New Sensors, Payloads Expanding Small UAS Capabilities

Small tactical unmanned aircraft have become essential to military operations. Now they are getting smarter.

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Having widely deployed small tactical unmanned aircraft systems (UAS) across its forces, the U.S. military is moving to increase their usefulness through sensor upgrades and new payloads. The most numerous are Insitu's ScanEagle, Textron Systems' RQ-7 Shadow and AeroVironment's RQ-11 Raven and RQ-20 Puma. And while the procurement peak is past, upgrades are continuing.

The U.S. Army began fielding the latest RQ-7Bv2 Shadow in 2014, with 117 systems to be upgraded at the rate of 25 a year. At the end of June, Textron was awarded a $27.7 million contract to qualify an enhancement to the v2 baseline and produce "a new flightworthy configuration for the Shadow," says Bill Irby, Textron Systems Unmanned Systems senior vice president and general manager.

The baseline 467-lb. v2 introduces the K_u-band Tactical Common Data Link, already carried by the Army's larger General Atomics MQ-1C Gray Eagle. Wingspan is extended by 6 ft., to 20.4 ft., to increase endurance to 9 hr. from 6 hr. The UAV Engines Ltd. (UEL) AR741-1102 rotary powerplant incorporates electronic fuel injection to increase reliability and ease starting. The v2 enhancement upgrades the propulsion system to the Block 3, an improved UEL engine with an extra 10 hp and water cooling to increase reliability to 500 hr. between overhauls, double that of the current AR741. An improved muffler and revised gearbox reduce noise significantly, says Irby, producing the same thrust at lower propeller rpm.

The program also improves the Shadow's communications relay capability, makes the vehicle more capable of operating in poor weather, introduces a new small-mission computer and enables the aircraft to carry multiple payload types. Weatherization will enable the Shadow to fly in up to 2 in./hr. of rain, well beyond its current capability.

The v2's comms-relay payload is being made compatible with the Joint Tactical Radio System, and multiband capability is being added to handle both Sincgars radio and voice-over-internet-protocol communications between ground control stations. The small mission computer adds processing power and memory capacity to enable different navigation modes, including vision-based navigation, now in development, says Irby.

The upgraded RQ-7Bv2 Shadow tactical unmanned aircraft is to be further enhanced by 2019. Credit: Textron Systems

A new payload interface in the fuselage will allow the Shadow to carry multiple different sensors. For now, the Army is sticking with its Tamam POP300D electro-optical/infrared (EO/IR) and laser-designator turret, but the upgrade will allow new capabilities to be added in the future.

"Shadow will be there for the long term, until the FTUAS [Future Tactical Unmanned Aircraft System] is fielded, and will need interim upgrades," says Irby. "When they choose to integrate a new payload, there will be a competition, and this upgrade is to prepare for that competition."

FTUAS concept studies are to be completed in fiscal 2018, followed by configuration trades and analyses in fiscal 2018-19. These will lead to the Next-Generation Tactical Unmanned Aircraft System Technology Demonstration program in fiscal 2019-23, to competitively design, build and demo key technologies.

Under its RQ-7Bv2 enhancement contract, Textron will conduct ground and flight testing to qualify the upgrades by early 2019. Irby expects the changes to be fielded as a kit to upgrade existing airframes, with the improved v2 becoming the standard for future domestic and international customers.

The v2 has already been sold to Italy, and Irby says there are other export customers in line, though not signed yet. The U.S. Marine Corps also operates the Shadow but is not upgrading its systems to the v2 because it is moving instead to the Insitu RQ-21A Blackjack small tactical UAS.

Puma's new Mantis i45 gimbal packs multiple sensors into a waterproof, retractable unit. Credit: AeroVironment

Insitu's smaller ScanEagle has been improved steadily since its introduction in 2005, but the biggest step came in 2014 with launch of the ScanEagle 2. This has a heavy-fuel engine purpose-designed for Insitu by Australia's Orbital to improve reliability and increase power and payload.

It enables carriage of multiple payloads, notably the ViDAR wide-area maritime surface search sensor from Australia's Sentient Vision Systems.

Described as an "optical radar," ViDAR is installed as a modular fuselage "slice" behind the ScanEagle's standard EO/IR sensor. This houses a 9-megapixel digital video camera that

continuously scans a 180-deg. arc ahead of the aircraft, automatically detecting any object on the ocean and providing an image and location to the ground control station.

ViDAR can cue the ScanEagle's high-resolution EO/IR sensor for a closer look and has demonstrated detection of targets ranging from a fishing vessel at 14 nm to a person in the water at 1.7 nm. This "places the ViDAR on par with much more expensive and heavier synthetic aperture radars," says Insitu.

The Boeing subsidiary has also introduced the Tactical Compact Communications Relay (TCCR) Ultra payload to connect mission commanders, ground and air units within a 130-nm radius. Communications between the ScanEagle ground control station (GCS) and air traffic control (ATC) are also supported. TCCR Ultra detects transmissions from ATC or the GCS operator and retransmits the signal to the other.

Insitu's larger companion to the ScanEagle, the 135-lb. Integrator, was designed from the outset to enable multiple different payloads to be plugged into modular bays and carried in addition to the standard nose-mounted EO/IR sensor. In February, Insitu flew Logos Technologies' Redkite wide-area motion imagery sensor on the Integrator—the smallest UAS yet to carry a persistent surveillance capability, until now limited to larger unmanned and manned aircraft.

Insitu's smaller ScanEagle has been improved steadily since its introduction in 2005. Credit: Insitu

A version of the Integrator was selected by the U.S. Navy and Marines in 2010 to become the RQ-21A small tactical unmanned aircraft system. Now being fielded, the Blackjack is equipped initially with an EO/IR sensor, communications relay payload and Automatic Identification System to track ships.

"The RQ-21 Blackjack now employs an improved imager that is compatible with digital video architecture," says Insitu. "In addition, we are developing two other turret options that dramatically increase resolution, range, standoff distance, [and provide] extremely high optical zoom and additional tactical features to support kinetic engagements."

Fiscal 2018 budget documents show plans for the RQ-21A may include “laser designator, frequency agile communications relay, digital Common Data Link and cyclic refresh of the electro-optical/infrared camera.” The Marine Corps has a UAS Payloads program to develop upgrades for the RQ-21A that “include, but are not limited to, signals intelligence/electronic-warfare support, synthetic-aperture radar/moving-target Indicator, and wide-area and hyperspectral imagery.”

In volume terms, AeroVironment is the largest supplier of UAS to the Defense Department. Its widely deployed RQ-11B Raven was upgraded in 2012 with a gimballed payload comprising EO/IR sensor and laser illuminator. With Raven deliveries to the Pentagon complete, the focus has shifted to the larger RQ-20B Puma, deliveries of which continue to the Marine Corps and Special Operations Command.

In May, AeroVironment began shipping the Mantis i45 EO/IR sensor gimbal for the Puma. This provides the same EO image resolution as the previous i25 gimbal at seven times the distance, augmented by enhanced onboard digital stabilization, improving survivability and increasing intelligence.

The gimbal provides dual 15-megapixel EO color cameras with 50X electronic zoom, improved IR sensor, new low-light camera and a high-power laser illuminator, as well as an onboard image processor and optional onboard storage of high-definition imagery—all in an 850-gram (2-lb.)waterproof package that retracts into the Puma’s fuselage to protect the payload during takeoff and landing.

With migration of its family of small UAS to the encrypted, IP-based Digital Data Link complete, AeroVironment has delivered the first Ravens and Pumas equipped to use the Defense Department’s reallocated small UAS radio frequencies, called M1/M2/M5. All three frequency bands are combined in a single transceiver module.

As part of the requirement to move Ravens and Pumas to the new frequency range, the Army is procuring a new handheld ground control station (H-GCS) being developed by GECO, a small avionics company based in Mesa, Arizona. At 4 lb., the H-GCS is more than 10 lb. lighter than the current controller and provides an intuitive touch-screen user interface, says Maj. Will Taylor, assistant product manager for small UAS.

GECO’s H-GCS uses the Tactical Open Government Architecture (TOGA)—an open software and hardware standard owned by the government that will allow the Army to “shop around” for future upgrades, says Taylor. TOGA is compliant with the FACE standard for portable and reusable software and runs on a general-purpose Posix-based operating system, he says.

TOGA will be used with the RQ-11 and RQ-20, but “the desired end state . . . is that it can control any unmanned vehicle,” says Taylor. “Should the Army decide to upgrade its small UAS in the future, soldiers will not have to relearn a new controller.” The new H-GCS will be fielded over four years beginning in mid-2019.