



Federal Aviation Administration
Alaskan Region

Capstone Program Management Office
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Capstone Program Plan

Version 2.0
10 March 2000



Preamble

This document is designed as a high-level program plan for the FAA Alaskan Region's Capstone Program. The term high-level, as it is used here, means the contents are intended to create an umbrella of objectives under which detailed work plans are developed and accomplished. Each organization tasked with a particular objective or element takes on the responsibility for developing their own work plan, for developing procedures for participants to use their element, and for recording and reporting the progress made toward validation. To accommodate future developments facilitated by the Capstone Program validation efforts, the number and the date of each successive version is printed on the cover.

This version 2.0 of the Capstone Program Plan is complimentary to Version 1.0. Version 1.0 established the procurement of the initial Capstone avionics and ground infrastructure. This version documents the activities supporting the Bethel/Yukon-Kuskokwim delta area operational implementation and evaluation being conducted between 2000 – 2002 with the main focus on FY 2000.

EXECUTIVE SUMMARY

The Capstone Program accelerates nationwide efforts to improve aviation safety and efficiency through a multi-year introduction of current and emerging concepts and technologies. Initial validation plans include the installation of government-furnished Global Positioning System (GPS) driven avionics suites in up to 200 commercial aircraft serving the Bethel/Yukon-Kuskokwim delta area. For the first year and beyond, compatible data link transceivers installed at strategically located ground sites are designed to facilitate Air Traffic Control and flight information services.

The name “Capstone” is derived from the program’s effect of drawing and holding together concepts and recommendations contained in reports from the Radio Telecommunications Conference of America (RTCA), the National Transportation Safety Board (NTSB) and the Alaskan aviation community. Each of these groups work in partnership with the FAA to identify and mitigate risks associated with a transition toward modernization of the National Airspace System. The plan incorporates guidance from both, internal and external, national and local organizations as we draw together safety improvements and validation work under a single program.

Elevated accidents rates and the absence of services such as radar make Alaska the ideal location to evaluate key new communications, navigation and surveillance (CNS) technologies. Increased pilot situational awareness tops the list of safety improvements possible through introduction of modern avionics suites and ground stations; and this correlates well with Alaska’s needs. Aircraft chosen to participate in the Capstone program are equipped with:

- An IFR-certified GPS receiver for enhanced visual navigation capabilities,
- A Universal Access Transceiver (UAT) data link radio to provide the pilot with current decision making information via Automatic Dependent Surveillance-Broadcast (ADS-B), Traffic Information Services-Broadcast (TIS-B), and Flight Information Services (FIS - graphical weather maps, METARs, TAFs, NOTAMs, SIGMETs, and PIREPs),
- A panel mounted multiple function color display to present information from the above components and to present a terrain advisory database to help avoid collisions with terrain.

The initial ground station network unites new data link technologies with existing telecommunications facilities at up to twelve (12) locations in the Bethel/Yukon-Kuskokwim delta area. As technologies are validated, more sites are planned in future years to allow for coverage area growth. The sites create a connection between FAA air traffic control facilities and participating aircraft. The major components of the ground system are:

- Modification to the Anchorage ARTCC Micro En Route Automated Radar Tracking System (Micro-EARTS) automation system to incorporate ADS-B data for processing and display at Anchorage ARTCC and Bethel Tower;
- Capstone Server that establishes the relationships that control the flow of information (e.g., ADS-B, FIS, TIS-B) within the Capstone ground system architecture, and

- Ground broadcast transceivers (GBT) remote ground stations with communication and router capability to Anchorage Air Route Traffic Control Center (ARTCC).

Other major parts of the Capstone Program include:

- Flight following/locating capabilities for aircraft operators/dispatch offices,
- GPS non-precision instrument approach procedures developed for runways at remote village airports within the Capstone area, and
- FAA-certified automated weather observation systems (AWOS III) with radio broadcast capability installed to enable air carrier use of the new non-precision GPS instrument approach procedures.

Capstone is working with the Safe Flight 21 Program Office at FAA Headquarters to document the operational benefits of these systems, the impact on safety, and the cost benefit of equipage. While the Capstone Program Office demonstrates and documents the operational benefits that are to be gained through 2001, planning for statewide implementation is also occurring for 2002 – 2005 and beyond.

The Capstone Program Office will continue to work with the Alaska aviation industry to build on the lessons learned in the Bethel/Yukon-Kuskokwim area and to explore expansion of the use of these technologies to improve aviation in other areas of Alaska.

The Capstone Program Office reports to the Alaskan Regional Administrator, and serves to plan and coordinate implementation. The office is staffed by individuals detailed from various “straight lined” divisions within the Region. Oversight of the program is provided by a Management Review Board, made up of Senior Executive and FAA managers from participating organizations, providing periodic review of the Capstone Program.

TABLE OF CONTENTS

1	INTRODUCTION.....	1
1.1	Background	1
1.1.1	Alaska Aviation Industry Consensus.....	2
1.1.2	Operational Enhancements.....	4
1.2	Purpose.....	5
1.3	Objectives.....	5
1.3.1	Safety.....	5
1.3.2	Capacity and Efficiency.....	6
1.3.3	Information for Decision-Makers.....	6
1.4	Strategy.....	6
1.4.1	Safety.....	7
1.4.2	Capacity and Efficiency.....	7
1.4.3	Information for Decision-Makers.....	7
2	CONCEPT OF OPERATIONS	8
2.1	Vision	8
2.2	Improving the Aviation System	8
2.2.1	Weather and Other Information to the Cockpit	8
2.2.2	Cost Effective CFIT Avoidance	9
2.2.3	Enhanced See and Avoid.....	9
2.2.4	Enhanced En Route Air-to-Air Operations.....	9
2.2.5	Improved Surface Surveillance and Navigation for the Pilot	9
2.2.6	ADS-B Surveillance in Non-Radar Airspace	9
2.2.7	ADS-B Surveillance in Radar Airspace	10
3	ARCHITECTURE	10
3.1	Capstone Ground System.....	11
3.2	Capstone Avionics.....	12
3.3	AWOS III	14
4	CAPSTONE ACTIVITIES	14
4.1	Developmental Test and Evaluation	15
4.1.1	Ground Systems.....	15
4.1.2	Airborne System.....	16
4.2	Implementation and Operational Evaluation.....	16

4.3	Test Plan Activities	17
4.4	Training and Safety Study.....	17
4.5	Cost Benefit Analysis.....	18
4.6	Operational Safety Review.....	18
5	IMPLEMENTATION.....	18
5.1	Near Term	19
5.1.1	FY 1999.....	19
5.1.2	FY 2000.....	19
5.1.3	FY 2001.....	19
5.2	Getting to the Vision - Implementation 2002-2005	20
6	CAPSTONE PROGRAM MANAGEMENT.....	20
6.1	Capstone Organization	20
6.1.1	Capstone Management Review Board.....	20
6.1.2	Capstone Program Office (CPO).....	21
6.1.3	Capstone Program Office Staffing.....	22
6.1.4	Alaska Aviation Industry Capstone Coordination	24

Attachments

Attachment 1	Capstone Requirements and Costs (FY '99 – '01)	page 1
Attachment 2	Cost and Schedule for Statewide Implementation F&E (FY '02 – '05).....	page 2

Appendices

Appendix A	Acronyms	A-1
Appendix B	Capstone Test and Evaluation Master Plan (TEMP)	A-2

1 INTRODUCTION

The first priority of Capstone is to improve aviation system safety, and capacity and efficiency in Alaska through the introduction of new communications, navigation, and surveillance (CNS) technologies that enable pilots to deal with terrain, traffic conflict, and weather hazards. This includes providing Automatic Dependent Surveillance-Broadcast (ADS-B) data to air traffic controllers to expand surveillance coverage and ATC services.

Secondly, Capstone provides answers to technical, operational, and cost/benefit questions that enable FAA and industry decision-makers to make key new CNS technology implementation choices. Some of these questions were raised in the RTCA Free Flight Operational Enhancement document.¹ Capstone addresses many of these areas and the Safe Flight 21 Program addresses the remainder through additional work with the aviation industry.

Capstone provides an improved aviation system and an infrastructure from which to gather data necessary to make better decisions on implementing the future National Airspace System (NAS) architecture.

1.1 Background

Alaska experiences an average loss of 45 lives each year from aircraft accidents. These numbers are five times greater than other areas of the U.S. The National Transportation Safety Board (NTSB) identified a number of improvements in Alaska's aviation system that could reduce fatal accidents in the various sectors of Alaska.² An FAA, ASD-430, Operations and Research Analysis Branch study concluded that approximately 38 percent of these fatal accidents could be avoided by providing the pilot with an improved situational awareness of terrain, traffic and weather.³ For the remaining percentage of accidents the intent is to provide surveillance capabilities that can improve search and rescue efforts in the hopes of saving additional lives.

The area around Bethel and the Yukon-Kuskokwim (Y-K) delta was identified by the Alaska aviation industry as the location to start the Capstone improvements. The following characterize this flying environment:

- A representative number of Alaskan accidents occurring in the area;
- No radar coverage below approximately 5000 feet;
- No highway structure connecting communities, making aviation the primary form of transportation;
- The aircraft fleet is geographically contained by mountains limiting service to communities inside the area;

¹ Joint Government/Industry Roadmap for Free Flight Operational Enhancements, August 1998.

² Safety Study NTSB/SS-95/03, Aviation Safety in Alaska, November 1995.

³ Economic Justification for FAA's Flight 2000 Program, September 23, 1997.

- Lower terrain in the immediate proximity reduces safety risks associated with the validation of Capstone components;
- Most of the 55 community airports in the area are without weather reporting capabilities, NAS instrument routes, or approach structures; and
- Remote living conditions make it difficult for carriers to attract and retain experienced flight crews.

1.1.1 Alaska Aviation Industry Consensus

Capstone participation with Alaska aviation industry is vital to the successful outcome of the program. Industry “buy-in” connects everyone to the goals and objectives of Capstone and ensures support. This involvement helped establish the avionics and ground system equipment requirements and drives the need to demonstrate early tangible progress in improving aviation safety and efficiency.

1.1.1.1 Capstone Capabilities

Capstone purchased and is providing the following capabilities (further description is included in Section 3.0).

- Avionics
 - An IFR-certified GPS receiver for enhanced visual navigation capabilities,
 - A Universal Access Transceiver (UAT) data link radio to provide the pilot with current decision making information via Automatic Dependent Surveillance-Broadcast (ADS-B), Traffic Information Services-Broadcast (TIS-B), and Flight Information Services (FIS - graphical weather maps, METARs, TAFs, NOTAMs, SIGMETs, and PIREPs),
 - A panel mounted multiple function color display to present the information from the above components and to present a terrain advisory database to help avoid collisions with terrain.
- Ground System
 - Modification to the Anchorage ARTCC Micro En Route Automated Radar Tracking System (Micro-EARTS) automation system to incorporate ADS-B data for processing and display at Anchorage ARTCC and Bethel Tower;
 - Capstone Server that establishes the relationships that control the flow of information (e.g., ADS-B, FIS, TIS-B) within the Capstone ground system architecture, and
 - Ground broadcast transceivers (GBT) remote ground stations with communication and router capability to Anchorage Air Route Traffic Control Center (ARTCC).
- Other Major Capstone Capabilities

- Flight following/locating capabilities for aircraft operators/dispatch offices,
- GPS non-precision instrument approach procedures developed for runways at remote village airports within the Capstone area, and
- FAA-certified automated weather observation systems (AWOS III) with radio broadcast capability installed to enable air carrier use of the new non-precision GPS instrument approach procedures.

1.1.1.2 Capstone Installations

1.1.1.2.1 Avionics

An amended Supplemental Type Certification (STC) for Visual Flight Rules (VFR) use of the avionics was issued February 3, 2000. Certified avionics system installations have subsequently begun. The following are the aircraft types covered under the STC and additional aircraft types may be included as the program expands.

- Raytheon A36, 200 Series, 1900 Series, C90 Series;
- Britten-Norman BN-2 Series;
- Cessna 170 Series, 172 Various Series, 180 Series, 182 Series, 185 Series, 206 Series, 207 Series, 208 Series, 402 Series;
- DeHavilland DHC-2 Series, DHC-6 Series;
- Fairchild SA227 Various Series;
- Piper PA-28 Series, PA-31 Various Series, PA-32 Series, PA-34 Series;
- Partenavia P-68C;
- Short Brothers SC-7; and
- Casa 212-200

1.1.1.2.2 Ground Broadcast Transceivers (GBT)

The GBTs will be installed at the following locations beginning January 2000. Developmental GBTs were installed at Bethel and Anchorage in January 2000.

- | | |
|-----------------|---------------|
| • Bethel | • St. Mary's |
| • Aniak | • Kipnuk |
| • Anvik | • Sparrevohn |
| • Cape Newenham | • Tatalina |
| • Cape Romanzof | • Unalakleet |
| • Anchorage | • King Salmon |
| • Dillingham | |

1.1.1.2.3 AWOS III

An AWOS III will be installed at the following locations between January and October 2000 to enable Instrument Flight Rules route and terminal NAS expansion. Installations have begun at Holy Cross, Mountain Village, Scammon Bay, and St. Michael as of February 2000.

- Holy Cross
- Kalskag
- Kipnuk
- Koliganek
- Pilot Point
- Mountain Village
- Platinum
- Russian Mission
- Scammon Bay
- St. Michael

1.1.1.2.4 GPS Non-Precision Approaches

Stand alone GPS non-precision approaches for the following airports inside the Capstone area are planned for publication by August 2000. Approaches were published for St. Michael, Mountain Village, and Platinum in December 1999, and for Kalskag and Koliganek in February 2000.

- St. Michael
- Holy Cross
- Kalskag
- Kipnuk
- Koliganek
- Pilot Point
- Mountain Village
- Egegik
- Russian Mission
- Scammon Bay
- Platinum

1.1.2 Operational Enhancements

The Capstone Program will implement and evaluate, over the next 3 years, the operational enhancements depicted in Table 1-1. As experience is gained, the implementation will be refined and expanded. Specifics on these enhancements are discussed in Section 2.0. Data collected from pilots and controllers is vital to refining the use of the Capstone technologies, training, and procedures. The Alaska aviation industry placed priority on developing radar-like services in the Bethel area using ADS-B by January 2001, and as a result the FAA Administrator committed the necessary support to make this happen.

Operational Enhancement⁴	FY 00	FY 01	FY 02
Weather and Other Information to the Cockpit	X	—	→
Cost Effective CFIT Avoidance	X	—	→
Enhanced See and Avoid	X	—	→
Enhanced En Route Air-to-Air Operations	X	—	→
Improved Surface Surveillance and Navigation for the Pilot	—	X	→
ADS-B Surveillance in Non-Radar Airspace	X	—	→
Surveillance in Radar Airspace	X	—	→

Table 1-1. Operational Enhancements

1.2 Purpose

Capstone provides the avionics and ground system infrastructure that will lead to improved aviation safety in Alaska. It also provides the launching platform for validation of many essential elements needed to move toward the Free Flight concept. Introduction of the future CNS components of the NAS architecture allows an assessment of operational capabilities and mitigation of monetary and safety risk exposure. The technology fielded under Capstone may be modified during national implementation and need to be upgraded or replaced.

1.3 Objectives

The major Capstone objective is to improve flight safety in Alaska. Equipage of aircraft in the Bethel/Yukon-Kuskokwim delta area provides an excellent opportunity to work with the Safe Flight 21 office to evaluate CNS technology and the operational enhancements identified by RTCA.⁵ Specific objectives of Capstone are:

1.3.1 Safety

- Reduce the fatal accident rate (on a per-flight-hour basis) due to en route and approach navigational errors in marginal visibility situations by 25% in the equipped aircraft within one year after installation of equipment and new low altitude airspace design and procedures are in place.
- Reduce the fatal accident rate from mid-air collisions en route between the airports involved in Capstone and in the vicinity of Bethel by 25%.
- Reduce the fatality rate due to search and rescue failures for equipped aircraft in the Bethel area.

⁴ Joint Government/Industry Roadmap for Free Flight Operational Enhancements, August 1998.

⁵ Ibid

1.3.2 Capacity and Efficiency

- Reduce the number of flights cancelled after departure due to inadequate destination weather reporting at airports equipped with new automated weather sources by 10% within one year.
- Reduce flight delays due to weather by 5% within one year for flights into Capstone airports.
- Reduce operators' cost for fuel wasted due to adverse weather situations on equipped aircraft in the Bethel area within one year.

1.3.3 Information for Decision-Makers

Together with the Safe Flight 21 office, Capstone can provide experience and data to support technical and operational CNS evaluation. Capstone specifically provides the opportunity to look at technologies in non-radar and radar areas, with mountainous and non-mountainous terrain, at low altitudes, in extremely low temperature and severe weather conditions, and on a variety of general aviation airframes. Cost benefit data, such as equipment installation costs and fuel savings achieved due to better in-flight information can also be developed.

1.4 Strategy

Capstone provides the avionics and ground system infrastructure that will lead to improved aviation safety, capacity and efficiency in Alaska. Capstone also initiates a streamlined way of integrating activities needed to implement new technologies and a method of providing answers to technical, operational and cost/benefit questions. As these technologies are evaluated and approved for the various operational improvements, the FAA will expand the ground infrastructure and pilots will be allowed to self-equip with compatible avionics.

Capstone integrates the planning of resources required to implement Capstone technologies. This is demonstrated by the tasks for establishing radar-like services using ADS-B in the Bethel area as outlined below by the FAA Administrator:

- Approve airborne equipment including the global positioning system and data link equipment that transmits the ADS-B signals,
- Approve ground-based systems and ensure that adequate radio spectrum is available and certified to meet identified user requirements,
- Ensure compatibility of systems transmitting ADS-B information to the appropriate air traffic control facility,
- Approve equipment that will be used to display ADS-B information and establish procedures for the use of ADS-B,
- Approve operational standards and associated operations specifications permitting use of radar-like services based on ADS-B equipment, and

- Perform an operational safety review and determine that the Capstone ADS-B system is at least equivalent to radar in terms of reliability and system performance.

1.4.1 Safety

Capstone provides an improved ground and air infrastructure that furnishes pilots with better information on the location and severity of hazardous weather, on proximity to terrain, on improved instrument approaches to small airports, and on traffic information for the reduction of mid-air collisions. Additionally, improved surveillance information to controllers and dispatchers/operators will assist in sequencing, separation, flight following, and search and rescue activities.

1.4.2 Capacity and Efficiency

Capstone provides improved aircraft operational capacities and efficiencies such as fuel savings by:

- Using ADS-B to provide radar-like services
- Enhancing the use of weather observations
- Improving capability for dispatchers and controllers to flight follow aircraft
- Improving area navigation and GPS non-precision approach capabilities
- Facilitating search and rescue missions by recorded aircraft flight tracks

1.4.3 Information for Decision-Makers

Capstone provides information for FAA and industry decision-makers as they examine and test CNS technology to be fielded as part of the NAS architecture enhancements.

- FAA decision-makers will allocate resources toward the implementation of systems, set regulatory policies on equipment standardization and certification, as well as determine what changes in air traffic or flight operations procedures are appropriate for new avionics and ground systems.
- Decision-makers across the industry must determine whether to allocate resources for the development of a specified type of avionics based on expected demand.
- Decision-makers at airlines and general aviation aircraft owners must determine whether to allocate resources to purchase new CNS equipment based on expected costs and operational benefits.

The Capstone program provides answers to key questions, such as what air traffic procedures work best with new equipment, based on real time flight operations. Information will be provided to operators on the actual costs of acquiring, installing, maintaining, and operating the equipment; and on the safety, capacity, and efficiency benefits of the equipment.

2 CONCEPT OF OPERATIONS

2.1 Vision

Under Capstone, the Alaskan Region will serve as a real-world evaluation of CNS technologies, procedures, and certification techniques. During the project, selected commercially operated aircraft will be equipped to interface with Alaskan ground sites. Capstone implements technology that has not been previously widely used by small aircraft, and focuses on operational benefits that can result by implementing avionics, ground systems, and operational procedures.

As follow-on to the initial evaluation in the Bethel/Yukon-Kuskokwim Delta area, the Alaska aviation industry supports statewide implementation while they continue to consider new technologies and procedures to address passenger safety and operational needs throughout the state. For example, Instrument Flight Rules (IFR) routes and airport approaches in mountainous areas could be improved by incorporating flight path guidance available through a combination of GPS navigation capabilities, ADS-B surveillance, and terrain information in the cockpit.

2.2 Improving the Aviation System

The Capstone Program Office, in coordination with the Safe Flight 21 Program, reviewed the ADS-B applications published in the ADS-B Minimum Aviation System Performance Standards (MASPS)⁶, as well as other applications recommended under Flight Information Service-Broadcast (FIS-B) and Controlled Flight into Terrain (CFIT) avoidance. The Alaskan aviation industry helped select enhancements and applications⁷ under the Capstone program. See the Safe Flight 21 Master Plan for more detail.

The Capstone Office will develop plans as necessary for these applications to identify operational procedures, equipment certification requirements, and other steps required for implementation. An example is included in Appendix B, Capstone Test and Master Plan for ADS-B Radar-like Services.

2.2.1 Weather and Other Information to the Cockpit

This enhancement will use the FIS-CAPSTONE to receive current and forecasted weather, weather-related information and other information. The information will be displayed in text and graphics to the pilot.

Applications

- Initial FIS-CAPSTONE is based on today's availability. (METAR/SPECI, TAFs, SIGMETs, AIRMETs, PIREPs and severe weather forecast alerts)
- Add products such as NOTAMs, NEXRAD graphics, lightning, icing, turbulence, real time SUA, and Volcanic Ash

⁶ RTCA/DO-242 Minimum Aviation System Performance Standards for Automatic Dependent Surveillance Broadcast (ADS-B), February 19, 1998.

⁷ Safe Flight 21 Master Plan Version 2.0 Draft N, February 2000.

2.2.2 Cost Effective CFIT Avoidance

There have been many fatal accidents involving controlled flight into terrain (CFIT) due to poor pilot situational awareness. This enhancement will increase the pilot's situational awareness by providing a cost/effective terrain database and display in the cockpit.

Applications

- Low cost terrain situational awareness

2.2.3 Enhanced See and Avoid

This enhancement will provide traffic information, electronically, to the cockpit using ADS-B and Traffic Information Service-Broadcast (TIS-B). This will enable the pilot to maintain situational awareness of surrounding traffic.

Applications

- Enhanced visual acquisition of other traffic for see-and-avoid (ADS-B and TIS-B)

2.2.4 Enhanced En Route Air-to-Air Operations

This enhancement will evaluate use of the traffic display and ADS-B to allow delegation of separation authority to the cockpit, resulting in increased efficiency. Capstone will implement this enhancement by looking at flight path adjustments beyond visual range while pilots are operating VFR.

Applications

- Pilot situational awareness beyond visual range

2.2.5 Improved Surface Surveillance and Navigation for the Pilot

This enhancement will be designed to allow pilots in the cockpit and the operators of equipped vehicles on the airport surface to “see” all the other traffic on a display with a moving map, resulting in safer and more efficient surface operations. Also, aircraft will be able to taxi using augmented GPS navigation and maps and in extremely low visibility conditions using LAAS.

Applications

- Runway and final approach occupancy awareness (using ADS-B and TIS-B)
- Airport surface situational awareness

2.2.6 ADS-B Surveillance in Non-Radar Airspace

This enhancement will use ADS-B to provide additional surveillance coverage and fill gaps in radar coverage.

Applications

- Center situational awareness with ADS-B
- Radar-like services with ADS-B

- Tower situational awareness beyond visual range

2.2.7 ADS-B Surveillance in Radar Airspace

Current automation is limited in providing benefits to users based on existing radar accuracy. This enhancement will integrate ADS-B data with radar and conflict alert to determine if separation standards can be reduced.

Applications

- Radar enhancement with ADS-B (en route/terminal)

3 ARCHITECTURE

The high-level Capstone architecture is depicted in Figure 3-1 and described in three segments. The weather observation equipment (AWOS III) is not depicted in this architecture figure given it is a stand-alone system, but is explained later in this section.

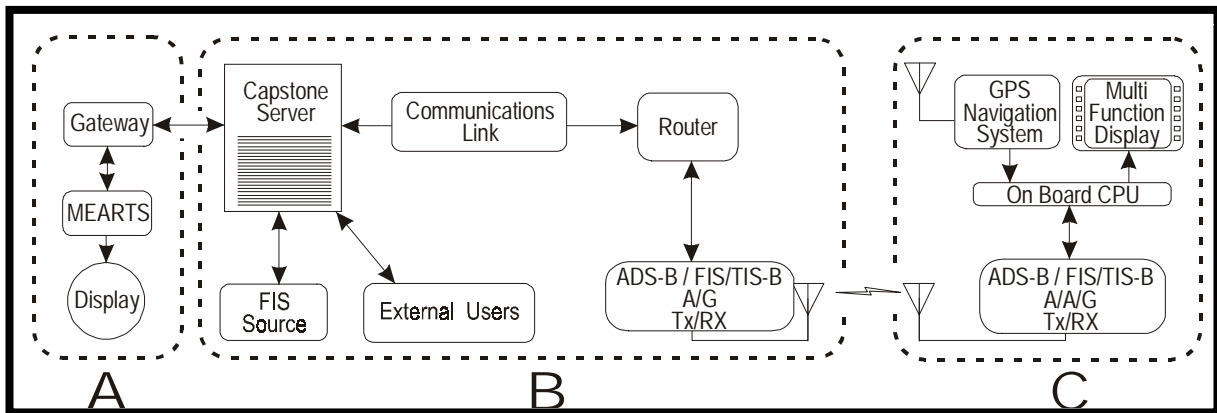


Figure 3-1. High-Level Capstone Architecture

Segment A is comprised of a gateway computer, Micro En Route Automated Radar Tracking System (Micro-EARTS), and controller displays. The gateway provides the physical interface for data transfer between Micro-EARTS and the Capstone Server. Micro-EARTS will process ADS-B target information obtained from appropriately equipped aircraft and collected via the Capstone network. Among the planned features for Micro-EARTS is the ability to incorporate both radar and ADS-B surveillance data in track processing. In addition, surveillance tracks can be returned as TIS-B data for transfer to appropriately equipped aircraft. A display screen will depict the target data at Anchorage Center (ZAN) for use in separation/sequencing as well as safety functions like conflict alerting, safe altitude warnings, etc. There will also be a display located in the Bethel tower.

Segment B includes the Capstone Server, FIS data and user accesses, the telecommunications link, router, and the transmitter/receiver radios (GBTs). The Capstone Server will collect, process, and transmit data between the Micro-EARTS gateway and the transmitter/receiver radios. The FIS data will come from existing sources and be integrated into the data flow. The Capstone Server will be able to

prioritize and geographically filter the combined data for efficient transmission as well as provide access to selected data for external users. The telecommunications links will be provided by the Alaska NAS Interfacility Communications System (ANICS), or leased, long-haul commercial service. The router will interface the transmitter/receiver radios to the network. The radios will capture the ADS-B data from appropriately equipped aircraft, and broadcast FIS-B/TIS-B data to the airborne segment.

Segment C is the airborne segment. The airborne transmitter broadcasts the ADS-B data to the ground based and airborne receivers. The receivers collect ADS-B data from the other transmitters as well as FIS-B and TIS-B information from the ground segments, for processing by the On-Board computer (CPU). The CPU regenerates the collected data onto a multi-function display into a format usable by the flight crew. The onboard Global Positioning System (GPS) produces three-dimensional location information for own aircraft navigation, terrain database accuracy and incorporation into the ADS-B.

3.1 Capstone Ground System

The Capstone ground system architecture, as shown in Figure 3-1, supports multiple services with emphasis on products (ADS-B, FIS-B, TIS-B) that meet the goals of the aviation community. The ground system architecture will provide ADS-B information to the Micro-EARTS, and information such as text/graphical weather (i.e., FIS-B) and radar tracked targets (i.e., TIS-B) will be broadcast to the aircraft. To ensure all services provided meet the required level of certification (Critical for surveillance, Essential for information) the Capstone ground system architecture will have phased certification. The Phase 1 ADS-B architecture (shown in Figure 3.2) is designed to meet the Administrators commitment and schedule (i.e., January 1, 2001) for ADS-B radar-like services. The phased design goal is to allow development of FIS-B and TIS-B products without impact to the operational Micro-EARTS ADS-B services and to field initial operational infrastructure capable of meeting AOS requirements with the ability to move into Airway Facilities support.

The Phase 1 Capstone ADS-B Ground system includes the Micro-EARTS to process and display ADS-B information, and a telecommunications system architecture that includes remotely located GBTs, ADS-B fixed parrots, long haul telecommunications (ANICS and/or leased telecommunications), and routers to the Micro-EARTS gateway. Figure 3.2 depicts this fully redundant Phase 1 operational architecture. Note that the Capstone Server is not part of initial operational architecture, but will be included in a developmental system (fielded in parallel) to allow for FIS-B and TIS-B testing.

The Micro-EARTS will be certified through a NAS Change Proposal (NCP) process (Capstone Case File NCP-AL512-MEARTS-013), that involves software changes to the currently certified Micro-EARTS baseline to incorporate processing of ADS-B data. The Capstone telecommunications architecture must support surveillance (i.e., critical level) services in accordance with NAS performance requirements. Design goals for these requirements are specified in the FAA's NAS System Requirements Specification (NAS-SR-1000). The Capstone ground system communication architecture will be tested via a FAA AOS-500/AAL-500/400 agreed upon NCP process.

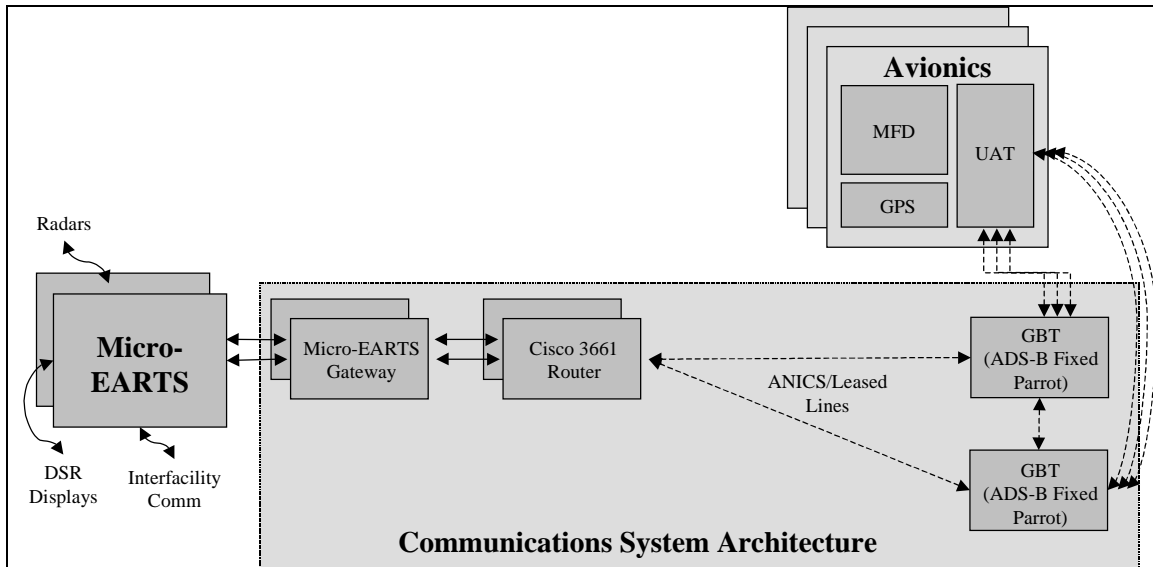


Figure 3-2: Phase 1 Capstone ADS-B System Block Diagram

FAA technicians and/or contractor personnel, in accordance with the manufacturer’s instructions, perform system installations and maintenance. The initial installations will be at existing FAA and joint-use FAA/military facilities.

Phase 1 will allow operational use of ADS-B in both Anchorage Center and Bethel Airport Traffic Control Tower. Anchorage Center controllers will use it to perform VFR and IFR radar-like services. Bethel Tower, currently being a VFR-only tower, will be able to use the ADS-B information for VFR services. ADS-B traffic information processed through the Anchorage Center Micro-EARTS will be made available to aircraft operators/dispatchers for flight following/locating activities.

3.2 Capstone Avionics

During 2000, installation of government provided avionics will begin for approximately one hundred and fifty commercially operated aircraft. The Capstone program provides three UPS Aviation Technologies avionics products: the Apollo GX60 TSO-C129A certified GPS navigator/VHF communication radio (or GX50 TSO-C129A certified GPS navigator), the Apollo MX20 multi-function cockpit display (Capstone configured), and the UAT transceiver. Installation of these avionics is covered under a multiple make, model, and series FAA STC (No. SA02149AK) in accordance with UPS Aviation Technologies' Capstone STC Master Drawing List. The avionics are limited to supplemental VFR operations via the FAA approved Airplane Flight Manual Supplement or Supplemental Airplane Flight Manual for Capstone System Installation. This system will be placarded “GPS and MFD limited to VFR use only”, and the aircraft/pilot must have other navigation capability appropriate to the route of flight. A description of the avionics is provided below with a block diagram depicted in Figure 3-3.

- GX60 GPS/VHF Communication System is TSO-C129A Class A1 approved for IFR non-precision approach operation and also TSO-C37d, TSO-C38d and TSO-C128 approved 760-channel VHF communication transceiver. The Apollo GX60 will provide navigational data to the pilot via the internal moving map. The

Capstone installation limits the GX60 for VFR operation only. (Note the GX50, provided on a few Capstone aircraft, is equivalent to a GX60 without the communication transceiver.)

- MX20 Multi-Function Display is capable of displaying ADS-B traffic, flight information service, moving map, terrain awareness information, and VFR/IFR charting functions. The Capstone version of the MX20 display has an internal GPS receiver to provide timing and positioning for the UAT datalink. Further, the MX20 uses the internal GPS for own-ship display.
- Universal Access Transceiver (UAT) radio will transmit the ADS-B position reports as generated by the MX20 (via the internal GPS receiver). The transceiver will receive data from other aircraft as well as data transmitted by ground stations (i.e., FIS-B and TIS-B) and transfer it to the MX20. Dual antennas are installed to resolve shadows created from various mounting configurations. One antenna is top mounted; the second antenna is bottom mounted.

FAA certified technicians, in accordance with the manufacturer’s instructions, install the avionics equipment and perform post installation checkouts.

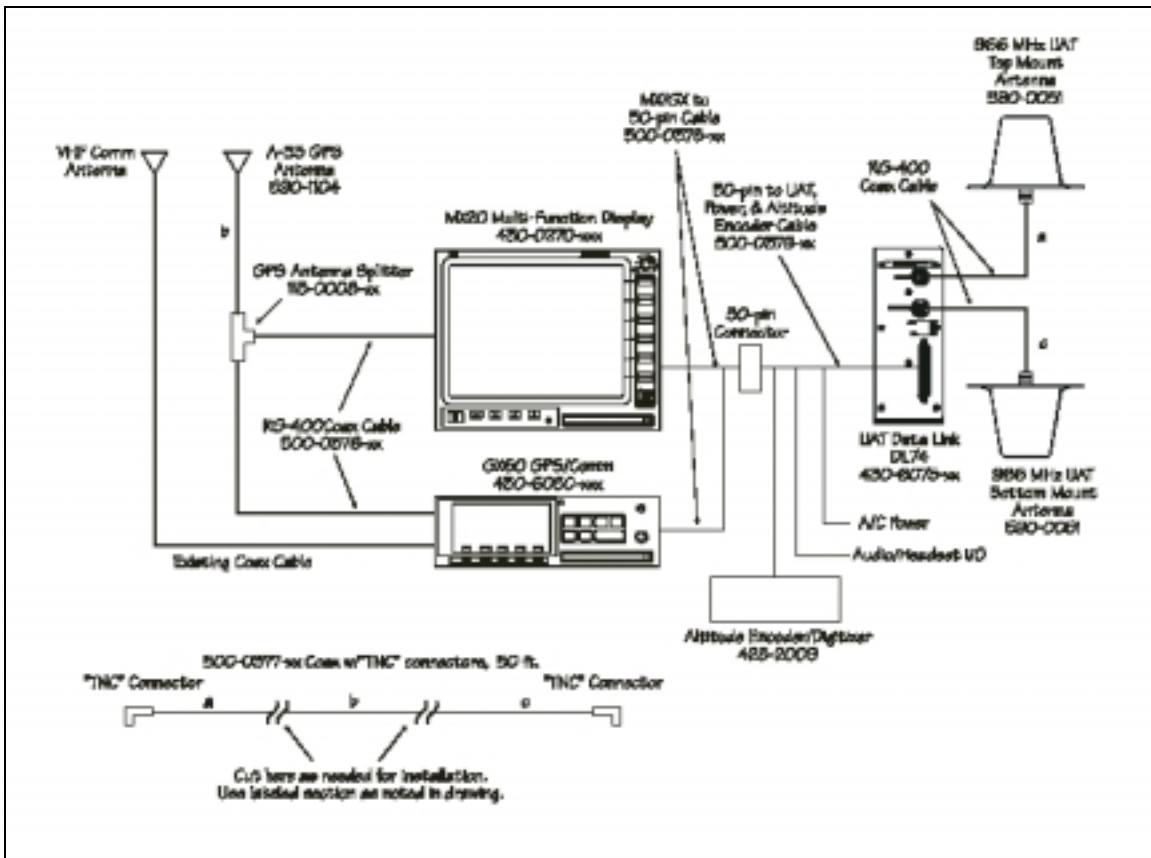


Figure 3-3. Capstone Avionics Block Diagram

3.3 AWOS III

The weather observation equipment will meet at least the minimum functionality required by the Federal Aviation Regulations (FAR) to support an instrument approach procedure for commercial operators. Weather sensors will provide the following observations:

- Wind speed, direction, and gusts;
- Altimeter setting;
- Temperature and dew-point;
- Cloud height and sky cover; and
- Visibility.

The equipment will provide an automatic radio broadcast of observations and have the capability to provide remote weather observations via a telephone line or other connections. The equipment will be capable of remote status and maintenance monitoring. Equipment specifications will incorporate Airway Facilities Division's requirements for standardization, maintenance training, and supply support. The weather observation equipment is installed at airports by FAA technicians and/or contractors in accordance with the manufacturer's instructions.

4 CAPSTONE ACTIVITIES

The Alaska aviation industry has entrusted the Capstone Program Office with the responsibility to procure, test, and deploy avionics and ground systems so as to provide specific operational benefits. This section outlines the air and ground equipment testing and the other activities underway to provide the desired operational enhancements. Tests that lead to operational system deployment approval include certification acceptance testing conducted at the FAA William J. Hughes Technical Center (WJHTC) for the ground systems as well as those conducted by the FAA Anchorage Aircraft Certification Office for the avionics. The following is a list of the range of activities that need to take place in order to guide an application from an initial concept to operational use.

- Development of an operational concept,
- Description of the anticipated benefits and constraints,
- Development of operational procedures,
- Evaluation of the human factors,
- Establishment of end-to-end performance and technical requirements,
- Establishment of interoperability requirements for airborne and ground systems,
- Conducting a system safety analysis,
- Conducting operational evaluation,
- Certifying the systems,

- Obtaining operational approval from Flight Standards and Air Traffic, and
- Developing an implementation strategy.

4.1 Developmental Test and Evaluation

Developmental Test and Evaluation (DT&E) will be used to identify and resolve critical technical and operational issues leading toward certifications and approvals. Test and evaluation activities will be accomplished prior to the delivery of systems to the field and also prior to approval of operational applications. For example, the software that will allow the Micro-EARTS to integrate the display of ADS-B targets along with radar targets will be tested at the WJHTC prior to being installed for operational key site testing in Anchorage.

4.1.1 Ground Systems

4.1.1.1 Equipment

Various DT&E activities were performed by the ground equipment manufacturers (Lockheed Martin for Micro-EARTS, UPS Aviation Technologies for the GBT), both in their factories as well as in conjunction with the FAA (e.g., August 1999 Bethel demonstration). The bulk of the DT&E activities as they relate to radar-like services will take place at the WJHTC for acceptance testing (April 2000) and in Alaska for key site testing (June-Aug 2000).

Testing at the WJHTC includes AUA-640 for overall test process management, AOS-400 as Micro-EARTS test director, ACT-300 for flight tests, AAL/Anchorage Center for regional coordination, and Lockheed Martin as test manager. Various other organizations are also involved, including, the CNS Engineering and Test Division (AOS-300), NAS System Engineering and Analysis Division (AOS-500), and the Facility Services and Engineering Division (AOS-600). These tests will include end-to-end testing of ADS-B targets on the Micro-EARTS using a test configuration of the Capstone ground system and WJHTC aircraft equipped with Capstone avionics.

Following the acceptance testing process at the WJHTC, key site operational and maintainability testing will be conducted by AAL-500 at the Anchorage Center. During this testing, data will be collected and archived using targets of opportunity (i.e., aircraft flying VFR with installed avionics) and possibly dedicated flight checks. Air traffic maintenance and operations will use this data to support commissioning of the ground system. The technical reports from this certification process will provide a satisfactory determination that the Capstone ADS-B system is at least equivalent to radar.

4.1.1.2 Procedures and Training

Air traffic specialists from both Anchorage Center and ATP-100 will scrub the controller's handbook (Order 7110.65, Air Traffic Control) and various other FAA documents (7210.3, 7610.4, AIM, Letters of Agreements, Alaska Flight Information Supplement) to adopt and apply current radar separation rules and procedures (e.g., alignment check, positive identification and validation, separation standards) for ADS-B radar-like services. The basic idea will be to add "ADS-B" wherever the term "radar"

appears, permitting full use/acceptance of ADS-B for both VFR and IFR services. This work, as well as development of a controller training package, will take place between January and March 2000. Formal NATCA coordination and controller training will be completed prior to initial operational capability scheduled for the summer 2000.

4.1.1.3 Approvals

Standard approval and authorization processes will certify the ground systems for operational use. This certification is based on performance and reliability results from DT&E activities. Approval for the use of ADS-B for 5-mile radar-like separation will require data showing that the Capstone ADS-B system is at least equivalent to radar in terms of reliability and system performance. This approval process will be a collaborative effort between flight standards (AFS), air traffic procedures (ATP) and the Alaska Region.

4.1.2 Airborne System

4.1.2.1 Equipment

DT&E activities (e.g., bench and flight tests) in 1999 at UPS Aviation Technologies' Salem, Oregon facilities and activities in Alaska led to the issuance of a STC for the Capstone avionics. The STC for the provisioning of wiring, antenna, and mounting hardware was issued in November 1999. An amended STC was issued following flight tests of the multi-function display and UAT in February 2000. This amended STC covers the Capstone avionics to support navigation, terrain, and traffic (using ADS-B) awareness for supplemental VFR operations. These avionics are planned to be upgraded during calendar year 2000 for various functions, including FIS-B, TIS-B, ATC's use for radar-like services (e.g., frequency change etc.). Continued DT&E activities will support the certification of these upgrades.

4.1.2.2 Procedures and Training

The University of Alaska at Anchorage (UAA) is contracted by the Capstone Program Office to administer FAR Part 135 approved initial and recurrent training for pilots with Capstone avionics. This includes training, as determined by FAA flight standards, for use of ADS-B when radar-like services or other upgrades become available.

4.1.2.3 Approvals

The FAA Flight Standards Principal Inspectors (operations, maintenance, avionics) for the participating operators have approved the training and procedures for the supplemental VFR avionics. Appropriate oversight will continue as new avionics functionality is introduced.

4.2 Implementation and Operational Evaluation

Implementation and operational evaluation within normal revenue service flying will be conducted to monitor Capstone systems performance and to collect operational feedback from the pilots and controllers. The implementation and operational evaluation for the airborne systems will start in February 2000 with the initial avionics installations, and

will largely be accomplished by UAA, using pilot surveys and questionnaires. Implementation and operational evaluation of the ground systems will commence with key site testing beginning in June 2000. Acceptable levels of performance, reliability, integrity and pilot/controller operational feedback will permit the transition to radar-like services and statewide implementation.

4.3 Test Plan Activities

Test documentation consists of test plans and reports for the ground and avionics systems, as well as the plans for the various operational applications (e.g., ADS-B radar-like services). The following test plans exist or are being prepared:

- Capstone Avionics System Certification Plan,
- Capstone Test Plan for Micro-EARTS (draft), and
- Capstone Test and Evaluation Master Plan for ADS-B Radar-Like Services (draft).

4.4 Training and Safety Study

The Capstone contract with UAA provides initial, upgrade, requalification and recurrent training program for pilots, FAA personnel, and others in the use of Capstone avionics equipment. Training will include enhanced pilot/dispatcher decision making capabilities with the use of the avionics as well as the collection and forwarding of data. Training will be made available at Anchorage in the UAA's Aviation Complex and at Bethel. Beta-testing of the training was accomplished in December 1999 and January 2000. Initial classes began in February 2000. The training program will be updated to include new functionality in the avionics and reflect pilot operational feedback.

The UAA is also under contract to perform a three year study addressing the safety and benefits that result from the Capstone Program and associated new flight procedures in the Bethel/Yukon-Kuskokwim Delta area commercial aircraft. The safety study includes:

- Documenting a baseline of Capstone area operations (e.g., accidents/incidents/near mid-air collisions, carriers/operators, pilots, airports, approaches, nav aids and all facilities to include weather, communication, and navigation)
- Monitoring and documenting infrastructure changes within Capstone area (e.g., IFR approaches established, ADS-B ground system coverage, Capstone avionics acceptance/usability, operator reliance on avionics, equipment failure rate, training, accidents/incidents/near mid-air collisions, human factors relating to usefulness and acceptance)
- Preparing annual and final reports on safety change measured (e.g., review of accidents/incidents/near mid-air collisions, analysis of pre-Capstone/post-Capstone safety posture, survey of Capstone users)

The baseline study is in draft coordination as of March 2000. Annual reports will cover each year of the Capstone program.

4.5 Cost Benefit Analysis

The Capstone and Safe Flight 21 Programs are participating in a cost benefit analysis to help document the rationale for future Government and operator/pilot investment in the Capstone technologies. FAA ASD-400 is leading this analysis effort, which covers statewide implementation, for 2002-2005. The analysis reviews the current investment, the anticipated value of improvements in safety and efficiency, the projected additional FAA expenses, and the cost of aircraft equipage beyond the FAA provided avionics. Included in this process is the installation of 31 of the remaining 49 airport weather stations, the implementation throughout Alaska of 188 ADS-B ground stations, the installation of LAAS stations for 12 major airports, and ADS-B equipment installed in ground vehicles to support improved surface operational awareness and to help reduce runway incursions.

4.6 Operational Safety Review

An end-to-end system-level operational safety review for Capstone ADS-B radar-like services is being performed by FAA ASY-300 in coordination with the Capstone Program Office and the Alaska Region. A Capstone safety review working group has been formed that includes Alaska operations and safety specialists. This analysis will include hazard identification, risk assessment, severity and probability determination, and controls and mitigation documentation specific to Capstone avionics, ground systems and procedures. A draft Capstone Radar-Like Services Using ADS-B Safety Engineering Report will be available in April 2000, with a final scheduled for July 2000.

5 IMPLEMENTATION

Because the Capstone Program was conceived as an urgent safety initiative to reduce the high accident rate of small aircraft operations in western Alaska, implementation been on a fast track. Operational implementation and evaluation of advanced avionics capabilities are leading toward implementation of NAS enhancements. Another Capstone aim is to stimulate the avionics industry into designing and producing affordable equipment for small aircraft.

Capstone is working with the Safe Flight 21 Program Office to document the operational benefits of these systems, the impact on safety, and the cost benefit of equipage. While the Capstone Program Office demonstrates and documents the operational benefits that are to be gained through 2001, planning for statewide implementation is also occurring for 2002 – 2005 and beyond. Capstone has provided both the avionics and ground systems for initial implementation in the Bethel/Yukon-Kuskokwim delta area, however funding during statewide implementation will only be for the ground systems while aircraft owners will provide the avionics.

The Capstone Program Office will continue to work with the Alaska aviation industry to build on the lessons learned in the Bethel/Yukon-Kuskokwim delta area and to explore expansion of the use of these technologies to improve aviation in other areas of Alaska. The Alaska aviation industry will continue to help identify the operational enhancements that will improve aviation safety in Alaska. Many areas of Alaska have terrain limitations and will require further work to develop the technology that will enable operational enhancements for those locations.

5.1 Near Term

The Capstone Program Office has documented the equipment requirements for FY99-FY01. Specific equipment and costs that were budgeted are included in Attachment 1.

5.1.1 FY 1999

During FY 1999, FAA purchased Capstone avionics suites for installation in small commercial service aircraft operating in the Bethel area. The avionics suites consisted of a GPS navigation unit, a multi-function display with moving map and terrain database, and ADS-B service via a Universal Access Transceiver (UAT) data link radio.

Demonstration and certification activities were conducted throughout FY1999, including an end-to-end demonstration in Bethel during August 1999. Planning and development continued for a network of GBT ground stations to receive and forward aircraft ADS-B position reports to the Anchorage ARTCC for processing and display by the Micro-EARTS. Preparation of GPS non-precision approach procedures for ten village airports and installation of AWOS IIIs to support these first-time instrument approach procedures began. The University of Alaska was contracted to develop an independent safety analysis and a pilot training program for use of the Capstone avionics. Within the Alaskan Region, the Capstone Program continued modeling a transition to the future National Airspace System architecture and serving as the focal point for unified planning, coordination, and development.

5.1.2 FY 2000

For FY2000, the Capstone Program will continue its partnerships with the air carrier and avionics industries, the Safe Flight 21 Program, and national FIS office. With certification of the avionics for supplemental VFR use complete, delivery and installation of the avionics began in February 2000. FIS and TIS-B upgrades are expected to be available summer 2000. In addition, work on certifying the avionics for ATC radar-like services has begun. A major milestone for this year's work will be the certification and installation of the Capstone ground system and avionics architecture which provides radar like services. Coinciding with the ground system installation, operator's dispatch offices will be provided with ADS-B position reports for flight following of their aircraft. Additional village airports will be GPS-surveyed and furnished with first-time non-precision GPS approach procedures. Capstone will continue to incorporate certain "technology-driven" improvements recommended in the March 1995 NTSB Alaska Safety Study; for example, more AWOS will be installed and near real-time weather products will be disseminated via the Capstone FIS system to the pilot.

5.1.3 FY 2001

While the initial Capstone system improves the pilot's situational awareness in VFR, work will be completed in FY 2001 in meeting an operational date of January 2001, for use of the Capstone ADS-B system for radar-like services in airspace in and around Bethel, Alaska. With the proper approvals in place, this will be the first time ADS-B will be used by ATC for separation, sequencing, and other radar-like services. In addition, Capstone capabilities will begin expansion to other parts of Alaska. For example, TIS-B will be demonstrated in Anchorage, ADS-B surveillance coverage will be expanded, and

new FIS capabilities will be added. At selected village airports, surface vehicles will be equipped with ADS-B transmitters to reduce the possibility of runway incursion accidents. Based on initial pilot and controller Capstone feedback, new Special VFR procedures, strongly desired by participating air carriers in Bethel, can be implemented. The Capstone Program will also work toward demonstration of additional, high priority, operational enhancements recommended by the RTCA and the Safe Flight 21 Program Office. Capstone will foster an increase in IFR operations, as suggested by NTSB, by development of low-level GPS routes. New separation and sequencing procedures requested by the industry, and enabled by ADS-B technology, will be explored. Capstone will continue to model NAS transition toward full utilization of GPS-driven systems and procedures.

5.2 Getting to the Vision - Implementation 2002-2005

While the Capstone Program Office demonstrates and documents the operational benefits that are to be gained through 2001, planning for statewide implementation is also occurring for 2002 – 2005 and are included in Attachment 2. Beyond the 2001 timeframe, the Capstone Program becomes a statewide implementation of CNS technology. ADS-B ground stations, LAAS equipment, servers, networks and weather enhancement equipment will be procured using specifications developed during the initial Capstone implementation in the Bethel/Yukon-Kuskokwim delta area and other FAA programs.

6 CAPSTONE PROGRAM MANAGEMENT

6.1 Capstone Organization

The following describes the structure and responsibilities of the Capstone management process. This management structure provides a platform for program oversight and coordination, a means for participation in Capstone evaluation and subsequent implementation activities by appropriate FAA offices, and coordination with the Alaska aviation industry.

6.1.1 Capstone Management Review Board

The Capstone Management Review Board provides broad FAA policy guidance, advice, and counsel to the Capstone Program Office. The following FAA executives or their designees provide connectivity between primary lines of business impacted by the Capstone validation:

- Associate Administrator for Research and Acquisitions, ARA-1
- Assistant Administrator for Region and Center Operations, ARC-1
- FAA Director for Communications, Navigation, and Surveillance, AND-1
- Product Lead for Advanced Technologies, AND-500
- Administrator, Alaskan Region, AAL-1 (Chair)

- Manager, Flight Standards Division, AAL-200
- Manager, Airway Facilities Division, AAL-400
- Manager, Air Traffic Division, AAL-500
- Manager, Airports Division, AAL-600
- Manager, NAS Implementation Center, ANI-700
- Manager, Aircraft Certification Office, ACE-115N

The Management Review Board convenes approximately once per quarter, or as requested by any executive member, to review the Capstone Program progress. The Product Lead for Advanced Technologies, AND-500, is responsible for day-to-day coordination with the Capstone office on matters concerning Capstone funding and planning.

6.1.2 Capstone Program Office (CPO)

The CPO operates under the direct authority of the Alaskan Regional Administrator, AAL-1, for all coordination efforts during the project. The CPO is led by the Capstone Program Manager and staffed on a full-time basis by a small number of FAA and contract support personnel. Members of the CPO work within their straight-line divisions as program requirements dictate, to support and assist the CPO as described below. Division representatives attend scheduled meetings and perform services as the need arises.

The CPO representatives assist the Capstone Program Manager with planning, scheduling, budgeting, implementing, and evaluating the Capstone Program. FAA representatives ensure appropriate program coordination is effected within their own straight-line organization at the regional and national levels.

The Capstone Program Office is responsible for the following:

- Developing the Capstone Program architecture and defining system interfaces.
- Advocating and supporting technology demonstrations under the Safe Flight 21 “Free Flight Operational Enhancements” program umbrella.
- Maintaining a procurement process featuring the selection and assignment of a responsible lead office for each major acquisition and a method for documenting agency consensus for procurement decisions.
- Promoting, on a regional and national basis and with industry, participation in Capstone Program planning and activities.

- Developing program plans, specifications, cost estimates, selection criteria, and other procurement documentation for acquisition of Capstone systems and equipment.
- Establishing an integrated Capstone program schedule. The schedule will include program goals, acquisition schedules, equipment delivery, and site implementation milestones; and will illustrate program dependencies.
- Implementing a progress reporting system to facilitate the flow of information and assist with communication and coordination mechanisms.
- Coordinating all programs and activities directly contributing to the accomplishment of the Capstone Program.
- Preparing future budget requirements for equipment services, personnel, and other resources with the Safe Flight 21 office.
- Coordinating the development of test and evaluation plans including schedules, responsibilities, and field support requirements for operational capability demonstrations, contractor acceptance testing, certification, and flight check as necessary.
- Developing and maintaining database tools to support the various aspects of the Capstone Program implementation. Where applicable, these database tools will be linked to the master program schedules.
- Preparing “after action” reports detailing program accomplishments, lessons learned, and recommendations to achieve future Free Flight Operational Enhancements on a national basis.
- Supporting Safe Flight 21 activities to develop and implement plans and schedules for Capstone activities in the Alaskan Region which support evaluation of Free Flight Operational Enhancements and ADS-B data link.

6.1.3 Capstone Program Office Staffing

The Capstone Program Office is staffed and supported through temporary assignments by the Alaskan Region straight-line organizations and the Regional Administrators staff. A major requirement of the Capstone Program is to develop, test, and certify aircraft, air traffic control, and flight standards procedures. The assigned representatives from the organizations listed in Table 6-1 are responsible for completion of the related tasks. Each line of the business provides inputs to detailed work plans to ensure project timelines are identified and maintained, air traffic and pilot procedures are identified as necessary, and progress is documented.

Office staffing consists of, but is not limited to, the following representatives:

- Office Manager,

- Business Manager,
- Administrative Officer,
- Fight Standards,
- Air Traffic Control,
- Airways Facilities,
- National Airspace System Implementation,
- Aircraft Certification,
- Logistics,
- Legal Counsel,
- Contractor assistance,
- Liaison to the Safe Flight 21 Program Office in Washington DC, and
- AVN procedures.

Capstone Elements	Office of Primary Interest (OPI)
Ground Systems	
Micro-EARTS adaptation	AF/AT
Gateway for Micro-EARTS (Automation, Software)	AF/AT
Capstone Server	AF
FIS	AT
AT LAN network	AF/AT
Telecommunications links	AF
GBT	AF/AT
AWOS III	ANI
Spectrum	AF/ACO
Flight check	FS/AVN
Avionics	
GPS Navigator	ACO/FS

Multi-Function Display	ACO/FS
UAT Transceiver	ACO/FS
Procedures/Operations	
Procedures (ATC, pilot, maintenance)	AT/FS/AF/ANI
Training program (ATC, pilot, maintenance)	AT/FS/AF/ANI
Operational Approval	AT/FS
GPS non-precision procedures	AVN
Contract oversight at UAA	FS

Table 6-1 Capstone Elements and OPIs

6.1.4 Alaska Aviation Industry Capstone Coordination

Organizations actively involved with the Capstone Program include the Aircraft Owners and Pilots Association (AOPA), Alaska Airmen’s Association (AAA), Alaskan Aviation Safety Foundation (AASF), Alaska Air Carriers Association (AACCA), Cargo Airline Association (CAA), and Northern Alaska Aviation Users Group (NAAUG). They represent the varied interests of aviators in the state. These organizations bring users’ concerns and issues to the table and help insure a continued dialogue with aviators.

Attachment 1 Capstone Requirements and Costs (FY'99 - '01)

Category	FY99	Comments	FY00	Comments	FY01	Comments
Avionics	\$4M	Up to 150 aircraft	\$904K			
MEARTS	\$2.8M				\$130K	Extended network
Ground Stations	\$1.2M	12 locations	\$1.300M	1 additional for ANC - Maintenance for initial 12	\$2M	6 additional
FIS	\$250K	Subscription		Subscription	\$100K	Subscription
UAA	\$500K					
AWOS III	\$1M	10 locations	\$1,080K	3 additional AWOS III	\$800K	5 additional AWOS
Spectrum Change			\$500K	Transfer from 966 to 981MHz		
TIS-B			\$100K	Develop TIS capability		
LAAS					\$1M	
Ground Vehicles			\$150K	Equip 26 vehicles at 13 village airports	\$200K	Equip 200 vehicles at ANC
Certification/ Procedures			\$300K	Support IFR operations		
GPS Surveys			\$225K		\$150K	ANC surface
SATCOM					\$800K	ADS-B thru satellite for Mt. pass coverage
AT Network for FSS					\$250K	
Tech Support	\$850K		\$1.441M	CPO and MITRE	\$1.1M	Capstone Program Office and MITRE
Totals	\$10.6M		\$6.0M		\$9.2	

Attachment 2, Cost and Schedule for Statewide Implementation F&E (FY'02 - '05)

Requirements	Number	FY 02	Number	FY 03	Number	FY 04	Number	FY 05	Totals	Remarks
AWOS III	8	\$4.769	8	\$4.869	8	\$4.940	7	\$4.519	\$19.456	39 of the additional 49 airports
ADS-B	50	\$8.526	50	\$10.178	50	\$10.998	38	\$9.713	\$28.20	Ground Stations, Mx,spares, telecom,etc
LAAS	3	\$2.355	3	\$2.448	3	\$2.441	3	\$2.492	\$9.787	Major state airports with ILS
Fusion Server (Airports)	3	\$0.9	3	\$0.919	3	\$0.880	2	\$0.648	\$3.348	1 Fusion server per LAAS for surface, radar, ADS processing
CPO (Office)		\$0.781		\$0.797		\$0.814		\$0.831	\$3.223	Office operation, lease, copier, supplies, equipment, etc.
Vehicles	470	\$1.245	270	\$0.760	150	\$0.463	114	\$0.377	\$2.846	ADS for vehicles on airport surface
Software Updates		\$0.521		\$0.532		\$0.543		\$0.555	\$2.151	Automation Requirements
Totals		\$19.097		\$20.504		\$21.080		\$19.136	\$82.022	

Appendix A
ACRONYMS

AAA	Alaska Airmen’s Association
AACA	Alaska Air Carriers Association
AAL	FAA Alaskan Region
AASF	Alaskan Aviation Safety Foundation
ACE	Small Airplane Directorate
ADS-A	Automatic Dependent Surveillance-Addressed
ADS-B	Automatic Dependent Surveillance-Broadcast
AIR	Aircraft Certification Service
AND	Communications, Navigation, and Surveillance Systems Research and Acquisitions
ANI	FAA Engineering Center
ANICS	Alaskan NAS Interfacility Communications System
AOPA	Aircraft Owners and Pilots Association
AOS	Operational Support Enroute Systems Engineering, Communications System Engineering, and Field Support
ARA	Associate Administrator for Research and Acquisitions
ARC	Associate Administrator for Region and Center Operations
ARTCC	Air Route Traffic Control Center
ASD	System Architecture and Investment Analysis
ATP	Air Traffic Procedures
AVN	Aviation Systems Standards
AWOS	Automated Weather Observing System
CAA	Cargo Airline Association
CCCS	Capstone Communications Control Server
CFIT	Controlled Flight into Terrain
CNS	Communications, Navigation and Surveillance
CPO	Capstone Program Office
DT&E	Developmental Test and Evaluation
FIS	Flight Information Services
GBT	Ground broadcast transceivers

GPS	Global Positioning System
IFR	Instrument Flight Rules
LAAS	Local Area Augmentation System
MASPS	Minimum Aviation System Performance Standards
METAR/TAF	International Meteorological Aviation Report Format/International Terminal Area Forecast Format
MFD	Multiple Function Display
Micro-EARTS	Micro En Route Automated Radar Tracking System
MOCA	Minimum Obstacle Clearance Altitudes
MSAW	Minimum Altitude Safe Warning
NAAUG	Northern Alaska Aviation Users Group
NAS	National Airspace System
NAVAID	Navigational Aid
NEXRAD	Next Generation Weather Radar
NISC	NAS Implementation Support Contract
NOTAM	Notice to Airmen
NTSB	National Transportation Safety Board
PIREP	Pilot Report
POI	Principal Operations Inspector
SIGMET/AIRMET	Significant Meteorological Information/Airman's Meteorological Information
STC	Supplemental Type Certificate
SUA	Special Use Airspace
TIS	Traffic Information Service
TIS-B	Traffic Information Services-Broadcast
SETA	System Engineering and Technical Assistance
UAA	University of Alaska, Anchorage
UAT	Universal Access Transceiver
VFR	Visual Flight Rules
WJHTC	William J. Hughes Technical Center
ZAN	Anchorage Center

Appendix B
**CAPSTONE TEST AND MASTER PLAN FOR ADS-B RADAR-LIKE
SERVICES**

Available on the Capstone web site: www.alaska.faa.gov/capstone