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

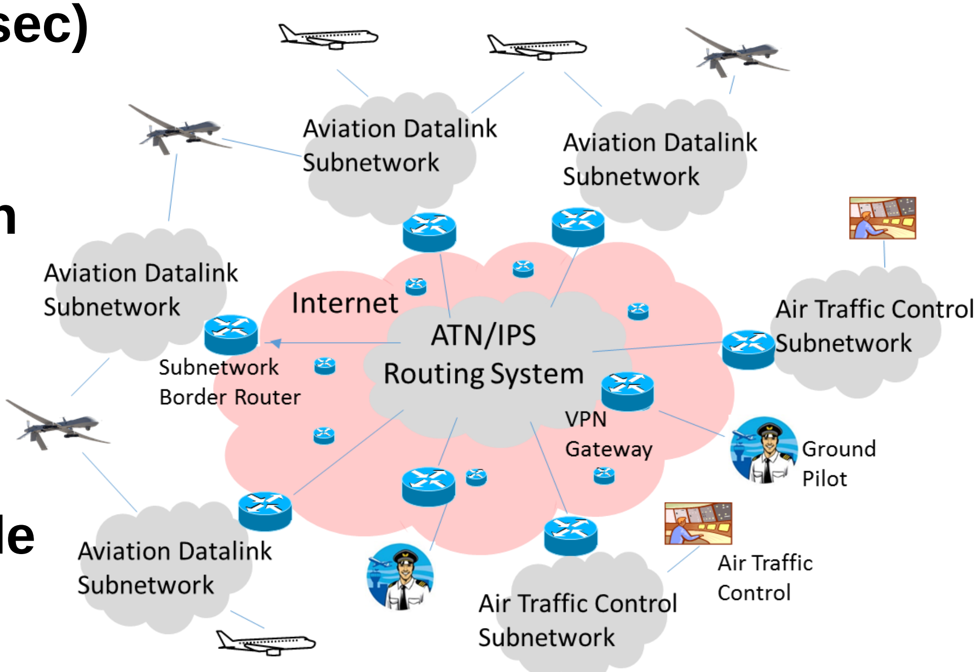
- **The International Civil Aviation Organization (ICAO) is developing an Aeronautical Telecommunications Network with Internet Protocol Services (ATN/IPS) for worldwide Air Traffic Management**
- **RTCA Special Committee 223 (SC-223) is identifying an IPS architecture for Remotely Piloted Air Systems (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**

Aviation and Communications Standards Bodies (2)

- **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

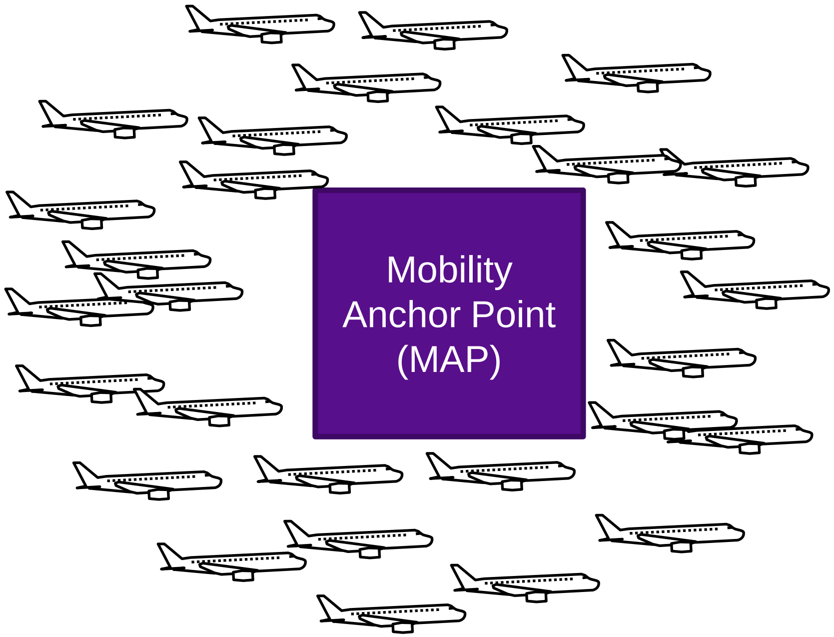


Scaling Considerations for Aviation

- **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:**

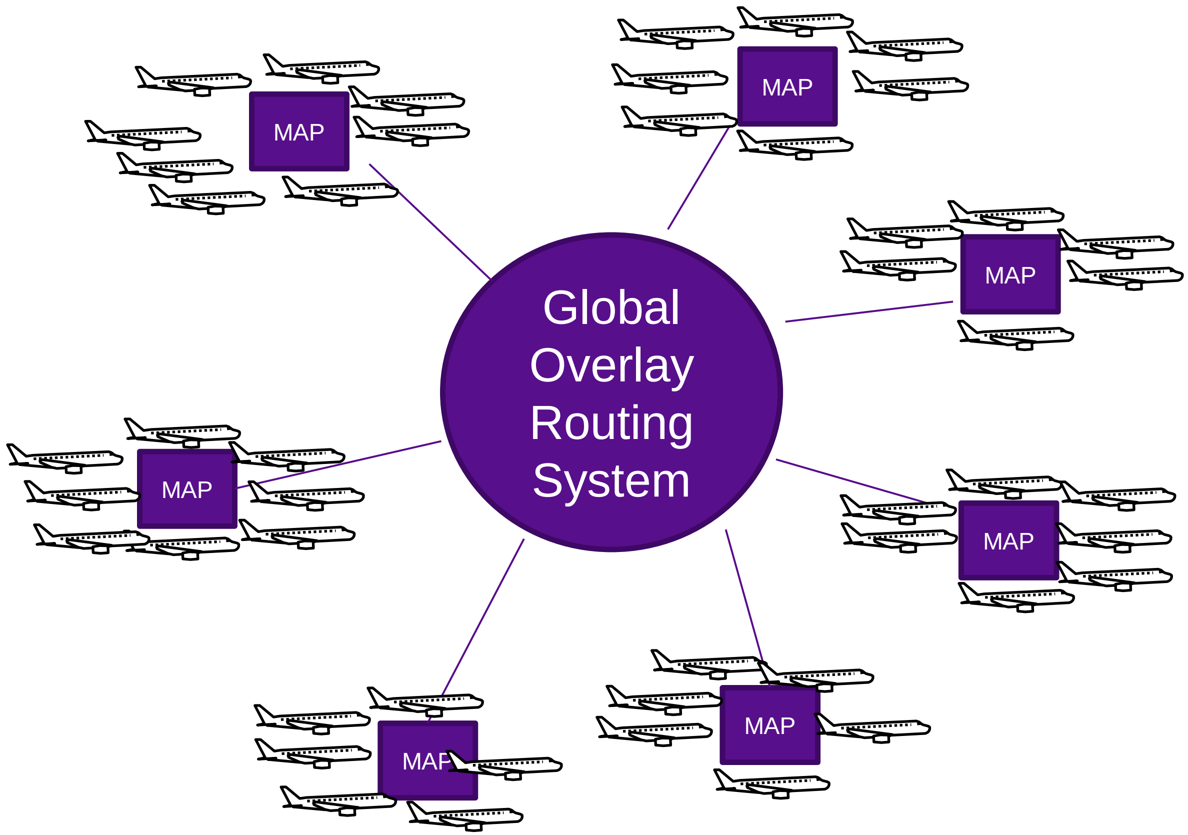


CMM Considerations

- **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**

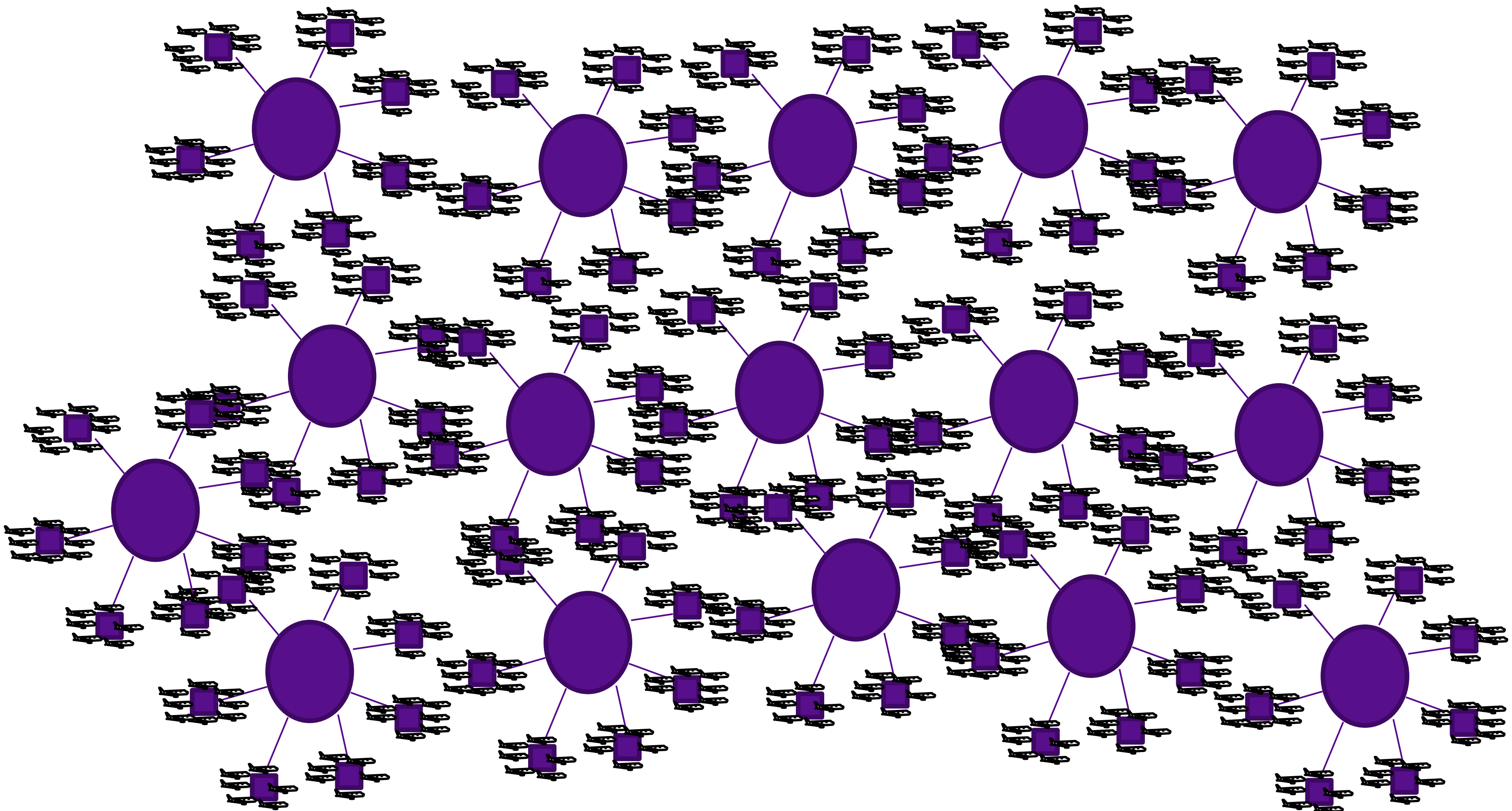
draft-ietf-rtgwg-atn-bgp

- **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