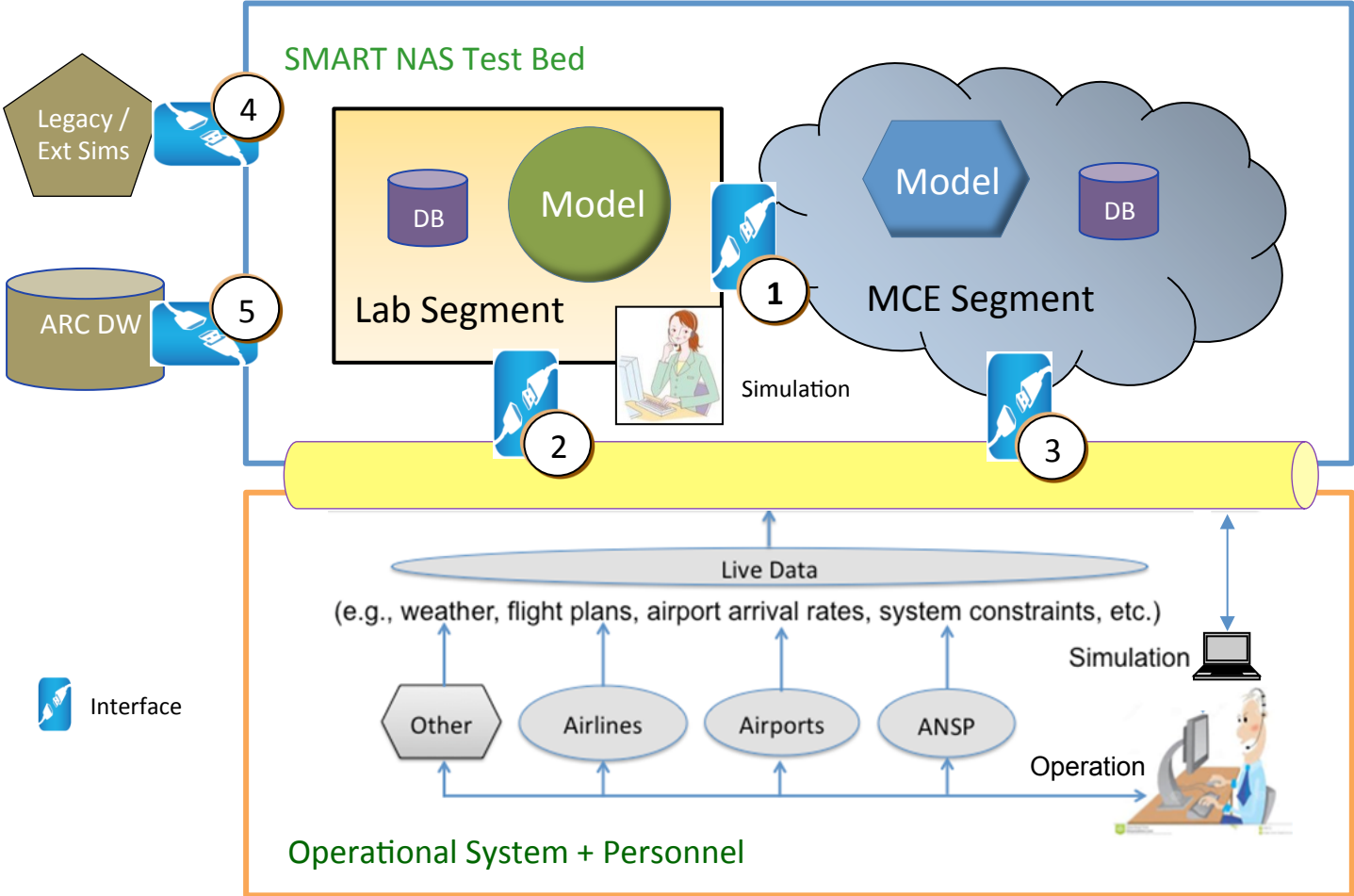


SMART NAS Test Bed Overview

Kee Palopo

August 31, 2016

SMART NAS Test Bed and Context



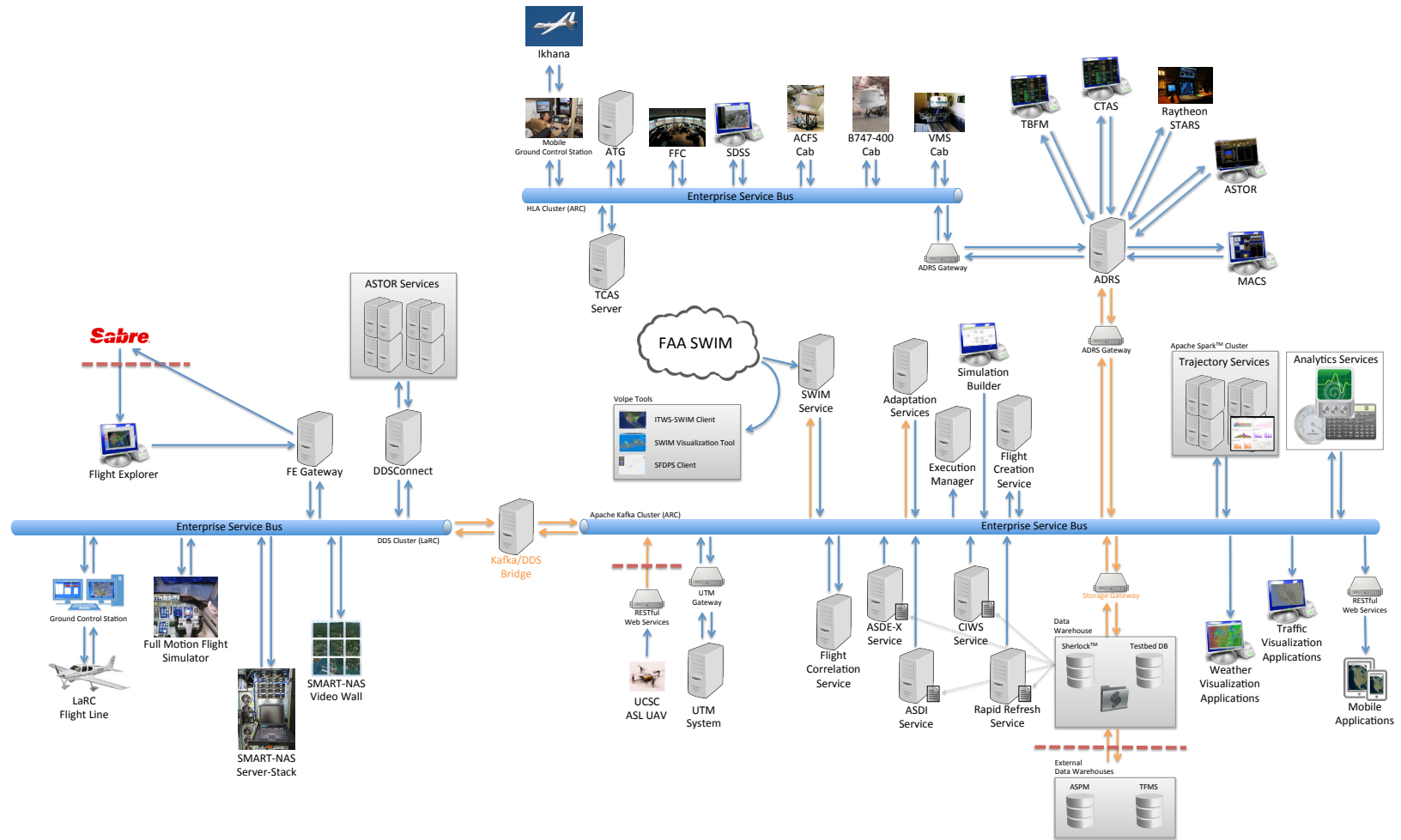


SNTB Year #1 Architecture



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SMART-NAS Test Bed Overview

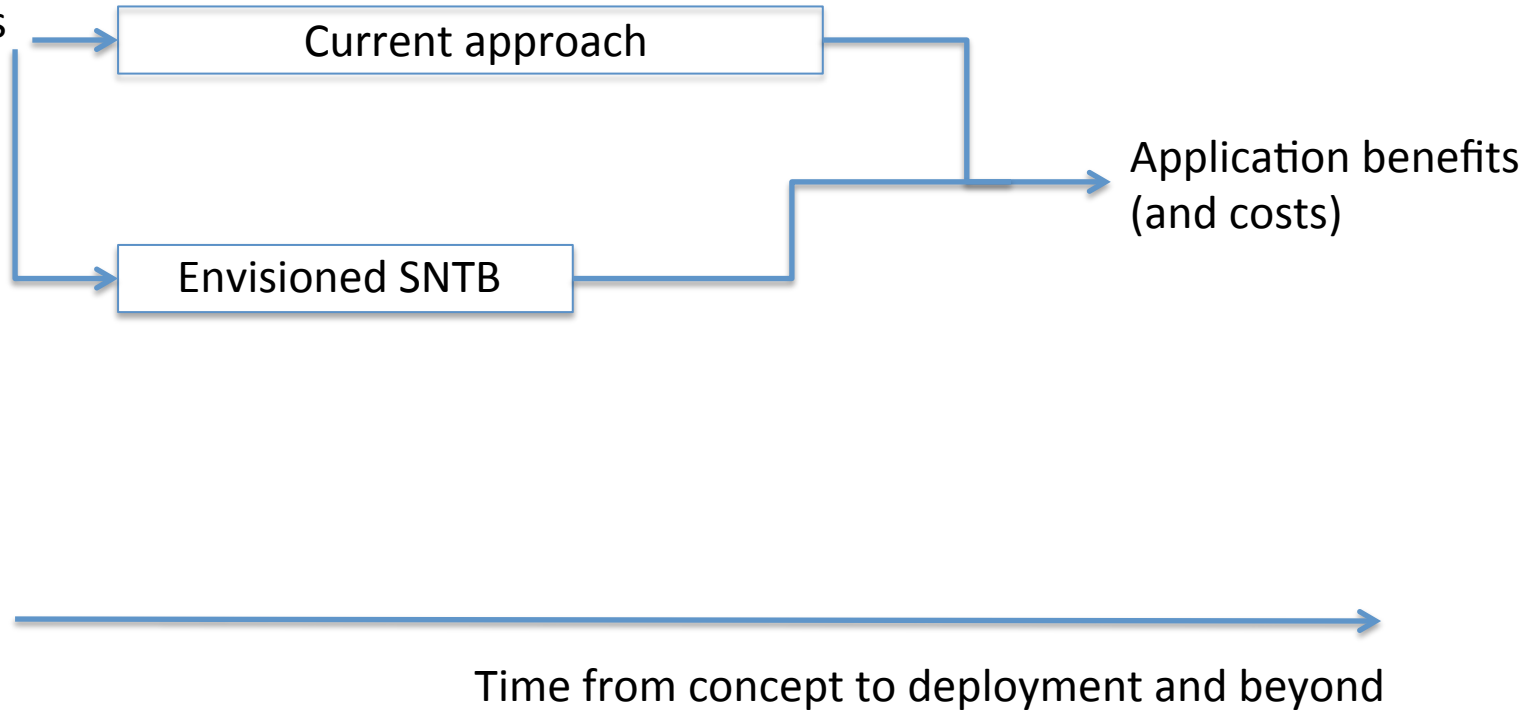


- SMART NAS Test Bed role
- Metric and Benefits
- Objectives
- Use Cases
 - Trajectory-Based Operations
 - UAS Integration
 - Real-time System-wide Safety Assurance
- Approach
 - Use-case driven
 - Concepts & Technologies development life cycle
- Status



SNTB Role

Trajectory
Based
Operation
Concepts &
Technologies





Metric



- Concepts & Technologies measures:
 - Delay/cost reduction
 - Increased throughput
 - On time/predictability/stability, flexible schedule/on demand
 - Maintain or enhance safety and environmental impact
 - Maintain or reduce workload

Accelerated delivery of benefits of Concepts & Technologies



Benefits



- **Higher Complexity and Broader Scope**
 - Integrate across ATM domains and beyond physical labs
 - Evaluate more diverse operations
- **Higher Fidelity**
 - Standardize simulation infrastructure across work-groups
 - Use live, virtual, and high-fidelity constructive assets
- **Easier Access to Real-time Simulations**
 - Automate human-intensive preparation and post-processing
 - Leverage advances in software assurance and big data



Objectives



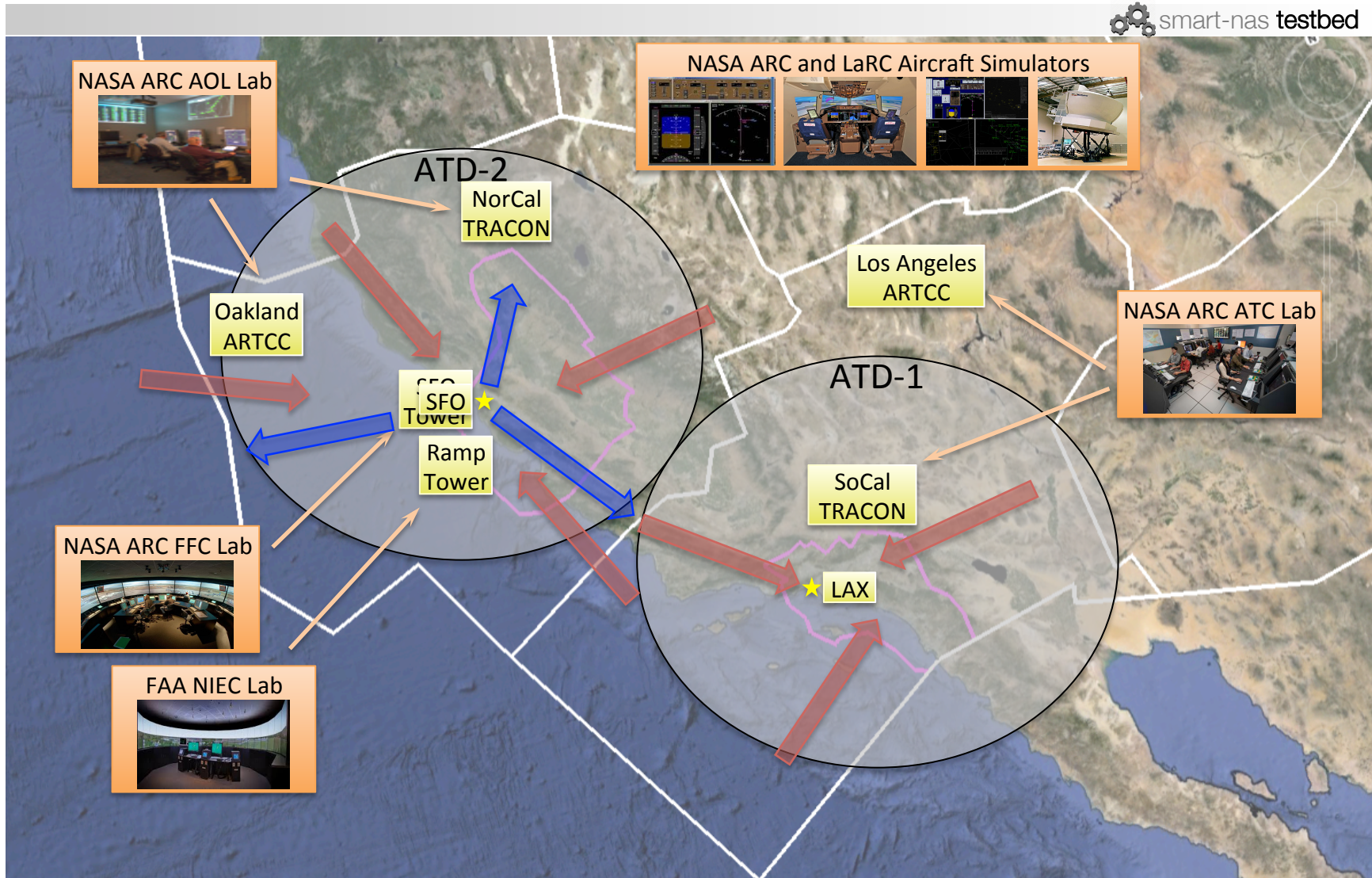
Enable high-fidelity human-in-the-loop and automation-in-the-loop simulations and tests that are either impractical or impossible today but are needed to:

- Validate concepts using multiple operational domains (gate-to-gate TBO)
- Investigate concepts related to revolutionary operations (UAS integration)
- Provide a high-fidelity test environment for real-time system-wide safety assurance (RSSA) capabilities



Arrival/Departure TBO Use Case

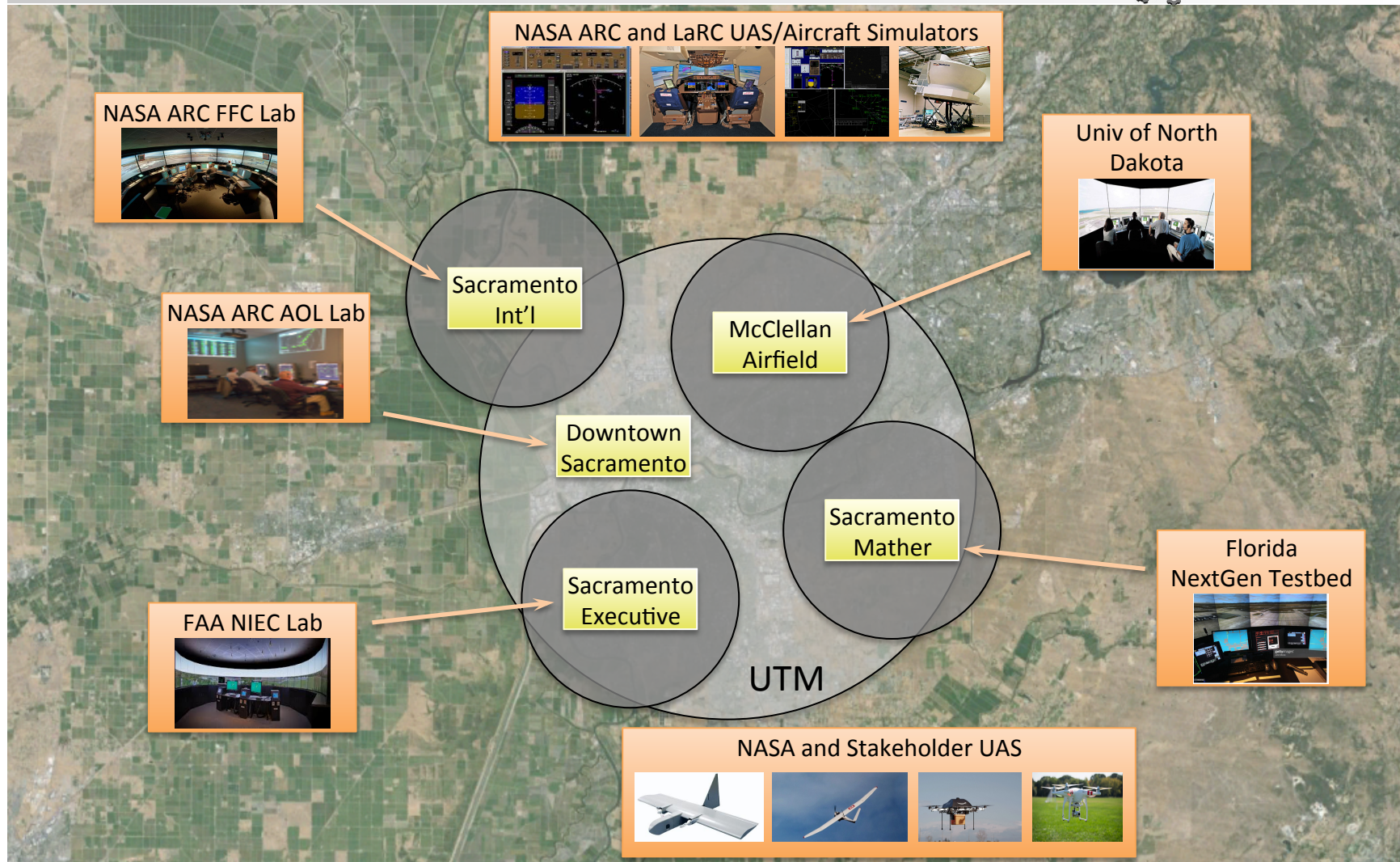
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Integrated UTM Use Case

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Real-time System-wide Safety Assurance



- **Current Capabilities**
 - Testing uses limited amounts of data
 - Data access is cumbersome and not centralized
 - Safety algorithms separate from real-time human-in-the-loop simulations

- **SMART-NAS Test Bed Capabilities**
 - Testing uses data from throughout the NAS
 - Data access is via standardized interfaces
 - Safety modeling algorithms integrated with simulation infrastructure



Concepts & Technologies Development Life Cycle



- Research and Exploration
- Architecture and Design
- Product Development
- Product Testing
- Product Deployment
- Product Support
- Maintenance & Migration



Use Cases (Year 1 and Year 2)

2016

- **UC-1: Scenario Validation**
 - User Management and GUI Front End
 - Fixed Component Library
 - Simulation Architect
 - Big Data Driven Scenario Builder
 - Execution Manager
 - DDS Message Bus
 - WorldWind Visualization
- **UC-5: Phase 1 TBO Simulation (Metroplex)**
 - Integrated Industry and NASA Simulation
 - Metroplex arrival and departure scheduling integration
 - JFK OPD arrival and 4 runway operations
 - Large scale simulation with low and medium fidelity components
 - High Fidelity Visualization
- **UC-8: Data Analytics**
 - UTM Connectivity
 - Real-time System-Wide Safety Connectivity
 - SWIM/**Legacy** Data Streaming
 - Data Warehouse Data Streaming
 - Static Resource Allocation

2017

- **UC-5: Phase 1 TBO Simulation (ATD-1)**
 - Participant VoiceComm
 - Distributed Environments (NASA)
 - En Route and Terminal Platforms
 - Metrics Dashboard
- **UC-2a: Autonomy Simulation**
 - Open Component Library
 - Give-Take Scenario Builder
 - Participant DataComm
 - Dynamic Resource Allocation
 - Cloud Support
 - Limited Scaled Real-time Support



Use Cases (Year 3 and Year 4)

2018

- UC-2a: Autonomy Simulation
 - Extensive Scaled Real-time Support
- UC2b: UAS Simulation (UTM)
 - Out-the-Window Visualization (Tower)
 - Out-the-Window Visualization (Aircraft)
 - Airport Tower Platforms
 - Ground Control Stations
- UC4: Phase 2 TBO Simulation (ATD-2)
 - Distributed Environments (External)
 - Airline Ramp Tower Platforms

2019

- UC3: Phase 3 TBO Simulation (ATD-3)
 - Secure Component Library
 - Convective Weather Integration
 - Oceanic Platforms
 - Airline Operations Center Platforms



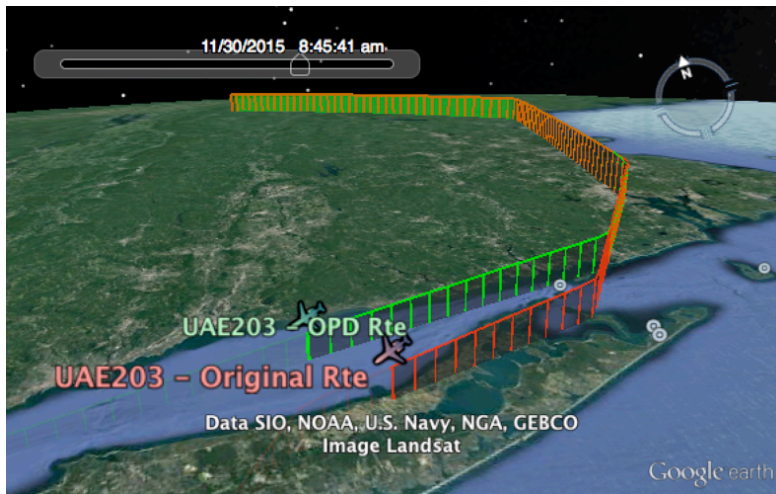
Status



- **Finished 2-Year Testbed Architecture NRAs**
 - Defined enterprise service bus architecture for distributed high-fidelity simulations
 - Cost/benefit assessments showed positive benefits for both research activities and deployment of new ATM systems
- **Developed Proof-of-Concept Testbed Software**
 - Focused on traffic, weather, and airspace data integration
 - Investigated several software assurance, cloud-computing, big data, and real-time analytics technologies relevant to implementation
- **Implementing Full-scale Testbed Software**
 - Realistic scenario design and validation for gate-to-gate TBO simulations
 - Scalable and distributed data provider for real-time data analytics

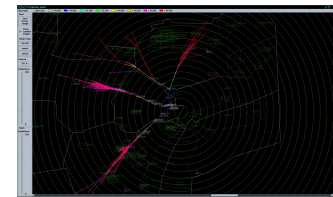
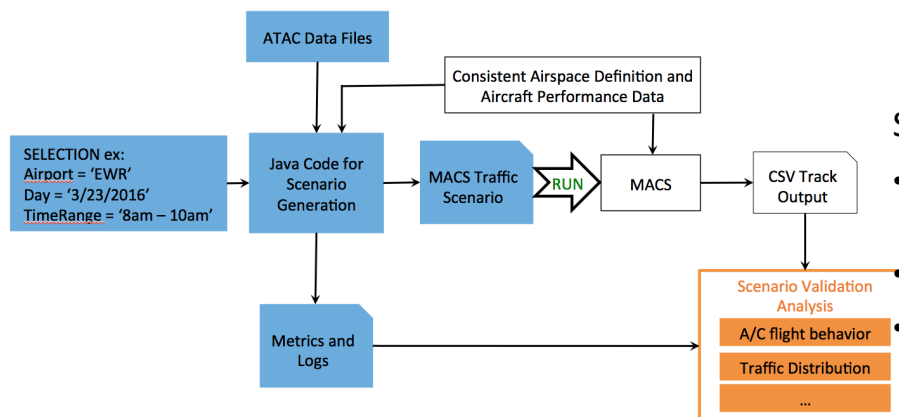


SMART NAS Test Bed Highlight



Early exploration enabling metroplex-type simulation of NY-area airports. As part of NY TBO project and working with PANYNJ

- In July 2016, NY metroplex with combined arrival, departure, and surface operations was simulated using early SNTB execution and connection framework for distributed simulation
- Preliminary SNTB enabled metroplex scenario simulation



Scenario Validation (Use Case #2)

- Initial auto-generation of MACS scenario input file from data in database (minutes to generate)
- Manually verify on MACS and keep statistics
- Next: automating the verification step