Medium-Priced Autonomous Drones

By John Benson

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1. Introduction

Small drones are everywhere. At times I think they blot out the sun. And they are very inexpensive -- The highly rated Black Falcon 4K camera drone only costs $99 to $199.[1]

But this paper is not about low-end drones, it is about medium sized high-performance drones that cost anywhere from $tens-of-thousands to $hundreds-of-thousands. Their primary customers are various defense agencies, but they also have many interesting civilian applications. An article in Forbes alerted me to these and what is probably the builder of the most advanced design, which is just starting to take off.

2. Anduril Industries

In exploring the Anduril Industries Website, I discovered several things.[2] Although their initial product appears to be the Roadrunner autonomous drone, they appear to have several other drones in the pipeline, both areal and submarine. Their foundation product appears to be a software operating system that allows them to customize these for mission flexibility. The other thing I learned is that their headquarters is in Costa Mesa, California, in Orange County just southeast of Los Angeles.

2.1. Founder

Anduril Industries says it wants to become the Lockheed Martin of the 21st century. One way the defense-tech startup, cofounded by billionaire Palmer Luckey, is trying to get there is by developing gear on its own dime rather than waiting for Pentagon contract competitions. It's betting that it knows what the U.S. military is going to want.[3]

Palmer Freeman Luckey (born September 19, 1992) is an American entrepreneur best known as the founder of Oculus VR and designer of the Oculus Rift, a virtual reality head-mounted display that is widely credited with reviving the virtual reality industry. In 2017, Luckey left Oculus and founded defense contractor Anduril Industries, a defense technology company focused on autonomous drones and sensors for military applications. Luckey ranked number 22 on Forbes' 2016 List of America's Richest Entrepreneurs Under 40.[4]

Back to Reference 3.

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[1] Dave F., Best Digs, "Why Is This Black Falcon Drone The Trendiest New Gadget of The Year? It's Simply Genius..." Nov 8, 2023, https://bestdigs.org/black-falcon-drone-review/ Also see: "Top 5 Best 4K Camera Drones for Beginners - Compared & Ranked by Drone Expert," https://bestdigs.org/best-camera-drone-us/

[2] https://www.anduril.com/

[3] Jeremy Bogaisky, Forbes, "Billionaire Palmer Luckey Unveils A New Jet-Powered Drone — And It Looks Bonkers," Dec 1, 2023, https://www.forbes.com/sites/jeremybogaisky/2023/12/01/billionaire-palmer-luckey-anduril-drone/?utm_source=newsletter&utm_medium=email&utm_campaign=dailydozen&cdlcid=628673ca6e1a1d1211f1d747&section=tech&sh=6ca186906b3f

[4] Wikipedia article on Palmer Luckey, https://en.wikipedia.org/wiki/Palmer_Luckey

On Friday (Dec 1), the Southern California-based Anduril pulled the wraps off its latest ambitious bet: an autonomous jet-powered drone designed to serve as an interceptor of aerial threats ranging from large drones to manned aircraft. Anduril says it already has a buyer that it will only describe as a "U.S. customer" and it's set to launch production at a rate of hundreds of them a year. (Update: The customer appears to be U.S. Special Operations Command, which signed a $12.5 million contract with Anduril last year for Roadrunner counter-drone hardware — h/t 404 Media.)

2.2. Roadrunner

The company says the drone, called Roadrunner, is powered by twin turbojet engines that enable it to reach "high subsonic speed" — presumably approaching 700 mph. It launches vertically from a climate-controlled box called a Nest that Anduril says will keep the drone ready to go for months at a time in harsh field conditions.

The concept is that squadrons of Roadrunners can be dispatched to assess a threat picked up on radar or reported by observers. If the blip turns out to be a hostile aircraft, a Roadrunner equipped with a warhead will intercept and blow it up, along with itself. If it's a false alarm, the drone can return to base and land on its tail vertically.

Author's comment: The Forbes article (Reference 3) site has a really good video of Roadrunner. It even has a real roadrunner.

The drone costs in the "low hundreds of thousands of dollars," Luckey, the loquacious tech wunderkind, told reporters on a video-conference call, and its value is enhanced by its reusability.

"This is a totally new category of weapon that's never really existed before," he said. "It's somewhere between a reusable missile and a full-scale autonomous aircraft."

Roadrunner, which Luckey first described in broad strokes to Forbes last year, was designed to defeat an emerging class of aerial threats that lie between small quadcopters and ballistic missiles. That kind of threat has been seen in Ukraine, where Russia is trying to overwhelm Ukrainian air defenses with barrages of missiles and one-way kamikaze attack drones like Iran's Shahed.

"The requirements that we built into Roadrunner were focused on addressing the threat, where it was going and then where we believe it's going to continue to metastasize beyond where it is today," said Christian Brose, Anduril's chief strategy officer.

Anduril declined to share specs on Roadrunner's capabilities, but claims that compared with similar drones on the market it has three times the warhead payload capacity, 10 times the one-way effective range, and is three times more maneuverable.

Its name is a playful jab at one competitor: RTX's Coyote Block 2, also a jet-powered, kamikaze counter-drone system, which is being used by the U.S. Army. (As Looney Tunes fans know, Roadrunner always beats Coyote.)

Author's comment: See section 3 for a deep dive on the above-mentioned Roadrunner competitor.

Roadrunner's engines, which Anduril developed in-house, are "the most power-dense turbojet engines that have ever been built," Luckey said.

The company says a single operator can launch and supervise multiple Roadrunner squadrons. The aircraft are capable of autonomously determining flight paths, including intercept courses against a maneuvering target after being given the command to destroy.

A big part of Roadrunner's value, Luckey and Brose said, lies in the ability to use it to scope out an unclear threat rather than scrambling a manned fighter, which is expensive, or having to make a quick decision to launch a missile.

"The benefit of the Roadrunner is that you can launch without regret," said Brose.

2.3. Regretful Mistakes

A hasty error by an air defense battery can lead to tragedy, like the 2020 downing of a Ukrainian airliner in Iran at a time when Iranian forces were on high alert for potential American retaliation to their missile attacks on U.S. bases in Iraq.

"I think that Roadrunners, most of their missions are not going to be blowing up," said Luckey. "Most of the time it's going to be launching, minimizing your risk and getting more information on what exactly things are."

It's unclear whether Roadrunner could be used to intercept faster fighter jets, but it could take some stress off air forces in places like Taiwan and Japan, which have been forced to scramble their fighters at a high tempo in recent years to respond to airspace incursions by Chinese aircraft.

2.4. Alternate Missions

Anduril plans to produce non-kamikaze Roadrunners with different types of payloads, such as electronic warfare equipment. Luckey also said the company envisions using them to fight forest fires. If the beginning of a blaze is picked up by satellite or other means, a Roadrunner could jet to the scene and drop a fire suppressant. (Fighting wildfires has become a preoccupation of tech titans following the blazes that have swept across the U.S. West recently.)

The performance claims Anduril is making sound plausible, Zachary Kallenborn, a drone expert who's an adjunct fellow with the Center for Strategic and International Studies, told Forbes. Rising use of autonomy will eventually render obsolete one the most effective current defenses against drones — jamming the radio control links to their remote pilots — calling for more brute force countermeasures like Roadrunner, he noted.

3. Roadrunner's Competitor?

Who is Roadrunner's competitor? Need you ask?

3.1. RTX's Coyote

The Coyote is a different sort of animal. OK, I'll stop with the puns.

The most capable in its class, the Coyote® unmanned aircraft system is small, expendable and tube-launched. It can be deployed from the ground, air or a ship.[5]

[5] Raytheon Coyote Website, https://www.rtx.com/raytheon/what-we-do/integrated-air-and-missile-defense/coyote

Coyote can be flown individually or netted together in swarms, and it is adaptable for a variety of missions including surveillance, electronic warfare and strike. The system will operate up to one hour and is designed for interchangeable payloads.

Coyote can handle reasonably large accelerations during launch, a critical feature for all tube-launch applications. It's ideal for improved surveillance imagery, enhanced targeting capability, near real-time damage assessment and reduced threat to manned aircraft.

3.1.1. Counter-UAS

The U.S. Army has selected the Coyote drone for a near-term counter-UAS (Unmanned Aerial Systems) solution. Equipped with an advanced seeker and warhead, the Coyote-enabled system can successfully identify and eliminate threat UAVs (Unmanned Aerial Vehicles).

3.1.2. Intelligence, Surveillance and Reconnaissance (ISR)

In a series of 2016 demonstrations conducted on land and at sea, more than two dozen Coyote systems successfully launched in a swarm and moved in formation, demonstrating the effectiveness of autonomous networking. The swarming capability can be applicable in multiple missions, from ISR activity to strikes against moving targets in a battlefield environment.

3.2. Other Raytheon Aerial Systems

Raytheon makes a ride range of military-focused aerial systems. For more information on the systems see the site linked at the end of this paragraph.[6]

Global Patriot Solutions: Global Patriot® Solutions defeat tactical ballistic missiles, cruise missiles, drones, advanced aircraft and other threats.

Global Patriot® Solutions is a missile defense system consisting of radars, command-and-control technology and multiple types of interceptors, all working together to detect, identify and defeat tactical ballistic missiles, cruise missiles, drones, advanced aircraft and other threats.

Patriot is the foundation of integrated air and missile defense for 18 nations.

The David's Sling system and SkyCeptor® missile: *protect against missile and aircraft threats at medium range.*

[6] Raytheon, Integrated Air & Missile Defense, https://www.rtx.com/raytheon/what-we-do/integrated-air-and-missile-defense

Declared fully operational in 2017, David's Sling was co-developed by RTX and Israel's Rafael Advanced Defense Systems. In addition to partnering on the system's Stunner interceptor, RTX produces the system's missile firing units. Teams in nearly 30 states across the U.S. produce the missile and its firing unit.

David's Sling comprises the multi-pulse Stunner missile, which uses sophisticated sensors and control systems and an active electronically scanned array, or AESA, multi-mission radar for targeting and guidance. Repeated testing has proven the system's ability to destroy large torrents of high-caliber rockets and short-range ballistic missiles.

David's Sling's maneuverable, two-stage, hit-to-kill Stunner missile has no warhead; the interceptor destroys threats with sheer force of impact. The Stunner missile is proven to defeat all short-range ballistic missiles – 92 percent of the worldwide theater ballistic missile threat inventory. Stunner is in full-rate production and helps the system to bolster Israel's defensive capabilities. It ensures safety for Israel's infrastructure, way of life and its people.

Author's final comment: It appears that Raytheon is highly engaged with the Global Defense Industry, and Anduril is a creative startup with a very innovative product. I don't believe the latter offers a threat to Raytheon, and if anything, there is an opportunity for a partnership. This might leave Anduril free to pursue non-defense opportunities like wild-fire first response.