CNS/ATM
Preserving Airline Opportunity

Captain Russ Chew

American Airlines

C/AFT Goal

Establish a common economic foundation and focus for justifying transition to CNS/ATM

C/AFT Objectives

- Identify commonality from global CNS/ATM plans.
- Define transitional steps and operating concepts to facilitate cost/benefit analysis.
- Determine the value of CNS/ATM plans to the major commercial aviation stakeholders.
- Establish a common economic basis for all stakeholders to justify their respective capital costs.
- Use economic output to provide feedback to regional CNS/ATM transition plans.

The Cost/Benefit Challenge

- Traditional Cost/Benefit Analysis is Difficult
  - Compound assumptions required for end state
  - Plans lack transition path and operating concepts
  - Needs more detail for cost, benefit, and safety analysis
- Previous Cost/Benefit Efforts
  - Overlapping and fragmented benefit studies
  - Questionable financial credibility
  - Benefits sometimes inappropriately added
- Government Capital Plan Uncertainties
  - Threatens ATC provider commitments
  - Higher risks makes capital commitments difficult

Airline Capital Justification

- Return on Investment
- Cost Avoidance
- Competitive Position
- Non-cooperative Regulatory Mandate

Return on Investment

- Based on competing for capital
- Requirements driven by uncertainties
  - ATC provider infrastructure commitment
- High hurdle rates
- High discount rates
- Short term pay-back
- Current examples
  - Pacific/Far East Russia CNS/ATM
  - U.S. Terminal RNAV

Cost Avoidance

- Based on potential future costs
- Must establish future scenario assumptions
- Highly dependent on the probability of outcome
- Current examples
  - North Atlantic RVSM
  - Pacific RNP-10

Competitive Position

- Based on protecting market share
- Projections of impact to revenue
- Current examples
  - Cabin Entertainment Systems
  - Cabin Satellite Phone Systems

Justifying CNS/ATM

- Cost Avoidance and Competitive Position Basis
  - Major, longer term infrastructure changes
  - First steps may require major capital investment in long term transitional strategies
  - Improve probability and risk by minimizing assumptions
  - Understand competitive position sensitivities
  - Relate to avionics and aircraft life cycles
- Return on Investment Basis
  - A widely accepted capital justification standard
  - May be useful for incremental operational enhancements

AA NAS Congestion Study

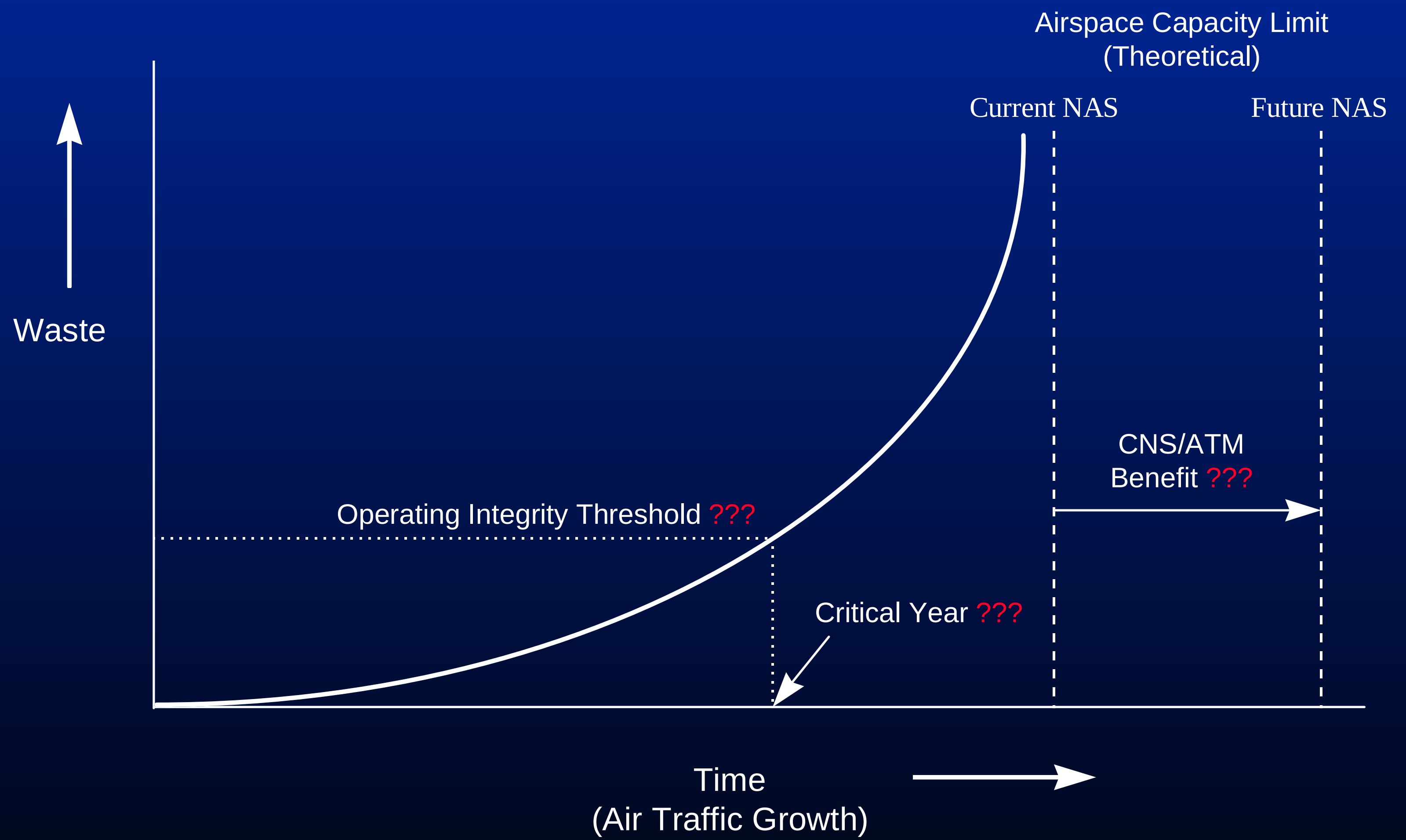
- American Airlines and AMR SABRE Group
- To understand risk to scheduled airline operations
- To estimate probability of outcome
- To complement other industry studies to date
- To estimate effects on airline schedules
  - Good VFR weather used as baseline scheduling opportunity

AA NAS Study Objectives

- Waste is delay cost and lost revenue opportunity.
  - How and when will the waste curve slope increase?
- Airspace is becoming congested.
  - When does saturation become critical?
- CNS/ATM is a long term investment.
  - How long will improvements last?
  - Is it compatible with life-cycle of new aircraft and avionics?
- We need time to implement.
  - When do we have to start?
  - How long will ATC implementation take?
  - Can we accommodate airline phase check schedules?

AA NAS Study

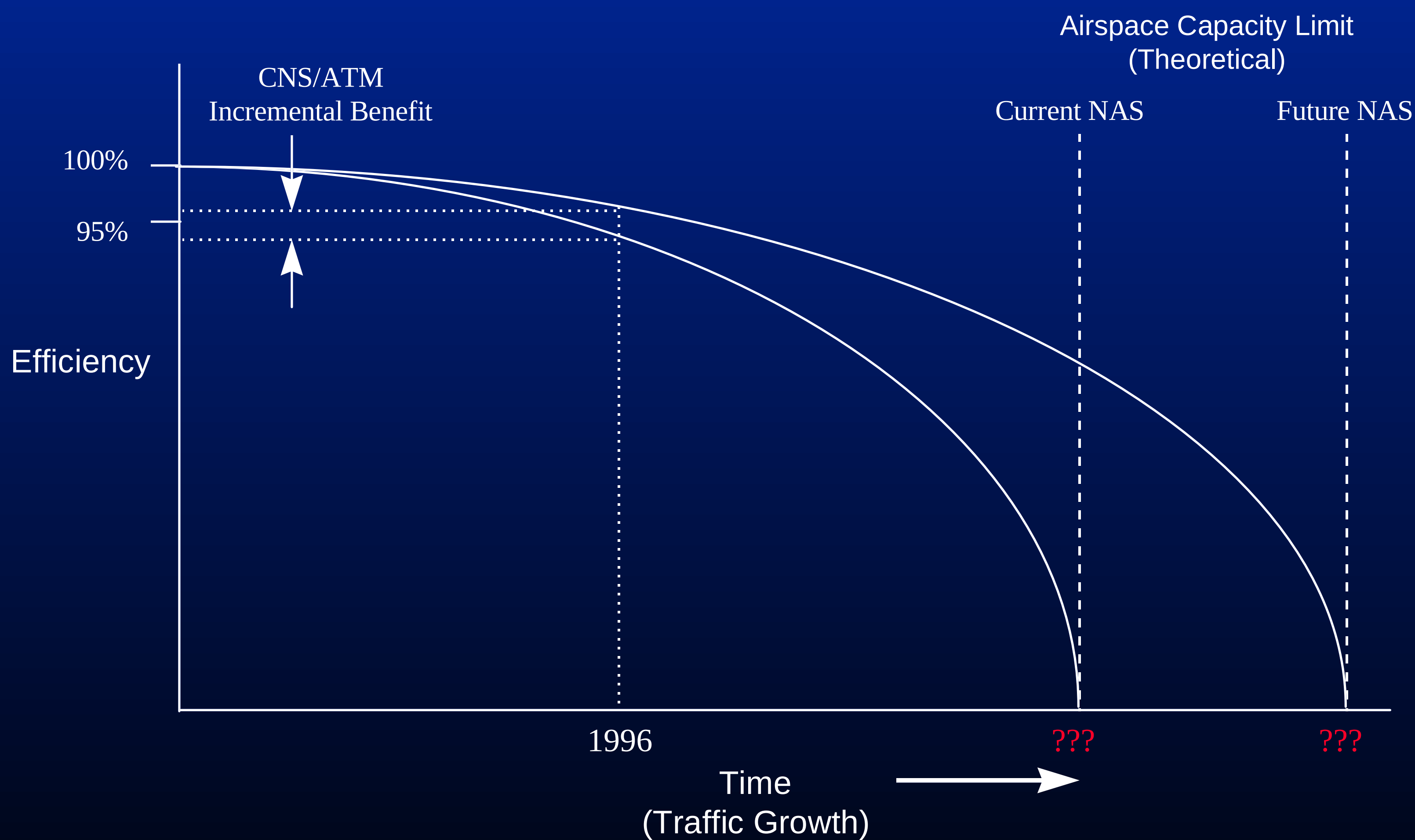
Notional Capacity Effects



CNS/ATM Focus Team

AA NAS Study

Notional Operating Efficiency Benefits



CNS/ATM Focus Team

AA NAS Study

Building a Credible Methodology

- Develop model based on present constraints
- Use accepted computer simulation platform
- Make minimal, conservative assumptions
- Validate and calibrate with actual data history
- Estimate future NAS by reducing separation

AA NAS Study

Uses Conservative Assumptions

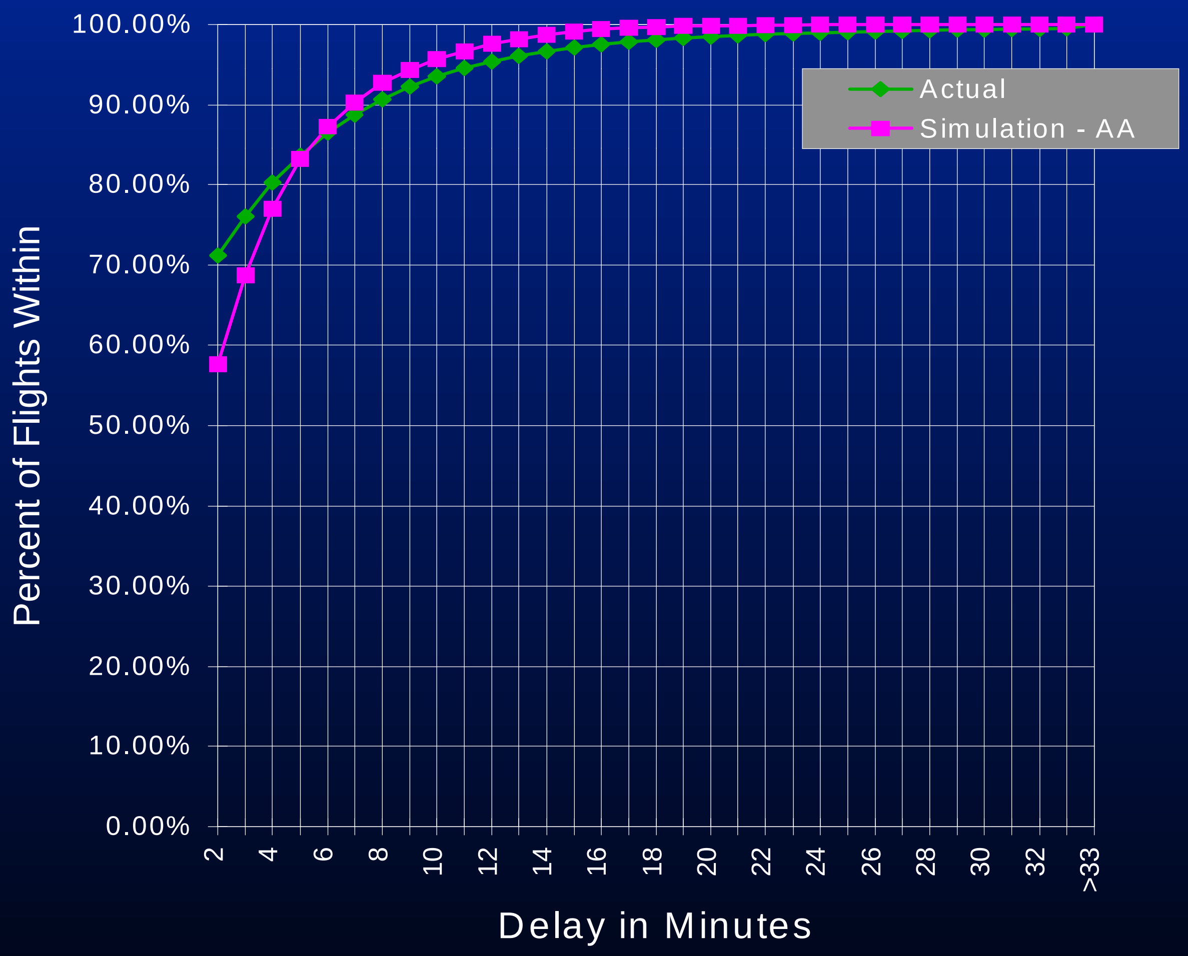
- 1996 OAG data for starting point
  - Over 18,000 flights per day
- Jet traffic between 50 busiest U.S. airports
  - Over 4,000 routes
- Annualized traffic growth of 2.3%
  - Over 4% growth in passenger enplanements
  - Consistent with FAA and Boeing 1996 Outlook estimates
- Current NAS uses observed separation standards
  - 7 nm en route, 4 nm terminal, 1.9-4.5 wake turbulence
- Future NAS projects new separation standards
  - 3 nm en route, 2 nm terminal, 1.5-2.5 wake turbulence

AA NAS Study

Validation and Calibration

- Calibrated to 1996 as the starting point
  - Simulated 1996 good VFR weather days only
  - Airline builds schedules to good VFR delay probabilities
- Validated simulation vs actual delay data
  - Regression analysis performed
  - 98% correlation for delays of 5 minutes or more
- Validated actual elapsed flight time
  - 85% of simulated flights were within 15 min of actual

AA NAS Study
Validated with Actual Delay Data

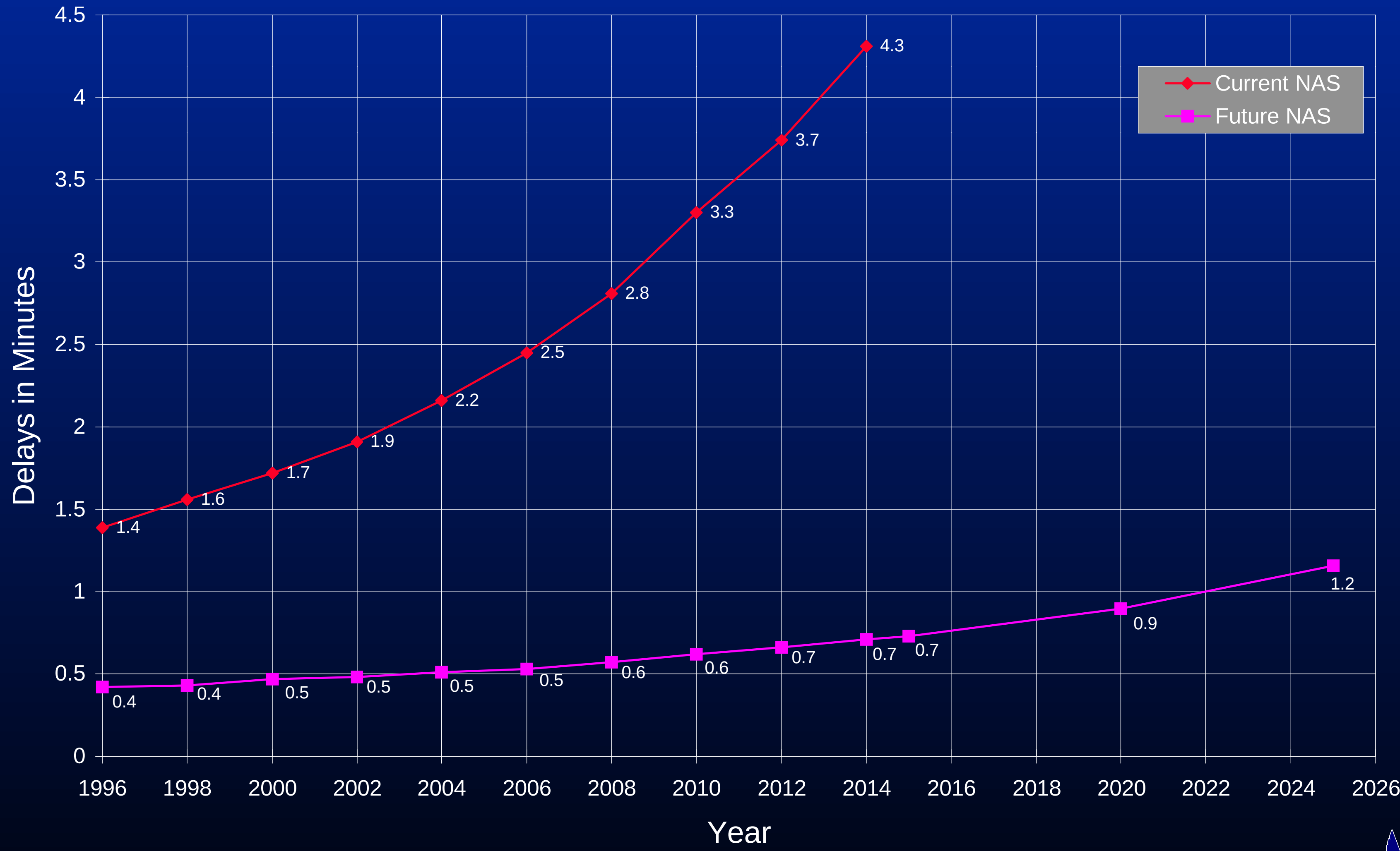


CNS/ATM Focus Team

Using AA NAS Results

- Predictable Delay from Congestion
  - Increased block time
  - Applies to individual flights
  - Increased crew costs
  - Decreased aircraft utilization
  - Lost scheduling opportunity and revenue
- Unpredictable Delay from Congestion
  - Increased variance
  - Applicable to all flights within a region
  - Reduced operating integrity
  - Cumulative effects worsen over time
  - Lost scheduling opportunity and revenue

AA NAS Study Results
Average Air Delay Per Flight

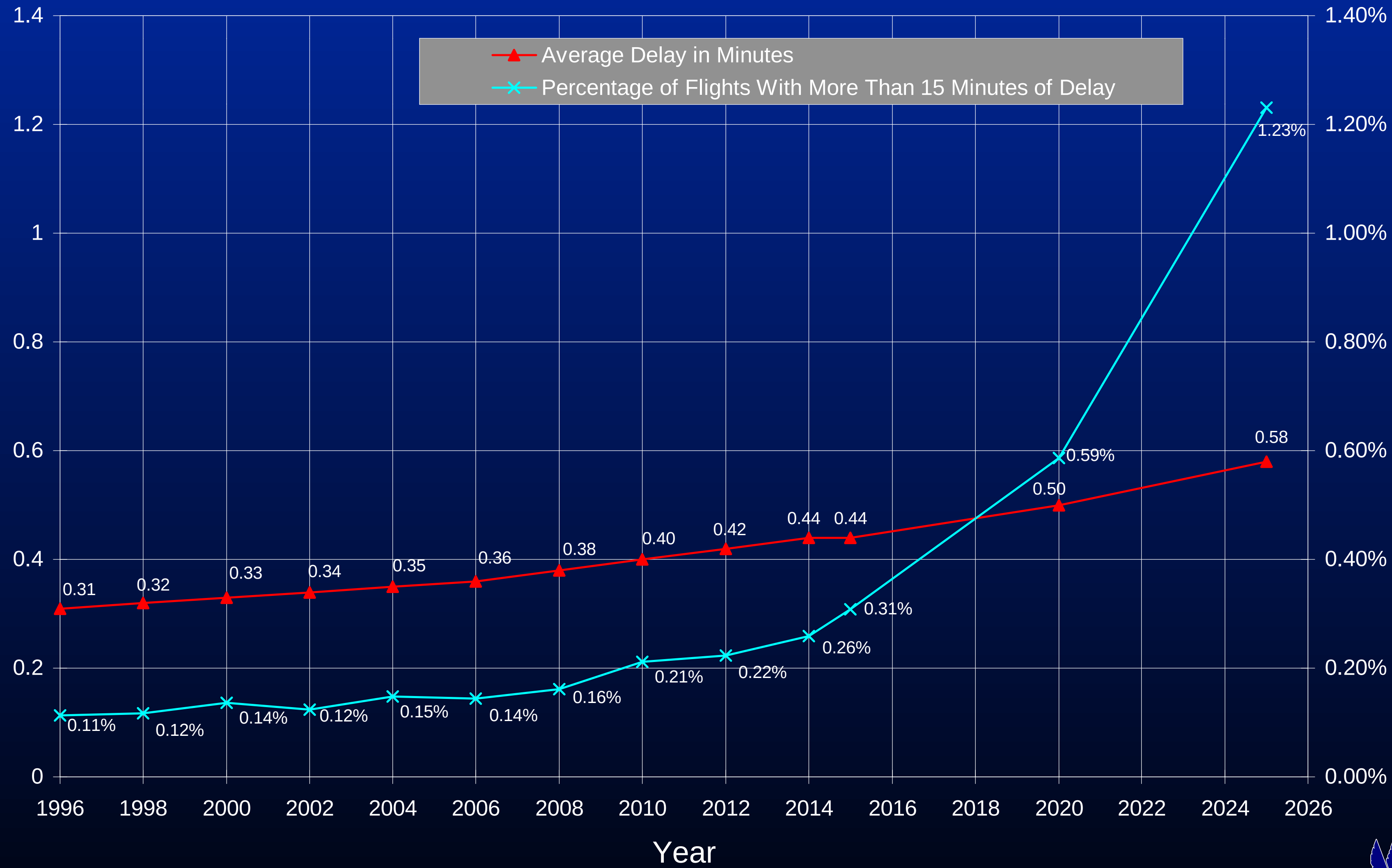


CNS/ATM Focus Team

AA NAS Study Results
Current NAS - Delay Variance and Minutes

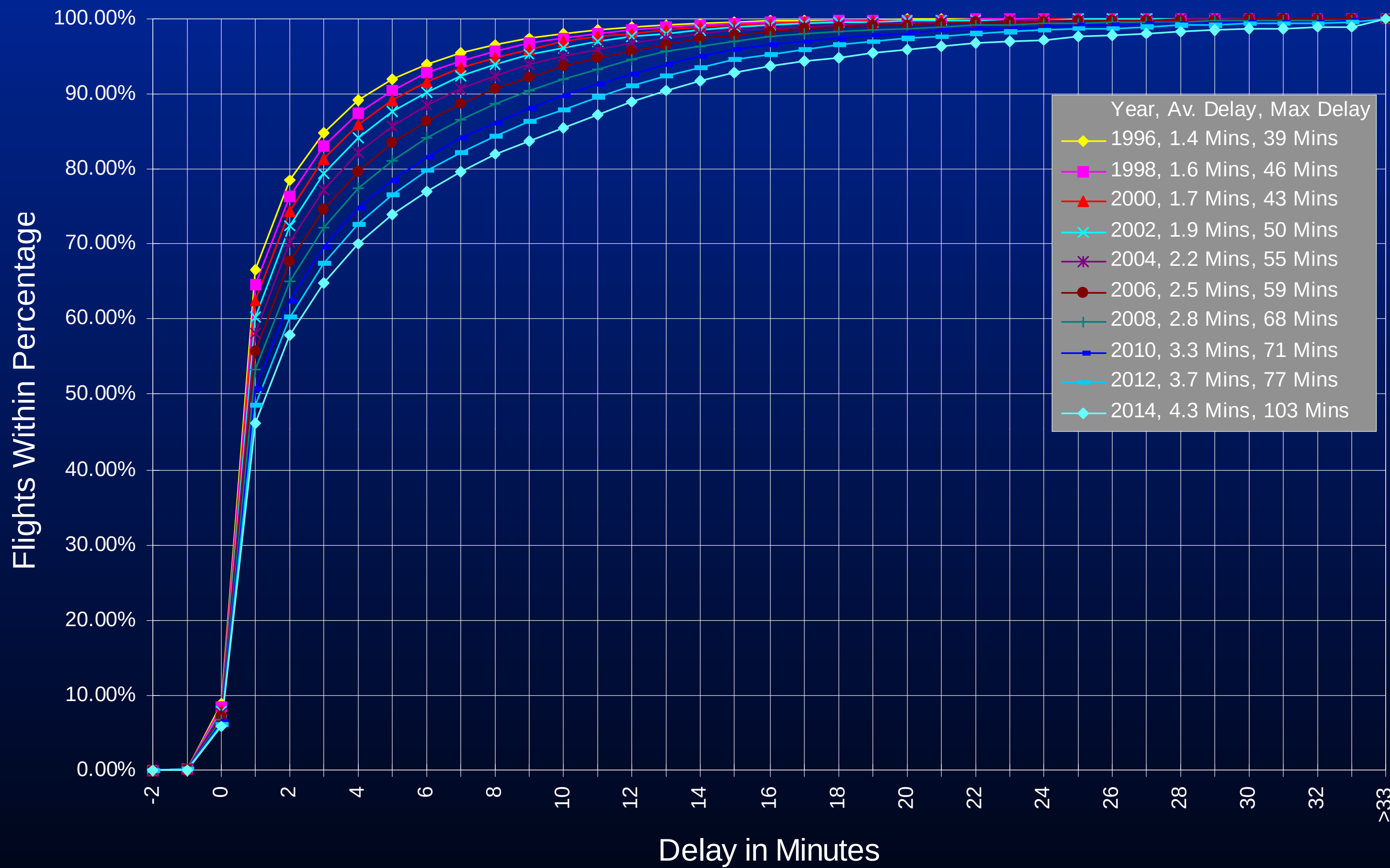
CNS/ATM Focus Team

AA NAS Study Results
Future NAS - Delay Variance and Minutes



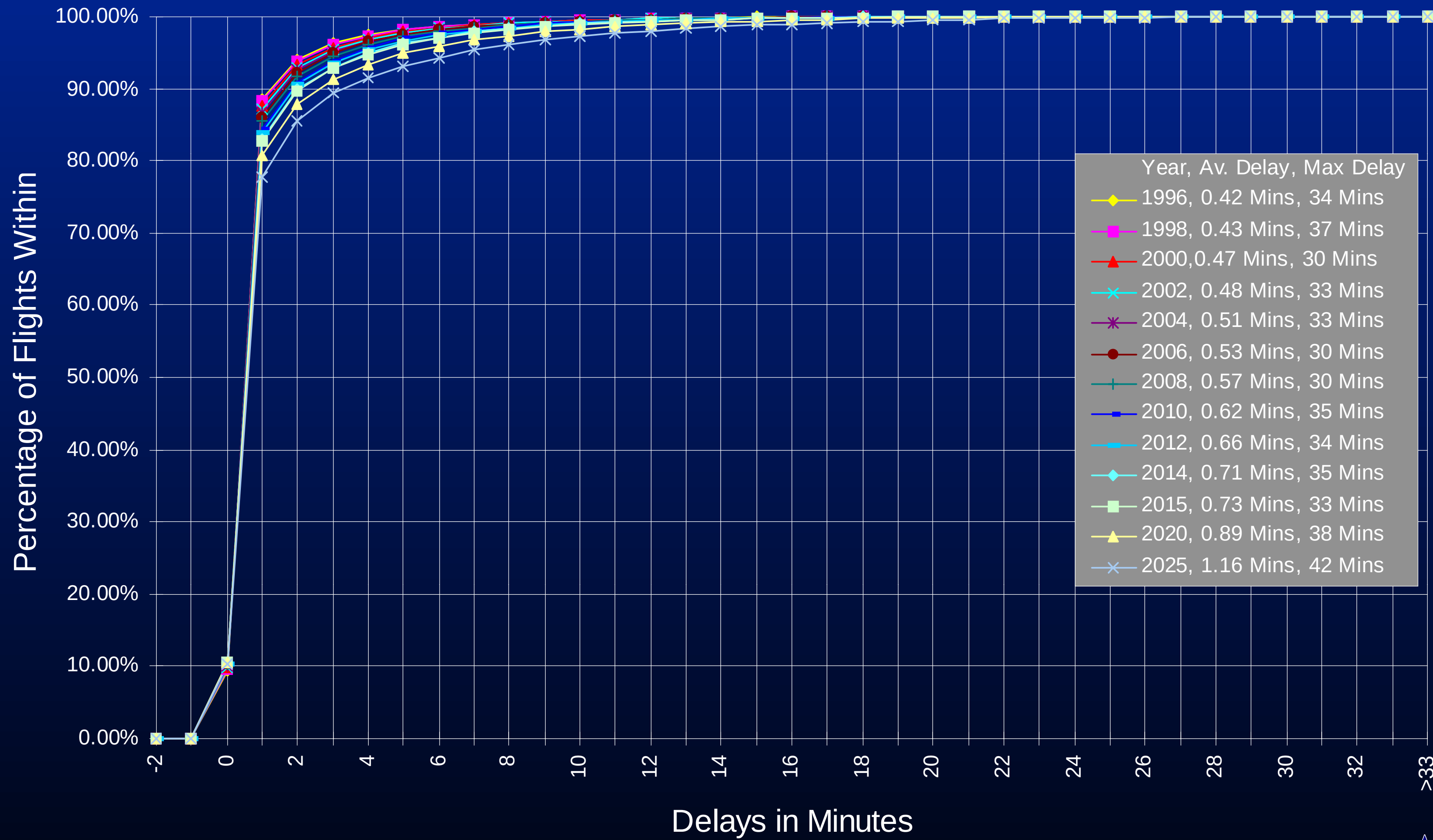
CNS/ATM Focus Team

AA NAS Study Results
Current NAS - Cumulative Probability of Delay



CNS/ATM Focus Team

AA NAS Study Results
Future NAS - Cumulative Probability of Delay



CNS/ATM Focus Team

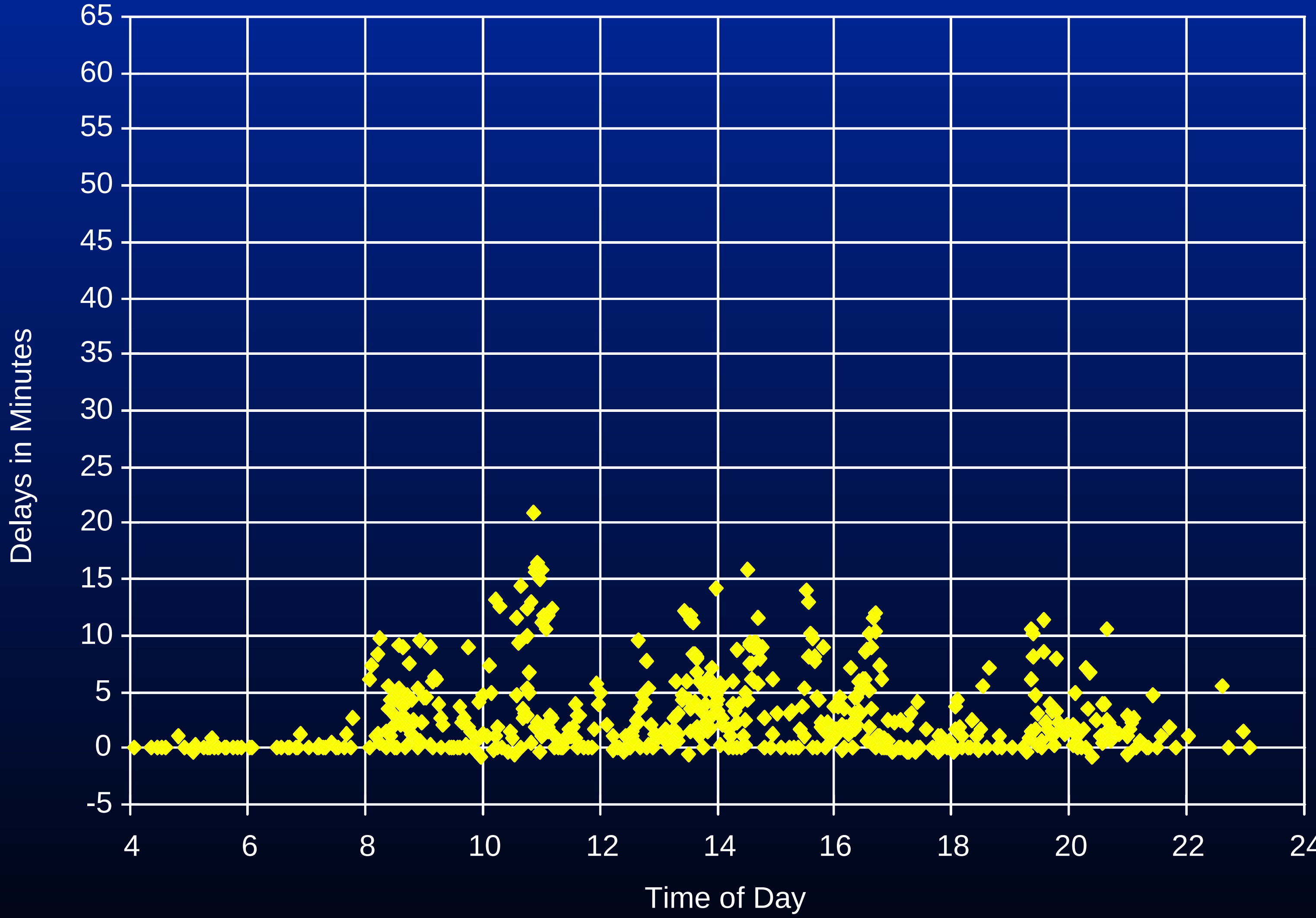
AA NAS Study Results
Estimated Departure Runway Queue

CNS/ATM Focus Team

Understanding "Average Delay"

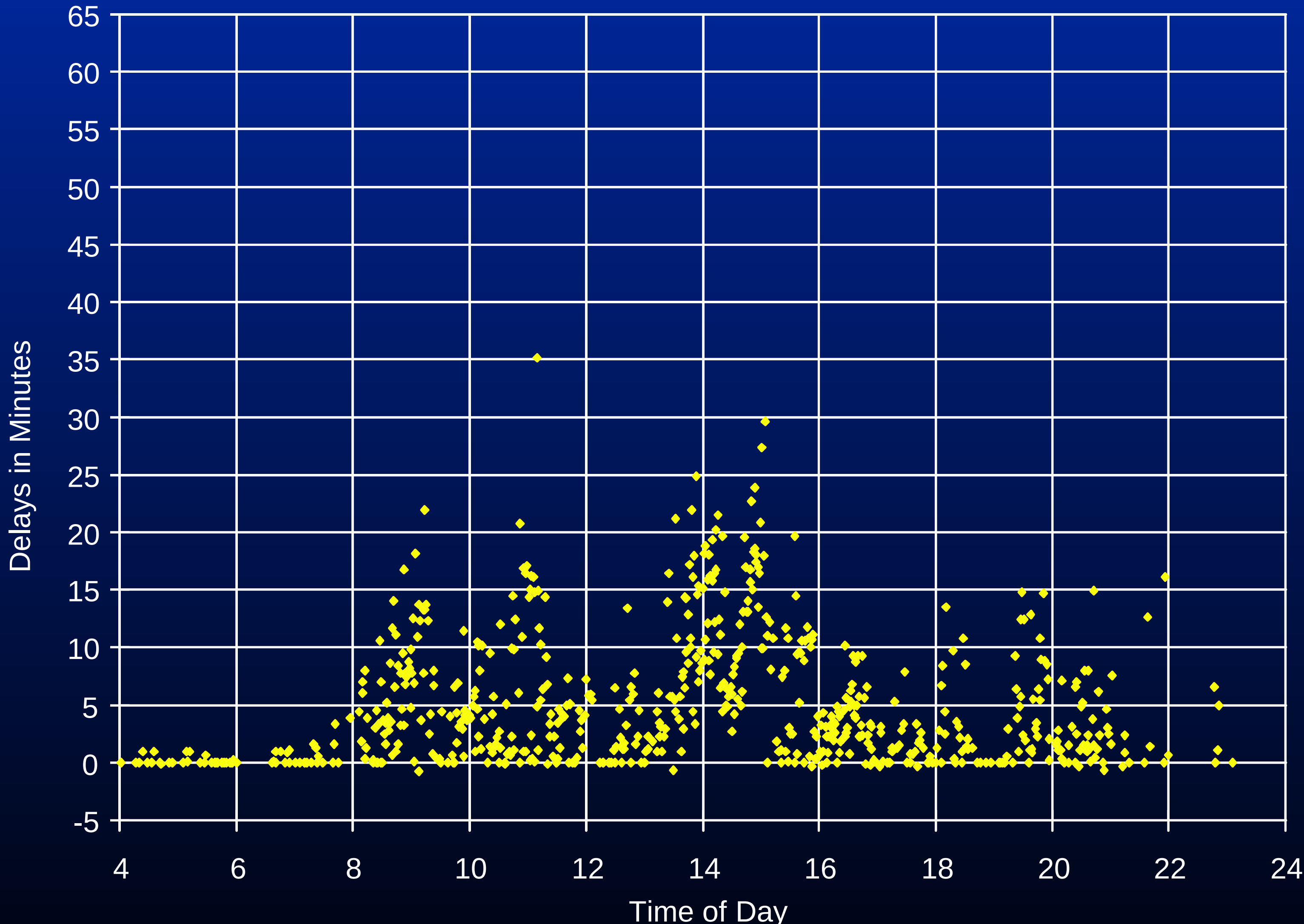
- Expect higher averages at busier airports
  - Expect 2 to 3 times the average delay
  - Expect greater variance with higher averages
- Expect greater variance in already congested areas
  - Northeast "Triangle" Regions
  - Southeast and Southwest Regions
  - Further study under consideration at this time
- Other factors will increase variance from average
  - Incidence of IFR weather conditions
    - U.S. airlines build schedules to VFR standards
  - Taxiway configuration and detail
  - Further study not under consideration at this time

AA NAS Study
Arrival Dependability - 4.1 Minutes Avg Delay



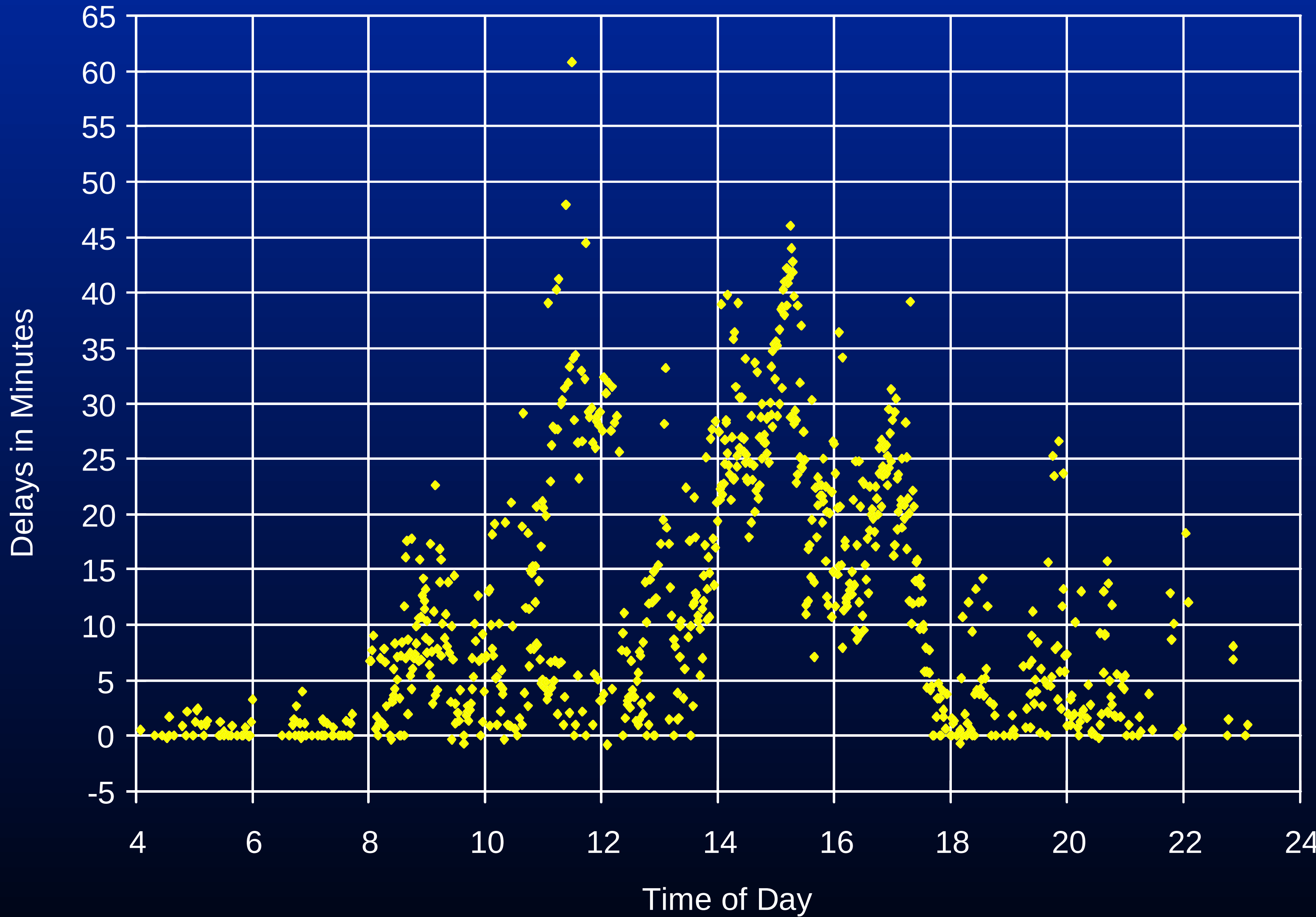
CNS/ATM Focus Team

AA NAS Study
Arrival Dependability - 7.0 Minutes Avg Delay



CNS/ATM Focus Team

AA NAS Study
Arrival Dependability - 13 Minutes Avg Delay



CNS/ATM Focus Team

Summary of Results

- Current NAS problems are real
  - With conservative traffic growth projections, traffic delays from congestion of U.S. domestic airspace will increase at an accelerating rate.
  - Delay variance will increase at an even faster rate.
  - Airspace delays will dramatically constrain airline operations and scheduling opportunities in the next decade.
- Future NAS Solution is possible
  - CNS/ATM can significantly extend NAS capacity, even without new arrival runways.
  - More departure runways will eventually be needed.

Answers and Conclusions

- How and when will the waste curve slope increase?
  – It has already started and will continue to accelerate.
- When does saturation become critical?
  – Major operating constraints will be apparent by 2005.
- How long will CNS/ATM improvements last?
  – Estimated to extend current conditions by 25+ years.
  – Compatible with life-cycle of new aircraft and avionics.
- When do we have to start?
  – Now.
  – ATC infrastructure changes by 2005 is optimistic.
  – An incremental approach to improvements is necessary.
  – Airline phase check schedules can be accommodated.

Where do we go from here?

- We must continue to make progress.
- Preserving our ability to meet the future demand for air travel is essential for sustaining economic growth.
- Long term economic justification for CNS/ATM projects is possible if a common transition path is defined and probability of outcome is improved.
- Ongoing data collection and airspace studies will be needed for stakeholders to justify large capital commitments for aircraft and airspace improvements.

Consensus Required

- We must "agree to agree" to make progress.
- We must move ahead with incremental global infrastructure standards and improvements, allowing validation and experience guide us along the way.
- All airlines and stakeholders must actively support existing government/industry collaborative CNS/ATM planning and implementation processes.