Route Servers for !Dummies

or: Scaling is Hard; Let's Go Shopping!

inex

internet neutral exchange

Nick Hilliard

Head of Operations

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Some Blurb on INEX

- Currently only member-owner IXP in Ireland
- 59 members, 46 full members, 13 associate
- Estimate about 90% eyeballs in Ireland (South)
- Traffic levels: daytime peaks of 6G
- Provide usual services - 10M to 10G ethernet
- Two separate L2 infrastructures
- Three PoPs: Telecity Dublin, DEG, Interxion DUB1
- Mixture of Brocade (FES-X624, TI24X) and Cisco 6500
- Fibre lit with Transmode DWDM kit - N x 10G
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Free Beer at Meetings !!!11!!

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- Highly active community interest
- Oh yeah, we have some route-servers too

Route Servers for Dummies

- Platform for multi lateral peering agreements (MPLA)
- Similar to a route reflector, except uses eBGP
- Very fashionable at IXPs right now
  - Reduce administrative load of peering
  - Simple interconnection to lots of other partners
  - Instant RoI (ISP management likes this)
  - Outsourcing RIB calculations to fast machines(!)
  - “Safe” if IXP has implemented prefix filtering
- Considered ghetto routing by larger providers
  - There are good reasons for this opinion
  - INEX recommends peering with route servers unless you know why you shouldn’t
  - Because route servers are not for everyone
- Route prefix filtering considered indispensable by IXP participants

Route Servers for Dummies

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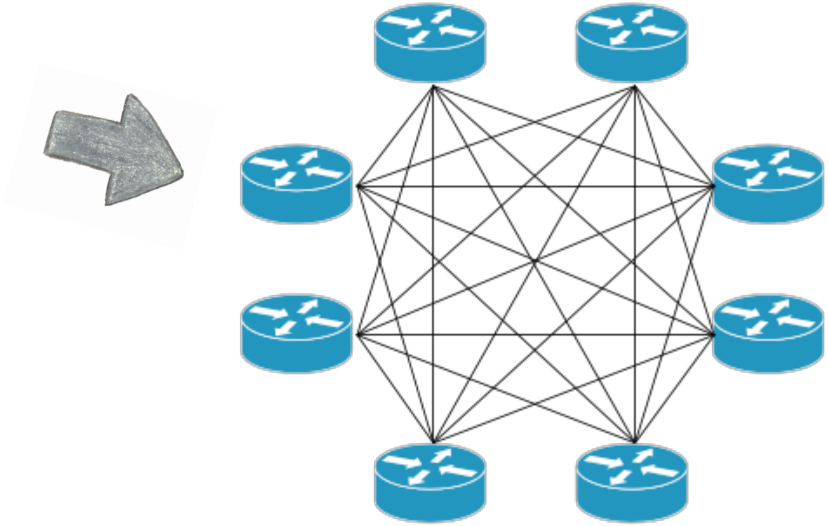
Peering on IXP without Route Servers



Route Servers for Dummies

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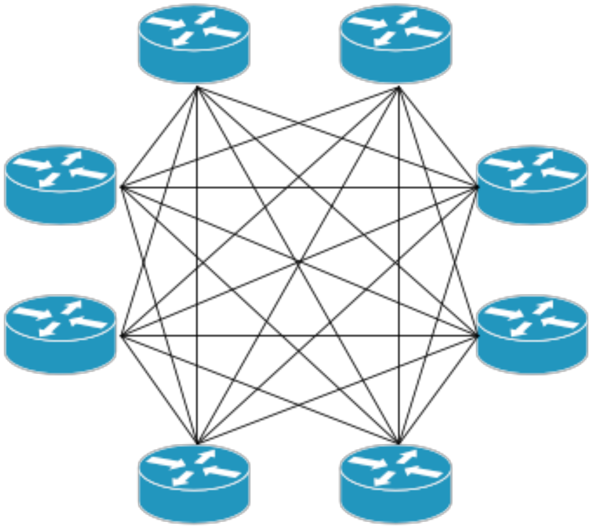

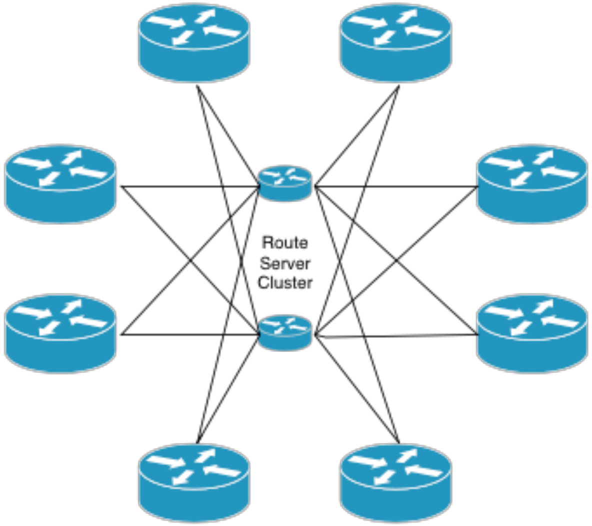

Peering on IXP with Route Servers

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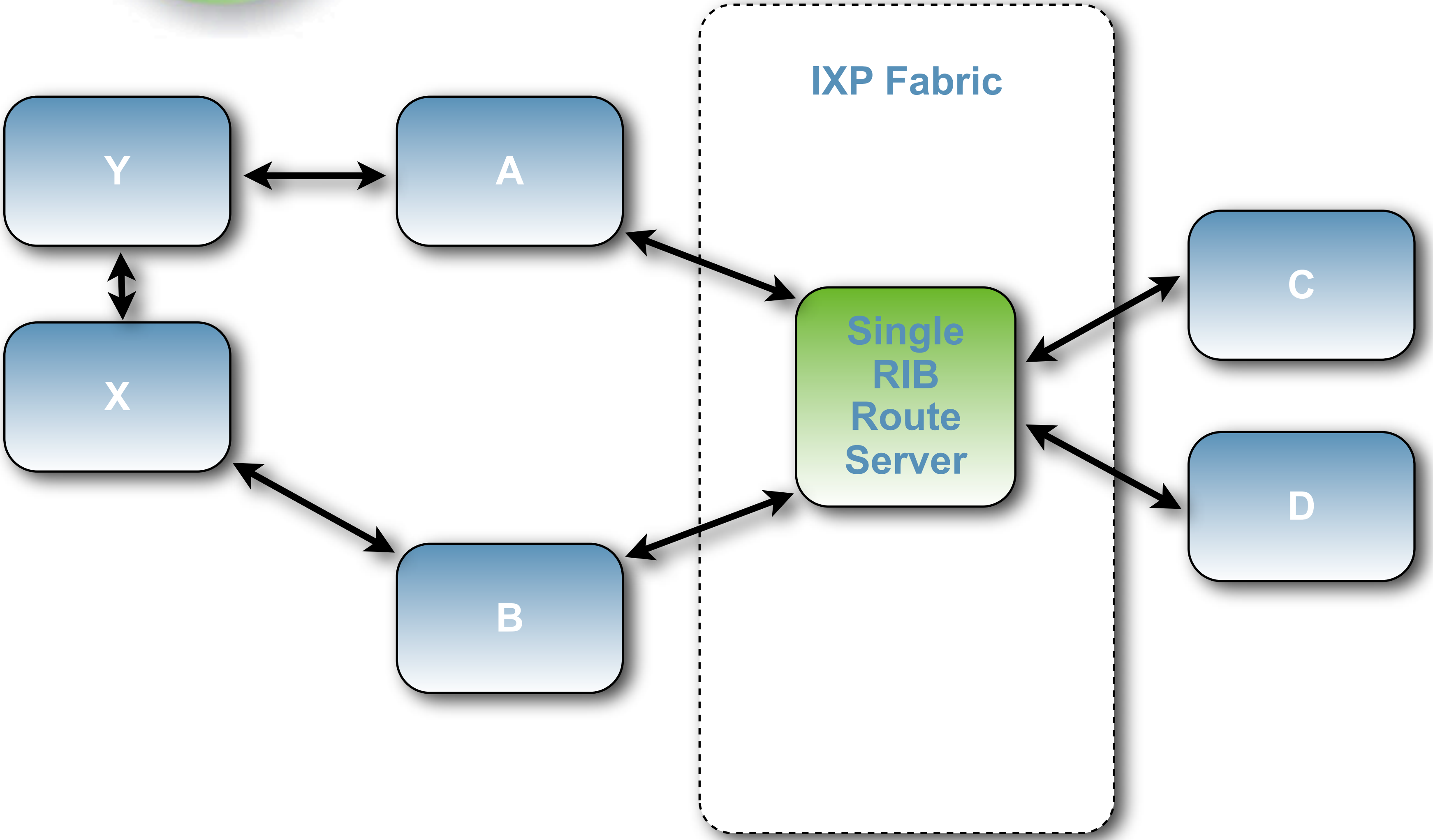
Single-RIB BGP policy problem



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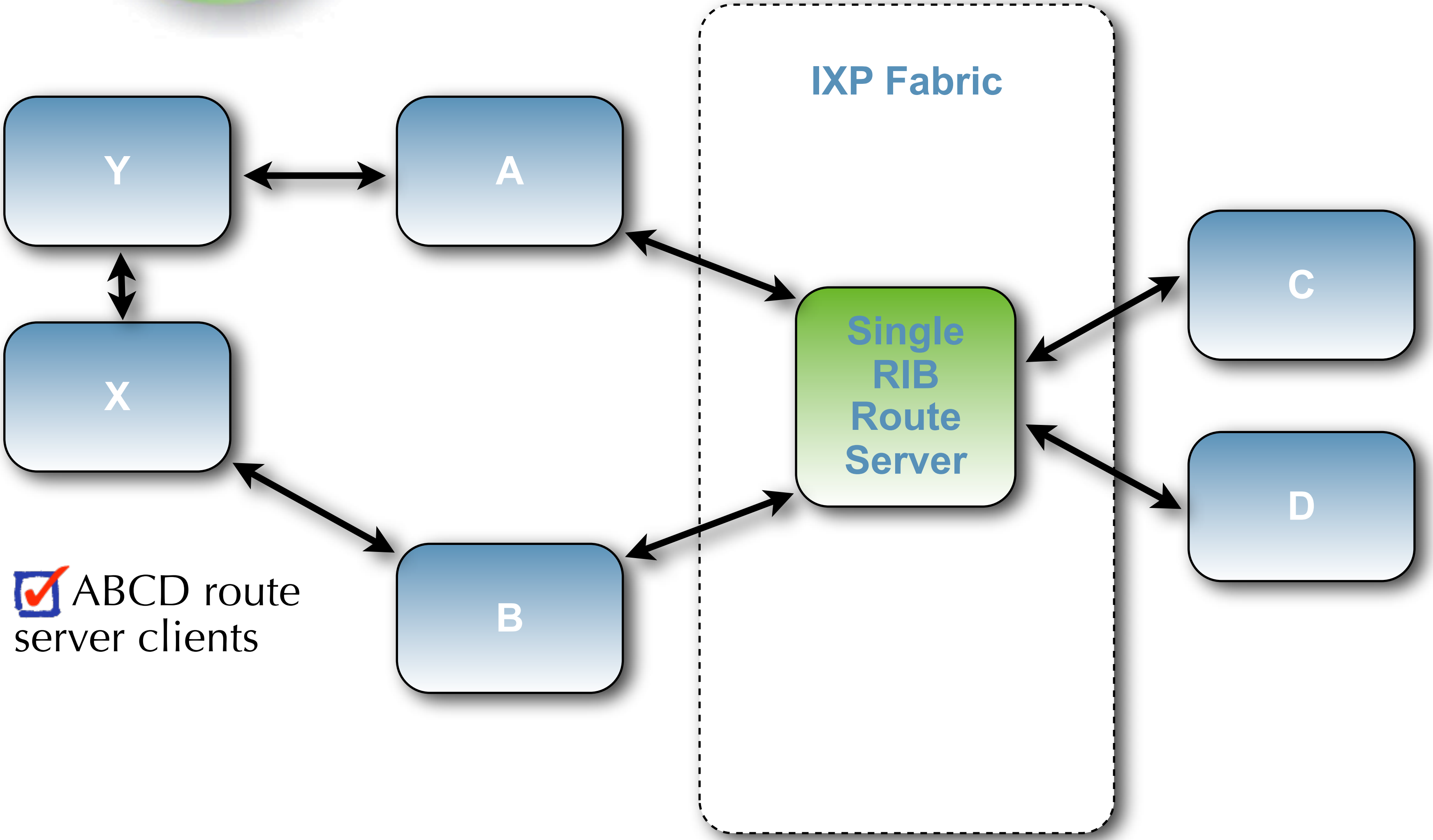

☑ ABCD route server clients

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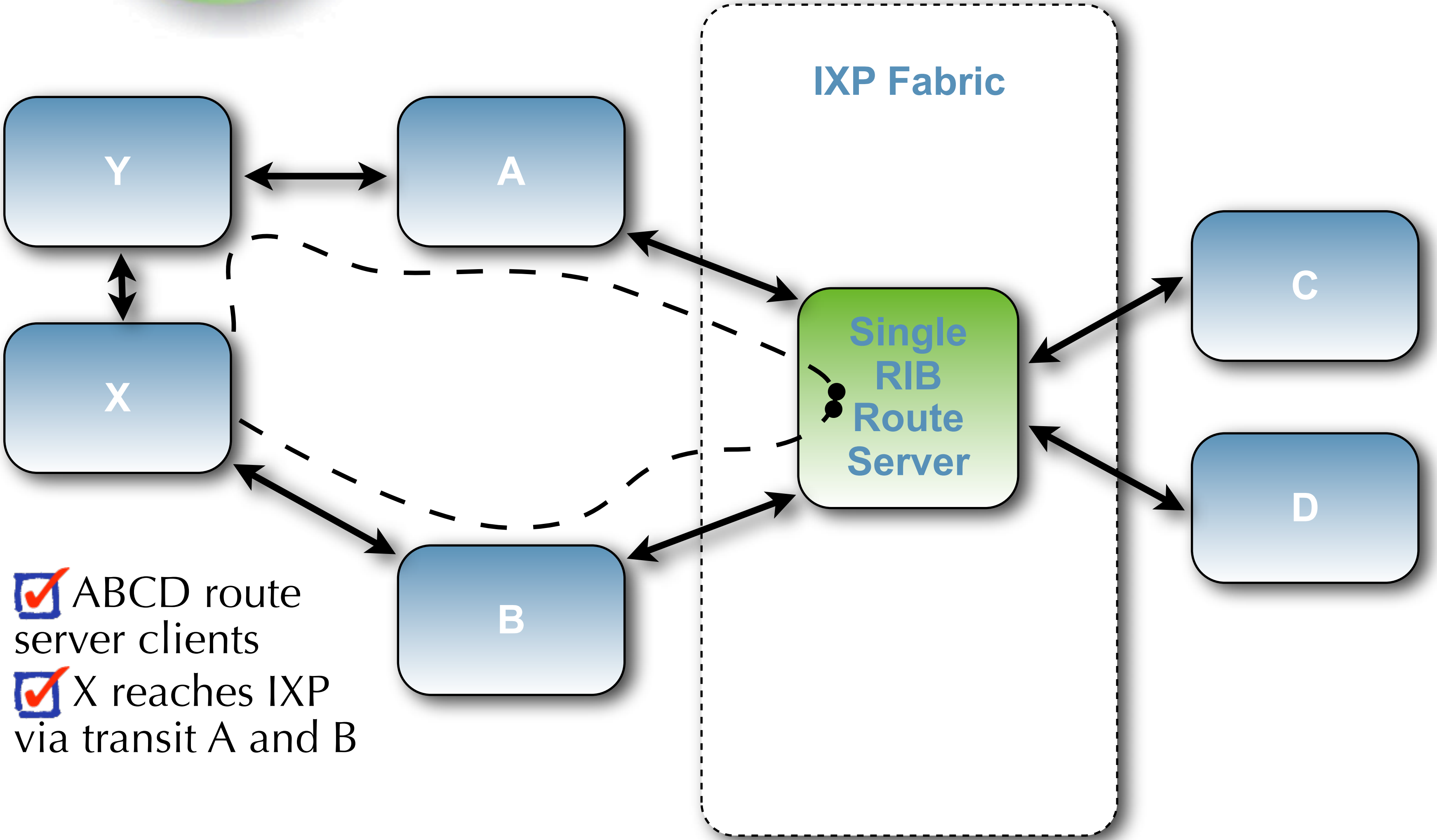

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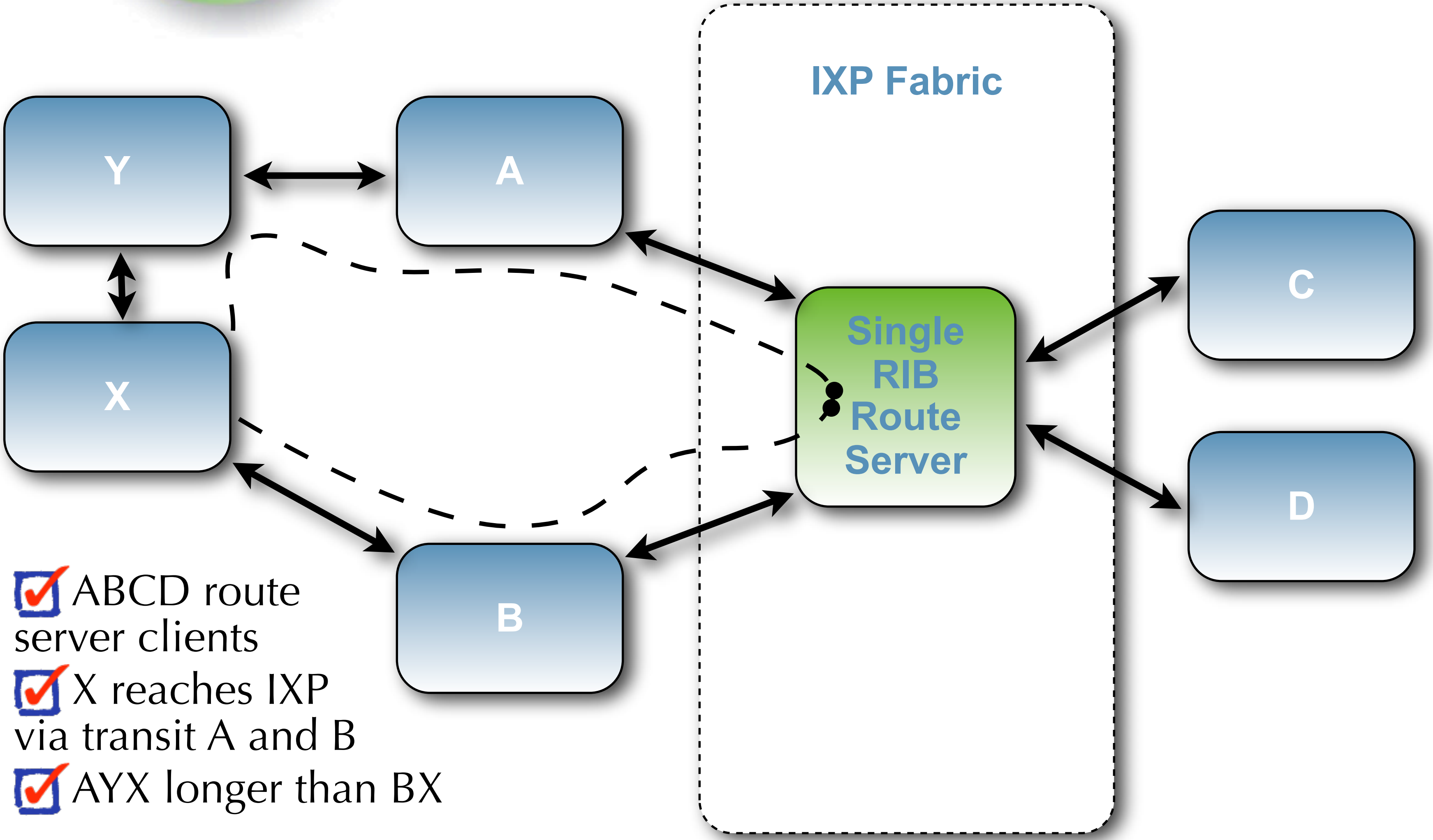

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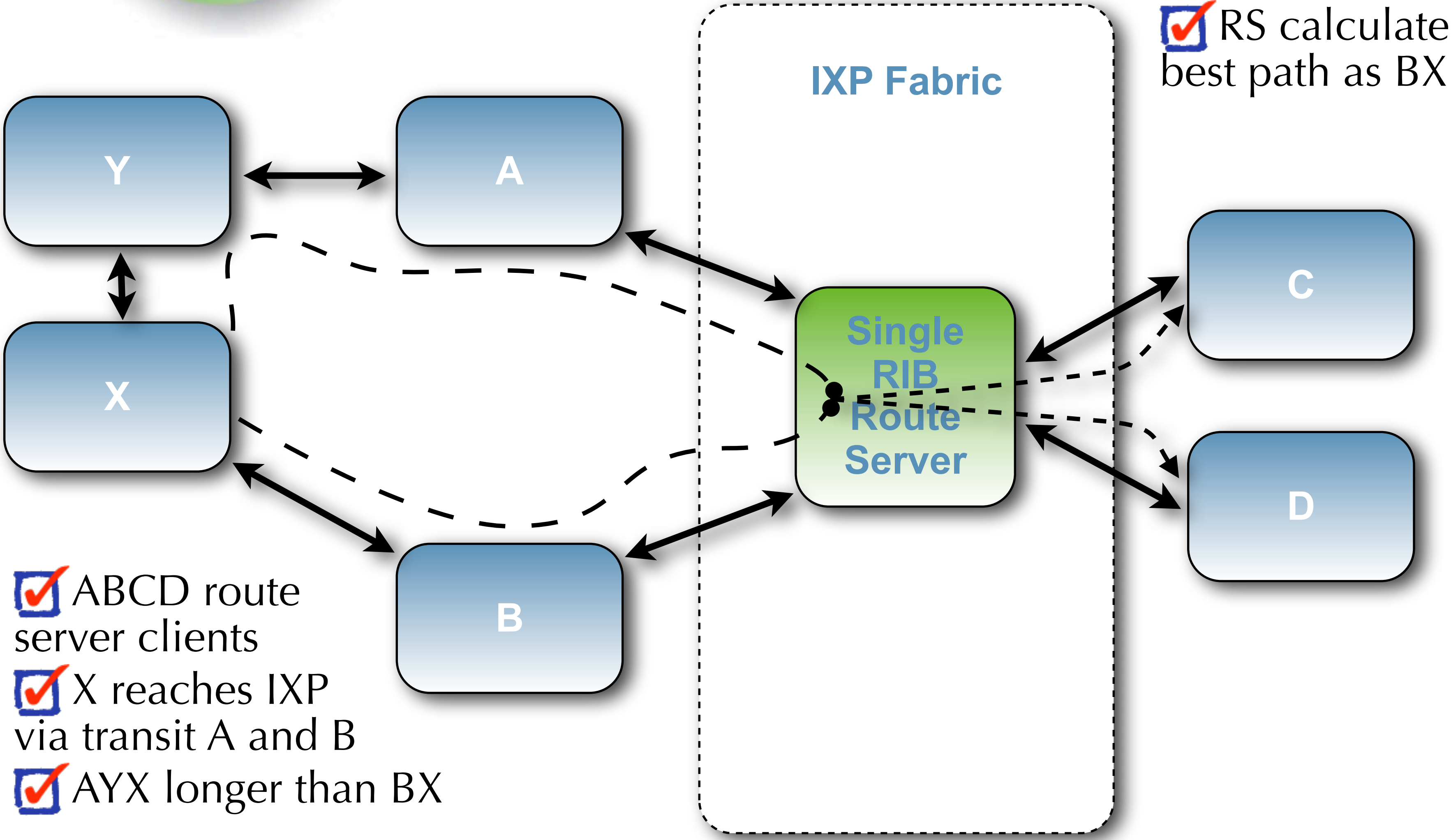

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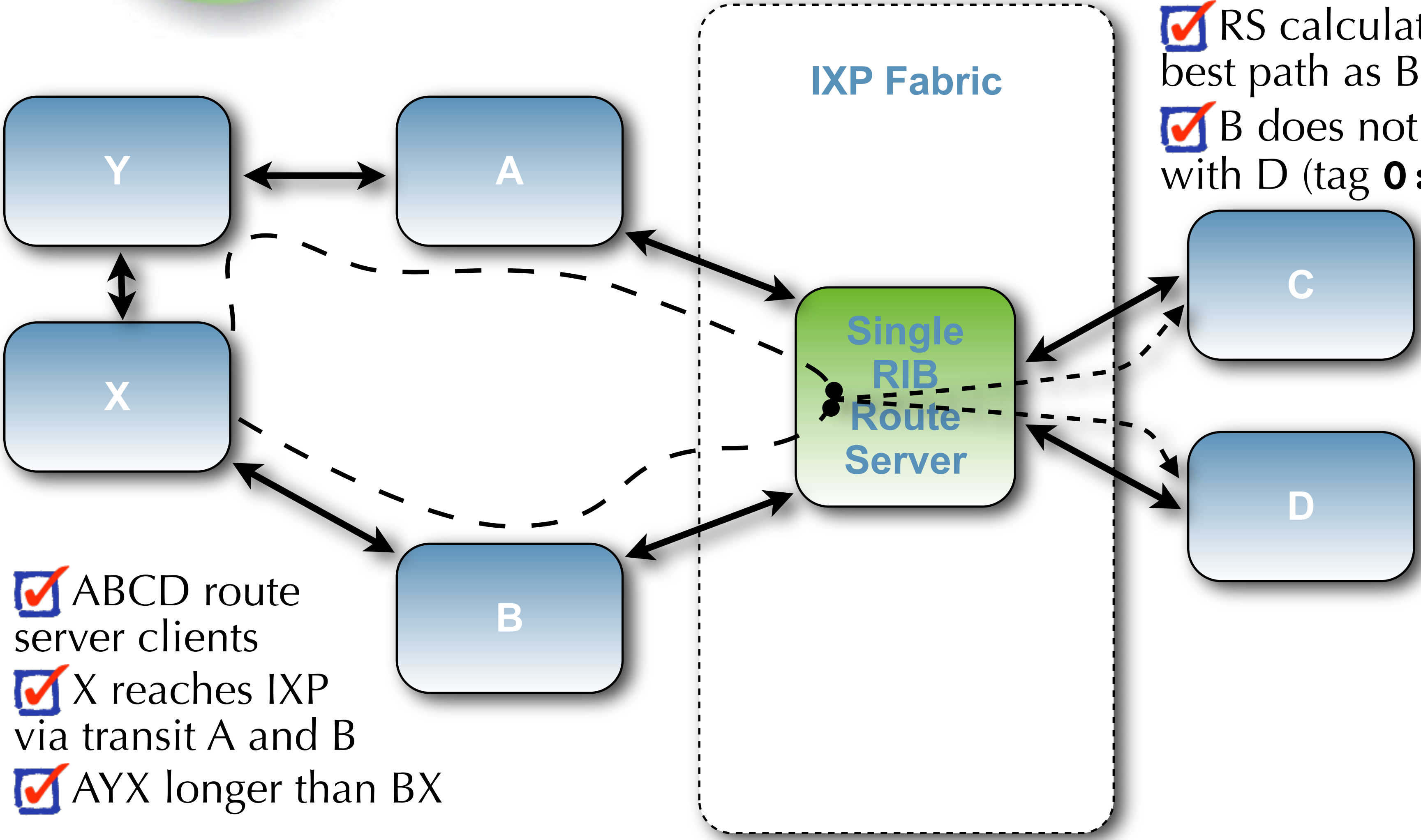

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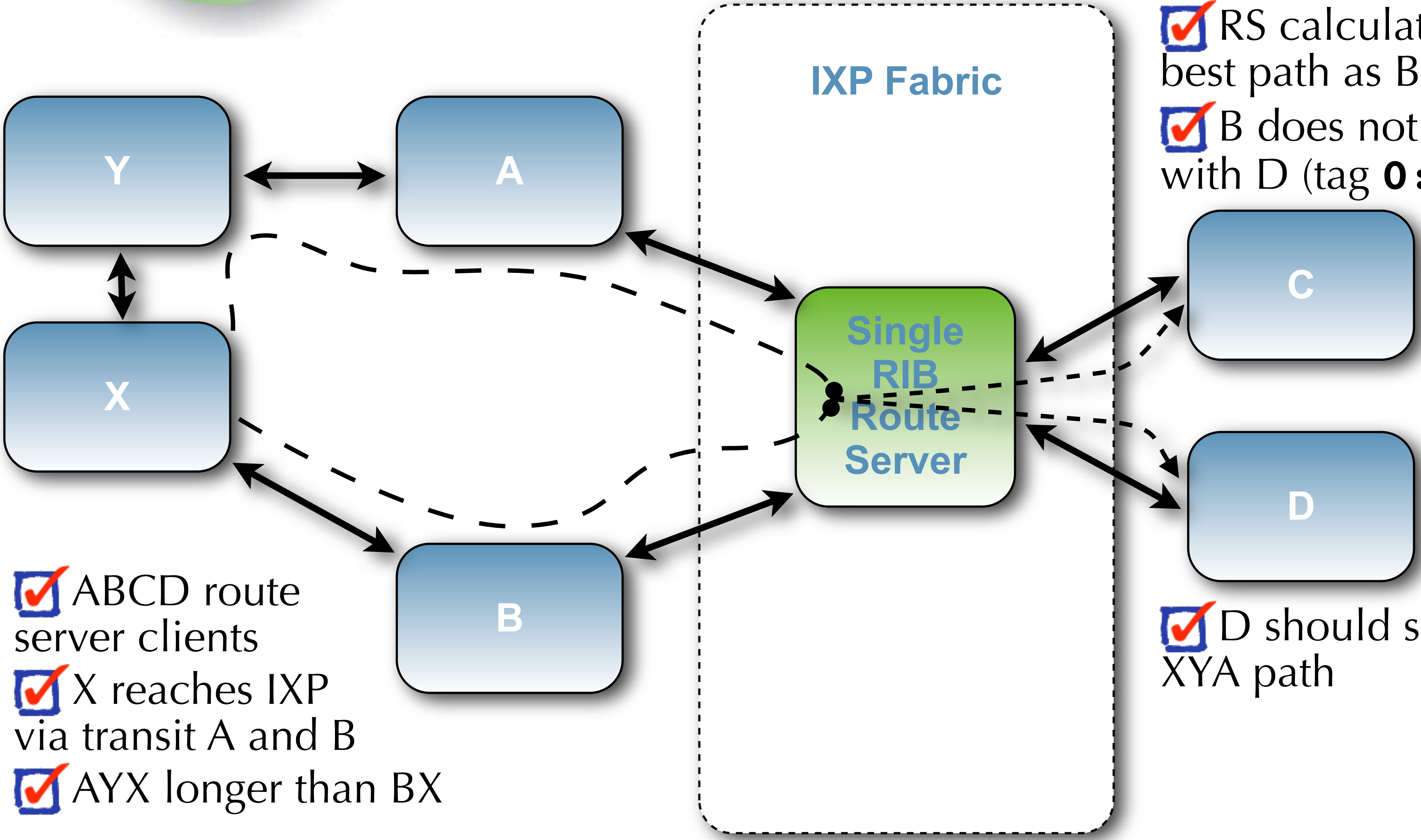

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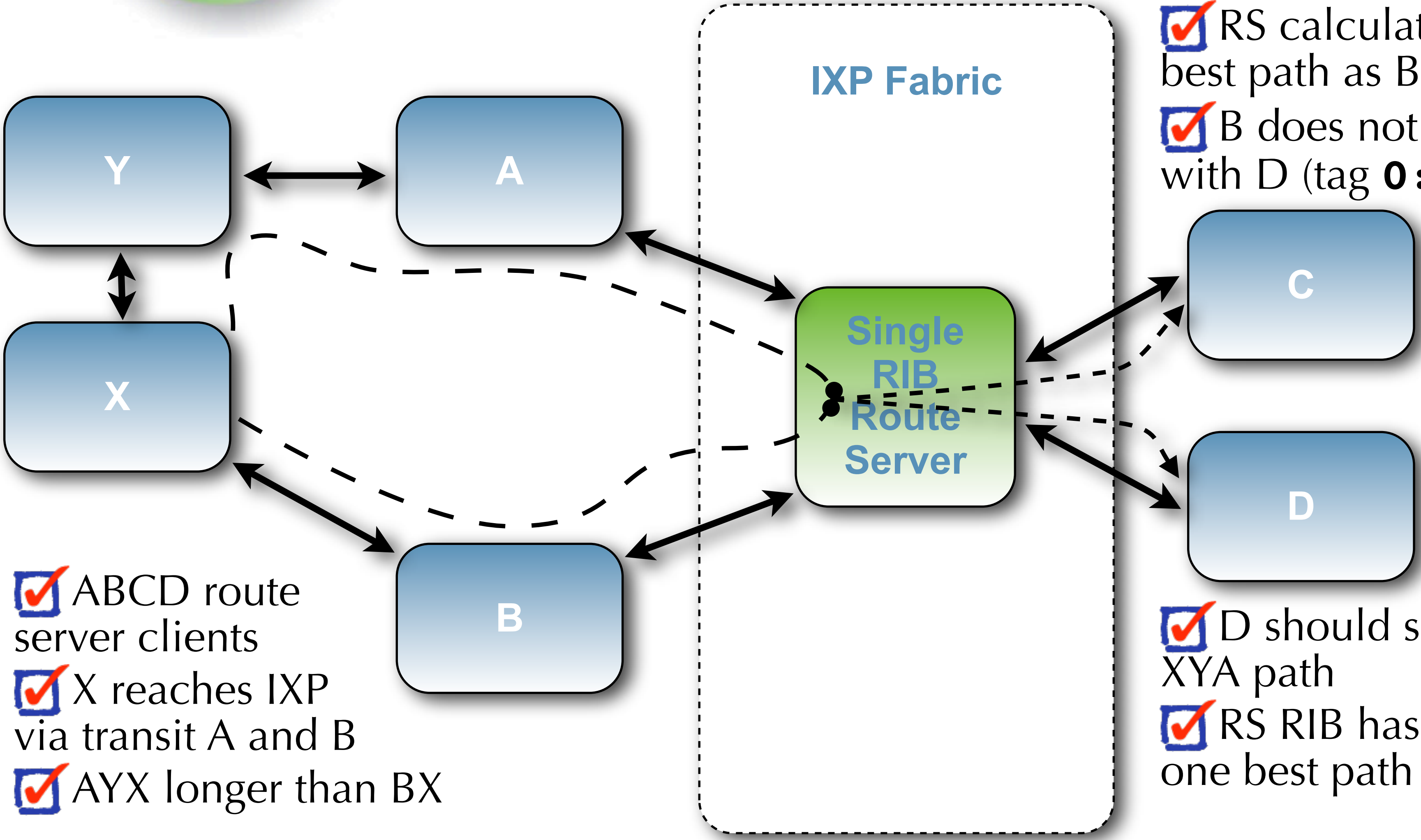

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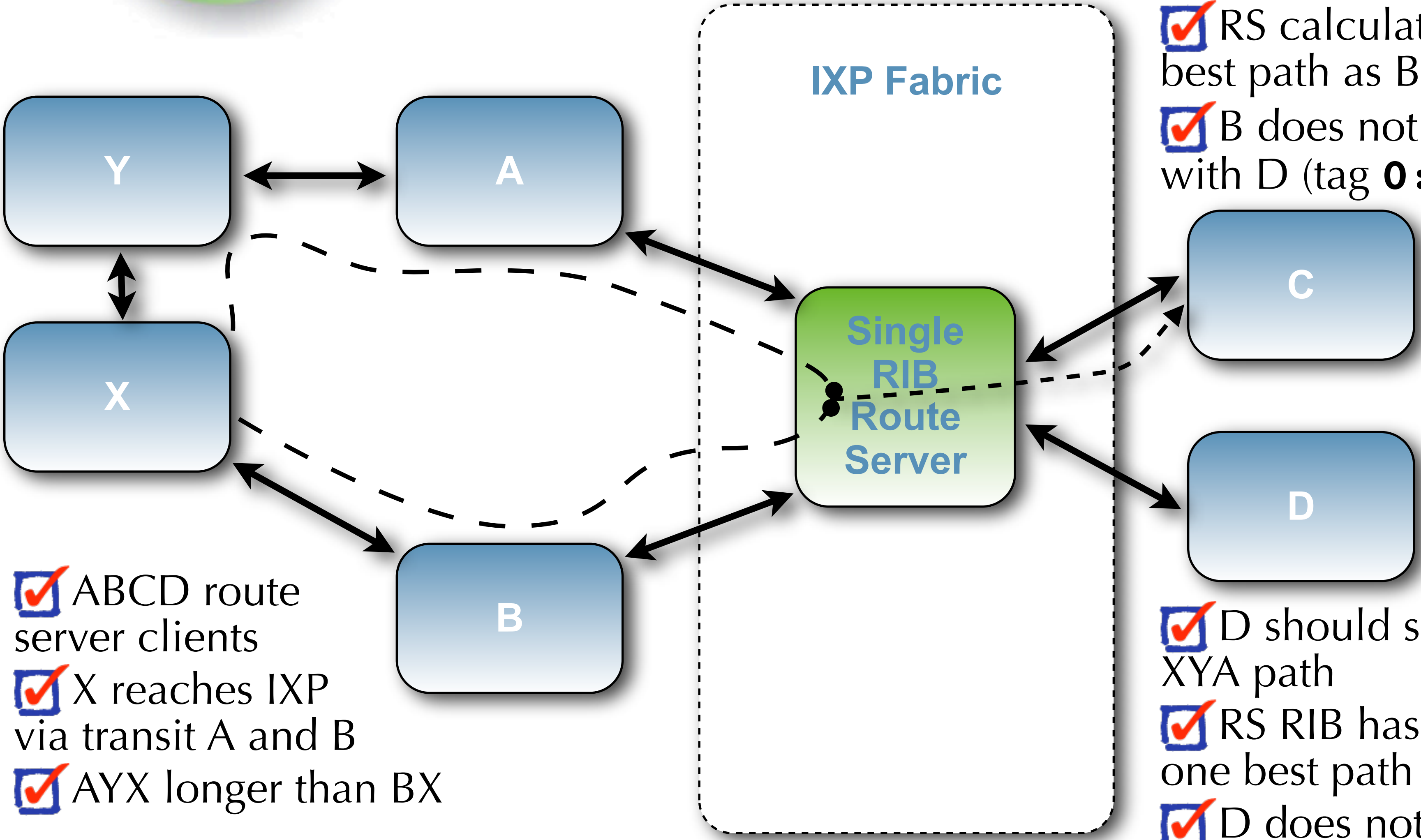

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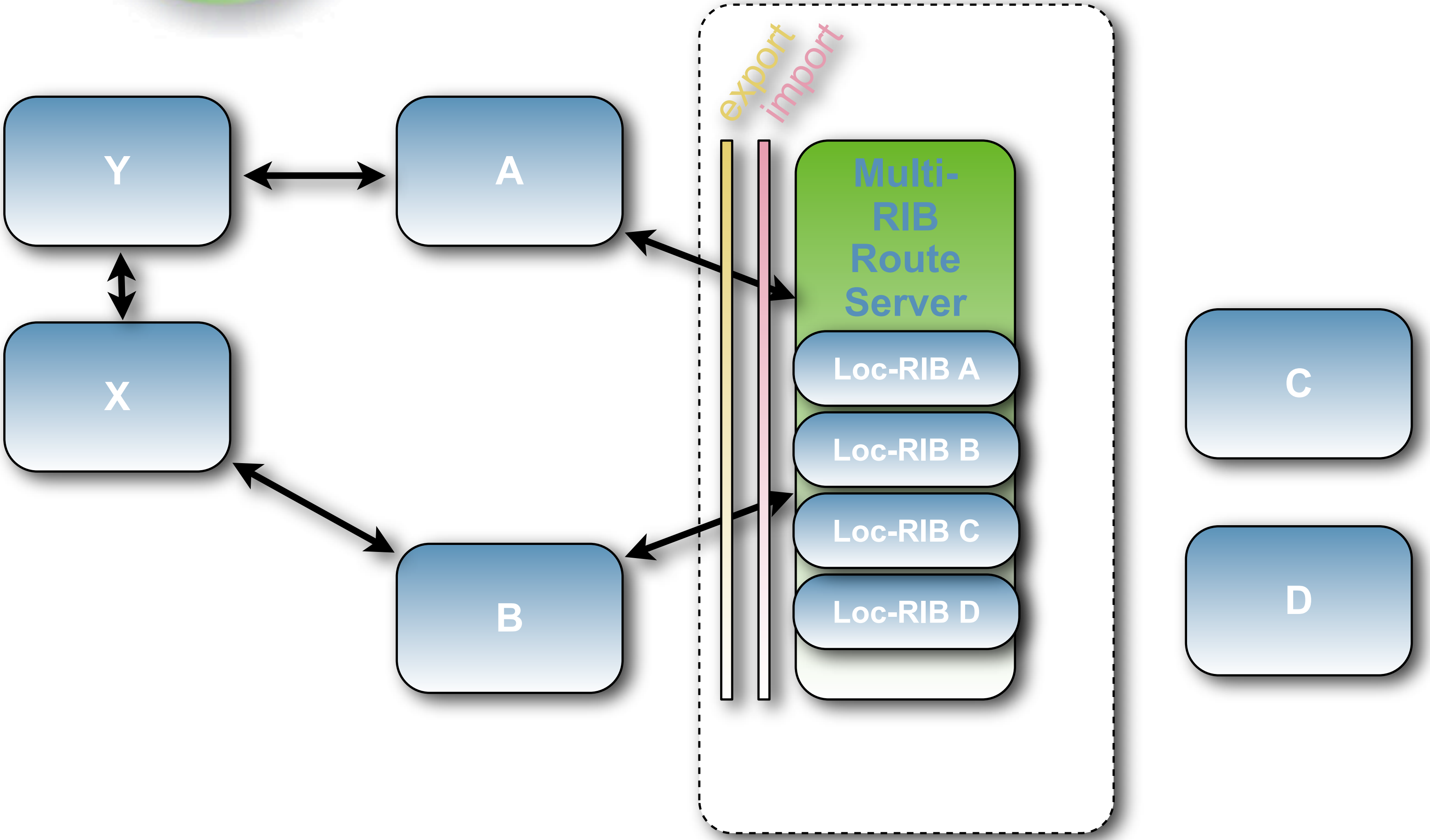
How Per-Client Loc-RIBs Work



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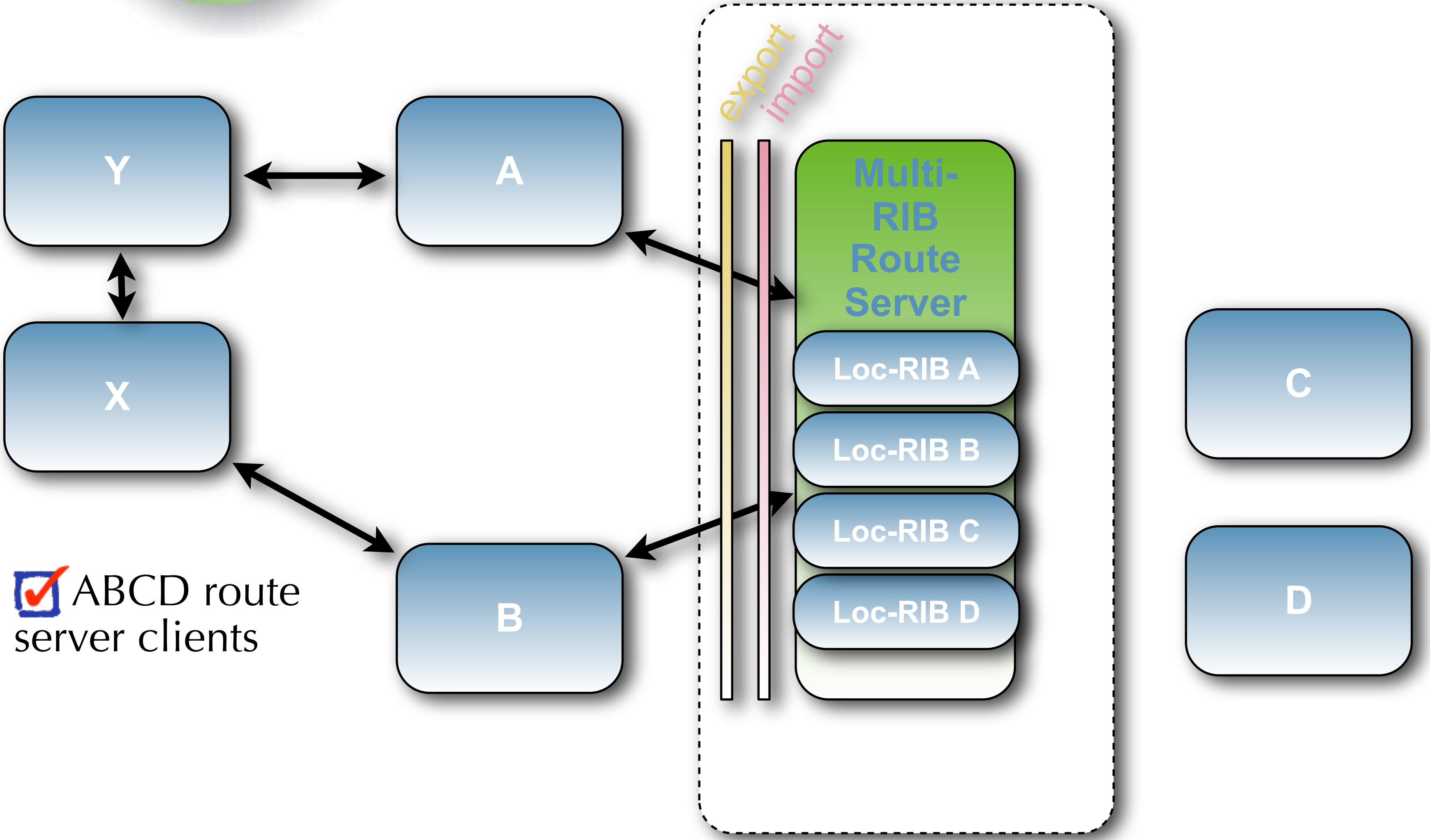

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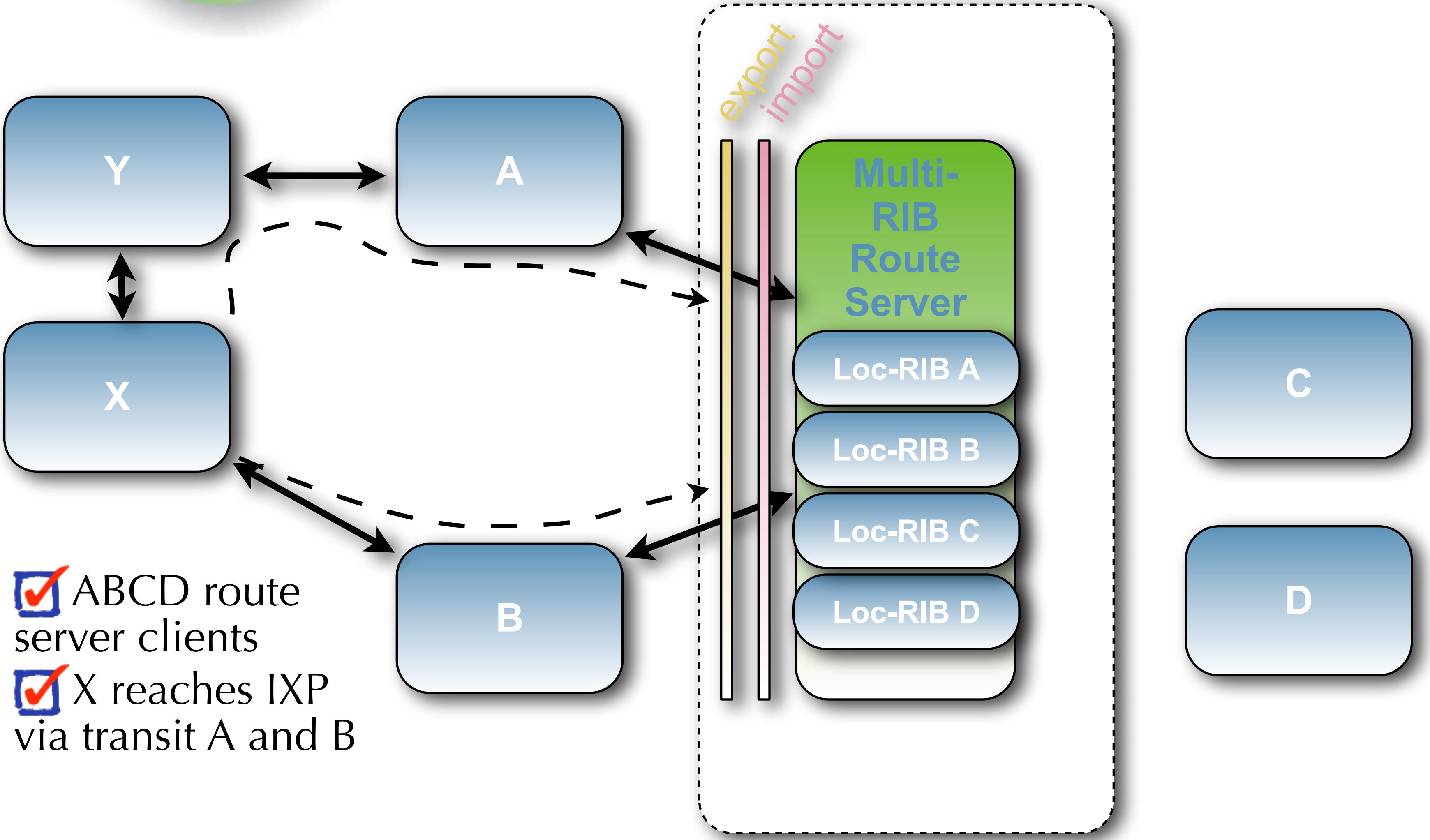

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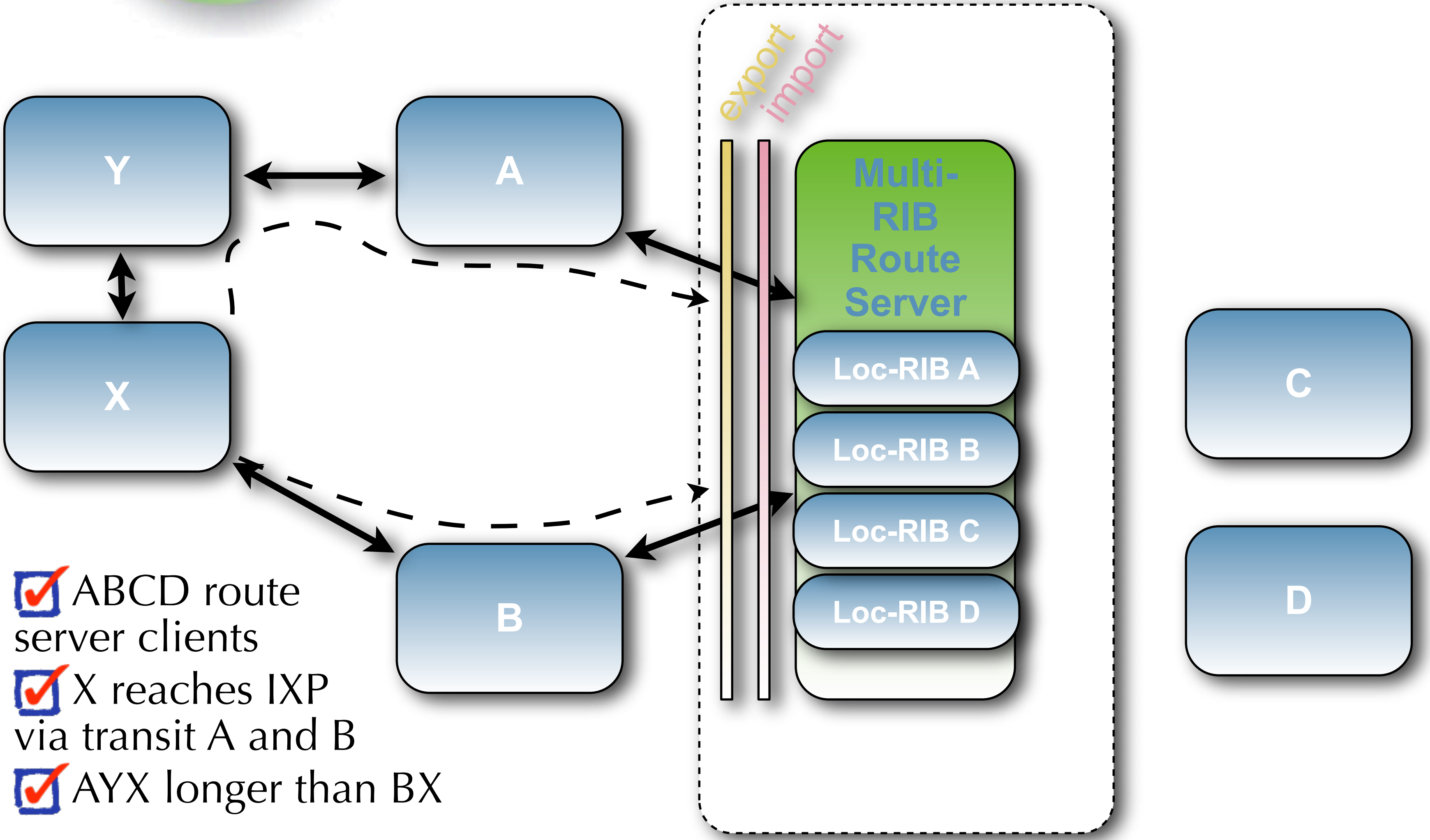

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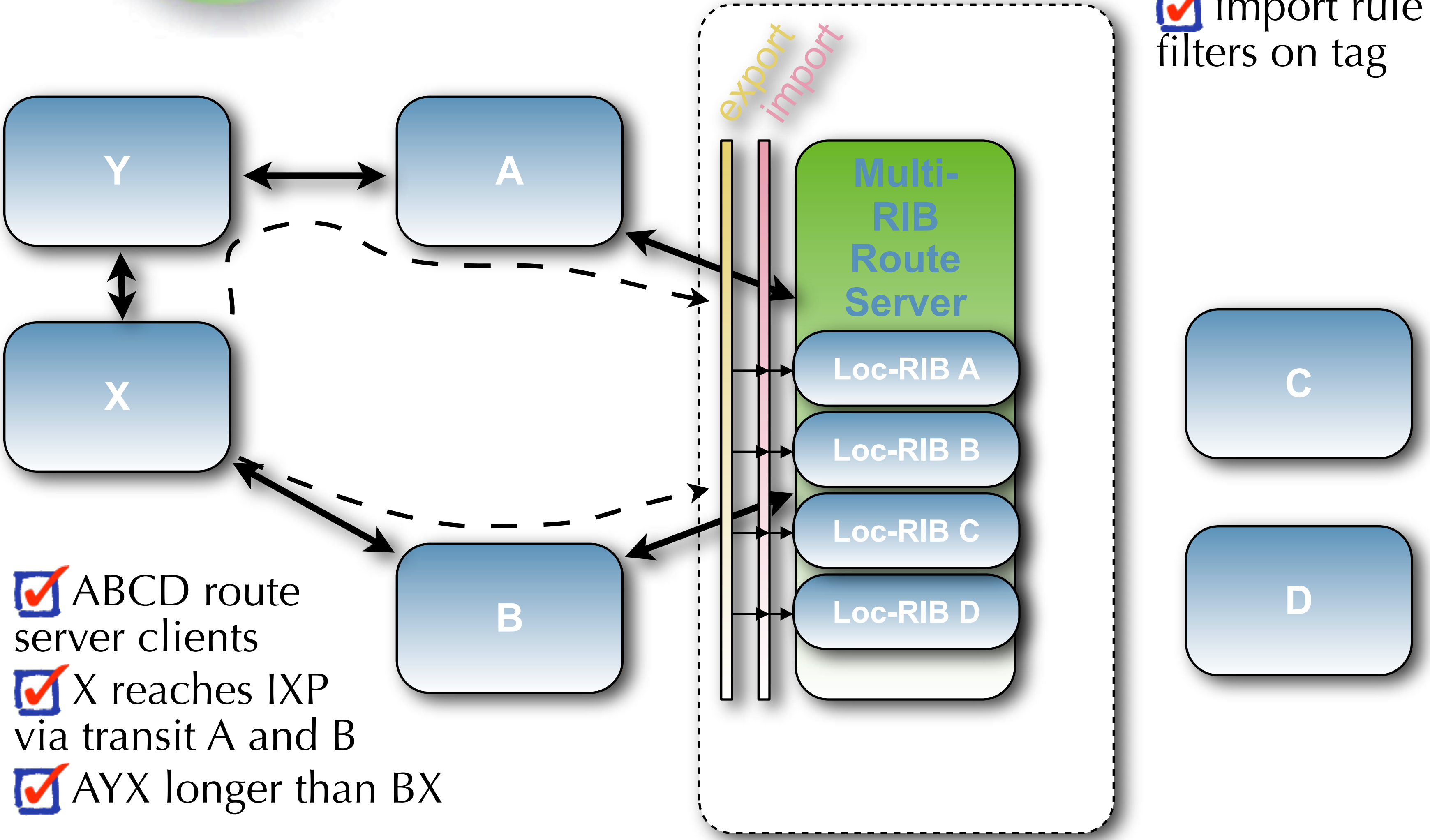

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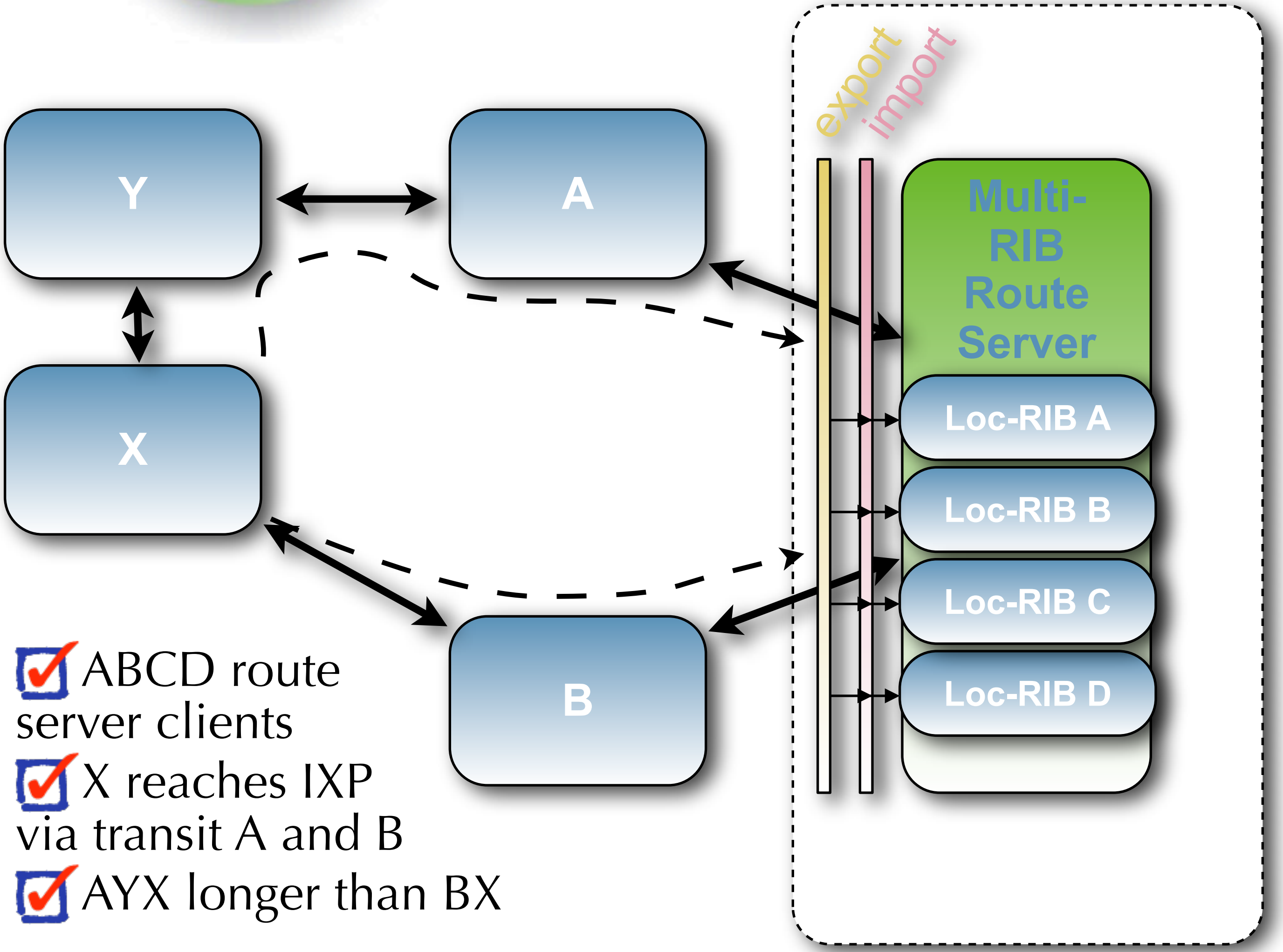

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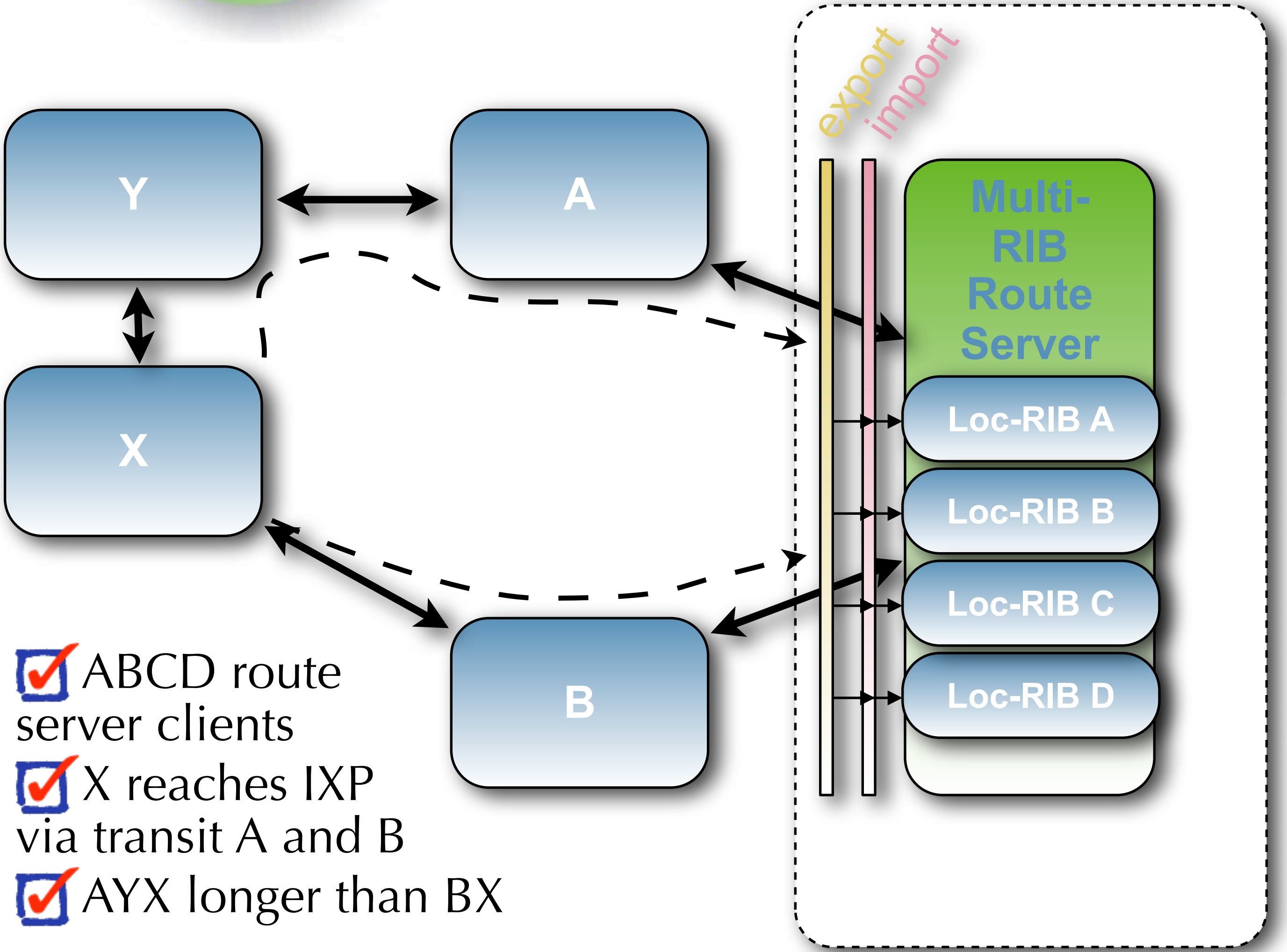

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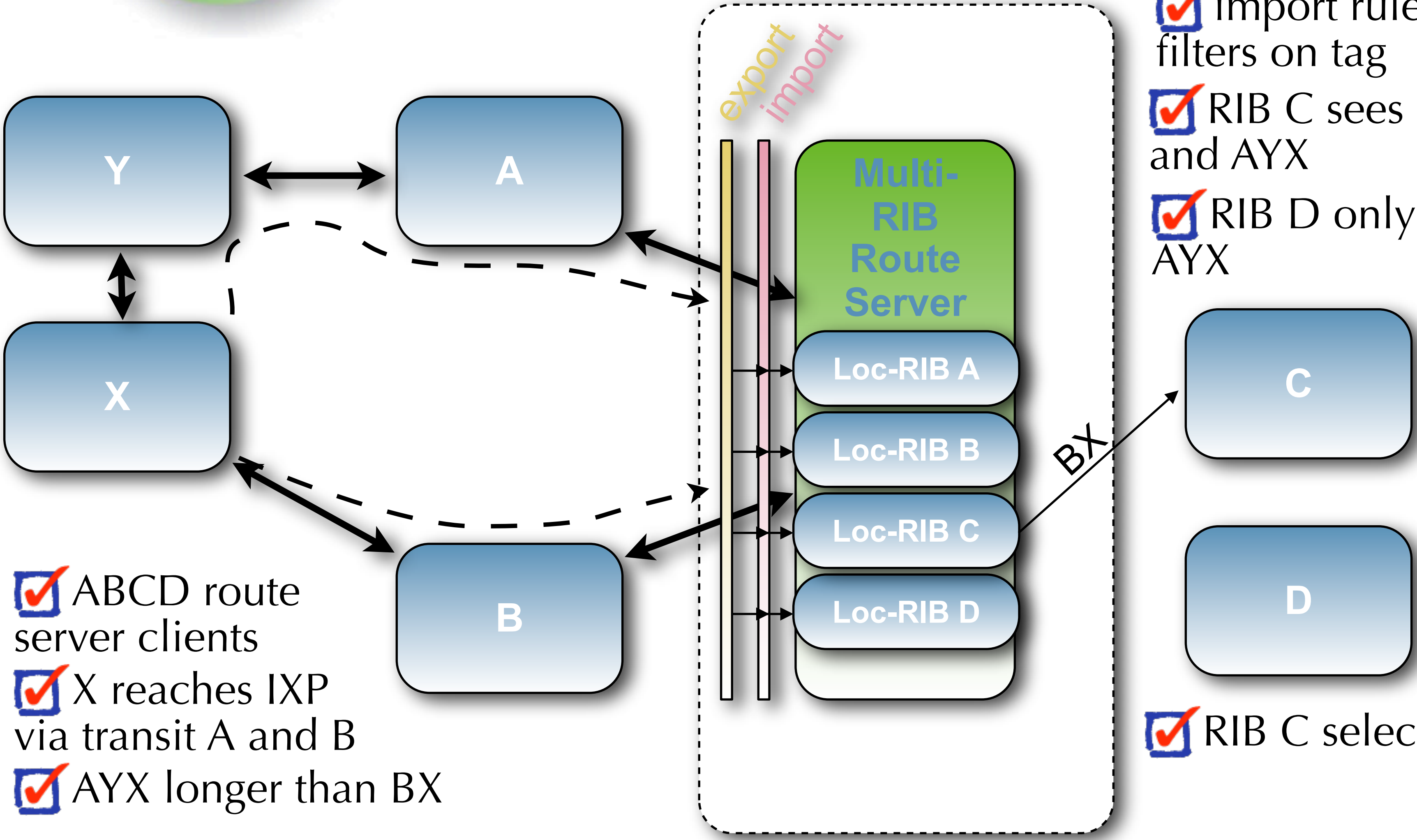

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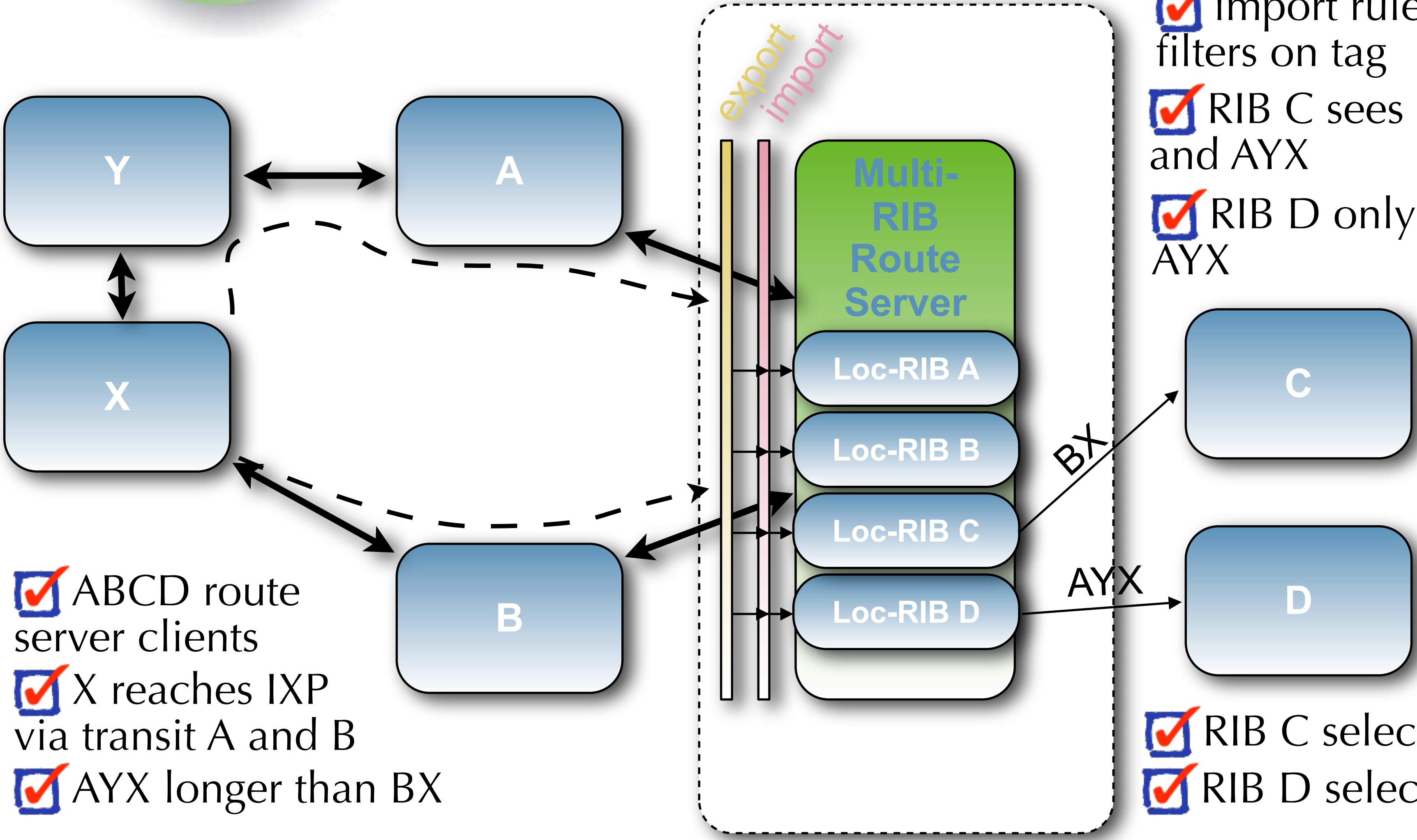

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☑ RIB D selects AYX

Ceiling Cat is Watching you Propagate

Problems with Multiple Loc-RIBs

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- Multiple Loc-RIBs mean:
  - Memory, CPU consumption go from O(M) to O(N x M)
    - N = number of clients
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    - Memory, CPU consumption go from O(M) to O(N x M)
        - N = number of clients
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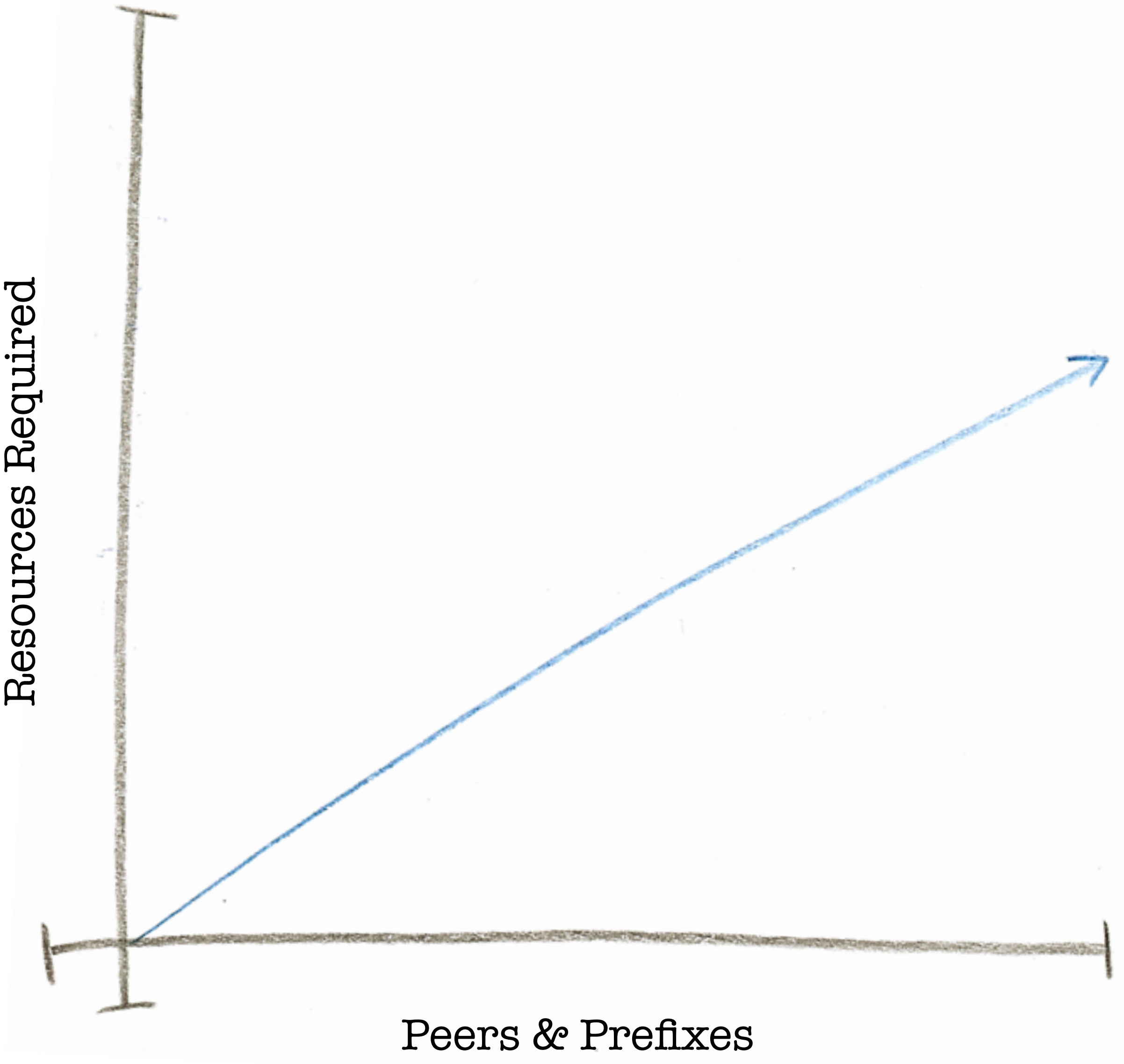
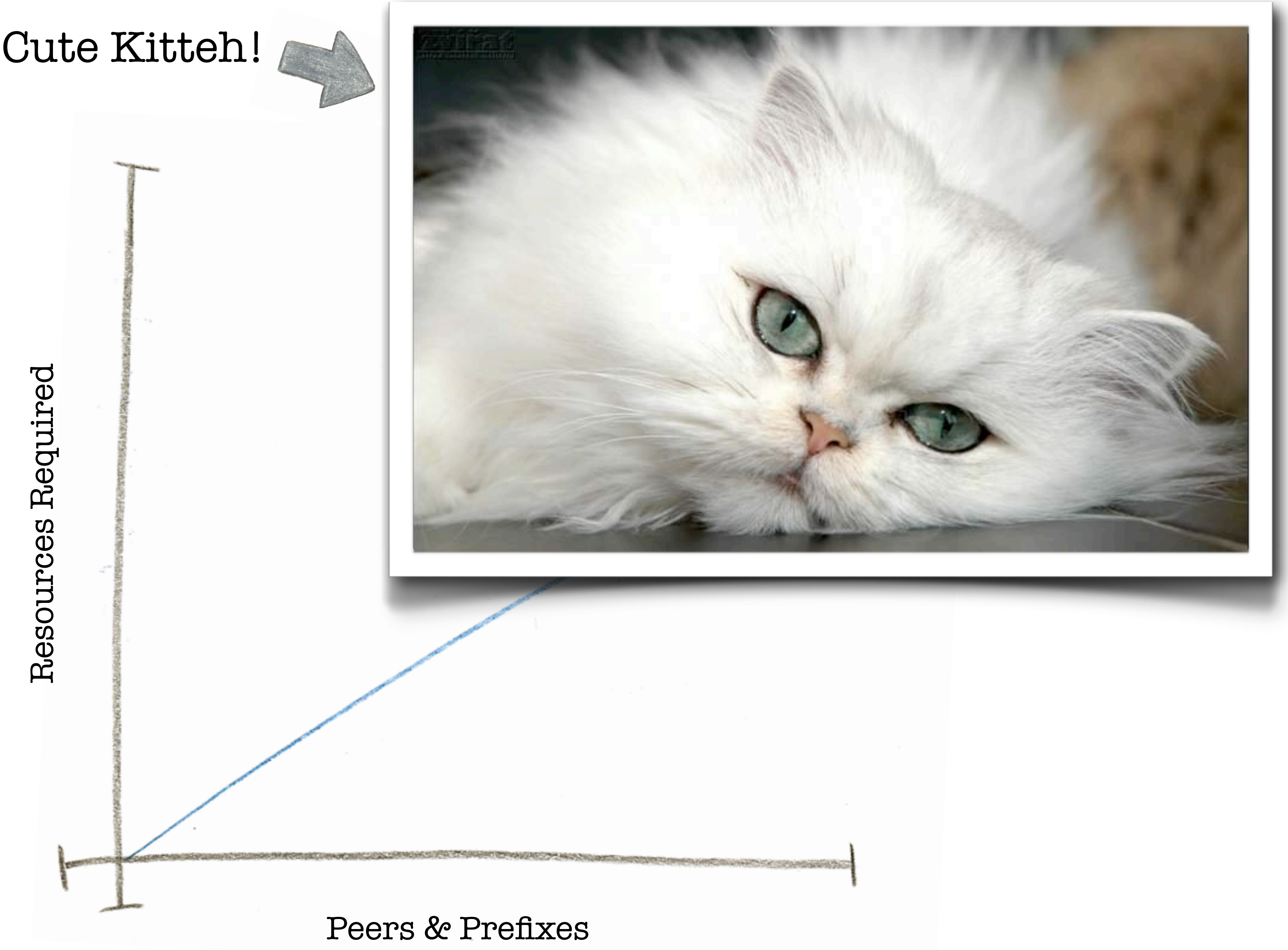
    - Update processing resources required are:

$$\sum_{1}^{N}(P(n)\bullet(N-1))$$

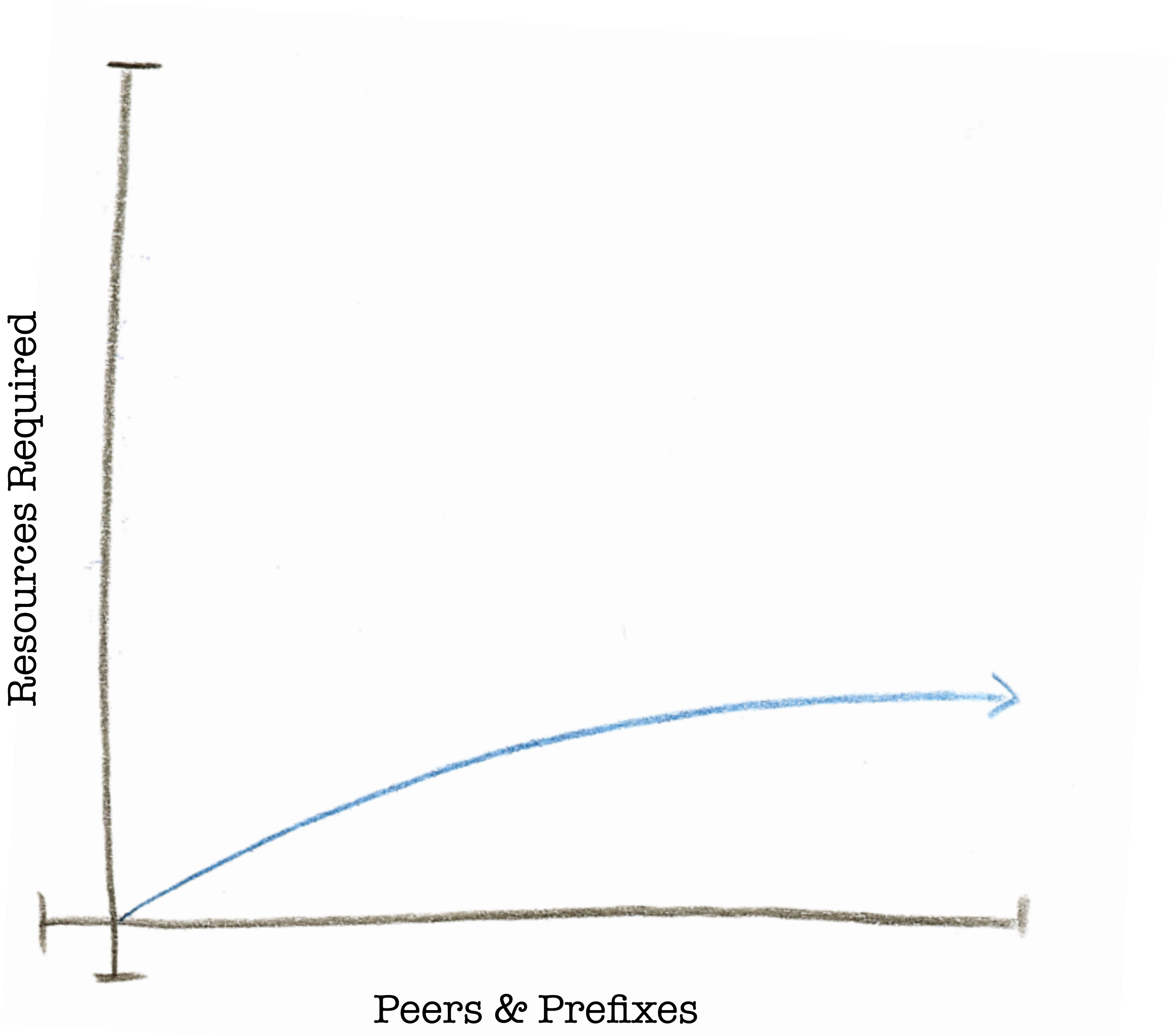
- Where
    - P(n) = the number of prefixes from peer n
    - N = number of peers connected to system
- This scales as $P_{average} * N^2$

Help!


Resources Required
Peers & Prefixes



Cute Kitteh!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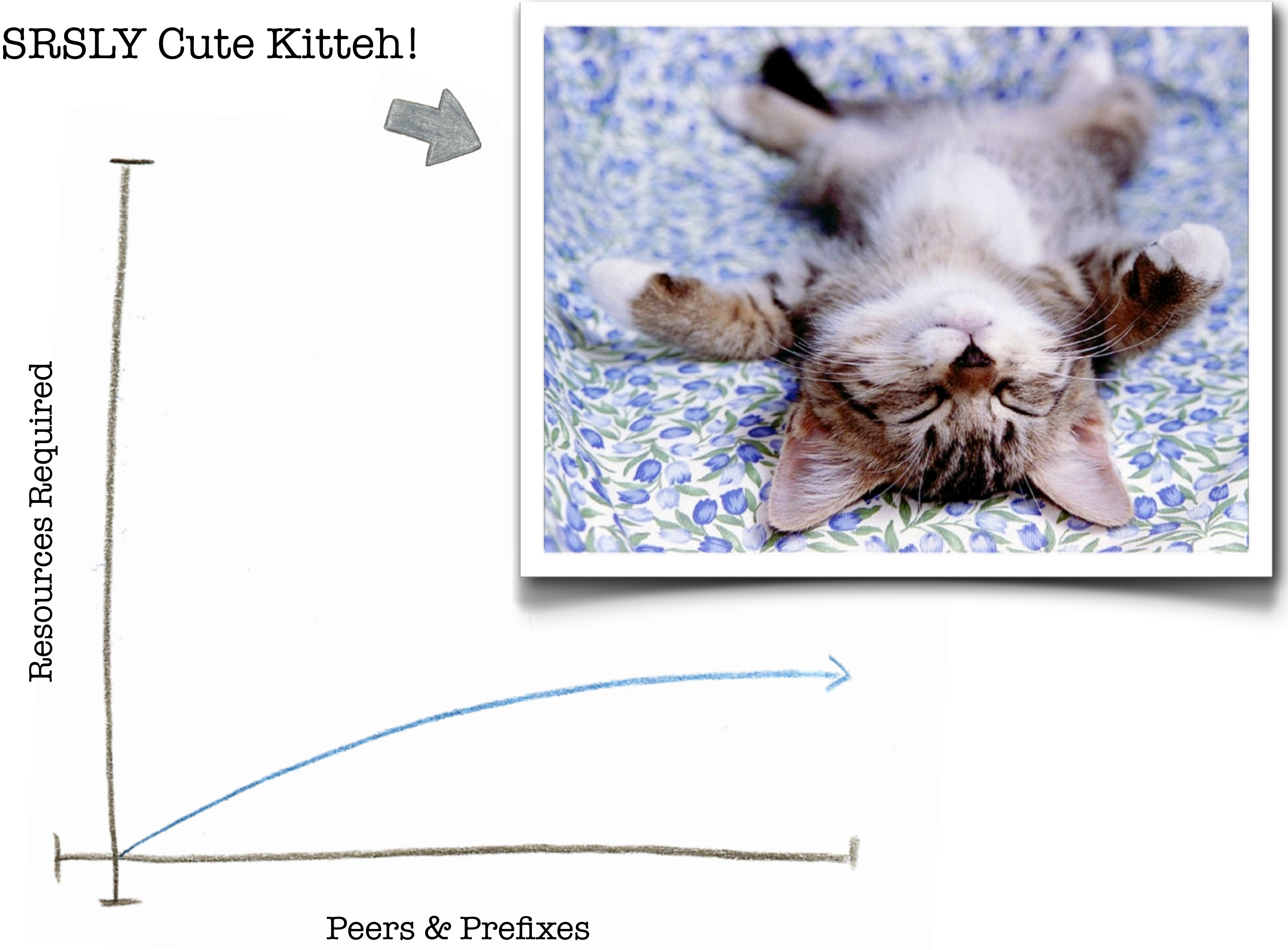
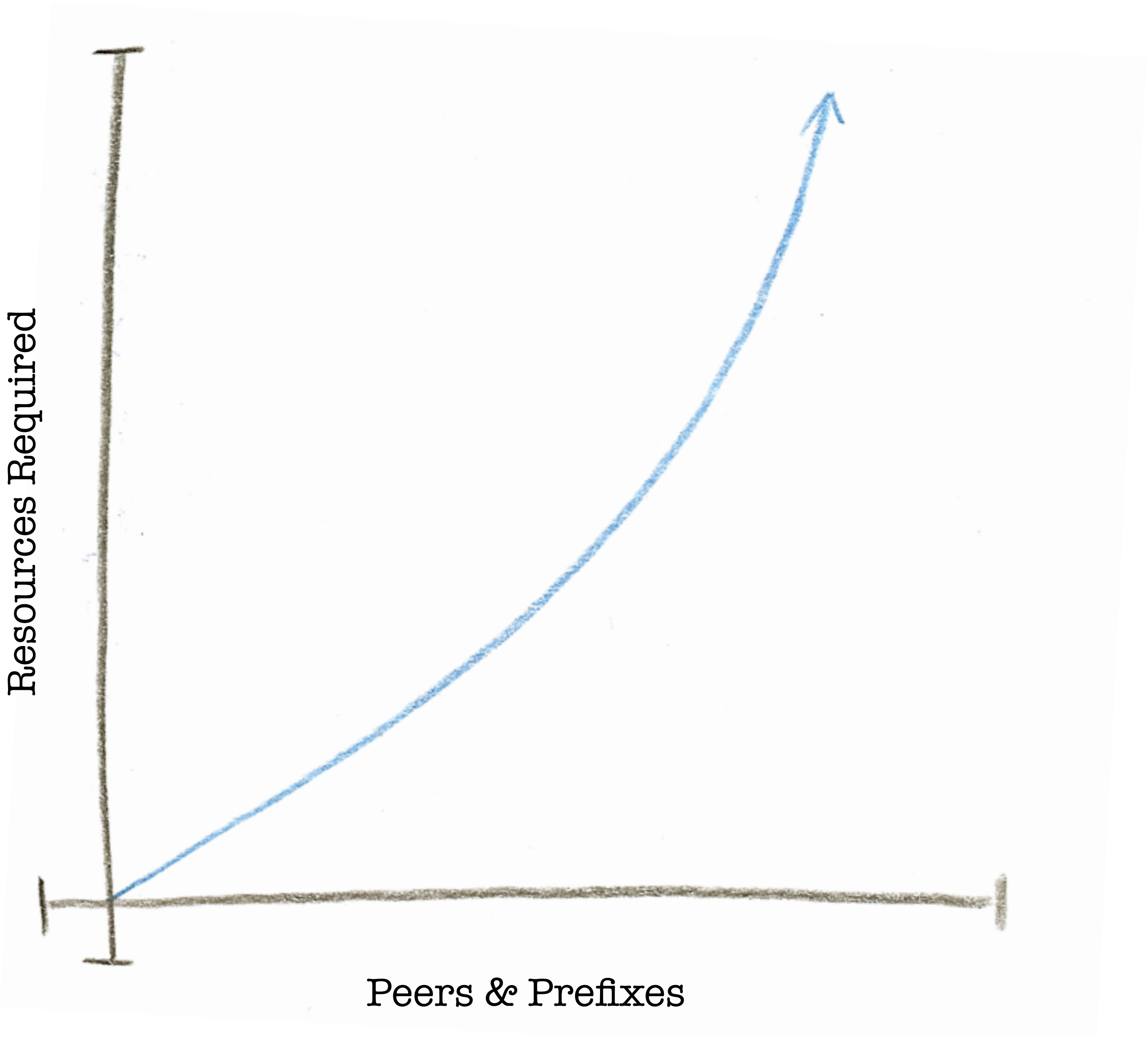
SRSLY Cute Kitteh!

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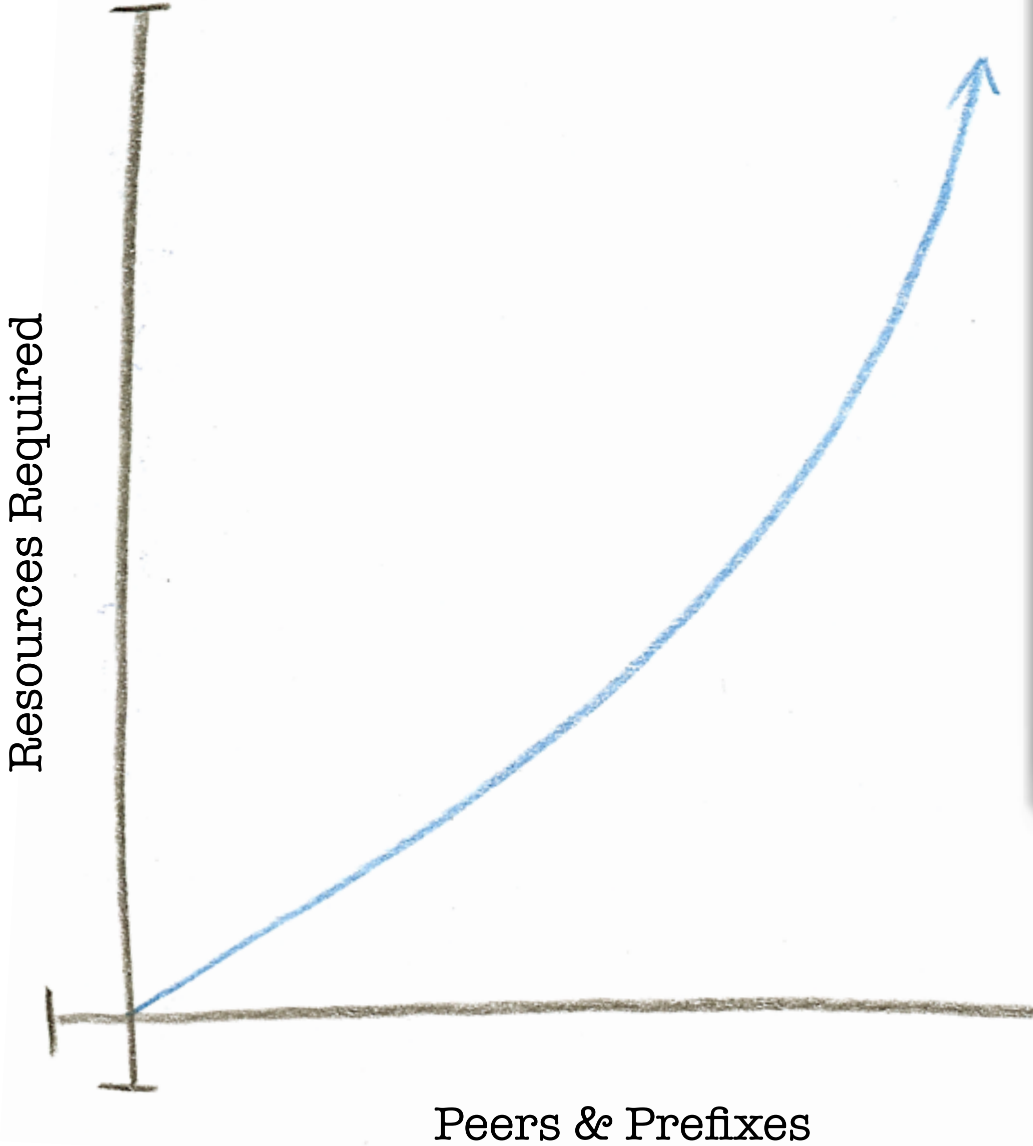
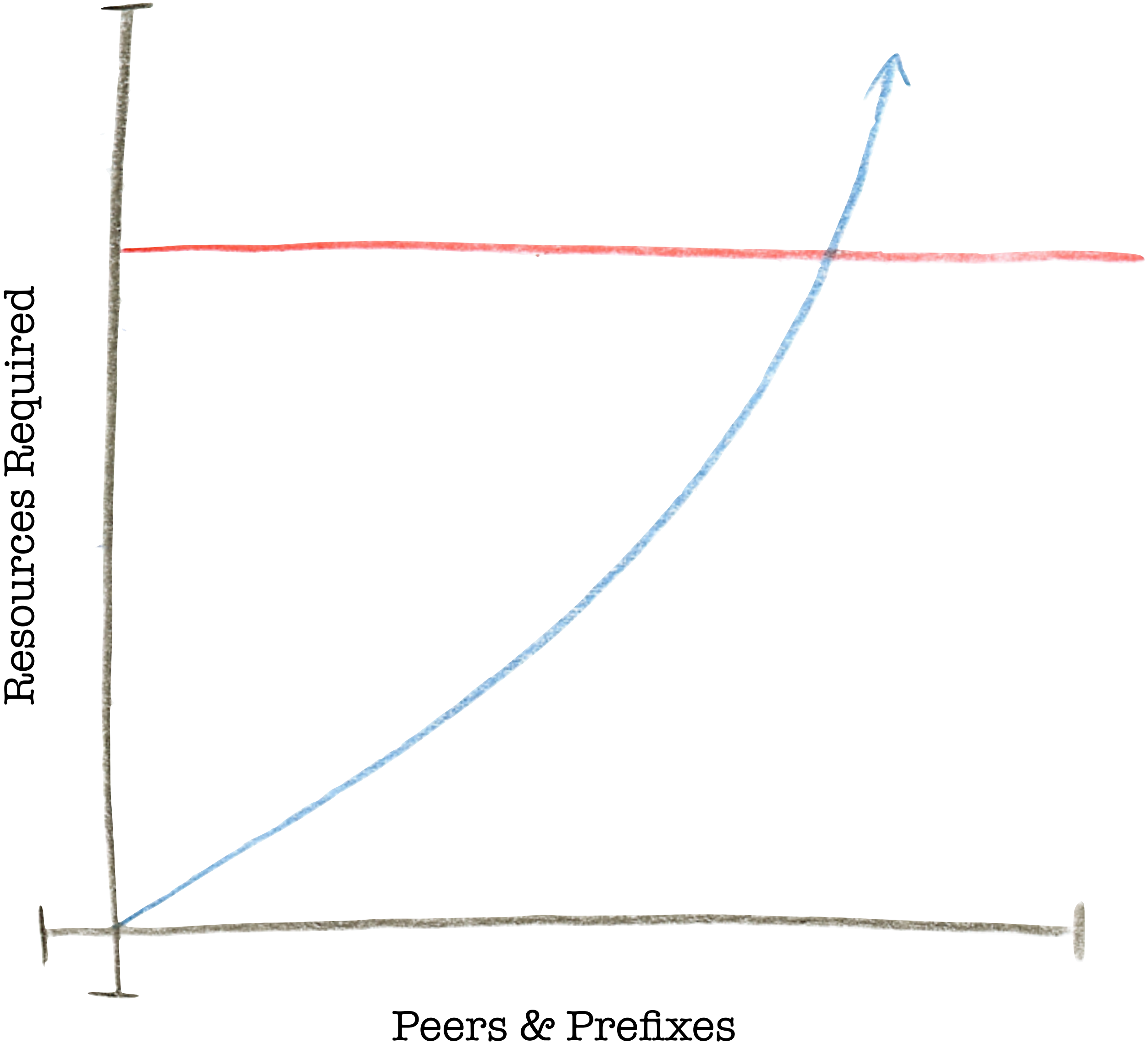
Evil Kitteh!

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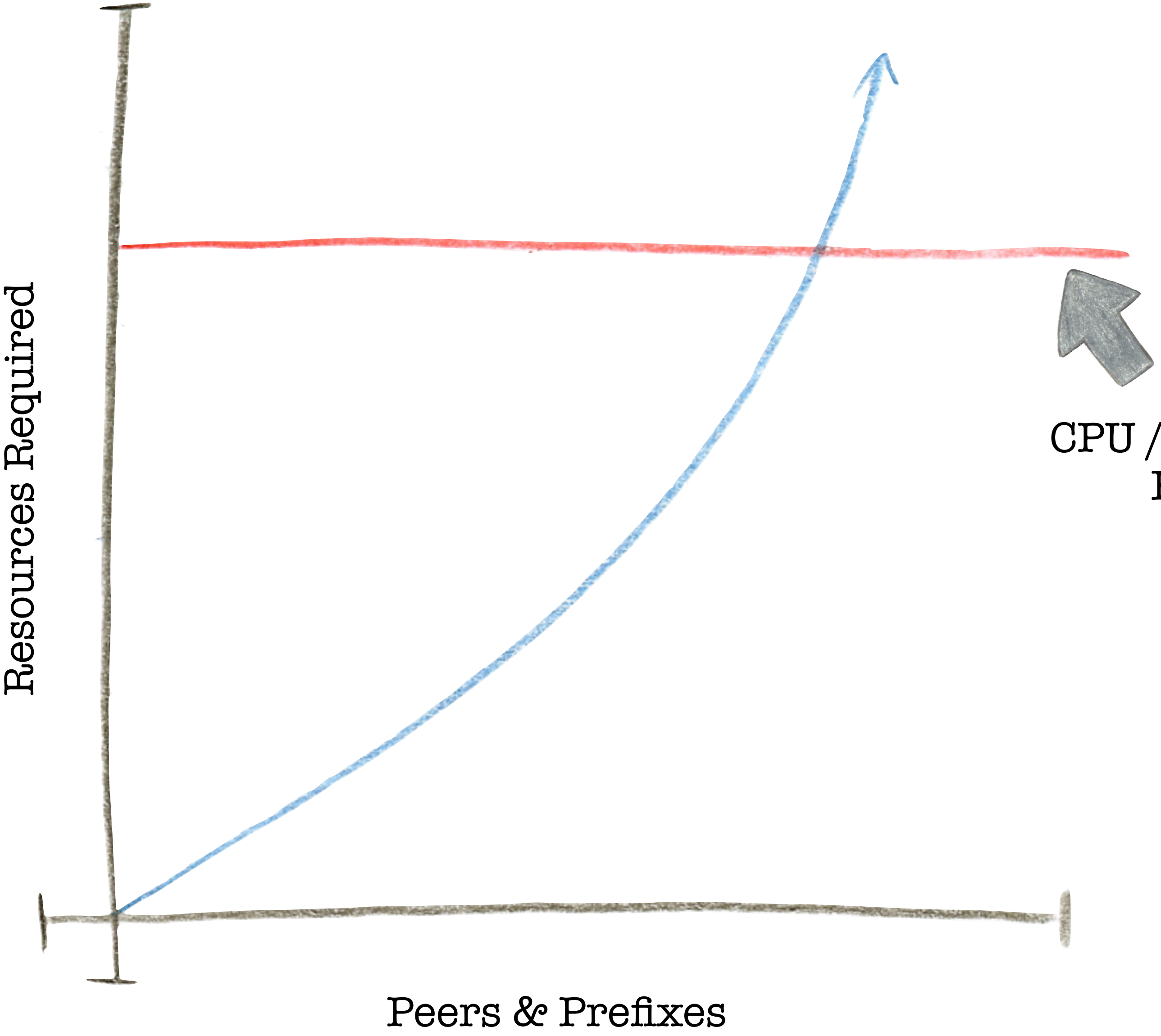
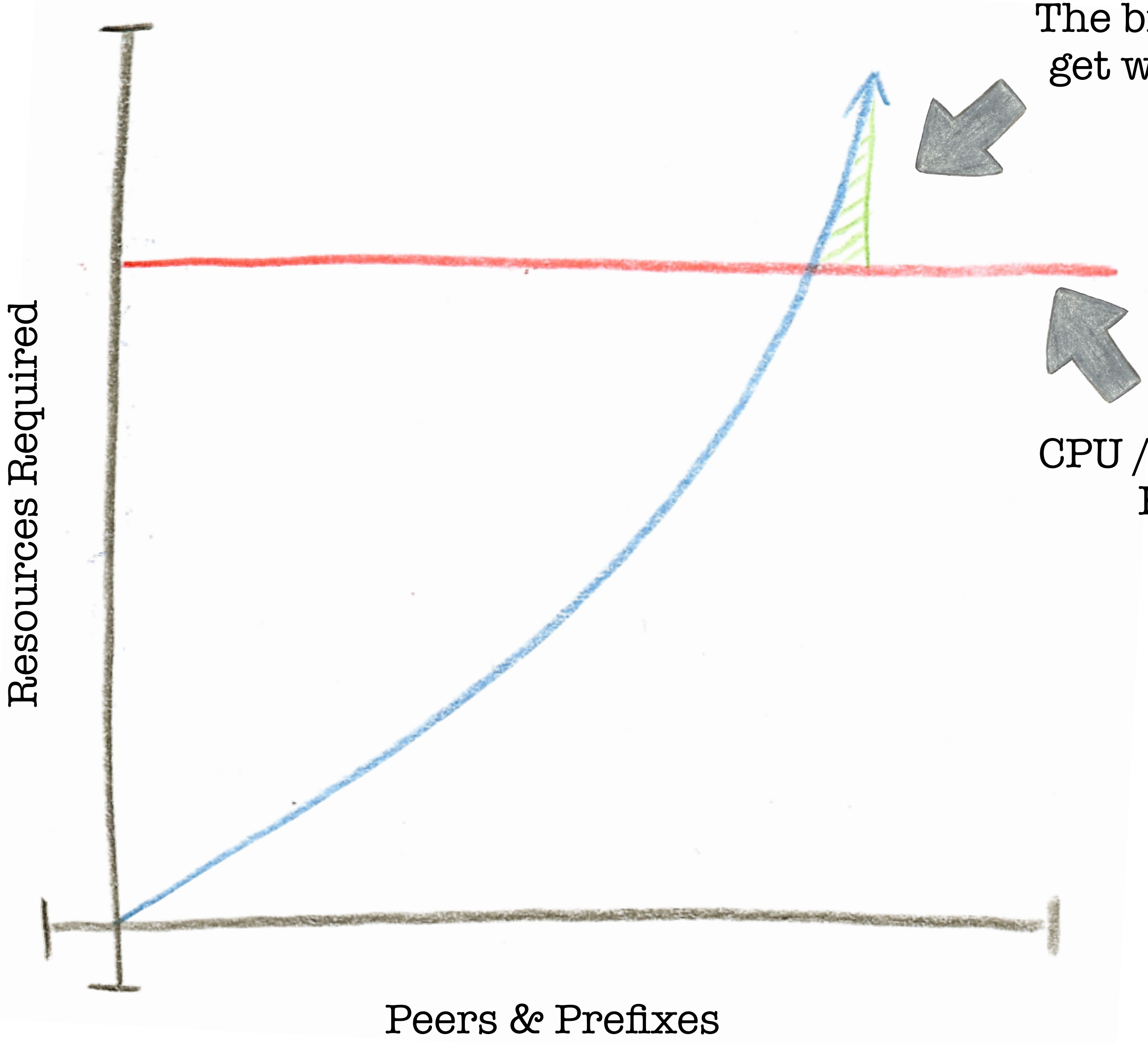
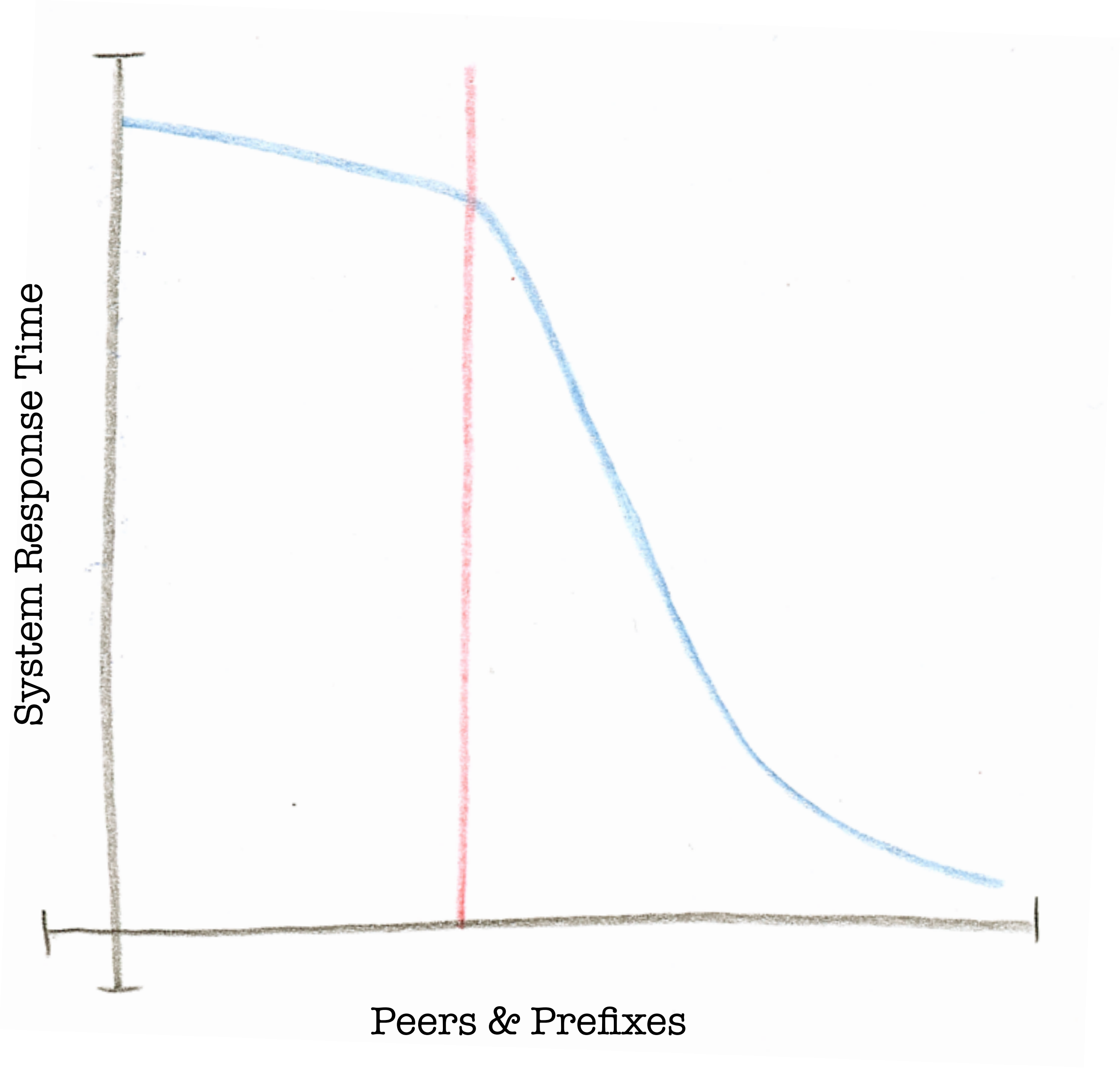


CPU / Memory / Network
Resource Limit



The bit you need to get worried about

CPU / Memory / Network Resource Limit


System Response Time
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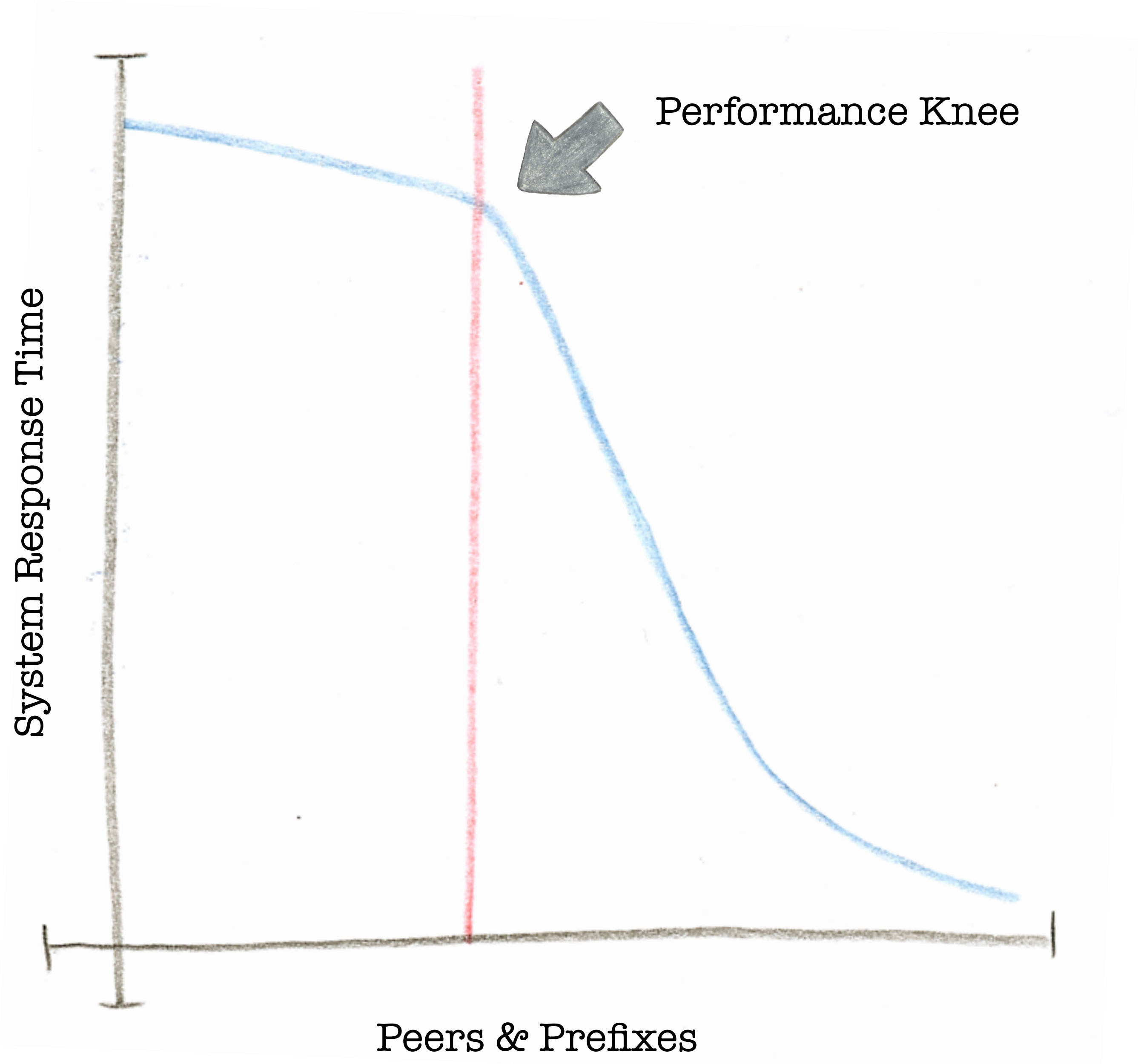
Performance Knee
System Response Time
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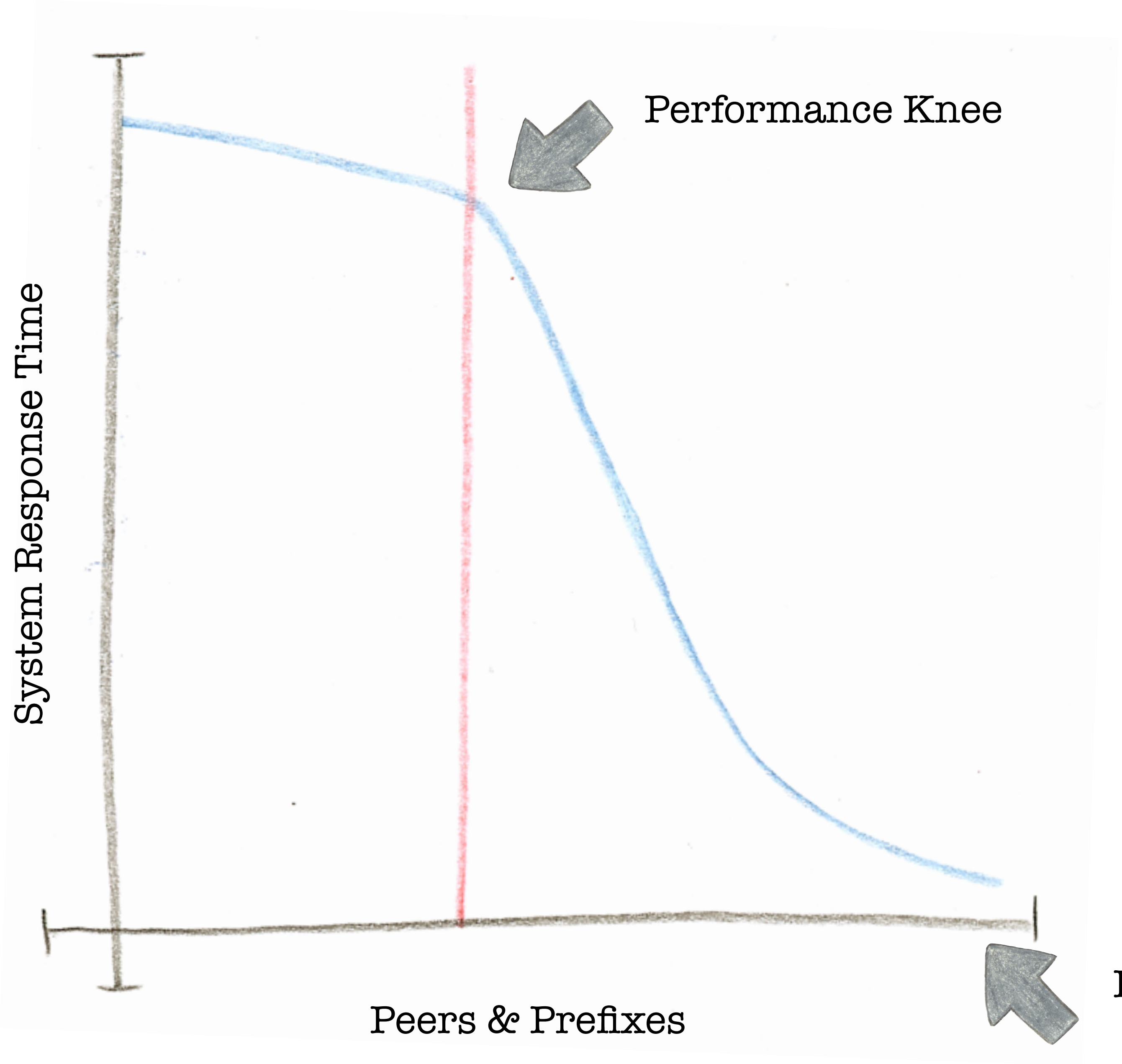

Performance Knee

Performance Goes to
Hell in a Handcart

Facts and Figures

- A single BGP prefix update
  - might take 10 - 30 bytes on network to send to peer
  - might take 10 - 30µS to process update
- Disclaimer
  - this ignores attributes, path length, cpu speed, and a pile of other highly relevant parameters

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- Ok, it's hand-waving

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- 200 clients
- Average 100 prefixes each

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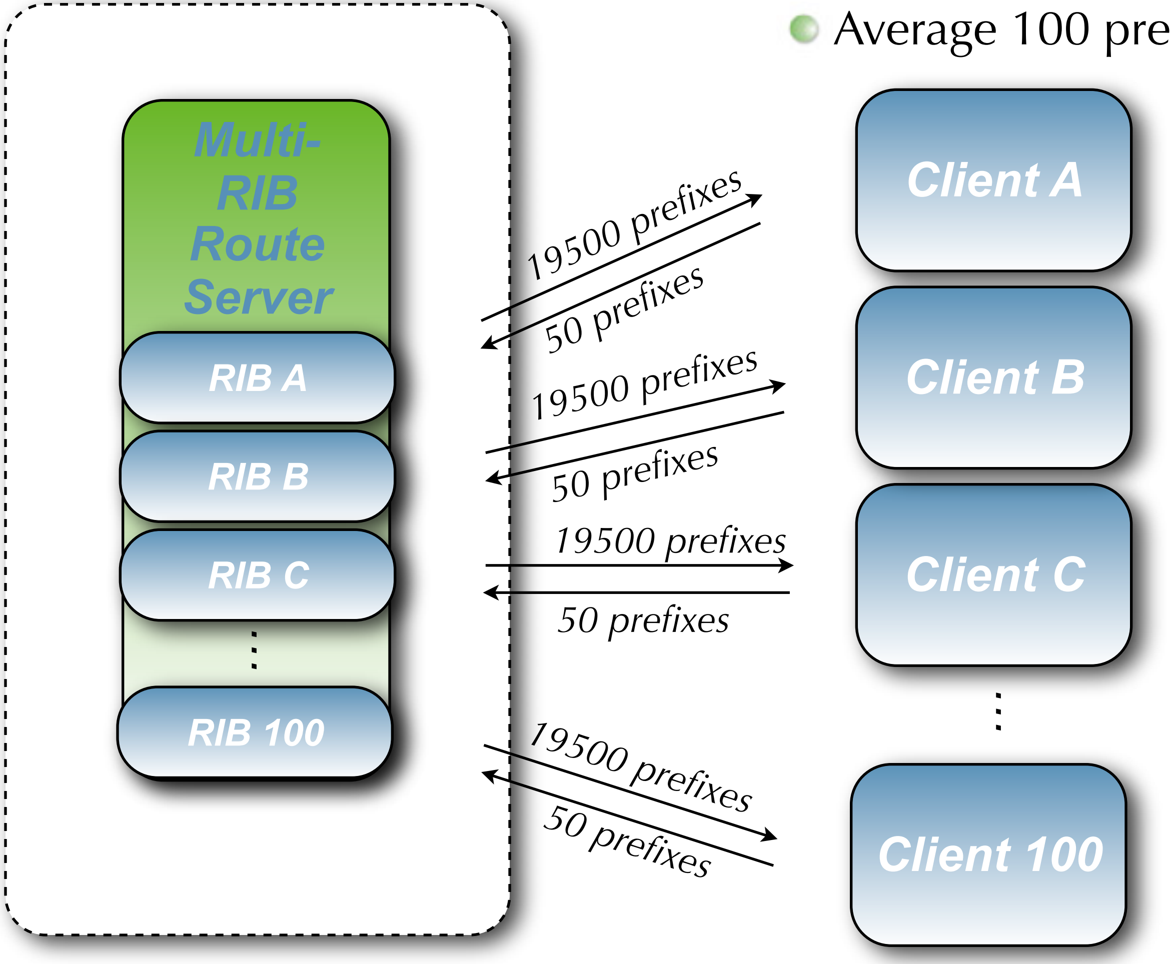

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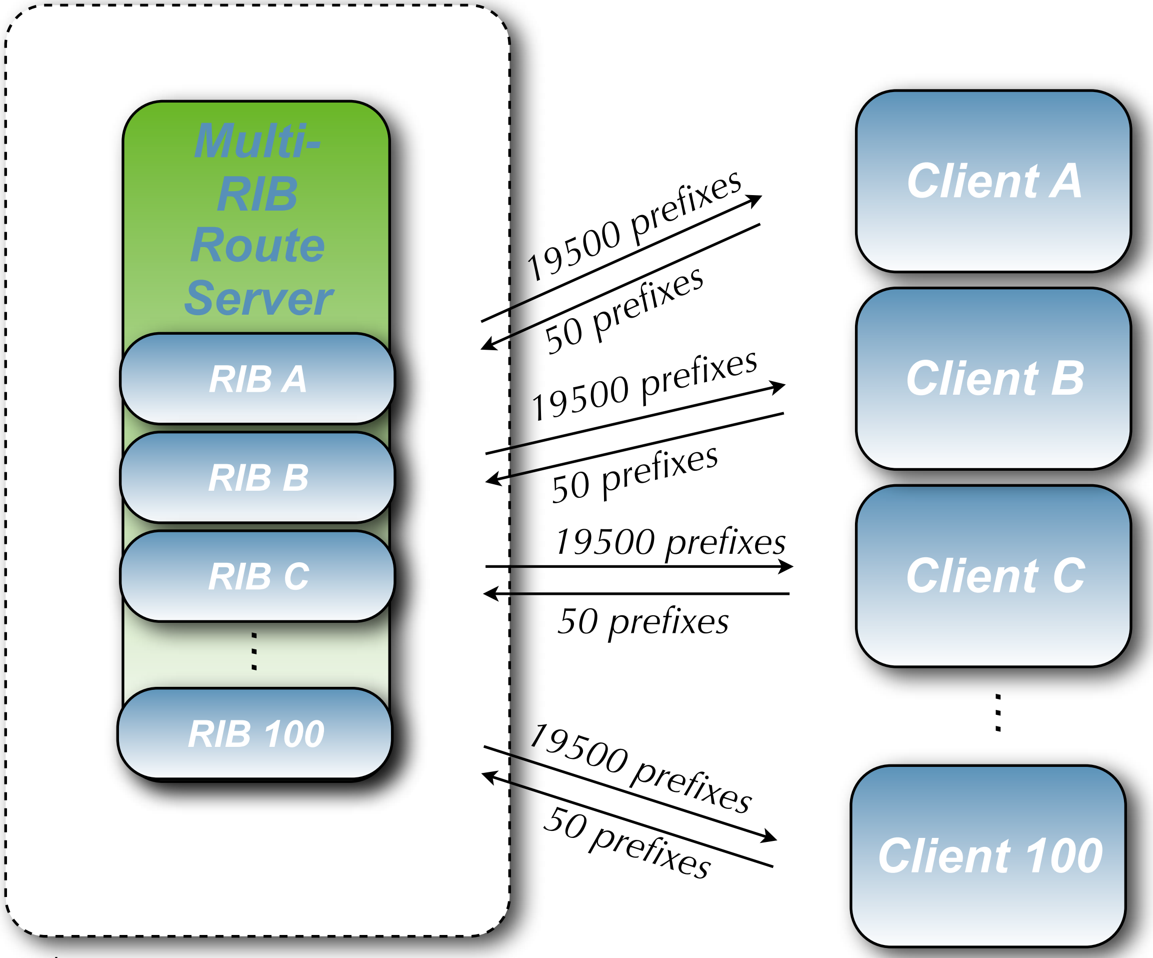

- 200 clients
- Average 100 prefixes each

- RS to Client updates:
  - 19500*200 = 3,900,000
- Client to RS updates:
  - 100 * 200 = 20000 updates
- Total BGP updates: 4,000,000

- 40-120M of network traffic
- 40-120s CPU time

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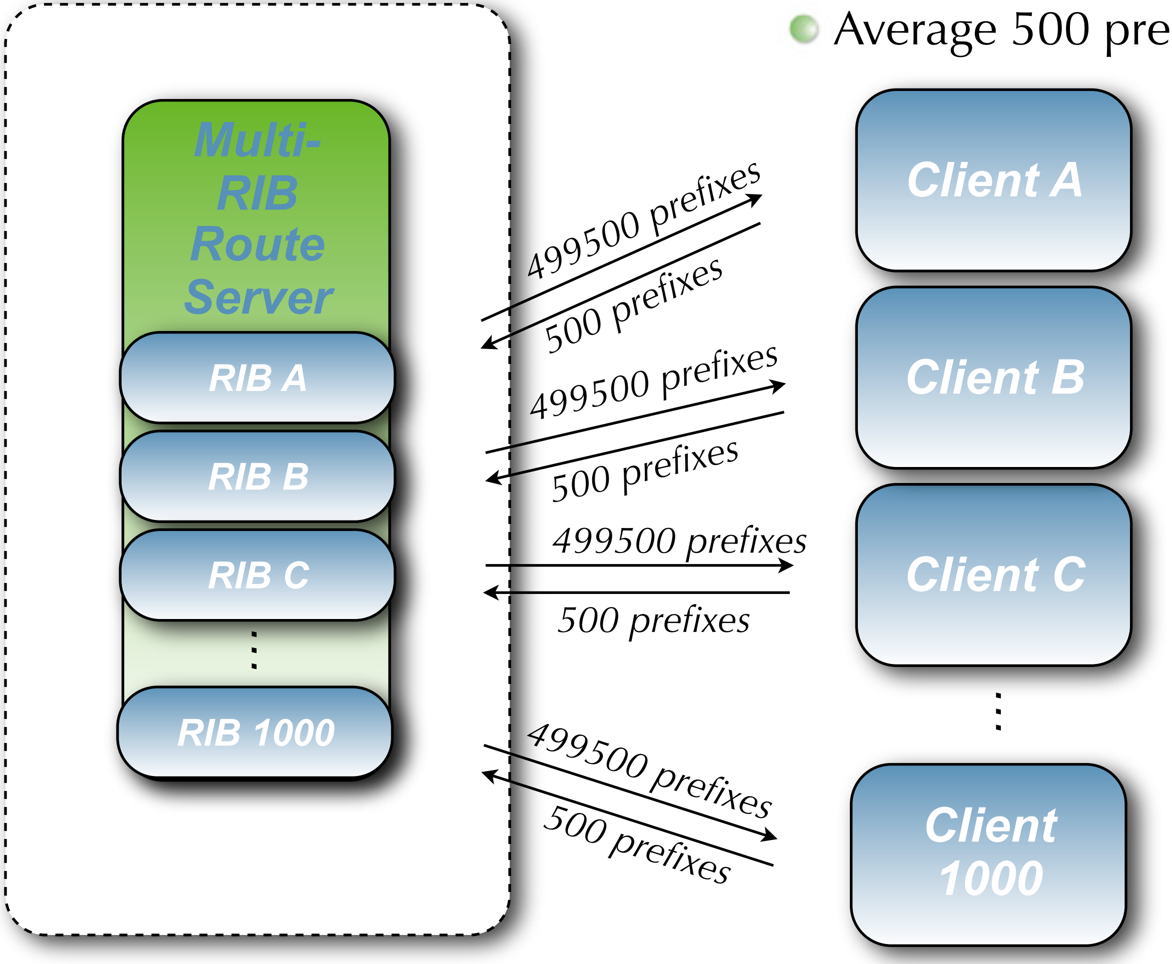

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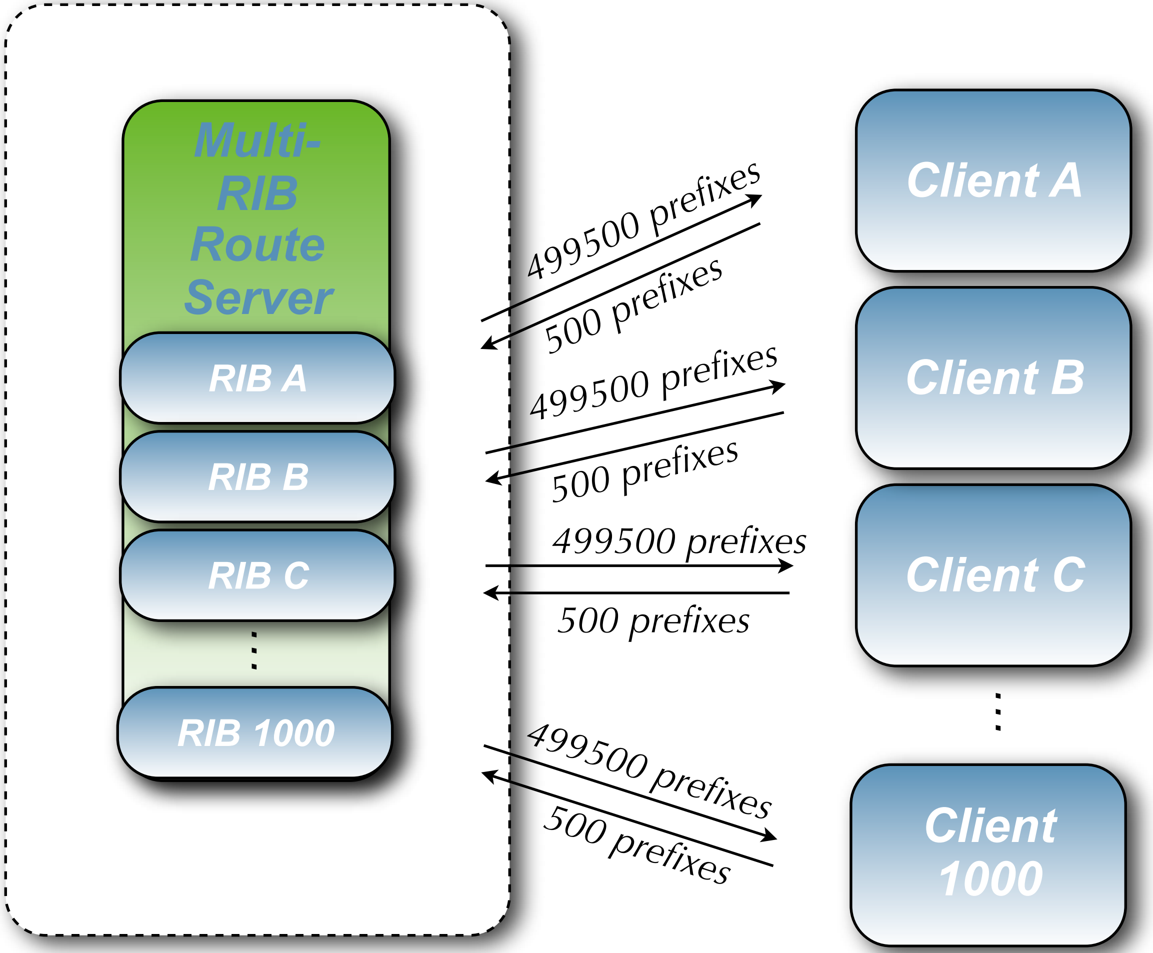

- 1000 clients
- Average 500 prefixes each
- RS to Client updates:
  - 499000*1000 = 499.5m
- Client to RS updates:
  - 1000 * 500 = 500k updates
- Total BGP updates: 500m
- 5-15G of network traffic
- 85 - 250m CPU time

How Do We Fix This?

- Super-linear scaling causes inherent breakage
  - Moving away from one Loc-RIB per client model is critical
  - Right now, this isn’t the primary cause of IXP breakage
- Three primary models to escape this limitation
  - Collapse multiple Loc-RIBs in memory into single gargantuan Loc-RIB
    - less memory, less CPU
    - “You can run but you can’t hide”
  - Use prior knowledge
    - “Web based peering”
    - Disable unique Loc-RIB on per client basis
  - BGP `ADD_PATH` Capability
    - Published as ID: `draft-walton-bgp-add-paths`
    - Moves BGP Best Path Selection to client, so filtering can be performed without selecting