

SOLUTIONS FOR GLOBAL AIRSPACE ELECTRONICS

AVIONICS®

June 2007

magazine

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'SafeRoute' ARRIVES

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In-Trail, On-Time



UPS Boeing 767 lands at cargo carrier's Louisville, Ky., hub.

By Brian Evans

Over the years, a large number of concepts to increase airspace and airport capacity and to smooth traffic flows have been proposed, but few of them have reached operational application. Some die because they just aren't practical; others are seen to be promising but require major investment coupled with dramatic changes in established procedures. Some just fade away as they undergo apparently endless studies and analysis by industry and government specialists.

Today, bringing focus and discipline to this process is the challenge of FAA's Joint Program and Development Office as it seeks to define the Next Generation Air Transportation System, or NextGen. But while NextGen is aiming toward the 2020s, some operators are looking for

much closer solutions. One is overnight package carrier UPS, of Louisville, Ky., for whom on-time performance is the critical imperative.

As the eighth largest air carrier in the world, with some 284 large jets and more on order, plus incredibly tight unload and reload turnaround times, UPS can't afford to wait for the future. In the late 1990s, the company pioneered Automatic Dependent Surveillance-Broadcast (ADS-B) when the system was virtually unknown in aviation circles. In those days, UPS Capt. Bob Hilb, now the company's director of advanced technologies, was a frequent but solitary champion at air traffic control conferences.

Yet, in a series of demonstrations called OpEvals, UPS in 2000 demonstrated the use of ADS-B for pilot self-separation from other traffic at night, with five Boeing 727s holding precise in-

trail spacing as they took off, flew around the Louisville airport circuit and landed, followed by an exacting test of airport surface navigation.

According to one industry official, "without UPS's large aircraft initiative, FAA couldn't have launched its ADS-B program." But the message took time to get through. At a major air traffic control convention shortly after the demonstrations, Karen Lee, a 747 captain and now UPS's director of flight operations, reviewed the benefits of ADS-B and challenged attendees to "think beyond a radar mindset, and focus on implementation."

In 2010, FAA's nationwide ADS-B implementation will begin. By then, UPS will have moved even further ahead, equipping its entire fleet with "SafeRoute" systems, developed by Aviation Communications & Surveillance Systems (ACSS) of Phoenix, a joint venture of L-3

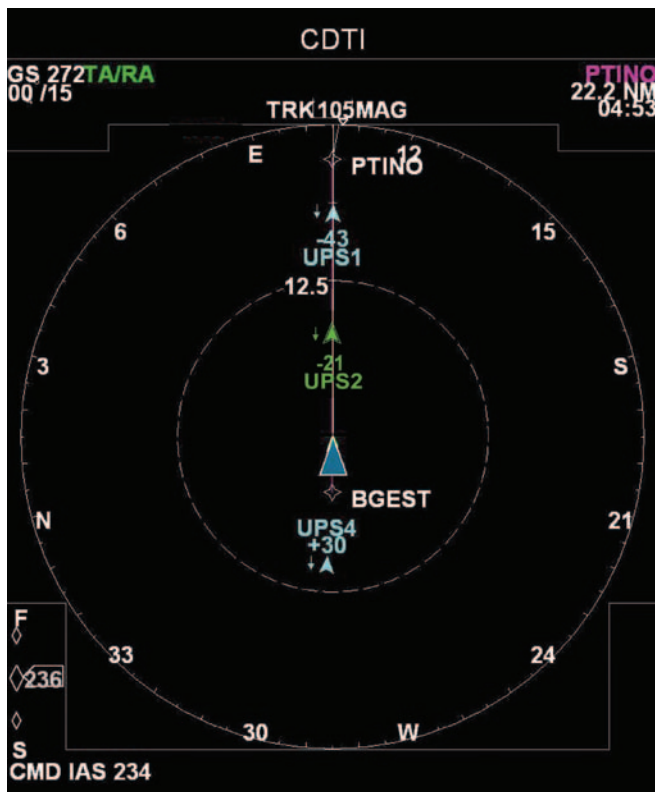
Continued, page 36



UPS will deploy the 'SafeRoute' system, making use of ADS-B positioning for merging and spacing and surface surveillance applications



SafeRoute EFB display shows four UPS freighters, including own ship (blue triangle), heading from different points toward the PRINC waypoint, 47.8 miles and 6.13 minutes ahead of own ship. All aircraft are enroute to the hub airport. Each aircraft symbol shows its position and current heading, plus its relative altitude above or below own ship. UPS2 is 2,000 feet (-20) below own ship's altitude; UPS4 is 2000 feet above own ship (+20); UPS1 is 4000 feet below own ship (-40). All aircraft are in level flight, and the EFB shows that the next heading after reaching PRINC will be toward the BGEST waypoint. Fast/slow indicator of own ship's EFB display shows that it is flying at 272 knots indicated air speed (IAS), but in order to comply with SafeRoute's Merging and Spacing program, it has been commanded to reduce its IAS to 257 knots. Own ship will follow green-delineated UPS2.



SafeRoute has now merged all four aircraft into a precisely spaced stream, all heading to the PTINO waypoint and all four aircraft have just passed the BGEST waypoint and all four aircraft are now descending, as shown by the small downward pointing arrows to the left of each aircraft's heading symbol. All aircraft are now in their continuous descent approach (CDA) configuration, maintaining similar relative altitude separations as they did in previous cruise flight, although UPS4 — possibly a different aircraft type than the other three — has been commanded by SafeRoute to remain 3,000 feet higher than own ship. Own ship's indicated airspeed (IAS) readout shows its current airspeed during the CDA idle thrust power descent is 236 knots, but SafeRoute is commanding the crew to further reduce speed by two knots to 234 knots to maintain correct separation.

Communications and Thales Avionics. SafeRoute is a sophisticated software program that embodies a major step forward in air traffic management, both on the ground and in the air.

The ACSS SafeRoute software portfolio of "ADS-B In" applications will be hosted in the ACSS Surveillance Processor. Streaming data from the processor will be displayed through the Cockpit Display of Traffic Information (CDTI) application hosted in the Boeing Class 3 Electronic Flight Bags (EFBs) manufactured by Astronautics

Corporation of America. Milwaukee-based Astronautics wrote the CDTI application based on an ACSS specification.

Bill Ruhl, Astronautics regional marketing manager in Phoenix, said the CDTI application, hosted on the Linux operating system, has been certified to DO-178B, Level C software criticality as part of the company's EFB development with Boeing. Open-source Linux was chosen in part because it provides all the information needed to certify software to this level of safety, he said.

In a recent briefing for *Avionics* at the



Aviation Communication & Surveillance Systems' Surveillance Processor will host SafeRoute software program.

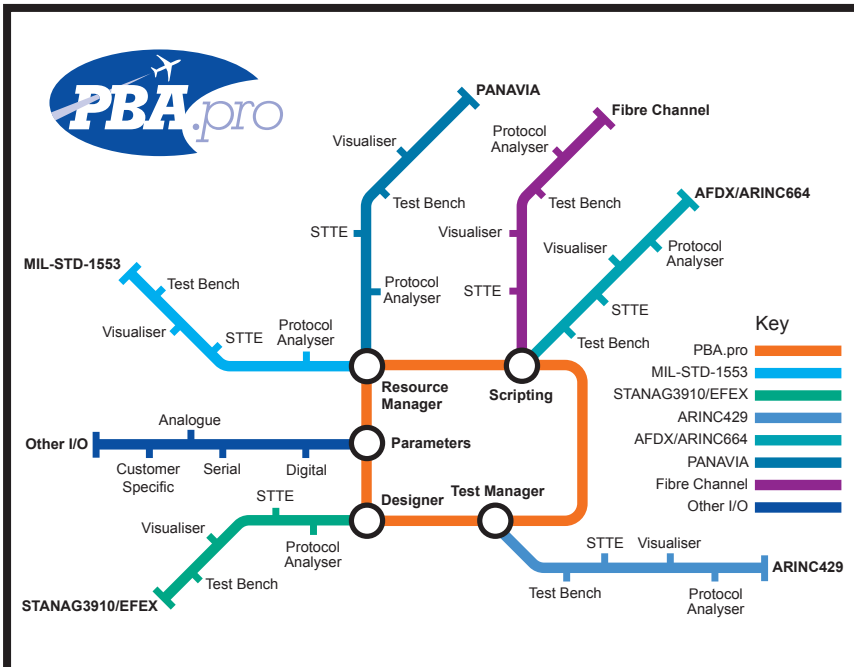
company plant, ACSS officials described SafeRoute as a "platform independent" software package, which the company will offer to other vendors under closely controlled license agreements. While the Class 3 EFB interface was based on the Linux OS, the company was investigating its application to lower-cost Class 2 units, using a Windows environment.

At this writing, only a small number of UPS Boeing 757s had been equipped with preproduction SafeRoute systems for certification, procedure evaluation and development. The balance of the fleet will have Boeing-approved wiring harnesses installed during each aircraft's scheduled heavy maintenance check over the next two years. But UPS was aiming to have its first fully certified production installation flying Aug. 28, to mark "Big Brown's" 100th anniversary.

Surface Management

In operation, SafeRoute will provide UPS pilots and operations staff with two essential functions. On the ground, its Surface Area Movement Management (SAMM) function will provide company pilots, via their dual EFBs, with an exact map of the airport surface, showing ramps, taxiways and runways, including their entry and exit points, plus the aircraft's precise position and heading.

Pilots can immediately see the quickest way to and from the active runway, as well as the positions of all other aircraft, including those taking off and landing, thereby minimizing the risk of runway incursions. This is aided by SafeRoute's "runway occupancy" alerting feature, which turns the runway outline to red whenever an aircraft enters a runway for take off or is about to land. The outline turns to yellow if the landing aircraft has touched down and is decelerating to a runway exit.



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But pilots are not the only beneficiaries of SAMM. With its use, UPS ground traffic controllers can release loaded aircraft in a carefully timed stream to the runway, assuring minimum pre-takeoff delays and unnecessary fuel burn, while incoming freighters can be directed along the most expeditious taxiways to pre-selected unloading gates surrounding the company's massive sorting facility.

Yet it is in flight that SafeRoute promises the major payback to the company.

Unlike conventional airports, freighter hubs are unusual in that they come alive in the very early morning, when a large number of airplanes converge on them within a brief period of time, unload and reload, and then depart.

Adding to the challenge is that the airplanes are arriving from all points of the compass, and subsequently departing in the same way.

In conjunction with FAA's future traffic movement predictions, the UPS

Global Operational Center at Louisville coordinates the departure times of all its aircraft inbound from outlying pick-up airports, in order to produce a constant arrival stream at their designated hubs.

This is done by calculating en route flight times, which vary according to aircraft type, payload, wind and other factors. Arrivals must be integrated among flights departing at different times from around the country.

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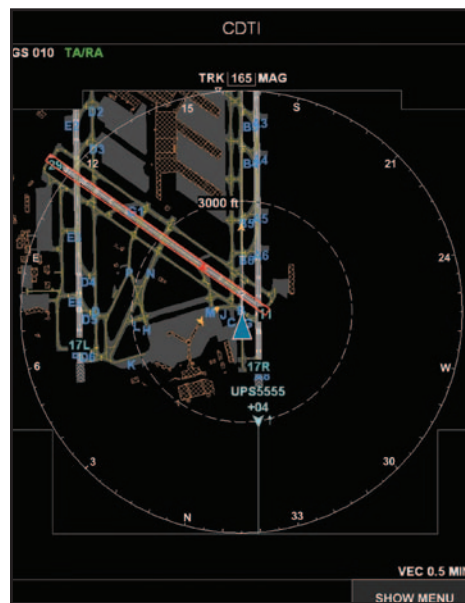
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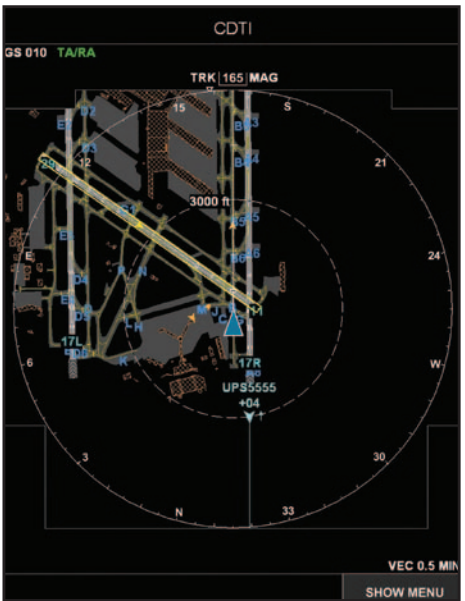
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Red runway outline on EFB display warns that an aircraft is taking off on runway 29. Own ship (blue triangle) waits at hold point until safe to cross.



SafeRoute determines that a landing aircraft is decelerating, and could shortly exit runway. Caution is advised before own ship can cross runway.

Merging and Spacing

While this technique brings the aircraft to Louisville and other UPS hubs in a cohesive stream, SafeRoute's Merging and Spacing program will take things a giant leap forward. Essentially, the program uses ADS-B to gather information on all inbound aircraft within about one hour's flying distance from the freighter hubs and then calculates their optimum maneuvers to join the arrival stream at precisely spaced intervals, at precisely the right time, in an integration exercise where time is counted in seconds. This is an extremely complex calculation, with aircraft coming from several directions, speeds and altitudes.

The merging instructions are presented to the pilots on the screens of their EFBs, which also show the relative positions and intended merge paths of all other aircraft in the vicinity. As well, it shows the pilots the target airspeeds they should achieve to enter the stream at the right place and the right time, and then the speed they must maintain to keep at the correct spacing thereafter. Initially, Hilb said, UPS will use 180-second, in-trail spacing but eventually would like to close that to 120 seconds.

The system then coordinates the stream to the top-of-descent point of the continuous descent approach (CDA) procedure to the runway. In this procedure, developed in conjunction with the Massachusetts Institute of Technology and already used by UPS 757s and 767s, pilots reduce power to flight idle thrust, and hold the aircraft in a steady descent to 1,500 feet at the final approach fix, around five miles from the runway, without the need to increase or decrease power at any point.

UPS tests of the CDA concept in 2004 showed that on average it saved two minutes and up to 360 pounds of fuel on every approach, with the extra benefit of up to 6 decibel reductions in the noise footprint over built-up areas below the flight paths. Nitrous oxides were reduced as much as 34 percent below 3,000 feet, with comparable reductions in carbon dioxide and other emissions.

The approach then continues to touchdown, during which the system continues to show the aircraft's progress on the EFBs, even though the pilots may have the preceding aircraft in sight. This is important, since in lower visibility conditions, or with patches of low cloud, aircraft may briefly disappear from view. In those cases, the pilots will revert to the

EFBs to conduct cockpit display of traffic information-assisted visual separation procedures to accurately maintain their approach positions.

As the aircraft nears the runway, the EFB display will switch to the SAMM surface presentation, but at a scale that extends out beyond the landing aircraft, while still enabling the crew to monitor the runway and surrounding areas for potential runway incursions or other hazards.

As with its earlier pioneering work

with ADS-B, UPS again is leading the industry with its use of the SafeRoute system. The techniques the system supports are now under evaluation by Eurocontrol, and the productivity gains and traffic flow management benefits have attracted a high level of interest among other air carriers, particularly European airlines with major hubs. The concept also is an important aspect of the NextGen plan, particularly for proposed "Super Density Terminals" of the future. **avs**

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