

Fast-Time Simulation of the Benefits of NextGen

Processes and Pontifications

Presented to: 2009 NAS Performance Workshop

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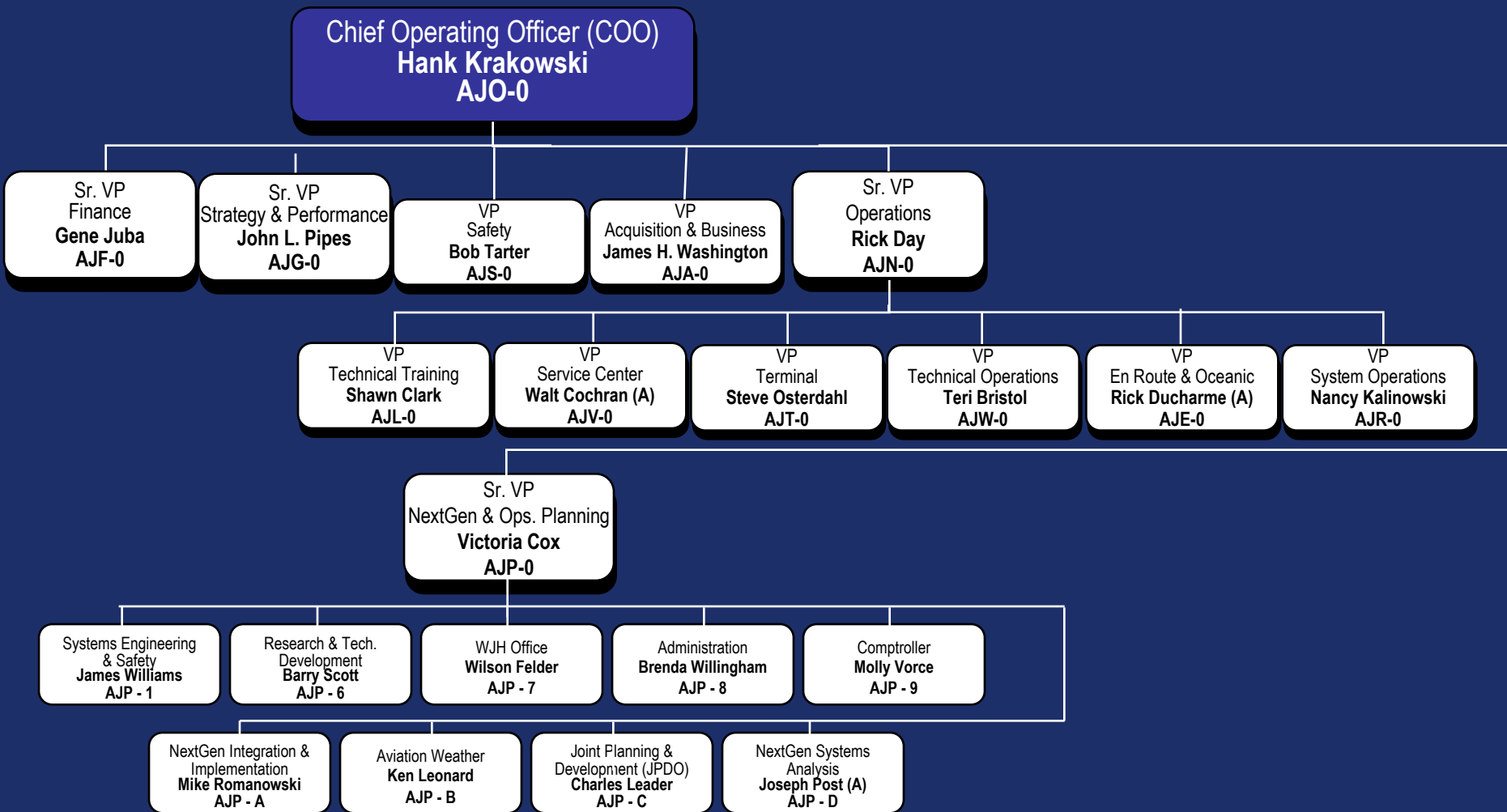
Date: April 15 2009



Federal Aviation
Administration



ATO Organizational Context



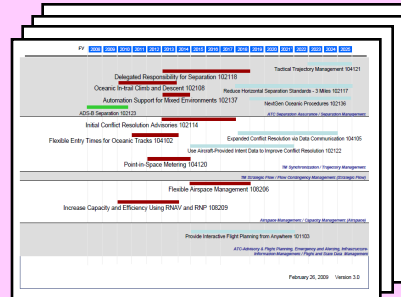
FAA NextGen Portfolio

7

Solution Sets

TBO
High Density Airports
Flexible Terminal & Airports
CATM
Reduced Weather Impact
Safety, Security, & Environ.
Transform Facilities

41 Mid-Term Capabilities



Transformational Programs

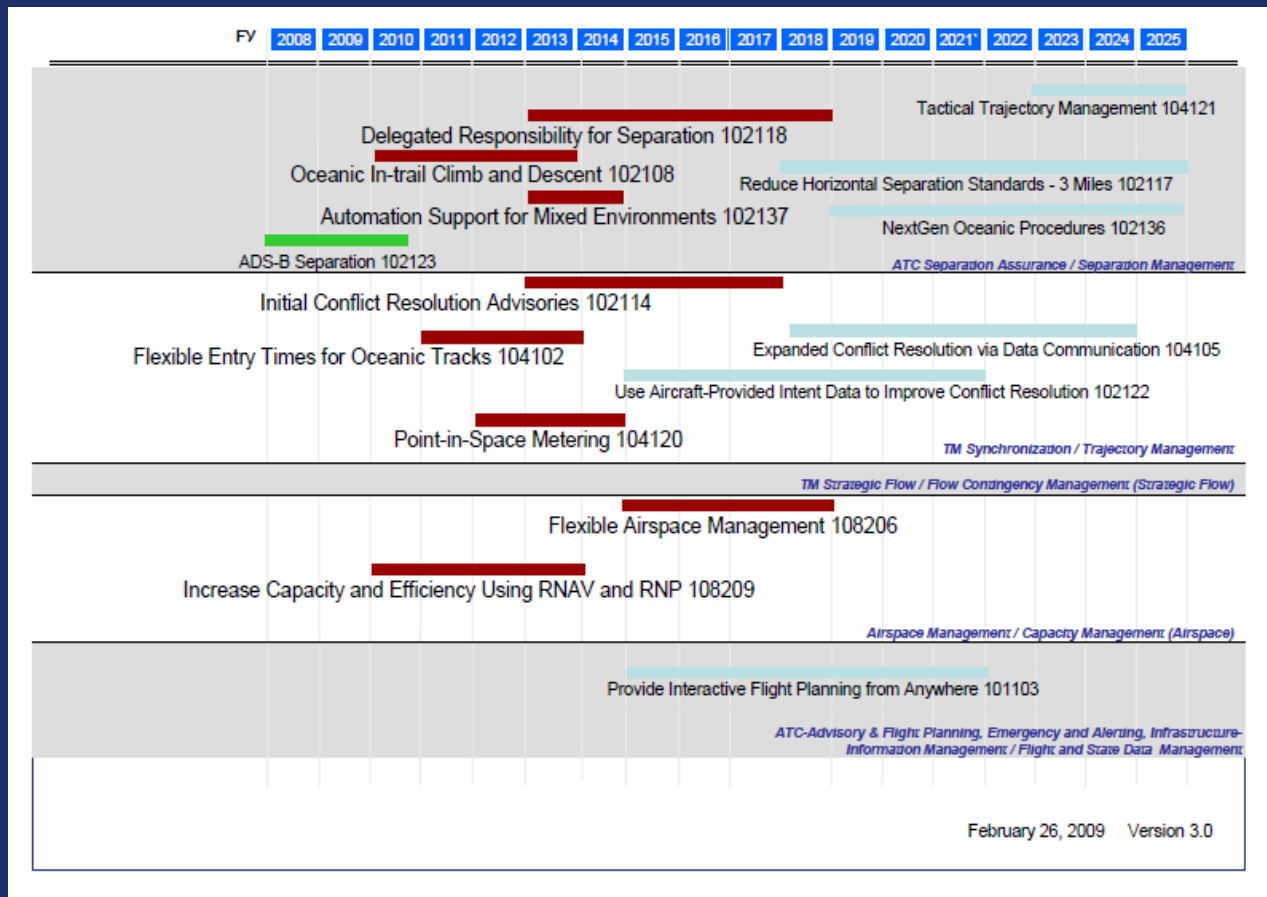
ADS-B
SWIM
NextGen Data Communications
NextGen Network Enabled Weather
NAS Voice Switch
RNAV/RNP

Airfield Improvements

New Runways
Runway Extensions
Airfield Reconfigurations

Example: TBO

Initiate Trajectory-Based Operations



PROCESSES



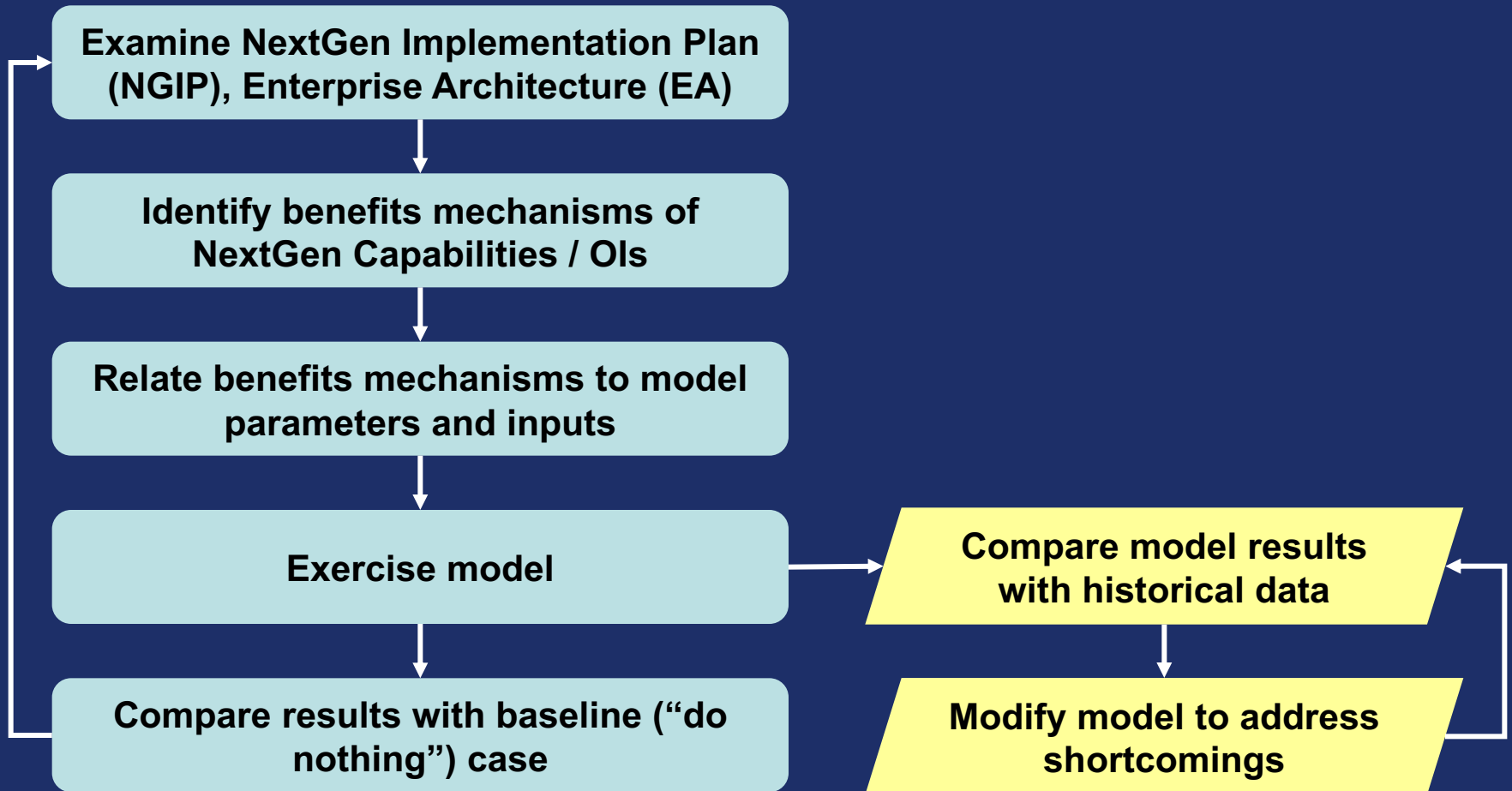
NextGen Portfolio Modeling

Objective: To develop a modeling environment that can be used for NextGen trade studies and investment decision-making

- **Estimates the operational benefits of NextGen improvements**
- **National in scope**
 - Uses FAA NAS-wide simulation environment
- **Fully-integrated model accounting for interaction effects**
- **NextGen "capability" and airport runway focus**
 - Capital programs implied
- **Ten year projection**
- **Incorporates latest APO operations & fleet forecasts**
- **Builds on more detailed capability-level analyses**
- **Continuous validation and refinement**

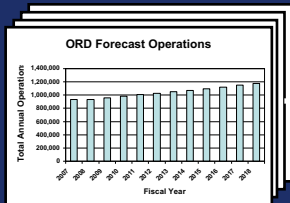


Analytical Process



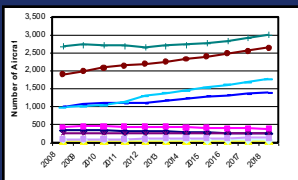
Modeling Framework

Operations Forecast

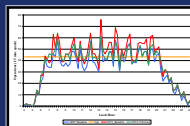


ETMS Data

Fleet Forecast



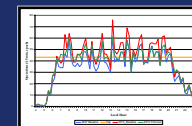
Unconstrained Schedules



Future Schedule Generator

Industry/Regulator Response

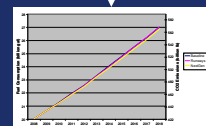
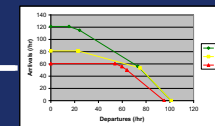
Constrained Schedules



Aircraft Performance

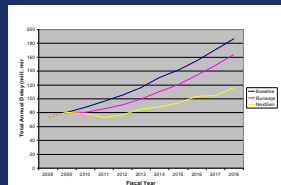
Trajectory Model

Airport Capacities



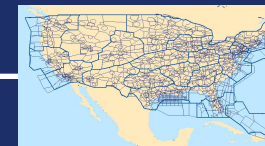
Fuel Burn

Delay



Queuing Model

Sector Capacities



Metrics

- **Flights accommodated**
 - NextGen allows more operations at capacity-constrained airports
- **Delay**
 - Gate push-back
 - Departure runway/fix queuing
 - Sector queuing
 - Arrival fix/runway queuing
- **Fuel Burn**
 - Origin to Destination
 - US airspace
- **CO₂**
 - Jet A savings converted to CO₂ using multiplier of 21.095 lb/gal



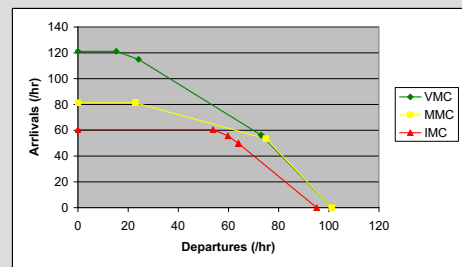
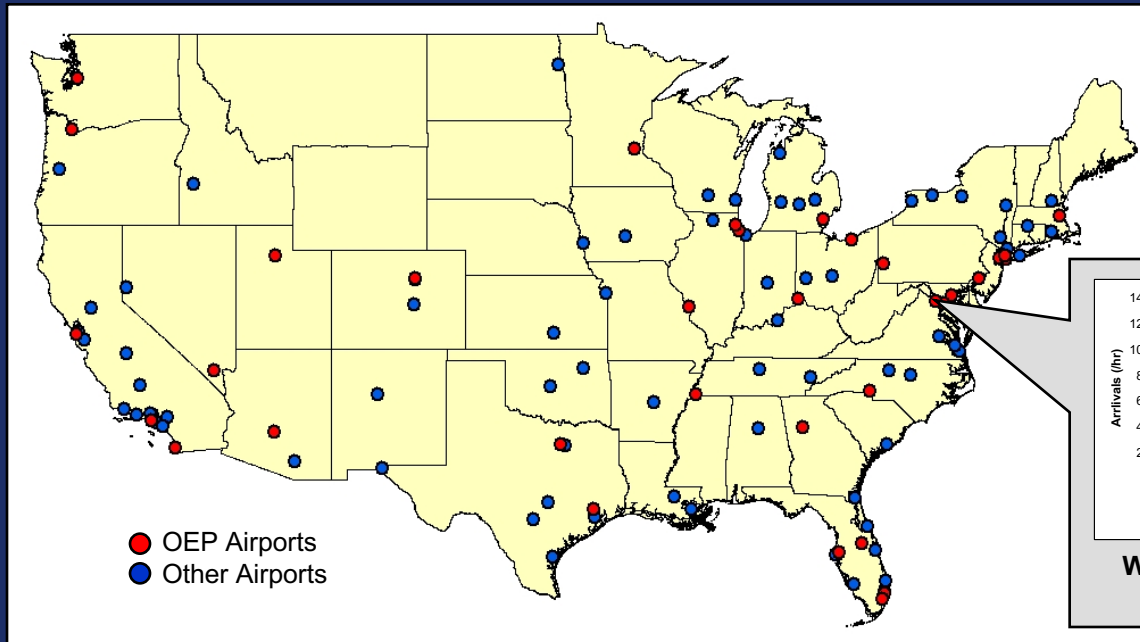
Experiment Design

Three cases typically examined:

1. "Do nothing"
 - 2007 airport capacities, technologies, and procedures
2. "Concrete Only"
 - New runways, runway extensions, and airport configurations included as they are projected to occur
3. NextGen \equiv Concrete + ATM Improvements
 - New runways, runway extensions, and airport configurations included as they are projected to occur
 - NextGen technologies and procedures also included

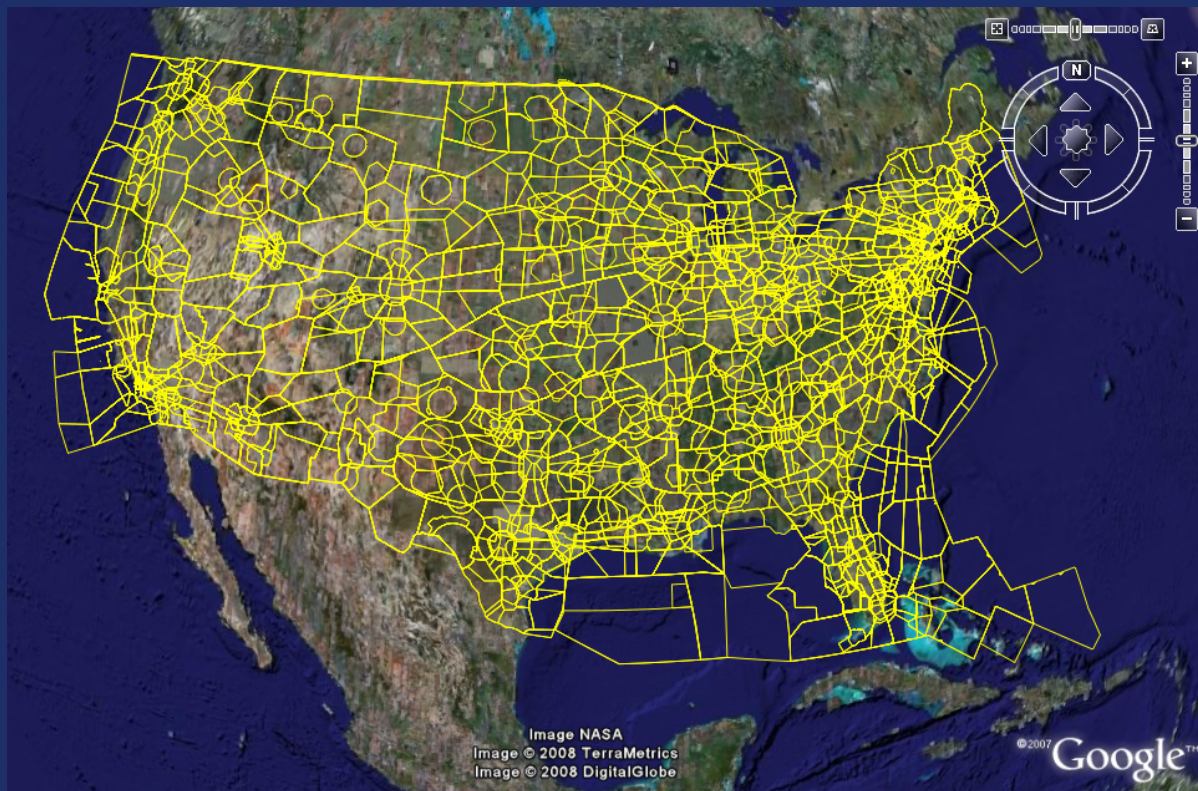
Airports Represented in NASPAC

- Arrival/departure capacities for 110 airports
 - All other airports assumed to have infinite capacity
- VFR traffic included at subset of 73 airports
- NextGen procedural/technological improvements at OEP 35 airports

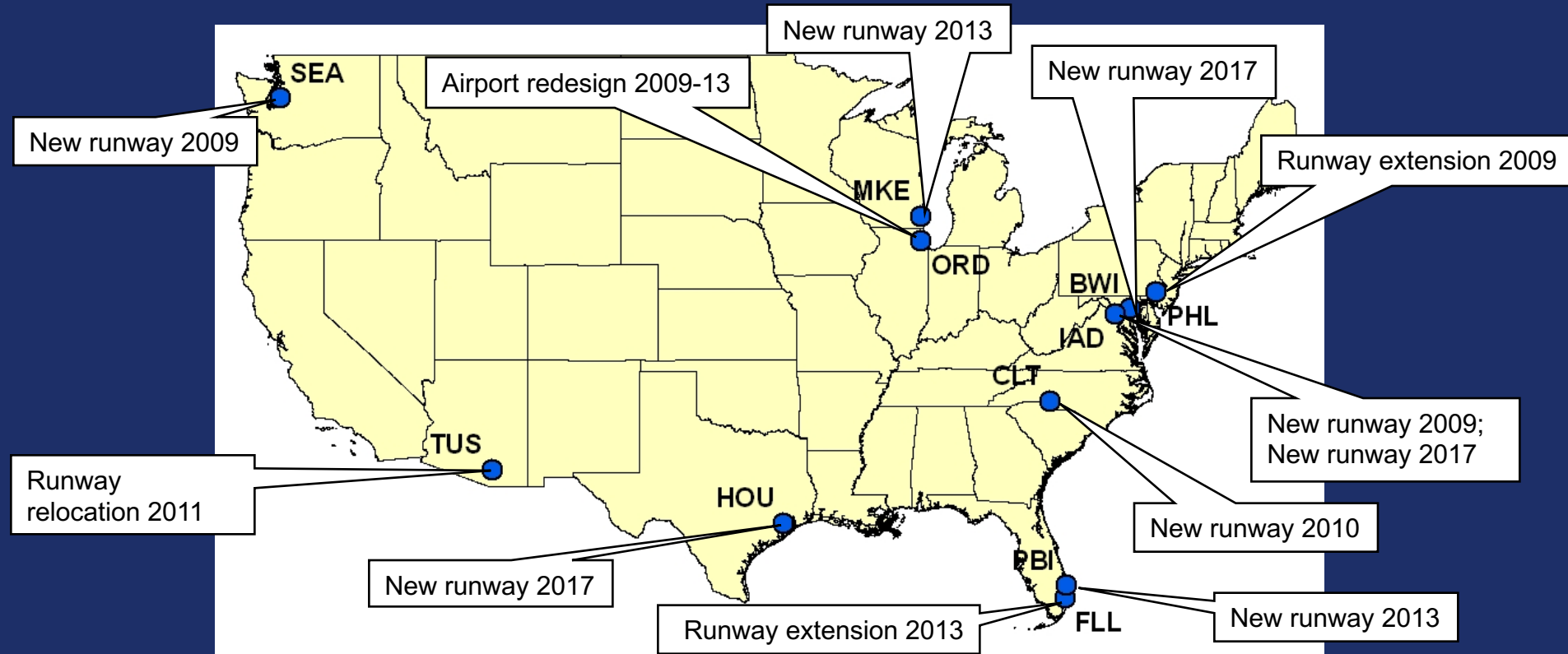


Airspace Modeled

- All IFR flights in US airspace
- 939 airspace elements "capacitated"



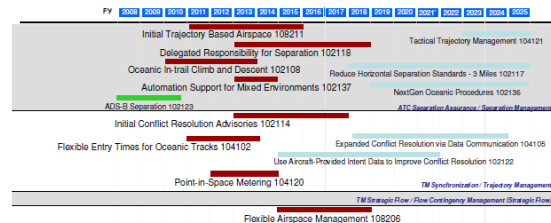
Runway Project Assumptions



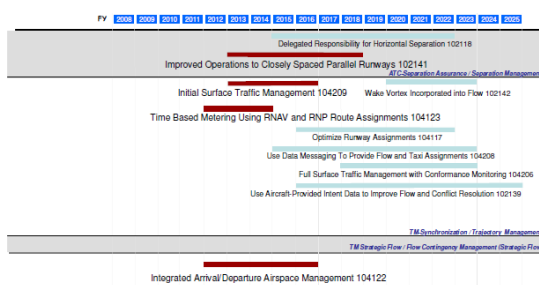
Airport improvement assumed to take effect the first full year following that indicated.
AJP makes no claims about the need for, or benefits of, these projects.

NextGen Improvements

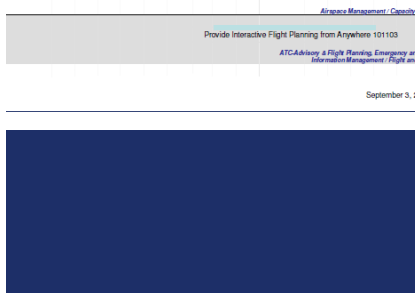
Initiate Trajectory-Based Operations



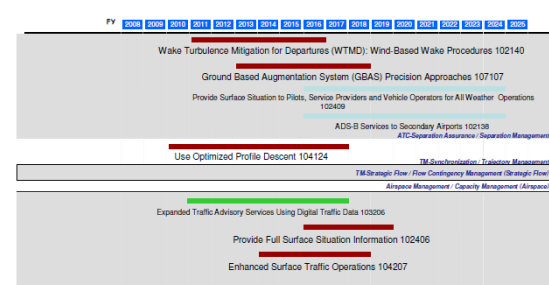
Increase Arrivals/Departures at High Density Airports



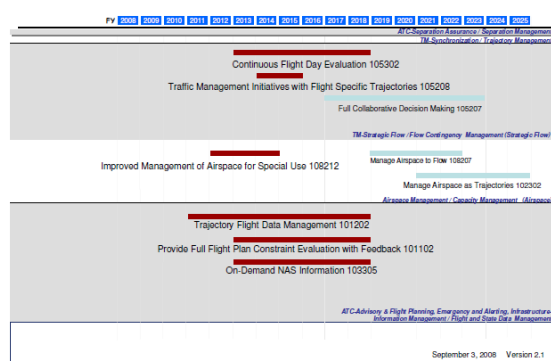
Increase Capacity and Efficiency Using RNAV and RNP 108209



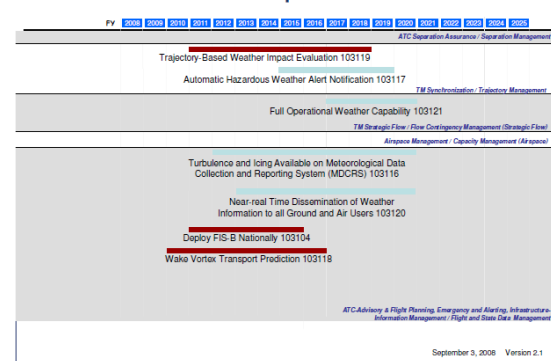
Increase Flexibility in the Terminal Environment



Improve Collaborative ATM

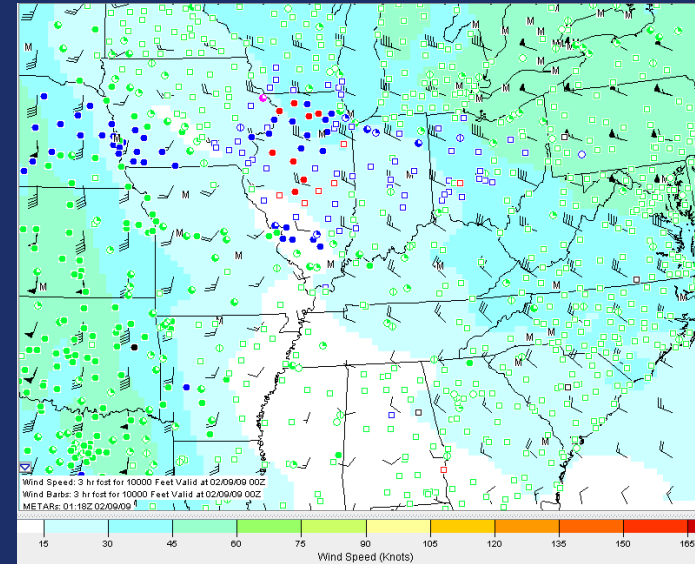


Reduce Weather Impact



Demand and Weather

- **Historical traffic and weather data used to generate future scenarios**
 - Sufficient number and scope of historical days needed for accurate annualization of effects
- **Variables to consider**
 - Traffic (i.e., demand)
 - Weekly, seasonal, and regional variation
 - Weather
 - Surface weather (ceiling, visibility), convective weather, winds, etc.
- **Eight days used to represent year**
 - High demand (weekday), low demand (weekend)
 - Four seasons



Sources of Uncertainty

- **Modeling limitations**
 - Airport capacities
 - Arrival/departure fix constraints & TRACONs
 - Traffic Flow Management (TFM)
 - Controller workload and sector capacity
 - Weather effects
 - Etc.
- **Demand forecasting**
 - Economic growth
 - Operator response
 - Route network
 - Scheduling
 - Fleet evolution
 - Mergers and acquisitions
- **NextGen Capabilities**
 - Schedule
 - Effectiveness
 - Equipage



Typical Test Matrix

	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18
10/19/2006	●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
12/10/2006	●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
1/21/2007	●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
3/15/2007	●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
4/19/2007	●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
6/23/2007	●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
8/18/2007	●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
8/30/2007	●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●

↑
Seed Year

- No runway or ATM enhancements
- New runways only
- New runways and ATM enhancements

8 days
x 11 years
x 3 treatments

264 model runs

NextGen Modeling Next Steps

- **Regular annual update**
 - Jan. 2009 traffic forecast
 - New fleet forecast
 - Review airport infrastructure assumptions
 - New NextGen Implementation Plan
- **Model enhancements**
 - Improved airport capacities
 - Accommodate multiple airport configurations
 - Update capacities for “next 30” airports
 - Local airfield weather effects
 - Revised itinerary algorithm and input data distributions
 - GDP function
 - En route weather
 - Other improvements?
 - Arrival/departure fix constraints
 - Airspace capacity models
 - Sectors, TRACONs
 - Improve trajectory module
 - STARs, DPs, fuel burn
 - Oceanic constraints

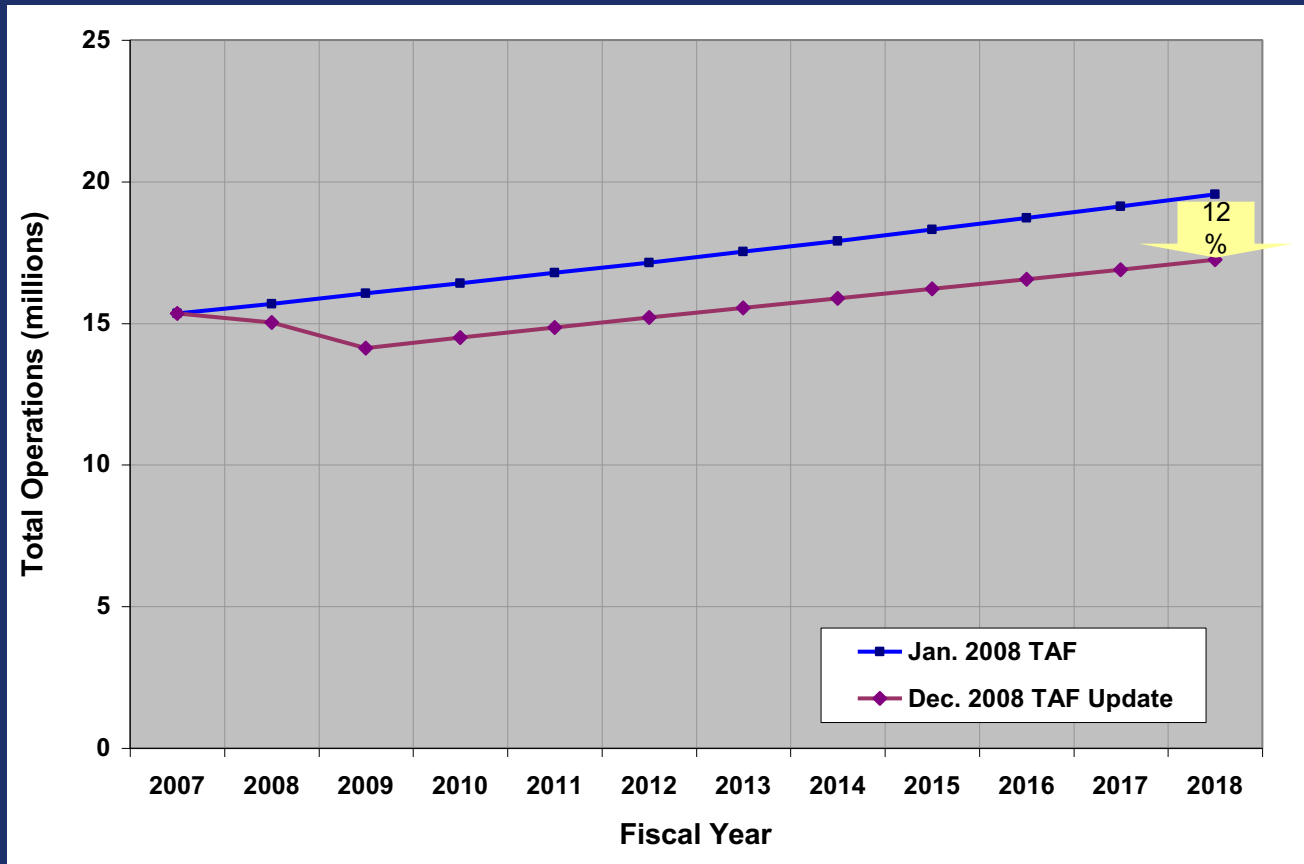


Pontifications



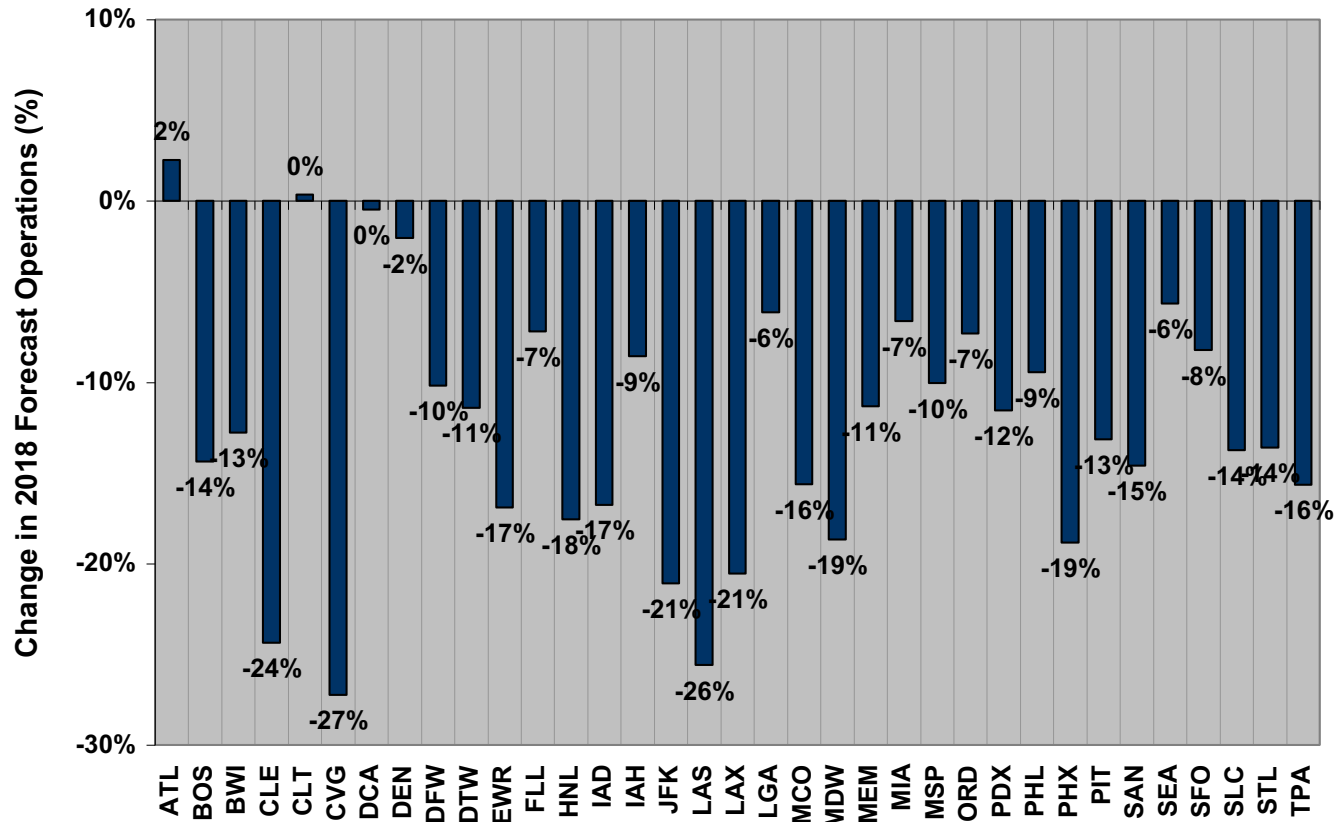
Changing Traffic Forecasts (1 of 2)

Forecast Operations at OEP 35 Airports

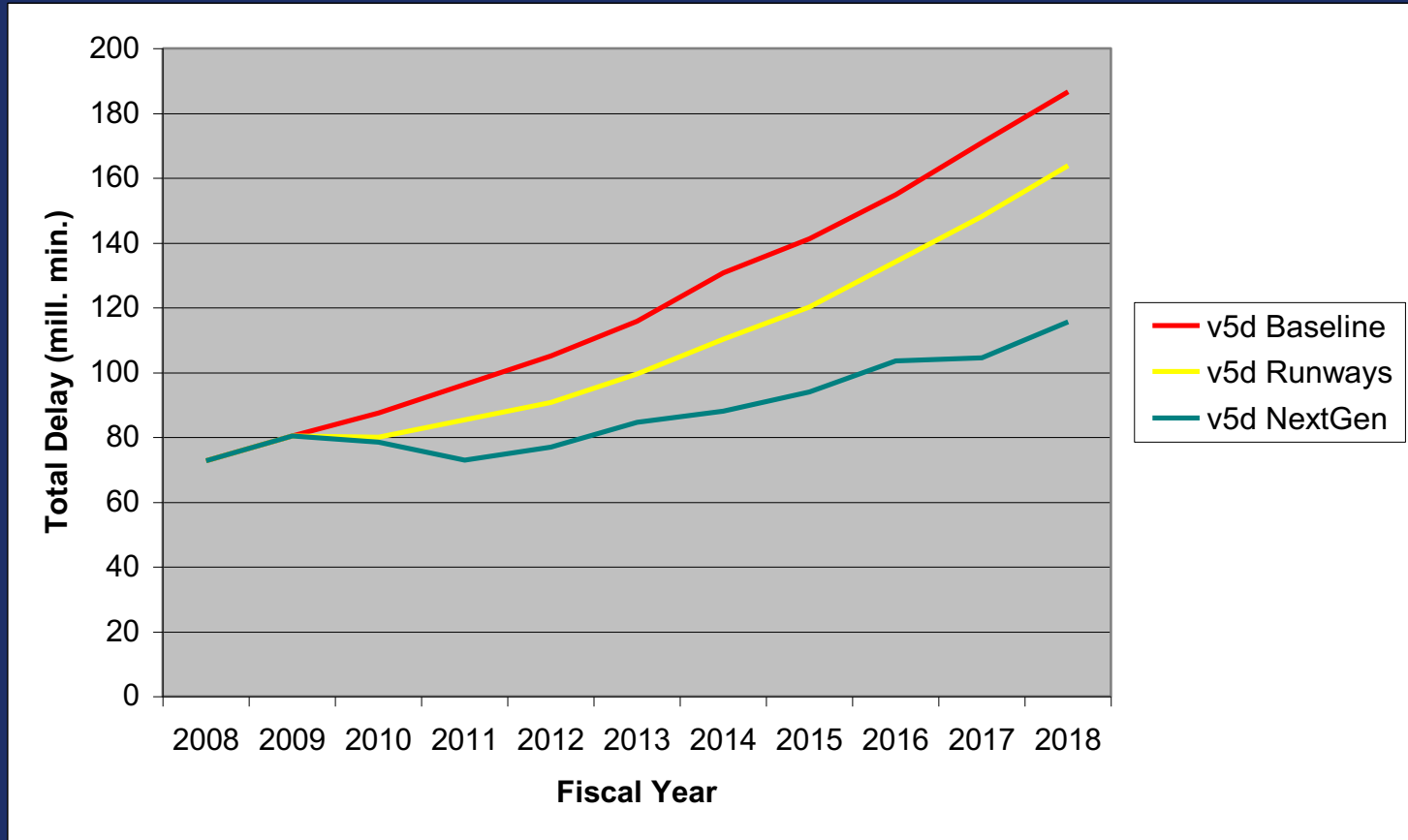


Changing Traffic Forecasts (2 of 2)

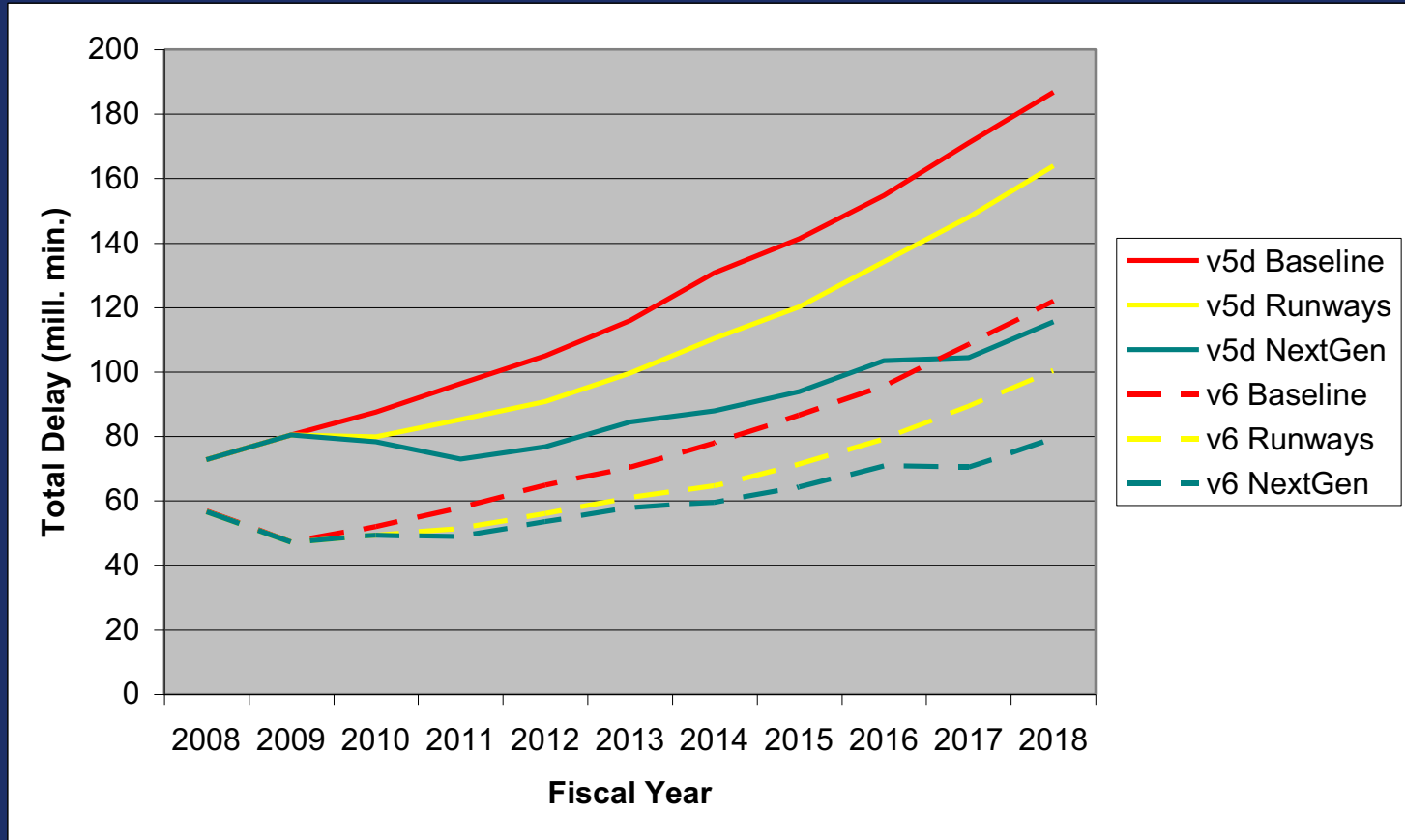
Change in Forecast Operations, OEP 35 Airports



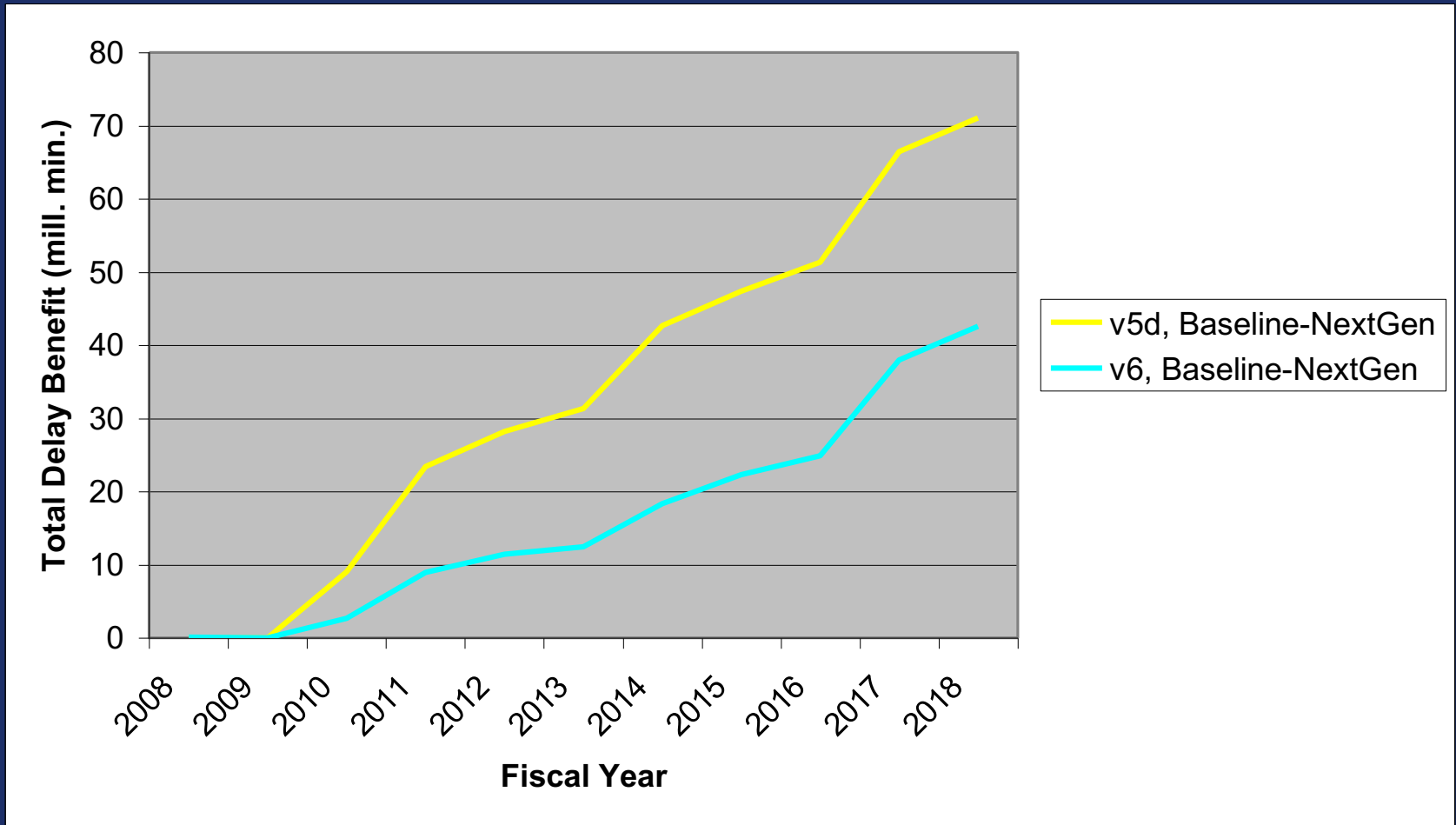
Delay Projections, Jan. 2008 TAF



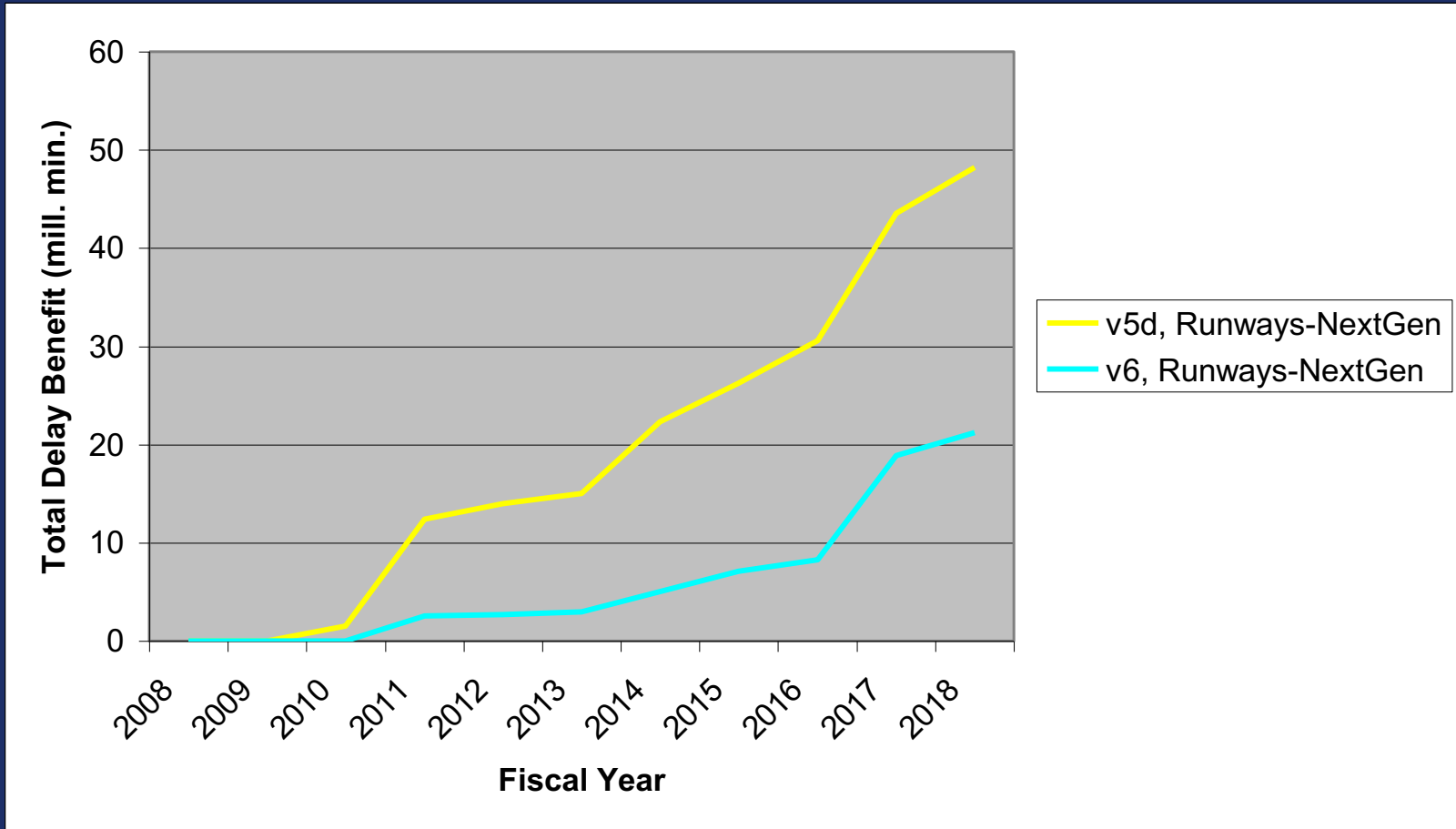
Delay Projections, Dec. 2008 TAF



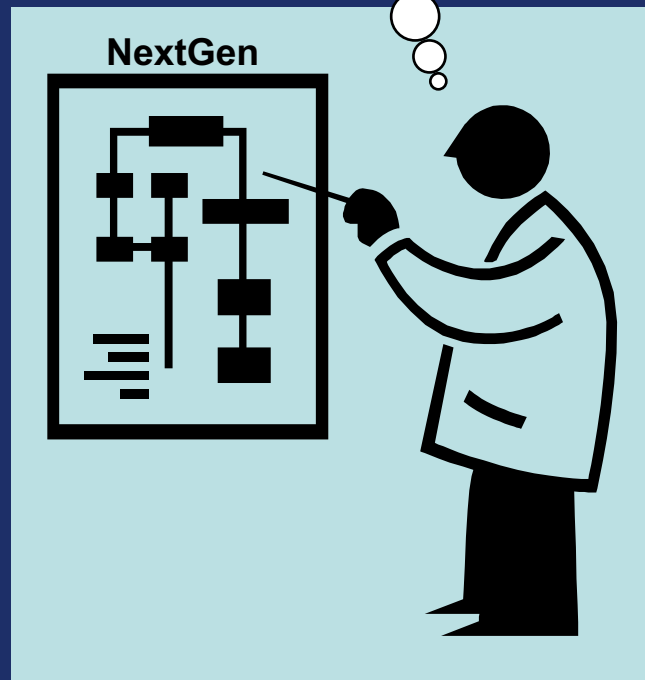
NextGen Delay Benefit (1 of 2)



NextGen Delay Benefit (2 of 2)



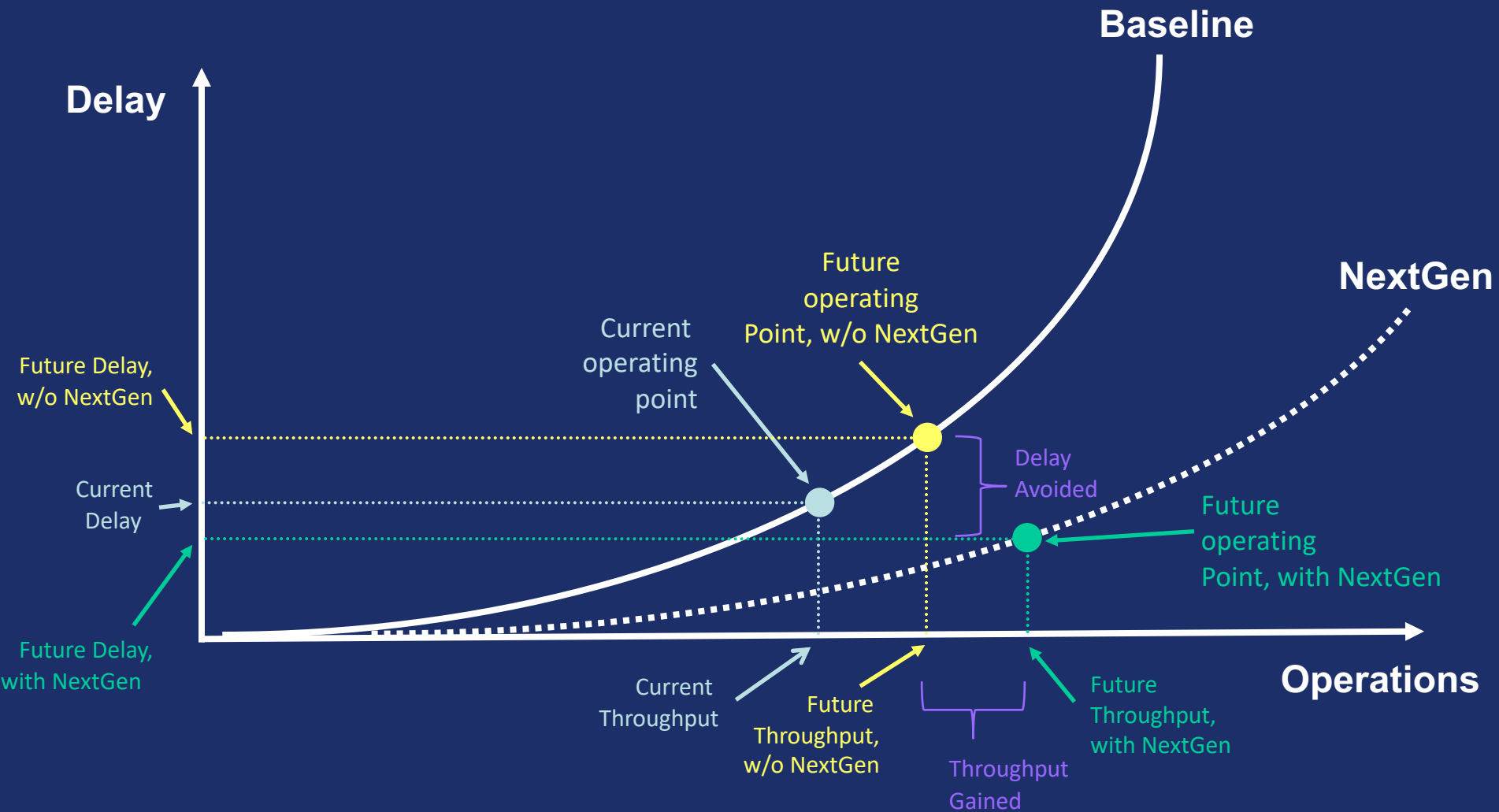
If we can't model
the current system,
how can we model
this thing?



Back-up Slides



Throughput and Delay



Modeling Framework

