

# Plane Sense on Cockpit Avionics

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## Memorandum of Cooperation

The FAA's NextGen and the EU's SESAR, what does it all mean and how does it affect you?

by **Brian Wilson**

The inter-operability of the two ATM systems is in fact essential to airspace users – airlines and private aircraft in particular – as it will enable aircraft to fly in US and EU airspaces with the same equipment

**O**n June 18, 2010 in Madrid, Spain, representatives of the U.S. Federal Aviation Administration (FAA) and the European Commission officially concluded negotiations to jointly pursue a common goal: To reduce flight delays, increase capacity, reduce fuel consumption and carbon emissions to protect the environment, and share in the financial stability of the aviation community.

The two delegations will coordinate their technical efforts and research and development resources in support of their goal to have a global standardization of the Air Traffic Management (ATM) systems. The inter-operability of the two ATM systems is in fact essential to airspace users – airlines and private aircraft in particular – as it will enable aircraft to fly in US and EU airspaces with the same equipment to navigate, communicate and report essential flight information.

The United States and the European Union share

the same concern; air traffic is forecast to double by 2030 and the existing infrastructure and ground-based technology is outdated, and has not been overhauled since the 1970s. The technical gaps between this legacy equipment and new technologies have reached a point where they are impossible to bridge. The NextGen-SESAR cooperation has been launched to investigate and develop operational and technical solutions.

One example of these operational trials started in June 2009 and is currently operating under the Atlantic Interoperability Initiative to Reduce Emissions (A.I.R.E. initiative), a program designed to explore ways to reduce Aviation's carbon footprint. Participating in the daily trials are numerous American and European airlines.

Flights over the Atlantic are monitored by a modernized operations center in New York which receives new trajectory clearance requests from the crew who want to take advantage of favorable

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winds or routing to save time and fuel consumption. The request is sent from the cockpit Flight Management System (FMS) via a modified data link called Controller Pilot Data Link Communications (CPDLC). Usually within a minute, the Air Traffic Controller in New York reviews the request and sends the corresponding approval back to the crew which then programs the new route into the FMS.

The second component of the initiative is the issuance of Tailored Arrival Clearances into Miami known as Optimum Profile Descents, which allow the aircraft to "glide" on idle thrust from the Top of Descent all the way to the runway. The results: a major reduction in fuel savings compared to the normal step-down approach currently in use today.

All of us can relate to the step-down sensation as the pilot starts to descend to the airport, then throttles the aircraft forward, glides again and repeats this cyclical roller-coaster ride numerous times until landing. Just imagine driving over a mountain path and reaching the top; just when you start heading down you put your car in neutral, this is essentially what the crew wants to do. The fuel savings and hence the reduced carbon footprint would be huge. Neighborhoods along the approach path would benefit from noise reductions too.

## NEXT GENERATION AIR TRANSPORTATION SYSTEM (NEXTGEN)

NextGen is an estimated \$40 Billion comprehensive overhaul of the US National Airspace System (NAS) to make air travel more convenient and reliable, while ensuring flights are as safe, secure and efficient as possible.

Considered by many to be the single biggest infrastructure endeavor ever undertaken, the failure to implement this would have an enormous negative impact on the US economy. The FAA estimates that by 2022, the failure to implement NextGen would cost the economy \$22 Billion, annually, in lost economic activity - increasing to over \$40 Billion by 2033.

The timetable to implement NextGen covers three phrases: Near-Term 2008-2012, Mid-Term 2012-2018 and Far-term 2018-2025.

Wilson Felder, Director of the FAA William J. Hughes technical center, based in Atlantic City, NJ has already witnessed the positive effects of what the FAA calls the backbone of NextGen, titled Automatic Dependent Surveillance-Broadcast (ADS-B). Seven aircraft (including a Bombardier Global 5000) have been outfitted with ADS-B equipment and Mr. Felder has personally flown over sixty hours on board these aircraft, stating "ADS-B provides a tremendous piece of mind to the pilot in terms of safety" (by providing the pilot with a visual position of the other aircraft in the area and real-time weather all on one screen).

Currently a network of more than 850 ADS-B ground stations are being installed nationwide with completion scheduled for 2013. Ground stations have already been installed in strategic areas including the Gulf of Mexico, Hudson Bay, Alaska,



Philadelphia and South Florida, and properly equipped aircraft are already benefiting from ADS-B in these regions.

ADS-B when implemented will completely transform how aircraft are tracked today, providing increased safety and accuracy. Today's Air Traffic Controllers (ATC) use radar technology invented decades ago to track aircraft equipped with Transponders that react to the signal from the ground radar.

The inherent delays result in accuracy of the aircraft's actual position to within one-two miles; hence the required three miles of aircraft separation required by the FAA. Position updates currently received every five-to-ten seconds will be increased to every second, reducing nose to tail separation of commercial and corporate aircraft currently set at 120 miles to five miles. Helicopters in the Gulf of Mexico once limited to one aircraft per 400 square mile grid are now allowed to fly to within five miles of each other.

## S.W.I.M.

System Wide Information Management (SWIM) provides the infrastructure and services to deliver network-enabled information access to everyone in the industry that was once unattainable in the past. SWIM will allow more collaboration between the

FAA and the airspace users who currently are unaware of all the information the FAA has available to them.

This information sharing system will work similar to a company intranet that will allow users to customize their access to look at specific work-related subjects like weather, airspace status and flight planning. Standard protocol and applications will be set and will alleviate the previous focus on unique, point-to-point interfaces. Thus, SWIM will allow people to get the information they need to make better informed decisions.

NextGen will also focus on a transformation from voice communication to data communication between ATC and the crew. With most aircraft equipped with data link capabilities already, the FAA will introduce data communications as an additional means of two-way interaction for ATC clearances, instructions, advisories, flight crew requests and reports.

For those aircraft currently equipped with Satellite communications, they could benefit from the elimination of the noisy, and often unreliable HF reporting over the oceanic tracks.

The final two elements of NextGen will focus on a single national weather information system to provide real-time weather to the ground and air crew and a consolidation of the existing seventeen

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different voice switching systems used by NAS personnel into a single air/ground and ground/ground voice system.

## SINGLE EUROPEAN SKY ATM RESEARCH (SESAR)

SESAR, the European equivalent of NextGen, was formed in 2007 by the European Commission and Eurocontrol, and consists of 15 founding members and 70 private companies. The mission is to form a single European sky initiative and develop a modernized air traffic management system for Europe. The defined objectives are:

- Handle three times the air traffic;
- Increase safety by a factor of 10;
- Reduce environmental impact per flight by 10%;
- Save 8-14 minutes and 300-500kg of fuel per flight;
- Cut ATM costs 50%.

SESAR ranks as one of the most ambitious research and development projects ever launched by the European Community. Executed in cooperation with the 15 members and comprising of 16 work packages, SESAR unites the whole aviation community. Each work package has been divided between several of the founding members to reach an operational objective.

Environmental aspects are dealt with in all the work packages with a focus on fuel burn, the release of greenhouse and other gases from the engines and the concern for aircraft noise management.

There are many similar goals and objectives between Europe's SESAR and the United States' NextGen. Both are committed to the sharing of information via the SWIM program, and both have three phases of implementation. The near-term or Definition phase 2008-2012, mid-term or development phase 2012-2018 and far-term or deployment phase 2018-2025.

## SO WHAT DOES THIS MEAN TO THE OPERATOR?

Many articles have already been written that compare the cost to implement NextGen and SESAR versus the benefit to airline and corporate operators. Some airlines have already spent tens of mil-

Properly equipped aircraft are already receiving the benefits of preferred routing in limited geographical areas.



PHOTO © MIKE VINES

lions of dollars to equip their fleets while others are lobbying for Government subsidies.

As to this writer's view, increasing our air space capacity, reducing delays, increasing safety and helping our environment through reduced carbon emissions, it's a no-brainer. Even though the nearest mandate is years away (2020 for ADS-B in the United States), Australia and Europe have targeted earlier dates of 2012 and 2015 respectively.

Properly equipped aircraft are already receiving the benefits of preferred routing in limited geographical areas.

## ADS-B

As mentioned, a network of 850 ADS-B ground stations are currently being installed - and at last check were on track to be completed by 2013. On May 28, 2010, the FAA released the ADS-B final rule and stated all aircraft flying above 18,000 feet mean sea level (MSL) Class A airspace must have ADS-B Out performance capabilities using the 1090 MHz Extended Squitter (ES) broadcast link.

Europe, Australia and other regions have also decided on the Extended Squitter technology. Since most corporate aircraft flying between Europe and the United States via the North Atlantic Tracks (NAT) already have Enhanced Surveillance (EHS) on their aircraft there will be "minimal" cost associated with meeting the requirements of ADS-B.

Simply put, Extended Squitter (ES) is a modifica-

tion of your existing Mode "S" Transponders, which would be interfaced to the Flight Management System, Air Data Computers and/or the Inertial Reference systems to report aircraft position, velocity, projectory, Flight I.D. and other parameters 'automatically' to the ground.

Most Avionics shops could simply review your documentation for when you performed your EHS upgrade and provide you a comprehensive quote. Upgrade costs for corporate operators will run between \$15,000.00 to \$45,000.00 USD.

## DATA COMMUNICATIONS

The current method of communication between an air traffic controller and the crew is voice communication, either by VHF line-of-sight technology or HF bands for longer over-the-pond flights.

The problem is that all aircraft flying in a designated region are tuned to the same frequency and trying to talk to the air traffic controller. The crew must listen to all transmissions, then try to communicate themselves without accidentally overriding another crew. Although English is the international language, accents coupled with degraded communications increase the chance for a misconceived message being carried out by the crew.

Controller Pilot Data Link Communication (CPDLC) will be the solution moving forward. Similar to the Future Air Navigation System (FANS) designed by Boeing back in the mid-1990s, and

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designated by SESAR as the LINKS 2000+ program, CPDLC allows the crew and the controller to communicate via a data link for ATC communications.

Simulations carried out have shown the occupancy of the voice channel in congested airspace to decrease 75%, which increases flight safety and efficiency through more effective communications. The pilot simply "logs on" to the data link network via his CDU on the FMS using the aircraft registration, flight ID, departure and arrival points and the date. The pilot will then receive a message indicating he is "logged on".

Anything from flight level changes to position-reporting over the NAT is now done without the need for voice communication. Although retrofit aircraft are not mandated before February of 2015, CPDLC is available in select areas of Europe as of this writing. Operators will need to obtain CPDLC operational authorization which will require pilots to provide proof of some sort of operational training.

FANS equipped aircraft are exempt from the mandate, but almost all of these aircraft fall under the airline category. Today's corporate aircraft flying over the NAT are equipped with Dual FMS, Satcom and HF and simply by installing a compatible data link transceiver and a VHF antenna your aircraft will be properly equipped.

The transceiver would be interfaced to the FMS and send/receive data information either through the VHF band when line-of-sight is available, or over the Satcom when crossing the ocean. Upgrade costs are estimated to be \$35,000.00 to \$50,000.00 USD.

## REQUIRED NAVIGATION PERFORMANCE (RNP)

On June 16th 2009, Novair flight NVR352 originating from Zakynthos, Greece received clearance to fly the RNP descent and approach into Stockholm airport runway 01R. This flight marked the beginning of SESAR's plan to reduce carbon emissions by optimizing the descent profile and reducing the lateral track distance between aircraft through the use of RNP.

Aircraft navigation has long been constrained by the location of ground-based navigation aids, which restricted aircraft paths or airspace. RNP operations remove this reliance, thereby allowing aircraft better access and permitting flexibility of point-to-point routing.

RNP is the ability of the onboard Navigation system; primarily the GPS equipped Flight Management System (FMS), to self-monitor the navigation performance it achieves and to inform the crew if the requirement is not met.

This onboard monitoring and alerting capability enhances the pilot's situation awareness and can enable closer route spacing. Basic RNP operations are defined as RNP-2 en route, RNP-1 terminal and RNP-0.3 final approaches. The number signifies the total system error allowed; RNP-2 en route procedures require the total system error of not more than two nautical miles for 95 percent of the flight time.

The technology means airplanes don't have to fly



in straight lines for instrument landings: they can fly shorter, curved approaches in almost any weather condition. So airplanes that can handle RNP approaches will get priority from the air traffic controllers over aircraft that aren't equipped.

Shorter routes, coupled by idled descents and curved approaches will save operators tremendous costs on fuel which, in turn will greatly reduce carbon emissions. One US-based airline spent \$175 Million USD to properly equip its aircraft and train its pilots, claiming it could recoup its investment if just one minute is shaved off each flight.

Besides the requirement to equip your aircraft, the crew has to be properly trained and the aircraft qualified and approved by the local regulatory agency. Certain RNP operations require advanced features of the onboard navigation systems along with approved training and procedures for the crew. These operations must receive approvals that are characterized as Special Aircraft and Aircrew Authorization Required (SAAAR), similar to approvals required for Category II and III approaches.

Operators need to evaluate their onboard Navigation equipment to see if they will meet the requirements of RNP. Most legacy equipment will have to be replaced, or at least modified to meet the new specifications.

New WAAS enabled Flight Management Systems will comply with the new rules and further enhance the aircraft capabilities, especially if your aircraft

has been modified for Localizer Performance with Vertical Guidance (LPV) approaches.

Pricing to replace legacy equipment could easily exceed \$100,000.00 USD. Although stricter mandates for RNP will not happen until 2015, operators need to understand what equipment and training their aircraft will need and budget both time and money to implement a program so their aircraft doesn't have to join the back of the queue nearer the time.

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