Start Point: CDA for Nighttime Operations in the United States

A step toward Low Density Implementation

Presented to: Air Carrier Flt Procedure Developers
By: Sandy R. Liu,
FAA Office of Environment & Energy
Date: January 19-20, 2006
Georgia Institute of Technology Campus
Atlanta, GA
Motivation

• FAA ambitious to build on the success of the Louisville flight tests and initiate environmental reductions.
  – Near term: start with the demonstrated nighttime CDA
  – Long term (vision): continue R&D to explore the means to a system-wide implementation in the future.

• Many interested in the benefits of CDA procedures
  – PARTNER and the FAA have received numerous expressions of interest by many airports and operators
COE Project 4 – Environmental Mitigation Procedures

Objectives:

• **Long-term**
  – Advance implementation of CDA procedures by identifying and resolving operational issues at airports where these procedures will be very beneficial
  – Develop cockpit and/or controller tools to enable traffic implementation at higher traffic level

• **Near term**
  – Identify airports where introduction of CDA would provide significant fuel burn, emissions, noise reduction
CDA Research to Implementation

**NGAT DIRECTION**

Aviation Environmental RESEARCH

**PROTOTYPE**

METHODS

NAS

**IMPLEMENTATION**

- Design CDA profiles
- Formulate separation methods/technologies
- Validate methods by simulation & flight tests

**FAA Center of Excellence (COE):**
Project 4 – Env. Mitigation Procedures

- Coordination & collaboration
- Prototype Demonstrations
- Define standards & ‘next steps’
- Supports policy & science decisions

**AEE: CDA Advancement/OEP FLOW-4**

- Utilize analytical tools
- Certify through 18-step process

**Aviation Environmental Design Tool (AEDT)**

- Establish comprehensive analytical methods & tools
- Harmonize internationally

**Environmental Integrated Project Team (EIPT):**
Operations Panel
Pieces to Implementing CDA

- Louisville Flight Test
- Optimized Vertical Profiles, a/c & FMS performance
- Cockpit & Controller Feedback & Observed Economic and Environmental Benefits
- Plans for RNAV Implementation & approval
- Using TARGETS for development and approval of applicants
- NIRS Environmental Assessment Airspace changes
- On-going and Future R&D
- Southern California TRACON Airspace ReDesign
- Aviation Environmental Design Tool (AEDT)
Path to CDA “Special” Procedure Application

Aircraft Procedure Definition

- "Hand" design prelim vertical procedure for a/c
- Modify constraints of FMS in simulator
- Iteratively test profile in Sim
- Define acceptable profile

ATC Procedure Definition

- Assess fleet type and airspace ops constraints
- Identify operational performance criteria
- Monte Carlo analysis: compute safe separation
- Define sequencing logic/method

CDA Design

- Design new procedure chart
- Modify FMS in aircraft/fleet
- Train pilots & ATC
- Field test vertical profile procedure with sequencing

System Procedure Demonstration

- Apply for FAA ATO procedure approval
  - Submit procedure (using TARGETS) for 18-step Review

NAS Change Assessment/Procedural Administration

- Environmental Assessment ($) of ac types and routes for noise impact (use NIRS)
  - Institute recurrent Pilot training ($)
- Publish final procedure chart ($)

Other CDA Investment expenses

CDA approved procedure

- Reduced noise
- Less fuel burn
- Less engine emissions

CDA for Nighttime Operations in the United States
Next Steps: Low Density Implementation
Status:

• UPS “Special” CDA procedure at Louisville airport is under FAA review for acceptance.

• CDA procedure characteristics:
  – only for nighttime operations at SDF (a period of minimal mixed traffic and low arrival)
  – only applicable to FMS programmed B757 and B767
  – Flown with aircraft sequencing to establish passive safe separation distance between aircraft
Implementation Issues

• Limited resources
  – Federal budgetary constraints
  – Limited number of PARTNER researchers/designers
  – Finite FAA resources for safety review and approval and would be strained with high demand.

• Quantitative CDA candidate screening criteria has been established for airports that would most benefit from CDA
  – SDF was fundamentally a target of opportunity under R&D.
CDA Screening Factors – Initial Assessment

- Emissions
  ~ Fuel Burn
- Noise
- Availability
  ~ Complexity

CDA
Comprehensive CDA Screening Methodology

- Acquire aircraft trajectory (ACARS) and airport meteorological (NOAA) data and adjust aircraft altitude based on airport pressure
  - Aircraft altitude reported as “standard-day altitude”
  - Airport altitude is “physical altitude”
  - Pressure reading at airport used to convert physical altitude into “equivalent standard-day airport altitude”

- **Determine Operational opportunities for CDA**
  - Determine maximum number of arrivals (in each 15 minute period) with CDA separation requirements and actual number of departures
  - Determine if actual number of arrivals is less than maximum
Comprehensive CDA Screening Methodology (cont’d)

- **Determine fuel burn ranking**
  - Extract trajectory segments between 10,000 ft AGL and runway
    - Previous result show that most savings occur below 10,000 ft
  - Determine time aircraft spends below 10,000 ft v. time of day
    - Time is a good proxy for fuel burn because we are only concerned with the relative ranking of airports
  - Determine time savings below 10,000 ft v. time of day
    - Subtract time below 10,000 ft for CDA from actual times over the same range in altitude
  - Determine total possible saving
    - Sum savings from those periods where the number of arrivals is less than the maximum number of arrival with CDA
Comprehensive CDA Screening Methodology (cont’d)

- **Determine emissions ranking**
  - Extract trajectory segments between 3,000 ft AGL and runway
    - Mixing height is typically 3,000 ft AFE but may vary due to local conditions
  - Determine time aircraft spends in mixing layer v. time of day
    - Time is also a good proxy for emissions because we are only concerned with the relative ranking of airports
  - Determine time savings in mixing layer v. time of day
    - Subtract time below 3,000 ft for CDA from actual times over the same range in altitude
  - Determine total possible saving
    - Sum savings from those periods where the number of arrivals is less than the maximum number of arrival with CDA
Comprehensive CDA Screening Methodology (cont’d)

- **Determine noise ranking**
  - Use aircraft trajectory data to develop INM input files with and without CDA for airports under review
    - Input to MAGENTA which thus far has assumed CDA type trajectories
      - Determine noise contours at each airport with and without CDA
      - Determine reductions in the size of the noise contours at each airport
- **Weigh other factors**
  - Complexity of airspace
  - Cooperation of airlines and airport authority
CDA Screening Factors – Initial Assessment

“Simplified” Screening:
- Assess Radar Approach Profiles for 30 OEP airports
- identify the “time aloft” surrogate metric from 3000ft to touch down.
- High time value is indicative of greater emission and noise.
- Preliminary Ranking of 30 OEP airports performed.
Existing Airline Route Prescreening for low traffic

Airlines initial scoping:

• Delta Airline (J. Brooks) suggests application of the ASMP database for preliminary analysis of “low traffic” windows of opportunity.

• See: [www.apo.data.faa.gov](http://www.apo.data.faa.gov)
Current Program

• FAA will support CDA development for several CDA airports that fit the FAA benefits screening criteria (noise, emissions & operations)

• Upon identification of interest, this voluntary collaboration does require applicants to invest resources to pursue and support demonstration and application process.

• Interested applicants should contact Dr. J-P Clarke or Sandy Liu to discuss collaboration opportunities.