A Simple BGP-Based Mobile Routing System for the Aeronautical Telecommunications Network

IETF 104 Routing Working Group
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Aviation and Communications Standards Bodies

- The International Civil Aviation Organization (ICAO) is developing an Aeronautical Telecommunications Network with Internet Protocol Services (ATN/IPS) for worldwide Air Traffic Management.
- RTCA Special Committee 223 (SC-223) is identifying an IPS architecture for Remotely Piloted Air Systems (RPAS) (same as “UAS”).
- RTCA SC-228 is identifying communications data links for RPAS coordination.
- ARINC and AEEC have a stake in defining their own UAS standards.
- The Internet Engineering Task Force (IETF) is the worldwide authority for internetworking standards.
We believe that communication network standards for both manned and unmanned aviation:

- BEGIN with ICAO
- HARMONIZED in RTCA, ARINC, AEEC
- END in the IETF
ICAO ATN/IPS Overview

- Currently under investigation in ICAO Working Group I
- Aeronautical Telecommunications Network with Internet Protocol Services (ATN/IPS)
- Based on Internet Protocol, version 6 (IPv6)
- Overlay network over an underlying Internetwork
- Internetwork could be private links and/or secured tunnels (IPsec) over the public Internet
- Single ATM service for all manned/unmanned aviation
- Each aircraft gets an IPv6 prefix that travels with the aircraft wherever it goes
- Remote pilots, ATCs and aircraft globally addressable at all times
Scaling Considerations for Aviation

- Each aircraft is a mobile network, and receives an IPv6 Mobile Network Prefix (MNP).
- Numbers of commercial airplanes operating worldwide today currently $O(10^4)$ – perhaps growing to $O(10^5)$ in coming years.
- However, Unmanned Air Systems and Personal Air Vehicle growth anticipated in the near future soon need to consider larger orders of magnitude.
- Mobility plays a role in control messaging overhead, and aircraft are highly mobile. Need a system that scales.
Centralized vs Distributed Mobility Management

• In Centralized Mobility Management (CMM), one Mobility Anchor Point (MAP) for the entire worldwide aviation environment:
CMM Considerations

- CMM Advantages:
  - Immediate mobility and QoS signaling, since all aircraft are serviced by the same MAP
- CMM Disadvantages:
  - Scaling limitations not only in numbers of aircraft, but also in the amount of mobility signaling
  - Localized mobility events cause global instability
Distributed Mobility Management

- In Distributed Mobility Management (DMM), many regional MAPs distribute scaling load without impacting the routing system:
DMM Considerations

- **DMM Advantages:**
  - Distributes load among many MAPs:
    - Scalable numbers of aircraft (up to 1M per routing core)
    - Scalable mobility signaling
  - Localized mobility events kept local without causing global instability

- **DMM Disadvantages:**
  - Requires an effective route optimization service to reduce congestion in the core
  - **BUT, WE KNOW HOW TO DO THIS**
BGP overlay routing system for DMM
Hub-and-spokes ASBR arrangement
  - Core ASBRs (c-ASBRs) in hub
  - Stub ASBRs (s-ASBRs) in spokes
BGP updates unidirectional from s-ASBRs to c-ASBRs; c-ASBRs originate “default”
BGP routing designed for short-term forwarding of initial data packets only – route optimization keeps data traffic out of core
Mobility management services in stub ASes – could be (P)MIPv6, LISP, AERO, etc.
Document status:
Changes from -00 to -01:
  o incorporated clarifications due to list comments and questions
  o new section 7 on Stub AS Mobile Routing Services
  o updated references, and included new reference for MIPv6 and LISP
Massively Distributed Mobility Management

- In Massively Distributed Mobility Management (MDMM), many routing cores linked together
Scalable De-Aggregation for MDMM

- Entire system supports a Mobility Service Prefix (MSP), e.g., 2001:db8::/32
- Each routing core maintains an independent BGP Routing Information Base (RIB) with up to 1M MNPs
- Each RIB services a different Mobility Group Prefix (MGP), e.g., 2001:db8::/44, 2001:db8:0010::/44, 2001:db8:0020::/44, 2001:db8:0030::/44, etc.
- MAPs peer with each routing core and apply route filters so that each MNP registers with a single RIB
- So, with 1K RIBs each servicing a different MGP the total system can support up to 1B BGP routes
  - Mobiles can register with any available MAP
  - Route optimization keeps data traffic out of core
  - MAPs keep mobility signaling out of core
Draft Status

“A Simple BGP-based Mobile Routing System for the Aeronautical Telecommunications Network”
(https://datatracker.ietf.org/doc/draft-ietf-rtgwg-atn-bgp/)

“Scalable De-Aggregation for Overlays Using the Border Gateway Protocol (BGP)”
(https://datatracker.ietf.org/doc/draft-templin-rtgwg-scalable-bgp/)
Backups