

# LISP MS Federation

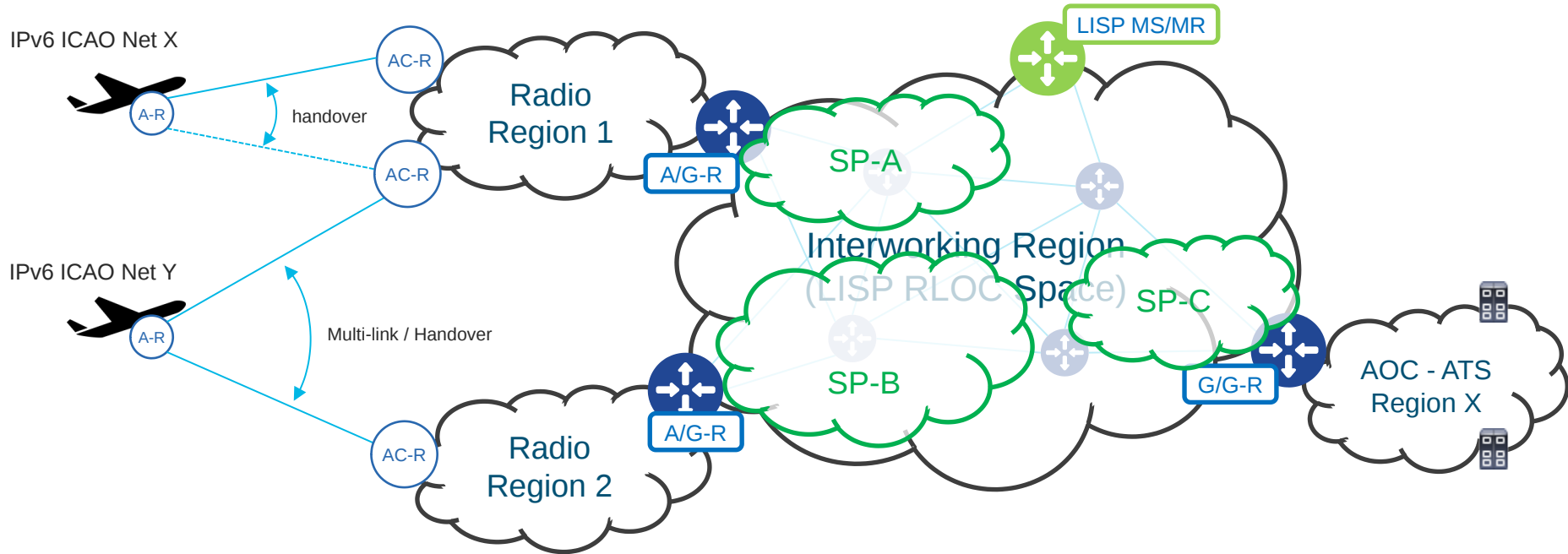
LISP-WG IETF 108 July 2020

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# Agenda

- Ground Based LISP refresher
- Multi-operator Federation Requirements
- Solutions discussed

# Ground Based LISP (GBL) - Reference Topology



## AC-R: Access Ground Router

A-R: Airborne Router

## A-E: Airborne End-system

## A/G-R: Air/Ground Router (LISP XTR)

G/G-R: Ground/Ground Router (LISP XTR)



# 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

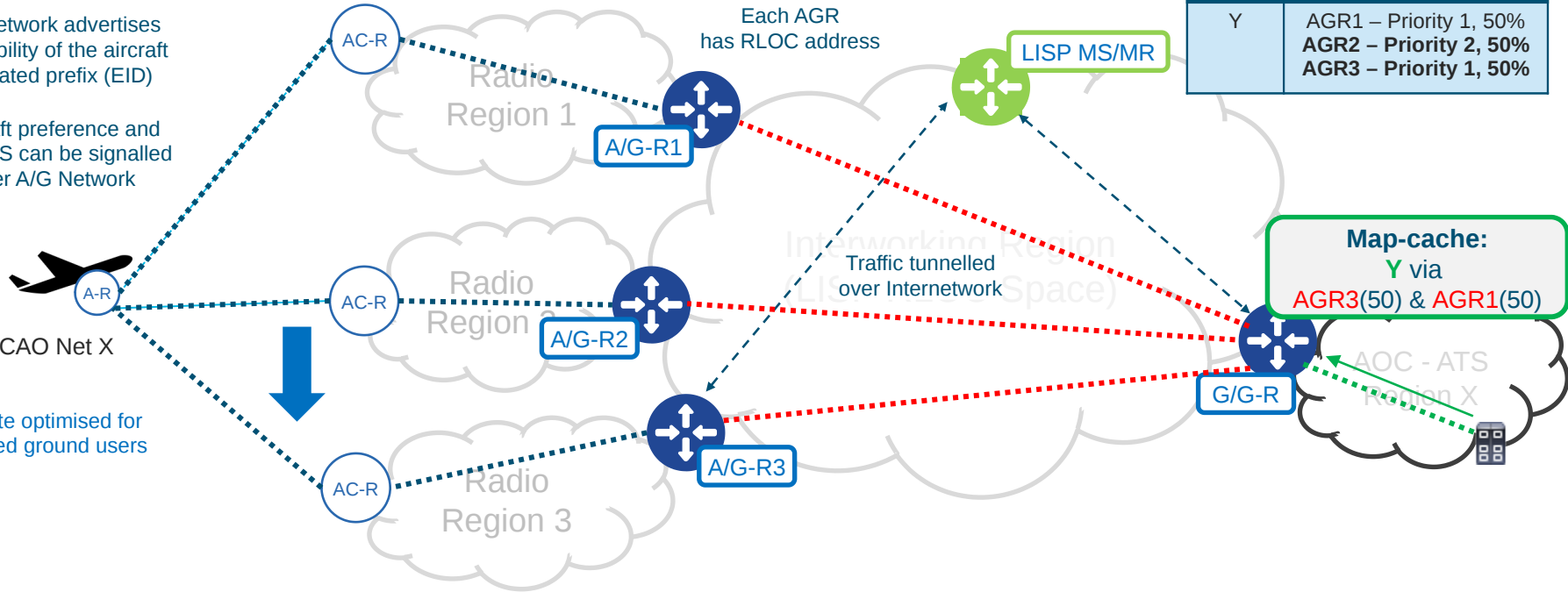
Each AGR has RLOC address

Traffic tunnelled over Internetwork

EID	RLOC
Y	AGR1 – Priority 1, 50% AGR2 – Priority 2, 50% AGR3 – Priority 1, 50%

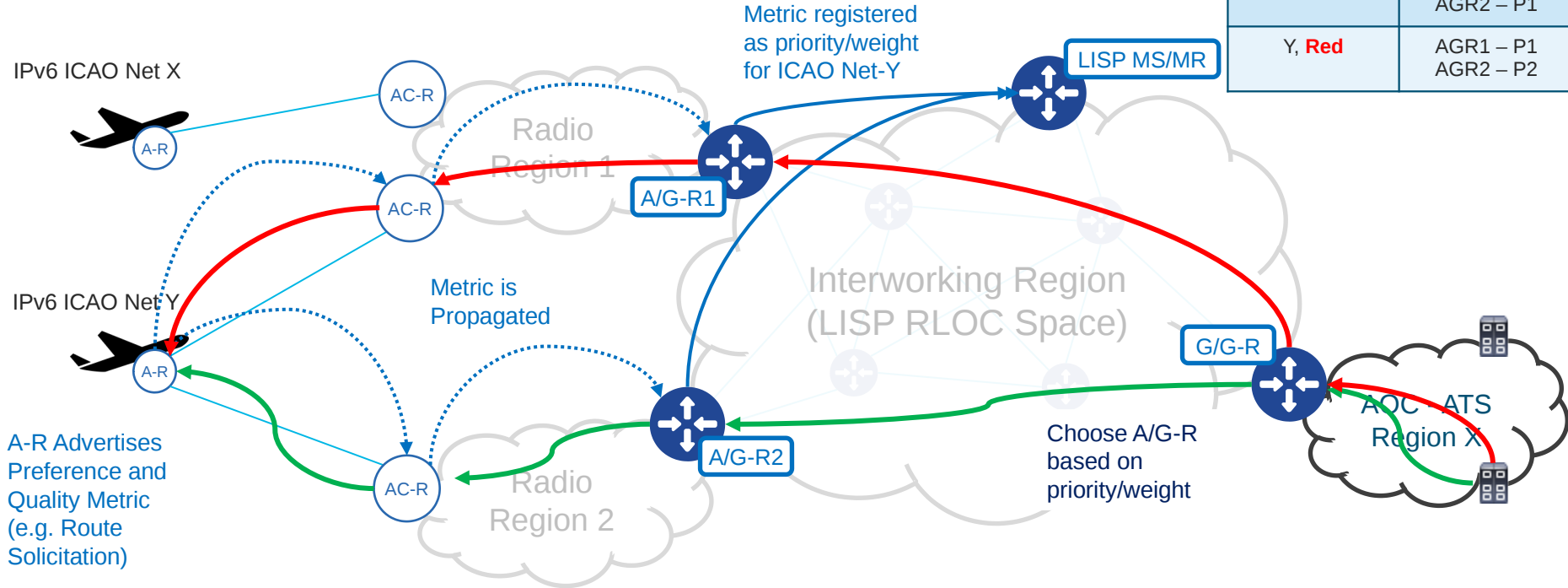
**Map-cache:**  
Y via  
AGR3(50) & AGR1(50)

AOC - ATS  
Region X



# Per Application Path Preference

EID (IP, DSCP)	RLOC
Y, <b>Green</b>	AGR1 – P2 AGR2 – P1
Y, <b>Red</b>	AGR1 – P1 AGR2 – P2

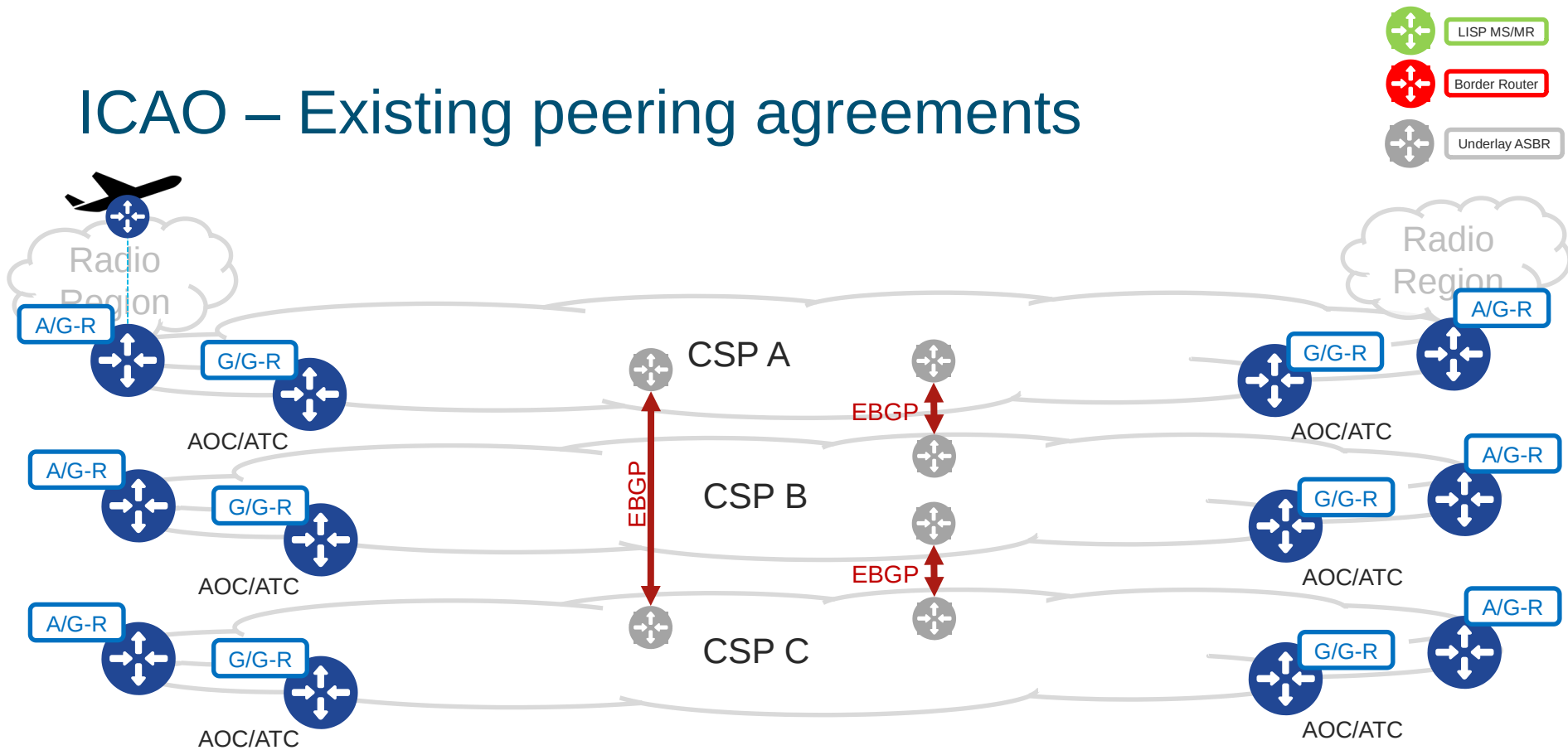


Air-to-ground path decided on Aircraft Router  
Ground-to-air path governed by Aircraft defined metrics  
Exception routing for certain Apps based on DSCP

# 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. Each provider owns and operates their own xTRs, border-RTRs and Map Servers.
- 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.

# ICAO – Existing peering agreements

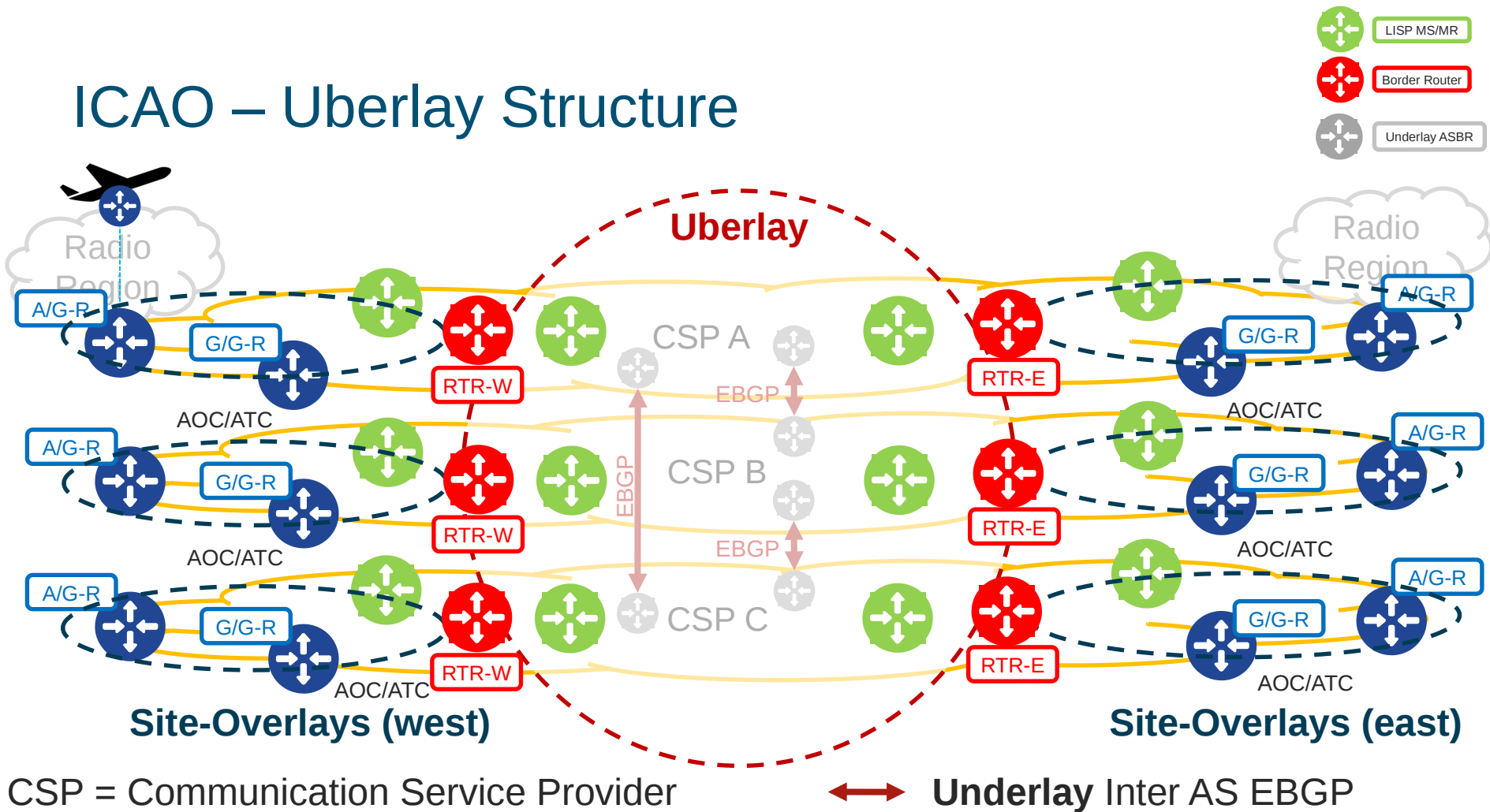


CSP = Communication Service Provider

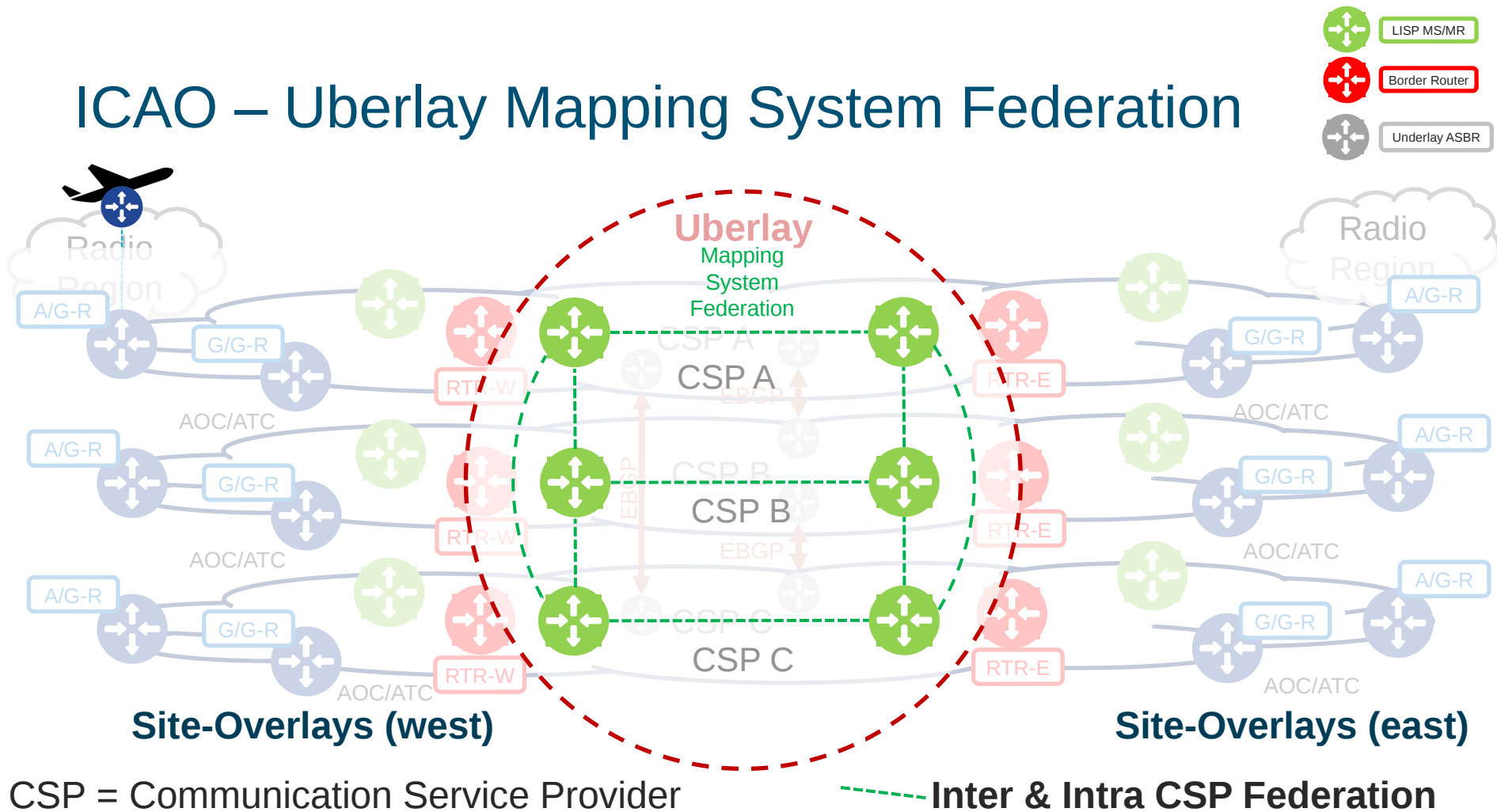
↔ **Underlay Inter AS EBGP**



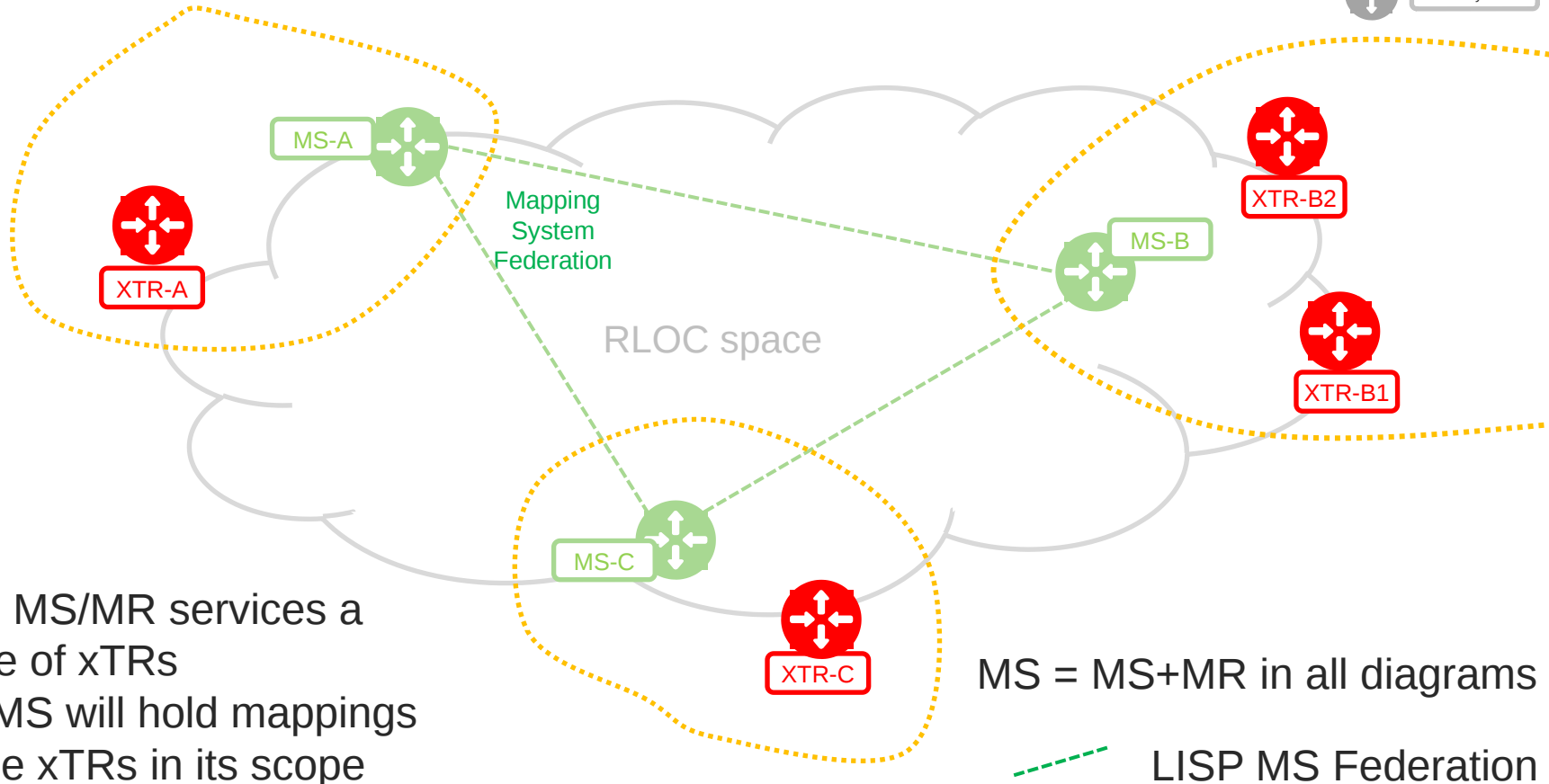
# ICAO – Uberlay Structure



# ICAO – Uberlay Mapping System Federation

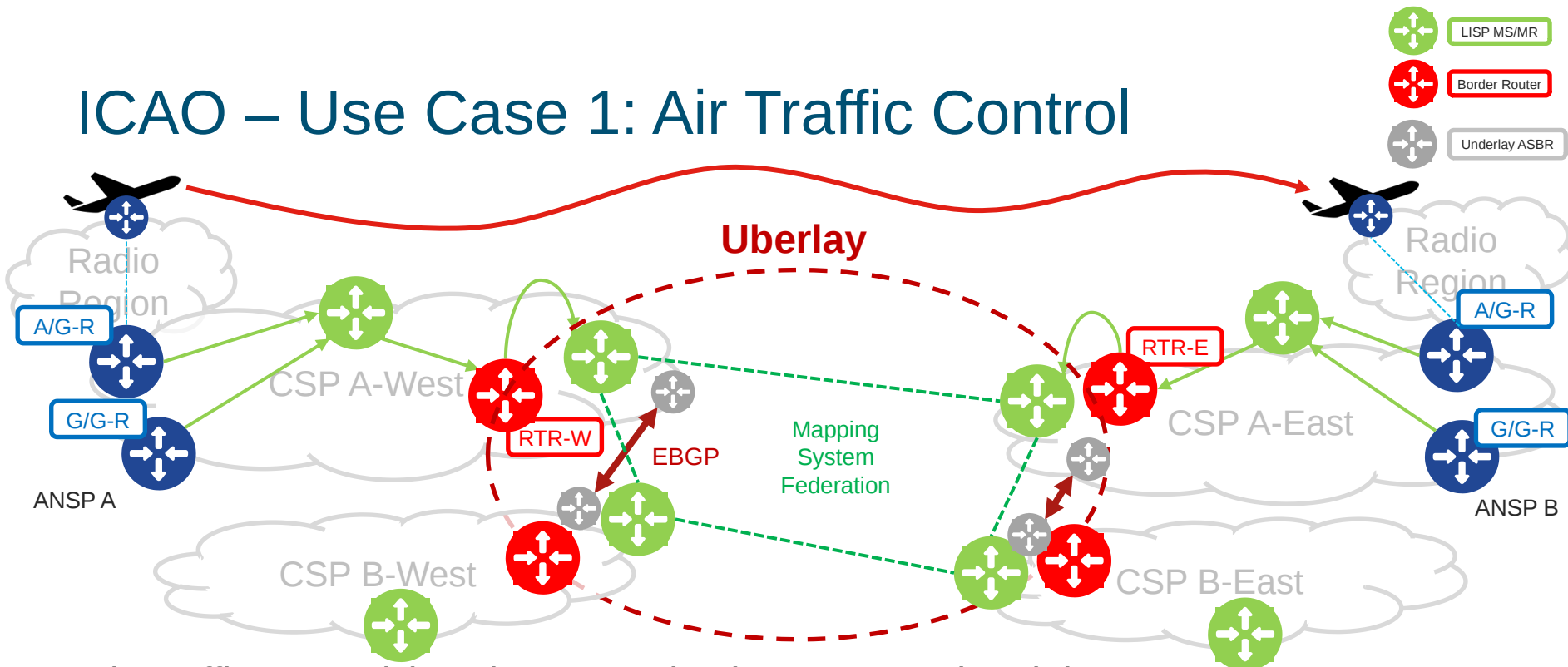


# Generalized Mapping System Federation



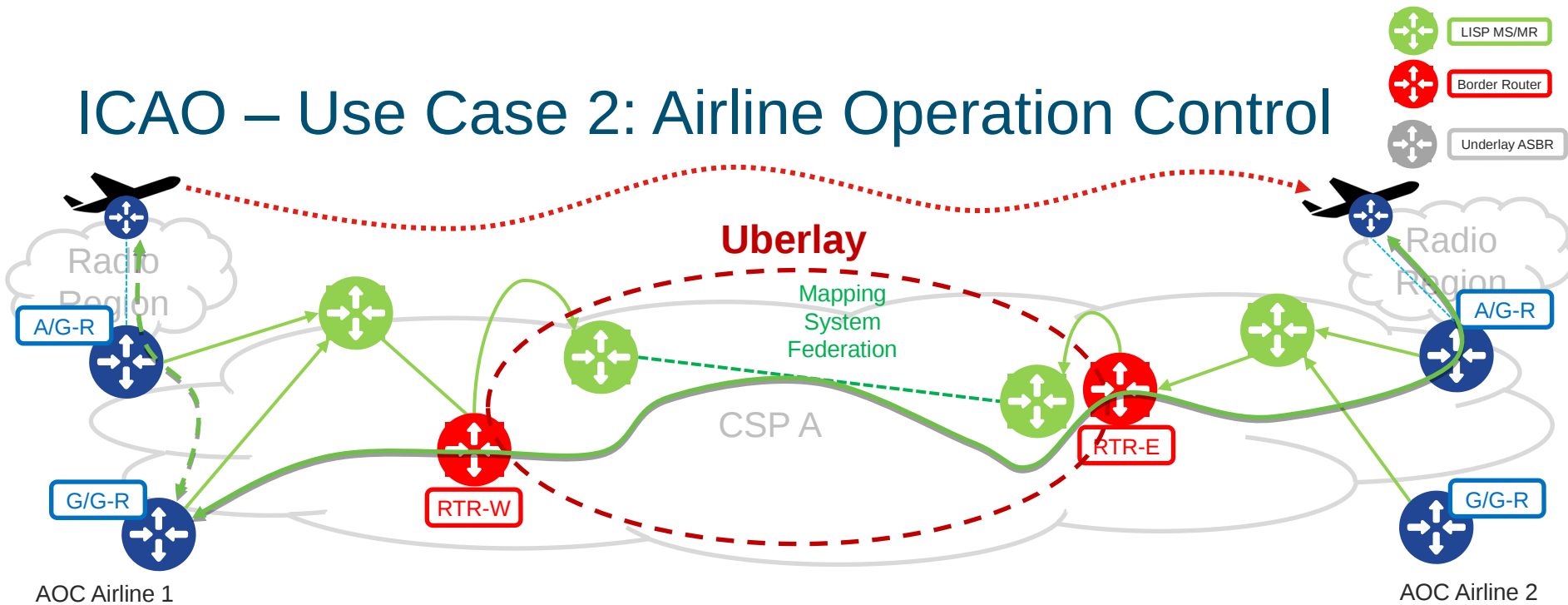
- Each MS/MR services a scope of xTRs
- The MS will hold mappings for the xTRs in its scope

# ICAO – Use Case 1: Air Traffic Control



- 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

# ICAO – Use Case 2: Airline Operation Control



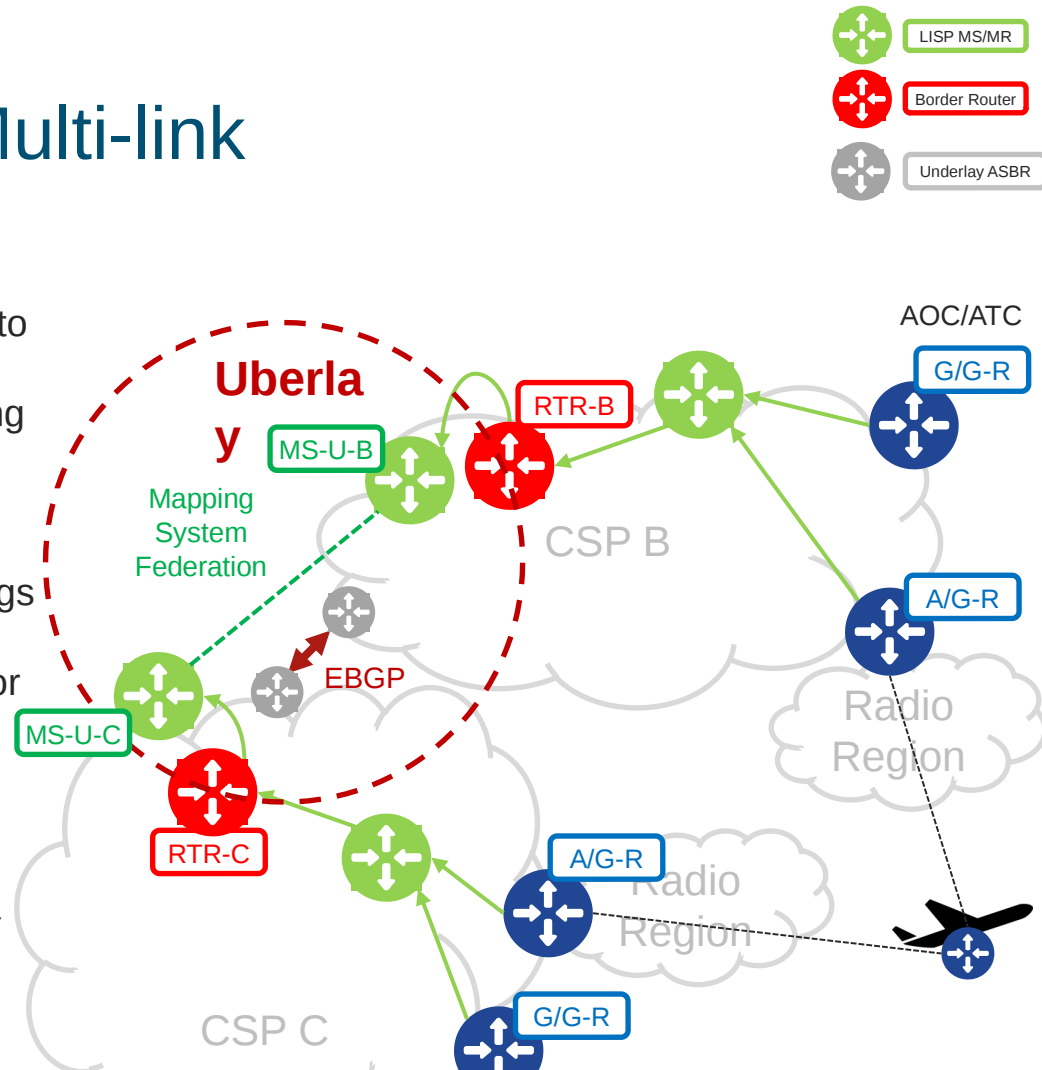
- Airline Operation Control (AOC) communications may traverse CSPs, often an Airline will work with a single global CSP
- A dedicated IP address for AOC (AOC-EID) has been proposed.
- Policy: Maintain authority @ connecting CSP's Uberlay Mapping System
  - Registrations, Access Control, Accountability
  - Path preferences expressed by aircraft, rendered by CSPs

# Drivers for Re-homing EIDs across CSP Uberlay Map Systems

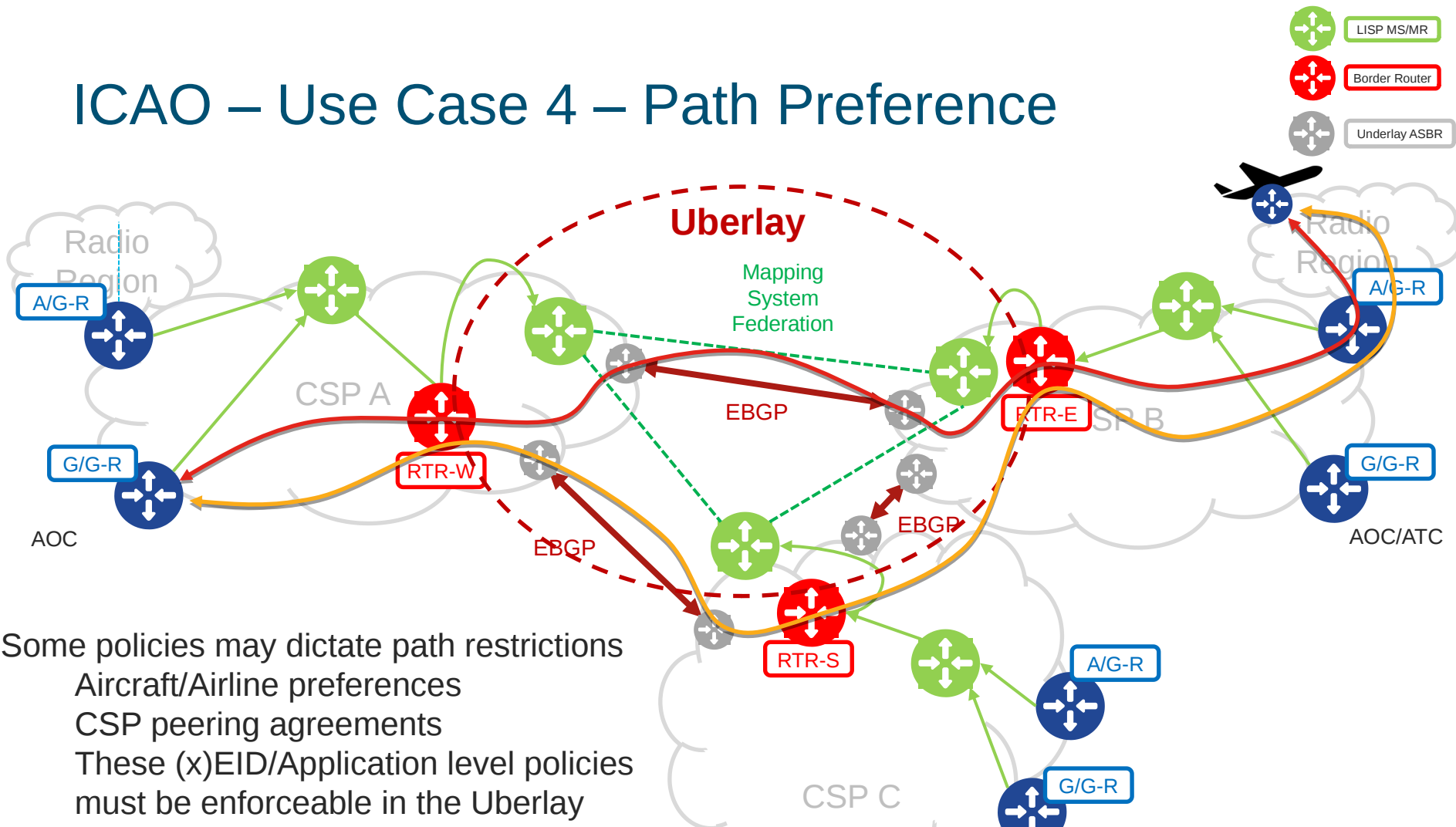
- Resiliency and survivability. A problem in one CSP should not impact aircraft connected to other CSPs
- Latency. Minimize RTT of signaling
- Authority assignment. CSPs must be able to autonomously render and assure services, service levels and the enforcement of policies
- Accountability and Audit. 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

# 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



# ICAO – Use Case 4 – Path Preference





# 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

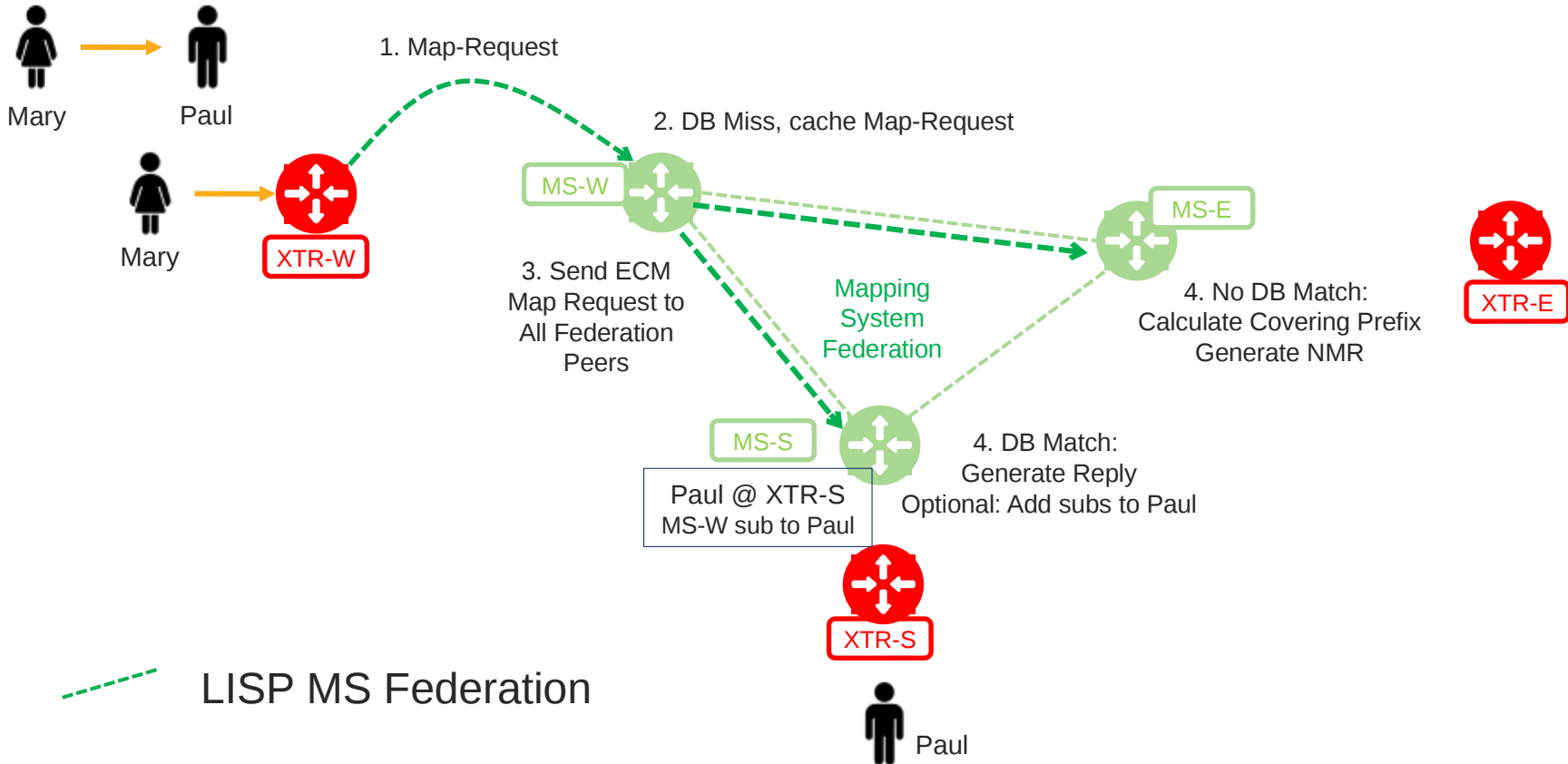
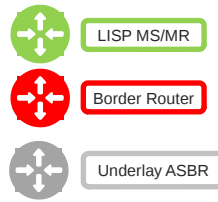
- Cache Referral System / DDT
  - New Mobility enhancements for a Federated Mapping System
  - LISP De-cent
  - Others ...
- 
- Document as its own draft? Or part of the Uberlay draft?

# Concerns

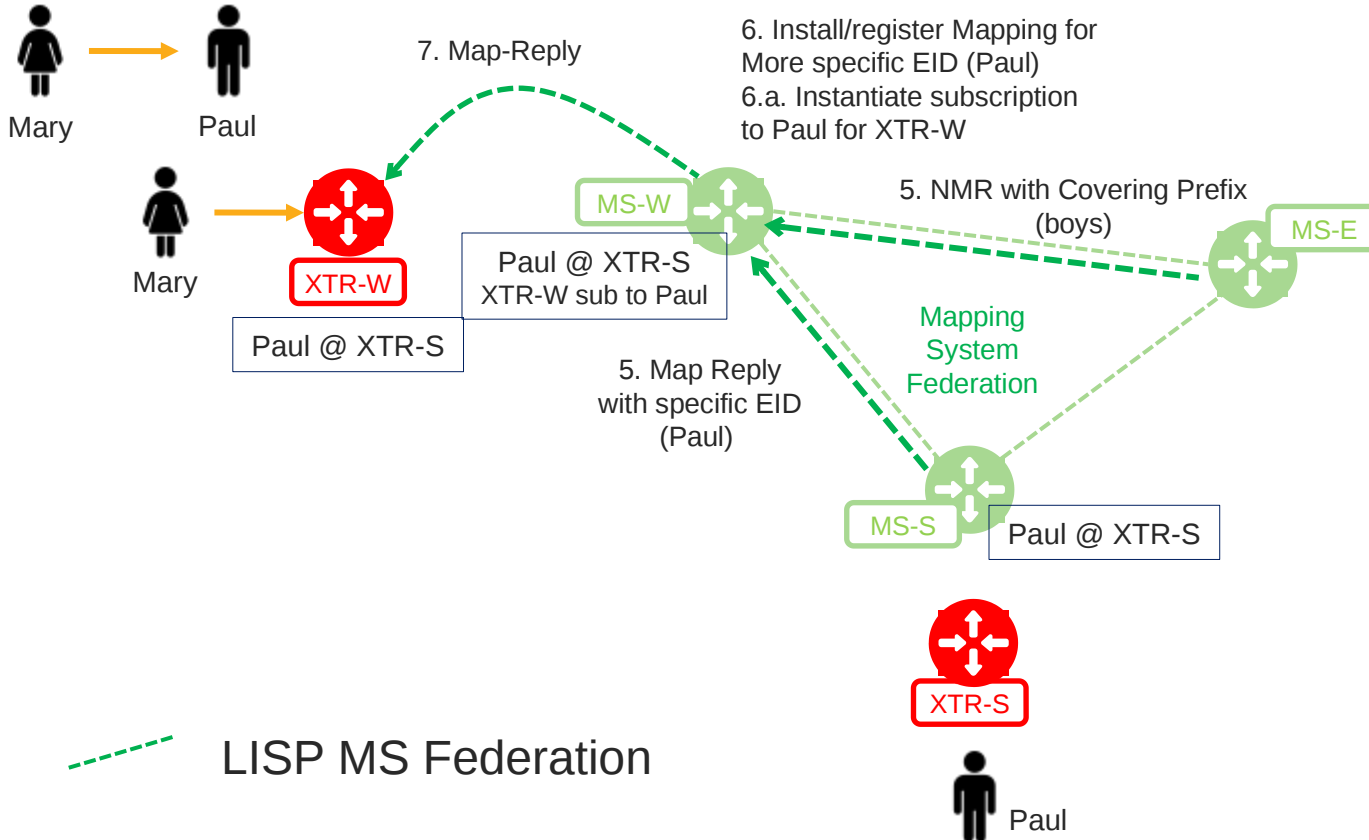
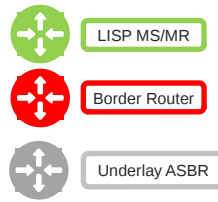
- Avoid replicating the underlay BGP peering topology in the overlay
- The policy applied must be consistent with the underlay peering agreements
- In a federated environment, the policy is flow specific. Destination based policies may not suffice.
- Mobility of EID registrations between Administrative 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)

# Uberlay extensions proposal

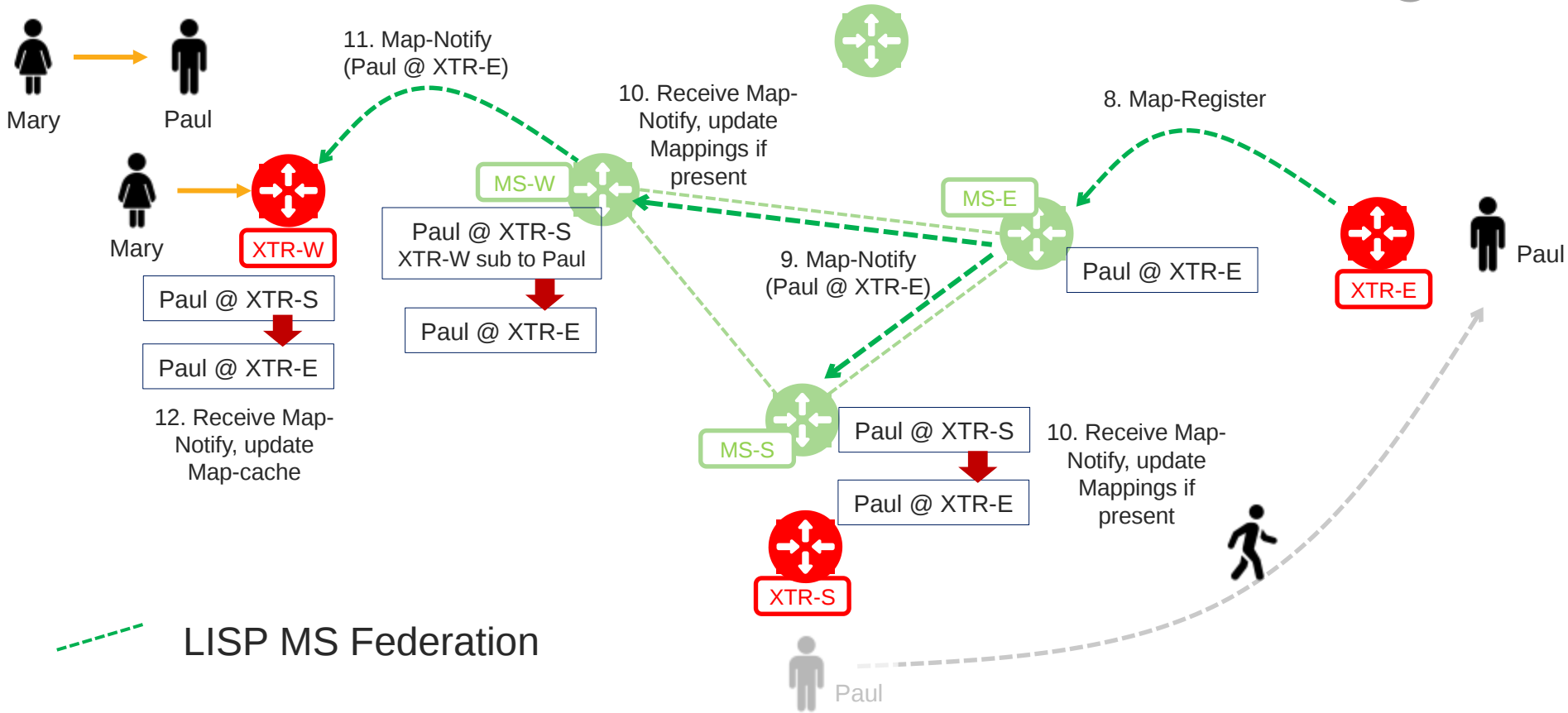
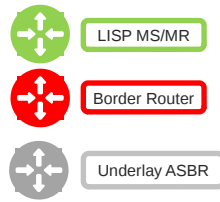
# MS Federation – Map-Request - 1



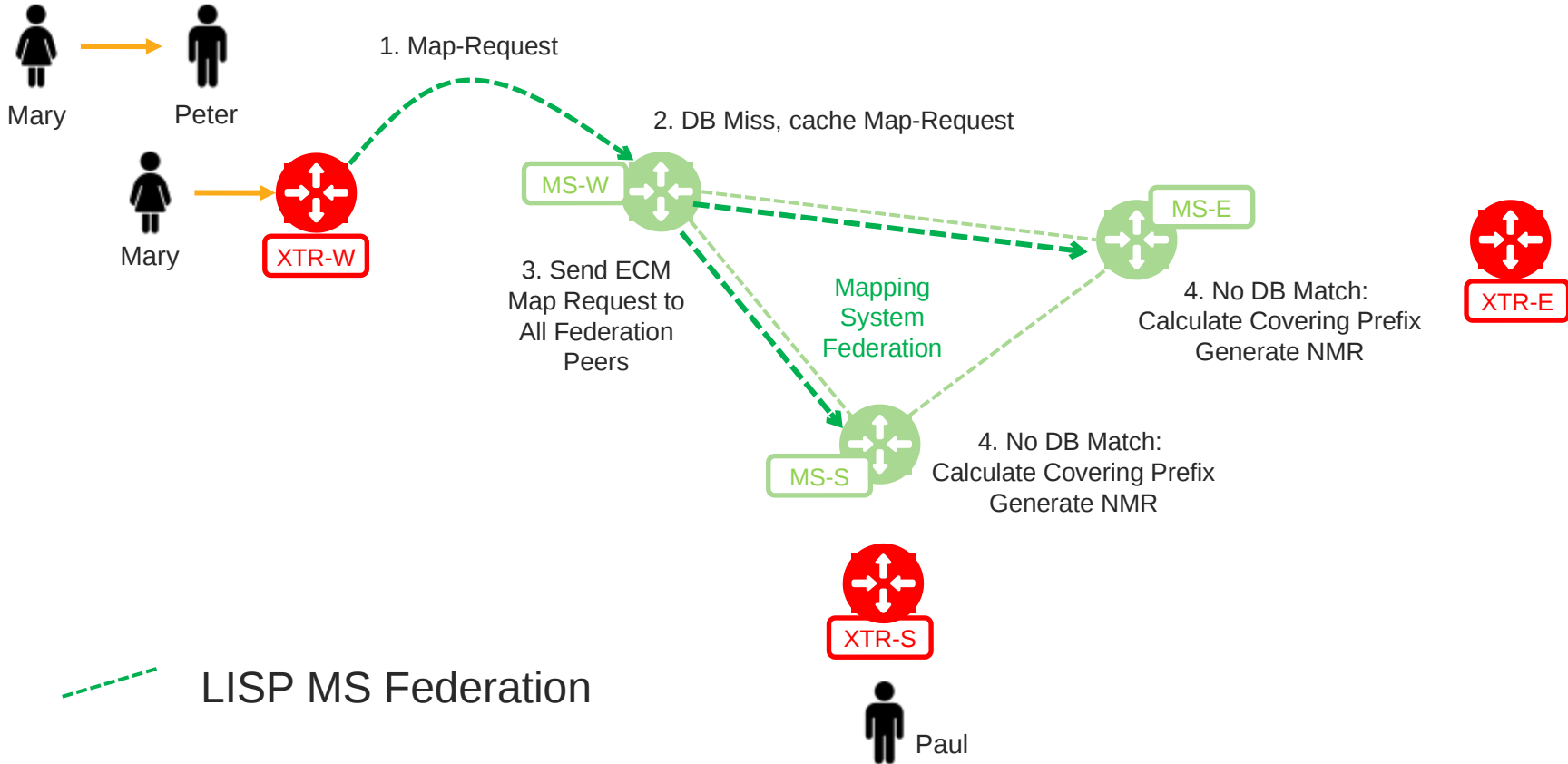
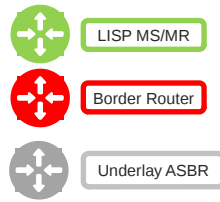
# MS Federation – Map-Reply - 2



# MS Federation – Registrations/EID Moves - 3

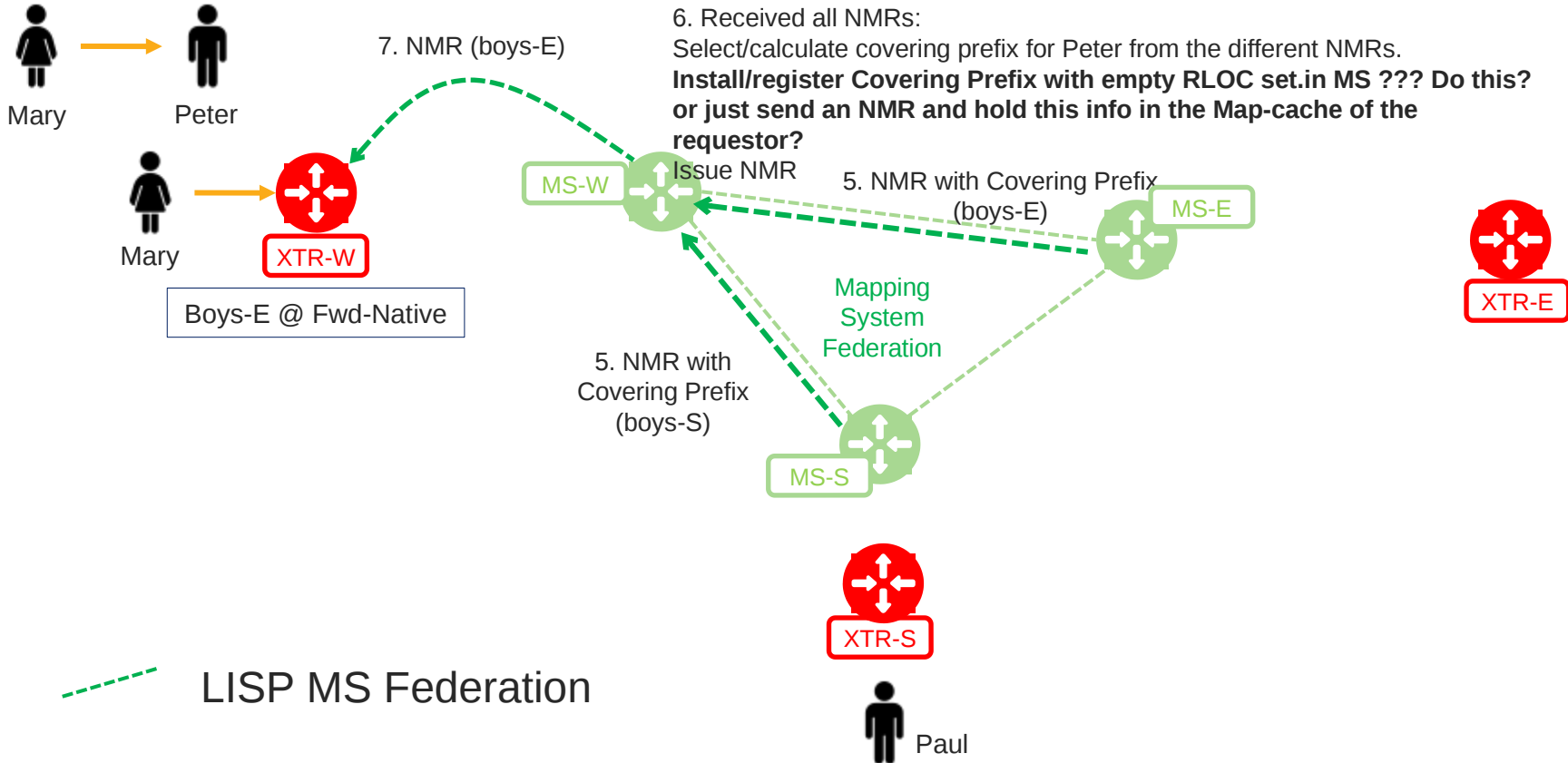
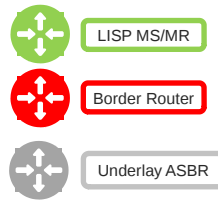


# MS Federation – Unknown Destinations – 1a

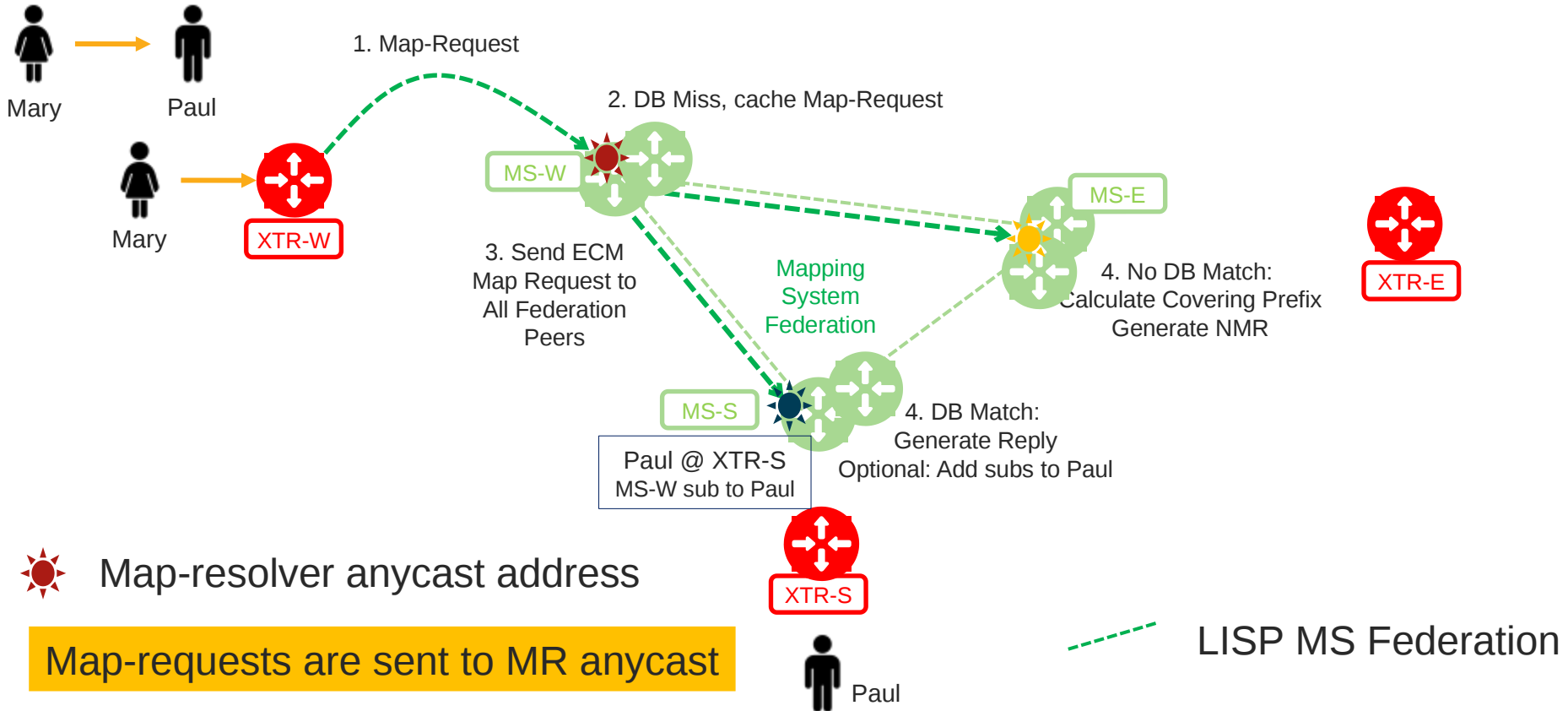
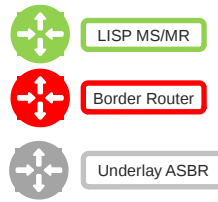




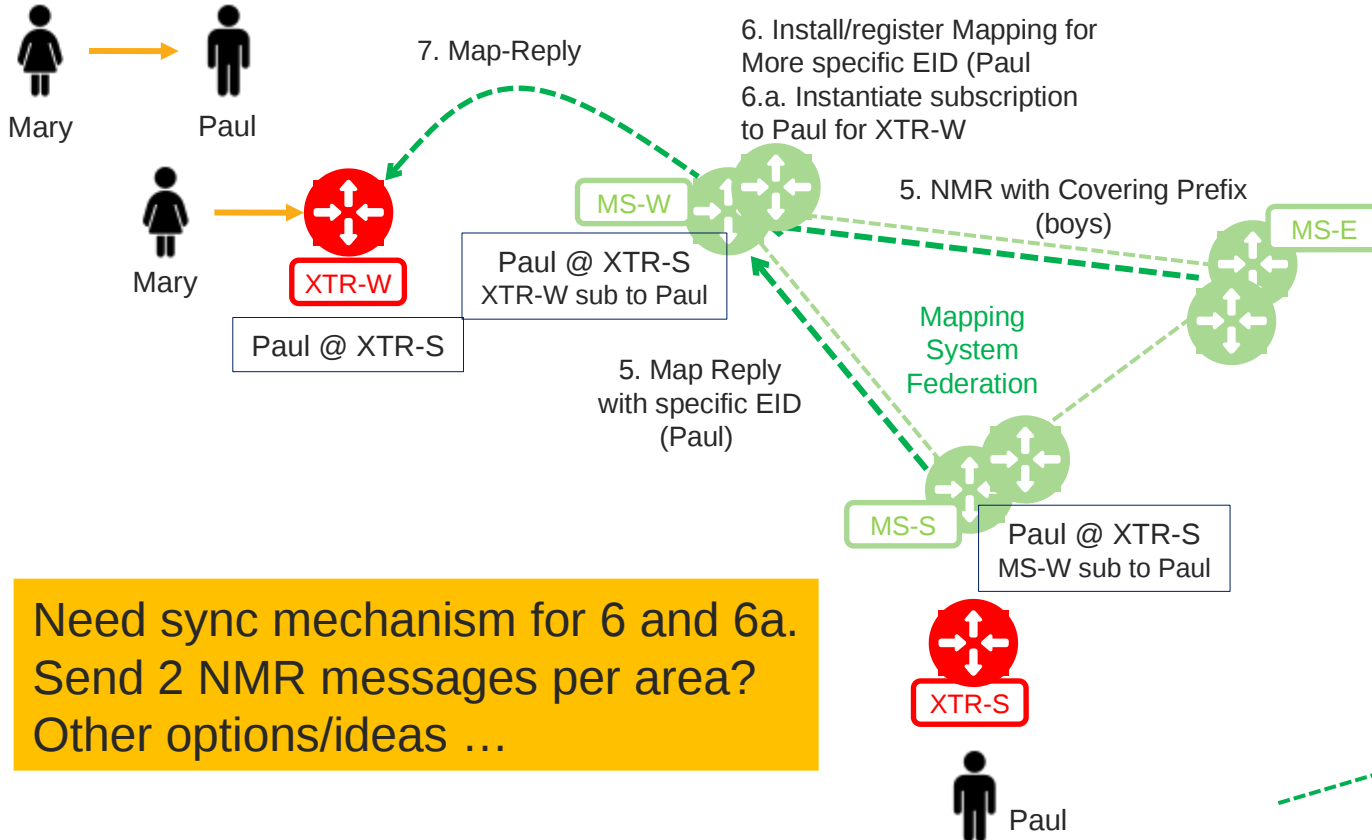
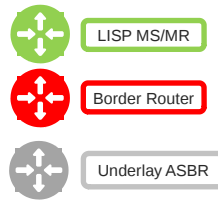
# MS Federation – Unknown Destinations – 2a



# MS Federation Resiliency – Map-Request – 1b



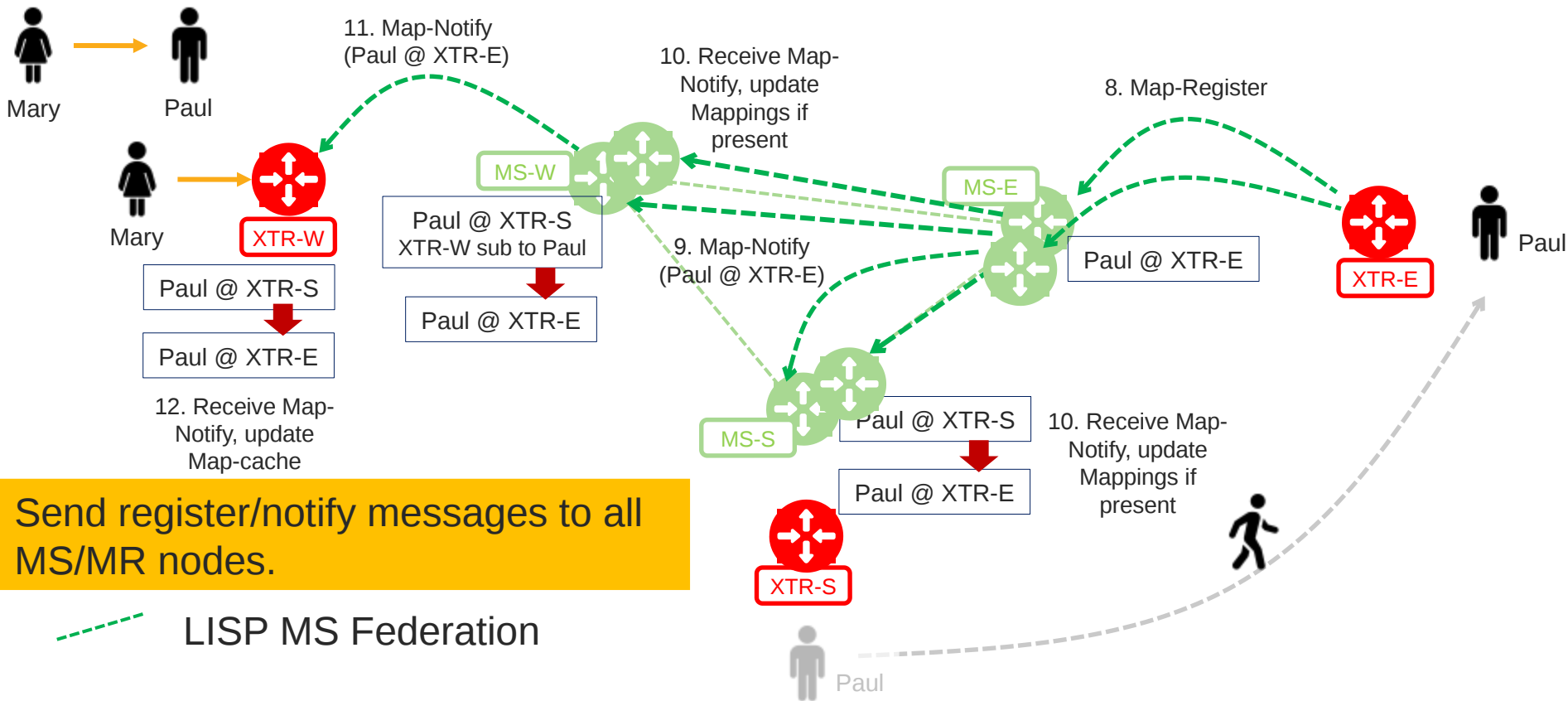
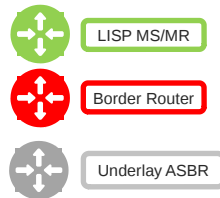
# MS Federation Resiliency – Map-Reply – 2b



Need sync mechanism for 6 and 6a.  
Send 2 NMR messages per area?  
Other options/ideas ...

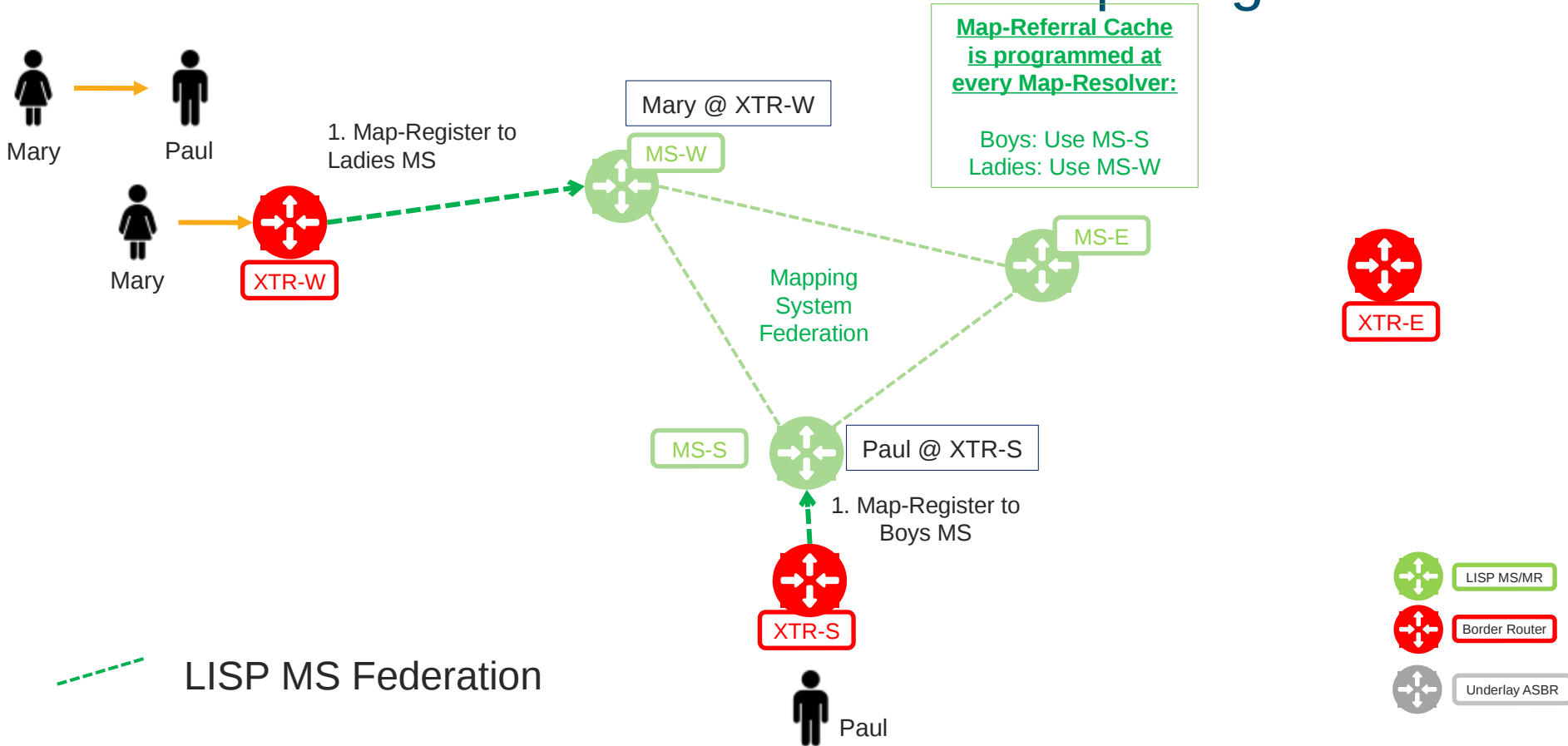
LISP MS Federation

# MS Federation Resiliency – Registrations/EID Moves – 3b

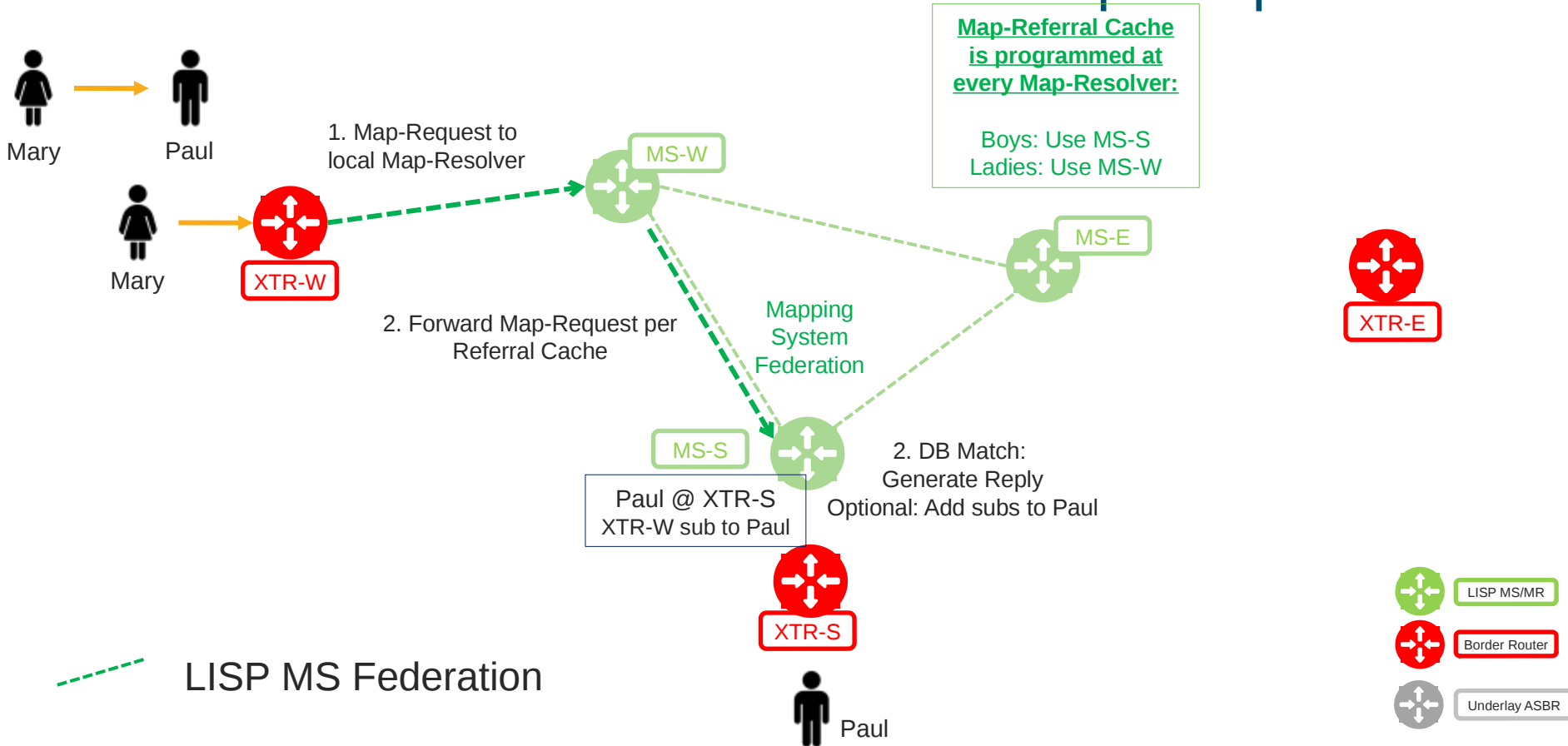


# Cache Referral System

# MS Federation: Referral Cache – Map-Register - 0



# MS Federation: Referral Cache – Map-Request - 1



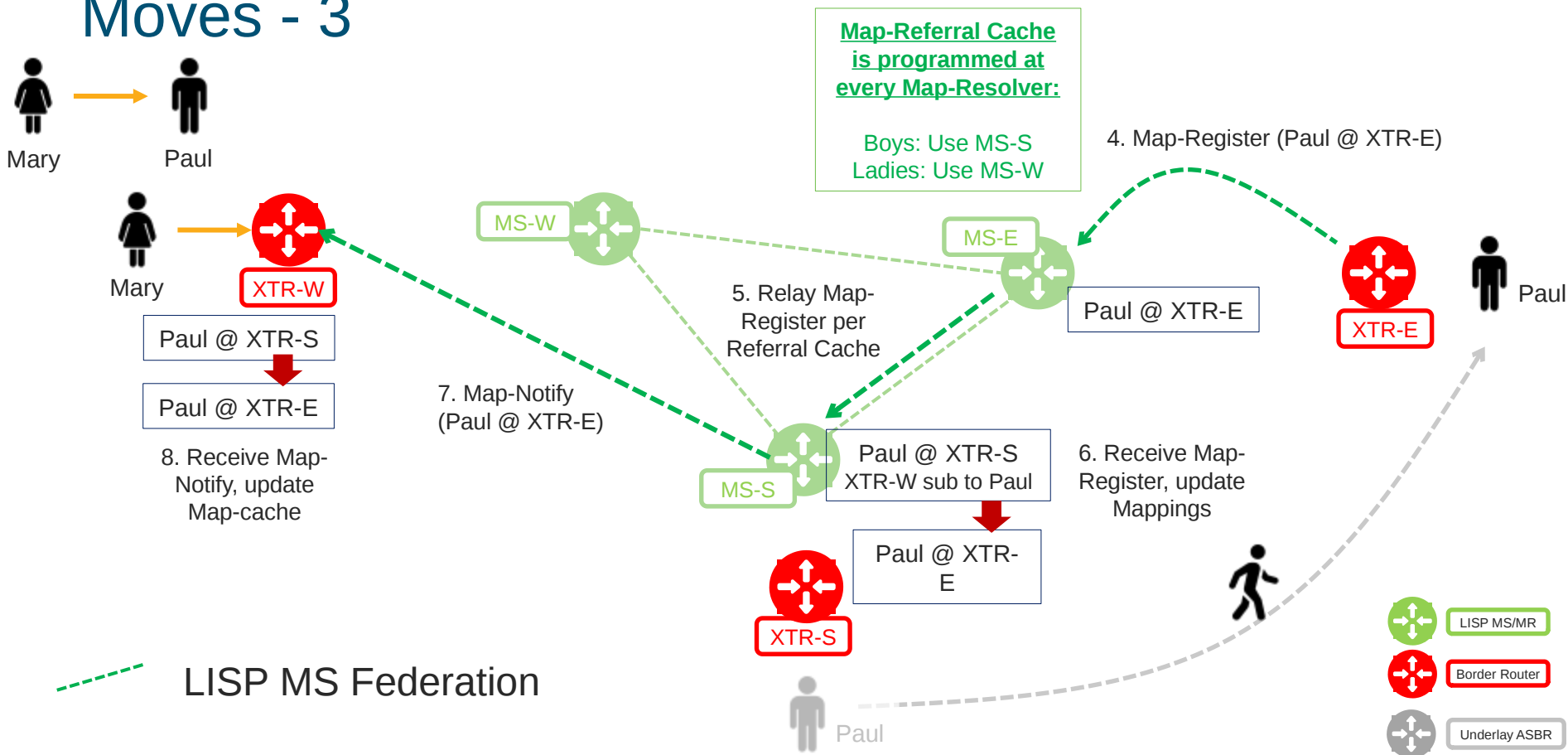
Map-Referral Cache is programmed at every Map-Resolver:

Boys: Use MS-S  
Ladies: Use MS-W





# MS Federation: Referral Cache – Registrations/EID Moves - 3



# Pros/Cons

- Pros:
  - Simple model, aligned with DDT logic (single tier).
- Cons:
  - May not satisfy all requirements. SP wants control over EIDs connected to their network so that policies can be enforced.
  - Assumes certain SPs are authoritative for certain EID ranges, regardless of where they connect.