Remote Peering:
More Peering without Internet Flattening

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“Everything depends on the color of the crystal that one looks through”

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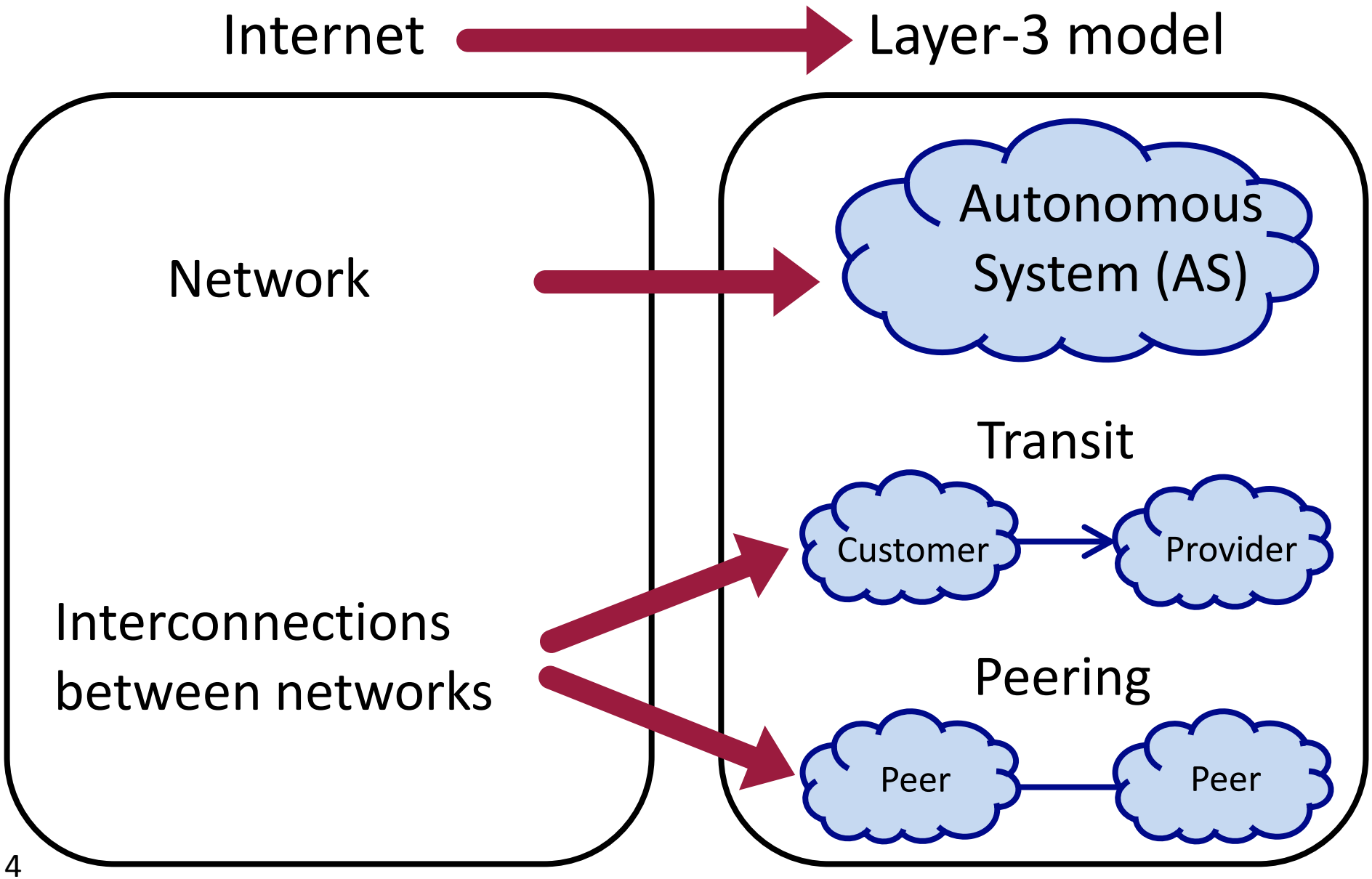
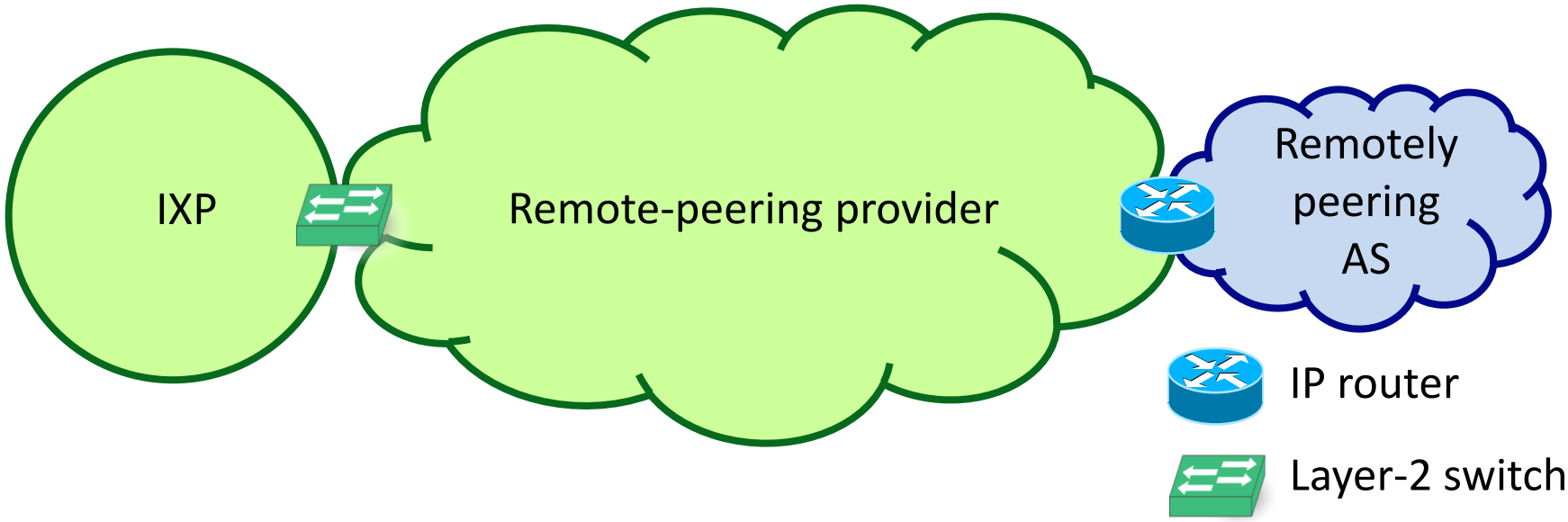
Looking at the Internet through layer-3 glasses

Modeling of Internet Economics



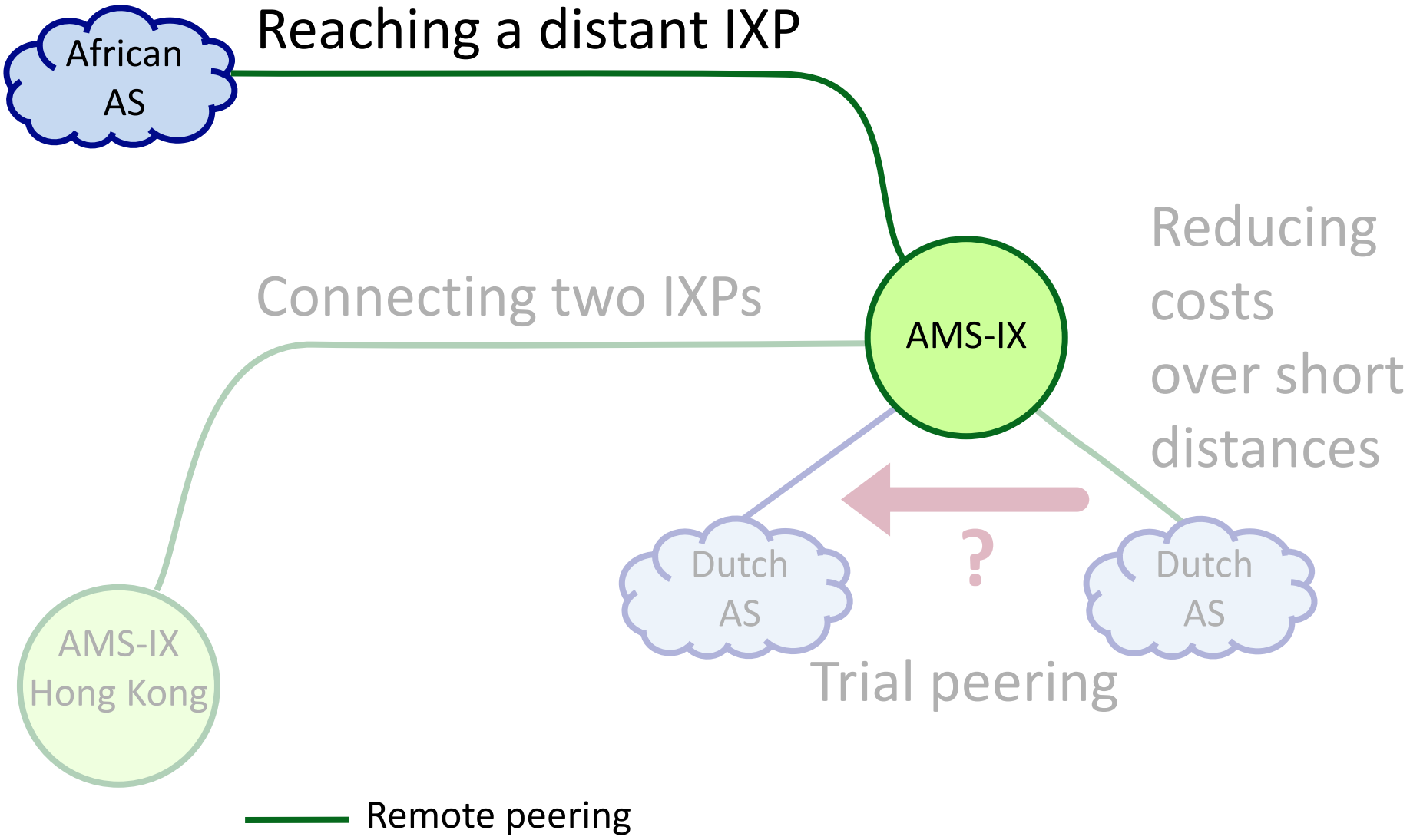

Is there
anything else?

Remote-Peering Providers

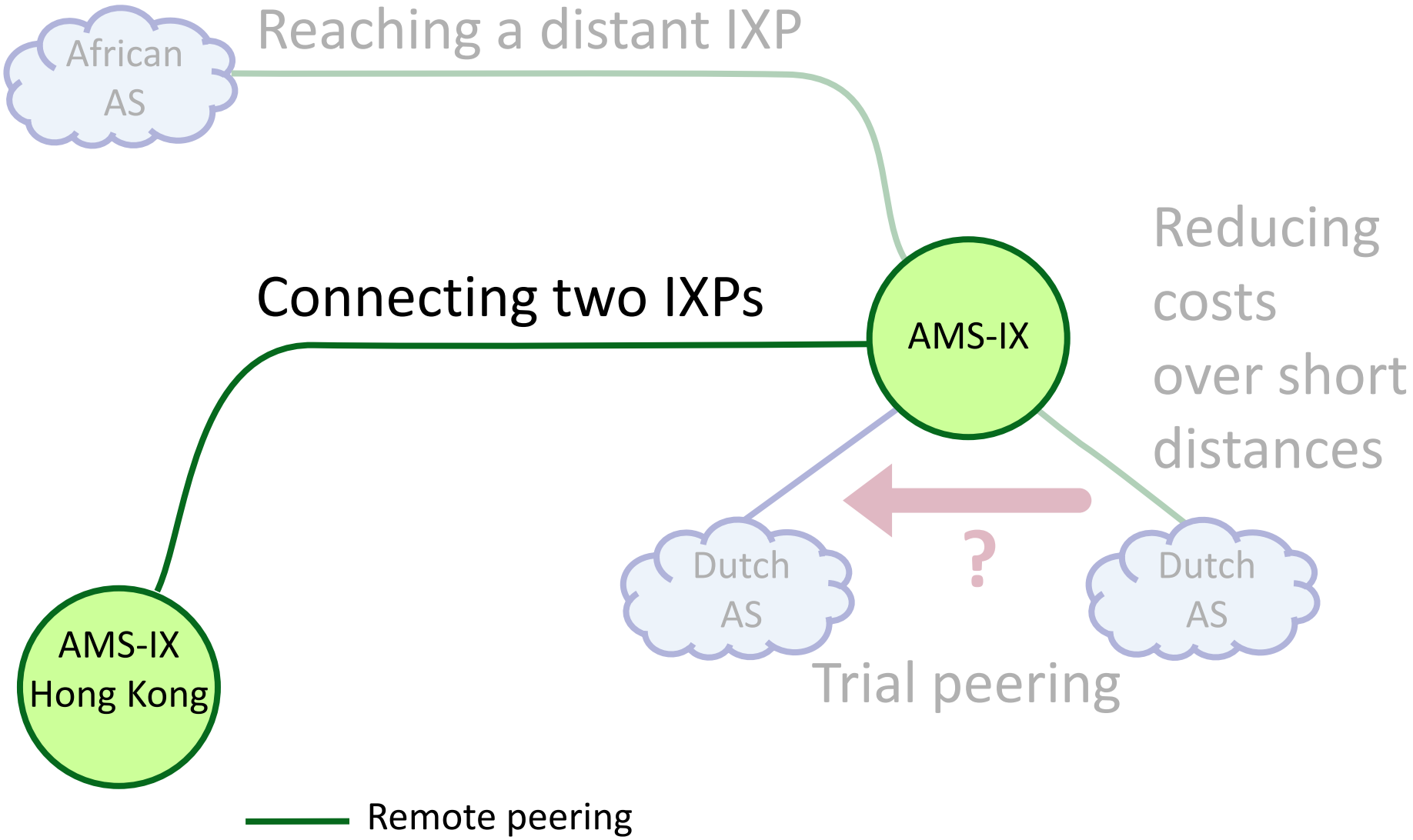


- Service components
  - Layer-2 connectivity of the AS to the IXP
  - Peering equipment at the IXP

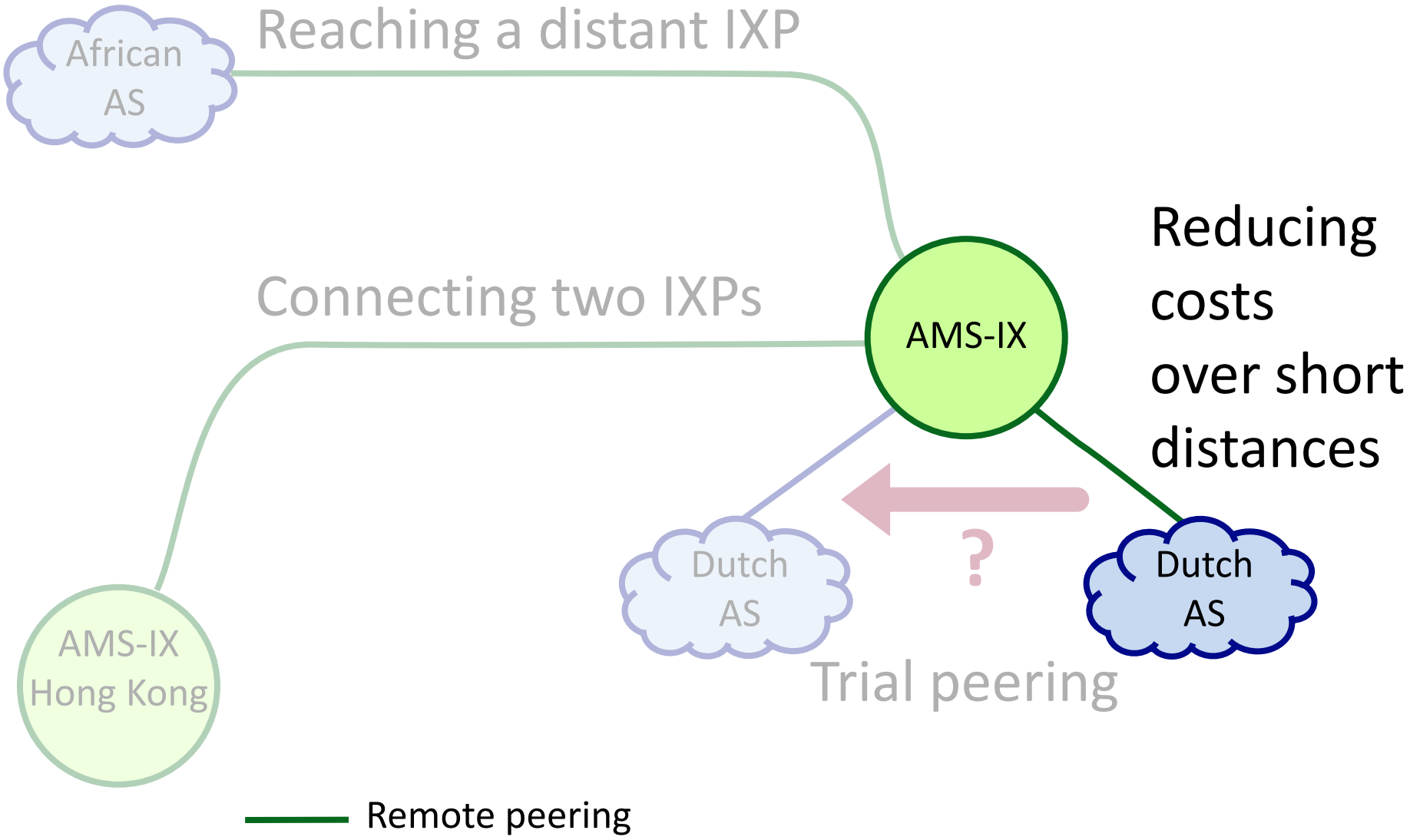
Usage of Remote Peering



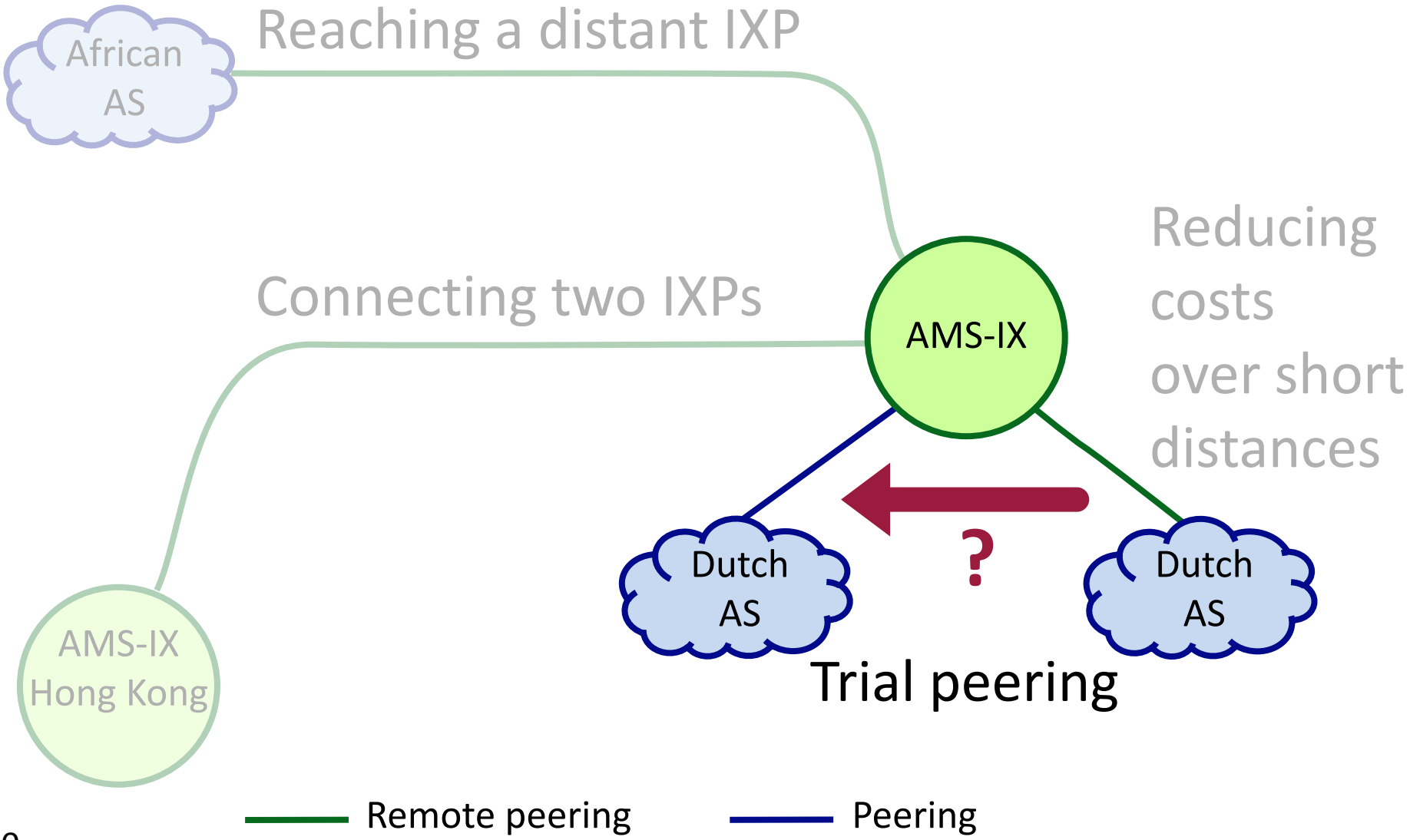
Usage of Remote Peering



Usage of Remote Reering



Usage of Remote Peering



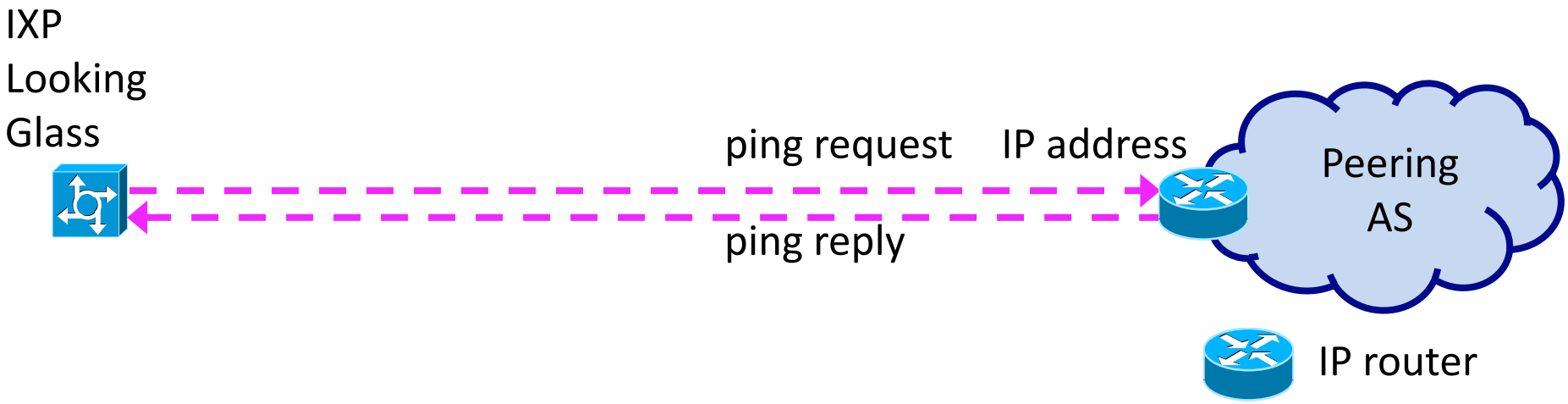
Our Contributions

- **Measurement-based studies**
  - **Spread of remote peering**
  - Impact of remote peering on Internet traffic
- Modeling of economic viability
  - Remote peering vs. transit and direct peering

Estimating the Spread

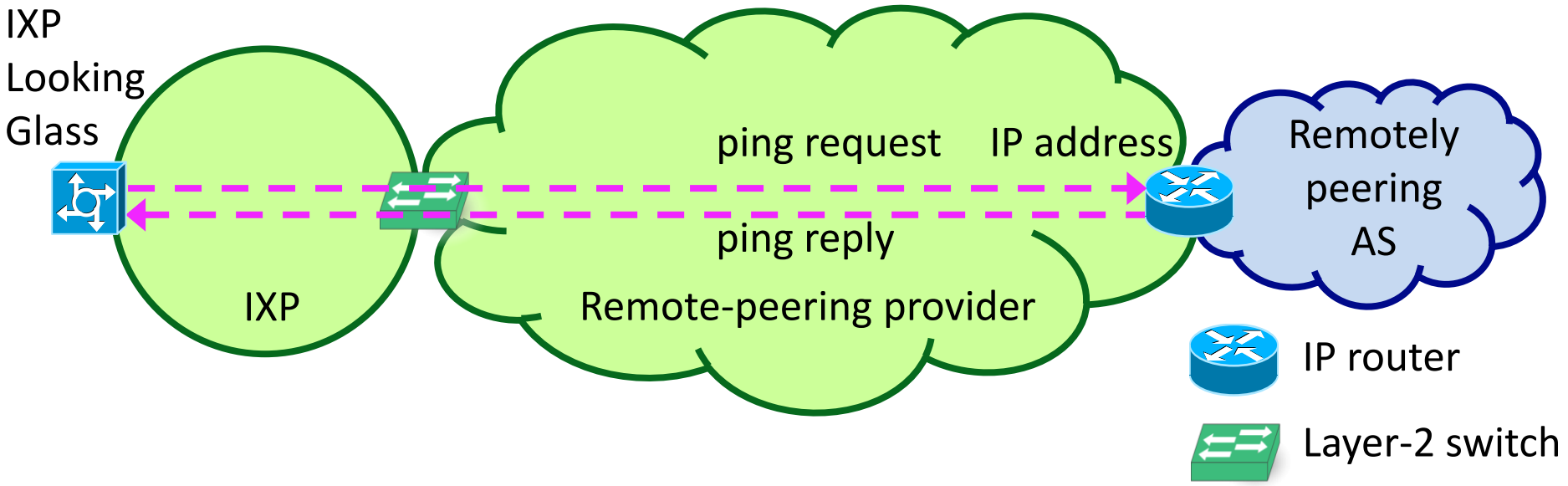
- Studied questions
  - How many IXPs have remote peering?
  - How many IXP members are remote peers?
- Approach
  - Conservative estimate
  - RTT (Round-Trip Time) as a metric of peer remoteness
  - 22 IXPs with colocated Looking Glass servers

Classification of Peers as Remote



- IP address from PCH, PeeringDB, and IXPs websites
- Ping reply within one IP hop if its TTL = maximum TTL
- 4 months and 6 filters to get minimum RTT reliably
- If RTT > threshold, classify the peer as remote
  - Empirical threshold of 10 ms

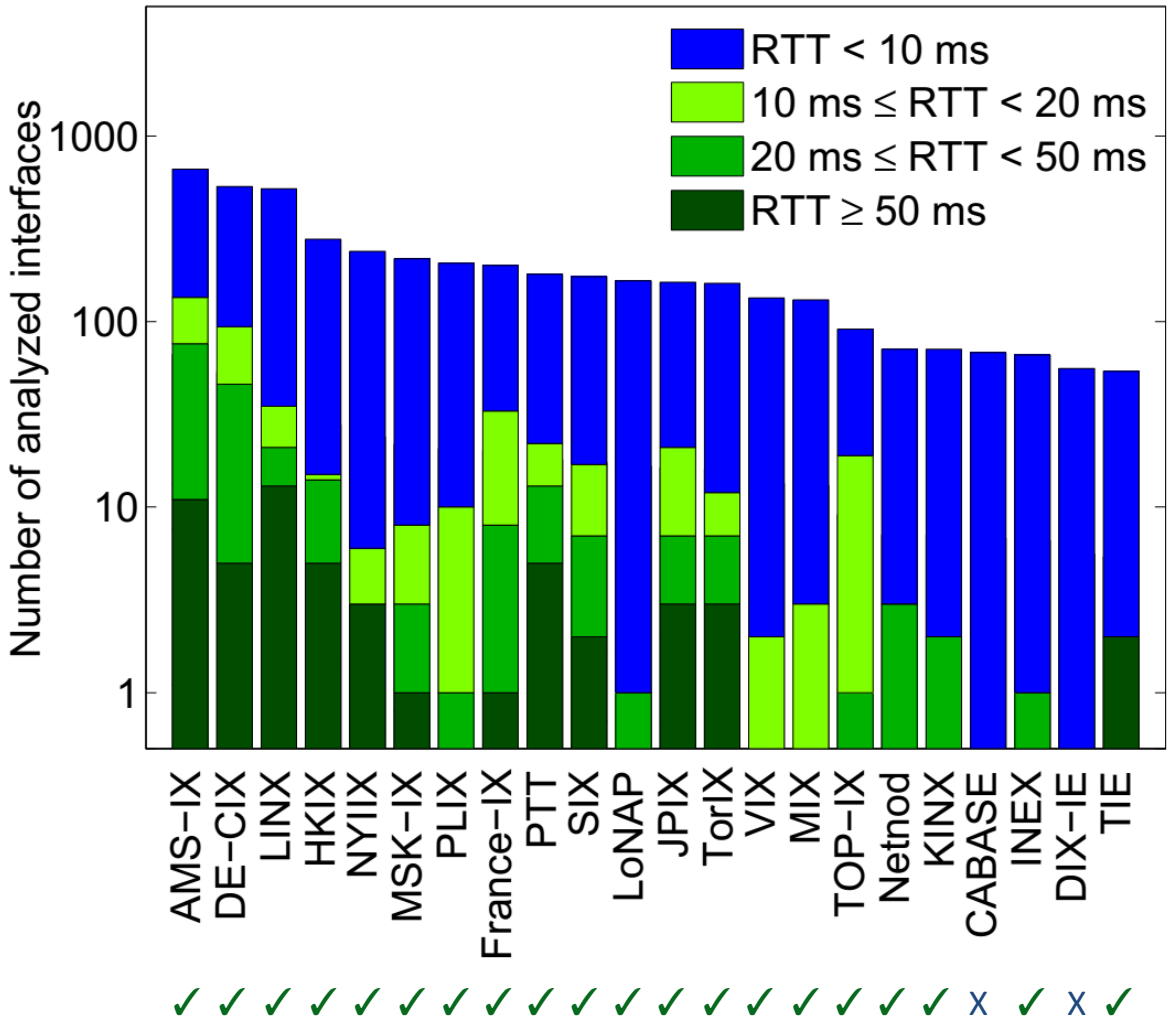
Validation



- Public IXP information on remote peers
- Ground truth from TorIX
  - RTT measurements
  - Remotely peering ASes

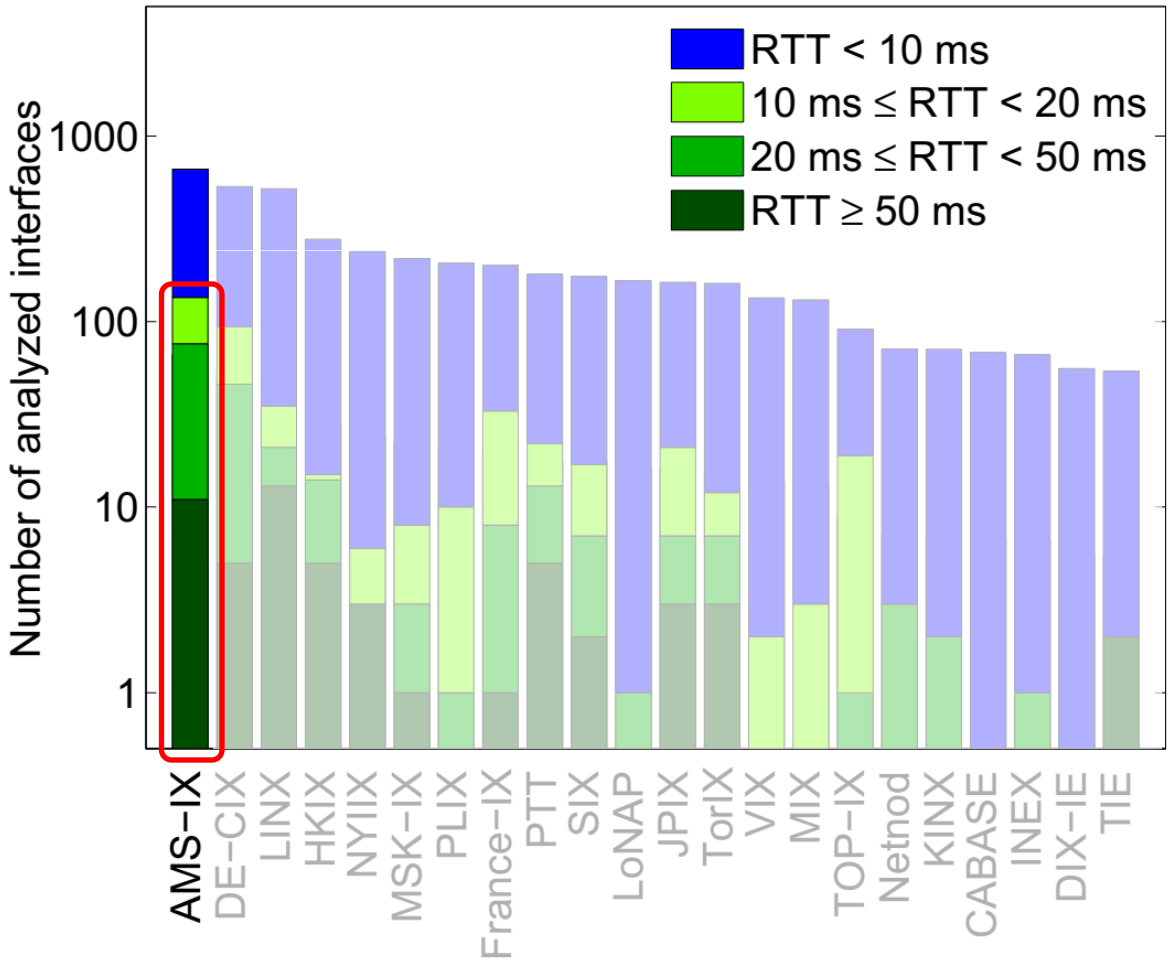
torix
toronto internet exchange

Spread across IXPs



91% of the IXPs have remote peering

Spread within IXPs



Around 20% of AMS-IX peers are remote

Our Contributions

- **Measurement-based studies**
  - Spread of remote peering
  - **Impact of remote peering on Internet traffic**
- Modeling of economic viability
  - Remote peering vs. transit and direct peering

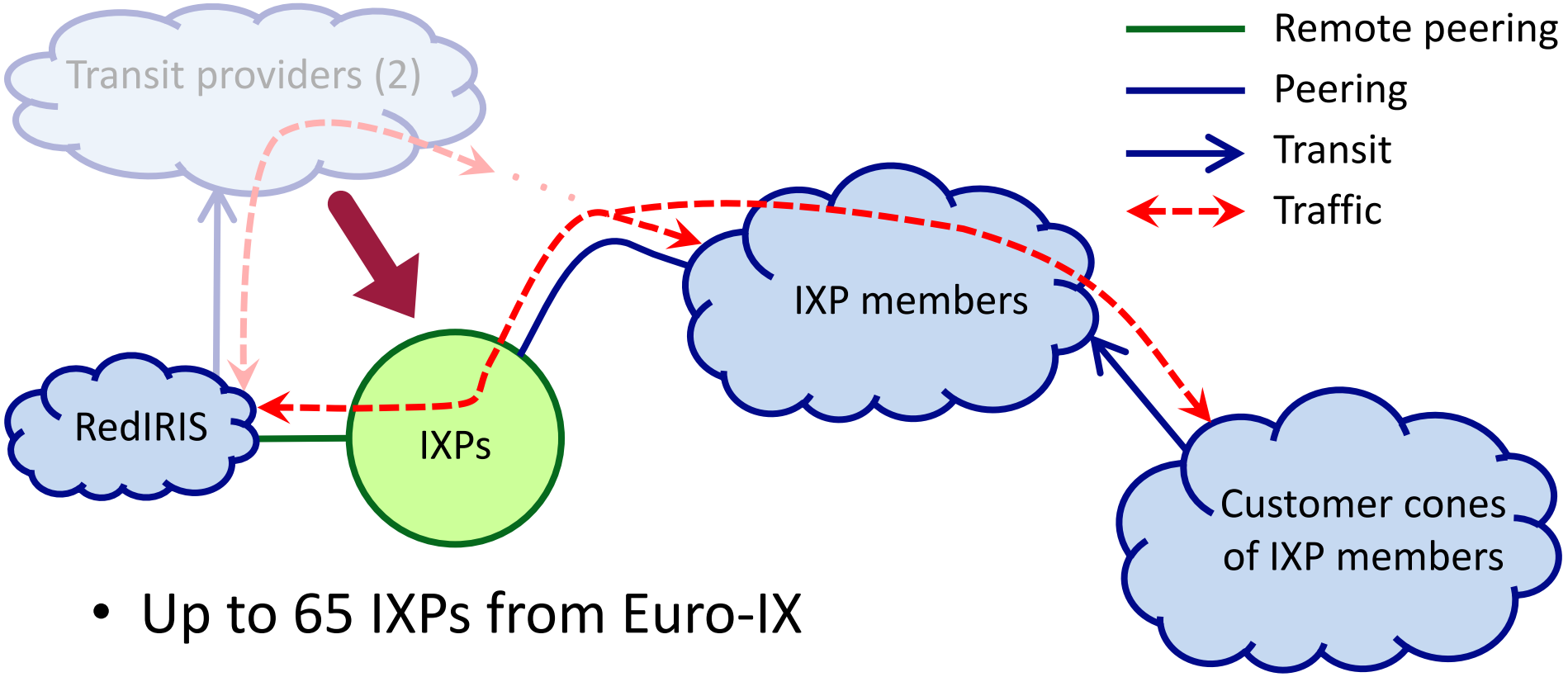
Estimating the Offload Potential

- Studied questions
  - How can an AS benefit from remote peering?
  - How much traffic can the AS offload from its transit-provider links?
- Evaluated AS
  - RedIRIS, the Spanish national academic network
  - 1 month of NetFlow traffic data
  - Routing tables

Transit-Provider Traffic of RedIRIS

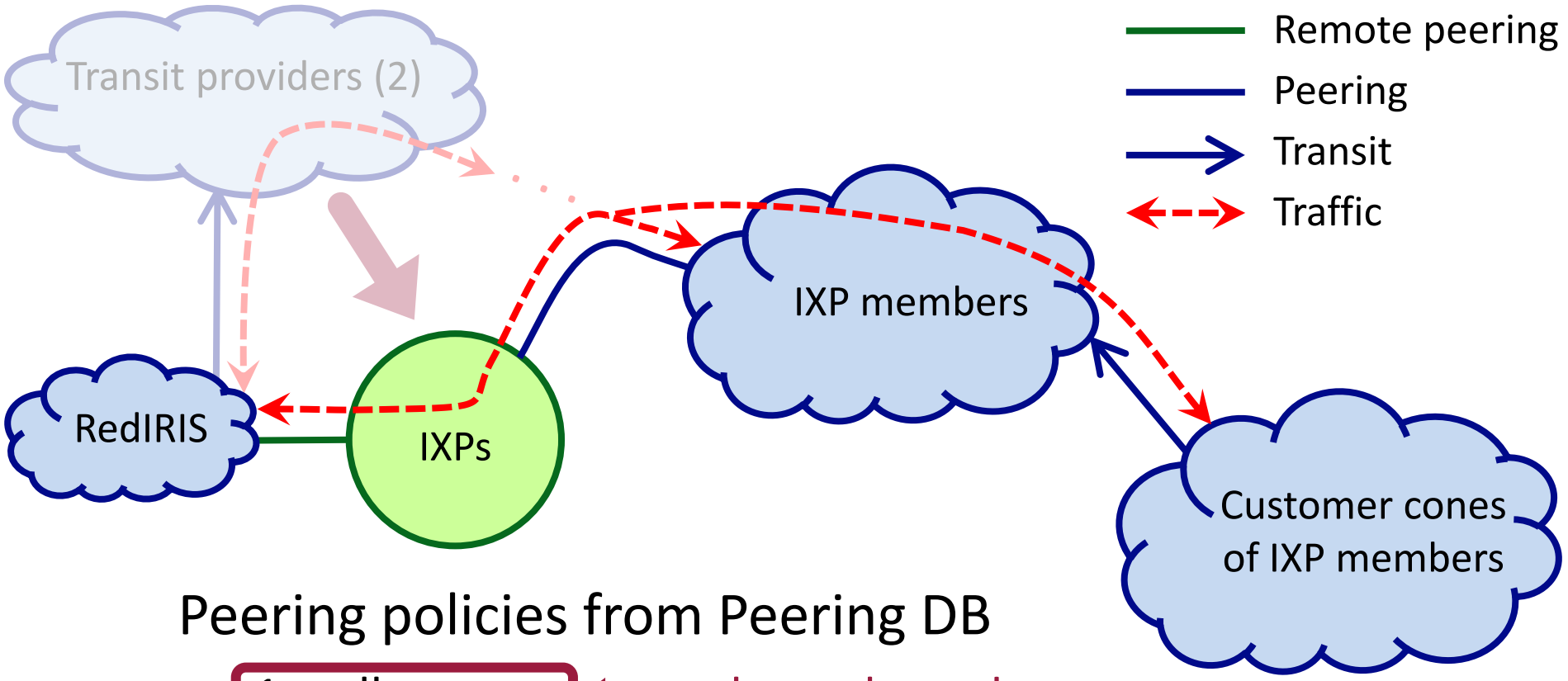
- 2 transit providers
- 29,570 ASes contribute transit traffic

Choice of Reached IXPs



- Up to 65 IXPs from Euro-IX
- Reaching up to 12,238 ASes
  - Out of 29,570 ASes with RedIRIS transit traffic

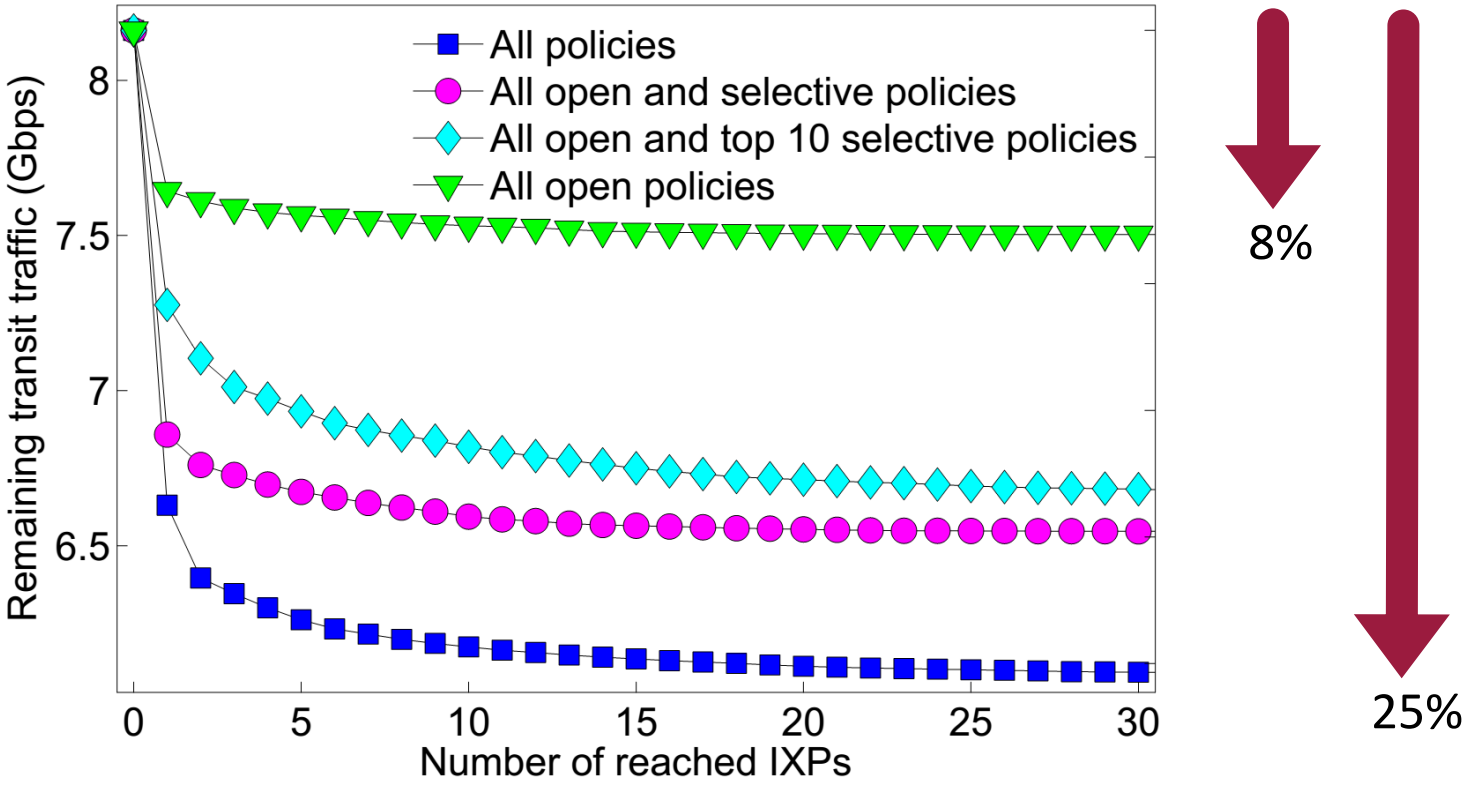
Choice of Peers for RedIRIS



Peering policies from Peering DB

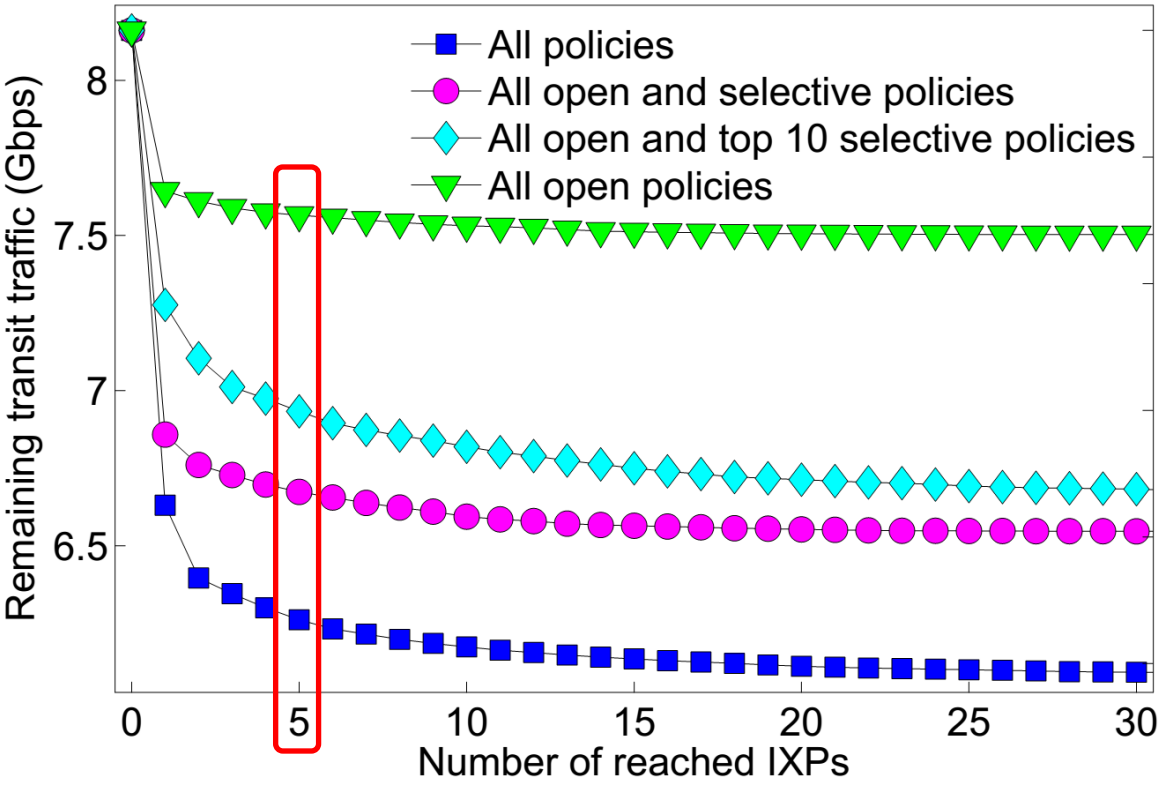
1. all open, ← lower bound
2. all open and top 10 selective,
3. all open and selective,
4. all policies ← upper bound

How Much Traffic can RedIRIS Offload?



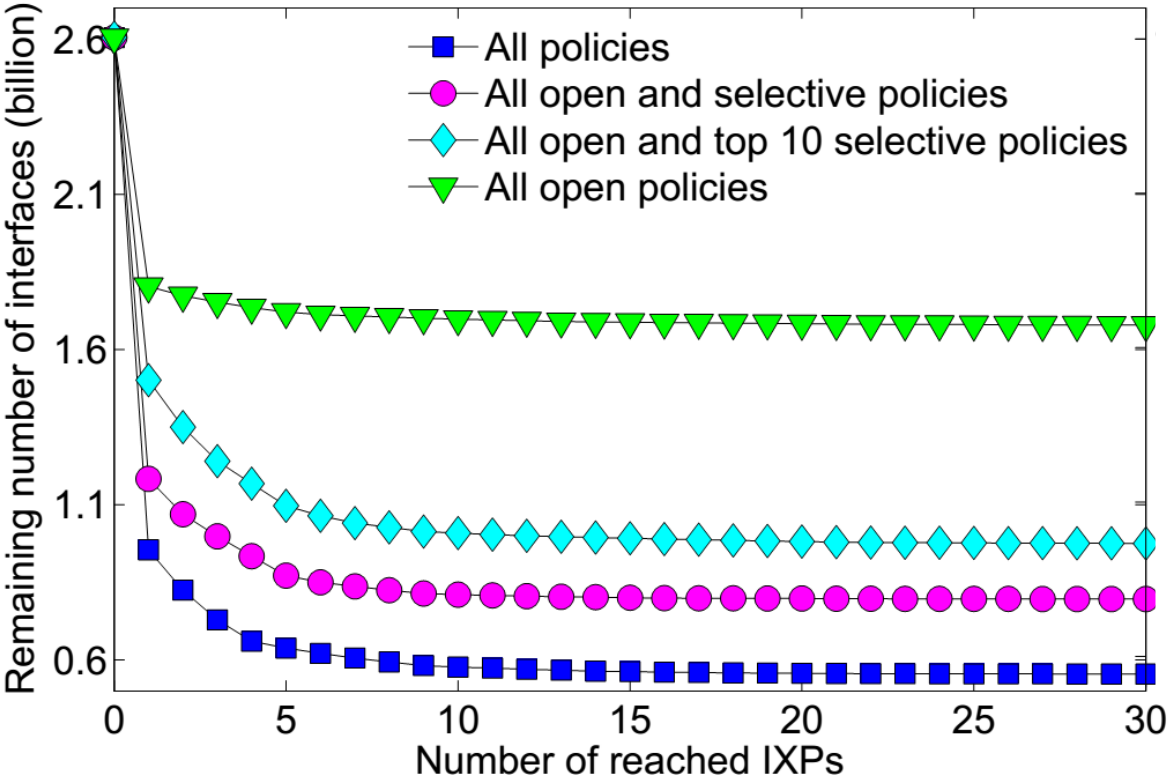
Between 8% and 25% of reduction in transit traffic

Utility of Reaching an Additional IXP



Reaching only 5 IXPs realizes most of the offload potential

Is the RedIRIS Case Representative?



Decreasing marginal utility of reaching an additional IXP is a general property

Conclusions

- Remote peering, a new common interconnection
  - AS reaches and peers at IXP via a layer-2 provider
- Potential impact on Internet traffic is substantial
  - Reaching only 5 IXPs realizes most of the potential
- Internet economic structure needs refined models
  - Layer-2 entities need to be represented

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