Agenda

- Uberlay and GB-LISP Recap
- Multi-AS Federation Requirements
- Next steps
ICAO Federated Network

• The International Civil Aviation Organization (ICAO) Aeronautical Telecommunications Network (ATN) is run by a consortium of different providers.
  • This network must support mobility and multi-homing across the different providers

• The Uberlay model has been proposed as a way to architect this mixed environment.

• The providers require a mechanism to peer with each other without requiring an intermediary organization to run the Uberlay for them.
  • A federated Uberlay Mapping System amongst the providers is desirable.
  • Peering agreements must be enforced
ICA O – Existing peering agreements

CSP A

CSP B

CSP C

CSP = Communication Service Provider

Underlay Inter AS EBGP
ICAO – Uberlay Structure

CSP = Communication Service Provider

Underlay Inter AS EBGP
ICAO – Uberlay Mapping System Federation

CSP = Communication Service Provider

CSP A

CSP B

CSP C

Site-Overlays (west)

Site-Overlays (east)

Inter & Intra CSP Federation

CSP = Communication Service Provider
Multi-AS Uberlay - Federation

- Each MS/MR services the XTRs in its AS
- As hosts move, their EIDs must be registered to the MS in the AS they are connected to
- EID related Peering agreements across ASs must be enforced

MS = MS+MR in all diagrams

LISP MS/MR
Border Router
Underlay ASBR

Underlay-AS-A
MS-A
EBGP
MS-B
Underlay-AS-B

Underlay-AS-C
MS-C
XTR-B2
XTR-B1
XTR-C

XTR-A

Each MS/MR services the XTRs in its AS
As hosts move, their EIDs must be registered to the MS in the AS they are connected to
EID related Peering agreements across ASs must be enforced
Peering agreements and policies

Peering Agreements
• Refer to EID prefixes
• Terms of Service
• Govern use of all resources in the AS (Over & Under)

• Policies Based on peering Agreements
  • Transit: EID-prefixes allowed/denied in certain ASs
  • Ingress: Preferable terms via a particular AS_PATH

MS = MS+MR in all diagrams

Underlay Inter AS EBGP
LISP MS Federation
Multi-AS Uberlay – Scenarios

Paths:
1. Multi-AS Transit
2. Direct
3. Transit
4. Intra-AS
Summary of Requirements

- Scope overlay resources (XTRs, MS/MRs) per Underlay-AS
  - Intra-AS scopes are a secondary requirement
- Federation without intermediaries
- Scope EID state per AS or intra-AS region
- Support intra and inter-AS connectivity
- Support EID mobility across ASs
- Support EID multi-homing
- Enforce policies derived from peering agreements (match on EID enforce in the underlay)
- Support different path scenarios: Transit, Direct, Intra-AS
- Should not require RTRs at AS-Borders
Next steps

- Firm up requirements definition: draft-moreno-lisp-multi-as
- Explore applicability of DDT, document as deployment
- Explore alternative approaches if necessary
Background Information
Drivers for Re-homing EIDs across CSP Uberlay Map Systems

• Resiliency and survivability. A problem in one CSP should not impact aircraft connected to other CSPs

• Latency. Minimize RTT of signaling

• Authority assignment. CSPs must be able to autonomously render and assure services, service levels and the enforcement of policies

• Accountability and Audit. CSPs are accountable for all communications of connected devices and must be able to show complete Audit logs

• Trust. Limited across CSPs, governments and other stakeholders
Requirements for a Federated Mapping System

• EIDs should be in full control of the SP they attach to.

• The Federated Mapping System in the Uberlay should support the peering agreements by different mechanisms (e.g. engineered paths, etc.)

• Each SP should be autonomous in defining and enforcing policy for EIDs connected to their network. The policy includes constraints derived from peering agreements.

• An EID (aircraft) may multi-home to 2 or more provider networks. So policies would likely need to be enforced at a flow level (Src+Dest RLOCs rather than a Pure Destination EID level)
Options to Consider

- Cache Referral System / DDT
- New Mobility enhancements for a Federated Mapping System
- LISP De-cent
- Others …

- Document as its own draft? Or part of the Uberlay draft?
Concerns

• Avoid replicating the underlay BGP peering topology in the overlay
• The policy applied must be consistent with the underlay peering agreements
• Mobility of EID registrations between Administrative Domains may be a hard requirement. This would mean moving the point of authority in the MS federation (ruling out a few of the existing mechanisms)
Air Traffic Control (ATC) communications are Regional, but cross-CSPs.

A dedicated IP address for ATC (ATC-EID) has been proposed.

Policy: maintain the ATC EIDs local to the region, all CSPs involved must be updated.
Airline Operation Control (AOC) communications may traverse CSPs, often an Airline will work with a single global CSP.

A dedicated IP address for AOC (AOC-EID) has been proposed.

Policy: Maintain authority @ connecting CSP’s Uberlay Mapping System
- Registrations, Access Control, Accountability
- Path preferences expressed by aircraft, rendered by CSPs
ICAO – Use Case 3: Multi-link

- Aircraft connects to more than one CSP
- Aircraft sends communication preferences to A/G-Rs (A/G Interface) per GB-LISP
  - Mappings are registered with matching Priorities and Weights
  - Aircraft signals whether it is leaving a link or adding new links
- RTRs register the separate Aircraft mappings in the different Uberlay Map Servers
- Federated MS must merge the mappings for the aircraft
  - Map-Notifications
  - LISP-decent updates
  - Others?
  - Discuss whether there is a need for a site or region identifier
Some policies may dictate path restrictions
Aircraft/Airline preferences
CSP peering agreements
These (x)EID/Application level policies
must be enforceable in the Uberlay
Aircraft attaches to one or more A/G Networks

A/G Network advertises reachability of the aircraft delegated prefix (EID)

Aircraft preference and link QoS can be signalled over A/G Network

IPv6 ICAO Net X

Mapping Server maintains RLOC-EID mapping

Each AGR has RLOC address

Traffic tunnelled over Internetwork

EID | RLOC
---|---
Y | AGR1 – Priority 1, 50%
   | AGR2 – Priority 1, 50%

Map-cache:
Y via AGR2(50) & AGR1(50)

GGR needs to query which RLOC(s) serve destination EID
Ground Based LISP (GBL) – Behavior (2)

- Aircraft attaches to one or more A/G Networks
- A/G Network advertises reachability of the aircraft delegated prefix (EID)
- Aircraft preference and link QoS can be signalled over A/G Network

IPv6 ICAO Net X

Route optimised for served ground users

Each AGR has RLOC address

Traffic tunnelled over Internetwork

Map-cache:
Y via AGR3(50) & AGR1(50)

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<tr>
<th>EID</th>
<th>RLOC</th>
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<tr>
<td>Y</td>
<td>AGR1 – Priority 1, 50% AGR2 – Priority 2, 50% AGR3 – Priority 1, 50%</td>
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Aircraft preference and link QoS can be signalled over A/G Network
Air-to-ground path decided on Aircraft Router
Ground-to-air path governed by Aircraft defined metrics
Exception routing for certain Apps based on DSCP