16.72
Oceanic and International ATC

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and others

MIT International Center for Air Transportation
Oceanic Attributes

- International
  - ICAO Oversight
- Low CNS Performance
- Generally Low Density
- Limited Diversion Opportunities
- Limited Weather Observations
Adapted from “Implementation Plan for Oceanic Airspace Enhancements and Separation Reductions”, FAA, 1998
MUCH OF ATLANTIC AIRSPACE OUT OF RANGE OF VHF & RADAR
PACIFIC OCEANIC FLIGHT INFORMATION REGIONS (FIR’S)
FANS Data Link Deployment Areas in Grey
Atlantic Oceanic Area Control Centers (OACCs)
POSITION REPORT TO OACC
EVERY 10° VIA HF RADIO

Ground controller receives position update from each aircraft about once per hour
PROPOSED FUTURE OCEANIC: STATUS REPORTING TO OACC EVERY FEW MINUTES VIA SATCOM DATALINK

Ground controller receives position update from each aircraft about once per hour
Overview of Facilities

- REYKJAVIK ATCC
- SHANWICK ATCC
- GANDER
- NEW YORK ATCC
- SANTA MARIA
ZNY Airspace

NAT (North Atlantic Traffic):
- Organized Track System (OTS)
- Iberian Peninsula to Caribbean/South America
- Random routes between Europe and North America

WATRS (West Atlantic Route System):
- Complex web of crossing fixed routes
- Heaviest major traffic flow - US east coast to Puerto Rico

Adapted from “Strategic Plan for Oceanic Airspace Enhancements and Separation Reductions”, FAA, 2000
WATRS Plus Airspace

- Airspace being considered for oceanic lateral separation reduction
- Intended to show general location of WATRS Plus airspace
- Full WATRS coordinates posted at www.faa.gov/ats/ato/watrs.htm
**WATRS area ARINC message**

<table>
<thead>
<tr>
<th>Field</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight ID</td>
<td>QU OAFOOXA.NYCXGXA 141440</td>
</tr>
<tr>
<td>Day message sent</td>
<td>POS</td>
</tr>
<tr>
<td>Position report point</td>
<td>FI COA512/OV BURTT 1437 F350/EO NANCE 1505/NP LETON/FB 28.7 DT NYC LS B 141438 11</td>
</tr>
<tr>
<td>Altitude</td>
<td>; 2261440 MDFA7 516</td>
</tr>
<tr>
<td>Next reporting point</td>
<td>;</td>
</tr>
<tr>
<td>Next reporting time</td>
<td>;</td>
</tr>
<tr>
<td>Reporting point after next</td>
<td>;</td>
</tr>
<tr>
<td>Fuel remaining</td>
<td>;</td>
</tr>
<tr>
<td>(in tons)</td>
<td>;</td>
</tr>
</tbody>
</table>

Type of message: position report

Downstream Sector

Day message sent

Time message sent “over”
Workstation: North Atlantic

Paper Strips for flights in sector

- electronic messages
- Situation Display

Controller

Paper Strips for flights arriving in sector in ~ 1 hour
Sector Controllers

- Responsible for controlling aircraft in sector
- Communicates with pilot, ARINC, other controllers
- Resolves conflicts using grease pencil and map, because do not have access to Situation Display

ODAPS Controller

- Serve as a “safety net” to sector controllers
- Ensures conflicts alerts are being handled by sector controllers
- Confirm that all messages are received

Paper Flight Strips (flights in sector)
### NY Oceanic Flight Strip

<table>
<thead>
<tr>
<th>Aircraft ID</th>
<th>Aircraft type</th>
<th>Sector number</th>
<th>Computer ID</th>
<th>Flight Strip Number</th>
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<tbody>
<tr>
<td>RAM201</td>
<td>H/B763/Q</td>
<td>19 19</td>
<td>404 03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T472 6530</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0121</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current waypoint/ degree of longitude reporting point</th>
<th>Estimated time at next reporting point</th>
<th>Next reporting point</th>
<th>Reporting point after next</th>
<th>Route of flight</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOBTU 01 35 370</td>
<td>4337 4500</td>
<td>KJFK ./ BOBTU 4400N</td>
<td>05000W 4300N/04000W 4200N/03000W 3900N/02000W</td>
<td>LUTAK BEXAL OSTED OSTE2A GMHN/0705</td>
</tr>
<tr>
<td>4400/5000</td>
<td>4400/5000</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimated time at reporting point after next</th>
<th>Next facility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ZCS</td>
</tr>
</tbody>
</table>
For a single aircraft there will be a flight strip for each longitudinal position on the strip bay that the aircraft traverses (e.g., 4 strips for this aircraft on this strip bay, since it enters at 55°W)

<table>
<thead>
<tr>
<th>RAM201</th>
<th>BOBTU</th>
<th>35</th>
<th>370</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0121</td>
<td>4337</td>
<td>4500</td>
</tr>
<tr>
<td>T472 6530</td>
<td>03</td>
<td>4400/5000</td>
<td></td>
</tr>
<tr>
<td>404 03</td>
<td>404</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KJFK: / BOBTU 4400N/05000W 4300N/04000W 4200N/03000W 3900N/02000W LUTAK BEXAL OSTED OST2A GHNN/0705</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>RAM201</th>
<th>4337</th>
<th>02</th>
<th>370</th>
</tr>
</thead>
<tbody>
<tr>
<td>H/B763/Q</td>
<td>0200</td>
<td>4400/4000</td>
<td></td>
</tr>
<tr>
<td>T472 6541</td>
<td>03</td>
<td>4300/4000</td>
<td></td>
</tr>
<tr>
<td>404 05</td>
<td>404</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KJFK: / 4400N/05000W 4300N/04000W 4200N/03000W 3900N/02000W LUTAK BEXAL OSTED OST2A GHNN/0705</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>26/60°W</th>
<th>34/50°W</th>
<th>41/40°W</th>
</tr>
</thead>
<tbody>
<tr>
<td>30/55°W</td>
<td>37/45°W</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Comments by Controllers:
- Controllers will use Situation Display instead of strips for separation
- ADS information will be displayed (and have priority over position reports, if there is a discrepancy), but radar information will not be displayed until Build 2
- Can click on multiple aircraft to view distance between them (cannot view time between them)
ATOP Datablock

Switched if aircraft is climbing

(Callsign)  
(Actual Altitude)  
(Cleared Altitude)  
(Mach Number)  

- can add other information to datablock, such as:  
  - ground speed  
  - sector #  
  - …

- Controller will be alerted on datablock when new coordination is received and will be able to click on datablock to receive coordination information

- Datablock will flash when there is a conflict
ATOP Overview

• Based on New Zealand System (changed for sectorization)

Schedule:
- Just beginning training of first controllers
- Implementation planned for Summer 2004

Changes due to automation:
- Controllers will use spatial Situation Display for separation instead of electronic flight strips (Reasoning: ATOP is more accurate than ODAPS and has more tools to assist controllers)
- Automation determines when events will occur, as opposed to where
- Before Clearances are administered, they are automatically probed and alerts the controller of any conflicts

What procedural changes do you anticipate because of this implementation?
- Controllers will be made aware of conflicts further in the future, which will make their coordination more efficient
- Moving towards 30nm lateral separation
Coordinating Hand-offs

- Standard Operating Procedures say that hand-offs must be coordinated before the aircraft reaches the boundary of sector.

- Letters of Agreement with adjacent facilities more conservatively specify how far in advance hand-offs need to be coordinated with each facility:
  - Santa Maria: > 1 hour
  - Monkton: > 1 hour
  - Gander: > 1 hour
  - San Juan: <1 hour, > 45 mins
  - Piarco: > 45 mins
Estimate Used for Separation

- Controller is responsible for separating based on CENTER’S ESTIMATE of time at waypoint

- If pilot’s estimate is significantly different from center’s estimate, controller will ask the pilot for his or her estimate again (if pilot’s estimate is > 3 minutes off of center’s estimate, controller is required to re-coordinate)

- Controller may adjust center’s estimate based on headwind information, however if there is a violation of separation, he will be held responsible based on center’s estimate
• Draft route redesign proposal formulated by FAA TF
• 50 – 75% increase in route options
• To be presented at NAT/CAR Working Group Meeting September 19 – 21 in Miami
Taskload

How many aircraft can you handle at a time?

☐ Radar: 18-20
☐ Oceanic: ~40
☐ Most ever handled by controller: 65 (could not honor any requests)

What is the hardest sector?

☐ radar – reduced separation, not as much time as non-radar
☐ WATRS (as opposed to North Atlantic) – traffic is more dense with more crossings
☐ North Atlantic – have to use latitude and longitude coordinates as opposed to the fixes used in WATRS
☐ south sector in WATRS – traffic is more random
North Atlantic Track Planning

• Get major airlines routes (for 8 major city pairs) for the next shift from airline flight plan database
  - write route information into a spreadsheet: degrees of longitude consistent– latitude & altitude for every 10 degree of longitude

• Get computer estimate of track location, based on routes and jet stream - shown in red
  - fill into same spreadsheet

• Get Gander's tracks via phone (or Shanwick’s tracks for night)
  - Negotiate altitude if certain altitudes are needed for crossings
  - Plot Gander’s tracks on map with grease pencil

• Choose tracks based on computer estimate and planned flights, more weight placed on major airline routes’ flight plans, try to choose between two options

• Tell Gander of planned tracks and negotiate altitudes if Gander requests changes

• Plot next shift’s tracks on map with grease pencil for the next shift’s supervisor
Emergencies

- occur ~1/week
  - on board medical emergencies (most frequent)
  - mechanical problems
  - natural occurrences, e.g., volcanoes
Hourly Distribution of Traffic

Daytime traffic flow: WESTBOUND
Nighttime traffic flow: EASTBOUND

Source: Helgi, Chief Controller of Reykjavik ATCC
Flight Data Processing System

Limitations cited by controllers:

- window view: **cannot get a snapshot overview of strips, have to scroll**
- trust:
  - new system
  - electronic information – have to print out paper strips in case of a breakdown
- nuisance warnings: **conflict warnings, coordination warnings, etc**
Electronic Flight Strips

- **Flight strip direction, time, and altitude groupings provide** structure-based abstractions for controllers:
  - Strip arrangement (position matrix) mimics traffic structure
  - Color represents direction of flight
    (westbound are turquoise & eastbound are yellow)
Situation Display

- Graphically depicts extrapolation of aircraft path based on flight strip assumptions
- Not utilized as much as expected
- Currently, Iceland’s Operating Procedures encourage use of Situation Display to assist in separation, but require that controllers tactically ensure separation using strips
- Controllers in mixed environment have to cognitively integrate nearly continuous information from radar screen with discrete information from Situation Display
### Emergencies

<table>
<thead>
<tr>
<th>Most Common Emergencies</th>
<th>5 responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical emergencies</td>
<td>3 responses</td>
</tr>
<tr>
<td>Lose engine (~1/month)</td>
<td>2 responses</td>
</tr>
<tr>
<td>Emergency descent</td>
<td>2 responses</td>
</tr>
<tr>
<td>Small aircraft lost</td>
<td>1 response</td>
</tr>
<tr>
<td>Run out of fuel</td>
<td>1 response</td>
</tr>
<tr>
<td>Overdue aircraft</td>
<td>1 response</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Most Difficult Emergencies</th>
<th>4 responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency decent</td>
<td>2 responses</td>
</tr>
<tr>
<td>Hijack</td>
<td>2 responses</td>
</tr>
<tr>
<td>Malfunction</td>
<td>1 response</td>
</tr>
</tbody>
</table>

**What do you do with aircraft?**

- **Emergency descent** – blind transmit all aircraft on the frequency the situation and location of aircraft.
- **Hijack** – get rid of all traffic in sector and don’t accept any new traffic, continue to communicate with aircraft.
- **Flight malfunctions** – determine location and update it as frequently as possible so that search and rescue can find exact position, or help it to land safely somewhere.
North Atlantic Tracks Transition Area

May 2001 3:18 p.m.

Sector Structure  Observed Flows
Scottish Oceanic Area Control Centre
Preswick Oceanic Area

Supervisor

Traffic Dispatch Operators
modify messages rejected by FDPS

CPDLC Station
transcribes datalink requests into FDPS

Tracks Station

Clearance Delivery Operators (CDOs)
Receive position reports/requests through VHF & direct call to appropriate planner/controller

Enroute Controllers
Control aircraft once aircraft enter oceanic airspace

Planners
Give clearances before entering ocean & perform modifications to clearances before aircraft enter ocean
Observations from Shanwick

**Sectorization**

- Unlike other oceanic facilities, Shanwick separates sectors by flight level rather than geographically:
  - 360 and higher
  - 330 and lower
  - 340-350
- Approximately 60 aircraft average per sector

**Inter-facility Communication**

- **Automated Data Transfer**: all hand-off data sent and received automatically to and from other facilities

**Planner Projection**

- **Project for conflicts manually, then computer probe clearance**
- **If aircraft routes are perpendicular, check for conflicts with computer only**
  - Few N/S routings across tracks
  - Do rough position estimates at 50N & 55N, then estimate E/W position
    - If need to draw aircraft positions spatially, just put aircraft at different altitudes or send N/S aircraft under tracks
On N/S route through tracks flight must be listed for every track crossed for comparison with other flights on that track.

Controllers commented that spatial conflict was very difficult to visualize on these situations.
Future Information System

- SAATS- Shanwick Automated Air Traffic System
- Derivative of the GAATS system at Gander in Canada
Today

- Pacific Organized Track System
- Required Navigation Performance
- Reduced Vertical Separation Minima
- User Preferred Routes
- ATS Inter-Facility Data Communications

Source: Dave Maynard, Oakland ARTCC IOAC Briefing
Today

- Implementation of Ocean21 System
- ADS Based 50/50
- UPR Dynamic Airborne Reroute Procedure (DARP)
- 10 minute longitudinal separation without MNT
- ADS Based 30/30 Trials in South Pacific
- AIDC 2.0 Implementation

Source: Dave Maynard, Oakland ARTCC IOAC Briefing
Implementation of Ocean21 System

- Part Time Initial Daily Use began in June 2004
- Full Time Use began in October 2005

Source: Dave Maynard, Oakland ARTCC IOAC Briefing
Distance Based Longitudinal Separation

- D50 Longitudinal first applied on Oct. 27, 2004
- 30/30 implemented on Dec. 22, 2005

Source: Dave Maynard, Oakland ARTCC IOAC Briefing
• User Preferred Routes in South Pacific began December 2000

• DARPS Trials completed

• Daily User Preferred Reroutes between Oakland & Auckland Centers supported in July, 2006
ADS In-Trail Climb
SOUTHERN PACIFIC FANS-
INITIAL IMPLEMENTATION

- Limited operational fleet
  - B-747-400
- Limited FIRs
  - Sydney
  - Auckland oceanic
  - Oakland oceanic
- Low density airspace (Order 40 A/C)
- Routing flexibility
- Significant benefits claimed by airlines
- Growth Areas
  - Polar Regions
  - Asia
  - Africa
  - South America