



The Safe Flight 21 Program: An Overview

MITRE

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Outline

- Background
- Ohio Valley / Cargo Airline Association
- Alaska / Capstone Project
- Lessons Learned

Safe Flight 21

- **Cooperative Government/Industry research program**
 - **Consists of two efforts**
 - **Cargo Airline Association/Ohio Valley**
 - **Capstone/Alaska**
 - **3-4 year program starting in FY99**
 - **likely to require 1-2 additional years**
 - **Created in the Summer '98 by RTCA**
 - **Replaced the Flight 2000/Halaska project**

Safe Flight 21

(continued)

- **Objective: Near-term deployment of new CNS technologies/procedures that will bring operational benefits to government, industry, and users**
 - **Enable and expedite decisions by stakeholders on implementing the “nine operational enhancements”**
 - **Reduce the risk of implementing the operational enhancements**
 - **use innovative processes to expedite certification and operational approval**
 - **employ operational demonstrations/evaluations**

Safe Flight 21

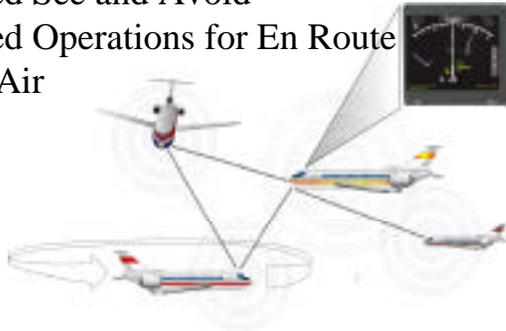
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- **Oversight by RTCA**
 - **Safe Flight 21 Steering Committee**
 - **Airlines**
 - **Unions**
 - **Aviation User Groups (e.g., AOPA)**
 - **FAA**
 - **MITRE**
- **Spiral development program**
 - **Examine requirements and risks, build a little, test a little, deploy a little, repeat**
 - **Reduces risk**
 - **Keeps stakeholders closely involved in the process**

Safe Flight 21 Nine Operational Enhancements

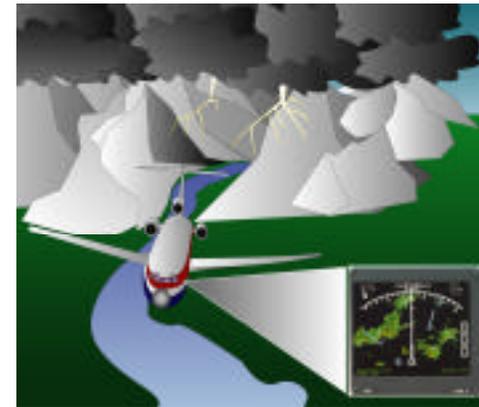
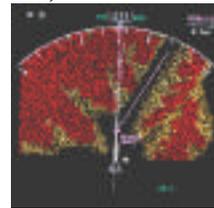
Air-to-Air

- Improved Separation Standards
- Improved Low-Visibility Approaches
- Enhanced See and Avoid
- Enhanced Operations for En Route Air-to-Air



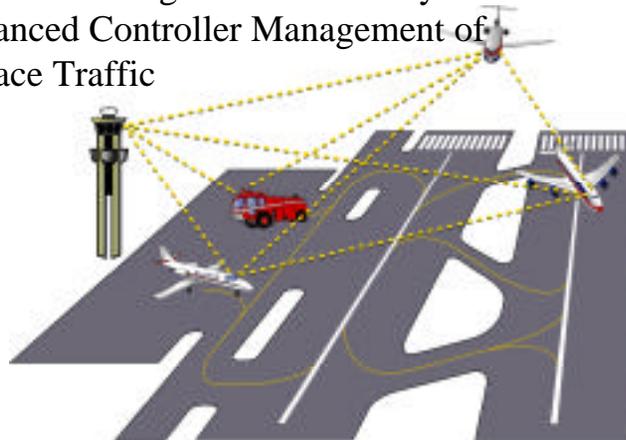
Air-to-Ground

- Surveillance Coverage in Non-Radar Airspace
- Affordable Reduction of Controlled Flight into Terrain (CFIT)



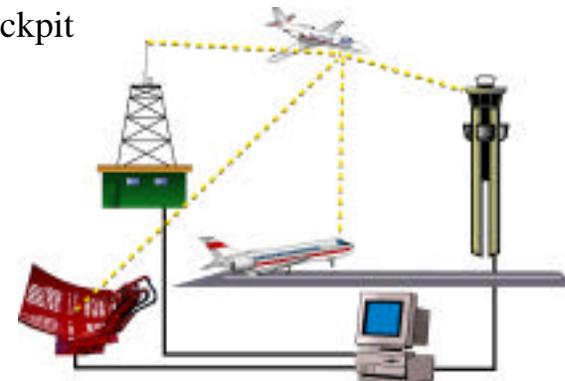
Ground-to-Ground

- Improved Navigation on Taxiways
- Enhanced Controller Management of Surface Traffic



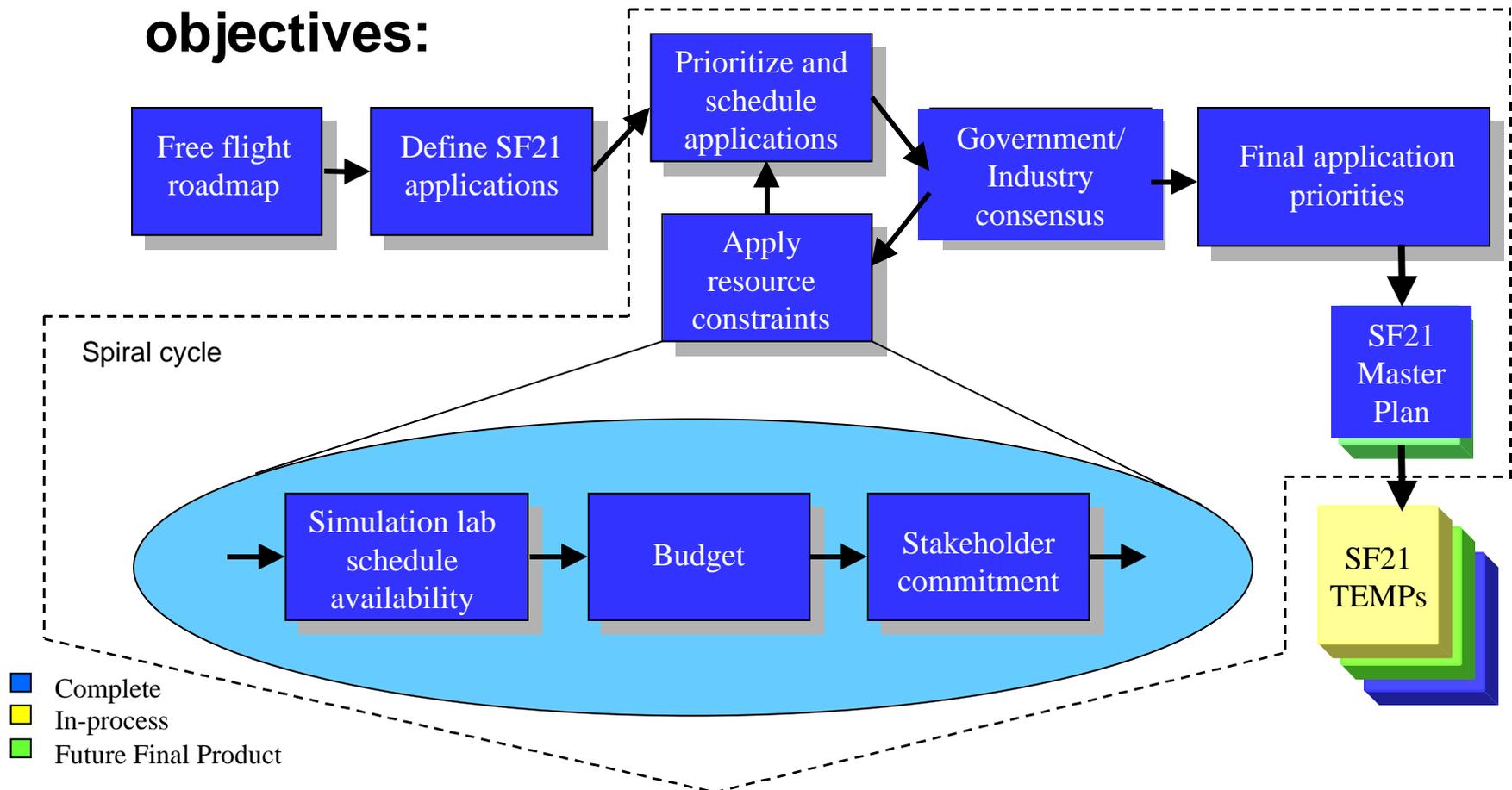
Ground-to-Air

- Weather and Other Data to the Cockpit



SF21 Planning

- Plan for 2000-2002 based on achievable objectives:



SF21 Planning

Current Priorities / Schedule

Operational Enhancement	FY 99	FY 00	FY 01	FY 02	FY 03+
1. Weather and other information to the cockpit		1	1		
2. Cost effective CFIT Avoidance		1	1		
3. Improved terminal operations in low visibility	1		4	1	1
4. Enhanced see and avoid	1	1	1		1
5. Enhanced en route air-to-air operations		1			1
6. Improved surface navigation for the pilot			1	2	1
7. Enhanced surface surveillance for the controller			1	1	
8. ADS-B surveillance in non-radar airspace		2	1		
9. ADS-B separation standards		1	1		3

Note: Numbers shown represent number of applications to be evaluated for enhancements in a given fiscal year

SF21 Locations & Objectives

- **Ohio Valley - Cargo Airline Association (CAA)**
 - Airborne Express, UPS, & FedEx
 - Phase 1: *Enhanced See-and-Avoid*
 - Phase 2: *Conflict Detection; Improved Surface Navigation*
 - Phase 3: *Conflict Resolution; Improved low vis approaches*
- **Alaska Capstone / FAA Alaska Region**
 - General Aviation / Air Taxi using low-end GA
 - Reduce accident rates
 - Poor weather
 - Lack of radar coverage
 - Controlled Flight Into Terrain (CFIT)
 - Surveillance coverage in non-radar space
 - Integrated cockpit services
- **Leveraging similar avionics and architecture**
 - Avionics produced by UPS Aviation Technologies
 - Architecture based on MITRE Ground Broadcast Server (GBS)

Ohio Valley Operational Evaluation: 10 July 1999 Statistics



- **24 Aircraft** Equipped at Wilmington, Ohio
 - 12 cargo airline aircraft
 - 5 government aircraft (FAA, NASA, US Navy)
 - 7 General Aviation and industry
- Approximately **175 total flight hours**
 - 217 approaches + other applications
 - weather improved from Instrument to Visual conditions
 - extra data on CDTI in IFR
- Significant press coverage
 - NY Times, AP, Reuters, CNN, Aviation Week, Flight International, Business & Commercial Aviation



Ohio Valley FY99 Operational Evaluation: Results Summary

- **Government/Industry worked well together to accomplish common goals**
- **ADS-B technology is viable for the initial applications and can likely offer benefits**
 - **Technology not yet fully mature**
- **Flight crews and controllers both reported that this technology had positive impact, but human factors and other issues need to be resolved**
- **Operational approval underway for “enhanced see and avoid”**

Ohio Valley--Current Status

- **Analysis of FY99 operational evaluation (and related activities) nearly complete**
 - OpEval '99 Report (complete)
 - Link evaluation/RF performance (Phase 1 complete)
 - Human Factors (complete)
 - Cost/benefit (near completion)
- **Planning and development underway for future operational evaluations**
 - Louisville (UPS hub): late '00
 - Memphis (FedEx hub): Spring '01

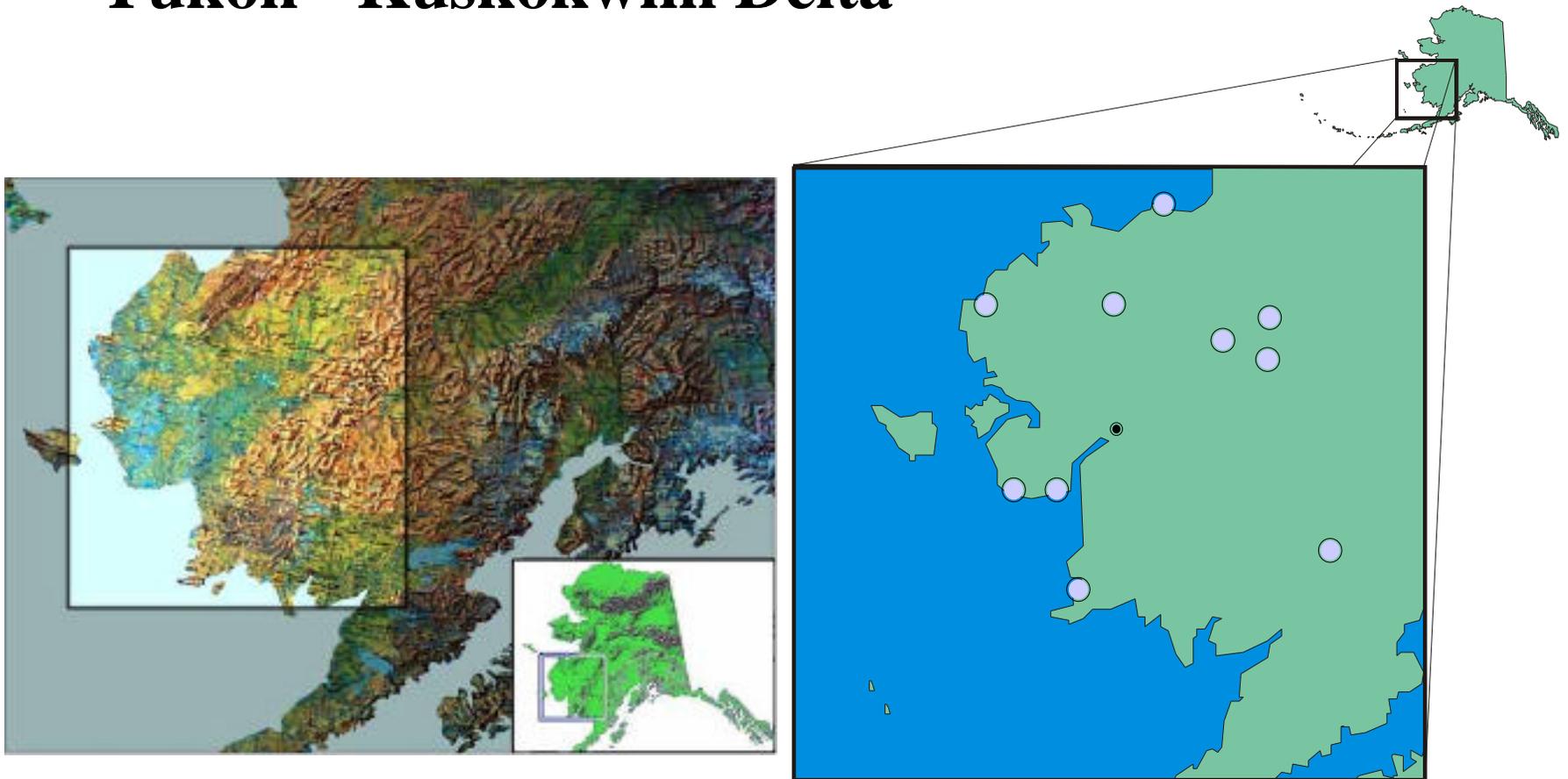
Ohio Valley--Current Status: Louisville OpEval Objectives

- **Develop and evaluate avionics and procedural modifications needed to support operational approval for the following SF21 Master Plan applications:**
 - **Approach Spacing (3.2.1 - Primary, 3.2.2 - Secondary)**
 - **Departure Spacing/Clearance (3.4)**
 - **Runway and Final Approach Occupancy Awareness (6.1.1)**
 - **Airport Surface Situational Awareness (6.2)**
- **Evaluate air traffic controller use of ADS-B in terminal area environment, concentrating on the above four applications.**
- **Limited demonstration to key industry participants**

Alaska Capstone: Objectives

- **Primary Objective: Improve Aviation Safety**
 - Reduce the fatal accident rate due to en route and approach navigational errors in reduced visibility by 25% in the equipped aircraft
 - 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 by improving search and rescue
- **Secondary Objective: Improve Capacity & Efficiency**
 - Reduce cancellation rate by 10% through improved weather sensors and distribution
 - Reduce flight delays by 5% with navigation and weather reporting improvements
 - Reduce fuel waste caused by weather

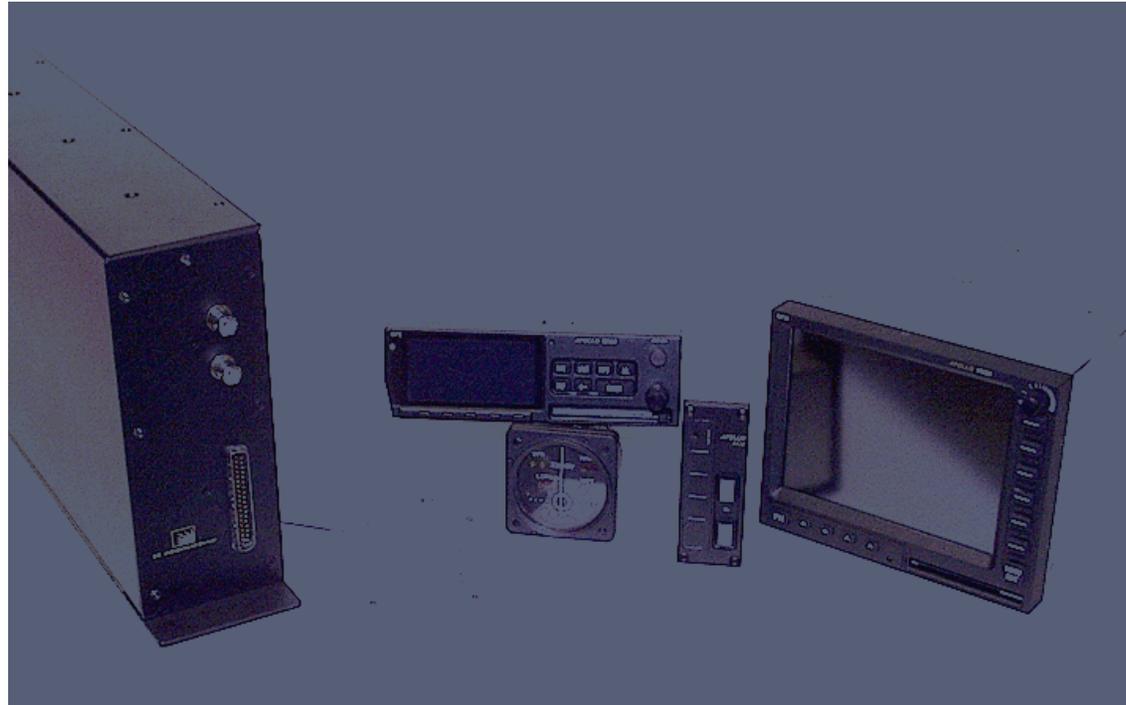
Initial Capstone Area of Interest: Yukon - Kuskokwim Delta



Capstone FY00 Program Specifics

- **Yukon - Kuskokwim Delta Region**
 - Initial area of interest--plan to cover the entire state later
 - Region is nearly 100% dependent upon aviation
 - Bethel is the “hub”
 - Plan 12 ground stations for this region
- **Up to 150 aircraft equipped (near 100% equipage)**
 - Light piston single/twin aircraft in Part 135 (Air Taxi) operations
 - Avionics equipage:
 - IFR-certified GPS receiver
 - Integrated ADS-B / TIS-B / FIS-B transceiver (UAT)
 - Terrain database/CFIT avoidance
 - Multi-function color graphics display for presentation of above information
 - \$15-20k (current pricing)
 - **All costs incurred by FAA Alaska**

Capstone Avionics



 **UPS Aviation Technologies** SM
A subsidiary of United Parcel Service

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CAASD

Capstone FY00 Program Specifics

(concluded)

- **Connection to Anchorage En Route Center MicroEARTS & other remote displays, including airport towers and operator dispatch offices**

Capstone Services

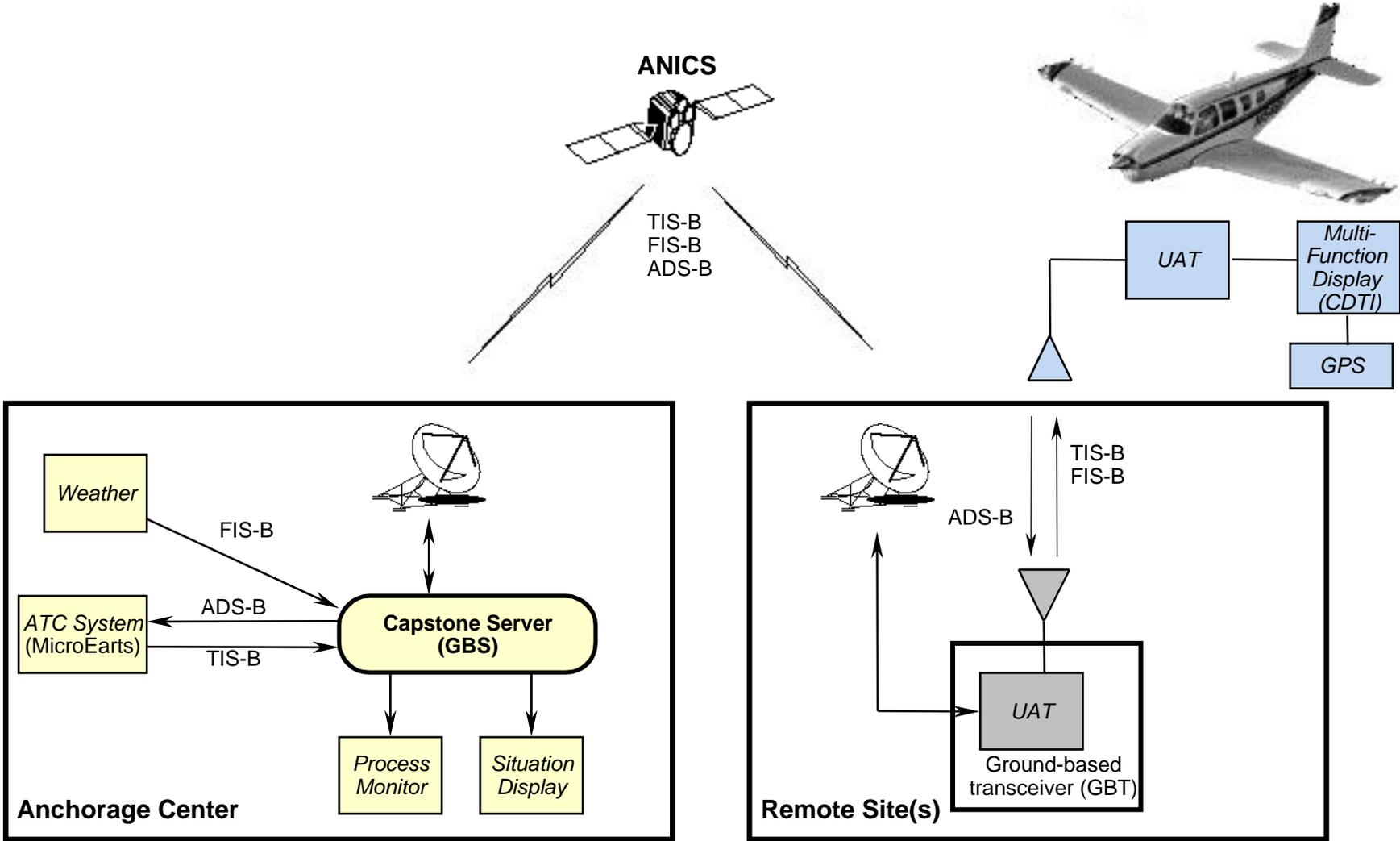
- **ADS-B air-to-air:** use as aircraft equip
- **ADS-B air-to-ground**
 - Initial implementation into Anchorage Center MicroEARTS in “shadow mode”
 - Eventual migration to operational use (target Jan. ‘01)
 - ADS-B targets handled like radar targets
- **TIS-B ground-to-air**
 - Surveillance source: MicroEARTS or direct from local radars (schedule TBD)
 - “TIS-B” currently being defined
 - TIS-B testbed being developed at WJHTC

Capstone Services

(concluded)

- **FIS-B** (weather, NOTAMs, SUAs etc.)
 - First deployment--late spring/early summer '00
- **New GPS non-precision approaches to small village airports**
- **New FAA-certified Automated Weather Observing System stations with broadcast capability**

Capstone Architecture



Capstone Schedule

- **Near-term schedule**

- Aircraft equipage..... Feb-ongoing
- Initial ground infrastructure (3 sites).....Jan-July '00
- Initial ADS-B air-to-air services.....as equip
- MicroEARTS/ADS-B ingest cert..... April '00
- UPS-AT avionics Phase II cert..... July '00
- MicroEARTS/ADS-B deployment to ZAN..Summer '00
- Initial ADS-B air-to-ground services..... Summer '00
- Initial FIS-B services..... Summer '00
- Initial TIS-B services..... Summer '00
- UPS-AT avionics Phase III cert..... December '00
- **Operational ADS-B air-to-ground..... January '01
services**

Lessons Learned

- **Stakeholder buy-in essential**
 - Long coordination times needed with numerous stakeholders
- **Certification and procedures**
 - Time consuming and expensive--to both government and private industry
 - Requires extensive coordination
- **Long lead time obtaining spectrum**
- **New technology**
 - requires extensive testing
 - make time to fix problems

Lessons Learned

(concluded)

- **Ground system installs**
 - potential long lead times
 - space planning
 - approvals
- **Political/Institutional challenges**
 - new technology threatens legacy systems
 - new technology may change existing procedures
 - choice of technology (competing technologies)
 - international coordination sometimes difficult