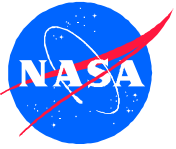


Network Mobility Alternatives

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Goals

- Guidance for upcoming research
 - Areas that need work
 - Prioritization
- Experimental Network Development
 - Who is interested in participating?
 - What issues need to be addressed?
 - Where should this network reside?
 - FAA Tech Center?
 - Small (big) Airport such as Akron/Canton?

**The Ultimate Goal is to
Network the Air Traffic Controller**



Breakout Session Format

- Short presentations on issues affecting mobility
 - Network (Will Ivancic)
 - Application (Chris Wargo)
 - Transport (Wes Eddy)
 - Media Access Issues: IP over VDL-3 results (Brian Frantz)
 - Networking and bridging radio systems – (Phil Paulsen)
- Open Discussion
 - Notes taken during discussion
 - Notes will be fed back to ACAST program but no feedback session will follow this breakout session.



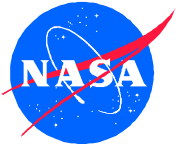
Outline

- Mobility at what layer?
 - Application
 - Shim
 - Host Identity Protocol
 - Site Multihoming by IPv6 Intermediation (shim6)
 - Transport
 - SCTP
 - Network
 - NEMO (shared infrastructure)
 - Routing (own everything)
- Open or Closed Network?
- Issues to keep in mind
 - Multihoming
 - Off the Aircraft
 - At Corporate Network (Multiple ISPs)
 - Security and its influence on architecture and protocols
 - Alternative Radio Links
 - Commercial and/or specially developed for Aeronautics
 - Media Access Technology (IPv6, QoS, Fast handover)



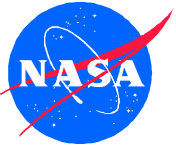
Global Airspace System Requirements

1. Must be value added
 - Cannot add cost without a return on investment that meets or exceeds those costs.
2. Must be capable of seamless global operation.
3. Must be capable of operating independently of available communications link. Must support critical Air Traffic Management (ATM) functions over low-bandwidth links with required performance.
4. Must use same security mechanisms for Air Mobile and Ground Infrastructure (surface, terminal, en router, oceanic and space)
 - Critical ATM messages must be authenticated.
 - Must be capable of encryption when deemed necessary
 - Security mechanisms must be usable globally
 - Must not violate International Traffic in Arms Regulations
5. Must operate across networks owned and operated by various entities
 - Must be able to share network infrastructure
6. Must make maximum use of standard commercial technologies (i.e. core networking hardware and protocols)
7. Must enable sharing of information with proper security, authentication, and authorization
 - Situational Awareness
 - Passenger Lists
 - Aircraft Maintenance
8. Same network must accommodate both commercial, military and general aviation.




Design Concepts

- Must be IPv6 based.
- Must be capable of a prioritized mixing of traffic over a single RF link (e.g. ATM, maintenance, onboard security, weather and entertainment).
- Must utilize IPsec-based security with Security Associations (SAs) bound to permanent host identities (e.g. certificates) and not ephemeral host locators (e.g. IP addresses).
- Must be capable of accommodating mobile networks.
- Must be capable of multicasting
- Must be scalable to tens of thousands of aircraft




Link Independence

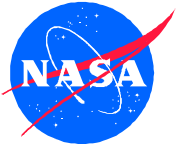
- Most important considerations for this is not technical, but related to cost, safety, and politics
- Facilitates globalization and supports positive ROI
- Requires change in policy 
- Change in use of spectrum
 - World Radio Conference to allow use of other frequencies for air traffic control messages
- Air Traffic Controller is now networked.

These are some very different modes of operation from what the aeronautics community is comfortable with.



Further Studies and Investigation

- QoS related to mixing ATM traffic with other information
- Much research is needed regarding network mobility
- Networking ATM traffic for use over multiple links and service providers
- IP over narrow-band aeronautical links.
- Mobile-IP, NEMO and Ad Hoc networking
 - Route Optimization
 - Placement of Location Manager (Home Agent)
 - Ping-pong routing
 - QoS and delay issues
 - Multi-homing (use of best available link)
 - To load balance or not to load balance?
 - Make before break or not?
 - Policy-based routing (current aeronautical requirement - Ouch!)? 
- Application of Ad Hoc type networking for Oceanic to extend networks (MANETs or Mobile-IPv6)



Mobile Networking Solutions

- Routing Protocols
 - 😊 Route Optimization
 - 😞 Convergence Time
 - 😞 Sharing Infrastructure – who owns the network?
- Mobile-IP
 - 😊 Route Optimization (Being Worked)
 - 😊 Convergence Time
 - 😊 Sharing Infrastructure
 - 😊 Security – Relatively Easy to Secure
- Domain Name Servers
 - 😊 Route Optimization
 - 😞 Convergence Time
 - 😞 Reliability