <https://wing.com/australia/canberra/> [https://perma.cc/E628-VJKH].

20. *Id.*

21. OFFICE OF INSPECTOR GEN., U.S. POSTAL SERV., RARC-WP-17-001, PUBLIC PERCEPTION OF DRONE DELIVERY IN THE UNITED STATES 2 (2016).

22. *Id.* at 8.

23. *First Prime Air Delivery*, AMAZON: PRIME AIR (Dec. 7, 2016), <https://www.amazon.com/Amazon-Prime-Air/b?ie=UTF8&node=8037720011> [https://perma.cc/VGQ3-Q3KP].

24. *Frequently Asked Questions*, AMAZON: PRIME AIR, <https://www.amazon.com/Amazon-Prime-Air/b?ie=UTF8&node=8037720011> [https://perma.cc/VGQ3-Q3KP].

25. *Id.*

26. *See infra* Page 5.

27. AMAZON: PRIME AIR, <https://www.amazon.com/Amazon-Prime-Air/b?ie=UTF8&node=8037720011> [https://perma.cc/VGQ3-Q3KP].

28. *See* Jeff Desjardins, *Amazon and UPS Are Betting Big on Drone Delivery*, BUS. INSIDER (Mar. 11, 2018, 10:47 AM), <https://www.businessinsider.com/amazon-and-ups-are-betting-big-on-drone-delivery-2018-3> [https://perma.cc/J8HJ-QW7H].

29. Alan Boyle, *Amazon Prime Air Drone Gets Delivered to Smithsonian for Museum Display in 2021*, GEEKWIRE (Aug. 14, 2018, 4:55 PM), <https://www.geekwire.com/2018/amazon-prime-drone-gets-delivered-smithsonian-museum-exhibition-2021/> [https://perma.cc/8PGY-YFLE].

Emerging from Google's secret technology lab, aptly named Google X, Project Wing has been tackling some of the same issues as Amazon Prime Air.³⁰ Focused more on the support systems necessary to operate commercial delivery drones than on the actual drones, Project Wing's development team maps drone delivery routes.³¹ This routing platform, known as the Unmanned Air System Traffic Management (UTM), will allow delivery drones to communicate and navigate with each other.³² Google's cloud of millions of servers provides the computing power necessary to process and analyze data to map the physical terrain delivery drones must navigate.³³ Home to one of the earliest drone flights, Australia hosted Project Wing's first trial deliveries.³⁴ Geographical expansion has been restricted due to FAA regulations,³⁵ but as those restrictions continue to adapt to these systems, Project Wing will continue to map larger delivery routes. Until then, the company will continue to work on specific technologies to support drone deliveries.

NASA is spearheading a program to develop a Universal Traffic Management (UTM) system for drones.³⁶ Companies like Project Wing and AT&T help develop this program by connecting their own flight management prototypes with the UTM research platform.³⁷ Once connected, the program configures drones to match their function: "drone deliveries, video surveillance, search and rescue missions, and farmland and infrastructure inspection."³⁸ Orchestrating a system of connected drones enables automated flight management, which allows drones to avoid conflicts and collisions without a manual operator.³⁹ Implementing the UTM system would also facilitate airspace design, dynamic geofencing, severe weather avoidance, congestion management, route planning, and separation management.⁴⁰ Drone identification technologies, which are analogous to motor vehicle licensing, are

30. Nick Heath, *Project Wing: A Cheat Sheet on Alphabet's Drone Delivery Project*, TECHREPUBLIC (Apr. 4, 2018, 4:08 AM), <https://www.techrepublic.com/article/project-wing-a-cheat-sheet/> [<https://perma.cc/828J-MXYH>].

31. *Id.*

32. *Id.*

33. *Id.*

34. *Wing Australia*, *supra* note 19.

35. 14 C.F.R. pt. 107 (2016). Though restricted, test sites have been granted to select drone companies and initiatives so that more commercially-friendly regulations may be enacted. FED. AVIATION ADMIN. UNMANNED AIRCRAFT SYSTEMS TEST SITE DATA COLLECTION AND ANALYSIS (2016), https://www.faa.gov/uas/programs_partnerships/test_sites/media/UAS-Test-Site-Data-Collection-and-Analysis.pdf [<https://perma.cc/5W4N-6A2L>].

36. Chase Martin, *NASA Advances Drone Traffic Management System*, MEDIAPOST: AI & IOT DAILY (June 8, 2017), <https://www.mediapost.com/publications/article/302472/nasa-advances-drone-traffic-management-system.html> [<https://perma.cc/T5H5-NV8F>].

37. *Id.*

38. *Id.*

39. *Id.*

40. *Unmanned Aircraft System (UAS) Traffic Management (UTM)*, NASA, <https://utm.arc.nasa.gov/index.shtml> [<https://perma.cc/L3VP-35K3>].

instrumental to this process.⁴¹ Drone identification technologies will enable drones to communicate with each other and to identify malfunctioning or improperly handled drones.⁴²

These technologies can help alleviate some public concern about drone misuse, but for some, drone management technologies alone are not enough to dissipate uncertainty. A group of lawyers called the Uniform Law Commission (ULC) aims to “provide[] states with non-partisan, well-conceived and well-drafted legislation that brings clarity and stability to critical areas of state statutory law.”⁴³ Contributing to the drone regulatory discussion, the Commission has been working on model legislation to establish new tort liability for drone operators flying above homes and private property.⁴⁴ Known as the Tort Law Relating to Drones Act, the draft proposal draws a line 200 feet in the sky that would create a new trespass cause of action for homeowners and private property owners.⁴⁵ Criticisms of the model act quickly emerged, which are largely attributed to the stifled innovation the model act would cause.⁴⁶ Ostensibly, drone deliveries would suffer a major defeat if drone companies faced tort liability each time they entered private airspace above a parcel. The drone industry, the U.S. Department of Transportation, and the FAA have publicly opposed the ULC’s efforts to promote their model act, but the ULC has disregarded those concerns and has continued to advocate for its enactment.⁴⁷

Fortunately, drone companies that utilize the airspace above public highways will be able to avoid tort liability if legislatures were to adopt this model act. In fact, the model act expressly addresses this scenario and precludes tort liability if the conduct is “undertaken by employees or contractors of a holder of a valid . . . right of way or license.”⁴⁸ However, once a drone highway infrastructure expands to include flights over private parcels, flying over private property will be necessary and drone companies will need to navigate potential tort liability. But until then, drone delivery companies can avoid trespass and tort liability altogether by staying above the highways.

41. See Miriam McNabb, *What’s Next for Drone Laws? The Commercial UAV Policy Panel at Airworks*, DRONELIFE (Nov. 2, 2018), <https://dronelife.com/2018/11/02/whats-next-for-drone-laws-the-commercial-uav-policy-panel-at-airworks/> [https://perma.cc/K9AY-BMY5].

42. See *id.*

43. *Overview: About Us*, UNIFORM LAW COMMISSION, <https://www.uniformlaws.org/aboutulc/overview> [https://perma.cc/JR9S-WT45].

44. Brian Wynne & Gary Shapiro, *The Biggest Threat to Drone Innovation Is a Group You’ve Never Heard Of*, TECHCRUNCH (Oct. 25, 2018, 1:30PM), <https://techcrunch.com/2018/10/25/the-biggest-threat-to-drone-innovation-is-a-group-youve-never-heard-of/> [https://perma.cc/8ZK9-BHN8].

45. TORT LAW RELATING TO DRONES ACT § 301(a) (UNIF. LAW COMM’N, Proposed Draft for Discussion, 2018).

46. See Wynne & Shapiro, *supra* note 44.

47. *Id.*

48. TORT LAW RELATING TO DRONES ACT, *supra* note 45, § 301(b)(5).

II. PART 107

A more immediate obstacle to drone delivery companies is the FAA's regulations on small unmanned aircraft systems, Part 107.⁴⁹ In effect since August 29, 2016, these restrictions require commercial drone operators to obtain a new specialized remote pilot certificate, fly below 400 feet above ground level, maintain visual line of sight with the drone, not fly over humans or above moving vehicles, not exceed a total drone and package weight of fifty-five pounds, and only fly during the daylight hours and good weather conditions.⁵⁰ Safety is the FAA's top concern,⁵¹ so most of these restrictions intuitively reflect that concern. But those restrictions nevertheless cripple drone deliveries and are the subject of much legal debate.⁵² Companies like Amazon want a fully autonomous fleet of delivery drones, which would require breaking several of these restrictions, including maintaining visual line of sight.⁵³ Until the FAA changes Part 107, drone deliveries will remain impractical for companies, but the growing support from both the FAA and Congress to amend Part 107 indicates an attitude shift in the near future.⁵⁴

Demonstrating one of the most promising efforts to support drone deliveries, the FAA has collaborated with the drone industry to establish the FAA UAS Data Exchange.⁵⁵ This exchange facilitates the sharing of airspace data between commercial drone operators and the FAA to promote aviation safety and efficiency.⁵⁶ Developed through this collaborative exchange, the Low Altitude Authorization and Notification Capability (LAANC) provides drone operators access to airspace near airports by processing the relevant authorizations almost instantaneously.⁵⁷

49. 14 C.F.R. pt. 107 (2016).

50. *Id.*

51. U.S. DEP'T OF TRANSP., *supra* note 6.

52. See, e.g., Thomas Carlton, *New Heights, New Uses, and New Questions: Can Individuals Enforce Their Property Rights Against the Impending Rise of Low-Flying Civilian Drones?*, 59 B.C. L. REV. 2135 (2018); Stephen J. Migala, *UAS: Understanding the Airspace of States*, 82 J. AIR L. & COM. 3 (2017).

53. See *Frequently Asked Questions*, *supra* note 24.

54. See FAA Reauthorization Act of 2018, Pub. L. No. 115-254, § 348, 132 Stat. 3186, 3296-97 (codified at 49 U.S.C. § 44808 (2018)) (requiring the FAA to update regulations on the "carriage of property by operators of small unmanned aircraft systems for compensation or hire within the United States."). Notably, Congress wants the FAA to shift its overtly cautious stance on drone safety to a stance more aligned with performance-based requirements to mitigate—instead of avoid—risk. *Id.* § 348(b)(2). Additionally, Congress wants the FAA to consider the autonomous characteristics of UAS, which could be a nod towards Amazon and Project X's autonomous drone fleets. *Id.* § 348(b)(3).

55. *UAS Data Exchange (LAANC)*, FED. AVIATION ADMIN. https://www.faa.gov/uas/programs_partnerships/uas_data_exchange/ [<https://perma.cc/X9PT-3ZTN>].

56. *Id.*

57. *Id.* These authorizations and notifications include temporary flight restrictions, Notice to Airmen (NOTAMS), and UAS Facility Maps. *Id.* Without LAANC, drone pilots must apply for these authorizations manually, which can take significantly more time. *Id.*

Programs like these suggest that the FAA wants commercial drone development, but this suggestion remains muted by the agency's top concern: safety.⁵⁸ Until the FAA and Congress can be sure that delivery drones can *safely* be integrated into national airspace, drones will not be delivering products to Americans.

Escaping the avalanche of restrictions, model acts, public disapproval, and general pessimism regarding delivery drones will continue to challenge interested industries. If the solution to that challenge involves overhauling regulations, forcing drone deliveries on the public, or ignoring the inherent problems with drone deliveries, then drone deliveries will fail. No one expects drone deliveries to occur overnight like the electric scooter invasion,⁵⁹ but integrating drones into the airspace in stages would mitigate and avoid some of the issues raised above. In particular, airspace above America's highways offers an opportunity for drone companies to initialize a drone infrastructure. States can convey such airspace and the roads beneath it to provide existing routes that connect America's most populated regions.

III. ANALYZING AIRSPACE RIGHTS

Roman jurist Accursius proclaimed: "*cuius est solum, eius est usque ad coelum et ad inferos*," which has been translated to mean "whoever owns [the] soil, [it] is theirs all the way [up] to Heaven and [down] to Hell."⁶⁰ Sir William Blackstone secured the *ad coelum* doctrine in the common law by including it in his treatise, *Commentaries on the Laws of England*.⁶¹ Presumably, neither Accursius nor Sir Blackstone could have expected the *ad coelum* doctrine to be applied in a sky filled with airplanes and drones.

Under common law, courts allow property owners to bring a cause of action against an individual for trespass on the landowner's land without their consent.⁶² Most of these actions involved trespass onto the *ground* of a landowner's property. Merging this cause of action with Blackstone's influential adaption of Accursius' maxim, courts began to allow actions against an individual for trespassing on the landowner's *airspace*.⁶³ As flight technologies developed and more airspace could

58. U.S. DEP'T OF TRANSP., *supra* note 6.

59. See Brandi Vincent, 'I've Seen a Lot of Tears' – Electric Scooter Invasion Generates Safety Concerns, NBC NEWS (Nov. 18, 2018, 7:29 AM), <https://www.nbcnews.com/tech/tech-news/i-ve-seen-lot-tears-electric-scooter-invasion-generates-safety-n937376> [<https://perma.cc/PS84-APQJ>].

60. Samantha J. Hepburn, *Ownership Models for Geological Sequestration: A Comparison of the Emergent Regulatory Models in Australia and the United States*, 44 ENVTL. L. REP. NEWS & ANALYSIS 10310, 10313 (2014) (alterations in original); see also *AERONAUTICS: Sky the Limit?*, TIME (Aug. 4, 1930), <http://content.time.com/time/magazine/article/0,9171,740024,00.html> [<https://perma.cc/FSP9-BHV5>].

61. 2 WILLIAM BLACKSTONE, COMMENTARIES *18.

62. See *Heller v. New York, N.H. & H.R. Co.*, 265 F. 192, 194 (2d Cir. 1920).

63. See, e.g., *Herrin v. Sutherland*, 241 P. 328, 331 (Mont. 1925) (firing shotgun over landowner's property constituted trespass); *Butler v. Frontier Tel. Co.*, 79 N.E. 716, 718 (N.Y. 1906) (hanging telephone wire thirty feet above property constituted trespass). *But see Ivancic v. Olmstead*, 488 N.E.2d 72, 74–75 (N.Y. 1985) (allowing tree to naturally grow into landowner's airspace did not constitute

be occupied by someone or some entity other than the landowner, courts have been forced to draw lines in the air. Shortly after World War II, the Supreme Court explicitly rejected the common law *ad coelum* approach to airspace rights and held that a claim of property ownership indefinitely upward “has no place in the modern world.”⁶⁴ Airspace that is in “the immediate reaches of the enveloping atmosphere,” however, remains in the exclusive control of the landowner.⁶⁵

Ownership of airspace can also be held by public entities. As a threshold matter, the FAA has exclusive jurisdiction over navigable airspace.⁶⁶ Members of the public have a “right of freedom to transit through navigable airspace,”⁶⁷ which is frustratingly defined as “airspace above the minimum safe altitudes of flight prescribed by regulations.”⁶⁸ What remains after excluding private airspace and navigable airspace comprises a vastly unexplored area. Congress authorized states “to use or permit the use of the airspace above and below . . . [interstate] highway pavement,”⁶⁹ but courts have rarely interpreted this provision. Commercial drone delivery companies have yet to test whether states could convey that airspace to them for a drone highway infrastructure. This Part will investigate that possibility. At the time Congress authorized states to convey that airspace, drones did not exist. Thus, when it passed the statute in 1958,⁷⁰ Congress could not have considered the possibility of drones using this airspace to deliver groceries and video games to Americans. Assuming that this statute would permit states to transfer the airspace above interstate highways to commercial drone delivery companies, drone deliveries in America could happen sooner rather than later.

A. Transfer of Airspace Rights Above Highways

Identifying where commercial delivery drones can fly is one of the first tasks a commercial drone operator should undertake. To address this issue, this Section will define highway airspace, who can lease it, and how it can be leased. Each state may approach these definitions independently; however, the basic elements generally remain the same for each state. Equipped with this information, commercial drone operators can contact the appropriate state department and negotiate the lease of highway airspace. While a highway airspace lease has never been used to facilitate a commercial drone delivery system, examples of other uses have included: green strips, small parks, play areas, parking, advertising billboards, and “public or quasi-public use which would . . . enhance other publicly supported programs.”⁷¹

trespass).

64. *United States v. Causby*, 328 U.S. 256, 261 (1946).

65. *Id.* at 264.

66. 49 U.S.C. §§ 44502, 44701–44735 (2019); *see also* FED. AVIATION ADMIN. OFFICE OF CHIEF COUNSEL, STATE AND LOCAL REGULATION OF UNMANNED AIRCRAFT SYSTEMS (UAS) FACT SHEET 1 (2015).

67. 49 U.S.C. § 40101(c)(2).

68. 49 U.S.C. § 40102(32).

69. 23 U.S.C. § 111(a) (2012).

70. Act of August 27, 1958, Pub. L. No. 85-767, 72 Stat. 885 (current version at 23 U.S.C. § 111 (2012)).

71. Sandra Bullington, *Airspace Guidelines for Projects Over Highways*, in 7D

1. Highway Airspace Defined

Highway airspace is generally the area above and below the highway's established grade line.⁷² This includes the area beneath an elevated highway structure or adjacent to the roadway.⁷³ Airspace must also be located within the approved right-of-way boundary.⁷⁴ Each state and municipality defines this right-of-way boundary locally, but it is considered an interest in land⁷⁵ providing an "exclusive right to possession and use of [that] land" for public travel.⁷⁶ Generally, this includes the surface of the land, "subjacent strata" to support the highway, and—most importantly for commercial drone delivery—the airspace above the land.⁷⁷ Right-of-way easements often extend to sidewalks and parking strips (the area between the sidewalk and road used for parking.)⁷⁸ Determining the actual boundary of the right-of-way is often completed through surveying, but in a legal dispute, that boundary may be decided as a matter of fact before a jury or finder of fact.⁷⁹ Once this location is determined, highway airspace occupies the vertical space above that area. Precisely where highway airspace ends and navigable airspace begins is still shrouded in ambiguity, but one certainty exists: the FAA would maintain regulatory jurisdiction over any navigable airspace.⁸⁰

For purposes of transferring highway airspace (or any airspace, for that matter), describing the area to be conveyed poses interesting challenges. Unlike surface land that can be surveyed and precisely conveyed, there are currently no instruments to accurately survey airspace and mark its boundaries. Some states have allowed airspace to be "divided or apportioned horizontally and vertically, and in any geometric shape or design."⁸¹ This approach is directly adopted from the Model

CURRENT LEASING LAW AND TECHNIQUES—FORMS § 15.15 (2002).

72. See, e.g., PENN. SOC'Y OF LAND SURVEYORS, HIGHWAYS AND THE LAND SURVEYOR 2.

73. See Bullington, *supra* note 71.

74. *Id.*

75. Generally, states do not receive a fee simple absolute in the land. Instead, the right-of-way interest is an easement for highway purposes. *But see* Kiely v. Graves, 271 P.3d 226, 231 (Wash. 2012) (en banc) ("If the intent is to grant a fee interest, that intent should be clearly stated and the use should be unrestricted" (quoting 6 WASH. STATE BAR ASS'N, WASHINGTON REAL PROPERTY DESKBOOK § 91.9(1) (3d ed. 2001))). This distinction could present future problems for commercial drone companies if the easement expires or is no longer needed. If this were to happen, the land would revert back to the original title holder. In other words, for those property scholars reading this, there is a possibility of reverter in the right-of-way interest. See PENN. SOC'Y OF LAND SURVEYORS, *supra* note 72, at 3, 10.

76. See PENN. SOC'Y OF LAND SURVEYORS, *supra* note 71, at 2.

77. *Id.*

78. Bob Meinig, *What is the Nature of a Public Right-of-Way?*, MRSC (Jan. 2, 2014), <http://mrsc.org/Home/Stay-Informed/MRSC-Insight/January-2014/What-is-the-Nature-of-a-Public-Right-of-Way.aspx> [<https://perma.cc/YN9X-QA2B>].

79. See PENN. SOC'Y OF LAND SURVEYORS, *supra* note 72, at 13.

80. 49 U.S.C. §§ 44502, 44701–44735 (2019).

81. OKLA. STAT. tit. 60, § 807 (1973).

Airspace Act, which the American Bar Association produced in 1970.⁸² Some developers have attempted to describe airspace conveyances in their deeds, but those descriptions often fall short of an easily defined space. For example, a developer in the Bronx region of New York City attempted to describe a horizontal property division by specifically defining the location of each conveyed horizontal plane.⁸³ As a result, the deed described a pillar of airspace resembling a wedding cake. Another approach, which a developer used to convey space of varying height and angles above the Grand Central Terminal, conveys several two-dimensional planes above the land's surface but carves out areas to remain with the grantor.⁸⁴

No matter how airspace is described in a conveyance, maintaining the boundaries set in that conveyance will prove to be difficult. Applied to highway airspace conveyances, the most practical approach would be to establish a horizontal plane at a set height above the highway surface. Right-of-way boundaries would determine the vertical limits of the conveyed airspace. Many of the developing technologies, such as the UTM platform, could track these boundaries and assist autonomous drones to navigate these routes. Research beyond the scope of this paper would be necessary to route these paths, but the pre-existing infrastructure and paths could help drone industries develop navigable drone delivery routes.

2. Who May Lease Highway Airspace

Once highway airspace has been identified, the next logical issue is determining who may lease highway airspace. Interstates, state highways, and municipal roads are each leased by their respective right-of-way interest holders.⁸⁵ To effectively manage a commercial drone delivery system, companies wishing to enter this industry must lease from the respective interest holders. These include, but are not limited to, the United States Secretary of Transportation, state transportation secretaries, and municipal governments.⁸⁶

i. Interstate System: Federal and State Governments

As a threshold matter, it is important to understand how the Interstate System emerged because most of the optimal highway airspace for commercial drone deliveries ostensibly exists above Interstates. In 1958, Congress passed the Federal

82. MODEL AIRSPACE ACT (AM. BAR ASS'N, Final Draft 1972).

83. Sandra R. Bullington, *Lender Considerations in Airspace Projects*, in 5B REAL ESTATE FINANCING § 12.03 (2018).

84. *Id.*

85. Each state has its own statute that provides a process for the transfer of rights-of-way interests. A complete list of these statutes can be found on the National Telecommunications and Information Administration's website. NAT'L TELECOMM. & INFO. ADMIN., *50-State Survey of Right-of-Way Statutes*, <https://www.ntia.doc.gov/legacy/ntiahome/staterow/rowtable.pdf> [<https://perma.cc/3UTB-V7CY>] (relying on research from NARUC and NATOA); *see also* 23 U.S.C. § 111(a) (2012).

86. *See* NAT'L TELECOMM. & INFO. ADMIN., *supra* note 85; *see also* 23 U.S.C. § 111(a) (2012).

Aid Highway Act (“the Act”), establishing the National Highway System (NHS).⁸⁷ Broadly speaking, Congress defines the NHS as “the highway routes and connections to transportation facilities that shall serve [major transportation areas]; meet national defense requirements; and serve interstate and interregional travel and commerce.”⁸⁸ Part of the NHS is comprised of the Interstate System, which is the same Interstate System most Americans are familiar with.⁸⁹ Land to be used for the Interstate System can be acquired by either the state, or, when the state is unable, the federal government.⁹⁰

In most instances, the state highway department initiates this process by identifying a route for the Interstate System, which must be approved by the Secretary.⁹¹ Next, the state submits to the Secretary its plans, specifications, and estimates to construct the highway.⁹² If approved, the Secretary must act on the project “as soon as practicable” and enter a formal agreement with the state transportation department.⁹³ At this point, the United States has a contractual obligation to provide the agreed funds to the state to complete the project.⁹⁴

Construction on the Interstate System may be permitted, but it is typically subject to agreements between the Secretary and the State Transportation Department.⁹⁵ These agreements control the use and access to the right-of-way on the Interstate System.⁹⁶ Originally, Congress authorized states, and their political subdivisions, “to use the airspace above and below the established grade line of the highway pavement for the parking of motor vehicles.”⁹⁷ Presumably, this was to allow states to develop the necessary support infrastructure to establish the Interstate System. Amending this language since enacting the Act in 1958, Congress inserted “or permit the use of” after “to use,” which allows states to recruit third parties “to use . . . the airspace above and below the established [highway pavement]grade line.”⁹⁸ As the Act stands today, agreements between a state and the Secretary may authorize states to “permit the use of” the airspace above highways by “other commercial establishment[s],” so long as such use does not “impair the full use and safety of the highway,” or “interfere . . . with the free flow of traffic.”⁹⁹

Confined to the language of the Act, drone delivery companies wishing to lease this airspace should be most concerned about the definition of other commercial

87. Act of August 27, 1958, Pub. L. No. 85-767, 72 Stat. 885 (current version at 23 U.S.C. § 103 (2012)).

88. 23 U.S.C. § 103(b) (2012).

89. *Id.* § 103(a).

90. *Id.* § 107(a).

91. *Id.* § 103(c)(1)(D).

92. *Id.* § 106(a)(1).

93. *Id.* § 106(a)(2).

94. *Id.* § 106(a)(3). Throughout this process, the Secretary must conform to certain standards set by Congress in section 109 of the Act. *Id.* § 109.

95. *Id.* § 111(a).

96. *Id.*

97. Act of August 27, 1958, Pub. L. No. 85-767 § 111, 72 Stat. 885, 895 (current version at 23 U.S.C. § 111 (2012)).

98. Federal-Aid Highway Act of 1961, Pub. L. No. 87-61 § 104(a), 75 Stat. 122, 122 (current version at 23 U.S.C. § 111).

99. 23 U.S.C. § 111(a) (2012).

establishments. At first glance, it seems that Congress intended to permit other commercial establishments only if they “serv[e] motor vehicles.”¹⁰⁰ However, Congress has authorized states to develop rest areas, vending machines, motorist call boxes, and other commercial establishments that do not inherently serve motor vehicles.¹⁰¹ Moreover, Congress omitted the service to motor vehicles modifier in the next sentence, which discusses the leasing of airspace. Instead, Congress left “other commercial establishment” unmodified as it pertains to airspace.¹⁰²

Whether commercial drone operators could fall within this commercial establishment category depends on what constitutes a commercial establishment. Statutory interpretation canons, such as *noscitur a sociis*, offer some assistance, but fall short of a precise definition.¹⁰³ Immediately following the commercial establishment paragraph, the Act enumerates which commercial activities are permitted in rest areas on the Interstate System.¹⁰⁴ Most of those commercial activities relate to tourism and travel, but private parties are permitted to operate such commercial activities.¹⁰⁵ Drone operations do not neatly fit within this description, but that does not preclude the possibility. Besides, these commercial activities are specific to rest areas, not the general highway airspace above the right-of-way boundaries. Until a state requests authorization from the Secretary to lease that airspace for drone deliveries, any attempt at identifying the boundaries of commercial activity would be mere conjecture.

Even if drones fell into the Act’s commercial activity category, one component of the Act could prevent drones above highways altogether. Pursuant to the Act, drone delivery operations could not “impair the full use and safety of the highway” or “interfere in any way with the free flow of traffic on the Interstate System.”¹⁰⁶ Unlike rest stations or vending machines, drone delivery could pose a unique and significant risk to the Interstate System. Falling packages and malfunctioning drones would interfere with the free flow of traffic, but how the Secretary would weigh that risk has yet to be determined. Considering that traditional delivery methods already pose certain risks to the free flow of traffic on the Interstate System,¹⁰⁷ the danger that

100. *Id.*

101. *Id.* § 111(b)–(d).

102. *Id.* § 111(a).

103. *State v. Murzda*, 183 A. 305, 308 (N.J. 1936) (“*Noscitur a sociis*. This maxim [is] grounded in grammar and firmly established as a rule of exposition since its adoption by Lord Hale . . .”).

104. *Id.* § 111(b)(2).

105. *Id.*

106. *Id.* § 111(a).

107. *See, e.g.*, Patrick Lortie, Rod Case & Alexandre LeFort, *Trucking May Enjoy Lower Costs, but Lots More Traffic*, FORBES (Nov. 14, 2018, 9:51 AM), <https://www.forbes.com/sites/oliverwyman/2018/11/14/trucking-may-enjoy-lower-costs-but-lots-more-traffic/#1aaca562511b> [<https://perma.cc/T9B9-96Z5>]; *see also* U.S. DEP’T OF TRANSP., FED. MOTOR CARRIER SAFETY ADMIN., LARGE TRUCK AND BUS CRASH FACTS 2016 (2018), <https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/safety/data-and-statistics/398686/lbcbf-2016-final-508c-may-2018.pdf> [<https://perma.cc/J28Q-XL2K>] (reporting 4,440 large trucks and buses involved in accidents in 2016).

drone deliveries may pose to the Interstate System may be a risk the Secretary is willing to assume. Moreover, highways do not need to remain open at all times to avoid interference,¹⁰⁸ so minor traffic delays or highway closures resulting from delivery drones would not necessarily interfere with the free flow of traffic. Additionally, shifting much of the interstate congestion from trucks to drones will serve several policy goals highlighted in the Act.¹⁰⁹

Regulations promulgated by the Secretary and authorized by the Act¹¹⁰ may prove more helpful to determine whether drone deliveries could constitute a proscribed commercial activity. Specifically, the Secretary has established regulations regarding “nonhighway purposes,”¹¹¹ which may better characterize drone deliveries. Such uses may be approved, but only if the non-highway use is “in the public interest and will not impair the highway or interfere with the free and safe flow of traffic.”¹¹² One federal district court in Ohio construed this language to broadly grant the Secretary discretion in implementing the policy objectives of the Act, opining that a “use is ‘in the public interest’ if it is not inconsistent with the purposes of the Act and it either furthers some recognized public good or minimizes a public harm.”¹¹³ Thus, the court held that the Secretary did not abuse that discretion by authorizing an agreement that permitted a mining company to cross an Interstate with heavy equipment ten times in a forty-year period.¹¹⁴

Reapplying the court’s analysis to drone deliveries requires a thorough examination of the Act’s policy objectives to determine whether the Secretary could authorize such a project under her discretionary role. But as the court in *Citizens Organized* explained, “the broad language of the Highway Act and the ambiguous . . . uninterpreted limitations on the nonhighway uses of rights-of-way found in the regulations, create unusual problems of statutory construction.”¹¹⁵

Restricted to the limited times Congress and the courts have offered guideposts for the Act, predicting how Congress will receive a drone delivery infrastructure is at best challenging and at worst impossible. A glass-half-empty perspective relies solely on statutory interpretation and suggests that commercial drone delivery companies would struggle to operate above the interstate. A glass-half-full

108. *Citizens Organized to Def. the Env't, Inc. v. Volpe*, 353 F. Supp. 520, 533–34 (S.D. Ohio 1972) (“The Court does not believe that the phrase means that volume of traffic, free at all times to travel at the maximum rate of speed, which can safely be accommodated during ordinary road conditions. Nor does the Court believe that the temporary closing of a short stretch of a highway and the rerouting of traffic around that section necessarily interferes with the free flow of traffic.”).

109. 23 U.S.C. § 101(b)(3) (2012).

110. *Id.* § 315.

111. 23 C.F.R. § 1.23(c) (2018).

112. *Id.*

113. *Citizens Organized to Def. the Env't, Inc.*, 353 F. Supp. at 531. In coming to this conclusion, the court noted that “[t]hese terms are not defined in the Regulations. There are no cases construing 23 C.F.R. § 1.23. The meaning of the regulation is not clear from a reading of the regulations or the statutes which constitute the authority for the regulation.” *Id.* at 530. This same issue continues to complicate a meaningful interpretation of the Act.

114. *Id.*

115. *Id.* at 533.

perspective considers the broad discretionary role the Secretary holds to effectuate the Act's purposes and suggests—and perhaps supports—the idea that drones will be flying above the interstate in the near future. As the court in *Citizens Organized* explained, “[t]he Highway Act is not a narrowly drawn statute which carefully delimits the Secretary's duties. On the contrary, the Secretary's authority under the Highway Act to approve and finance highway construction is a grant of broad, often discretionary, powers to effectuate the purposes of the Act.”¹¹⁶ Failing to expressly provide a particular situation, like a drone delivery infrastructure, does not preclude the Secretary from effectuating it.¹¹⁷

Following the glass-half-full perspective, delivery drones satisfy many of the policy goals specifically mentioned in the Act. Considering the Secretary's duty to “take appropriate actions” to ensure the Interstate System meets the “needs of the 21st Century,”¹¹⁸ drone delivery systems would appeal to the Secretary in his or her discretionary role. Addressing the needs of the twenty-first century in the Act, Congress specifically established that: (1) “the current urban and long distance personal travel and freight movement demands have surpassed the original forecasts and travel demand patterns are expected to continue to change;”¹¹⁹ (2) “continued planning for and investment in surface transportation is critical to ensure the surface transportation system adequately meets the changing travel demands of the future;”¹²⁰ and (3) “transportation should play a significant role in promoting economic growth, improving the environment, and sustaining the quality of life.”¹²¹ Commercial drone delivery systems intuitively square with these policy goals.

First, Congress expects changes in travel demand patterns due to the unexpected growth in travel.¹²² Drone deliveries offer a practical solution to stabilizing surface traffic patterns because they are an alternative to commercial traffic. Second, Congress encourages and expects transportation planning and investment to meet those travel demands.¹²³ Transferring airspace rights to drone delivery companies to facilitate a new infrastructure serves this policy without building new roads or reshaping the ones that exist. New travel systems will require investment and are not without risk, but air travel avoids the cost of producing physical roads and the resulting road construction congestion.

116. *Id.* at 526.

117. *See id.*

118. 23 U.S.C. § 101(b)(3)(H) (2012); *see also Citizens Organized to Def. the Env't, Inc.*, 353 F. Supp. at 530–31 (policy considerations that the Secretary should consider include “meet[ing] the needs of local and interstate commerce,” “highway safety,” “highway construction compatible with the needs of each locality,” “the creation of an efficient highway transportation network,” “highways that provide direct and convenient access to public facilities,” and “expeditious and economical highway construction.”). Of course, Congress has amended the Act since 1972 when the court decided the case, but the federal district court used these policy considerations to guide its understanding of when the Secretary may approve nonhighway use of the Interstate System. *Id.*

119. 23 U.S.C. § 101(b)(3)(B) (2012).

120. *Id.* § 101(b)(3)(C).

121. *Id.* § 101(b)(3)(G).

122. *Id.* § 101(b)(3)(B).

123. *Id.* § 101(b)(3)(C).

Third, Congress's language indicates its concern with transportation's role in "economic growth," "improving the environment," and "sustaining . . . quality of life."¹²⁴ Connecting drone delivery and economic growth does not require much imagination or speculation. An in-depth economic analysis falls outside the scope of this paper, but substantial economic growth is almost inevitable.¹²⁵ Scholars and environmentalists have only recently begun studying the environmental effects that drones could offer,¹²⁶ but traditional commercial delivery systems already pose environmental dangers.¹²⁷ Fifty-four billion gallons of fuel is used each year by truck deliveries, which is consumed to deliver twenty-seven percent of goods shipped in America.¹²⁸ Drones do not innocently fly around without consuming energy and fuel; however, for small, direct shipments, they are more fuel-efficient than conventional delivery systems.¹²⁹ Anne Goodchild, a professor of civil and environmental engineering concluded that she "was amazed at how energy-efficient drones are in some contexts. Trucks compete better on heavier loads, but for really light packages, drones are awesome."¹³⁰

Admittedly, a drone delivery infrastructure above the Interstate System is as ambitious as it is uncertain. With so many unknown factors and so few comparable instances, almost any legal analysis would be speculative at best. However, this system appeals to the policy objectives specifically enumerated in the Act. If the Secretary, in her discretionary capacity, were to recognize the potential economic, environmental, and social gains that a drone delivery infrastructure could offer, then perhaps an interstate drone infrastructure could exist in the near future.

124. *Id.* § 101(b)(3)(G).

125. See ASS'N FOR UNMANNED VEHICLE SYS. INT'L, *THE ECONOMIC IMPACT OF UNMANNED AIRCRAFT SYSTEMS INTEGRATION IN THE UNITED STATES 2* (2013) (estimating drones will result in 100,000 new jobs and an \$82 billion economic impact by 2025).

126. Jennifer Langston, *Drone vs. Truck Deliveries: Which Create Less Carbon Pollution?*, UNIV. OF WASH.: UW NEWS (May 30, 2017), <http://www.washington.edu/news/2017/05/30/drone-vs-truck-deliveries-which-create-less-carbon-pollution/> [https://perma.cc/27B6-U3WH]; see also Jim Lyza, *Could Drones Give Your Package a Sustainable Lift?*, GREENBIZ: SPEAKING SUSTAINABLY (May 2, 2014, 5:30 AM), <http://www.greenbiz.com/blog/2014/05/02/could-drones-give-your-package-sustainable-lift> [https://perma.cc/9MWP-9RC9] ("[F]or small, single order packages, drones could offer a very energy-efficient mode of delivery.").

127. *Trucking Industry Statistics*, TRUCKER PATH (June 27, 2017), <https://truckerpath.com/blog/trucking-industry-statistics/> [https://perma.cc/G8FT-8NB4].

128. *Id.*

129. See Langston, *supra* note 126; see also Constantine Samaras & Joshua Stolaroff, *Is Drone Delivery Good for the Environment?*, SMITHSONIAN (Feb. 14, 2018), <https://www.smithsonianmag.com/innovation/drone-delivery-good-for-environment-180968157/> [https://perma.cc/R832-7LZF].

130. Langston, *supra* note 126; see also Samaras & Stolaroff *supra* note 125.

ii. State Governments

Harmonizing a drone infrastructure would require state cooperation. Even if drone delivery companies secure interstate highway airspace, they must also be able to navigate above state highways. Fortunately, most states address the transfer of public airspace, and some specifically address the transfer of highway airspace. Due to the vast variation in state approaches to transferring airspace, most of the following Section will summarize a few of the most popular approaches. To obtain the right to operate in this airspace, commercial drone delivery companies would need to negotiate a lease with the department of transportation, or equivalent government office, in each state where they wish to operate.

States that specifically address highway airspace typically allow that airspace to be leased for up to ninety-nine years.¹³¹ For example, California, Nebraska, and Minnesota¹³² subscribe to this approach.¹³³ Challenging and subsequently providing one of the only guideposts for such a statute, an engineering labor organization and taxpayers challenged the California Department of Transportation's ability to lease highway property that had yet to be developed.¹³⁴ Part of the agreement granted the lessee, a public transportation developer, an option to lease the airspace above the highway for commercial improvements.¹³⁵ Rejecting the notions that highway leases are only valid if they convey airspace above existing highways and "for the purpose of facilitating those projects," the court instead opined that the airspace leases are valid because they serve as a "financial incentive to engage private enterprise . . . to improve our state's infrastructure."¹³⁶ Neither the district court nor the appellate court described what commercial improvements were to be made on the leased airspace, but commercial delivery drones may fit that description. Once delivery drones are recognized as a commercial improvement, California's highway airspace leasing statute could enable drone delivery companies to acquire that airspace as part of a drone infrastructure. This would allow California to be one of the first states to adopt a drone delivery infrastructure above its highways.

Other states are more ambiguous in describing how airspace above highways may be leased. For example, Georgia authorizes its department of transportation to lease air rights above limited-access highways "for development as commercial enterprises or activities."¹³⁷ Lacking any case law interpreting this statute or any further explanation as to what those commercial activities may entail, drone delivery companies would likely be the first to test the bounds of this leasing authorization.

131. See, e.g., CAL. STS. & HIGH. CODE § 104.12(a) (Deering 2018).

132. Interestingly, the text of Minnesota's airspace leasing statute specifically mentions title 23 of the United States Code, which establishes the leasing of airspace above the Interstate System. MINN. STAT. ANN. § 161.433 (West 2018). Additionally, many of the prohibitions found within title 23 are reproduced in Minnesota's statute. *Id.*

133. CAL. STS. & HIGH. CODE § 104.12(a); MINN. STAT. ANN. § 161.433; NEB. REV. STAT. ANN. § 14-1730 (LexisNexis 2018).

134. *Prof'l Eng'rs v. Dep't of Transp.*, 13 Cal. App. 4th 585 (1993).

135. *Id.* at 595.

136. *Id.* at 595-96.

137. GA. CODE ANN. § 32-6-117 (West 2018).

A comprehensive explanation of each state's airspace leasing statute would be unnecessarily dense. Without a model or uniform law designed to facilitate these leases, drone delivery companies will struggle to navigate the patchwork of state legislation.¹³⁸ Assuming that the drone infrastructure is successful in the first few states to negotiate leases, states may feel compelled to address their own airspace leasing statutes. Of course, states would be free to exclude the service, but over time popular demand may prompt legislative action from those states. In fact, the United States Postal Services conducted a survey to measure public perception of drone deliveries in 2016.¹³⁹ While the overall findings are ambiguous, the survey indicated that seventy-five percent of Americans expect drone deliveries by 2021.¹⁴⁰ Additionally, drone malfunction was the most selected primary concern over delivery drones,¹⁴¹ which is a concern that could drastically dissipate if drone companies can prove the overall stability of the program. In the immediate future, drone delivery companies should concentrate their efforts on a workable interstate highway infrastructure and test that approach on the highways of a few interested states.

IV. MUNICIPAL GOVERNMENTS & DEVELOPING A UNIFORM DRONE INFRASTRUCTURE

Entering municipalities, delivery drone companies will need to negotiate airspace leases with the municipality's authorizing agent, which is usually proscribed by a statute. In fact, many of the statutes that authorize states to lease airspace are the same statutes that authorize municipalities to lease airspace.¹⁴² Consequentially, many of the same issues that drone delivery companies would face by leasing airspace from state governments are replicated in the municipal context. Patchwork legislation is difficult for companies to navigate, but over time, as more municipal governments realize the benefits a drone delivery infrastructure offers, municipal governments may simplify the leasing process for drone delivery companies. And as the data suggests, Americans are expecting these drone deliveries soon,¹⁴³ so gathering popular support for such an undertaking is within the realm of possibilities.

While challenges to these municipal airspace statutes are rare, almost every state court dealing with the issue has supported the notion that municipal governments are

138. Uniform laws often facilitate their respective industries. The Uniform Law Commission is working on a uniform law that will address automated driving systems. *HIGHLY AUTOMATED VEHICLES ACT (UNIF. LAW COMM'N Proposed Draft 2019)*. Part of the proposed uniform act will cover business models related to automated driving systems. *Id.* ¶ 3, prefatory note. By anticipating those business models, the uniform act will develop a system in which businesses can reliably operate. *But see* Larry E. Ribstein & Bruce H. Kobayashi, *An Economic Analysis of Uniform State Laws*, 25 J. Legal Stud. 131 (1996) (arguing that uniform lawmaking bodies may produce results that are both unnecessary and perverse).

139. OFFICE OF INSPECTOR GEN., U.S. POSTAL SERV., *supra* note 21, at 1–2.

140. *Id.* at 7.

141. *Id.* at 8.

142. *See, e.g.*, S.C. CODE ANN. § 4-9-30(15) (1999).

143. *See* OFFICE OF INSPECTOR GEN., U.S. POSTAL SERV., *supra* note 21, at 7.

authorized to lease airspace above public property.¹⁴⁴ A municipal government's ability to convey public property does not cease if that property happens to exist in the air. These airspace leases could allow drone delivery companies to avoid drone zoning laws¹⁴⁵ and other restrictions by including relevant provisions to escape liability. To be sure, these leasing provisions could still accommodate the core function of drone zoning laws: limiting drone operations to suitable land.¹⁴⁶ Admittedly, not every municipal road is suitable for a drone delivery infrastructure, but both drone delivery companies and municipal governments can negotiate that aspect in the airspace leases.

Realistically, obtaining these leases from every municipal government to create a drone infrastructure is impractical, inefficient, and costly. However, in the short run, this approach would allow drone delivery companies to test some prototype of a drone infrastructure. Weaving together a series of leasing agreements with state and municipal governments is feasible in controlled locations, and if the infrastructure proves to be useful and safe, the prospect of drone integration into the national airspace becomes more likely. After all, no sustainable infrastructure is developed overnight.

Mitchell Sipus is an urban designer who understands this reality.¹⁴⁷ Drawing an explicit parallel between traffic and drone law, Sipus engineered a hypothetical matrix of drone ordinances to establish a reliable drone infrastructure above cities. As a premise, he states:

[Drone traffic is] not really that different than regular automobile traffic. Back in the day, cars were invented, people who could afford them started driving like crazy, getting drunk, driving off the road, driving into trees, causing all sorts of chaos. But clearly there were a lot more benefits to having automobiles than sticking to the old horse and buggy system. So instead of banning cars altogether, people were reasonable in trying to develop traffic laws, and infrastructure to support those traffic laws, like four-way stop signs, lanes on the road, speed limits, don't get drunk. If we think of this the same way, for a pilot, "don't drink and drive" becomes "don't drink and drone."¹⁴⁸

Extending the traffic analogy to airspace, Sipus's hypothetical drone infrastructure relies on a system of green, yellow, orange, and red airspace.¹⁴⁹ Green

144. *R. E. Short Co. v. City of Minneapolis*, 269 N.W.2d 331, 339 (Minn. 1978) ("The city is clearly authorized to lease air rights over the public parking ramp . . ."); *Op. of Justices*, 254 A.2d 273, 277 (N.H. 1969) ("[T]he Legislature may authorize municipalities to lease as provided by House Bill 708 such air rights as they may have . . .").

145. See Troy A. Rule, *Drone Zoning*, 95 N.C.L. REV. 133, 136–37 (2016) (discussing the rise of drone zoning laws and preemption).

146. See *id.* at 137.

147. Kelsey D. Atherton, *The Future of Urban Planning: Zoning for Drones*, POPULAR SCI. (Aug. 22, 2014), <http://www.popsoci.com/article/technology/future-urban-planning-zoning-drones> [<https://perma.cc/FX2E-S9RH>].

148. *Id.*

149. *Id.*

airspace would allow drones to travel quickly above less populated and open areas.¹⁵⁰ Yellow airspace would allow drones to travel at night to avoid disturbing populated airspace during the day (e.g., residential neighborhoods).¹⁵¹ Orange airspace would establish dynamic areas that have specific limitations, such as exclusive nighttime operation.¹⁵² Red airspace would establish no-fly areas or heavily restricted areas.¹⁵³ Of course, cities must be willing to invest the time and resources into plotting an infrastructure like this,¹⁵⁴ but if the initial airspace leasing infrastructure demonstrates a promising return-on-investment, then those cities would have an incentive to develop a drone infrastructure.

CONCLUSION

Transforming infrastructure takes time. No one expects Amazon to deliver a package via drone service tomorrow, but at least three-quarters of Americans expect it by 2021.¹⁵⁵ Faced with this reality, drone industries, lawmakers, and other interested parties should consider how American airspace will support the drone age.¹⁵⁶ If drones are released into a heavily regulated airspace that lacks a foundational infrastructure, the skies will become a chaotic web of uncoordinated flying objects.

Instead, regulators and drone industries should introduce a workable drone infrastructure in stages and test each individual element. Merging highway and airspace infrastructures, delivery drones could integrate into national airspace in a safe and efficient manner. To secure that infrastructure, states and municipalities could convey the airspace above their respective highways and roads to drone delivery companies. Over time, those routes would become interconnected and help launch a more uniform drone highway infrastructure.

Not too far into the future, delivery drones could travel via a uniform drone highway that connects to and travels over private property, public property, human beings, and other aircraft. Until then, lawmakers and drone industries must continue collaborating to establish the safest, most efficient, and most workable drone infrastructure if drones are to successfully integrate into the national airspace. Flying in the airspace above highways will hopefully initialize that process and begin the drone delivery era.

150. *Id.*

151. *Id.*

152. *Id.*

153. *Id.*

154. Michelle Bolos, Note, *A Highway in the Sky: A Look at Land Use Issues That Will Arise with the Integration of Drone Technology*, 2015 U. ILL. J.L. TECH. & POL'Y 411, 434 .

155. OFFICE OF INSPECTOR GEN., U.S. POSTAL SERV., *supra* note 21, at 7.

156. *Welcome to the Drone Age*, *supra* note 15.