

SUMMARY OF DRONE SPENDING IN THE FY 2019 DEFENSE BUDGET REQUEST

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The Department of Defense has requested approximately \$9.39 billion for unmanned systems and associated technologies in the FY 2019 budget. This proposal includes funding for the procurement of 3,447 new air, ground, and sea drones. The FY 2019 budget proposal represents a significant expansion in drone spending over the FY 2018 requested budget, which contained approximately \$7.5 billion in drone-related spending and orders for 807 drones. This document outlines a few of the largest and most noteworthy drone-related spending items in the FY 2019 budget request.

Estimated Drone Spending in FY 2019

All figures in millions.

Spending by Department	\$M
Air Force	2,636
Navy and Marines	3,766
Army	1,701
Defense Wide	1,287
Spending by Category	\$M
Air	6,045
Ground	429
Sea	982
Counter-Drone	1,052
Autonomy, Teaming, Swarms	866
Other	16
Total	9,390

KEY TAKEAWAYS

- A preliminary review of the Department of Defense’s budget request for FY 2019 finds approximately \$9.39 billion in drone-related procurement, research and development, and construction funding, 26 percent more than the FY 2018 request;
- The FY 2019 request contains orders for at least 3,447 new unmanned air, ground, and sea systems, a threefold increase over the FY 2018 request;
- The FY 2019 request also contains orders for 1,618 Switchblade loitering munitions—the largest to date—and 532 other unmanned systems such as aerostats and target drones;
- Compared to the FY 2018 request, Navy funding for unmanned systems increased by approximately \$1 billion (38 percent) and Army funding increased by \$719 million (73 percent);
- Funding for the Air Force’s MQ-9 Reaper, which remains the single largest drone budget item, grew by over \$200 million, from \$1.23 billion to \$1.44 billion;
- A more than \$500 million boost to the Navy’s MQ-25 Stingray research and development program is the single greatest contributor to the overall increase in drone spending;
- The Army and Navy intend to initiate the procurement of new unmanned ground and sea vehicles and have increased funding for the development of larger, more autonomous drones;
- Funding for counter-drone systems—including a shipboard laser—continues to rise, growing by 99 percent to around \$1.05 billion;
- The Pentagon has introduced new research programs that address autonomy and artificial intelligence and has boosted funding for Project Maven, an artificial intelligence program, by 81 percent to over \$100 million.

Edited by Arthur Holland Michel. Presentation by Dan Gettinger. Copyright © 2018 Center for the Study of the Drone at Bard College

METHODOLOGY NOTE

This document reflects an estimate of drone-related procurement, research and development (RDT&E), and military construction in the FY 2019 budget request. This estimate is based on a database of more than 300 drone-related line items sourced from the Department of Defense's FY 2019 budget justification books. As with prior reports on drone-related defense spending, the determination as to whether budget items are mostly or wholly related to unmanned systems is based on the project description contained in the budget justification books. Each spending item in this document contains a procurement line item or research program element (PE) for reference. This document does not address drone-related operations and maintenance or military personnel spending. All figures are in millions unless otherwise stated.

Any estimates of year-over-year changes between FY 2018 and FY 2019 are based on the DoD's budget requests for both years and not the final appropriation by Congress. As a result, the final allocation for drone-related items is likely to change. Any comparisons between the FY 2019 request and historical spending are based on the prior year figures extracted from the FY 2019 request. These may differ from previous estimates of drone spending due to alterations made by Congress, Pentagon reprogramming actions, or amended budget submissions for prior years. For example, some projects that received spending in prior years according to the FY 2019 request were not listed in previous budget submissions to Congress. As a result, spending on drones in FY 2017 is around 17 percent greater than previously estimated and approximately 8 percent greater than previously estimated in the FY 2018 request.

(Right) An RQ-20B Puma. Photo by Cpl. Miguel Rosales.



AIR SYSTEMS

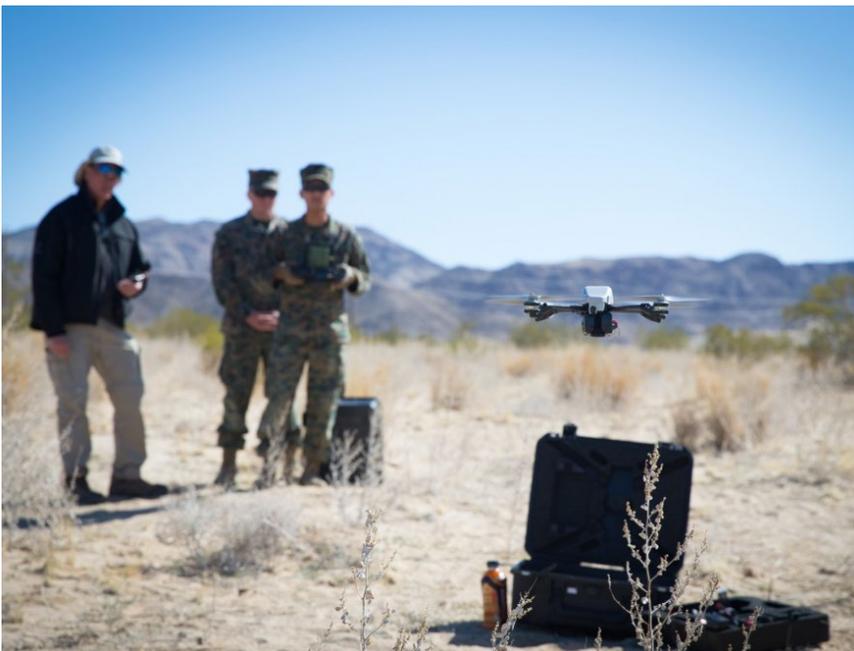
The proposed budget for unmanned aircraft systems in FY 2019 is approximately \$6.05 billion. This is up from around \$5 billion in both the FY 2018 request and the FY 2017 appropriated budget. The aircraft budget is divided between \$3.71 billion in procurement, \$2.14 billion in research and development, and \$198 million in military construction. The DoD intends to purchase a total of 3,250 unmanned air vehicles.

More Small Drones

In the Fiscal Year 2019 proposed budget, the U.S. military is aiming to significantly expand its inventory of small unmanned air systems. After years of budget stagnation for small unmanned aircraft programs, each of the military services is directing fresh funding streams both to “legacy” small drones like the AeroVironment RQ-11 Raven and to new procurement projects. The procurement budget for small drones is around \$279 million, up from \$89 million in the FY 2018 request and \$136 million in the FY 2017 appropriation. These funds will be used to procure approximately 3,070* new small drones. This is the greatest quantity of drones the Pentagon has purchased in at least six years. The last significant order of small drones was in FY 2012, when the Army ordered over 1,100 RQ-11 Raven drones.

The reason for the surge in drone orders is twofold: to fill existing requirement gaps and to modernize the military’s fleets of small drones. To meet the former, the Army and the Air Force have budgeted for new AeroVironment RQ-11 Raven and RQ-20B Puma systems, which will be put to use for specialized missions like base perimeter security and training partner forces. To modernize, the Army, Marine Corps, and Special Operations Command are looking to significantly expand the number and diversity of small unmanned aircraft. Most existing small unmanned aircraft in the U.S. military’s inventory are fixed-wing systems that are battalion-level assets designed for short- to medium-range reconnaissance. These new procurement efforts are aimed at smaller, lighter, and more agile unmanned aircraft that utilize advances in commercial off-the-shelf drone technology. DoD is looking specifically at drones that can improve the situational awareness of small units and that are able to perform complex missions in urban environments such as reconnoitering a building. The FY 2019 budget contains the first significant steps toward meeting these goals. In the coming years, DoD is expected to purchase thousands more small drones for these programs.

**Note: The quantity figures expressed in the budget justification books are often in terms of drone systems, which may include more than one aircraft. For example, a Marine Corps RQ-20B Puma system consists of two air vehicles, an Army RQ-11 Raven system includes three air vehicles, and a Navy RQ-21A Blackjack system includes five air vehicles. For simplicity, the total procurement quantities are expressed here in terms of the number of air vehicles when that information is available. However, since some of the new procurement programs (like SBS) have yet to settle on a type of drone, the actual number of new unmanned aircraft that the Pentagon plans to purchase in FY 2019 is likely greater than the quantity figures expressed here. This estimate also does not include drones that are to be purchased with non-procurement funding, such as RDT&E-funded test platforms.*



The U.S. Marine Corps has chosen the Physical Sciences InstantEye quadrotor drones for its “Quads for Squads” program. Photo by Cpl. Miguel Rosales.

Summary of Key Small Drone Programs

- The Air Force is requesting \$13.5 million for 60 AeroVironment RQ-20B Puma systems. In September 2017, the Air Force requested that Congress [reprogram FY 2017 funds to purchase Puma](#) drones for base perimeter security. That request was denied after the Senate Armed Services Committee failed to respond, leading the Air Force to include the Puma in this year's request. . One Puma system costs \$226,000.
- The Army is restarting the AeroVironment RQ-11 Raven procurement budget line after two years of dormancy. The FY 2019 request contains \$46.4 million for 200 RQ-11B systems (600 air vehicles). These drones will be delivered to Army Security Force Assistance Brigades, which will train and advise partner nations on the correct use of the Raven. In future years, the Army predicts it will spend around \$105 million on a new, smaller type of drone (likely not the Raven) for its Short Range Micro UAV requirement. One Raven system costs \$180,400.
- The Army has allocated \$21.7 million for the Soldier Borne Sensor program to purchase 1,084 systems. The SBS program is designed to give an infantry squad a lightweight drone that can be easily carried and deployed for short-range, quick-look reconnaissance. Although the type of aircraft has yet to be determined, it could be something like the AeroVironment Snipe, a nano quadrotor drone. The Army budgeted for 200 SBS systems in FY 2018 and, over the next few years, plans to purchase several thousand more drones. One SBS is estimated to cost \$15,923.
- The U.S. Marine Corps has requested \$2.9 million for 100 unmanned vertical takeoff and landing systems (200 air vehicles). These are likely the Physical Sciences InstantEye Mk-2 GEN3-A0 quadrotor, although other aircraft types may be considered. Like the Army's SBS, this program envisions equipping Marine infantry squads with their own nano vertical takeoff and landing drone for organic, short-range reconnaissance. One system costs \$28,950.
- The U.S. Special Operations Command has requested \$74.7 million to acquire a variety of unmanned air systems, including \$38.9 million for seven different types of small drones. The systems range from quadcopters to Unmanned Tethered Aerial Systems. (This is likely the first bulk purchase of tethered drones by any service.) The largest SOCOM order is \$10.5 million for 527 Nano VTOL drones, which could resemble the Marine Corps' InstantEye UAV.

MQ-9 Reaper

The budget for the Air Force's MQ-9 Reaper—\$1.43 billion in the FY 2019 request, up from \$1.23 in the FY 2018 request—remains the single largest drone budget item. This includes the procurement of 29 new airframes that will [replace lost or unusable aircraft](#). The Air Force plans to invest \$197 million in four construction projects—two at Creech AFB, one at Holloman AFB, and one at Shaw AFB—that will expand MQ-9 Reaper operating facilities. This request is as much as the Air Force's combined budget for drone-related construction over the past six years. The Air Force has also boosted funding for the procurement of communications hardware and software for the MQ-9 Special Operations Center from \$7.7 million to \$87.6 million. Air Force funding for Reaper modifications (-47 percent) and research (-31 percent) is down in the FY 2019 request. The Reaper budget contains \$43 million in Special Operations Command procurement and research funding for specialized payloads.

Future Air Systems Research

The budget for the MQ-25 Stingray, a Navy initiative to develop a drone capable of conducting aerial refueling missions for manned fighters, grew from \$224 million in the FY 2018 request to a total of \$756 million in the FY 2019 proposal. Fiscal Year 2019 will mark the start of the development of two MQ-25 air vehicles. The Navy has created a new procurement budget line (4269), allocated \$32 million in the FY 2019 request, to purchase command and control systems for the Stingray. The Navy is boosting funding for the Miniature Air-Launched Decoy (MALD)—a cross between a cruise missile and a drone—from \$20 million to \$100 million (PE 0604659N). The Marine Corps budget for the development of the MUX system (PE 0304240M), a medium-altitude long-endurance shipboard VTOL concept, is up from \$5 to \$20.4 million in the FY 2019 request. The Army has allocated a total of \$15.4 million to two new programs (PE 0603003A and PE 0604113A) dedicated to developing the Future Tactical Unmanned Aircraft System, the successor to the RQ-7 Shadow tactical UAS. Funding for the Strategic Capabilities Office's AVATAR program, which converts manned aircraft and target drones into autonomous unmanned aircraft, doubled from \$25 to \$50 million. A new DARPA project called AVIATE (PE 0603286E) is allocated \$5.9 million to develop a drone that is fully integrated into a ground vehicle and capable of autonomous take-off and landing.

Unmanned Aircraft Procurement Programs

Department	System	\$M*	Qty**	Relevant Programs
Air Force	MQ-9 Reaper	1,394	29	APAF PRDTB1, APAF PRDTB2, APAF PRDTB3, APAF 000999, OPAF 837300, PE 0205219F, PE 0604233F, PE 0305208F, MILCON-AF
	RQ-4 Global Hawk/AGS	361	0	APAF RQ4DIS, APAF 000075, APAF 000999, APAF HAWK00, APAF 832070, PE 0305220F, PE 0305238F
	RQ-20 Puma	13.5	120	APAF Q020BR
Army	MQ-1C Gray Eagle	262	10	APA A00005, APA A01001, APA AA6601, PE 0305219F, PE 0603710A
	RQ-11 Raven	52.6	600	APA A00010, PE 0305232A
	RQ-7 Shadow	167	10	APA A00018, APA A01002, APA AA0723, PE 0305233A, PE 0203752A
	Soldier Borne Sensor	25.2	1,084	OPA W12002, PE 0605053A
DoD	Quadcopters	0.14	100	CTEF
	ScanEagle	46.5	0	ASFF
Navy & Marines	MQ-4 Triton	1,055	3	APN 0442, APN 0442AP, APN 0596, APN 0605, PE 0305220N, PE 0305421N
	MQ-8 Fire Scout	132.8	0	APN 0443, APN 0588, APN 0605, PE 0305231N, PE 0305204N
	RQ-21A Blackjack/Integrator	90	22	APN 0598, APN 0444, APN 0605, PE 0305239M, PE 0305234N
	Nano VTOL (InstantEye)	3.9	200	PMC 4757
	Blackwing UAS	8.9	36	OPN 5420, PE 0604562N, PE 0603561N
Special Operations Command	Grp 2 Long Range/Long Endurance	113.4	6	PDW 0201UMNISR, PE 1160434BB
	Grp 1 Medium Range/Medium Endurance		6	
	Grp 1 VTOL Short Range/ Short Endurance		225	
	Grp 1 Micro VTOL		160	
	Grp 1 Nano VTOL		527	
	Unmanned Tethered Aerial System		56	
	Puma II		2	
	Quadcopter		50	
	Stalker		4	
	MQ-9 Reaper	43	0	PDW 1108MQ9, PE 1105219BB

*Reflects the sum of system-specific procurement, research, and military construction budget items.

**Reflects the number of air vehicles to be purchased. See page 3 for more information.



Among the other types of unmanned systems the U.S. military intends to purchase in FY 2019 are 1,618 AeroVironment Switchblades, a loitering munition also known as the the Lethal Miniature Aerial Munition System (LMAMS). It is the largest order of Switchblades to date. Photo by Sgt. Gregory Summers.

Other Unmanned Systems Procurement

Department	System	\$M*	Qty	Relevant Programs
Air Force	QF-16	152	19	APAF 10TRGT, APAF 000074, PE 0305116F
	BQM-167		29	
Army	LMAMS (Switchblade)	113	1,518**	MPA C88001
	PSS-T Aerostat	20.1	16	OPA BL5287
	Remotely Piloted Vehicle Target	6.4	394	OPA 1242C93000
Navy & Marines	QF-16	143.6	2	APN 2290, PE 0604258N
	BQM-177		57	
	GQM-163A (SST)		15	
	LMAMS (Switchblade)	5.6	100	PMC 4733

**Reflects the sum of system-specific procurement and research budget items.*

***Includes 200 inert training rounds.*

GROUND SYSTEMS

Total spending on robots in the FY 2019 request is \$429 million, up from \$310 million in the FY 2018 request and \$212 million in the FY 2017 appropriated budget. Of the \$429 million, approximately \$86 million is allocated for procurement and \$343 million is earmarked for research and development. The DoD intends to purchase 134 new unmanned ground vehicles in FY 2019.

More Robots

The most significant change in the FY 2019 request is that the Army is initiating the procurement of several unmanned ground vehicles. The Army will begin purchasing new MTRS Inc II and CRS(I) ordnance disposal robots (W12002). Although the Army only intends to purchase a total of 63 of these robots in FY 2019, procurement is expected to accelerate in future years. A separate Army procurement budget line to upgrade the MTRS II ordnance disposal robots

(W12001) with a new radio and battery increased from \$10 million to \$14 million in the FY 2019 request. The Army will also acquire 28 new robots from QinetiQ for chemical, biological, radiological and nuclear hazards disposal (M01001). For the first time since 2014, the Army will buy eight new Dok-ing M160 systems for the Robotic Combat Support System (M80400). The Navy and Air Force have allocated funds for robot procurement; the Navy has requested \$8.5 million for 35 Northrop Grumman AEODRS robots and the Air Force has requested \$10 million for upgrades to the Northrop Grumman F6A robot.



Future Ground Systems Research

The Army has introduced a suite of projects aimed at developing unmanned ground combat vehicles and autonomous robots. The most significant of these is the Robotic Combat Vehicle Experimental Unit Prototypes project (PE 0604017A), a new program that is allocated \$38.9 million to develop and field a surrogate combat robot based on the M113 armored personnel carrier by the end of FY 2019. Eventually, the Army envisions that the successor unmanned platforms to this program will be able to [accompany the optionally manned Next Generation Combat Vehicle](#), the Army’s planned replacement of the Bradley Fighting Vehicle. Another new project, Unmanned Ground Systems Research (PE 0602601A), is allocated \$10.6 million to explore ways that robotic and autonomous systems can support Army combat formations by conducting live and simulated tests of manned-unmanned teaming. Meanwhile, the

An unmanned ground vehicle at the Advanced Naval Technology Exercise 2018. The Army is adding research funding for projects to develop an armed unmanned ground vehicle and a robotic equipment transport. Photo by Lance Cpl. Rhita Daniel.

Army is boosting funding for the Autonomous Ground Vehicle Architecture Integration and Demonstration project (PE 0603005A), which seeks to enable the autonomous operations of “tactically relevant unmanned ground systems,” from \$6.4 million to \$16.5 million in the FY 2019 request. Each of these programs emphasize the need to accelerate the development of unmanned ground systems that can autonomously navigate both complex and austere environments, an essential requirement if armed combat robots are to serve alongside humans on the battlefield.

Unmanned Ground Vehicle Procurement Programs

Department	System	\$M*	Qty	Relevant Programs
Air Force	F6A Robot Upgrades	10	0	OPAF 845100
Army	CBRN Robotic	22.6	28	OPA M01001
	Common Robotic System I	32.5	20	OPA W12002, PE 0605053A
	Robotic Combat Support System	18.1	8	OPA M80400, PE 0604808A
	Man-Transportable Robotic System II	40.8	43	OPA W12002, OPA W12001, PE 0605053A
Navy & Marines	Advanced EOD Robotics System	14.8	35	OPA 5509, PE 0603654N

**Reflects the sum of system-specific procurement and research budget items.*

Funding for one of the Army's primary ground robotics research programs (PE 0605053A) increased from \$70 million to \$86.2 million in the FY 2019 request. This program contains eight different projects, the largest of which are the Common Robotic Systems project (\$29.3 million), the Squad Multipurpose Equipment Transport project (\$19 million), and the MTRS Standardization project (\$15.7 million). In a separate program, the Army is increasing funding for the leader-follower autonomous transport vehicle project (PE 0604017A) from \$36 million to \$51.5 million in the FY 2019 request. This program completed a milestone test last year when a convoy of autonomous trucks [successfully crossed the Blue Water Bridge](#) between the U.S. and Canada.

Longer-term robotics research conducted by DARPA focuses on the development of robots that work collaboratively with soldiers and that can navigate complex urban environments and subterranean passages. Squad X (PE 0602702E), one of DARPA's largest programs in this area, is allocated \$28.5 million in FY 2019, a 25 percent decline from FY 2018 due to the gradual transition of the program to the Army. Funding for DARPA's Subterranean Challenge (PE 0602702E), a competition that will test different robotic and autonomous systems for exploring complex underground spaces, grew from \$5 million to \$16 million. One curious new DARPA project (PE 0601101E) in FY 2019 is the Short Range Independent Microrobotics Program—SHRIMP—which will aim to create "ant-sized" microrobots that can "self navigate to an objective location and operate indefinitely from harvested energy."

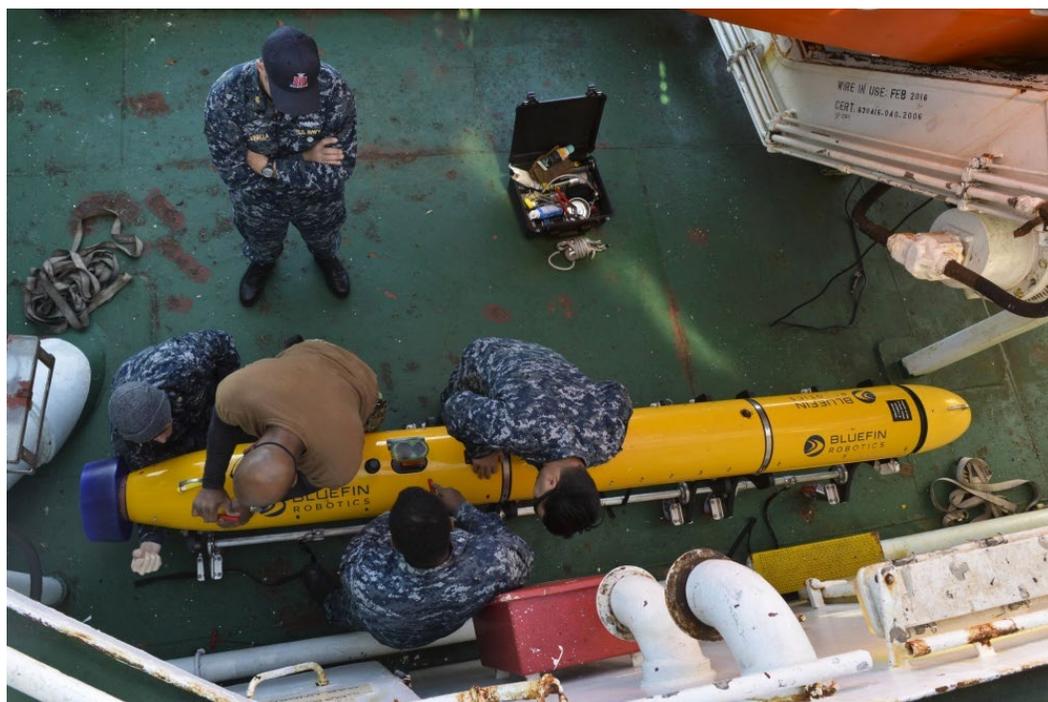
MARITIME SYSTEMS

Funding for unmanned underwater vehicles and unmanned surface vehicles is \$982 million, up from \$788 million in the FY 2018 request and \$524 million in the FY 2017 appropriated budget. In FY 2019, unmanned maritime vehicle spending is divided between \$212 million for procurement and \$770 million for research and development. The DoD plans to purchase 61 new unmanned maritime vehicles in FY 2019, up from 35 vehicles in the FY 2018 request.

More Surface and Underwater Drones

Although it is dwarfed by research spending, some of the most significant shifts in terms of maritime drone spending occurs on the procurement side. After years in development, the Navy plans to begin purchasing the Knifefish unmanned underwater vehicle. The Navy intends to spend \$47.5 million to purchase three Knifefish UUVs (1601 and 2622) and an additional \$16.7 million on Knifefish product research and development (PE 0604028N). The Knifefish is part of the suite of unmanned mine countermeasure systems planned for the Navy's Littoral Combat Ship. As part of this package, the Navy will also spend \$12.1 million to purchase one Unmanned Influence Sweep System, an unmanned surface vehicle built by Textron, and

U.S. Navy sailors with the Unmanned Undersea Vehicle Squadron 1 preform maintenance on a Bluefin-12D UUV in November 2017. Photo by Petty Officer 2nd Class Derek Harkins/U.S. Navy.



\$35 million on two other unmanned surface vehicles based on the UISS design (1601). The Navy has almost doubled RDT&E funding for testing these underwater and surface drones aboard the USS Independence from \$22 to \$41.8 million in the FY 2019 budget request (PE 0603596N).

Funding to purchase other types of unmanned underwater vehicles also increased in this budget request. As part of the Underwater EOD Programs (0977), the Navy has allocated \$74.7 million for 19 MK18 MOD 1 Swordfish UUVs, nine MK18 MOD 2 Kingfish UUVs, nine Remotely Operated Vehicles, and a host of retrofit kits and payloads for underwater drones. Funding for this program is 34 percent greater than the FY 2018 request. Research and development funding for the MK18 family of systems (PE 0603654N) declined slightly from \$19 million to \$16.9 million. Meanwhile, the Navy intends to spend \$14 million to purchase 16 Littoral Battlespace Sensors Gliders (LBS-G) and two LBS-Autonomous Underwater Vehicles (LBS-AUV) for meteorological surveys (4226). The LBS-AUV is based on the same system (Hydroid’s REMUS 600 UUV) as the MK 18 Mod 2 Kingfish.

Future Maritime Systems Research

Two of the largest maritime drone projects, the large and extra-large displacement unmanned underwater vehicles (LDUUV and XLUUV), received significant boosts in the FY 2019 request. Research funding for the LDUUV (PE 0604031N) grew from \$60 to \$92 million while the XLUUV budget (PE 0604536N and

PE 0604029N) grew from \$66 to \$117.9 million. Last year, the Navy [awarded Boeing and Lockheed Martin](#) contracts to develop prototype XLUUVs; in FY 2019, the Navy intends to downselect to one industry partner and award a contract for up to five XLUUV systems. In the FY 2019 request, the Navy has created a new \$30.2 million program (PE 0604029N) dedicated to developing XLUUV command and control and lethal and non-lethal payloads. Meanwhile, DARPA has increased funding for Hunter (PE 0603788E), a payload delivery system for the XLUUV, from \$15.2 million to \$22.5 million in the FY 2019 request. The Navy is boosting funding for the Barracuda mine neutralizer from \$20.8 million in the FY 2018 request to \$31.3 million in the FY 2019 request. The Barracuda is the undersea equivalent of an aerial loitering munition; it’s a low-cost underwater drone equipped with an explosive payload that’s designed to navigate to a sea mine and blow itself up. The Navy has created a new project that will continue the work that DARPA started on the Medium Displacement Unmanned Surface Vehicle (MDUSV), also known as Sea Hunter. The MDUSV project is allocated just \$2.8 million in the FY 2019 request, but it is projected to grow to \$23.9 million in FY 2020.

DARPA will start a new \$12 million project called Lobster (PE 0602702E) that is aimed at developing underwater robotic systems that are “significantly ahead of the state of the art.” And the Strategic Capabilities Office has allocated \$187 million in FY 2019 to Ghost Fleet (PE 0604250D8Z), a project that aims to enable swarms unmanned vessels to work collaboratively. Ghost Fleet remains the single largest research project dedicated to unmanned ground or maritime vehicles.

Unmanned Maritime Vehicle Procurement Programs

Department	System	\$M*	Qty	Relevant Programs
Navy	Knifefish	59.4	3	OPN 1601, OPN 2622, PE 0604028N
	UISS USV	91.8	1	OPN 1601, OPN 2622, PE 0603502N
	MCM USV		2	
	LBS-Glider	3.2	16	OPN 5226, PE 0604218N
	LBS-AUV	4.7	2	
	MK 18 Mod 1 UUV	96.7	19	OPN 0977, OPN 1210, PE 0603654N
	MK 18 Mod 2 UUV		9	
	MOTS Remotely Operated Vehicle		9	
	ESE UUV	0.7	2	OPN 8126

**Reflects the sum of system-specific procurement and research budget items.*



U.S. Marines test the IXI Technology Drone Killer system at the Urban Advanced Naval Technology Exercise 2018. Photo by Lance Cpl. Rhita Daniel.

COUNTER-DRONE SYSTEMS

As we noted [in our February report](#), the market for counter-drone solutions is flourishing. The DoD's counter-drone budget rose from \$528.8 million in the FY 2018 request to \$1.05 billion in the FY 2019 proposal—\$468.8 million in procurement and \$583.9 million in research and development. Of this requested funding, \$280.8 million is allocated for the Army's Indirect Fire Protection Family of Systems procurement budget line (BZ0501), which will buy 25 counter-drone systems currently known as the [Low-slow-small Integrated Defense System \(LIDS\)](#). The Army has allocated an additional \$188.3 million in RDT&E funds for work on the Low-slow-small Integrated Defense System and other C-UAS solutions (PE 0604741A). This project received \$143 million in FY 2017, but was not funded in the FY 2018 request. Other significant procurement line items are the Air Force's Physical Security System (834130) and the Navy's Physical Security Equipment (8128), which are each allocated approximately \$72 million for C-UAS procurement. FY 2019 could be the peak of C-UAS procurement spending for the foreseeable future; the DoD's estimates of spending on these systems over the next few years are generally significantly lower than the current request.

The Marine Corps boosted research and development funding for the Ground-Based Air Defense Future

Weapons System (PE 0206313M), which the Marines are developing specifically to counter drones, from \$18 million to \$72 million in this request. The C-UAS research budget includes two Navy projects (PE 0603925N) to develop a ship-board laser system to defend against drones and small, fast manned attack boats. Funding for the Surface Navy Laser Weapon System increased from \$63.3 million to \$190.2 million [in order to purchase two laser units](#). Funding for another project, Lasers for Navy Applications, dropped from \$44 million to \$33.1 million. DARPA's two dedicated C-UAS projects are Mobile Force Protection (PE 0602702), allocated \$37 million, and Aerial Dragnet (PE 0603767), allocated \$18.2 million. The former project is dedicated to developing a system capable of defending a convoy from a swarm of self-guided drones, while the latter project seeks to develop a system capable of detecting drones in an urban environment.

AUTONOMY, TEAMING, AND SWARMS

Funding for research into drone-related autonomy, human-machine teaming, and swarms is roughly \$865.9 million in the FY 2019 request, up from \$833.8 million in the FY 2018 request, and \$549 million in the FY 2017 appropriated budget. (This category only covers stand-alone projects in this field and does not include funding for autonomy research embedded in other

Counter-Drone Procurement Programs

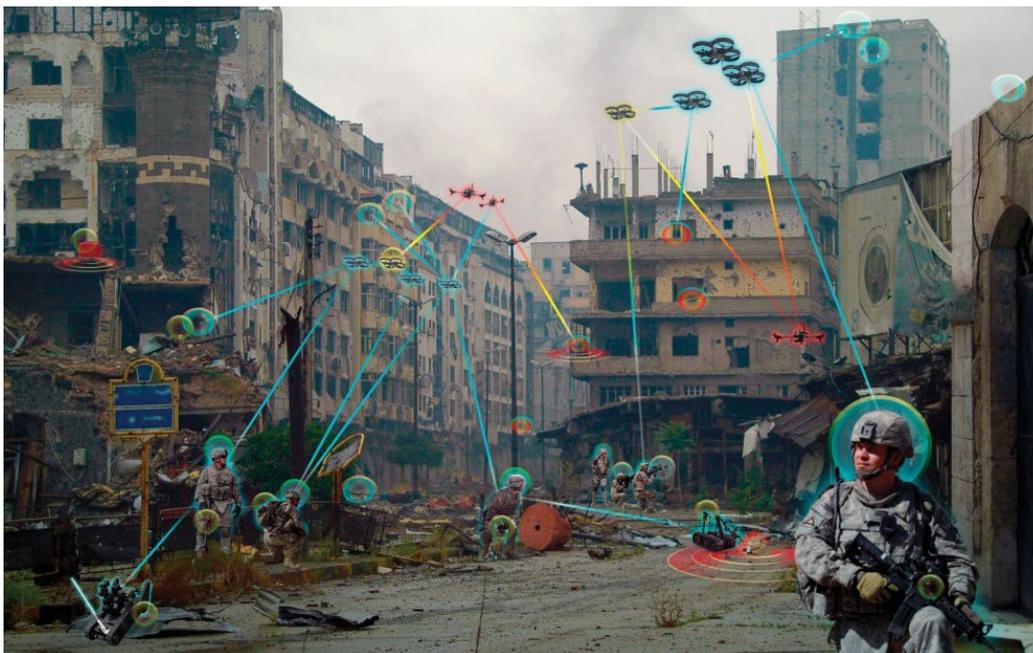
Department	System	\$M*	Qty	Relevant Programs
Air Force	Physical Security C-UAS	72.1		OPAF 0834130
Army	LIDS	469.1	25	OPA BZ0501, PE 0604741A
Navy & Marines	JCREW C-UAS	43.8	50	OPN 5509, PE 0603654N
	Physical Security C-UAS	71.4		OPN 8128
	I-Stalker C-UAS Capability	10.1		OPN 5231
	MK38 Gun C-UAS Capability	3		OPN 4217

*Reflects the sum of system-specific procurement and research budget items.

unmanned systems projects.) An Army program to field advanced manned-unmanned teaming technologies has increased from \$6.4 million to \$18.9 million in FY 2019. While the Army has been working on teaming for several years, the reason for this particular increase is that manned-unmanned teaming is a requirement for the Army’s Future Vertical Lift program, a manned tilt-rotor project. The budget for the Navy’s Unmanned and Autonomous Systems project (PE 0602792N) rose from \$48.4 million to \$60.1 million in FY 2019 due to a requirement for additional research into the autonomous capabilities of unmanned surface and undersea vehicles.

The Office of the Secretary of Defense (OSD) has increased funding for Project Maven (PE 0305245D8Z) from \$60 million in FY 2018 to approximately \$109 million in FY 2019. Maven uses commercial artificial intelligence technology to identify and track objects

in drone video, thereby reducing the burden on human analysts. In the budget justification, OSD describes Project Maven as the “pathfinder AI initiative for the DoD” that will help the Pentagon build artificial intelligence into other platforms. Two new OSD-funded projects (PE 0604250D8Z)—Hoover (\$74.5 million) and Carnac (\$22 million)—both involve applying machine learning algorithms to vehicle sensors in order to reduce operator workload. (OSD technically allocated funding to Hoover in FY 2018, but the project is listed for the first time in the FY 2019 books.) DARPA is boosting funding for a suite of autonomy and artificial intelligence programs including programs like Assured Autonomy, Explainable Artificial Intelligence, Autonomous Building Search Persistent Deterrence in Urban Environments, and Machine Common Sense. Each of these programs are either new starts or received a boost in funding in the FY 2019 request over the prior year.



A host of autonomous unmanned air and ground systems could accompany soldiers in the near future. U.S. Army photo.

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