“M&S Applications in the Next Generation Air Transportation System”

Presented to: M&S Caucus Leadership Summit

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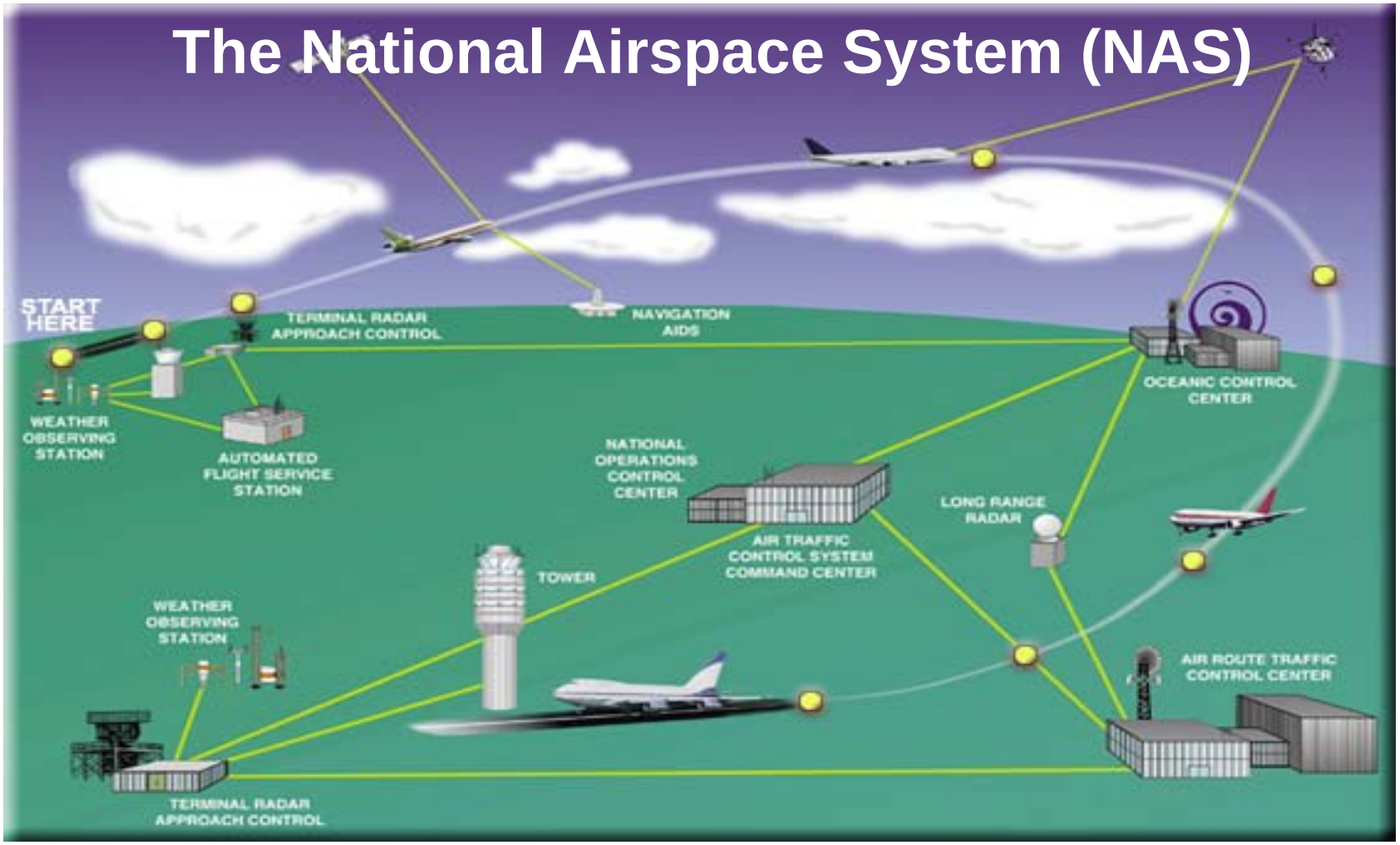
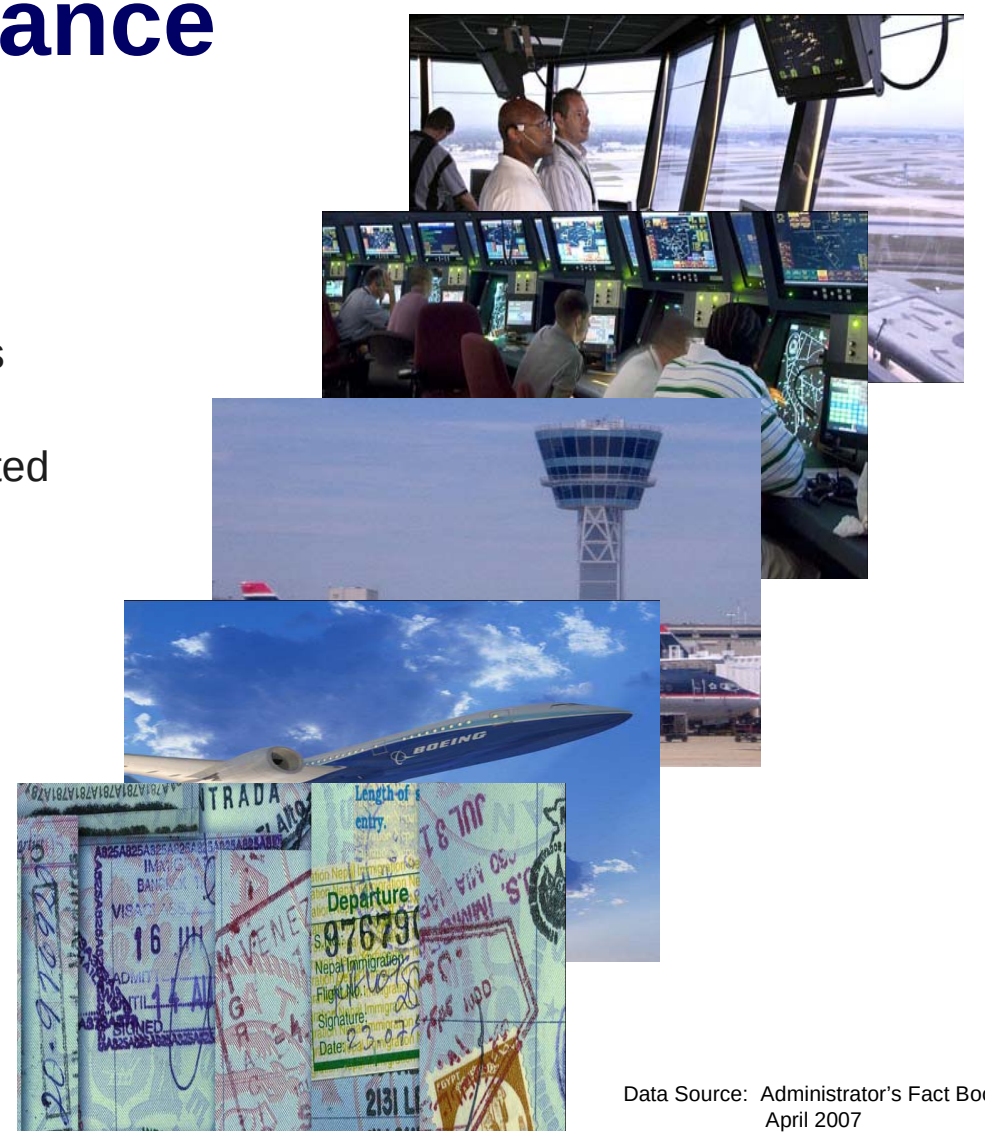
How It Works


The National Airspace System (NAS)
START HERE
TERMINAL RADAR APPROACH CONTROL
NAVIGATION AIDS
OCEANIC CONTROL CENTER
WEATHER OBSERVING STATION
AUTOMATED FLIGHT SERVICE STATION
NATIONAL OPERATIONS CONTROL CENTER
LONG RANGE RADAR
AIR TRAFFIC CONTROL SYSTEM COMMAND CENTER
TOWER
WEATHER OBSERVING STATION
AIR ROUTE TRAFFIC CONTROL CENTER
TERMINAL RADAR APPROACH CONTROL

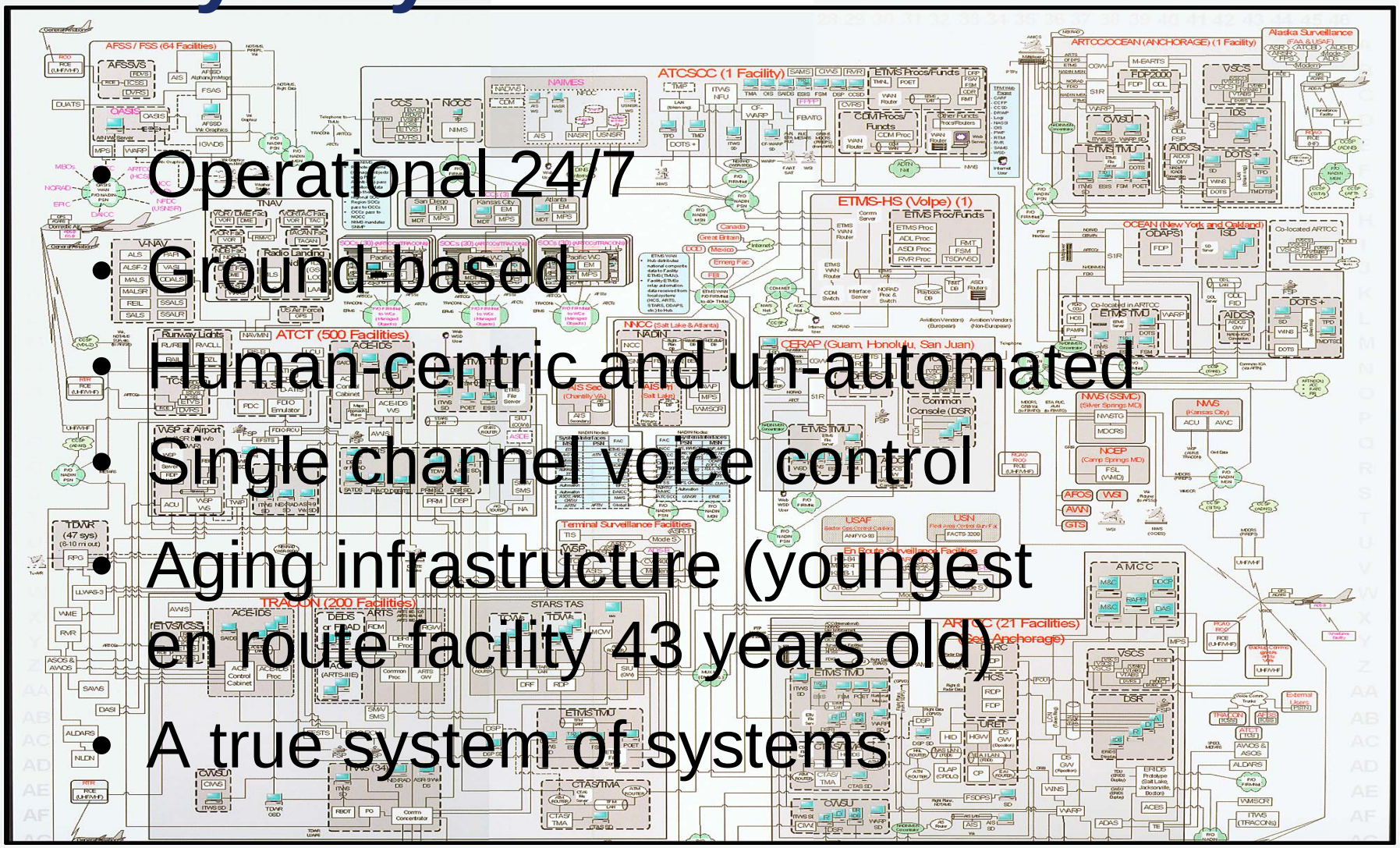
NAS Stats at a Glance

- **People – 47,329**
- **Operational Facilities**
  - 40,639 NAS operational facilities
  - 21 air route traffic control centers
  - 517 airport traffic control towers
  - 75 flight service stations/automated flight service stations
- **Airports – 19,983**
- **Pilots/Aircraft**
  - 609,603 pilots
  - 233,670 (active U.S. carrier and general aviation aircraft)
  - 28.3M (general aviation hours flown)
  - 8,211M (U.S. carrier miles flown)
- **Budget Authority – $14,310M**



Data Source: Administrator's Fact Book April 2007

Today's System



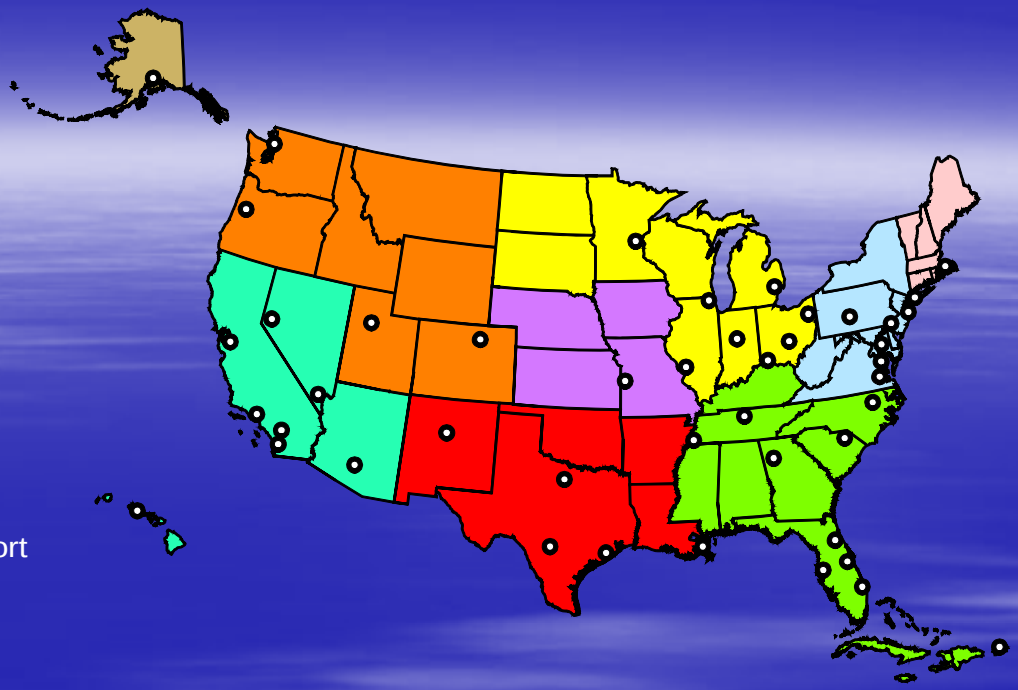
Annual Service Volume Studies

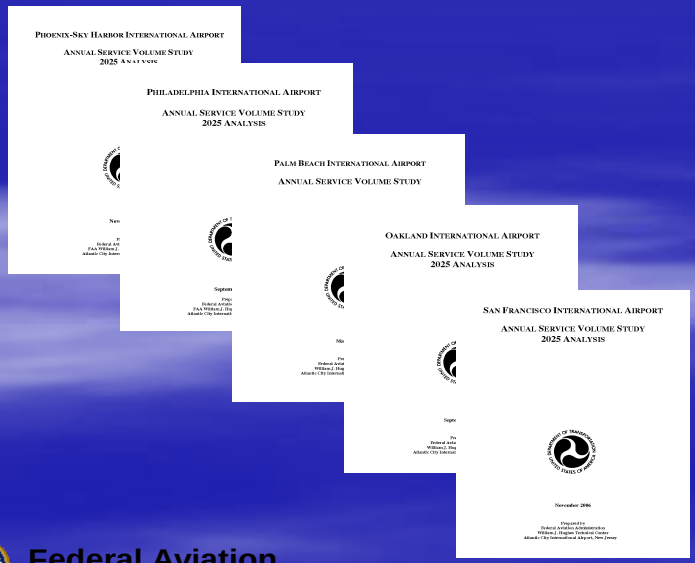
Methodology

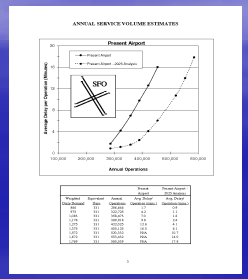
- Determine the number of annual operations at an airport with a specified delay
- Developed this technique utilizing the Runway Delay Simulation Model (RDSIM) and demand forecasting used in the Airport Capacity Enhancement Design Team Studies
- Over 130 studies completed since 1999

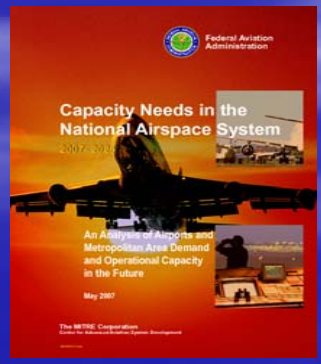
Function

- The Annual Service Volume Studies are a major part of the Administrator's Answer to Congress on the Present and Future Capacity Needs of the Air Transportation System
- Results used in Future Airport Capacity Task (FACT2) Report



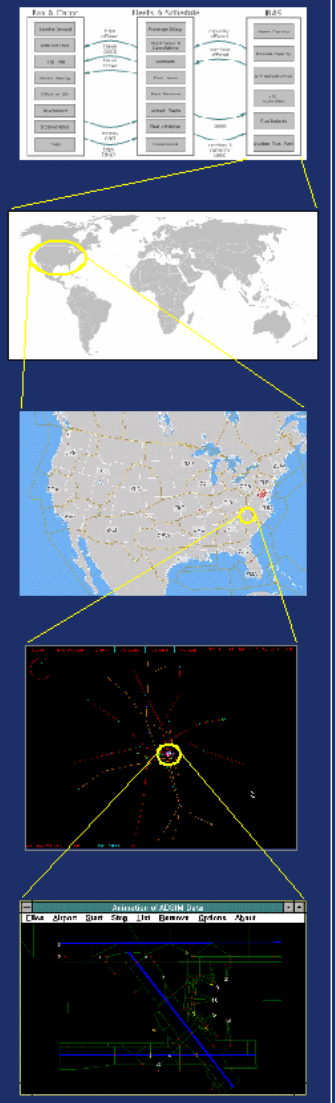






Federal Aviation Administration

ATO Operations Planning *Modeling Suite*



NAS Strategy Simulator

The NSS is a multi-year system dynamics representation of the entire air transportation system, including airline passengers, cargo, and general aviation activity.

AwSim/AERALIB

AwSim, and its associated AERALIb object-oriented software library, are used to model 4D flight trajectories.

NASPAC

The National Airspace System Performance Analysis Capability represents all sectors, TRACONs, and airports in U.S. domestic airspace.

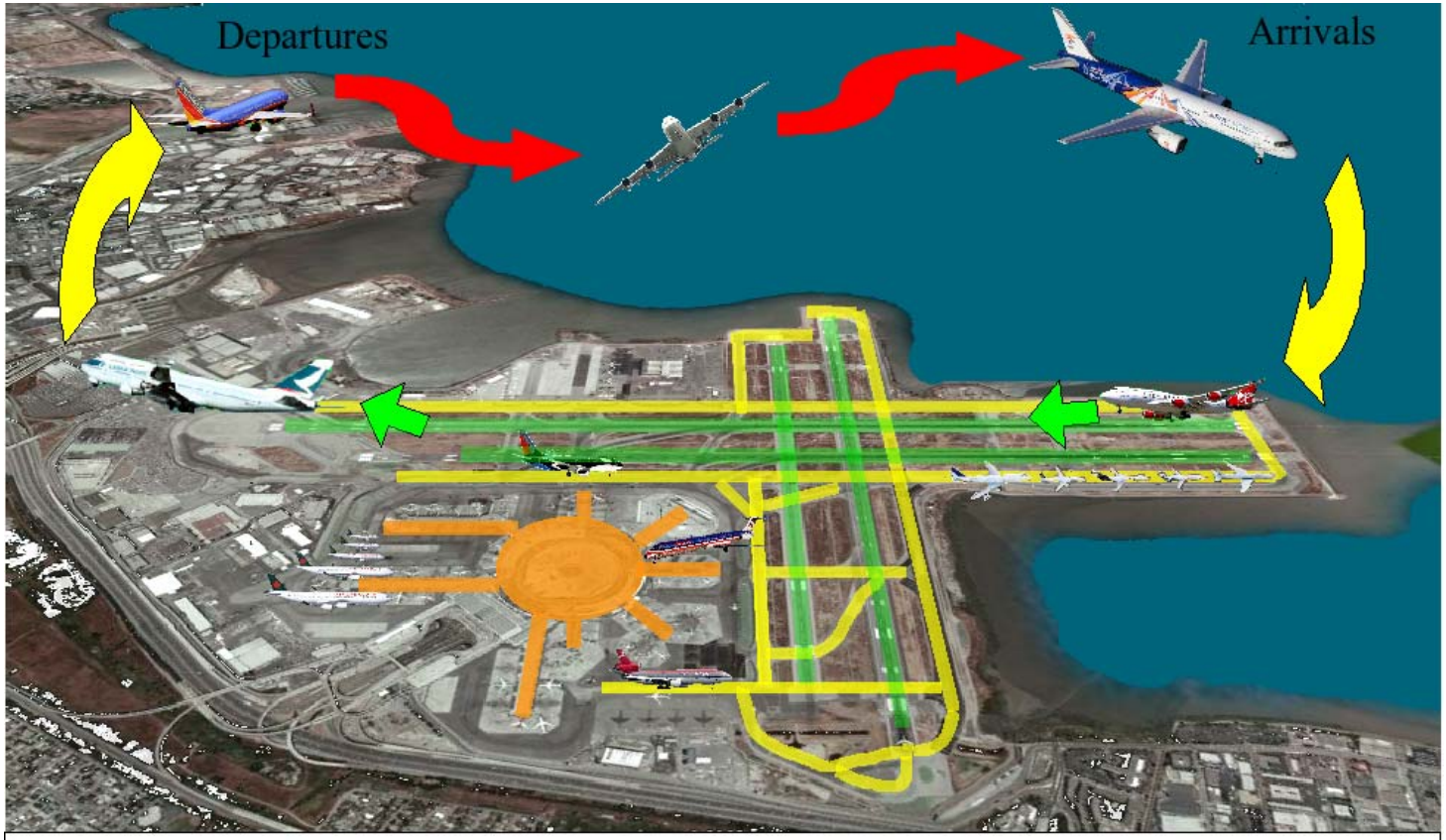
Airport & Airspace Simulation Model

The Airport & Airspace Simulation Model traces the movement of individual aircraft through a node-link representation of airspace and/or the airport surface.

RDSIM/ADSIM

The Runway Delay Simulation model simulates runway operations and computes delay and capacity. The Airfield Delay Simulation Model simulates the movement of individual aircraft on the airport surface.

Simulation *Models – Today*



Runway Delay Simulation Model (RDSIM)

Airfield Delay Simulation Model (ADSIM)

Airport & Airspace Simulation Model (SIMMOD™)

International Projects

- AeroThai, Thailand - using FAA's Airport & Airspace Simulation Model
  - Simulating new third & fourth runways
  - Simultaneous Independent Parallel Approaches
  - New Suvarnabhumi Airport and the re-opening of the old Donmuang Airport
- South Korea Civil Aviation Authority - using FAA's Airport & Airspace Simulation Model
  - Simulated Incheon Intl Airport,
  - US is provided technical expertise about modeling
- Sochi, Russia - used a version of the FAA's Airport & Airspace Simulation Model
  - In the Sochi Intl Airport capacity study
  - Simulated new terminal, re-opening of a closed runway, and runway extension

Modeling the impact of the A380

Jennifer Morris
Acting Manager – Capacity Modeling and Analysis Group, FAA William J. Hughes Technical Center

What will happen when the first A380 aircraft lands at a U.S. airport? Will the runways and taxiways be able to accommodate the wingspan and weight of the new large aircraft? The Federal Aviation Administration's (FAA) Capacity Modeling and Analysis Group is helping airport operators and air traffic controllers answer these questions by providing an invaluable tool – computer simulation expertise.

Major airports worldwide are eagerly anticipating the introduction of the Airbus A380 aircraft into their fleets, but this major advancement brings with it logistical issues and concerns. Are airports ready for the Airbus A380? The computer simulation capability of the Capacity Modeling and Analysis Group, based at the FAA William J. Hughes Technical Center near Atlantic City, N.J., enables any airport to conduct a site-specific "dry run" of how the A380 will operate. The group of 13 FAA analysts – a unique blend of operations research analysts, computer specialists and mathematicians – has performed fast-time simulation work supporting studies at San Francisco, John F. Kennedy and Memphis International Airports. These simulations are used to analyse the impact of the introduction of new large aircraft into the fleets of major air carriers, using the Airfield Delay Simulation Model (ADSIM).

Many issues have to be addressed prior to the introduction of the Airbus A380 into the airline fleets, now scheduled for late 2006. The size and weight of the aircraft constrain the use of runways, taxiways and gates.

How does the A380 compare in size to a Boeing 747-400?

The wingspan of the A380 is 261.7 feet, compared to 211.4 feet for the 747-400. The maximum takeoff weight of the A380 is 1,235,000 pounds; that of a 747-400 is 875,000 pounds. The A380 is 79.6 feet high compared to 63.7 feet for the 747-400. The maximum fuel capacity for the A380 is 81,890 gallons, with 555 to 853 seats; the 747-400 holds 57,285 gallons and seats 416 to 660 passengers.

Simulations assume that all of the required airfield improvements will be in place to support the A380. The aircraft follows specific, pre-determined arrival and departure routes on the airfield to ensure that physical restrictions are met. Airport operators and FAA air traffic control personnel are designing routes to use taxiways and exits that will withstand the weight of the aircraft and avoid buildings and other obstructions at the airport. Alternate airports and taxiway routes will be available for the A380 to take in emergency situations or if something happens on the designated route.

Inputs required for modeling

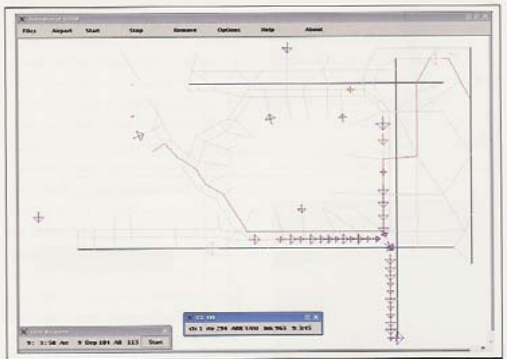
Runway occupancy times, runway exit probabilities, aircraft separations, gate service times, traffic schedules and weather data are essential inputs for modeling. The computer simulations start with today's demand at the individual airport. The methodology is to begin with a representative day of airport operations for the current demand. Normally, this is an average (typical) day in the peak month. The data from the Official Airline Guide, showing the scheduled arrivals and departures for an actual day serves as a starting point. Other sources are actual air traffic control counts, the Enhanced Traffic Management System counts and the Operations Network (OPSNET) to capture the unscheduled, military and general aviation operations. A traffic schedule is generated that combines this information into what is called the "baseline demand". The design team, usually comprised of representatives from the airport, FAA air traffic control, planning, airlines and other interested parties, agrees on the future demands based on the Terminal Area Forecast or Master Plan, previous studies, etc. The traffic is increased proportionally based on the characteristics and fleet mix of the baseline demand. This is where the A380 is introduced into the schedule.

Computer simulation can offer airports a "dry run" of how the A380 will operate

Generating results

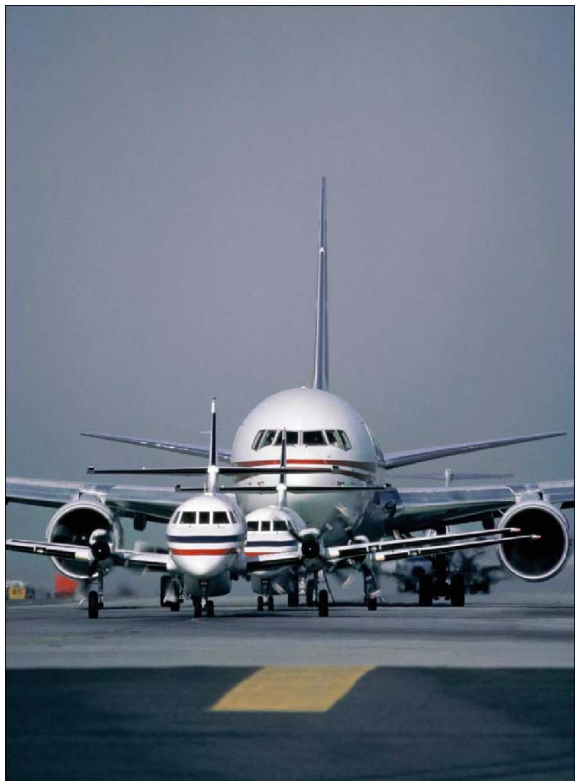
ADSIM computes hourly and daily delays to aircraft. The simulation model also calculates aircraft flow rates and travel times. ADSIM simulates in detail the movement of arrivals from the runway threshold to the gate, and the movement of departures from the gate to their roll on the runway. The effects of airspace delay, for arrivals from an approach fix and for departures to the first departure fix, also are modeled.

An animated playback feature, incorporated into the Airfield Delay Simulation Model (ADSIM), provides a visual presentation of the movement of the aircraft on the runways, taxiways and gates. The aircraft symbols are proportionally sized so that the A380 can be distinguished from the smaller aircraft. This feature is especially useful for more complex taxiway configurations like JFK.


A screen-shot of the ADSIM simulation for JFK Airport

Outlook

- Volume of air travel/transportation is expected to double over the next 10 years or even triple by the year 2025
- Current NAS and supporting infrastructure was simply not designed to handle the voluminous increases anticipated
- Advances in technologies (i.e., unmanned aerial vehicles) will mandate changes to the NAS



The current NAS will have to be redesigned from the ground up.

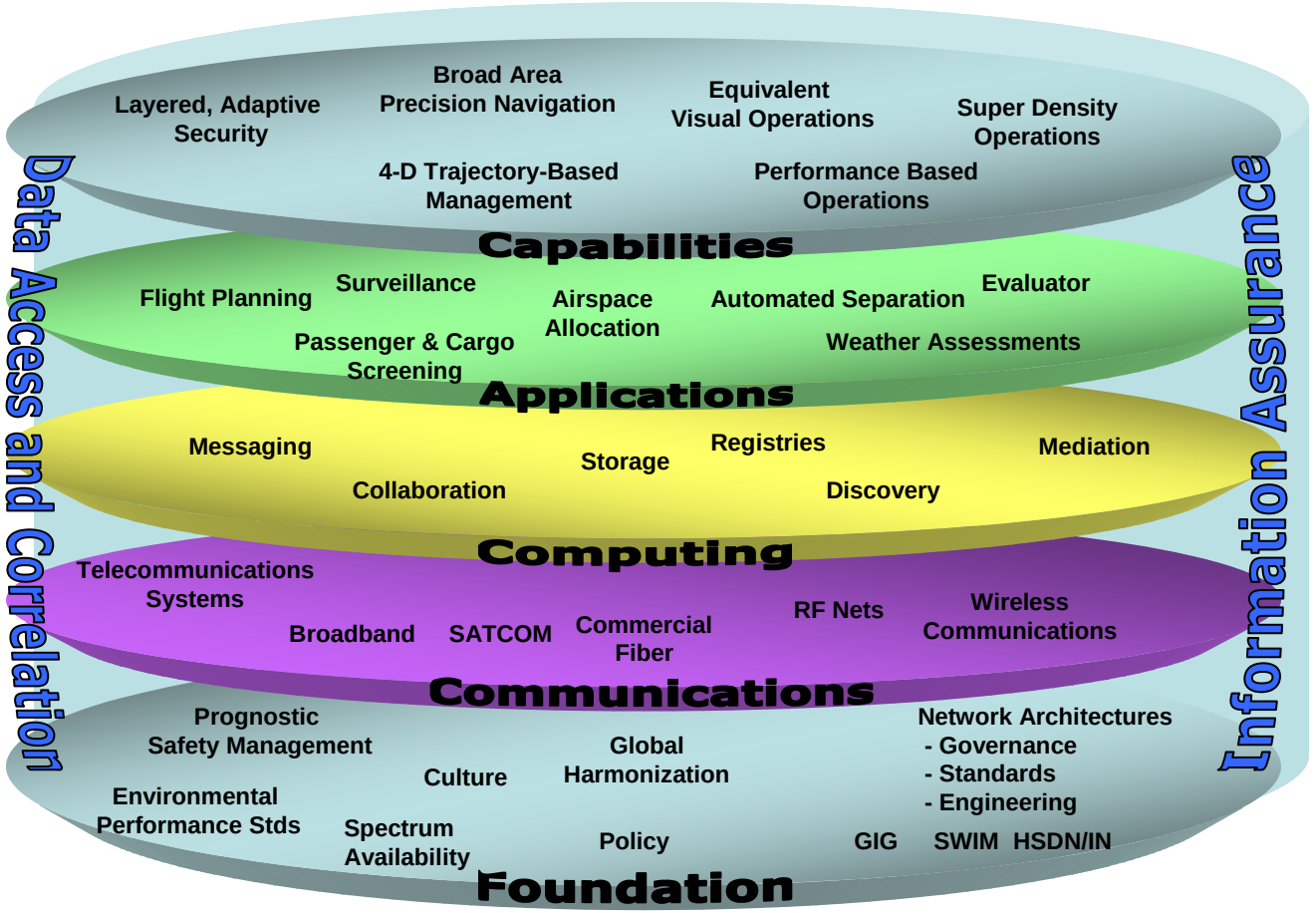
Transformation

- Created Joint Program Development Office (JPDO) via U.S. Public Law and Executive Order, consisting of DoT, FAA, NASA, DHS, DoD, and DoC
- Established to collectively support development of the Next Generation Air Transportation System (NextGen)…redesign of the NAS!

NextGen Key Capabilities

- Performance-Based Services
- Weather Assimilated Into Decision-Making
- Layered, Adaptive Security
- Position, Navigation, and Timing Services
- Trajectory-Based Aircraft Operations
- Equivalent Visual Operations
- Super Density Operations Equivalent
- Network Enabled Information Access

M&S Is Key To Achieving NextGen



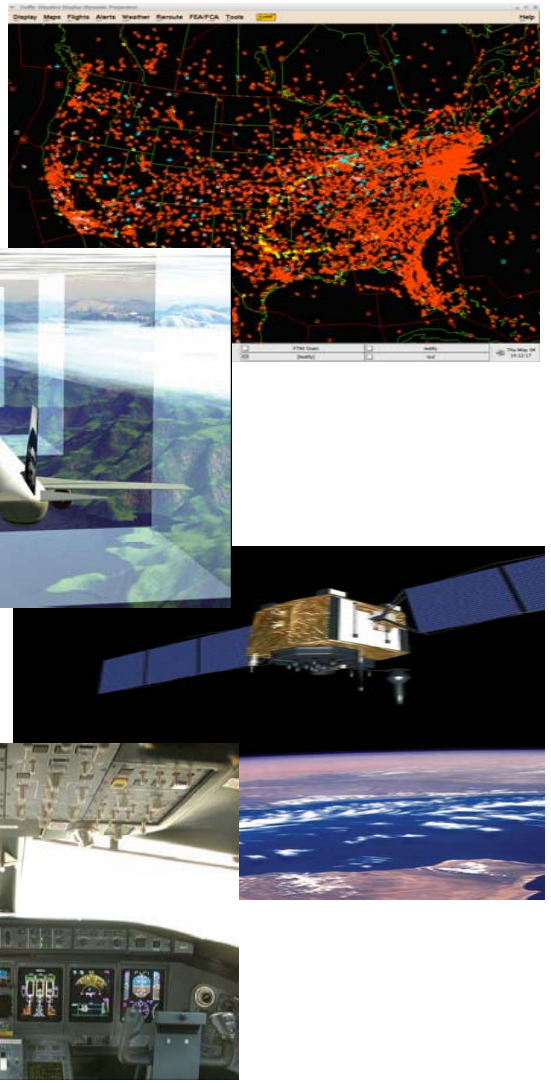
Joint Planning Development Office Studies

- High Density Case Study
- Perform fast-time simulation modeling of scenarios
  - 14 airports / 8 metropolitan areas
    - » ATL
    - » EWR
    - » FLL
    - » JFK
    - » LAS
    - » LAX
    - » LGA
    - » LGB
    - » MDW
    - » OAK
    - » PHL
    - » PHX
    - » SAN
    - » SFO
    - » SNA

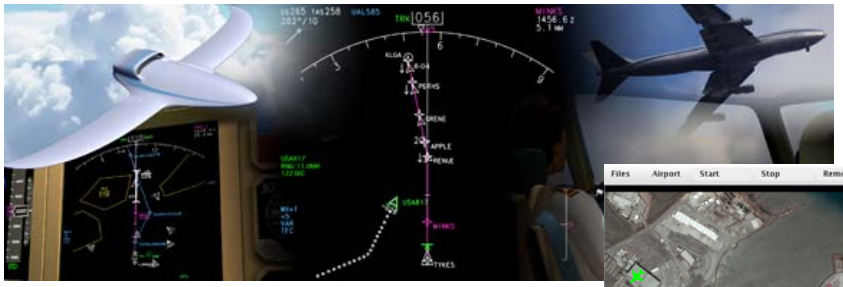
NextGen Challenges

- New concept of operation
- Current system operational 24/7
- Ability to design, develop, and implement multiple systems simultaneously
- Redefined roles of controllers, pilots, dispatchers, etc.
- Increased dependence on procedures and airspace as part of the system
- Aircraft equipage policies (national and international)
- Aircraft-centric
- System of systems
- Net-centric data sharing
- Aging facilities
- Ambitious roadmap (deliver on schedule and within budget)

Safety



M&S Ties The Communities Together



Research Community

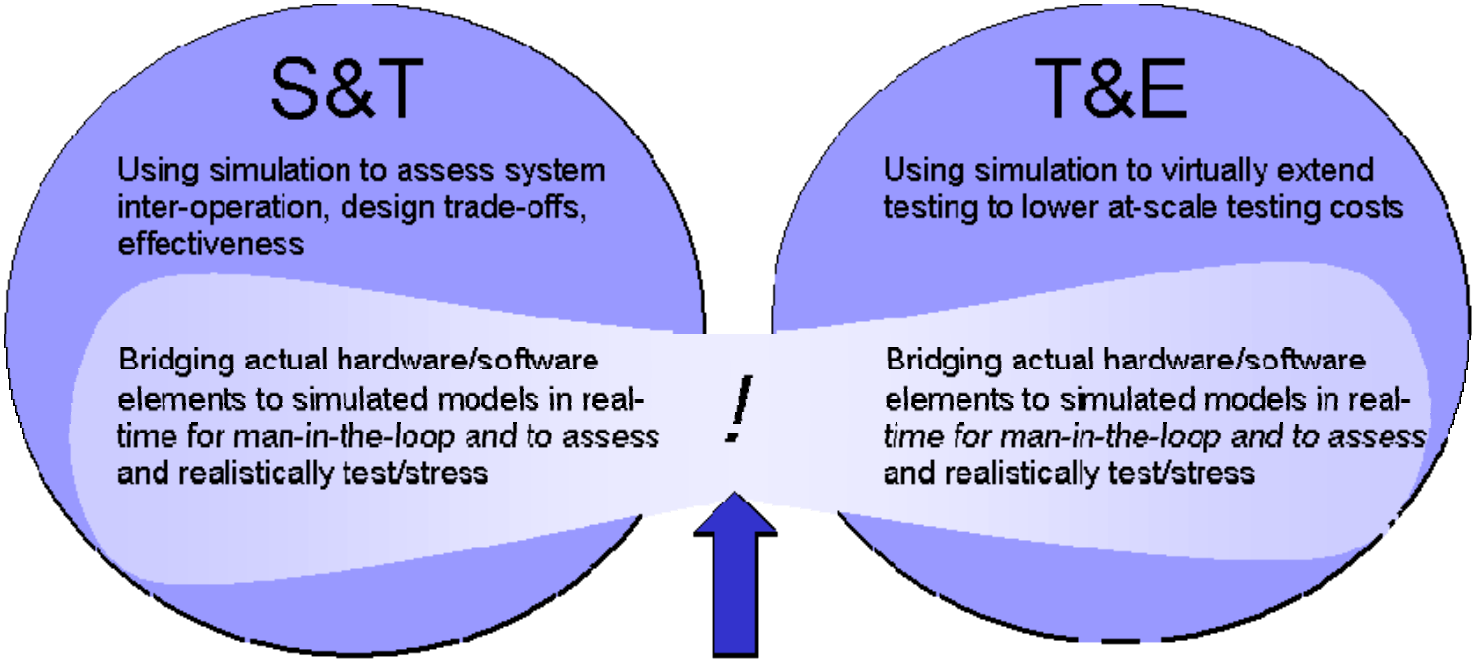
Engineering Community

Modeling and Simulation Community

Education and Training Community

User Community

M&S for S&T and T&E



S&T is simulation/analysis focused but uses real elements in some cases

Joint S&T and T&E communities are looking at the same problem from different perspectives

T&E is test focused and uses simulated models to augment at-scale testing

Impact Development-to-Fielding Spectrum

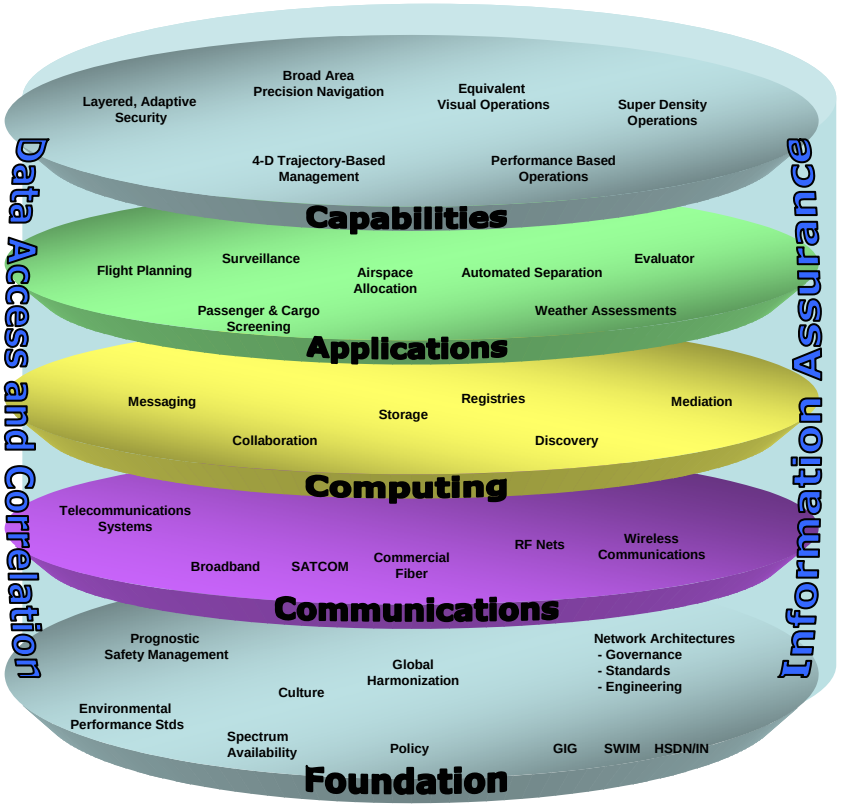
NextGen Test & Evaluation

William J. Hughes Technical Center

- Nation's leading aviation and air traffic management Federal laboratory
- Fully integrated network of specialized labs
- Only laboratories in the world where it is possible to simulate an end-to-end scenario (non-operational environment)
- Recognized aviation expertise – automation, communications, navigation, and surveillance
- Five decades of air traffic management test and evaluation achievements

NextGen T&E- Modeling & Simulation

- Concept Modeling
- Architecture Modeling
- Part Simulation
- Holistic Modeling
- Soft Science Models
- Engineering Models



Today → *Integrated* → **Tomorrow**

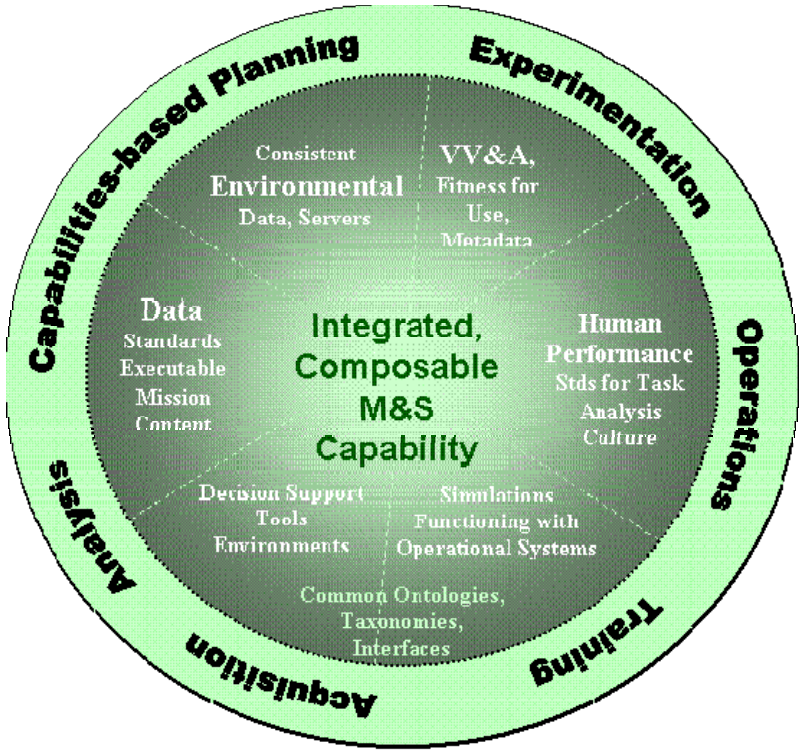
Challenge – Maturing M&S Environment

Right Models

Right Technologies

Right Disciplines

Having the Right Knowledge Base ?

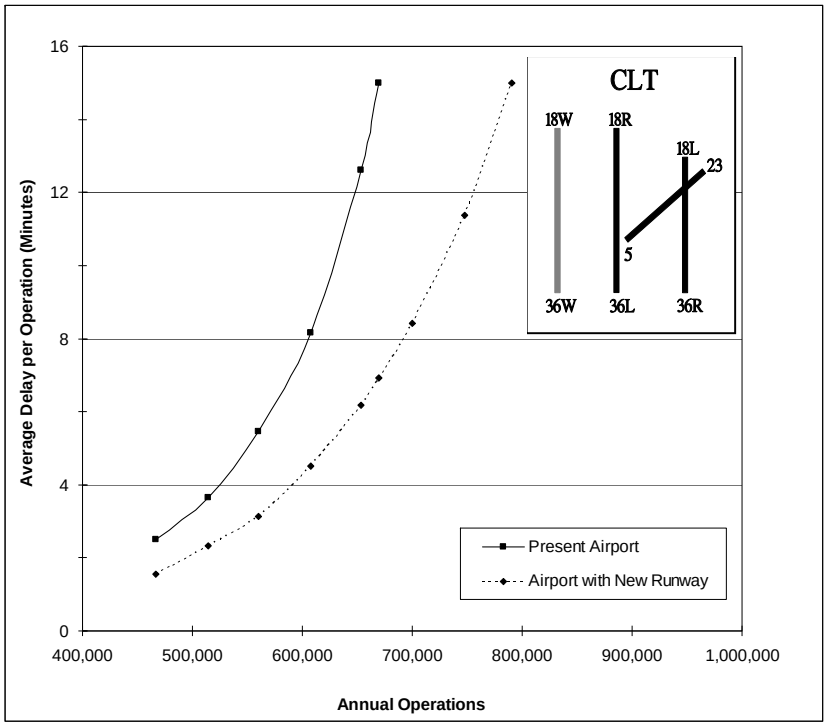


Source: DMSO

Now is the time to Build IT!

The Mid-Atlantic Institute for Simulation and Analysis (MAISA)

- **MAISA is a science and technology consortium focused on enhancing the MS&A capabilities in the region.**
- **Develop and increase inter-state, cross disciplinary collaboration among DE, MD, NJ & PA entities.**
- **Enhance technology education**
- **Foster collaboration within MS&A communities in the region.**



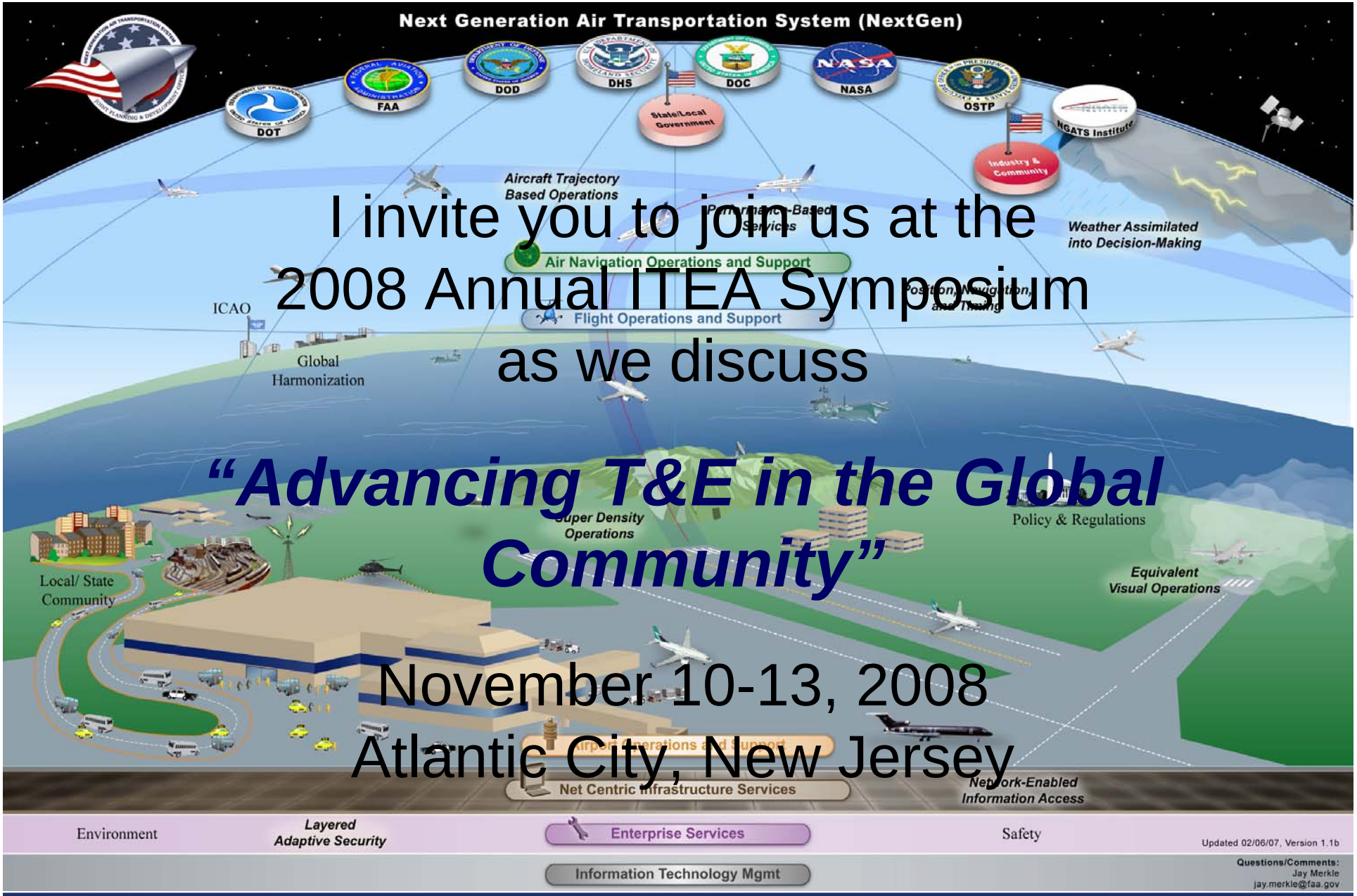
Major Regional Government Activities

- **FAA Technical Center (Atlantic City)**
  - **FAA**
  - **DHS (Coast Guard and Science & Technology)**
  - **DoD (Air National Guard 177th)**
- **Army (Aberdeen, Fort Dix, Fort Monmouth, Picatinny Arsenal & Fort Detrick)**
- **Coast Guard (Cape May)**
- **National Guard Joint Training and Training Development Center (Fort Dix)**
- **Naval Air (Lakehurst & Patuxent River)**
- **Naval Sea (Philadelphia)**

University & Industry Partners

- Burlington County College
- Carnegie Mellon University
- Drexel University
- New Jersey Institute of Technology
- University of Maryland
- University of Pennsylvania
- Villanova University

- ASTM HQ
- Boeing
  - Integrated Defense Systems
  - Phantom Works
- IDS Analysis,
- L3 Communication
- Lockheed Martin
- SMART
- ETC USA
- Instaknow
- Airproducts
- ESS World



I invite you to join us at the 2008 Annual ITEA Symposium as we discuss

"Advancing T&E in the Global Community"

November 10-13, 2008
Atlantic City, New Jersey

The Federal Aviation Administration

Our mission is to provide the safest, most efficient aerospace system in the world.

Our vision is to improve the safety and efficiency of aviation, while being responsive to our customers and accountable to the public.