EOO Research Rationale

Objectives

- Develop a globally accepted, near-term application of an Airborne Separation Assistance System (ASAS) that delivers airline operational benefits through the introduction of more efficient oceanic operations
- Investigate the impact of increasing levels of delegation of separation authority to the cockpit in a 4D traffic environment

Why a near-term application of ASAS?

- Use of ADS-B technology (a key component of ASAS) has been identified as a key characteristic of the Next Generation Air Transportation System (NGATS)
- Near term application provides operational experience with ASAS and incentive for operators to voluntarily equip with transformational technologies

Why Oceanic?

- Oceanic domain already contains key characteristics of NGATS including
  - Performance based services – Level of Required Navigation, Surveillance, and Communications Performance (RNP, RSP and RCP) impact separation services
  - Aircraft Trajectory-Based Operations – Oceanic operations involve 4D Trajectory prediction methods with some 4D Trajectory management
  - Oceanic domain provides a proving ground for researching 4D-ASAS concepts
- ASAS solutions are compatible with the existing 4D system while at the same time they have the potential to improve the existing system
- Tangible benefits are provided for operators who participate in early applications of 4D-ASAS

EOO Phased Approach

Phase 1 – Altitude Change Request Advisory Tool

- Tool that advises pilot of available altitudes
- Advisory information only (low certification)

Phase 2 – ASAS In-Trail Procedures

- Altitude changes are allowed based on cockpit-derived data
- No delegation of separation authority

Phase 3 – Enhanced ASAS In-Trail Procedures

- Active monitoring of other traffic during change
- Limited delegation of separation authority to cockpit
- Reduced separation criteria

Phase 4 – Airborne self-separation on the track

- Aircraft allowed to maneuver on specially approved tracks
- Closer to optimal fuel burn profile

Increasing Level of Separation Authority

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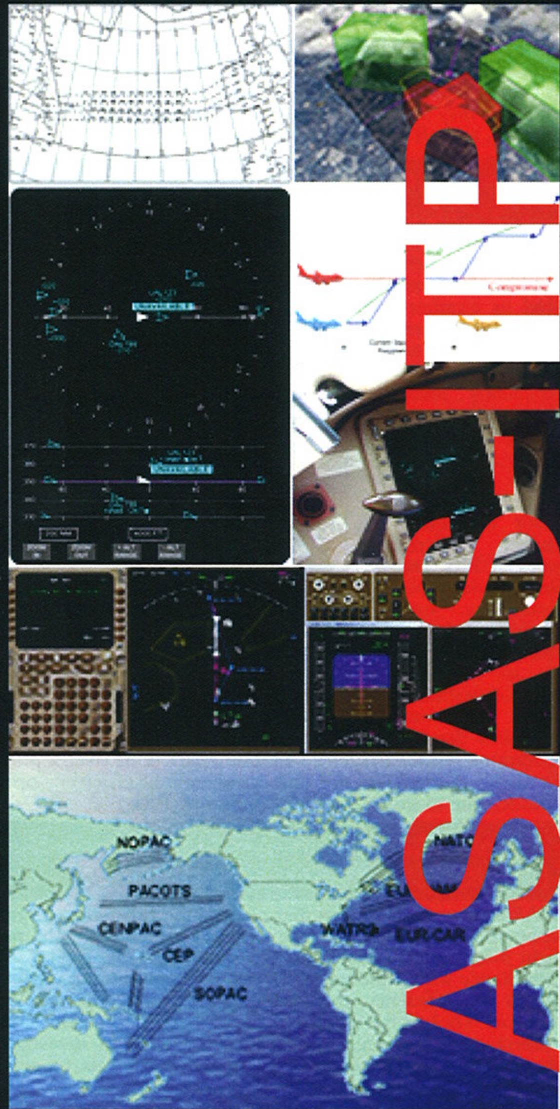
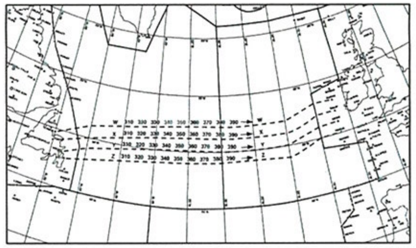
Enhanced Oceanic Operations



Oceanic Operations

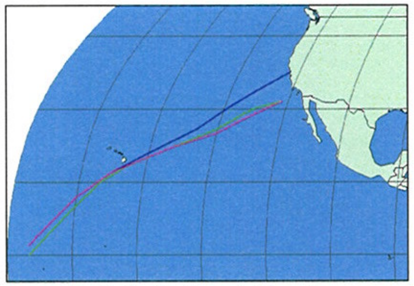
Oceanic operations, due to extended periods out of radar coverage have large longitudinal and lateral separation minima for safe procedural separation. Although these provide safe operations, they are often not fuel-efficient. Also, most airlines want the same tracks and altitudes. This results in altitude "congestion". In today's system, pilots sometimes fly at sub-optimal altitudes due to lack of appropriate information. Pilots do not know what altitudes are free and communication delays make it difficult to have dialogue with controllers. Aircraft are often "stuck" at a non-optimal altitude due to traffic "congestion". For efficient operations, aircraft need to climb as they burn fuel, but due to traffic congestion at higher altitudes, aircraft are often restricted from climbing.



Large longitudinal and lateral separation minima for Oceanic Operations

South Pacific Oceanic Region - Overview and Technical Challenges

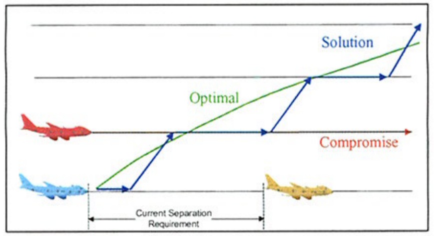
In the South pacific, there are primarily two types of routes - Fixed and User Preferred Routes (UPR). Fixed routes do not account for wind or weather (or airline efficiency considerations). UPR's are optimized routes generated by individual customers (preferred solution). However, most UPR's are generated by similar programs based on same wind data, so most end up on similar routes. Frequently there is pairwise con-jestion. Aircraft leave the west coast of the United States about the same market driven times. UPRs are filed to short-of-destination, fuel is evaluated en route with refil-ing to alternate short-of-destina-tion position. Even low density operations result in pairwise altitude restrictions over a portion of the flight. Aircraft are not able to operate at efficiency-optimized altitudes due to traffic conflicts, even on UPRs.



South Pacific Oceanic Operations

Airborne Separation Assistance Systems (ASAS) Phased Approaches

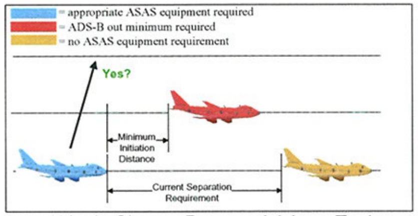
ASAS is an aircraft system that enables the flight crew to maintain separation of their aircraft from one or more aircraft, and provides flight information concerning surrounding traffic. Use of airborne surveillance and onboard tools can facilitate altitude changes for greater fuel efficiency, from the phase 1 Altitude Change Request Advisory Tool to the proposed phase 4 ASAS on a track. Current research uses the oceanic domain as a place to investigate this phased approach to integrating the various levels of separation authority delegation in a constrained 4D environment (in other words an opportunity to begin looking at 4D-ASAS). The simulation environment in the Air Traffic Operations Lab at NASA Langley provides a first step for testing concepts and developing the tools for each of these phases. It is used for operational feasibility assessments, system-level requirements definition, airborne and ground-based communication, navigation, and surveillance (CNS) technology requirements determination, and human-centered design and assessment of ATM concepts and flight-deck systems.



Oceanic domain for phased approach to 4D-ASAS

Phase 1 - Altitude Change Request Advisory Tool

The Altitude Change Request Advisory Tool is an on-board traffic situation awareness tool that indicates to the pilot what altitudes are available. It is an advisory system only that creates no change to current day operations. Pilot's still request and controllers still check and approve altitude change requests. It requires minimal certification, is low cost, and may provide an early "win" for those who equip.



Altitude Change Request Advisory Tool

Phase 2 - ASAS In-Trail Procedures (ITP)

ITP procedures were developed based on an ICAO approved DME procedure which allowed the controller to separate aircraft based on information derived from cockpit sources and relayed by the flight crew. ADS-B "In" and ASAS automation provide target aircraft flight ID, ground speed and range information. If traffic conflict geometry and dynamics are appropriate, the controller approves the climb based on information derived in the cockpit. ITP provides increased opportunities for flight-level changes. Restrictions based on today's procedures and standards can be decreased to a minimum initiation distance of 15nm and a maximum closure rate of 20 knots at a minimum climb rate of 300 fpm. The Controller with knowledge of all aircraft still approves the climb. There is no delegation of separation responsibility.

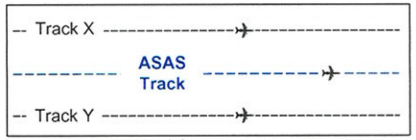
ASAS automation tools on Electronic Flight Bag

Phase 3 - ASAS ITP with limited delegation of separation authority

Similar to phase 2 but during the climb the aircraft is responsible for separation. This transfer of separation allows the separation and closure speed restrictions to be reduced. The ASAS system is used to provide required information and monitoring, including bearing, distance, closure, and conflict alerting and resolution.

Phase 4 - Airborne Self-Separation on a track

All aircraft similarly equipped with ADS-B, ASAS software and hardware. Aircraft maneuvers are based on approved procedures and onboard decision support systems. Potentially, aircraft can request an ASAS track in the middle of the current tracks.



Airborne Self-Separation on a track

ASAS ITP Concept of Operations

Objective and Purpose

Establish a single, globally accepted, concept of operations used to influence global standards for the procedure and equipment.

Requirements Focus Group (RFG)

Sponsored by FAA, EUROCONTROL, RTCA, and EUROCAE, the RFG was established to perform coordinated requirements determination and interoperability for early implementation of ADS-B/ASAS applications.

ASAS ITP Application Description

The Airborne Traffic Situation Awareness In-Trail Procedures (ATSA-ITP) Operational and Service Environment Description (OSED) development, led by NASA and Airbus, and contributed to by approximately 40 international participants produced a document that describes the application in sufficient detail to enable development of international standards for the procedure and equipment. OSED is the first step in a process that leads to safety and performance requirements definition and interoperability determination.

Global Air Traffic Interoperability (GATI) - ITP Flight Trial

FAA's Global Air Traffic Interoperability project consists of operational developments and flight trials that demonstrate and accelerate advances in global Air Traffic Management. Early emphasis of the project is a demonstration of Oceanic In-Trail Procedures to increase oceanic efficiency and safety. NASA's role is to provide modeling and simulation for concept and human machine interface (HMI) development, evaluation, and safety analyses.

GATI ITP goals

- Implement In-Trail Procedures globally
- Enable a 6 month operational flight trial of the proposed ASAS In-Trail Procedures on partner revenue aircraft

Flight Trial Objectives

Assess economic and operational feasibility of ASAS In-Trail Procedures to better understand system costs, assess benefits, gain operational experience with ASAS technologies, and establish basis for global ADS-B ITP implementation. The proposed SOPAC route (US to Australia/New Zealand) provides a unique beneficial environment (e.g., similar aircraft type, interested ATSPs, Australian ADS-B mandate, and limited number of operators)