Ann Tedford

Surveillance and Broadcast Services

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Federal Aviation Administration

TU Darmstadt -14. Kolloquium Luftverkehr

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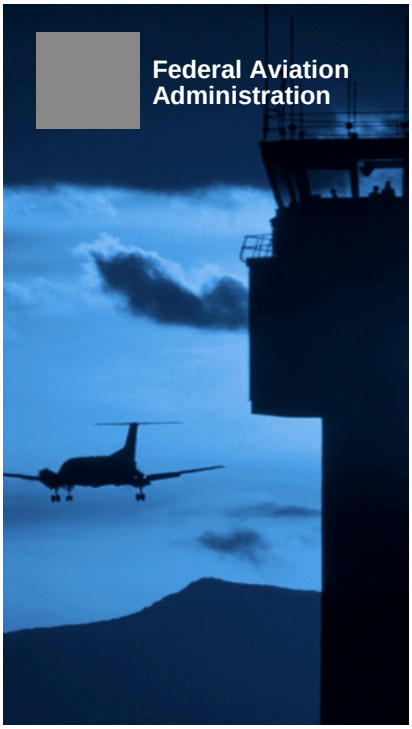
Vortrag von Ann Tedford, Federal Aviation Administratin (FAA), am 24. Januar 2007

Good evening ladies and gentlemen. Thank you for the invitation to speak at this symposium.

Surveillance and Broadcast Services

Presented to: 14. Kolloquium Luftverkehr
By: Ann Tedford, FAA Liaison to the DFS
Date: January 24, 2007



You have probably noticed that my briefing title “Surveillance and Broadcast Services” is not the same as the symposium flyer states “The FAA Capstone Program—More Safety Through Modern Technology in General Aviation.” Please trust me, the topics are related.

Tonight, I plan to talk about the FAA, the unique situation in Alaska (where Capstone is the solution), and the FAA’s plans for ADS-B, one of the technologies in the Capstone Program.

First, a few words about the FAA.

Federal Aviation Administration

- **Mission: To provide the safest, most efficient aerospace system in the world.**
- **Vision: To improve continuously the safety and efficiency of aviation, while being responsive to our customers and accountable to the public.**
- **Values:**
  - ***Safety is our passion.*** We're the world leaders in aerospace safety.
  - ***Quality is our trademark.*** We serve our country, our customers, and each other.
  - ***Integrity is our character.*** We do the right thing, even if no one is looking.
  - ***People are our strength.*** We treat people as we want to be treated.

Our mission is to provide the safest, most efficient aerospace system in the world. Our vision is to improve continuously the safety and efficiency of aviation, while being responsive to our customers and accountable to the public. Our values:

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Unlike the Deutsche Flugsicherung, the FAA is both the regulator and the air navigation service provider. Even with this difference in scope, I believe that the DFS mission, vision, and values are the same, or certainly similar.

This is my number chart to remind you of the extent of the FAA's operations.

Numbers

• **Budget for FY06**	**$14.3 Billion**
• **Airports**	**19,815**
• **Active pilots**	**749,834**
• **Total number of regulated aircraft**	**319,549**
• **Flight instructors**	**89,396**
• **Pieces of equipment**	**71,000**
• **Square miles of airspace monitored**	**17,017,092**
• **Total commercial passengers**	**688,500,000**
• **Total commercial miles flown**	**714,500,000,000**
• **Air traffic control facilities**	**617**
• **Flights handled per day**	**49,545**
• **FAA air traffic controllers**	**14,577**
• **FAA aviation safety inspectors**	**4,563**
• **FAA technicians**	**5,860**

Last year's budget totaled $14.3 Billion; there are approximately 750,000 active pilots in the US and we handle about 50,000 flights every day. Supporting this demand requires significant resources—people and equipment. To help put this in perspective, the US is about the size of Europe and has about the same amount of air traffic.

The FAA's Flight Plan (or Strategic Plan) includes four goals:

- Increased Safety
- Greater Capacity
- International Leadership, and
- Organizational Excellence.

FAA Flight Plan—Our Strategic Plan

- **Increased Safety**
  - Goal: To achieve the lowest possible accident rate and constantly improve safety
- **Greater Capacity**
  - Goal: Work with local governments and airspace users to provide capacity in the United States airspace system that meets projected demand in an environmentally sound manner
- **International Leadership**
  - Goal: Increase the safety and capacity of the global civil aerospace system in an environmentally sound manner
- **Organizational Excellence**
  - Goal: Ensure the success of the FAA's mission through stronger leadership, a better trained workforce, enhanced cost-control measures, and improved decision-making based on reliable data

The increased safety goal is to achieve the lowest possible accident rate and constantly improve safety.

The Flight Plan includes goals, objectives, strategies, and initiatives with measures. The Flight Plan is published annually – reports results, adjusts goals, and sets annual targets.

One of the objectives in the increased safety goal is to reduce the number of fatal accidents in general aviation. One of the strategies for this objective is to implement technologies and systems that will help pilots operate aircraft as safely as possible. Another strategy is to expand and accelerate implementing safety and air navigation improvements programs in Alaska.

So how are we increasing safety in Alaska? First let me describe the environment.

Alaska

- **615,230 square miles in Alaska (approximately 16% of the total US land area)**
- **13,628 miles of roads**
- **<10% of Alaska accessible via roads**
- **Challenging topography**
- **Harsh climate**

There are over 600,000 square miles in Alaska, which is a large portion of the US land area. If I were to place Alaska on top of the continental US, Alaska would extend almost as far north-to-south as the continent (Minnesota to Texas) and about two-thirds east-to-west. A very large area. As my chart notes less than ten percent of Alaska is accessible by roads. Juneau, the capital of Alaska, is only accessible via air or water. Between some small villages in the winter, transport is via snow travel.

There is minimal radar coverage in Alaska due to it's topography of mountains and water. Additionally, Alaska has a rather harsh climate.

Over a ten-year period in Alaska, small aircraft accidents were averaging an accident every other day, with one fatality every nine days.

The FAA and the aviation community wished to increase the safety in this region, and so the Capstone program was born.

Four safety problems were targeted by the Capstone program:

- CFIT accidents, controlled flight into terrain (within the navigation category)

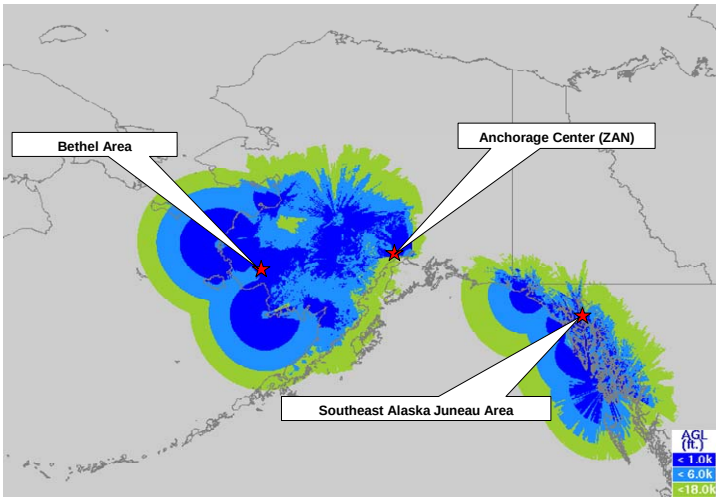
- Accidents associated with aircraft traffic, especially mid-air collisions
- Inadequate flight information, especially weather information
- Inadequate infrastructure to support IFR operations

Basically, improve situation awareness to both pilots and controllers.

A quick geography lesson…Alaska neighbors western Canada…the main part of Alaska is here, with it's neighbor the Yukon Territory. The southeast peninsula extends toward British Columbia and then a series of islands reaches toward Russia.

The Capstone Program is a joint industry and FAA effort to improve aviation safety and efficiency by putting cost effective, new technology avionics equipment into aircraft and providing the supporting ground infrastructure. The Capstone operational areas are non-radar environments where most of the air carrier operations have been limited to Visual Flight Rules.

What is Capstone?



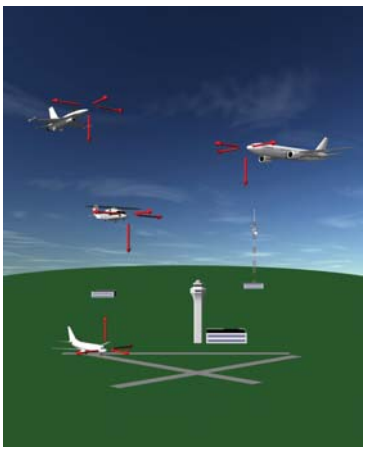
The Capstone program equipped aircraft used by commercial operators in the area with a government-furnished Global Positioning System-based avionics package. In addition to the avionics suites, Capstone deployed equipment for weather observation, data link communications, surveillance, and Flight Information Services.

Capstone has also increased the number of airports served by an instrument approach and now enables radar-like IFR air traffic control services.

So, Capstone technologies include:
Automatic Dependent Surveillance-Broadcast (or ADS-B)

Automatic Dependant Surveillance - Broadcast (ADS-B)

- **Automatic**
  - Periodically transmits information with no pilot or operator input required
- **Dependent**
  - Position and velocity vector are derived from the Global Positioning System (GPS) or a Flight Management System (FMS)
- **Surveillance -**
  - A method of determining position of aircraft, vehicles, or other asset
- **Broadcast**
  - Transmitted information available to anyone with the appropriate receiving equipment



As the slide notes:

- **A**utomatic
  - Periodically transmits information with no pilot or operator input required
- **D**ependent

- Position and velocity vector are derived from the Global Positioning System (GPS) or a Flight Management System (FMS)

- **S**urveillance -
  - A method of determining position of aircraft, vehicles, or other asset
- **B**roadcast
  - Transmitted information available to anyone with the appropriate receiving equipment

ADS-B is a function that broadcasts position, altitude, vector and other information for use by other aircraft, vehicles, and by ground facilities. ADS-B supports improved use of airspace, improved surface surveillance, and enhanced safety (such as conflict management) for users.

Capstone also includes Traffic Information Service - Broadcast (or TIS-B).

Traffic Information Service - Broadcast
Flight Information Service - Broadcast

TIS-B is a service which provides ADS-B equipped aircraft with position reports from secondary surveillance radar on non-ADS-B equipped aircraft.

FIS-B transmits graphical National Weather Service products, temporary flight restrictions (TFRs), and special use airspace.

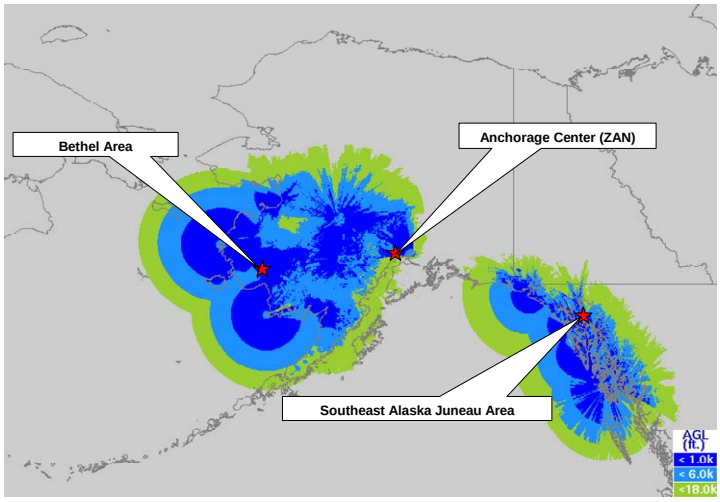
TIS-B is a service which provides ADS-B equipped aircraft with position reports from secondary surveillance radar on non-ADS-B equipped aircraft.

Flight Information Service - Broadcast (or FIS-B) transmits graphical National Weather Service products, temporary flight restrictions (TFRs), and special use airspace.

Capstone equipment also includes a Multi-function display which allows flight routes to be displayed on moving maps.

It was decided to initiate Capstone in the Yukon-Kuskokwin delta (or Y-K delta), around Bethel. Flights below 6000 feet in the Y-K Delta occur in a non-radar environment, the only radar coverage in the area is high-altitude coverage for long-range jets, controlled from Anchorage Center. The second phase of Capstone was in the Southeast peninsula around Juneau.

Capstone



- **GPS: Global Positioning System**
- **WAAS: Wide Area Augmentation System**
- **NAS: National Airspace System**
- **Performance-based NAS**

Before I show a couple videos discussing Capstone, I wish to review a few terms—I already discussed ADS-B, TIS-B, and FIS-B. First two navigation terms:

- GPS stands for Global Positioning System (the satellite positioning constellation) and
- WAAS, Wide Area Augmentation System (a Satellite Based Augmentation System similar to EGNOS).

A couple other terms you'll hear in the video:

- NAS, National Airspace System refers to the FAA's airspace system, and
- performance-based NAS which refers to using the airspace system with equipment that meets a certain level of performance—this is how we plan to address our future needs. Examples of performance-based navigation are Area Navigation or RNAV and Required Navigation performance or RNP.

The first video discusses the Capstone program, showing operations and results. The second video takes you on an airplane ride through Alaska and shows how each of the Capstone applications assist the pilot.

As was noted in the video, from 2000 to 2004 the accident rate of Capstone equipped aircraft decreased by 47% compared to other aircraft. Before Capstone this area had a two-to-four times higher than average accident rate.

Next I would like to discuss the FAA's plans for ADS-B.

ADS-B Program Objective

- **Develop a multi-segment, life cycle managed, performance-based ADS-B strategy that aligns with the Next Generation Air Transportation System (NGATS) vision and generates value for the National Airspace System (NAS)**

Recently, the FAA brought all the ADS-B initiatives into one program office (the Capstone program, the Safe Flight 21 program, and the national implementation program). The purpose of this program office is to develop a multi-segment, life cycle managed, performance-based ADS-B strategy that aligns with the Next Generation Air Transportation System (NGATS) vision and generates value for the National Airspace System (NAS).

There's a lot in that paragraph…

- A multi-segment program….ADS-B has a wide range of potential applications to be implemented, requiring airborne and ground equipment, training, and procedures. We want to implement this in stages
- Life-cycle managed…our technologies and equipment must operate for quite a while
- Performance-based ADS-B…what is the performance required from ADS-B applications
- Aligned with the US Next Generation Air Transportation System (referred to as NGATS or NextGen)….this is the system 20 years from now…similar to the European SESAR program.

What have we done?

- **ATM operations concepts**
- **Users requested ADS-B services**
- **RTCA and EUROCAE ADS-B standardization**
- **Technical link assessments**
- **Link decisions**
- **Trials, demonstrations, limited operations**

- First, a little history…ADS-B figures strongly in the Air Traffic management operations concepts that have been around for the last 20 years. These concepts note that in the future our airspace systems will be aircraft centric. The ICAO concept includes ADS-B applications. ADS-B applications are cornerstones in both the SESAR and NextGen visions.
- The FAA established the Capstone and Safe Flight 21 programs as joint government/industry initiatives to demonstrate the capabilities of advanced surveillance systems and air traffic procedures using ADS-B in a real-world environment.
- To get preliminary assessments of the costs, benefits, operational safety and security, and architectural requirements for ADS-B, the FAA conducted a series of operational evaluations in Alaska and the Ohio Valley. RTCA (a scientific advisory group that assists the FAA on technical issues) and EUROCAE developed the initial avionics standards for the new system, and the FAA conducted three joint government/industry meetings in 2001 to gather user and industry feedback.
- I was fortunate to co-chair the technical link assessment team with Mr. Costas Tamvaclis of EUROCONTROL's Experimental Center

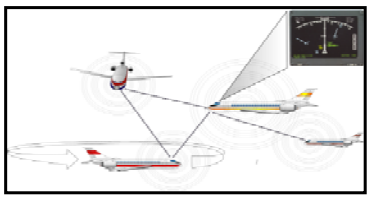
in Bretigny. The conclusions of this report and the results of operational evaluations resulted in the FAA's ADS-B "link decision" in June 2002. The link decision selected two ADS-B frequencies for use in the national airspace system — the 1090 Extended Squitter (1090 ES) and Universal Access Transceiver (UAT). The 1090 ES will be used by commercial aircraft, while UAT was selected for general aviation and vehicles. Revisions and development of additional avionics standards by RTCA and EUROCAE followed in 2003 and 2004.

- Prior to the FAA's link decision, EUROCONTROL and the FAA agreed upon a link strategy that stated that 1090 ES would be the interoperable link for the near-term, but recognized the need for a longer-term solution and the acceptance of local solutions.
- There have been and continue to be various trials, demonstrations, and operations—all with the purpose of gaining a better appreciation and understanding of the use and value of ADS-B applications
- Implementing new features into our airspace systems is challenging. Implementing ADS-B requires almost all constituents in the community to change something…
  - Install new avionics in aircraft
  - Implement new ground stations
  - Change the ATM automation software
  - Develop new procedures
  - Train all the users

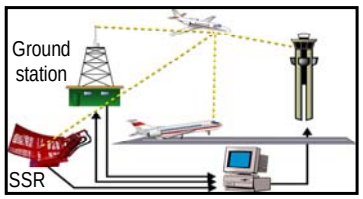
What do we want from ADS-B? When I first became involved with ADS-B, I used to say that ADS-B meant anything to anybody. There was a list of approximately 200 applications that ADS-B could do, and no consensus on which applications were most important, which should be implemented first, and which were really appropriate for ADS-B.

ADS-B Service Delivery Point

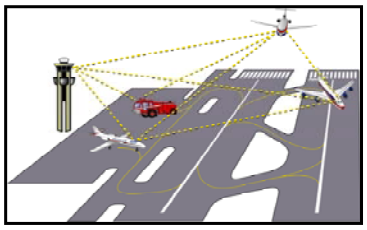
Air-to-Air Traffic
Enhanced see-and-avoid



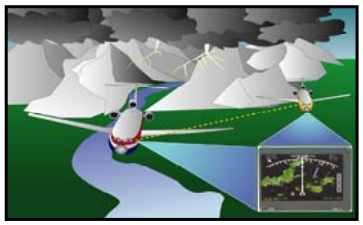
Ground-to-Air Traffic
Uplink FAA radar traffic



Ground-to-Ground
Improved surface navigation and traffic awareness



Ground-to-Air
Uplink graphical weather and airspace status



The first task was to identify the service delivery points:

- Air-to-air traffic applications, which includes enhanced see-and-avoid
- Ground-to-air traffic, where radar traffic information is uplinked to the aircraft
- Ground-to-ground applications, which includes improved surface navigation and traffic awareness
- Ground-to-air applications, where graphical weather information and airspace status is uplinked to the aircraft

Capstone and other demonstrations and trials have done a great job in validating the operations and benefits enabling us to identify initial beneficial applications.

For the last ten years significant effort has been made defining the various ADS-B applications through ICAO, RTCA, EUROCONTROL, and EUROCAE activities. Through RTCA and Eurocontrol user groups there is agreement on the initial ADS-B applications. These are the applications that the ADS-B program office is working towards, based on the recommendations of the user groups.

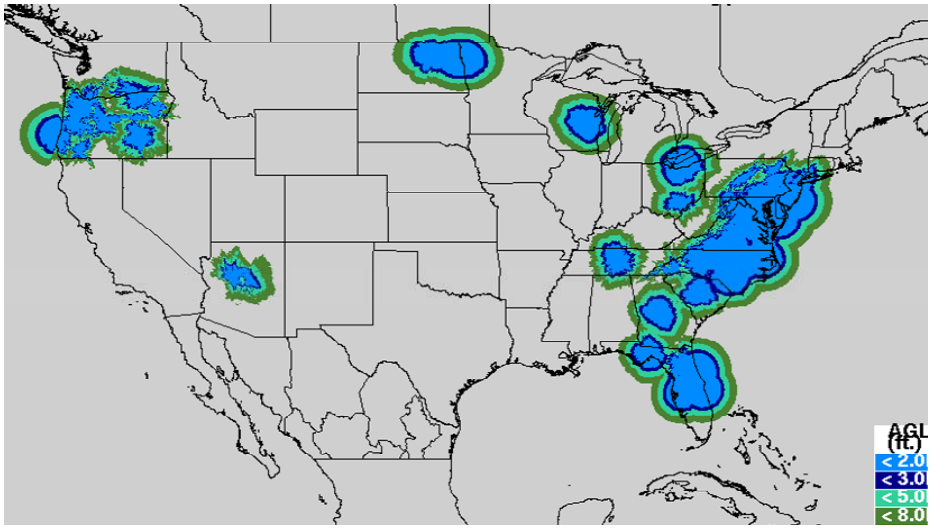
Initial ADS-B Services & Applications

Services / Applications:
Surveillance Broadcast Services (En Route, Terminal, Surface)
Traffic / Flight Information Broadcast Services
Enhanced Visual Acquisition
Enhanced Visual Approaches (1)
Final Approach and Runway Occupancy Awareness
Airport Surface Situational Awareness
Conflict Detection

(1) Merging and Spacing and Cockpit Display of Traffic Information (CDTI) Assisted Visual Separation (CAVS) are a part of the Enhanced Visual Approaches Application

So where will ADS-B be implemented?

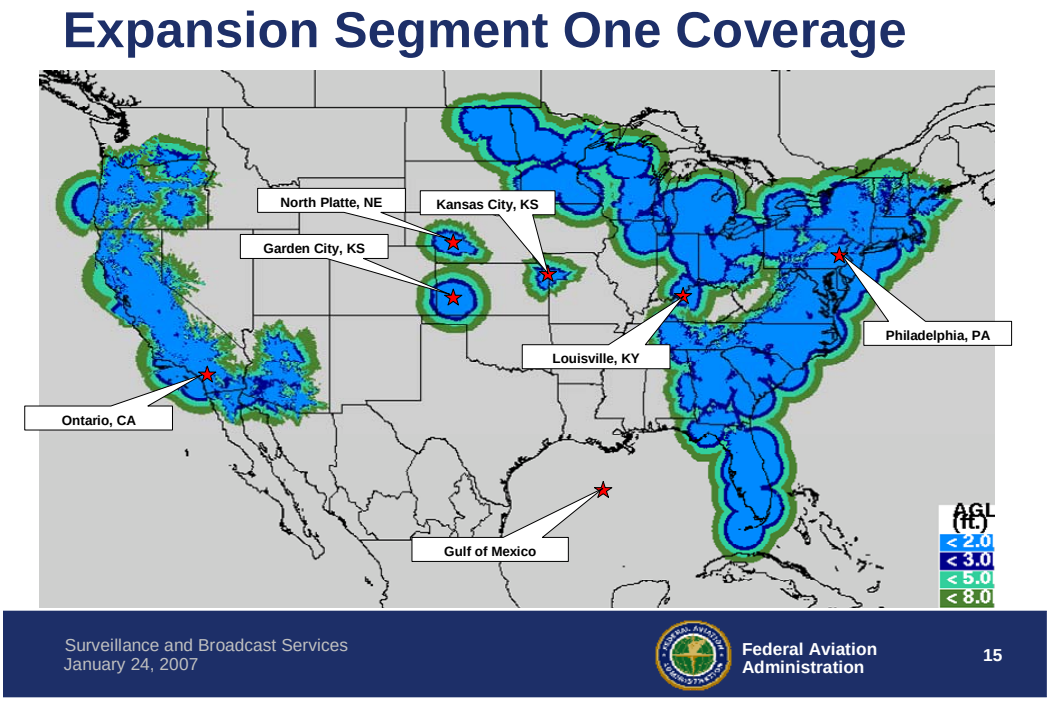
Current ADS-B Coverage



This chart shows the **current** ADS-B coverage in the continental United States. This includes programs known as Safe Flight 21, the East Coast Plan, and other state-subsidized initiatives.

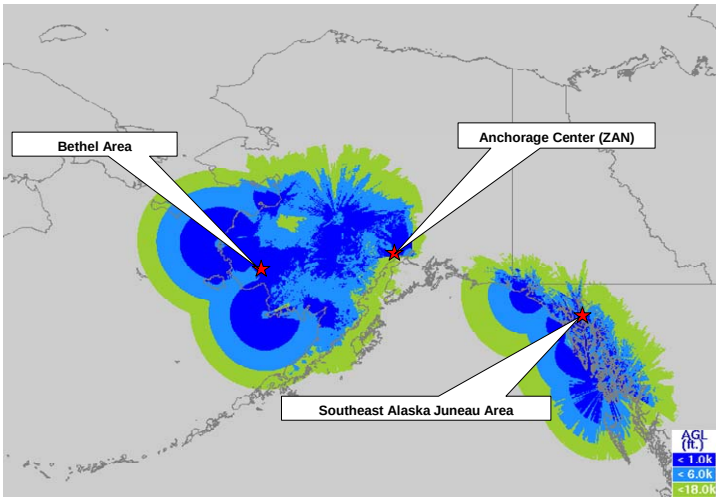
Cargo carriers--Ohio River Valley and Louisville, Kentucky
General Aviation—east coast plan
Embry Riddle—flight training in Arizona and Florida
And various state initiatives

This next chart shows the current coverage **PLUS** the sites starred are the additional sites included in segment one o



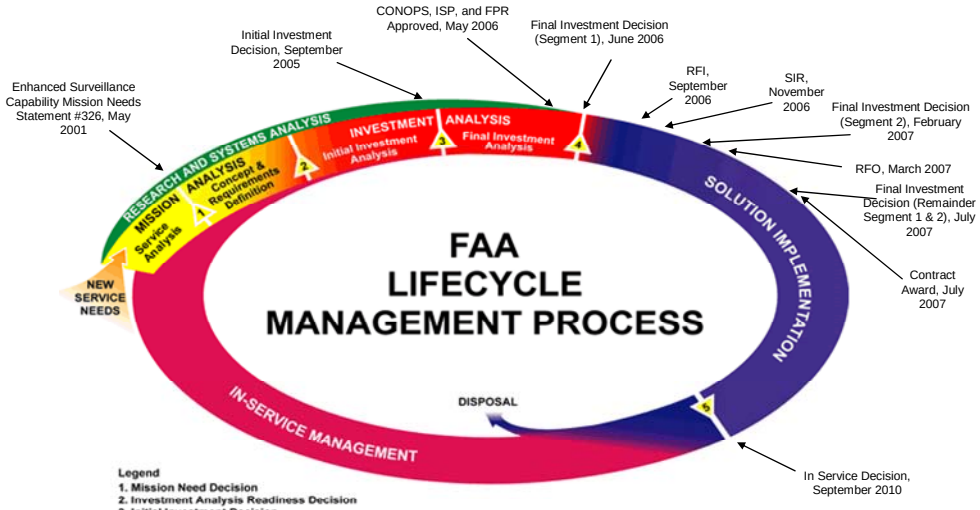
In the Capstone areas (the Y-K delta and the southeast area) we will commission operations for separating radar from ADS-B targets.

Segment One Locations Alaska



Now the how.

Acquisition: FAA Life Cycle Management Process



CONOPS = Concept of Operations; ISP = Integrated Safety Plan; FPR = Final Program Requirements; RFI = Request for Information; SIR = Screening Information Request; RFO = Request for Offer

- On September 9, 2005, the FAA officially committed to moving toward establishing ADS-B as the basis for air traffic control in the

future. Moving to ADS-B will allow the agency to eventually begin decommissioning some of the current infrastructure of ground radars in favor of a system that uses much more precise satellite data and provides greater benefit to everyone who uses the national airspace system.

- This is a key time for our ADS-B program. In March the FAA plans to release a Request for Offer, with the resultant contract to be awarded in July.
- With ADS-B, the FAA plans to let vendors install and maintain the equipment, and to lease services from them, just as the agency today buys telcom services from telecommunications companies. This will both reduce costs and give the agency greater flexibility. Once the ADS-B infrastructure is in place, vendors will likely use the system's capabilities to offer even more services to pilots and airlines.
- The agency is also looking at the possibility of rulemaking that would mandate the avionics necessary for implementing ADS-B across the national airspace system.
- The full evolution of ADS-B would take up to twenty years, taken in manageable segments of equipage and ground-station installation, with some legacy radars maintained throughout to provide a back-up system. However, benefits in improved safety and capacity, and better efficiency for airlines, would accrue with each step of the implementation.
- Develop a multi-segment, life cycle managed, performance based ADS-B strategy that aligns with the Next Generation Air Transportation System (NGATS) vision and generates value for the National Airspace System (NAS).

Conclusions

- **Capstone has provided operational benefits**
- **ADS-B implementation continues through a collaborative FAA/industry relationship**
- **ADS-B is a cornerstone to the FAA's NextGen**

- **Questions? ann.tedford@faa.gov**

- **Websites:**
  - www.faa.gov
  - www.ato.faa.gov
  - www.adsb.gov

In conclusion, I would like to note that:

- Capstone has provided operational benefits

This year's FAA Flight Plan (strategic plan) notes that we will:

  - Continue delivery of dependent surveillance to key sites
  - Provide text and graphical data through programs such as ADS-B, TIS-B, and FIS-B to the cockpit through flight information services,
  - Increase situational awareness by improving the capabilities of small aircraft wit integrated displays, data-link, and traffic information.

- ADS-B implementation continues through a collaborative FAA/industry relationship by
  - Defining the business case
  - Developing separation standards
  - Defining an equipage strategy
  - Establishing critical milestones
- ADS-B is a cornerstone to the FAA's NextGen
  - ADS-B is the future of air traffic control. Instead of using radar data to keep aircraft at safe distances from one another, in the future, signals from Global Positioning Satellites will provide air traffic controllers and pilots with much more

accurate information that will help keep aircraft safely separated in the sky and on runways.

- Eventually, with ADS-B, some of the responsibility for keeping safe distances between aircraft will shift from air traffic controllers on the ground to pilots who will have displays in the cockpits pinpointing all the air traffic around them, along with local weather displays—providing value to all users

Once again, thank you for the opportunity to speak at this symposium.