Operational Procedures for LAQ

John-Paul Clarke
Associate Professor of Aerospace Engineering
Director of the Air Transportation Laboratory
Georgia Institute of Technology

Outline

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2. Continuous Descent Arrival
3. Surface Movement Optimization
4. Conclusions

Introduction

Air transportation is:

- Enabler of economic growth
- Catalyst for economic development

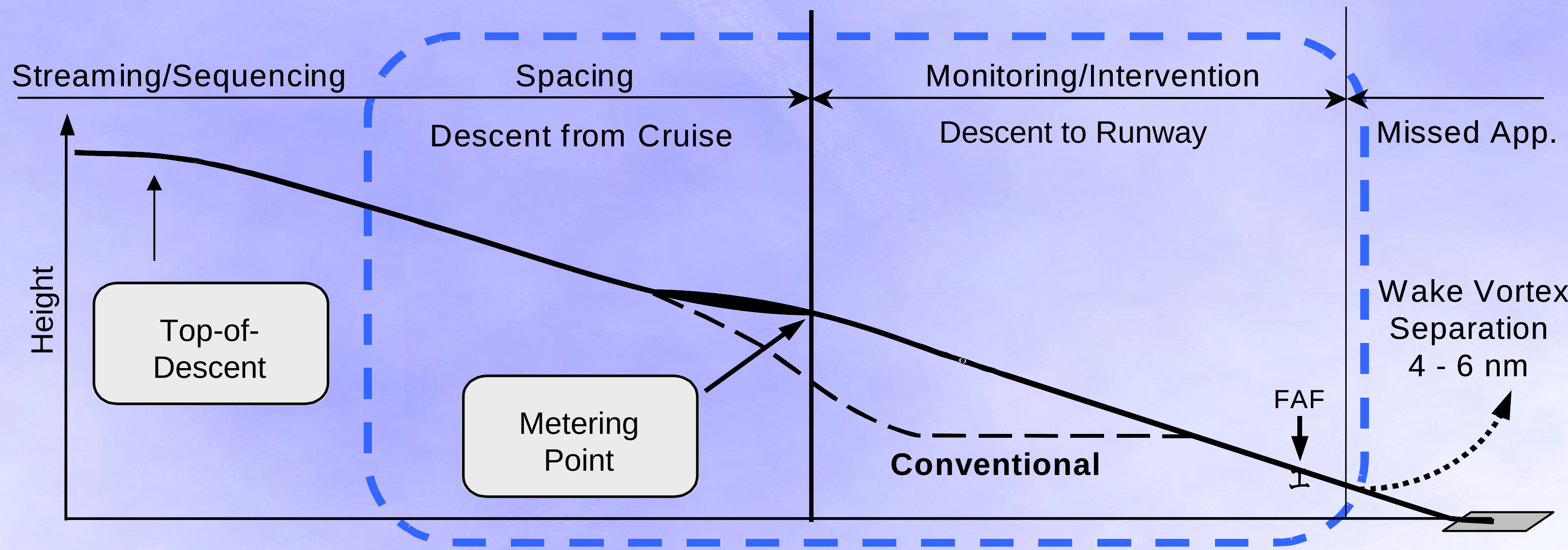
Environmental impact of aviation is:

- Significant concern at the global and local levels
- Local air quality is a rapidly growing concern

Issue must be addressed in a comprehensive way

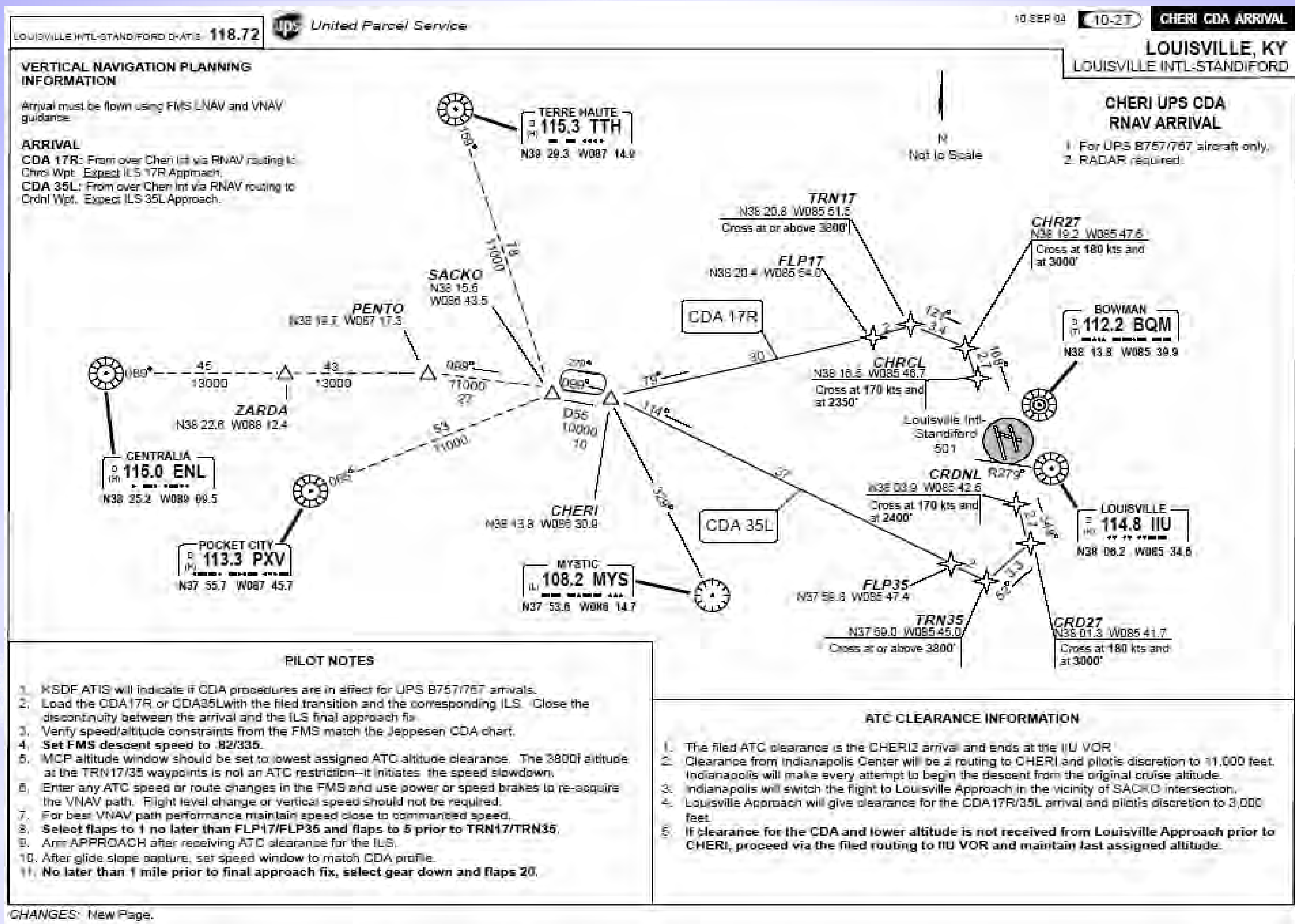
- Reductions at source
- Operational procedures*
- Operational charges and restrictions

Continuous Descent Arrival (CDA)



- Sequence and spacing achieved between top-of-descent and metering point (during descent from cruise a.k.a. initial portion of descent)
- No vectoring after passing metering point (during descent to runway a.k.a. latter portion of descent)
- Metering point dependent on traffic conditions

CDA for 2004 SDF Flight Trials



VERTICAL NAVIGATION PLANNING INFORMATION

Arrival must be flown using FMS LNAV and VNAV guidance.

ARRIVAL

CDA 17R: From over Cheri Int via RNAV routing to Chrcl Wpt. Expect ILS 17R Approach.
CDA 35L: From over Cheri Int via RNAV routing to Crdnl Wpt. Expect ILS 35L Approach.

PILOT NOTES

1. KSDF ATIS will indicate if CDA procedures are in effect for UPS B757/767 arrivals.
2. Load the CDA17R or CDA35Lwith the filed transition and the corresponding ILS. Close the discontinuity between the arrival and the ILS final approach fix.
3. Verify speed/altitude constraints from the FMS match the Jeppesen CDA chart.
4. **Set FMS descent speed to .82/335.**
5. MCP altitude window should be set to lowest assigned ATC altitude clearance. The 3800' altitude at the TRN17/35 waypoints is not an ATC restriction--it initiates the speed slowdown.
6. Enter any ATC speed or route changes in the FMS and use power or speed brakes to re-acquire the VNAV path. Flight level change or vertical speed should not be required.
7. For best VNAV path performance maintain speed close to commanded speed.
8. **Select flaps to 1 no later than FLP17/FLP35 and flaps to 5 prior to TRN17/TRN35.**
9. Arm APPROACH after receiving ATC clearance for the ILS.
10. After glide slope capture, set speed window to match CDA profile.
11. **No later than 1 mile prior to final approach fix, select gear down and flaps 20.**

ATC CLEARANCE INFORMATION

1. The filed ATC clearance is the CHERI2 arrival and ends at the IIU VOR.
2. Clearance from Indianapolis Center will be a routing to CHERI and pilot's discretion to 11,000 feet. Indianapolis will make every attempt to begin the descent from the original cruise altitude.
3. Indianapolis will switch the flight to Louisville Approach in the vicinity of SACKO intersection.
4. Louisville Approach will give clearance for the CDA17R/35L arrival and pilot's discretion to 3,000 feet.
5. **If clearance for the CDA and lower altitude is not received from Louisville Approach prior to CHERI, proceed via the filed routing to IIU VOR and maintain last assigned altitude.**

CHANGES: New Page.

LAQ, Noise, and Economic Benefits

Local emissions reduced

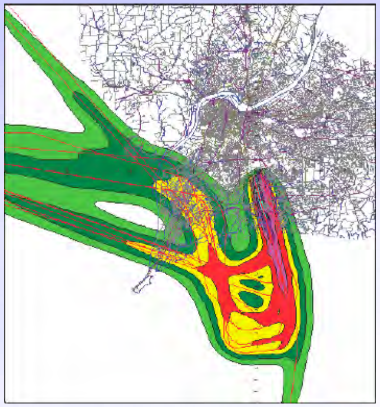
- CO below 3,000 ft reduced by 12.7% (B-767) and 20.1% (B-757)
- HC below 3,000 ft reduced by 11.0% (B-767) and 25.1% (B-757)
- NOx below 3,000 ft reduced by 34.3% (B-767) and 34.4% (B-757)

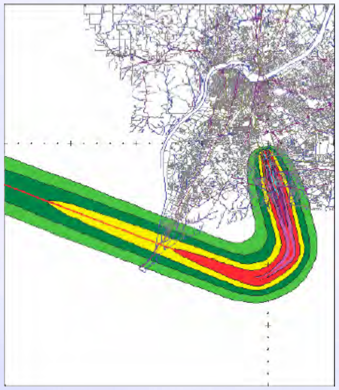
Noise impact reduced

- Lower per aircraft noise levels
  (3 to 6 dBA; 7 to 15 NM from runway)
- Impact concentrated in narrow corridors

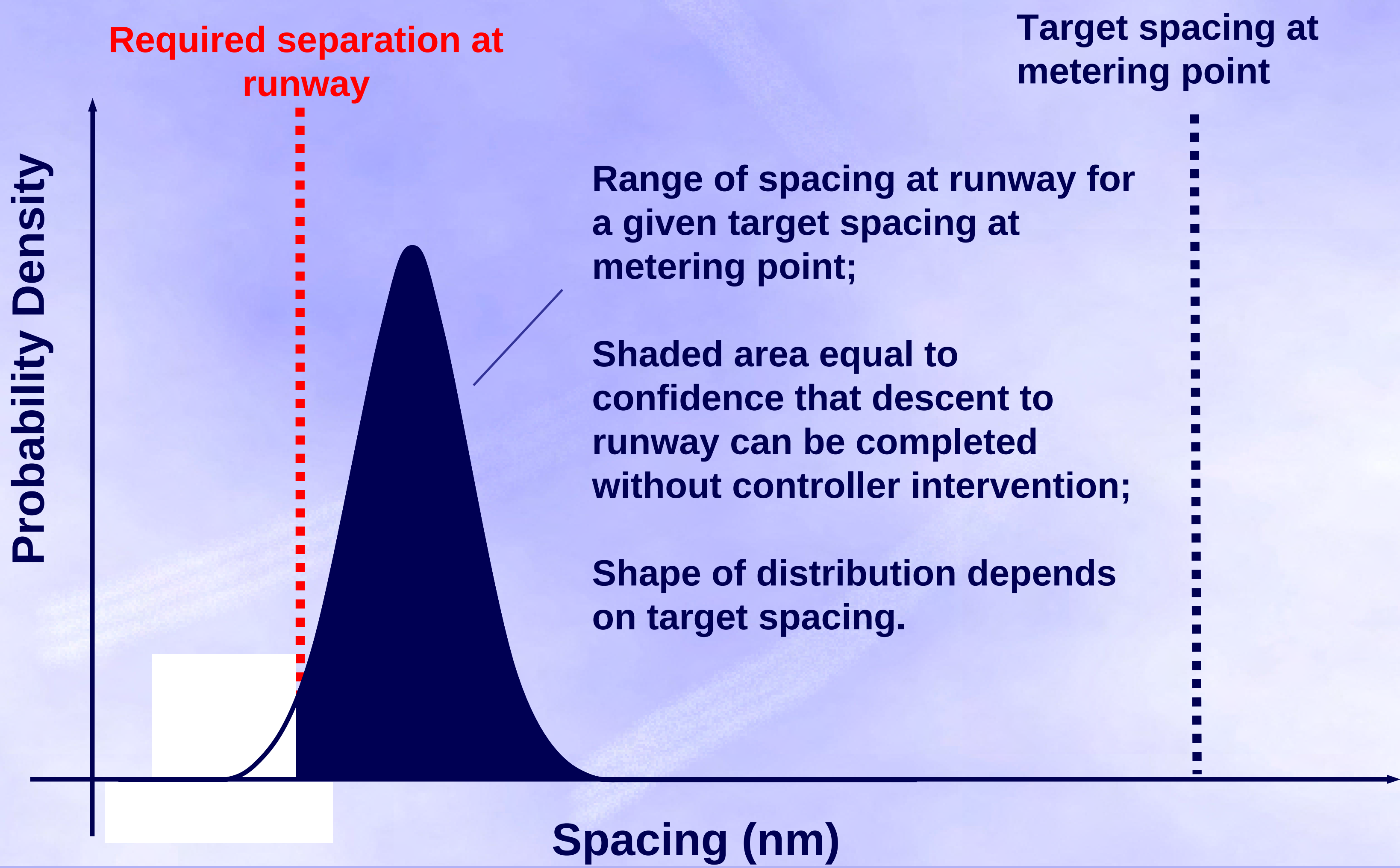
Economic costs reduced

- Fuel to fly last 180 nm to runway reduced by
  364 lbs/flight (B-767) and 118 lbs/flight (B-757)
- Time to fly last 180 nm to runway reduced by
  147 seconds/flight (B-767) and 118 seconds/flight (B-757)

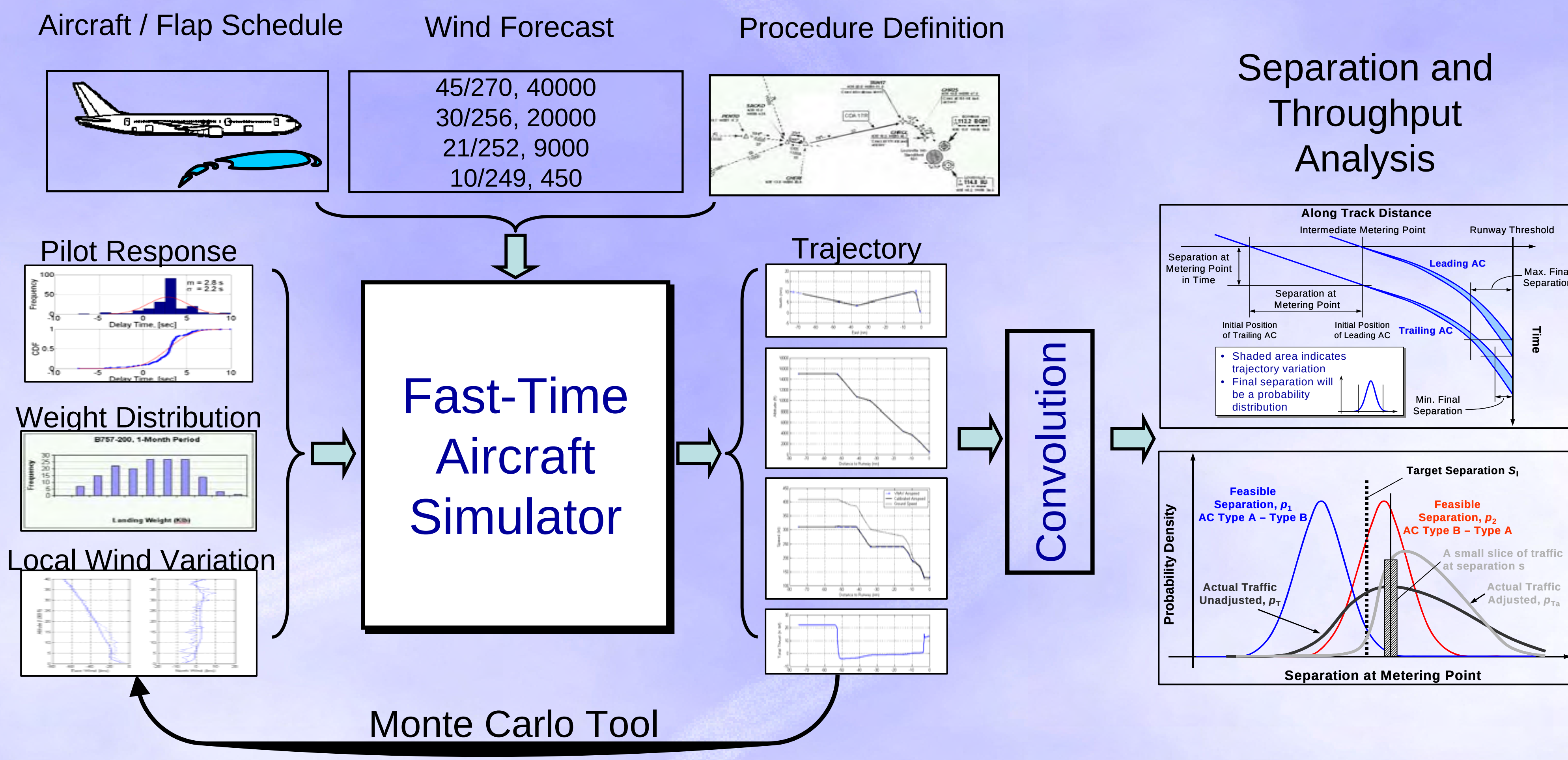




Challenge: Getting the “Right” Spacing



Tool for the Analysis of Separation and Throughput (TASAT)



R&D Activities in Atlanta

Flight test of time-based arrival fix metering*

- Demonstrate ability to set initial spacing based on aircraft type, weight, and wind, and deliver aircraft on final approach with very high accuracy in terms of both time and spacing
- Began on 16 April 2007

Time-based metering of arrivals from NE and NW destined to 8L/26R*

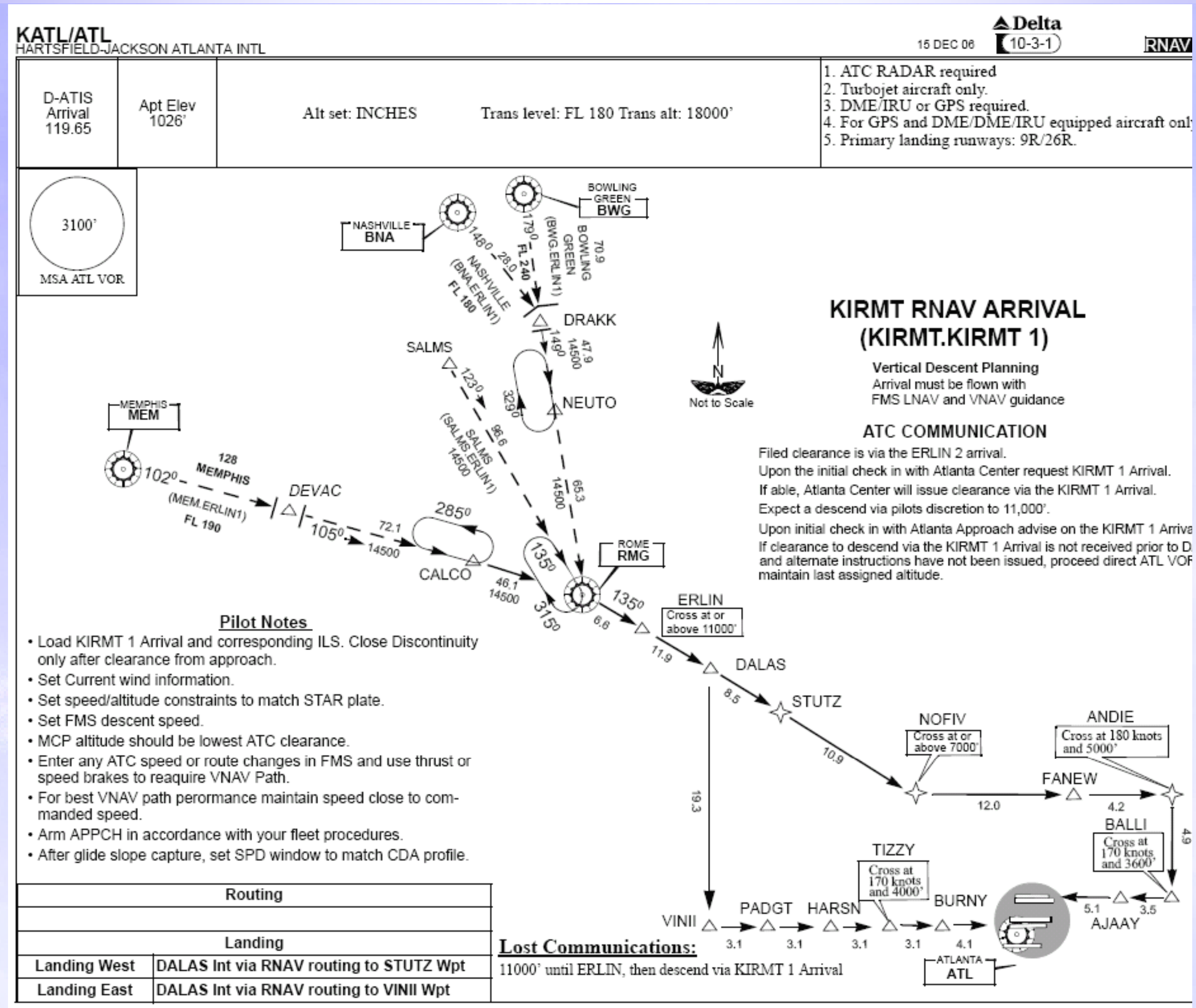
- Build upon results of 2007 flight test
- Starting in 2008 or 2009

Metroplex design for 2015 and 2025

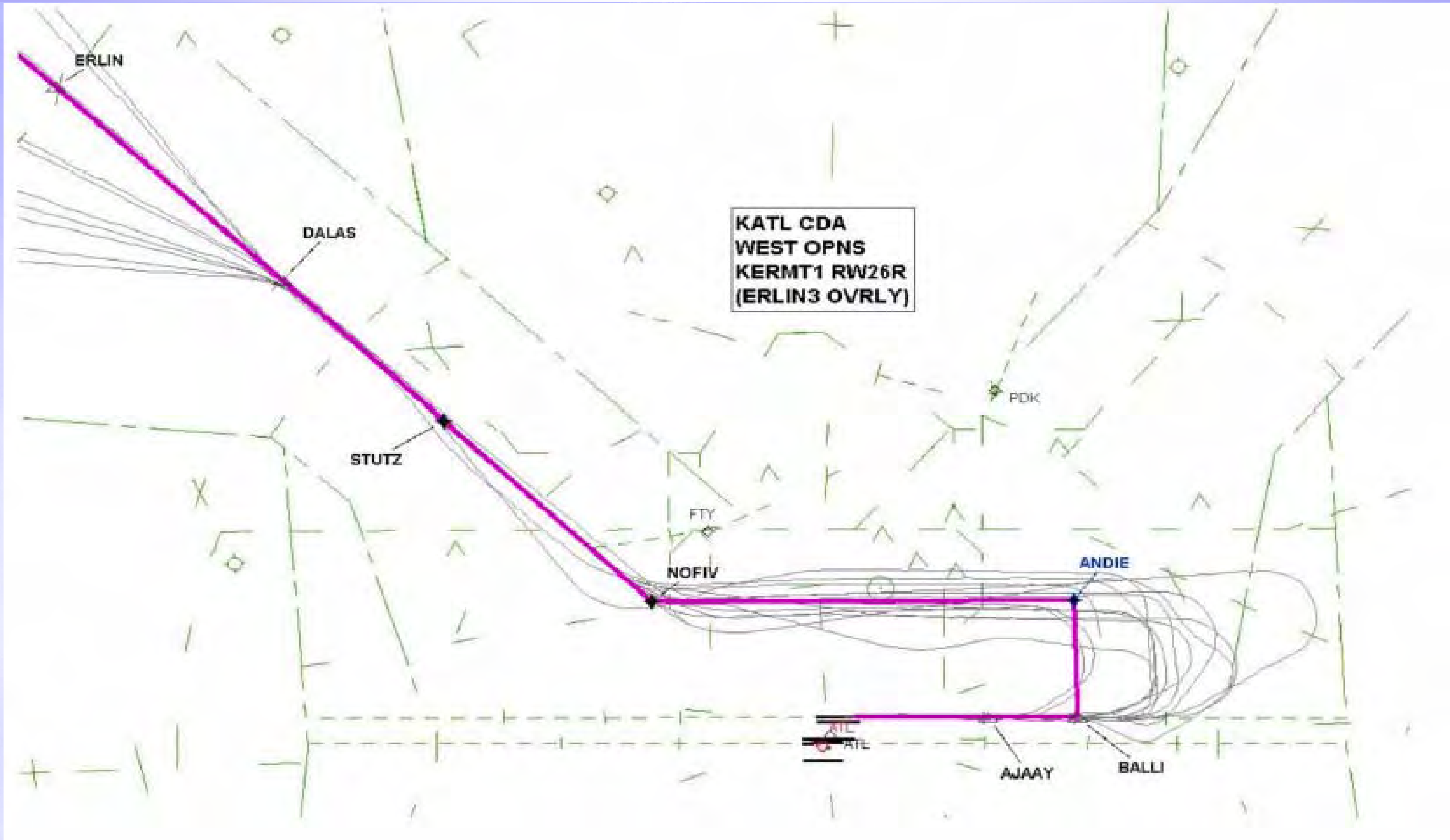
- JPDO project to develop a concept of operations for 2015 and 2025 at ATL

* Partnership between Delta, Georgia Tech, FAA (HQ, ZTL, ZTL-A80)

CDA for 2007 ATL Flight Trials



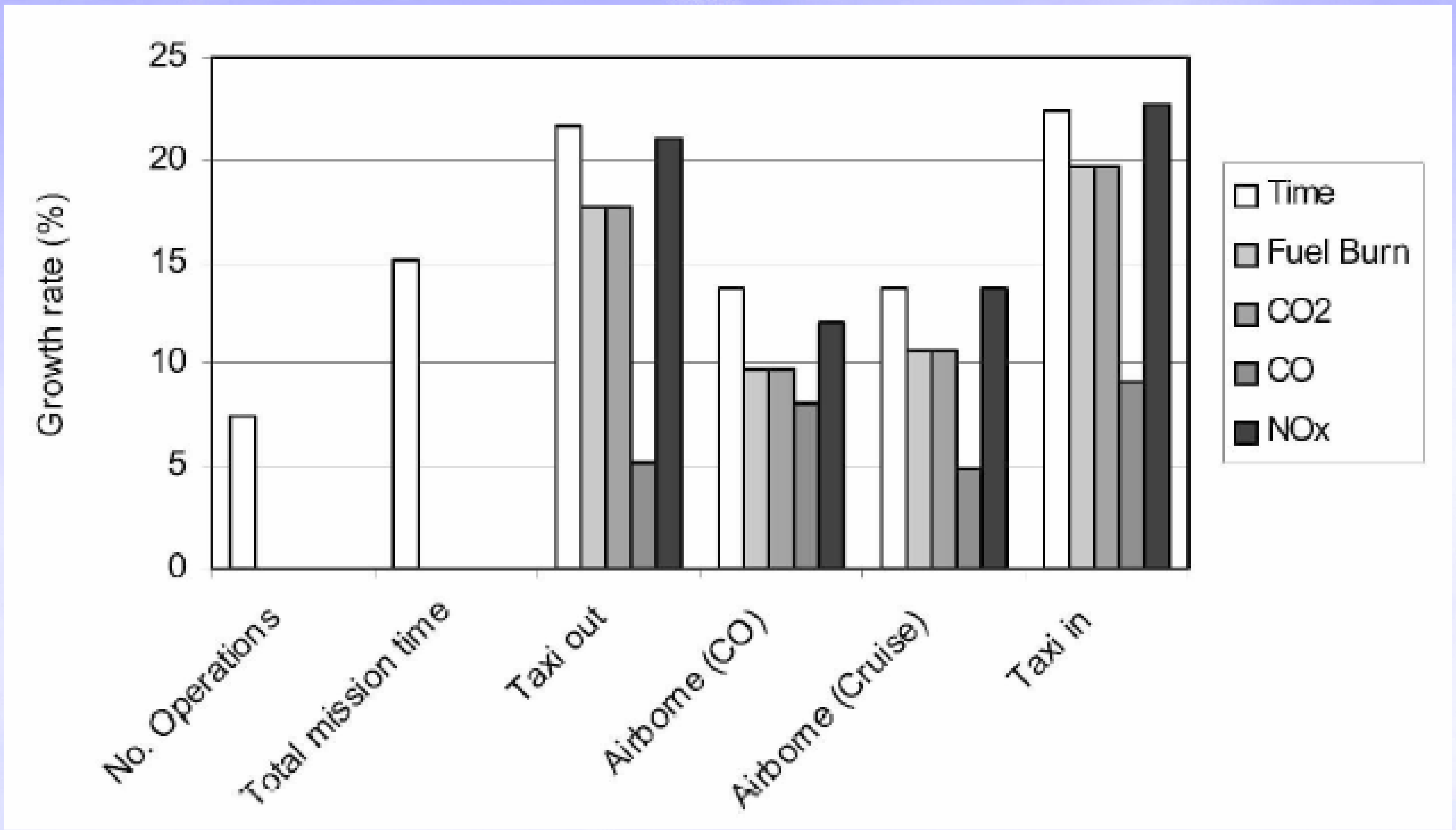
Reduced Low Altitude Vectoring



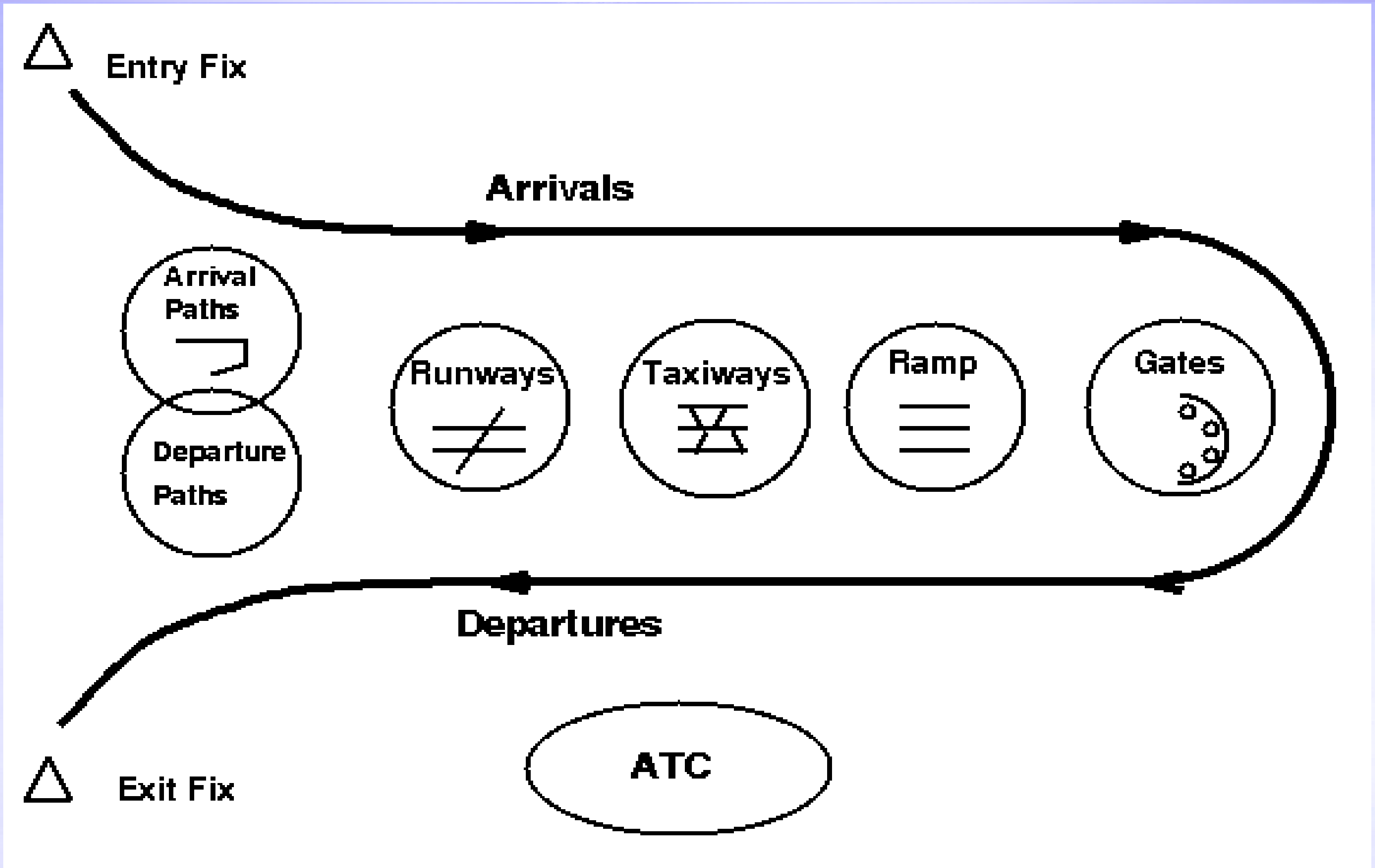
Surface Movement Optimization

What's wrong with this picture?

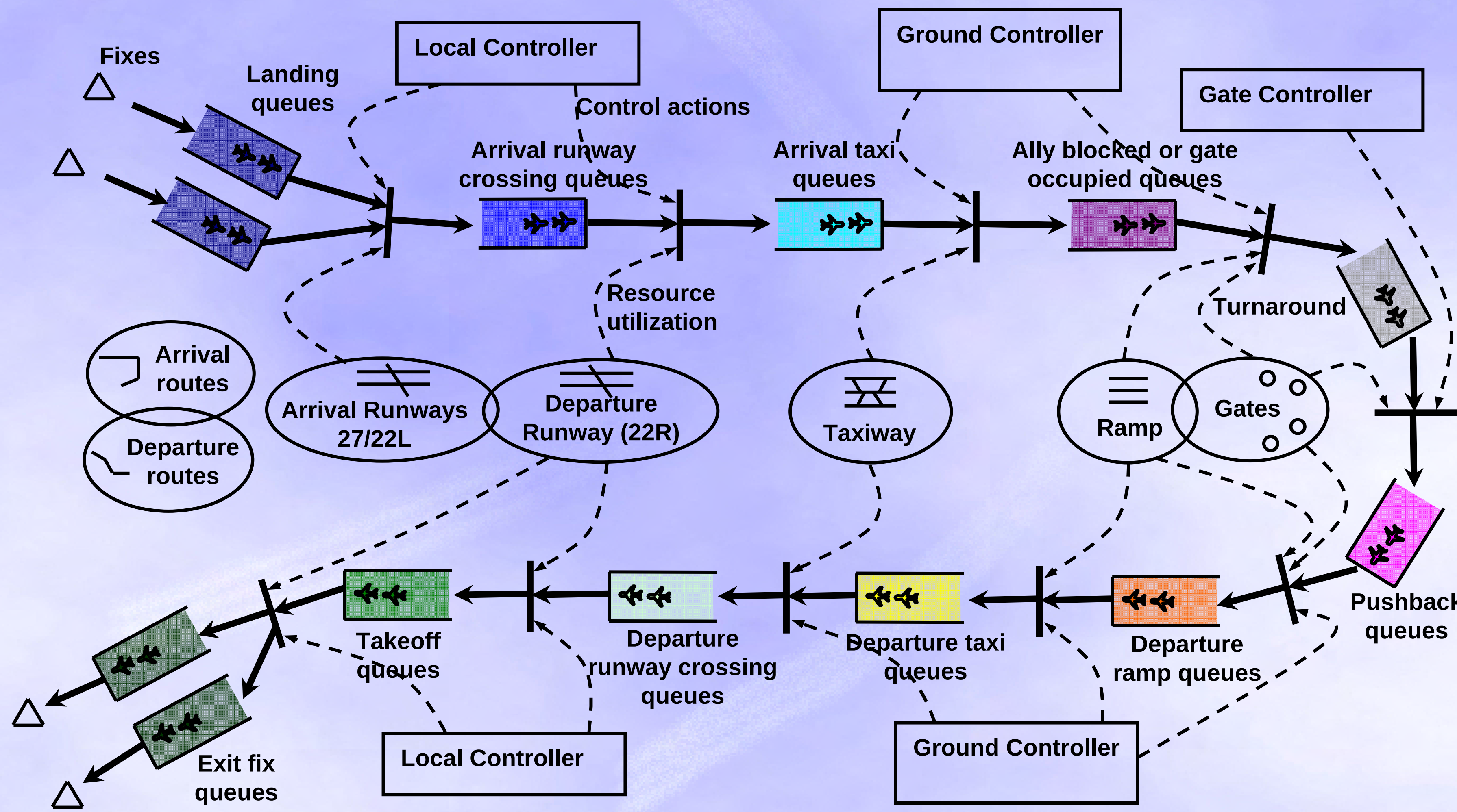
Growth Rates versus Phase of Flight



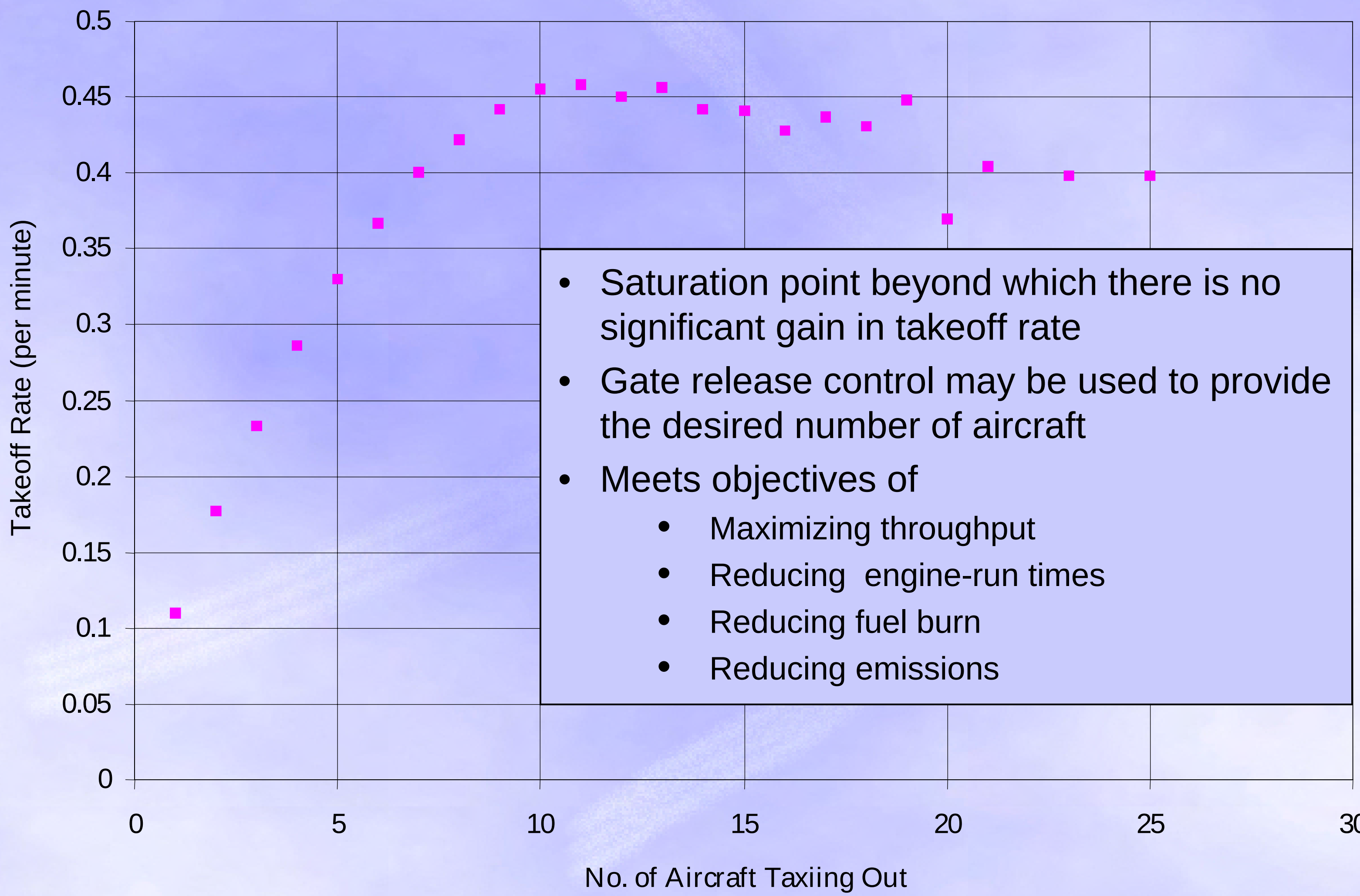
Airport & Terminal Area Traffic Flow



Airport & Terminal Area Queues

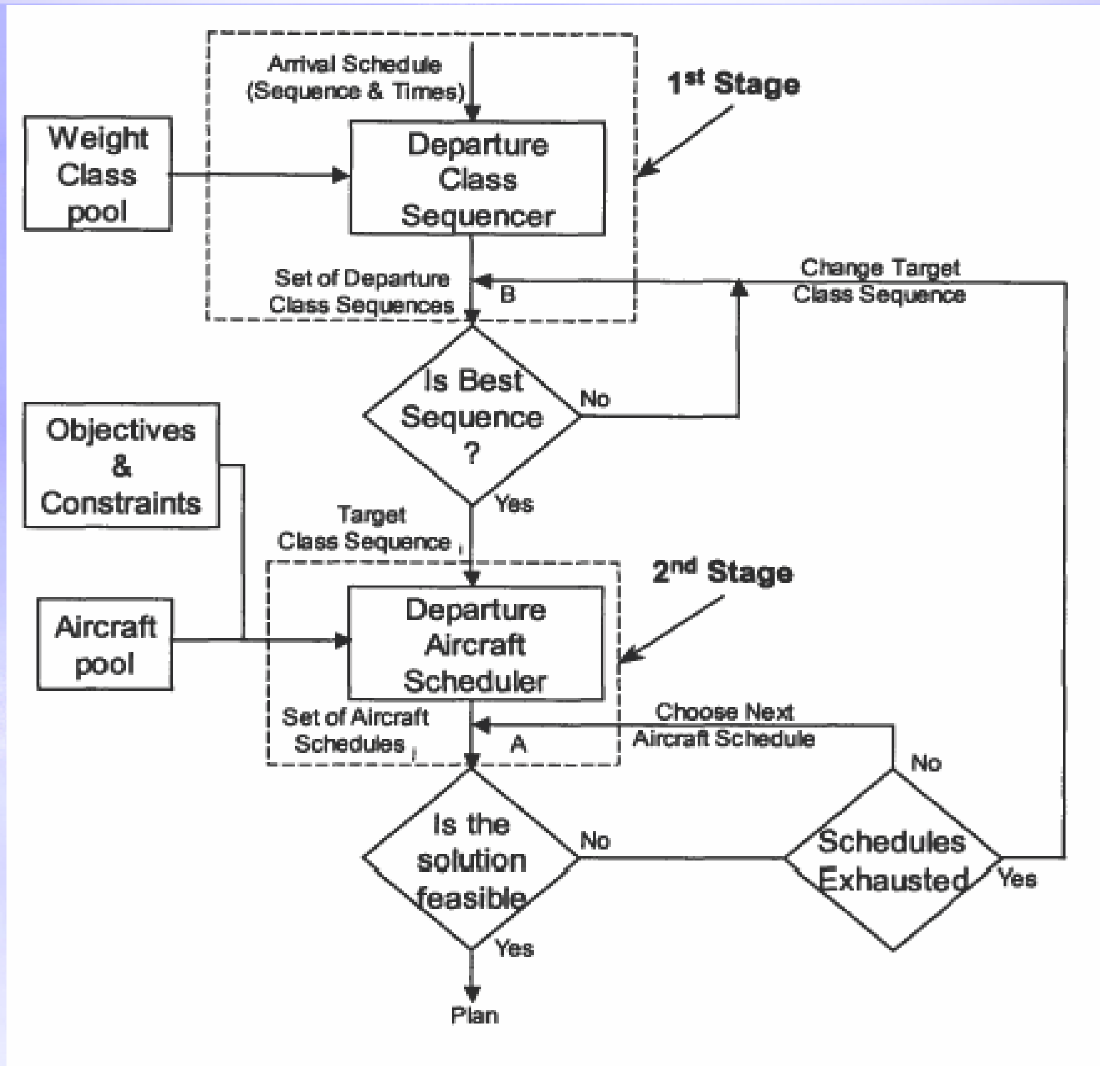


" N Control"



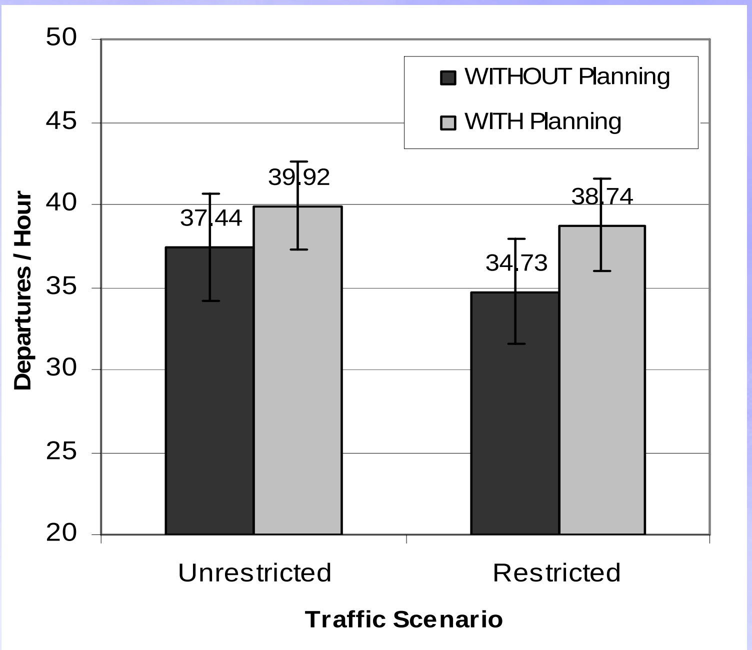
- Saturation point beyond which there is no significant gain in takeoff rate
- Gate release control may be used to provide the desired number of aircraft
- Meets objectives of
    - Maximizing throughput
    - Reducing engine-run times
    - Reducing fuel burn
    - Reducing emissions

Two-Stage Optimization Algorithm

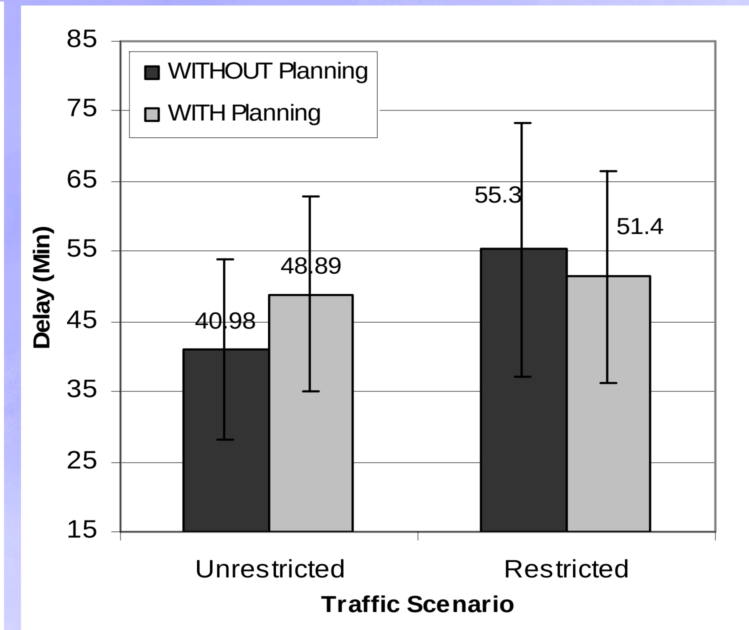


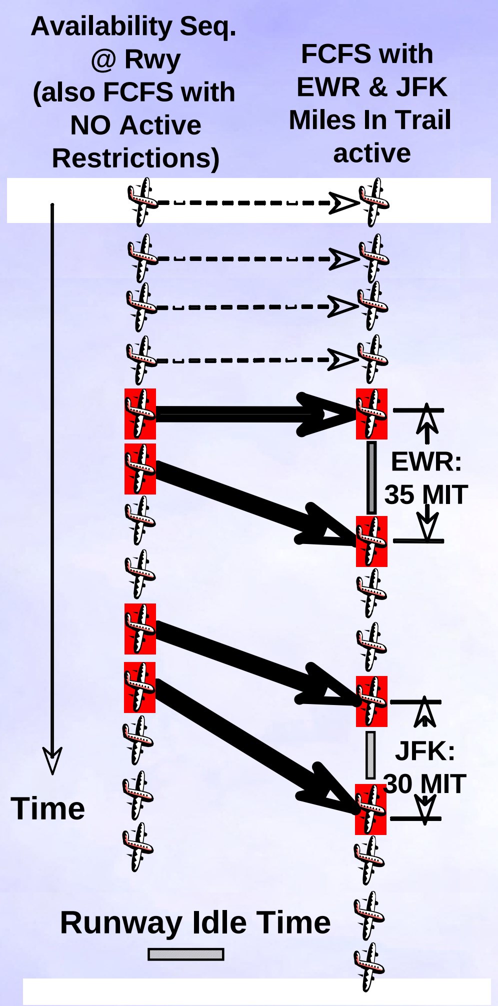
Operational Benefits of Optimization

increased throughput



decreased delay





LAQ Benefits of Optimization

Strategy	Percent NOx		Percent CO		Percent CO_2	
	Taxi Out	Taxi In	Taxi Out	Taxi In	Taxi Out	Taxi In
Improved operations	–45.36	–45.31	–46.29	–45.61	–45.27	–45.12
Single engine	–31.82	–7.97	–30.38	–7.96	–31.39	–7.76
CNG tugs	–40.92	–41.04	75.35	77.14	N/A	N/A
Gasoline tugs	–60.92	–60.70	250.71	254.28	N/A	N/A
Diesel tugs	37.50	37.47	–92.58	–92.49	N/A	N/A
OEM optimized CNG tugs	–65.54	–65.61	–96.93	–96.90	N/A	N/A

Conclusions

Operational procedures can provide (and are providing) much needed LAQ benefits:

- Well designed CDA's significantly reduce (in many cases eliminate) low altitude vectoring and reduce the time in the mixing layer
- Surface movement optimization significantly reduces taxi time and thus the emissions from surface operations (fastest growing emissions segment)

Development of operational procedures will also provide solutions to some fundamental air traffic control questions:

- How does terminal area trajectory prediction accuracy vary as a function of uncertainties in wind, aircraft weight, pilot performance?
  - 4-D trajectory management limits
- Under what conditions can precise aircraft sequencing and spacing be achieved in the terminal area and one the surface with "strategic control?"
  - Requirements for avionics, air traffic control decision support and wind prediction tools