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Air Force Next-Generation Air Dominance Program: An Introduction

On September 15, 2020, U.S. Air Force acquisition executive Dr. Will Roper announced that the Air Force had flown a full-scale flight demonstrator as part of the Next-Generation Air Dominance (NGAD) program.

The announcement came as a surprise to many observers, both as the NGAD program was believed to be an early-phase technology development program unlikely to yield hardware in the near term, and because funding began two years ago, which is unusually fast to design and build a military aircraft. DOD had mentioned an interest in building a new “X-plane” prototype as far back as 2014, but it is not clear whether this led to the NGAD demonstrator.

What Is the NGAD Program?

The Air Force has said that NGAD exists to examine five major technologies that are likely to appear on next generation aircraft, with the goal of enhancements in survivability, lethality, and persistence. It has not specified what four of those technologies are.

The one acknowledged NGAD-related technology is propulsion. Over the past few years, the Air Force has invested substantially in variable cycle engines. Other likely candidates include new forms of stealth; advanced weapons, including directed energy; and thermal management. The current engine on the F-35 and its variants expected to be on the B-21 produce a tremendous amount of electrical power that can enable new weapons. That could require advanced techniques to manage generated heat, so that it does not become part of the aircraft signatures and make the plane easier to detect.

Is the Goal of NGAD a New Fighter?

The technologies involved in NGAD are being developed to provide air dominance. Part of the program’s goal is to determine how to achieve that end, independent of traditional ideas. NGAD could take the form of a single aircraft and/or a number of complementary systems—manned, unmanned, optionally manned, cyber, electronic—forms that would not resemble the traditional “fighter.”

For example, a larger aircraft the size of a B-21 may not maneuver like a fighter. But that large an aircraft carrying a directed energy weapon, with multiple engines making substantial electrical power for that weapon, could ensure that no enemy flies in a large amount of airspace. That is air dominance. There appears little reason to assume that NGAD is going to yield a plane the size that one person sits in, and that goes out and dogfights kinetically, trying to outturn another plane—or that sensors and weapons have to be on the same aircraft.

Budget and Program Structure

Air Force NGAD is budgeted at \$9 billion from 2019 to 2025. The FY2021 budget is \$1 billion, with a request of \$1.5 billion for FY2022.

NGAD was originally mooted as a joint project between the Navy and the Air Force, and there is still some cooperation between them, but the two services have created separate NGAD offices.

What Does the Flight Demonstration Mean?

Based on the movements of senior DOD officials, CRS assesses the first flight came on or about August 21, 2020. Some news sources have referred to this event as the first flight of a new fighter, and speculated as to the design and characteristics of such a fighter. However, it is notable that the aircraft was described as a “full-scale flight demonstrator,” not a “prototype.” The former phrase is used to describe an aircraft that is showing off some form of technology and is different from “prototype,” which indicates a more production-representative system.

Figure 1. Northrop Tacit Blue



Source: U.S. Air Force photo.

The history of full-scale flight demonstrators shows that they are not always followed by broader contracts. For example, in the early 1980s, Northrop flew a full-scale flight demonstrator in the Tacit Blue program. That was a single-passenger stealthy aircraft used to investigate operating a sophisticated sensor system in threatened airspace. Northrop built one Tacit Blue and did not wind up subsequently building anything that looked like it. Some of the technology explored in that program eventually went into JSTARS, an airliner-sized, nonstealthy sensor platform that had nothing physically in common with the flight demonstrator.

Another full-scale flight demonstrator, the Boeing Bird of Prey, flown in 1996, was used to demonstrate stealth and other technologies. Boeing made one Bird of Prey and did not receive any contract publicly connected to the work that flight demonstrator performed. These cases illustrate the

difference between demonstrators, which are research aircraft, and prototypes, early examples of finished systems.

Figure 2. Boeing Bird of Prey



Source: U.S. Air Force photo.

While Tacit Blue was a fighter-sized aircraft that led to an airliner-sized system, both the F-22 and F-35 programs included the opposite—airliners fitted out with those fighters’ avionics and sensor suites, so the subsystems could be flight tested while accompanied by a crew of engineers to monitor and adjust performance. These aircraft were full-scale flight demonstrators of those subsystems, in an airframe that in no way resembled the eventual aircraft. There is therefore little evidence to describe what the Air Force recently flew based on the phrase “full-scale flight demonstrator.”

Figure 3. Boeing F-22 Flying Test Bed



Source: U.S. Air Force photo by Ethan Wagner.

What Companies Are Involved?

DOD has made no mention of specific NGAD contractors. The three traditional aviation primes all have units devoted to advanced development and prototypes, the best known of which is Lockheed Advanced Development (popularly, the “Skunk Works.”) In 2007, Northrop Grumman acquired Scaled Composites, a dedicated builder of one-off prototypes. Boeing complemented its internal Phantom Works with the acquisition of Aurora Flight Sciences in 2017 and Insitu in 2008, increasing its boutique design capabilities, particularly in unmanned aircraft.

Also, Textron proved a capability to quickly design and produce an aircraft with its Scorpion trainer/light attack jet, and General Atomics has shown a series of increasingly sophisticated designs with capacity for low-rate serial production.

The NGAD demonstrator was not declared to be a new design. Northrop, for example, built a prototype for the T-X trainer competition the company later decided not to enter.

Such an existing airframe could be augmented with one or two NGAD technologies to become a full-scale flight demonstrator, considerably shortening time to “first flight.”

What Else Is Important About NGAD?

The NGAD program is part of the Air Force’s reengineering of how it does acquisition. One goal is an effort to split design, production, and sustainment so that whoever designs an aircraft might not get the production contract, and whoever gets the production contract may not also support the aircraft in the field.

Ultimately, that vision could result in firms specializing in design that pass their designs to high-tech manufacturing centers capable of producing anything sent to them in digital form, rather than maintaining dedicated airplane factories. Companies with global logistics chains could be tasked with the sustainment mission. This reallocation of roles could open Air Force programs to firms that are not traditional military aviation primes.

This concept complements the Air Force’s other goal, to move from long programs to short runs of different aircraft, theoretically made possible and economical by flexible production lines. This might lower sustainment costs because they would be replaced by newer designs rather than being kept in service for long periods. This effort is often referred to as the “digital Century series,” referring to simultaneous Air Force development programs of the 1950s and 60s.

Does NGAD Compete with F-35 or Other Programs?

For the next few years, at least, NGAD is a research effort, with no current plans to acquire production aircraft or other systems that may result. Congress authorizes and appropriates research and development funds and production funds in separate budget lines. F-35 is substantially funded through procurement, NGAD through R&D, and those are not directly fungible.

Further, even if the flight demonstrator were a fully production representative aircraft, it could still take industry several years to create production facilities. While the Air Force is trying to move to new agile forms of production, it’s not clear that contractors have kept pace with that initiative.

The F-35 is a program of record, with funding projected for the next five years at least. The Air Force has not budged off its ultimate goal of 1,763 F-35s. No acquisition goal or fleet size has been posited for NGAD. Also, the air dominance role NGAD is intended for is more in line with the current mission of the F-22 or F-15EX than F-35.

That said, these programs would all have to fit within an Air Force topline budget, which could lead to pressures to favor one program over another in funding decisions.

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