The Future of Arlington 36 | The Case for 5th-Gen Airpower 41 | How Boeing Won T-X 27

AIR FORCE MAGAZINE

THE BIG 30

B-2 Spirit reaches a critical milestone. 31

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DETERRENCE

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AIR FORCE

July / August 2019. Vol. 102, No. 6

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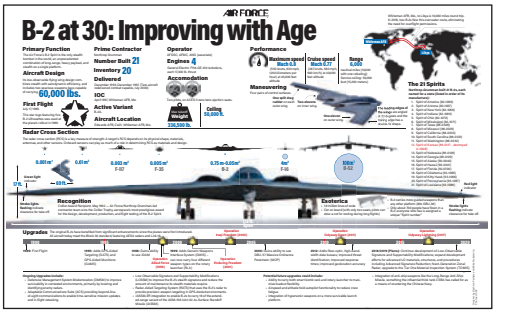
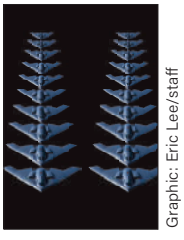
DEPARTMENTS

FEATURES



The Air Force Memorial may become part of Arlington National Cemetery. See p. 36.

ON THE COVER



Graphic: Eric Lee/staff

An imagined B-2 elephant walk. See "The B-2 at 30," p. 31.

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By Tobias Naegele

Game Changers

The surface-to-air missile that destroyed a US Navy drone in June heightened tensions with Iran and throughout the region. More importantly, however, it blew a hole in the notion that US aircraft designed to operate in permissive airspace—airspace absent advanced surface-to-air missile (SAM) threats—can operate with impunity anyplace and anytime.

Let that be a wake-up call. Maybe Iran's Revolutionary Guard did the US a favor.

Iran shot down an unarmed, remotely piloted US Navy Broad Area Maritime Surveillance (BAMS) aircraft, a variant of the Air Force Global Hawk with the wingspan of a Boeing 737 and a body about the size of a V-22, equipped with cameras and other intelligence-gathering sensors. Operating in international airspace at an altitude of around 50,000 feet, it posed no direct threat to Iran. The Revolutionary Guard shot it down anyway.

This raises critical issues of security policy, strategy, and equipment.

Without a clear policy for how the US responds to attacks on unmanned aircraft, the United States came within a hair's breadth of launching a retaliatory strike that might have killed dozens. Applying the principal of proportionality to call off that counterattack leaves open the question of how future attacks will be interpreted in Washington. Did Iran get one free shot, and after that no more? Does every challenger get equal treatment? The failure to be clear risks a *de facto* open season on unarmed, unmanned aircraft operating in international airspace.

Strategically, one of America's asymmetric advantages is its superior situational awareness, made possible by a combination of air-, cyber-, sea-, and space-based intelligence assets. Failure to protect those assets, particularly those that are unmanned, risks ceding that advantage to smaller adversaries. To deter foes, they must see that the cost of attacking an American ISR asset is greater than the benefit.

These threats are not limited to ISR aircraft. Whether Iran took down the MQ-4C with a home-built Khordad 3 missile fired from a mobile launcher, as it claimed, or was using some other system does not matter so much as what they proved they could do: Intercept a reasonably fast aircraft operating at a reasonably high altitude. Sure, the RQ-4 is slower than an F-16 or F/A-18, but if they can shoot down one, they can learn to shoot down the other. It's just a matter of time.

Houthi rebels in Yemen shot down a US MQ-9 in June; while Iran probably contributed to that attack, it is a further demonstration of the vulnerability of unprotected/undefended ISR systems. If there is no consequence to shooting down uninhabited surveillance systems, what is next? US surveillance satellites?

That Iran could successfully shoot down the Navy drone demonstrates the increasingly sophisticated integrated air defense systems US forces will encounter, not just among peer competitors but among middle-weight regional powers and, as demonstrated by the Houthis, by insurgent threats, as well.

The US must answer the growing threat of advanced integrated air defense systems. To preserve ISR superiority, the US must counter surface-to-air and anti-space threats through a combination of stealth and jamming for airborne assets and increased numbers of satellites in low-Earth orbit protected by space-based defenses.

On the low end, large numbers of inexpensive drones operating in coordination with one another could overwhelm these emerging threats with sheer numbers. Instead of tracking one big, slow-moving, nonstealthy drone following a predictable flight pattern, the US could deploy a cloud full of smaller drones autonomously operating in concert with one another. Iran could expect to shoot down some of them, but couldn't keep up with the volume.

Photo: Bob Brown/Northrop Grumman

In shooting down a Navy BAMS drone, maybe Iran's Revolutionary Guard did the US a favor?

On the high end, the US must continue to invest in stealth, speed, and jamming technologies that can overcome proliferating air defenses. Compared to a BAMS drone, the F-35A is like a mosquito, practically invisible to a SAM site, and its inherent ISR capabilities mean it can vacuum up information as it races, unobserved, overhead. Sustained investment in the F-35, the B-21 bomber, and Next Generation Air Dominance systems are all essential. These aircraft are more than fighters and bombers; each will be a highly effective multi-sensor ISR platform, as well.

To complement those manned systems, the Air Force must also invest in unmanned low-observable aircraft and in advanced automated self-protection systems to neutralize enemy air defenses. Equipping some ISR aircraft with electronic self-protection would raise the bar for emboldened adversaries.

Finally, in space, the shrinking size of satellites and the declining cost of their deployment is already making commercial constellations of compact, low-Earth-orbit satellites for earth observation a reality. These constellations will present challenges to those seeking to counter US assets in space. As with a cloud of drones, constellations of hundreds of ISR satellites presents a much more complicated problem set to those seeking to counter US superiority in space.

China might be able to take out dozens or more, but it is a significantly more difficult challenge to take out a whole constellation. Meanwhile, technology now exists that brings the cost and feasibility of deploying lasers in space to defend those satellites into reality.

The United States placed its bets long ago on having a technologically superior force with the best training, education, and discipline in the world. But the latter three matter little if the first of these priorities falls into decline. America's rivals are catching up.

Two decades of shrinking force structure and delayed investment have starved US air and space forces of the resources needed to maintain technological superiority. It's time to reverse the trend. ✪

LETTERS

Historic Importance

I hope the decision to delete the roster of leaders of past Air Force commands in the 2019 Air Force Almanac is a "one-off" and you will restore them in future almanacs ["Leaders," June, p. 77].

By eliminating these legacy commands you deprive readers a vast repository of iconic names and famous commands that built the Air Force. Why exclude the leaders of SAC, TAC, MAC, AFLC, AFSC, and other legacy commands? An almanac is defined by including, not excluding, the organization's history and leaders. Readers miss seeing names such as Gens. Russ Dougherty, Bruce Holloway, Bennie Schriever, Jerry O'Malley, Al Slay, Chappie James, Bryce Poe, Bill Creech, and many, many more Air Force leaders that created our Air Force but no longer appear in the almanac.

Sending readers to an online listing, as you suggested, to find this major part of Air Force history is not the answer. I went online and found that you saved a mere four pages in a 144-page publication by excluding past commands and their leaders. Was it worth it? I think not.

Gen. John Michael Loh,
USAF (Ret.)
Williamsburg, Va.

OCP, ABU, BDU

It was disappointing that an *Air Force Magazine* editor didn't jump in to gently correct retired Col. Don Hengesh when in his letter he misidentified Gen. Stephen W. Wilson's AFA Air Warfare Symposium attire as "BDUs" ["Letters: Battle Dress Blues," June, p. 4].

The Air Force's battle dress uniform was phased out in 2011 in favor of the Air Force unique ABU—airman battle uniform. ABUs are now on the way out, to be replaced by the Army's OCP (operational camouflage pattern) uniform that General Wilson was sporting at the symposium.

I share Colonel Hengesh's concern as to the propriety of wearing a utility uniform at a public event involving civilians largely in business attire. That camouflage doesn't work well in that setting. Would it not be more appropriate for airmen to exercise good professional judgment and respond in kind at such a gathering?

Col. Bill Malec,
USAF (Ret.)
O'Fallon, Ill.

Space Force

This letter is about the possibility of a Space Force, as detailed in the May 2019 issue of *Air Force Magazine* ["Questions Remain as Lawmakers Mull Space Force Proposal," p. 20].

From the 1955 Aviation Cadet Corps program at Houston's Ellington Air Force Base, I was commissioned and rated as a navigator at the age of 20. I learned a lot from my five years' Active Duty. I learned that I needed to get a college degree if I wanted an Air Force career. So, I got off Active Duty and went back to the University of Illinois on the Korean [War] G.I. Bill in 1958, and got a B.S. in 1961 and M.S. in 1962, both in electrical engineering. My intention was to go back on Active Duty. But, I was then too old for pilot training, so my wife asked if we could go back to Houston, somehow. I told her we could go to this new outfit named NASA, which had just opened an operation in Houston in early 1962.

NASA taught me that manned space was interesting for someone with a military background. In fact, the first NASA pilots were mostly military. I learned a lot from them while I taught space radio theory to the second and third astronaut classes. What I learned from the astronauts and mission control guys was what the functional requirements were going to be for the design of their lunar radio system, both space and ground. And that design was going to depend on what flight operations were going to be done in deep space.

Now, some 54 years later, here we are, thinking about a military Space Force. And the design of that force is going to include a lot more than just hardware. My opinion is that the most difficult part of the design is going to be the design of the organization itself. In 1962, we had to design a Houston organization that could take us to the Moon. Nobody knew how to do that, and we had a seven-year deadline. So, we used the younger guys who flooded into Houston to not only manage the design of the hardware, but the organization itself. It worked.

I suggest that the Air Force get a lot of help from NASA in thinking this organizational design out. In fact, there will probably be a lot of younger NASA people who will want to transfer into the US Space Force. If I was in my 30s again, I would.

John H. Painter
College Station, Texas

Wouldn't It Be Nice

The Air Force and this magazine overtly support new technology over numbers. The latest example being the vilification of the F-15EX ["F-15EX vs. F-35A," May, p. 30].

The F-15 Eagle platform is combat-proven with at least 104 air-to-air kills versus no losses. The strike platform based on the F-15E is a world-class fighter bomber, and its variations are still being purchased by many allied nations.

Always waiting for the next greatest aircraft, be it a sixth-generation fighter or more F-35s, comes at the expense of current inventory fighters or upgrades, leaving the warfighter and this country woefully short of combat aircraft when the time comes.

It would be nice if all the early F-35s were combat-capable and were able to be easily upgraded, if the plane had

WRITE TO US

Do you have a comment about a current article in the magazine? Write to "Letters," *Air Force Magazine*, 1501 Lee Highway, Arlington, VA 22209-1198 or email us at letters@afa.org. Letters should be concise and timely. We cannot acknowledge receipt of letters. We reserve the right to condense letters. Letters without name and city/base and state are not acceptable. Photographs cannot be used or returned.

—The Editors

been fully tested before purchase, if the software packages worked correctly, if we had air superiority fighters in the correct locations and numbers where needed, if we had high operational availability rates, or even an internal gun with enough ammunition that it could accurately hit its target. In the F-15 platform, particularly the F-15EX model being considered, we will get these things.

The F-15EX has the family history, the current updates, the new technology, the maintenance base, the AESA radar, two engines, longer range, a large and diverse weapons load, a new IRST system, and an Eagle pilot base requiring limited training to get them to speed. Maintenance costs will be significantly lower over time than on the F-35.

The F-15EX will sweep the skies of almost any current enemy aircraft in the world, would be an excellent interceptor for the continental United States, and will add modern platforms into the inventory.

The Air Force and this magazine have many times supported retiring the A-10 and F-15 aircraft and even replacing F-15s with F-16s. The Air Force is all over the map as long as they spend a ton of money on F-35s that so far have been rather unavailable for prime time. The F-35 is not an A-10 and it is not an F-15. It never will be. Hardworking, reliable, and capable aircraft that can quickly go to war are needed. The F-15EX is one of these aircraft, and they will be the most capable F-15s ever produced. Buy them.

Scott Shannon
Leawood, Kan.

I'm extremely skeptical about the numbers presented for the F-15EX in [the May] issue regarding combat radius and weapons capacity. With a max takeoff weight of 81,000 pounds, I don't see how you can achieve a weapons capacity of 29,500 lb, let alone the advertised combat radius of 1,100 miles. With an internal fuel capacity of 13,550 pounds, over half of the max takeoff weight would consist of fuel and weapons. There clearly needs to be some disclaimers added to these numbers, such as the advertised combat radius is achieved with conformal fuel tanks, which will decrease the weapons capacity so as not to exceed the max takeoff weight. Or how about citing what a realistic combat load would be, e.g., conformal fuel tanks plus 5,000 lb of ordnance with a combat radius of 1,100 miles. The same can be said for the F-35A external weapons capacity of 22,000 lb. It's just not realistic given the max takeoff weight of 70,000 lb and an internal fuel capacity of 18,250 lb. These are both fighter aircraft, they're not designed to carry large loads of weapons, so why advertise that capability? In an actual combat situation, they'll be loaded with a mix of air-to-air and air-to-ground ordnance (designed to match that target/mission) and a full internal fuel load. Any combat radius numbers should be based on that. Not some unrealistic number of weapons that can be loaded on a jet that never leaves the parking ramp.

Lt. Col. Greg Nowell,
USAF (Ret.)
Stafford, Va.

Although the F-15 is arguably the best air superiority fighter ever built, I think the money could be put to better use on more advanced systems. Maybe the Silent Eagle?

Mike Hupence
Schnectady, N.Y.

Which Weather?

Having read the article, "For USAF Bases, Hard Choices Follow Storms" in the May issue [p. 23], I really had some questions about what was actually meant about some of the bases mentioned. I live a couple miles from Offutt [Air Force Base] and witnessed the destruction caused by spring 2019 flooding. Two of the buildings where I worked while stationed there in the mid '80s were engulfed by 8 to 10 feet of water. I can't imagine what the inside of them looked liked—the many tools, equipment, personal items, etc., floating around the buildings.

As I continued to read the article, I found it difficult to understand how the Air Force determined the 10 facilities most at risk for weather-related damage, especially with no explanation whatsoever what that damage might be from. Malmstrom? Hill? Greeley? Andrews? San Antonio? The others, I could imagine—hurricanes and tornadoes. But

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AFA's Mission

Our mission is to promote a dominant United States Air Force and a strong national defense and to honor airmen and our Air Force heritage.

To accomplish this, we:

- **Educate** the public on the critical need for unmatched aerospace power and a technically superior workforce to ensure US national security.
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- **Support** the Total Air Force family and promote aerospace education.

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really—the others? What weather conditions would affect them so badly as we experience here in the Midwest?

Yes, the weather is an adversary, but let's be reasonable in determining what bases are really in danger!

Maj. Dean Hayes,
USAF (Ret.)
Bellevue, Neb.

New Nukes

Nuclear weapons are back on the front burner ["Time to Update NC3", April, p. 52]. China is modernizing their nuclear weapons and continuously adding to their nuclear arsenal. For many years, Russia has given top priority to modernizing their nuclear weapons increasing range, accuracy, and novel delivery systems. North Korea is advancing its nuclear weapon capabilities and its long-range missiles. All are aimed at the US or our allies. Let us look reality in the eye and see the world as it is.

We are behind in nuclear modernization. The US put off modernizing the three legs of its nuclear deterrent for 25 years. We thought we might get a peace dividend when the USSR collapsed in 1990 and when China adopted some trade and capitalistic ways. That was not to be. It is essential we modernize our air, land, and sea nuclear forces to guarantee our safety and security by regaining technological superiority over China and Russia.

In my backyard, Grand Forks AFB, N.D., was host to 150 silos with the Minuteman II and III nuclear missiles for 34 years, from 1964 to 1998. Based on the 1995 START II agreements, three missile fields were deactivated, including Grand Forks. Our 1970s Minuteman III missiles were sent to Malmstrom AFB, Mont., to replace their outdated Minuteman II missiles. They remain there 20 years later.

There is no more can to kick down the road. The US Air Force has figured out ways to keep our nuclear missile system going for another 10 years—49 years beyond its intended life—but we *have* to use that time to replace it with a more modern system ... soon.

How do we know deterrence works? No one has dared use another nuclear weapon in 75 years. That is the evidence of effectiveness.

We have to maintain a nuclear force modern and large enough to be capable of absorbing an enemy nuclear attack, yet retain enough surviving nuclear force to retaliate with a devastating counterattack, knocking out their ability to strike again with nuclear or conventional weapons. Nuclear superiority means our enemy loses everything. Our losses would be high, but we would remain viable and strong. Bullies do not hit— or play chicken—if they know they will get hit with a lethal force.

To prevent nuclear proliferation, the US provides "nuclear umbrella" protection to over 30 allied countries with whom we have treaties, which includes NATO members, Japan, South Korea, Australia, and other distant nations. We protect the free world from dangerous authoritarian rivals.

Can we afford to modernize? The Congressional Budget Office's report "Projected Costs of US Nuclear Forces, 2019 to 2028" estimates DOD needs to invest $326 billion over the next 10 years to modernize the nuclear triad. That is a lot of money. But it is 6.4 percent of the defense budget at its peak, and just 3 percent most of the years. This is less than 1 percent of our federal budget. Effective defense and strategic deterrence are affordable. Let your senators and congressmen know nuclear modernization is of vital importance.

President [Donald J.] Trump called for a nuclear force that was "at the top of the pack." I agree. We need to modernize to reduce US vulnerability to nuclear war to the greatest extent possible, while simultaneously maximizing adversary vulnerability. With strong deterrence, the world's most destructive weapons will likely never be used again.

Bruce Gjovig
Grand Forks, N.D.

Crossed Fingers

Thank you for providing Amy McCullough's take on the Air Force's interesting new method to overcome time issues in military contracts ["Instant Contracts," May, p. 34]. Use of credit cards isn't new, perhaps the release of credit limits might be! But it is good to see a creative attempt to overcome the cumbersome nature of our military contracting system.

I was a pilot that entered the contracting world through the old "gates" system of the '70s and '80s Air Force. I wasn't at a super high level of contracting, but was taught by some great and knowledgeable experts about the demands of the field. I understand that we need to be more responsive in our new era ... and that this article's process can help fill a void in reacting to innovation from our technical, IT, and/or AI communities, or those similar technological advances of our enemies.

There are two factors that don't seem to be addressed. One of the reasons our system is so "clunky" is that there are safeguards set up throughout the process. Contractual oversight is important. The Pitch Day winners will be new to government requirements for safety and quality. Do these new methods provide for this "other side" of the purchase? How many times have we (with weapon systems or personal home products) not received what we thought we had bargained for? Secondly ... with all the constant criticism and cynicism about government contracts, what do we do if someone didn't negotiate with an honest intent? Most of our [procurement] laws are written because someone stretched the legal limits with questionable ethics. Exciting new methods will help, but human nature is human nature.

Are these startup companies vetted enough that these issues will be addressed? I hope the new process works, but I have seen too much stretching by contractors, even with oversight, to think we will succeed without some further filters.

Lt. Col. Robert A. Turk,
USAF (Ret.)
Fort Worth, Texas

Better Left Alone

I have to admit I enjoyed Major Nordhagen's letter ["Tanker Tops BUFF Bargain," May, p. 3]. He is absolutely right that "we are a team." BUFF crews could not have done their planned SIOP [Single Integrated Operational Plan] missions deep inside the Soviet Union or conventional operations in Southeast Asia or Afghanistan without the KC-135 crews doing theirs safely outside of SAM and MiG range.

He should have ended his comments there in my opinion. Instead he goes on to mention costs and how many more KC-135's are still flying today while BUFFs are being retired to the boneyard to justify why tankers were a better bargain. He neglects to mention the total number of BUFFs are limited to 74 by [the] SALT treaty and the tankers aren't. Tankers exist for one reason and one reason only, and that is to pass enough gas to get warriors to their targets. BUFFs are programmed to remain in the inventory to 2050, a legacy aircraft by any measure. I doubt that the KC-135s will still be around to pass the gas when the last BUFF goes to the Boneyard.

Pete Gandy
Pace, Fla.

Three-quarters of a century after the Allied invasion of France, an American F-16 soars over peaceful German hillsides alongside Scat VII, the P-51 Mustang flown by triple ace Robin Olds at the end of World War II. Scat VII, itself, is a survivor: Having crashed more than once, it's been rebuilt and remains one of the last P-51s still flying in Europe.

Photo: MSgt. Roldan Carlson

British boaters race across the English Channel 75 years after the greatest amphibious assault in human history crossed those very same waters—under far less favorable circumstances. Thundering above them through pristine skies, two American F-15Es sport "heritage" paint schemes in a salute to the Greatest Generation.

Photo: TSgt. Matthew Plew

SrA. Sawyer Ezzell, a crew chief, services the liquid oxygen system of a Kentucky ANG C-130 at Aviano AB, Italy. Liquid oxygen is converted to gas form to provide fresh air to aircrews during high-altitude flights. The vapor is from the cold liquid oxygen reacting to contact with the warm ground air.

Photo: SSgt. Joshua Horton/ANG

Specialty Officers Needed

The Air Force circulated a proposed officer promotion system in May, aimed at giving experts in emerging specialties a better shot at ascending to the top ranks of the service. The current system lumps 87 percent of officers into a single promotion category. That disadvantages those with unconventional career paths—frequently those with less common specialties. In mid-June, Deputy Chief of Staff for Manpower, Personnel, and Services Lt. Gen. Brian T. Kelly spoke with Editorial Director John A. Tirpak and Editor in Chief Tobias Naegele about the new promotion system, the Air Force's pilot shortage, and a new expeditionary force presentation construct.

Q. The Air Force is looking at a new way to promote its officers. What are you changing, and why?

A. What we're really doing is not changing the promotion system, but looking forward and saying, 'What do we need to be as an Air Force?' And what type of officers are we going to need for the future?

The development and promotion system we have today has served us really well. But as we look to the future, and the National Defense Strategy, we know we're going to need a little bit more agility in terms of being able to develop our officers in a variety of ways.

The current system, particularly the Line of the Air Force category … tends to be limiting in terms of developmental agility. The Air Force has evolved from operating in an air domain to air, space, cyber, and further; it's also joint integration with land and maritime components. So the development paths can be tailored and look toward what's required in a variety of areas.

We already do this in many ways. Our chaplains, doctors, dentists, nurses, and JAG (Judge Advocate General) officers are promoted in categories by themselves, which recognize the need for different developmental paths and opportunities within those categories. The way we educate, train, and experience officers in those categories are different, and so we've organized them into different promotion categories over the years. As we've evolved as a service, the number of specialty codes has grown significantly, and the differences in requirements in those areas have also grown.

[Now], we're looking at whether it's time to look at different developmental paths for education, training, and experience in the Line of the Air Force—as leaders or supporters of a joint campaign—depending on what your specialty is.

The work we've done to date has included lots of reviews with the field. We've talked with folks, starting with [Air Force Chief of Staff]General [David L.] Goldfein's 'revitalizing the squadron' work. We've reviewed our existing databases and run some mock promotion boards to look at different configurations.

We've come up with six categories that represent the joint fighting skills we need: air and special warfare operations; space operations; missile operations; information warfare; combat support; and force modernization. We think those six categories will give us the developmental agility we need so we can maximize capability across the force.

Photo: TSgt. DeAndre Curtiss

Lt. Gen. Brian Kelly speaks at the Air Force Association's Air, Space & Cyber Conference in September 2018.

Q. Is the idea that some specialties were stunted with everybody lumped into the Line of the Air Force, and this will ensure them some progression up through the ranks?

A. The Secretary of the Air Force sets the promotion opportunity, … which says how many folks are going to get promoted on each promotion board, based on the needs of the service. Those are not the same in every category. For instance, promotion to lieutenant colonel for Line of the Air Force, that category may be around 85 percent, but that's not the same for chaplains, the JAGs, the medical folks.

We would expect that in this future system, the same thing would occur, but the requirements of the Air Force would dictate the promotion opportunities in each of these six new categories. It would be based on the existing inventory and what the Secretary views as the needs of the force at the time.

Q. This seems to expand promotion opportunities in certain categories, but doesn't it also cap how far an officer can go if they are, say, nonrated? Are you creating more tribes and confining people to those tribes?

A. That's a good question. We hear that a lot. There's a basic set of requirements for being an Air Force officer today across the categories that already exist. Now there's going to be some unique routes … or an agile route, for those folks in terms of development.

I don't necessarily view that agility as creating additional tribes; even in today's system, you can have tribes. What creates tribes is if we do not force ourselves to value integration across the service. But certainly I would decouple the promotion system from tribalism. What drives tribalism is behavior and processes, and we've got to guard against that, now or in a future system.

Q. Is there a way to institutionalize that or will it just be guidelines to promotion boards?

A. Guidelines will be a big part of it. Boards will have to value things like being able to understand and integrate across different domains. We'll ask our boards to make sure the [candidates] have an understanding of how multi-domain command and control works. We value people who can successfully integrate air, space,

and cyber and then further integrate that with the maritime and land domains. When you value that, it drives behavior, and that will drive development and help us eliminate the stovepipes, which is our going-in position. That's our way to institutionalize that.

Q. How does this play into the 'Force We Need' of 386 squadrons?

A. A couple of things. The Air Force We Need is the 386 operational squadrons, and then, of course the supporting squadrons that go behind that.

Another thing is the right level of decision-making. The Secretary and the Chief were working on pushing that down, revitalizing squadrons, getting folks at lower levels to be comfortable with accountability and decision-making. That's another aspect of it. But it's all part of making sure we create the right development paths to build the officers we need, to build the force we need for the future. The work we're doing on promotion categories is required, but it's not sufficient in and of itself.

Q. What are some of the biggest drawbacks to this new approach that have emerged?

A. When we ran the mock board we had to figure out how to group these AFSCs [Air Force Specialty Codes] together. We did a lot of work to create them, but I'm 100 percent sure we didn't get it 100 percent right. Goldfein has asked us this summer to broaden the conversation, which we're doing by visiting bases, having virtual town-hall meetings, sharing what we think, and having folks give us feedback, so we can sharpen what we've already got. And some of that was already underway with the revitalized squadrons discussion.

Getting those categories exactly right is difficult. We may not have the categories exactly right.

Q. Are you concerned that this system could create an officer corps that's too specialized and lack the breadth necessary to operate wider forces?

A. That's certainly another risk. And when we've messaged this, we talked to both technical depth and breadth. [Officers are] going to need the breadth to be able to integrate that into a joint campaign. And so when it's appropriate, we'll make sure the promotion boards value breadth.

Q. It's unusual for the Air Force to socialize something like this before it's policy. Why are you doing it this way?

A. Promotions affect everybody. This is a rather large adjustment for the Air Force, right? And I think a sign of a very mature organization is that it's willing to have open dialogue and discussion. We did this with revitalizing squadrons, where we went out to the field and got grassroots-level inputs, talked to the airmen, made sure they got to be a part of the discussion and the process.

I think we're doing the same thing here, knowing that this is a pretty significant adjustment to how we've operated since 1947. It makes sense for us as a learning organization to get everybody's inputs and make sure everybody understands what we're doing before we make the major adjustment.

Q. What feedback are you getting from Congress?

A. We've talked a lot with our personnel subcommittees on both the Senate and House side. They are very supportive, actually. They've put language in previous National Defense Authorization Acts that spoke to the need for each of the services to utilize a flexibility they had been previously given to adjust promotions and the categories. Congress recognizes the nature of warfare is constantly changing, and the National Defense Strategy sets new requirements. They had previously indicated to all the services that this was something we should be doing. So from a basic standpoint, they're supportive, they're interested in what we hear and learn as we go out on our roadshows and get our feedback. Goldfein has talked with a number of key members in the Air Force caucus and on staff subcommittees, both House and Senate, as have the Secretary, legislative liaison, myself, and others. They've asked us to come back after we've gathered feedback and keep them informed.

Q. Do you need permission from Congress or do you have the go-ahead already?

A. No, we already have the authorities needed.

Q. On a different topic, General Goldfein has said the pilot shortage is easing. What's happening there?

A. There are multiple lines of effort we are taking to mitigate the pilot shortage. The main levers are, we've got to produce more pilots, we've got to keep and absorb and train more pilots, and we have to retain them. And I think we're making headway in all three areas.

Last year, we increased production slightly at Air Education and Training Command, there are plans to increase production this year, and across the rest of the FYDP (Future Years Defense Program). So that's going in a positive direction.

On retention, we've focused on quality of life, quality of service issues. … Getting rid of some additional duties and things that were a distraction. And we've provided more support staff in a squadron to help them with associated and administrative duties. Work was done on the assignment system to help our airmen have a little more visibility and say on where they're going to go. So they have a little bit more control over their careers. All these things combined—I think—have helped.

The pilot bonus take rate had been declining for almost five straight years. Last year, it stabilized. It didn't get to the level we wanted to get to, but that was a good sign that perhaps we're seeing some easing of the problem.

Q. How has the enlisted pilot program on the remotely piloted aircraft worked out? Will that continue, or are you reassessing that?

A. The first thing we learned is what we already assumed, but verified: that our enlisted force is incredibly capable and sharp. The enlisted pilots we put through the RPA program have all done remarkably well and are performing great.

We're going through the process of rethinking, now: How does that go forward? The first point—because I don't want to tie these together—is that enlisted pilots do not solve a pilot shortage, right? When you have a production problem, it doesn't matter what flavor of person you put through a schoolhouse … there's still only a limited number of seats. So we don't view that as a way of fixing the pilot retention issue.

That said, we're reviewing the CONOPS and saying, 'Okay, as we start to expand, especially in the RPA world, how does our enlisted force fit in?' That's what we'll be looking at to try and get a long-term plan.

Q. General Goldfein is working on a new expeditionary force plan. When will that roll out?

A. Our A3 team is leading that, and it's about how we present our forces. The National Defense Strategy and the Chief have called out the need to return to our expeditionary roots, and how we may have to put forces forward in a different way than we have in the past. … I would look to the fall for that. ✪

By John A. Tirpak

Shake-ups Leave DOD With Space Disarray, Army-Centric Leadership

Amid major challenges, such as a septic military confrontation with Iran, continuing congressional debate over creating a new Space Force, and US steps to eject Turkey from the F-35 program over that country's insistence on buying a Russian air-defense system, the Pentagon leadership was substantially reshuffled in June. The result is a slate of fresh players stepping in when these issues were all clearly far short of resolution.

Starting at the top, Patrick M. Shanahan, who in May was nominated by President Donald J. Trump to be Secretary of Defense—after half a year in an "acting" capacity—abruptly withdrew his nomination in mid-June and resigned as deputy after news surfaced about domestic violence charges involving his ex-wife and one of his children.

Mark T. Esper, Secretary of the Army, was nominated to be Defense Secretary, after assuming the duties of "acting" defense chief.

Throughout his tenure as deputy and then as Acting Defense Secretary, Shanahan's 30-year career at Boeing compelled him to recuse himself from Pentagon decisions affecting that company. Boeing's win of a string of big-ticket contracts during Shanahan's term—as well as the inclusion of Boeing F-15EX fighters in the 2020 defense budget request, despite Air Force resistance—cast a shadow on his impartiality.

Shanahan was the longest-serving Acting Defense Secretary in history. Taking over from Jim Mattis in January, he eclipsed the 60-day tenure of William Howard Taft IV in acting status by March 1, but that status continued until his sudden departure in late June.

The lack of a permanent, confirmed Secretary increasingly agitated lawmakers, especially given the US' involvement in armed conflicts in Syria and Afghanistan, engagement in a tense military showdown with Iran, and fraught negotiations with North Korea over its nuclear weapons program. Senate Armed Services Chair Sen. James M. Inhofe (R-Okla.) suggested in early June that the long delay in Shanahan's nomination was beginning to smack of a lack of confidence. "You need Senate-confirmed people of ability and competence in leadership," said Sen. Jim Cooper (D-Tenn.) on June 26. "You can't have a government of actings or vacant offices, and that's sadly what we increasingly have. And our tolerance for that should be zero."

ESPER, THE ARMY, AND RAYTHEON

Shanahan came to the Pentagon with no uniformed military experience, but Esper is a combat veteran. A 1986 West Point graduate, Esper was an infantry leader in the 1991 Gulf War, served in the Army Reserve and National Guard, and later worked on Capitol Hill as a military matters staffer supporting members such as former Republican Sen. Fred Thompson of Tennessee. He also worked military issues at the Heritage Foundation, a conservative think tank, and later as a lobbyist for Raytheon, where he was vice president for government relations.

Promising that Esper "is going to be outstanding, and we look forward to working with him for a long time to come," President Trump nominated him formally June 21.

Shanahan: Withdrew nomination for SecDef

Esper: From SecArmy to SecDef

Barrett: Nominated for SecAF

Gen. Milley: From Army Chief to JCS Chairman

Norquist: From comptroller to DepSecDef

Gen. Hyten: From StratCom Vice Chairman, JCS

Kennedy: Pushed out of space architect role

Stopher: Stepping down as USAF space adviser

Shank: Fired from SCO; office moved to DARPA

Tournear: Took over SDA and kept his R&E post

Gen. McConville: Becomes Army Chief

McCarthy: From Under Sec. to SecArmy

Photos: DOD (1,9); Monica King/USA (2,4,7); State Department; Sgt. Amber Smith/USA; USAF; Sun Vega/DOD; Andy Morataya/USAF; USA (11,12)

While Shanahan was legally able to fill in as SecDef because he was already the deputy, under the 1998 Vacancies Reform Act, Esper's nomination precluded him from acting as SecDef until he is confirmed, and he was obliged to resign as Army Secretary.

Esper faces a similar conflict-of-interest problem with Raytheon as Shanahan's with Boeing. Like Shanahan, he may have to recuse himself from Pentagon decisions involving his former employer. Not only was Esper heavily involved with one of Raytheon's signature products—the Patriot air defense system—but Raytheon is also now seeking Pentagon approval to merge with United Technologies Corp.; a green light would make the new company the nation's second-largest defense contractor.

Shanahan was no fan of meeting with the press, but Esper, as Army Secretary, made it a point to engage with the media at least quarterly and issued orders to Army public affairs that he wanted

media inquiries handled swiftly—especially when they were about bad news. "Delay breeds suspicions," he said.

Republican leaders on Capitol Hill praised Esper's nomination. "I think he's good," Inhofe remarked. "I've been in the field with him to see how he does with the troops. ... He does an exceptionally good job."

Esper was a West Point classmate of Secretary of State Mike Pompeo and will bring an undoubtedly Army-centric perspective to his new post. Meanwhile, the chairmanship of the Joint Chiefs of Staff is about to shift as well, also to the Army.

Army Gen. Mark A. Milley will succeed Marine Corps Gen. Joseph F. Dunford Jr. in the fall. A Princeton graduate who has been Army Chief of Staff since 2015, Milley will be succeeded by Army Vice Chief Gen. James C. McConville. Ryan McCarthy, who had been undersecretary, will be nominated to succeed Esper and is Acting Army Secretary for now, the White House said.

The White House said David Norquist, the Pentagon's Comptroller and acting Deputy Defense Secretary since Mattis departed, would soon be nominated to permanently fill the deputy position. No backfill for Norquist had been announced as of this writing, however.

HYTEN RUNS THE JROC

The Air Force, which hasn't held the chairmanship of the JCS since Gen. Richard B. Myers had the job from 2001-2005—the longest any service has gone without taking the JCS chair—will continue its hold on the Vice Chairman's job. The Vice Chairman leads the Joint Requirements Oversight Council, or JROC, a critical oversight role with regard to major acquisition programs. Air Force Gen. John E. Hyten will succeed Air Force Gen. Paul J. Selva in that role, likely before the end of the year.

Hyten, a Harvard graduate now head of US Strategic Command, has been an outspoken champion of space. Deeply experienced in space operations, he was previously head of USAF Space Command and has been supportive of the plan to create a Space Force within the Department of the Air Force ... for the time being. He testified in February, however, that he believes Space Force should eventually become a separate, sixth service.

As head of JROC, Hyten will supervise the joint-service operational requirements process, seeking consensus from the Joint Chiefs on acquisition priorities and advising the Defense Secretary on adjudicating intraservice conflicts.

CHANGING THE SPACE ARCHITECT

In addition to Shanahan, the Pentagon's space architect, Fred G. Kennedy, also stepped down in June after only a few months on the job. Kennedy had been director of the Space Development Agency, "on detail from DARPA," the Defense Advanced Research Projects Agency, according to Pentagon spokeswoman Heather Babb. She said June 21 that Kennedy would go back to DARPA.

John Stopher, space adviser to the Secretary of the Air Force, also announced plans to step down July 19.

Derek M. Tournear, assistant director for Space within the Pentagon's research and engineering undersecretariat, became the Acting Director of SDA three days later, and Babb said he would be dual-hatted; keeping his old job while also heading SDA. Tournear managed space systems at Harris Corp., served as a program manager at the Intelligence Advanced Research Projects Agency and DARPA, and also worked at the Los Alamos Labs. "There is no change to the mission or activities" of SDA, Babb told *Space News,* adding the agency will "drive the Department's future threat-driven space architecture and will accelerate the development and fielding of the new military space capabilities necessary to ensure our technological and military advantage."

Kennedy had only been in the job since March, but ran into conflicts with Michael D. Griffin, the Pentagon's head of research and engineering. Kennedy had been brought over from DARPA's Tactical Technology Office, where he worked in space systems research and management, and his initial charter was to spearhead an effort to launch hundreds of small satellites to establish resilient constellations in missile defense and communications. Kennedy's position was getting wan support from other space factions that felt SDA was redundant to missions already performed by the Air Force's Space and Missile Systems Center. Griffin pushed for the creation of SDA, which was also championed by Shanahan. Kennedy's charter now becomes Tournear's. Separately, Griffin also moved to sweep other areas, as well. In June, he fired Strategic Capabilities Office Director Chris Shank and moved to put the SCO under DARPA. Ranking House Armed Services Committee member Rep. Mac Thornberry (R-Texas) questioned that move and included language in the panel's markup of the National Defense Authorization Bill seeking further study. SCO specializes in quickly putting new gear in operator hands, advancing projects from requirement to the field in under two years. DARPA, on the other hand, focuses on long-term strategic research.

Will Roper, the Air Force's acquisition chief, was the prior SCO director and has said its best work stems from adapting existing capabilities for new missions not originally intended. Indo-European Command, European Command, and the Joint Staff challenged Griffin's decision, saying the SCO fills a crucial function not easily duplicated at DARPA. Selva told reporters in June he was concerned that the COCOMs needed to have access to SCO's ability to deliver quickly on urgent needs.

BARRETT'S SECOND GO

During the long debate on Space Force, the Air Force's position was well articulated by former Air Force Secretary Heather Wilson, whose departure on May 31 (to take a new job as a university president) left Undersecretary Matthew P. Donovan as the Acting Secretary. The White House announced May 21 it would nominate Ambassador Barbara Barrett—a lawyer, banker, and rancher—to succeed Wilson. If formally nominated—it had not been relayed to Capitol Hill by late June—it would be her second try for the job.

Barrett served as Ambassador to Finland late in the George W. Bush administration and as head of the now-defunct Civil Aeronautics Board under President Ronald Reagan. She has served on numerous advisory panels to the Pentagon, including the Defense Advisory Committee on Women In the Services, or DACOWITS, and on the boards of numerous aviation- or military-oriented organizations and companies, such as Raytheon, Jet Propulsion Laboratory and RAND, and was chairman of the nonprofit Aerospace Corp. Barrett is a private pilot with a multi-engine rating who also has great interest in space, having gone to Star City in Russia to prepare for a tourist trip to the International Space Station. If confirmed, she would be the third woman in a row and the fourth woman to serve as Secretary of the Air Force.

Barrett was nominated to be Air Force Secretary in 2004, and was intended to succeed James G. Roche in that capacity when Roche was nominated to move over to be Secretary of the Army. Roche's nomination was indefinitely held up, however, by the Sen. John S. McCain (R-Ariz.), who objected to Roche's planned attempt to lease air refueling tankers from Boeing. After months of delay, Roche withdrew his nomination and stayed on in the Air Force post, and Barrett's name was withdrawn.

The White House's desire to add momentum toward Space Force as a separate service was surely an important factor in the nomination of space enthusiast Barrett. The administration had expressed frustration with Wilson's highlighting of the cost and limited value-added of a Space Force at this particular time, and Barrett, if nominated, would likely champion the move with greater gusto. ✪

Water, Water, Everywhere

How Offutt is getting back on its feet after a "500-year flood."

Photo: TSgt. Rachelle Blake

Floodwaters spread over the flight line and surrounding areas at Offutt AFB, Neb., March 16, leaving tens of millions in damages.

By Rachel S. Cohen

OFFUTT AFB, NEB.—

The runway again hosts airplanes instead of floodwaters and fish, but Offutt Air Force Base still faces a long slog to normalcy.

Following a historic flood that covered about one-third of the base in March, officials here, just 12 miles south of Omaha, Neb., say it could take five years or more to fully restore damaged assets from the 55th Wing and US Strategic Command. Today's "get-well plan" includes mostly temporary fixes, such as replacing simulators destroyed by floodwaters with an RC-135 withheld from deploying so aircrews and maintainers have something to train with; moving about 3,200 employees into interim workspaces; and adopting around-the-clock maintenance shifts to make up for lost maintenance capacity.

The intelligence, surveillance, and reconnaissance wing lost three aircrew training systems, including one that can simulate all three RC-135 variants—the Rivet Joint, Combat Sent, and Cobra Ball—and two Rivet Joint-specific simulators. A fourth simulator, for sustainment, was damaged but was expected to be back up and running by the end of June. The best case for mission crew trainers would have "Band-Aid fixes" in place by the end of the year.

But these will not replace everything crews had before, said 55th Wing spokesman Ryan Hansen. "The 'Band-Aid' fix refers to the use of old but functioning spare parts to create what unfortunately will have limited capabilities, but meet minimum training requirements. A follow-on [simulator] will restore full capabilities lost in the flood."

Despite the flood damage, the 55th Wing hasn't missed a deployment. Col. Eric Paulson, 55th Operations Group commander, said the wing is meeting continued demand.

Maintainers quickly bounced back, as well. The first day they were able, maintainers moved tools out of the main maintenance complex and salvaged what they could from offices. One top priority was cleaning airplane docks so the airplanes could come inside for shelter and fixes.

"The first thing we did was inventory and relocate assets that were critical to the operation," said 55th Maintenance Group chief Col. Todd Hammond. "We created space in the docks at first, and then all the maintenance backshop capability. … Even without power … they were in the shops, cleaning, in an effort to get those shops back online."

The workshops support C-135 variants, as well as the Air

Photo: Zachary Hada/USAF

Charles Cswercko moves flood debris at Offutt AFB, Neb., clearing room for a temporary parking lot. Despite massive flood damage, the base hasn't missed a deployment and is meeting continued demands.

Force's E-4 nuclear command, control, and communications platform managed by STRATCOM.

"Things aren't perfect by any stretch of the imagination, but the things that we need are operational," Hammond said.

Many groups were forced out of their offices. The 55th Wing headquarters now occupies a low-slung, brown-brick conference center. Other units are sharing previously abandoned buildings, including a former library.

Doubling up employees in crowded buildings stresses the surviving facilities. More electronics, people, and working hours translates to more power, heating, and cooling. Groups have to vie for limited access to secure spaces.

"We've been trying to put additional resources in there, but we've come to a limitation," said Mo Krishna, a former 55th Operations Group commander who now helps lead flood recovery as a civilian. "Not as many people can do not as much work anymore because of a limitation on … [Sensitive Compartmented Information Facilities] space, computers, and the HVAC."

To ease the crowding, some airmen were sent to bases in Japan and the UK that support the RC-135. Others are traveling to depot facilities in Greenville, Texas.

But sending instructors and students away from Offutt isn't sustainable in the long run, Hansen said. The moves separate families and run up costs.

More than 100 mission crew students will spend six weeks away from home for training, then deploy for up to six months, Hansen said. It's worse for the instructors: They face up to six months away from their families in addition to operational deployments.

"You can meet it today, but the question is, are you going to have anybody left in the future to continue meeting this tasking?" Krishna said. "This is not even a marathon or an ultramarathon, this is just running for your life. This is what the wing's been doing for a very long time."

Rebuilding Offutt is currently expected to cost more than $650 million. That follows $20 million from a tornado in 2017 and another flood that rose to within 50 feet of the base's runway in 2011.

This time, a heavy winter snowfall quickly melted and joined with additional rainfall to overpower levees and sandbags near the base. No one at Offutt was hurt or killed.

"It was amazing how fast it got wet and warm when we had, what, like 18 inches of snow on the ground," Krishna said. "The ground was solid, frozen, and then all of a sudden, all the water came. The rain came, the heat came, the melt came."

Offutt was the second Air Force base hit by powerful weather events between October 2018 and March 2019, after Category 5 Hurricane Michael plowed through Tyndall AFB, Fla., last fall. Having a counterpart in disaster proved useful to Nebraskans, who looked to Tyndall's experience and proven best practices for storm cleanup, mold prevention and remediation, and setting up a recovery office.

Offutt officials have drawn up blueprints for how they intend to invest its share of $1.7 billion in congressionally approved disaster-relief funds for Air Force bases. A program management office will oversee that effort, partially modeled on its counterpart at Tyndall.

AFTER THE FLOOD

The response was swift, but lengthy. Within 72 hours of the flood, the Air Force, along with government services contractor Dyncorp, were already starting recovery efforts. Tyndall offered initial advice: "Cut the drywall, get things opened up, get the fans in there, and move forward and start the assessment process of the 44 [occupied] buildings that were affected down in the southeast quadrant," recalled Offutt Recovery Operations Center Director Lt. Col. Vance Goodfellow.

Officials said the base had everything it needed upfront to handle mold and other potential biohazards.

As with Tyndall, the Air Force's long-term vision for Offutt mirrors the base's plans for a more efficient, user-friendly installation. The Nebraska base wants to consolidate rebuilt facilities into eight campuses: a "nonkinetic effects center of excellence" for cyber and intelligence personnel; campus areas for security forces; bulk fuel storage; aircrews who stay on alert for the E-4 and E-6; another for NC3 operations; a training campus; a recreation area, hangars; and, possibly, a new backup power plant for STRATCOM.

About 50 of 137 above-ground structures need to be demolished and rebuilt in new areas and, in some cases, on higher land. Another 10 can be restored. Affected facilities are buildings and other structures, such as water pumps.

The flood also expedited the timeline for when the 55th Wing can move into a STRATCOM building as the combatant command transfers into its new, $1.3-billion command and

control facility. The two organizations will move into their new homes at the same time, instead of clearing one before the other comes in. Col David Norton, 55th Mission Support Group commander, said NC3 infrastructure can be rebuilt next to the modern STRATCOM building on higher ground.

Other structures will go up in nearly the same locations as before. "Just because it flooded and it was so devastating doesn't mean that we need to just walk away from that portion of the base," Norton said. "We still have to have these operational facilities right around the ramp where all the aircraft park."

Many more decisions about next steps have yet to be made. Hansen said the base is prepared to restore salvageable buildings and begin the demolition and rebuilding process for others. Officials will list their priorities "based on providing global combat airpower and the training required to support that effort," he added. Two top jobs are repairing the simulators and getting maintenance facilities back to 100 percent.

Operations and maintenance money must be obligated by Sept. 30. Military construction dollars would be available until the end of September 2023. The Air Force must send Congress a detailed plan for using the emergency money by the end of August.

"That probably remains to be seen exactly how the higher headquarters will sort through the finances of it," Norton said of the supplemental funding. "Here at the wing, certainly it's a good problem to have. But it's also going to be a lot of work for folks to push through such a large tranche of funding in a relatively short period of time."

Officials hope to restore full mission capability—albeit with temporary facilities and other limitations while the campus plans roll out—by 2022. They recognize that interim solutions will add to the total restoration cost, but say it's necessary to restore combat availability and training capacity, as well as to avoid rushing into hasty construction decisions.

Nearby assets, such as Tinker AFB, Okla., and facilities in Lincoln, Neb., will also lend support for operations while the future Offutt takes shape.

ADJUSTING TO REALITY

In the future, officials won't install electrical components lower than five feet on a building's first floor. Critical intelligence equipment will stay on the second floor or higher. They'll elevate the foundations by a few feet as an extra buffer against flooding. Local building codes already require preparing for high winds, and officials insist they don't have to alter disaster-response protocols.

Photo: 343rd RS/USAF

The 343rd Reconnaissance Squadron created a commemorative patch to remember the floods.

"We do exercise all these activities, and we look at lessons learned from other bases," Goodfellow said. "We were postured quite well."

Hard work, local hospitality, and humor have kept Offutt afloat: The 343rd Reconnaissance Squadron updated its patch to give its raven mascot a mask and snorkel, dubbing itself the "343rd Underwater Squadron."

"You almost became a Navy base," Facebook user Brian Skon commented.

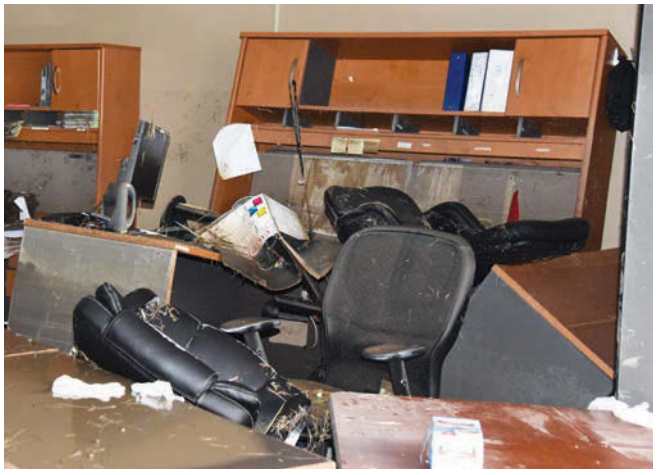


Photo: TSgt. R. Denise Mommens/ANG

The Nebraska ANG's 170th Group and 55th Operations Group workspaces at Offutt sustained significant damage.

The surrounding community stepped in to host the annual base picnic, typically held at Offutt's recreational lake.

A local pizza maker who lost his own home fed Team Offutt just weeks after the storm. More chaplains arrived to comfort residents alongside mental health professionals.

Parts of the base were still under water when *Air Force Magazine* visited in June, but elsewhere it can be hard to see signs of the storm—unless you know where to look.

Damaged furniture and equipment are piled up inside now-dark office buildings. Sustainment work on a British RC-135 was in full swing even as broad chunks of drywall were removed to save the structure in other areas of the building. A satellite communications building smells like a beach, surrounded by sand and dead cornstalks.

A local project to raise the nearby levees' height, which was supposed to start after the winter snow melted and likely would have saved Offutt from most or all of the water, is slated to take two years to complete—and can't start until the waterlogged ground dries. And though the worst weather has passed, Offutt remains wary of its neighboring river.

As the US Army Corps of Engineers in late May prepared to let out more than twice its early summer average of water from Gavins Point Dam, S.D., then-55th Wing Commander Col. Mike Manion warned the community that water levels could swell to nearly 31 feet in Omaha, Neb.—about four feet below the March 17 crest. At the same time, more snow accumulation than usual threatens further problems as the melt-off flows south from Montana to Nebraska.

The storm soaked signals intelligence data and analysis products—much of them paper—were left inside secure facilities, including the two-story 97th IS building. Those documents must be destroyed, but because SCIF alarms are dead, more than a dozen security forces personnel are posted around the clock to prevent unauthorized access.

To dispose of the data, Offutt hands the files over in barrels to a contractor, then tails them in a chase car to ensure all end up at their intended incinerator or a macerator.

Officials said they weren't sure what information those pages held or whether losing it will impact missions or national security—noting it hadn't so far. But that's just one example illustrating what Offutt has lost, and the ripple effects it may yet feel.

"Long recovery ahead," Manion wrote on Facebook May 29, undaunted by the challenge. "The 55th Wing finds a way to keep the mission going." ✪

Offutt's ISR Planes Prep for Evolving Threats

Photo: SrA. Jacob Skovo

An RC-135W Rivet Joint takes off from Offutt AFB, Neb. An "expeditionary mindset" has kept ISR aircraft on point, but new challenges in the Middle East and the Pacific will require training refreshers.

By Rachel S. Cohen

OFFUTT AFB, Neb.—

Great power competition may be the focus of the Pentagon's latest strategy, but the 55th Wing here has been flying the coasts of China and Russia for decades.

The wing's intelligence, surveillance, and reconnaissance jets routinely fly 12 miles off the coast of Russia and China in international airspace, so they don't expect their planes' unique electronic signals, missile launch, and radioactivity recon roles to change much in the coming years.

"Honestly, this wing's been doing that since the '60s," 55th Operations Group Commander Col. Eric C. Paulson said in a June 4 interview here. "We've spiraled our technology to meet adversary technology and kept up with it, but this is what we've been doing."

A longtime "expeditionary" mindset—being able to deploy quickly from spots around the globe—has helped Rivet Joints, Cobra Balls, Combat Sents, and Constant Phoenixes keep pace with the government's demand for their intelligence data.

But training also should evolve as geopolitical situations change, Paulson said, particularly if the RC-135 variants have to balance missions in the Middle East while taking on more in the Pacific. That will entail being aware of different threats, learning to use current capabilities in new ways, or using upgraded tools altogether.

He doesn't expect facing more advanced militaries will call for new crew positions aboard their jets, saying they can top off training instead. Everyone needs to focus more on cyber threats and how to stay relevant in increasingly digital warfare, Paulson said. And even as technology and training evolve, he acknowledged they may have to fall back on old practices for tasks like navigation if their systems are jammed in a fight.

"We'll do whatever's asked, and it's up to our national leadership to determine, 'Here's what I've got. What can I put here and there?'" Paulson said. "Once we know those [priorities], we'll work to make sure that those are met."

The real competition is in each nation's ability to collect, see, and understand what adversaries' intentions are and how their tools are changing, former 55th Wing Commander Col. Mike Manion said. Emerging technologies like artificial intelligence, machine learning, and autonomy will offer powerful boosts to the 55th Wing's ability to continue its work in an increasingly complicated, gray battle space, he noted.

New creations underway at the Air Force Research Laboratory and the Defense Advanced Research Projects Agency can dovetail with routine aircraft upgrades at Big Safari, which manages the Air Force's secretive big-wing ISR platforms. Each jet leaves Big Safari's depot every few months a little more advanced than its companions, and injecting AI tech on this rolling basis, rather than waiting for a block upgrade, could help 55th Wing fleet software stay on the cutting edge.

After the Air Force decided last year to abandon its E-8C Joint STARS replacement program, saying a new big-wing battle management jet wouldn't stand up against enemy air defenses, the same question has arisen about whether C-135s could survive in the future.

Paulson said improved air defenses haven't changed how the wing operates, but "should a war kick off, absolutely, that'll change some positioning."

Photo: SSgt. Arielle Vasquez

Airmen run flight control checks during preflight of an MQ-Reaper at an undisclosed location in Southwest Asia. US drones are taking fire from Iran in international airspace and over Yemen.

Manion isn't aware of any talk about putting self-defense systems on 55th Wing platforms, and that's intentional.

"We're not hiding our mission or our presence from anybody," Manion said. "We fly in international airspace, and there's a lot of rules of engagement that go along with that. I think we're intentionally painted white with no self-defense as a means to show that we're just here to be here. We mean you no harm."

The RC-135 and its variants are about a half-century old and face the wear and tear of old age. To remain viable for a possibly heavier mission load in the coming decades, maintainers are trying to stay one step ahead of what they might need to fix next and what crews could encounter in combat.

Col. Todd Hammond, 55th Maintenance Group commander, said his group starts each day with an intelligence brief focused on Russia, China, and North Korea.

"We want the technicians to understand the importance of why they're maintaining the aircraft, and why the systems need to function in those particular threat environments," he said. "We work together to make sure that as taskings come down … that we're working together jointly [across government] to optimize the systems to make sure that they can go forward and deploy."

Pilots report any discrepancies that occur during sorties, which are then considered as part of larger trends. Hammond is briefed weekly on the fleet's status, as well as monthly and quarterly on continuing trends.

"We're just working together a little closer [with government and depot partners] to make sure the availability essentially can be relied upon if we are to plus up in the Pacific, or if ISIS moves to Africa in the Sahel, that we can push there," he said. "If Russia begins to start something in Ukraine or Eastern Europe, then we can monitor."

Even as most eyes sit on simmering issues in the Eastern Hemisphere, in-demand ISR assets won't get a break from other conflicts du jour.

Mohan C. Krishna, a former 55th OG commander who is now helping lead Offutt's flood recovery effort as a civilian, told *Air Force Magazine* the service hoped the Trump administration's talk of removing troops from the Middle East would ease mission requirements at a time when 55th Wing fleets are stressed by the March storm. Then, US tensions with Iran flared.

An Iranian surface-to-air missile shot down a US drone over the Strait of Hormuz on June 19. The Navy's RQ-4A Global Hawk High-Altitude Long Endurance unmanned aircraft system, which is used for intelligence, surveillance, and reconnaissance operations—was operating in international airspace about 34 kilometers from the Iranian coast, Air Forces Central Command boss Lt. Gen. Joseph T. Guastella said.

The incident came just days after CENTCOM said Iran unsuccessfully tried to shoot down another US drone over the Gulf of Oman. US officials also believe Iran assisted the Houthis in a June 6 attack on an MQ-9 over Yemen that was successful.

"The drum's beating hard again," Krishna said. "The Joint Staff sees needs all over the place, combatant commanders see needs all over the place. Nobody's willingly going to give anything up. … We were hoping [US Central Command] was going to draw back and give us some breathing space. It's getting harder."

Recent developments in US Southern Command have also busied operators. The 55th OG headed to Puerto Rico earlier this year as a jumping-off point to gain insight into the situation on the ground in Venezuela, which is writhing with political and economic tumult and saw a failed coup in April, Paulson said.

No matter where the 55th Wing is called, Manion argues the Air Force will need a network of ISR sensors that can pick up on new developments in the battle space anywhere. He doesn't believe the Air Force needs to buy new big-wing ISR planes to fit the needs of each individual geographic area.

Lots will change, especially in Indo-Pacific Command, if the friction between the US, Russia, and China bubbles into a shooting war, Manion said.

"Everybody's worried about the 'fight tonight,'" Krishna added. "[Indo-]Pacific Command is worried about the fight tonight, CENTCOM's worried about the fight tonight. [US European Command] doesn't have that drum yet, but we're sure they will in the future." ✪

McConnell KC-46 Crews Shaping the Future of Refueling

Photo: Brian Everstine/staff

A KC-46 Pegasus from McConnell AFB, Kan., on the flight line at the Paris Air Show June 17. The appearance was the new tanker's international debut.

By Brian W. Everstine

LE BOURGET, France—

Despite extended delays and some continuing problems, the Air Force's KC-46 operating base is now flying a steady stream of firsts and setting milestones.

The KC-46 made its international debut at the Paris Air Show in June. To mark the occasion, crews onboard the trans-Atlantic flight from McConnell AFB, Kan., to Ramstein AB, Germany, made filet mignon on board. On the way back, the KC-46 crews will take on space-available passengers for the first time in the Pegasus program.

In early June, the 344th Air Refueling Squadron at McConnell began the initial operational test and evaluation for the aircraft as the base's six crews are learning what USAF's newest tanker is capable of, Lt. Col. Wesley Spurlock, the squadron commander, told *Air Force Magazine*.

During the testing, members of the Air Force Operational Test and Evaluation Center will monitor flights and operations, checking through test points to evaluate how the aircraft performs and how it will operate in the future.

For the crews, this means the flight operations are a "mix of everything," including international flights, such as the recent trip to Paris via Germany and a planned flight to the Pacific, along with cargo runs, and the first passenger flights, Spurlock said. The aircraft has been flying in formations, practicing tactical maneuvering, and— of course—refueling.

The squadron is making a "really robust flight profile. … We are really ramping up and getting the exposure for our instructors and aircraft commanders, and really our whole crew," Spurlock said. He added, "Our aircraft commanders are reporting after every single flight what they did, what they planned to do, lessons learned, issues they've had."

Every time the squadron flies, AFOTEC will "jump on with us" and go through the test points they need, he said. The daily flights aren't dictated by what AFOTEC needs, but rather, they go along with what aircrews are planning.

"Our mission is the test point. We don't change our sorties, per se, to meet the test points, they change test points to meet our sorties," Spurlock said.

McConnell's 344th ARS also is in the process of building up its first seven aircrews, with the expectation to reach 24 by the end of the year. The Reserve 924th Air Refueling Squadron is planning to get to 10 aircrews.

Because the KC-46 provides more than just refueling—it has sensors, data link connections, air defenses—the squadron wanted to pick pilots with diverse backgrounds to bring a different mindset to the mission. So far, new KC-46 pilots have experience flying the F-16, B-1, B-52, E-3, E-8, C-17, and C-130, along with KC-135s and KC-10s.

The KC-46's capabilities are "something we've never seen on a tanker," Spurlock noted. In addition to refueling, the tanker can help with targeting information and threat assessments. It's also designed with countermeasures, a first on a tanker, to get the fuel closer to the fight.

"We're happy to break out of the norm of what the tanker is for. … It's why we have F-16 and B-1 guys that understand the different parts of this, as we put all of this together it becomes a new thing," he said.

The initial cadre of pilots went through Boeing training and got 767-type ratings, but that only scratched the training surface. "It wasn't salient to the military-type of flying that we do. We've kind of had to push through that," Spurlock said.

The 344th is also close to standing up the first seven boom operators, and the plan is to reach 12 by the end of the year, with a final end state of 30 boom operators. The squadron did pull experienced KC-10 and KC-135 boom operators to join, but also looked at other career fields, such as sensor operators, to find "as diverse a group as possible," said SMSgt. Lindsay Moon, superintendent of the 344th ARS.

Through testing, the aircrews have been able to tell the dif-

ference between the KC-46 and legacy airplanes. For example, the KC-46 is more stable during refueling than the KC-135. When attached to a large aircraft such as the C-17, the Stratotanker would get "pushed around," Moon said. In the KC-46, the aircrews can't tell the difference as much between heavy receivers and smaller fighters.

For the pilots, the aircraft is simply more modern than KC-135s and KC-10s. It's a fully electronic "glass" cockpit with automatic landing and automatic braking. "There's a lot of bells and whistles, it's very user friendly … It's designed to be a modern airplane," Spurlock said.

For the boom operators, the nature of the KC-46's system is simply more comfortable. In the KC-135, operators lay on their stomachs for extended periods of time looking out the window to the receiver, Moon said. It got to the point where long-term operators would experience back pain and other physiological issues. A McConnell boom operator in 2018 won the Air Force's Spark Tank competition for inventing a platform for the KC-135 station to help alleviate pain.

In the KC-46, the operator is sitting upright, looking at large screens to operate the boom. "It is bearable to sustain operations as long as possible, being comfortable, and doing it while not feeling fatigued," Moon said.

The remote vision system has a heads-up display built-in to give the operators live readings of data such as the amount of fuel left to be off-loaded, which is a "big situational awareness tool," Moon said.

There are large, bright LED lights on the boom itself, visible day and night, that makes receiving easier, said Spurlock, who has flown as a pilot on both the receiving and off-loading end.

"It's kind of like a fifth-generation tanker," he said. "It's going to be a big deal."

Getting to this point has meant long delays for crews at McConnell as they waited for the aircraft to arrive. The base hosted a ribbon cutting for a maintenance hangar in October 2017, more than 14 months before the aircraft actually arrived. McConnell now has six aircraft, and it's waiting on the seventh to arrive, which was tentatively scheduled for the end of June.

The Air Force and Boeing are working together on determining a schedule for the already delivered aircraft to return to the company for an in-depth sweep for foreign object debris, such as tools from the factory that fell into areas of the jet during production. The aircraft that have been delivered have been deemed safe to fly, but still have remaining areas that need to be checked. These sweeps are expected to be finished in July.

At McConnell, maintenance crews are working through this issue and "when it happens, it happens, and we work around it," Spurlock said.

"At the end of the day, we're just flying what we have. We step out to the jet and, whatever the tail number is, we fly it," Spurlock said. While he did not discuss specific mission capability rates, he said, "Every time I've stepped to fly, I've flown."

Additionally, the Air Force and Boeing are working through three "category one" deficiencies—two focused on the RVS and one on the boom itself—with a fix not expected to be implemented for three to four years.

These flights and the ongoing IOT&E process give McConnell a unique mission. The KC-135 was first delivered in the 1950s, and KC-10s in the early 1980s. The airmen who flew, maintained, and operated the refueling booms at the time formed the processes and tactics that largely have stuck around for decades. This same process is now beginning with the 344th.

"We have a unique opportunity to leave our mark on the Air Force in the future," Spurlock said. ✪

Photo: MSgt. Joshua Almaraas

Gen. James Holmes during a question-and-answer session with airmen at Gowen Field near Boise, Idaho.

Holmes: USAF Can't Get Complacent with Readiness Gains

By Rachel S. Cohen

DAYTON, Ohio—

Air Force readiness improved by about 15 percent over the past year, but Air Combat Command's chief says the service must revamp its approach to managing aircraft and other weapon systems in less predictable, more complex combat environments.

"We need to fly the 16 sorties a month per airplane on Air Combat Command fighters," Gen. James M. Holmes said June 19 at the Air Force Life Cycle Industry Days conference. "We need to train the equivalent ways of that on our other systems, not just to check a box, and not just so I can write an update to my boss to tell them we made it. … The country is safe because of their training, so readiness is not just a number."

Last year, then-Defense Secretary Jim Mattis ordered the services to ramp up mission capable rates for F-35, F-22, F-16, and F/A-18 fighters to at least 80 percent by Sept. 30, 2019. Air Force leaders testified in March that more than 90 percent of the service's 204 "pacing" squadrons—the first group of unnamed aircraft that could be sent into a fight with an advanced adversary—were ready to deploy if needed.

"When we include their follow-on forces, these pacing squadrons are on track to reach 80 percent readiness before the end of fiscal year 2020, six years faster than originally projected," according to the prepared testimony. "As our front-line squadrons meet their readiness goals, we will also ensure the remainder of our operational squadrons reach the 80 percent readiness mark by 2022, as we continue to build toward the 386 operational squadrons we require."

Focused on those pacing units, the Air Force has been able to boost its ability to respond to conflict because of its current size and because it has settled into a familiar rhythm with the enduring wars of the last two decades, Holmes said.

This process works in today's "peacetime" stance, with demands limited to keeping ISIS and other terror groups at bay. But were the US to go to war with China or Russia—or some other peer adversary—the Pentagon wouldn't be able to rely on its typical supply chain and maintenance structure, which depends on centralized bases. Growing the service by 24 percent to 386 operational squadrons as envisioned could further stress resources, he suggested.

"The Life Cycle Management Center has worked to squeeze the fat out and to focus on the things that are required to meet those daily requirements in a very predictable set of conflicts that are based on sending rotational units over periodically," Holmes said. "Great power competition will be demanding

in ways that require different approaches to overcoming these constraints."

In a peer fight, one base holding 100 aircraft would be too vulnerable. Such challenges call for smaller footprints, with manpower and aircraft spread more thinly around the world. That, in turn, would stress parts supplies that could require delivering parts to destinations in contested areas. Cannibalizing other aircraft for spares won't necessarily be an option if fewer aircraft are available in a given location, Holmes stated.

"Every part we can avoid having to ship, everything we cannot think about because we're more reliable will be even more important," he continued. "We'll be dispersed, with only a minimum number of maintainers, often multiskilling the maintainers we have to do more than one job. ... Our units will have to operate more independently with what they've got in hand."

He implored industry to work with the government to boost the reliability of components and subcomponents so that parts fail less often and, so the Air Force can be better prepared when they do. For its part, the service will continue shifting money into aircraft availability initiatives and exploring modern sustainment ideas, such as 3-D printing parts and developing predictive maintenance algorithms. The Air Force needs to plan for those upkeep needs earlier in the development and procurement cycle, noted Holmes.

ACC is also rallying to the idea that developmental testing and operational testing could be merged. Driven by the success of the "Kessel Run" coding team in Massachusetts, where code is pushed out and improved in iterative "sprints" and requirements develop as projects mature, officials see the potential for faster, smoother, and more continuous improvement.

"We have built some combined test forces where we have OT and DT together on the same team," Holmes said. "We're looking at some organizational changes on what might be the next step."

Holmes said he would meet with Air Force Materiel Command boss Gen. Arnold W. Bunch Jr. this year to refine a path forward and hopes to work the new testing mindset into the 2021 budget. ✪

AFRL's New Goal: Bombs Smart Enough to Coordinate Attacks

By Rachel S. Cohen

DAYTON, Ohio—

The Air Force is abandoning its "Gray Wolf" swarming cruise missile development program to instead fund "Golden Horde," which would equip bombs with the smarts to cooperate in combat.

Brig. Gen. Anthony W. Genatempo, Air Force program executive officer for weapons, said in a June 20 interview that rather than develop another cruise missile, Golden Horde would enable the Small Diameter Bombs I and II, the Joint Air-to-Surface Standoff Missile, and the Miniature Air-Launched Decoy to act in concert with one another after launch.

"If we drop a number of the same genus, let's say all SDBs ... can the four of them act collaboratively together on an engagement?" Genatempo said.

Incorporating such decision-making technology into weapons without requiring human input is of growing interest to Pentagon planners, and is especially valuable in contested environments where human-machine communications might be spotty or severed.

Genatempo related the program to ongoing discussions with the Navy about its "Motley Crew" program, which *Military.com* described in 2017 as "a group of unmanned aerial systems that can share information and then assign tasks and make strategic targeting decisions based on available intelligence." That effort is progressing under a consortium of companies including Raytheon, Northrop Grumman, and Lockheed Martin, plus military laboratory representatives.

Photo: USAF

Brig. Gen. Anthony Genatempo

In December 2017, AFRL provided Lockheed and Northrop with $110 million contracts to prototype and demonstrate Gray Wolf low-cost, subsonic cruise missiles designed to defeat enemy air defenses. Five other bidders competed. Prototyping would have explored how the "plug-and-play" weapons could carry kinetic warheads, electronic-attack payloads, and intelligence, surveillance, and reconnaissance sensors, according to AFRL.

Now the Air Force plans to finish the first phase of the three-phase program in June or July, then scrap the remaining two stages in favor of Golden Horde, which it plans to demonstrate for the first time in about a year.

In March, California-based Scientific Applications Research Associates netted $100 million to demonstrate Golden Horde's "emerging munition technologies" after outbidding other companies, according to a Defense Department contract announcement.

"The effort is conceptualized as a fast-paced Air Force Research Laboratory-led demonstration project executed under the auspices of the Team Eglin Weapon Consortium," according to DOD. "Work will be performed in Cypress, Calif., and is expected to be complete by December 2021."

"What our warfighter is really interested in is, if I have a very large weapons truck like an F-15 or like one of our bombers that can drop multiple of these munitions, is there a way to act in such a way to provide better effects on targets? Or better [intelligence, surveillance, and reconnaissance] back to a command and control node?" Genatempo said. "We are still unraveling the onion on what that may actually mean as far as operational capability goes."

Think about last year's US air strikes on Syria, including the first combat use of Lockheed Martin's JASSM, he said. That mission succeeded thanks to extensive planning: Each Tomahawk and JASSM was dropped at a specific time, followed a predetermined flight path, and struck a particular target.

But what if the weapons could think through those steps on their own and send feedback to other munitions and airmen?

If they could say, "The first two of us that got here four minutes earlier, we actually took out this target," Genatempo said, then they could decide "the two of you that were coming in behind us ... you can go to Target B."

Within that four-minute flight time, he said, "there would be time to adjust to go to Target B."

AFRL, the Defense Advanced Research Projects Agency, and weapons manufacturers are collaborating to create such a network.

"That's to come," Genatempo said. ✪

New Commanders at 9th, 19th Air Forces

By Brian W. Everstine

Maj. Gen. Chad P. Franks took command of 9th Air Force and Maj. Gen. Craig D. Wills took the reins of 19th Air Force in separate change of command ceremonies June 13.

Franks assumed command from Maj. Gen. Scott J. Zobrist, who is retiring after more than 30 years in uniform, during a ceremony at Shaw AFB, S.C. Franks previously served as the deputy commander of Combined Joint Task Force-Operation Inherent Resolve and as the vice commander of 14th Air Force.

Photo: USAF

Gen. Chad Franks

Wills took over 19th Air Force from Maj. Gen. Patrick J. Doherty during a ceremony at JBSA-Randolph, Texas. He previously served as the deputy chief in the Office of Security Cooperation-Iraq at the US Embassy in Baghdad.

The Air Force hadn't officially announced Doherty's next move as of press time. ✪

Air Force Developing AMRAAM Replacement to Counter China

By Rachel S. Cohen

DAYTON, Ohio—

The Air Force is developing a new air-to-air missile, dubbed the AIM-260, that offers longer range than Raytheon's Advanced Medium-Range Air-to-Air Missile (AMRAAM) and would be used to counter the Chinese PL-15 weapon.

Air Force Weapons Program Executive Officer, Brig. Gen. Anthony Genatempo, told reporters in a June 20 interview the service is working with Lockheed Martin, the US Army, and the US Navy to field the Joint Advanced Tactical Missile in 2022. Work began about two years ago.

"It has a range greater than AMRAAM, different capabilities onboard to go after that specific [next generation air-dominance] threat set, but certainly longer legs," he said. "As I bring up JATM (Joint Air Tactical Missile) production, AMRAAM production is kind of going to start tailing off."

The weapon is initially planned to fly in the F-22's main weapons bay and on the Navy's F/A-18, with the F-35 to follow. Flight tests will begin in 2021, and initial operational capability is slated for 2022, Genatempo said.

"It is meant to be the next air-to-air air dominance weapon for our air-to-air fighters," he said.

The Air Force will buy its last AMRAAMs in fiscal 2026 as JATM ramps up, answering combatant commanders' needs, Genatempo said.

He told *Air Force Magazine* the service hasn't settled on how many JATMs it might buy in the outyears or how the program will ramp up.

"The future of what JATM looks like, especially out in that outyear increment, is very, very up in the air right now," Genatempo said. "As far as lot sizes go, it's on the order of a couple hundred per lot, and I don't think we have a definite plan."

He expects JATM could be in production as long as AMRAAM, which was first deployed in 1991. ✪

Illustration: Staff

Northrop, Raytheon Team Up to Develop Scramjet Hypersonic Weapons

By Brian W. Everstine

LE BOURGET, France—

Northrop Grumman and Raytheon announced June 18 they are teaming up to develop hypersonic scramjet weapons. Northrop will develop scramjet combustors to power air-breathing hypersonic weapons developed by Raytheon.

The two companies are working under a $200 million Hypersonic Air-Breathing Weapons Concept program through the Air Force and the Defense Advanced Research Projects Agency, according to a Northrop release.

Scramjet weapons use the missile's high vehicle speed to forcibly compress the air it takes in before combustion to sustain flight. The two companies announced the agreement at the Paris Air Show. The Air Force has selected Raytheon and Lockheed Martin to both develop HAWC weapons, along with Lockheed's separate Tactical Boost Glide weapon development. ✪

MQ-9 Air-to-Air Missiles Postponed for Higher Priorities

By Rachel S. Cohen

DAYTON, Ohio—

MQ-9 Reapers will keep their slew of air-to-surface weapons, but the Air Force is holding off on adding air-to-air missiles to the drone's arsenal for now, the service's program executive officer for intelligence, surveillance, reconnaissance, and special operations forces said.

The Air Force hasn't vetted the MQ-9's air-to-air combat skills since a 2017 test that proved the armed unmanned aircraft could shoot down other small drones, said Col. Dale White in a June 19 interview here. He indicated the concept has been pushed to the back burner as Air Combat Command pursues other ideas needed to meet the National Defense Strategy's focus on more advanced technologies.

"Right now, I can tell you it's not something we're actively … pursuing," White said. "It's one of those things where we always say, 'there's no limit to what you can do with enough time and money.' … It is a capability we'll always keep at the forefront of something that we can do."

In March 2018, the Air Force said it planned to offer General Atomics a contract to develop an air-to-air missile engagement simulator for the Reaper, although no firm plans were made to add the new weapon to the airframe.

The service has said it wants to use unmanned aircraft less often in low-intensity counterinsurgency fights and bring them into contested environments, though their vulnerability is in the spotlight this month following the shootdown of a Navy RQ-4A variant by an Iranian surface-to-air missile. ✪

Photo: SrA. Keifer Brown

A B-52H over Southwest Asia. New modifications proposed for the venerable bomber may make the H models into Js.

New Mods Mean B-52s May Add a 'J'

By John A. Tirpak

DAYTON, Ohio—

The Air Force is likely to redesignate the B-52H as the B-52J once it receives upgrades that add up to a "major modification," Brig. Gen. Heath A. Collins, service program executive officer for fighters and bombers, told reporters June 20.

Typically, the Air Force makes a letter-change designation to an aircraft—what Collins described as "rolling the series"—only when it adds enough new equipment to constitute a virtually new system, he said at the Life Cycle Industry Days here.

For example, when the B-52 gets new engines beginning in about 10 years, "that probably would be enough" to warrant a letter change, he said. But the venerable bomber will also get new digital systems, communications, new weapons, and a new radar, as well as a variety of other improvements.

Collins also said Air Combat Command is considering the possibility of reducing the number of aircrew on the B-52—now that some functions that used to require weapon systems officers can operate autonomously.

"Discussions continue with Global Strike Command about crew size," Collins said.

A B-52 test aircraft has been receiving modifications since 2015 to evaluate new systems, including the Long-Range Standoff weapon and several hypersonic systems, according to slides shared at the symposium. Collins said hypersonic missiles will be a key new capability of the B-52 in the 2020s.

The first captive-carry flight test of a new hypersonic weapon, launching a prototype from a B-52 out of Edwards AFB, Calif., took place June 12. The sensor-only version of the AGM-183 Air-Launched Rapid Response Weapon (ARRW) was carried externally on the B-52 to evaluate the drag and wind impacts on the weapon, which was not launched during the flight, according to an Air Force release.

While the B-52 is going through "the most active" period of modification in its history, the B-1 is entering a fairly quiet time regarding modifications, Collins noted. The emphasis with the B-1 for the next few years will be on readiness, he said, after a prolonged period when the B-1 was heavily used in Afghanistan, Iraq, and Syria.

The B-2, meanwhile, is also going through an intensive modification program as the defensive management system suite is upgraded. The upgrade constitutes a Major Defense Acquisition Program—an ACAT-1D—Collins noted, meaning it gets supervision at the undersecretary of defense for acquisition and sustainment level. After some delays, the program will be "re-baselined this summer." Collins said, the "quality of the software has been high" and is substantially better than the earlier version. ✪

Photo: SrA. Donald Hudson

Airmen load a Humvee onto a C-130J at Yokota AB, Japan. C-130s will be assessed for cyber vulnerabilities by the end of the year.

Raytheon to Conduct Cyber Assessments of USAF Aircraft Systems

By Brian W. Everstine

LE BOURGET, France—

Raytheon and the Air Force are working on a type of "bug bounty," focused on addressing cyber deficiencies—but this time on aircraft.

The company is contracted to conduct cyber vulnerability assessments on several aircraft subsystems and then work to mitigate the issues through resiliency instead of simply aiming to be impervious to attacks, said Dave Wajsgras, Raytheon's president of Intelligence, Information, and Services. Raytheon will begin working on the C-130J and F-15 in the fourth quarter of this year.

"The Air Force is taking the threat quite seriously," Wajsgras said.

The threat assessment process will look at how vulnerable aircraft systems, such as the mission computers, avionics, and navigation, are to attack. The objective is to strengthen those systems enough so that if one comes under a cyber attack, it doesn't simply go offline, leaving the aircrew without that capability.

"Resiliency says that even if something were to breach, and malware does enter, the system is resilient and can continue to function as intended," he said. ✪

■ The War on Terrorism

Casualties:

As of June 27, 71 Americans had died in Operation Freedom's Sentinel in Afghanistan, and 79 Americans had died in Operation Inherent Resolve in Iraq, Syria, and other locations.

The total includes 145 troops and five Defense Department civilians. Of these deaths, 69 were killed in action with the enemy while 81 died in noncombat incidents.

There have been 408 troops wounded in action during OFS and 81 troops in OIR.

FACES OF THE FORCE

Courtesy photo

Every US Air Force Academy cadet over comes obstacles to earn their bars. But **2nd Lt. Parker Hammond's** journey became especially challenging after a testicular cancer diagnosis during his junior year put his future as an officer in jeopardy. After entering remission in September 2018 and getting the waivers needed to commission in January, Hammond became an officer in May.

Photo: SrA. Cassidy Woody

When **Capt. Matthew Powell** had a chance to repay his mentor, he never wavered. Retired **Lt. Col. George "Buckshot" McKinney Jr.'s** dying wish was to have his remains flown in an F-35A fighter over Eglin AFB, Fla., where he had been stationed several times. An F-4 pilot who flew in Vietnam, McKinney mentored Powell before he even joined the Air Force. After his death, Powell took his ashes skyward. "He helped me so much over the years, and it was an honor to fly him one last time."

Photo: USAF

Maj. Bradley DeWees completed a Harvard Ph.D. in three years as part of an Air Force fellowship. The USAFA alum rose to the occasion in part by coordinating with security so he could start his studies before school buildings formally opened to students each day, according to the university. He will serve as the assistant director of operations at Fort Carson in Colorado, working with the Army and USAF to support ground commanders.

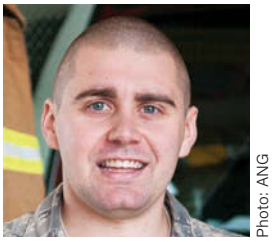


Photo: ANG

SSgt. Michael Ginikos has been recognized as the 2018 Air National Guard Firefighter of the Year. Ginikos, who holds down a full-time job and volunteers with Habitat for Humanity when he's not battling blazes, credited his Guard experience with inspiring his current effort to join the Columbus Fire Department. "I'm not just a firefighter these two days a month," he said. "They want to see me giving back to the community on a daily basis, and that's what I try to do."

Photo: TSgt. Christopher Gross

Maj. Andrea Matesick thought joining USAF meant shedding her dream of becoming a professional equestrian, but the F-15E weapons system officer and instructor at Columbus AFB, Ohio, now splits her time between Strike Eagles and horse competitions nationwide as a member of the Air Force Sport program's equestrian division. "If you're competing in a ... sport ... at a certain level, the Air Force will let you go compete for them," she said.

Photo: USAF

Brig. Gen. Michele Edmondson became USAFA's 29th commandant of cadets on May 31. Academy Superintendent Lt. Gen. Jay Silveria said her experience—which includes directing space policy for the National Security Council, three master's degrees, and an undergraduate degree in aerospace engineering—made her the best candidate for the job. "My challenge to you is to elevate the performance of the cadet wing to even greater heights," Silveria said.

Photo: SrA. Kathryn Reaves

Maj. Garret "Toro" Schmitz was certified as the F-16 Viper Demo Team's newest commander and pilot on May 16. Schmitz has more than 2,500 flight hours, 55 combat missions supporting Operation Inherent Resolve, and more than a decade of service under his belt. His training included more than "20 practice missions and 45 hours of study, which prepared him for four certifications" at the 20th OG, 20th FW, 9th Air Force, and ACC levels."

Photo: SSgt. Anthony Agosti/ANG

118th Force Support Squadron Commander **Maj. Melissa Danley,** the first Active Duty USAF officer to lead an ANG squadron, received ANG's 2018 Lt. Gen. Norm Lezy Award, which recognizes "commanders in the personnel career field making outstanding contributions through their leadership and ingenuity," according to an 118th Wing release. Danley gave credit for the award to her team. "We say that leaders never win awards based on what they do, they win awards based on what their folks do."

Photo: TSgt. Michael Farrar

815th Airlift Squadron loadmaster **SrA. John Boudreaux** nearly lost his flight status due to a car crash that fractured three of his vertebrae. But after foregoing pain medications, going under the knife for surgery, completing physical therapy, and a lot of paperwork, his waiver was approved, and he's back in the air. "If I wouldn't have been fighting to come back to fly," Boudreaux said, "I don't think I would have healed as well because I wouldn't have had something to drive me."

Photo: L. Cunningham/USAF

"None know better than the combat veteran that the cost of freedom is high," retired **Lt. Col. Barry Bridger** who spent 2,232 days in the "Hanoi Hilton" during the Vietnam War told Offutt airmen during a briefing. "What I am most inspired about is his message that the ideas of the American spirit exist throughout generations and that this young generation has that same DNA" said then-55th Wing Commander Col. Michael Manion, who said the current generation of airmen possesses "that same core, that same spirit of resiliency, innovation."

Know of someone we should recognize? Send nominees to afmag@afa.org

How Boeing Won the T-X

Aggressive technology, schedule, and pricing made the difference.

Photo: Eric Shindelbower/Boeing

Boeing, with partner Saab, made a calculated investment and landed the Air Force's T-X Trainer contract worth upward of $9.2 billion.

By John A. Tirpak

Boeing bet big on the T-X Advanced Trainer competition: The company put a lot of its own money on the line and counted on new design and manufacturing technologies to win the contract with an all-new aircraft, even as the Air Force pressed for a low-risk, off-the-shelf approach. The company also viewed T-X as a proving ground for a design and development approach it could apply to future programs. "The risk was super high," said Boeing Vice President and T-X Program Manager Steve Parker.

"If we hadn't met our own schedule, if we hadn't met our own design reviews and quality, if the software wasn't mature, and we couldn't fly those test points," Parker said, there would have been "no point submitting a proposal."

He added, "You can't game the system. It's got to be mature."

Just how much Boeing invested in the T-X isn't clear. Company sources suggest the amount exceeded $100 million. The payoff could be huge, though. Last fall the Air Force signed Boeing, and its partner Saab, to a contract potentially worth $9.2 billion, not counting variants the service could order for other roles, such as companion trainer, aggressor, or light fighter. Boeing sees a market for 2,000 of the aircraft, including those for the Air Force.

"If we hadn't met our own schedule, if we hadn't met our own design reviews and quality, if the software wasn't mature, and we couldn't fly those test points .... no point submitting a proposal."—Boeing T-X Vice President Steve Parker

Paul Niewald, Boeing's T-X chief engineer, said the company was preparing for the T-X long before the competition even got underway. Company leaders believed modern, computer-driven design and manufacturing could dramatically shorten the development cycle, saving time and money with 3-D modeling and precision manufacturing that would reduce labor and accelerate software development.

Initially, the Air Force pushed competitors to offer a variant of an in-production airplane, the better to reduce risk. "We were competing against proven, in-production aircraft, so we had to do things differently," Niewald said. Although there were lessons learned from Boeing's other programs, the T-X was a "petri dish" for "a lot of different innovations," he noted.

New 3-D modeling software meant the company could create a digital twin, test performance in virtual wind tunnels, and make adjustments rapidly, without having to bend metal. This permitted the company to "rapidly get out there with a configuration," he said.

Boeing's T-X advanced pilot training aircraft were developed to meet the specific requirements of the USAF.

Photo: John Parker/Boeing

Next came systems development. "We adopted an agile mindset and a block plan approach to hardware and software integration," he explained. "This had us releasing software every eight weeks and testing it at the system level to validate our requirements. By doing this, in such a disciplined way—at frequency—it allowed us to reduce our software effort by 50 percent."

The ground-based training system was developed in parallel with the aircraft. Because the aircraft software and simulator software are on a matching pace, pilots will never see something different in the airplane than they see in the sim, Niewald said.

The 3-D models translated into parts so precisely tooled that pieces fit perfectly together on Day One. "This allows us to have a shimless design," Niewald said. "We had one master tool on the program, and the parts were self-locating. This allowed us to have something like a 75 percent increase in first-time parts quality." Among parts suppliers, "everybody knew what their interfaces were."

Computer-aided design and modeling has existed for decades, but the level of fidelity possible today is greater. By applying "dimensional management and dimensional analysis on the parts, we knew with certainty that when the parts were manufactured and came together, they would come together just as we had modeled," Niewald said.

Parts came back "one-time, first-time quality. It comes back, it fits together."

So great is the fidelity of Boeing's virtual wind tunnel tests, in fact, that Boeing expects it could skip some flight testing.

Indeed, Niewald said the strong validation of the models—and the performance of the actual aircraft in flight—may make future wind tunnel tests unnecessary. "If it were me," he said, all wind tunnel testing would be eliminated. Boeing had full trust in the model to "represent full-scale flight with the computational fluid dynamics, because it continues to advance."

All assumptions were questioned, and new techniques were developed. For example, the canopy transparency is attached to the frame with an "injected adhesive sealant," eliminating 600 fasteners. "We had planned six weeks in the schedule to assemble the canopy," Niewald said. "It took us eight days."

Overall, T-X requires 80 percent less touch labor than traditional manufacture, and rework has been reduced to 0.03 percent, he claimed.

So confident was Boeing in its new approach that it priced its offer to the Air Force about $9 billion below what service officials anticipated.

Precisely how those savings break out are a matter of competitive edge for the company. "This is a story that we have guarded jealously, for a number of years, in term of the

T-X training jets built at Boeing's St. Louis manufacturing facility used labor-saving processes and precision design to reduce touch labor by 80 percent over conventional manufacturing.

Photo: Eric Shindelbower/Boeing

advancements," said Boeing spokesman Walt Rice. "I don't think we're ready to share that level of detail."

So much of the software was validated prior to the contract award that updates have become less frequent while the company waits for the Air Force to decide what additional features and revisions it wants.

PARTNERS COUNT

Partnering with Saab made sense because both have a "similar mindset" about innovation, Niewald said.

The T-X benefits from "a little bit of Swedish design philosophy," said Parker. The aircraft draws some inspiration from Saab's fourth-generation fighter, the Gripen, such as built-in stand-on doors, access panels that can be reached without a ladder, and maintenance that doesn't require specialized tools.

The design went from drawing board to first flight in three years, skipping the prototype stage and going directly to "production representative jets." The second T-X to be built flew within 24 hours of the first, he added, and they are "the most identical jets we've ever built."

Now the same processes used to build them will be used to build the rest of the fleet.

These first two aircraft racked up 71 flights during the evaluation period, at one point flying four times in one day. That's comparable to what the Air Force expects to do with operational aircraft, and "unheard of" on brand-new aircraft, Niewald said. The first two aircraft expanded the flight envelope and demonstrated high angle-of-attack performance, as required.

"Probably the most significant stats that we had, we went through the first 14 flights without a pilot squawk," Niewald said. That is a testament to how we went through this journey, [we] had a robust design."

The Boeing T-X was built to the Air Force's stated requirements: the only extra features were those that could be included without a cost, weight, or space penalty.

"I had a lot of guys on the program that wanted to design a fighter," Niewald allowed, but that wasn't the aim. Instead, design focused on meeting requirements, safety, maintainability, and building in "smart growth" capacity.

"We have volume, and we have power and cooling that can support new systems," he asserted. The aircraft was "provisioned" for air refueling, and the fuel tanks are all in the fuselage; the wings are dry. Despite large fairings for actuators under the wings, he insisted there's room for hardpoints that could carry ordnance.

Parker said the Air Force acquisition leadership is committed to getting equipment to the user faster than ever, and the T-X will be a way to "challenge the bureaucracy... [on] how

The Air Force plans to purchase 351 T-X aircraft to replace the T-38 Talon, which has been in service for 57 years.

Photo: SECAF Public Affairs

industry and government supercharges how we do things."

Boeing is already adapting some of the approaches from the T-X to other programs. Manufacturing lessons have been applied to new-build F-15s and other programs, he explained.

CHANGING MINDSETS

Boeing had to convince the Air Force that buying a clean-sheet airplane wouldn't cause undue delay, and that began with producing those first "two production representative jets," Parker said. "The best form of convincing people is to show them how we do it—not with a piece of paper."

Parker noted that starting fresh had some advantages over offering an established design. The requirement to accommodate men and women of a wide range of pilot heights and weights, "would have been a major redesign for other folks," he said. "When you come in with a clean sheet, [and] new design, we just went through that testing, [and had] already measured it ourselves, before contract award. That's one of the advantages of a clean sheet."

The next step is engineering and manufacturing development, where five more airplanes will be built and tested. They will expand the flight envelope—flutter, loads, and mission systems testing—with the 412th and 416th Flight Test Squadrons at Edwards AFB, Calif., beginning this year with the first two jets. New capabilities added will include night vision capability, but Parker called such revisions minor.

Unlike conventional development programs, he added, "we don't have to go through the normal milestones," such as critical design review. "We're already done. We don't have to go into a traditional program."

Boeing's critics have suggested that the company lowballed the T-X bid—as it did on the KC-46—and may have to absorb losses for a while before it can make up the deficit. Boeing has already taken more than $3.5 billion in losses on the KC-46.

Parker said that move was calculated.

"We made an investment up front. That's good business practice," he said. "That allowed us to compete, and we won. And we expect that—based on the interest we're already seeing internationally—and what we may do in America, that's a smart investment."

With plenty of space, weight, and power for added capability, he added, "we have a very clear growth path where we expect to take the aircraft over time."

He also said the T-X was designed with an open architecture, per Air Force requirements, because "it's going to be around a long time." The T-38, which the T-X will replace, will have lasted more than 70 years by the time it retires.

The greater lesson the Air Force needs is to "change its thinking" on how it considers what's possible. By being open about its requirements early, the Air Force provided transparency that allowed for Boeing's up-front investment.

"Now we've got to execute," Parker said, but he urged that other companies follow suit. "Hopefully the Air Force can get with industry and work together. We need to get these weapon systems out quicker. The days of perfection and testing forever, those days are over. There are smarter ways of doing things." ✪

THE SPIRIT TURNS 30

This is America's best-known secret weapon. The B-2 Spirit is easily the most recognizable aircraft in the Air Force inventory, its sleek, black, improbable shape blending science fiction with reality even now, 30 years after its first flight.

When America goes to war, the B-2 is usually the opening act. Flying imperceptibly through enemy air defenses, its opening night missions destroy enemy air defenses so follow-on forces can destroy the enemy's ability and will to fight. The B-2 doesn't just kick open doors; it opens the skies.

Only 21 B-2s were built, and just 20 remain. They comprise a tailor-made fleet of handcrafted aircraft, each ever-so-slightly different from the next, each able to carry a flexible arsenal of firepower in a two-man aircraft capable of flying unnoticed halfway around the world. One B-2 can strike 43 percent more long-range targets than an entire Arleigh Burke-class Navy destroyer.

Today's B-2s are not the same airplanes that first attracted attention in the 1990s. These jets feature enhanced targeting and threat-identification systems, precision weapons, improved stealth, and the capacity to deliver the biggest bombs in the US arsenal.

The Air Force's Bomber Vector calls for retiring the B-2 fleet by 2032, well before its successor, the B-21, is fully on line. The B-21, which is still in development, will be similar in shape and design to the B-2, but only about two-thirds the size. B-21 deliveries are targeted to start in the mid-2020s, and under current plans, B-2s would be retired as those new aircraft join the operational fleet.

But plans change. Within months after the Bomber Vector was released, the Air Force unveiled "The Air Force We Need," a plan to grow the force from 312 to 386 operational squadrons. Now, Chief of Staff Gen. David L. Goldfein is leaving the door open to extend the B-2's operational career.

"It's still in the works in terms of how we look at the force," Goldfein said June 26. The 386-squadron plan is built to deter and, if necessary, fight and win against a nuclear peer, he said. The B-2 delivers value to that equation. "Whether we retire the B-2 in the time frame with the B-21, all of that has to be nested" in the build-out of that 386-squadron force, where the greatest growth is in long-range bombers and tankers. "That should not be surprising or lost on anyone," he said. "Because as we see the advancing threat, and the missions the Air Force provides, having that increased range to execute our missions becomes even more essential in the future."

—Tobias Naegele

Photo: USAF

AIR FORCE MAGAZINE

B-2 at 30: Improving with Age

Primary Function

The Air Force's B-2 Spirit is the only stealth bomber in the world, an unprecedented combination of long-range, heavy payload, and stealth on a single platform.

Aircraft Design

Its low-observable flying wing design combines stealth with aerodynamic efficiency, and includes two spacious weapons bays capable of carrying **60,000 lbs.**

First Flight

July 17, 1989.

This star logo featuring five B-2 silhouettes was used at the plane's rollout in 1989.

Prime Contractor

Northrop Grumman

Number Built 21

Inventory 20

Delivered

December 1993-December 1997. (Test-aircraft redelivered combat capable, July 2000)

IOC

April 1997, Whiteman AFB, Mo.

Active Variant

B-2A.

Aircraft Location

Edwards AFB, Calif.; Whiteman AFB, Mo.

Operator

AFGSC, AFMC, ANG (associate)

Engines 4

General Electric F118-GE-100 turbofans, each 17,300 lb. thrust

Accomodation

Two pilots, on ACES II zero/zero ejection seats.

Max takeoff **Weight** 336,500 lb.

Ceiling 50,000 ft.

Performance

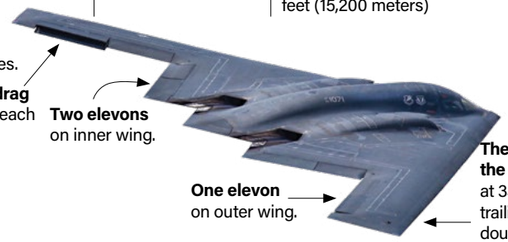
Maximum speed Mach 0.8 (550 knots, 630 mph, 1,010 kilometers per hour) at 40,000 feet altitude

Cruise speed Mach 0.77 (487 knots, 560 mph, 900 km/h) at 40,000 feet altitude

Range 6,000 nautical miles (10,000 with one refueling); Service ceiling: 50,000 feet (15,200 meters)

Maneuvering

Four pairs of control surfaces.

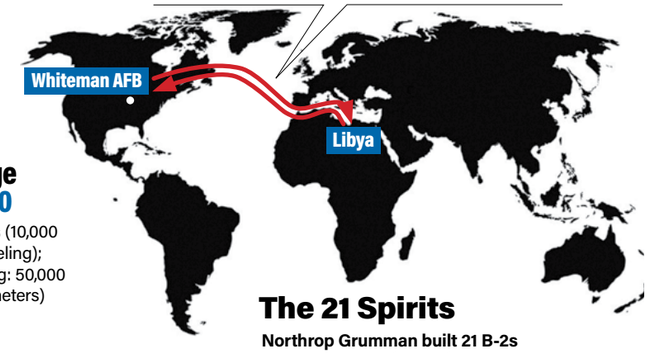


One split drag rudder on each outer wing

Two elevons on inner wing.

One elevon on outer wing.

The leading edges of the wings are angled at 33 degrees and the trailing edge has a double-W shape.



Whiteman AFB, Mo., to Libya is 10,000 miles round trip. In 2016, two B-2s flew this overwater route, eliminating the need for overflight permissions.

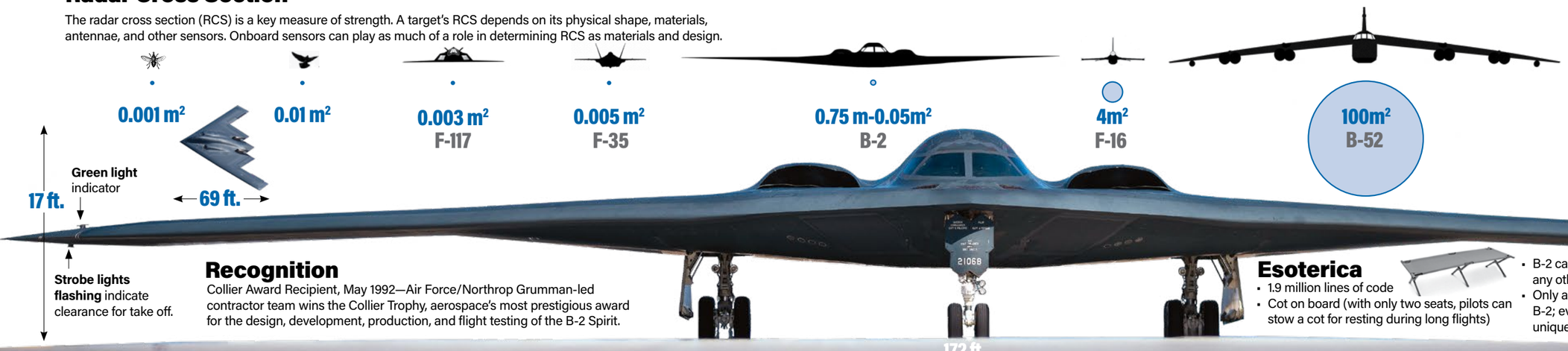
The 21 Spirits

Northrop Grumman built 21 B-2s (listed in order of manufacture):

1. *Spirit of America* (82-1066)
2. *Spirit of Arizona* (82-1067)
3. *Spirit of New York* (82-1068)
4. *Spirit of Indiana* (82-1069)
5. *Spirit of Ohio* (82-1070)
6. *Spirit of Mississippi* (82-1071)
7. *Spirit of Texas* (88-0328)
8. *Spirit of Missouri* (88-0329)
9. *Spirit of California* (88-0330)
10. *Spirit of South Carolina* (88-0331)
11. *Spirit of Washington* (88-0332)
12. *Spirit of Kansas* (89-0127, destroyed in 2008)
13. *Spirit of Nebraska* (89-0128)
14. *Spirit of Georgia* (89-0129)
15. *Spirit of Alaska* (90-0040)
16. *Spirit of Hawaii* (90-0041)
17. *Spirit of Florida* (92-0700)
18. *Spirit of Oklahoma* (93-1085)
19. *Spirit of Kitty Hawk* (93-1086)
20. *Spirit of Pennsylvania* (93-1087)
21. *Spirit of Louisiana* (93-1088)

Radar Cross Section

The radar cross section (RCS) is a key measure of strength. A target's RCS depends on its physical shape, materials, antennae, and other sensors. Onboard sensors can play as much of a role in determining RCS as materials and design.



Recognition

Collier Award Recipient, May 1992—Air Force/Northrop Grumman-led contractor team wins the Collier Trophy, aerospace's most prestigious award for the design, development, production, and flight testing of the B-2 Spirit.

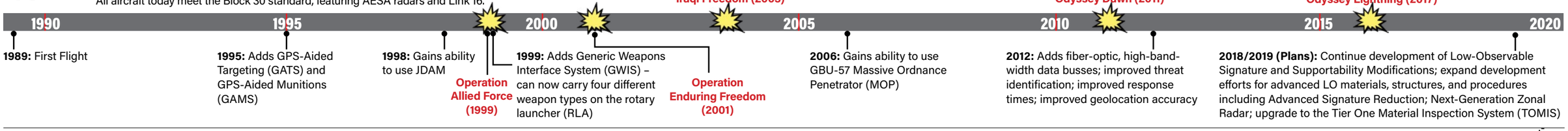
Esoterica

- 1.9 million lines of code
- Cot on board (with only two seats, pilots can stow a cot for resting during long flights)

- B-2 carries more guided weapons than any other platform (80x GBU-38)
- Only about 700 people have flown in a B-2; everyone who has is assigned a unique "Spirit number"

Upgrades

The original B-2s have benefited from significant enhancements since the planes were first introduced. All aircraft today meet the Block 30 standard, featuring AESA radars and Link 16.



1989: First Flight

1995: Adds GPS-Aided Targeting (GATS) and GPS-Aided Munitions (GAMS)

1998: Gains ability to use JDAM

1999: Adds Generic Weapons Interface System (GWIS) – can now carry four different weapon types on the rotary launcher (RLA)

2006: Gains ability to use GBU-57 Massive Ordnance Penetrator (MOP)

2012: Adds fiber-optic, high-bandwidth data busses; improved threat identification; improved response times; improved geolocation accuracy

2018/2019 (Plans): Continue development of Low-Observable Signature and Supportability Modifications; expand development efforts for advanced LO materials, structures, and procedures including Advanced Signature Reduction; Next-Generation Zonal Radar; upgrade to the Tier One Material Inspection System (TOMIS)

Ongoing Upgrades Include:

- Defensive Management System Modernization (DMSM) to improve survivability in contested environments, primarily by locating and identifying enemy radars.
- Adaptable Communications Suite (ACS) providing beyond-line-of-sight communications to enable time-sensitive mission updates and in-flight retasking.
- Low-Observable Signature and Supportability Modifications (LOSSM) to improve the B-2's stealth signature and reduce the amount of maintenance its stealth materials require.
- Radar-Aided Targeting System (RATS) that uses the B-2's radar to provide precision weapon targeting in GPS-denied environments.
- JASSM-ER integration to enable B-2s to carry 16 of the extended-range variant of the AGM-158 Joint Air-to-Surface Standoff Missile (JASSM).

Potential future upgrades could include:

- Ability to carry both smart bomb rack and rotary launcher to maximize loadout flexibility.
- Airspeed and altitude hold autopilot functionality to reduce crew fatigue.
- Integration of hypersonic weapons on a more survivable launch platform.
- Integration of anti-ship weapons such as the Long-Range Anti-Ship Missile, something the influential think tank CSBA has called for as a means of countering the Chinese Navy.

Graphic by Dashton Parham and Mike Tsukamoto; Photos: USAF

A KC-46 refuels a B-2 in April over Edwards AFB, Calif. It was the first time the two aircraft types linked up.

Photos Christian Turner/USAF; Pfc. Jason Northcutt/US Army

Refueling

Fueling receptacle rotates to open and closed position.

Historic Details

Operation Allied Force (1999)

- First combat mission—March 24, 1999.
- First sustained bombing campaign launched from continental United States.
- Two B-2s flew more than 31 hours from Whiteman AFB, Mo., to attack multiple targets in Kosovo.
- Though flying less than 1 percent of total missions, B-2s destroyed 33 percent of all targets in conflict's first eight weeks.

Operation Enduring Freedom (2001).

- Longest flight—44 hours, October 7-8, 2001—longest air combat mission in history.
- *Spirit of America* and five other B-2s were first to enter Afghan airspace following the 9/11 attacks on New York and Washington, D.C.
- After dropping ordnance, the planes made a 45-minute pit stop with engines still running for crew and service change, then flew home 30+ hours to Missouri. Total flight time, including the pit stop, was about 75 consecutive hours.

Operation Iraqi Freedom (2003)

- 6 B-2s struck critical regime infrastructure on night 1 (3 from Whiteman AFB, 3 from Diego Garcia).
- B-2s dropped 1.5 million pounds of ordnance on 600 targets in 49 sorties over 10 days.
- B-2s achieved 85 percent mission capable rate (higher than B-1 or B-52).

Operation Odyssey Dawn (2011)

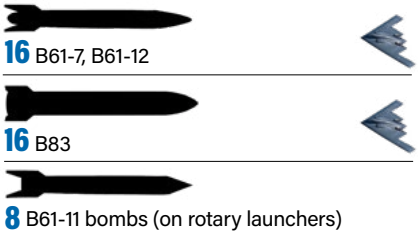
- 3 B-2s launch from Whiteman AFB; one turns back, but two strike and destroy 45 hardened aircraft shelters near Sirte, Qaddafi's hometown.
- Flew overwater route via Mediterranean, eliminating need for overflight/diplomatic permissions.
- Total mission is 25 hours, with two refuelings in each direction.

Operation Odyssey Lightning (2016)

- 2 B-2s launch from Whiteman AFB and drop 108 500-lb GBU-28 JDAMs on ISIS mobile targets in Libya.
- 34-hour mission is supported by 15 KC-135 and KC-10 tankers.

Armaments

Nuclear



16 B61-7, B61-12

16 B83

8 B61-11 bombs (on rotary launchers)

Conventional

80 Mk 62 500-lb sea mines

80 Mk 82 500-lb bombs

80 GBU-38 JDAMs

16 GBU-31 JDAMs

16 Mk 84 (2,000-lb) bombs

16 AGM-154 JSOWs

16 AGM-158 JASSMs

8 GBU-28 LGBs

2 GBU-57 Massive Ordnance Penetrators

B-2 is the only aircraft that can deliver these weapons.

Photo: SrA. Joel Pfiester

80 GBU-38 guided ammunitions inside one bay door of a B-2 before Libya mission.

Accidents

Photo: FAA

2008: *Spirit of Kansas* crashes shortly after takeoff at Andersen AFB, Guam. Both pilots eject safely, before the aircraft is destroyed. Investigators later blame moisture from heavy rains for maintenance crews improperly calibrating air-data sensors.

Photo: Staff Sgt. Alexandra Boutte

2010: *Spirit of Washington* suffers a catastrophic engine fire in Guam, severely damaging the aircraft and all four engines. With only 20 B-2 aircraft in the inventory, however, the Air Force returns the jet to service four years later.

VERBATIM

Higher Learning

Photo: SSgt. Janiqua Robinson

"There aren't a whole lot of places where good airspace and good schools go together."

Gen. Mike Holmes on one of the problems in retaining pilots who have families, at Air Force Life Cycle Industry Days, Dayton, Ohio, [June 19].

Pirates in Spaaace

Graphic: Mike Tsukamoto/staff

"Pirates threaten the open seas. And the same is possible in space. In this way, too, I believe we now should recognize the necessity of a Space Force."

Sen. Ted Cruz (R-Texas), remarks at Senate Committee on Commerce, Science, and Transportation subcommittee hearing on space and aviation [May 15].

HELP WANTED

"I don't trust the Air Force, on its own, within its existing structure, to properly prioritize space. And I would challenge anyone who's gonna argue that point with me."

HASC Chairman **Rep. Adam Smith (D-Wash.)** to defense reporters [June 10].

Photo: PLA Rocket Force

Unidentified Flying Object

"Do you believe in this world there are UFOs?"

China's Peoples Liberation Army Rocket Force, on its official Weibo social media account, showing a mobile ICBM launcher [June 2019].

Photo: Russia's Presidential Press & Information Office

No Lipstick Needed

"I could kiss Putin. Not just because he's an attractive, short, shirtless man, but because he made election security a bipartisan [issue]."

Lt. Gen. Bradford J. Shwedo, director for command, control, communications, and computers/cyber and chief information officer for the Joint Staff, on the power of a common enemy in rallying the interest of national leaders to defend against cyber attacks on the election system during a lecture at the Mitchell Institute for Aerospace Studies [June 6].

Information Warfare

"If the US is to compete effectively with our near-peer adversaries, we must realign our approach to the information environment. Our government currently deals with the infospace in a reactive and disjointed manner—there is no standardized political-military doctrine or interagency methodology guiding our responses to information warfare attacks. In many ways, DOD should approach the infospace as it does physical space—by mapping, analyzing, and maneuvering in the information environment with the same principles currently applied to geospatial terrain and human networks. Instead of treating the infospace as an add-on to kinetic operations, we need to accept it as the primary operational domain for day-to-day competitive activities."

Center for Naval Analysis report [May 2019].

Photo: POIC Dominique Piniero/USN

Look Before You Leap

"I understand ... about quarterly earnings statements and bottom lines. But, just as I have to think about the close fight and the deep fight, what I am asking Industry to do is think about the close fight and the deep fight. What may be convenient for you in the close fight, may be inconsistent with your interests in the deep fight as you start seeing a world that isn't informed by US leadership—that isn't informed by US values."

Chairman of the Joint Chiefs of Staff, Marine Corps **Gen. Joseph F. Dunford Jr.,** upon receiving the Eisenhower Award from National Defense Industrial Association [May 10].

Bravo!!

Graphic: SVG SILH

"Our vision is to eliminate passwords, ... continuous multifactor authentication (CMFA) will run seamlessly in the background allowing access through biometric data distinct to each user."

DISA Director **Vice Adm. Nancy Norton** in her keynote address at AFCEA's TechNet Cyber Conference in Baltimore [May 16].

SIGN ME UP

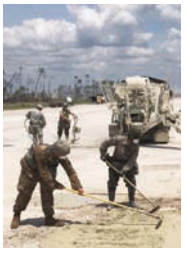


Photo: SSgt. Thomas Swanson

"I had to come back on to Active Duty for this. It's really a once-in-a-lifetime opportunity to almost start from scratch and build a new base."

Brig. Gen. Patrice A. Melancon, on rebuilding hurricane-damaged Tyndall AFB, Fla. [June 6].

Arlington's Southern Expansion

With space running out, Arlington spreads out to surround the US Air Force Memorial—and to limit who can be buried on its hallowed grounds.

By Brian W. Everstine

The spires of the Air Force Memorial, adjacent to Arlington National Cemetery, soar into the evening sky as visitors study a black granite wall inscribed with Air Force core values such as valor, integrity, and service.

Photo: Mike Tsukamoto/staff

The day after Virginia voted to secede from the union in 1861, US Army troops crossed the Potomac and took a strategic hill overlooking Washington, D.C. From a hilltop mansion built by President George Washington's adopted grandson, they had a commanding view of the White House and Capitol, and they quickly settled in on the property. Almost exactly three years later, the first American soldier was buried there.

There would be many more. The estate belonged to Mary Custis Lee, wife of Gen. Robert E. Lee, and both she and her children had been raised there. Lee, who had declined President Abraham Lincoln's offer to command the Union Army in a fight against the South, had hoped to preserve the property, but Union Gen. Montgomery C. Meigs had other ideas. In his view, Lee was a traitor, and his punishment deserved to be severe, personal, and lasting.

"I recommend," Meigs wrote in June 1864 to Secretary of War Edwin M. Stanton, that "the land surrounding the Arlington Mansion, now understood to be the property of the United States, be appropriated as a National Military Cemetery."

Flash forward 155 years. Meigs never imagined more than 200 acres would be needed, even in the midst of the bloodiest war in American history. He certainly couldn't have envisioned that Arlington National Cemetery would still be operating today, the final resting place for 375,000 men and women, sprawling out into 624 acres of rolling hills, dotted with row after row of white marble headstones. And at the present rate of activity, Arlington will run out of its remaining 67,000 burial sites in about 12 years.

With more than 20 million living veterans today, nearly 2 million currently serving members in the Active, Guard, and Reserve components, and tens of thousands of new veterans becoming eligible for burial at Arlington every year, change is in the wind.

"It's a tough reality," Karen Durham-Aguilera, the executive director of Army National Military Cemeteries, told lawmakers in March 2018. "We cannot serve that population."

CHANGES COMING

For Arlington National Cemetery to remain an active burial ground, something has to give. Two sets of changes are coming: First is a major expansion, the first since the Millennium Project begun in 2007—which was the first expansion in almost 40 years. Surrounded by highways, parks, the Pentagon, and other military facilities, space is limited. But there is room on the south side of the cemetery, where the former Navy Annex once stood, up the hill from

Arlington National Cemetery: A complex history

From the first military burial in Arlington National Cemetery in 1864 through its pending southern expansion, America's most iconic military burial ground has been steeped in history—and controversy.

1800

1802: George Washington Parke Custis, the adopted son of George Washington, builds Arlington House on a hill overlooking the Potomac River and the nation's capital.

1820

1831: Custis' daughter, Mary Anna, marries Lt. Robert E. Lee in the main hall of the mansion. The couple lives in the Custis-Lee mansion and raise their children there.

1840

April 1861: Having declined the Union Army, Robert E. Lee takes command of the Confederate Army instead.

1860

June 1862: Congress approves a law to collect taxes on real estate in "insurrectionary districts," leading to a tax of $92.07 on the Custis-Lee estate in Arlington.

May 1861: Militia occupy the property and the Union Army transforms Arlington House into a military headquarters.

May 13, 1864: Pvt. William Henry Christman is the first non-family member buried on the grounds.

1864: Secretary of War Edwin Stanton declares the grounds a military cemetery. The government acquires the land at a tax sale for about $26,800.

1874: Custis Lee, the heir to Robert E. Lee's estate, sues for ownership of Arlington.

1880

1868: Gen. Ulysses S. Grant and Gen. James Garfield attend the first Decoration Day commemoration held at the cemetery. Decoration Day is eventually renamed Memorial Day.

December 1882: The US Supreme Court rules 5-4 in Lee's favor that the property had been confiscated without due process, returning ownership of the estate to Lee.

March 1883: Custis Lee sells the estate back to the government for $150,000, and the land becomes a military reservation.

1887: The Army's Quartermaster General orders the closure of nearby Freedman's Village where the government constructed housing for up to 3,000 freed slaves. In all, some 4,000 former slaves were buried in Section 27 of the cemetery.

1900

June 1900: Congress authorizes a Confederate section of the cemetery. Soldiers of the Confederacy already interred at the cemetery are moved to the new section the following year.

June 4, 1914: A memorial to Confederate soldiers is constructed.

1920

Arlington National Cemetery Southern Expansion

The southern expansion incorporates the grounds of the former Navy Annex, roadways, medians, and other space to add room for 60,000 burial spots in the cemetery.

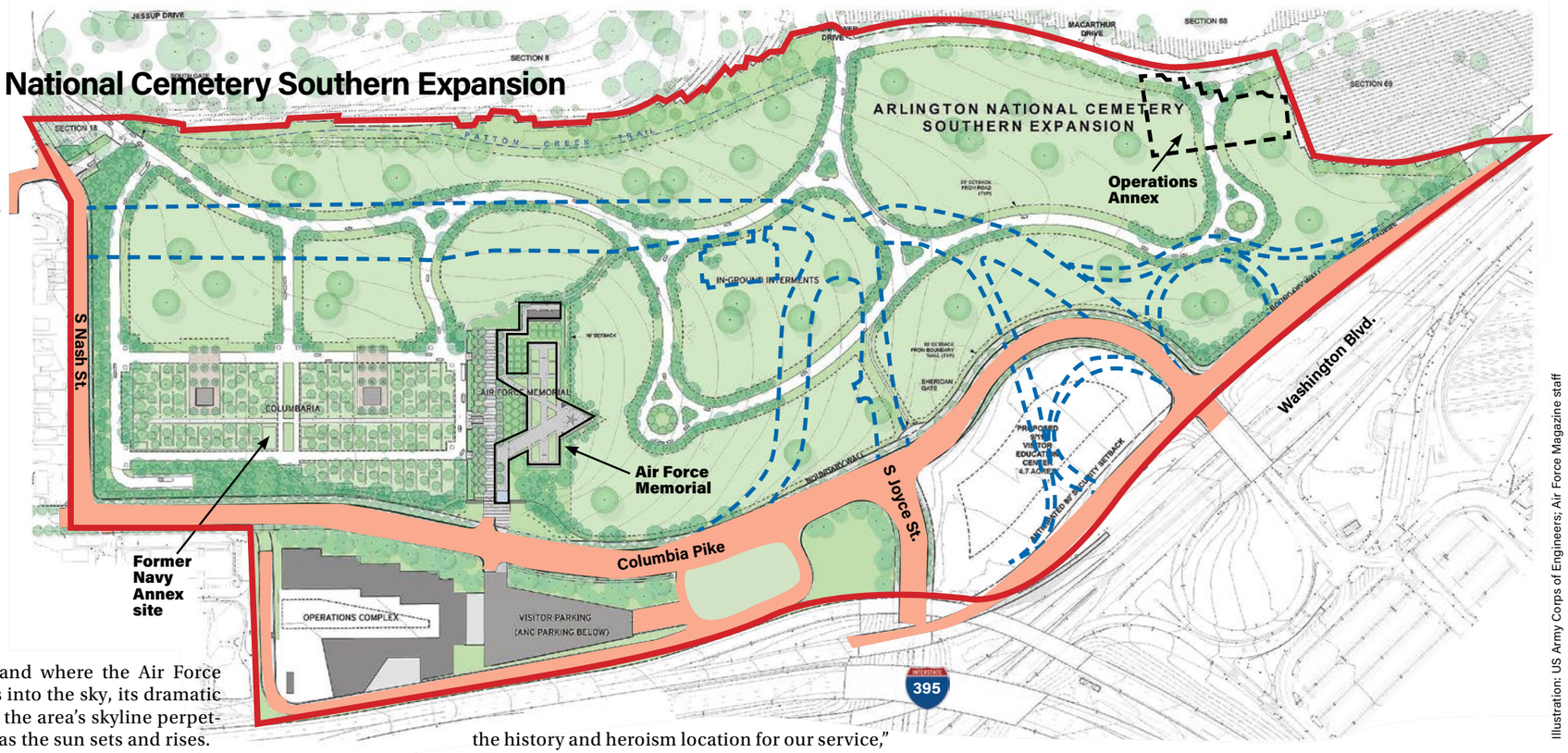


Illustration: US Army Corps of Engineers; Air Force Magazine staff

Photo: Wikipedia

Arlington House, once home to Robert E. Lee and his family, has been surrounded by gravesites since the Civil War.

the Pentagon, and where the Air Force Memorial soars into the sky, its dramatic contribution to the area's skyline perpetually changing as the sun sets and rises.

A five-year construction plan aims to add up to 60,000 new burial plots and an additional columbarium to hold the ashes of thousands more. The plan would turn the Air Force Memorial into the centerpiece of a new southern entrance to the facility, potentially bringing thousands more people to the memorial each year.

The change will alter the landscape, traffic flow, and even the way people experience the memorial, which today is accessible 24 hours a day, but under the new plan, it would be contained within the cemetery's perimeter and only accessible during daylight hours. The memorial entrance would have a multilevel parking facility and an anticipated five-fold increase in visitors, said Maj. Gen. James A. Jacobson, commander of the Air Force District of Washington.

"This will further enshrine the Air Force Memorial as the history and heroism location for our service," he said. "Tying it in with the cemetery does what it can't do standing alone."

But adding another 60,000 burial sites only forestalls the inevitable. At the present pace, the cemetery will run out of space in just 25 years. The second forecasted change will help the Pentagon and Congress keep it operating far longer than that, which is why they're committing to modifying the rules that say who can be buried at the cemetery.

In November 2018, the Advisory Committee on Arlington National Cemetery recommended that interment at Arlington limit in-ground burial to service members who were:

- Killed in action
- Wounded in action and awarded the Purple Heart Medal
- Awarded a Silver Star, or higher, decoration
- Held as prisoners of war
- Or who died on Active Duty

Additionally, the panel recommended above-ground inurnment for remaining World War II and Korean War veterans who do not otherwise qualify.

Under the change, military retirees who served during the Vietnam and later eras would no longer be eligible for burial at Arlington unless they had been a POW, wounded in action, or awarded an eligible medal.

Today, any Active Duty member or veteran with at least one day of active service is eligible for burial at Arlington.

A MATTER OF SCALE

The United States has 300 National Military Cemeteries, Veterans Affairs cemeteries, and state cemeteries available to veterans. Yet of all of these, Arlington is by far the most requested final resting place.

Each weekday, Arlington hosts 25 to 30 services, plus another 10 on Saturday. In 2018, almost 6,500 service members were buried at Arlington, many of them veterans of World War II, Korea, and conflicts in Southeast Asia.

"We have a very high demand of veterans and their families that want to come in to Arlington National Cemetery," Durham-Aguilera said. "The demand far exceeds our capability to meet them. So what that means is that we have families that could wait anywhere from two weeks to several months—nine months—for that date."

In September 2018, there were 3,471 burial requests in process, including 3,259 for cremation service and 212 for casketed service, according to a report released in May by the Defense Department inspector general. The number of requests, coupled with documentation requirements, is what drives delays from five to 49 weeks from the date of an initial burial request.

The cemetery's $81.7 million Millennium Project included new burial sections, including one for in-ground burial of ashes. That project added 27 acres and some 25,000 new burial spots, and it extended the cemetery's life by eight years, Durham-Aguilera told lawmakers. Even that was only a small start, however.

Expanding to the south (project "Southern Expansion"), as proposed by the cemetery and the Army Corps of Engineers, will add about 37 acres and up to 60,000 additional plots, extending the life of the cemetery to the 2050s. To accommodate that, roads must be rerouted and masses of dirt moved, beginning in 2020 and running through 2022.

May 30, 1929: President Herbert Hoover conducts the first Memorial Day ceremony at the cemetery.

April 1932: The Tomb of the Unknown Soldier is completed and opened to the public.

April 1948: The US Army's 3rd US Infantry Regiment "The Old Guard" begins its watch of the Tomb of the Unknown Soldier.

July 1948: President Harry S. Truman issues Executive Order 9981 to desegregate burials at Arlington.

November 1963: President John F. Kennedy is buried at Arlington. Four years later, he is re-interred at a new site with the eternal flame.

January 1986: A memorial to the seven astronauts killed in the launch of the space shuttle Challenger is dedicated.

1991: Cemetery leadership begins a $1.4 million project, clearing a 13-acre parking lot to make room for 9,000 new gravesites.

1996: Ownership of 12 acres of woodland is transferred from the National Park Service to the cemetery, making room for more burial sites.

1998: Remains from the Tomb of the Unknown Soldier are identified as USAF 1st Lt. Michael Joseph Blassie, who was shot down in Vietnam in 1972. The remains are returned to his hometown of St. Louis.

1999: The Army transfers eight acres from Fort Myer to the cemetery.

2000: Congress authorizes the Defense Department to demolish the Navy Annex and transfer the property for cemetery expansion.

September 2002: A memorial to the 184 victims of the 9/11 attacks at the Pentagon is dedicated.

2007: The cemetery begins the Millennium Project, making room for some 26,000 new gravesites and 5,000 inurnments.

February 2004: A memorial to the astronauts killed in the space shuttle Columbia disaster is dedicated.

2013: The Navy Annex is demolished. Congress approves $84 million for the Defense Department to construct the Millennium Project.

2004-05: Property expansion continues with four acres from Arlington County and 10 from Fort Myer.

August 2018: A draft environmental assessment of the southern expansion is released.

2025: Construction for the southern expansion ends.

2023: Anticipated roadway construction ends, cemetery construction begins.

1940 1960 1980 2000 2020

The 2019 National Defense Authorization Act provides $60 million of an anticipated $350 million to pay for the project; in all, $219.1 million is already authorized. Air Force and Army officials have begun discussing the plan and sharing the vision with stakeholders.

Once the roadwork is done, cemetery construction and earthmoving can begin in earnest to better accommodate more burial plots. That work is expected to be finished in 2025.

MEMORIAL RISING

Smack in the center of the planned expansion stand the three curved spires of the Air Force Memorial, which represent the contrails and flight path of three jet fighters flying a signature aerial maneuver in which they converge on a central point and then pull straight up and climb skyward before peeling away from one another.

The memorial was initiated by the Air Force Association through a Memorial Foundation, and in 2017 AFA transferred ownership responsibility to Air Force District of Washington.

"I think that will bring such prominence to the memorial and encapsulate it in a way that integrates it further in the Washington, D.C., psyche," Jacobson said.

As such, it will change the way it is seen and experienced. A summer evening concert, as in the past, won't be possible once the site is part of Arlington. On the other hand, the new situation will better suggest the solemnity of the site, which is framed by granite walls bearing the names of Air Force Medal of Honor recipients.

"It is about retaining the memory of the history, heritage, and heroism of service," Jacobson said. "It's alone. Now, it will be encapsulated in a venue that does that for the entire nation."

The Air Force District of Washington has worked side by side with Arlington National Cemetery to plan for the project, and the cemetery's leadership has responded to all of the Air Force's concerns throughout the process, Jacobson said, and he updates Air Force Chief of Staff Gen. David L. Goldfein monthly, a sign of the Chief's focus and concern.

As part of the project, the cemetery and Air Force District of Washington are evaluating the site for inclusion in the National Register of Historic Places, an unusual step for such a new structure. But while most facilities must wait at least 50 years before they may be considered, there are cases where newer facilities can be listed. Doing so would be a "testament to the design and the memorial's place in the architecture of the city," Jacobson said.

Public support is high. A July 2017 survey conducted by the Army and the cemetery polled 28,000 people, 94 percent of whom supported keeping the cemetery remain active well into the future, according to the Army.

CRITERIA CHANGES

Changing eligibility for burial at Arlington will be more controversial, however. Barely 50 percent of respondents recognized a need to alter eligibility rules as a necessary means of extending the operational life of the cemetery. On the other hand, 70 percent said the criteria would have to change if no expansion is completed.

Today, with more than 21 million living veterans and dependents eligible for burial at Arlington, space is running out and time is short to find a solution. The Army Secretary faces a Sept. 30 deadline to determine what changes should be made.

Cremated remains of any veteran with at least one day of active service other than training and an honorable discharge are eligible for above ground inurnment. Likewise, spouses, widows, widowers, minor children, and permanently dependent children of eligible veterans are also eligible for above-ground interment. In-ground burial is limited to service members killed in action, killed on Active Duty, awarded qualifying medals, or who have retired from the armed forces.

The Military Officers Association of America sharply criticized the plan in a letter to then-Army Secretary Mark T. Esper in April: The recommendations "break faith with those who are eligible today," the letter said. "No one can predict how Arlington will be perceived or appreciated a century from now, nor can we sacrifice the benefit of the living population of veterans to preserve burial space for those not yet born."

The Advisory Committee acknowledged the challenge in outlining its plan. "The committee makes these recommendations fully aware that these are difficult choices and respects that there are differing views on this sensitive issue and that there are currently eligible populations that will be excluded from ANC."

In congressional testimony, the Air Force Association and others opposed curtailing eligibility for Arlington. "We strongly believe that our nation's decision-makers should explore an 'all of the above' strategy, to include land expansion and land optimization before reducing or curtailing eligibility," said AFA's Director of Government Relations Keith Zuegel in testimony before the House Armed Services Military Personnel Subcommittee in 2018. "It is important to keep the cemetery viable as long as possible for future Medal of Honor recipients, those killed in combat, and top medal awardees."

Having earned a Silver Star during the first Gulf War, Zuegel, a retired colonel, would be eligible for burial regardless of whether eligibility for Arlington burials changes. Others who might be even more famous, however, would not be so fortunate. "If the proposed rules were in place today, World War II hero Lt. Col. Dick Cole would not be allowed to be buried in Arlington," Zuegel said, referring to the last surviving member of the Doolittle Raiders. Cole, who died April 1, was buried soon after in Arlington. "He didn't meet the new eligibility criteria." Meanwhile, he added, an Active Duty airman killed in a car accident on their way home from basic training could be buried in Arlington.

For now, though, the focus should be on answering the existing need, Zuegel said. More can be done to develop land adjacent to the cemetery and make it part of Arlington. "If the Air Force Memorial can be brought inside the boundary," he added, "why not the Marine Corps Memorial" depicting the raising of the flag on Iwo Jima. That property is adjacent to Arlington land, but is outside its jurisdiction.

AFA issued a joint statement last fall with the Association of the US Army, the Association of the US Navy, and the Marine Corps League, arguing there is still room to further expand Arlington National Cemetery. "Although the cemetery's majestic serenity should be largely preserved, there are avenues to increase burial locations without losing the cemetery's solemn presence," the organizations said. "In addition to exploring expansion possibilities, more above-ground inurnments should be considered." ✪

Fast-Forward with 5G

The next generation of wireless networks is coming.

Photo: A1C Caitlin Russell

A1C Angelo Trent views a portable maintenance aid during exercise Patriot Grizzly at Marine Corps Air Station Miramar in San Diego. 5G wireless networks would deliver dramatically increased data rates to flight line equipment.

By Rachel S. Cohen

Sometimes the most valuable military assets are those you can't see. That may be the case with 5G—the lightning-fast, next-generation wireless network technologies that commercial network providers such as Verizon and AT&T are now bringing online.

5G is more than a better, faster cell phone network. It's a transformative data-sharing and communications capability that will radically increase bandwidth and speed, enabling nascent technologies such as artificial intelligence to deliver their full potential over wireless connections. That means enhanced command and control and situational awareness for everything from driverless technology and improved traffic flow to predictive maintenance and high-fidelity simulation and training.

5G employs compression technology and high-speed transmission to increase wireless network speeds twentyfold over today's 4G LTE networks. That kind of performance will reduce latency, or lag time, which is what makes real-time uses like driverless cars possible.

The challenges are as great as the opportunities, however. In the United States, commercial 5G technology is for now restricted to millimeter-wave

"Our base areas, we tell them, are pretty large—it's not just on the flight line, it's a big, huge circle."

—Frank Konieczny, the Air Force's chief technology officer

USAF and Verizon Will Bring 5G Networks to 10 Bases Beginning Soon

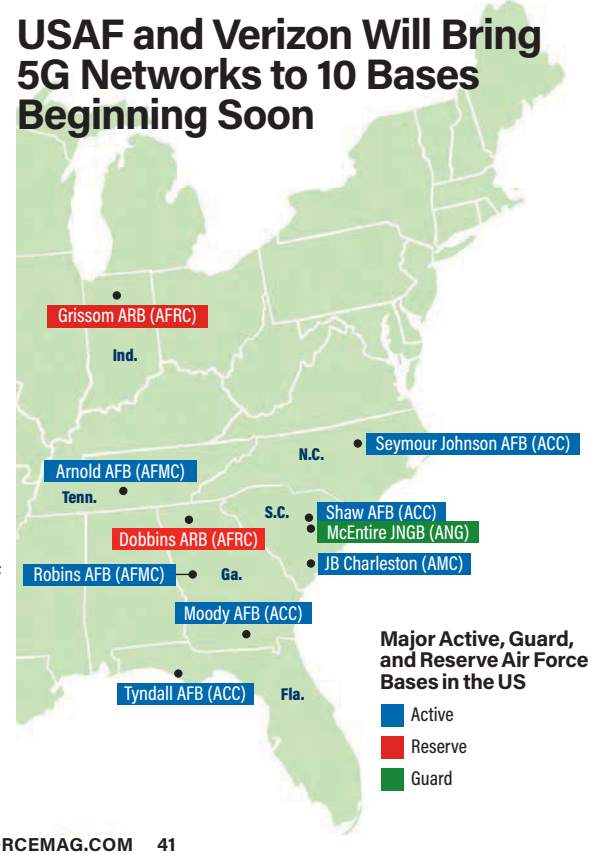


Photo: SSgt. Mercedes Taylor

MSgt. Ryan Stark (l) leads SSgt. Krystopher Fletcher through a virtual reality (VR) scenario emulating the interior of an aircraft at Little Rock AFB, Ark. VR could get a boost from 5G wireless networks.

spectrum that will work well in urban areas, interiors, and over short distances, but will break down over longer distances. 5G implementations will also use spectrum beneath 6 GHz, a band largely controlled by the Defense Department in the US. That disconnect is a critical piece of the ongoing controversy pitting the US against China, and in particular, China's 5G technology champion, Huawei.

CONNECTING BASES

The Air Force, meanwhile, is forging ahead as an early adopter of commercial 5G technology. The service is teaming with 5G wireless network providers to install commercial network infrastructure on 10 bases now, with more to come. It plans to use that wireless connectivity to support secure mission applications.

The Air Force's nearest-term project enlists Verizon to bring 5G infrastructure to:

- Moody AFB, Ga.
- Robins AFB, Ga.
- Dobbins ARB, Ga.
- Seymour Johnson AFB, N.C.
- JB Charleston, S.C.
- Shaw AFB, S.C.
- McEntire JNGB, S.C.
- Tyndall AFB, Fla.
- Arnold AFB, Tenn.
- Grissom ARB, Ind.

By clustering small and large bases in each agreement, the Air Force is enticing companies to take on smaller populations that might otherwise be less attractive from a business perspective.

Verizon is now in the early stages of planning where antennas and other hardware should go. At the same time, Verizon and AT&T are each pursuing parallel efforts in building out 5G networks in a variety of US cities. In a sense, then, these initial Air Force forays treat military bases like self-contained metropolitan areas.

"Our base areas, we tell them, are pretty large—it's not just on the flight line, it's a big, huge circle," Frank Konieczny, the Air Force's chief technology officer, said in a May 20 interview. Coverage is focused on where the network will be used, however. "We didn't want to go from fence line to fence line," he said. "We concentrated on where the populace was and where they would be working."

Konieczny said the rollout costs the Air Force nothing. Verizon will install the 5G infrastructure on or near Air Force property under no-fee leases stretching up to 25 years. "It's not a contract for money, it's a contract that says you can use our facilities, our ground and buildings, to put on your devices," he said. "We're not paying for any infrastructure modifications to support the commercial side. They are paying for it themselves."

Verizon beat out AT&T for the first group of bases, Konieczny said, and both are expected to compete for the next set, which stretch from California to North Dakota. A local wireless consortium could also vie for the Northwest cluster this summer, he said. Overseas bases aren't yet part of the initiative.

Some lawmakers are already backing the effort: The Senate Armed Services Committee's mark of the 2020 defense policy bill offers funding to start work at two locations.

As the Air Force connects more and more of its systems to a wireless network, it must also bake in greater security. 5G supports software-defined security features that are richer than today's 4G networks, but that does not make the networks invulnerable.

"A security standard should be established for connections to/through 5G networks, such as all traffic must be encrypted using DOD encryption standards and separated into separate secure network slices for transmission," Konieczny said.

The Pentagon is likewise considering how to deal with network traffic and establishing alternative paths for data where and when some part of the spectrum is unavailable.

FASTER IS BETTER

So what might the Air Force achieve if it can securely move data at rates up to 10 Gbps—20 times faster than today's fastest 4G LTE mobile networks?

Imagine high-speed wireless connectivity supporting flight line test equipment, or lightning-fast animated simulation and training, or full-motion, high-definition video to support telemedicine, and instantaneous artificial intelligence for biometric identification.

Officials hope it could make operations more efficient and maintenance sensors more helpful at a reborn Tyndall

AFB, Fla., where the service plans to build the technology into its "base of the future."

And 5G technology is not limited to commercial wireless networks. The same capabilities could also be used in targeting and command, control, and communications for hypersonic weapons, Pentagon spokeswoman Elissa Smith suggested.

The Defense Innovation Board said in an April report on 5G that it also "has the potential to strengthen existing missions like nuclear" command, control, and communications.

"At an enterprise level, 5G can vastly improve day-to-day tasks such as logistics and maintenance, elevating the efficiency and speed of work across DOD," the report said.

Indeed, Samsung predicted in a 2018 blog post that 5G would help reinvent how the Air Force monitors its supply chain and tracks its assets. "Flight line operations and maintenance teams can leverage secure tablets within a secure 5G environment to view real-time inventory and schematics, better utilize spare parts, manage aircraft diagnostics solutions, and more," the company wrote.

Konieczny said a "flight line of the future" project is already underway that would bring secure wireless connectivity to maintainers where they work.

At a Senate Judiciary Committee hearing in May, Christopher C. Krebs, director of the Department of Homeland Security's Cybersecurity and Infrastructure Security Agency, said greater bandwidth will provide new capacity to support the ever-expanding "Internet of things"—network-enabled devices embedded in everything from base maintenance and security sensors to training systems.

A Defense Department-wide 5G experiment will look to create a "smart" port or depot by connecting maintenance and test systems together, automating work that airmen do manually today, Konieczny said. "It's a way of actually knowing where all your assets are going," he said. Smart systems could automatically track where spare parts are installed, eliminating time-consuming paperwork. "We can link together, dynamically, what parts are existing in a particular component based upon the tags they have already attached to them."

MULTI-DOMAIN OPERATIONS

5G also promises to enable Air Force Chief of Staff Gen. David L. Goldfein's vision for multi-domain operations, speeding decision-making through enhanced situational awareness.

Air Force Chief Scientist Richard J. Joseph said in an April 15 interview that 5G capability will come first, followed by use cases that leverage it. "It's sort of 'build it and they will come,'" he said. "You will see protocols for how we move our information around, because now we're moving a lot more information. The question is, when we have the capacity to move a lot more around, will other things happen? Will we move so much information around that our problem will be sifting through the information and figuring out what it means?"

As 5G drives new ways of waging war, airmen will have to train and think differently. That promises ripple effects in areas like Air Education and Training Command's Pilot Training Next initiative and in how missions are organized and planned.

"Mission planning may be more interesting. We don't know how they're going to do that yet because we haven't talked about it yet," Konieczny said. "If we have good 5G connectivity, you may be able to get [intelligence, surveillance, and reconnaissance] information into your virtual reality headgear and understand it better."

Photo: SSgt. Ceaira Tinsley

Using a laptop and portable diagnostic equipment during exercise Africa Lion 2019 in Morocco, avionics maintainers from the 555th Aircraft Maintenance Unit perform an airspeed-leakage test on an F-16C.

Elsa B. Kania, an adjunct senior fellow in technology and national security at the Center for a New American Security, sees training as a natural beneficiary of increased speed and decreased latency or delay.

"The intersection between AI and 5G will be really interesting, and it goes both ways," Kania said. "You'll need AI to manage 5G systems, given the complexity, and the connectivity that 5G provides" will allow increased machine-to-machine communications so data fusion and AI capabilities run more smoothly.

Kania said more can be done in experiments as well as in evaluating potential risks and deciding how battle networks should operate in a world where untrustworthy network and hardware providers could be part of the ecosystem.

The Air Force should invest more money in basic research for next-generation telecommunications like 5G, Kania said.

"Given that a lot of 5G applications are relevant in air, space, and cyber, I think the Air Force could be at the forefront of a lot of this going forward as they build upon existing programs and research to explore new directions," she said.

TOTALLY WIRELESS NETWORKING?

While the Air Force's regional 5G rollout gets underway, another information technology pilot program could also lay the foundation for future progress: Enterprise IT as a Service (EITaaS).

Konieczny imagines the Air Force could someday replace fiber and wireline networks with a totally wireless solution.

Mike Leff, AT&T's vice president for defense, said wireless infrastructure could be transformative. "We view it as a platform to explore how the Air Force can ultimately benefit from the power of 5G and a network that delivers faster speeds and response times," he wrote in an email. "We can explore the future potential for a massive number of smart connections that can enable new mission capabilities like never before."

Huawei, Spectrum, Global Competition, and the Future of 5G

Most mobile communication today takes place at spectrum bands below 3 GHz, according to mobile technology chipmaker Qualcomm. But 5G wireless networks in the US will operate in the millimeter-wave band, between 30 GHz and 300 GHz, a part of the spectrum set aside for this use in this country, but not worldwide.

This issue is at the center of today's struggle between the US and China over 5G technology and the role played by Chinese telecommunications technology provider Huawei.

In the millimeter-wave band, signals do not propagate well over long distances, which poses a problem: While acceptable for dense urban and crowded indoor areas, where positioning additional antennae is relatively easy, the higher frequencies are ill-suited to open areas where frequent placement of antennae is impractical. There, bands below six GHz ("sub-6") are more effective.

The trouble is, that spectrum isn't available in the US for general commercial use—it's reserved for the Defense Department. DOD must now determine if and how to share it with commercial users.

Some suggest the military should focus on higher bands. "Access to the 5G millimeter-wave bandwidth will be critical to operations in all warfighting domains, in particular, space C2," wrote Air University scholars in a 2018 report. "[Electromagnetic spectrum] experts assess that 5G market share could be 'locked up' by US competitors in under three years with no second chances to enter the race."

The Defense Innovation Board, however, came to a different conclusion. It called DOD's focus on millimeter-wave spectrum "fundamentally flawed" and "impractical."

"The United States may choose to continue down the path of mmWave, but the rest of the world is focused on building out sub-6 infrastructure, with China in the lead," the DIB wrote. "Although mmWave components are typically more compact than sub-6 components, mmWave requires many more base stations positioned within close proximity of one another to maintain connection (and even then, there is still the risk that interference such as objects moving in front of the base station or weather will interrupt the connection)."

The board pointed to a 2010 broadband plan that could offer a blueprint for sharing the sub-6 part of the spectrum with non-DOD users by giving DOD priority access while allowing commercial users access when that spectrum is not in military use.

The DIB raised concerns that crowding sub-6 could reduce system performance and create vulnerabilities, and that tools built for certain parts of the spectrum would not be compatible with tools built for the others.

"In the current 5G competition, neither DOD nor the United States writ large is in a position to dictate the content and integration of the 5G supply chain—our focus on building a mmWave 5G ecosystem leaves us out of the global supply chain for the sub-6 5G ecosystem," the DIB wrote. "This mismatch will create serious security risks for DOD going forward if the rest of the world accepts Chinese products as the cheaper and superior option for 5G."

The DIB issued three public recommendations and one classified suggestion to DOD for moving forward on 5G.

■ First, come up with a plan for sharing parts of the sub-6 GHz spectrum that lays out how much—and which—bandwidths should be shared, when, and how it may affect DOD systems. Stop focusing on the more limited mmWave and instead think about how to coexist with civil operations on the 5G network. Prioritize moving to the most developed bands to make the jump faster.

"5G capability requires larger bands of spectrum, and without that additional bandwidth, the United States will not gain true 5G capability beyond the limited range that mmWave can provide," according to the DIB. "In the next year, DOD is in the position to enable or inhibit 5G adoption in the United States based on its use of sub-6 GHz spectrum."

■ Second, the report predicts the US will likely lose wireless network dominance. DOD should funnel research and development funds toward system security and resiliency, including testing and experimenting on technology past 5G, and must assume that all network infrastructure could be hit by cyberattacks.

■ Third, the DIB wants DOD to advocate for a stronger supply chain that is rewarded for its security and punished with heavy tariffs when faults are discovered. The DIB said the "Five Eyes" intelligence-sharing partners (the US, UK, Canada, Australia, and New Zealand) and NATO should adopt the same tariffs, and allies need to protect their own industrial bases as well.

Notably, the DIB predicts the move to 5G could also increase the likelihood of offensive cyber operations as defense gets harder.

Ready or not, 5G is coming—and the Pentagon's innovation advisers aren't entirely optimistic.

"Gaining a competitive edge over China [in sub-6] would require action at a rate and magnitude previously unseen within DOD," the DIB warned. "For this reason, it is probable that most of the world outside of the United States will adopt a sub-6 5G solution, forcing DOD to operate on a 'post-Western' wireless ecosystem."

—Rachel S. Cohen

Under EITaaS, the Air Force is outsourcing IT services to AT&T and Microsoft under three-year agreements ending in September 2021. Instead of buying a specialized, overarching IT system, the companies will design a more efficient and secure data network using commercial products at Buckley AFB, Colo., Offutt AFB, Neb., JB Elmendorf-Richardson, Alaska, Hurlburt Field, Fla., Cannon AFB, N.M., and Maxwell AFB, Ala., according to the Defense Department.

The bases involved should see 5G by 2021 or 2022, Leff said.

Leff expects bases will see a combination of existing 4G LTE coverage across the installation, plus 5G connectivity in specific areas like the flight line that demand better connectivity.

By casting a wide enough net across its bases, the Air Force is trying to structure its 5G service in a way that airmen won't feel the difference in connectivity. It also needs to figure out how to keep people and items connected once they leave the base.

"The problem space is not going to be on the base, it's going to be off the base," Konieczny said. "We're going to have clusters of bases that have 5G but it may not be widespread enough outside of that."

Pentagon leaders have started speaking publicly about their considerations for the next decade in telecommunications, albeit in broad terms.

Photo: SSgt. Alexander Henninger

Tyndall AFB, Fla., after Hurricane Michael in October 2018. Rebuilding plans include installing 5G networks and making it a "base of the future."

"In order to get relevant situational understanding, we are trading information back and forth all the time," Ellen Lord, the Defense Department's acquisition chief, said in March. "What will happen is, if we do not embrace 5G, and we are just getting going in 4G in a lot of areas, we are going to have a latency or a delay in those conversations that could render everything we have as ineffective."

Lord expects to see a "huge call to action" this year to create a national industrial policy for 5G. An "intensive dialogue" is underway about America's partnerships in Europe, where countries including Germany are attracted to infrastructure products from low-cost Chinese supplier Huawei.

Much of the discussion around 5G centers on concerns that the Chinese government, using Chinese-built 5G infrastructure, will be able to infiltrate and disrupt communications that rely on that network. Bad actors anywhere could find back doors to steal personal information and intellectual property, or use the network to launch cyber attacks and spread malware.

"Chinese telecom infrastructure dominance in a theater of operations may limit the US military's ability to conduct precision targeting that leverages signals intelligence collection on 5G telecommunications networks," Erica Borghard and Shawn Lonergan from West Point's Army Cyber Institute recently warned in a Council on Foreign Relations publication.

The US needs a framework through which it can assess risks, Krebs said, particularly when overseas operations rely on networks with Chinese components.

"If it's a mission in Europe or a mission in Africa or elsewhere, if it's running on a commercial network that's supported by Huawei ... they control whether we can communicate," Krebs said. "At that point, who cares whether they're listening in? they can control whether we can connect dots. It's increasingly about availability of the networks."

None of the four major US mobile carriers—AT&T, Sprint, T-Mobile, and Verizon—will use Chinese technology in their 5G infrastructure, Robert L. Strayer, deputy assistant secretary for cyber and international communications and information policy at the State Department, told Congress in May. The next hurdle is convincing allied countries to pledge the same.

But T. Charles Clancy, executive director of the Hume Center for National Security and Technology at Virginia Tech, sees little evidence the Chinese government is driving security flaws into equipment to benefit its military. He said 5G will be the most secure wireless network to date.

Clancy does see how China could use Huawei technology in other countries' infrastructure to "fundamentally cripple" command and control during combat operations.

Kania said such problems could come from more than just Huawei.

"I worry sometimes which vendors and which companies or technologies are we not paying attention to or scrutinizing as closely because everyone is so concerned with Huawei," she said in a May 7 interview with *Air Force Magazine*. "From what I can tell, it's been a somewhat limited conversation so far, and I would argue, unfortunately, Huawei has been taking up too much of the oxygen in the overall conversation."

As the US spends tens of billions of dollars on advanced platforms such as the F-35 and aircraft carriers, the military can't let that money go to waste by failing to secure the networks that could enable them, Sen. Richard Blumenthal (D-Conn.) warned at the May hearing.

That's why Krebs and the Trump administration see Huawei as such a critical piece of the puzzle. Security comes down to supply chain management, Krebs said. When relying on a global supply chain that runs through countries whose policies the US may not agree with, the US must take new measures to ensure its military-grade parts are cybersecure. That's why the power to direct the government to address those supply chain risks now rests with the Pentagon. And there is little question where then-Acting Secretary of Defense Patrick M. Shanahan stood on the issue.

"Huawei exemplifies the Chinese Communist Party's systemic, organized, and state-driven approach to achieve global leadership in advanced technology," Shanahan told a House Appropriations subcommittee in May. "China aims to steal its way to a China-controlled global technological infrastructure, including 5G."

Pentagon CIO Dana Deasy doesn't believe Huawei's rise around the world is the end of the story. "For me, that conversation is, let's get focused on, OK, what is it we now need to build out, where are the alternative sources we're going to go to?" he said. "I've never seen a technology that we've ever created where we've said, 'Too late, that's it, there's never going to be another choice.' " ✪

Ensuring the Common Defense:

The Case for Fifth-Generation and NGAD Airpower

By Lt. Gen. David A. Deptula, USAF (Ret.), Maj. Gen. Lawrence A. Stutzriem, USAF (Ret.), and Heather R. Penney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Ensuring the Common Defense:
The Case for Fifth Generation Airpower

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This article is adapted from the Mitchell Institute Policy Paper, Ensuring the Common Defense: The Case for Fifth Generation Airpower, *which can be downloaded in its entirety at: www.mitchellaerospacepower.org.*

The United States Air Force today is operating a fighter aircraft inventory on the brink of disaster. Most of the service's air superiority jets were designed at the conclusion of the Vietnam War, produced in the 1980s, and are ill-suited to meet future threats. Making the situation worse, aircraft such as the F-15C Eagle will wear out their basic structural integrity in the early- to mid-2020s. An immediate change in defense policy and resourcing is required to restore this critical component of US military capability and capacity, made even more urgent given the objectives of the new National Defense Strategy and real-world security challenges.

This was not the scenario the Air Force anticipated. The Air Force intended to acquire more than 750 F-22 Raptors to replace its F-15s, and 1,763 F-35 Lightning IIs to replace its F-16 and A-10 fleets. The F-22 and F-35 were designed to complement each other: The F-22 was

F-22 Demonstration Team Raptors over Northern California, en route to Travis AFB, Calif. The F-22 was optimized for air-to-air dominance and designed to complement the F-35.

Photo: 2nd Lt. Samuel Eckholm

optimized for air-to-air dominance, providing the cover for the F-35's multirole air-to-air and air-to-ground missions. Both aircraft designs incorporated stealth technology and advanced fifth-generation sensors, computing power, and secure communications tools to collaborate across areas of operation.

The end of the Cold War decreased the planned buy of F-22s to just 381, well short of the needed replacements for the F-15. The F-22 program was then prematurely canceled in 2009 at just 186 Raptors—less than half the Air Force's last stated F-22 requirement—in order to free up funds for the wars in Afghanistan and Iraq. At the time, the expectation was that the Air Force would have hundreds more F-35s by now. Instead, the Air Force has had to extend the life of its F-15 fleet well beyond planned service.

Delayed F-35 production has also meant extending fourth-generation F-16s and A-10 airframes. The average age of the Air Force's fourth-generation jets now exceeds 25 years. While they remain flyable (albeit with significant structural limitations), they are not survivable in an advanced threat scenario such as a great power competition.

What was once "tomorrow's threat" is now today's reality.

With only 186 F-22s and about 200 F-35s to complement its aging fourth-generation fighters, the Air Force has too few fighters to defend the United States in a modern security environment including a potential North Korean conflict occurring simultaneously with a requirement to check Russian revanchist actions in Europe, or Chinese aggression in East Asia.

Yet instead of increasing the buy rate for more low-observable F-35s to support the goals of the new defense strategy, the Department of Defense (DOD) fiscal 2020 budget request seeks to purchase eight F-15EX fighters—aircraft based on a design that dates back to the late 1960s. Even as new-build with upgraded capabilities, these fourth-generation F-15EXs will lack key attributes necessary to survive and operate in the priority advanced threat environments identified in the National Defense Strategy. Low observability, commonly known as stealth, and sensor fusion are not bolt-on capabilities and cannot be retrofitted or modified: They must be designed into an aircraft from Day 1.

Air superiority is a prerequisite to joint operations. Without Air Force contributions, other military services' capabilities cannot be realized. Ships, ground forces, space and cyber facilities, logistics nodes, and support aircraft are all exceedingly vulnerable to attack from modern weapons. Failure to modernize our air forces with relevant, capable, and survivable aircraft will result in crippling losses in a conflict with a rival such as China or Russia. Recapitalizing the Air Force fighter force with fifth-generation aircraft is fundamental to fielding viable US military power around the globe.

Given those stakes, it is crucial to prioritize the production of fifth-generation fighter aircraft. The US should increase F-35 procurement rates and accelerate investment in the Next-Generation Air Dominance (NGAD) program to make up for its undersized F-22 fleet. Today's fighter force consists of 82 percent fourth-generation and only 18 percent fifth-generation aircraft. Reversing that balance is the only way to ensure America's sons and daughters strap into aircraft that can successfully execute their missions against the world's most challenging threats—and return home safely.

THE THREAT ENVIRONMENT

The National Defense Strategy Commission's recent assessment of the 2018 National Defense Strategy concluded that America's hard military power has eroded "to a dangerous degree." America's ability to defend its allies, partners, and its own vital interests is increasingly in doubt, the commission stated, and if the US does not act promptly, the consequences will be "grave and lasting."

America's military dominance is waning at the worst time. The reemergence of great power competition means that America faces its greatest strategic challenge since the end of the Cold War, and the rest of the globe is as complex and unstable as it ever has been. China and Russia are asserting their power around the world and modernizing their militaries, regional crises simmer and flare in the Middle East, the Korean Peninsula remains unpredictable, and violent extremists demand US attention.

In the three decades since the fall of the Soviet Union, low-intensity conflicts and counterinsurgency operations created a strategic amnesia regarding what it takes to pre-

Photo: Liu Chuan/ Chinese Ministry of National Defense

A surface-to-air missile defense system in the desert of northwest China. China and Russia are modernizing their militaries as crises flare around the world.

vail in high-end combat. During those years, some defense leaders even derided strategies and technologies focused on high-end warfare, dismissing air superiority fighters as "gold-plated" Cold War relics. Not surprisingly, Congressional budget cuts and Pentagon programmatic decisions cost the Air Force more aircraft during this time than any adversary since 1947. From 1990 to 2016, the Air Force total aircraft inventory plunged more than 45 percent, from 9,907 aircraft to 5,369 aircraft.

Over those same three decades, airpower's successes—first in Operation Desert Storm, then in Operation Allied Force over Serbia and Kosovo—produced a false security that fighters purchased during the Reagan administration would remain viable against well-equipped adversaries in future conflicts. As a result, the air superiority component was cut by almost half, from 3,206 F-4D/Es, F-15A/Cs, and F-16A/Cs in 1990, to just 1,753 F-15Cs, F-15Es, F-16s, F-22s, and F-35s today.

UNDERSTANDING FIFTH-GENERATION ATTRIBUTES

Why, then, if the US military is facing a critical military capability gap, is there still a consistent assault on fifth-generation airpower? What is driving the notion that 20th century aircraft can prevail in 21st century warfare?

One reason for believing that legacy aircraft are "good enough" is experience. For the past 30 years, these aircraft have indeed been successful at every mission-set assigned to them. After the spectacular performance of fourth-generation aircraft in Operation Desert Storm, no adversary has posed a serious air defense challenge to US airpower in a military campaign. Since 1992, only four Air Force fighters have been shot down in combat by enemy surface-to-air missile systems.

That very success has bred a broad sense of complacency and a lack of concern about the potential vulnerability of US military power: Even the B-2 program was ended prematurely. Of the 132 stealth bombers planned, only 21 were procured. Just 20 remain in the inventory, forcing the Air Force to go to great lengths to preserve those aircraft because nothing else can match their essential range, payload, and penetration capability. For example, when a B-2 experienced a catastrophic engine fire in 2010, the Air Force invested over $105 million over four years to rebuild major sections of the jet by hand. With such an undersized and uniquely capable fleet, Air Force leaders had no choice.

Because fourth-generation fighters have been dubbed "good enough" for the last 30 years, the vast improvements provided by fifth-generation technologies are not sufficiently understood by policymakers. Modernization has incrementally increased the capabilities of fourth-generation aircraft through improvements in sensors, displays, pods, and increased processing. Yet, fourth- generation aircraft, even with advanced avionics modifications like those on the F-15EX, are simply not survivable against modern threats.

These airplanes lack three critical attributes:

- All-aspect stealth and superior aerodynamic performance
- Advanced automated sensors and information fusion
- The synergy of stealth, fused information, and integrated automated processing.

STEALTH AND SURVIVABILITY

Stealth is the attribute for which fifth-generation aircraft are best known. Visually striking, the strange angled facets of the F-117, the smooth, blended flying wing of the B-2, or the canted angles of the F-22 and F-35 are the result of highly engineered radar-deflecting designs. No other fifth-generation attributes would matter if the underlying stealth wasn't part of the package. Stealth is the cost of entry into anti-access/area-denial (A2/AD) threat environments, where modern air defenses turn fourth-generation penetrators into stand-off assets because of their advanced radars and missile systems. If legacy fighters cannot enter an advanced threat environment, then they cannot execute their mission.

Understanding how radar interacts with aircraft is critical to appreciating the value of stealth in war. The radar cross section (RCS) of an aircraft is the magnitude of radar energy from a threat system that reflects off an aircraft. This reflection is not uniform. As radar energy bounces off the surface of the aircraft it may return straight back to the radar receiver, reflect on an axis different from the original energy source, or scatter in a variety of directions. Evidence of an object reflecting energy in the radar field of view is termed a "radar or target return." It can "bloom" or "fade" depending on the angle of attack. The challenge facing aircraft designers is to create a low-observable (stealthy) signature that does not increase in strength or "bloom" dramatically from any viewing angle, either horizontally or vertically. Reducing reflected radar energy requires all sensors, weapons, and fuel

Two Russian Sukhoi Su-57 fifth-generation fighters in 2017. Russia has narrowed the gap between its capabilities and those of the US.

Photo: Anna Zvereva

to be housed internally, because any external store becomes a major radar reflector, even when shaped and coated to reduce its radar signature.

Early on, designers had to make compromises between aerodynamic performance and stealth, because the multi-faceted shape required to scatter radar energy runs counter to the design considerations needed to maximize aerodynamic maneuverability. But neither the F-22 nor F-35 compromise performance to become "very low observable (VLO)." Thanks to advanced computer processing, lessons learned from earlier stealth designs, and innovative radar-absorbing materials, these fifth-generation aircraft deliver "all-aspect stealth" while still exceeding the air combat maneuverability of fourth-generation fighters. As a result, neither the F-22 nor F-35 have to be predictable in their flight path maneuvering. In a dense and highly dynamic threat environment, they can aggressively react to threats or prosecute targets.

Importantly, stealth is much more than minimizing the RCS of an aircraft. Passive sensors have improved in sensitivity and capability over the years, making traditional omni-directional radios a major vulnerability. Fifth-generation aircraft must have low probability of detection (LPD) and low probability of intercept (LPI) radios and data links. Directionally focused with low power and narrow beam width, LPD and LPI transmissions make it extremely difficult for adversaries to exploit fifth-generation aircraft radios and data links for targeting or even early warning. Fifth-generation aircraft automatically manage the power and direction of their own sensors and rely upon passive sensors as well.

BATTLESPACE AWARENESS, DECISION SUPERIORITY

A fifth-generation aircraft's game-changing characteristics are also attributable to its power to gather, process, and harness information. While some fourth-generation aircraft may feature elements of this technology, the sheer volume and quality of information available to a fifth-generation pilot dramatically increases combat mission effectiveness. Combining data from off-board sources and the aircraft's own array of multispectral active and passive sensors, a powerful central computer uses sophisticated algorithms to correlate, compare, evaluate, and fuse information into a highly accurate, real-time situational awareness picture. According to two experienced fifth-generation Air Force pilots, the power of fifth-generation aircraft to gather, process, exploit, and share information "turns operators of these advanced aircraft into mission commanders, rather than having them focus on managing and operating subsystems."

Fourth-generation aircraft have loosely federated sensors—their radar systems are separate from data links, which are also separate from electronic warfare systems and other components. In a fourth-generation aircraft, pilots must not only manage each sensor and system individually, but also interpret the information from each sensor and system and make sense of the whole—all while flying and maneuvering the aircraft.

But the advanced sensors in fifth-generation aircraft are automated and require little to no active control from the pilot. Sensor data is automatically shared with other aircraft via data link, allowing a collaborative approach where the aircraft automatically correlate, compare, and fill in the best information with other aircraft in their flight. The result is a robust, common battlespace picture shared among all flight members. With this enhanced situational awareness, pilots can better execute threat avoidance, target detection, direction of forces, engagement decisions, and other command actions. In short, fifth-generation aircraft provide superior information and decision advantage.

"We have more information at our fingertips than other aircraft," one F-22 pilot who flew sorties during Operation Inherent Resolve over Syria explained. "We have an easier time making big decisions."

Although modernization has made some legacy aircraft more capable, fifth-generation information fusion cannot be retrofitted to legacy airframes. Fifth-generation information and sensor fusion must be built into the design of an aircraft from the beginning.

STEALTH AND INFORMATION

Combining stealth with information and decision superiority transforms battlespace awareness into superior initiative and maneuver, providing a true asymmetric advantage for fifth-generation aircraft over older aircraft designs.

This battlespace initiative is what stealth skeptics tend to overlook. Stealth increases the aircraft's probability of survival while at the same time making defense against fifth-generation aircraft much more difficult for the enemy. While older, legacy stealth aircraft required a so-called "black line" of a predetermined flight path to thread in between

Photo: A1C Codie Trimble

Lt. Gen. Mark Kelly, 12th Air Force Commander, in an F-35 leads a formation of F-15Es over the Utah Test and Training Range in July 2018. The US should increase F-35 procurement rates to make up for USAF's undersized F-22 fleet.

threats, fifth-generation fighters have freedom of maneuver because they are both stealthy and they know where threats are located. "I see radars. I see airplanes. I see surface-to-air missiles, and the jet knows where those things are and tells me," an F-22 pilot said of his experience flying combat sorties over Syria in Operation Inherent Resolve. "So, I have a picture of the battlespace."

With that high degree of battlespace awareness, a fifth-generation pilot can turn stealth into an offensive attribute for attack.

Stealth, therefore, is not just a defensive survival attribute; it's a prerequisite to successful offensive operations, combining the advantage of surprise with increased lethality.

UNDERSTANDING THE COST AND VALUE OF STEALTH

Unfortunately, multiple oversight agencies, including the respected Congressional Budget Office (CBO), continue to treat fourth- and fifth-generation aircraft as if they are interchangeable. This leads to questionable analytical outcomes given outdated assessment models. One recently released CBO report presented startling options to offset a hypothetical cancellation of the F-35: Fill the gap by purchasing legacy fighters like the F-16 and F/A-18. The same report also floated the idea of divesting the entire F-22 fleet without suggesting how to deliver comparable capability.

These are poorly reasoned options and false choices. Treating all fighter aircraft as similar commodities, regardless of capabilities, reveals a dangerous disconnect between the threats America faces and the Air Force America needs.

Additionally, most—if not all—of DOD's focus on unit and sustainment costs per aircraft type ignore the actual costs necessary to accomplish desired objectives against the priority threats of the National Defense Strategy. For example, fifth-generation aircraft do not require the large mission package of additional specialized support aircraft to jam radars, defeat enemy fighters, and negate surface-to-air-missile systems that fourth-generation aircraft do. This mission support package is not part of DOD's cost analysis, but it should be considered to make any cost assessment relevant. Meeting actual mission objectives is what matters, and cost-per-effect is a more relevant metric than cost per aircraft or cost per flying hour.

Including support asset requirements in an "apples-to-apples" cost-effectiveness assessment shows that fifth-generation aircraft are significantly more cost-effective than fourth-generation aircraft. Additional force-protection packaging for fourth-generation fighters also drive up requirements for additional pilots and support personnel, along with additional mission support aircraft such as air-to-air refueling tankers. Against peer threats, the cost of achieving a desired effect with fourth-generation aircraft is dramatically higher than the same effect delivered from fifth-generation aircraft. In a simple cost analysis, the return on investment is substantially greater with fifth-generation aircraft.

FIXING THE CAPABILITY AND CAPACITY GAP

In testimony last year to the Senate Armed Services Committee, Air Force Chief of Staff Gen David L. Goldfein and then-Air Force Secretary Heather Wilson addressed the health of the Air Force. Service advantage and readiness shrank, they said, "due to the longest continuous stretch of combat in our nation's history, coupled with years of inconsistent and insufficient funding." All the while, China and Russia have closed gaps in both capacity and capability. The result, they added, has been "an overstretched and under-resourced United States Air Force."

For three decades, the Air Force has divested capabilities to help meet budget requirements, fueling today's recapitalization crisis. The service is now too small and risks getting smaller as aircraft age out of service. To stabilize the force and meet the objectives of the National Defense

An F-15C on a training exercise out of Kadena AB, Japan. F-15Cs will wear out their basic structural integrity by the early- to mid-2020s.

Photo: A1C Matthew Seefeldt

Strategy, the Air Force must acquire at least 72 fighters per year. Failure to sustain that rate risks a force that does not have the necessary capacity to meet our national security needs.

However, the issue is not simply about quantity of aircraft, but also about the capability of those aircraft. As the Chairman of the Joint Chiefs of Staff, Marine Gen. Joseph Dunford, said on May 29, "Where you have to make a choice between capacity and capability, I would go with capability."

Air Force written testimony to Congress makes that point plainly, stating "to meet emerging worldwide threats across the spectrum of conflict … the cornerstone of the Air Force [must be a] shift from 4th/5th-generation to a 5th/6th-generation fleet." Increasing the procurement rate of fifth-generation aircraft and accelerating NGAD development are the paths necessary to ensure this goal is met.

While some defense observers suggest that the F-15EX program will come from additive funds, history suggests otherwise over the long haul. Budget plus-ups of this sort disappear when defense budgets decline, but the mandate to pay the bill remains. Given today's ballooning federal deficits, economic uncertainty, and mounting pressure from mandatory federal spending accounts, it is unlikely that current spending levels can be sustained. Further looming over the budget is a sharply divided and gridlocked Congress, with the growing possibility of a return to sequester-level spending. Either path could lead to a competition between the F-35 and F-15EX for funding, with severe ramifications for the F-35.

If the F-15EX becomes a program of record and funds are appropriated for production, it is likely that any future budget trade-offs could come out of planned F-35 purchases. This would reduce F-35 production rates, pushing up the cost per plane. If that happens, new doubts will emerge about F-35 program sustainability and affordability, yielding further cuts and further price hikes. This is what Washington calls a "death spiral," a self-reinforcing dynamic that leads to an inevitable early end to expensive programs.

Recently departed Secretary of the Air Force Heather Wilson pushed back against the trade-off of F-35 for F-15EX, prudently explaining: "If the budget gets crunched in the out years, you can't start trading off and saying we're going to keep open an F-15 line. … We're not going to trade off fifth-generation for fourth-generation." In reality, however, once the F-15EX becomes a line item in the budget, that decision will not be in the hands of the Air Force. Congress will make that call, with local politics, not prudent planning, the foremost driver in the debate.

It is ironic that it is because the F-22—itself a victim of the death spiral—was prematurely canceled that an F-15EX is even being considered. The only difference this time is that dramatic reductions to the Air Force F-35 program would also impact the US Navy, the US Marine Corps, and a host of allied militaries also buying the F-35.

While each military service will need new capabilities and capacities to fulfill their obligations, none of those investments will matter if the Air Force is unable to provide the airpower foundation upon which joint combat operations depend. America must now have the resolve to rebuild its Air Force to be able to defeat advanced adversaries as outlined in the National Defense Strategy. The following actions are prudent means to accomplish this objective:

- Ensure fifth-generation aircraft and NGAD receive top priority for finite budget resources. Procuring F-15EXs cannot come at the cost of these essential modernization programs
- Increase the F-35A production rate to 80 aircraft per year beginning in fiscal year 2021
- Reduce the ratio of fourth- to fifth-generation fighters from 82/18 to 50/50 as rapidly as possible
- Encourage allies to buy fifth-generation aircraft
- Eliminate "aircraft unit cost" as a decision metric on programs and replace it with a "cost-per-effect" model
- Replace the simplistic cost-per-flying-hour metric with the more holistic metric of total annual cost per aircraft.

America's sons and daughters will fly into harm's way in whatever combat aircraft their nation procures. We must do everything in our power to ensure those aircraft can get the job done in the face of an increasingly challenging threat, while also ensuring the airmen inside will return home safely from their missions. That requires investing in modern, capable, and relevant advanced aircraft designs and technology. ✪

The Counter-Revolution in Military Affairs

For the ground forces, the problem with the RMA was airpower, not technology.

By John T. Correll

The notion of a "Revolution in Military Affairs" started with the Russians in the late 1970s. Marshal Nikolai V. Ogarkov, chief of the Soviet general staff, was among those who declared that a "military-technical revolution," later called an RMA, was underway.

As the Russians saw it, advanced technologies—especially "informatics"—and precision strike weapons employed at long ranges were beginning to revolutionize the nature of warfare.

However, the RMA concept was initially based on theory, not combat experience. The first opportunity to make a judgment from the evidence of a significant conflict was the Gulf War of 1991.

Senior military officials in Washington expected the Gulf War to unfold in traditional fashion. In December 1990, they forecast a violent overland struggle, possibly involving the greatest tank battle in the history of warfare. Ground forces were anticipated to be decisive. Airpower would be a supporting element. The Center for Strategic and International Studies predicted 15,000 US casualties. Some estimates ran much higher.

The RMA was a threat to budgets and roles and missions for the ground forces, and the Army struck back.

The reality of Operation Desert Storm was far different. Airpower opened the attack at 3 a.m. on Jan. 17, 1991. By dawn, Iraq's command and control network had been destroyed. A 38-day air campaign left the Iraqi forces reeling, unable to conduct coherent operations. They were finished off in a 100-hour, four-day ground action. Casualties for the allied coalition were 247 dead and 901 wounded, with US losses accounting for about half of the total.

Precision strikes and information superiority set a new standard for effectiveness, making it possible for coalition airpower to hit 150 individual targets the first day. By contrast, Eighth Air Force in World War II struck only about 50 target sets in all of 1943.

Two USAF F-15Cs, an F-15E, and two F-16s over burning oil fields in Kuwait during Operation Desert Storm. US airpower destroyed Iraq's command and control operations in less than 24 hours.

Photo: USAF

Photo: USAF via AFA library

Gen. Ronald Fogleman prepares to board an F-15 at Langley AFB, Va. Fogleman said the US was obligated to transition to an asymmetric force strategy that could bend an adversary to its will with the least cost of US lives and treasure. He meant airpower.

In 1992, the Pentagon Office of Net Assessment concluded that the Russians had been right and that a Revolution in Military Affairs was in progress. Regional conflicts in Bosnia (1995) and Serbia (1999) lent further credibility to that conclusion.

The RMA concept included all of the combat arms, but it was increasingly identified with airpower. It was seen as an alternative to the emphasis in traditional warfare on attrition and the clash of force on force. The RMA was recognized by the Joint Chiefs of Staff in 1996 and by the Department of Defense in 1997.

RMA advocates had not reckoned sufficiently with the political power of the Army in the Pentagon. The RMA was a threat to budgets and roles and missions for the ground forces, and the Army struck back, rallying its supporters to the slogan of "Boots on the Ground."

The issue was not technology. It was airpower. The ground forces could accept airpower in a supporting role but not in the leading or supported role. Accordingly, the RMA was rolled back. The JCS position was reversed and the Air Force was reminded emphatically that its main role was support of the ground forces.

After the terrorist attacks in New York and Washington, D.C., in 2001, US strategy focused on low-intensity encounters with low-technology adversaries. The emergence of a threat from a military "peer competitor" was of little or no concern. The RMA doctrine was effectively dead.

Two decades into the 21st century, though, the decision to abandon the RMA no longer looks as incisive as it seemed. In 2018, the bipartisan National Defense Strategy Commission warned that the skills necessary for US forces to conduct operations against capable adversaries had "atrophied" and that they might actually "lose a war against China or Russia."

The National Security Strategy was revised in 2018 with a goal of better responding to "rapid technological advancements and the changing character of war." It was carefully worded, but it sounded much like the Revolution in Military Affairs.

SIGNS OF A REVOLUTION

The concept of an RMA gained a foothold in the United States when Andrew Marshall, the legendary director of the Pentagon Office of Net Assessment, ordered a major study of the Russian theory in light of the Gulf War experience.

The report, written by Andrew Krepinevich, was published in 1992. It said that a RMA was indeed underway and that "we are probably in the early stages of a transition to a new era of warfare."

Thomas Ricks, writing in the *Washington Post,* summarized Marshall's views in an interview: "Mass armies may be replaced by smaller, more professional forces packing more firepower and fighting from a distance, rather than closing with and destroying the enemy. The main mission of forward ground forces may shift from laying direct fire on the enemy toward spotting targets for 'standoff' weapons and assessing the damage they do."

Adm. William A. Owens, Vice Chairman of the Joint Chiefs of Staff, agreed that an RMA was coming and predicted that it would "lead to a more lethal military with more interservice cooperation."

The RMA gained additional standing from Operation Deliberate Force, the NATO air campaign in Bosnia, in

Photo: SSgt. Dixie Trawick via National Archives

USAF airmen at Aviano AB, Italy, coordinate aircraft involved in NATO air strikes during Operation Deliberate Force on Nov. 6, 1995. The 11-day action consisted almost entirely of airpower and imposed a cease-fire on the Serb aggressors in the Yugoslav civil war.

1995. The 11-day action consisted almost entirely of airpower and imposed a cease fire on the Serb aggressors in the Yugoslav civil war.

Meanwhile, the Army was showing discomfort with the RMA and sought to discredit the effectiveness attributed to airpower in the Gulf War.

"The recent air campaign against Iraqi forces gained not a single one of the US or UN objectives in the Persian Gulf," said retired Gen. Frederick J. Kroesen of the Association of the US Army (AUSA) Institute of Land Warfare. "Four days of land combat—aided immeasurably by the air campaign—achieved every goal and victory."

"Armies are the foundation of nearly all military forces," declared Maj. Gen. Jay M. Garner, assistant Army deputy chief of staff for operations and plans. "Air forces and navies are 'add-ons.' "

Conversely, Gen. Ronald R. Fogleman, Air Force Chief of Staff, said in February 1996 that "developments in recent years have given hope that we are on the verge of introducing a new American way of war."

Fogleman said the nation "has not only the opportunity, but the obligation, to transition from a concept of annihilation and attrition warfare" and "brute force-on-force conflicts" to an "asymmetric force strategy" that could "compel an adversary to do our will at the least cost to the United States, in lives and resources."

Among the factors making the new American way of war possible, he said, were "the extended range, the precision, and the lethality of modern weapon systems that are increasingly leveraging and leveraged by an agile C4I [command, control, communications, computers, and intelligence] capability that enables war fighters to analyze, to act, and to assess before an adversary has the capability to react."

CONFIRMATION

"Joint Vision 2010," published in July 1996 by the Joint Chiefs of Staff, took a similar position. "Instead of relying on massed forces and sequential operations, we will achieve massed effects in other ways," it said.

With precision targeting and longer range systems, it continued, "we should be increasingly able to accomplish the effects of mass—the necessary concentration of combat power at the decisive time and place—with less need to mass forces physically than in the past."

That struck at the heart of the core capability of land forces, and a JCS expansion of the vision statement in May 1997 went further. It specifically acknowledged a Revolution in Military Affairs that promised to "transform traditional ideas about maneuver, strike, protection, and logistics" and possibly "a complete renovation of the conduct of war."

The Quadrennial Defense Review, also in 1997, said that the RMA would "fundamentally change the way US forces fight."

In the spring of 1999, Operation Allied Force in the Balkans compelled the Serbs to withdraw from Kosovo and accept the peace terms dictated by NATO. Airpower was the only force engaged in the 78-day operation.

Nevertheless, that did not keep Army officers away from a different explanation. At AUSA, Lt. Gen. Theodore G. Stroup attributed the victory to the Kosovo Liberation Army, which consisted of about 2,000 irregulars who had been in action for only a few days with no visible results.

Army Gen. Wesley Clark, in overall command of the NATO operation, said the decisive factor was not airpower but rather pressure from the "planning and preparation for ground operations" and the threat of a ground invasion. In fact, NATO had no plans to invade Serbia, and no land invasion could have been conducted for another six months, if then.

REVERSAL

The backlash was unrelenting. In November 1996, the Army put out is own vision statement that said the contribution of land forces was "to make permanent the otherwise transitory advantages achieved by air and naval forces."

AUSA's Kroesen said that "airpower is still a part-time participant that cannot provide the final, decisive action that wins wars." Retired Army Maj. Gen. Robert H. Scales

Then-USAF Chief of Staff Gen. T. Michael Moseley and then-Air Force Secretary Michael Wynne were both forced to resign in 2008 by Secretary of Defense Robert Gates for their unwavering commitment to the F-22, which he canceled.

Photo: MSgt. Jim Varhegyi

and retired Marine Corps Lt. Gen. Paul K. Van Riper said that "America's next war, like those which have preceded it, almost certainly will be won—or lost—on the ground."

"We are out of the era—if we were ever in it—of airpower being able to cause someone to do something," said Gen. Gordon R. Sullivan, former Army Chief of Staff and, in 1998, president of AUSA.

Secretary of the Army Louis Caldera said in 1999, "We are committed to making the Army the force of choice of the country," adding that, "only one service closes with and destroys the enemy."

"In the final analysis, if you want to radically change the behavior of your opponent, it takes boots on the ground to do it," said retired Marine Corps Gen. Bernard E. Trainor.

In May 2000, the Joint Chiefs rewrote their vision document, making a complete reversal from their previous position. "Overseas or US-based units will mass forces or effects directly to the operational theater," they now said.

"The capability to rapidly mass force or forces and the effect of dispersed forces allow the joint force commander to establish control of the battle space at the proper time and place," the new Joint Vision said. "Beyond the actual physical presence of the force, dominant maneuver creates an impact in the minds of opponents and others in the operational area. ... The presence or anticipated presence of a decisive force might well cause an enemy to surrender after minimal resistance."

The counter-revolution in military affairs was almost complete. What was left of the RMA was destroyed by a series of events and decisions over the next few years.

DECAPITATION

The immediate response to the terrorist attacks in 2001 centered on air strikes in Afghanistan, which were effective and successful. Within months, though, the focus shifted to ground operations in Iraq, eventually evolving to an emphasis on counterinsurgency.

There was no part in it for RMA. "We hear many terms, whether it's 'transformation,' 'military technical revolution,' 'revolution in military affairs,' all indicating something revolutionary has happened," Van Riper said in a *PBS* interview. "What I see are slogans masquerading as ideas."

Ralph Peters, a retired Army officer and widely published military analyst, dismissed the RMA as a "doctrinal cult of the past decade."

"Wars are won by seizing and holding ground, and only ground forces can do that," said Deputy Secretary of Defense Paul D. Wolfowitz.

A new Quadrennial Defense Review in 2005 said that irregular warfare was the dominant form of warfare confronting the United States. The 2005 National Defense Strategy listed several "key assumptions," one of which was that, "We will have no global peer competitors and will remain unmatched in traditional military capability."

Sen. Conrad Burns (R-Mont.), a former Marine, lectured Air Force leaders at a budget hearing. "The future of the Air Force is in the service to the mission on the ground," he said. "Waves of Russian fighters will not be coming over the horizon any time soon."

USAF fortunes sank to a low point in 2008 when Secretary of Defense Robert M. Gates forced both the Secretary of the Air Force and the Chief of Staff to resign. The cover story for the decapitation was failure to ensure security and control of nuclear weapons, but the real reason was what Gates considered to be excessive advocacy of airpower.

Gates was determined to cut the F-22 fighter program radically. "We are fighting two wars, in Iraq and Afghanistan, and the F-22 has not performed a single mission in either theater," he told a Senate committee.

The two deposed Air Force leaders fought against the F-22 cuts. They also disagreed with Gates when he wanted to divert airmen from their regular specialties and send them to Iraq to guard prisoners and drive fuel trucks.

In 2009, Gates "prematurely canceled the F-22 purchase

Two Chinese fifth-generation fighters maneuver during an air show in 2018.

Photo: Emperornie

at less than half the Air Force's stated requirement to free up funds for wars in Afghanistan and Iraq," according to a report from the Air Force Association's Mitchell Institute for Aerospace Studies.

Over the next several years, the Air Force made what was called a "conscious choice" not to aggressively promote airpower, attempting to demonstrate instead that it was "all in" on supporting the ground forces and doing whatever was needed.

"Our most important air and space mission is supporting our troops and those of our allies on the front lines," Deputy Secretary of Defense William J. Lynn III announced in 2010.

RECONSIDERATION

Scattered doubt began to rise. Even within the ground forces, there was concern that the counter-revolution in military affairs had gone too far.

An internal Pentagon report in 2008 speculated that the Army's focus on counterinsurgency had weakened its ability to fight conventional battles. Army Col. Gian P. Gentile, director of the military history program at West Point, said that "the US Army has become a counterinsurgency-only force."

"The current strategy requires the United States to engage in a relatively low-tech, manpower-intensive form of warfare that pits one of its greatest weaknesses against one of its opponents' greatest strengths," said Richard B. Andres, professor of national security at the National War College.

Retired Air Force Maj. Gen. Charles J. Dunlap Jr. raised a larger issue. "Today's thinking about defense spending is hobbled by the Pentagon's inability to distinguish sufficiently between the serious challenge of irregular wars and the need to deter truly existential threats posed by nation states," he said.

The first official break came in revised strategic guidance from Secretary of Defense Leon E. Panetta in 2012. "This country is at a strategic turning point," he said, calling for a transition "from emphasis on today's wars to preparing for future challenges."

However, Panetta's guidance was motivated mostly by the wish of the Obama administration to cut the defense budget rather than any driving doctrinal conviction. Pentagon officials said they wanted to reduce ground force troop strength by 10 to 15 percent.

In 2014, Panetta's successor, Chuck Hagel, announced the "Third Offset," a broad effort to leap ahead of competitors in advanced military technologies. In 2016, the Trump administration phased out the Third Offset language, although many of the concepts continued.

A new National Defense Strategy in January 2018 declared an end to the long fixation on terrorism and small-scale conflicts. "Inter-state strategic competition, not terrorism, is now the primary concern in US national security," it said. "The central challenge to US prosperity and security is the re-emergence of long-term strategic competition."

To meet that challenge, the US defense program will have to overcome 20 years of discounting airpower and RMA technology. The Air Force is much smaller than it was in the 1990s, in aircraft as well as in operational squadrons. The erosion has been especially acute in high-end systems. The combined number of F-22 and F-35 stealth aircraft, once projected at 2,144, has reached only 361 so far.

Gen. Joseph F. Dunford Jr., Chairman of the Joint Chiefs of Staff, said that Russia and China had become "near-peer competitors" and that they "can actually challenge our ability to project power and challenge us in all domains."

The National Defense Strategy Commission—a bipartisan group created by Congress to replace the Quadrennial Defense Review—warned in 2018 that a "crisis of national security" existed. "The US military could suffer unacceptably high casualties and loss of major capital assets in its next conflict," the commission said. "It might struggle to win, or perhaps lose, a war against China or Russia."

Whether the culture of the Pentagon can tolerate a doctrine and strategy that addresses that problem remains to be seen. ✪

John T. Correll *was editor in chief of* Air Force Magazine *for 18 years and is a frequent contributor. His most recent article,* "Team B Tackles the CIA," *appeared in the June issue.*

AFA Nominees 2019-2020

Candidates for National Office and the Board of Directors.

The Air Force Association Nominating Committee met on May 4 and selected candidates to send forward for National Officer positions and National Director positions on the Board of Directors. The Committee consists of three past Chairmen of the Board, one person selected by each of the two Vice Chairmen of the Board, two persons representing each geographic area, and one person each representing the Total Air Force, Air Force veterans, and aerospace industry constituencies. The slate of candidates will be presented to the delegates at the AFA National Convention in National Harbor, Md., in September.

CHAIRMAN OF THE BOARD

Gerald R. Murray, King Mountain, N.C., nominated for a first-year term as Chairman of the Board, joined AFA in 1994, becoming a Life Member in 2002. Murray served 29 years in the Air Force, culminating as the highest ranking noncommissioned officer in USAF, the 14th Chief Master Sergeant of the Air Force. Prior, he performed various duties in aircraft maintenance and logistics with F-4, F-16, and A-10 aircraft, and as a command chief master sergeant at wing, numbered air force, and major command levels. Murray's previous AFA involvement has been as a National Director, Membership Committee, Chapter 331 President, Force Capabilities Advisory Group, AFA National Director At Large, and as the Georgia and Utah State Delegate. He earned a bachelor's degree in business administration from Saint Leo University in Florida and an associate of applied science in aircraft systems maintenance technology from the Community College of the Air Force. Murray has received the Air Force Distinguished Service Medal, a Bronze Star Medal, Defense Meritorious Service Medal, four AF Meritorious Service Medals, and three AF Commendation Medals. Additionally, he was the 1991 recipient of the Air Force Gen. Lew Allen Trophy. He has volunteered as an AFA Emerging Leader Mentor, with the AFA Focus on Defense Forum, and with the Top of Utah Military Affairs Committee. Murray currently serves on the USAA Board of Directors, the Air Force Association National Board of Directors, the Air Force Museum Foundation Board of Trustees, the Air Force Enlisted Village Development Council, and the Air Force Memorial Foundation.

VICE CHAIRMAN OF THE BOARD, FIELD OPERATIONS

F. Gavin MacAloon, Nashua, N.H., nominated for Vice Chairman of the Board for Field Operations for a fourth one-year term. A Life Member, MacAloon ("Mac") joined AFA in 1984. He served for three years as the Central East Region President and served on the Field Council as Chairman of the e-Business and the Emerging Leader Program Subcommittees. He is a Founding Member of AFA's Wounded Airman Program and served in national-level positions on the Nominating Committee, and as Supervisor of Elections, and in several chapter and state positions, including President of the D.W. Steele Sr. Memorial Chapter in Northern Virginia and Vice President for Fund-raising, Virginia State AFA. He has received an AFA Chairman's Citation, an Exceptional Service Award, a Medal of Merit, and numerous awards from the region, state, and chapter, most notably the 2012 Virginia Member of the Year. Mac earned a bachelor's degree in psychology from Southeast Missouri State University and a master's degree in administration from Central Michigan University. He served in the Air Force for 22 years as a Master Air Battle Manager on AWACS and the Airborne Battlefield Command and Control Center (ABCCC) aircraft, accumulating 3,000 hours, including 500 combat support hours. Mac also

served in the Pentagon on the Air Staff and on the initial cadre of Joint Task Force Four in Key West. Following USAF retirement, he completed a second career with a large aerospace company as a business development manager, working with AWACS, C-17, and UAS programs. Mac is currently a senior acquisition Program Manager for the PEO, C3I & Networks/HNX, at Hanscom AFB, Mass. He is a member of the Association of Old Crows, the National Defense Industrial Association, Military Officers Association of America, and The River Rats.

VICE CHAIRMAN OF THE BOARD, AEROSPACE EDUCATION

James T. Hannam, Burke, Va., nominated for a second one-year term as Vice Chairman, Aerospace Education, an AFA Member since 1976. Hannam earned a bachelor's degree in engineering science from the United States Air Force Academy, a master's degree in applied mechanics from Stanford University, and a master

of business administration from Auburn University. He was a fighter pilot with 100 combat missions over North Vietnam in F-105 Thunderchiefs. He also flew F-4 Phantoms in Southeast Asia and Europe and F-16 Falcons in Europe. Hannam served as an Assistant Professor in Engineering Mechanics and as a Flying/Soaring Instructor at US Air Force Academy, in Europe as Wing Director of Operations, IG Director of Inspection, and Aviano Group Commander, and on the TAC and Air Staffs in Fighter Requirements, retiring as a colonel. After Air Force retirement he worked in business development. He is a member of the Red River Valley Fighter Pilots Association, MOAA, and Daedalians. Hannam serves on the Executive Committee of the D.W. Steele Chapter, and previously as Steele Chapter President, Virginia State Secretary, Central East Region President, Director AFA Board of Directors, Long-Range Planning Committee, Chairman Strategic Planning Committee, and for the many years, Vice Chairman, Aerospace Education Council. AFA Awards include Medal of Merit, Exceptional Service Award, President's and Chairman's Awards, and AFA Member of the Year.

NATIONAL SECRETARY

Richard W. "Rick" Hartle, Layton, Utah, nominated for a second one-year term as National Secretary. An AFA Life Member since 1998, Hartle has served AFA on the national level as a National Director at Large from 2011 to 2014 and 2017 to 2018.

He currently chairs the Audit Committee, has chaired the Development Committee, and served on the Strategic Planning and Transition Constitution Committees. Hartle has been the Utah State President, Utah Aerospace Education Foundation President and Board Chair, AFA Utah Industrial Associates VP, and Ute-Rocky Mountain Chapter President. He has received a national-level Medal of Merit, the AFA Utah State Presidential Citation, and the Utah AEF Exceptional Service Award. He and his wife, Amy, are AFA Thunderbird Society members. His community involvement includes board positions with the Utah Defense Alliance, Strategic Deterrent Coalition, and the Top of Utah Military Affairs Committee. Hartle earned a bachelor's in electrical engineering from New Mexico State University and completed National Defense University and Boeing Leadership Center courses in management, business development, finance, and leadership. Hartle is retired from a 35-year career with an aerospace contractor.

NATIONAL TREASURER

Steven R. Lundgren, Fairbanks, Alaska, nominated for a third one-

year term as National Treasurer. An AFA member for more than 30 years, Lundgren was AFA National Treasurer from 2005 to 2010. He serves as AFA Alaska State Treasurer. Lundgren has been a Northwest Region President and served on the national-level Finance, Audit, and Executive Committees. He received AFA's Member of the Year Award in 2011 and was awarded a Presidential Citation in 2003. His volunteer and civic organization work includes the Alaskan Command Civilian Advisory Board, the American Bankers Association (ABA) Community Bankers Council, the Fairbanks Economic Development Corporation Board, and the Greater Fairbanks Chamber of Commerce Board. He is vice chairman of the Alaska Committee for the Employer Support of the Guard and Reserve program. Lundgren, who was president of the Alaska Bankers Association 2015-16, earned a bachelor's degree in business administration from Oregon State University and has attended ABA professional-school courses. Lundgren began his career in banking in 1978 and is president and CEO of a community bank in Fairbanks.

NATIONAL DIRECTOR AT LARGE

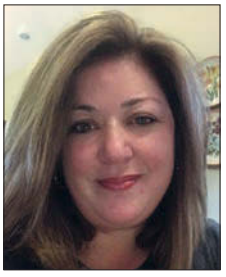
The Nominating Committee submits four names for National Director at Large. Two will be elected for a three-year term.

Joseph M. Burke, Centreville, Va., a Life Member, joined AFA in 1985. He has held numerous elected or appointed offices at the chapter and state levels, currently as the Virginia Vice President for Communications.

He also serves AFA at the national level on the Field Council Technology Committee, Membership Committee, and Advocacy Committee. He previously served as President of the General Charles A. Gabriel Chapter. Burke has received an AFA Exceptional Service Award, Storz Award, Medal of Merit, and numerous region, state, and chapter awards, most notably being selected as Virginia Member of Year and Central East Region Member of Year. He earned a bachelor's degree in management (cum laude) from University System of New Hampshire Granite State College and a master's degree in administration from Central Michigan University. He is also a certified Project Management Professional (PMP) with specialized experience in project management and program manage-

ment of software development, system/software test, software IV&V, and information technology services. He is a former Civil Air Patrol cadet and veteran of both the US Coast Guard and the US Air Force. As an Air Force NCO, Burke served as a power production specialist in CE, was selected for "Operation Bootstrap" and Officer Training School, then served as an Air Force commissioned officer in ICBM Missile Operations. He is presently a vice president of business development for a woman-owned, small disadvantaged business. Burke has over 40 years of progressive experience in the military and private industry, including both senior operations and executive business development positions for aerospace and defense companies.

Cristina Lussier, Alexandria, Va., joined AFA in 1995, becoming a Life Member in 2012. Lussier has been involved in AFA since she was an AFROTC cadet over 24 years ago. She has held numerous EXCOM positions at the chapter level and has received a myriad of AFA awards and honors, to include being selected as an inaugural member of AFA's Emerging Leader Program in 2014 and serving on AFA's National Strategic Planning Committee. After earning her bachelor's degree in Political Science from Pepperdine University and a commission in USAF, she went on to earn a master's degree in leadership from the University of San Diego; a master's in defense decision making & planning from the Naval Postgraduate School, and an executive master's of business administration from Pepperdine University's Graziadio Business School. She currently serves as the D.W. Steele Chapter President in Northern Virginia, is a retired veteran, and most recently a member of USAF civil service.



James Navarro, Colchester, Vt., an AFA Life Member since 1988 when he joined the Arnold Air Society. Navarro has served as the CyberPatriot Vice President for the Green Mountain Chapter and the State of Vermont for the past six years and previously worked as their Community Partner lead. He was awarded an AFA Medal of Merit in 2017 for his work with CyberPatriot and the Chapter's successful partnership with Champlain College. Navarro was selected as an AFA Emerging Leader in 2018, participated as a member of the Wounded Airman Program Committee, and participated in Strategic Planning and Field Council meetings. He earned a bachelor's degree in mathematics at Syracuse University and has a master's in public administration from Troy University. Navarro spent over seven years in the Air Force as a targeteer, three years in the Air Force Reserve, almost 20 years in the national security industry, and was awarded the National Intelligence Certificate of Distinction. Navarro currently splits his time between Vermont and Virginia where he is the chief operating officer of a national security and defense consulting business.

Molly Mae Potter, Austin, Texas, joined AFA in 2006. Potter is a graduate of Embry-Riddle Aeronautical University where she was an active member of the Silver Wings Challenger Chapter. She served on Active Duty in USAF from 2007-2013 as a test engineer. In October 2016, she was crowned Ms. Veteran America 2016 and supported its mission to raise awareness about and advocate to end homelessness among women veterans. Potter serves as the Austin Chapter AFA President and was selected as one of the 2016-2017 AFA Emerging Leaders. She is currently on the Board of Trustees and has served as a national administrative consultant for 10-plus years as a member of the Arnold Air Society and Silver Wings. Locally, she has served the city of Austin as a commissioner for veteran's affairs, active in promoting veteran entrepreneurship and start-ups. In 2017 she was named a National Military Influencer in Entrepreneurship. Potter was recently appointed to the board of directors for the Vetted Foundation, which places proven transitioning military leaders into corporate leadership roles. She earned a master's degree in engineering from the University of Florida and a master's in business from the University of Texas. Currently living in Austin, Texas, she leads business operations for client engineering at a multinational technology company.

NATIONAL DIRECTOR, CENTRAL AREA

The Nominating Committee submits one name for National Director, Central Area, for a three-year term.

James W. Simons, Minot, N.D., an AFA member and Community Partner since 1995. Simons has over 24 years of field experience from the chapter to the regional level, serving as the David C. Jones Chapter President and Treasurer, North Dakota State President, and the North Central Region President. He was a charter member of the AFA Field Council and also served on the National Membership Committee. Simons has received the AF Medal of Merit, Exceptional Service Medal, Chairman's Citation in 2009, National Member of the Year Award in 2014, and the Mary Anne Thompson Award in 2009. He is currently the David C. Jones Chapter Vice President for Leadership Development. Simons earned a bachelor's degree in criminal justice from Michigan State University, a master's in systems management from the University of Southern California, and a master's in administration of justice from Wichita State University. A retired US Army Military Police Officer, Simons is currently a financial adviser for a financial services company.

AIRMAN FOR LIFE

Updates on AFA's activities, outreach, awards, and advocacy.

CAP Cadets Visit Science Museum

Fifty-three Civil Air Patrol cadets and six supervising senior members participated in a tour organized for the 2019 Joint Mid-Atlantic & Virginia Wing Conference and sponsored by the **Richmond (Va.) AFA Chapter,** which paid for cadets' admission to the museum and arranged for no additional cadet activity/conference fees.

The cadets formed teams to participate in the Soaring Satellites Challenge, designing a "satellite" that could hover at a specific height in a wind tunnel and competing for the longest hover.

More than 300 cadets and senior members gathered at the Richmond convention center during the conference. They participated in professional development opportunities, flight simulator sessions, and seminars, as well as discussing CAP's response to Hurricane Florence. Col. Bruce B. Heinlein, Mid-Atlantic Region commander, said that every wing within the region participated in Hurricane Florence relief efforts.

Photo: CAP

Cadets from CAP's newly re-named Mid-Atlantic Region visited the Science Museum of Virginia thanks to the Richmond (Va.) AFA Chapter.

Cheesecon in Milwaukee

Arnold Air Society and Silver Wings held their 72nd National Conclave—otherwise referred to as "Cheesecon"—at the Hilton City Central and Milwaukee Convention Center from April 19-22.

AAS-SW work together to develop future leaders, promote leadership skills, heighten military awareness, encourage professional development, and perform community service. They meet yearly at various locations, attracting almost 1,000 attendees.

Highlights of this year's event included a Pre-Trustee and Trustee dinner; a Profession of Arms Center of Excellence Workshop (PACE), focused on promoting the Air Force core values throughout the Profession of Arms and Air Force mission; an AFA luncheon and award presentation with then-undersecretary of the Air Force Matthew P. Donovan; an International Air attaché panel discussion with Brig. Gen. (Air) Georges Franchomme from Belgium and Group Capt. Stephen Richards from the UK; and ended with a USAA military banquet. The guest speaker for the event was retired Gen. Robin Rand, the new chairman, Board of Trustees for Arnold Air Society and Silver Wings. Next year's conference will be held in Las Vegas.

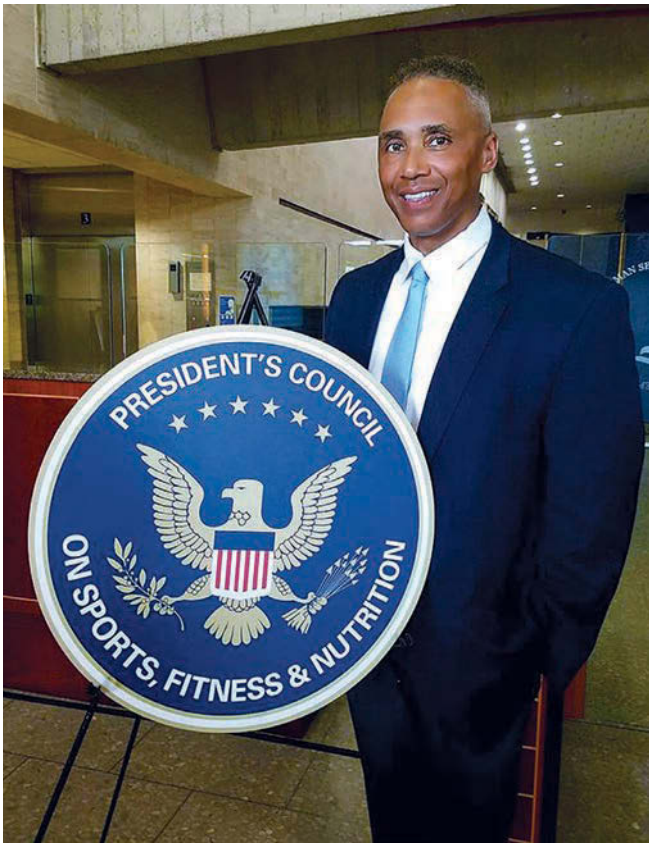


Photo: Rob Wilkins

Rob Wilkins has been an advocate for health and fitness for many years and continues his efforts on the President's Council.

USAF Vet on President's Council on Sports, Fitness, & Nutrition

An AFA Life Member, retired MSgt. Rob Wilkins, has been appointed by President Donald J. Trump to the President's Council on Sports, Fitness, & Nutrition (PCSFN), whose mission, since 1956, is to increase sports participation among youths of all backgrounds and abilities, and to promote healthy eating and active lifestyles for all Americans. There are currently 23 members serving on the PCSFN.

Wilkins served 26 years in the Air Force as a unit fitness adviser, retiring in 2009, and has developed several fitness and exercise-related programs for unit personnel. He currently serves on the board of Boulder Crest Retreat for Military Veteran Wellness. He once trained to be a bodybuilder, and is also president of Rolling Thunder, Washington, D.C.

As a recognized Air Force fitness expert, he received an Air Force Commendation Medal for setting up life-saving health screenings for three military personnel, each diagnosed with diabetes, and he has also worked to promote health and fitness to children participating in the Special Olympics.

Other members on the president's council include MLB Hall of Famer Mariano Rivera, former NFL great Herschel Walker, and TV show host Dr. Mehmet Oz.

For a list of ways to be active and keep up with your physical fitness, go to: https://www.hhs.gov/fitness/be-active/ways-to-be-active/index.html.

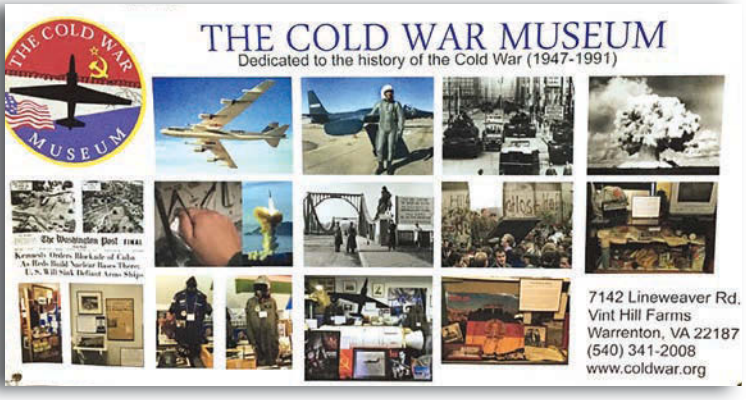
Cold War Museum Presentation

Photo: Courtesy of the Cold War Museum

Retired Col. Charlie Simpson speaks to the attendees about the Cuban Missile Crisis at a Cold War Museum briefing.

Members of the **AFA Gabriel (Va.) Chapter** and the Association of Air Force Missileers (AAFM) gathered at Vint Hill, Va., in April for a Cold War Museum briefing on the Cuban Missile Crisis by retired Col. Charlie Simpson, founder and director of the AAFM. In October 1962, the US faced the Soviet Union in a nuclear standoff, known as the Cuban Missile Crisis, when the Soviets placed medium-range ballistic missiles in Cuba. The confrontation resulted in our military attaining the highest level of alert—DEFCON 2—in our history. This presentation, originally presented to over 800 young missile and bomber crew members, maintainers, and security forces personnel at the 2012 Air Force Global Strike Challenge, covered the events leading to the crisis, the US response, and its resolution.

The Cold War Museum is an AFA Gabriel Chapter Community Partner. It houses unusual artifacts from signals intelligence, image intelligence, aerial surveillance, civil defense, Berlin, the East German Secret Police (Stasi), the Cuban Missile Crisis, the Pueblo and Liberty incidents, and more.



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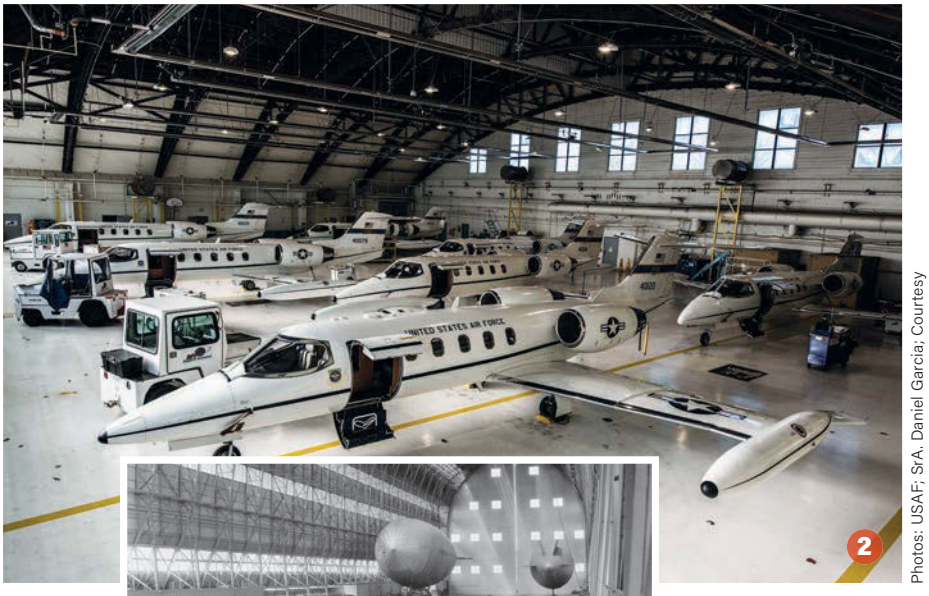

1/Cpl. Frank Scott. 2/ C-21s in a hangar at Scott AFB, Ill. 3/Dirigibles in a hangar at Scott Field in 1923.

Photos: USAF; SrA. Daniel Garcia; Courtesy

SCOTT

The One and Only

The Air Force has built scores of air bases, but only one was named after an enlisted man. That man was Army Cpl. Frank S. Scott.

Scott perished in an airplane crash in 1912, becoming the first enlisted fatality in the history of US military aviation.

Service brass in 1917 bestowed Scott's name on a new base east of St. Louis. "Scott Field" grew into today's Scott AFB, Ill.

Despite this singular honor, little is known about Scott. Records show he was born Dec. 2, 1883, in Braddock, Pa., near Pittsburgh. On May 31, 1889, he lost his parents in the historic Johnstown Flood. The six-year-old was taken in by an aunt.

Then comes a 19-year gap. Scott does not reappear in the public record until 1908 when, at 24, he joined the Army.

Scott enlisted at Fort Slocum, N.Y., near the Bronx. His military career started in the Field Artillery Branch, where he put in three years and acquired a corporal's stripes.

In July 1911, Scott contracted what proved to be a long and serious illness. Deemed unable to carry out "mounted duty," he was discharged with an "excellent character" rating.

Before 1911 was out, however, Scott re-enlisted in the Signal Corps and began hot-air balloon duty, likely at the Fort Wood, N.Y., test site.

On April 2, 1912, the Signal Corps re-opened the Aviation School at College Park Flying Field, Md. The school needed airplane mechanics and Scott, who had mechanical skills, got the job.

He soon became chief mechanic for one of the Wright Type-B biplanes there. The scene at College Park was high-energy. Two soon-to-be famous lieutenants—Henry Harley Arnold and Thomas Dewitt Milling—served as flight instructors and test pilots.

Scott was drawn to the excitement and importuned a student pilot, 2nd Lt. Lewis C. Rockwell, to take him up some day. On Sept. 27, 1912, Rockwell agreed. Scott was to fly the next day.

On Sept. 28, Rockwell went up alone to test Signal Corps No. 4, a two-seat Wright Model B airplane. Satisfied that this machine was working properly, Rockwell landed to pick up Scott.

At the last minute, an officer tried to bump Scott. Rockwell told him, "No, you're too heavy," and Scott clambered aboard.

They took off and soared for 10 minutes. Before landing, however, the aircraft developed engine trouble, nosed downward, and crashed hard. Scott died instantly, Rockwell only hours later.

It was history's first-ever multi-fatality aviation accident.

Both were buried at Arlington National Cemetery. Rockwell's name, like Scott's, wound up on an air base—the old Rockwell Field (now NAS North Island) in San Diego.

Scott Air Force Base, with its 1917 birth date, is USAF's fourth-oldest continuously active installation. Located there are, among many service and joint units: headquarters of Air Mobility Command and US Transportation Command; the 126th Air Refueling Wing and 375th Air Mobility Wing; the Tanker/Airlift Control Center; and the Defense Information Systems Agency's Global Operations Command. ✪

FRANK S. SCOTT

Born: Dec. 2, 1883 Braddock, Pa.
Died: Sept. 28, 1912 College Park, Md.
Education: Unknown
Occupation: US non-commissioned officer
Service: US Army (Field Artillery, Signal Corps)
Era: Experimental
Years of Service: 1908-12
Combat: None
Final Grade: Corporal

SCOTT AIR FORCE BASE

State: Illinois
Nearest City: Belleville
Area: 5.46 sq mi / 3,500+ acres
Status: Open, operational
Site acquired: June 14, 1917
Named Scott Field: July 20, 1917
Opened: Sept. 1, 1917
First flight: Sept. 2, 1917
Renamed Scott AFB: Jan. 13, 1948
Current owner: Air Mobility Command
Former owners: Signal Corps, Bureau of Military Aeronautics, Air Service, Air Corps, GHQ Air Force, Technical Training Command, Air Training Command, Military Air Transport Service, Military Airlift Command

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