

This month, the Air Force will seek the blessing of Frank Kendall, Pentagon acquisition, technology, and logistics chief, to proceed with a new program to replace the E-8C Joint Surveillance Target Attack Radar System fleet. If the program is approved, USAF could have the first of a new generation of ground surveillance radar aircraft serving by 2023, and—if

the ambitious schedule holds—potentially replace the entire E-8 JSTARS inventory by the end of 2026.

Known for now simply as the “JSTARS Recap”—for “recapitalization”—the project surfaced a year ago, when Gen. Mark A. Welsh III, Air Force Chief of Staff, said replacing JSTARS had become the service’s fourth highest acquisition priority, after the F-35 fighter, KC-46 tanker, and Long-Range Strike Bomber. Air Combat Command chief

Gen. Gilmary Michael Hostage III, now retired, said in September that JSTARS operating costs “are eating us up,” and finding a replacement is urgent.

The Air Force pegs JSTARS operating costs at about \$14,000 per hour. After a brace of analyses of alternatives and extended talks with industry, program officials think that figure could be cut two-thirds. The Air Force is so sure a new system will be far cheaper than the old one that it expects the whole program

Ground surveillance could get smaller, cheaper, and more powerful.

The JSTARS RECAP

By John A. Tirpak, Editorial Director

The 751st Electronic Systems Group’s E-8C JSTARS test aircraft, T-3, undergoes flight testing with JT8D-219 engines in 2009. An up-engined JSTARS was ruled out, however, due to the airframe’s age.

to pay for itself by 2030, only seven years after the first JSTARS Recap jet becomes operational. Across 25 years of life cycle costs, retiring JSTARS and buying a new system is expected to net a savings of \$11 billion.

FILLING GAPS

Kendall will render what's called a materiel development decision. It approves a requirement, acknowledges that an analysis of alternatives (AOA) has been completed, and allows the Air Force to conduct detailed discussions with industry about potential solutions. If all goes as planned, a request for proposals for technology maturation and risk reduction will be out to industry this spring.

Lt. Gen. Ellen M. Pawlikowski, the uniformed deputy acquisition chief for the Air Force, told defense reporters in November that "we have spent a good portion of the last eight months" working with ACC to understand what it needs and "dial in those requirements" to the JSTARS Recap. She said the project aims chiefly to replace the existing function, but also fill "certain gaps" in capability that combatant commanders have identified. She didn't address what those gaps are.

She emphasized the main objective is to find "a more affordable way to provide" the surveillance and battle management command and control (or BMC2) products that JSTARS delivers today. The idea is not to "reinvent" or take "undue risk in terms of trying to explore new radar technology," but to use "existing technology" and package it in a smaller, more efficient system that provides at least what field commanders already get from JSTARS.

The Air Force has 16 E-8C JSTARS airplanes. Conceived and procured in the 1980s, the E-8's original, Cold War function was to use its 24-foot-long radar to map the battlefield and detect, track, and target moving ground vehicles. It can keep watch over 19,000 square miles with a 120-degree field of view; the radar can slew to look at one side of the aircraft or the other and detect ground targets more than 120 miles away.

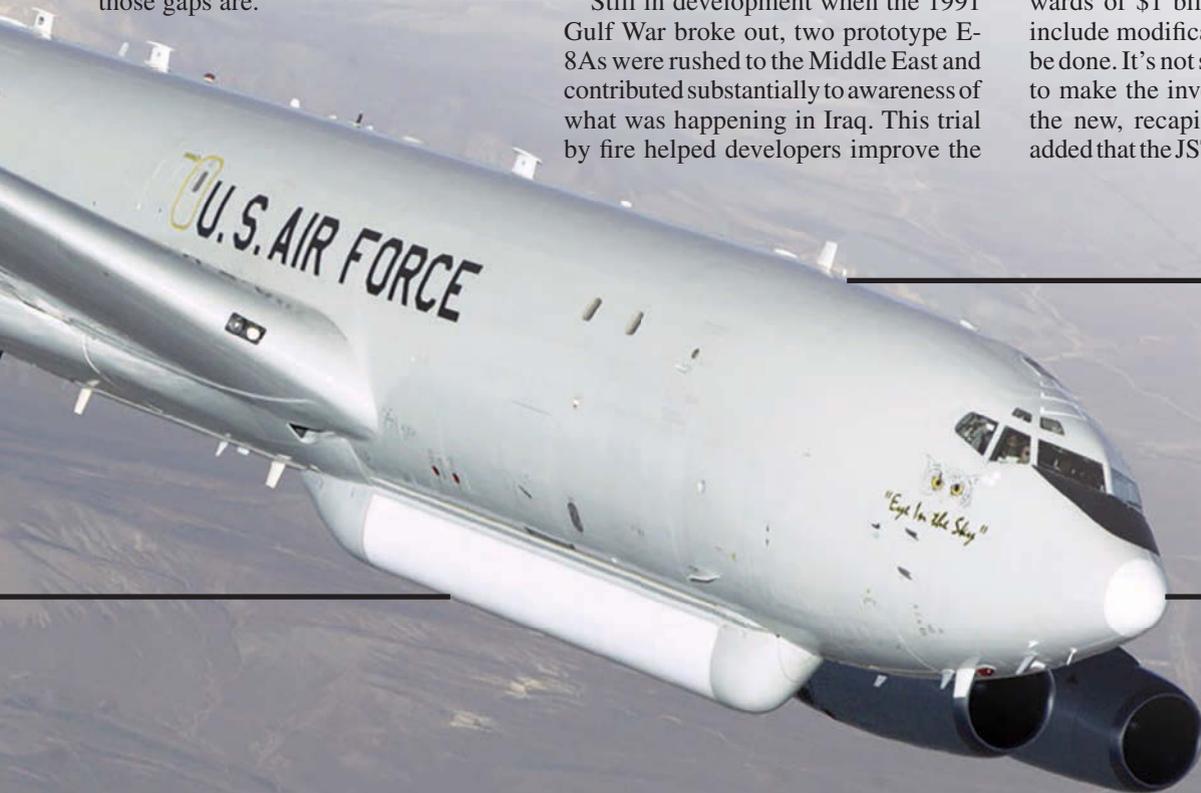
Over time, improvements and variations of this function have been added, recording time-lapse imagery of an area to build up a library of patterns, capturing the flight of aircraft at low altitude, a maritime surveillance mode, and tracking the movements of smaller and smaller moving objects on the ground.

Still in development when the 1991 Gulf War broke out, two prototype E-8As were rushed to the Middle East and contributed substantially to awareness of what was happening in Iraq. This trial by fire helped developers improve the

system; it wasn't declared operational until 1997.

Although the sensor and onboard processing systems have been updated many times over its 25-year history, JSTARS has become so expensive chiefly because of the platform the Air Force picked to host it. The Air Force chose used 707-300 airliners—old, even then—to serve as the carrier for the JSTARS system, comprising the large radar under the fuselage (housed in what's called the "canoe"), antennas and communication gear, and a series of computer terminals and workstations aboard the aircraft. The idea was that the aircraft, built in the 1960s, would have some commonality with the C-135-series aircraft that served USAF in a variety of functions—such as KC-135 tankers, E-3 AWACS, and RC-135 surveillance airplanes—and thus save money on parts and maintenance. It didn't quite work out that way; the aircraft were all different, to varying degrees, and even today, a common configuration has been elusive.

William A. LaPlante, assistant secretary of the Air Force for acquisition, said at the Air Force Association's Air & Space Conference last September JSTARS sustainment is "costing upwards of \$1 billion a year, when you include modifications that will need to be done. It's not sustainable. So we need to make the investment today to build the new, recapitalized airframes." He added that the JSTARS airframes "are on



Courtesy photo

average 45 years old, so it's something we're just going to have to do."

Although a "joint" program with the Army—which puts some operators on board—JSTARS sustainment and operations are funded almost entirely by USAF.

Northrop Grumman got the contract to develop JSTARS and convert the used airliners to carry it. In 1998 dollars, the aircraft cost \$244 million apiece.

An effort to do a large-scale JSTARS replacement got underway about a decade ago, when the Air Force envisioned a massive sensor and battle management craft called the E-10 that would also have performed some of the E-3 AWACS mission. Notionally to be hosted on a Boeing 767, the system proved too complex and too expensive and was soon canceled.

A second attempt at recapitalizing JSTARS was made some four years ago, when commanders decided the E-8 needed more power to fly to efficient altitudes and generate electricity for the system's voracious electronics and cooling systems. An AOA concluded in 2011 that while re-engining the E-8C fleet would have been operationally useful, it didn't make any sense to invest more in airframes that were getting harder and harder to keep airworthy. A USAF spokesperson said these "additional expenses associated with the aging ... Boeing 707" included "diminishing manufacturer supply sources, corrosion, and structural integrity."

The service then decided it made the most sense to move to a new platform—probably a smaller, business jet-type

aircraft. But in 2012, then-Chief of Staff Gen. Norton A. Schwartz told Congress the budget simply didn't allow for it.

Through a spokesperson, the Air Force said the life cycle cost of maintaining the existing JSTARS fleet through Fiscal Year 2045 is estimated at \$38.7 billion. For a replacement system based on a smaller jet, the cost—including procurement of new airplanes and hardware—is expected to be \$27.6 billion over the same period.

GET-STARTED MONEY

The JSTARS Recap is budgeted for \$2.4 billion across the service's Future Years Defense Program (FYDP), although Welsh has said he won't presuppose Congress' support for it.

To demonstrate USAF's seriousness about the need for the system, however, the service is borrowing against itself to pay for development. In the Fiscal 2015 budget request, the Air Force proposed retiring a test E-8 and taking five operational E-8Cs out of service to generate \$705 million of savings over the FYDP to be used to defray the cost of acquiring the E-8's successor.

"We are taking some risk with this," Hostage said in September, but the financial situation and operational reality had to be reconciled somehow.

LaPlante said the funds are "get started" money. The keys will be to use "mature technology, replicate the performance, more or less, of the JSTARS," and take the money from divesting some of the platforms now. "We are refining the acquisition strategy" with the Office of the Secretary of Defense, LaPlante noted.

Pawlikowski said the biggest risk on the program is the integration of the sensors, the battle management system, and the airplane. The battle management system itself is not risky, she said, because of "all the great progress we've made over the years" in that area.

"We seem to have a good range of aircraft that are in play right now," she said of potential contenders, and she reported being pleased "with what we've seen from industry" during the analyses of alternatives and various industry days and requirements clarifications sessions.

"Industry is ... leaning forward," she said, and there are "lots of demonstrations that are coming out to us. I like to say I want to get past the 'glossy brochure' piece in the engagement with industry and into the no-kidding, what-the-numbers-really-look-like" phase of the program.

LaPlante said requirements for the JSTARS should be set by the end of this year. Proposals would be turned in and a contractor selected in 2016.

Although the Air Force has yet to decide if it wants a single prime to integrate all the pieces that will have to be part of the JSTARS Recap, contractors are guessing that it will. Even so, industry reps from several companies all said they are waiting to see firmer requirements before choosing teammates to supply radars, other sensors, and aircraft.

"The size of the radar has a direct impact on the performance in the capabilities," Pawlikowski said. Much of the tradeoff analysis will be finding precisely the right size radar—the "knee in the curve"—where the cost of the JSTARS

An artist's illustration of Boeing's proposal based on a 737-700 airframe.





USAF photo by Mark Herlihy

A Bombardier aircraft on display at Hanscom AFB, Mass. Aircraft and communications companies gathered at the base last April to discuss JSTARS Recap.

Recap system greatly increases if the size of the radar increases.

She added that the program will be a “pathfinder” project for the Air Force—a guinea pig for some of the new acquisition practices mandated by Kendall’s shop under what he’s dubbed the Better Buying Power series of reforms. A key element will be building in “agility”: The system will have to have an open architecture to allow frequent and easy swap-outs for new technology as it becomes available and as the aircraft’s mission changes over time.

Although Schwartz, Welsh, and other top USAF leaders have talked about a business jet as the ideal platform for the JSTARS Recap, that’s not an ironclad requirement. A spokesperson said the Air Force “will not dictate the specific platform. That will be determined during the source selection for the EMD [Engineering and Manufacturing Development] phase. The Air Force desires an affordable, efficient aircraft with the ability to best meet the requirements” as

laid out in the Capability Development Document.

THE CHALLENGES

“The Air Force used the term ‘business jet’ in the AOA as a generic term for a commercially available class of aircraft that are smaller and more efficient than the ... E-8C,” the service said in a written response to questions.

Contractors eyeing the JSTARS Recap prize have taken to heart that the biggest challenges of the program are affordability, speed to ramp—getting the airplane in service as fast as the Air Force wants it—life cycle cost, and adaptability to changing missions and hardware. The Air Force also wants an aircraft that can be refueled in the air.

During USAF’s flirtation with re-engining and upgrading the E-8C, Boeing had offered a variant of its 737-based P-8 Poseidon maritime patrol airplane, now in production for the Navy. The company believed with minor tweaking the P-8 could easily be adapted to meet

the JSTARS mission and USAF could have all-new airplanes for less than the price of re-engining and upgrading the hoary E-8 fleet.

As the Air Force’s AOAs seemed to settle on a more business jet-type aircraft, it became clear the P-8 “wasn’t going to meet some of those initial suggestions on those overarching requirements,” said Rod Meranda, Boeing’s business development lead for the JSTARS Recap.

Based on its conversations with the Air Combat Command, Boeing did its own six-month analysis and decided to offer a system based on its 737-700.

The 700 series “is the smallest of the 737 families,” Meranda said. “It’s about 110 feet, nose to tail,” and technically counts as a business jet, operated by many customers as a long-distance executive or luxury transport. A JSTARS is 152.9 feet long.

While larger than the business jets other contractors may offer, Boeing thinks the Air Force will want a somewhat larger size to provide amenities that a crew will want on missions of 12 hours or longer, as well as room for growth if the Air Force wants to add more battle management functions to the system, such as a designated control station for unmanned systems. Boeing’s notional offering would use the CFM-56 engine already in the Air Force’s inventory on the KC-135. It would also generate a lot of extra power for the electronics and can take advantage of 737 parts at facilities all over the world.

Growth capacity is important for a system expected to last 30 years, Meranda asserted. “We have a lot of orders for 737s in various configurations,” well



ANG photo by S/A. Kari Giles

Capt. Brandon Rieker, an air battle manager with the Georgia Air National Guard, at a work station on an E-8C JSTARS. A new battle management system is not risky, said Lt. Gen. Ellen Pawlikowski, but integrating it with the sensors and airplane might be difficult.



USAF photo by Mark Herlihy

Northrop Grumman's Gulfstream demonstrator takes off from Hanscom. The program office is looking for smaller, more efficient aircraft as the new JSTARS.

through the 2020s, Meranda said, so the company will still be there, making parts and offering engineering support for many years.

The Air Force wants to fly high and get there fast, Meranda reported, because the higher the aircraft flies, the farther it can see.

Alan Metzger, vice president at Northrop Grumman for next generation surveillance and targeting, said flying higher makes it easier to see in mountainous regions, allowing the crew to see things “you wouldn’t see if you flew at a lower altitude.”

He added that flying between 30,000 and 40,000 feet, as the Air Force has said it wants JSTARS Recap to do, provides “significant operational enhancements,” especially in mountainous terrain.

Metzger said radar technology has come a long way since the JSTARS was created, with the advent of active, electronically scanned array (AESA) systems that vastly reduce the number of moving parts and multiply the combinations of modes possible.

USAF wants equipment that can be easily upgraded by swapping out circuit cards and boxes, and JSTARS wasn’t designed with an open architecture in mind.

Metzger said Northrop Grumman has done trade studies on “over 120 different types of airplanes and racked and stacked them all. I would say there are three or four that are leading candidates, whether you want a business jet or business liner-type aircraft, and so any number of business jets will work.” The company looked at 737s and Airbus products, and there are “pros and cons” associated with them all, Metzger said. The final choice for what Northrop Grumman may offer will be driven by USAF’s requirements, he said.

One of the cost-cutting drives is to reduce crew size. The E-8 has a crew of up to 22 people: four flight crew,

15 Air Force specialists working at consoles, and as many as three Army specialists.

Meranda said cutting flight crew will be made easier by adopting a new aircraft and new processors that automate much of the work now done by separate individuals. For Boeing’s concept, flight crew can be reduced from four to two, and with automatic diagnostic, test, and self-correction features, four onboard technicians could be taken off. Automating some of the tasks performed by the trackers can also reduce that contingent by at least a couple of people.

“The Air Force is looking for between 10 and 13 operators on this airplane. [That is] what they think is the right number,” he said. “We agree with the Air Force that there is the technology to reduce the crew size. What the number is, is still being debated.”

IT DEPENDS

As for the radar, Meranda said the Air Force has expressed interest in a unit sized from 16 to 20 feet long, which “fits nicely on our particular airplane.”

Metzger noted that Northrop Grumman has outfitted a Gulfstream 550 aircraft with a radar and workstations, proving out various concepts it could offer when the Air Force nails down its requirements. It has taken the jet to Air Combat Command headquarters at JB Langley-Eustis, Va.; to Hanscom AFB, Mass., home of Electronics Systems Center; to JB Andrews, Md., for members of USAF HQ and other Pentagon officials to look at; and to Robins AFB, Ga., where the current JSTARS is flown.

The demonstrator showed off “the aircraft itself, the outer mold lines, the things we have done [with] advanced BMC2 consoles, capabilities, and most importantly, the mission software, which I would characterize as an 85-90 percent solution.” The G550 is also an airplane in USAF’s inventory, as the basis of the C-37 executive transport.

Though the G550 is smaller than Boeing’s approach, Metzger said it has plenty of room for growth.

“It has available room in racks and space inside” and can do the same mission the E-8C performs with fewer operators.

However, “if you take a look at the history of JSTARS over the last 25 years, we have gone through four major upgrades [but] these upgrades have not yielded an increase in overall weight or space,” Metzger pointed out. At the same time, “we have increased exponentially the amount of capability that has been added to that platform,” due to size reductions and processing power gains with each generation of computers.

“What used to be in desktops are now into blade computers,” he said. “Tomorrow, what is on a blade will be on a chip, if it’s not already. ... I have absolutely no reason to believe that you will not see the same effect ... over the next 20 years.” Metzger said the Northrop Grumman concept has “margins ... today,” and “we expect those margins to increase as time goes on.”

Other companies expected to offer a JSTARS Recap solution declined to comment—most saying that they did not want to presume what requirements USAF will ultimately set or divulge competitive information.

Pawlikowski said the program has many moving and interrelated parts. When the last E-8s retire, she said, will be affected by “the price we can get for this replacement.” But she also said USAF has a “bow wave” of recapitalization projects coming up fast and a determination to craft and stick to a 10-year “balanced budget.”

The JSTARS Recap, Long-Range Strike Bomber, F-35, and KC-46 tanker “all go into play in terms of what we can buy and how many we can buy,” Pawlikowski said. And so, “as often happens in the acquisition business,” the answer to any question about JSTARS Recap right now is, “it depends.”