National Aeronautics and Space Administration

Network-Enabled Air Traffic Management Research Overview for NASA Langley Research Center

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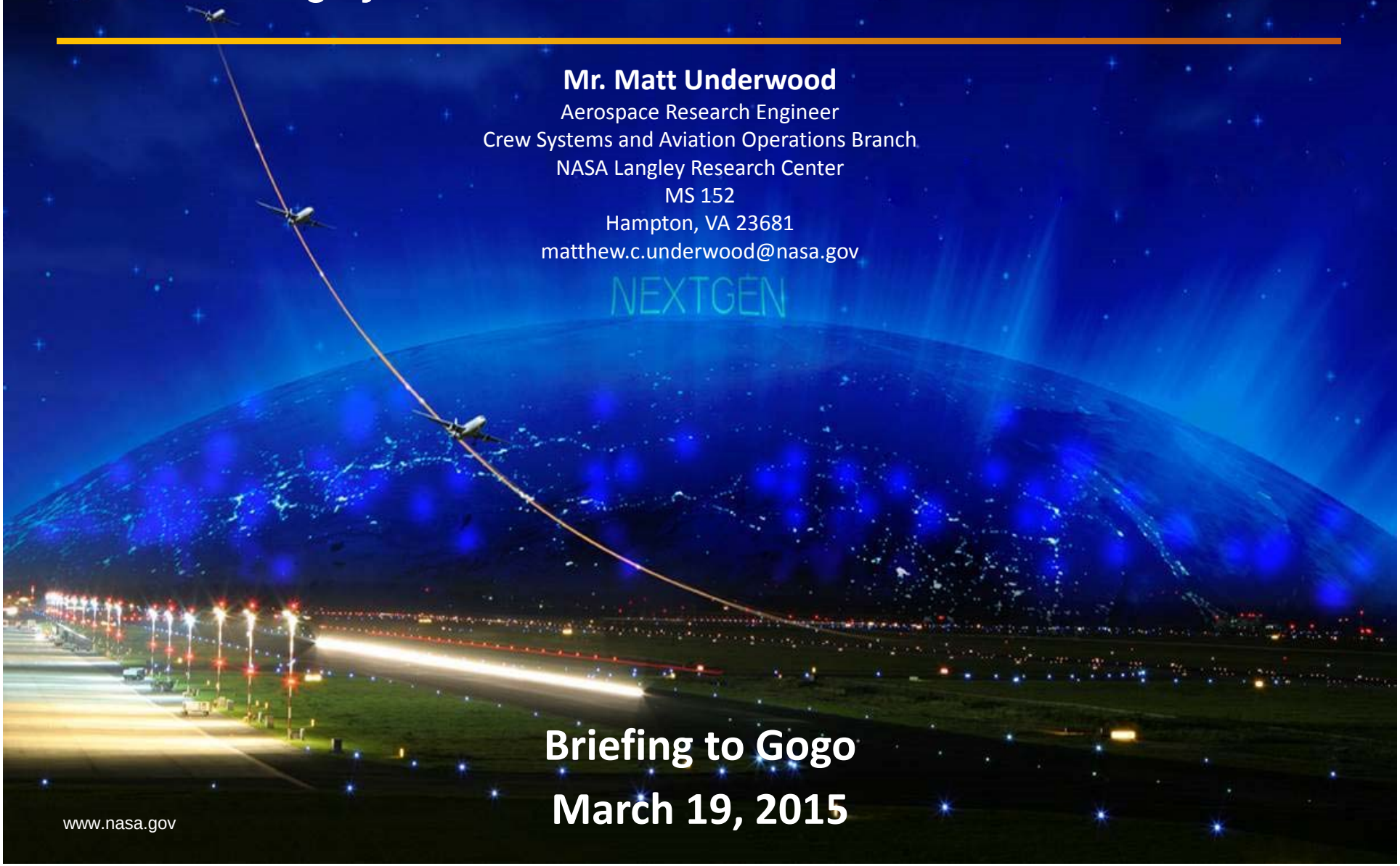


Briefing to Gogo
March 19, 2015

Outline

- Mission Statement
- Government and Industry Interest
- Key Enabling Technology
- Benefits Mechanisms
- Motivation
- Example Research
- Conclusion

Mission Statement

- The Network-Enabled Air Traffic Management (ATM) subproject at NASA Langley is investigating game-changing applications that leverage the following concepts and technologies to air traffic operations:
  - Advanced networking through modern information sharing technologies
  - Machine intelligence
  - Big data analytics
  - Cloud-computing business models
- Anticipated Benefits:
  - Maintains safety while modernizing the National Airspace System (NAS)
  - Improves operational efficiency
  - Increases NAS Capacity
  - Provides robust integrated decision making in air traffic management

Government Interest

- The FAA is developing an infrastructure known as System Wide Information Management (SWIM) that implements a set of Information Technology principles in the National Airspace System to provide users with access to relevant and commonly understandable information
- The FAA is also establishing an airborne component of the ground-based SWIM service oriented architecture known as Aircraft Access to SWIM (AAtS) that utilizes an IP datalink to perform certain functions that rely on the exchange of data between the air and the ground

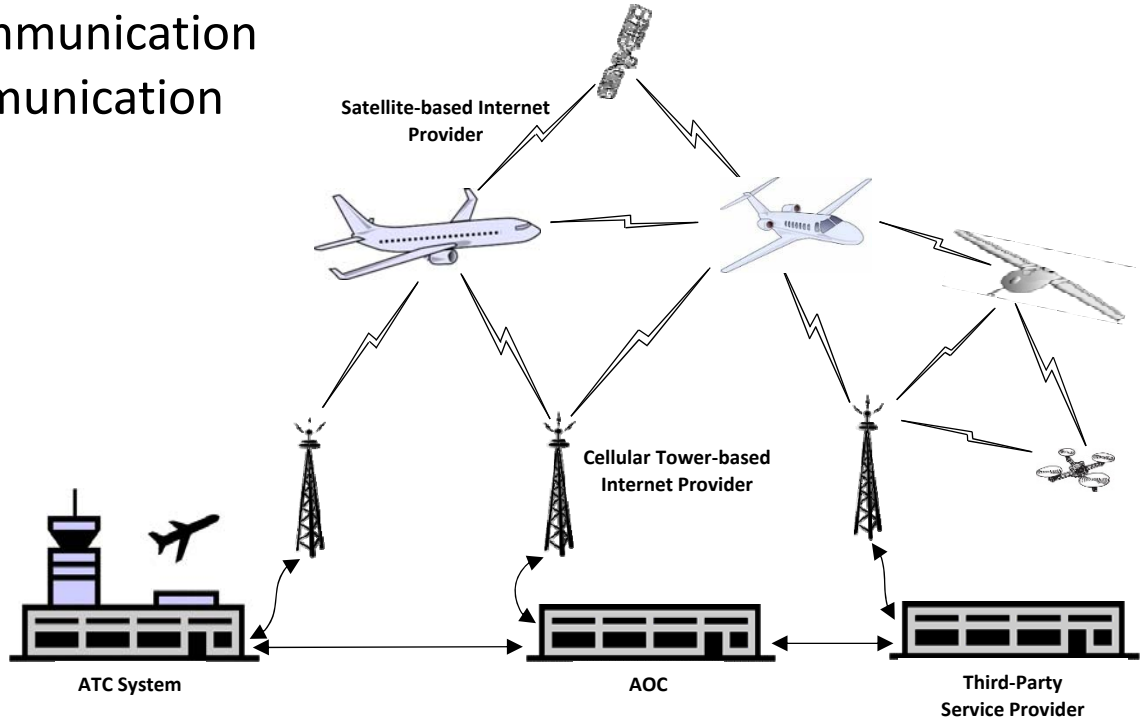
Industry Interest

- Both traditional and non-traditional avionics manufacturers are currently building airborne servers that provide:
  - Processing capabilities
  - Storage
  - Network connectivity

The Network-Enabled ATM Subproject at NASA is focused on partnering with government agencies and industry to develop advanced ATM concepts that utilize these infrastructures

Key Enabler: Data Sharing

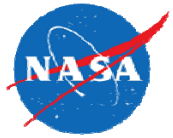
- Historically, the aviation industry relied on the government to provide communication infrastructures (e.g., ADS-B, CPDLC)
- Currently, the aviation industry is actively equipping their aircraft with technology that can enable a data sharing infrastructure
- This communications infrastructure will include:
  - Peer-to-peer communication
  - Centralized communication
  - Broadcast
  - Interrogation



Net-ATM Benefits Mechanisms

- Increased data availability to estimate system state
  - Feed prediction models with more data
  - Example: Utilize aircraft as sensors to provide data that feeds the national weather prediction model
- Collaboration
  - Example: Highly collaborative trajectory-based operations (TBO) as envisioned by the Joint Planning and Development Office (JPDO)
- NAS prognostics using big data
  - Data mining and analytics
  - Examples: Real-time safety prognostics, Real-time efficiency prognostics
- Machine learning
  - Key enabler of future autonomous NAS operations, which aligns with NASA Aeronautics' goal of increased autonomy
  - Example: Human operator intent inferencing
- Cloud Computing Business Models
  - Enables new paths to NAS modernization
  - Examples: Resource Pooling, Software/Hardware as a service

Motivation for Networked ATM



- Net-enabled ATM provides:
  - Better NAS predictability for improved planning and scheduling
    - Enables better trajectory prediction for ATM functions
    - May be critical to achieve TBO benefits
      - Air-ground trajectory negotiation
      - Better flight planning, both pre-flight and during flight via trajectory sharing
  - Increased system state awareness through air-to-ground data transfer
    - Sharing timely information between multiple parties
      - Utilize aircraft as sensors
    - Large scale real-time analysis
  - Increased system responsiveness and resilience
  - A more realizable path towards autonomous ATM operations
    - Provides data necessary for big data analytics and machine learning
    - Highly collaborative automated decision making
  - New business models that may offer innovative paths for implementing advanced ATM concepts and technologies in commercial aviation

Example Research

- Identification and investigation of post-gate pushback ATM concepts and applications that may benefit from a highly networked ATM system.
  - Information sharing between aircraft, including, but not limited to:
    - Weather information (WXXM)
    - Flight information (FIXM)
    - Aeronautical information (AIXM)
  - Flight efficiency and system capacity enhancements through networking
  - Networked functions to support flight safety and security
  - Networked automated collaboration functions to support airline fleet management and NAS-wide and international Collaborative Decision Making (CDM)
  - Trajectory sharing and negotiation with other aircraft, airline dispatchers, and the Air Navigation Service Provider (ANSP)
  - Contingency functions that allow for safety-critical network-based applications.
  - Remote information management and organization to support flight crews, potentially enabling reduced-crew operations, and possibly leading to non-piloted scheduled air carrier (Part 121) operations in the long term.

Example Research, cont.

Question	How can net-enabled data sharing be used to facilitate collaborative decision making between the flight crew and dispatchers when choosing a Traffic Aware Strategic Aircrew Requests (TASAR)/Traffic Aware Planner (TAP) solution to execute?
Rationale	Dispatchers would like access to TASAR/TAP solutions that deviate more than a set distance parameter from the original flight path, or solutions that impact fuel use and flight time outside of AOC-set boundaries.
Approach	Utilize in-flight Internet on the aircraft to transmit data to the AOC
Metrics	Improved collaborative decision making resulting in TASAR/TAP route modifications that are acceptable to both the flight crew and the dispatchers

Flight demonstration tentatively scheduled for late FY15

Conclusion

- Advanced networking through modern information sharing technologies will lead to the development of ATM concepts and applications that leverage, machine intelligence, big data analytics, and cloud-computing business models
- NASA is focused on partnering with other government agencies and industry stakeholders to develop these advanced ATM concepts and applications

These applications and concepts have the potential to be game-changing