Despite all the fits and starts, NextGen in the U.S. will eventually affect business aircraft operators, although perhaps not on the schedule that the FAA currently espouses. It is not too soon to start considering the impact of NextGen on business aviation and how it will drive equipment requirements.

Promised NextGen benefits are coming, albeit slowly

by Matt Thurber

When the FAA air traffic control system was created, it had a simple mandate: keep aircraft apart. And that mandate stemmed from misadventures that generated overwhelming public interest in crafting a way to keep aircraft from running into each other.

Fast forward a few years. Now we have the NextGen mandate, one that isn’t driven by accidents, which is a good thing because too many FAA regulations stem from tragedy. But because it isn’t driven by an overwhelming need to prevent immediate bloodshed, the Next Generation Air Transportation System is a kitchen sink of desirable features, an all-encompassing package of government and aircraft operator spending that promises to solve a lot of problems and that is going to cost a bunch of someone a lot of money.

Here is a seemingly innocuous statement from the latest version of the FAA’s NextGen Implementation Plan, recently updated in March: “The primary goals of NextGen are to enhance the safety and reliability of air transportation, to improve efficiency in the [National Airspace System] and to reduce aviation’s impact on our environment.”

Certainly these are well intentioned goals, and they reflect the fact that the FAA’s mission has morphed into something more substantial than it was when the agency was founded in 1958. The NextGen plan is part of an effort to wrap ATC modernization into the FAA’s vision “to reach the next level of safety, efficiency environmental responsibility and global leadership.” When NextGen is fully implemented in U.S. airspace it will lead to great improvements in efficiency and consequent reductions in aviation-related emissions.

The global leadership part is debatable, because many air navigation service providers (ANSPs) around the world are in much more advanced stages of ATC modernization. In the U.S, NextGen funding remains hung up in FAA reauthorization legislation, which has been extended 19 times and remains bogged by legislators’ incessant penchant for adding burdensome special-interest riders onto the legislation. Many ANSPs in other regions are funded through user fees, which might explain why they are able to adopt new technology more quickly, but that’s an entirely different issue.

For operators, NextGen will affect three key areas: communications, navigation and surveillance, according to Andy McDowell, Jeppesen director of airspace and airports. “The goal of NextGen is higher capacity and efficiency within the system,” he explained. “The system consists of operations in airspace as well as on the ground. On surveillance, we’re looking at the transition to ADS-B. Communication is the move from voice-based to datalink. And navigation is the route structure based solely on Rnav and RNP. We’re going to have all three in place, the technology as well as the ATC operational plan that makes use of those technologies.” Surveillance is currently the sole FAA mandate, the Jan. 1, 2020 deadline to install avionics capable of broadcasting precise position information, known as automatic dependent surveillance-broadcast out (ADS-B OUT). While this is not yet an FAA mandate, some regions have imposed requirements for controller-pilot datalink communications (CPDLC) and future air navigation system (Fans 1A) capabilities. CPDLC and Fans 1A are datalink communications systems that allow pilots to communicate with controllers and the FAA's aging Host flight data processing network by 2010. By late 2008, however, the pre-production system was beginning to suffer from what the DOT IG described as “numerous technical problems,” including mis-tagging aircraft, controller handoff errors and more than 200 software issues. As a result, the schedules were “pushed well beyond original completion dates, and cost estimates increased by hundreds of millions of dollars.”

The FAA’s planned deployment at 20 en route facilities by 2010 has slipped to 2014, with the additional costs estimated as “close to $500 million.” Sadly, and apparently due to the FAA’s premature “acceptance” of the system, those additional costs go on the agency’s tab. Because NextGen is a “system of systems,” Eram’s problems don’t happen in isolation, and they have a domino effect on other major programs such as ADS-B, data communications (DataComm) and system wide information management (Swin)—that have already been allocated more than $500 million for Eram integration. Further, the IG pointed out, FAA documents acknowledge that Eram delays will affect development of trajectory-based operations and the planned transition to a common terminal and en route automation platform, while prolonged delays could affect future software enhancements estimated to cost $1 billion.

‘Best equipped, Best Served’

The FAA has commissioned a number of RNP approaches, but the FAA also makes positive references to required navigation performance (RNP) in the March document, yet the agency has been slow to encourage the technique, even though its use in other nations demonstrates that it provides significant user benefits. In Canada alone, operators routinely use time- and fuel-saving RNP procedures on more than 100 separate approaches.

The FAA has commissioned a number of RNP approaches, but the majority are simply overlays of ILS approaches. While useful for pilot familiarity and training, these offer little benefit in the real world. The FAA’s March 2011 NextGen implementation plan is certainly a finely drawn view of what we should expect to see by 2018. Replete with charts, graphs, attractive photography and explanatory text, the document makes for exciting reading. Sculpted as it has been from its 1990s birth as the Next Generation Air Transportation System--and with its clumsy N-GATS acronym dropped in favor of the zippy NextGen--the system has clearly caught the imagination of media and politicians alike.

Possibly, too, its gestation many years ago captured for its developers the theme of Field of Dreams, a then-current movie that gave us “If you build it, they will come,” a notion that one suspects still lives on in the minds of many FAA officials. Unfortunately, several of NextGen’s ongoing development efforts also remind some of us of another movie, the one that brought us the Dark Side of the Force.

Regrettably, the implementation plan omits mentioning the ongoing delays and cost escalation in several of NextGen’s more advanced systems, typified by those currently experienced with its $2.1 billion en route automation modernization (Eram) program, a foundational NextGen building block, upon which much of the eventual NextGen structure will depend.

Eram: A Wobbly Pillar

Launched in 2003, Eram was intended to replace the FAA’s aging ground automation modernization (Eram) program, a foundational NextGen building block, upon which much of the eventual NextGen structure will depend.

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via electronic messages instead of voice. Over the ocean, datalink messages are routed via satcom.

**Ground to Air**

At its core, NextGen involves the transition from a ground-based to an aircraft-based navigation system, explained Steve Fulton, technical fellow at GE’s Naverus business. Fulton, who helped develop RNP procedures while flying for Alaska Airlines, cofounded Naverus, which was later sold to GE. “It’s a higher performance capability,” he said. “We’re no longer constrained to fly paths directly to or from ground nav aids, we can create any path we need as the situation desires. There’s a tremendous amount of flexibility in the lateral and vertical paths.” To make NextGen work, it’s necessary to employ something called performance-based navigation. PBN adds the time element to the three-dimensional path flown by an airplane to create a “4-D” solution, a defined trajectory that can be anything from an approach to an arrival to a full flight from parking at the destination to the three-dimensional path flown and where it will cross particular points in space. With the trajectory defined, Fulton explained, airplanes can arrive from divergent paths and fly to a merge point where they are synchronized into the arrival flow. Because they are using precise RNP navigation and ADS-B to broadcast accurate position, separation can be maintained at a tighter level than with ordinary radar surveillance. This allows for more aircraft to be handled, although airport capacity constraints still limit overall traffic levels. However, NextGen includes airport features such as real-time tracking and display of all aircraft and vehicles, which may help prevent incidents such as the one on April 11 in which an Airbus A380’s wingtip sideswiped the tail of a CRJ700 at JFK Airport.

**Picture ADS-B as an aircraft surveillance operating system, just as Microsoft’s Windows or Apple’s OS X are computer operating systems.**

The current system using radar and controllers vectoring aircraft is inefficient, because the time element isn’t precisely planned. Aircraft coming off an arrival procedure are vectored to an ILS first-come, first-served, and each aircraft carves a new path each time. PBN defines the trajectory that the airplane will fly, which includes when and where it will cross particular points in space. With the trajectory defined, Fulton explained, airplanes can arrive from divergent paths and fly to a merge point where they are synchronized into the arrival flow. Because they are using precise RNP navigation and ADS-B to broadcast accurate position, separation can be maintained at a tighter level than with ordinary radar surveillance. This allows for more aircraft to be handled, although airport capacity constraints still limit overall traffic levels. However, NextGen includes airport features such as real-time tracking and display of all aircraft and vehicles, which may help prevent incidents such as the one on April 11 in which an Airbus A380’s wingtip sideswiped the tail of a CRJ700 at JFK Airport.

ADS-B is here, now. A network of ground stations already provides coverage across much of the U.S., including the West and East Coasts, most of the Midwest, the Gulf Coast and a huge chunk of Alaska. Within these areas, properly equipped aircraft can already use some ADS-B services. Picture ADS-B as an aircraft surveillance operating system, just as Microsoft’s Windows or Apple’s OS X are computer operating systems.

**The increased precision of RNP, RNP and optimized RNP approach procedures will save operators time and money as it shortens their time in the air.**

of 1090ES systems will be able to see traffic on CDTI displays, but the 1090ES doesn’t have the bandwidth to include datalink weather. However, avionics providers are including datalink weather capability in their systems using commercial service providers, but this isn’t free.

For low-altitude operations, it will soon (third quarter 2011) be possible to buy a TSO’d 978 UAT ADS-B transmitter for $4,995 from FreeFlight Systems, providing not only ADS-B out capability but also ADS-B in traffic information. A company called Radenna makes a $950 UAT ADS-B receiver for the Apple iPad, which works either with Radenna’s SkyRadar or WingX’s moving-map software. For business aircraft, transponders, avionics systems and major upgrade packages include ADS-B out capability, but ADS-B in equipment is not yet ubiquitous.

**What Next, FAA?**

The big question: when will the FAA begin using all the capability the surveillance part of the NextGen equation offers? The ADS-B network is scheduled to be complete in both U.S. and Europe in 2013. The plan is to make some of the more advanced and useful ADS-B tools available starting around then, including in-trail procedures and automation over ocean routes. This means that properly equipped aircraft would be able to climb and descend to more optimal altitudes, in areas where aircraft currently can’t change altitude because of the huge separation standards needed for aircraft that can’t provide information about their precise position.

ACSS, a joint-venture company owned by L-3 and Thales, is doing some interesting work on these tools, and other major avionics manufacturers such as Honeywell, Rockwell Collins and Universal Avionics are developing or have made available some ADS-B capability. ACSS says it has certified its Tcos with the SafeRoute ADS-B in system to the highest level of ADS-B capability, DO-260B. “We’re specializing in ADS-B in and out capability,” said Stephanie Chartier, ACSS Safe Route marketing manager. “That’s a huge component of NextGen.” ACSS’s equipment is already in use in or in the planning stages by companies such as UPS, US Airways, Delta Air Lines and British Airways. UPS is using SafeRoute to track aircraft on the ground and in the air and operate aircraft more efficiently.
“There are a lot of industry committees that are evaluating different NextGen applications around the planet, and I don’t think there’s enough of a [business aviation] voice. These things are being evaluated from an airline-centric perspective.” –Stephanie Chartier, ACSS

The Dark Side of NextGen
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FAA is understood to be considering the development of non-overlap procedures, but this is likely to be a time-consuming process. In some cases, environmental impact consultations have added years to procedure approvals. At the same time, there appears to be official reluctance (to phrase it diplomatically) to make wider use of those private organizations that have already provided demonstrably safe procedures in the U.S. and overseas. This is unfortunate, and could be costly for U.S. leadership in the future, when RNP procedures become the standard in NextGen and international airspace, and demand increases rapidly.

“Best equipped, best served” is rarely mentioned in the NextGen implementation plan. Yet this concept was the unspoken issue during the FAA/operator discussions before the agency’s re-ordering of priorities in its original NextGen plans. Airline and corporate operators of new aircraft repeatedly stressed that their machines already carry systems with capabilities far in advance of those provided by FAA/ATC services. Furthermore, their new technology represented major investments for which operators could obtain no payback. This paradox eventually led to the concept of “best equipped, best served,” to selectively replace aviation’s traditional “first come, first served” practice.

In operation, an aircraft’s flight plan would include its certified best equipped, best served rating, driven by its key avionics equipment (ADS-B in, DataComm, RNP 0.1, FANS 1A, GBAS Cat 3 and so on), which would then be checked for its planned operation. Flight-plan processing could then use this data appropriately to adjust the aircraft’s departure, climb, cruise, descent and approach times.

Proponents state that common-sense ATC rules would prevent “queue jumping,” while pointing out that a “best equipped, best served” policy offers three real advantages. First, it could optimize traffic flows; second, it would provide operators incentive to upgrade their equipment; and third, it would avoid the cost-inefficiency of equipment mandates. Nevertheless, a “best equipped, best served” evaluation still seems far away.

If Only We Had Done It This Way...

At this point in NextGen’s life, it’s probably a bit late to say that maybe we should have brought the kid up differently. Yet there were sources of sound advice available to NextGen’s parents at the time. Possibly the most cogent, and most readable, of these was—and still is—“NextGen Considerations from a Program Manager’s Perspective,” presented to an ATCA Annual Conference in the mid-1990s by Michael Lewis of Boeing’s Air Traffic Management Division. Those who read Lewis’s paper and subsequently followed NextGen’s rather toruous trail will remember his recommendations well, and sometimes painfully. They would also have been encouraged to hear Deputy Administrator Huerta tell attendees at this year’s FAA/ATCA Technical Symposium in Atlantic City that “to develop and deliver the NextGen programs themselves, we are establishing within the ATO a program management organization. This will ensure that NextGen programs receive dedicated oversight and management while maintaining close links with operation. . . . The investment in NextGen requires nothing less than the best management of the program to ensure that we all get the maximum benefit.”

Better Now than Never: 2025 Draws Closer

In 2018, just seven years away, we will leave NextGen’s mid-term phase and enter its third and final phase on the run up to 2025. As we make the transition, what new technologies and systems can we expect to see? What new air traffic management procedures will be introduced? What new avionics might we need?

Unfortunately, as the FAA and its Joint Planning and Development Office (JPDO) will admit, no one knows. The increasing pace of technology advance makes forecasting difficult and major government investment decisions even more perilous. On the other hand, if those new systems are anything as complex as Lockheed Martin’s Eram (still mired in software development problems after eight years and not expected to be operationally ready for another three), then we are already running late, even before we’ve announced what the future system is going to be.

But here, the planners have given the FAA and its budget masters a break. The estimate to complete all NextGen projects and accomplish implementation problems after eight years and not expected to be operationally ready for another three), then we are already running late, even before we’ve announced what the future system is going to be.

With NextGen, the federal government has some lofty ambitions—enhancing the safety and reliability of air transportation, improving efficiency in the NAS and reducing aviation’s environmental impact—for the many agencies involved in the project.
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NextGen

advocacy council, has already made NextGen capabilities available on avionics systems in modern Gulfstream (PlaneView) and Falcon (EASy II) cockpits. About 3,000 aircraft equipped with NZ2000 FMS are going to be upgradeable, too, but those with older displays such as Primus 1000 and 2000 systems will need to install Primus Elite LCDs so they can display charts and NextGen graphics.

Carl Esposito, Honeywell leader of marketing and product management, wants operators to understand that NextGen is not just one simple upgrade but rather “a phased implementation and phased capability of technology that improves situational awareness, safety, airspace utilization and overall aircraft/airspace efficiency and productivity.”

To upgrade a Primus 2000 system, for example, the FMS needs to be modified for RNP and Waas LPV capability as well as Fans 1/A, and it also needs the new Primus Elite LCDs to display uplink weather and charts and to provide a platform for later software upgrades that will be needed for eventual NextGen features. Radars need to be upgraded for datalink communications capability and TCAs upgraded for ADS-B out and in. “It is a layered technology and capability approach,” he said. “Depending on the customers’ operating conditions, where they’re flying, whether international or domestic, the flexibility in the upgrade lets them tailor the NextGen capability they need to meet the mission now and upgrade as the mission expands in the future and as NextGen gets rolled out around the world.” Most of this technology is available now from Honeywell or in the final phases of certification, Esposito said. “NextGen is now for Honeywell.”

Rockwell Collins has helped develop NextGen technologies as part of the System Engineering 2020 team led by ITT. The team’s efforts include “concept development work across all dimensions of air traffic control, including ground systems, avionics, aircraft, ATC rules and procedures, human factors, safety and security, environmental and standards.”

More recently, Rockwell Collins announced that the FMS-4200 installed in CRJ700 through 1000 jets’ Pro Line 4 avionics has been upgraded for RNP AR approaches. And the Pro Line 21 upgrade package includes capabilities for future NextGen equipage. The company’s latest avionics suite, Pro Line Fusion, is also designed to accommodate NextGen features.

Universal Avionics is well into NextGen capabilities with its systems, including the Fans 1/A-compliant UniLink 800/801 communications management unit and RNP AR-capable FMSs.

NextGen Benefits

“When you’re using an aircraft for business purposes, you’re looking for as efficient an operation as you can have,” said Steve Brown, NBAA senior vice president, operations and administration. “Anything that NextGen can do that saves time, reduces fuel burn and lowers emissions is beneficial to the overall mission to transport people in the most efficient way.”

For the near-term, technology that will be part of NextGen already offers operators improved access to airports, via Waas LPV and RNP AR approaches with lower minimums. “It creates some increased capacity at congested airports as well,” he said. Brown expects to see Waas LPV approaches used for general aviation airports and larger metropolitan airports adopting RNP AR procedures, because of the greater need for the curved flight paths RNP offers where multiple airports have to share the same airspace. Teterboro is an airport in a congested area that could benefit from RNP procedures, and Brown said that one is scheduled for implementation later this year.

Precision GPS-based approaches are just one of the building blocks of NextGen, Brown explained, and the next blocks are already being deployed, with the goal of accommodating growth in air traffic. When ADS-B in becomes available, he added, “There will be a host of weather and traffic information services that will enhance safety.”

While the FAA thus far has not intended that ADS-B in for high-altitude aircraft should include free datalink weather, Brown said that the agency is researching how that could be provided for airline and business aircraft. “The FAA is doing additional research to find out the range limitations within the network,” he said. “It’s partly a product of the spacing of the transmitters.”

For business aircraft operators, there are two ways to approach the NextGen equipment question. “If you have the type of aircraft, where avionics are not highly integrated,” Brown said, “you can afford to take a modular approach.” To meet the 2020 ADS-B out surveillance mandate, it’s a matter of swapping in a new transponder. The communications aspect will require new radios. And navigation means an upgraded FMS. For integrated avionics systems, he said, when buying a new system or new aircraft, he advised operators to “make sure you get what you need.”

Join the Movement

ACSS’s Chartier wants to see more business aviation operator involvement in NextGen development. “There are a lot of industry committees that are evaluating different applications around the planet,” he said, “and I don’t think there’s enough of a [business aviation] voice. These things are being evaluated from an airline-centric perspective. We at ACSS are putting the puzzle together for the business jet world and we would like to have the voice of business jet operators be a proponent in this discussion.”

ACSS is surveying the business aviation community to get operators’ perspectives and to show them what tools such as SafeRoute can do. “Government entities have a lot invested in this,” Chartier said, “and they want the industry to embrace it. They’re willing to play ball, but if you don’t ask, you don’t get.” Business jet operators that show interest in learning about and preparing for NextGen, he added, will get preferential treatment and perhaps even some funding to help pay for upgrades. FAA Administrator Randy Babbitt underscored the need for all aviation participants to support the move to NextGen in a speech he gave at a symposium held by the Society of Aviation and Flight Educators on May 5. “I know there is a perception that NextGen benefits only big operators,” he said. “The reality is that everyone in aviation stands to gain from NextGen. NextGen bundles dozens of improvements in airports, avionics and ATC. The entire NextGen effort will create a much more efficient, responsive, ‘green’ airspace system that serves the public and supports our national economy.”

Aviation & Systems Integration Group, North Little Rock, Ark., may have put it best in a recent blog post about NextGen: “Don’t fool yourself into thinking that, with the ADS-B out requirement in 2020, you have a lot of time. Nearly all of the NextGen components—PBN/RNP, ADS-B and datalink communication—are up and running in various parts of the nation. Like rocks of technology strategically dropped into the airspace pool, their rings of operational readiness are growing ever larger.”

In today’s state-of-the-art cockpits, pilots are not able to see what controllers see. By 2020 all will be required to be equipped for ADS-B out, on the road to the more capable ADS-B in equipage. Honeywell emphasizes that NextGen implementation will be a phased introduction of technology rather than one simple upgrade.

This ACSS SafeRoute display depicts the aircraft’s position in cyan as the aircraft is holding on the runway. The crew gets an aural alert and yellow visual alert, left, that another aircraft is on short final for the same runway. When the other aircraft is on final, the system issues an aural warning―“Traffic on Final!”―and turns the runway and traffic red.