



Federal Aviation Administration
Alaskan Region

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Concept of Operations

Southeast, Alaska

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Alaska Airlines

Wings of Alaska

University of Alaska Anchorage

FAA National Air Traffic Operations Program Office

FAA National Flight Technologies and Procedures Division

FAA Alaskan Region Flight Standards Division

The Anchorage Office of Aircraft Certification

FAA Alaskan Region Air Traffic Division

FAA Juneau AFSS

FAA Juneau ATCT

FAA Anchorage ARTCC

FAA Anchorage ATCT

National Association of Air Traffic Specialists (NAATS)

National Air Traffic Controllers Association (NATCA)

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Overview: An aviation evolution, using satellite based technology, is leading the way to the future for the Federal Aviation Administration (FAA) and the National Airspace System (NAS). Over the next several decades the partnership formed by FAA and the Alaskan industry will enable a practical evaluation of a phased implementation of an end to end “mini” NAS system leading to end state NAS modernization. ***Global Positioning System (GPS) technology will provide aircraft flight path, position generation, and Data Link technology to users and service providers. . These changes are driven primarily by injection of Wide Area Augmentation of the Global Positioning System (GPS). The injection of Augmented space based navigation*** aids in conjunction with terrain and traffic avoidance data enhances the future pilot’s ability to operate safely by introducing a method to phase in a layering of first VFR, and later IFR area navigation (RNAV) routes in an area with no existing infrastructure. These same Global Positioning System (GPS) signals, when data-linked between users and service providers, allow Air Traffic Control (ATC) to use ***Automatic Dependent Surveillance to technology fused with present day transponders to create a low-cost radar-like environment*** in areas previously not served. This practical evaluation, known as Capstone Phase II, will validate the application and functional capabilities of these technologies and their ability to increase aviation safety and airspace capacity while decreasing the cost of the supporting infrastructure and aircraft avionics equipment and systems. To best describe this transition, we will follow a typical “flight through the system” to observe the changes these technologies offers. Technology changes are depicted in ***Bold Italics***. Due to the large number of acronyms in this document, and to support broad understanding of the contents, each phrase with an associated acronym is spelled out followed by the acronym in parenthesis.

Flight Planning: The pilot, dispatcher, and flight follower begin flight planning with the weather and Notices to Airmen (NOTAMs) for the departure airport, route of flight, and destination airport. Users will also access other information needed during flight planning, such as Special Use Airspace (SUA), system congestion projections etc. There are several means available to obtain them:

- Call 1-800-WX-Brief for a Flight Service Station (FSS) Specialist.
- Use our home or office personal computer to access the Direct User Access Terminal Service (DUATS) or the Internet to view near real-time weather camera photos and other weather products.
- The pilot may activate the aircraft data link system to provide us with weather and other information.

Weather products come from many sources: National Weather Service observers and forecasters, Automated Weather Observing Systems (AWOS), Automated Surface Observation Systems (ASOS), Flight Service Station (FSS) Specialists, or Contract Weather Observers (CWO); Supplemental Aviation Weather Reporting Services (SAWRS),

or affiliated weather reporting stations. Each source becomes a candidate for **data linking to aircraft** as well as being provided over the **internet**.

Each flight planner also searches Notice to Airmen (NOTAM) information for any anticipated anomalies in the Automatic Dependent Surveillance-Broadcast (ADS-B) ground sites, **Global Positioning System (GPS) augmentation system**, and the Global Positioning System (GPS) Receiver Autonomous Integrity Monitoring (RAIM), Failure Detection, or constellation broadcast signals.

If planning favors a successful flight, we file our flight plan (instrument or visual) using Direct User Access Terminal Service (DUATS), our 1-800-WX-Brief connection, or our data-link connection. We ensure the aircraft specific code appears in the comment section of our flight plan for inclusion into the Air Traffic Control (ATC) system. **We indicate the track designation for each Augmented Global Positioning System enhanced low altitude route** used during the trip, on our flight plan. Air Traffic personnel enter our flight path information into the automation system for use in the **Flight Plan Monitoring system** and for storage in the Air Route Traffic Control Center (ARTCC) automation system.

Pre-Flight and Taxi:

We are ready to begin our aircraft preflight. We ensure the aircraft's **avionics** include a functional **Terrain Alerting and Warning System** appropriate for the type of flight planned. We ensure we have Automatic Dependent Surveillance (ADS) for use in areas of radar-like coverage and as a collision avoidance tool. We ensure that Global Positioning System (GPS) is fully functional for all navigational needs and the planned flight path information is programmed into the cockpit flight display system. We check the Flight Information Services (FIS) feature of our data link system. Throughout our flight the data link will acquire weather, Notice to Airmen (NOTAM), Special Use Airspace (SUA), and other supplemental flight information from a Ground Based Transceiver (GBT) and present it, on demand, onto the Multi-Function Display (MFD) unit in the cockpit. Having checked out our aircraft and its avionics systems, we are ready to taxi to the active runway. Upon starting our aircraft and powering up our avionics, our data link will enable us to view the location of other aircraft and specially equipped vehicles in our area. Each aircraft that are transmitting position information from Automatic Dependent Surveillance (ADS), or any transponder mode to the **Multi Lateration System**, can be seen on our cockpit display. We radio our dispatch, flight follower, or the Flight Service specialist to confirm they are able to **view our position on their Personal Computer (PC) display**. We use the aircraft's data link display to obtain continuous updates to weather information needed for the route to be flown. We contact the control tower or controlling agency for clearance to the movement area. If our flight plan has been properly entered the FAA facility's equipment automatically acquires and tracks **our aircraft on the controller display**.

We taxi to the runway in use ***using the airport diagram on our display***, while we monitor our radio to ensure we are complying with the Air Traffic Control (ATC) clearance and are clear of all traffic. If we are on an uncontrolled airport, we observe the ramp and taxiways for activity, monitor the Common Traffic Advisory Frequency (CTAF), and announce our position and intentions.

As we taxi into position on the assigned runway, we view ***the terrain alerting and warning features*** on the Multi-Function Display (MFD).

Departure and En Route:

As we depart, we radio the departure time to Air Traffic Control (ATC) and receive Automatic Dependent Surveillance (ADS) surveillance service. The automation equipment in the facility acquires our aircraft specific identification and tags the aircraft displayed for the controller or specialist. Our Multi Function Display (MFD) indicates our route, areas of significant weather and terrain, and ***other transponder equipped aircraft utilizing Traffic Information Services (TIS) or Automatic Dependent Surveillance (ADS) traffic*** operating in the vicinity. If we already have the route information stored in the on board system database and we begin to receive radar like services based on our aircraft specific Automatic Dependent Surveillance (ADS) signal. Using Flight Information Services (FIS), we are able to monitor all available of weather, Notice to Airmen (NOTAMs), weather forecasts, and Special Use Airspace (SUA), information.

The pilot ***listens for aural terrain warnings, and views traffic information, custom sectional map displays, enroute and approach charts, airport information, and accesses other supplemental text information as the need arises. Terrain alerts and warning presentation on the Multi Functions Display (MFD) and primary flight display highway in the sky help us identify and avoid areas of rising terrain along our flight path.*** Our displayed traffic target symbols are tagged with the flight identification, present location, speed, altitude, and velocity vectors of other aircraft. This information helps us avoid conflicts and collisions and optimizes airspace capacity. Our aircraft appears on the Multi Function Display (MFD) on other aircraft's panel for use in the same manner by other crews. **The ground based controllers; specialist and airline operation personnel continuously monitor the progress of our aircraft flight path.** Special Use Airspace (SUA) areas, and areas of significant weather appear on our display. ***Terrain information can be superimposed on our display to determine the aircraft's exact relationship to terrain.*** Along our route, we use remote communications outlets to relay flight information etc. ***Dispatchers and flight followers watch data block/targets of their flights progress over a map of their operating area on their Personal Computer (PC) displays.*** When a flight arrives at its destination, a message is forwarded via the dispatchers data link advising airline personnel of arrival times. The flight is handled the same upon departure.

The map depicted on the Personal Computer screen displays the flight's data block as it progresses from the departure airport towards its next destination airport. Airports are also depicted on the map. The flight number and destination airport identifiers are displayed in the data block

Arrival:

As we near our destination, we review airport information, current weather and Notice to Airmen (NOTAM) information using the Flight Information Services (FIS) feature on the Multi Function Display (MFD). We also check the display for any traffic operating in our vicinity that cannot be detected visually. Our Automatic Dependent Surveillance (ADS) and transponder continue to report our Global Positioning System (GPS)-based position to the Ground Based Transceiver (GBT) *or multi lateration* ground host and to other aircraft in our vicinity. After receiving an instrument approach clearance when flying under instrument rules, we contact the Air Traffic Control (ATC) facility for the airport on the appropriate radio frequency of landing instructions and clearances.

At uncontrolled airports, we broadcast our intentions on the Common Traffic Advisory Frequency (CTAF) for those aircraft without the data link. *We scan the Multi Function Display (MFD) to detect any unannounced airborne or surface traffic near or on the airport surface.* We monitor the topographical information provided on the Multi-Function Display (MFD) to ensure proper terrain clearance is maintained. *We scan the primary synthetic view and crosscheck the highway in the sky information* for flight path information to the runway.

Taxi to Parking:

We have cleared the active runway. We contact the Automated Flight Service Station (AFSS) and/or the airline operations center on VHF or data link to report our arrival and end *our flight plan monitoring*. During taxi we monitor the airport diagram on our Multi Function Display (MFD) to ensure compliance with instructions and to locate parking.

The Pilot, Dispatcher, Flight Following Side**Pilots, Flight Followers, and Dispatchers**

The safety of any flight operation is very important to the pilot, his passengers and cargo and is equally important to the dispatcher who helped plan the operation and who will be flight following. The Capstone equipment will improve the safety of operation while providing the pilot and dispatcher additional and much needed information about the flight operations. Valid and timely decisions are easier to make when the greatest amount of information is available to pilots and dispatchers. Pilots will be able to concentrate their efforts on safety of operations when they have a good situational awareness by knowing exactly where they are in relation to terrain, traffic and their destination. By *blending synthetic vision components into a primary flight display* and *enhancing the accuracy of terrain and traffic data* presented on a

multifunction display pilot workload is minimized. *Dispatchers, use the data generated by ADS as an accurate flight-following tool.* They will be able to follow company flights and advise customers of delays. This will enable airline operation centers to keep people advised of flight progress based on actual aircraft position and movement *on a Personal Computer map display* and through communications with the flight crew.

The ATC Side

Along with the user point of view, there are *new technologies* that support enhancements to the Air Traffic system.

Flight Service:

The Automated Flight Service Stations (AFSS's) and Flight Service Stations (FSS's) render services to pilots in all phases of flight. Some of the more visible services provided include weather collection, dissemination, and storage in the Weather Message Switching Center Replacement (WMSCR) database. They work closely with the National Weather Service (NWS). The Notice to Airmen (NOTAM) system is maintained by the Notice to Airmen (NOTAM) Office with information principally provided by the Automated Flight Service Stations (AFSS) and Flight Service Stations (FSS's) community. Special Use Airspace (SUA) status information is also provided to enhance the safety of flight.

Automation displays will be linked with other displays throughout the Air Traffic Control (ATC) system, allowing the Automated Flight Service Stations (AFSS's) and Flight Service Stations (FSS's) to obtain information from and make information available to other facilities. The Automatic Dependent Surveillance-Broadcast (ADS-B) or transponder signal will be used to create a database that AFSS/FSS specialists will use to provide the "Flight Plan Monitoring service," where specialists will monitor the flight progress of participating aircraft for search and rescue purposes, allowing quick response to downed aircraft. The Automatic Dependent Surveillance-Broadcast (ADS-B) signal is adapted for presentation on a display screen used by the specialist. *Each aircraft in the Automatic Dependent Surveillance (ADS) Ground transceiver coverage area is shown along its route of flight. Loss of an aircraft signal would result in the capability of initiating an immediate search.*

Terminal

In the Terminal arena, automation displays will be linked with all other automation display options throughout the Air Traffic Control (ATC) system. This will aid them in separation, sequencing and issuing traffic and enable a facility to obtain information and display pertinent data to other facilities within the system. *In addition to this Up/Down concept of information sharing, Automatic Dependent Surveillance-Broadcast (ADS-B) equipped aircraft will share much of the information available within the Air Traffic Control (ATC) system as well as between other Automatic Dependent Surveillance (ADS) equipped aircraft.* Items such as flow control, weather, holding information, position of identified aircraft and airport specific data will be available to all service providers within the system. Controllers will have access to the entire database, including active route information and flight plans. Automation displays will depict aircraft, regardless of the source of position information. *Multi-lateration, Automatic Dependent Surveillance (ADS), transponder and radar targets will be simultaneously displayed for information and control purposes.* This compatibility of displayed data will enable installation and utilization of radar-like services in areas previously void of radar coverage.

En Route:

En Route:

At each airport with Instrument Approach Procedures in SE Alaska aircraft will be digitally presented as targets on the DSR displays with full or limited data blocks at all altitudes. Target information will be derived from multiple sources of information: ADS-B; **multi-lateration**; transponders; and newer technologies. These new technologies will provide enroute aircraft target information and data blocks as low as the Minimum Enroute Altitudes (MEA) on Airways and other routes and procedures. Aircraft target information and data block coverage will also be displayed as low as Minimum IFR Altitudes (MIA). VHF radio coverage area will be greatly expanded: down to the surface at IFR airports and, whenever possible, down to the MEA's along airways, arrival and departure procedures, and approaches. Data Link may be used for limited communications where terrain prohibits VHF radio coverage at MEA's and at MIA's. Instrument departure, enroute, and arrival procedures and separation standards will not be tied to conventional NAVAID's. The new technology and positioning systems will provide more precise primary navigation, reduced lateral separation standards, and more arrival and departure paths at airports that are now one-way in and out. IFR services will be greatly improved and delays will be reduced during periods of peak traffic and bad weather.

Summary:

We have concluded our “flight through the system” and a brief synopsis from each user and service provider. Automatic Dependent Surveillance-Broadcast (ADS-B) and multi-lateration were employed to provide: surveillance in a radar like environment; flight tracking and following for Airline Operations Centers (AOC); and flight plan monitoring by the AFSS for enhanced flight locating, surface and

airborne collision avoidance tools for pilots and controllers. Our efforts bundle technologies which are driven by Wide Area Augmented Global Position System information and incorporate into Primary and Multi Function Flight displays of certified terrain data for enhanced low altitude navigation, synthetic vision, Highway in The Sky (HITS), traffic avoidance, moving maps and charts and Flight Information Service (FIS). Safety is the paramount element in all of these concepts; however, demonstration of increased capacity and the cost-benefits of deploying new world technologies are also vital. The final piece, the “Capstone”, bonds government and industry interests to common goals and objectives which facilitates the implementation of field proven concepts that will improve passenger safety throughout this millennium.