

Metrics for the NextGen Approach for 4D Trajectory- Based Separation

Michael Harrison

Aviation Management Associates

Alexandria, Virginia

mharrison@avmgt.com



Overview

- Concepts of Operations - NextGen Elements
- Demand and Delay
- Predictability and Flexibility
- Metrics of Performance in a 4D world
- Getting to ADS-x from ADS-B
- The Challenges Ahead



NextGen CONOPS

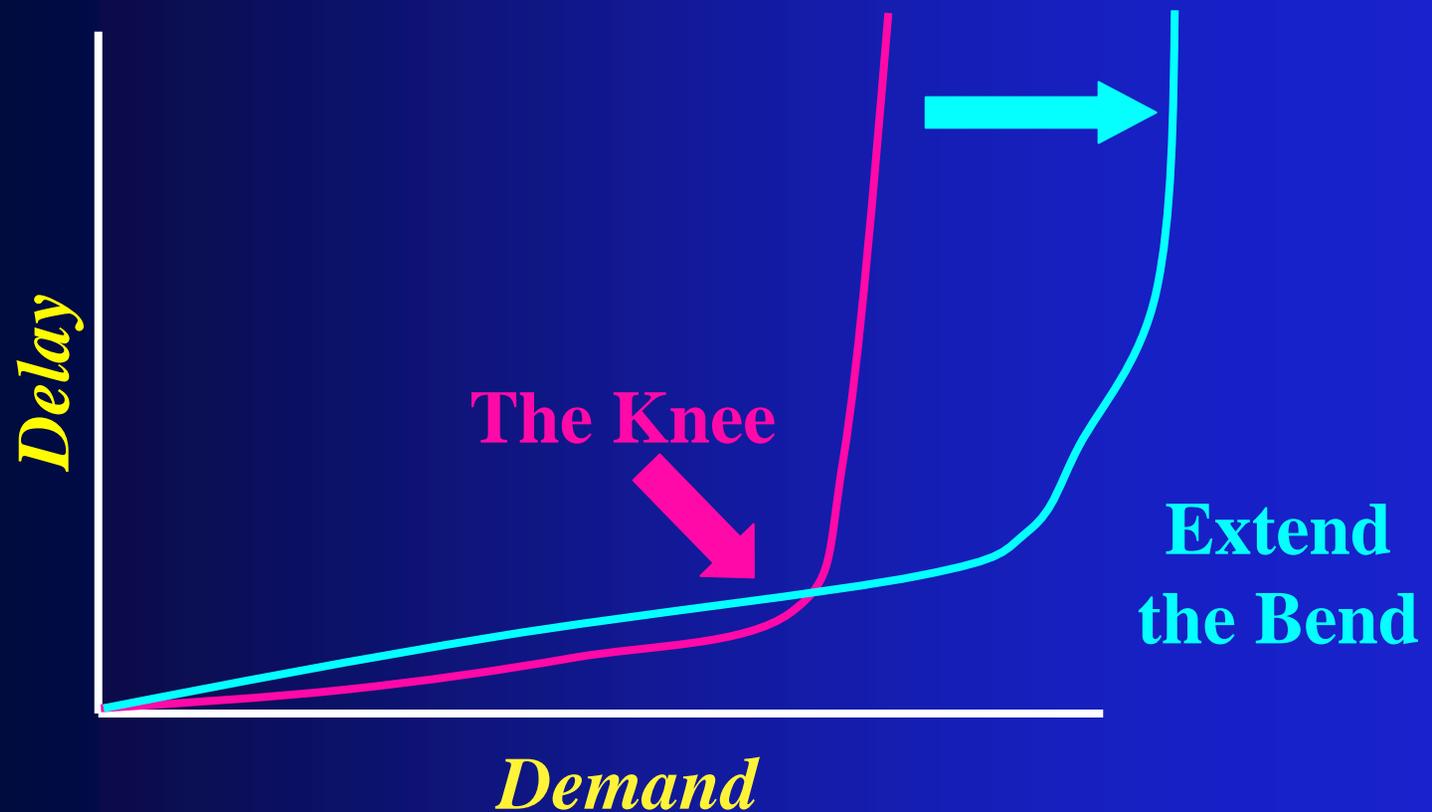
see www.jpdo.aero for more

- **4-D trajectory-based separation** - Precision positioning, intent and performance combined to project time-based separation down stream - the essence of a “contract”
- **Control by exception** - automation monitors conformance to a “contract” with controllers interceding to manage exceptions
- **Performance-based services and operations** - RNP, RSP, RCP
- **Super-density operations** - removal of inter-arrival variability and special procedures to bring instrument capacities closer to visual capacities
- **Layered adaptive security** - with negotiated trajectories and “contracts” authentication and encryption become part of the mix



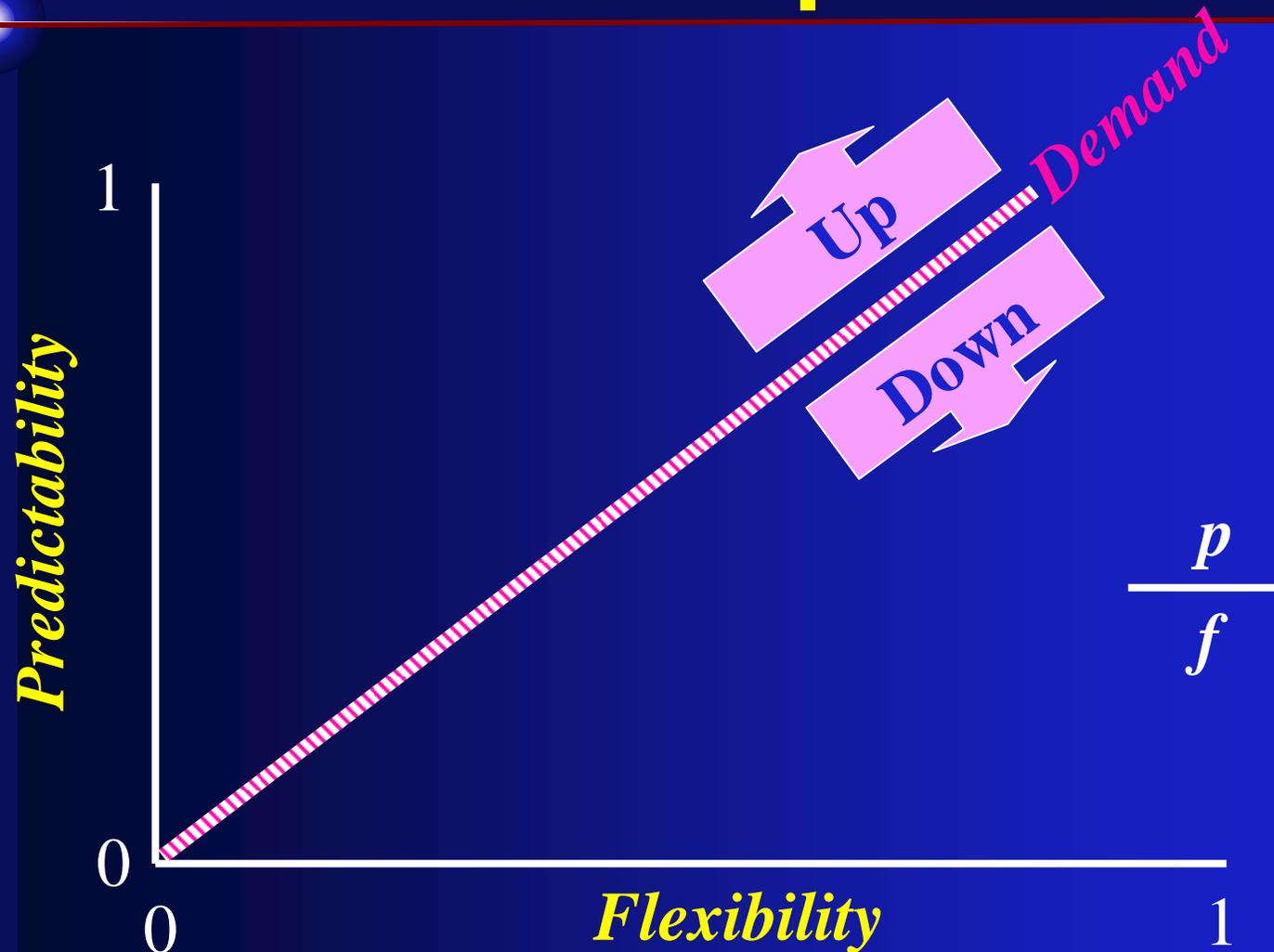
Living at the Knee of the Curve

What brings the NAS to its knees:



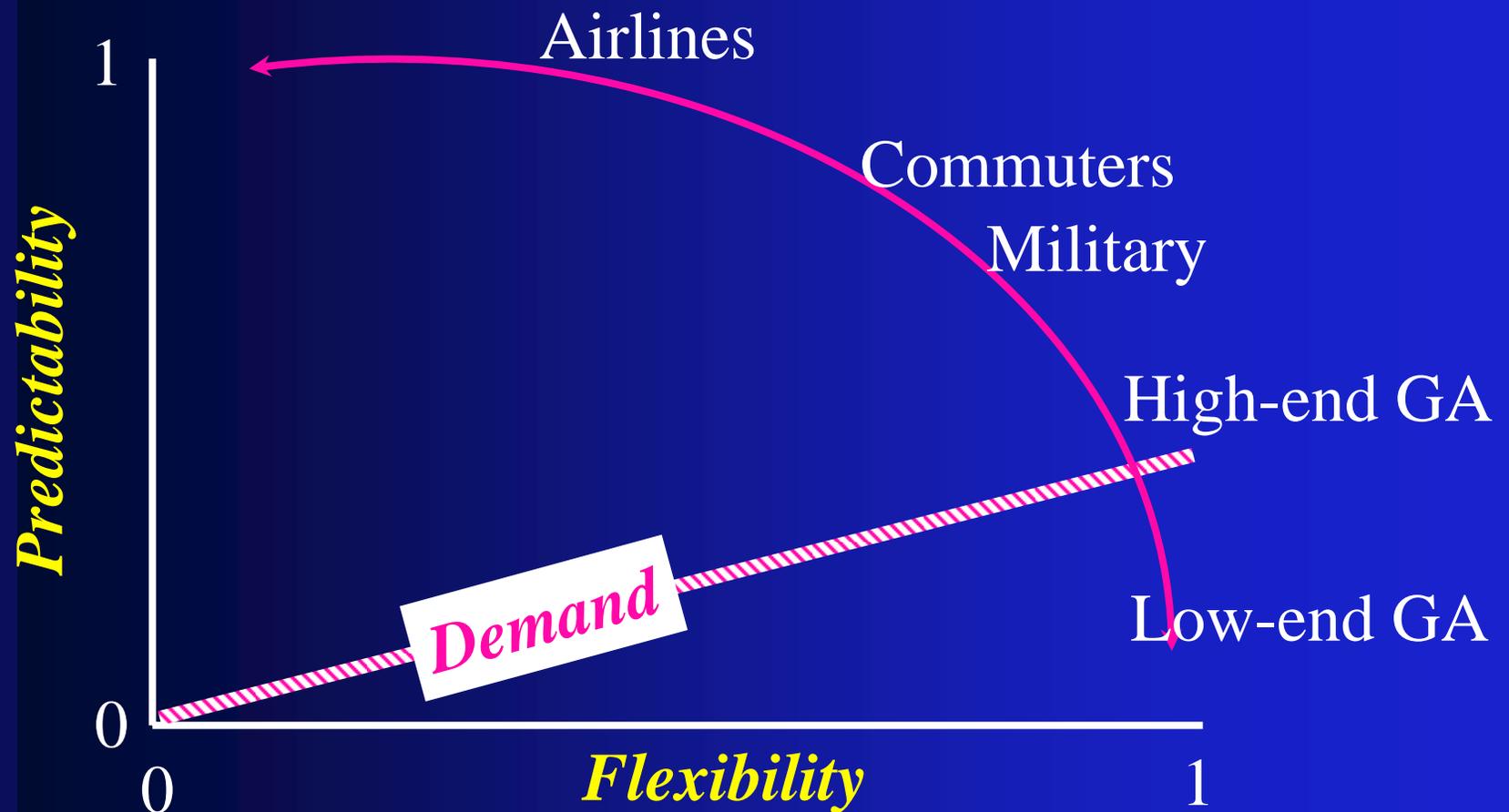


Predictable Service Flexible Operations



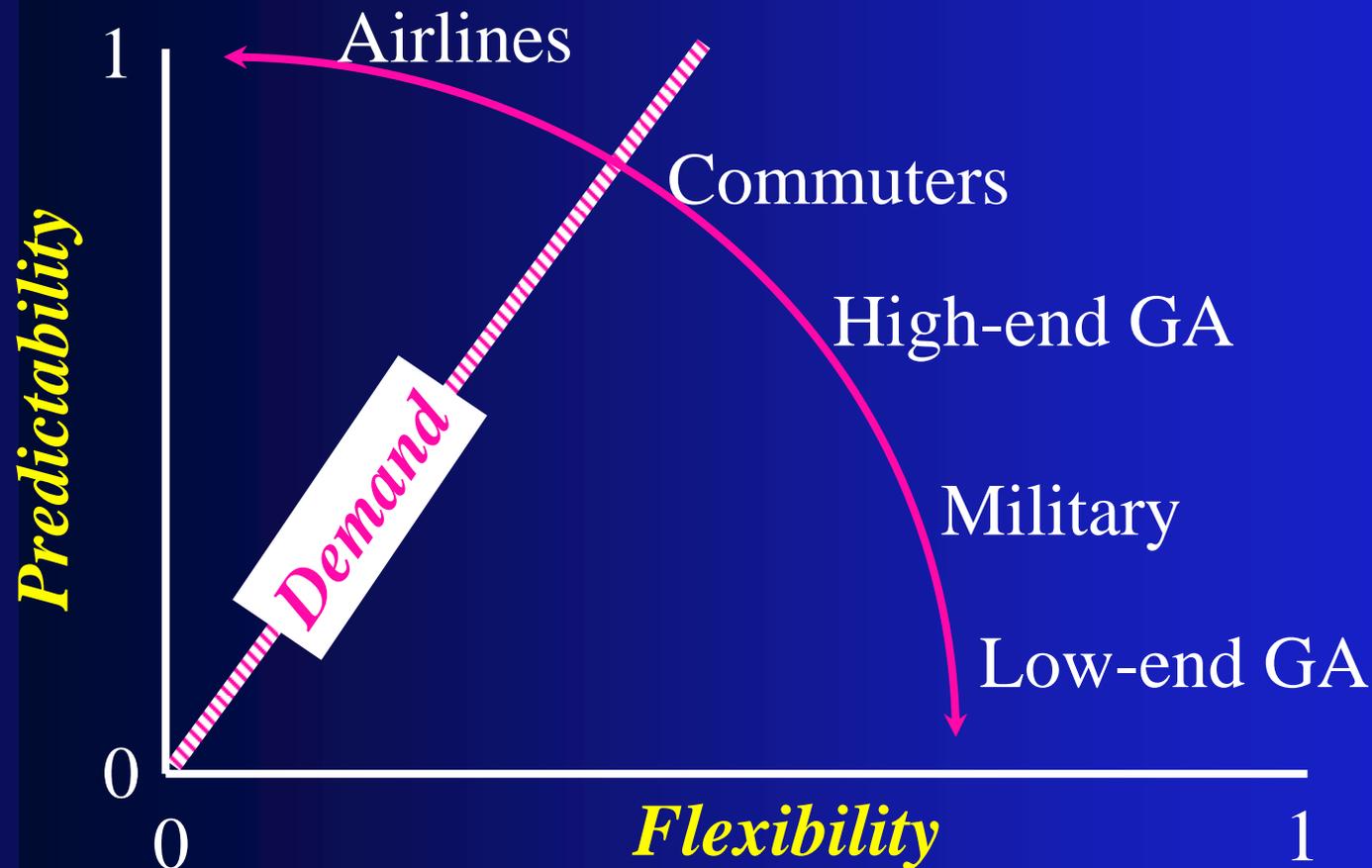


Predictable Service Flexible Operations



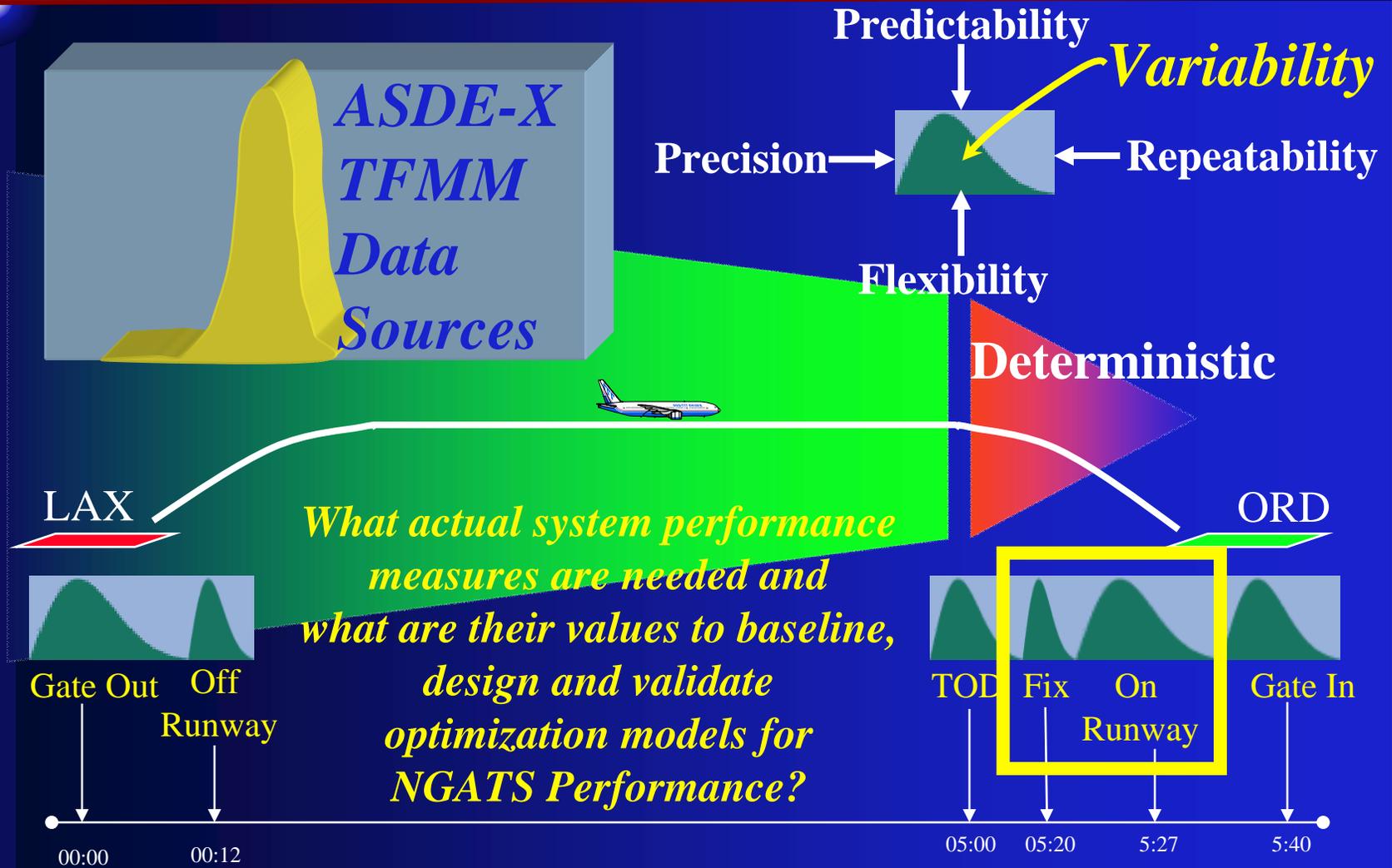


Predictable Service Flexible Operations





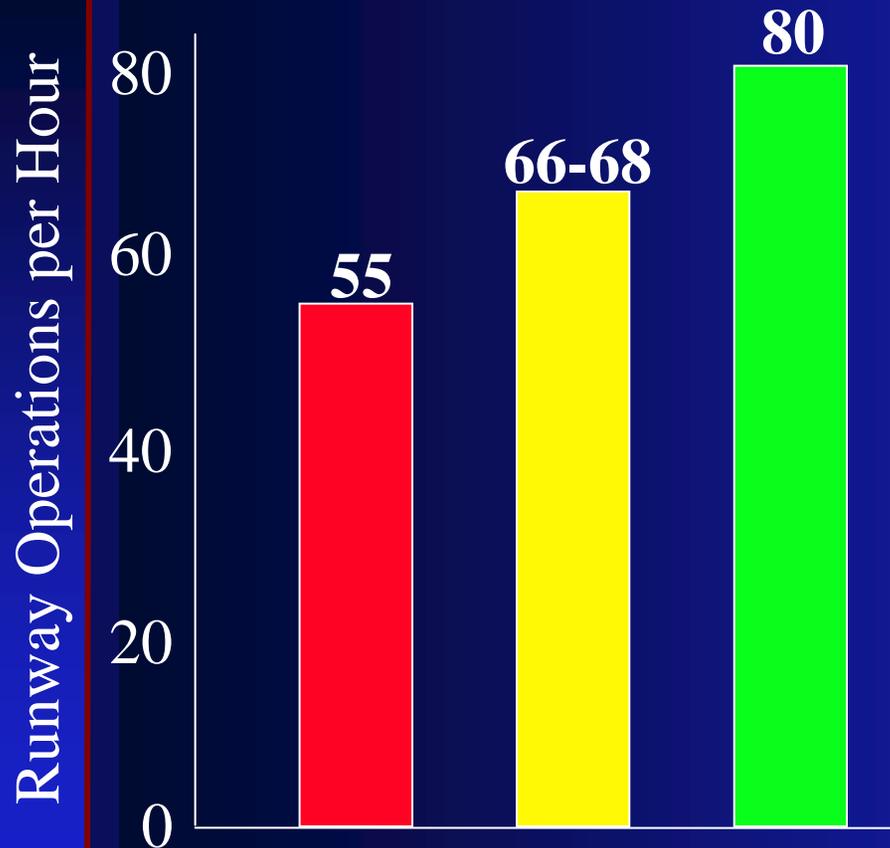
Actual System Performance





Benefits Are About Operations/Hour

Super-density Airport Operations



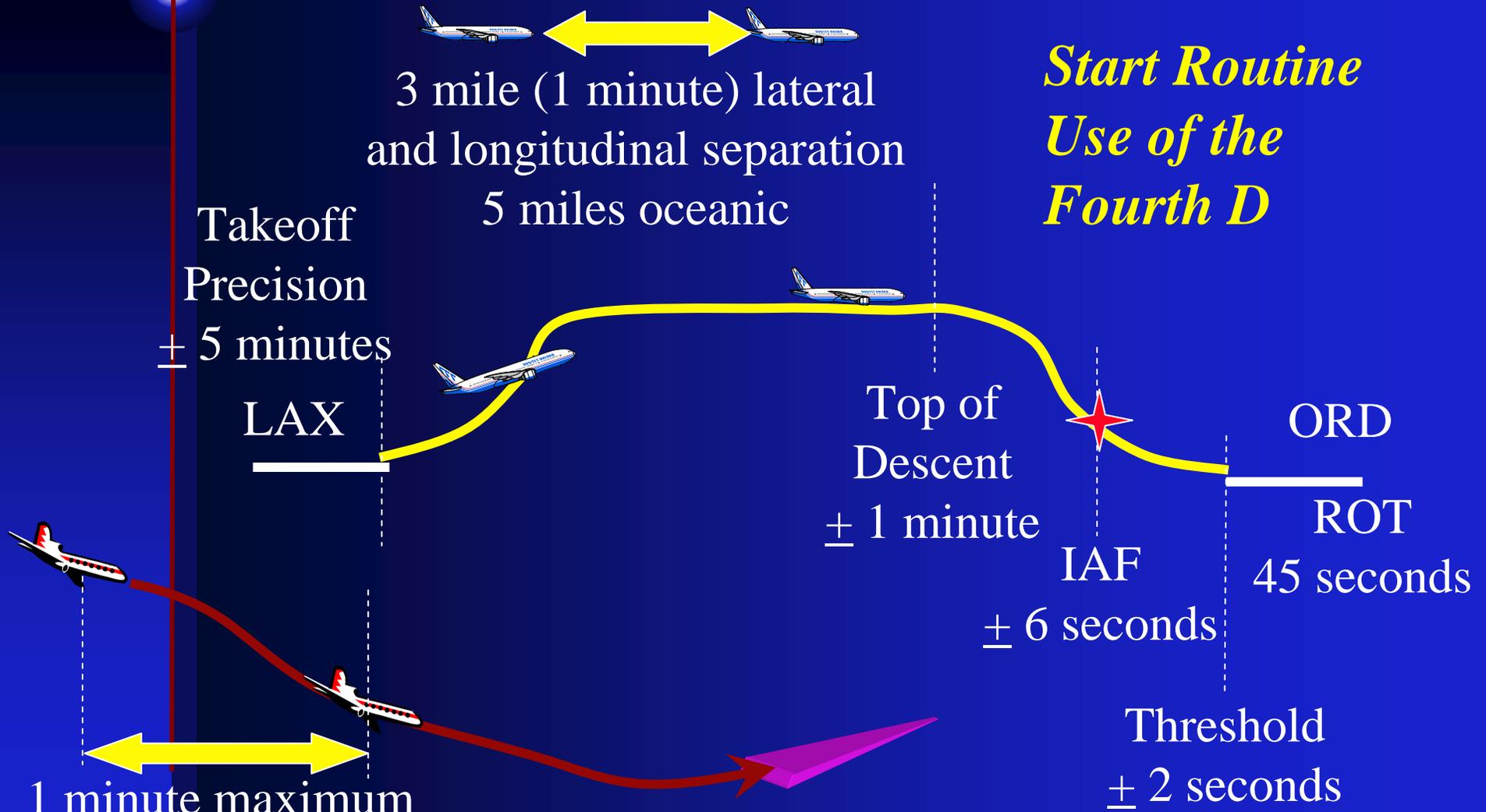
Current Visual Capacity
per Runway

Reduce Inter-arrival
Variability ± 2 Seconds

Reduce Runway Occupancy
Time to 45 Seconds



NextGen Performance Metrics





Getting to 4D

- Combine RNP with Surveillance (RSP)
- Use time as the system performance metric
- Reduce current variability - practice precision
- Create the tools to set the sequence
- Monitor conformance - track and time - control by exception
 - ☎ Non-performers get the penalties
 - ☎ Good performers get predictable, flexible services



Business Case “killer apps”

- The “killer application” makes the business case for equipage
 - ☎ Instrument Landing System - all-weather ops
 - ☎ ACARS - out-off-on-in - aircrew billing
 - ☎ Global Positioning System - RNAV
 - ☎ Required Navigation Performance - new arrivals and departures
- Why invest in ADS-B as a surveillance tool in a surveillance-rich environment?



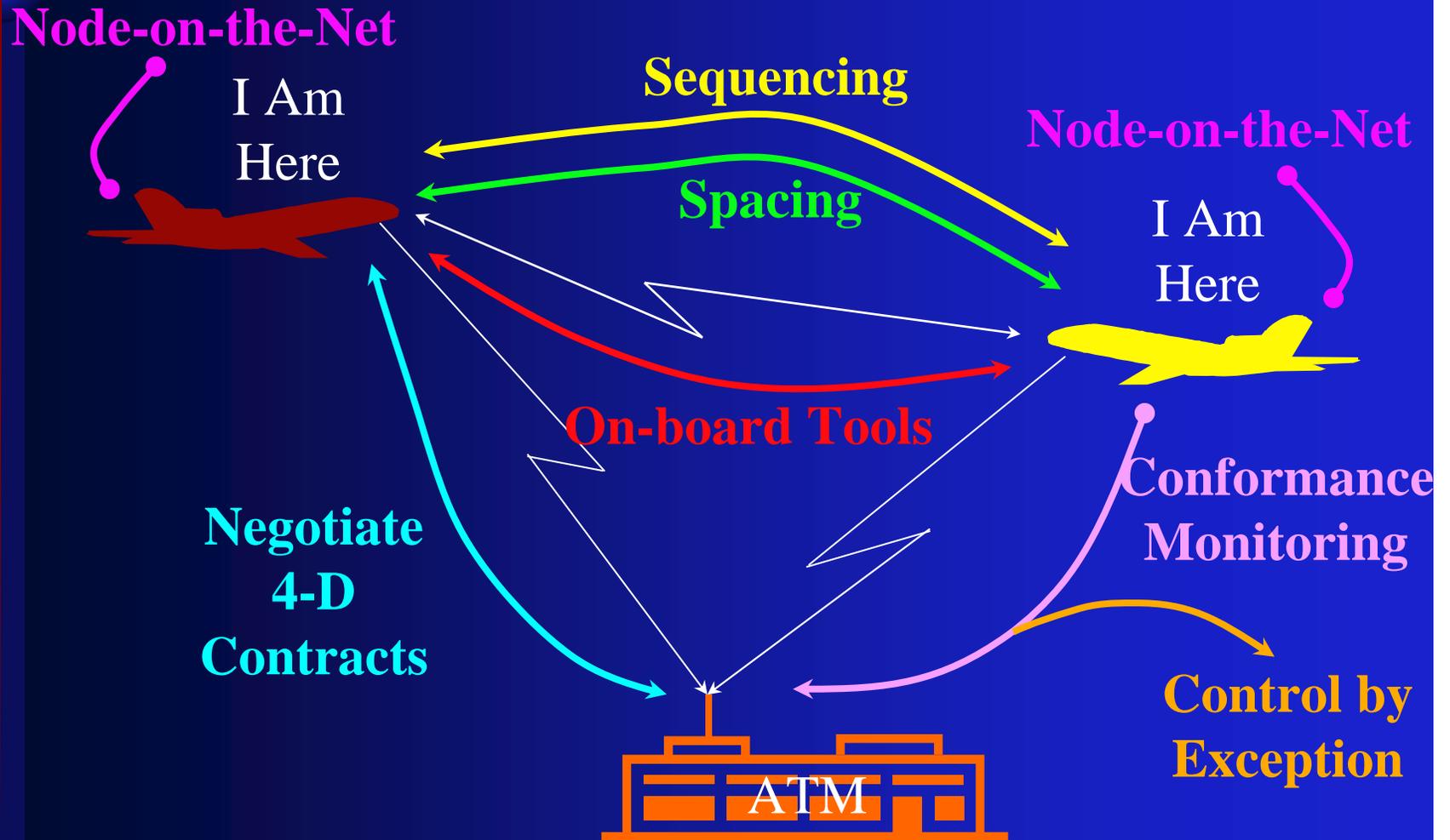
ADS-B's Killer App has yet to be written

- The application sits beyond 2014
 - ☎ Common situational awareness with pilot sequencing and spacing
 - ☎ Use of ADS-B for automated monitoring of trajectories with alerting in conformance monitoring
 - ☎ Automation-to-automation 4D trajectory-based separation
 - ☎ The aircraft as a node-on-a-net

Procedural push needed to get to the business case



ADS-B to ADS-x Transformation





The Essence of ADS-x

- While ADS-B starts with surveillance and common situational awareness, it doesn't go far enough
- ADS-B is simple, the NextGen 4D is complex

The essence of ADS-x is
To provide precision positioning, intent, and
aircraft performance information so that ATM tasks
can be handled by automation - whether the
task is done by the controller, pilot or
automation-to-automation



Challenges in Performance

- First called - first served migrates to priority to the equipped
- Leveraging constant descent arrivals for multiple aircraft on multiple RNP tracks to the same runway - **not** RNP of controller's current vectors
This is about aircraft performance, not ATC
- Understand where variability exists today and begin to manage it
 - ☎ ASDE-X airports
 - ☎ En Route monitoring
- The concept of “critical aircraft” - A new business case being developed



Harrison's Law

The vision of the future
can only be realized
through an immersion in the
present *and* separation
from the past

Today's Technology
New Concepts, Procedures and Policies