Development of a High-Fidelity Simulation Environment for Shadow-Mode Assessments of Air Traffic Concepts

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Example Recent Human-in-the-Loop Simulation
Trajectory-Based Operations for Arrival
Example of Future SMART-NAS Test Bed-enabled Simulation

Gate-to-Gate Simulation

Arrival and Departures

- SFO Tower
- NorCal Terminal Area
- Oakland En Route

Arrivals

- SoCal Terminal Area
- LAX

Departures

- SFO
- SFO Tower
- Ramp Tower

NASAs

- NASA Lab
- NASA Aircraft Simulators
- LOS Angeles En Route
- NASA Tower Simulator
- FAA Lab

NASA Lab
SMART-NAS Test Bed Goals

The SMART-NAS Test Bed will provide a test environment that will aid in:

• Performing Multiple-Air Traffic Management (ATM) Domain Evaluations

• Increasing Assessment Pace

• Collaborating with Stakeholders

• Testing During Concept Maturation

• Performing Live, Virtual and Constructive Operations
Outline

• SMART-NAS Test Bed Vision
• SMART-NAS Test Bed Implementation Status
• SMART-NAS Test Bed Utilization
• Next Steps
• Conclusion
SMART-NAS Test Bed Vision
Test Bed Requirements

1) Provide standardized environment to design, conduct, and analyze real-time simulations

2) Integrate real ATM systems, high-fidelity emulators, and aircraft without modification

3) Leverage advances in software assurance, cloud-computing, big data, and real-time analytics

4) Permit adaptability and scalability to future simulations

5) Deliver incremental capabilities with demonstrable value to early users
Test Bed Architecture

DDS – Data Distribution Service

Test Bed Visualization Services

UAS Traffic Management (UTM)

Stakeholder Tools

Traffic Generators

ATM Functional Services

Scheduler

Trajectory Generator

Conflict Detection

Conflict Resolution

External Simulators

GovCloud

Component A

Component B

Component C

Component D

Component X

UAS Live Virtual Constructive-Distributed Environment (LVC-DE)

Component B

Component D

Component X
Test Bed Elements and Capabilities

Support Services
- Web-based Services
- Scenario Generation
- Simulation and Asset Configuration
- Command, Control, Monitor, Archive
- Analysis Support
- Libraries

- Allow extension by NASA and Industry stakeholders
- Enable sharing of capabilities and simulation artifacts

- Permit concurrent high-fidelity simulations
- Leverage historic data

Lab Infrastructure
- Connect geographically distributed capabilities

Live Data and Flight Assets
- Integrate live, virtual, and constructive operations

Data Warehouse
- Incorporate fielded ATM and ATC systems

ATM Automation
- Simulate current and alternative multiple ATM domain concepts

Real-Time ATM Concepts
- Permit extension by NASA and Industry stakeholders
- Enable sharing of capabilities and simulation artifacts

GovCloud
- Connect geographically distributed capabilities

DDoS
- Incorporate fielded ATM and ATC systems

Smart-nas test bed
Concept of Operations
SMART-NAS Test Bed
Implementation Status
Scenario Generation GUI
Simulation Configuration: GUI

Integration Example: SWIM, Traffic Generator, Conflict Detection, and Viewer
Simulation Configuration
Integration Example: SWIM, Traffic Generator, Conflict Detection, and Viewer
Test Bed Utilization

• SNTB Scenario Generation service
  • Used for two Human-in-the-Loop (HITL) simulations
  • Planned to be used by 2 other Projects

• Provided Live FAA SWIM Traffic Data Feed
  • Real Time Safety Monitoring
Next Steps

• Integrating Live Virtual Constructive simulation capability
• Working with Integrated Demand Management (IDM) Project - Automated Simulation Capability
• Expanding network capability
• Maturing current capabilities
Conclusion

The SMART-NAS Test Bed

• will be a collaborative, rapidly deployable, and distributed ATM simulation and test environment
• will provide a flexible and scalable architecture
• enable simulations spanning multiple-ATM domains
• is being developed incrementally for value to early users
Backup Slides
Program Overview

- Originally under: Shadow Mode Assessment Using Realistic Technologies for the National Airspace System (SMART-NAS) Project
- Continuing under: Air Traffic Management – Exploration (ATM-X)
- Phased development
  - 2014-2015 SMART-NAS Test Bed architecture NASA Research Agreements (NRAs) by four industry teams
  - 2015 In-house proof-of-concept demo of key technologies by Ames and Langley Research Centers
  - 2016-2020 Full-scale development focused on customer use cases