National Aeronautics Research and Development Plan: Mobility Coordinating Group

Outreach Session at the AIAA Joint Propulsion Conference

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Outline

- Mobility Definition and Scope
- Impetus and Challenges
- Implementation Epochs
- Mobility Chapter Organization
- Discussion Topics

Mobility

Mobility through the air is vital to economic stability, growth, and security as a nation

- Requires an aeronautics enterprise with:
  - sufficient capacity to meet increasing demand for air travel and transport
  - sufficient flexibility and affordability to accommodate the full range of aircraft requirements and attributes

- The capability to move goods and people, point-to-point, anywhere in the nation and around the world is essential to advance the local, state, and national economies of the US.

- The US, in cooperation with international partners, should play a leading role in ensuring global interoperability.

Mobility CG Scope

- The National Aeronautics R&D Policy, dated December 20, 2006, states
  - "As the science and application of aeronautics progressed, an interdependence developed among the aircraft, the air transportation system, and the people who use these systems, resulting in a multi-dimensional, highly integrated aeronautics enterprise."
  - Furthermore, "design or modification of any of these individual systems or parts, without consideration for the collective effect on the enterprise, may result in adverse or unintended consequences."
  - "Treating the entire system as a whole is complex but necessary…"

Mobility considers together the air transportation system and the vehicles that fly within it.

It's More Than Just the Movement of People and Goods

- Aviation and Aerospace represent 5.4% of U.S. GDP.
- If expanded to include related industries, its 9% of U.S. GDP
- Contributes 11 million jobs to our economy

All Signs Point to Continued Strong Growth

- One Billion+ Passengers in U.S. Skies by 2015
- Potential for Triple Demand by 2025
- New Entrants Such as Very Light Jets
- Global Market Opportunities
- U.S. Travel and Tourism to Grow 4.2% Annually

General Aviation Challenges

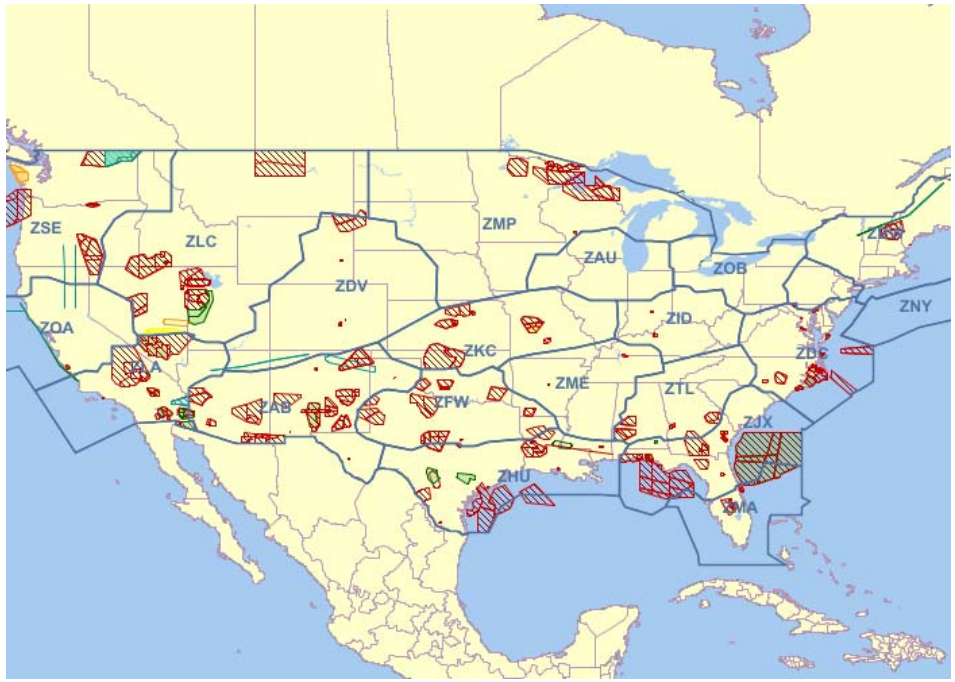
- Maintaining access to National Airspace
- Preserving VFR
- Limiting Equipage Costs
- Limiting Restricted Airspace

Air Taxi/VLJ Challenges

- **Personal Air Travel Alliance Survey of top five Air Taxi Operators**
  - 500 VLJ's within three years
  - 200-300 mile average flight
  - 18,000 – 21,000 feet altitude at 340 knots
  - Primarily secondary airport destinations
  - Target 1000 hrs/yr operation per VLJ
  - Dramatic Demand growth outside legacy carrier route structure

Defense (DoD/DHS) Airspace Challenges

- 13,000 aircraft fleet
- Management of Air Defense Identification zones
- Temporary flight restrictions
- Special Use Airspace
- Equipage costs
- Homeland Defense Requirements



Mobility Core Thrusts

- Proposed Core Thrusts
  - Aircraft
    - *Aircraft systems (airframe, propulsion, etc.) for subsonic or supersonic vehicles*
    - *Avionics*
    - *Flight deck human factors*
  - Airports
  - Airspace
- Discussion Question
  - What are the technical design challenges for vehicle performance and procedures that are required to enable NextGen trajectory based operations?

Mobility Content Structure

Core Thrust

Aircraft

Airspace

Airports

Cross Cutting

Weather

Human/Machine Integration

Wake Turbulence

Enterprise Level

Other

ATM "view" of evolution

Research

FY07 – 11
4DT Management
Performance-Based Ops & Services
Equivalent Visual Ops (CDTI)
Roles of Pilots & Controllers

FY12 – 18
Super Density Operations
Time-Based Surface Ops
Right Sizing of Facilities

FY19 – 25
Research for Transformed NextGen State

Building NextGen

Core Technologies, Capabilities & Sys Eng

Epoch 1 FY07-11

- Complete R&D leading to mid-term
- Continue R&D that address long-term NextGen challenges
- Develop & implement known & new procedures, infrastructure, technologies
- Develop NextGen systems integration plan for mid-term transition to NextGen
- Complete infrastructure and systems engineering for mid-term

Mid-Term Transition to NextGen

Epoch 2 FY12-18

- Aircraft equipped for the mid-term & upgradeable to NextGen target
- Deliver NextGen services & capabilities across domains
- Complete "hard" infrastructure – airports, runways, terminals, security
- Management & operating models support transition to NextGen and long-term sustainability

NextGen Solutions Fully Integrated & Operating

Epoch 3 FY19-25

- NextGen solutions fully-integrated & operating across air transportation system
- Services managed & operating in ways that achieve transformational outcomes across air transportation system

7/12/2007

Mobility Chapter Structure

- Background and Scope
- State of the Art and Critical Challenges
- National Goals and Objectives
- Summary of R&D Needs
- Gap Analysis
- Cross Cutting Themes

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White Paper Themes

- 19 White Papers were received and reviewed by the Mobility CG
- Several common themes were identified within the White Papers submitted to the Mobility CG
  - Leverage existing studies as basis for mobility plan including the 2006 Decadel study, the JPDO roadmap for ATM, and the NIA report for vehicle-related R&D
  - Insert new vehicle classes into the airspace such as rotorcraft and UAS
  - Consider system design including multi-mode transportation and multidisciplinary design optimization for vehicles
  - Pursue design of new aircraft, particularly supersonic aircraft
  - Insure aircraft avionics components enable precision navigation

Outreach Meetings

- Public Forums:
  - “Friends/Partners in Aviation Weather” Vision Forum - June 27
  - **Joint Propulsion Conf - Cincinnati, July 8 -11**
  - **West Coast Venue - ARC July 30**
  - AFM, GNC, Modeling & Sim Conf - Hilton Head, Aug 20-23
  - Industry/Association Forum???
- Focus will be on gathering input from the participants on their perspectives of what should be included in the plan

Discussion Questions

- What are the technical design challenges for vehicle performance and procedures that are required to enable NextGen trajectory based operations?
- What are the key critical challenges (5, 10, 20 years) and how does one measure success against these challenges?
- What are the critical decisions associated that require focused R&D activities to assist in making these decisions?

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Backup

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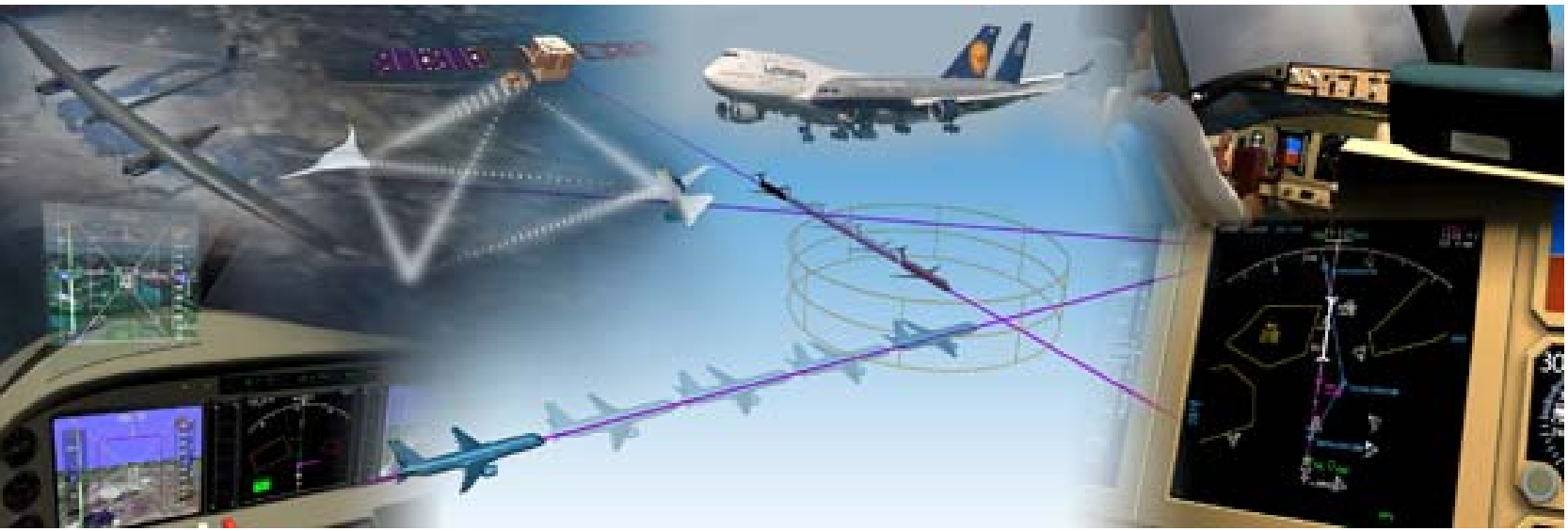
Key Capabilities: Performance-Based Operations and Services



- Collaborative ATM
- Modernized Surface Ops.
- Weather Impacted Ops.
- Trajectory-based Ops.
- Trajectory-based Separation Management
- Dynamic Resource & Aerospace Management

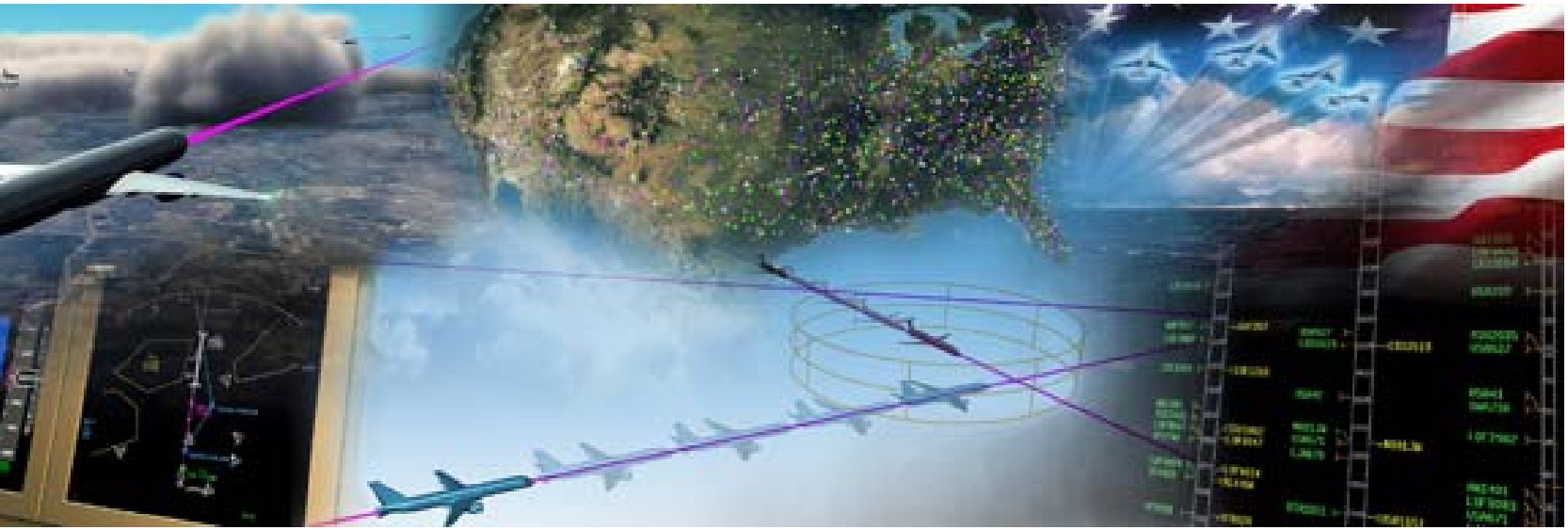
Key Capabilities:
Network Enabled Information Access

- Network Enabled Operations (NEO)
- Network Enabled Infrastructure (NEI)
- Network Enabled Weather (NEW)

Key Capabilities: Weather Assimilated into Decision Making

- Net-centric weather information is made available and understandable to all approved users
- A reliable virtual, common weather picture is foundational for optimal air transportation decision-making
- Presentation of weather data is tailored to user operational needs
- Widespread use of integrated probabilistic weather-related decision support systems
- Automatic updates to users based on operational need
- An adaptive observing system integrating ground, airborne and spaced-based sensors

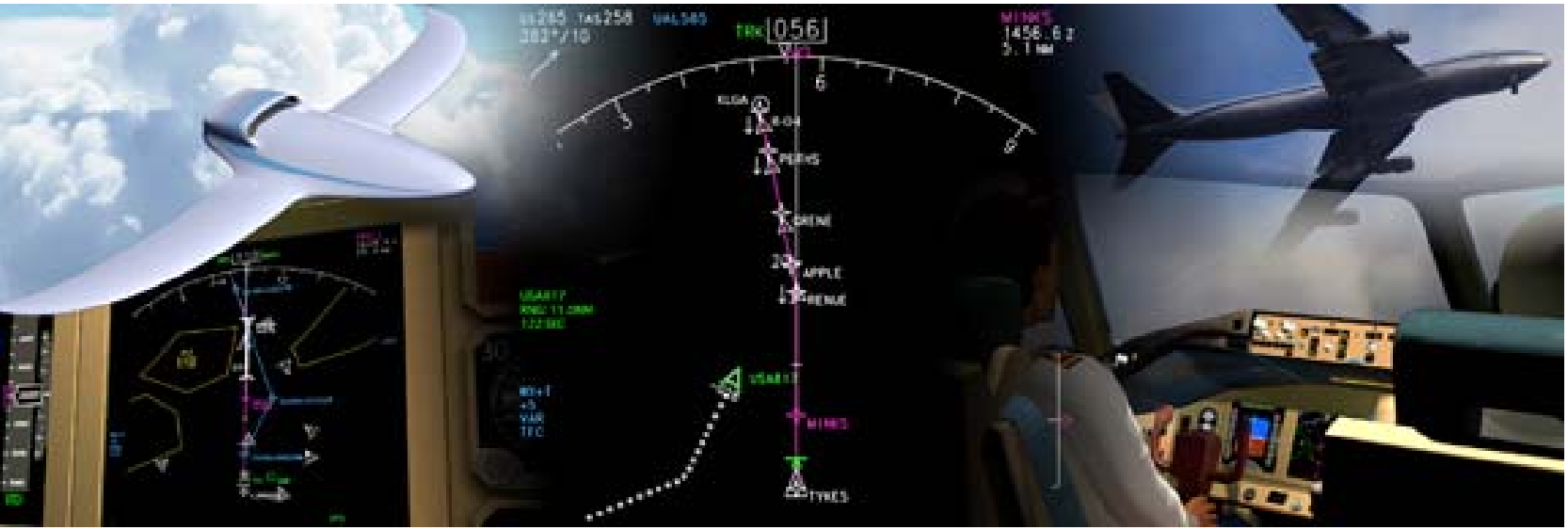
Key Capabilities:
Aircraft Trajectory-Based Operations



Services and Operations based on precise trajectory execution

- Self-Separation Services
- Flow Corridors
- Super Density Arrival/Departure Airspace

Key Capabilities:
Equivalent Visual Operations



- Improved information availability which allows aircraft operations without regard to visibility
- Access to PNT enables increased accessibility for airport surface and arrival/departure operations
- Enables more predictable and efficient operations regardless of meteorological conditions

Key Capabilities:
Super Density Operations

- Use of RNP operations and procedures
- Mitigation of wake vortex constraints
- Improved runway incursion prevention algorithms
- Automatic distribution of runway braking action reports
- Distribution of taxi instructions before landing
- Use of aircraft sensors