

# **GOLD**

## **Advanced Data Link Operations**

Presented to:

ICAO Seminar/Workshop on the  
Implementation of Ground-ground  
and Air-ground Data Links in the  
SAM Region

By: Paul Radford  
Airways New Zealand

Date: 12 September 2012



**Federal Aviation  
Administration**

**AIRWAYS**  
NEW ZEALAND

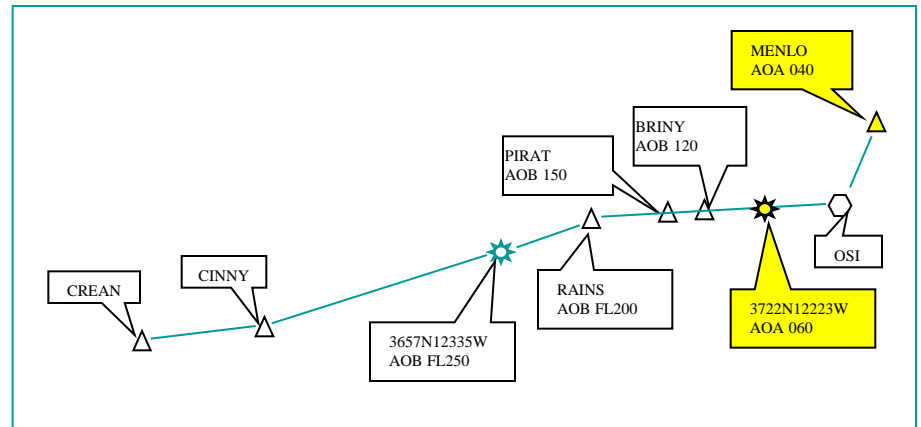


# KSFO Tailored Arrival (TA) Trials

- **Initial TA Trials began in 2006**
  - Early Morning Traffic with little airport demand.
  - UAL aircraft only
- **Latest TA Trials began December 2007**
  - Expanded beyond early morning flights
  - Refined arrival routing and renamed the arrival
  - Added additional operators
  - Reduced coordination requirements for controllers

# KSFO Tailored Arrival Profiles

- Determining the TA profile



- Initial Altitude
- Descent Speed
- Winds
- Aircraft type

Drawings not to scale

# Profile Development Goals

- **Meet ATC requirements**
  - Minimum IFR Altitudes
  - Noise Abatement
  - ATC Altitude Crossing Requirements
- **Continuous Descent**
- **Idle Power Descent**
- **Keep aircraft within the expected descent profile.**

# TAILORED ARRIVAL UPLINK

A COMPLEX 4D  
TRAJECTORY  
PROFILE  
CLEARANCE IS  
UPLINKED TO  
THE AIRCRAFT  
FMS





# Tailored Arrival Route Clearance

- Element One: Clearance Name

CLEARANCE

AN23C

5126N17258E 0833/ 4637N17425E 0908/ 4030N17536E 0952/ 3401N17626E 1039/ 2719N17519E 112.

Urgent	Rpt	Negot	Rspn	Misc	Vert	Route	Speed	X-ing	Conn							
RP	RR	climb	@Time	@Fix	↳Time	↳Fix	↳DSCND	@Time	@Fix	↳Time	↳Fix	CROSS	XAOA	XAOB	NDA	HOLD

(169) (freetext) PACIFIC TWO TA

INS

DEL

PRB

CAN

TPRB

SND

UNREL

VHF

SAVE

EALT

OVRD

COORD

ACPT

REJ

HLP

CLS

# Tailored Arrival Clearance

- Controller constructs the TA clearance using MOPS Element 83 Route Clearance

CLEARANCE

ANZ3C 5126N17258E 2308/ 4637N17425E 2343/ 4030N17536E 0027/ 3401N17626E 0113/ 2517N17658E 0211

Urgent	Rpt	Negot	Rspn	Misc	Vert	Route	Speed	X-ing	Conn				
RP	RR	Climb	QTime	QFix	bTime	bFix	DSCN	ATC_CLEARANCE	CROSS	AOA	AOB	NDA	HOLD

73 AT (time) CLEARED (rte clr) ALT (alt) FREQ (freq) SSR (beacon code)

79 CLEARED TO (pos) (rte clr)

80 CLEARED (rte clr)

83 AT (pos) CLEARED (rte clr)

74 PROCEED DIRECT TO (pos)

76 AT (time) PROCEED DIRECT TO (pos)

77 AT (pos) PROCEED DIRECT TO (npos)

PRD CAN TPRD S

# Tailored Arrival Clearance

Route Information

Departure Airport :

Arrival Airport : **KSFO**

Departure Runway :

Arrival Runway : **28R**

Departure Procedure :

Approach Procedure : **ILS28R MENLO**

Arrival Procedure :

Intercept Course :

Route :

**CINNY 3657N12335W/F250B RAINS/F210B  
PIRAT/N0250A150B BRINY/N0250A120B  
3722N12223W/A060A OSI MENLO/N0210A040A**

OK Reset Copy Cancel



# Tailored Arrival Route Clearance

- **The clearance is constructed to clear the flight via the TA route and to maintain current altitude.**
- **The clearance is probed for conflicts and then sent to the aircraft.**

CLEARANCE																
<b>ANZ3C</b>	5126N17258E 0833/ 4637N17425E 0908/ 4030N17536E 0952/ 3401N17626E 1039/ 2719N17519E 1127															
Urgent	Rpt	Negot	Rspn	Misc	Vert	Route	Speed	X-ing	Conn							
RP	RR	Climb	@Time	@Fix	bTime	bFix	DSCND	@Time	@Fix	bTime	bFix	CROSS	AOA	AOB	NDA	HOLD
<div style="display: flex; justify-content: space-between;"> <div> <p>(169) (freetext) PACIFIC TWO TA</p> <p>(83) AT COSTS CLEARED ROUTE</p> <p>(19) MAINTAIN F330</p> </div> <div style="border: 1px solid #ccc; padding: 5px; text-align: center;"> <p>INS</p> <p>DEL</p> </div> </div>																
<div style="display: flex; justify-content: space-between; padding: 5px;"> <span>PRB</span> <span>CAN</span> <span>TPRB</span> <span>SND</span> <span>UNDEL</span> <span>VNF</span> <span>SAVE</span> <span>EALT</span> <span>DVRD</span> <span>COORD</span> <span>RCPT</span> <span>REJ</span> <span>HLP</span> <span>CLS</span> </div>																

# TAILORED ARRIVAL UPLINK

- Tailored Arrivals enable VNAV path to the Localizer.
- FMS determines most efficient aircraft descent profile



# TA Radar Vectoring/Routing

- **The goal of the controller is to let the aircraft fly the TA without intervention, however at times it may be necessary to change an aircraft's flight path. To do this, the controller must:**
  - Issue a radar vector for traffic.
  - When the vector is complete or to shortcut an aircraft, the following instructions are issued:
    - "Call Sign, cleared direct (waypoint on the TA) the remainder of the Pacific Two TA. Comply with Restrictions."

# Termination of Tailored Arrival

- **At any time the Tailored Arrival may be terminated by the aircraft or ATC.**
- **If the flight crew replies “UNABLE” to any TA clearance, or requests cancellation of the TA, the TA is terminated for that flight.**
- **If the Tailored Arrival is terminated.**
  - Advise the aircraft “Tailored Arrival is terminated”. Issue a new Route and Altitude clearance to the aircraft.
- **Notify the downstream controller of OTA cancellation.**

# Fuel Savings from Top of Descent Cruise to Landing

	777-200/GE90-85B	747-400/PW4056
Full TA	1,303 lbs	2,291 lbs
Partial TA	379 lbs	1,100 lbs

- Fuel consumption was calculated using the Boeing Climbout Program (BCOP) for low speed performance below 10,000 ft altitude.
- Fuel consumption above 10,000 ft altitude was calculated using the Boeing INFLT tool for cruise and descent.
- The vertical profile generated from BCOP and INFLT was matched to the mean descent paths of the collective ANOMS8 radar data.



# GOLD

## Dynamic Airborne Reroute Procedure (DARP)



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# Dynamic Airborne Reroutes

- **Allows Airborne Rerouting of Aircraft When Winds Indicate a More Fuel Efficient Route is Available**
- **Reduce Operating Costs by Taking Advantage of Updated Winds**
- **FANS and Air Traffic Services Inter-facility Data Communications (AIDC) Required**
- **Ongoing Trials in the South Pacific**

# Dynamic Airborne Reroute Procedure



ZOA

AOC

Dynamic Reroute

User Preferred Route

Auckland



# Dynamic Airborne Reroutes

ZSE,  
ZOA,  
ZLA



RJTG

DARPS have  
saved flights 2000  
pounds of fuel burn  
and 7 minutes  
flying time

YBBB

NFFF

NZZO

NTTT

# ADS-C CDP Clearances

Procedure is based on in-trail Distance Measuring Equipment (DME) rules in ICAO Doc 4444, paragraph 5.4.2.3.2.

□ **UAL892** \*3  
◦ 340 ↑ 360  
◦ N561

□ **AAR202**  
◦ 350  
◦ N549  
□ **AAR2**  
◦ 370  
◦ N533

\*Near Simultaneous ADS-C Demand Reports

\*Climb/Descend an aircraft through the altitude of a blocking aircraft

□ **CPA870** \*3  
◦ 350  
◦ N555

□ **AAR2821**  
◦ 340  
◦ N564





