



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



Alan G. Lee - SMART-NAS Test Bed Deputy Technical Lead
John E. Robinson
Jack (Chok) Lai
NASA Ames Research Center

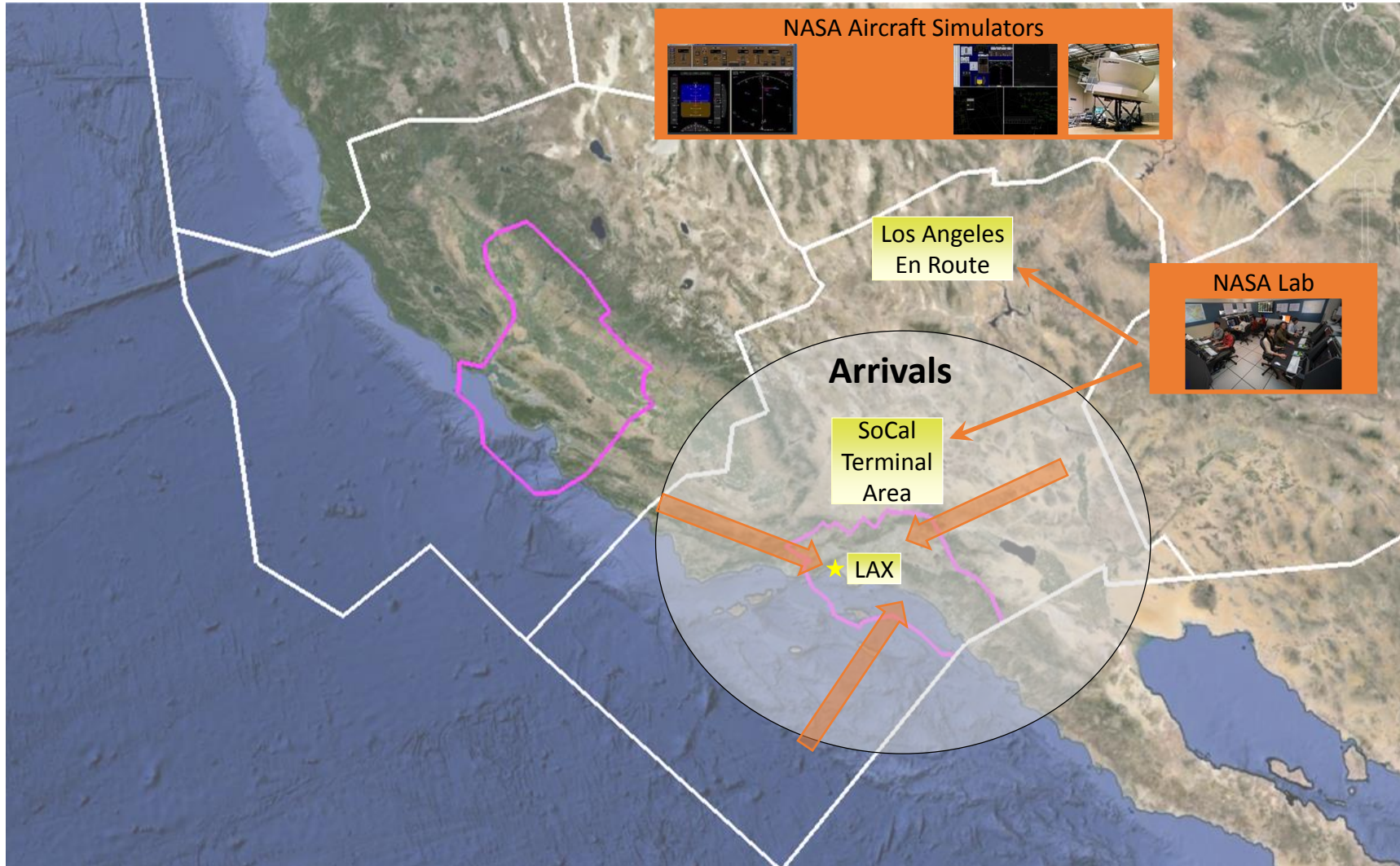
November 14, 2017

Example Recent Human-in-the-Loop Simulation

Trajectory-Based Operations for Arrival



smart-nas test bed

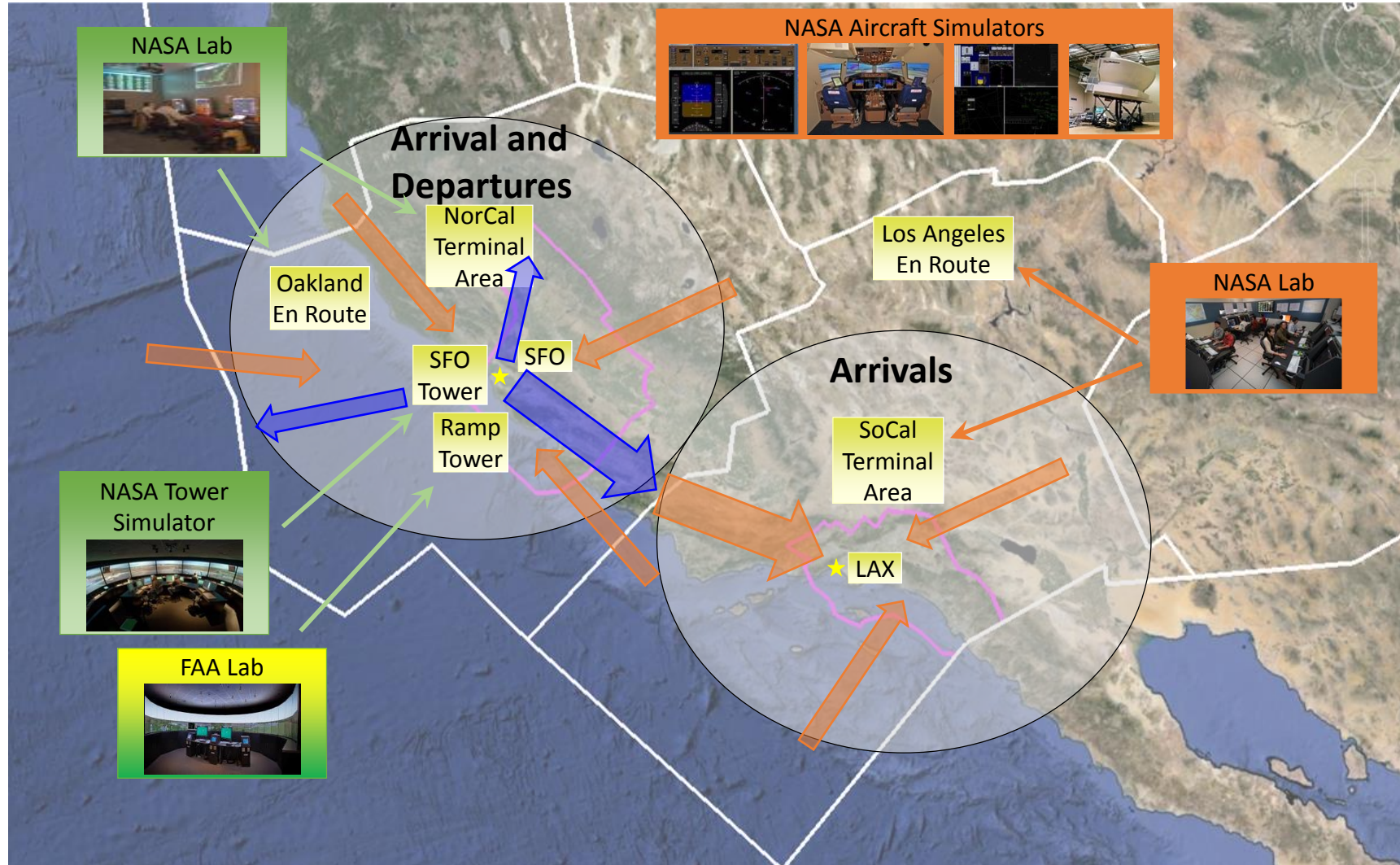


Example of Future SMART-NAS Test Bed-enabled Simulation

Gate-to-Gate Simulation



smart-nas test bed



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

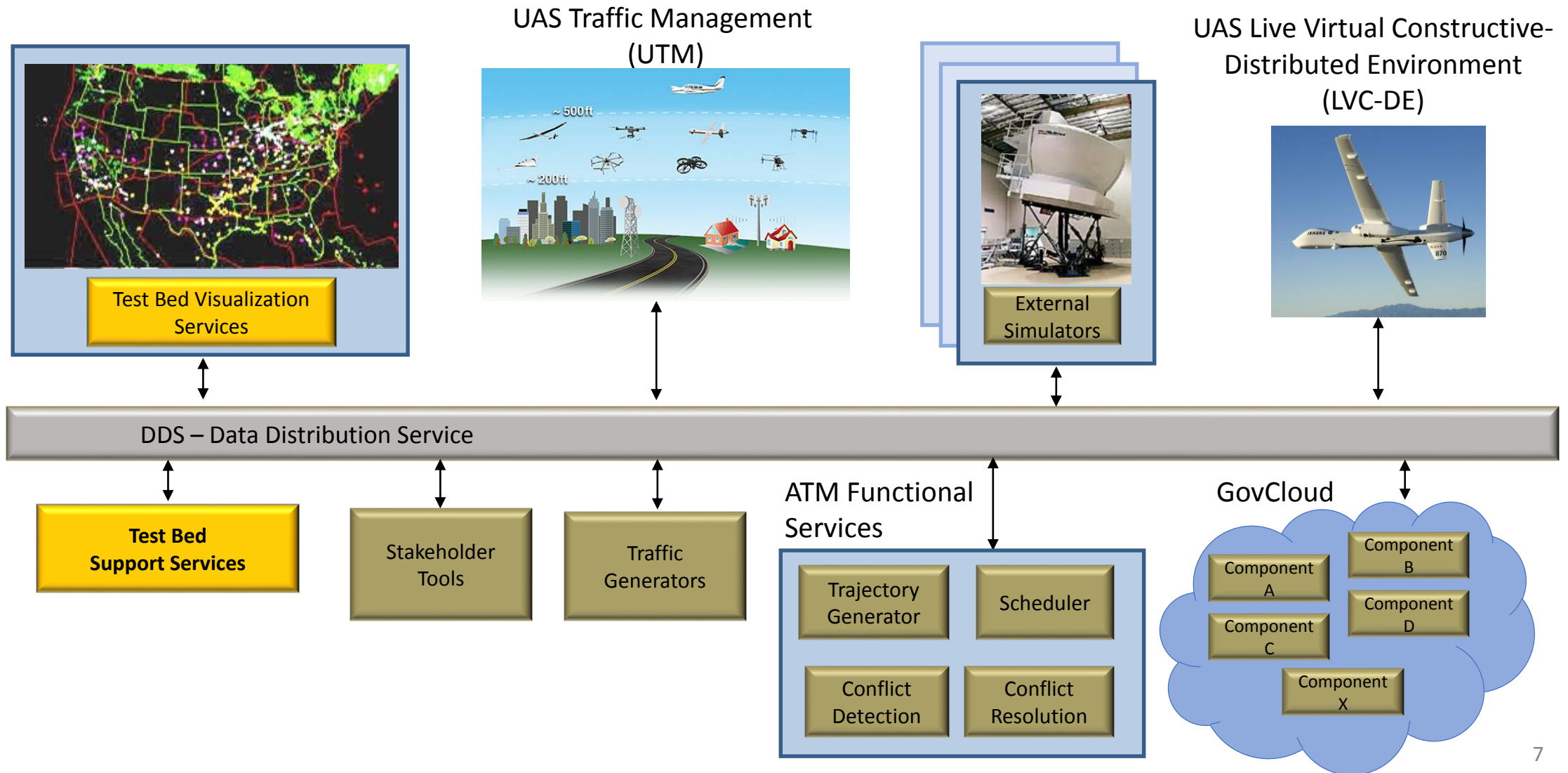


- 1) Provide standardized environment to design, conduct, and analyze real-time simulations
- 2) Integrate real ATM systems, high-fidelity emulators, and aircraft without modification
- 3) Leverage advances in software assurance, cloud-computing, big data, and real-time analytics
- 4) Permit adaptability and scalability to future simulations
- 5) Deliver incremental capabilities with demonstrable value to early users

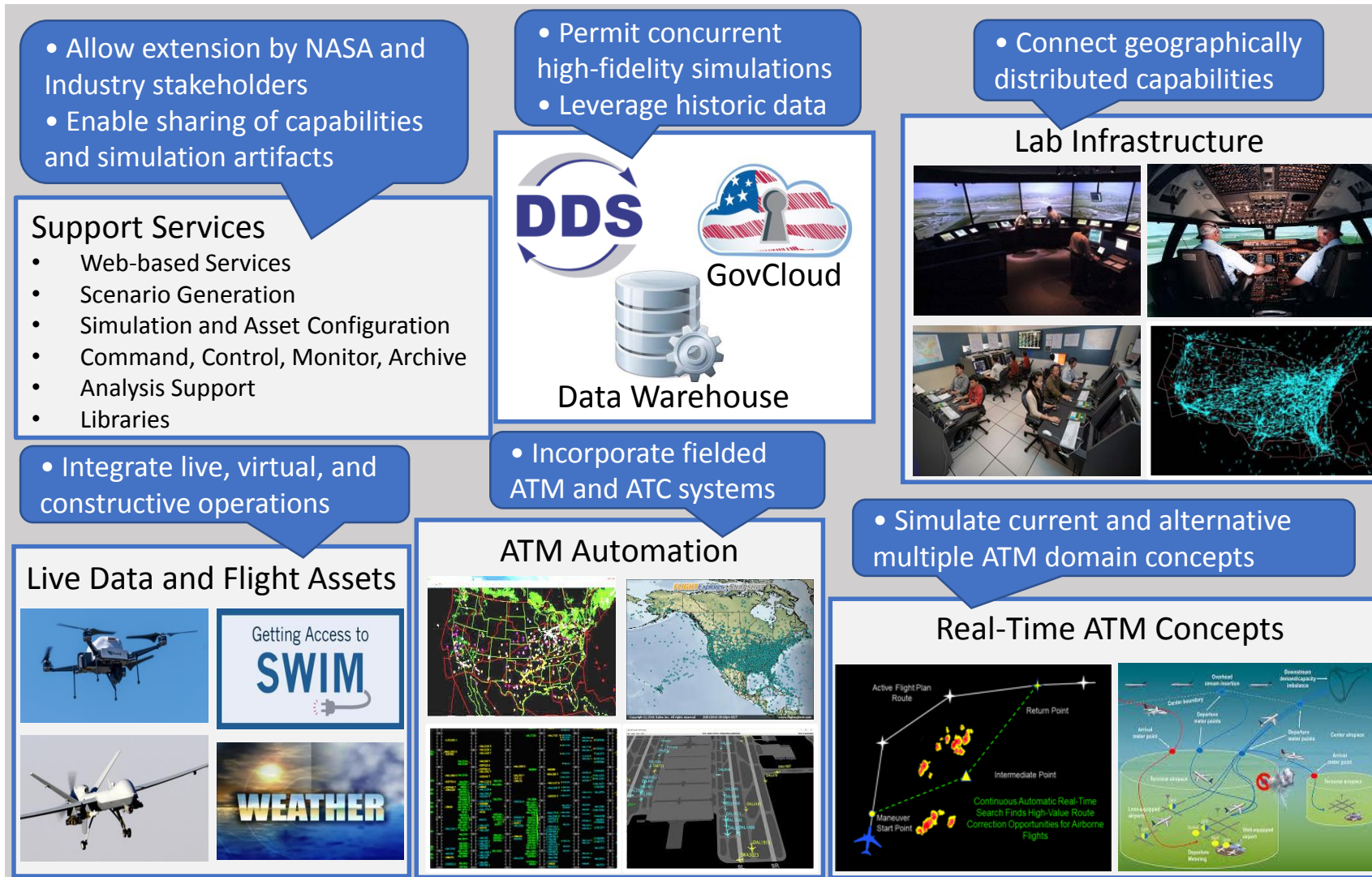
Test Bed Architecture



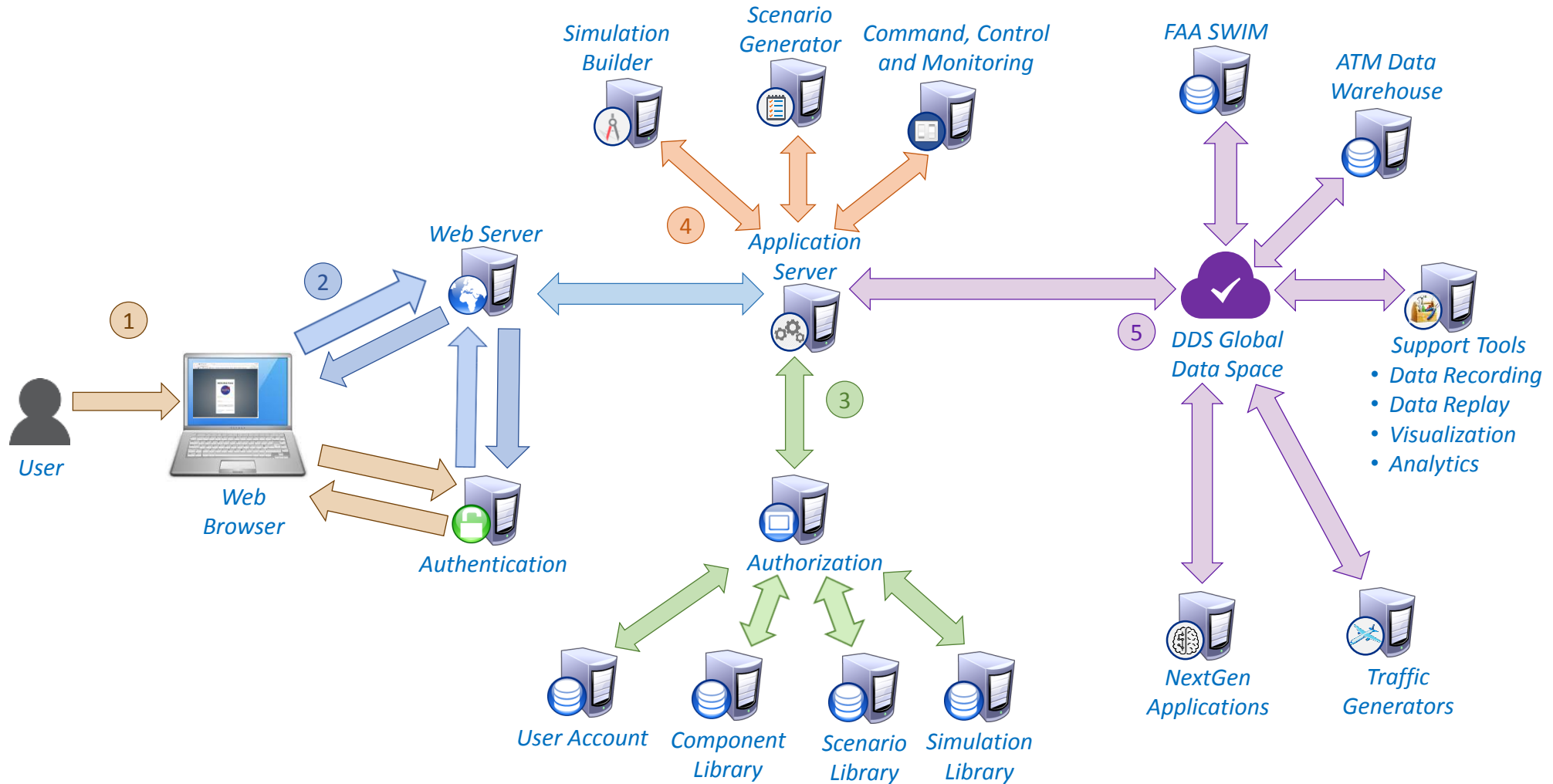
smart-nas test bed



Test Bed Elements and Capabilities



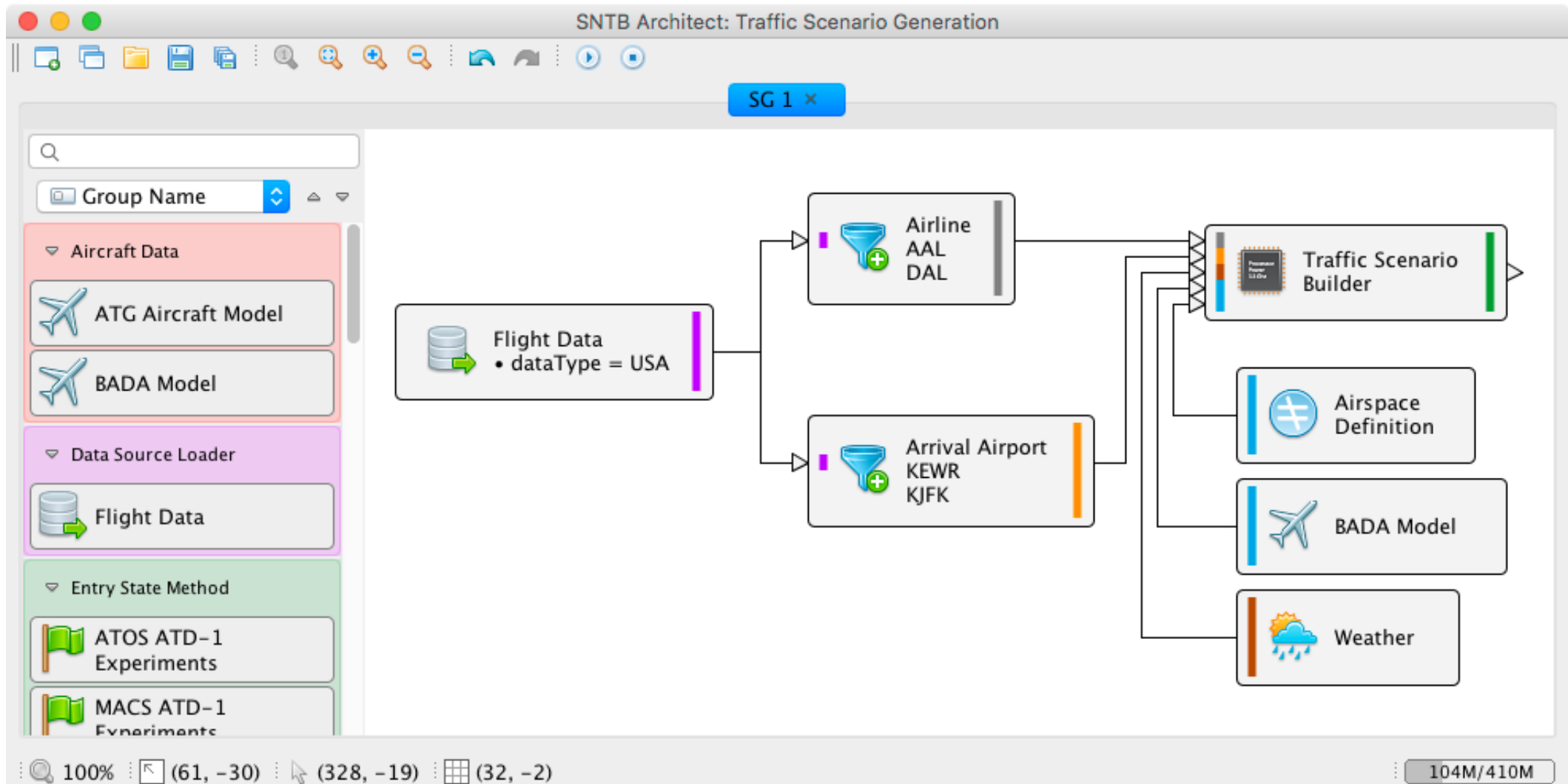
Concept of Operations





SMART-NAS Test Bed Implementation Status

Scenario Generation GUI

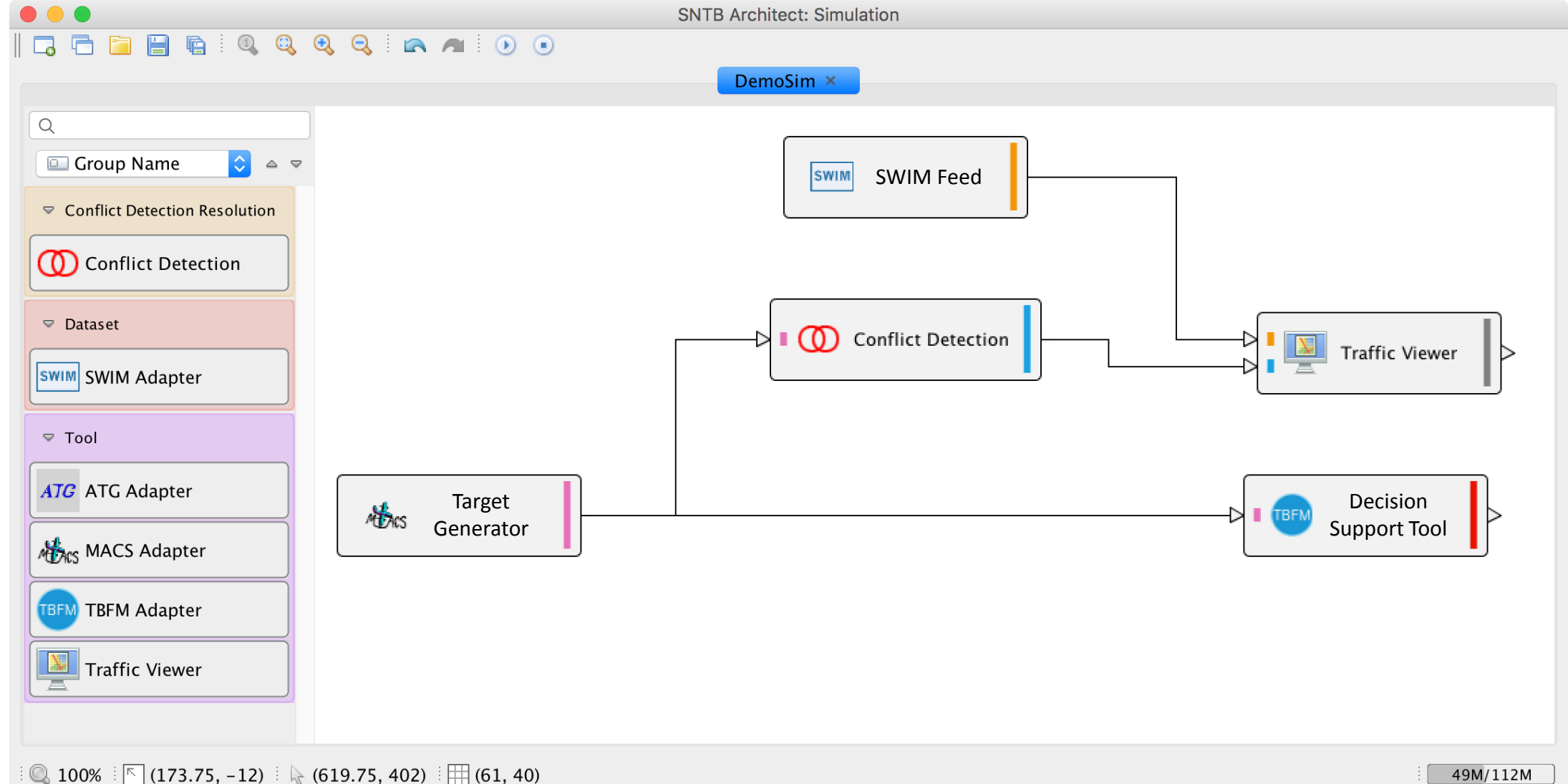


Simulation Configuration: GUI

Integration Example: SWIM, Traffic Generator, Conflict Detection, and Viewer



smart-nas test bed



Simulation Configuration

Integration Example: SWIM, Traffic Generator, Conflict Detection, and Viewer



smart-nas test bed

The image displays a simulation configuration window titled "SNTB Architect: Simulation" and a corresponding traffic viewer window. The configuration window, labeled "DemoSim", shows a flowchart with the following components and connections:

- Target Generator** (ATC icon) connects to **Conflict Detection** (CD icon) via a yellow arrow.
- SWIM Feed** (SWIM icon) connects to **Conflict Detection** via a blue arrow.
- Conflict Detection** connects to **Traffic Viewer** (TV icon) via a red arrow.
- Conflict Detection** connects to **Decision Support Tool** (DST icon) via a red arrow.
- Decision Support Tool** connects to **Traffic Viewer** via a red arrow.

The traffic viewer window shows a dark sky with numerous small aircraft icons (blue and yellow) and three large, semi-transparent circular boundaries in yellow, blue, and red. The viewer includes a status bar in the top right corner with the following data:

- CenterBoundary: 6 ms
- TrackPoint: 5 ms
- Clock: 0 ms
- Total: 11 ms

At the bottom of the viewer, there is a timestamp and technical data: "2017/10/04 22:48:23 Z | zoom:8 | map:(lat=30.46, lon=-94.71) | world:(60.65, 105.24) | pixel:(15527, 26942) | tile:(60, 105) | cursor:(1854, 1340) | translate:(13673, 25602) | 418M/1079M".

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

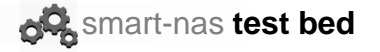


The SMART-NAS Test Bed

- 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