Straight Talk about

NextGen

Editor's Notes

NextGen is a term that we are hearing more and more each day, yet it has been difficult to grasp all that it encompasses and its relationship to other initiatives both in and outside of the United States. There are a number of questions at this point. The retrofit of business aircraft with NextGen compatible equipment will be a significant event for all of us. We want to get as much information in front of our customers as possible. To a certain degree, every aircraft in U.S. airspace will be affected and we want to arm you with the right information to answer the questions posed to you and make informed decisions based on that information.

There is much to understand on the topic of NextGen. We believe our efforts in finding and condensing this information should address many of your concerns. This Straight Talk booklet gives an overview of NextGen, providing a simple explanation of the many systems, standards, policies and procedures that will ensure safe and efficient aircraft operations in the future.

At Duncan Aviation, we consider ourselves to be on the cutting edge of all avionics technology, and the subject of NextGen is no different. We have done ample research and talked with hundreds of our customers to develop the most valuable information we can provide.

There are a number of subjects and systems which fall under the subject of NextGen. We recognize that you may require a greater level of detail and explanation surrounding some of these concepts and technologies. Therefore, we have created other Straight Talk books specific to a number of them. Visit www.DuncanAviation.aero/straighttalk to view our complete collection.

Duncan Aviation acknowledges the FAA Engineering and Safety Groups, Aircraft Electronics Association and the avionics manufacturers who are working on the products to make your flying safer, easier and affordable.

As always, we look to improve ourselves and our knowledge. Feel free to contact our avionics experts to answer any of your questions and talk about your challenges when the subject arises.

Duncan Aviation Avionics Sales Team

Straight Talk about NextGen

What is NextGen?

What is NextGen?

Most people in aviation have heard about the Federal Aviation Administration's (FAA) vision for the future of national airspace management and control called Next Generation Air Transportation System, or NextGen. The concept evolved from modernization initiatives started during President Bill Clinton's administration.

The goal of the NextGen initiative is to create capabilities that make air transportation safer and more reliable while increasing the capacity of our airspace and reducing aviation's environmental impact. Projections indicate that air traffic will increase by 20 percent over the next decade. The systems being implemented now and in the mid-term are needed to accommodate the increasing demands on our national airspace system. In addition, the FAA is working with its global counterparts to ensure that NextGen is compatible with future foreign airspace requirements.

The term NextGen has been thrown around over the last few years because the vision is quickly becoming a reality. The FAA is working with industry organizations and manufacturers to implement the plan, which it believes will increase safety and efficiency of airspace in the United States by providing more complete and reliable traffic and weather data to pilots and controllers.

With the increased traffic, very light jets, unmanned aerial vehicles, and commercial space flight in our near future, there is an imminent need to be proactive in upgrading the national airspace system.

What does NextGen encompass?

- The gradual incorporation of digital communication application to decrease errors and inefficiencies in air traffic controlling.

- Improvements in information technologies that permit aircrews to make more informed decisions about potential hazards.

- The eventual further reduction of lateral separation to accommodate true departure to destination flights, and increase aircraft densities in critical flight routes (North Atlantic, etc.)

- Overall improvements that decrease fuel burn and increase efficiencies in the National Airspace System (NAS).

The Infrastructure of NextGen

The Infrastructure of NextGen

NextGen is not only dependent on operators upgrading their aircraft with the appropriate systems. The FAA must undergo a serious overhaul of their systems as well. The greatest NextGen infrastructure achievement to date has been the deployment of ADS-B stations. At the time of this publication, ground stations are 40 percent complete. As a result, they already have around a 70 percent or higher coverage of Continental U.S. at 10,000ft or above.

Another significant system that will make up the NextGen infrastructure is the En Route Automation Modernization (ERAM) program. In-work since 2003, ERAM will eventually replace the FAA's host flight data processing network. It was to be in place and working by 2010 but has suffered from many problems causing significant delays and cost overruns. When complete, this software will allow aircraft to file the most direct route from departure to destination and make in-flight route changes fast and efficient.

The change in infrastructure to support the NextGen initiatives is costly. Here are some statistics gathered from the U.S. Department of Transportaion, giving an idea of current and future expenses.

- $50M to display ADS-B data for use by controllers in the high-altitude environment.

- $400M to develop an interface that provides controller-pilot message processing and displays information to controllers in the en route centers.

- $117.7M (for SWIM Segment 1 only) to modernize and enhance its flight data processing and external interfaces with terminal air traffic control and the Traffic Flow Management systems.

With the proper equipment on your aircraft, the right ground infrastructure controllers will be able to manage 1,900 aircraft at one time instead of the 1,100 they can handle today. With things like weather integration, Conflict Resolution, better cockpit communications and strategic flow management, we will see more airspace flexibility as a result.

Systems of NextGen

Systems of NextGen

In the FAA's NextGen Implementation Plan Document (Dated March 2011), the FAA outlines NextGen today as encompassing the following aircraft systems and technologies:

ADS-B – Automatic Dependent Surveillance Broadcast (Out and In)

RNAV / RNP – Performance Based Routing including Initial Tailored Arrival (ITA)

WAAS – Wide Area Augmentation System with Localizer Performance with Vertical Guidance (LPV) approach procedures.

FANS / CPDLC – Future Air Navigation System and Controller Pilot Data Link Communications.

In this section, we will touch on each of these systems and technologies to provide general descriptions and guidance.

ADS-B

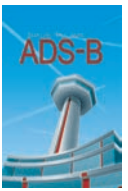
ADS-B is an aircraft and satellite-based transmission system. ADS-B can be broken into two primary functions, ADS-B Out and ADS-B In. An aircraft equipped with ADS-B Out works by sending GPS-derived position and velocity data from the aircraft systems, through an ADS-B-modified Mode S Transponder or a Universal Access Transceiver (UAT) to other aircraft, ground vehicles and ground stations for the purpose of Air Traffic Control and coordination.

ADS-B Out allows an aircraft to transmit information to Air Traffic Control (ATC) ground stations and to properly equipped aircraft. Position data will be automatically broadcast from all ADS-B Out-equipped aircraft. ATC ground stations and ADS-B In-equipped aircraft will receive this data. ADS-B Out has been mandated by the FAA in the airspace that now requires Mode-C transponder.

ADS-B In is the ability of an aircraft to receive information from other transmitting aircraft and the ATC ground infrastructure. In addition to location data, it will provide traffic and weather information to pilots. Traffic information will be similar to that received from the current Traffic Information System (TIS), Traffic Advisory System (TAS), and TCAS technologies in use today. Weather information will be similar to the current XM Weather, except that it will be customized to the aircraft's geographic location and it will not require a subscription. The information will be free to anyone who chooses to equip their aircraft with certified ADS-B In capability. At this time, ADS-B In will be optional for most aircraft.

The FAA is working with the International Civil Aviation Organization (ICAO), Civil Air Navigation Service Organization (CANSO) and other foreign governments to develop standards for the equipage of aircraft capable of international travel. A Mode S transponder with Extended Squitter (ES) will be required for this capability and is already mandated in parts of Europe. The specific guidance from the Single Sky Committee of the European Commission is expected to approve the Surveillance

and Performance Interoperability Implementing Rule (SPI-IR) identifying surveillance system performance and ground and airborne interoperability requirements for ADS-B in Europe very soon (expected to be published by the end of 2011). The mandate for ADS-B in Europe will be for forward-fit aircraft to be equipped by January 2015, and retrofit to be required by December 2017. These provisions will apply to aircraft with an mtow with more than 12,566 pounds (5,700 kg), or with a cruising speed of more than 250 knots, including those operated by international carriers.



Please refer to Duncan Aviation's ADS-B Straight Talk Book for additional information on ADS-B In and Out.

RNAV/RNP

Both Area Navigation (RNAV) and Required Navigation Performance (RNP) are types of navigation that allow an aircraft to fly a specific path between two points in space. The main difference between the two is that the RNP specification for the on-board navigation equipment requires performance monitoring and alerting.

You will often see a number following the acronym of RNP. An example is RNP 10. This means that the navigation system must have the performance ability to provide position calculations within a circle that has a radius of 10 nautical miles. Another common example is RNP .1. Now with the popularity of very accurate WAAS GPS, RNP .1 means that the navigation system can calculate its position to within a circle with a radius of one-tenth of a nautical mile.

In an oceanic airspace an RNP value of 4 vs. 10 will allow the aircraft with the lower RNP-valued system to maintain a closer separation between other aircraft. On approaches, aircraft with capable equipment and RNP values down to .1 can allow very precise 3D curved flight paths known as SAAAR or RNP AR. Approvals for this operation are rare due to the limited number of approaches and strict requirements. Watch for this to gain in popularity over this next decade.

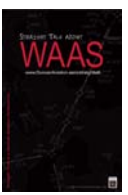
WAAS

In 2007, the FAA completed and certified a significant upgrade to the GPS system. This new system, dubbed Wide Area Augmentation System (WAAS) uses a network of over 25 precision ground stations to provide corrections to the GPS navigation signal. The network of precisely surveyed ground reference stations is strategically positioned across the country including Alaska, Hawaii, Puerto Rico, Canada and Mexico to collect GPS satellite data. Using this collected error information, a message is developed to correct any signal errors. These correction messages are then broadcast through communication satellites to the airborne GPS receiver using the same frequency as GPS.

WAAS is designed to provide the accuracy, availability and integrity necessary to allow flight crews to rely on GPS for all phases of flight, from en-route through GPS precision approach for all qualified airports within the WAAS coverage area. This provides a capability for the development of more standardized precision approaches, missed approaches and departure guidance for thousands of runways and hundreds of heliport/helipads in the U.S. airspace.

At the time of this publication, there are more than twice as many WAAS approaches than ILS approaches in the United Sates (totaling 2,600). WAAS will also provide the capability for increased accuracy in position reporting, allowing for more uniform and high-quality worldwide air traffic management. WAAS is a critical part of the FAA's NextGen program.

The current primary advantage of WAAS / LPV is that it permits the use of more fuel efficient flight planning and approaches that have reduced minimums. WAAS-approved units also incorporate necessary RNP / RNAV to take advantage of preferential flight routing such as PBR (Performance Based Routing)



Please refer to Duncan Aviation's WAAS Straight Talk Book for additional information on the subjects of RNAV / RNP and WAAS.

FANS/CPDLC

Future Air Navigation System (FANS) is an initiative which began in the early 1980s by the International Civil Aviation Organization (ICAO). ICAO became concerned with the aging infrastructure and the inherent faults with traditional air traffic management methods. In an effort to increase aircraft safety and limit the amount of human error ICAO developed a council to investigate ways to increase safety. The FANS concept for the future of Air Traffic Management (ATM) is through the use of digital Communications and Navigation Systems (CNS) including the use of Global Positioning Systems (GPS), and surveillance improvements. The mixture of improvements in communication, navigation and surveillance allow authorities to reduce separation distance between aircraft, allowing aircraft to fly at their most favorable altitudes and consume less fuel.

Controller Pilot Data Link Communication (CPDLC) is a means of communication between a controller and a pilot using data link for ATC communication. You can think of this like texting. In the case of CPDLC, ATC and the flight crews are using text messages to replace many of the voice communications that are used in the traditional flight deck ATC relationship. The CPDLC application has three primary functions:

1. The exchange of controller/pilot messages with the ATC that is currently in control of the aircraft.

2. The transfer of ATC authority over that aircraft.

3. Downstream clearance delivery, or the approval of other ATCs in adjacent centers to view the aircraft reports.

FANS-1/A is a format of communication for CPDLC. FANS-1 was originally developed by Boeing. Later, Airbus developed FANS-A. Merged together, they are now known as a single product type known as FANS-1/A.

One major part of FANS-1/A is Automatic Dependent Surveillance Contract (ADS-C). Automatic position reports are known as ADS-C and require no pilot interaction. The contract in ADS-C means that ATC will control the reporting system. There can be up to five separate ATC contracts at any one time.

There are 3 types of contracts:

1. Periodic, where ATC can set or alter the update rate as needed (a higher update rate is usually required in high traffic areas).

2. Event, where ATC contracts are used if there is a change in Vertical Rate, Lateral Deviation or Altitude.

3. Demand, where ATC can request a one-off update as needed. This does not affect an existing contract preset rate.

There is a fourth type of contract, but unlike the previous three it is initiated and cancelled by the pilot, not the controller: Emergency is a type of contract that is automatically triggered by a MAYDAY message.

Just as RVSM reduced the vertical separation of aircraft, the goal of ADS-C is to reduce separation of aircraft. ADS-C is expected to reduce separation from 100 nm laterally and 10 minutes trailing to 50 nm longitudinal, 30 nm laterally and 30 nm trailing.

Please refer to Duncan Aviation's FANS Straight Talk Book for additional information on this subject.

International Implementation

International Implementation

NextGen is a United States initiative. However, Europe has been running a parallel initiative called Single European Sky or Single European Sky ATM Research (SESAR). The goals are nearly the same and in 2010, the United States and European authorities reached initial agreements on the interoperability between their future air traffic management systems.

Just as the goals are nearly the same, Europe and other countries around the world are looking to similar systems. Referenced below are the NextGen systems from the U.S. with the equal or similar systems from Europe.

ADS-B – Automatic Dependent Surveillance Broadcast (Out and In)

→ In Europe the terminologies are essentially the same.

RNAV / RNP – Performance Based Routing including Initial Tailored Arrival (ITA).

→ B-RNAV – Basic – RNAV defines European RNAV operations, which satisfy a required track keeping accuracy of plus-minus five nautical miles for at least 95 percent of the flight time.

→ P-RNAV – Precision – RNAV defines European RNAV operations where waypoints are located below MSA or MRVA (Minimum Radar Vectoring Altitudes).

WAAS – Wide Area Augmentation System with Localizer Performance with Vertical Guidance (LPV) approach procedures.

→ EGNOS (European Geostationary Navigation Overly Service) is the European system. Like WAAS, EGNOS supplements GPS, GLONASS and Galileo satellite systems.

FANS – Future Air Navigation System.

→ In Europe, the terminologies are essentially the same.

CPDLC – Controller Pilot Data Link Communications.

→ In Europe, Link 2000+ is the Eurocontrol Program which coordinates the implementation of operational CPDLC. Link 2000+ is similar to the FANS / CPDLC system used in North Atlantic Airspace. The difference being, Link 2000+ uses VDL Mode 2 datalink and Aeronoautical telecommunications network (ATN) instead of ACARS.

The Benefits of NextGen

The Benefits of NextGen

The key advantages of NextGen are:

- Increased safety
- Reduced emissions
- Reduced delays
- Reduced airport congestion
- Reduction in fuel used

The deployment of NextGen systems and procedures are currently underway and some operators are already seeing benefits today. Additional benefits to both the NAS operators and users will come as NextGen deployment continues to roll out over the next decade.

The timing will depend greatly on aircraft operators and their willingness to invest in the on-board systems and training needed to use the NextGen infrastructure effectively. The benefits must be clear and make good business sense. The incentives for aircraft operators to upgrade sooner rather than later will come as a result of preferential treatment for those properly equipped. In the future, you may hear the phrase "Best equipped, best served."
For those operators that take advantage of NextGen upgrades to their systems, the FAA has predicted the following statistics estimated for the period of 2010 to 2018:

- 35 percent - The reduction in delays as a result of improvements in NextGen air traffic management.

- $23 Billion - Cumulative benefits to aircraft operators, the traveling public and FAA.

- 1.4 Billion Gallons - Savings in aviation fuel during this period.

- 14 Million Tons - Reduction in carbon dioxide emissions during this period.

NextGen FAQs

Will I receive preferential treatment if I adopt all or some NextGen initiatives?

Yes, ATC intends to provide "best-equipped, best-served" priority in the NAS to early adopters consistent with safe and efficient operations.

Does Europe have a similar "umbrella" traffic management plan?

Yes, Europe is implementing the Single European Sky (SES) initiative. The Single European Sky Air Traffic Management Research (SESAR) technical planning group consists of members from EASA (European Aviation Safety Agency), the EU (European Commission) and Eurocontrol.

Do the NextGen and SES plans have the same subcomponent parts?

NextGen and SES are not identical due to air traffic differences in Europe versus the U.S. Restricted airspace over the individual sovereign countries has created high concentrations of air traffic indirect routing within established Functional Airspace Blocks (FABs). A significant part of the SES initiative is to reduce and enlarge the FABs to create more direct routing and reduce congestion. Another unique SES component is TCAS Change 7.1 prompted by past mishaps in European airspace which have highlighted the need for more advanced traffic avoidance equipment. Other NextGen\SES initiatives, however, are similar in that they are built around performance-based navigation.

How will NextGen component plans be implemented without disrupting Air Traffic Management services?

NextGen capabilities will come on-line gradually and a cautious approach will be exercised to avoid ATC disruption.

What are the chief benefits of NextGen?

The advantages of NextGen are:

- Increased safety – advanced systems both in the aircraft and in the control tower.
- Reduced emissions – moving aircraft to their destinations sooner and more efficiently.
- Reduced delays – improvements in aircraft systems and traffic management.
- Reduced airport congestion – improvements in ground tracking and traffic management.
- Reduction in fuel used – moving aircraft to their destinations sooner and more efficiently.

Which, if any, NextGen initiatives will be mandated?

At the time of this publication, ADS-B Out will be mandated by the FAA by 2020, and EASA by 2017. In addition, FANS-1A will be mandated by EASA by 2015. In the future, contact a Duncan Aviation expert for the most up-to-date mandate information regarding NextGen.

What can I do now to incorporate NextGen components in my aircraft?

In the scale of things, not much by way of NextGen avionics is available today. At the time of this publication, some systems and procedures have become available and are recommended, including:

- EASy II ADS-B Out Service Bulletin
- ADS-B DO260A-Collins TDR-94D Transponder upgrades
- CPDLC – compliant data com systems such as Collins CMS-4000 or Universal UL-801
- WAAS – capable FMS/GPS components which will be required in most cases for both ADS-B and FANS

It is important as an operator to understand that NextGen components will be a hot topic over the next few years. It is expected that numerous systems and upgrades will be developed and released in the near future. You can count on Duncan Aviation to provide the most up-to-date information in regards to NextGen components and solutions.

Key Terms

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Automatic Dependent Surveillance-Broadcast (ADS-B) – is a cooperative system which transmits messages of position and flight profile information for the purposes of Air Traffic Control.

Controller Pilot Data Link Communication (CPDLC) – is a data link application that allows for the direct exchange of text-based messages between a controller and a pilot.

Future Air Navigation System (FANS-1A) – is a Next Generation total air traffic system that includes communication, navigation, and monitoring functions. Its purpose is to cope with the increasing volume of air traffic and provide more effective navigation.

RNP-Required Navigation Performance (RNP) – is a type of performance-based navigation (PBN) that allows an aircraft to fly a specific path between two three-dimensionally defined points in space.

RNP-AR (Authorization Required) aka RNP SAAAR - Required Navigation Performance - Special Aircraft and Aircrew Authorization Required – enables aircraft to fly very precise, curved path approaches with lower minimums at airports with challenging airspace and/or terrain. In order for operators to utilize RNP-AR, an approval process similar to ILS CAT II//III approval is required.

Performance Based Routing (PBN) – is a framework for defining performance requirements in "navigation specifications." PBN framework can be applied to an air traffic route, instrument procedure, or defined airspace. PBN provides a basis for the design and implementation of automated flight paths as well as for airspace design and obstacle clearance. The two main components of PBN framework are Area Navigation (RNAV) and Required Navigation Performance (RNP). Once the required performance level is established, the aircraft's own

capability determines whether it can safely achieve the specified performance and qualify for the operation.

Reduced Vertical Separation Minimum (RVSM) – is a minimum vertical separation requirement between aircraft above flight level 290 (29,000 ft.), from 2,000 feet to 1,000 feet. RVSM was implemented to increase airspace capacity, by essentially doubling the number of flight levels between 29,000 and 41,000 feet. Planes must have certified altimeters and autopilots must meet more accurate standards to operate in RVSM airspace.

Single European Sky ATM Research (SESAR) – The EU Single European Sky is an ambitious initiative launched by the European Commission in 2004 to reform the architecture of European air traffic management. It proposes a legislative approach to meet future capacity and safety needs at a European rather than a local level. The Single European Sky is the only way to provide a uniform and high level of safety and efficiency over Europe's skies.

1090 MHz (ES) – is a data link which uses 1090 MHZ Extended Squitter that supports ADS-B but does not support FIS-B, intended for use in air carrier, business, and other high performance aircraft. This link is capable of using an existing Mode S transponder with specific modifications.

978 MHz Universal Access Transceiver (UAT) – is a data link that supports ADS-B as well as TIS-B and FIS-B for use in airspace below 18,000 feet.

International Civil Aviation Organization (ICAO) – is a specialized agency of the United Nations. It codifies the principles and techniques of international air navigation and fosters the planning and development of international civil aviation to ensure safe and orderly growth. Its headquarters are located in Canada.

Surveillance and Performance Interoperability Implementing Rule (SPI-IR) – specifies the requirements for the European Air Traffic Management Network and how new surveillance technologies and applications will be introduced to Europe's Air Traffic Management system. The aircraft identification rule will require air navigation service providers (ANSPs) to use down-linked aircraft identification for identifying aircraft, without having to rely solely on Secondary Surveillance Radar codes.

Civil Air Navigation Service Organization (CANSO) – is the global voice of the companies that provide air traffic control and represents the interests of Air Navigation Service Providers (ANSPs) worldwide. CANSO members are responsible for supporting over 85 percent of world air traffic, and through its workgroups, members share information and develop new policies, with the ultimate aim of improving air navigation services on the ground and in the air. CANSO has an extensive network of Associate Members drawn from across the aviation industry, and it represents CANSO members' views in major regulatory and industry forums, including at the ICAO, where it has official Observer status.

Link 200+ – is a Euro control program which coordinates the implementation of operational CPDLC in Europe. Link 2000+ is similar to FANS CPDLC system used in North Atlantic airspace. The difference being it uses VDL Mode 2 datalink and Aeronautical Telecommunications Network (ATN) instead of ACARS.

Primary Surveillance Radar (PSR) – is a ground-based radar system that measures distance and bearing to an aircraft based solely on radar reflection.

Secondary Surveillance Radar (SSR) – is a ground-based system which makes use of an aircrafts' transponder(s) to relay the following information: a four-digit identification code (Mode A), altitude (Mode C), a unique identifier (Mode S), a flight

identification number (Elementary Surveillance), and more detailed position and trajectory data (Enhanced Surveillance). It supplements PSR, giving Air Traffic Control more information.

Traffic Information Services (TIS-B) – is a system which transmits traffic known to the ground-based ATC system to an aircraft. This fills the gap for aircraft equipped with transponders but not ADS-B.

Flight Information Services Broadcast (FIS-B) – is a system which provides weather text and graphics, Notice to Airman (NOTAMs), Automatic Terminal Information Service (ATIS), and other information to be provided over the Universal Access Transceiver link.

Cockpit Display of Traffic Information (CDTI) – is a stand-alone or integrated display which provides an aircraft crew with detailed information about other aircraft, specifically spacing intervals.

Ground Based Augmentation System (GBAS) – is a system that supports regional augmentation through the use of terrestrial radio messages.

Satellite Based Augmentation System (SBAS) – is a system that supports wide-area or regional augmentation through the use of satellite messages.

Wide Area Augmentation System (WAAS) – is a system developed to augment Global Positioning Systems (GPS), with the goal of improving its accuracy, integrity, and availability. It is intended to enable aircraft to rely on GPS for all phases of flight, including precision approaches to any airport within its coverage area.

European Geostationary Navigation Overlay Service (EGNOS) – is a satellite-based augmentation system (SBAS) developed by the European Space Agency, the European Commission and EUROCONTROL. It supplements the GPS,

GLONASS and Galileo systems by reporting on the reliability and accuracy of the signals. The EGNOS system consists of three geostationary satellites and a network of ground stations.

GPS Aided Geo Augmented Navigation or GPS and Geo Augmented Navigation (GAGAN) – is Satellite Based Augmentation System (SBAS) by India. It is a system to improve the accuracy of a GNSS receiver by providing reference signals.

B-RNAV – (Basic) RNAV defines European RNAV operations which satisfy a required track keeping accuracy of ± 5 NM for at least 95 percent of the flight time.

P-RNAV: (Precision) – RNAV defines European RNAV operations which satisfy a required track-keeping accuracy of ±1 NM for at least 95 percent of the flight time. The waypoints are located below MSA or MRVA (minimum radar vectoring altitudes).

En Route Automation Modernization (ERAM) – New software which allow the aircraft to file the most direct route from departure to destination and make in-flight route changes fast and efficiently.

Wide Area Multilateration (WAM) – Multilateration is the method of determining a target's position from the TDOA (Time Difference of Arrival) of Transponder replies at spatially separate receivers. With Wide Area Multilateration, the receivers are spread much further apart.

Airport Surface Detection Equipment, Model X (ASDE-X) – A runway safety tool which enables air traffic controllers to detect potential runway conflicts by providing detailed coverage of movement on runways and taxiways.

Continuous Descent Approach (CDA) – Known as Optimized Profile Descent (OPD) in the U.S., CDA involves maintaining a constant three-degree descent angle during landing, instead of approaching an airport in a stair-step fashion.

TCAS version 7.1 – TCAS version 7.1 will be offered as an upgrade by all of the major TCAS manufacturers, and also makes two important safety enhancements. Version 7.1 changes the current TCAS II aural warning from "Adjust Vertical Speed, Adjust" to "Level Off, Level Off". It also corrects missed and late TCAS reversals. TCAS reversals were introduced in TCAS version 7.0 to adapt to changing situations where the original sense had clearly become the wrong thing to do, in particular the situation when one of the pilots decides not to follow the Resolution Advisory (RA), or is instructed by ATC to perform a particular maneuver. The solution in Change 7.1 introduces improvements to the current reversal logic to address late issuance of reversal RAs and potential failures to initiate reversal RAs.

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Notes

Notes

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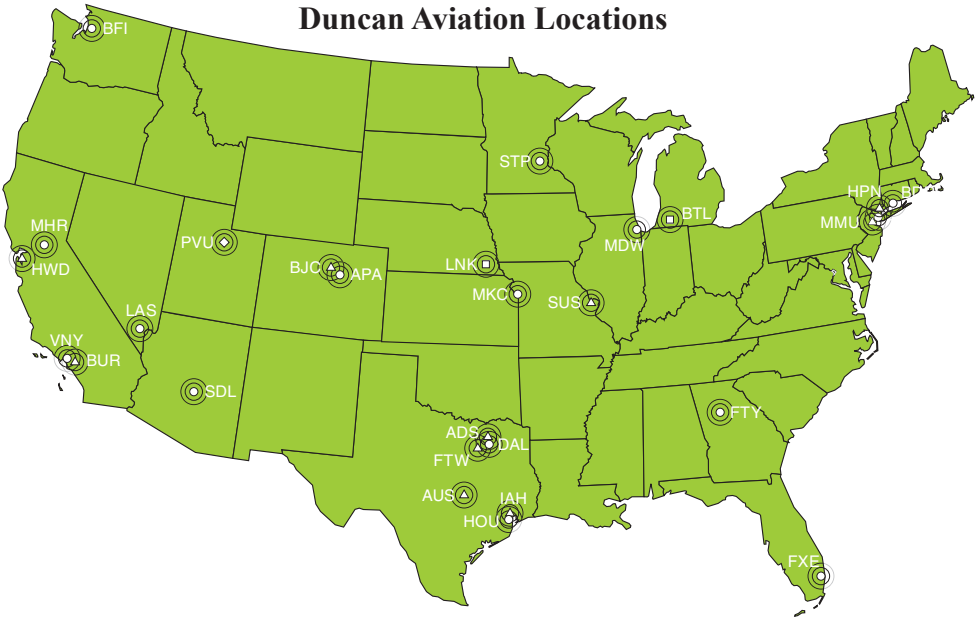

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