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# **Aircraft Mobility Within an Internet- Protocol-based National Airspace System**

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# Topics

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- Network view of NAS
- NAS Mobility
- MANET Overview
- MANET Advantages in NAS
- Research Challenges
- Q & A



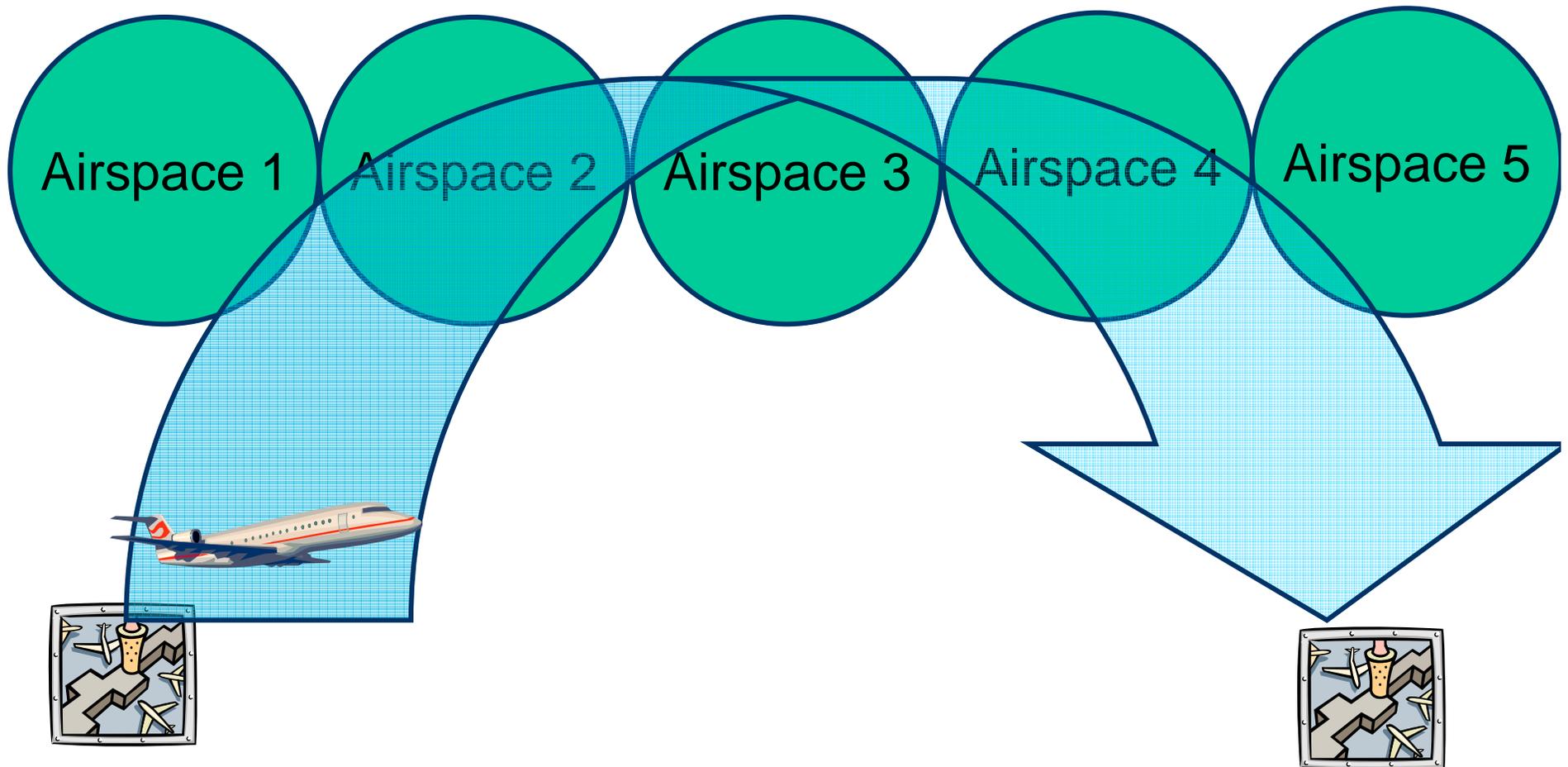
# Network View of the NAS

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- Highly mobile platforms (obviously)
- Structured mobility
  - Defined transition points and times
- Relatively dense inter-connectivity
  - Most planes in an airspace can communicate with each other directly
- Nodal velocity is high (100s of mph)
- **Security is a critical**

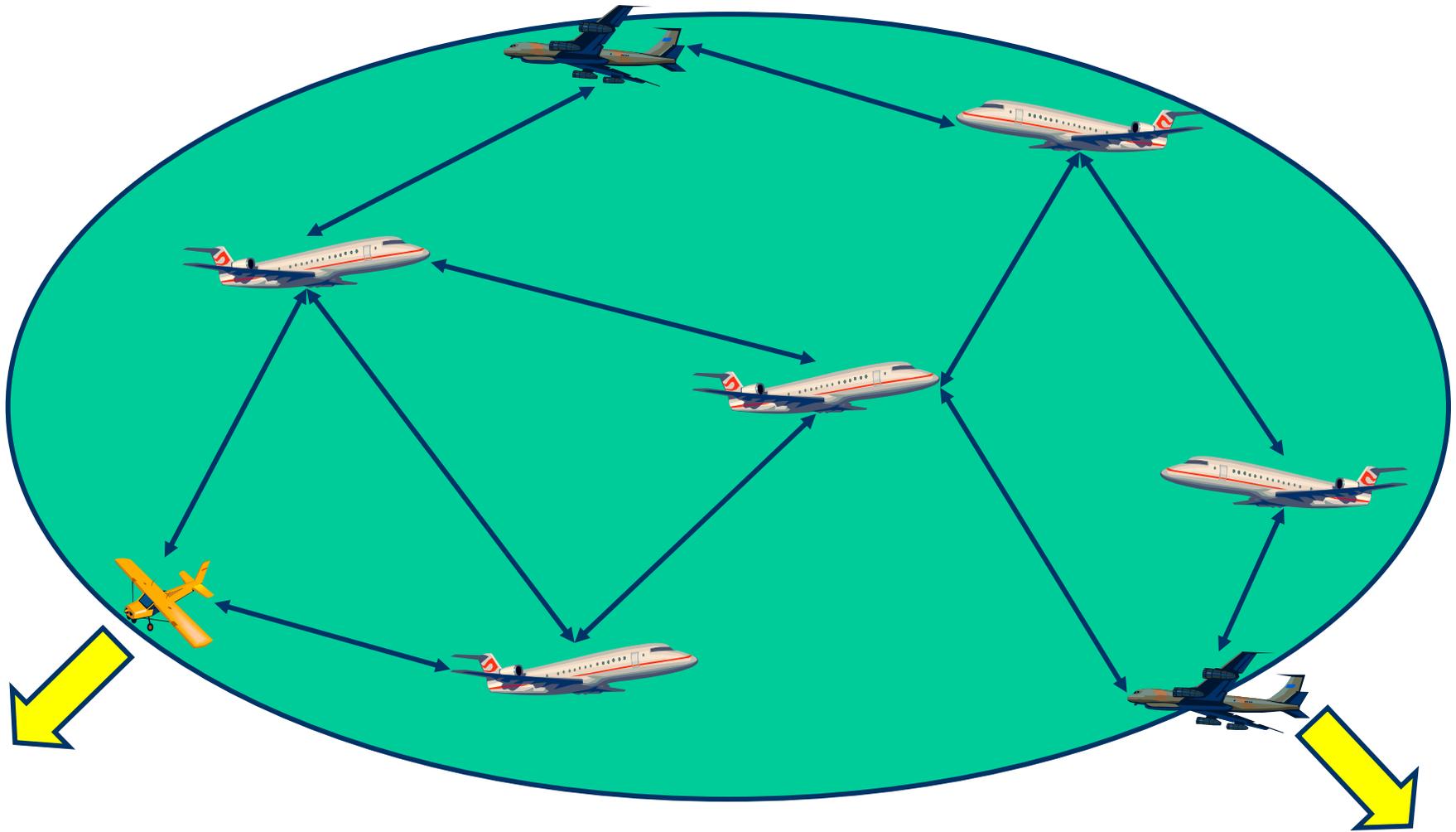


# Network View of the NAS





# Network View of the NAS





# NAS Mobility

- Generally deterministic transitions between airspaces
- Dramatic differences in velocities in airspaces
  - E.g. Terminal versus En Route
- Straightforward mobility model
  - Speed, direction, altitude changes known a priori
- Inter-plane connectivity can be determined

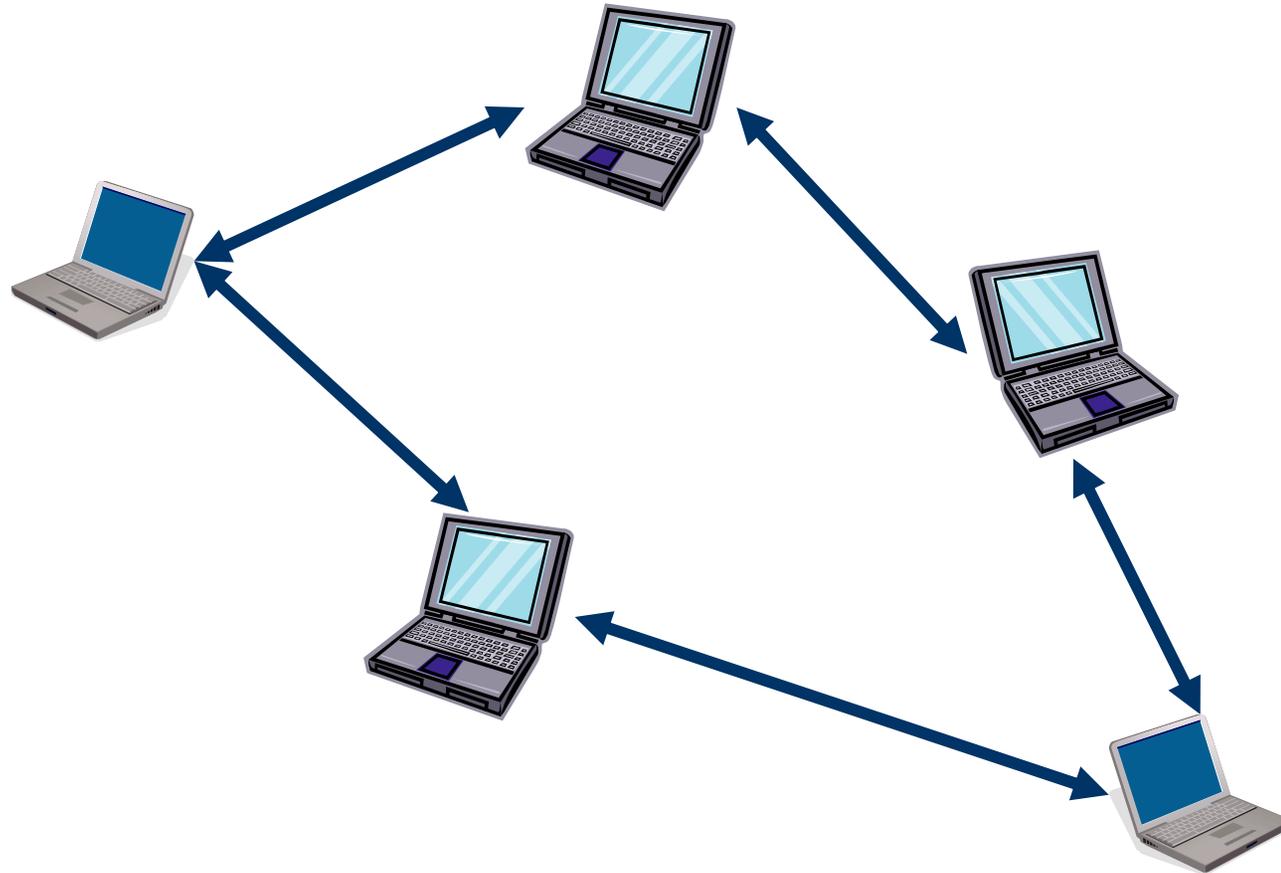


# MANET Overview

- Routing approaches are varied
  - **Proactive** protocols calculate routes to all destinations
  - **Reactive** protocols dynamically find routes when needed
  - **Hybrid** protocols do a little of both
- Ad hoc nature of network affects
  - Routing
  - Configuration
  - Security
  - Management
- Dynamic formation supports information exchange *when it is needed, even without infrastructure*



# MANET Overview





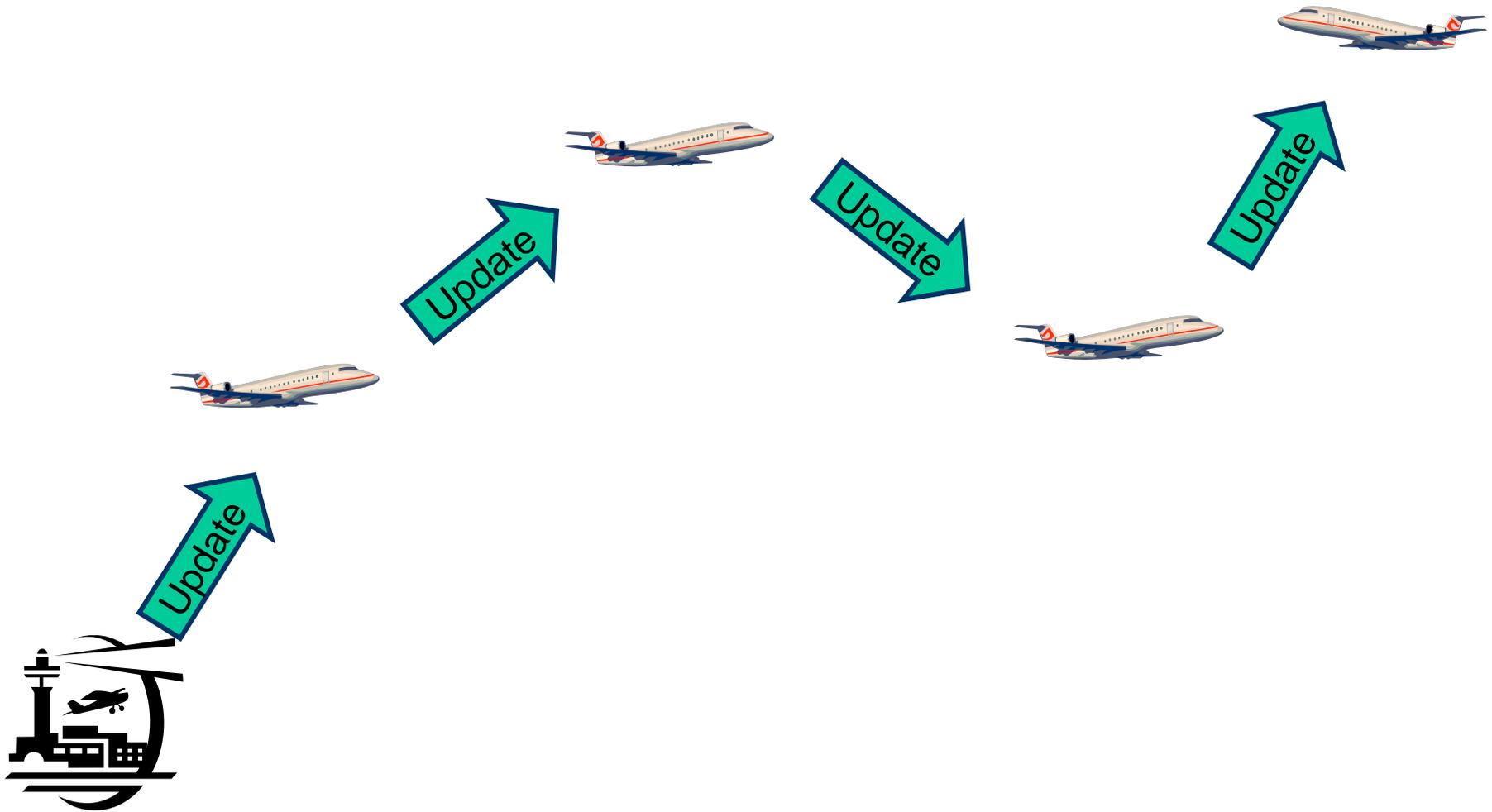
# MANET Advantages in NAS

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- MANET routing extends **reach** of data
  - Plane-plane relaying avoids development of ground-based infrastructure
- Increased digital data routed over optimal network links
  - Multiple paths increase reliability
- Ad hoc network formation increases reach
  - Advantageous for oceanic and polar routes
- Protocols (routing) react well to topology changes



# MANET Advantages in NAS





# Research Challenges

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- Interfacing MANET routing with existing Internet infrastructure
- Security protocols (especially PKI) for MANETs
- Network management architectures
  - Address configuration
  - Node monitoring
  - Network management (e.g. SNMP)
- Reliability for high-assurance networks
- MANETS are higher-speeds



***Questions?***