APT Incremental Deployment

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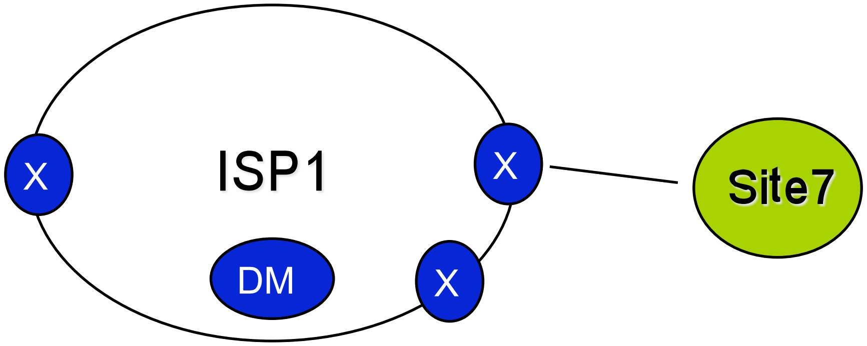
http://www.cs.ucla.edu/~meisel/draft-apt-incremental-00.txt

Why This Talk

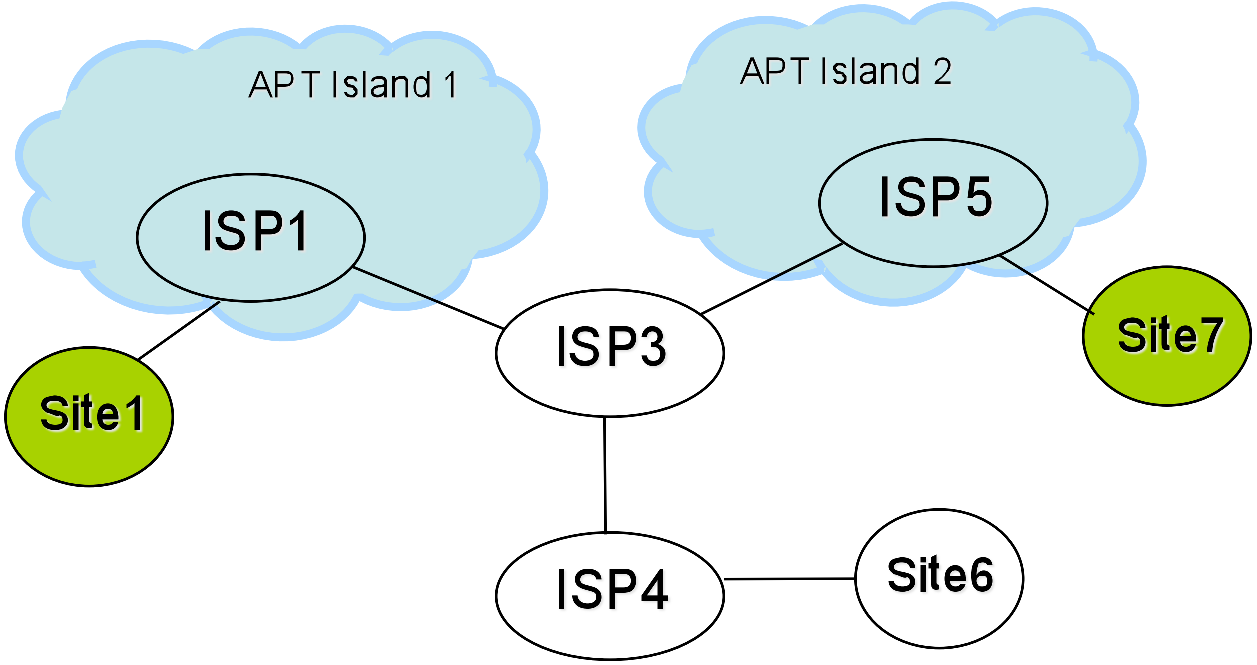
- Incrememtal deployability is one of major factors in APT design
- Something useful learned from the exercise
  - still in exploration/comparison stage
  - So this talk differs from the earlier draft...
- Come here to share and discuss
- Feedback most welcome

Basic Ideas for Inremental Deployment

- Align benefit with deployment cost: ISPs benefit, they should deploy
- Day-0
  - Must be a unilateral decision to turn on APT
    - Map-n-encap: need both tunnel points under one party's control
  - Must provide incentives for the first mover
    - Being able to reduce BGP table size: remove internal customers' prefixes from routing to mapping



APT Incremental Deployment

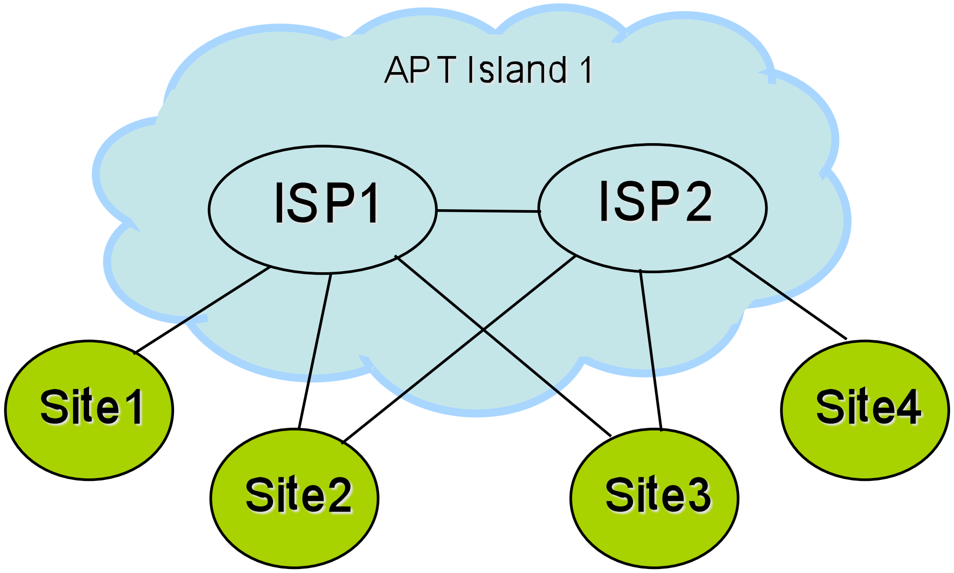


- Day-1: Expect a few APT regions in a BGP world
  - Benefit first mover: remove an APT island's internal customers' prefixes from routing to mapping
  - No harm/no change to the rest: inject *those prefixes* into BGP table outside APT island

Terminology

- APT AS: A transit AS that has deployed APT
- APT Island: A topologically connected set of APT ASes
  - The smallest possible island: a single AS
- Island Mapping Table: all the mapping entries for the customer sites of a given APT island
  - Each entry maps an edge network prefix to their APT provider ETRs
  - Every APT AS in the island stores the full island mapping table

Benefits for a Single Island



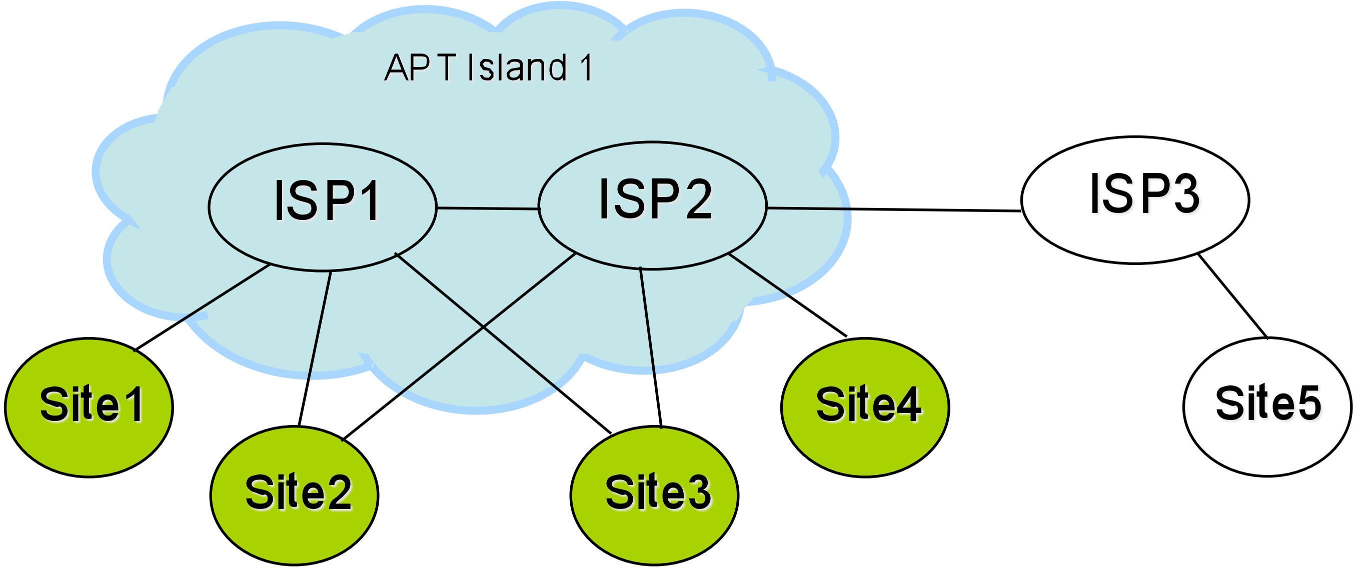
- Prefixes for Sites 1, 2, 3, and 4 removed from ISP1 and ISP2's BGP tables
  - Potentially large reduction in BGP table size
    - The reduced entries moved to the mapping table
- Offer benefits to such customers (next slide)

Benefits to Edge Networks

- For edge networks with *only* APT providers
  - Provider-independent addressing
  - Can explicitly express traffic engineering preferences

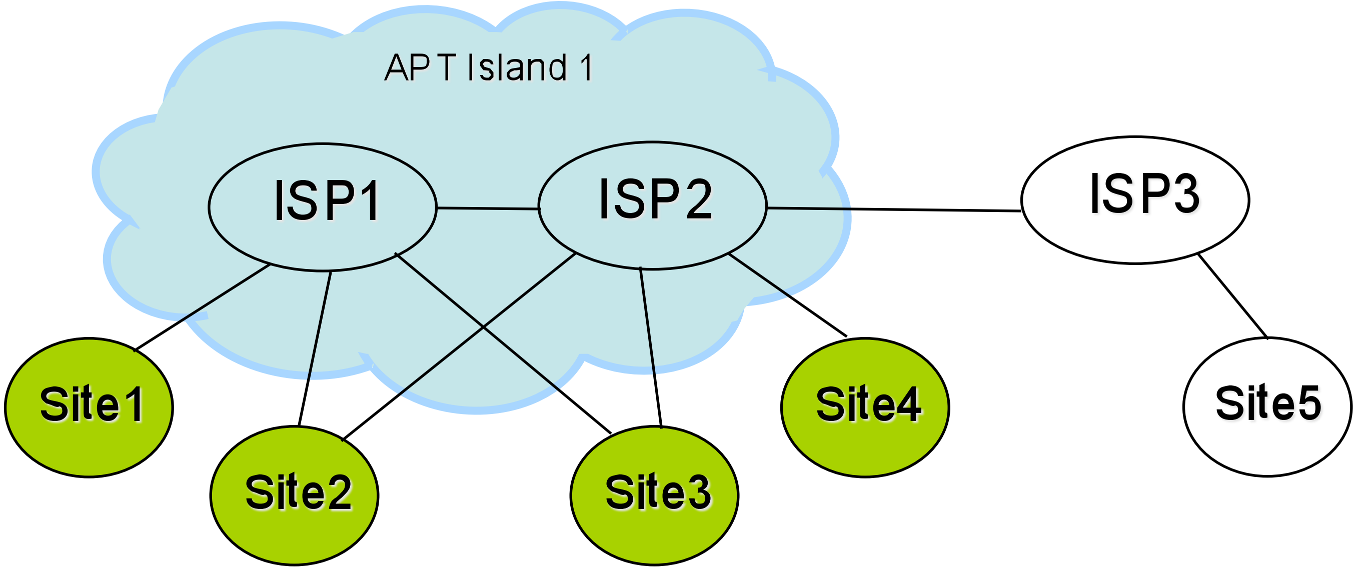
  (accomodates edge multihoming with both APT and non-APT providers)
- No changes required in edge networks
  - APT is deployed entirely in transit networks
- Some cost to transit ASes
  - Management of APT Default Mappers
  - Additional complexity of APT/BGP interactions

APT and Non-APT Interaction: Non-APT to APT (1/2)



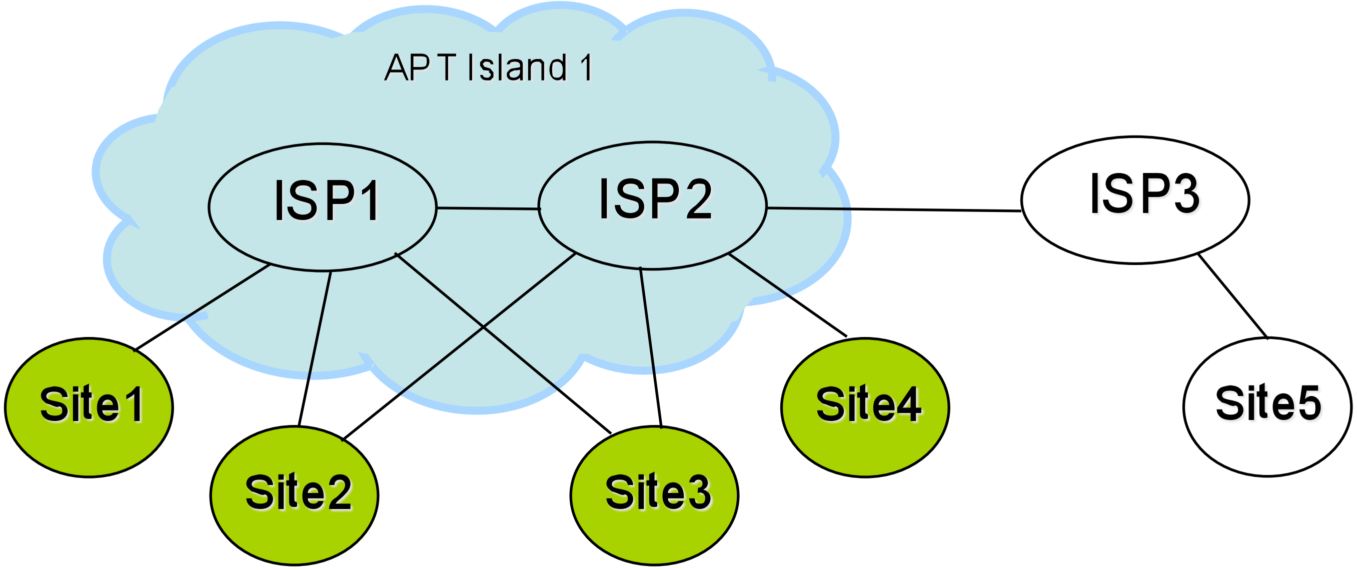
- How can Site5 reach Site3?
  - Site3's prefix is in APT Island 1's island mapping table
  - But Site5 and ISP3 don't understand APT
  - ISP2 must announce Site3's prefix into BGP

APT and Non-APT Interaction: Non-APT to APT (2/2)



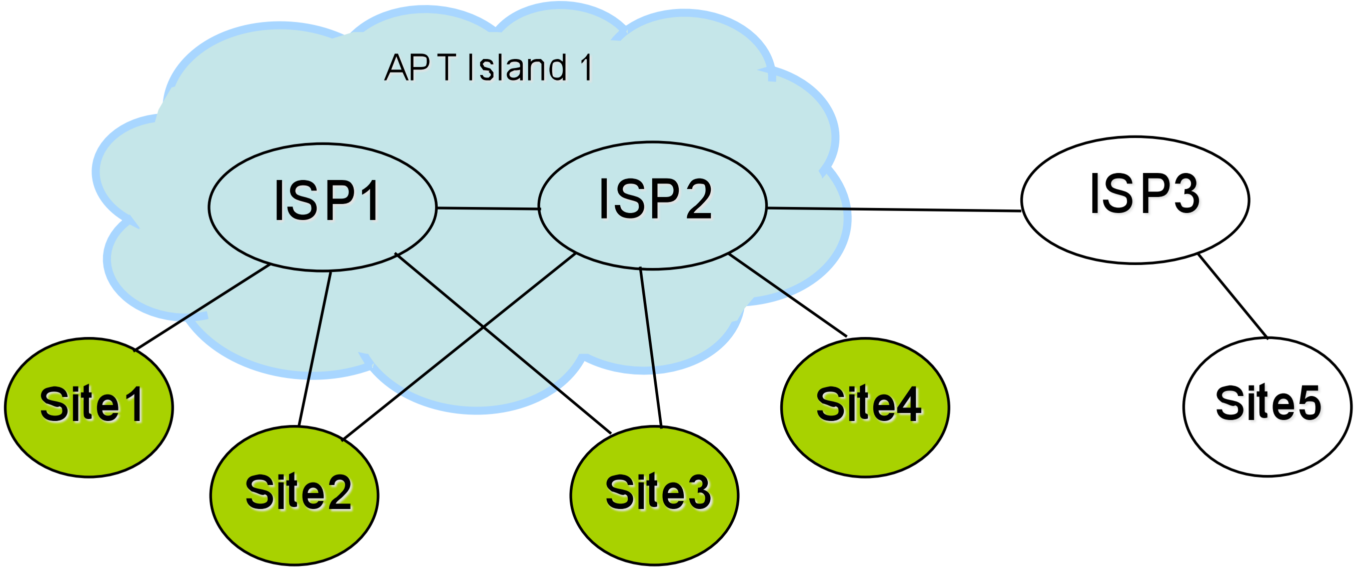
- How Can Site5 reach Site3?
  - ISP2’s Default Mapper (DM) gets Site3’s mapping
  - ISP2’s DM announces all APT edges’ prefixes into BGP
  - ISP3 receives and propagates the routes via BGP

APT and Non-APT Interaction: APT to Non-APT (1/2)



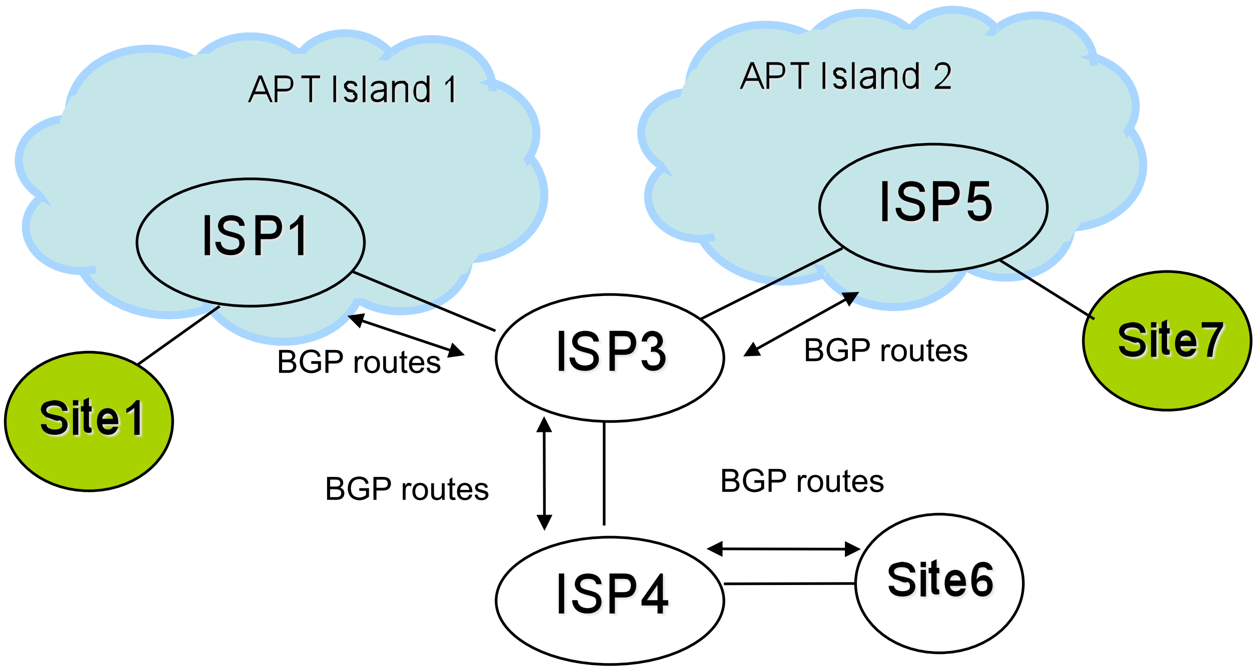
- How can Site1 reach Site5?
  - Site1 routes packets through ISP1
  - But Site5 is not in the APT mapping table…

APT and Non-APT Interaction: APT to Non-APT (2/2)



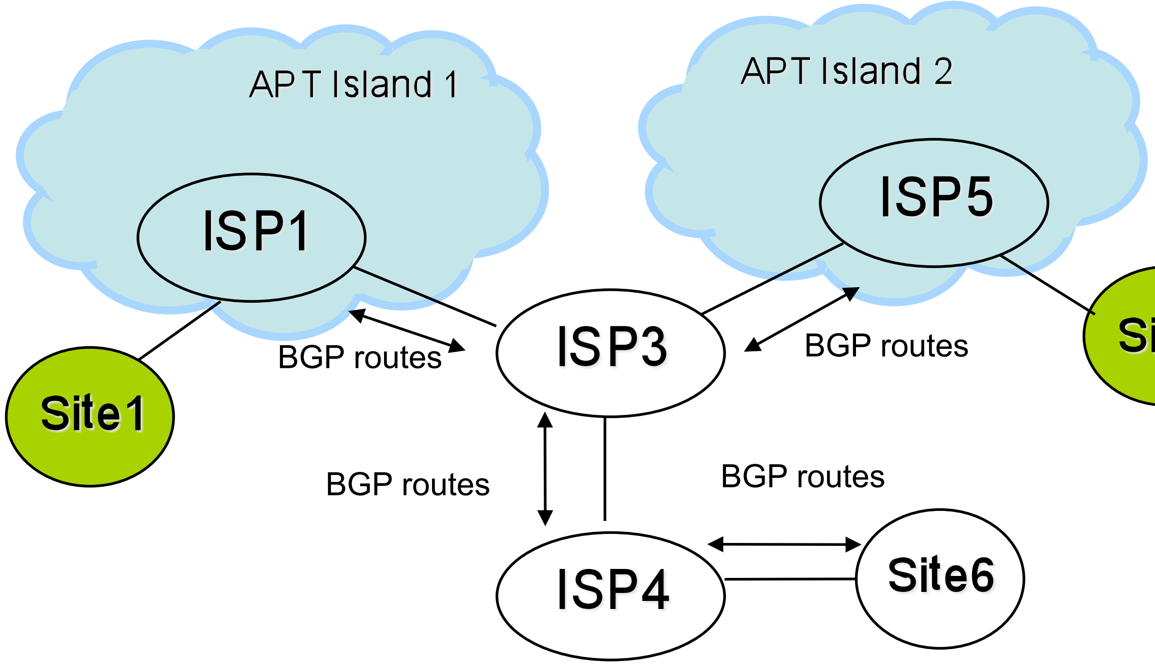
- How can Site1 reach Site5?
  - PE routers and DMs in APT Island 1 still have BGP tables that store non-APT prefixes
  - ISP1 forwards packets to the BGP next hop

Communication between APT Islands (1/2)



- How can Site1 and Site7 communicate?
  – Both Site1 and Site7 are connected to APT islands
  – Isolated APT islands don’t share mappings
  – ISP1 does’t have an APT mapping table entry for Site7

Communication between APT Islands (2/2)



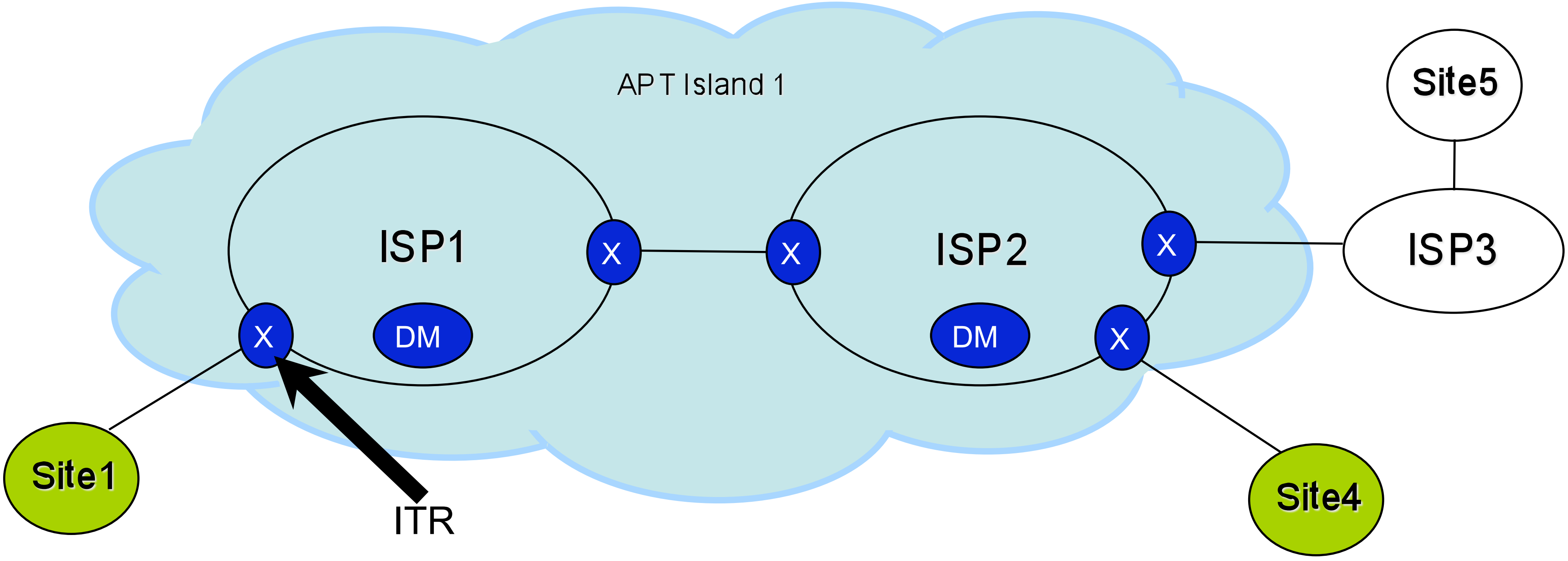
- How can Site1 and Site7 communicate?
  - ISP3 has a BGP route to Site7
  - ISP1 learns a BGP route to Site7 from ISP3
  - ISP1 can route to Site7 using the BGP route

(ISP1 does not know or care that Site7 is in an APT island)

APT Islands merge → even smaller BGP tables

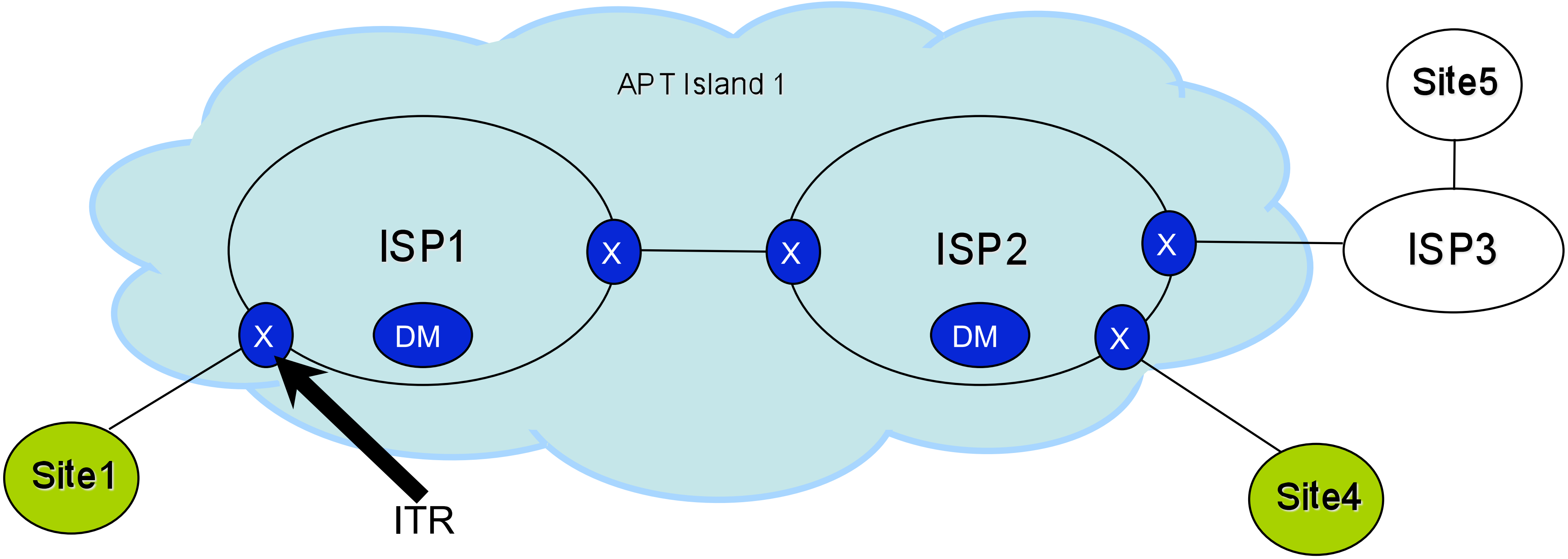
- APT ASes in the same island have the same island mapping table
  - APT ASes in different islands do not (for now)
- Topologically connected islands can merge
  - Their mapping tables merge
  - BGP tables at all the routers in the island shrink
- Future work: allowing topologically unconnected islands to merge
  - eliminate separate islands

Inside an APT Island



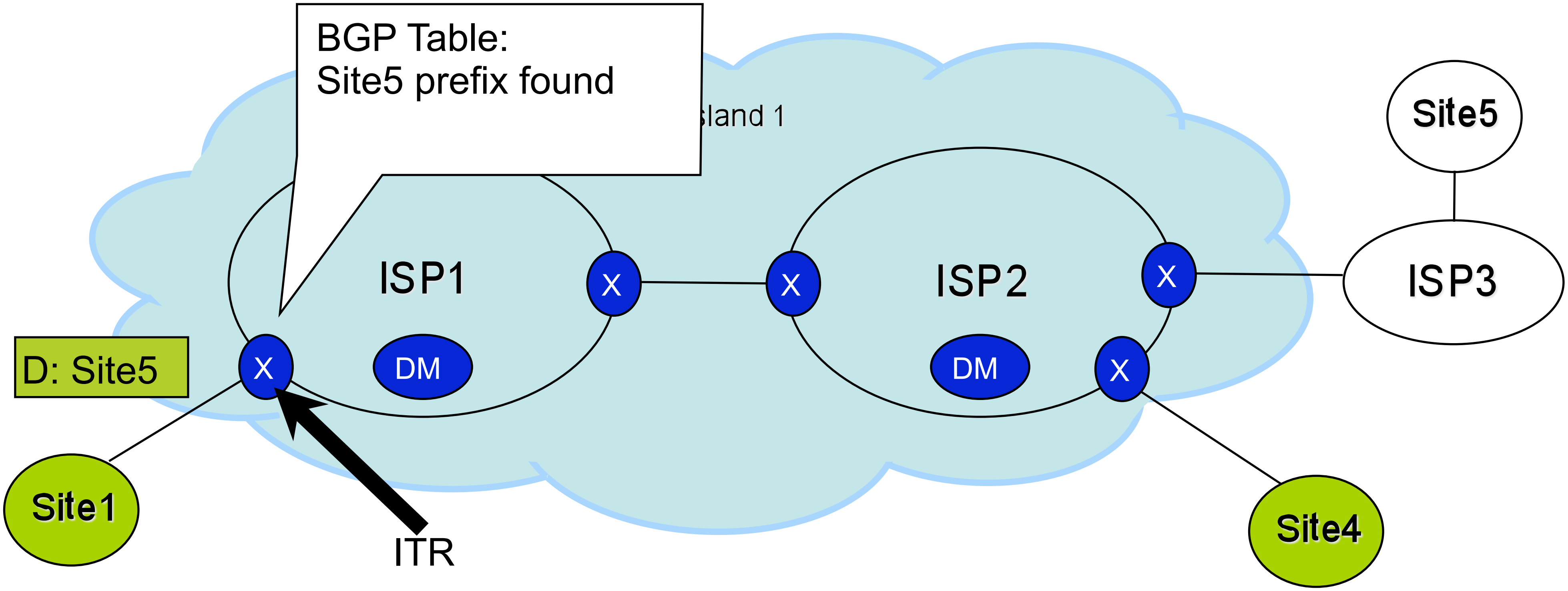
- Nodes labeled “X” are border routers
- Nodes labeled “DM” are default mappers

ITR Lookups



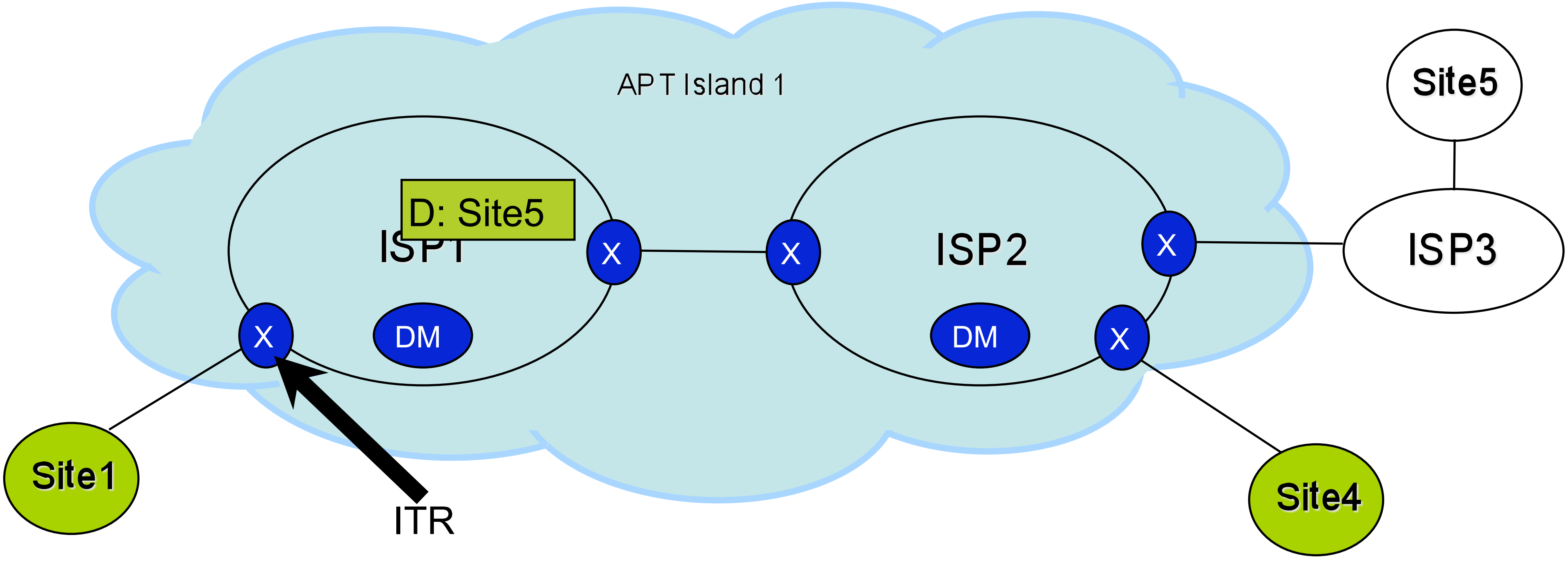
- How does the ITR decide where to forward a packet?
  - We are currently examining a few alternatives
  - The following is our favorite scheme as of now
    - Note that this is different from our draft

Sending to Non-APT Networks



- Site1 to Site5
  - Site5 is not attached to an APT network
  - The ITR has a BGP route to Site5
  - Packets are simply routed via BGP (not tunneled)

Sending to Non-APT Networks



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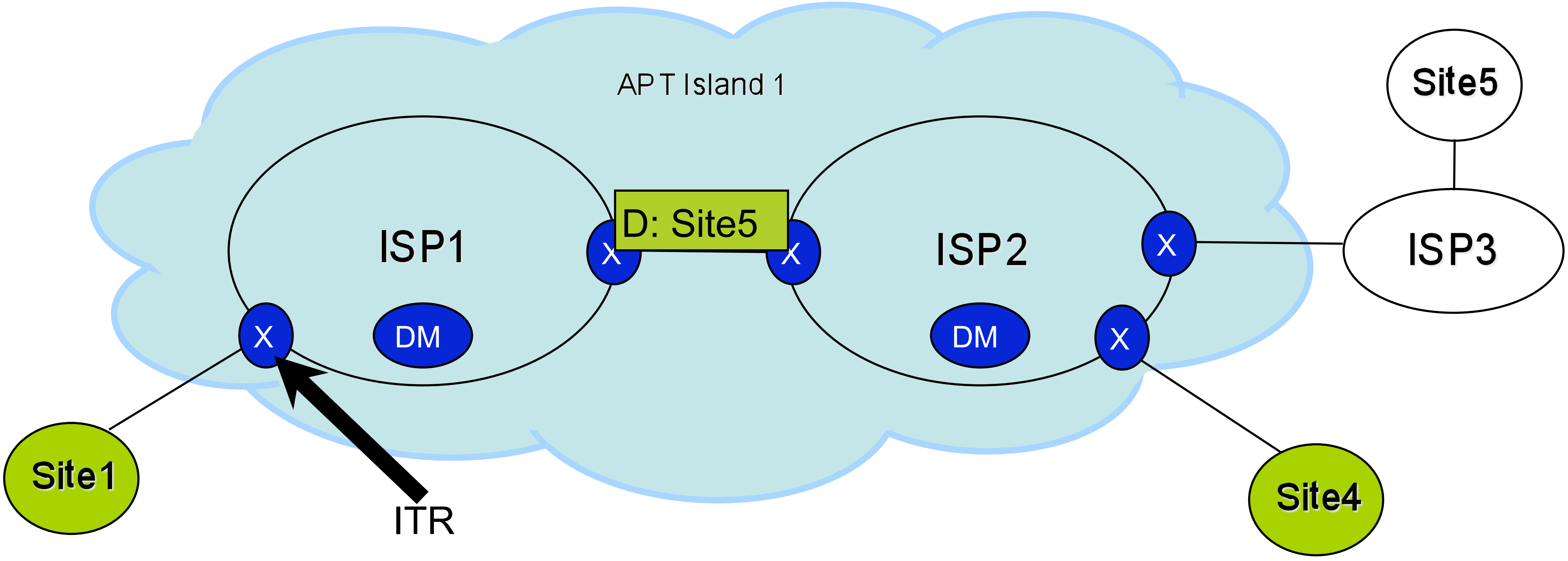

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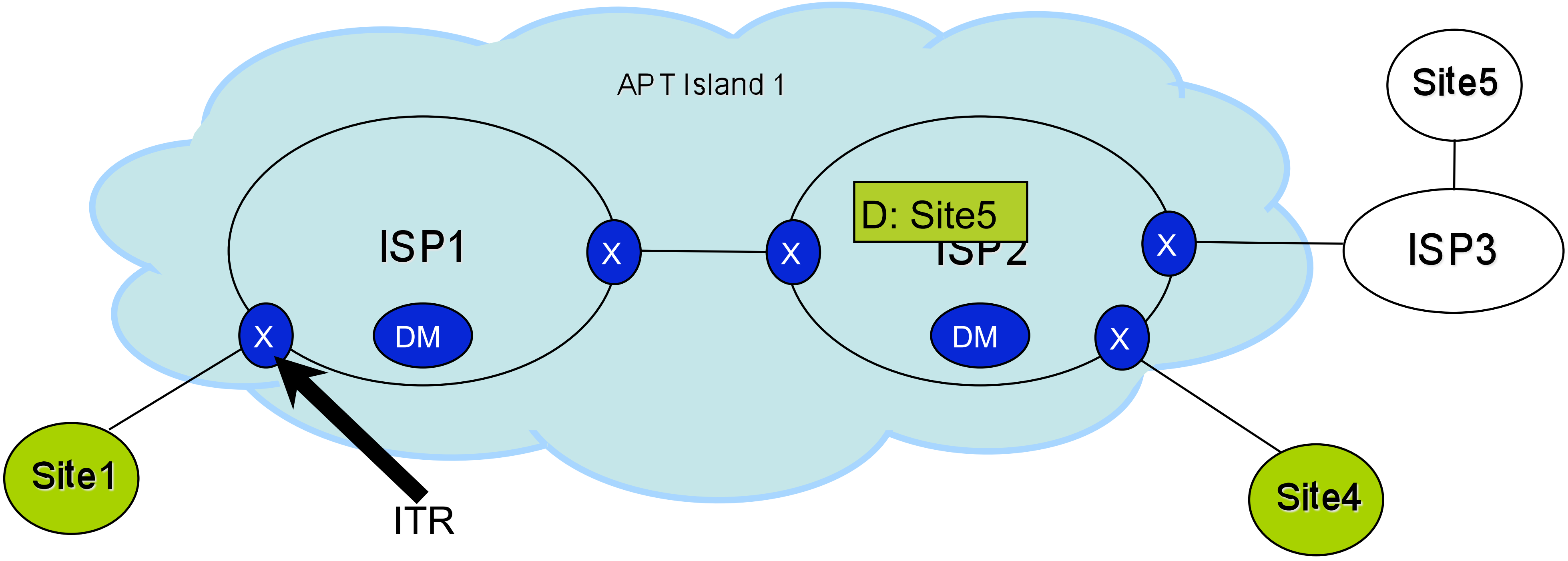

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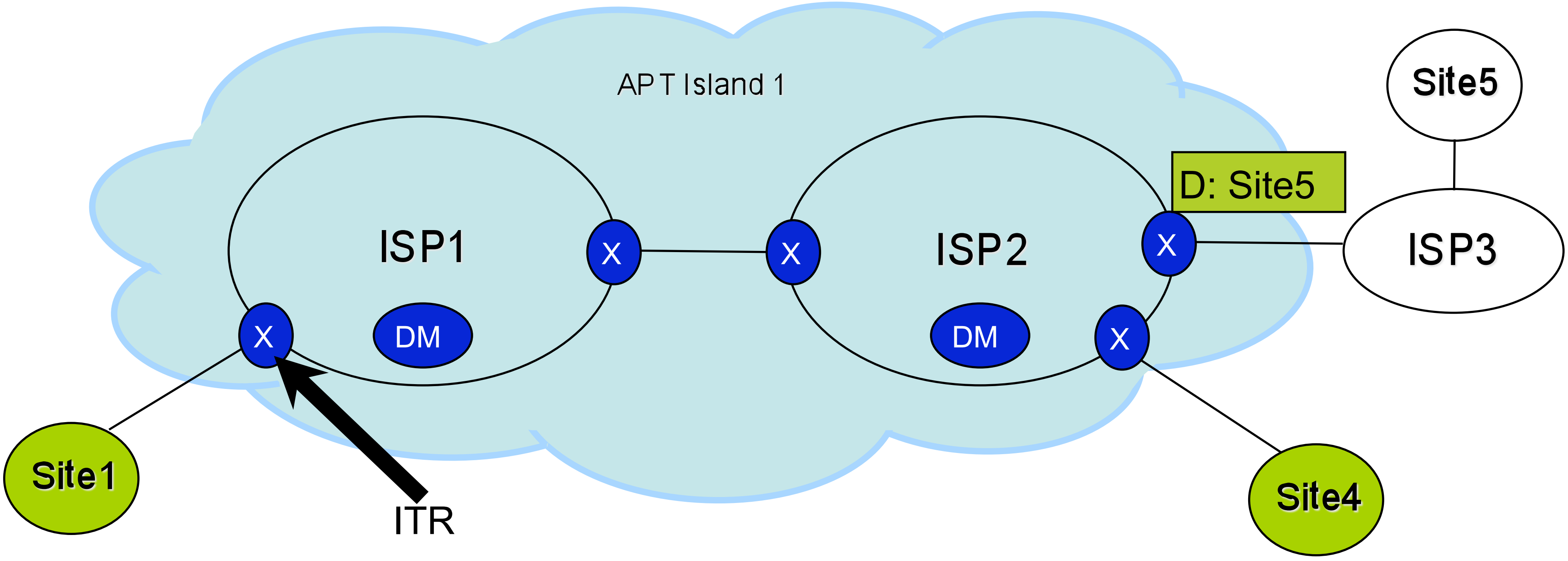

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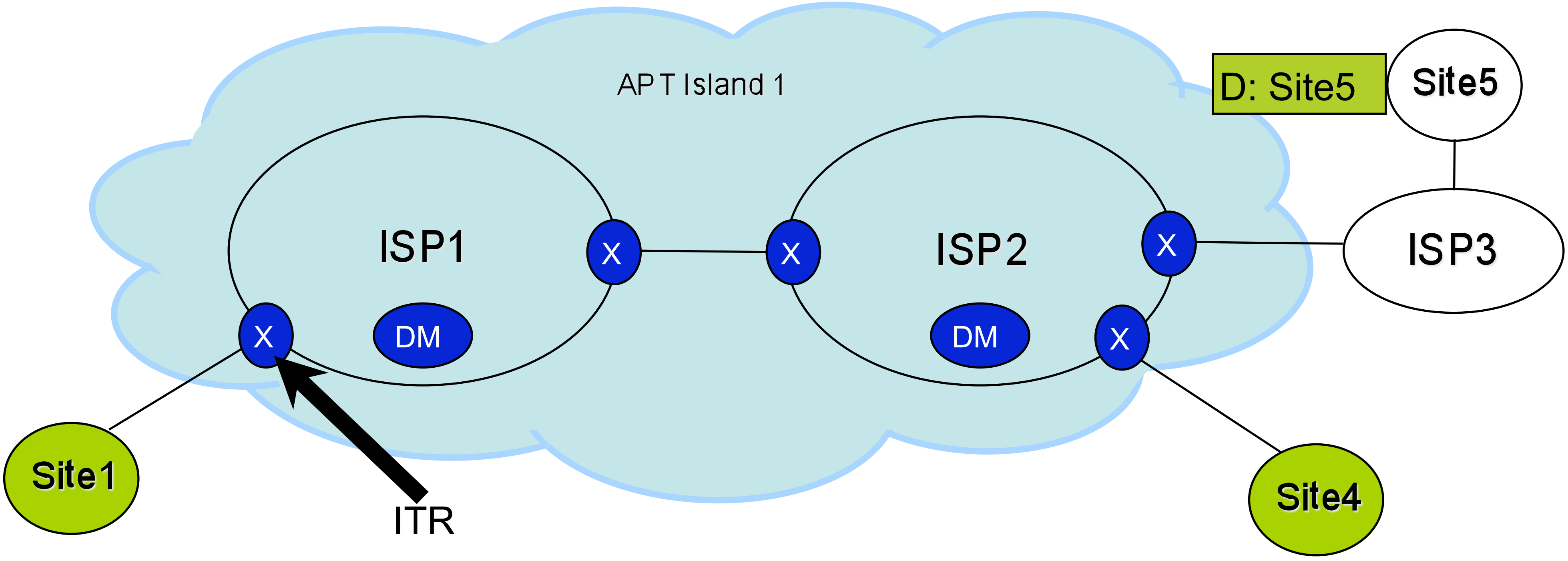

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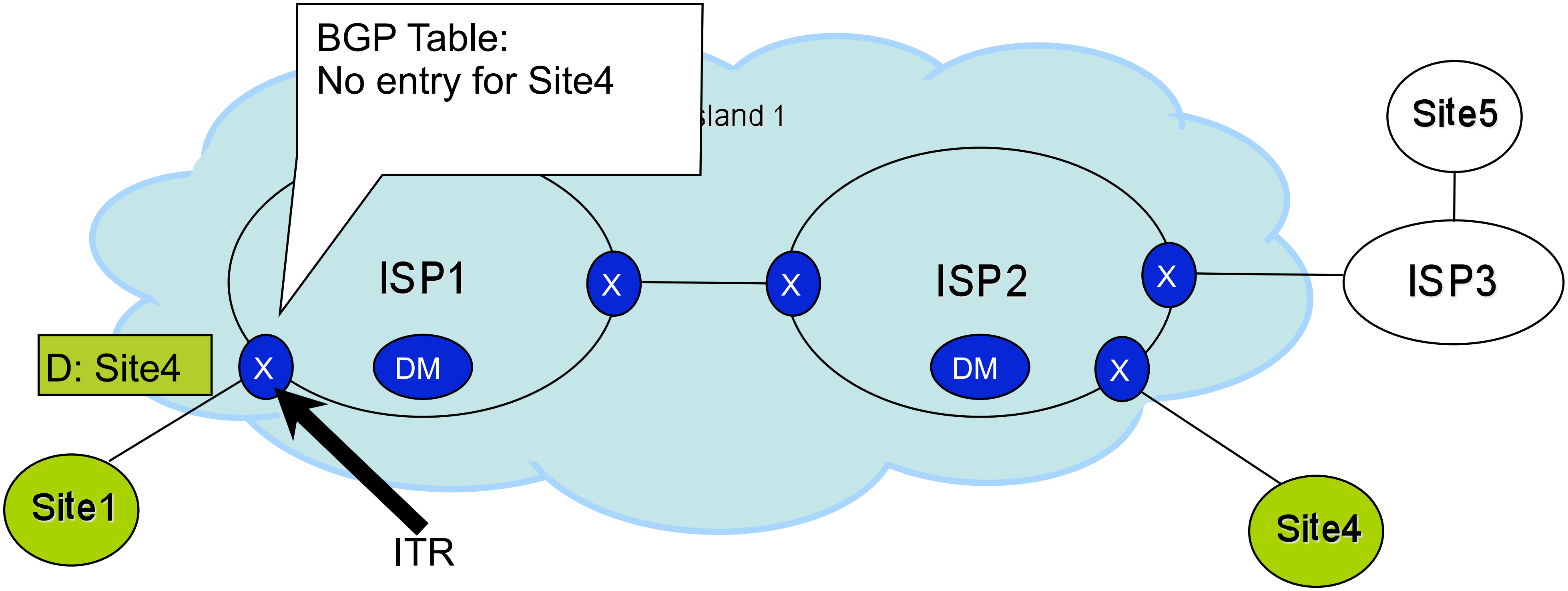
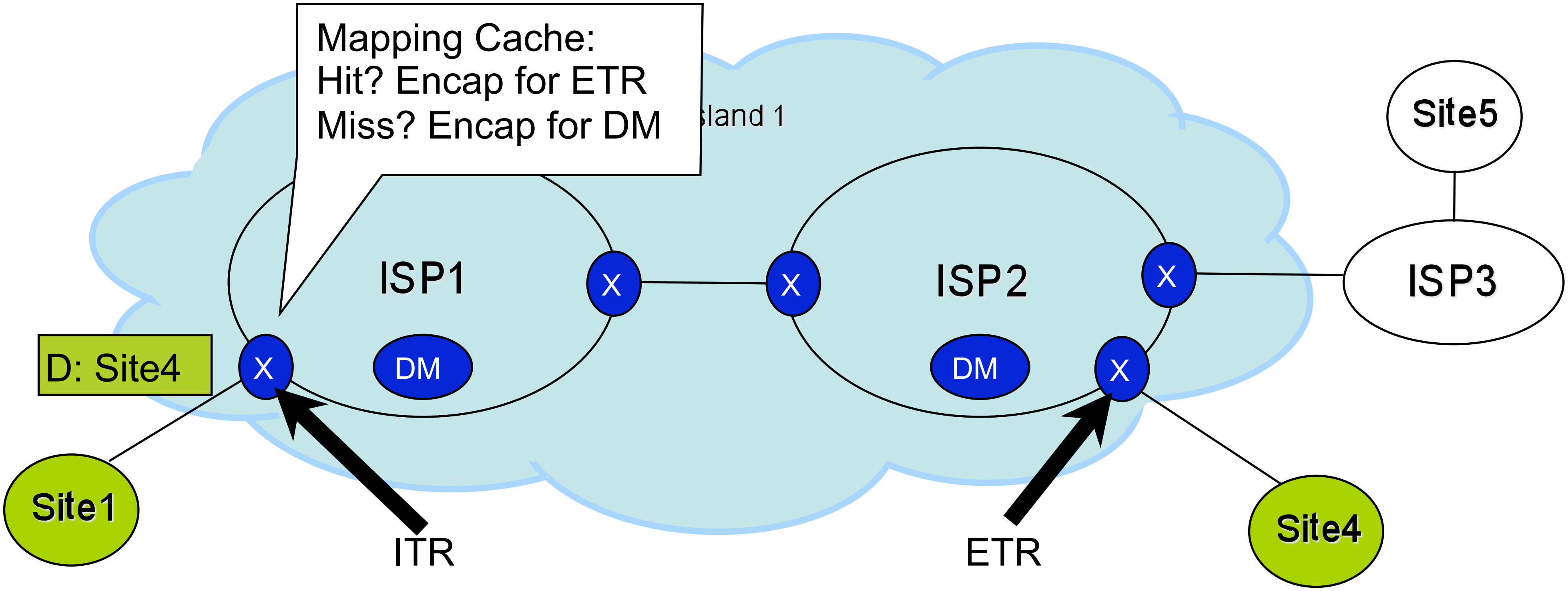
ITR Lookups for APT-Only Sites



BGP Table:
No entry for Site4

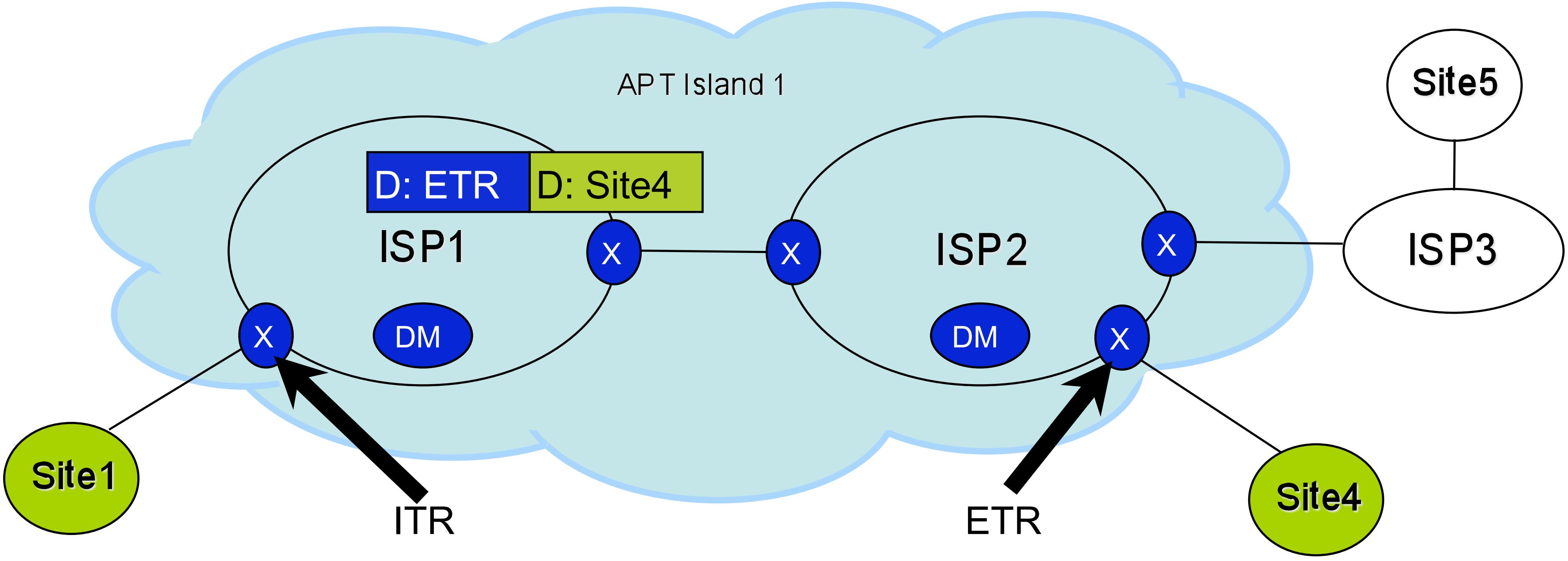
- ITR receives a packet for Site4
  - First look in the BGP table
  - Site4 is only connected to the APT island; ITRs in the island don’t keep Site4’s prefixes in their BGP tables

ITR Lookups for APT-Only Sites


Mapping Cache:
Hit? Encap for ETR
Miss? Encap for DM

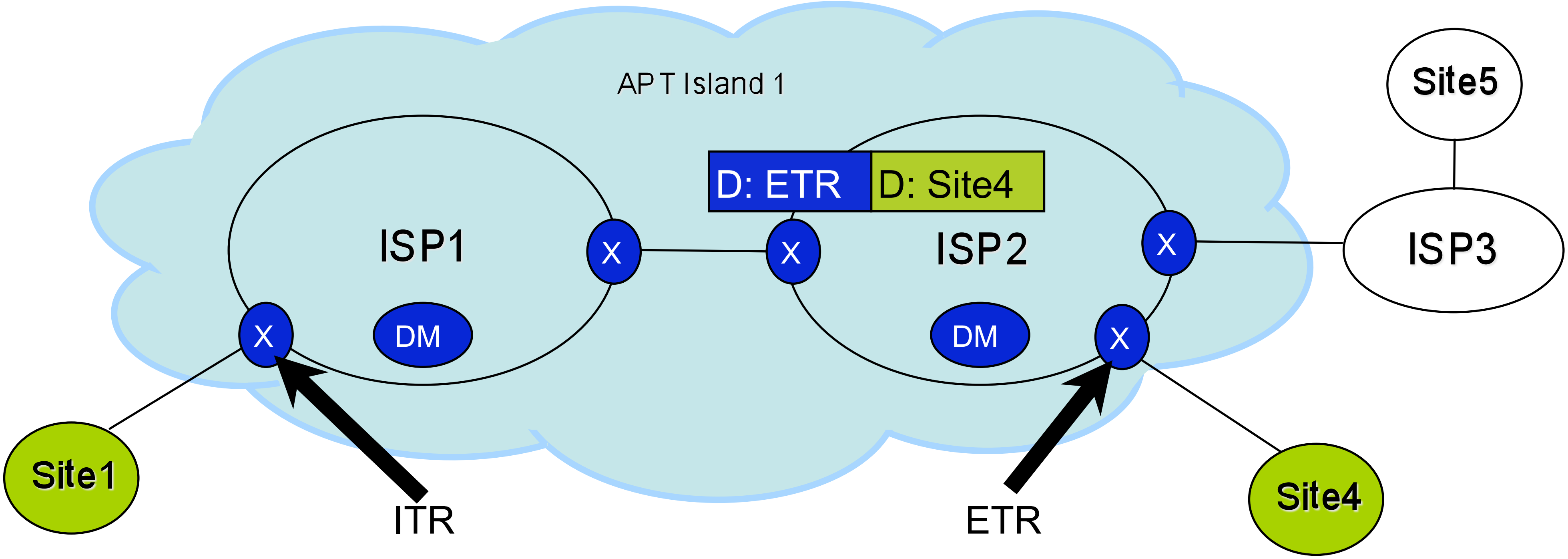
- ITR receives a packet for Site4
  - Next check mapping cache
  - On the event of a cache miss, use the DM
  - This is normal APT behavior

ITR Lookups for APT-Only Sites



- Assume there is a cache hit
  - Tunnel to the ETR

ITR Lookups for APT-Only Sites



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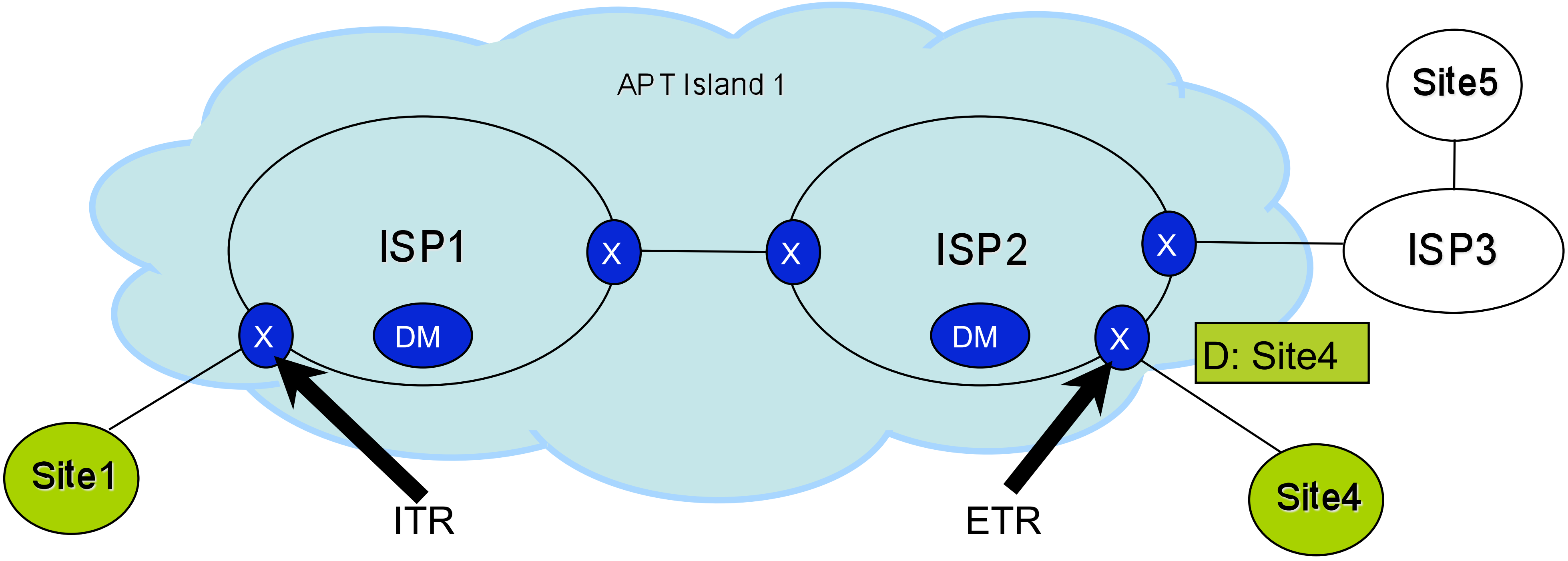

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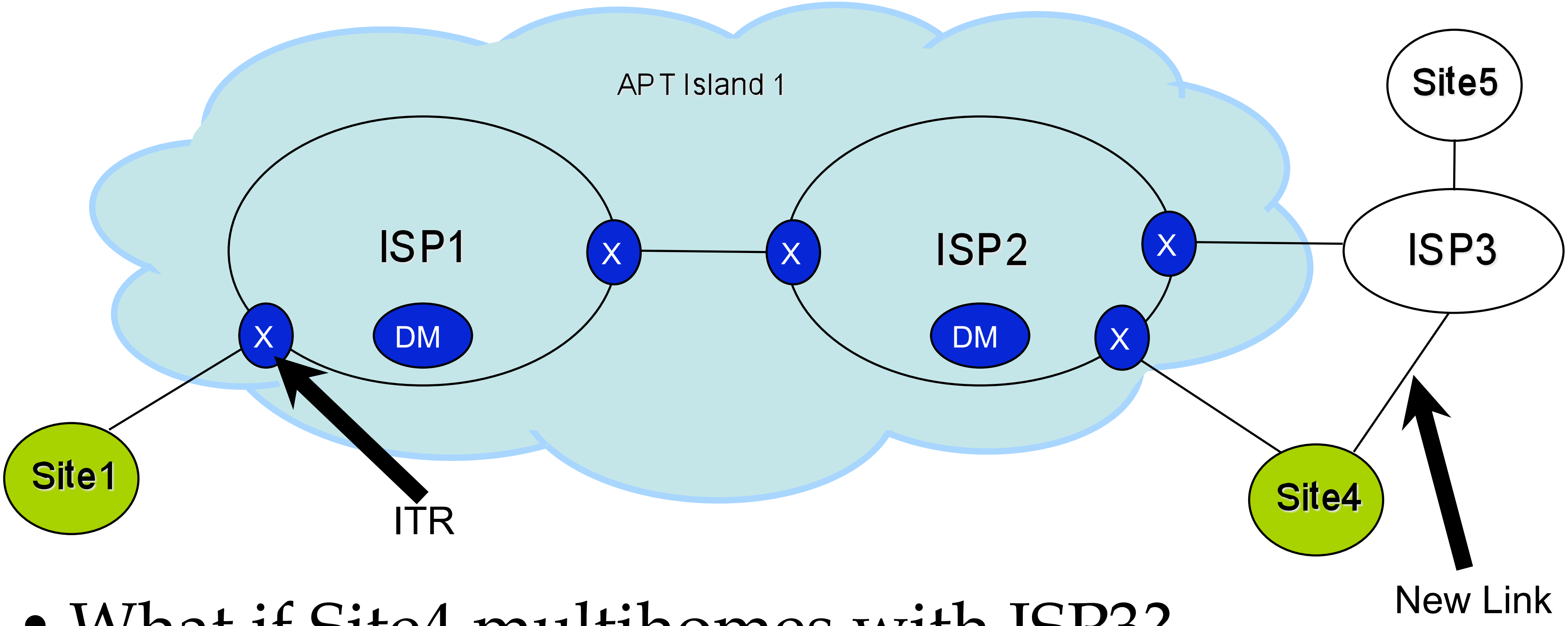
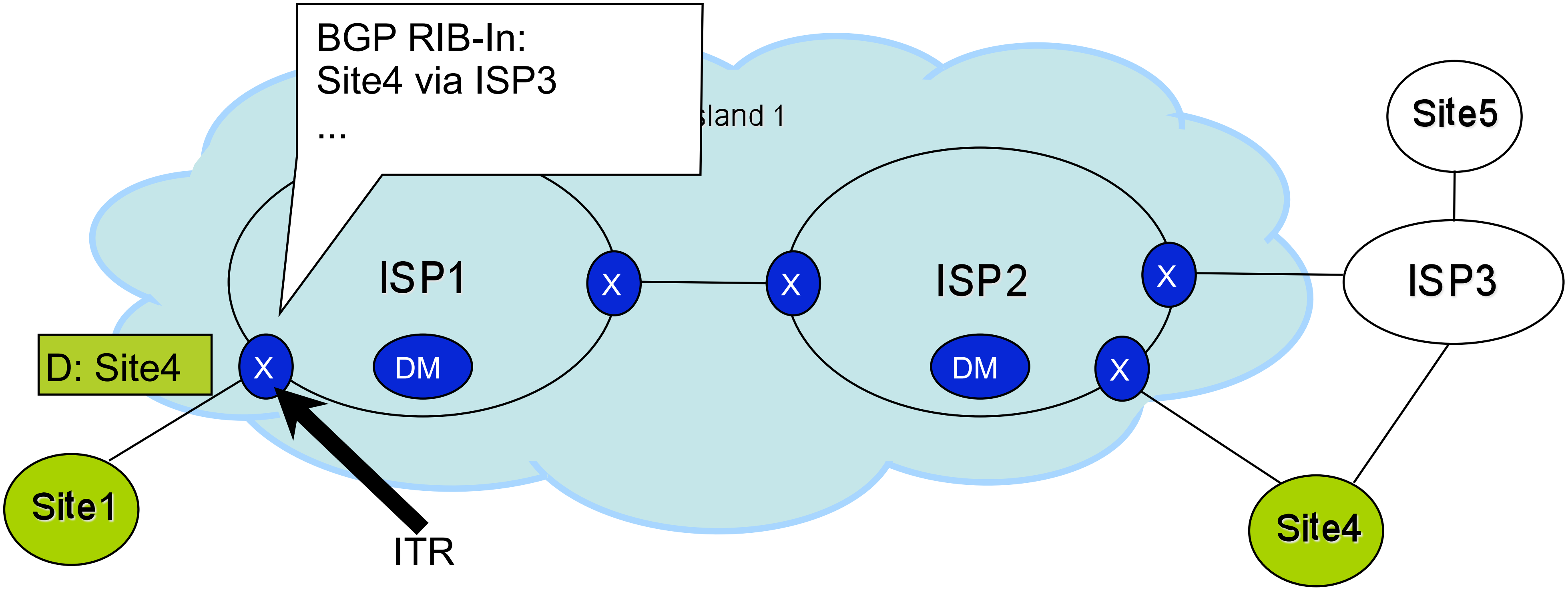
ITR Lookups for Sites Multihomed with APT and Non-APT Networks



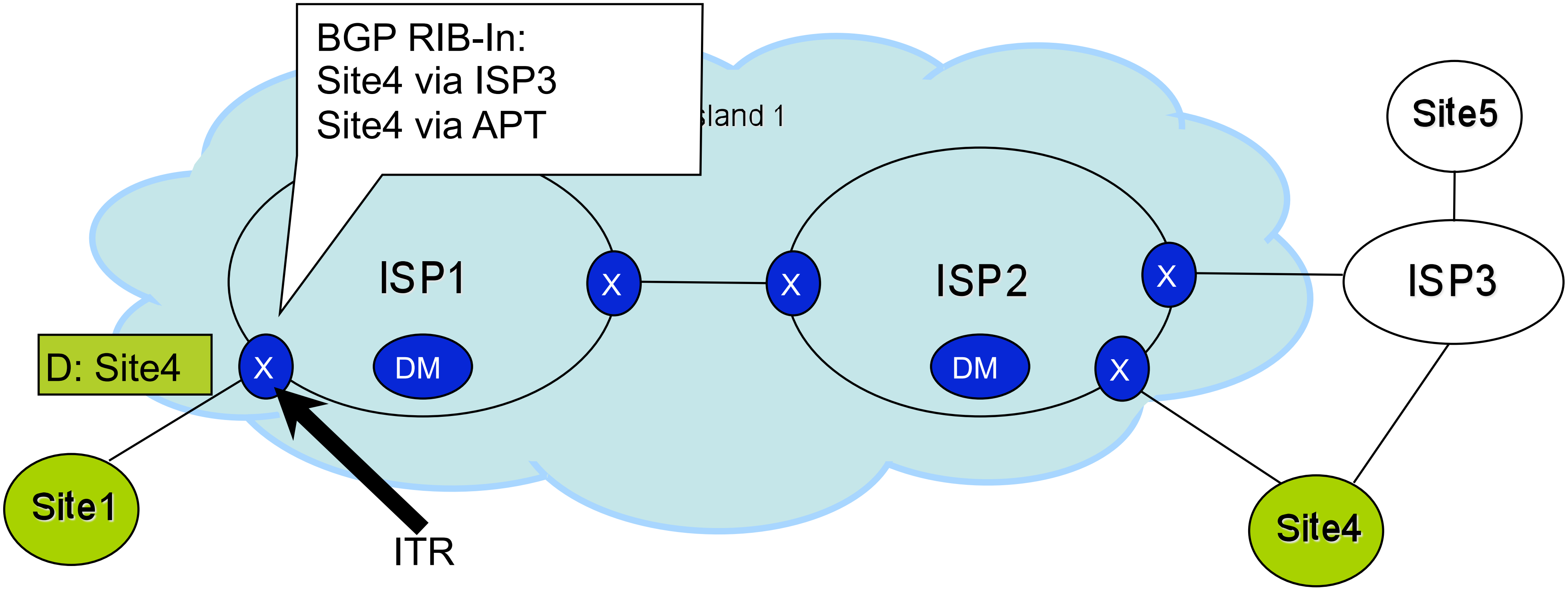
- What if Site4 multihomes with ISP3?

ITR Lookups for Sites Multihomed with APT and Non-APT Networks



- ITR receives a packet for Site4
  - Now ITRs in the island have a BGP route to Site4
  - But we don't want ITRs to only use the route through ISP3…

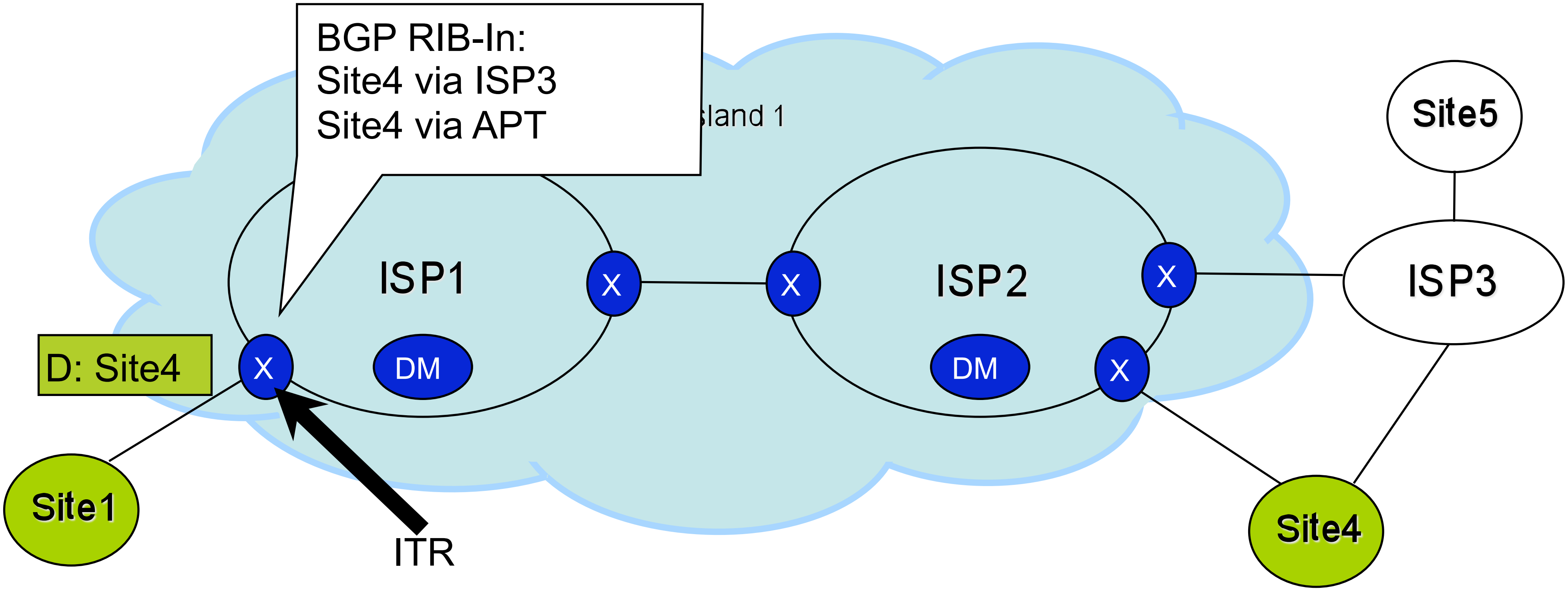
ITR Lookups for Sites Multihomed with APT and Non-APT Networks



BGP RIB-In:
Site4 via ISP3
Site4 via APT

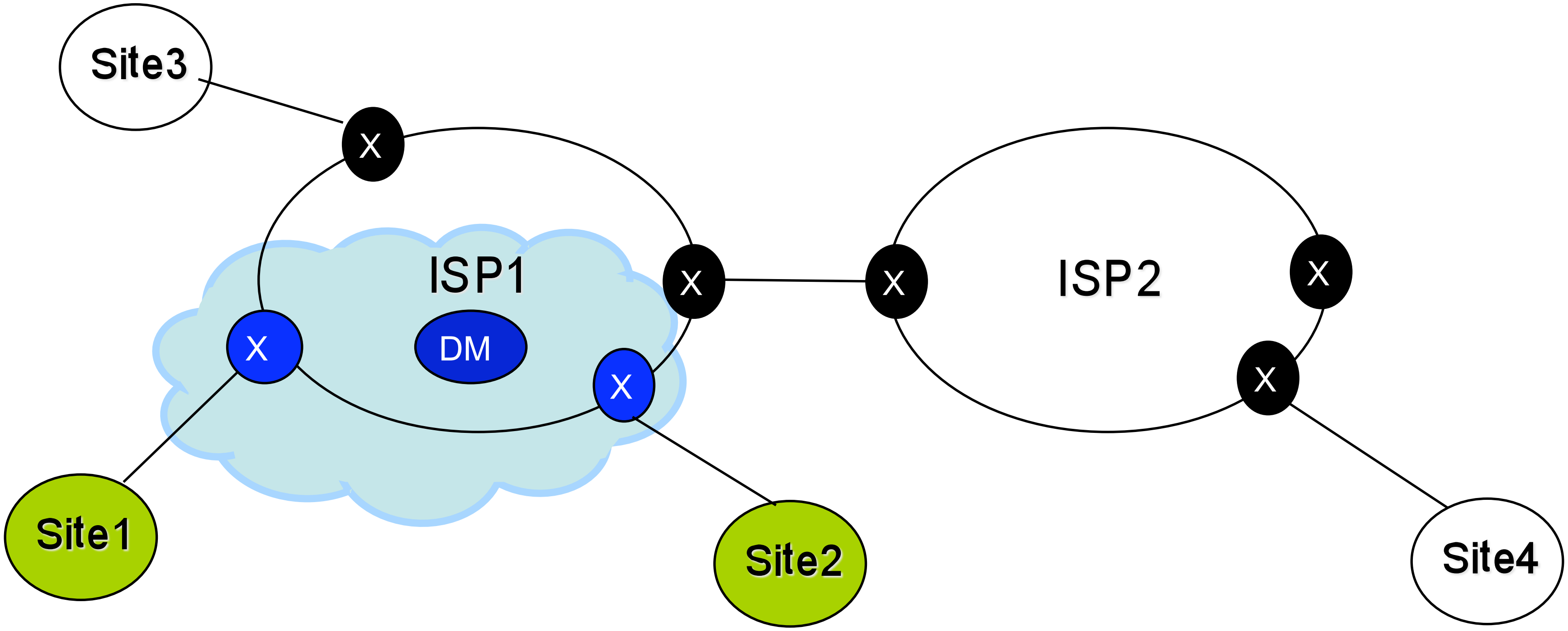
- Recall: DM generates BGP announcements for all prefixes in the mapping table
  - Special tag for sites multihomed with APT and non-APT nets
  - ITRs store these in their RIB-In
    - But still drop BGP routes for APT-only sites, which use a different tag

ITR Lookups for Sites Multihomed with APT and Non-APT Networks



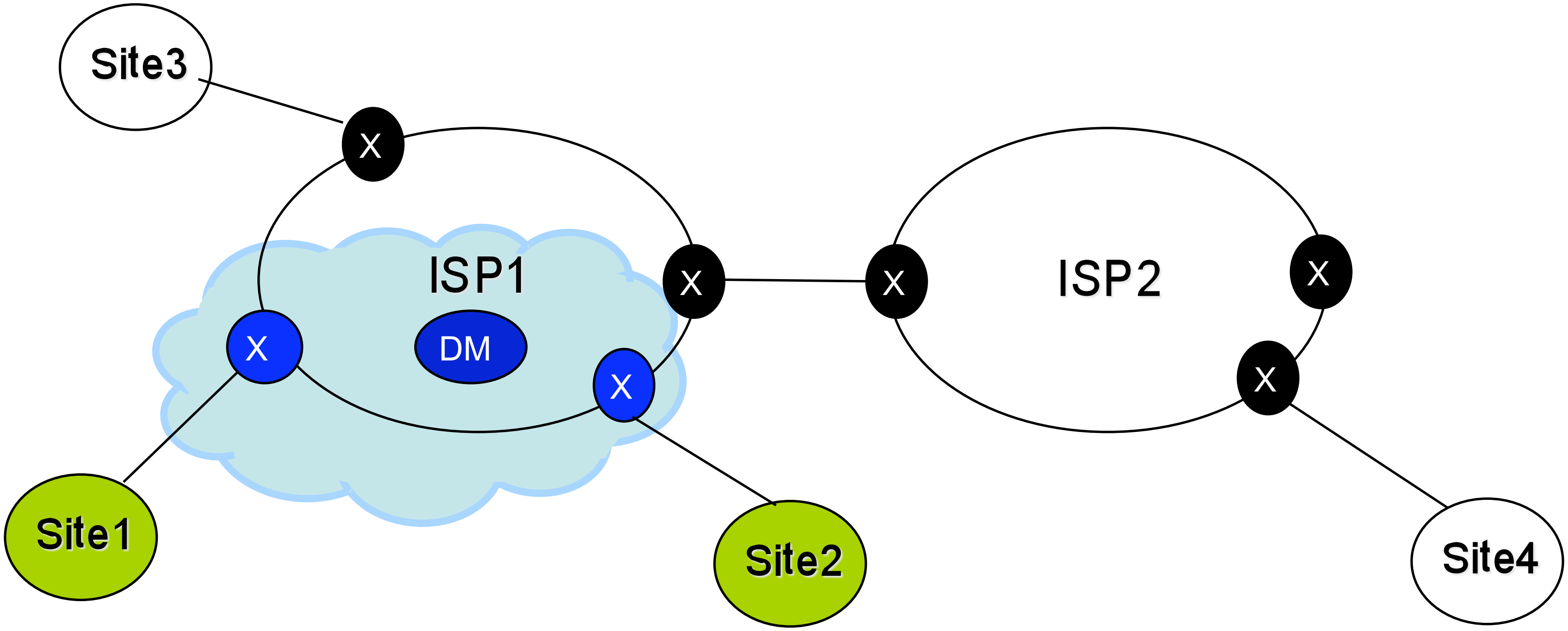
- If the ISP3 BGP route is preferred
  - Forward using BGP table
- If the APT BGP route is preferred
  - Normal APT behavior

ITR Lookups for Partial APT Networks



- What if ISP1 starts with partial APT deployment?
  - Now Site1 and Site2 are APT-only site
  - Site3 is non-APT site

ITR Lookups for Partial APT Networks



- DM injects Site1 & 2's prefixes into BGP
  - So all other sites can reach them
- Data between Site1-Site2 is tunneled
- Data to all other destinations use BGP table to send

Thank You!

- Questions?