Oceanic and Offshore Operations Support Group

Arrival Procedures- From Standard to Tailored Arrivals

Presented to: **LAX /Community Noise Roundtable**

By: **Steve Pinkerton, FAA**

Date: **10 July 2013**

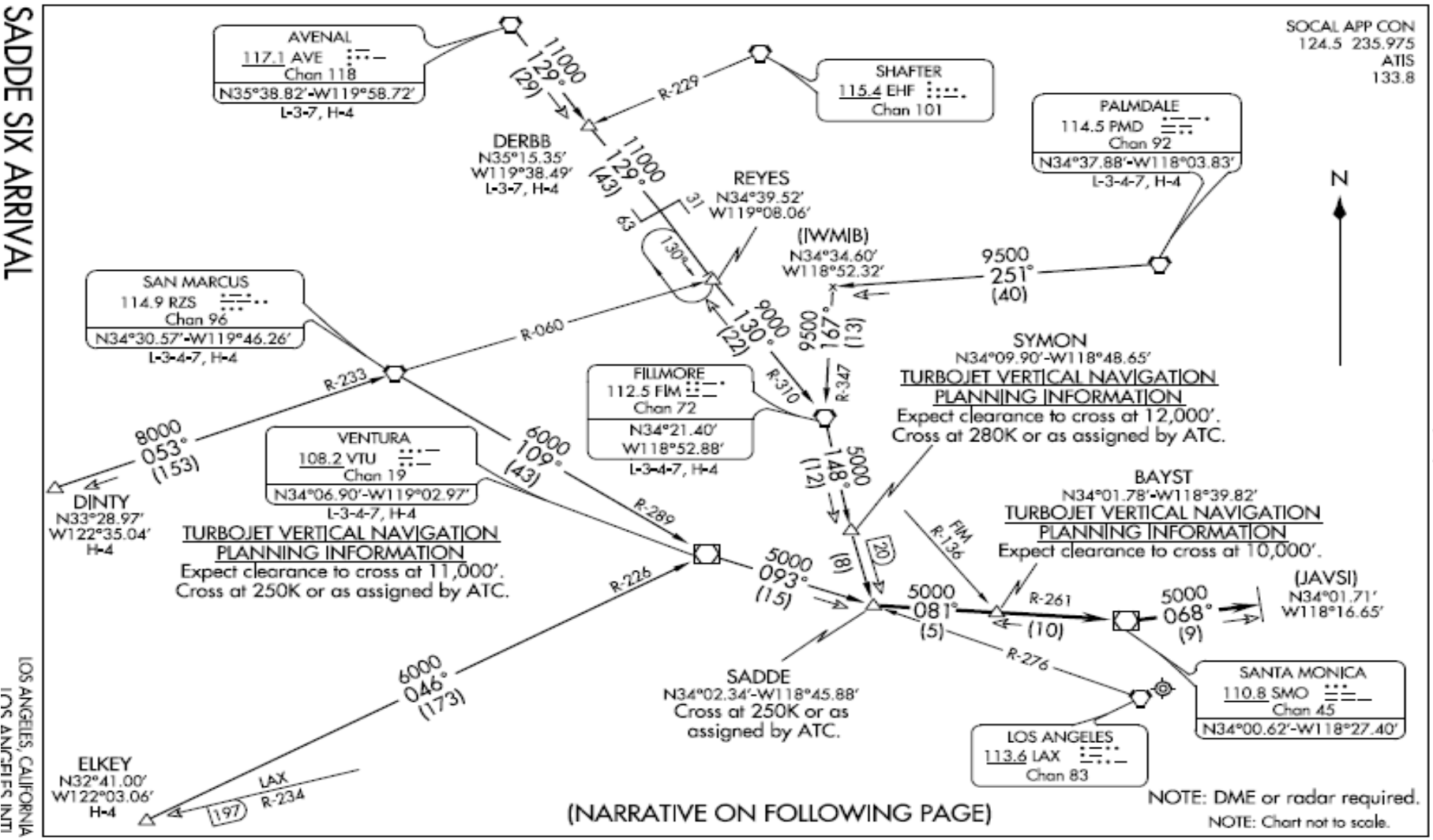
Arrival Procedures

- **Historically, arrival procedures designed with constraints related to traffic and aircraft capabilities**
  - Consider major traffic flows for both arriving and departing aircraft. Often have restrictions associated with traffic or procedural requirements
  - Environmental impact considered
  - Designed to ensure that a variety of aircraft can fly procedure, from basically equipped to the most modern equipped
  - Result has been safe arrival procedures but maybe not the most efficient from various standpoints

Standard Terminal Arrival (STAR)

- **Most common type of arrival procedure**
- **Has a defined lateral track**
- **Contains expected altitude and speed restrictions**
- **Generally, not designed as continuous descent procedure**
- **Can be flown by aircraft with various navigational capabilities**

Example of a STAR



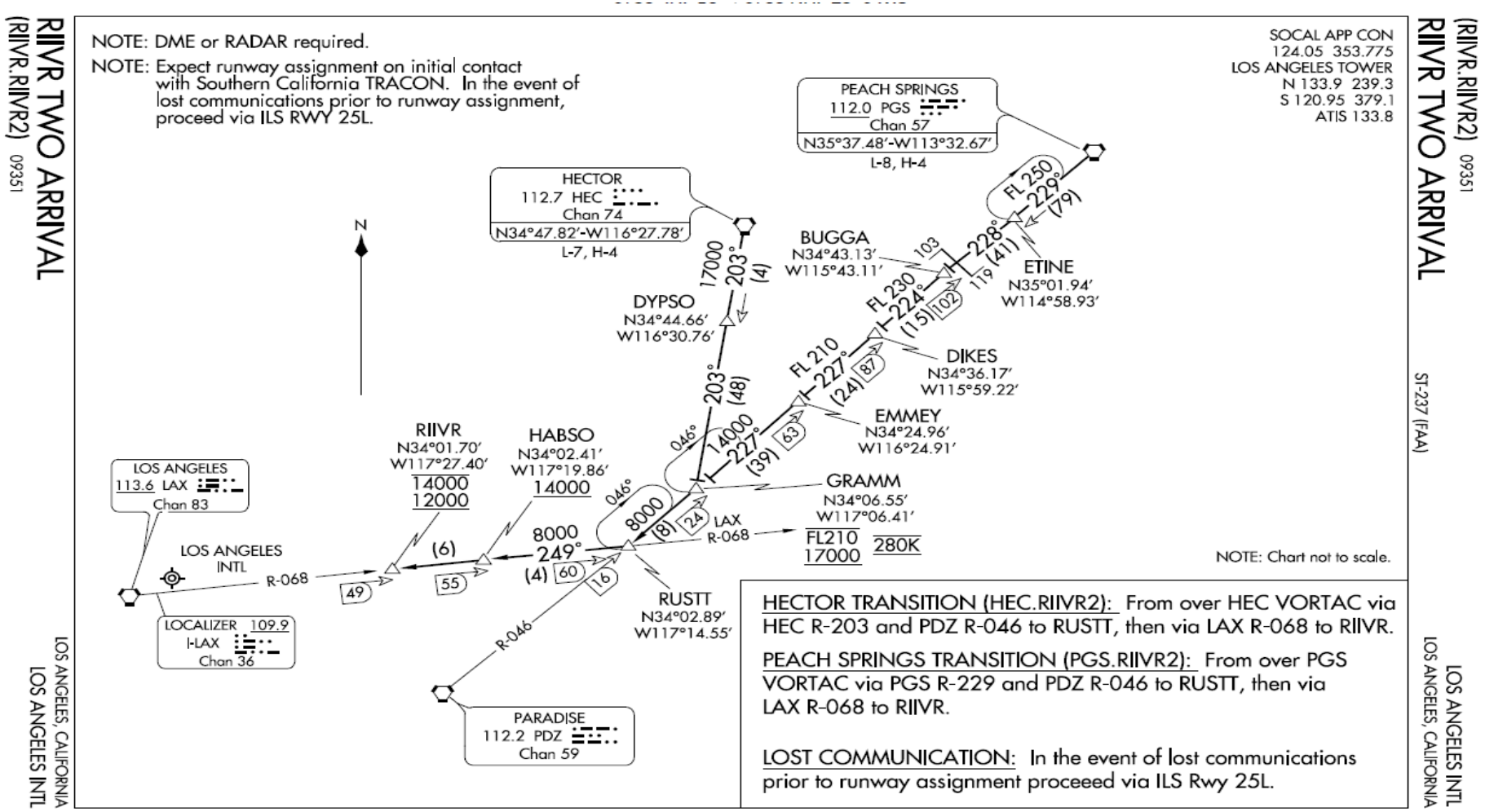
Continuous Descent Operations (CDO's)- Improved Arrival Procedures

- **Modern navigational capabilities have made more efficient arrival procedures a possibility**
- **CDO is a generic term that encompasses several different types of procedures. These procedures designed to allow aircraft to descend continuously, with minimal thrust**
  - Result is reduction in noise, fuel burn, and emissions

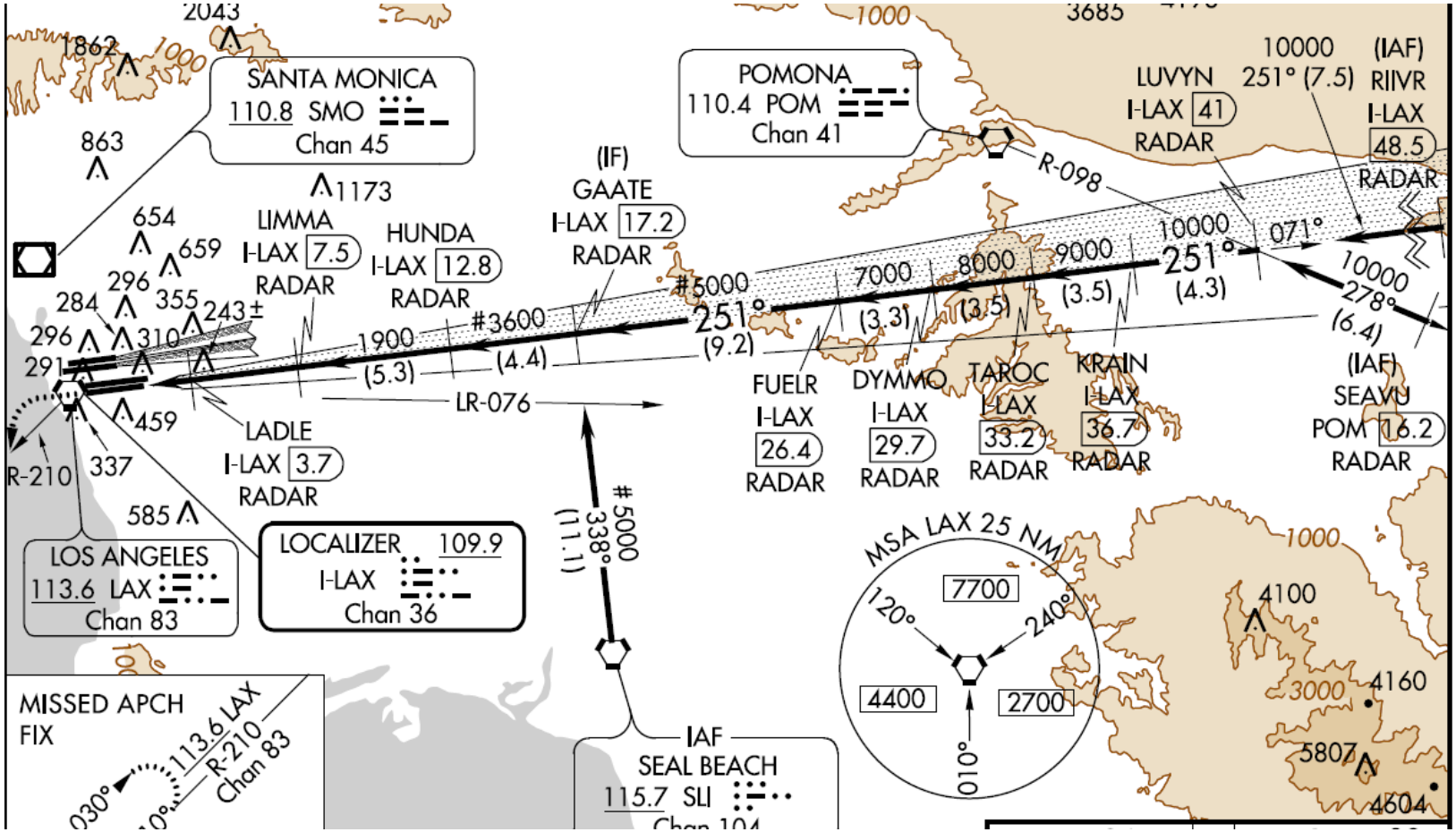
Optimized Profile Descent (OPD)

- **OPD's are a descent profile normally associated with a published standard terminal arrival (STAR).**
- **Designed to allow maximum practical use of a CDO. Considers the following:**
  - Airspace and ATC constraints
  - Traffic
  - Environment
  - Aircraft capabilities
  - Local airport issues
- **Seeing more frequent implementation**
  - Most modern aircraft equipped and able to fly
  - Used at numerous airports throughout country

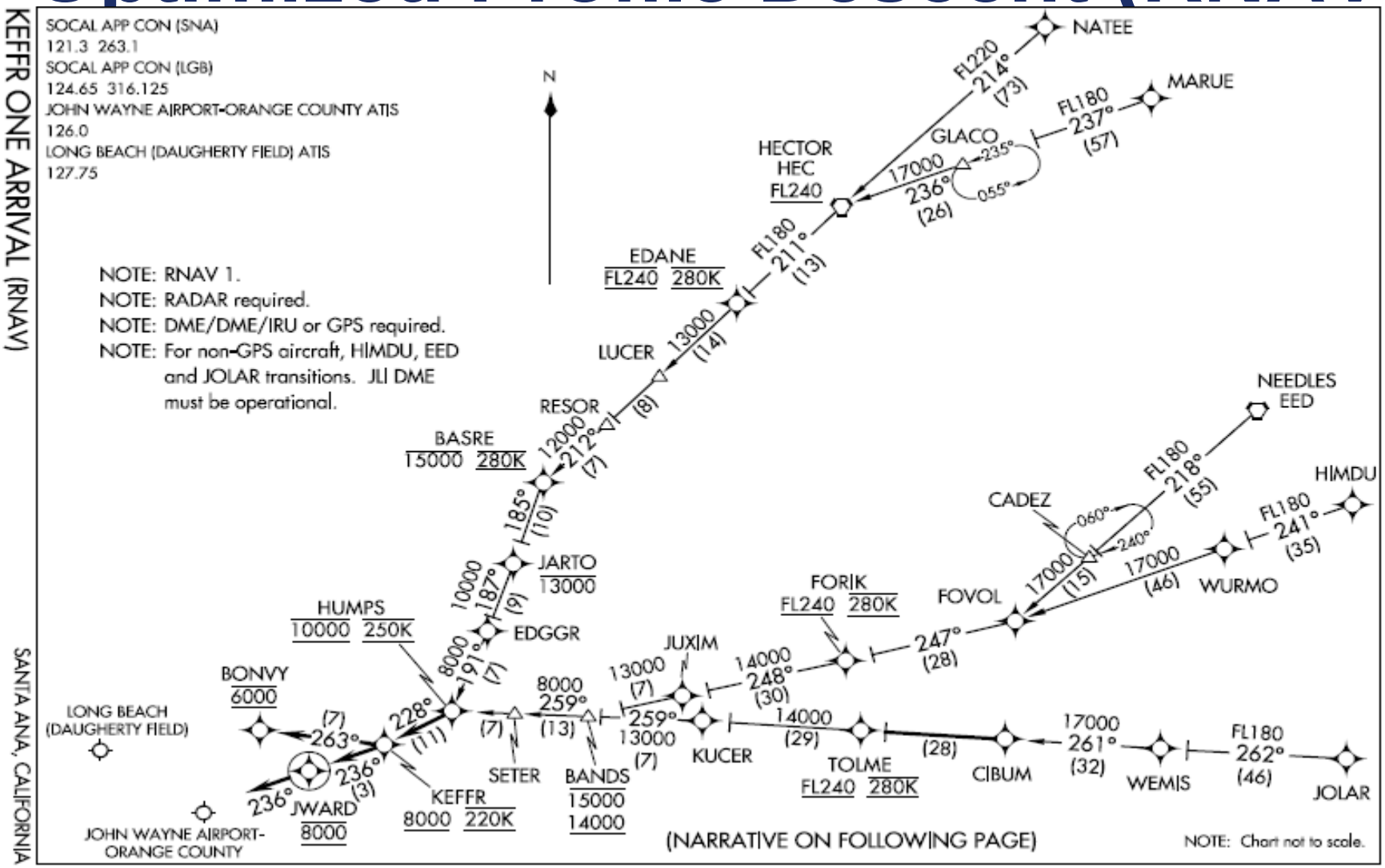
RIIVR STAR


RIIVR TWO ARRIVAL
(RIIVR.RIIVR2) 09351
LOS ANGELES, CALIFORNIA
LOS ANGELES INTL
NOTE: DME or RADAR required.
NOTE: Expect runway assignment on initial contact with Southern California TRACON. In the event of lost communications prior to runway assignment, proceed via ILS RWY 25L.
SOCAL APP CON
124.05 353.775
LOS ANGELES TOWER
N 133.9 239.3
S 120.95 379.1
ATIS 133.8
PEACH SPRINGS
112.0 PGS
Chan 57
N35°37.48'-W113°32.67'
L-8, H-4
HECTOR
112.7 HEC
Chan 74
N34°47.82'-W116°27.78'
L-7, H-4
BUGGA
N34°43.13'
W115°43.11'
ETINE
N35°01.94'
W114°58.93'
DYPSO
N34°44.66'
W116°30.76'
DIKES
N34°36.17'
W115°59.22'
EMMEY
N34°24.96'
W116°24.91'
GRAMM
N34°06.55'
W117°06.41'
RIIVR
N34°01.70'
W117°27.40'
HABSO
N34°02.41'
W117°19.86'
RUSTT
N34°02.89'
W117°14.55'
PARADISE
112.2 PDZ
Chan 59
LOS ANGELES
113.6 LAX
Chan 83
LOS ANGELES INTL
LOCALIZER 109.9
I-LAX
Chan 36
FL250
229°
(79)
228°
(41)
FL230
224°
(15)
FL210
227°
(24)
227°
(39)
203°
(48)
203°
(4)
17000
14000
14000
12000
14000
8000
249°
(4)
8000
(8)
(6)
046°
046°
R-068
R-068
R-046
103
119
102
87
53
24
60
55
49
16
FL210
17000
280K
NOTE: Chart not to scale.
HECTOR TRANSITION (HEC.RIIVR2): From over HEC VORTAC via HEC R-203 and PDZ R-046 to RUSTT, then via LAX R-068 to RIIVR.
PEACH SPRINGS TRANSITION (PGS.RIIVR2): From over PGS VORTAC via PGS R-229 and PDZ R-046 to RUSTT, then via LAX R-068 to RIIVR.
LOST COMMUNICATION: In the event of lost communications prior to runway assignment proceeed via ILS Rwy 25L.
ST-237 (FAA)

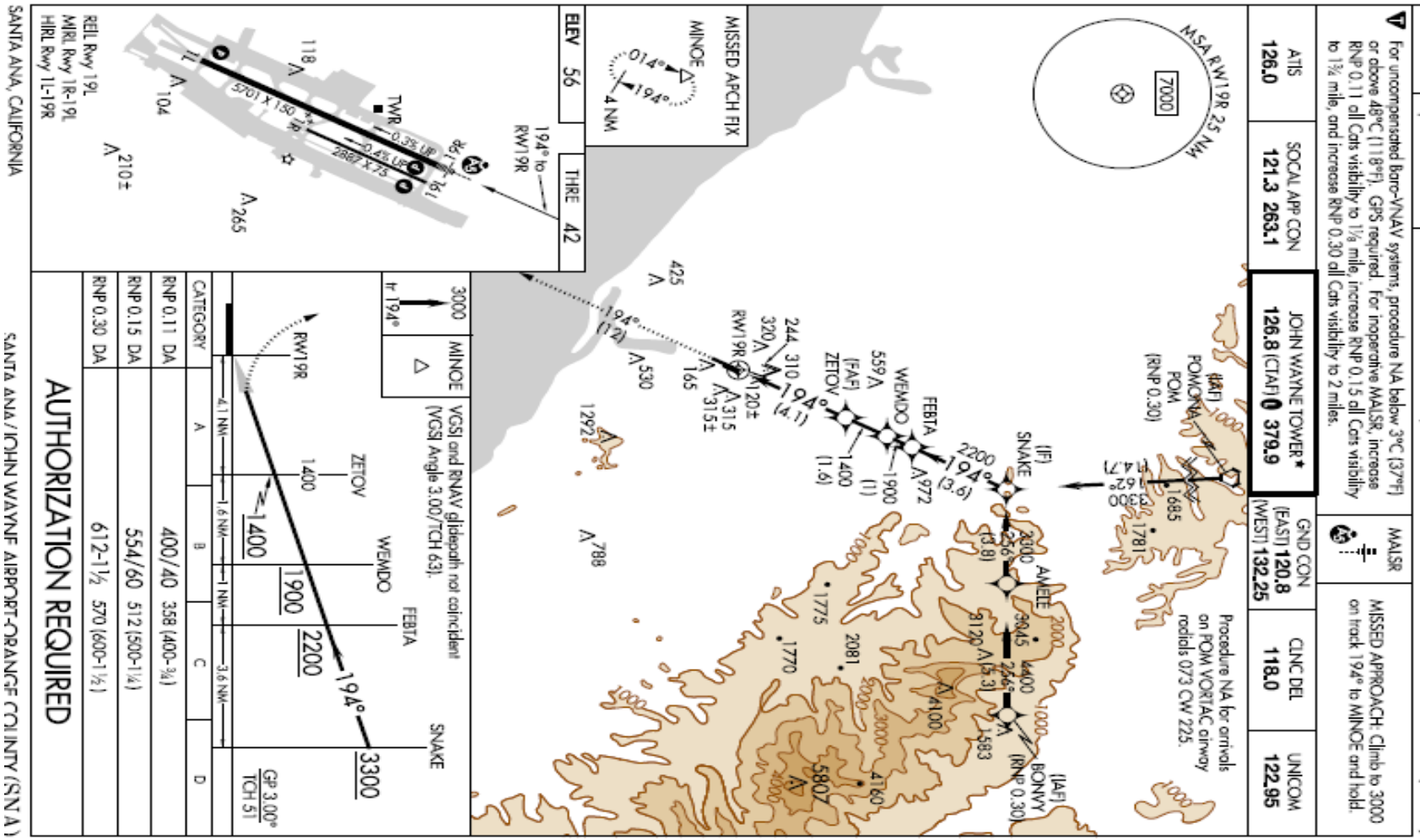
ILS 25 Left


SANTA MONICA
110.8 SMO
Chan 45
POMONA
110.4 POM
Chan 41
LUVYN
I-LAX 41
RADAR
10000
251° (7.5)
(IAF)
RIIVR
I-LAX
48.5
RADAR
(IF)
GAATE
I-LAX 17.2
RADAR
LIMMA
I-LAX 7.5
RADAR
HUNDA
I-LAX 12.8
RADAR
R-098
#5000
#3600
1900
(5.3)
(4.4)
251°
(9.2)
7000
(3.3)
8000
(3.5)
9000
(3.5)
10000
251°
(4.3)
071°
10000
278°
(6.4)
LR-076
FUELR
I-LAX
26.4
RADAR
DYMMO
I-LAX
29.7
RADAR
TAROC
I-LAX
33.2
RADAR
KRAIN
I-LAX
36.7
RADAR
(IAF)
SEAVU
POM 16.2
RADAR
LADLE
I-LAX 3.7
RADAR
R-210
337
LOS ANGELES
113.6 LAX
Chan 83
LOCALIZER 109.9
I-LAX
Chan 36
#5000
338°
(11.1)
MSA LAX 25 NM
7700
120°
240°
4400
2700
010°
MISSED APCH
FIX
113.6 LAX
R-210
Chan 83
030°
IAF
SEAL BEACH
115.7 SLI
Chan 104

Optimized Profile Descent (RNAV)



RNAV(RNP) Transition to SNA

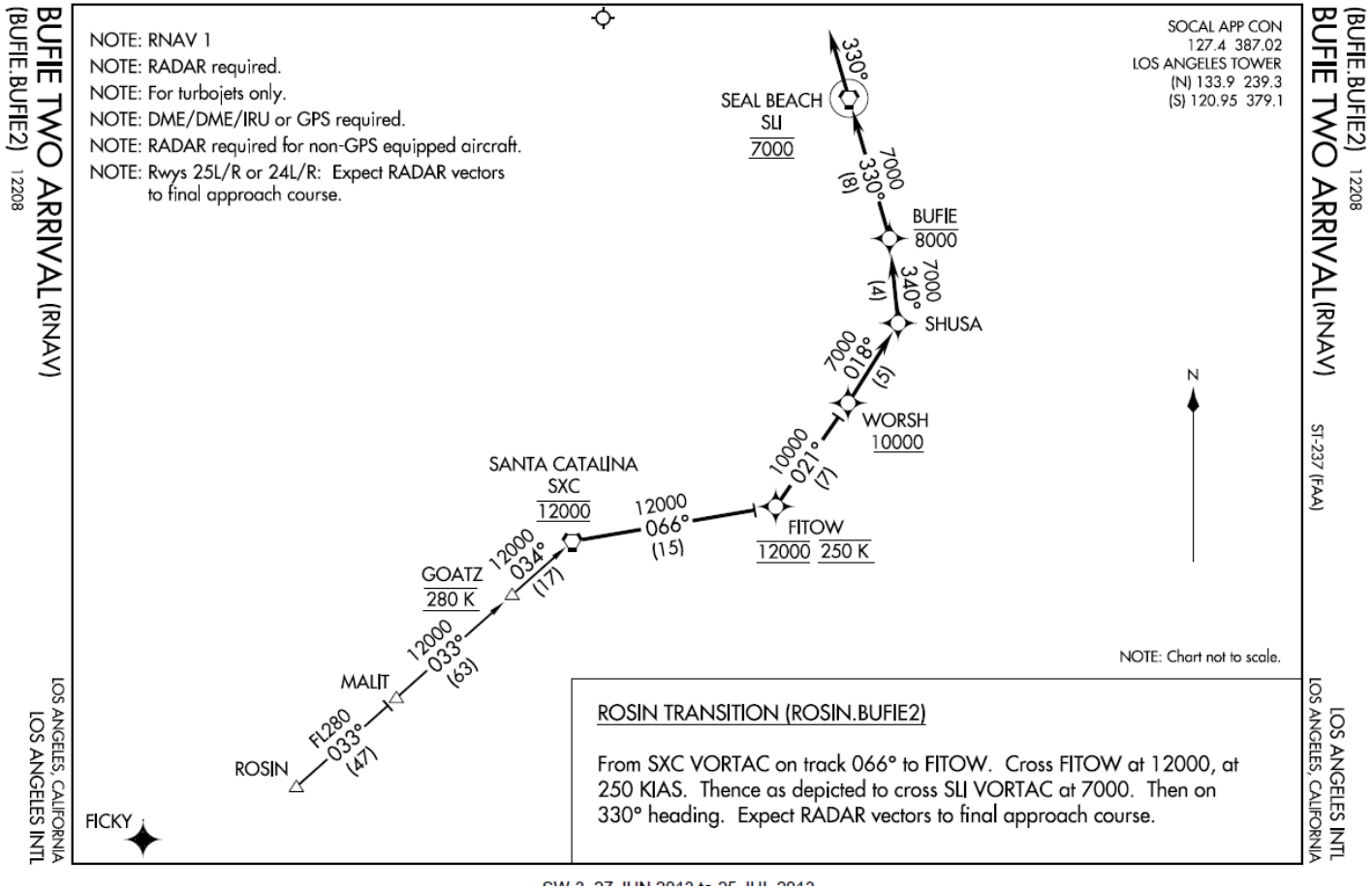


Tailored Arrival

- **Tailored Arrivals (TA)**
  - Similar concept to OPD, except a non-published, dynamic procedure
  - "Tailored" for traffic, environment, time, etc.
    - In current practice, "static"
  - Sent to aircraft from controller via Controller Pilot Data Link Communication (CPDLC)
  - Currently in an operational trial phase for Oceanic flights arriving at SFO, LAX, and MIA
    - Trial at MIA suspended- training/airspace issues
    - At LAX, only arrivals routed over SXC

LAX Tailored Arrival

BUFIE STAR

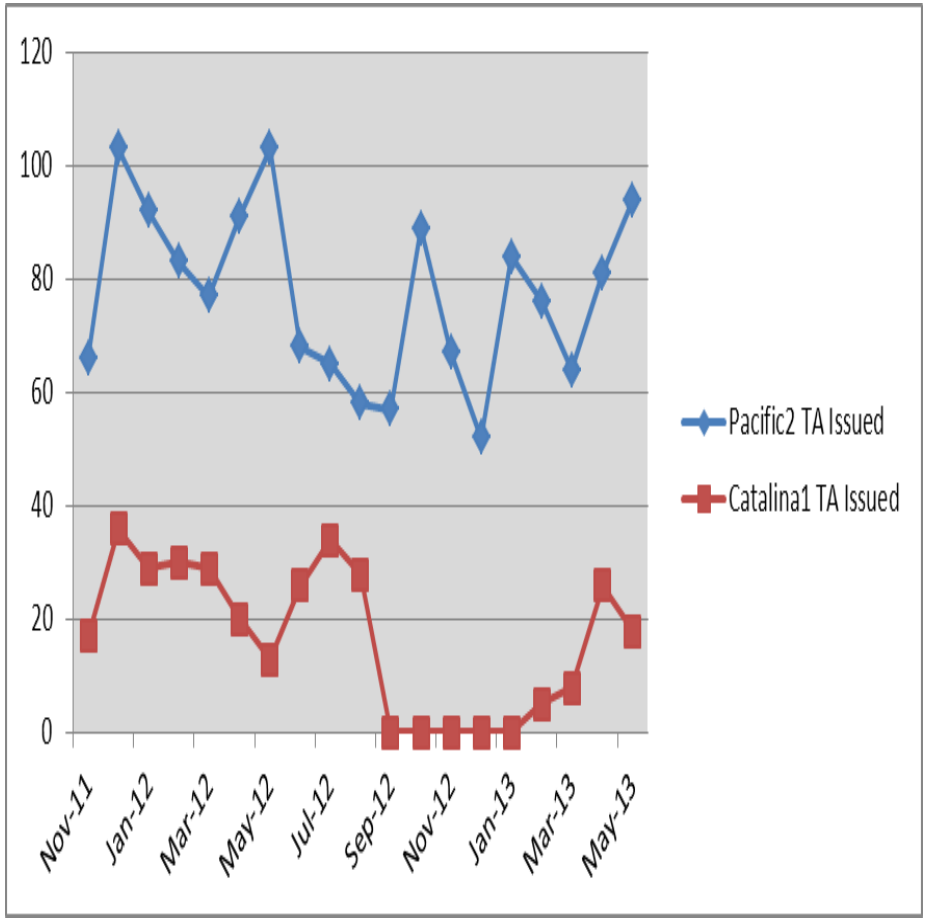

BUFIE TWO ARRIVAL (RNAV)
(BUFIE.BUFIE2) 12208
LOS ANGELES, CALIFORNIA
LOS ANGELES INTL
NOTE: RNAV 1
NOTE: RADAR required.
NOTE: For turbojets only.
NOTE: DME/DME/IRU or GPS required.
NOTE: RADAR required for non-GPS equipped aircraft.
NOTE: Rwys 25L/R or 24L/R: Expect RADAR vectors to final approach course.
SOCAL APP CON
127.4 387.02
LOS ANGELES TOWER
(N) 133.9 239.3
(S) 120.95 379.1
SEAL BEACH
SLI
7000
330°
7000
330°
(8)
BUFIE
8000
7000
340°
(4)
SHUSA
7000
018°
(5)
WORSH
10000
10000
021°
(7)
FITOW
12000 250 K
12000
066°
(15)
SANTA CATALINA
SXC
12000
12000
034°
(17)
GOATZ
280 K
12000
033°
(63)
MALIT
FL280
033°
(47)
ROSIN
FICKY
N
NOTE: Chart not to scale.
ROSIN TRANSITION (ROSIN.BUFIE2)
From SXC VORTAC on track 066° to FITOW. Cross FITOW at 12000, at 250 KIAS. Thence as depicted to cross SLI VORTAC at 7000. Then on 330° heading. Expect RADAR vectors to final approach course.
(BUFIE.BUFIE2) 12208
BUFIE TWO ARRIVAL (RNAV)
ST-237 (FAA)
LOS ANGELES INTL
LOS ANGELES, CALIFORNIA

Catalina 1 TA vs. BUFIE STAR

- **Both fly along the same ground track**
- **Current airspace design necessitates use of altitude restrictions to ensure separation from other traffic**
- **At present, aircraft on either arrival essentially fly the same descent profile after SXC**

LAX vs. SFO TA Use

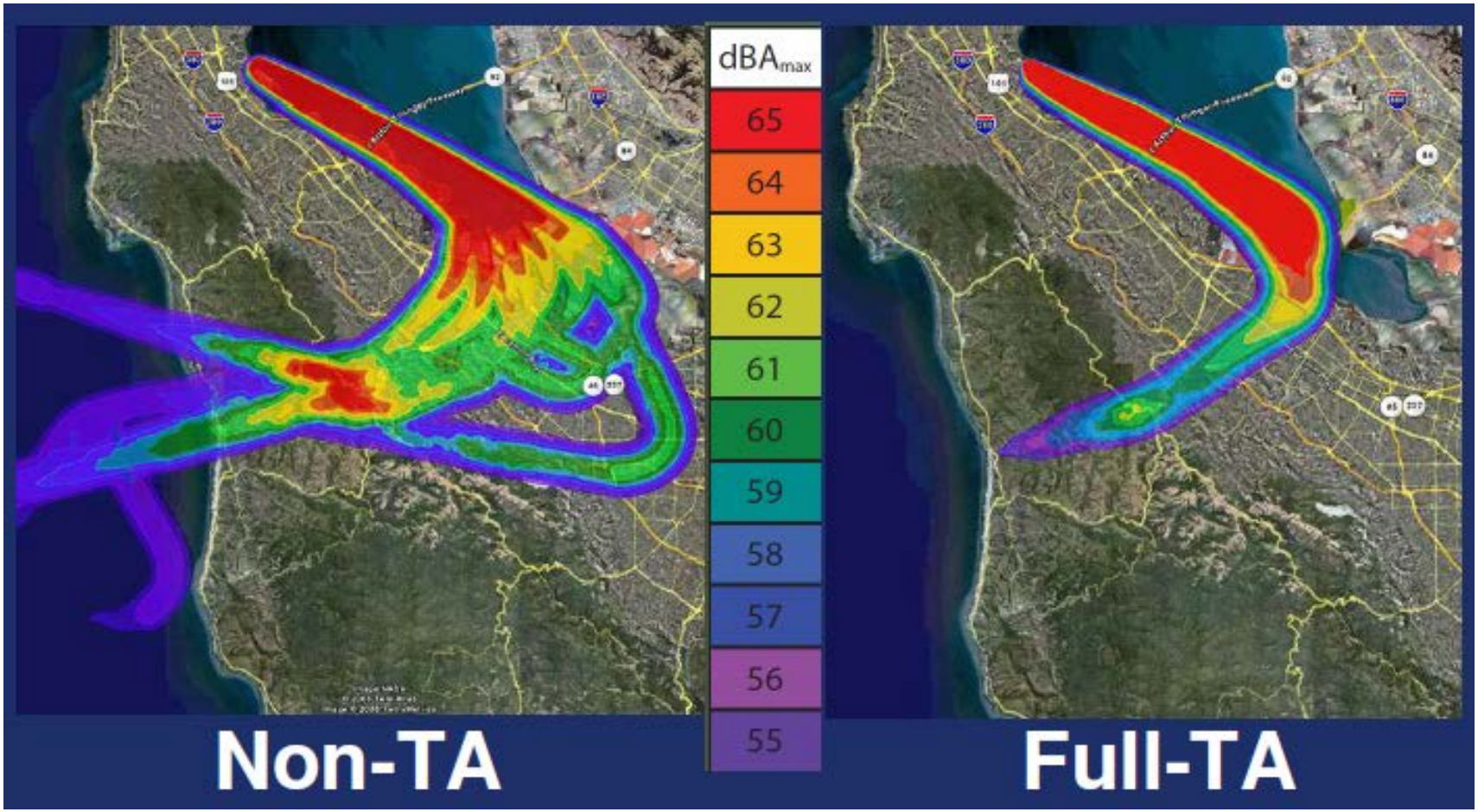
- **At SFO, approx. 33% of aircraft on a TA fly a full TA**
- **Arrivals assigned a TA arriving at LAX fly a partial TA**
- **SFO has opened trial to multiple airlines**
- **LAX trial limited to United, Air New Zealand, and Qantas**



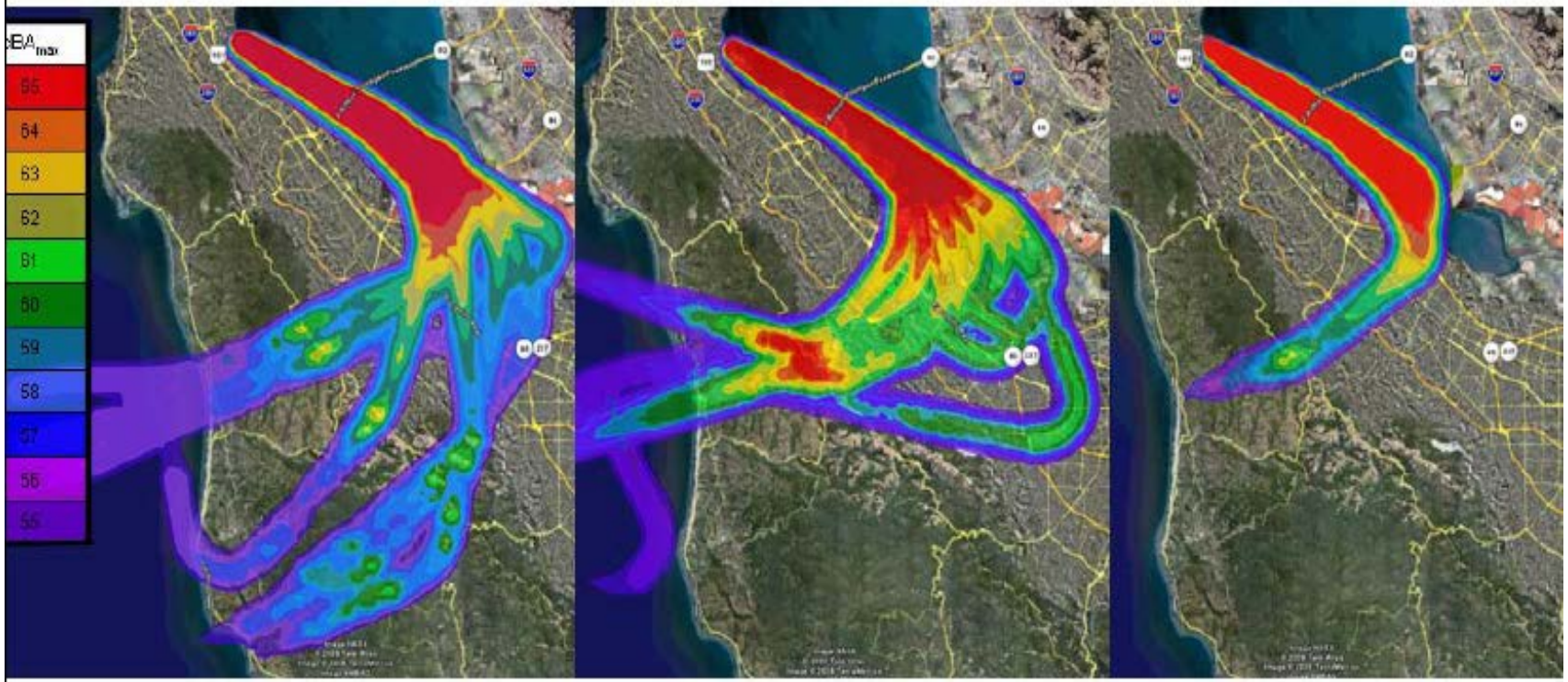
Benefits of TA's and OPD's

- **Noise Reduction**
  - Aircraft descending at optimal flight profile
  - Pilot advised of speed to maintain in descent
    - Flight Management System compensates for speeds and adjusts descent accordingly
  - Descent conducted at flight idle
    - Minimal power adjustments until final
  - Bottom line- Optimal descent profile + minimal power adjustments= less noise

SFO TA Noise Contours



SFO TA Noise Contours (Boeing Technology/Phantom Works)



Partial Tailored Arrival

Non Tailored Arrival

Tailored Arrival

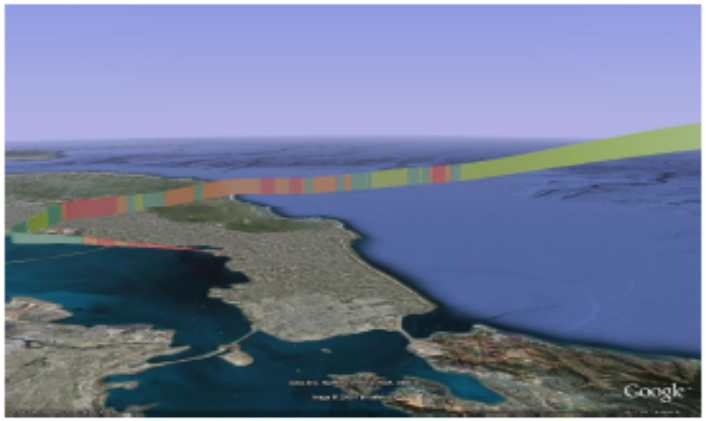
Benefits of TA's and OPD's

- **Fuel Savings**
  - Full tailored arrivals may save 2100+ lbs. (350+ gals.)of fuel per flight. Cost savings near $1 mil. annually
  - Partial TA's may save 660+ lbs. (110+ gals.) of fuel per flight. Cost savings of $300k+ annually
    - Data from Boeing Research and Technology, 2009 and based on B777-200 and B747-400 aircraft
  - OPD's may see savings of 300+ lbs. (50+ gals.) per flight. Cost savings of
    - One reason for difference between OPD's and TA's may be fleet mix
      - Different type aircraft and engines

SFO Non-Tailored Arrival

QF73 SYD-SFO 17 May 2009

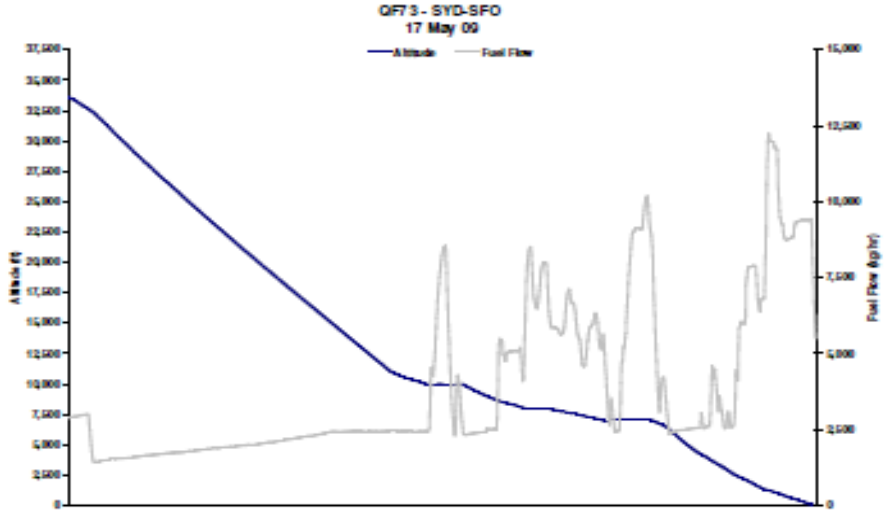
Non-Tailored Arrival



Fuel Flow
(kg/hr)

- < 2500
- 2500-5000
- 5000-7500
- >7500

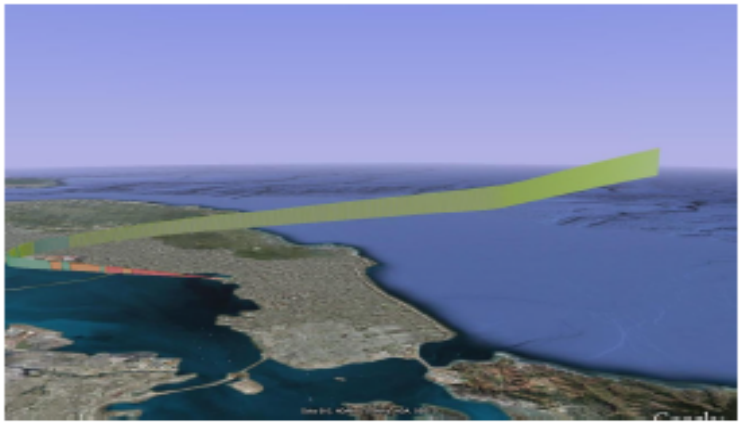
ZFW (*'000kg*)	Time from 32,500 ft (*mins*)	Fuel from 32,500 ft (*kg*)
230.2	26	1,680



SFO Tailored Arrival

QF73 SYD-SFO 20 May 2009

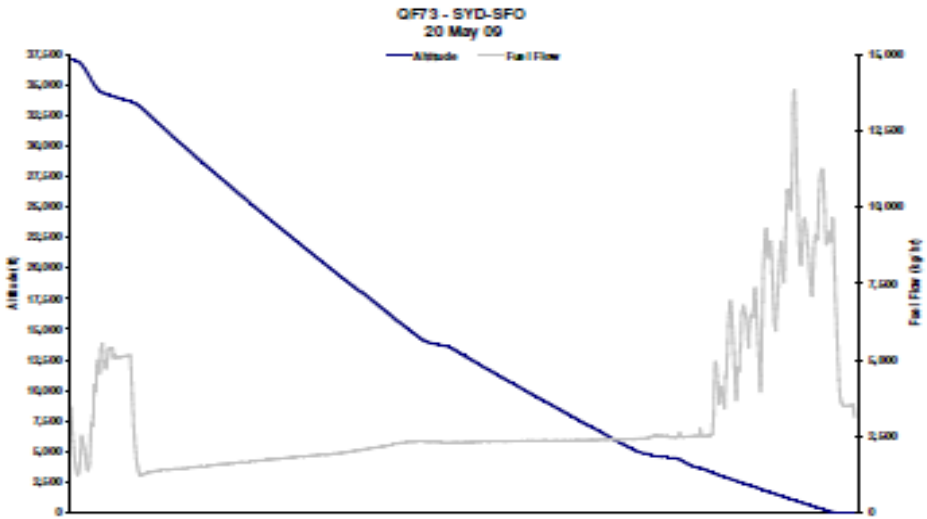
Tailored Arrival



Fuel Flow
(kg/hr)

< 2500
2500-5000
5000-7500
>7500

ZFW ('000kg)	Time from 32,500 ft (mins)	Fuel from 32,500 ft (kg)
236.1	24	1,220



Benefits of TA's and OPD's

- **Greenhouse Gas Emissions**

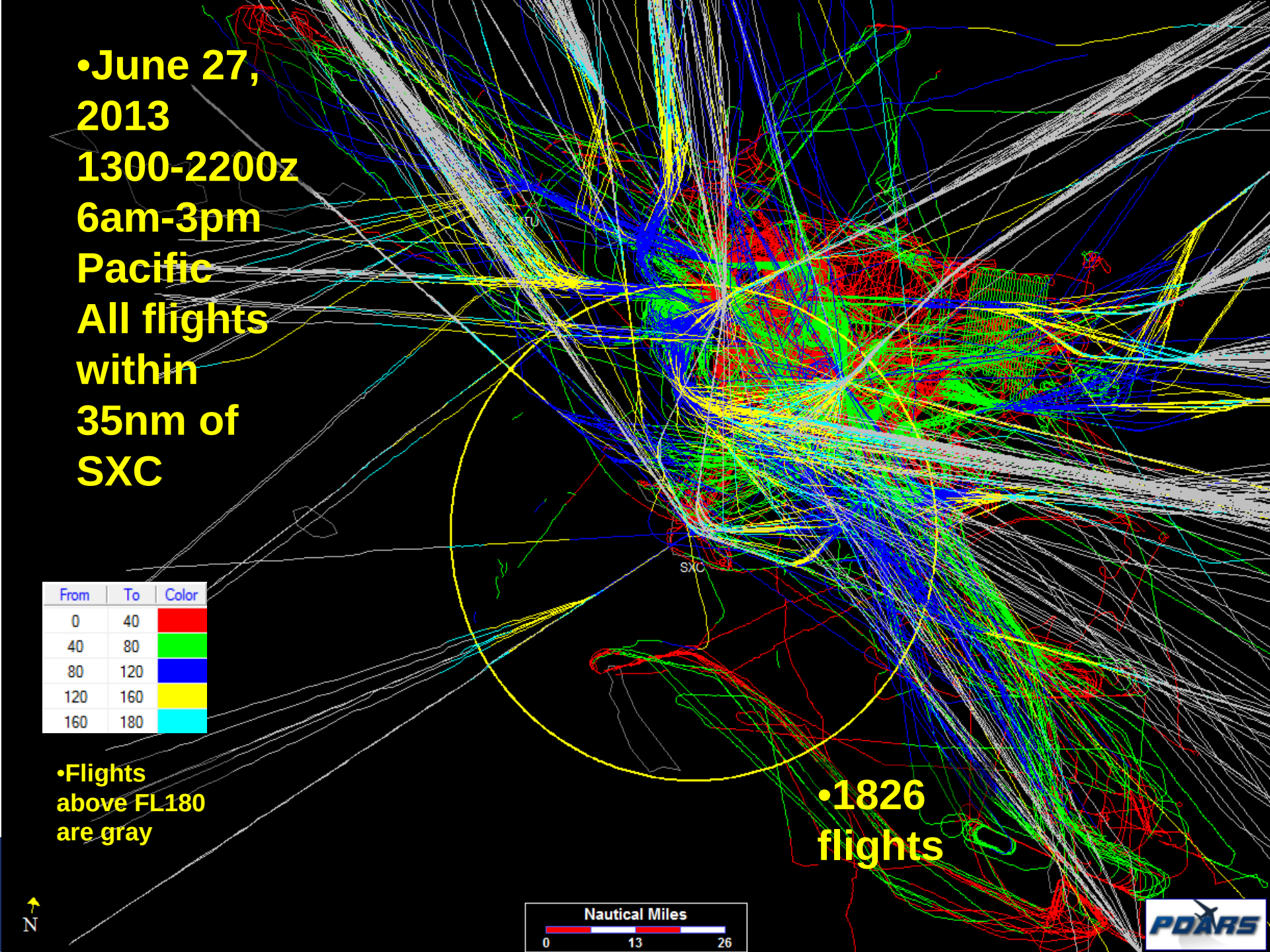
Type of Arrival	Annual CO2 Emissions Saved
Full TA	2,718,630 lbs.
Partial TA	854,867 lbs.
OPD	385,075 lbs.

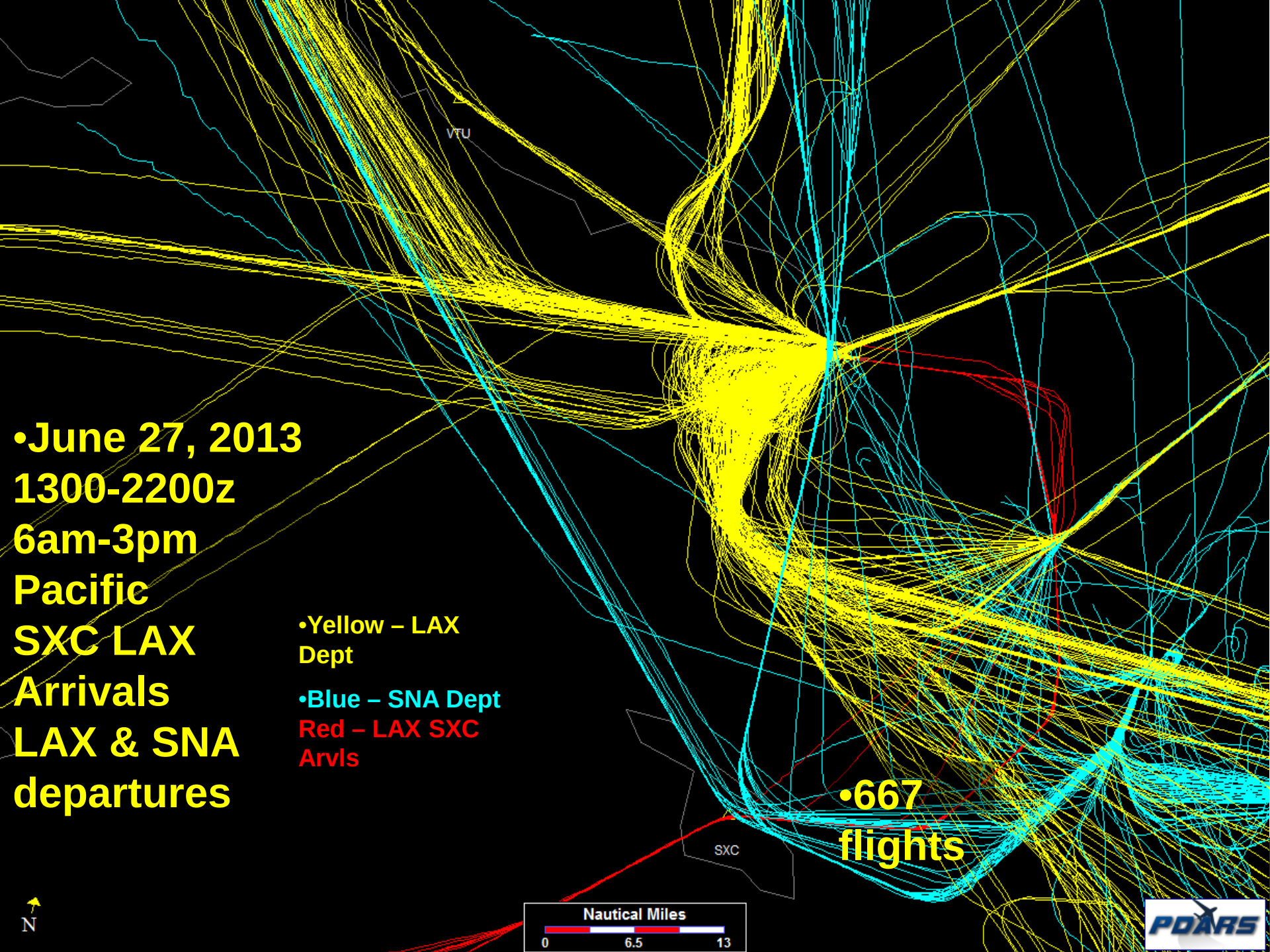
Why aren't TA's and OPD's everywhere?

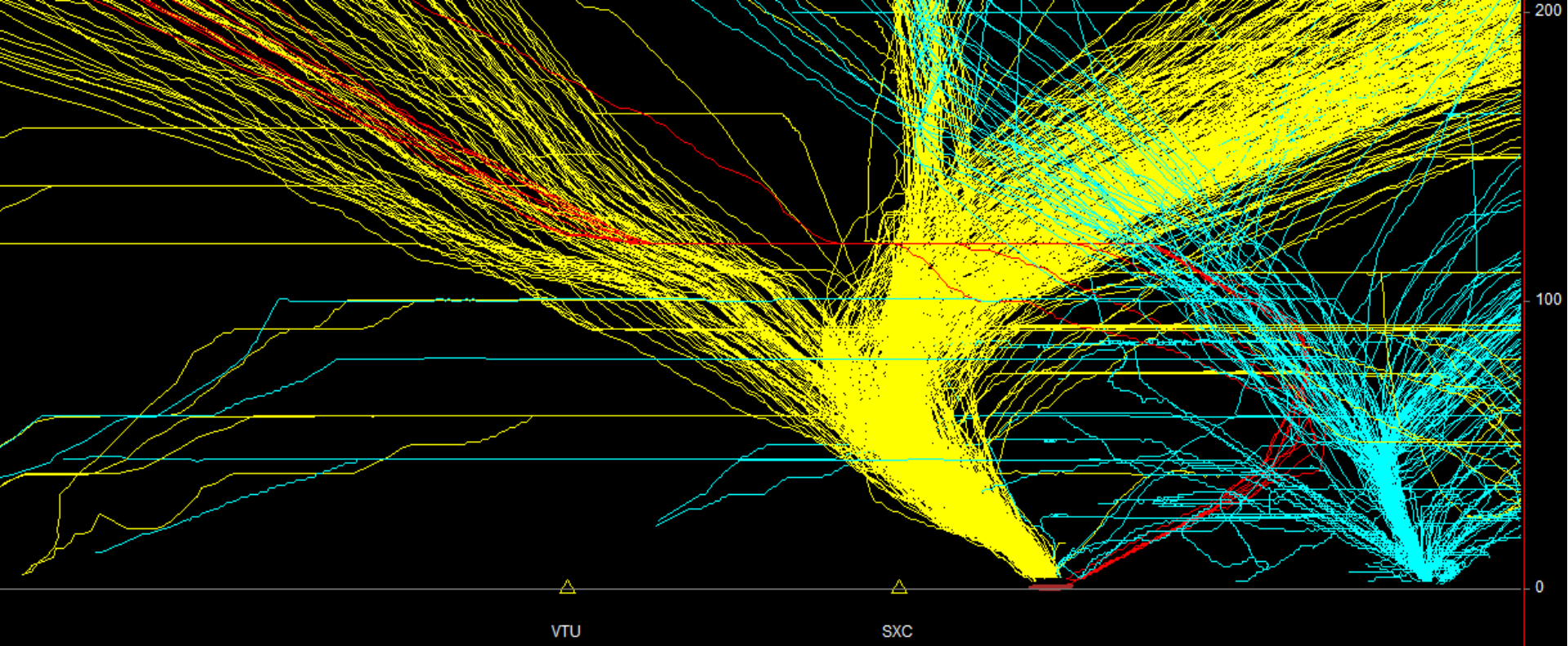
- **Equipment/Other**
  - Tailored arrivals require special equipment for aircraft (FANS 1/A, CPDLC)
    - Approx. 85% of flights from SoPac are equipped
    - Approx. 25% of flights in CEP equipped
  - Domestic En Route facilities currently not able to do CPDLC, which is required for TA's
  - Pilot requested procedure
    - If pilot doesn't request, they get BUFIE STAR to LAX
- **Training**
  - Controller and pilot training
    - Current issue with controller phraseology being addressed

Why aren't TA's and OPD's everywhere?

- **Airspace Design and Traffic Management Issues**
  - Current airspace design in LA Basin presents significant challenge to full TA's and OPD's
    - Multiple confliction points for Basin departures and arrivals
  - Full TA to runway and OPD's require very specific airspace procedures and rules to work
  - Due to the dynamic nature of air traffic, continued development of procedures and controller tools, such as Time Based Metering (TBM), need to continue


•June 27, 2013
1300-2200z
6am-3pm Pacific
All flights within 35nm of SXC
SXC
From | To | Color
0 | 40
40 | 80
80 | 120
120 | 160
160 | 180
•Flights above FL180 are gray
•1826 flights
N
Nautical Miles
0
13
26
PDARS


VTU
SXC
•June 27, 2013
1300-2200z
6am-3pm
Pacific
SXC LAX
Arrivals
LAX & SNA
departures
•Yellow – LAX Dept
•Blue – SNA Dept
Red – LAX SXC Arvls
•667 flights
N
Nautical Miles
0
6.5
13
PDARS



•June 27, 2013
1300-2200z
6am-3pm
Pacific
SXC LAX
Arrivals
LAX & SNA
departures

•Yellow – LAX Dept

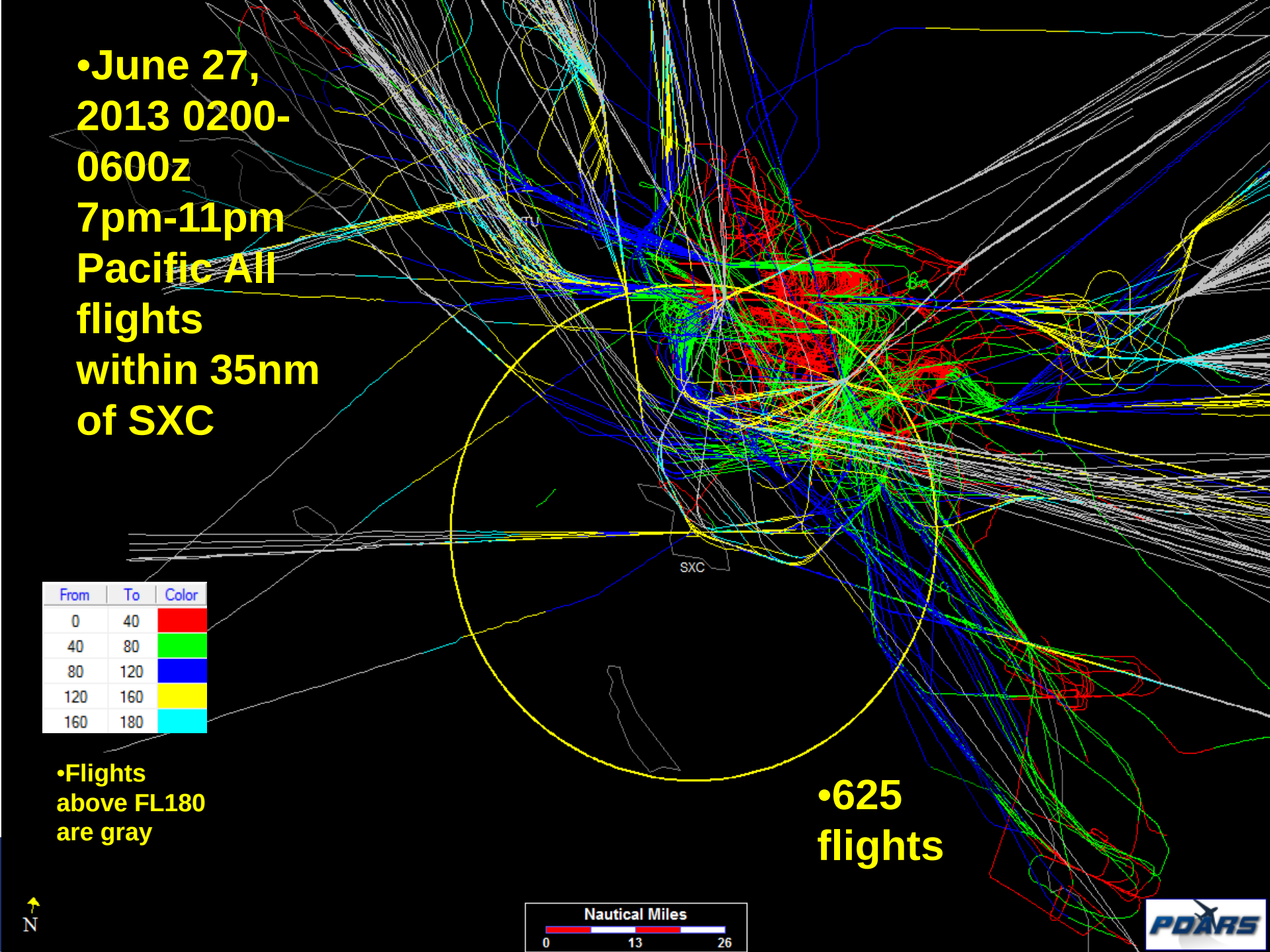
Blue – SNA Dept
Red – LAX SXC Arvls

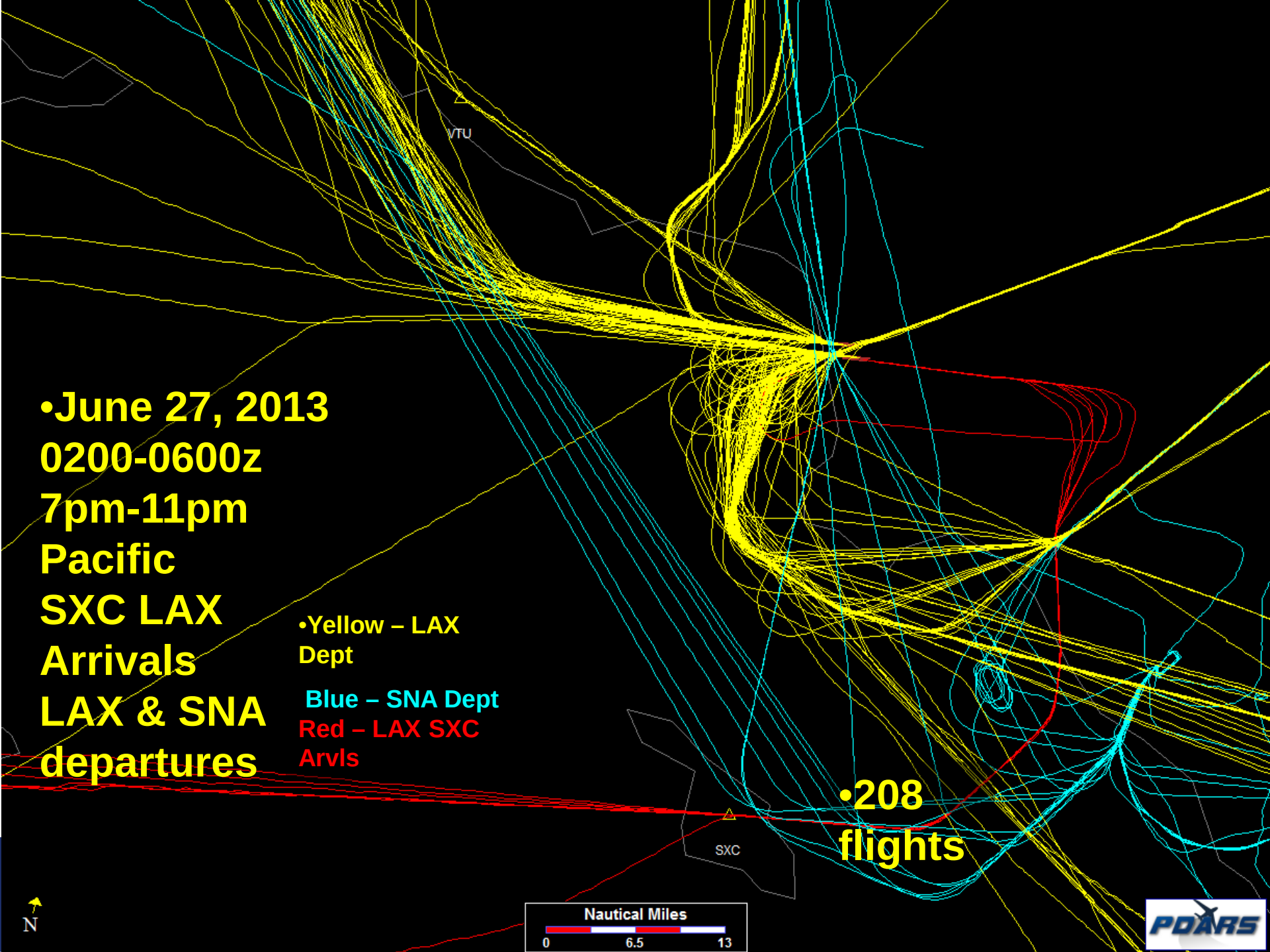
•667 flights

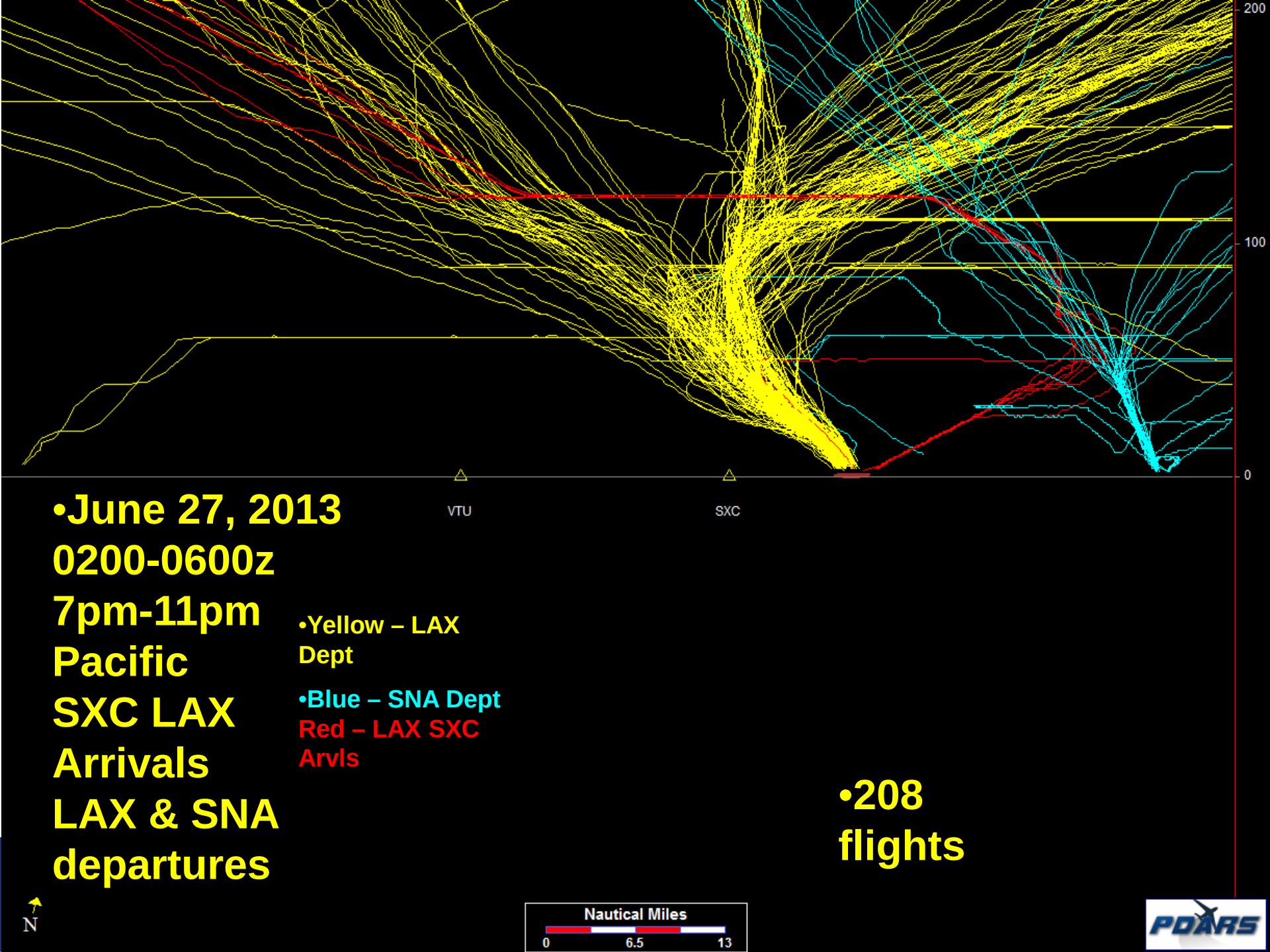
N

Nautical Miles
0 6.5 13

PDARS


•June 27, 2013 0200-0600z 7pm-11pm Pacific All flights within 35nm of SXC
From | To | Color
0 | 40
40 | 80
80 | 120
120 | 160
160 | 180
•Flights above FL180 are gray
•625 flights
SXC
N
Nautical Miles
0
13
26
PDARS


•June 27, 2013
0200-0600z
7pm-11pm
Pacific
SXC LAX
Arrivals
LAX & SNA
departures
•Yellow – LAX Dept
Blue – SNA Dept
Red – LAX SXC Arvls
•208 flights
VTU
SXC
N
Nautical Miles
0
6.5
13
PDARS


200
100
0
VTU
SXC
•June 27, 2013
0200-0600z
7pm-11pm
Pacific
SXC LAX
Arrivals
LAX & SNA
departures
•Yellow – LAX Dept
•Blue – SNA Dept
Red – LAX SXC Arvls
•208 flights
N
Nautical Miles
0
6.5
13
PDARS

Future of TA's and OPD's at LAX

- **Optimization of Airspace and Procedures in the Metroplex (OAPM)**
  - Part of NextGen
    - FAA Modernization Program
  - Redesign of airspace and procedures
  - Goal is to improve efficiencies for arrivals and departures
    - Designed with OPD and TA procedures as integral pieces
  - Current timeline for implementation projected within next 2 to 3 years

Questions?