Optimization of Airspace and Procedures in the Metroplex

SoCal Metroplex Project Overview

To: Metroplex
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DRAFT
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

• DRAFT
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 NAV AIDs
Limited Design Flexibility

RNAV
Increased Airspace Efficiency
Waypoints

RNP
Highly Optimized Use of Airspace
Seamless Vertical Path
“Curved” Paths
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
    o 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
    o Noise impacts assessed and reported in an Environmental Assessment (EA)
    o Draft EA will include a noise analysis and track/altitude information
    o Years modeled: 2015 and 2020 forecast conditions
    o 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.
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 HLWYD STAR (SEAVU)

LAX HLWYD STAR (SEAVU) 3/24/14

Terminal Procedure: STAR

Terminal Procedure: STAR

OAPM Study Team Reference(s)

Study Team Final Report: 4.3.1.1

Affected Airport(s), Facility, and Position:

ZLA, 19, 20, 37, 39

EAGL

Attach Additional Information

HIGH, BOBV, DQER, TERRY, GLEN, EAGL

LAX HLWYD STAR TARGETS

Distribution Package

Purpose

1. The RIVVR and SEAVU STARs are arrival procedures with level-offs over the GRAMM and KNONZ intersections. These level-offs were specifically identified by the facilities as an issue for these two airports.

2. The intersection of these STARs creates a single, dependent flow situation approximately 45 miles west of LAX. Procedural requirements necessitate that traffic on the RIVVR 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 (AKR).

3. The RIVVR and SEAVU STARs terminate approximately 45 nautical miles from LAX, as can be seen in Figure 1. Laterally, the termination lines for these STARs are approximately 4 miles apart, which necessitates a single dependent flow into SCT's airspace from ZLA. This procedural requirement to meet the RIVVR and SEAVU as a single flow creates a complex and inefficient transition 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 flows to assess the scope of this issue. In particular, HDS, POS, and TNP were identified as areas with frequent restrictions attributable to this single flow constraint.

4. The supporting data was obtained from the NTME MIT log for calendar year 2010. Restrictions were primarily due to volume (VCL), weather (WFT), or equipment/flight plan (CPD) reasons, as well as 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 (spaced in miles).

5. Over SEC and MPL the sum of LAX minute-mile restrictions for calendar year 2010 was approximately 110,000. During 2010, restrictions were issued on 168 days, or approximately two days a week.

6. Over POS and TBC the sum of LAX minute-mile restrictions for calendar year 2010 was approximately 940,000. In 2010, restrictions were issued on 334 days, or approximately 6.5 days a week.

Study Team Recommendation

1. The proposed replacements for the RIVVR and SEAVU STARs are designed as MIT procedures with OPT benefits that operate as dual independent arrivals and minimize procedural restriction, as shown in Figure 1.

2. These STARs are procedurally decoupled laterally within ZLA's and SCT's airspace, allowing for decoupled operations and the subsequent allowance of dual independent final operations. The current RIVVR and SEAVU STARs terminate approximately 1.5 RM from the airport. The proposed RIVVR and SEAVU STARs will terminate approximately 1.5 RM from the airport. The STARs remain laterally decoupled until out of the Reaction Radar Monitor (RRM) area. At these stages, traffic joining their respective final approach courses, vertical separations will be maintained until the aircraft are established on a common approach and are under precision approach control. Current operations dictate that the Runway 25L/R approaches are 1,000 feet higher than the Runway 24L/R approaches. The proposed RIVVR STARs will reverse this altitude configuration, as Runway 25L/R approaches incorporate a longer flight distance to the runway threshold than Runway 35L/R.

3. These STARs will include runway transitions to all runways, enabling the seamless transition of aircraft between Runway 24L/R and Runway 25L/R at LAX, which will facilitate the ability to balance the runway demand.

4. The introduction of the dual independent final design in these STARs will reduce the need for excessive delay vectors caused by sequencing to a single dependent fix.

5. It is assumed that allowing dual independent arrivals into LAX will mitigate the need for MIT restrictions and reduce delay vectors close to the airport.

6. To simulate the possible annual delay savings associated with the proposed dual independent arrivals, a TAAM model was developed to simulate the flows with an average day of 2 traffic both with and without the current procedural constraint.

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

Proposed Final Design
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 farther west than the Runway 25 complex. Instrument flight procedures incorporate a 3 degree descent gradient (316 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 rad east are assigned altitudes to allow for Class B containment.

In current state the EAST FEEDER (EAFF) 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 (offset) 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 profiles for the most heavily used STARS into LAX, the Design Team elected to design the ONT SCBAY, BUR TINNE, SNA ROBY and SNA DISNEE 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:
- TINDIA
- GABREL
- EITWD
- MEXER

Figure 2: Proposed Final Design for LAX HLYWD STAR
Sample Design Package

Southern California OAPM Design Package
LAX HLYWD STAR (SEAVU)

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

Southern California OAPM Design Package
LAX HLYWD STAR (SEAVU)

Additional Design Considerations:
- Validation through a Human-in-the-Loop simulation (HILs) 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 BIGH, BRUE, ANIL, SQLY, ROGO, DSFEE, TERNE, GLENO, and EAGL
- Requires modifications to SCT and Z.A facilities internal Standard Operating Procedures and Letter of Agreement
- Requires airspace modifications to:
  - Z.A: 19, 20, 37, 39
  - SCT: LAA (EAFF), EMP (NSM, NORK, SFGR)
- Controller training
- Automation changes

Attachment:
HLYWD STAR TARGETS Distribution Package
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.

Cruise TOD

FL350

FL290

Level Flight Segments

Other Protected Airspace/Aircraft

Optimized Segment

060
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 predictable flight paths
  - Simplifies operations for flight crews and ATC
  - Allows use of flight-deck automation
  - Stabilized and efficient approach operations
SoCal Metroplex Environmental Process

1. Metroplex Study Team Completes Recommendations
3. Circulate Draft EA for Public Review (30 Days)
4. Issue Notice of Intent to Prepare Draft EA (Jan 2014)
5. Agency Briefing Meetings (Fall 2014)
6. Conduct Public Workshops (Summer 2015)
7. Notional Designs Completed by D&I Team (June 2014)
8. Complete Draft EA (Spring 2015)
9. Review Comments and Prepare Responses (Summer 2015)
10. Circulate Final EA (Summer 2015)
11. FONSI (Proposed November 2015)
12. Implement Metroplex Procedures (Proposed March 2016)
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

[Map showing study area with airports marked: SBA, BUR/VNY, LAX, ONT, PSP, SNA, SAN.]
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

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## SoCal Metroplex Proposed Procedures

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**Note:**
## SoCal Metroplex Abbreviated Work Plan

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Response to Comments
Points of Contact

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QUESTIONS?