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PART I · THE ATOMIC WORLD

There's My Flying Car!

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An autogiro flies over the Treasury lawn, Washington, DC, October 2, 1936. Rotorcraft promised flight that could begin and end almost anywhere, if the rules and landing places could be built to match.
Photograph by Harris & Ewing / Library of Congress.

SUMMARY

The power of private, autonomous or heavily autonomous flight is sprinkled throughout science fiction and techno-futurist writings. But in a world of recursively self-improving software and machines, does this mean that sitting in traffic on the Beltway or waiting for a people-mover at Dulles fades into the tomorrow-world of *The Jetsons*? Such a future could be possible, but to realize its benefits, there must be corresponding institutional development in areas of airway protocols (how vehicles communicate), flight-enabling infrastructure, and deterrence mechanisms for rogue operators. By anticipating the need for such institutions and infrastructure, the U.S. and other nations can be prepared to take maximal advantage of the benefits created by this next iteration of transportation technology.

IN THE WORLD OF AGI, AUTONOMOUS VEHICLES HAVE BECOME PART OF EVERYDAY life. Human driving is reduced to sport or hobby, but much of day-to-day transportation has been automated, for both public systems and private vehicles. The more exciting future is what has occurred above the ground and within the clouds. The rapid

ADVANCEMENTS OF ELECTRIC VERTICAL-TAKE-OFF-LANDING (EVTOL) AND COMPUTER vision systems helped pave the way for flying cars, both for personal and commercial use.

To better understand what is needed for us to capture this marvelous future, there are three initial components that policymakers must consider and work to solve: airway protocols, which enable crafts to communicate with one another and other relevant flight infrastructure and third parties, and which will need to be standardized; the physical infrastructure, which ensures safety and consistency in our new aerial highways; and, most pressing in the near term, deterrence mechanisms to mitigate threats from rogue drone operators, terrorists, and adversaries.

In order to have flying cars, ensuring that motorists and their vehicles can navigate safely and efficiently among one another is paramount. This includes coordinating takeoff and landing, as well as flight itself.

Takeoff and landing are best understood in the context of our most common forms of air travel today: airplanes and helicopters. In the lead-up to flight, the craft coordinates with air traffic controllers (ATC) on the ground to confirm readiness, flight path, and clearance for takeoff. Similarly, when landing on the ground, the designated ATC will coordinate with the plane on its approach, confirming that the airspace is clear of vehicles and storms before landing on the ground. This requires significant coordination and sustained communication throughout the length of the journey.

In an AGI-defined future, such coordination and planning become a question of latency and agent-to-agent communication. Latency, the time it takes for information to travel from one device to another digitally, can enable crafts to coordinate with infrastructure on the ground to coordinate takeoff and landing in real-time. Such systems will be mediated by various agents through a protocol layer that is designed to identify, track, and manage the inbound and outbound flight reservation.

Once the vehicle is in the air, there are two discrete aspects worth considering, using terrestrial car travel as an analogue. The first is the physical protocols, such as speed limits, lanes, and stop-lights. All drivers on the road are required to operate their vehicle in adherence to such protocols. The second type of protocol is inter-traveller, which is a bit more subjective and based on the driver's preferences, but still crucial to safely operating a motor vehicle. This includes using a turn signal, turning on your lights at night or when it is raining, and yielding the right of way when necessary.

These protocols require the craft to communicate with infrastructure, but also to communicate with other vehicles. This will require a standardized protocol for sharing information between vehicles and the "drivers." Who has the right of way when zipping above the trees? What about trying to merge before landing? Protocols that enable intermediation between vehicles can help answer these questions.

Airspace markets, and using auctions to mediate congestion, are two solutions that are suitable to agents. Different "lanes" can be priced differently through airspace auctions and responsive lane pricing. The former enables landowners and infrastructure operators to sell access to their airspace. The latter allows for real-time traffic manage-

ment mediated by price, easing congestion and segmenting traffic, just as we do with HOV lanes and toll roads.

Enabling craft-to-craft and craft-to-ground communication requires physical infrastructure—the second challenge to be solved. Such infrastructure can be split into two categories: connectivity for on-board and intra-craft communications, and supporting takeoff and landing.

In the first category (connectivity), unmanned aerial systems (UAS) leverage radio-spectrum to enable tracking of their movements and communication with ATCs, other crafts, and critical infrastructure operators. Automatic Dependent Surveillance-Broadcast (ADS-B), which is a GPS-based system used by aircraft operators to broadcast their positioning while in the air, has emerged as an alternative to traditional communications systems that rely on legacy radio frequency-based technologies and spectrum-based communication. Unlike radar, which relies on radio waves, ADS-B takes advantage of satellite technology and enables continuous monitoring.

The main infrastructure demands here are towers and satellites, which enable drone pilots and ATC to label, track, and distinguish in-flight drones. An AGI-defined future will mean greater efficiency thanks to more satellites and enhanced spectrum management, as well as greater positioning thanks to quantum devices and photonics-based components. Such advancements require the necessary hardware and supply chains to support buildout.

But before crafts fly, they need a place to take off and land. The world of *The Jetsons* does not require George to walk to his local shuttle station or wait in line at TSA to start his commute. The car is there waiting for him, ready to whisk him to his next engagement. To realize this reality, it will be necessary to phase in options for air taxi operations, beginning with existing private airports, then moving to building the initial infrastructure for vertiports, and finally enabling residential liftoff from one's own home or a nearby parking garage.

The groundwork for the first two stages is already being laid today. When it comes to local airports and aerial infrastructure, pilot programs and drone testbeds in North Dakota, Alaska, Texas, New Mexico, and North Carolina have housed test sites since the mid-2010s, but an eVTOL test range became operational in Oklahoma City in March 2026. These locations should be used to test and develop procedures for monitoring, managing, and queuing aircrafts for takeoff and landing.

But we need to think bigger. A better test case is the initial flights being offered by Joby Aviation flying from JFK and Newark Airport into Manhattan, landing at existing heliport infrastructure in Midtown. Scaling this model will require integration with the monitoring and guidance software mentioned previously, but a way to price takeoff and landing slots. Creating a live market for such slots can improve operational safety and volume.

The final and most difficult task is to prevent crashes and deaths from drones. Drone warfare has become the defining feature of the Ukraine conflict, and it is likely only to spread. Throughout Ukraine, as well as nearby European nations, cargo nets

and other forms of shielding cover roadways for protection against enemy drones. Larger drones, particularly those deployed by actors with access to AGI-level systems, will overcome such defenses, and it is unlikely that scaling such physical protection could coexist with true commercial use.

The most obvious deterrence mechanism is software that prevents crafts from running into one another. Such a mandate is sensible to a degree, but likely insufficient. Motivated actors and a variable world mean that requiring all operators to "be safe" and "get a license" will always fall short. Monitoring will be key, and there are indeed companies today whose systems track and identify drones. But this is not enough, as deterrence will need to be more expansive than pushing a software update.

One approach worth exploring is using directed energy weapons or other forms of signal jamming to bring down rogue crafts without using kinetic force. Today, such capabilities' limited range and power handicap their effectiveness. Larger "shocks" will need to be administered to bring down such crafts. Developing such weapons and other methods of "energy deterrence" would be apt for a grand challenge administered by the Defense Advanced Research Projects Agency.

Today, deterrence activities are left to the Department of Homeland Security (DHS), as well as the Department of War. Routine failures to contain, track, and bring down small drones demonstrate the limited capability of today's technology. Autonomous turrets could play a role, and should be considered around sensitive or critical facilities. But in a world of flying cars, a shoot-first strategy that created flaming wreckage would likely make the technology an intolerable threat.

Direct interception is another deterrence method worth considering, in part because it is familiar: think of the cop pulling over the speeding car, or the fighter jets scrambling to escort a pilot to the ground. In conjunction with the development of the monitoring systems discussed above, if a craft or drone is not registered, is behaving erratically, or fails to communicate its flight path, an interceptor (or two) is dispatched. Depending on the location, this function could be performed by a government agency, such as the Federal Air Marshal Service, the Federal Aviation Administration, or DHS, or by private security firms.

In short, flying cars will create plenty of new tradeoffs and problems for engineers, policymakers, and everyday people to solve. But the true promise of the technology is unlocking a new way to see our nation and ideally, our world.

ABOUT THE AUTHOR

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