**Partnership for AiR Transportation Noise and Emission Reduction**

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# Continuous Descent Arrivals

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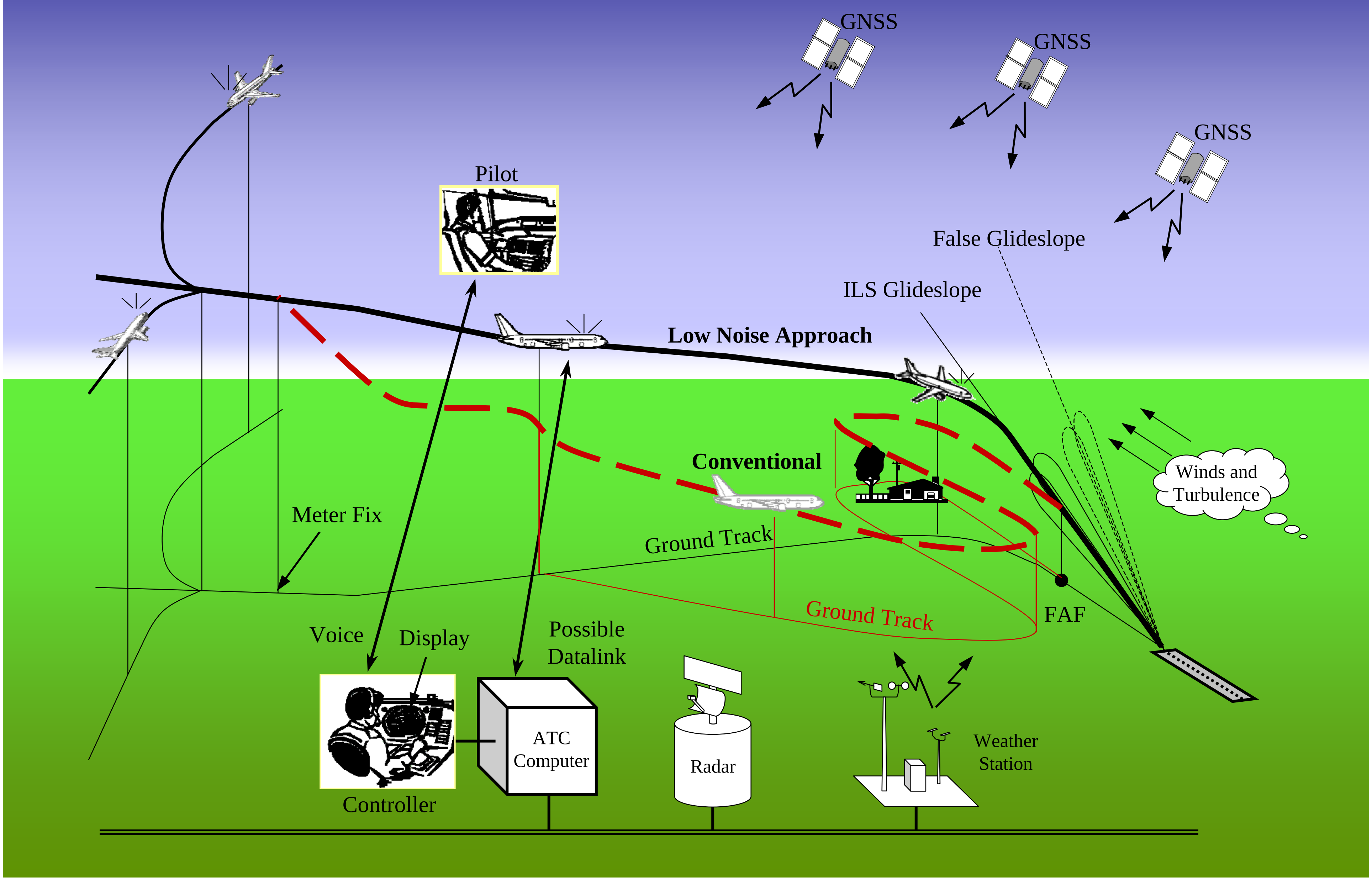
# What is CDA?

- Continuous descent arrival (CDA) is a procedure where aircraft descend from a relatively high altitude without leveling off
  - Also referred to as continuous decent approach
- CDAs being developed at Georgia Tech are Area Navigation (RNAV) procedures where…
  - Vertical profile (ideally between cruise altitude and the runway but at least between 10,000 ft and the runway) optimized to:
    - Eliminate level segments
    - Minimize emissions, flight time, fuel burn, noise
  - Inter-aircraft separations determined a priori:
    - Minimize need for controller intervention (vectoring) at low altitudes

# CDA and the ATC Environment



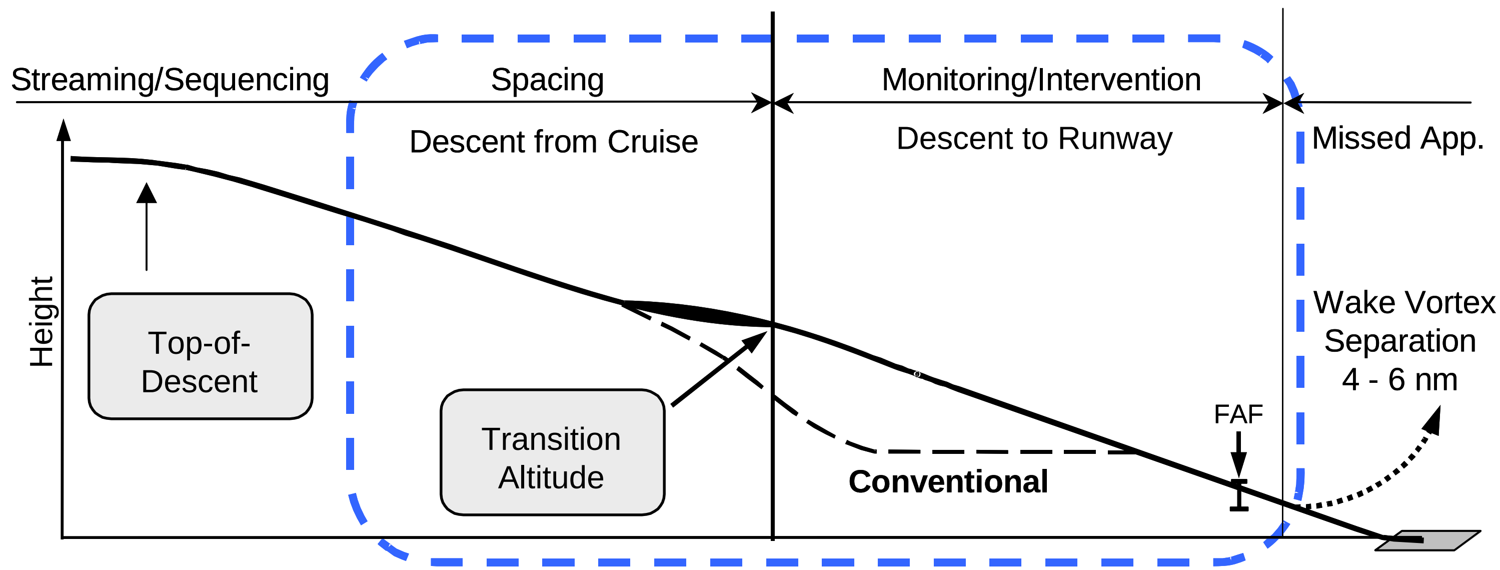
# What are the benefits of CDA?

- Noise
  - Up to 6 dBA reduction in peak level noise
  - Up to 30% reduction in noise contour area
- Emissions (below 3,000 ft)
  - Up to 20% reduction in CO
  - Up to 25% reduction in HC
  - Up to 35% reduction in NOx
- Fuel
  - 118 lb average reduction in B757 fuel burn
  - 364 lb average reduction in B767 fuel burn
- Time
  - 118 sec average reduction in B757 flight time
  - 147 sec average reduction in B767 flight time

# Research Objectives

- Develop design framework, methodology, and tool to determine the set of waypoint restrictions and inter-aircraft separations that:
  - Eliminate level segments
  - Minimize vectoring at low altitudes
  - Minimize emissions, flight time, fuel burn, noise
- Given variability and uncertainties in…
  - Aircraft dynamics and weight
  - Flight management system (FMS) logic
  - Pilot response
  - Wind speed and direction
- And use framework, methodology, and tool to create…
  - CDA procedures throughout the US
  - Controller and pilot tools for heavy traffic scenarios

# CDA Design Framework




- Controllers vector during descent from cruise altitude (top-of-descent) to transition altitude to establish separation and speed
- No planned vectoring during descent to runway i.e. below transition altitude
- Transition altitude dependent on traffic conditions

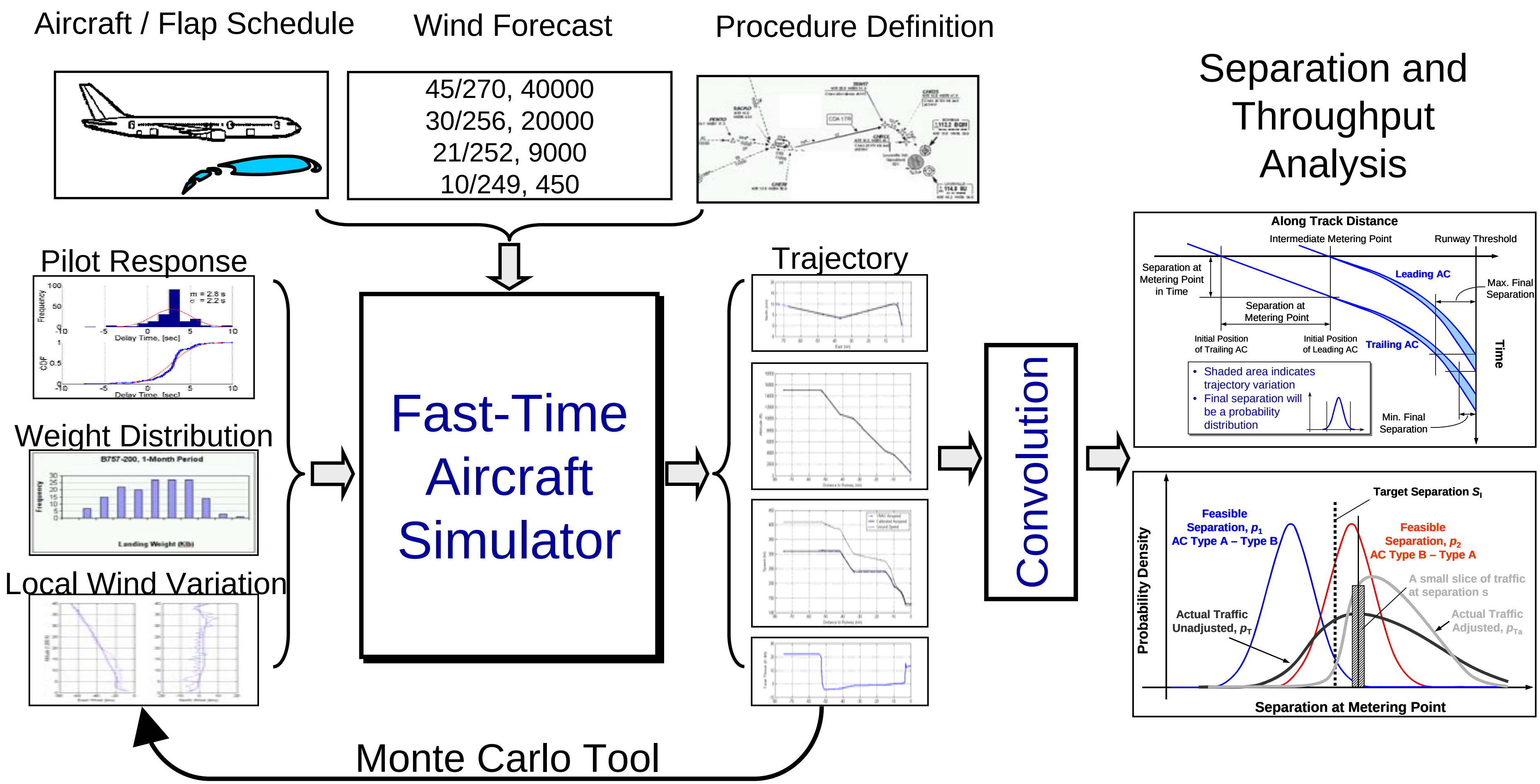
# CDA Design Methodology

- Determine lateral profile
  - Set transition altitude based on air space segmentation and point where traffic merge
- Build wind model
  - Develop separate model for each definable subset of wind conditions
- Use Monte Carlo Simulation-based Tool for the Analysis of Separation and Throughput (TASAT) to determine:
  - Range of crossing altitudes (at each waypoint) for each aircraft type in "unrestricted" descent from cruise
  - Required separation at (or near) top-of-descent and at transition altitude for each pair of aircraft types in unrestricted descent from cruise

# CDA Design Methodology (cont'd)

- Develop (if airspace is constrained) set of scenarios with different transition altitudes and waypoint (altitude and speed) restrictions
- Use TASAT to determine:
  - Required separation at (or near) top-of-descent and at transition altitude for each pair of aircraft types
- Determine "best" transition altitude, waypoint restrictions and required separations given:
  - Trade-off (if any) between emissions, fuel burn, noise, time, and throughput

# Design Tool -- TASAT



# Summary

- CDA is as cost effective means of achieving near-term reductions in noise and emissions
- Operators benefit from fuel and flight time savings
- Design framework, methodology, and tool has been developed and verified through flight test
- Positive feedback from controllers and pilot
- Framework, methodology, and tool being used to develop CDA procedures at US airports
  - e.g. ATL, LAX

# Future Directions

- Fully automate design process
  - Automate the iterative use of TASAT
  - Formulate and implement non-linear optimization algorithm to drive iterations
- Study effects on noise, emissions, fuel, time (and the balance between them) of…
  - descent speed variation
  - altitude and speed constraints to allow for crossing traffic
  - multiple metering points
- Determine requirements and logic for controller and pilot decision support tools for higher traffic conditions