
# *Exploiting Shared Precision Information*

## Technology Opportunities for the Future of Air Traffic Management

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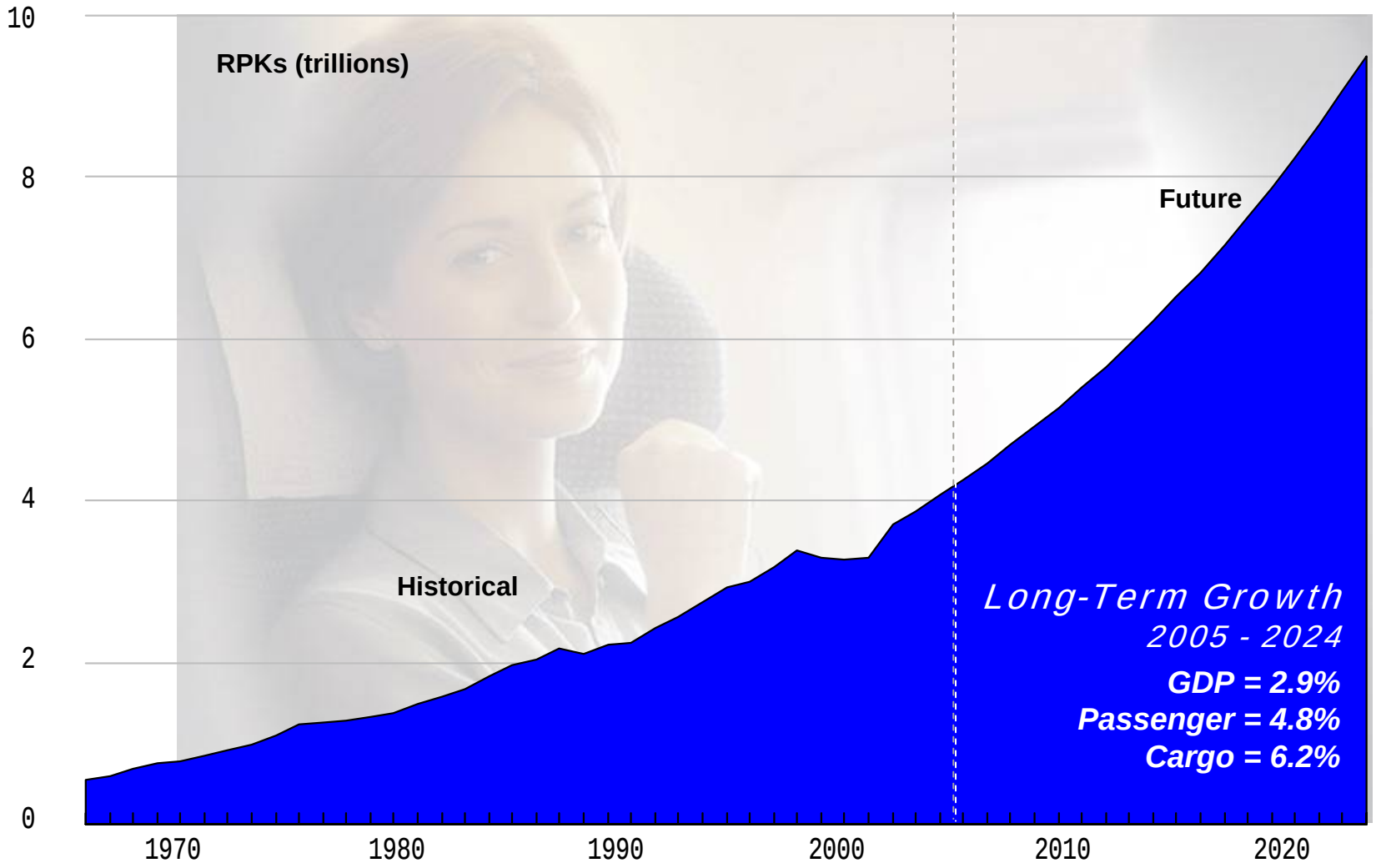
Air Traffic Management

# Demand for Air Travel Will Continue to Grow





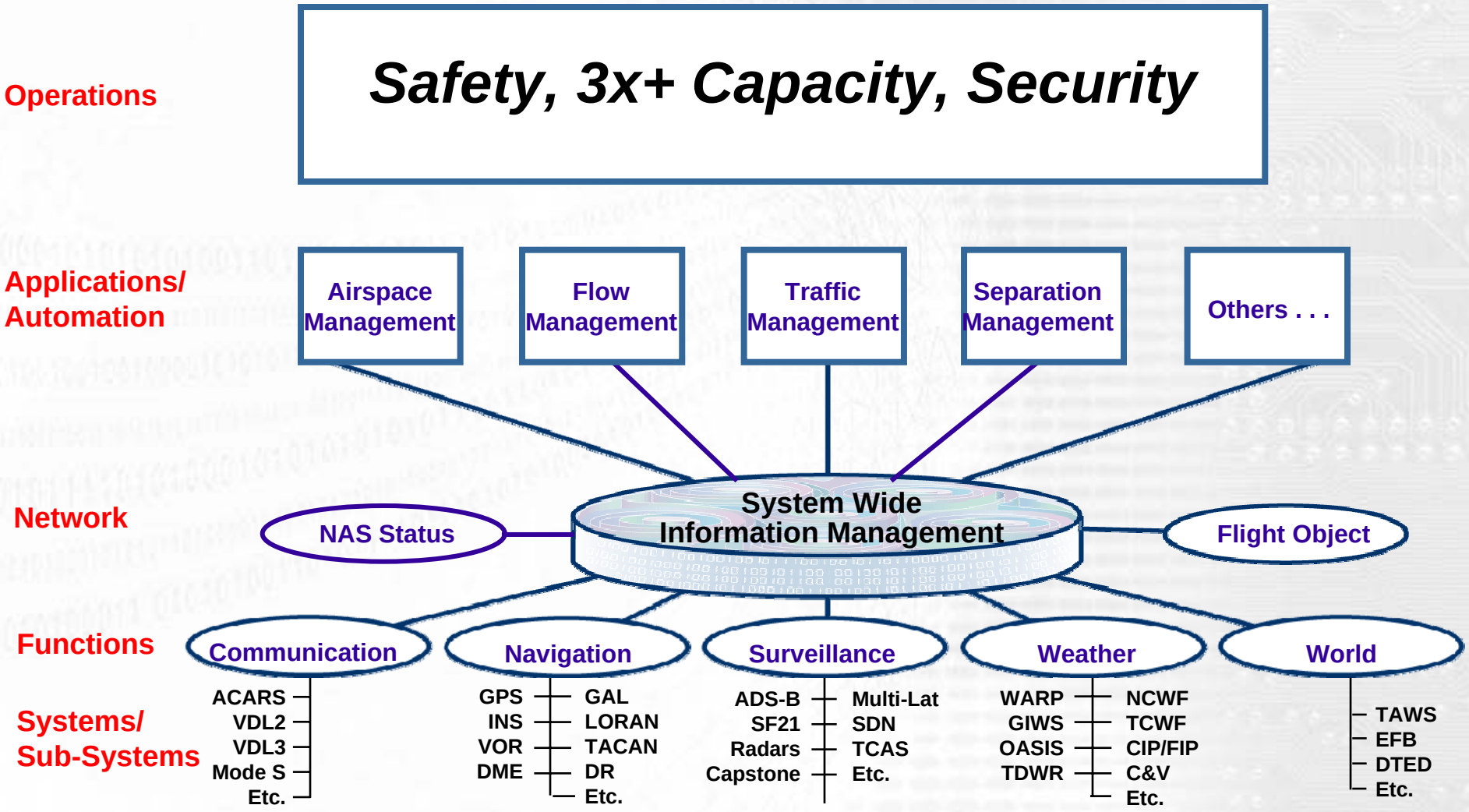
# A step change in every core assumption

## *Exploiting Shared Precision Information*

- Navigation uncertainty – few meters or less
- Surveillance uncertainty – few meters or less
- Flight deck traffic awareness – intuitively obvious with few meters accuracy
- Terrain/obstacle/runway position uncertainty - centimeters
- Pathway uncertainty - 4-D route known and intuitively obvious to self and others
- Wake position/strength uncertainty – known in real time
- Weather hazard uncertainty – encapsulated in volume and time
- Approach glideslope – dynamically variable glideslope and touchdown point
- Air-ground communications – high bandwidth digital links
- Sense/Decide/Command/Control decision time – few seconds

# A Network Centric Architecture

## *Exploiting Shared Precision Information*

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# The 9 steps that delivered >3x capacity

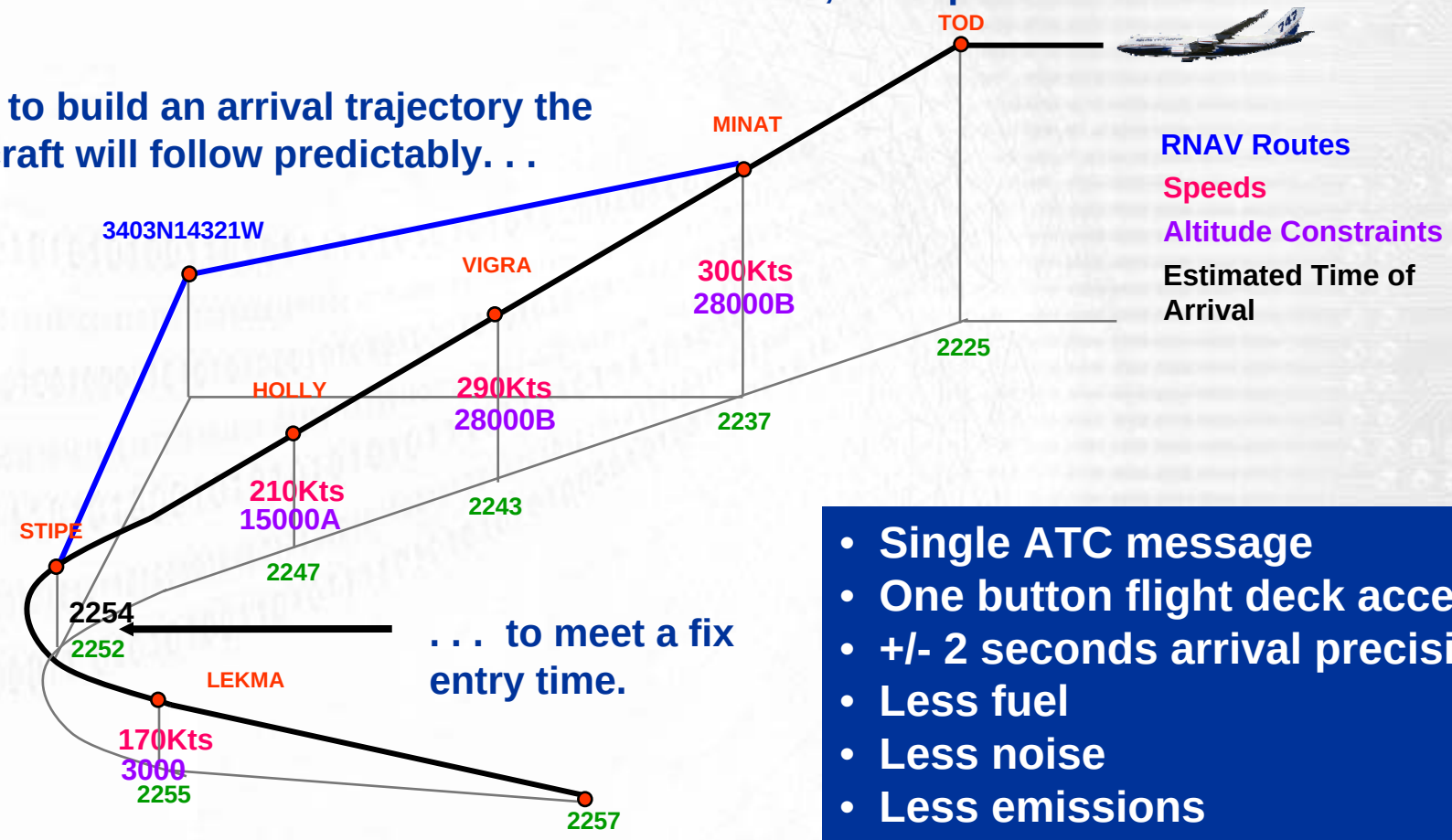
***Exploiting* Shared Precision Information**

1. **Visibility removed as an aviation issue**
2. **4-D paths to +/- 2 seconds arrival precision**

# An example of what we mean – Tailored Arrivals

The FMC can accept routes, altitudes, and speeds . . .

. . . to build an arrival trajectory the aircraft will follow predictably. . .




RNAV Routes
Speeds
Altitude Constraints
Estimated Time of Arrival

. . . to meet a fix entry time.

- Single ATC message
- One button flight deck acceptance
- +/- 2 seconds arrival precision
- Less fuel
- Less noise
- Less emissions
- 1000's of aircraft already equipped

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# The 9 steps that delivered >3x capacity

***Exploiting* Shared Precision Information**

1. **Visibility removed as an aviation issue**
2. **4-D paths to +/- 2 seconds arrival precision**
3. **All weather-safe airspace exploited**
4. **2-mile final approach spacing for all**
5. **“Pave down the middle”**
6. **Safe multi-aircraft runway operations**
7. **Fully utilize all airports**
8. **4-D paths with Control by Exception enroute**
9. **Smart flow control**

# The ATM Business Case – U.S. Example
## (the national economy business case is even better)

**If:**

- The efficiency benefits of a network centric infrastructure and operations are allowed to be realized, and
- Air travel can maintain a 4% annual growth rate or greater

**Then, over 20 years:**

- Airlines, cargo, and GA unit taxes and fees can be reduced every year
- A $15B transformation program can be financed and fully repaid at a 6% interest rate
- Air traffic controllers can have full job security and continuing real wage growth over inflation
- Air transportation will be safer, more secure, and more efficient and strongly support national economic growth

**And:**

- A $20B surplus will be left over.

# The U.S. National Economy Business Case

**(1) Faster, more efficient movement of people and goods improves economic productivity**

**(2) A 1% gain in economic productivity = $100+B/year in economic growth**

# Final Thoughts – looking back from 2025

- **Network centric architecture was the core enabler**
  - Precision navigation fundamental req't
  - The aircraft must be a node on the network
  - Capacity, safety, efficiency, security simultaneously improved

- **Four challenges had technology/solutions not ready in 2006**
  - Short term (0-2 hour) weather forecast accuracy
  - Wake vortex detection/prediction
  - Operational concept/HMI for 3x+ controller productivity
  - A financial, regulatory, and operations marketplace that motivates and rewards continuous technical and operational advances

# Final Thoughts – looking back from 2025

- Policy, Operational, Economic, and Technical solutions needed to be worked in concert
- The global ATM business case was *overwhelmingly* positive
  - Less expensive infrastructure
  - Stable/moderate increase in personnel costs
  - 3x revenue growth
  - Economic productivity multiplier