

National Aeronautics and Space Administration



Airspace

NASA NextGen Operations Research

Efficiency

NextGen

Systems Integration

Technology Transition

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www.nasa.gov

Setting the context....

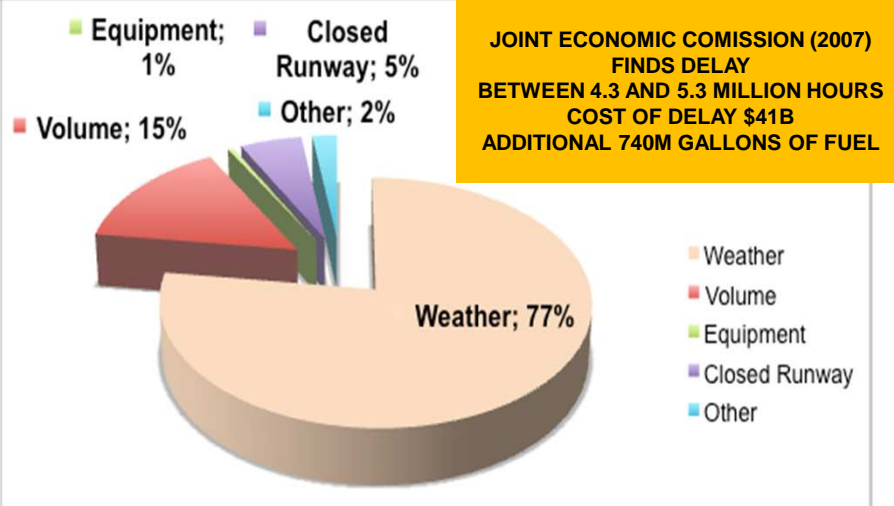


ARMD Global ATM and
US FACET
Video

National Airspace System Delays



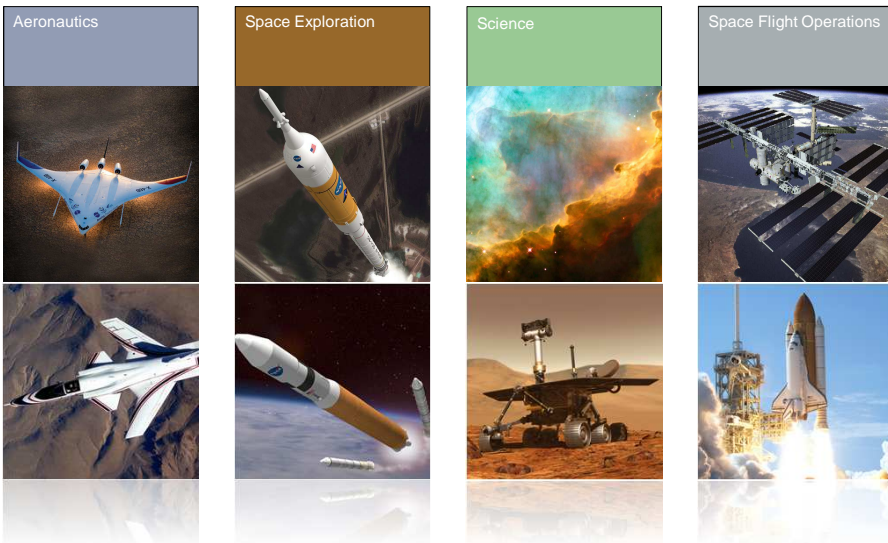
Period: September'08 – August'09 (Source FAA), Roughly 25% aircraft get delayed



Weather is a big delay contributor – Can't change it but we can optimize around it

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NASA's Missions



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NASA Aeronautics Programs



Vehicles

Safety

Integrated Systems Research

Air Traffic Management

Facilities

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This slide features a central collage of images related to NASA's aeronautics programs. At the top left, a white X-45 hypersonic aircraft is shown with its canards and wings. To its right, a cockpit view displays a futuristic instrument panel with green and blue displays. Below the X-45, a smaller image shows a person standing next to a small aircraft. In the center, a circular inset shows a blue and white commercial-style aircraft in flight. To the right of the circle, a runway view from a cockpit shows a green runway with white markings and a green horizon. Below the runway, a close-up of an aircraft engine is visible. At the bottom left, a map of the United States is overlaid with a network of yellow and green lines representing air traffic management. To the right of the map, a large aircraft engine is shown in a dark, industrial setting. At the bottom right, a small image shows a person working at a computer workstation.

NASA Headquarters and Centers



Ames

JPL

Dryden

Glenn

Goddard

HQ

Langley

Johnson

Stennis

Marshall

Kennedy

AMES

DRYDEN

GLENN

LANGLEY

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This slide displays a map of the United States with various NASA centers marked by colored dots and labels. The centers are: Ames (red dot, California), JPL (green dot, California), Dryden (red dot, Colorado), Glenn (red dot, Ohio), Goddard (red dot, Maryland), HQ (red dot, Washington D.C.), Langley (red dot, Virginia), Johnson (green dot, Texas), Stennis (green dot, Mississippi), Marshall (green dot, Alabama), and Kennedy (green dot, Florida). Below the map, four vertical panels provide a closer look at specific centers: Ames (a person working at a computer with a large screen), Dryden (a white X-45 aircraft), Glenn (a white X-45 aircraft with 'QTD2' on the side), and Langley (a large, curved structure, possibly a wind tunnel or test facility).

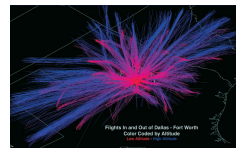
Airspace Systems Program Overview



Enable NextGen from Gate-to-Gate and Reduce the Total Cost of air transportation operations

Increase Maturation and Implementation of ASP technologies to accelerate NextGen

- **Concepts and Technology Development (CTD) Project:**
Develop gate-to-gate concepts and technologies for NextGen to enable significant increases in capacity and efficiency
- **Systems Analysis, Integration and Evaluation (SAIE) Project:**
Facilitates R&D maturation of integrated concepts and technologies through evaluation in relevant environments, enabling transition to stakeholders



CTD and SAIE will deliver on collaborative work plans to accelerate products and impacts for NextGen

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ASP Technical Challenges



TC 1: Develop Tactical Automation technologies for complex operational choke points including surface, arrival/departure, and dense terminal operations.

Target Technologies/Demonstrations: ATD-1, SARDA, PDRC, TRCM, F-IM, Metroplex

TC 2: Establish the basis for air/ground functional allocation for separation assurance including safe, graceful degradation of performance in response to off-nominal conditions.

Target Technologies/Demonstrations: F/A Mixed Equipage; Uncertainties; Off-Nominals

TC 3: Develop Strategic Automation technologies that integrate probabilistic weather information and flow management capabilities.

Target Technologies/Demonstrations: Stratus, DWR, TASAR, TFM with weather

TC 4: Conduct seamless integration of automation applications in a resilient, end-to-end Trajectory-Based Operations system.

Target Technologies/Demonstrations: SMART-NAS

TC 5: For the highest levels of NextGen performance and beyond, develop concepts, technologies, and system-wide evaluation and validation approaches.

Target Technologies/Demonstrations: Networked ATM F/A to reduce total cost, SPO

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Program Highlights



ACCELERATE NextGen by making an impact with it's stakeholders:

Efficient Descent Advisor (EDA) – Transferred to FAA 3D-PAM in Nov. 30, 2011. FAA working to define requirements for initial EDA deployment under GIM-S

- Benefits: Increased fuel efficient arrival profiles that are closer to optimal profile descents: potential for \$300M/yr fuel savings.



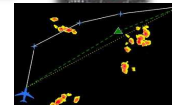
ATM Technology Demonstration (ATD) #1 – Demonstrate user operational benefits through the integration of ADS-B enabled Flight Deck Merging and Spacing and Terminal Area Precision Scheduling and Controller-Managed Spacing

- Benefits: Increased throughput and efficiency; benefit potential, 2020 - \$500M/yr



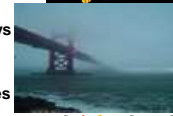
Dynamic Weather Routing – Delivering weather avoidance and time savings trajectories for better weather routes for aircraft in-flight

- Benefits: Increased fuel efficiency and reduced delays under severe weather conditions.



SFO Stratus - Ground Delay Program (GDP) Selection model for SFO airport to investigate reducing current ground delay policy leading to excessive unrecoverable delays

- Benefits: Reduced delays (2011: ~55,000 minutes)



In-Trail Procedures (ITP) - Enabling aircraft to achieve ADS-B enabled efficient altitudes and speeds by flight deck in-trail climb and descent in the oceanic environment

- Benefits: Increased fuel efficiency (\$200K/aircraft annually)



Precision Departure Release Capability - Integrate aircraft OFF time predictions to Traffic Management Advisor to fit departing aircraft in an overhead stream

- Benefits: Reduced delays. 8700/month lost overhead slot opportunities, PDRC may reclaim up to 80%

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Program Highlights



INNOVATE in emerging new capabilities:

Spot and Runway Departure Advisor (SARDA) – Integration of SARDA with airline collaboration in push back management to maximize the efficiency of surface operations

- Benefits: Reduced fuel/noise/emissions/delays



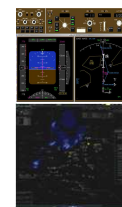
Compression monitoring and terminal conflict alert – Three-segment deceleration model for compression monitoring consistently has the best probability of detection

- Benefits: Increased capacity and safety



Separation Assurance Functional Allocation – 2nd the series of culminating simulations

- Benefits: Key enabler for NextGen automation implementation, increased capacity/efficiency/safety



LEAD the research community:

Shadow mode NextGen – SMART NAS

- Benefits: Full domain modeling and simulation of future automation and benefits analysis

Single Pilot Operations

- Benefits: Reduced user costs

Ground Based Surface CD&R


- Benefits: Increased safety and throughput

Strategic international partnerships

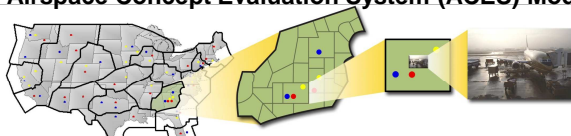
- Benefits: Influence concepts, set research direction, and attack broader solution space

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Airspace Modeling Tools



Airspace Concept Evaluation System (ACES) Models



National Traffic Management
Fast-time nationwide gate-to-gate simulation of NAS operations
Full flight schedule with flight plans, winds, gate-to-gate operations


Regional Traffic Management
Thousands of agents:

- National 1
- Regional 20
- Local 100s
- Airports 10,000s
- Aircraft 10,000s
- Airlines 10s

Local Approach and Departure Traffic Management
Airport and Surface Traffic Management

High Fidelity 4-DOF Trajectory Model

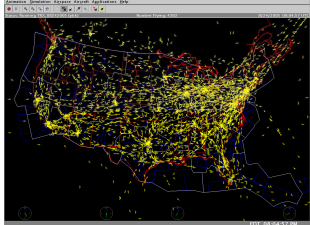
- Based on laws of physics
- Realistic pilot-based control laws
- Includes elliptic-earth trajectory propagation
- Contains modeling for aircraft/pilot variability




Future ATM Concepts Evaluation Tool (FACET) models the National Airspace System, for both research and operational use

Key FACET capabilities used by FAA traffic flow managers and airline dispatchers


- 500 traffic flow managers at 100 FAA operational sites
- 4,700 dispatchers at 600 air carriers via Flight Explorer




Airspace Facilities




AIRSPACE OPERATIONS LAB: Investigates human operator requirements for NextGen




AIR TRAFFIC OPERATIONS LAB (ATOL)
Multi-fidelity, part-task, air traffic simulation environment;




CREW-VEHICLE SYSTEMS RESEARCH FACILITY:
Full mission simulation capability in 747-400 and advanced concepts flight cabs and air traffic control



FUTURE FLIGHT CENTRAL: 360° full-scale Tower simulator for airport surface research



ATM SIM LAB:
Multi-facility air traffic simulation capability for advanced NextGen research



NORTH TEXAS RESEARCH STATION: Lab with established data networks to FAA air traffic facilities, air carriers, and other national research labs

Summary



- **Challenge can not be met without a partnership** of researchers, implementers, users, operators, and many others
- Explore collaboration to reduce fuel, noise, and emissions while increasing efficiency
 - **International partnerships for mutual bi-lateral benefits**
 - **NASA/FAA Research Transition Teams**
 - **ASP Industry Days and Technical Interchange Meetings**
 - **ATM Technical Demonstrations (ATDs)**

