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Advanced Continuous Descent Arrivals with PBN, Datalink, and ADS-B In

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Presentation Outline

- **What are Continuous Decent Arrivals (CDA)?**
- **3D-Path Arrival Management (3D-PAM)**
- **Tailored Arrivals (TA)**
- **Greener Skies**
- **Flight Interval Management for Spacing (FIM-S)**

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What is Continuous Descent?

- **According to International Civil Aviation Organization (ICAO),**
  - Continuous Descent Operation (CDO) is “an operation, enabled by airspace design, procedure design and ATC facilitation, in which an arriving aircraft descends continuously, to the greatest possible extent, by employing minimum engine thrust, ideally in a low drag configuration, prior to the final approach fix /final approach point”
  - Optimized Profile Descent (OPD) is “a descent profile normally associated with a published arrival (STAR) and designed to allow maximum practical use of a CDO…OPD is one method of facilitating CDO”

- **OPD is advanced CDO or Continuous Descent Arrival (CDA), e.g.,**
  - 3D-Path Arrival Management (3D-PAM)
  - Tailored Arrivals (TA)
  - Greener Skies
  - Flight Interval Management for Spacing (FIM-S)

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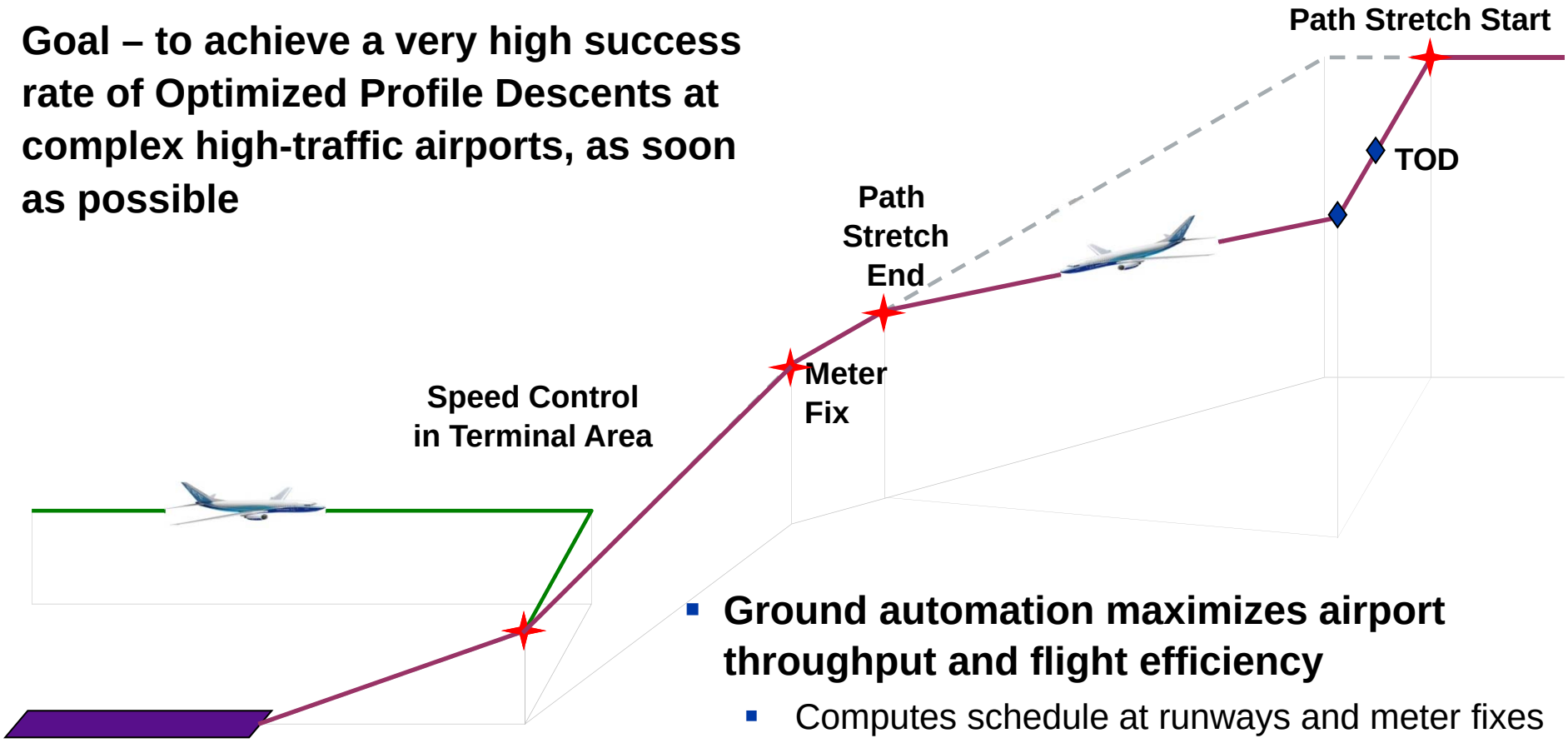
What is 3D-Paths Arrival Management (3D PAM)?

- **Goal – to achieve a very high success rate of Optimized Profile Descents at complex high-traffic airports, as soon as possible**



- **Ground automation maximizes airport throughput and flight efficiency**
  - Computes schedule at runways and meter fixes
  - Selects cruise/descent speeds and lateral path stretch to meet schedule
- **Path stretch Point-Bearing-Distance given to pilot by voice command for entry into the FMS**

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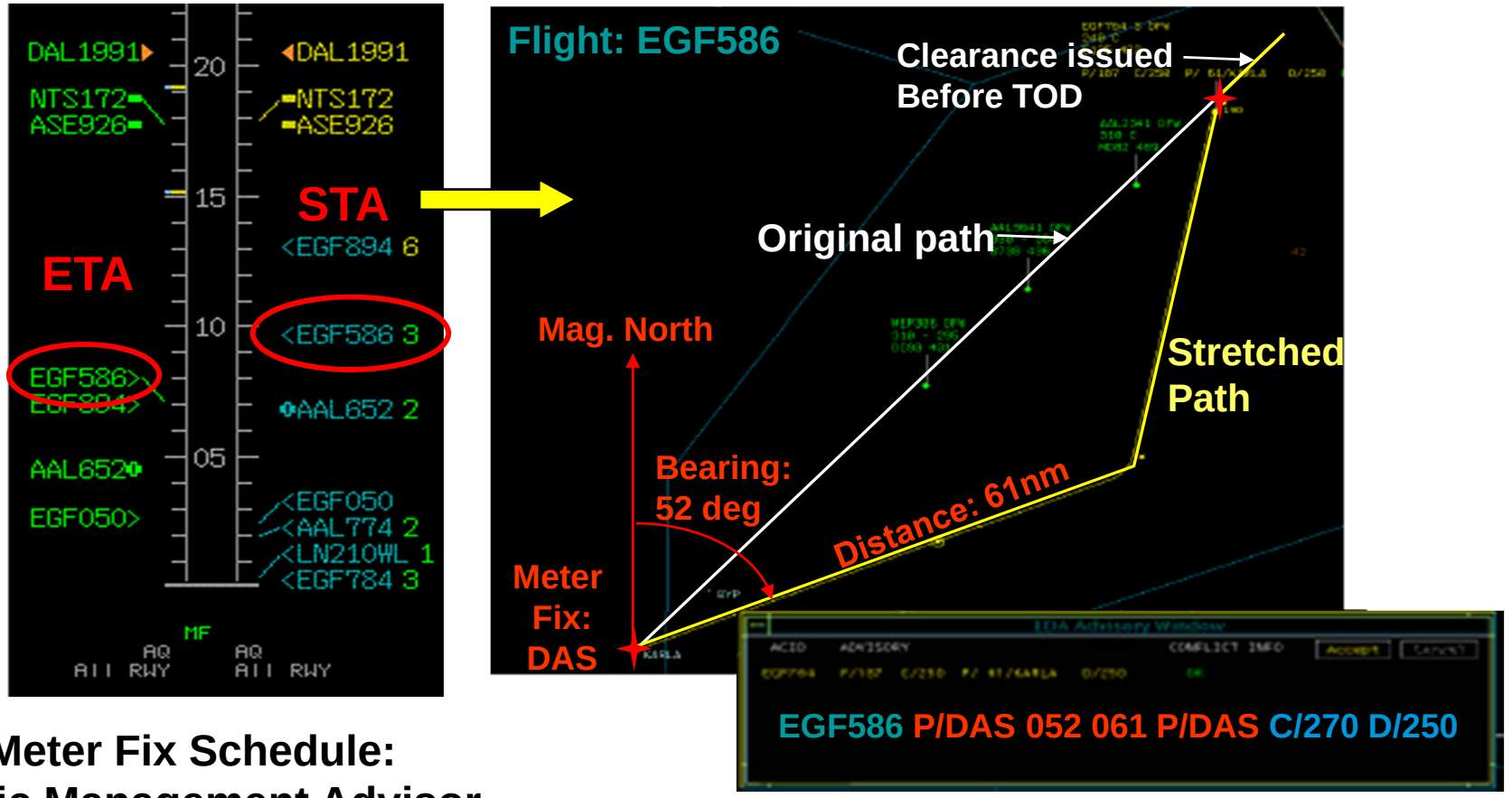
How is 3D-PAM Done?



Meter Fix Schedule: Traffic Management Advisor (TMA)

Path-Based Advisory to Meet the Schedule: Efficient Descent Advisor (EDA) Functionality

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What are 3D-PAM's Benefits?

- **Primary benefits mechanism**
  - Fuel efficient arrival operations
  - Higher predictability, reduced workload, and increased airport throughput

- **An interim step toward NextGen requirements for 4D-trajectory flight profiles**

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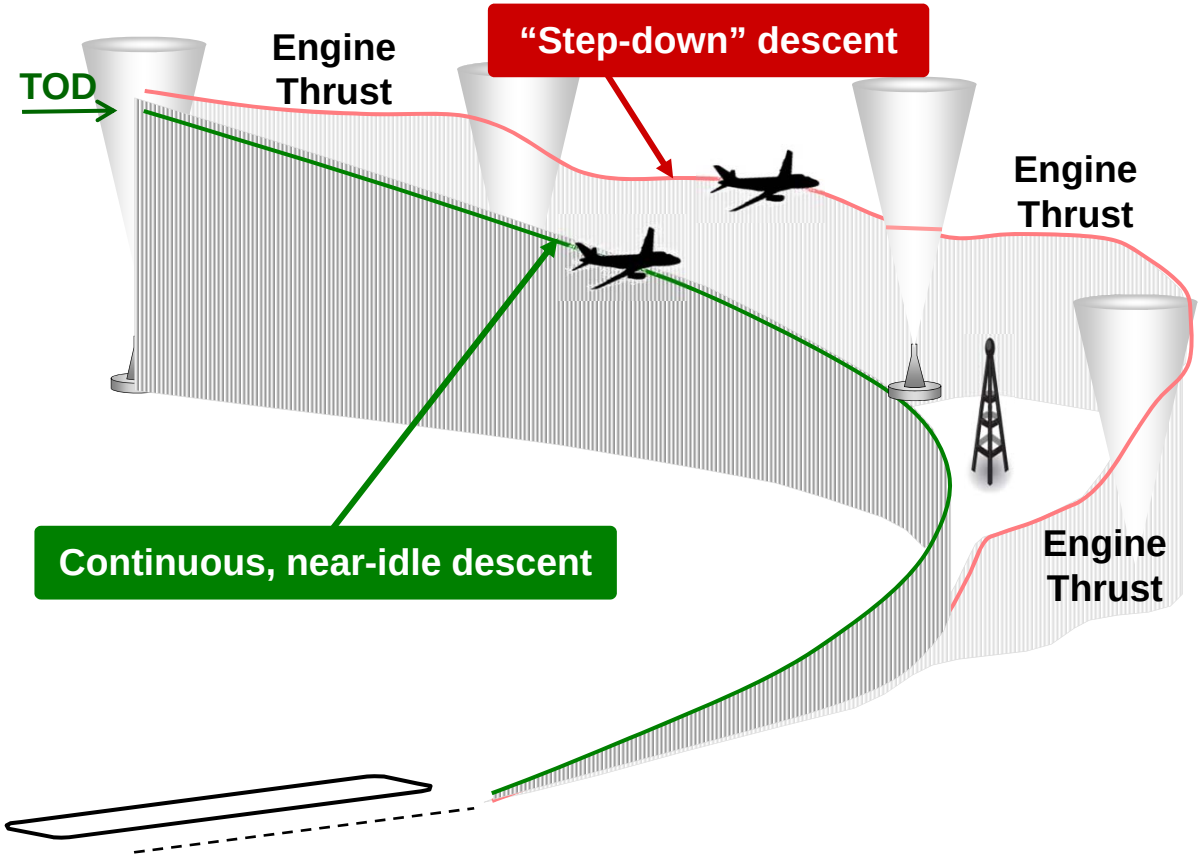
What are Tailored Arrivals (TAs)?

- **TAs are flight procedures that use customized, dynamic arrival trajectories enabling smooth, efficient descents from cruise altitude to runway**

- **TAs combine existing, pre-defined arrivals within a single clearance to permit aircraft's Flight Management System (FMS) to fly the most efficient trajectory from top of descent (TOD) to runway while subject to constraints**



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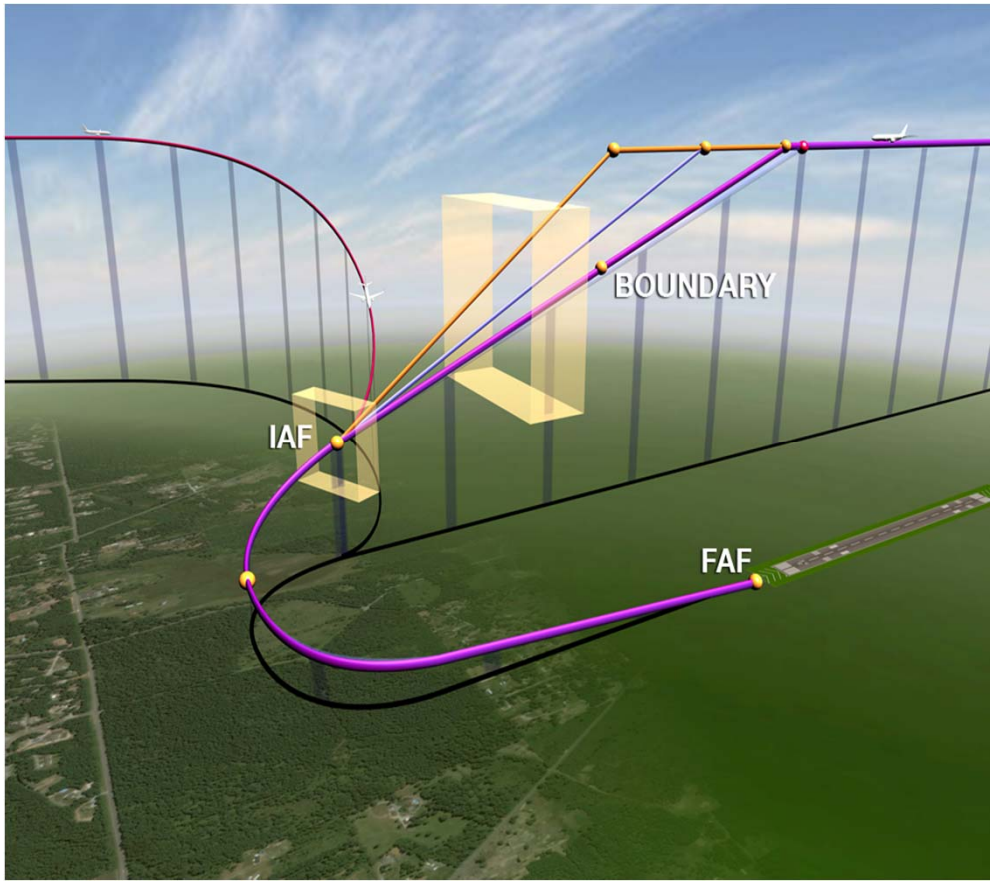
How are TAs Done?

- **Near-idle descent**
- **Tailored for traffic, environment**
- **Tailored for a specific airspace**
- **A single, integrated clearance**
- **Coordination among ATC facilities**
- **Customized and flown by FMS**
- **Predictable flight path in time & space (4D)**
- **Controller-to-aircraft communication by data link or voice**
- **Co-existence with standard arrivals**
- **Can be broken off at any time by ATC if necessary**



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What are TA Benefits?

- **Substantial near-term benefits**
  - Significantly reduced fuel consumption, emissions, and airplane noise footprints
  - Shorter flight durations and improved schedule compliance
  - Better flight path predictability
  - Reduced voice communications and coordination in busy terminal airspace
  - Less complex tasks for pilot and controller, with benefit to safety
  - A smoother, more comfortable ride for passengers
- **Maximize use of current aircraft capabilities**
  - Applicable to all aircraft types
  - No new investment required
- **Initial TAs use existing ground-based ATC systems**
- **Compatible with all existing Performance Based Navigation (PBN) technologies**
- **Co-existence with Standard Operating Procedures**

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What is the “Greener Skies” Project?

- **i-1. PBN instrument procedures in a complex airspace, while providing an environment for research**
  - OPD STARs and RNAV (RNP, GPS, RVFP) approaches
  - Flight Simulation/Flight Trials – June 2012
  - Environmental Study – Publish Procedures March 2013

- **i-2. Evaluate concepts, research alternatives, and establish requirements resulting in full implementation of PBN technologies first in SEA/BFI airspace and then NAS-wide**
  - RNP Established
  - RNP to ILS Capture
  - Concurrent Approaches
  - Procedurally Separating Arrivals/Departures
  - Decision support tools (example: RPI, RTA, TMA)

- **Implementation – ATC procedures, rule changes, training**

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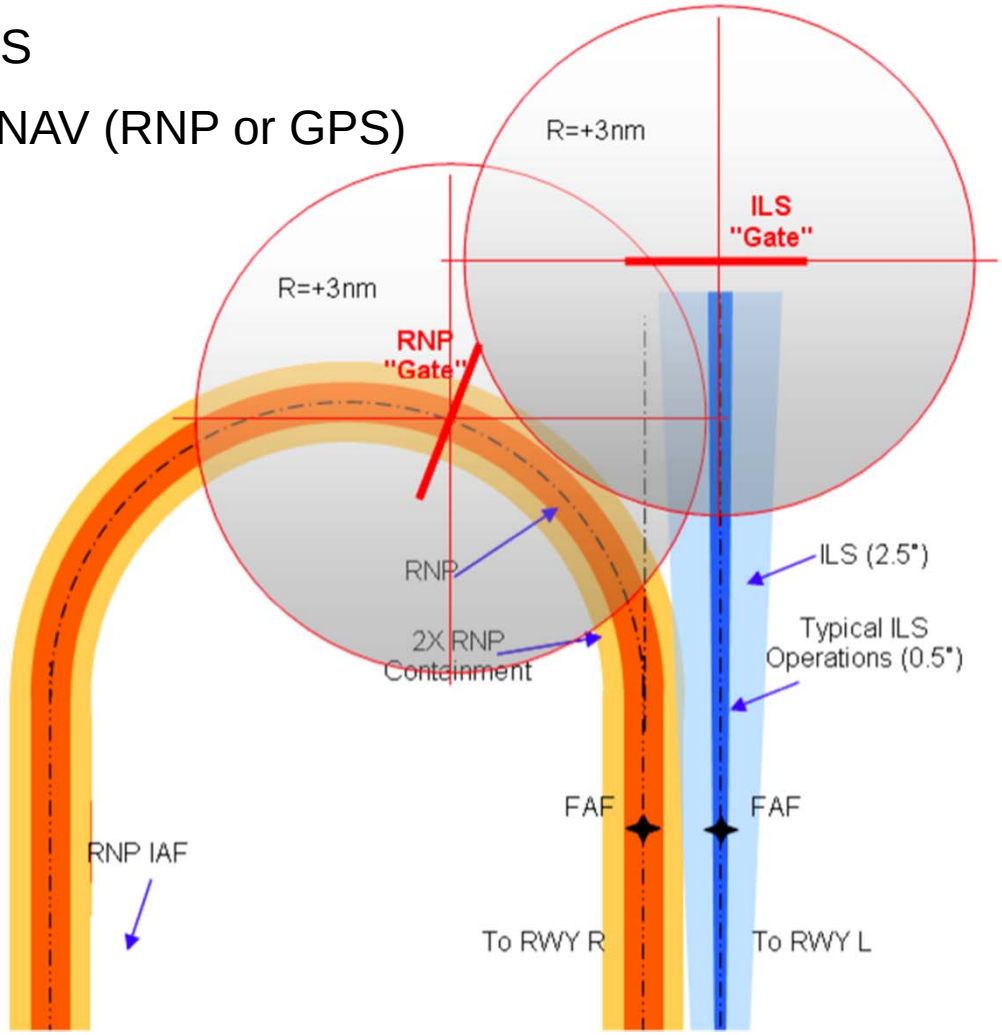
How is Greener Skies Done? (1 of 2)

- **RNP established**
  - RNAV (RNP) next to ILS
  - RNAV (RNP) next to RNAV (RNP or GPS)



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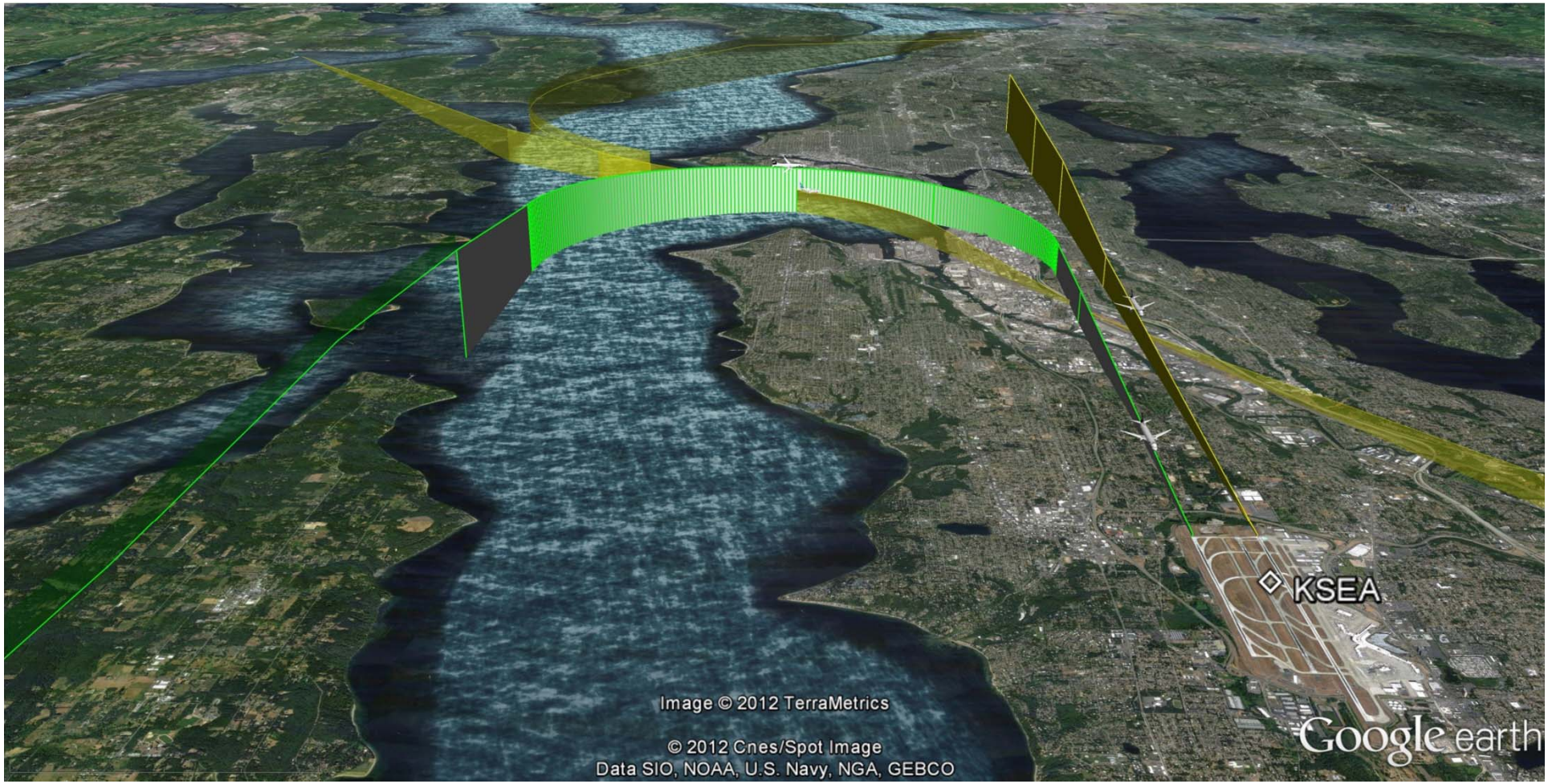
How is Greener Skies Done? (2 of 2)

The trial procedure capitalizes on RNAV/RNP system technology to promote stabilized visual approaches to a designated runway.



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What are Greener Skies' Benefits?

- **Enables aircraft to fly more consistent and more precise paths to closely spaced parallel runways**
- **Significantly shortens downwind leg, thus reducing fuel burn, emissions, and noise**
- **Reduces controller and flight crew workload and communications**

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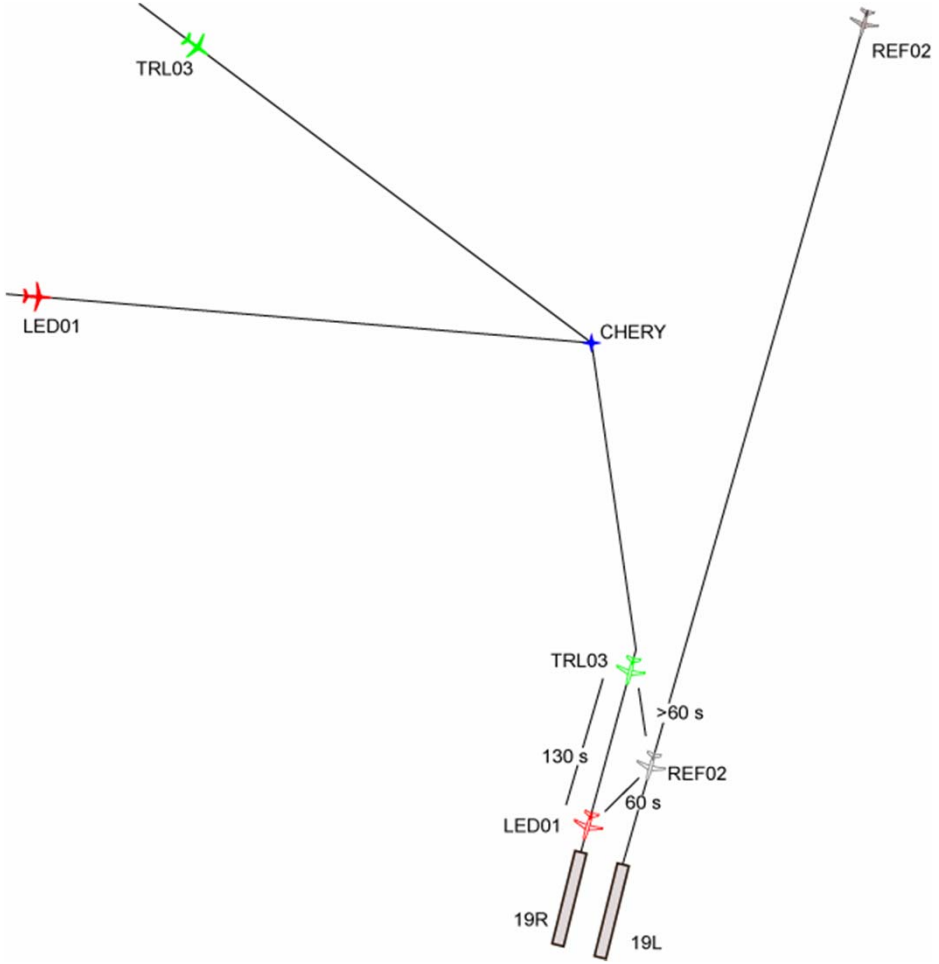
Flight Interval Management for Spacing

- **FIM-S can be used by the flight crew to achieve and maintain a spacing interval designated by ATC through adjustment of speed and path length if necessary**
- **To best perform an OPD, the FMS requires that the descent path required by ATC be defined prior to top of descent**
- **The combination of early sequencing by ATC and the spacing task being delegated to the flight crew will allow OPD to be performed in high traffic density environments, significantly reducing controller and flight crew workload**



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Summary

- **We are working on CDA technologies and procedures**
  - 3D-PAM
  - Tailored Arrivals
  - Greener Skies
  - FIM-S
- **All have benefits in terms of improving efficiency and reducing environmental impact**
- **Important steps toward NextGen system performance**

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