Optimization of Airspace and Procedures in the Metroplex

SoCal Metroplex Project Overview

To: Metroplex
By: Rob Henry, SoCal D&I Integration Manager
Jose Gonzalez, SoCal NATCA D&I Lead

Date: June 10, 2015

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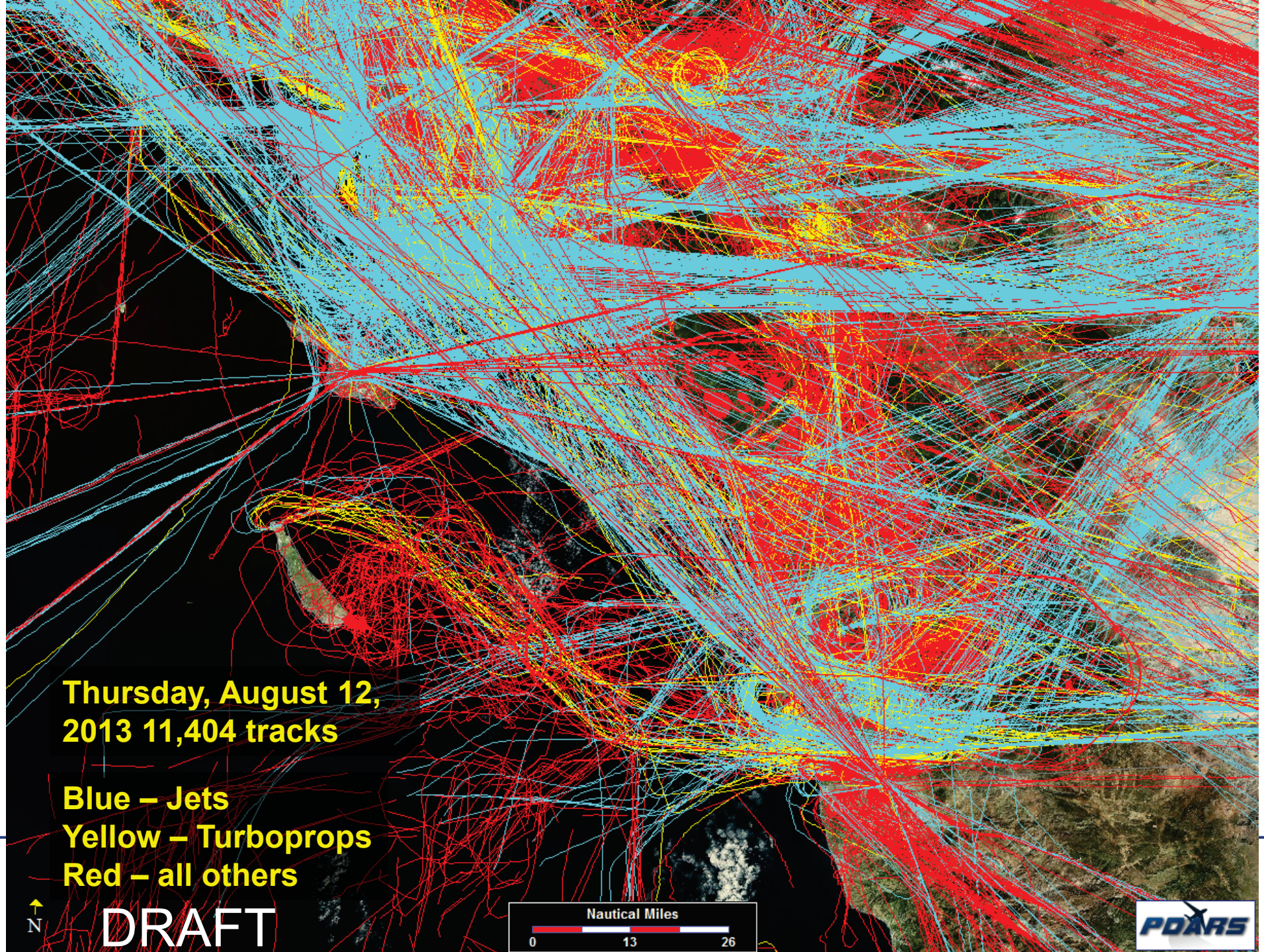
Federal Aviation Administration


Thursday, August 12, 2013 11,404 tracks
Blue – Jets
Yellow – Turboprops
Red – all others
N
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Nautical Miles
0
13
26
PDARS

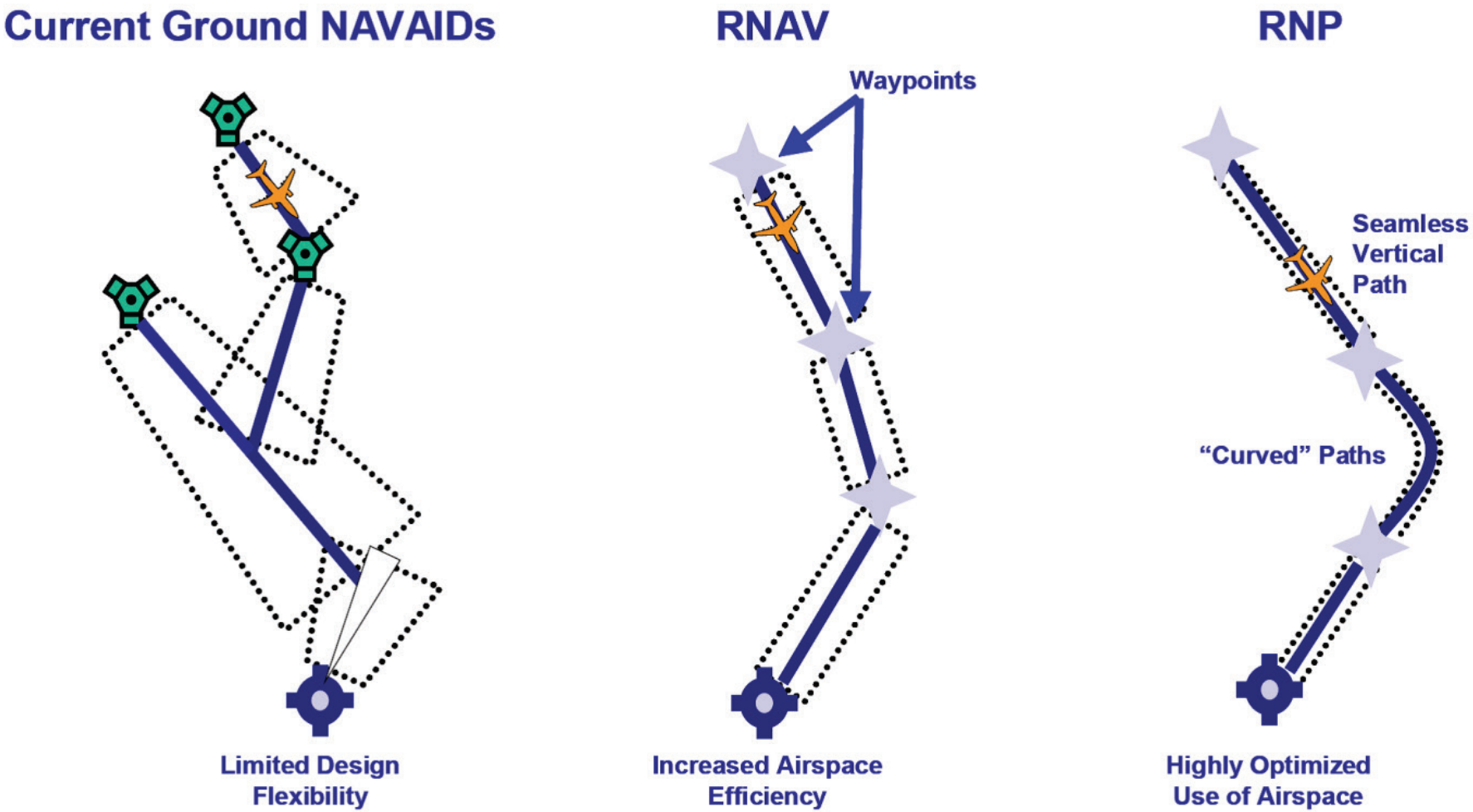
Agenda

- Overview of Metroplex process
- Airspace and Procedures overview
  - RNAV
  - STAR
  - SID
  - RNP
  - Airspace
    - Classification versus operational
- Scope of work
- Environmental Assessment
- Abbreviated work plan
- Proposed procedures

Metroplex and NextGen

- The purpose of the project is to improve airspace efficiency and reduce complexity
- RTCA's Task Force 5 recommendations for NextGen implementation included:
  - Focus on major metropolitan areas
  - Optimize flight paths and climb/descent profiles
  - Institute collaborative teams to broadly proliferate existing PBN experience and expertise
  - Promote RNAV "everywhere" and RNP (Required Navigational Performance) "where beneficial"
  - Integrate airspace and procedure design
  - Decouple operations arriving and departing adjacent airports
  - Use 3 NM and terminal separation rules wherever possible

RNAV and RNP

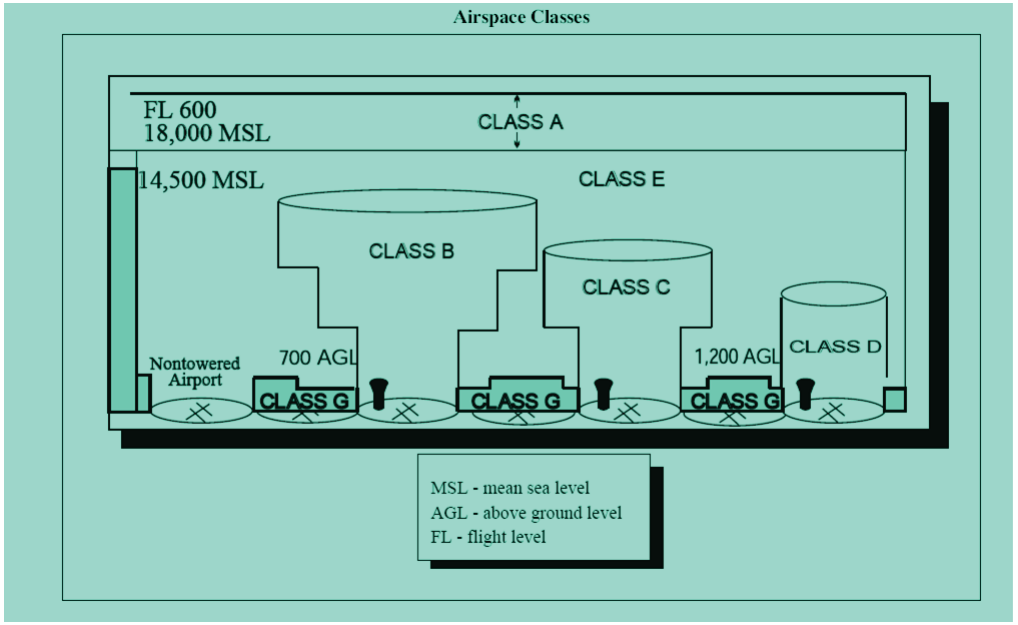

Current Ground NAVAIDs
RNAV
RNP
Waypoints
Seamless
Vertical
Path
"Curved" Paths
Limited Design
Flexibility
Increased Airspace
Efficiency
Highly Optimized
Use of Airspace

Airspace and Procedures Overview

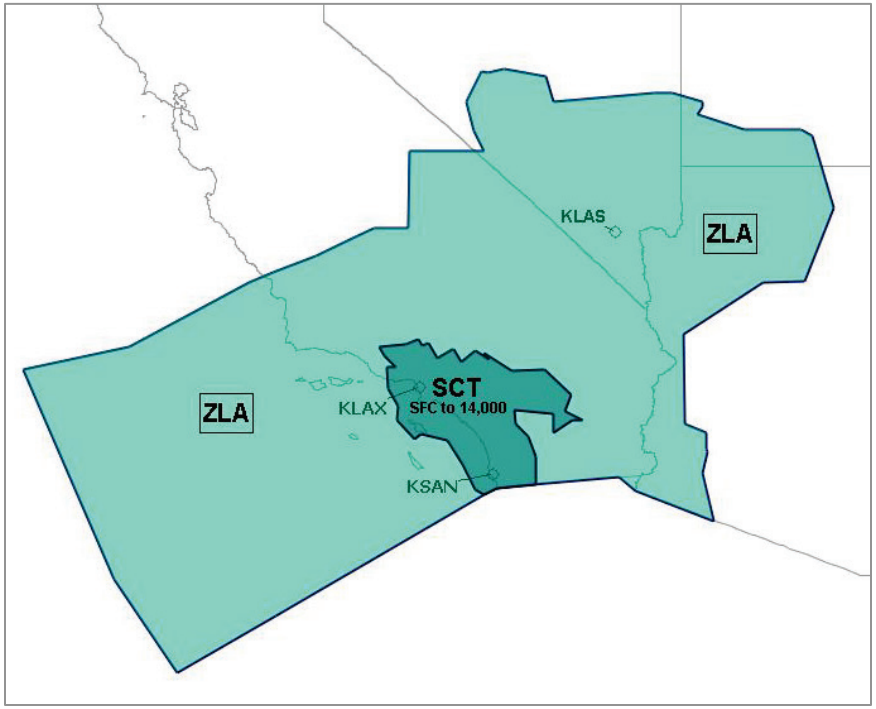
- Area Navigation (RNAV) mitigates the limitations of an aircraft navigating from one radial or station to a point to point system providing operational efficiencies
- A Standard Terminal Arrival Route (STAR) provides lateral and vertical navigation information to flight crews
  - The concept of a STAR is taken to a more precise level by creating STARs that incorporate RNAV and flight deck automation providing clear understanding of what is expected of flight crews and air traffic control (ATC)
- A Standard Instrument Departure (SID) is similar to a STAR
  - Currently SIDs tend to be expectation driven and ATC provides radar navigation to expedite departures out of a terminal area
  - A modern RNAV SID can contain specific vertical and lateral instructions like a STAR
- Required Navigation Performance (RNP) is a higher level of precision and allows more stringent criteria to be applied when developing navigation procedures and connectivity to an approach procedure

US Airspace Legal Definitions

- Airspace designations are regulatory in nature and include Class A, B, C, D, E and G (no class F in US)
  - To modify regulatory airspace a rulemaking process must take place that includes a public process for comment
- Class A is most restrictive and Class G is least restrictive
- If two classes overlap, the most restrictive is in effect
- Class B, C, and D are associated with tower controlled airports



US Airspace Operational Definition

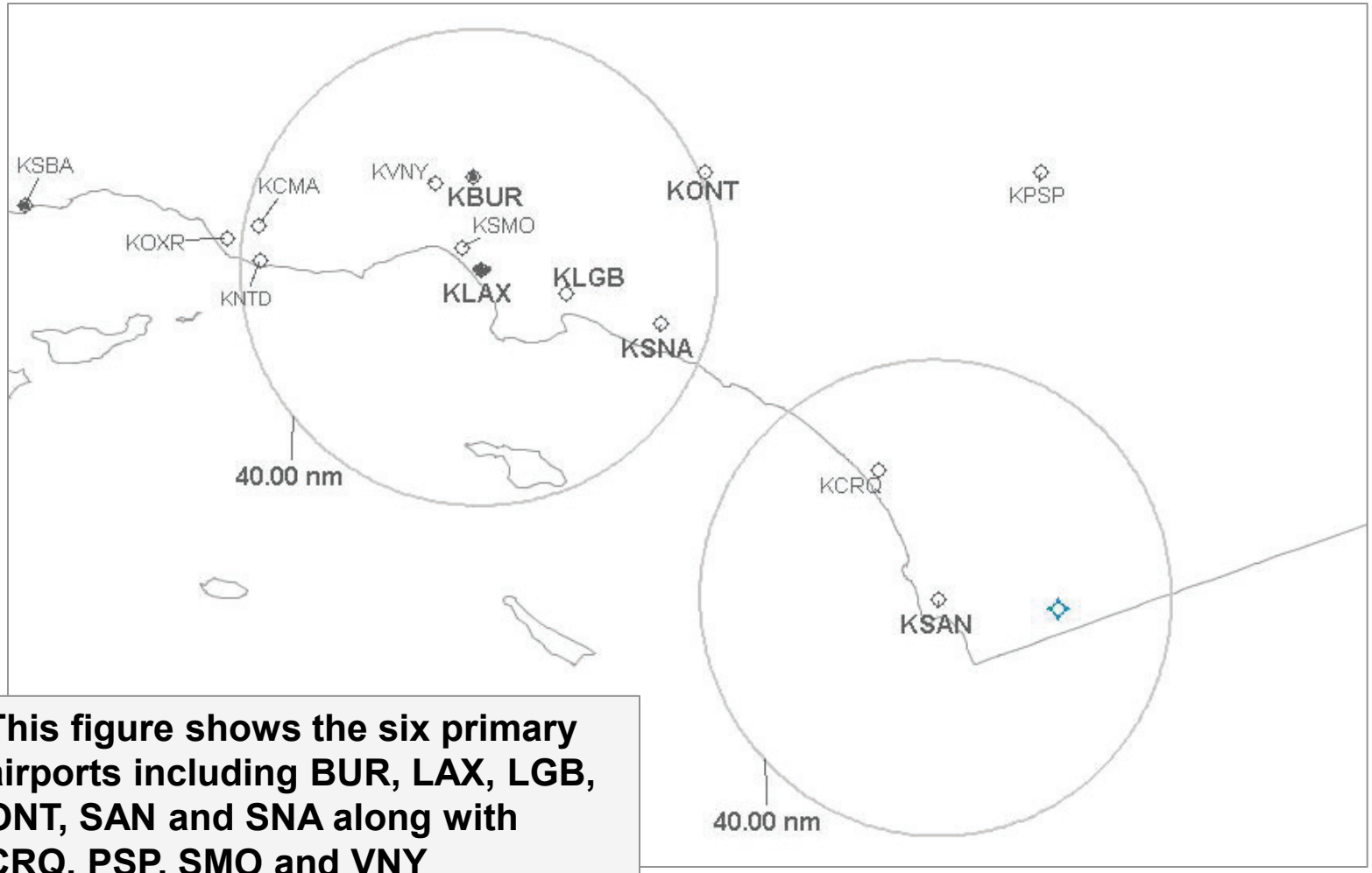


- Operational airspace is the environment flights transition through
  - Operational airspace can contain several legal classes of airspace
- The delegation of operational airspace is determined locally by agreement within or between air traffic control facilities
- Airspace within a facility is further divided into manageable vertical and lateral volumes

Southern California Metroplex Scope

- **Scope of work**
  - **Metroplex is an optimized approach to integrated airspace and procedures projects**
    - **Proposed solutions center on PBN procedures and airspace redesign**
  - **Airspace and procedures solutions are limited to those that can be achieved without producing significant noise increases**
    - **Noise impacts assessed and reported in an Environmental Assessment (EA)**
    - **Draft EA will include a noise analysis and track/altitude information**
    - **Years modeled: 2015 and 2020 forecast conditions**
    - **Analysis shows no reportable noise increases in the 65 DNL**

SoCal Metroplex Area of Interest



This figure shows the six primary airports including BUR, LAX, LGB, ONT, SAN and SNA along with CRQ, PSP, SMO and VNY

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2011 Southern California Metroplex Study Team Process

- In August 2011 the Study Team examined existing operations at Los Angeles ARTCC (ZLA), Southern California TRACON (SCT) and met with Industry
- Over 170 issues identified by SCT/ATCTs, ZLA, and Industry
  - En route: 43
  - Terminal: 83
  - Stakeholder: 44
- Issues were consolidated as appropriate
- Some proposed issues were out of scope under the Metroplex process

Summary of Qualitative Benefits

- Reduced ATC task complexity
- Reduced communications (flight deck and controller)
  - Reduced phraseology
  - Reduced frequency congestion
- Reduced pilot workload
- Repeatable, predictable flight paths
- Accurate fuel planning
- Laterally or vertically segregated flows where practical

Design

- The SoCal Design Team worked in cooperation with Industry
- Procedure design was focused on establishing Optimized Profile Descents (OPD) where feasible
  - Terrain and closely spaced airports contributed to design challenges
  - Where OPDs were not feasible the Design Team developed solutions with Industry to improve procedures over current conditions
  - RNP approaches attached to the end of a STAR were also developed with Industry partners

Sample Design Package

Southern California OAPM Design Package
LAX HLYWD STAR (SEAVU)

Name of Change and Airport/s	Date
LAX HLYWD STAR (SEAVU)	3/24/2014
Change Classification	**Current Phase of Design**
Terminal Procedure; STAR	☐ Preliminary Design (PD) ☐ Operational Design (OD) ☐ Operational Design Complete (ODC) ☒ Proposed Final Design (PFD) ☐ Final Design (FD)
OAPM Study Team Reference(s)	**Implementation Date**
Study Team Final Report: 4.3.1.1 Problem ID: T37, E2, S12, T38	2016
Affected Airport(s), Facilities and Positions, Areas, and/or Sectors	**Facility Points of Contact**
ZLA: 19, 20, 37, 39 SCT: LAA (EAFR), EMP (HEMR, NORR, SPGR)	Cynthia Cabico, ZLA FAA; 661-265-8333 Walter Alexis, ZLA NATCA; 661-547-5131 Ronald Cagle, SCT FAA; 858-537-5830 Mike Taylor, SCT NATCA; 858-537-5830
Related/Dependent Submissions	**Associated Data Files**
BIGBR, BRUEN, ANJLL, SCBBY, ROOBY, DSNEE, THRNE, GLRNO, EAGLZ	LAX HLYWD STAR TARGETS Distribution Package

Purpose

1. The RIIVR and SEAVU STARs are arrival procedures with level-offs over the GRAMM and KONZL intersections. These level-offs were specifically identified by the facilities as an issue for these two arrivals.
2. The interaction of these STARs creates a single, dependent flow situation approximately 45 miles east of LAX. Procedural requirements necessitate that traffic on the RIIVR and SEAVU STARs be in trail and delivered as a single flow to SCT. This single flow requirement creates a constraint that is responsible for excessive delay vectors, multiple traffic management restrictions, reduced throughput, and an inability to meet the LAX airport acceptance rate (AAR).
3. The RIIVR and SEAVU STARs terminate approximately 45 nautical miles from LAX, as can be seen in Figure 1. Laterally, the termination fixes for these STARs are approximately 4 miles apart, which necessitates a single dependent feed into SCT's airspace from ZLA. This procedural requirement to treat the RIIVR and SEAVU as a single flow creates a complex and inefficient east arrival flow into LAX. This situation was the highest priority challenge identified by both facilities for OST consideration. To alleviate the congestion at this "bottleneck," MIT restrictions and other constraints are introduced into the NAS by ZLA. The OST analyzed MIT restrictions placed upon east LAX arrival fixes to assess the scope of this issue. In particular, HEC, PGS, and TNP were identified as fixes with frequent restrictions attributable to this single flow constraint.
4. The supporting data was obtained from the NTML MIT log for calendar year 2010. Restrictions were primarily due to volume (VOL), weather (WX), or equipment/frequency failure (EQ); however, pass-back restrictions caused by constraints closer to the airport were not considered. The metric used is minute-miles. This is calculated by multiplying the total minutes the restriction was in effect by the imposed MIT value (spacing in miles).

1

Southern California OAPM Design Package
LAX HLYWD STAR (SEAVU)

5. Over HEC and MLF the sum of LAX minute-mile restrictions for calendar year 2010 was approximately 110,000. During 2010, restrictions were issued on 106 days, or approximately two days a week.
6. Over PGS and TBC the sum of LAX minute-mile restrictions for calendar year 2010 was approximately 940,000. In 2010, restrictions were issued on 336 days, or approximately 6.5 days a week.

Study Team Recommendation

1. The proposed replacements for the RIIVR and SEAVU STARs are designed as PBN procedures with OPD benefits that operate as dual independent arrivals and maintain procedural separation as shown in Figure 1.
2. These STARs are procedurally deconflicted laterally within ZLA's and SCT's airspace, allowing for deconflicted operations and the subsequent allowance of dual independent final operations. The current RIIVR and SEAVU STARs terminate at waypoints RIIVR and SEAVU. The proposed RIIVR and SEAVU STARs will terminate approximately 15 NM from the airport. The STARs remain laterally deconflicted until inside of the Precision Radar Monitor (PRM) areas. As these procedures turn to join their respective final approach courses, vertical separation will be maintained until the aircraft are established on a charted approach and are under precision monitor control. Current operations dictate that the Runways 25L/R approaches are 1,000 feet higher than the Runways 24L/R approaches. The proposed RNAV STARs will reverse this altitude configuration, as Runways 24L/R approaches incorporate a longer flight distance to the runway threshold than Runways 25L/R.
3. These STARs will include runway transitions to all runways, enabling the seamless transition of aircraft between Runways 24L/R and Runways 25L/R at LAX, which will facilitate the ability to balance the runway demands.
4. The introduction of the dual independent final design in these STARs will reduce the need for extensive delay vectoring caused by sequencing to a single dependent feed.
5. It is assumed that allowing dual independent arrivals into LAX would mitigate the need for MIT restrictions and reduce delay vectoring close to the airport.
6. To estimate the possible annual delay savings associated with the proposed dual independent arrivals, a TAAM model was developed to simulate the flows with an average day2 of traffic both with and without the current procedural constraint.

Figure 1: Current & Study Team Recommendation for LAX RIIVR & SEAVU STARs

Proposed Final Design

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Sample Design Package

Southern California OAPM Design Package
LAX HLYWD STAR (SEAVU)

The Design Team could not follow the Study Team recommendations for the HLYWD and ANILL STARS due to Class B containment and MVA's in the vicinity of LAX. The Design Team modified the Study Team proposal to allow for Class B containment while still providing an efficient vertical profile.

The Runway 24 complex is approximately 1 NM further west than the Runway 25 complex. Instrument flight procedures incorporate a 3 degree descent gradient (318 feet per nautical mile). There is insufficient distance between the runway complex thresholds to permit the higher intercept altitude for the Runway 24 complex. Aircraft arriving from the north and west utilize the north downwind traffic pattern permitting their descent to an altitude appropriate for IFR approaches. Aircraft arriving from the south and east are assigned altitudes to allow for Class B containment.

In current state the EAST FEEDER (EAFR) sector uses a variety of control techniques to accomplish lateral, vertical or visual separation for LAX arrivals. When meteorological conditions eliminate the application of visual separation, efficiency is reduced, requiring increased in trail spacing.

The Design Team was unable to reverse the current altitude interaction between the Runway 24/25 complexes.

The HLYWD STAR was designed as an RNAV procedure with OPD benefits. The Design Team worked closely with pilot representatives to increase efficiency wherever possible.

For west flow, LAX jet arrivals from the east will utilize this procedure.

The HLYWD STAR was designed in conjunction with the ANILL STAR. The HLYWD STAR incorporates an RNAV X approach (offload) procedure which can be used on a real time basis. Depending on meteorological conditions the use of the proposed RNAV-X procedure on the HLYWD has the potential to reduce the requirement for in trail restrictions on both STARS, with the possibility of a greater range of options available to the arrival controller.

This procedure will not de-conflict from the LAX ANILL STAR arrivals inside of SEAVU and will continue to require air traffic intervention to separate north and south complex arrivals to LAX, but has the potential to offer significant improvements (when combined with the ANILL STAR changes) during peak periods.

The HLYWD and ANILL STARS will be the most heavily used procedures in the Southern California area. In order to provide the most optimized descent possible for the most heavily used STARS into LAX, the Design Team elected to design the ONT SCBBY, BUR THRNE, SNA ROOBY and SNA DSNEE STARS with restrictions that would de-conflict from the HLYWD/ANILL.

Several enroute transitions were added to provide enroute structure, integrate OPD's and to segregate from other Los Angeles Basin area traffic allowing greater flexibility.

Transitions were added at:

- FNNDA
- GABBL
- ESTWD
- MDLER

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Southern California OAPM Design Package
LAX HLYWD STAR (SEAVU)

- HLYWD

Holding patterns were added at:

- MIDLR
- SEAVU
- NEILE

Waypoints on the ILS approach were moved to coincide with Class B airspace boundaries, reducing complexity for controllers and flight crews.

Figure 2: Proposed Final Design for LAX HLYWD STAR

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Sample Design Package

Southern California OAPM Design Package
LAX HLYWD STAR (SEAVU)

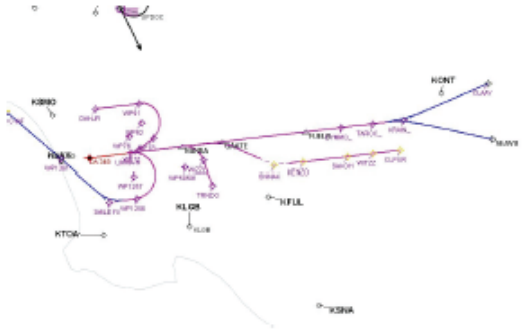

Figure 3: Proposed Final Design for LAX HLYWD RWY 25L/R RNAV (X)/RNP (Z) Approach

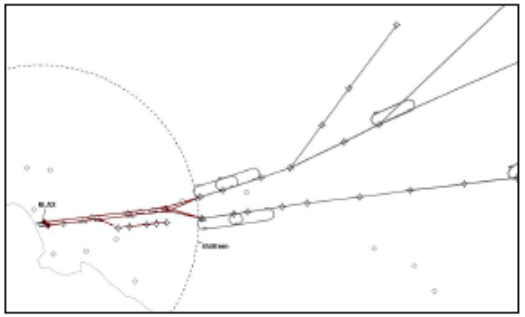

Figure 3: Proposed Final Design for LAX ANJLL STAR, LAX HLYWD STAR, & HLYWD Offload

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Southern California OAPM Design Package
LAX HLYWD STAR (SEAVU)

Additional Design Considerations:

- Validation through a Human-in-the-Loop simulation (HITLs) is anticipated.
- The descent profile for this procedure has benefitted from data obtained during industry flight simulations. Wherever feasible, this data has been incorporated into the design in order to provide the most optimal descent possible.

Implementation Dependencies:

- Dependent upon the submissions of the BIGBR, BRUEN, ANJLL, SCBBY, ROOBY, DSNEE, THRNE, GLRNO, and EAGLZ
- Requires modifications to SCT and ZLA facilities internal Standard Operating Procedures and Letters of Agreement
- Requires airspace modifications to;
  - ZLA: 19, 20, 37, 39
  - SCT: LAA (EAFR), EMP (HEMR, NORR, SPGR)
- Controller training
- Automation changes

Attachments:

HLYWD STAR TARGETS Distribution Package

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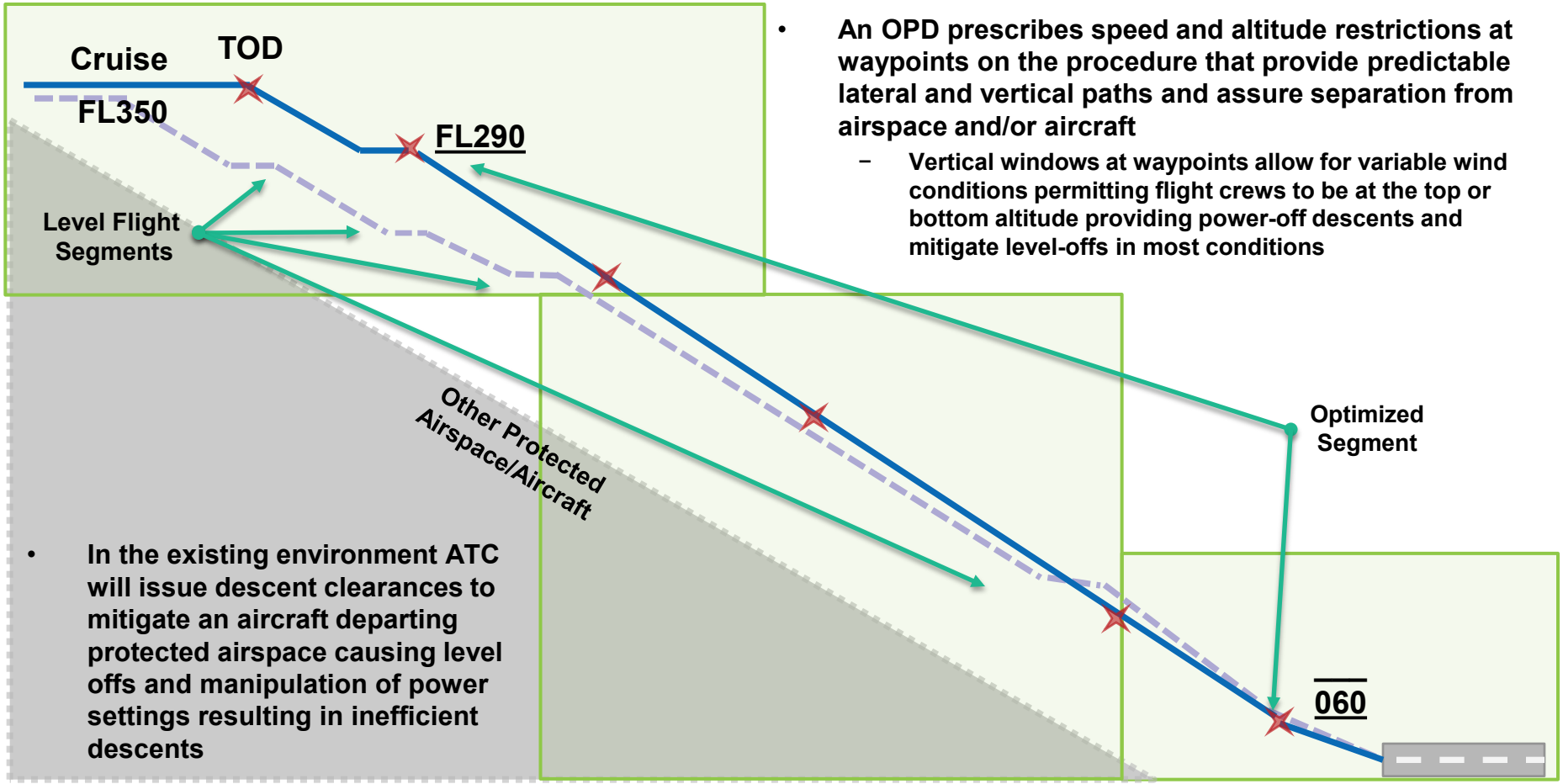
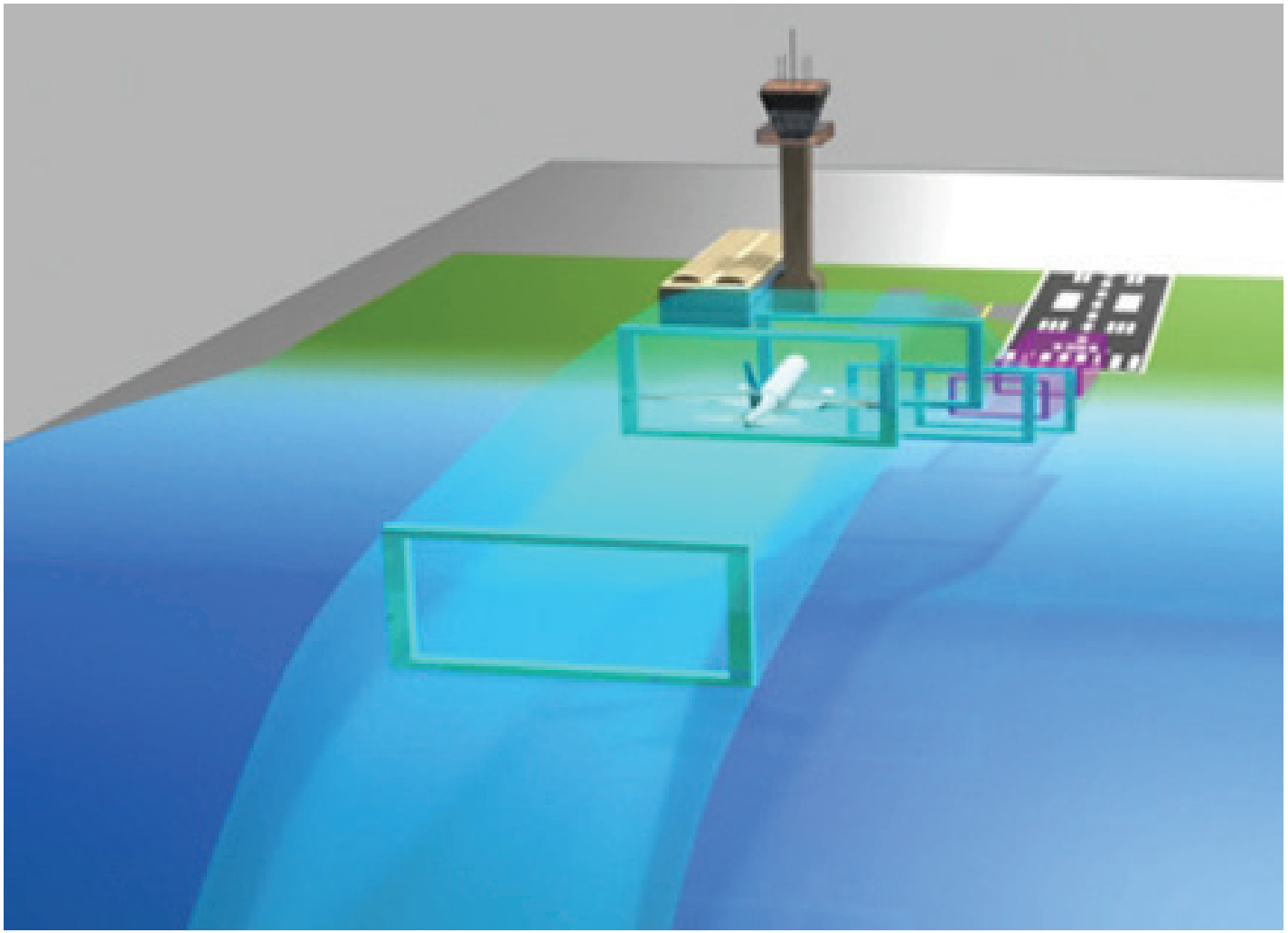
Optimized Profile Descent Example
(Arrival)



- An OPD prescribes speed and altitude restrictions at waypoints on the procedure that provide predictable lateral and vertical paths and assure separation from airspace and/or aircraft
  - Vertical windows at waypoints allow for variable wind conditions permitting flight crews to be at the top or bottom altitude providing power-off descents and mitigate level-offs in most conditions

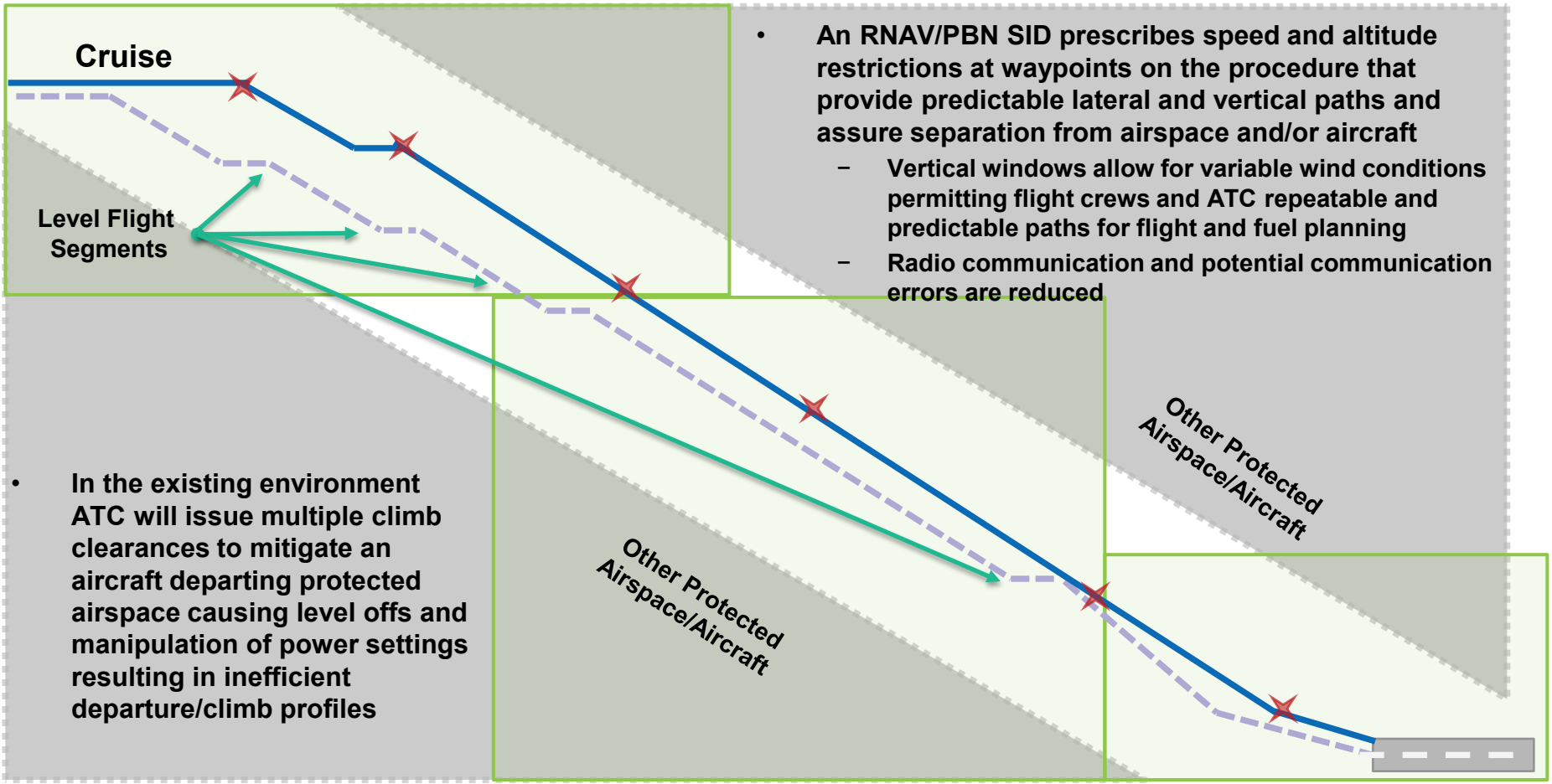
- In the existing environment ATC will issue descent clearances to mitigate an aircraft departing protected airspace causing level offs and manipulation of power settings resulting in inefficient descents

Optimized Guidance



Optimized Climb Profile Example

(Departure)

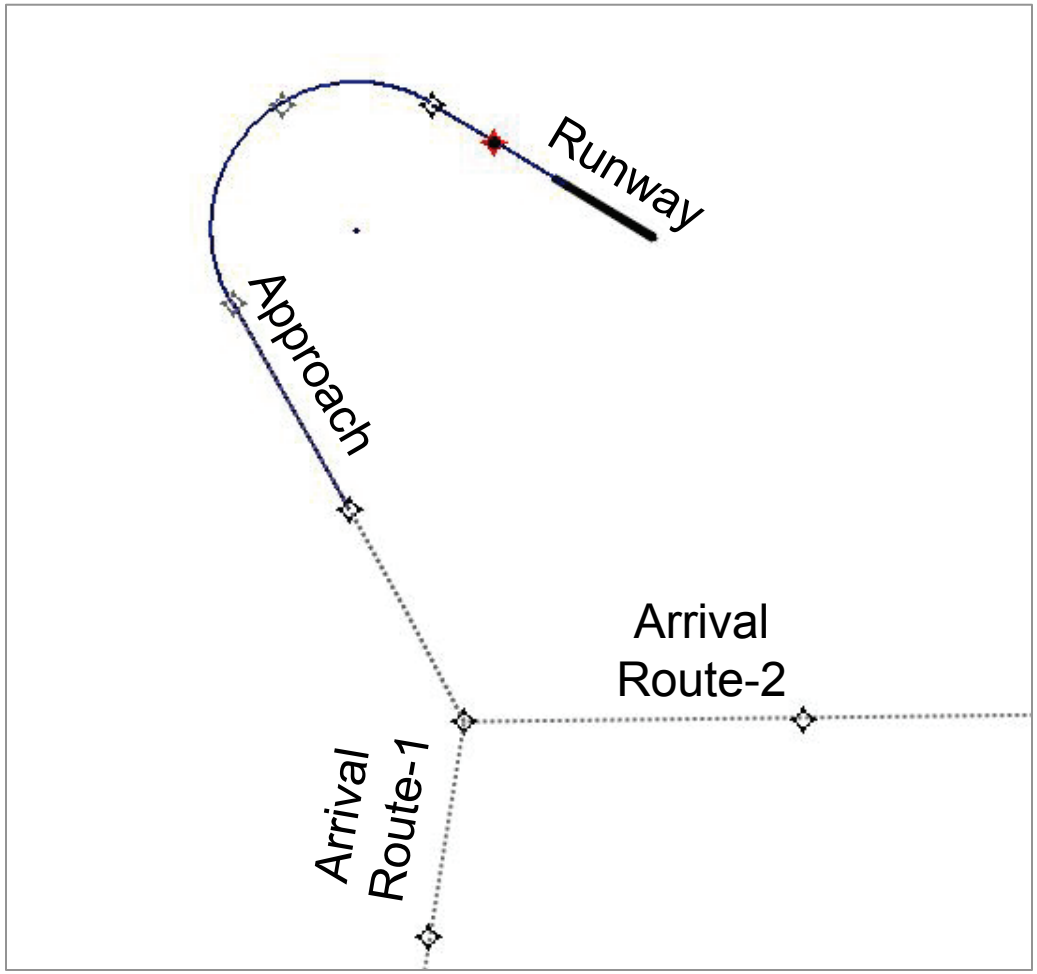


- An RNAV/PBN SID prescribes speed and altitude restrictions at waypoints on the procedure that provide predictable lateral and vertical paths and assure separation from airspace and/or aircraft
  - Vertical windows allow for variable wind conditions permitting flight crews and ATC repeatable and predictable paths for flight and fuel planning
  - Radio communication and potential communication errors are reduced

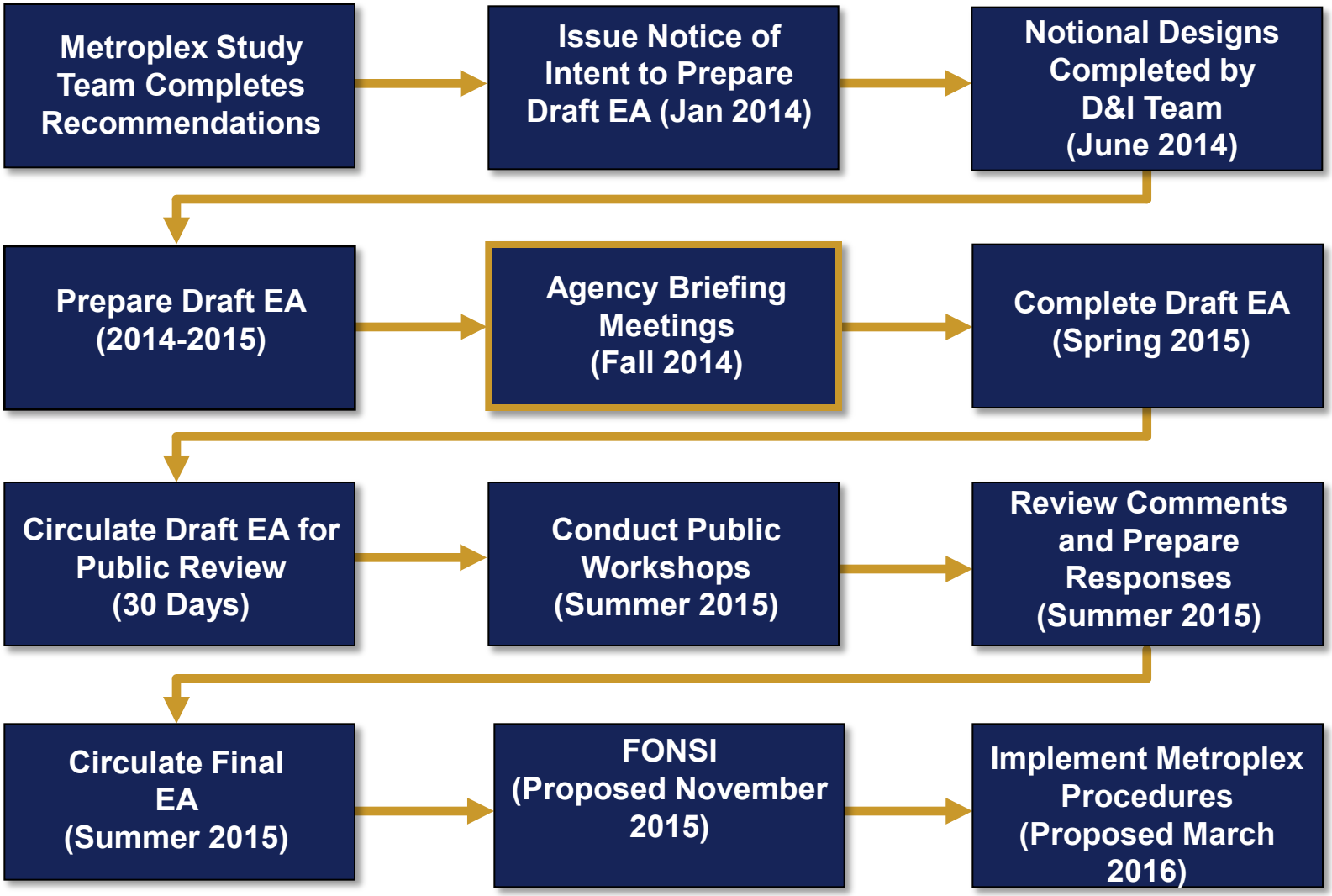
- In the existing environment ATC will issue multiple climb clearances to mitigate an aircraft departing protected airspace causing level offs and manipulation of power settings resulting in inefficient departure/climb profiles

RNAV RNP Example

- Current arrival procedures utilize ground based navigation and radar vectors
  - High workload for ATC and flight crew
  - Inconsistent flight paths
  - Inconsistent vertical profiles
- RNAV STAR connects an arrival route to an RNAV RNP approach procedure
- STAR/Approach connectivity provides repeatable and predicable flight paths
  - Simplifies operations for flight crews and ATC
  - Allows use of flight-deck automation
  - Stabilized and efficient approach operations



SoCal Metroplex Environmental Process



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Purpose & Need of Metroplex EA

- **Main Purpose of Metroplex**
  - **To enhance efficiency in the SoCal Metroplex**
    - **Reduce Complexity**
    - **Provide Predictability**
    - **Provide Flexibility**

Draft EA Study Area

Noise Analysis in DNL (NIRS)

- **Noise analysis completed for Proposed Action and No Action**
- **Years modeled: 2015 & 2020 forecast conditions**
- **Results:**
  - **No Significant Noise Increases of ±1.5 dB in the 65 DNL**
  - **No Reportable Noise Increases:**
    - **±3 dB in DNL 60 to 65**
    - **±5 dB in DNL 45 to 60**

SoCal Metroplex Public Workshops

15-Jun-15	16-Jun-15	17-Jun-15	18-Jun-15	19-Jun-15
	Public Workshop Santa Ana	Public Workshop Santa Monica	Public Workshop Los Angeles	
22-Jun-15	**23-Jun-15**	**24-Jun-15**	**25-Jun-15**	**26-Jun-15**
Public Workshop San Diego	Public Workshop Palm Springs	Public Workshop Torrance	Public Workshop Long Beach	Public Workshop Ontario
29-Jun-15	**30-Jun-15**	**1-Jul-15**	**2-Jul-15**	**3-Jul-15**
Public Workshop Ventura	Public Workshop Santa Barbara	Public Workshop Burbank		

SoCal Metroplex Proposed Procedures

New RNAV STARs,	New RNAV SIDs	Revised RNAV Proposed Action STAR,	Revised RNAV Proposed Action SIDs	Revised conventional Proposed Action STARs
36	41	1	8	3

Revised conventional Proposed Action SID	Revised conventional No Action SIDS	Revised conventional No Action STARS	Existing convention al SIDs
1	13	2	31

Note:

SoCal Metroplex Abbreviated Work Plan

Activity	Date	Complete
Notional Design Phase Start	10/15/2012	✓
Notional Design Complete	6/9/2014	✓
SMS Process Complete	4/27/2015	✓
Draft EA	6/10/2015	✓
EA Decision Document	11/11/2015	
A/S and Procedures SMS Process Complete	11/11/2015	
Implementation Phase Start	8/28/2015	
Procedure Implementation Complete	9/15/2016	

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Updated 2/6/2015

Response to Comments

Points of Contact

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- **Jose Gonzalez, SoCal NATCA D&I Lead**
  - **Jose.J.Gonzalez@faa.gov**

QUESTIONS?