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FIRMS: a Future InteRnet Mapping System

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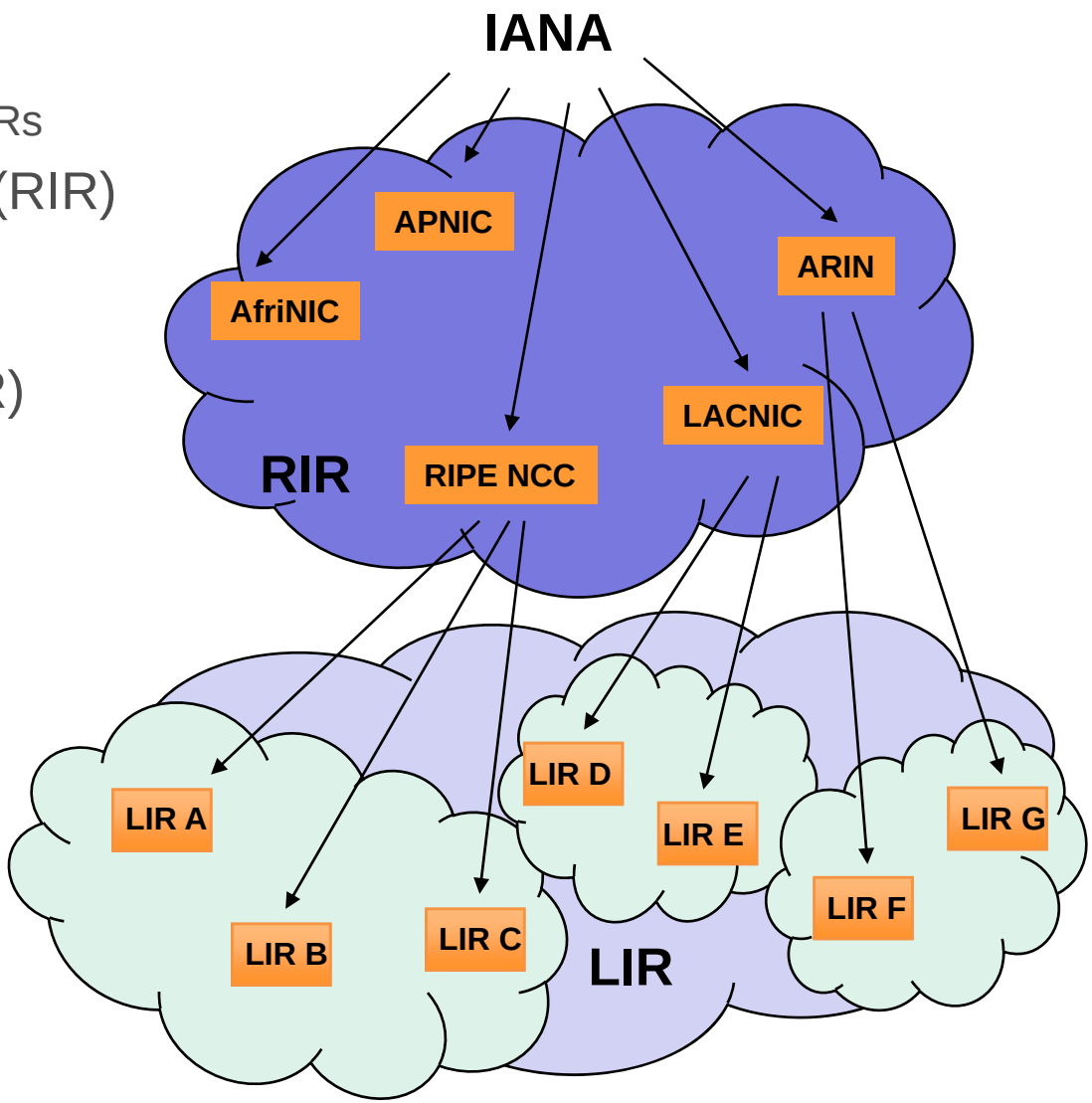
Overview

- The FIRMS architecture
  - Basic components
  - Operation
  - Scalability
  - Security
  - Resilience
- Summary

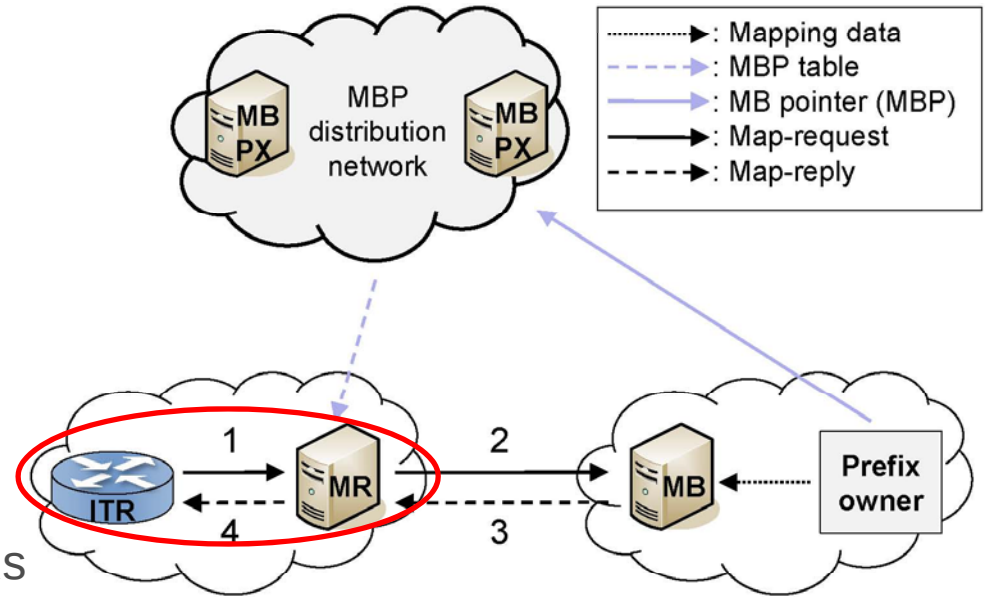
ID Assignment Structure (Example)

- IANA
  - Delegates ID ranges to 5 RIRs
- Regional Internet registry (RIR)
  - Assigns ID ranges to users
  - Delegates ID ranges to LIRs
- Local Internet registry (LIR)
  - Associated with single RIR
  - Assigns ID ranges to users



Basic Components

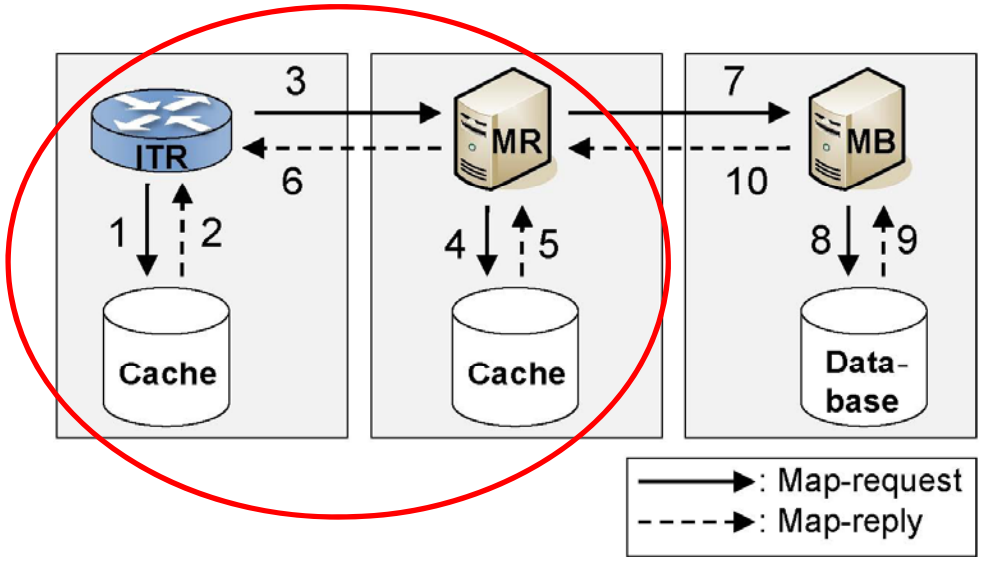
- Map-base (MB)
  - Authoritative source of mapping data
  - EID/EID prefix → RLOC list
  - Data controlled by ID owner or trusted agent
- MB pointer (MBP)
  - ID prefix → MB list
- Map-resolver (MR)
  - Answers map-requests
  - Holds MBP table
  - Finds and queries MB
  - Caches entries
- MBP distribution network
  - Collects all MBPs in table
  - Pushes MBP table to all MRs
- Ingress tunnel router (ITR)
  - Needs mapping data
  - Issues requests to MR
  - Caches entries
- ITR and MR may be collocated



Cascading Mapping Retrieval

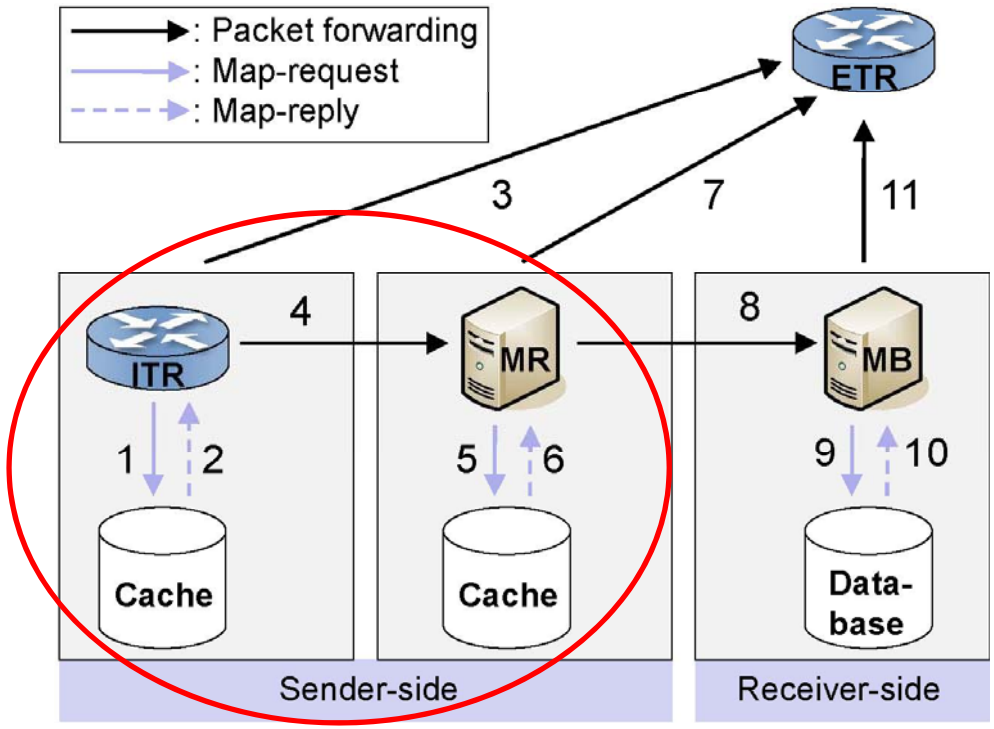
- ITR
  - Caches mappings
  - Queries MR in case of cache miss
- Map-resolver (MR)
  - Caches mappings
  - Returns mapping if available
  - Otherwise cache miss
    - Looks up MB in MBP table
    - Queries MB
    - Stores mapping on receipt
    - Forwards mapping to ITR
- Map-base (MB)
  - Holds mappings in DB
  - Answers map-requests

- Involved entities
  - Depends on caches
  - ITR
  - ITR and MR
  - ITR, MR, and MB



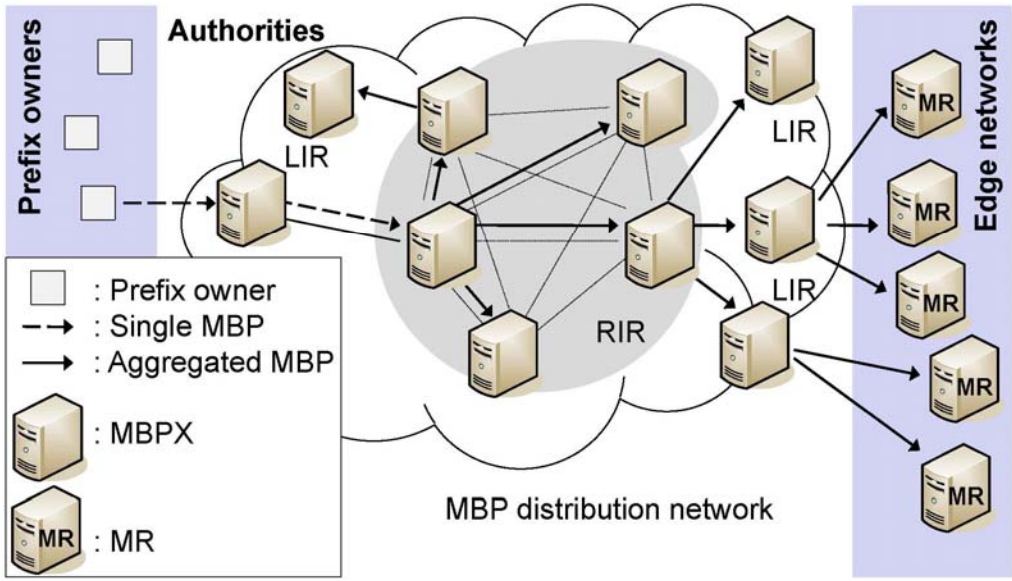
Cascading Packet Forwarding

- ITR
  - Sends packets to ETR
  - Cache miss
    - Tunnels packet to MR
- Map-resolver (MR)
  - Sends packets to ETR
  - Cache miss
    - Tunnels packet to MB
- Map-base (MB)
  - Sends packets to ETR



MBP Distribution Network

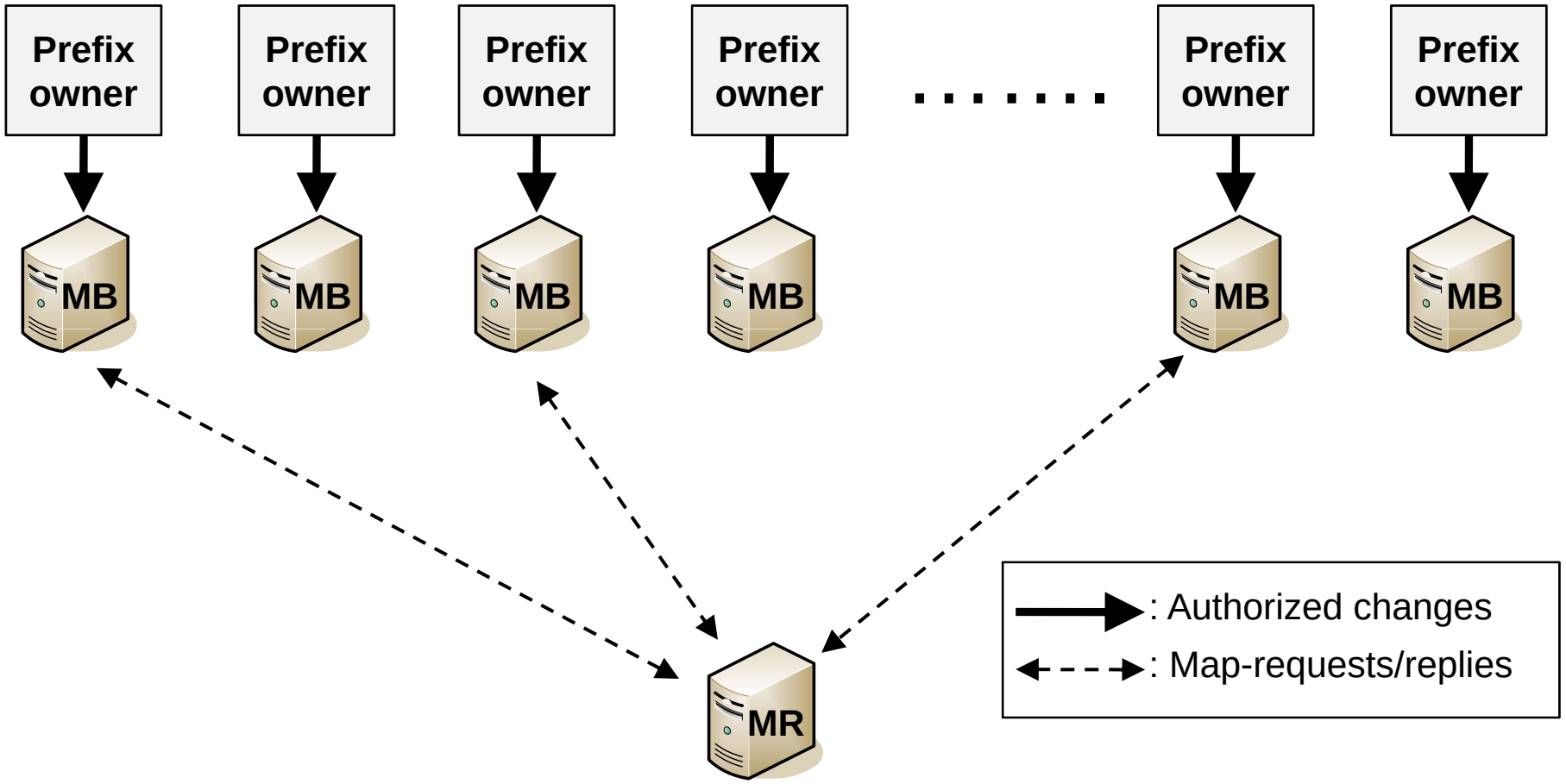
- LIRs/RIRs
  - Run MBP exchange nodes (MBPX)
- Prefix owners
  - Register MBP at LIR/RIR
  - LIR forwards MBP to RIR



- RIR
  - Constructs MBP table
  - Sequentially numbered updates (SNUs)
- LIRs/RIRs
  - Push MBP info to
    - Own LIRs and other RIRs
    - Registered MRs
  - MBP info
    - Entire table on system start
    - Incremental SNUs under normal operation

Normal Operation without MBP Distribution Network

- Map-requests do not need public infrastructure

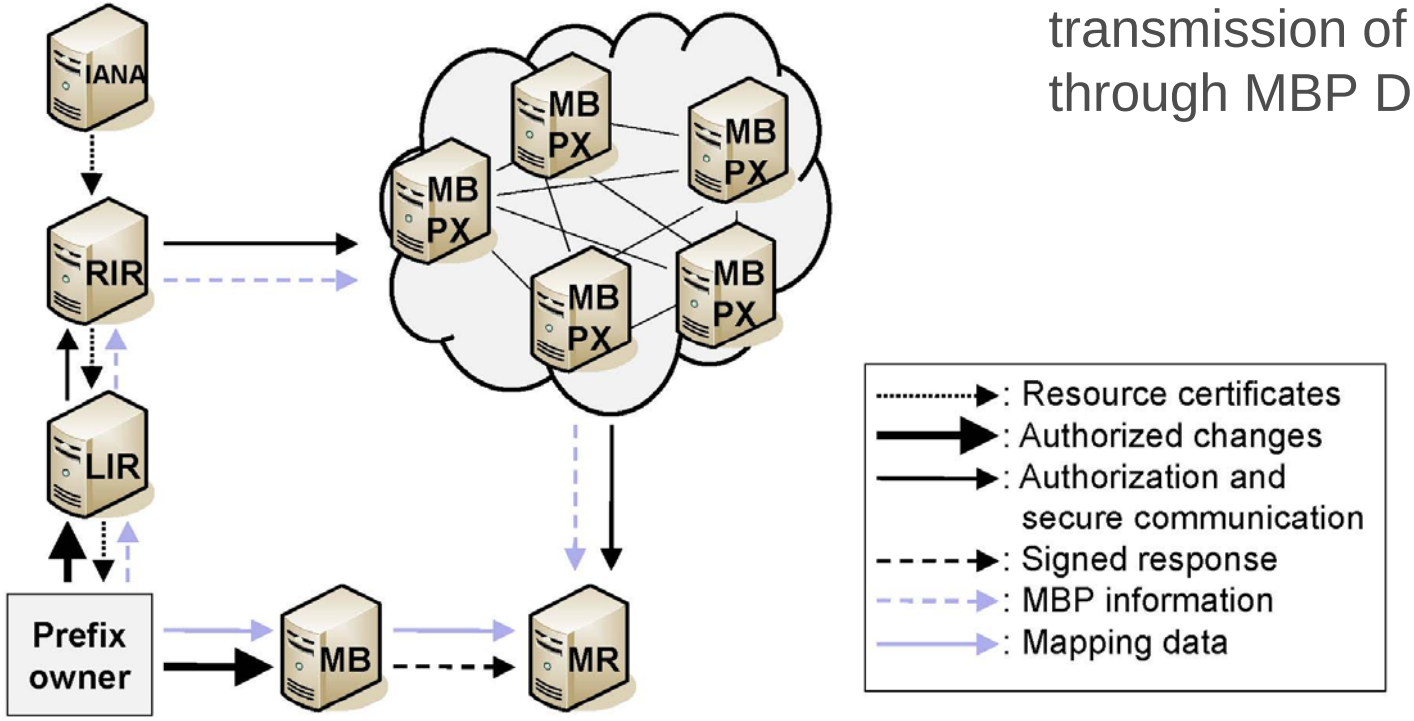


Scalability

- Does a global MBP table scale?
  - Size: 170 MBytes
    - 1,000,000 allocated prefixes ([45] R. NCC, “RIS Statistics Report,” http://www.ris.ripe.net/weekly-report/)
    - Average size of MBP: 170 bytes
  - Churn of MBP table: 160 KBytes/day
    - MBP changes every 3 years ([47] P. Martin, “Zen Internet UK Small Medium Enterprise (SME) survey,”)
  - Update traffic at RIRs: 12 KByte/s
    - RIR with more than 6000 LIRs (subscribers)

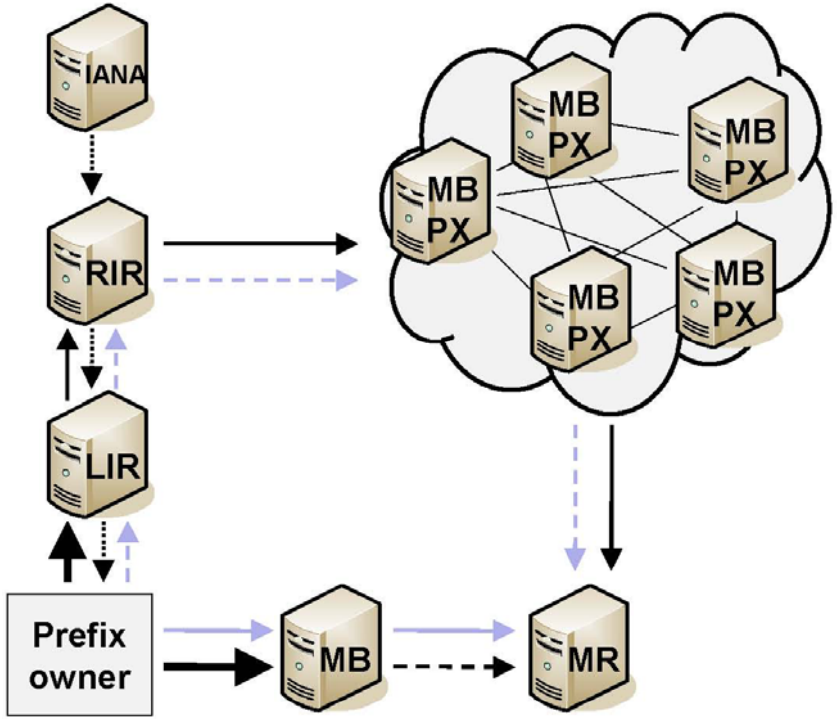
Security Concept – Securing MBP Information

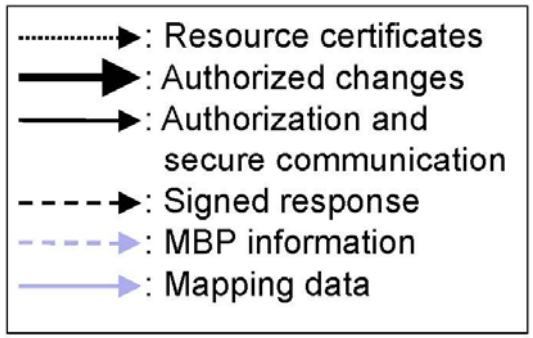
- Resource certificates for EID sub-spaces
  - Assigned in a chain from IANA over RIRs, LIRs to prefix owners
- Prefix owners
  - Use resource certificates for authentication at LIR and MB
- LIRs/RIRs
  - Authorization and secure transmission of MBP data through MBP DN to MR



Security Concept – Securing Mapping Data

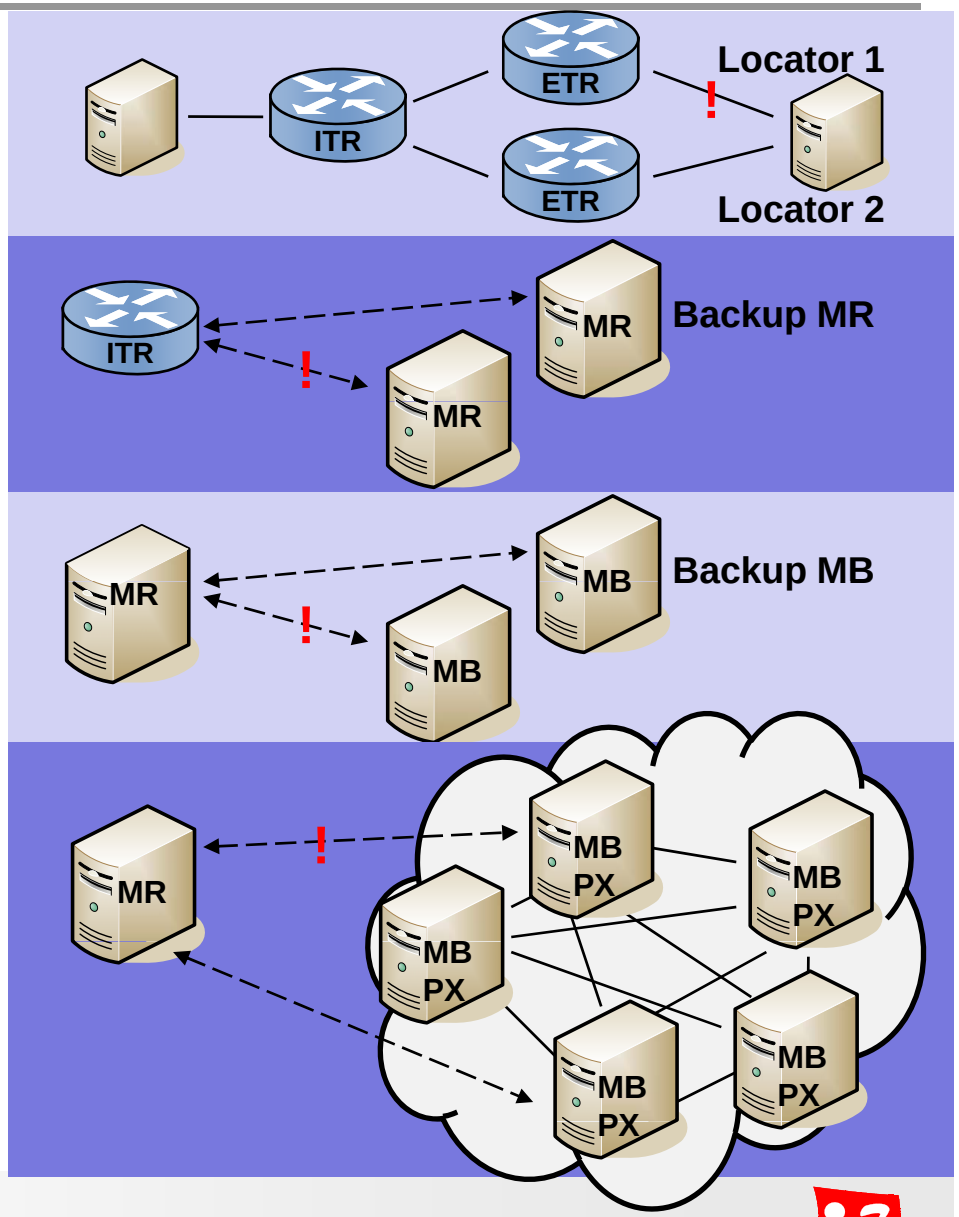
- Prefix owner
  - Includes public key of MB in MBP
- Map-bases
  - Sign map-replies with private key
- Map-resolvers
  - Extract public keys of MBs from MBP table
  - Validate map-replies using these keys





Resilience

- Locator failure
  - Mapping data contains multiple locators
- Map-resolver failure
  - ITRs configured with multiple MRs
- Map-base failure
  - MBP contains multiple MBs
- MBPX failure
  - Map-resolvers register with multiple MBPXs
  - MBP table available in multiple MBPXs



Summary

- Assumption: ID prefixes assigned by authorities
- Components
  - Map-bases (MBs)
  - Map-resolvers (MRs)
  - MB pointer distribution network
- Properties
  - Packet forwarding in case of cache miss
  - Strong trust
  - Strong resilience
  - Public infrastructure not needed for queries
- Further steps
  - Simulation in Omnet
  - Prototype in G-Lab