

Drone Dread

Evaluating the impact of drones on
manned helicopters.

By Henry Perritt, Jr. and Eliot Sprague

Inside the cockpit of an LAPD EC135
over Hollywood. Photos courtesy of
Henry Perritt and Eliot Sprague

When Jeff Bezos went on 60 Minutes in December and told Charlie Rose about Amazon's dream of using small drones to deliver packages, half the world started looking out their windows. Helicopter pilots are starting to look over their shoulders. How much longer can they expect to be in a cockpit as opposed to sitting in front of a video game console on the ground?

We saw the Bezos interview and his drone demonstration. One of us flies news helicopters for a living and the other flies helicopters for fun. Between us, we just finished an investigation of mechanisms for sharing public safety helicopters. We're not looking over our shoulders.

Now the FAA, after a shove by Congress, has published its "Roadmap" for integrating drones into the National Airspace System (NAS) and selected six test sites for demonstrating how drones can comply with tentative regulatory requirements. It's time to push back some of the hype and to probe a little more deeply into the impact of drone technology on helicopter aviation.

Two parts of the Roadmap seem quite sensible and are unlikely to change: a safe harbor at low altitudes for small drones that fly within sight of their operators – otherwise known as "microdrones" – and more demanding requirements for larger drones that rub shoulders with manned aircraft. We call these "machodrones." The machodrones, like manned aircraft after 2020, will have to be equipped with automatic dependent sur-

veillance-broadcast (ADS-B) to tell everyone their position, altitude, speed, and direction of flight at least once every second. The drones themselves will have to have airworthiness certificates, and their operators – we call them DRone-OPERators or "DROPs," will have to be certified under requirements resembling present pilot standards and processes.

The safe harbor for microdrones is not too different from that suggested by FAA for remotely controlled model aircraft: below 400



Eliot Sprague launches a Phantom microdrone at North Field Park in Glencoe, Ill. Photo by Henry Perritt

feet, subject to a weight limitation. They will have to stay near their operators and stay away from airports.

We took what we know about mission requirements for electronic newsgathering (ENG) and law enforcement patrol support, having flown as observers on such missions, and search and rescue (SAR), having participated in SAR training activities. We then set out to evaluate how well drones could fly these missions. To do so, we put a Phantom 2 Vision through a flight-

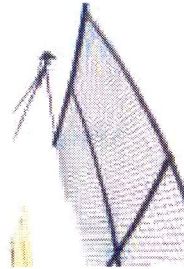
test program and conducted preliminary design of a machodrone about the size of a Robinson R22. The Phantom is a 2.5-lb, electrically powered quadcopter that represents the state-of-the-art in drones for hobbyists. It has the potential to be far more than a toy. A built-in high-def video camera can be tilted by commands sent through the remote-control link. The camera system streams full-motion video to the operator to assist with flying, and can download the videos for subsequent editing, analysis, and distribution.

The Phantom has a ceiling of around 600 feet, a top speed of about 30 knots, and can hover in a fixed position autonomously without the operator touching the controls – a feat that primary helicopter students long to achieve even with their knuckles white with their grip on the controls. If the control link is lost, the Phantom autonomously returns to its launching point. It zips up and down and back and forth, and spins around its yaw axis, responsive to its operator's fingers on the console unit, which has small collective and cyclic sticks.

The Phantom leaves no doubt that microdrones with similar or improved capability will allow law enforcement, news organizations, and utility operators to support their missions with a new kind of rotary wing asset. Police patrol cars can have microdrones in their trunks. When they get to a crime scene, they can launch the drone to scan rooftops and back yards in a residential area – or sidestreets and alleys in a commercial district – or to enforce a perimeter. For newsgathering, personnel in an ENG



Microdrone's aerial photo of Henry Perritt (left) and Eliot Sprague flying it at North Field Park in Glencoe, Ill.



truck can launch a microdrone for overhead shots of a fire or a crime scene. TV stations can solicit video imagery captured by freelance drones.

But microdrones will always operate at the margins, limited by a line-of-sight restriction: the DROP must be in the same general vicinity as the drone. Obviously, if ground transportation is required to get the drone where it is needed, transit times are increased substantially. One of the advantages of helicopters for crime fighting or news is that they can be dispatched from a central location and be on the scene in a matter of minutes.

In the law-enforcement context, microdrones would offer little help for foot- or vehicle pursuits: the suspect can easily outrun a microdrone's operating radius. In the newsgathering context, microdrones will not, with current and foreseeable video technologies, be able to get video imagery of the quality demanded by TV stations. Cineflex or FLIR cameras with their gimbals, transmitters, antennas, and recorders in ENG helicopters weigh 200-300 lbs.

Machodrones will be necessary to do what manned helicopters do today – in the case of foot- or vehicle-pursuits, to keep the suspect or his vehicle in sight, thereby reducing the risk of surprise threats to personnel pursuing on foot or of

vehicle collisions. Machodrones will be necessary to do what news helicopters do on every shift: reach a newsworthy event anywhere in a major metropolitan area like Chicago in a matter of minutes.

So what will these machodrones look like? We think there are two interesting possibilities. The first, more conservative, one, involves modification of an existing helicopter type, much as Boeing modified an R22 to become the A160T Hummingbird and then modified a MD 530F to become the Unmanned Little Bird. The U.S. Navy now is testing its MQ-8C, a Northrop Grumman-modified Bell 407.

The second, more ambitious, approach would design a machodrone from the ground up, optimizing it for mission instead of for carrying people – the fundamental design constraint for all operational aircraft.

Such a design will have four or more rotors, to eliminate the 30 percent parasitic power loss associated with a tail rotor. They will have an electric motor for each rotor rather than one or two piston or turbine engines to permit thrust to be varied by changing RPM rather than pitch. That will eliminate gearboxes, drive trains, control rods and pitch links, all of which add weight and complexity.

They will have more than enough useful load to carry all

the camera equipment, downlink transmitters and antennas, and high intensity searchlights a law-enforcement or news organization might want. Getting rid of 500 lbs of pilot and TFO or photojournalist leaves a lot of payload capability for something else.

They will have hover capability, and never-exceed speeds in the hundred-knot range. Service ceilings and endurance will be comparable to today's helicopters.

They will have ADS-B In and Out to let others know where they are and where they are going. The DROP will sit at consoles on the ground where the drone is based or at a location proximate to police dispatcher or newsdesk – the control link doesn't care where the DROP is, as long as he is within range – looking at an array of video screens that give him much the same perspective he would have if he were in the cockpit – with 270-degree azimuth, 90 degrees down and 45 degrees up.

Remote control is not as much of a challenge as it initially seems. Autopilots know how to fly airplanes and helicopters almost through their full flight regime. GPS pinpoints position in the airspace. Data links to connect ground-based operators with onboard control system have proven their reliability on billions of dollars of unmanned space systems.

Battery technology is a critical technology, but lithium-polymer batteries such as those used on the Phantom or in the electric automobiles on the market can be scaled up to provide the necessary power and endurance without eroding payload capability.

Maybe we should be looking over our shoulders.

But it's one thing to design a machodrone on paper, optimized to fly helicopter-like missions. It's



LAPD Airbus Helicopters (formerly Eurocopter) AS350 leaves for patrol.

quite another to get an airworthiness certificate, to manufacture and sell it at a competitive price, and to find a pipeline of qualified DROPs.

It's one thing to fly helicopters so as to blunt the intensity of opposition to noise, privacy invasions, and civil liberties threats. It's quite another to withstand the furor over drones that has led more than forty state legislatures to enact or consider new laws to restrict drone use.

Everyone can remain calm. The helicopter world is safe.

Good pilots will embrace the excitement occasioned by new technologies that permit all of us to re-experience the early days of aviation, when the only real limit on entrepreneurship and adventure was imagination. Good stewards of law enforcement and news gathering will welcome the opportunity to create strategies for air support that can use a much wider variety of assets, deploying each for their best purpose. Television stations are not going to become advocates of Do-it-Yourself; they are going to become even more reliant on their helicopter contractors of today to help them understand how they can use new technologies alongside the old to draw viewers.

Police chiefs and city councils will continue to thread their way through the shoals of providing the best protection of public safety with the best available equipment, while respecting the concerns, warranted or otherwise, about the potential for overzealousness to erode the values of a free society.

All of them will be well served by understanding what drones have to offer, watching and participating in

the evolving regulatory and political processes, and embracing the opportunity to add new kinds of aircraft to their mix.

But microdrones will only supplement manned helicopters at most. For machodrones, the future is overcast—with few breaks in the overcast. Development and certification will cost a fortune, and the FAA's rules will boost their operating costs. They'll probably end up costing more than manned helicopters. Flying helicopters not like working on an assembly line, where purely repetitive tasks requiring little judgment or instant adaptation can be performed well by a robot.

No one who has ever dipped the nose from a hover, watched the ground start to move underneath him, and felt a slight nudge against his butt as the helicopter meets ETL and starts to climb will ever be fully satisfied sitting in front of a DROP console. It won't matter how stunning the color is on the wraparound video display.

We'll still be in the cockpit. 🚁

About the Authors

Hank Perritt is a Professor of Law and former Dean at Chicago-Kent College of Law, the law school of Illinois Institute of Technology, which he served as Vice President and Chief Academic Officer for the Downtown Campus from 1997 to 2002. Mr. Perritt is a private helicopter and airplane pilot, and received his bachelor of science degree in aeronautics and astronautics from MIT. Before going to law school, he worked as an application engineer and senior sales planner for Lockheed Aircraft Corporation. He has written 20 books and nearly a 100 articles, many of them on law and technology. He served as the principal investigator of a review, commissioned by the Attorney General of the United States, of the FBI's Carnivore system and was a member of the Computer Science and Telecommunications Board of the National Research Council.

Eliot Sprague is professional ENG helicopter pilot, flying several times a day for TV stations. He is also director of market development and a commercial pilot for AM Air Service, a Chicago-area charter and tours operator, and a helicopter flight instructor and board member of the Midwestern Helicopter Association. Sprague is a graduate of Hillsboro Aviation flight school and holds helicopter CFII, CFI, and commercial pilot ratings, and a commercial airplane rating. Sprague taught Perritt how to fly helicopters.