Surveillance and Broadcast Services

Benefits Analysis Overview

August 2007 Final Investment Decision Baseline

January 3 , 2012

Federal Aviation Administration

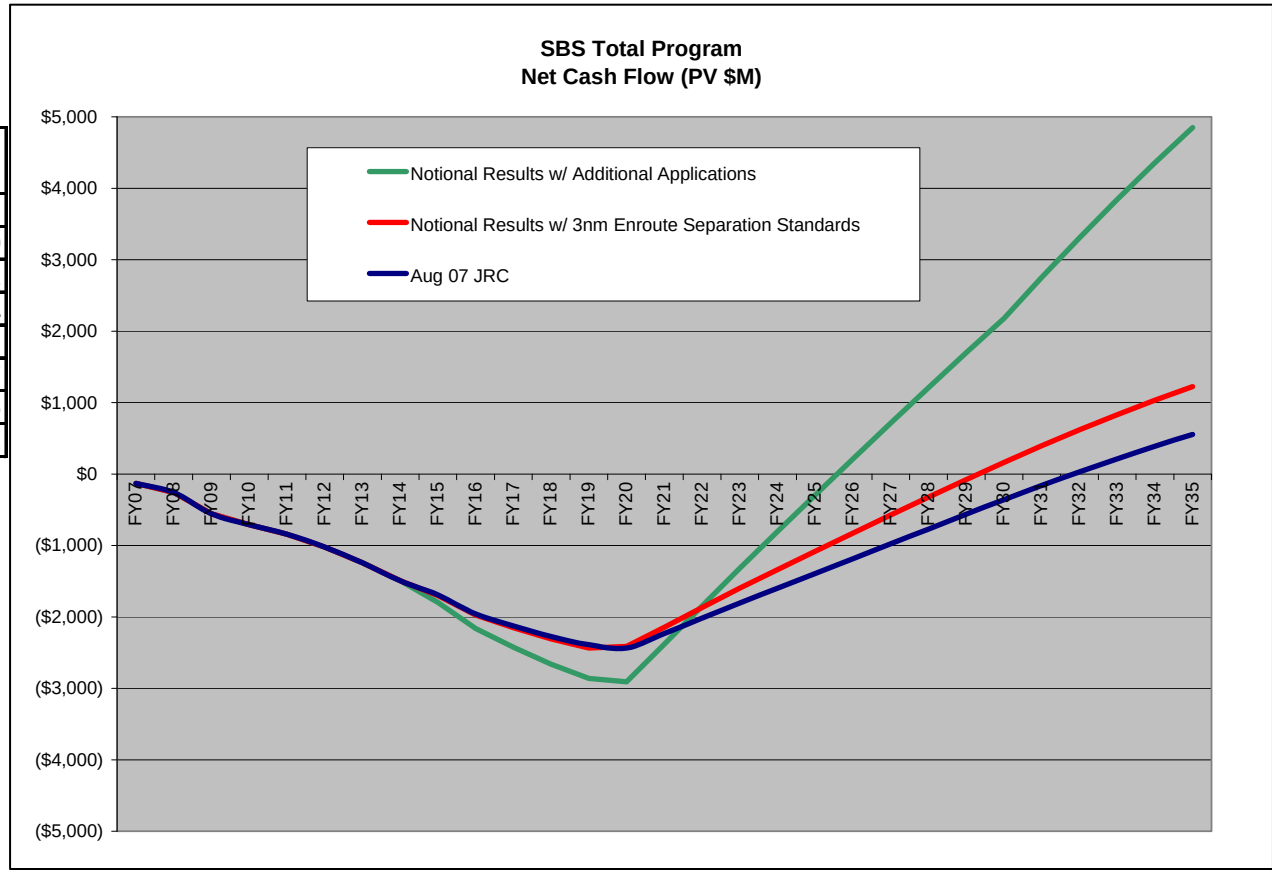
Program Status: Investment Decisions

- **September 9, 2005 initial investment decision:**
  - Establish a ATO-level Surveillance and Broadcast Services office
  - Obtain funding to support the agency-wide resources required to develop, implement, and manage the ADS-B future surveillance services
- **June 7, 2006 final investment decision (Segment 1):**
  - Baseline key site deployment
  - Return for Final Investment Decision for Balance of Program prior to Contract Award
  - ATO Chief Operating Officer (COO) and Associate Administrator for Aviation Safety (AVS) Designation for Co-ISD Authority
- **February 21, 2007 final investment decision (Segment 2):**
  - Baseline NAS-wide deployment
  - Return for Program Baseline of Segments 1 and 2 prior to Contract Award
  - Integration of Capstone Program
- **August 27, 2007 final investment decision (Segments 1 and 2)**
  - Program Baseline prior to Contract Award
- **March 16, 2011 baseline change decision**
  - Integration of Colorado Wide Area Multilateration (WAM) Phase 2
  - Rebaseline of Alaska Service Volumes

Business Case Summary

- **Total Cost / Benefit Summary (Risk Adjusted, Present Value) Through 2035**

	Total
Costs	
FAA	1882.0
Aviation System User	2631.1
Total FAA, User and Other Costs	**4513.1**
Benefits	
FAA	451.7
Aviation System User	4591.5
Total FAA, User and Other Benefits	**5043.2**



- **FAA Baseline Cost Summary**

	Baselined								Total Baselined
Estimated Cost	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	(FY07 - FY14)
Segment 1 and 2 F&E Program Plan	$90.0	$100.0	$308.4	$198.2	$175.2	$284.2	$270.7	$254.7	**$1,681.5**

Air Transport Benefits Summary

Location	Application	Outcome	Risk Adjusted PV $M
CONUS, Hawaii, and Caribbean Surveillance	Radar Airspace ATC Surveillance	Reduction and more efficient maneuvers in response to URET	$801.8
		More efficient metering based on improved TMA accuracy	$417.0
		Increased safety on the surface by controllers	$3.2
		More efficient ATC management of surface movement	$26.9
CONUS, Hawaii, and Caribbean Aircraft Applications	Enhanced Visual Approach - Initial Application	More efficient spacing on approach in VMC	$300.4
	Enhanced Visual Approach - CAVS	Continuation of Visual Approaches in marginal conditions	$196.4
	Enhanced Visual Approach - Merging and Spacing	Increased ability to allow continuous descent approaches	$796.0
	ADS-B ATC Automation Integration		
	Airport Surface Situational Awareness	Increased safety on the surface by pilots	$70.5
	Final Approach and Runway Occupancy Awareness		
Gulf of Mexico Surveillance	Non-radar Airspace ATC Surveillance (includes weather and comm as needed)	High Altitude - Increased Capacity	$459.3
		High Altitude - Optimal Routing	$86.5
Alaska Surveillance and Broadcast Services	Non-radar Airspace ATC Surveillance	Increased IFR capacity (JNU)	$1.1
Total			$3,159.1

ADS-B Out ADS-B In ADS-B In / Out

General Aviation Benefit Summary

Location	Application	Outcome	Risk Adjusted PV $M
CONUS, Hawaii, and Caribbean Broadcast Services	Enhanced Visual Acquisition and Conflict Detection	Fewer aircraft-to-aircraft conflicts	$203.6
	Weather and NAS Status Situational Awareness	Fewer encounters with hazardous weather	$232.5
		More efficient routes in adverse weather	$4.9
		Reduction in user costs to obtain weather info	$26.1
		Fewer aircraft-to-terrain conflicts	$284.3
Gulf of Mexico Surveillance	Non-Radar Airspace ATC Surveillance (includes weather and comm as needed)	Low Altitude - Increased Capacity	$84.2
		Low Altitude - Reduction in Weather Related Accidents	$5.0
Alaska Surveillance and Broadcast Services	Weather and NAS Status Situational Awareness Enhanced Visual Acquisition and Conflict Detection	Fewer aviation accidents in Alaska	$300.1
	Non-Radar Airspace ATC Surveillance	Access to lower altitude routes in Alaska	$19.5
		Fewer aircraft-to-aircraft conflicts (JNU)	$0.0
		Improved search and rescue services in Alaska	$7.0
Alaska Airport IFR Upgrade Services	Weather Automation upgrade and IFR Approach Development	Increased access to remote villages in Alaska	$90.0
		Increased Medevac access to remote villages in Alaska	$175.4
Total			**$1,432.6**

ADS-B Out ADS-B In ADS-B In / Out

FAA Benefits Summary

Location	Application	Outcome	Other
FAA Benefits			
CONUS, Hawaii, and Caribbean Surveillance	Radar Airspace ATC Surveillance	Surveillance cost avoidance	$371.1
		Reduction in FAA subscription charges due to value added services	$80.6
Total			$451.7

ADS-B Out ADS-B In ADS-B In / Out

- **Total Benefits = $5,043.2**

Benefits Analysis Process

- ➢ Identify capability shortfall or technological opportunity
- Specify current and future infrastructure and equipage components
- Describe how each benefit type is produced
- Develop methods to estimate each benefit type
  - Identify data requirements
  - Collect and analyze data
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  - Incorporate risk analysis

Mission Need

FAA Goals

Safety
- Reduce Commercial Airline Fatal Accident Rate
- Reduce Number of Fatal GA Accidents
- Reduce Risk of Runway Incursions

Capacity
- Increase Capacity to Meet Demand
- Increase On-Time Performance of Scheduled Carriers

Enhanced Surveillance
MNS 326 - Dated May 2001

- Gulf of Mexico
  MNS 0094: Feb 1999
- Aeronautical Data Link (ADL)
  MNS 042: May 1998
- Runway Incursion
  MNS 323: May 1998
- Enroute/Oceanic
  MNS 309: Nov 1997
- Airport Surface Traffic Mgt
  MNS 212: Dec 1994
- Traffic Flow Mgt
  MNS 307: Oct 1995

Performance Gaps

Service Area	Shortfall	Impact
Surface	Inability to precisely predict demand and capacity values, accommodate user preferred trajectories, system inflexibility (MNS #307)	Arrival rates; Taxi times; Departure delays; Fleet management; Surface accidents
	Limited pilot, controller, and vehicular shared situational awareness (MNS #323)	
Terminal	Lack of shared situational awareness and limited aircraft information (MNS #326)	Arrival delays
	Inability to provide surveillance coverage at reduced cost (MNS #326)	FAA life cycle costs; Terminal airspace congestion; User and Service Provider workloads
	Decreasing flight efficiency due to domestic routes	
	Unusable airspace caused by increased terminal congestion (MNS #172)	
En Route / Oceanic	Lack of surveillance coverage within specific regions of the NAS, lack of shared situational awareness, and limited aircraft information (MNS #326)	Delays due to constraints; Reduce probability of mid-air collisions; Search & rescue
	Lack of communication coverage, limited ATC options for severe weather avoidance, sustained traffic growth and a unique and compressed demand (NPI #0094)	Inefficiencies due to constraints; Reduce probability of mid-air collisions; Weather-related accidents; User and Service Provider workloads
	Decreasing flight efficiency due to oceanic track restrictions and domestic routes (MNS #172)	
Broadcast Services	Inability to readily access in-flight weather data, congested voice channels (MNS #42)	Weather-related accidents; NOTAM related accidents; Reduce probability of mid-air collisions; Weather deviations
	Limited pilot situational awareness (MNS #326)	

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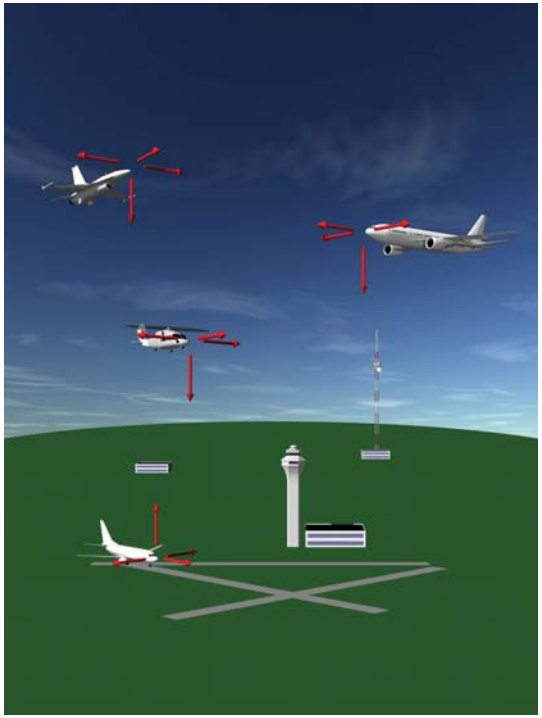
Automatic Dependent Surveillance - Broadcast (ADS-B)

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



- "**ADS-B Out"** refers to an appropriately equipped aircraft's broadcast of various aircraft information
- "**ADS-B In"** refers to the ability of an appropriately equipped aircraft to receive ADS-B Out transmissions from other aircraft and information broadcast from ground stations

Surveillance and Broadcast Services (SBS) Program

The FAA SBS program will provide:

- Air Traffic Control surveillance using ADS-B Out messages
- Traffic Information Service - Broadcast (TIS-B) and
- Flight Information Service - Broadcast (FIS-B)

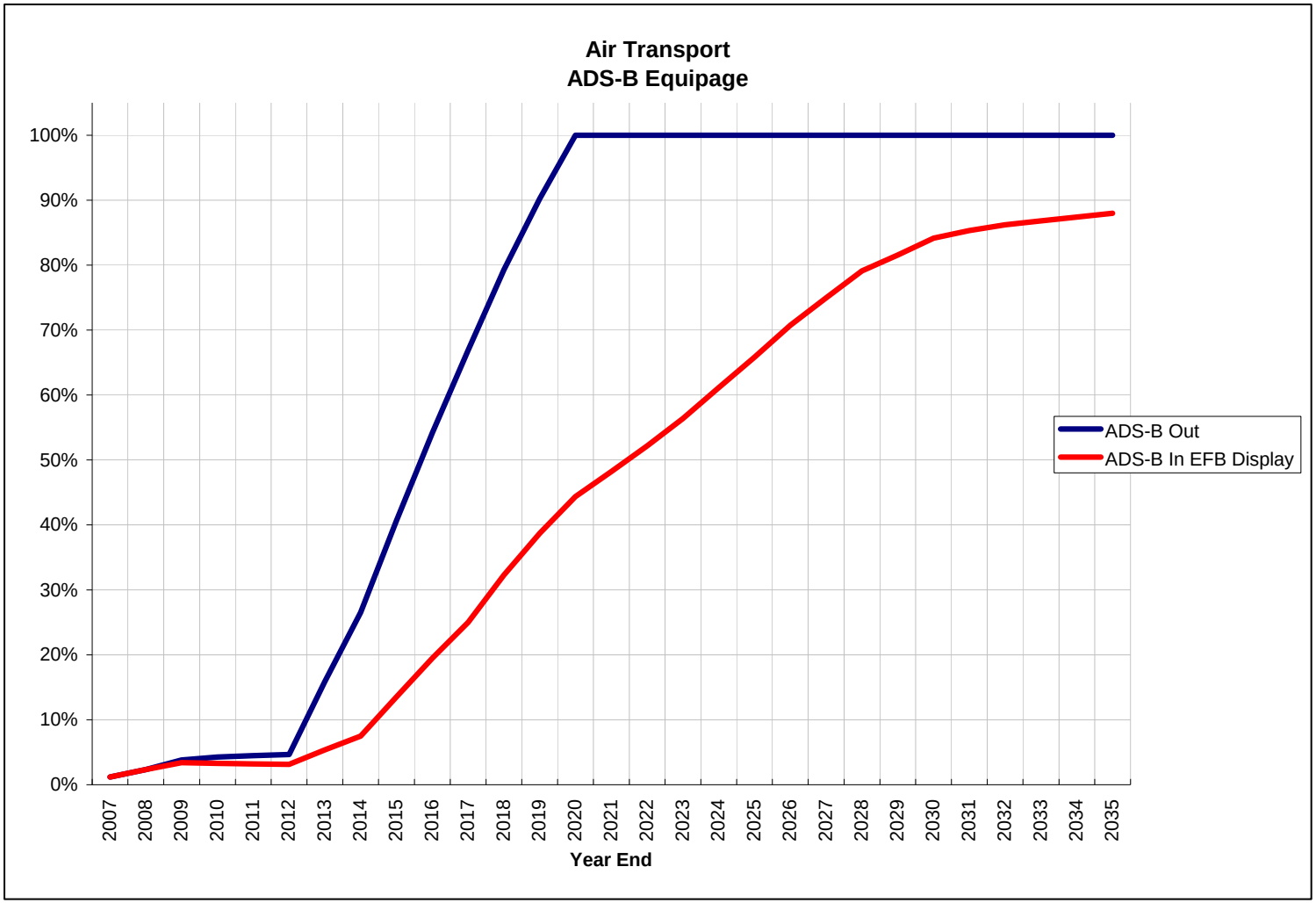
TIS-B is a service which provides ADS-B In equipped aircraft with position reports from secondary surveillance radar on non-ADS-B equipped aircraft.

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

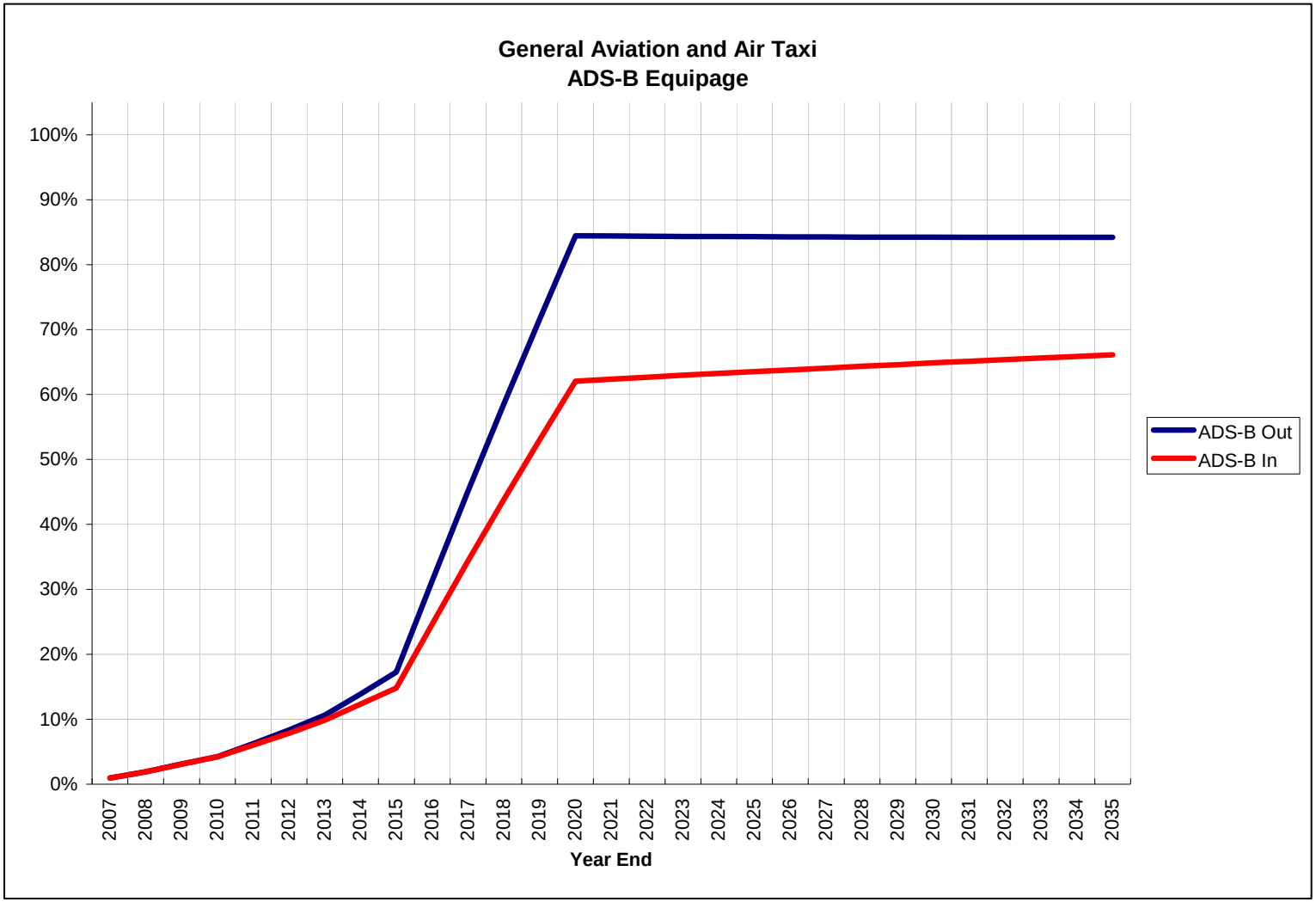
Initial ADS-B Services and Applications

Services:
Surveillance Broadcast Services (En Route, Terminal, Surface)
Traffic / Flight Information Broadcast Services
Applications:
Enhanced Visual Acquisition
Enhanced Visual Approaches
Final Approach and Runway Occupancy Awareness
Airport Surface Situational Awareness
Conflict Detection
Merging and Spacing
Cockpit Display of Traffic Information (CDTI) Assisted Visual Separation (CAVS)

Air Transport Equipage



GA and Air Taxi ADS-B Equipage



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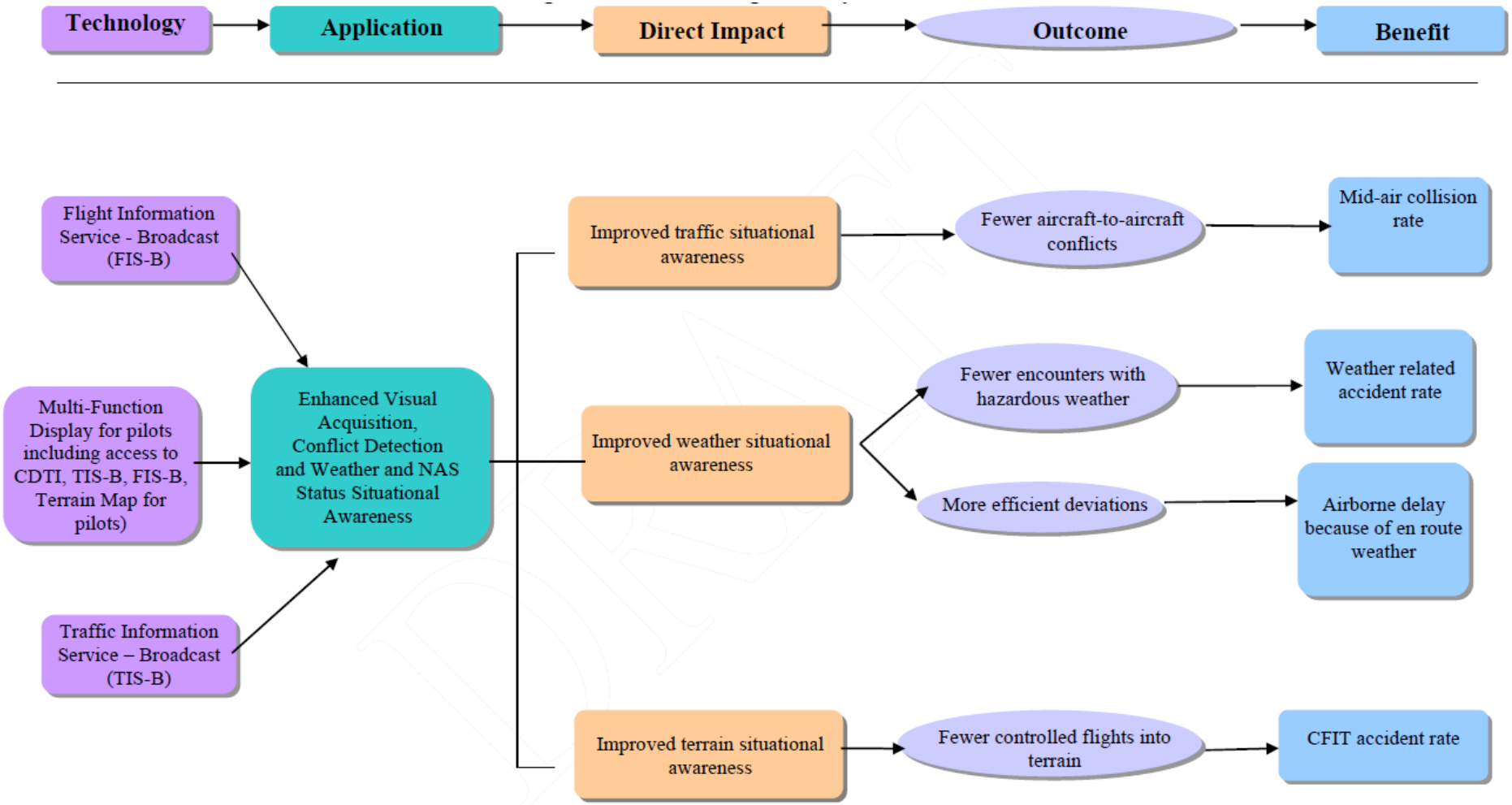
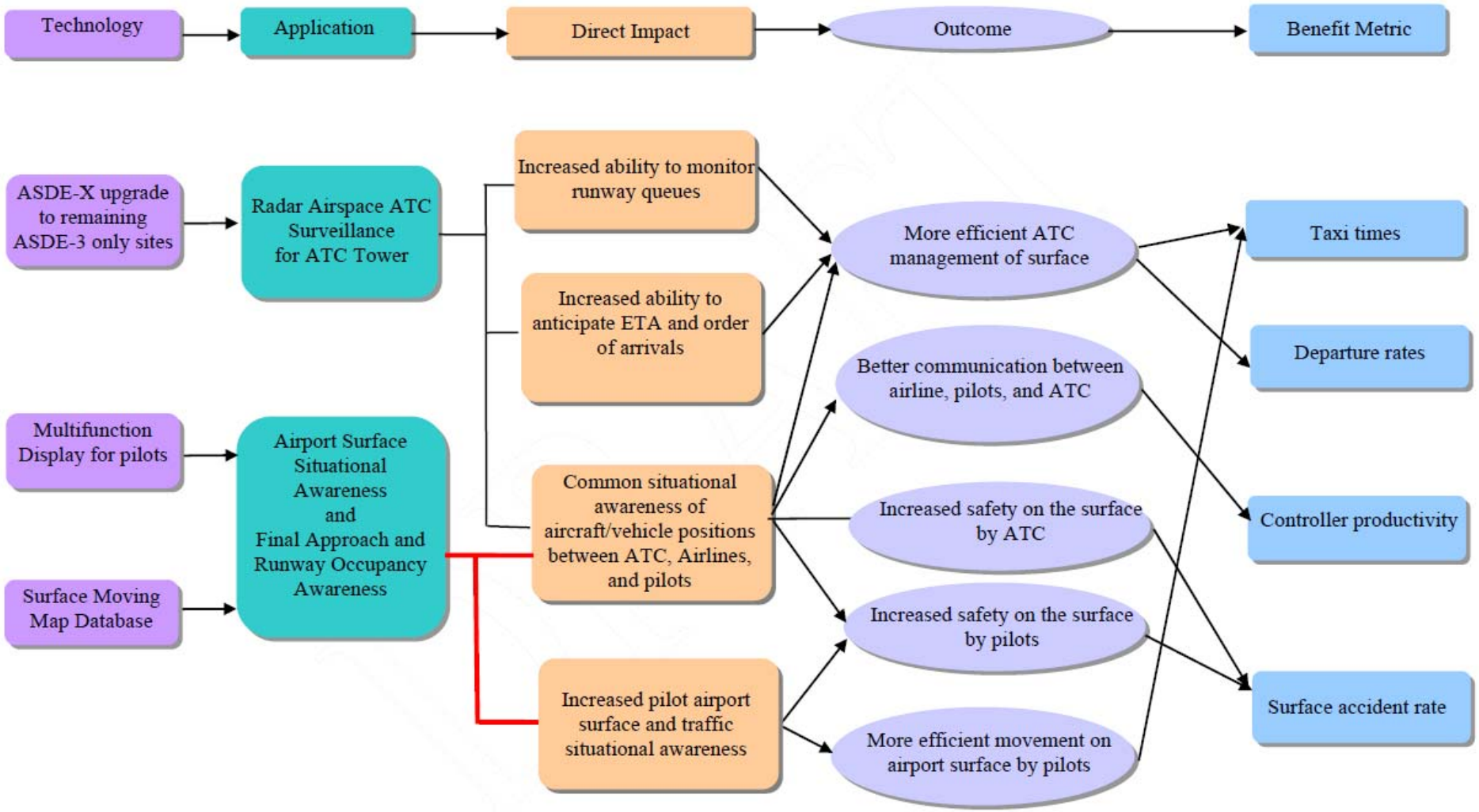
Benefits Identification

- Aviation system user benefits grouped into four categories:
  - Flight Safety
  - Surface
  - Terminal and En Route Radar Airspace
  - Non-Radar Airspace

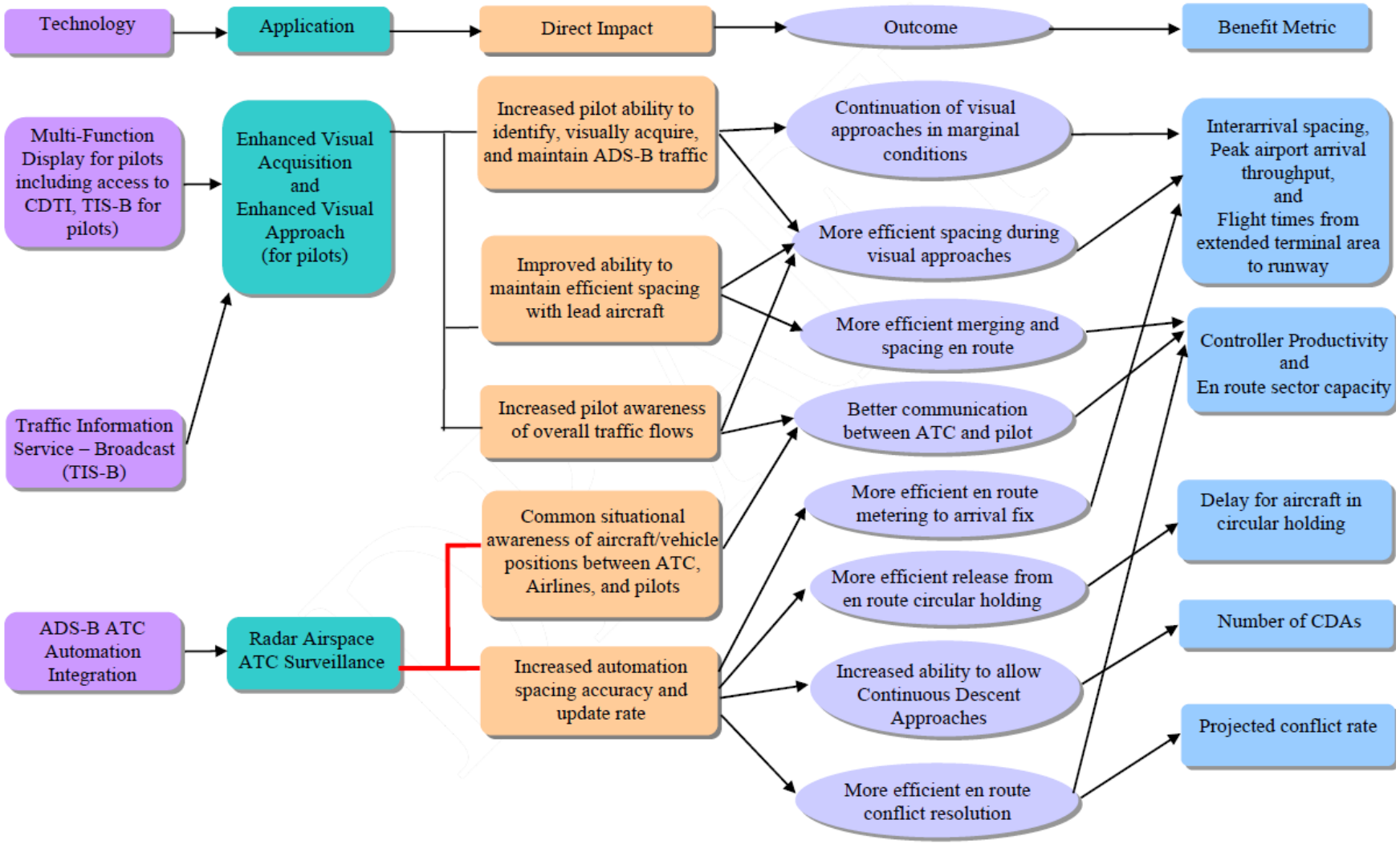
Flight Safety Benefits



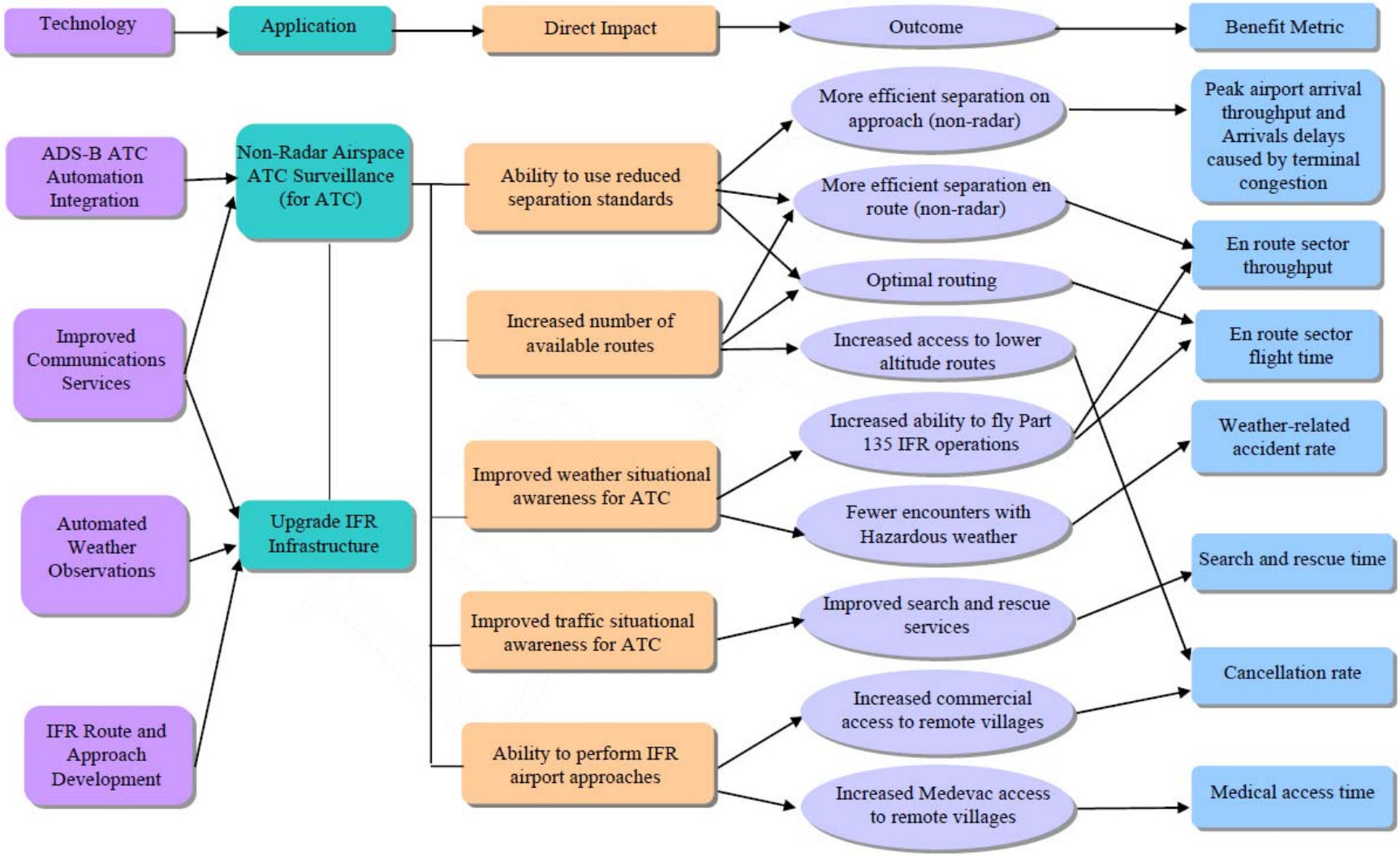
Surface Benefits



Terminal and En Route Radar Airspace Benefits



Non-Radar Airspace Benefits



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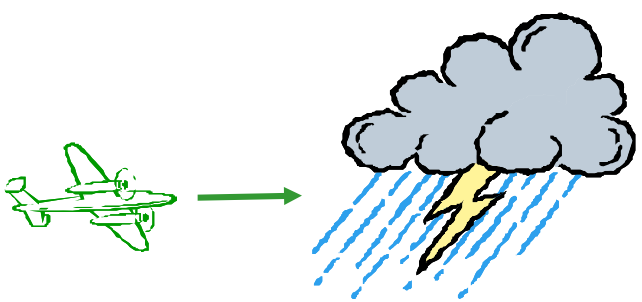
Global Benefits Analysis Inputs

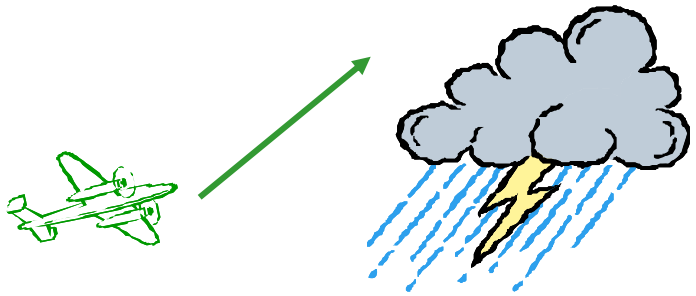
1. **Future Demand** – The FAA Terminal Area Forecast (TAF) projects demand at each NAS airport with the 2207 version covering from 2008-2027. Gulf of Mexico non-radar region demand was based on current ETMS recorded demand levels and FAA Policy and Planning Office estimates of demand growth from US to Latin America.
2. **Airport Capacities** – The arrival and departure capacities used within the SBS model come from the FAA Future Airport Capacity Task 2 (FACT 2) report. The future capacities at some airports change because of scheduled infrastructure improvements (i.e. runways).
3. **Economic Values** – Average Fuel costs, Aircraft Direct Operating costs, Passenger Value of Time, Injury, and Aircraft Damage unit costs provided by “Economic Values for Evaluation of Federal Aviation Administration Investment and Regulatory Programs”.
4. **ADS-B Out and In Projected Equipage** – Equipage based on ATMAC ADS-B Work Group and other industry inputs.

Flight Safety Benefit Example

- **Fewer Encounters with Hazardous Weather**



•Without Weather Information in Cockpit



•With Weather Information in Cockpit

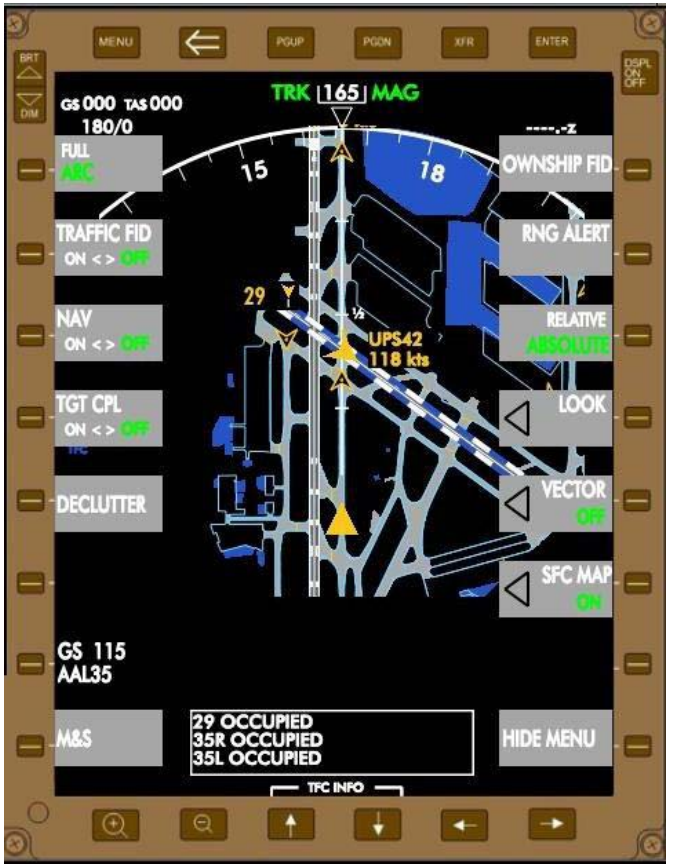
  - With weather information in the cockpit, the GA aircraft will avoid more hazardous weather and prevent accidents due to hazardous weather.
  - ADS-B In with weather information broadcast (e.g., Flight Information Service-Broadcast (FIS-B) in US)

- **Primary Analysis Inputs**
  - Historical accident rates by weather type
  - Effectiveness of capability in avoiding accidents by weather type
  - GA projections for ADS-B In equipage and future operations

Surface Benefit Example

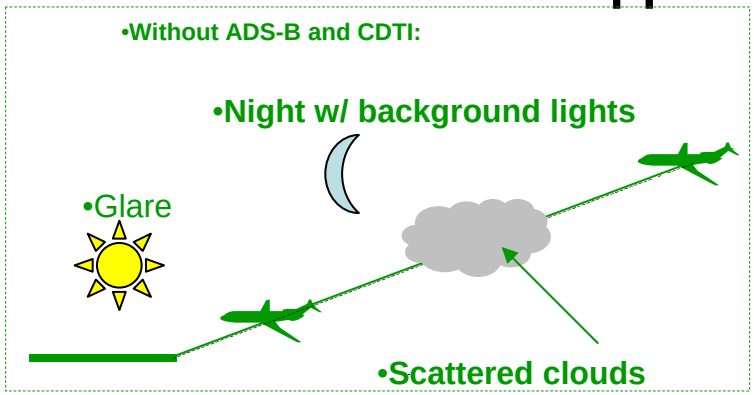
- **Increased safety on the surface by pilots**
  - With surface traffic information in the cockpit, the aircraft will avoid hazardous runway and taxiway situations and prevent surface accidents.
  - ADS-B In, a cockpit surface moving map display, and indication and alerting application software

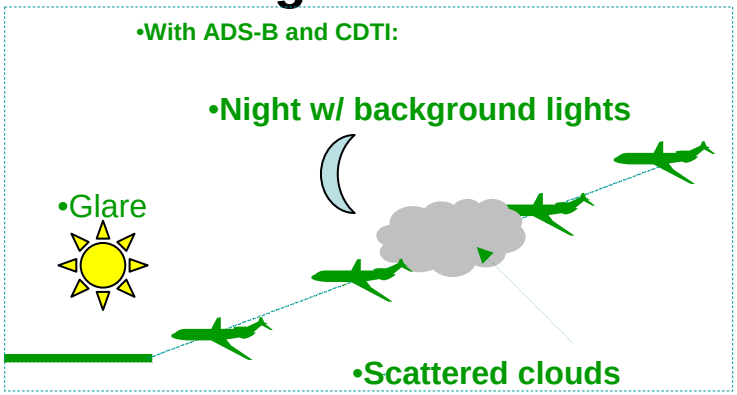
- **Primary Analysis Inputs**
  - Historical surface accident rates
  - Effectiveness of capability in avoiding accidents incremental to other surface safety improvements (e.g. ASDE-X, Runway Status Lights)
  - Projections for ADS-B In equipage and future operations



Terminal and En Route Radar Airspace Benefit Example

- **Continuation of Visual Approaches in Marginal Conditions**



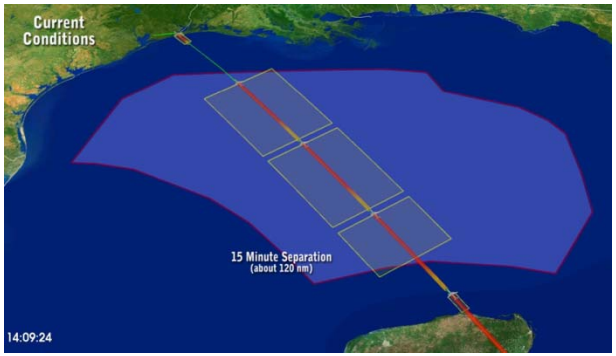


  - In good weather, pilot visually acquires runway and a target aircraft to follow
  - With ADS-B and CDTI, pilots can more reliably acquire relevant traffic in marginal conditions
  - Range of acceptable weather for visual approaches increases
  - Arrival rate increases in marginal weather

- **Primary Analysis Inputs**
  - Effective arrival capacity at major airports during VMC and Marginal VMC
  - Frequency of Marginal VMC at top 100 airports
  - Percentage of ADS-B Out arrivals and percent of ADS-B In Air Transport arrivals

Non-Radar Airspace Benefit Example

- **More Efficient Separation**



  - SBS program will provide ATC with surveillance for non-radar regions in the Gulf of Mexico allowing radar-like separation (~ 5 miles in trail), as opposed to current non-radar procedural separation (~ 50 miles in trail)

- **Primary Analysis Inputs**
  - Increase in capacity because of ADS-B surveillance*
  - Future Gulf of Mexico demand
  - Percentage of ADS-B Out flights

Configuration	Instantaneous Capacity (MAP)	Hourly Capacity
Baseline	30 (18+12)	56
Baseline with Surveillance*	40	75

* The instantaneous capacity with true radar-like separation would be much higher than 40; however, the new capacity assumption takes Mexican border constraints and maintaining the current number of sectors into account.

Summary

- Detailed and thorough benefits analysis used to support a wide array of decision making

Types of Analysis Results	Use of Analysis Results
Overall benefits	• If SBS is viable program for FAA
Benefits by service and by Air Transport and General Aviation users	• Internal implementation decisions • Convincing Air Transport and General Aviation to equip • Equipage strategies for user
Benefits by airport and application	• At which airports to implement infrastructure elements
Benefits by year for applications and benefit types	• Plan implementation schedules for infrastructure elements