SCATS, Inc. (Scientific Consulting & Automated Technological Services)

Point - in - Space Ghosting Technology

Enhancing Distributed Air/Ground Traffic Management

"To provide aviation research that meets the needs and requirements of the National Airspace System"

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SCATS – A WOMAN-OWNED, DIVERSE, SBA "8 (a)" CERTIFIED SMALL BUSINESS

- **System Requirements & Research & Development**
  - Requirements Identification & Definition
  - System Design & Development
  - Prototyping
  - Modeling & Simulation
  - Software Development
  - Engineering & Integration
  - Regulatory, Policies & Procedures Development
- **Systems Development and Integration**
- **Advanced Aircraft Certification**
- **Modeling, Prototyping and Simulation Tools**
  - Total Airspace and Airport Modeler (TAAM)
  - Air Traffic Modeler (ATModel)
  - Integrated Noise Model (INM)
  - Airport and Airspace Simulation Model
- **Human Factors Engineering**
- **Operational Concept Development**
- **Concept Definition & Integration**
- **Studies & Analysis**
- **OT&E**
  - Test & Evaluation
  - Report Writing

SCATS Achievements and Successes

- Successfully managed and implemented FAA program transitions
  - ATS GPS Oceanic Airspace Implementation Plan.
  - ATS development of the US Domestic GPS Airspace Plan.
  - Program management for ATS on Oceanic Data Link Communications, development, simulation, integration, & training for Oakland ARTCC implementation.
  - Potomac Airspace Management Plan.
  - Program management in developing a unique converging runway display aid and a Controller Automated Spacing Aid tool for use at the NY TRACON focused on Newark Airport
- Technical / Engineering & RE&D
  - Invented “point-in-space” automated application (Adaptive Path Ghosting) for Newark arrival operations. Algorithm now installed in all ARTS III systems.
  - Performed identification & analyses of NAS Aviation facilities’ hardware & software problems leading to future R & D efforts (AOP Contract).
  - Developed for AOP a Risk Mitigation assessment and recommended implementation plan

What Is Point-in-space Ghosting?

An automated spacing tool

- **Enables controllers & pilots to meet minimum spacing requirements**
- **Enhances Distributed Air/Ground Traffic Management**

How is this Accomplished?

The automated program presents a "ghost" of one aircraft (offset to add the necessary separation spacing) onto the flight path of another aircraft. This enables the controller or the cockpit crew, as assigned, to achieve the required spacing as the two flights converge.

What Can Point-in-space Do for the National Airspace System?

Improves airspace efficiencies for converging and crossing operations

Reduces controller and crew workload. "Time and attention" is eased for all operations thereby improving productivity.

Reduces delays

Enhances safety

Where Does Point-in-space Fit Into the DAG-TM Concept?

- **Terminal departure**
  - **Trajectory negotiation and free maneuvering for user-preferred routing**
- **En route**
  - **Trajectory negotiation and free maneuvering for user-preferred separation assurance and TFM conformance**

Where Does Point-in-space Fit Into the DAG-TM Concept? (2)

En route transition to arrival

- **Collaboration for user-preferred arrival metering**

Terminal arrival

- **Trajectory negotiation and free maneuvering for weather avoidance**
- **Trajectory exchange and self spacing for merging and in-trail separation**

DAG-TM Applications

- **Departure spacing and merging**
- **En route separation and spacing while allowing user-preferred routes**
- **Transition from Free Flight to arrival status**
- **Arrival route variance for weather avoidance while maintaining spacing**

DAG-TM Applications (Continued)

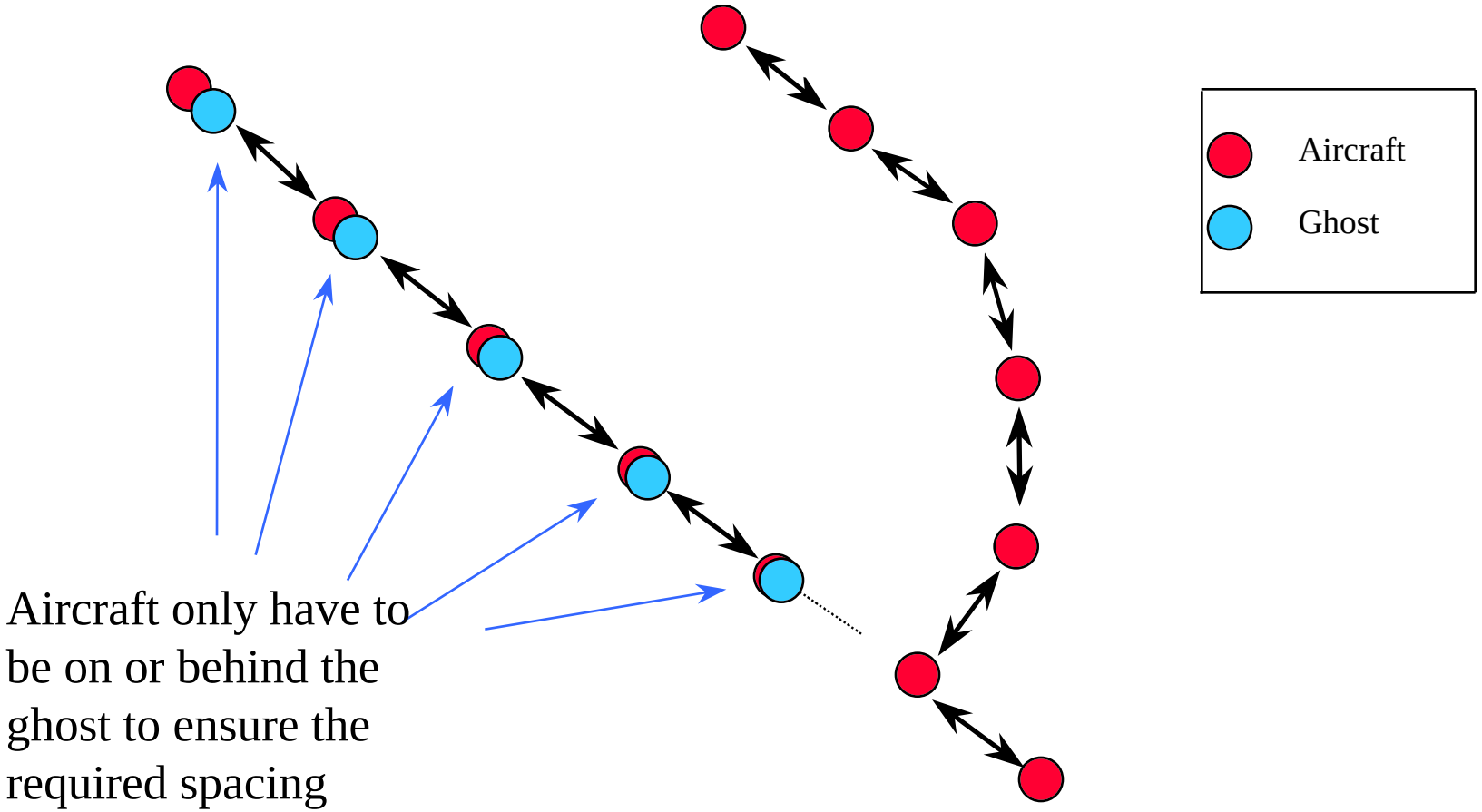
The ghost spacing algorithm can be adjusted by traffic management to increase or decrease spacing so that restrictions in effect for facilities or airports are met

- Arrival spacing to comply with active programs
- Departure spacing to comply with destination airport programs
- Enroute spacing to comply with all flow restrictions and active programs

Arrival-specific Applications

- Crossing traffic within approach control airspace
- Achieving spacing between aircraft conducting conflicting approaches to adjacent airports
- Merging arrival streams from multiple fixes onto a single feed to final approach

Point-in-Space Ghosting Incorporating Adaptive Curve Segment Technology

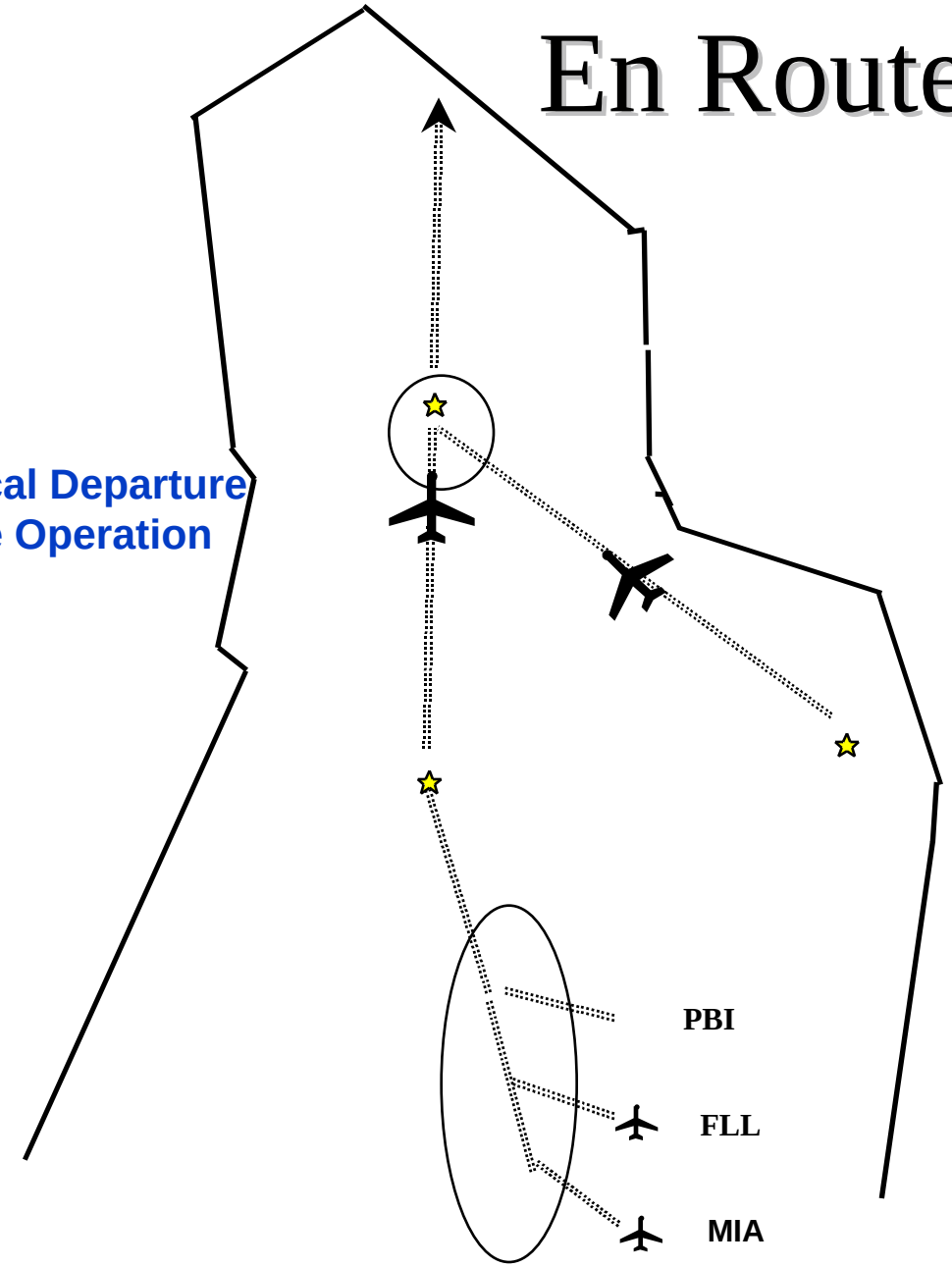


Each ghost will have a data block showing the speed of its correlated target

En Route-specific Applications

- **Merges multiple streams onto a single path**
- **Maintains spacing to comply with traffic management restrictions**
- **Crosses streams of traffic making efficient use of airspace**
- **Enables easy transition from Free Flight to arrival modes**
- **Provides tools for VFR pilots to separate themselves from IFR traffic**

En Route Example



FLL Airport

Fix

Possible Merge Points

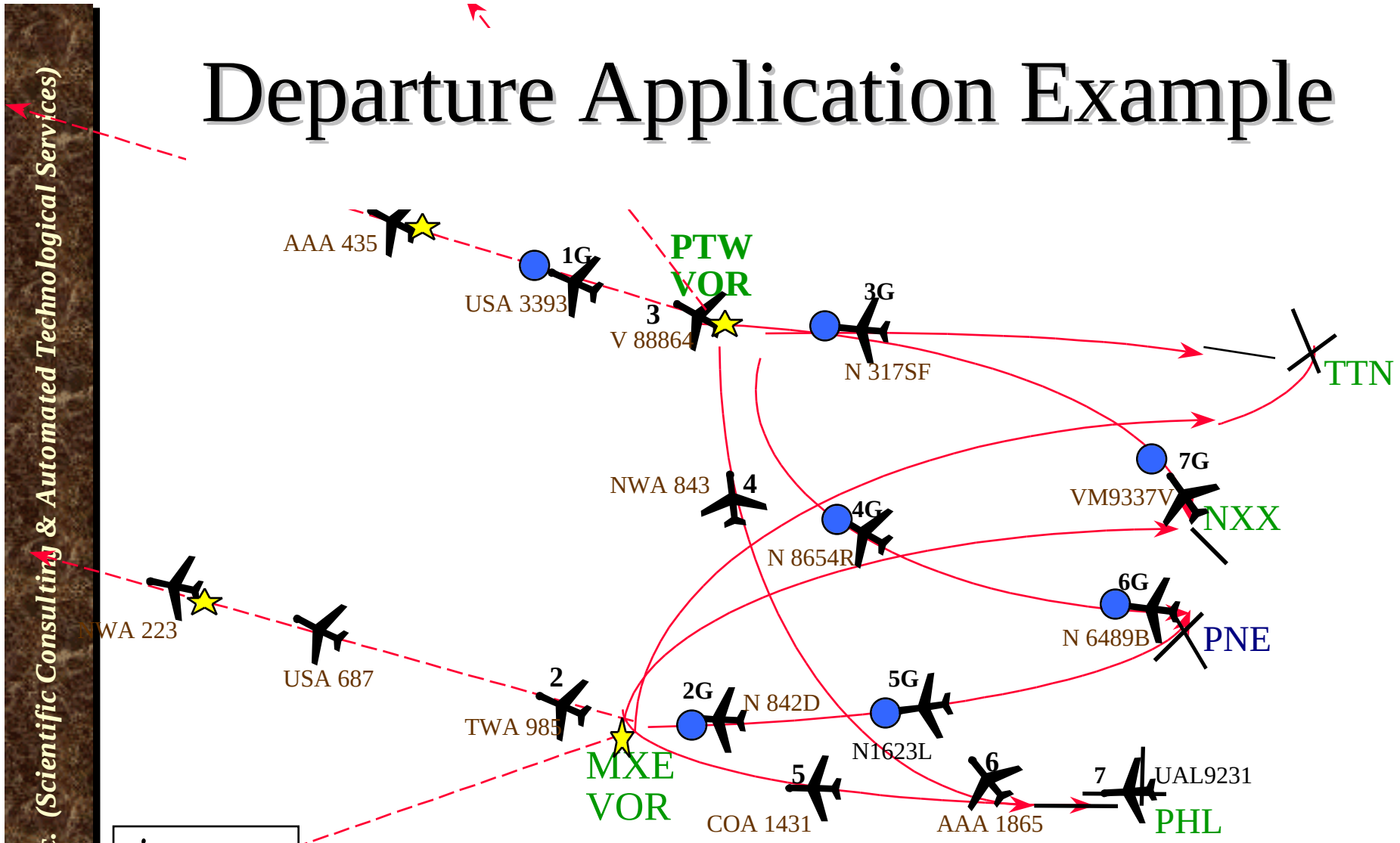
Hypothetical Departure And Merge Operation from ZMA

not to scale

Departure-specific Applications

- **Provides spacing from multiple runways from a single airport**
- **Provides spacing from several airports within approach control area**
- **Provides spacing to en route airspace**

Departure Application Example



Distances of actual aircraft are integrated to determine ghost position in relation to other aircraft (1:1G; 2: 2G; 3:3G).
Note: Distance to an established common reference point for airport pairs would be used to determine sequence for APG algorithm.

Controller and Pilot Displays

The controller's display will show a ghost generated by an aircraft that is on a conflicting or converging course. The Controller must vector the conflicting aircraft onto or behind the ghost until the conflict is resolved, or

The flight crew's CDIT will display a ghost aircraft that the crew must fly on or behind to ensure minimum spacing

(This demonstrates a transfer of separation responsibility from controller to crew)

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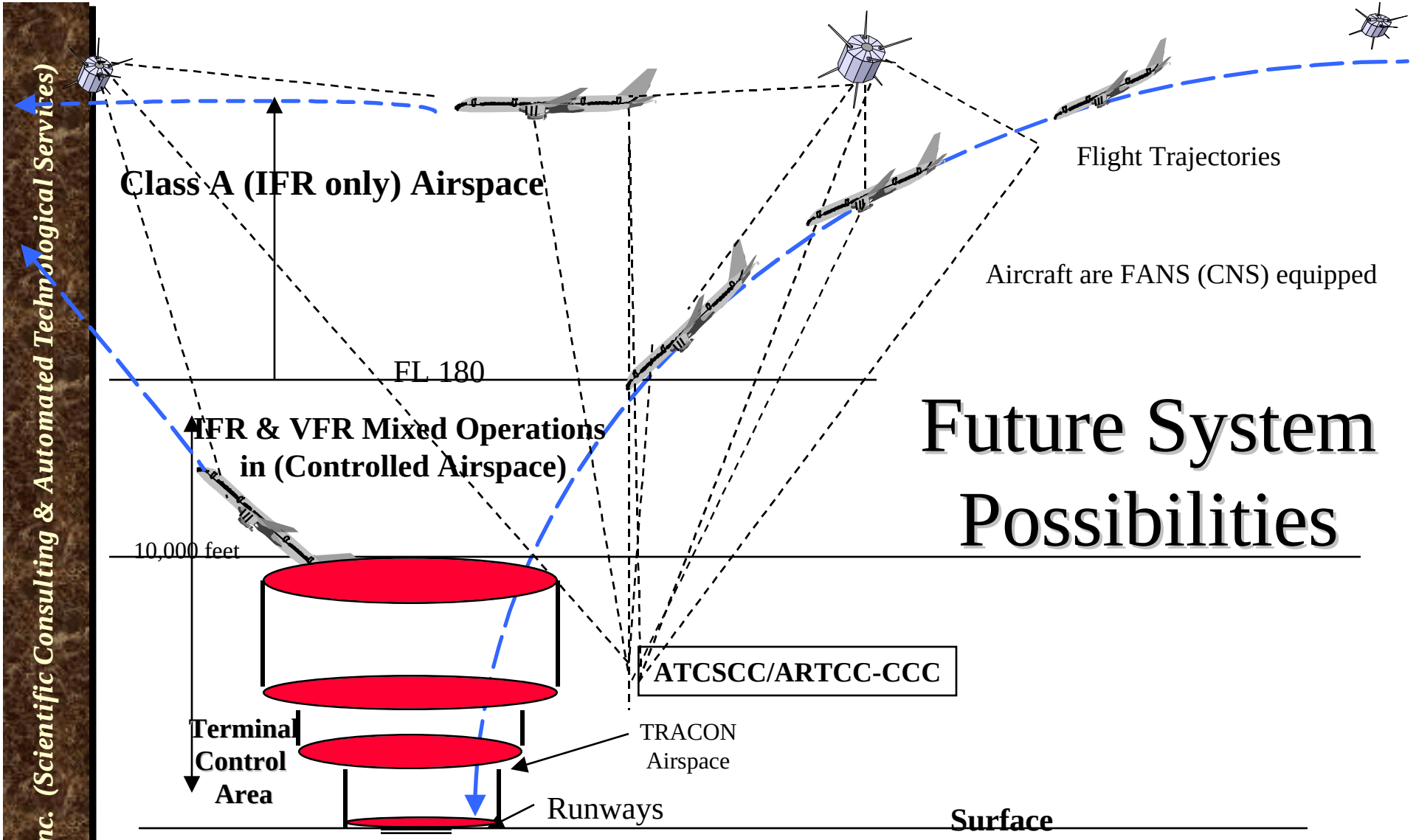
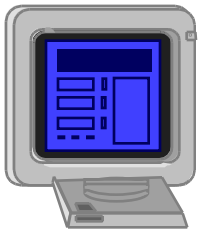
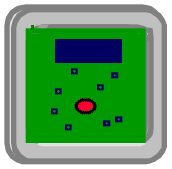
Future System Possibilities





Air Traffic Controller Display

CDTI



Cockpit Display Traffic Information

Point-in-Space Technology

- Provides a separation tool that clearly enhances safety
- Provides accurate spacing to ensure efficient use of airspace
- Makes the pilot and controller working environment easier and friendlier

Point-in-Space Technology
(continued)

Builds on the successful Converging Runway Display Aid (CRDA) and Adaptive Path Ghosting (APG) concepts already incorporated into the ARTS

Provides near-term solutions and benefits

The technology is proven and the capabilities are here and available now.