



Progress toward Developing & Validating the Airspace Concept Evaluation System

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Session Purpose

Objective: To provide potential users with the first in-depth look at the capabilities that are envisioned for the VAST non-real-time toolset.

Outline

- **Overview of the Airspace Concept Evaluation System (ACES) development plan**
- **Preparation of the simulation system for concept evaluation applications**
- **Detailed presentation of selected topics**



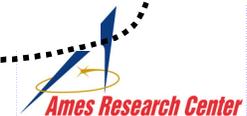
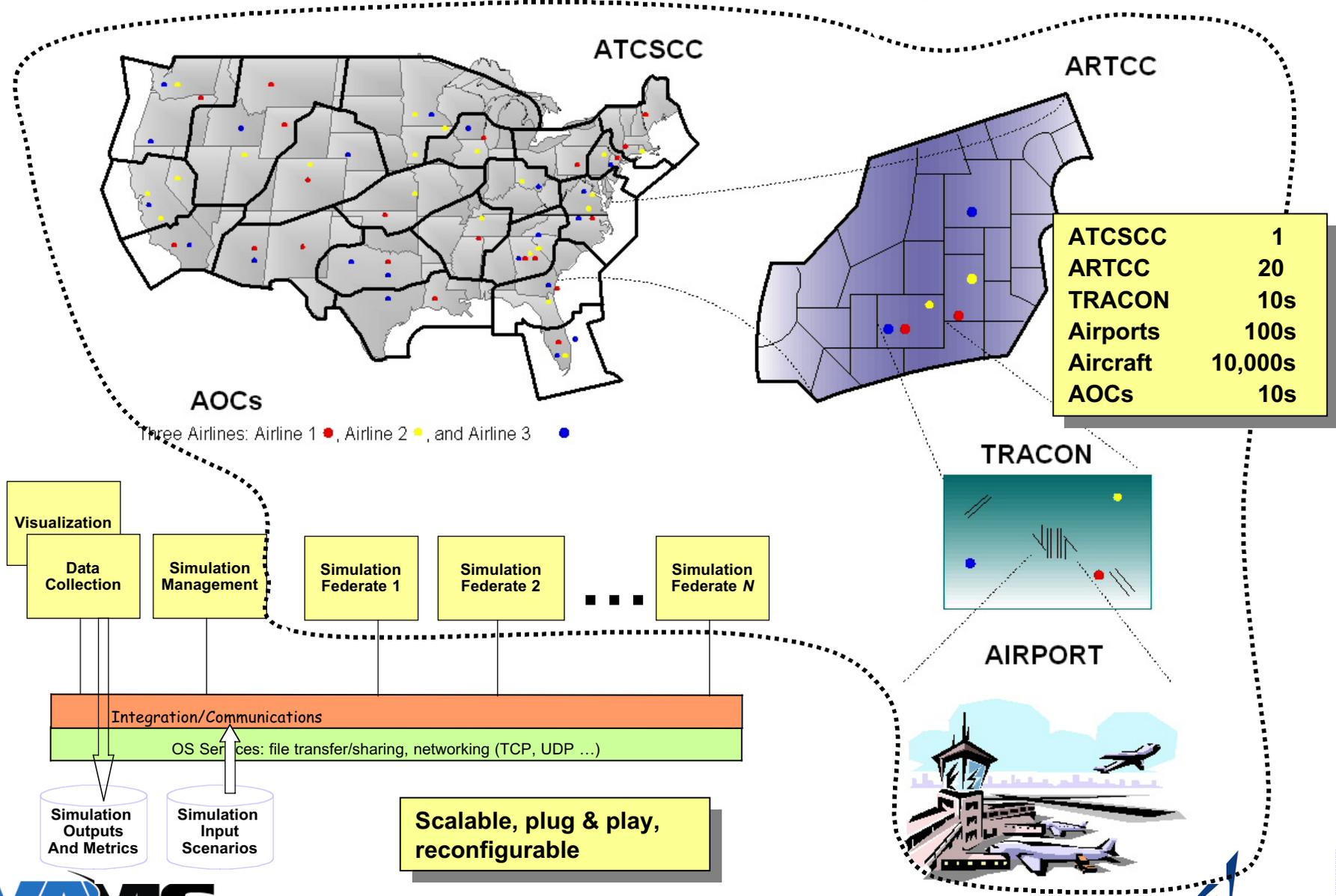
Airspace Concept Evaluation System Development Plan

- Demonstrated a **proof-of-concept** prototype 4/02
 - Selected the DoD’s HLA-RTI infrastructure with agent-based software to enable fast-time NAS-wide simulation
 - Established a modeling lab that leverages existing and emerging models and tools
- **Prove the feasibility** of the approach to capture interactions between NAS entities (Build-1 System) 12/02
 - Integrate a suite of low-medium fidelity NAS models
 - Model dynamic effects of interactive agents
 - Assess NAS operational performance
- **Enhance the modeling** toolbox by adding functionality. 8/04
 - Develop and validate new models of NAS components
 - Increase model fidelity and simulation speed
 - Improve usability to enable **technology transfer** to airspace analysts





Build-1 Simulation Description





Topics for Detailed Discussion

- **Overview..... (Doug Sweet)**
 - Terminology and Approach
 - Prototype
 - Build-1 Simulation System
- **Modeling Details..... (George Hunter)**
 - Requirements
 - Implementation
- **Data flow..... (Doug Sweet)**
 - Inputs
 - Outputs
- **Validation of Build-1..... (Paul Abramson)**



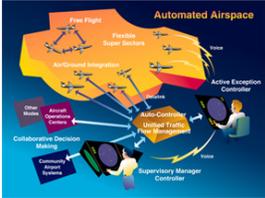
Enhancing the Modeling Toolbox

Several airspace modeling research activities support the growth of the Airspace Concept Evaluation System. Some examples are:

- **Cognitive human performance modeling**
 - Human/team performance model enhancements in APEX
 - Modeling of the Advanced Airspace Concept (NARI & SJSU)
- **Probabilistic forecasting**
- **Environmental models - noise, emissions & wake vortex**
- **Validation of new and existing airspace models**
 - Selection of datasets for a typical day (Metron Inc.)
 - Identification of critical parameters for model validation (GMU)



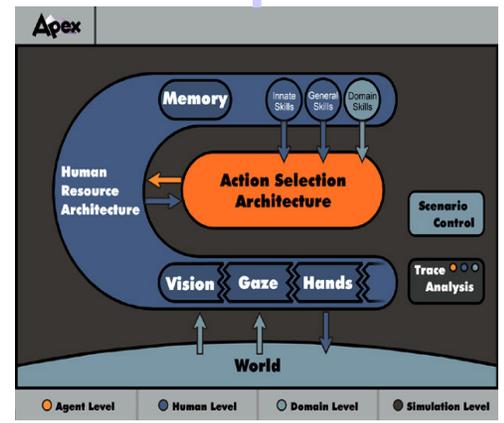
Concept Simulations



Human Factors Evaluations

Real-Time Simulation Suite

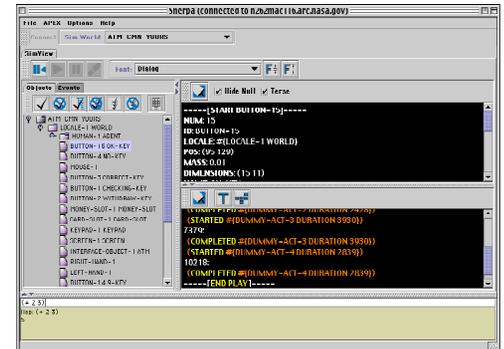
Fast-Time Simulation Toolkit



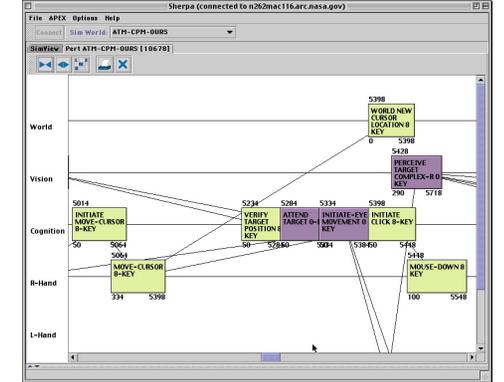
Simulated Human Agent

Model Support Tools

Modeler API

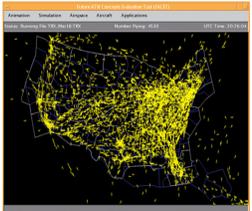


Behavioral Templates



Operator Task Demands

Situation Assessment



Distributed Decision Making



Communication

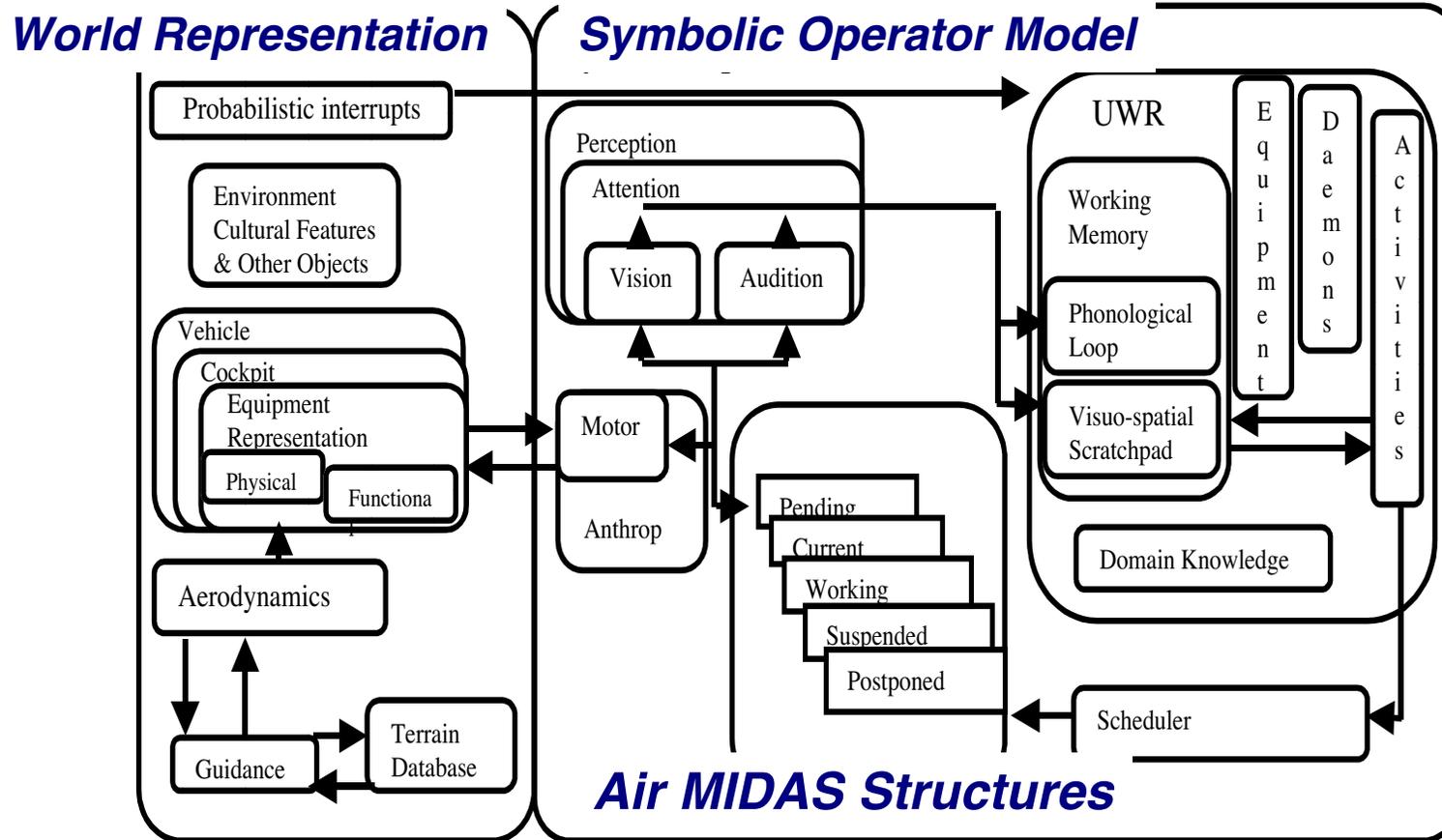


Psychological Theory & Data





Evaluation of the Advanced Airspace Concept from the Perspective of Human-System Integration

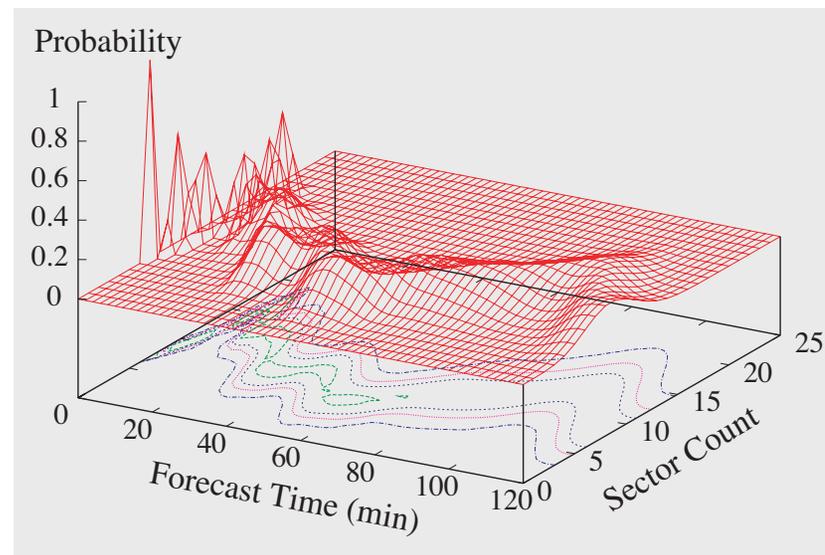


Integrate human performance models into the fast-time simulation environment and perform preliminary concept evaluation using methods proven in the Aviation Safety Program



Probabilistic Modeling for Traffic Flow Management

- **Forecasting and Assessment**
 - Forecasting of Airport Delays
 - Fast-time simulation assessment of aircraft delay absorption strategies
- **Cooperative Research (MIT)**
 - Sophisticated AOC Model
 - Probabilistic Airport Capacities Model
- **Concept Evaluations in FACET**
 - Non-linear Estimation of Departure Times
 - Probabilistic Modeling of Monitor Alerts
 - Spatio-Temporal Measures for Congestion



Reference:

Meyn, L., "Probabilistic Methods for Air Traffic Demand Forecasting," AIAA 2002-4766, Aug. 2002



Validation Methodology

- **Adapt terms and practices from military simulation and computational fluid dynamics domains to airspace simulation**
- **Extend the evaluation of the fidelity of existing air transportation models to develop the range of critical parameters needed to validate new models (GMU)**
- **Provide scientific evaluation of NAS data to select suitable days for NAS-wide model validation (Metron Inc.)**
 - **Define and quantify statistical properties of the NAS during a 1-2 year timeframe**
 - **Identify “typical” days and “standard” days in the NAS**



Basic Issues in Preparing the Simulation System for Concept Evaluations

- **Need to define a specific, concept-driven focus for each ACES software build**
- **Need to define the ACES operational paradigm**
 - User expertise requirement
 - System access (e.g. onsite or remote distributed access)
 - Development support (e.g. V&V and release management)
 - Operational support (e.g. maintenance)
- **Need to clarify ACES role within VAMS Project**
 - Interfaces/responsibilities across elements
 - VAST real-time and non-real-time roles



Concept-Driven Requirements

<u>Quarter</u>	<u>ACES Deliverable</u>	<u>SLIC Deliverable</u>
4Q02	Build-2 requirements defined	Phase 1 Concepts & Scenarios
1Q03	Build-1 delivered for validation	Phase 1 Concept Roadmap
2Q03	<i>NASA in-house tests, development & analyses</i>	
3Q03		
4Q03		<i>Possible access to Build-1</i>
1Q04	Build-2 delivered for validation	Phase 2 Self-Eval by Concept Developers
2Q04		
3Q04		
4Q04	Build-3 delivered for validation	<i>Possible access to Build-2</i>
1Q05		Phase 3 Self-Eval by Concept Developers and Assessment of GFI toolbox & scenarios

Limited input from concepts to Build-2



NASA in-house tests, development & analyses

Possible access to Build-1

Possible access to Build-2



Operational Assumptions

- **ACES provides a common platform for system-level evaluation of SLIC concepts**
- **ACES provides a modeling infrastructure and incorporates features common to many concepts**
- **Concept developers need to provide validated, concept-specific models with appropriate detail for system-level analysis**
- **ACES will evaluate several, but not all, concepts as part of the tool development and validation process**

***ACES will grow as a research capability,
not a production facility,
during the 5-year VAMS Project***





Near-Term Operational Considerations

- **During 2003, tests will be conducted by NASA in-house users, assisted by software developers, to determine the application readiness of the simulation system**
- **NASA's onsite software development team is currently exploring the ease of model integration and co-development by linking FACET into the RTI**
- **Recommended procedures for ACES maintenance and support are being drafted**
 - **Initial access to ACES will be in NASA's Lab**
 - **Minimal support will be available during early releases**



Introduction of Speakers

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