Advanced Technologies & Oceanic Procedures (ATOP)

ATOP Overview for The 40th Meeting of the Informal South Pacific ATC Coordinating Group (ISPACG/40)

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Advanced Technologies and Oceanic Procedures (ATOP) – Critical to the NAS

- **ATOP is the Federal Aviation Administration's oceanic air traffic management system**
  - Provides aircraft separation management in oceanic airspace
  - Provides capabilities to air traffic controllers that increase efficiencies through reduced separation management
  - Interfaces with other NAS systems to provide communications, surveillance and interfacility data transfer for a fully integrated air traffic system leveraged by air traffic personnel

Oakland ARTCC controller, controlling oceanic air traffic over the Pacific Ocean utilizing the ATOP Platform

ATOP is a critical component for the safe and efficient operations of the National Airspace System (NAS)

ATOP Overview

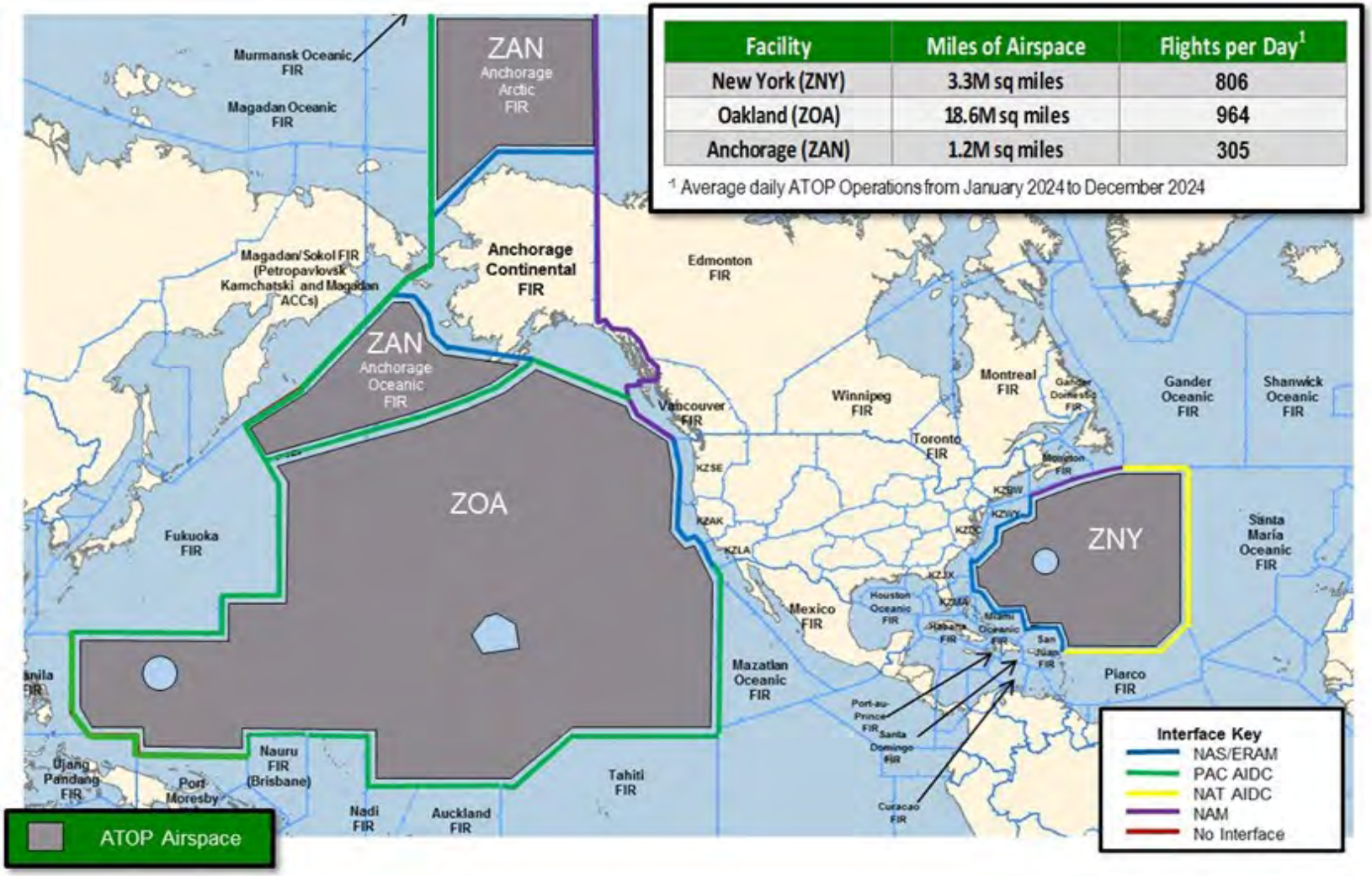
- **ATOP allows properly equipped aircraft and qualified aircrews to operate using reduced oceanic separation criteria resulting in more optimal routes and enhanced flight time (and fuel and payload) efficiency during oceanic legs of flight**

- **System Capabilities**
  - Integrated Flight and Surveillance Data Processing
  - Enhanced Conflict Probe
  - System-Maintained Electronic Flight Data
  - Radar Surveillance
  - Automatic Dependent Surveillance – Contract
  - Automatic Dependent Surveillance – Broadcast
  - Controller-Pilot Data Link Communications (CPDLC)
  - High Frequency (HF) Radio Operator Interface
  - Air Traffic Services Inter-Facility Data Communications (AIDC)
  - Integrated Monitor and Control (M&C)
  - 24/7 Operations (Dual Channel Architecture)

ATOP Program Benefits

- **Reduced separation standards** ✓
- **Increased sector capacity and throughput** ✓
- **Increased controller efficiency** ✓
- **Reduced delays and restrictions** ✓

ATOP Controlled Airspace



Facility	Miles of Airspace	Flights per Day[1]
New York (ZNY)	3.3M sq miles	806
Oakland (ZOA)	18.6M sq miles	964
Anchorage (ZAN)	1.2M sq miles	305

[1] Average daily ATOP Operations from January 2024 to December 2024

ATOP Major Deployments

Oakland Center

- Began daily operational use in June 2004
- Achieved full 24/7 transition in October 2005

New York Center

- Began initial live operations in March 2005
- Achieved full 24/7 transition in June 2005

Anchorage Center

- Began initial live operations in March 2006
- Achieved full 24/7 transition in March 2007

Procedural In-Service Decision (ISD) Achieved in March 2006
Operational Readiness Decision (ORD) Achieved in March 2006

Radar ISD Achieved in February 2008
ORD Achieved April 2008

System Tech Refreshes to replace end-of-life hardware and operating systems

- ATOP Tech Refresh 1 completed in 2009
- ATOP Sustainment 2 completed in 2020

Achieved Certificates of Completion 2009 & 2020

Program Initiatives

ATOP Investments and Initiatives

Investments / Initiatives	Operational Target
ATOP Enhancement 1 (E1)	2023 to 2027
Oceanic Improvements (OI)	Multi-Year
Space Launch and Reentry Concept	2027
ATOP Sustainment 3 (S3) Phase 1	2026 to 2030

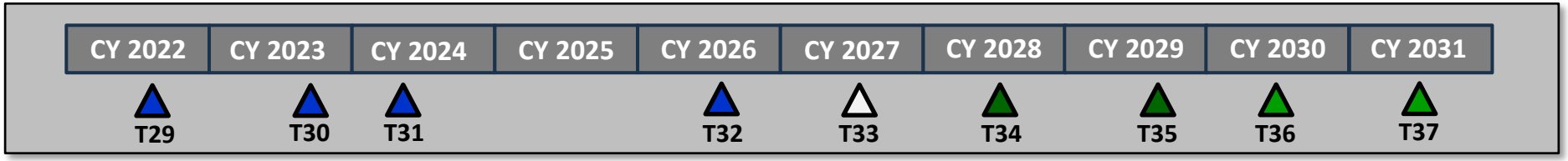
Rev 16

Risk Adjusted

ATOP Release Schedule

Note: All Releases except T36 will include Ops content

Key:
- Sys Support Modification
- ATOP Sustainment 3 (S3)
- ATOP Enhancement 1 (E1)
- Oceanic Improvements (OI)



T29 E1 Focus
23 Lat Implementation

Enhanced Trial Probe

OI NCPs

11.4 NCP KSLOC

T30 E1 Focus
Failure Mode Enhancement

Space-Based ADS-B Ingest and Process

OI NCPs

13.6 NCP KSLOC

T33

Space Launch and Re-entry Volumes

OI NCPs

T34 S3 Phase 1 Focus
FIXM Publish

Motif Replace Part 1

17.9 NCP KSLOC

T35 S3 Phase 1 Focus
Motif Replace Part 2

Surveillance Interface Modernization (SIM)

18.9 NCP KSLOC

T31 E1 Focus
Enhanced Conflict Probe for Surveillance Airspace

Enhanced Controller Coordination

20 Long Implementation

Wx Deviation Tool

OI NCPs

26.0 NCP KSLOC

T32 E1 Focus
Data Exchange via SWIM (SWIM Server & Sub WMSCR)

Data Exchange via SWIM (SIGMET Processing)

OI NCPs

12.4 NCP KSLOC

T36 S3 Phase 2 Focus
Compute Layer Solution

RHEL 10 Upgrade

TBD NCP KSLOC

T37 S3 Phase 2 Focus
IPv6 External Interfaces

IPv6 Internal Interfaces

Performance Improvements

TBD NCP KSLOC

ATOP E1

Investment started in 2019 to support enhancements to the existing ATOP system baseline from 2022 to 2027

- **ATOP E1 baselined in April 2019 to deliver five operational capabilities in four releases (T29-T32)**

Capability	Description	Deployment Range
ASEPS ADS-C Reduced Oceanic Separation (T29, T30, and T31)	• 23 nm lateral separation standard • Enhanced Trial Probe • Failure Mode Enhancement • 20 nm longitudinal separation standard • Cleared weather deviation tool and • Improved Comm/Surv Monitoring capabilities	• Deployed at all sites • Deployed at all sites • Deployed at all sites • Deployed at ZAN and ZOA / Late 2025 at ZNY • Deployed at all sites • Deployed at all sites
Enhanced Conflict Probe for Surveillance Airspace (T31)	Provides a conflict probe to oceanic controllers using approximate radar or ADS-B separation standards within radar or ADS-B Out coverage	• Late 2025 at ZAN
Enhanced Controller Coordination (T31)	Enhances the user interfaces and processing used for manual and automated coordination between ATOP and adjoining ANSPs	• Deployed June 2024 at ZAN / April 2025 at ZOA / June 2025 at ZNY
Data Exchange via SWIM (Interface Rehost) (T32)	Provides SWIM capability in ATOP to subscribe and convert legacy WMSCR point-to-point interface to support SIGMETs and volcanic ash location/forecast	• Late 2026 to 2027
Data Exchange via SWIM (New Services) (T32)	Provides capability in ATOP to present CSS-Wx SIGMETs and volcanic ash location/forecast	• Late 2026 to 2027

ATOP E1 Additional Content

ATOPzilla	Additional Key E1 Content	Release	Date
61044	Clearance for Direct To a Point on the Cleared Route	T32	May-26
60430	Phase 2 of Communication Monitoring	T33	Feb-27
60539	Additional System Capability to Detect Datalink Comm Degradations/Interruptions/Outages	T33	Feb-27

Present Position Reroute

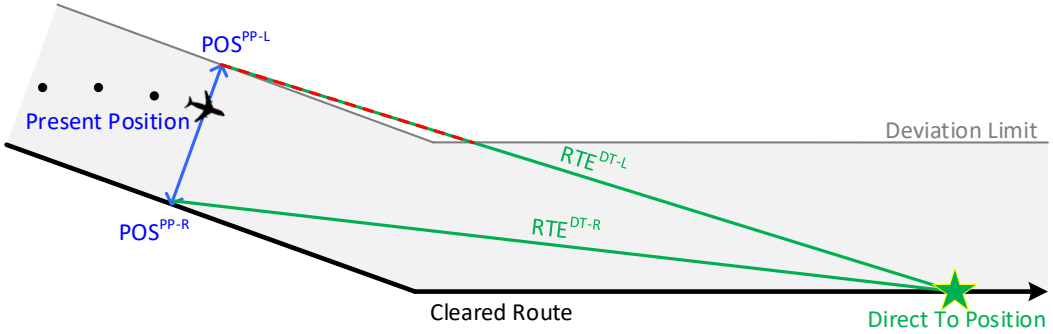
- On occasion, an aircraft which has been cleared to deviate for weather and is actively flying the deviation needs to be cleared direct to a position downstream on its route
  - This need can be because of a request by the aircrew, or it could be needed by ATC to resolve a traffic situation
- Due to existing software functionality, the current process used to issue this type of clearance requires many steps, some of which can affect the accuracy of an aircraft's protected profile
- As a result, ATC does not often employee these types of tactical reroutes

Present Position Reroute

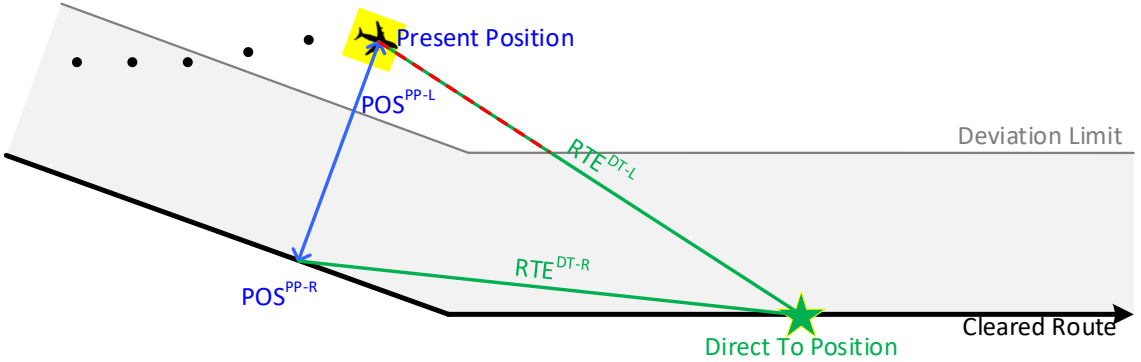
- New functionality will easily allow ATC to give route clearances to aircraft that are actively maneuvering on a weather deviation.
- These clearances may be issued to deviating aircraft using these CPDLC Up-link reroute message elements:
  - U74 PROCEED DIRECT TO [position]
  - U79 CLEARED TO [position] VIA [route clearance]
  - U80 CLEARED [route clearance]
- Present Position Reroute clearances can also be initiated by the aircrew using the CPDLC down-link message elements:
  - D22 REQUEST DIRECT TO [position]
    - Typically responded to with an U74
  - D24 REQUEST [route clearance]
    - Typically responded to with an U80 CLEARED [route clearance]

Present Position Reroute

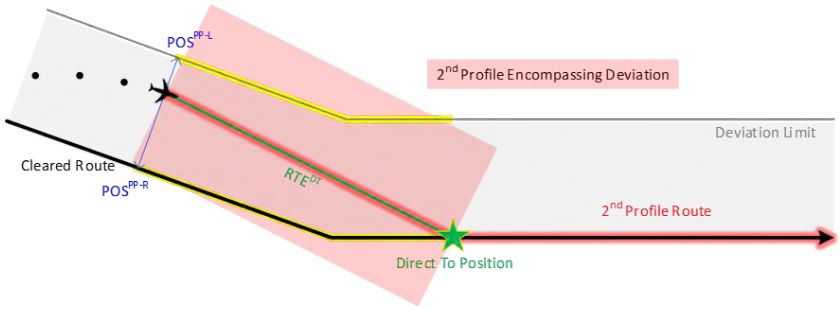
Present Position Reroute clearances will be profiled in such a way as to ensure accurate conflict probing and prediction



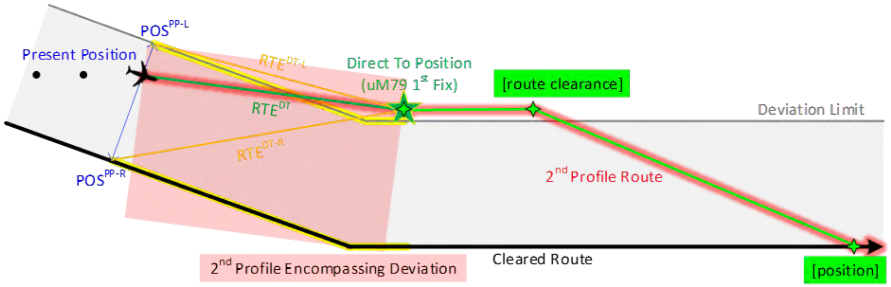
Even in cases where an aircraft is laterally out of conformance with the cleared deviation limits



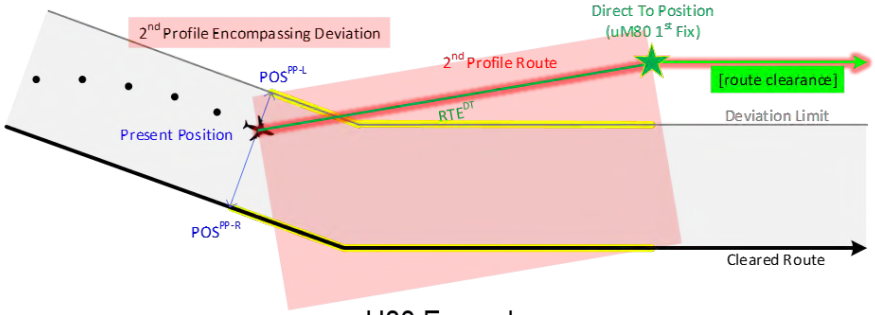
Present Position Reroute



U74 Example



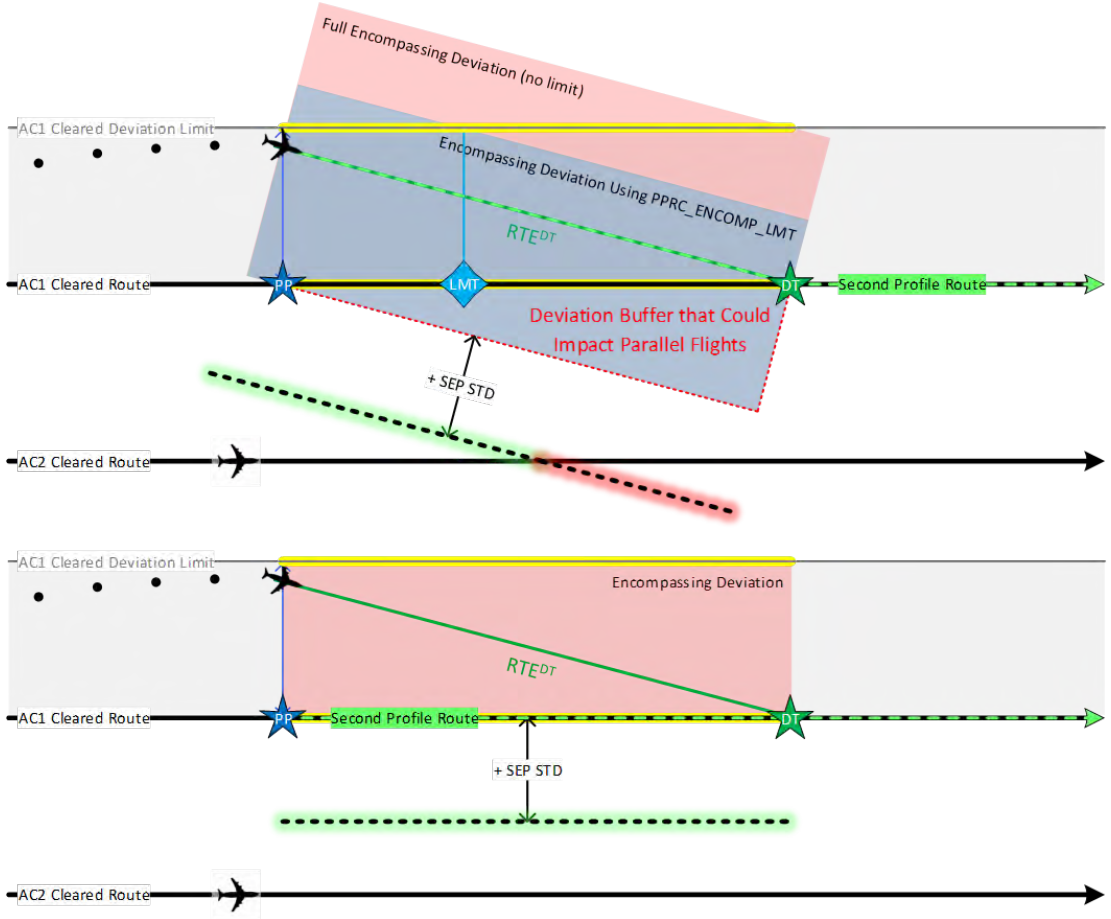
U79 Example



U80 Example

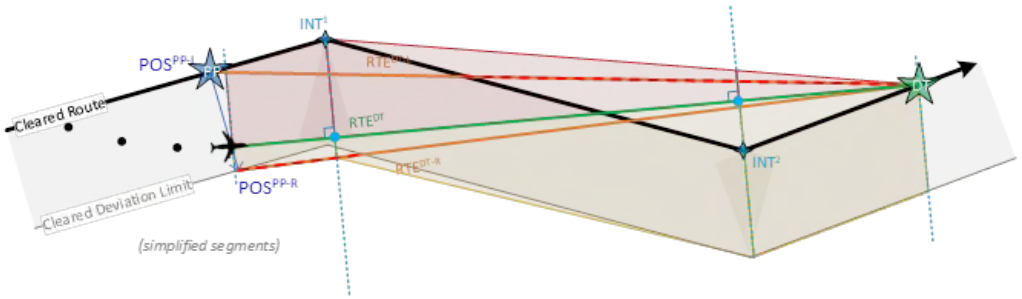
Present Position Reroute

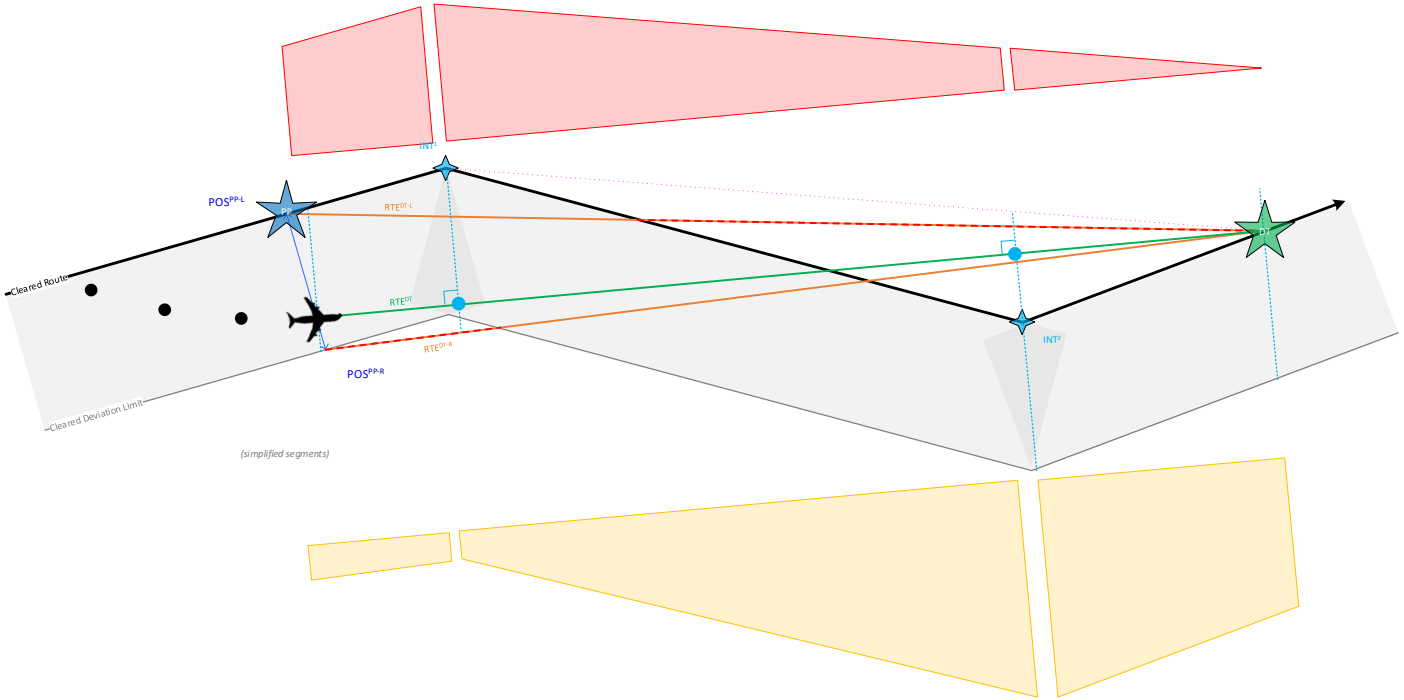
Conflicts due to encompassment for U74 PROCEED DIRECT TO [position] PPRCs will be mitigated by implementing a separate algorithm used to encompass and build the second profile



Present Position Reroute

The figures display variable encompassing deviation buffers





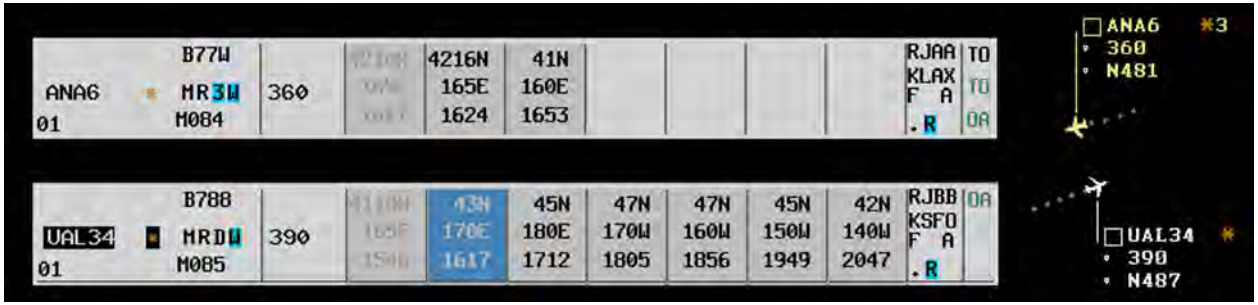
Phase 2 Communications Monitoring

- During times of unplanned datalink degradation, there is a significant increase in the number of undelivered or delayed ADS-C position reports for multiple flights. CPDLC message traffic is also delayed or undelivered. As a result, there is a spike in the number of Sector Queue and Supervisor Queue messages. These degradations lead to a decreased reliability of ADS-C position reports and CPDLC messaging, while increasing controller workload and the risk of possible user error

Phase 2 Communications Monitoring

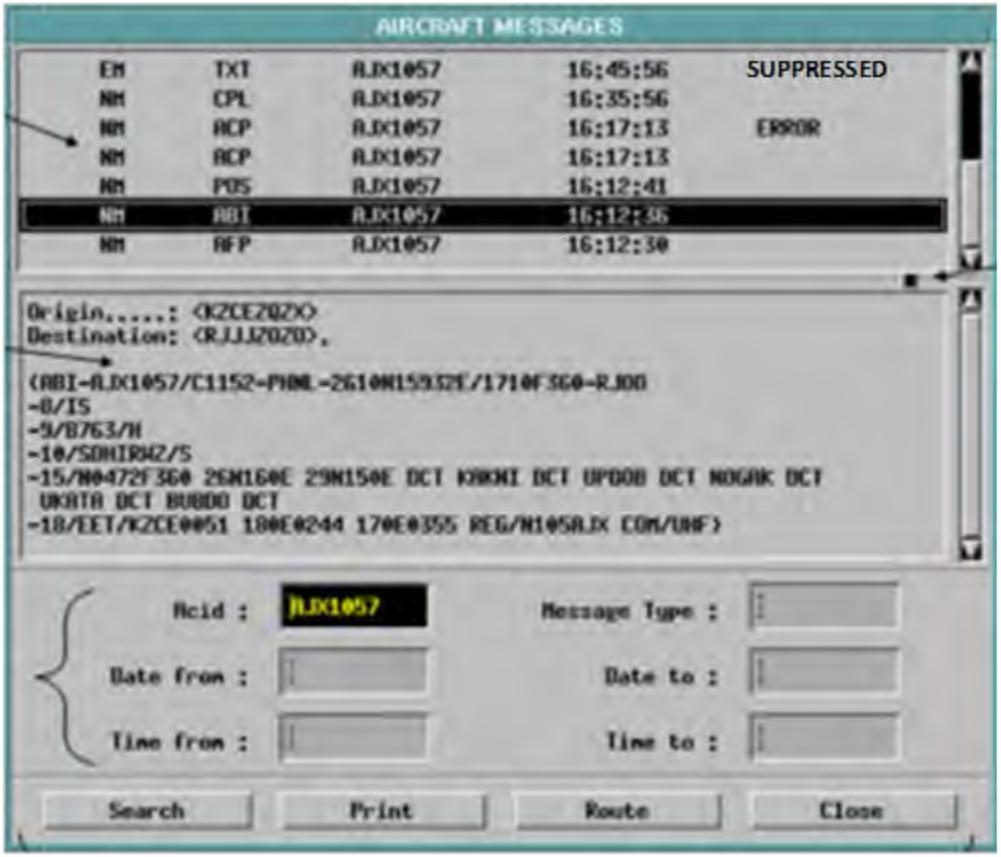
- 60539 will:
  - Alert the Technical Operations personnel when the system detects datalink degradation
- 60430 will:
  - Provide functionality to inform Air Traffic Controllers, Supervisors and CiCs as to which flights might be affected due to datalink degradation
  - Suppress certain Sector Queue messages related to delayed (or missing) datalink communications

Phase 2 Communications Monitoring



Example of an aircraft affected by datalink communications degradation

Phase 2 Communications Monitoring



Aircraft Messages History Window with SUPPRESSED Tag

Oceanic Improvements

- **Supports operational analysis, engineering analysis, solution development, and solution implementation activities designed to improve the delivery of oceanic domain air traffic services**

ATOP Space Launch & Reentry Concept

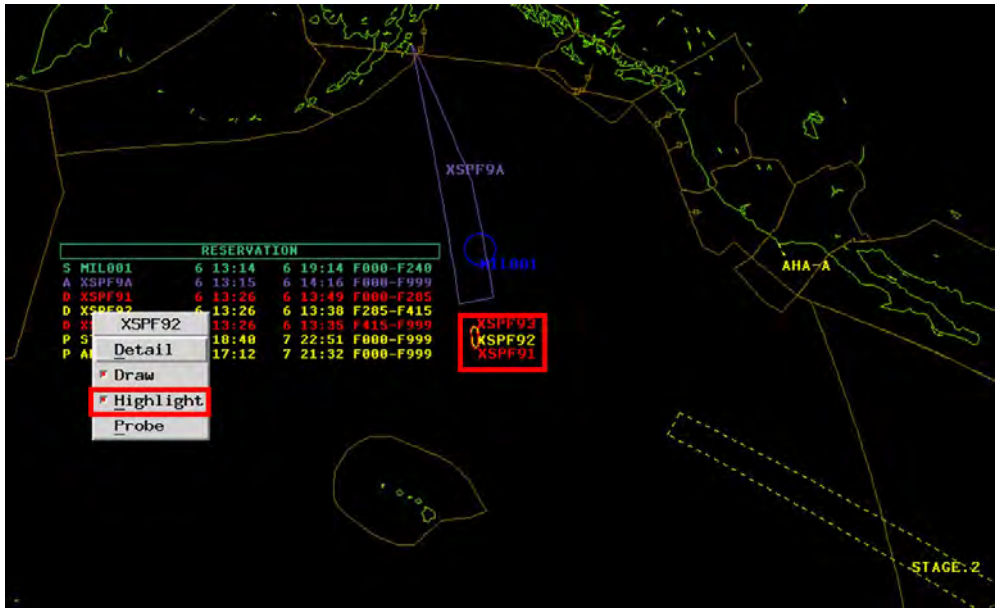
- **Problem Statement**
  - Sustaining space operations requires Traffic Management Coordinators (TMCs) and Controllers to separate aircraft from hazardous airspace
  - Due to a lack of data exchange capabilities between space Launch and Reentry Operators (LROs) and the National Airspace System (NAS), Air Traffic must manually enter mission data into their respective NAS automation systems
  - This manual data entry process requires input by multiple TMCs and CPCs at the respective related facilities, which increases workload and risk due to potential entry errors and data input delays
- **Current Oceanic Operations**
  - Aircraft Hazard Area (AHA) information typically exchanged via email/telecon
  - AHAs manually entered as airspace reservations in ATOP by site personnel several days in advance of planned space activity
  - AHA airspace reservations manually managed in ATOP in real-time by site personnel

ATOP Space Launch & Reentry Concept

- **Potential Future Oceanic Operations**
  - ATOP targeting T33 Release (2027) to deploy space launch and re-entry hazard volume processing
  - AHAs will be sent to and managed in the ATOP system via eXtensible Markup Language (XML) messages over the FAA System Wide Information Management (SWIM) infrastructure
    - AHAs sent several days in advance of planned space activity
    - AHAs updated/removed in real-time
  - Near-term planning occurring to address technical and operational safety panels and interoperability testing

ATOP Space Launch & Reentry Concept

- Reservation List automatically pops up whenever a reservation is displayed
- Airspaces and Reservation List entries are now distinguishable by color and Reservation List designator
- Highlight/preview selected reservation(s) from the Reservation List
- Conflict probe and automatic comm uplinks for affected aircraft to be determined via system requirements process



ATOP S3 Background

Infrastructure Investment to Sustain ATOP System through 2039

- **ATOP Sustainment 2 (S2) hardware was purchased in 2017, and the ATOP system will require a hardware/compute layer replacement by 2030**
- **Newly identified infrastructure and sustainability requirements need to be deployed sooner to address system security and Agency mandates**
- **ATOP program provides a unique opportunity as an Agency pathfinder for IPv6 and Red Hat Enterprise Linux (RHEL) 10 transition, and Automation Evolution Strategy (AES) concepts for automation systems**

ATOP S3 Scope

ATOP S3 Phase 1	• **Replace Motif (ATOP Graphical User Interface [GUI] toolkit) to allow transition to future versions of RHEL beyond RHEL 9.X** • **Interface Modernization** – Deploy Flight Information Exchange Model (FIXM) publish capability via System Wide Information Management (SWIM) to support further processing and dissemination of flight information – Deploy Surveillance Interface Modernization (SIM) to eliminate serial radar interfaces
ATOP S3 Phase 2	• **Transition to RHEL 10** • **Deploy Compute Layer Solution by 2030** – Option 1: Dedicated Hardware based on current hardware architecture – Option 2: Reduced Hardware footprint with applications running on virtual machines* – Option 3: Cloud-based Computing • **Deploy System Performance Improvements to support oceanic operations through 2039** • **Transition from Internet Protocol version 4 (IPv4) to IPv6** – External Interfaces at ATOP Demarc – Internal Interfaces

Q&A