

"I Can't Get No Satisfaction": Helping ASes Identify Their Unsatisfied Inter-domain Interests

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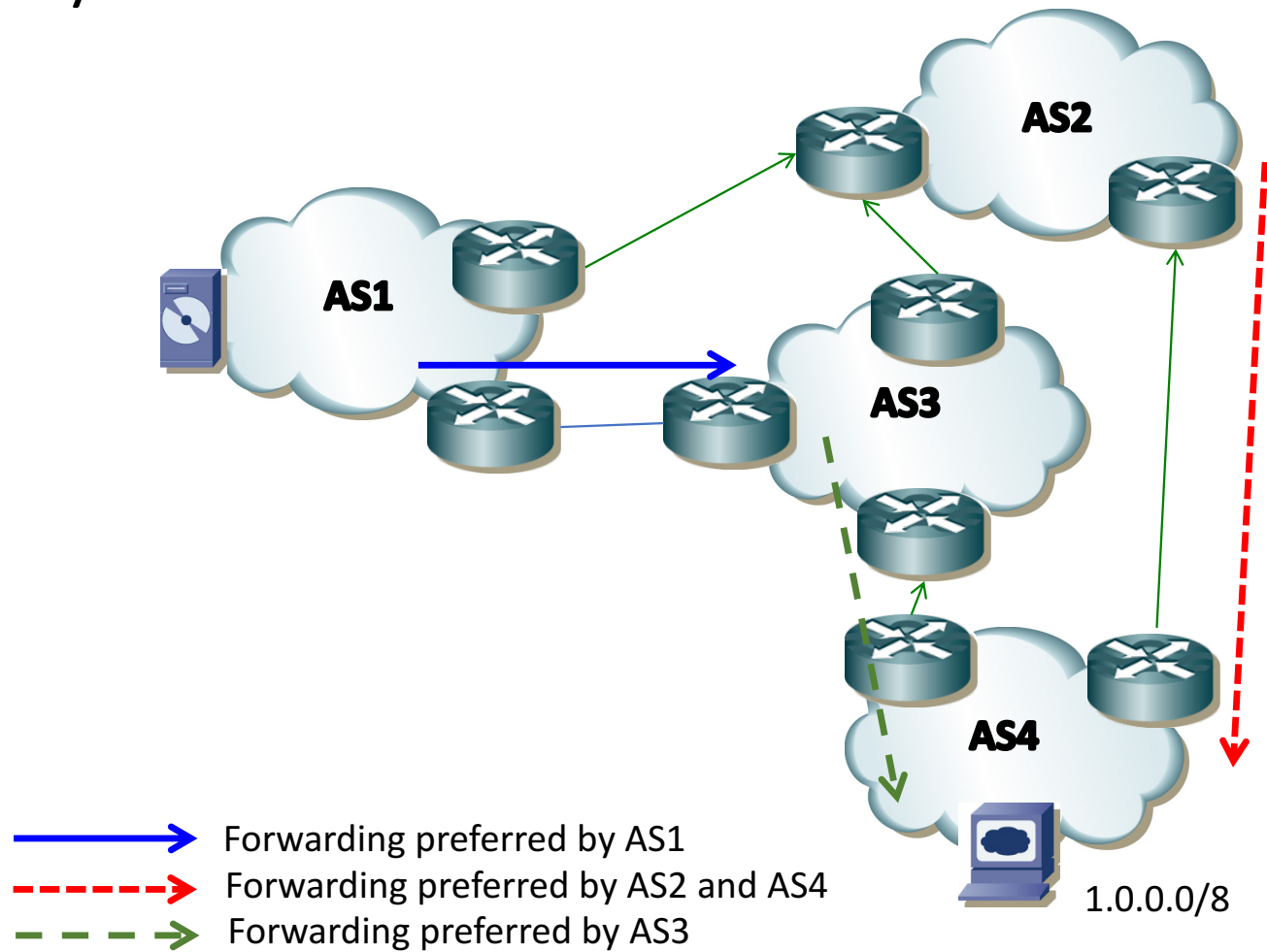
Paolo Lucente, NTT

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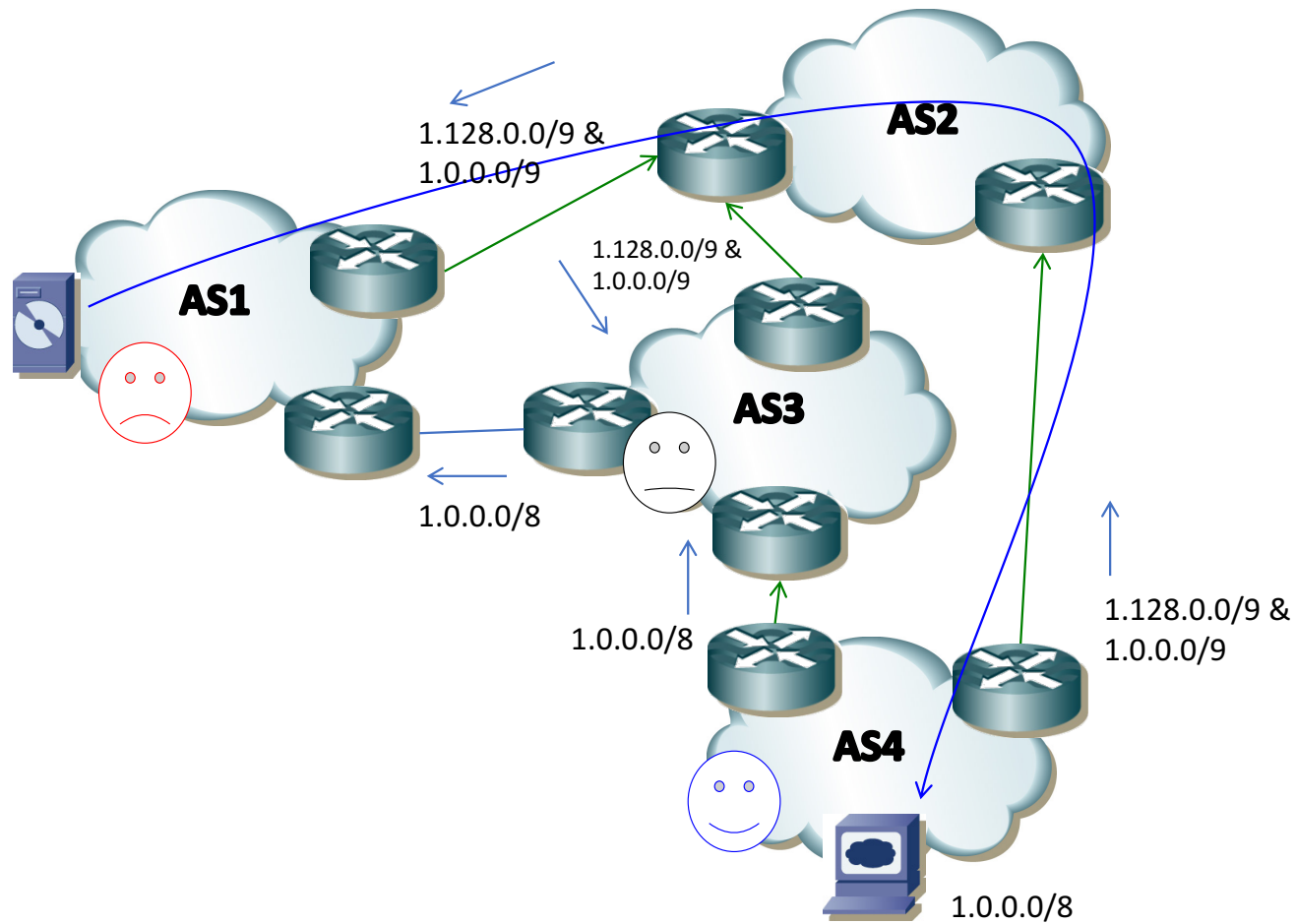
Introduction

- The network infrastructure of Autonomous systems (ASes) should offer:
 - Adequate link characteristics (e.g. cost, performance) for most important traffic
 - Decent path diversity
- The policy of an AS defines the links the operators prefer for their traffic
 - The policy stems from the business requirements of the network
 - The AS is satisfied when traffic distribution fits its policy
- The actual inter-domain traffic distribution is the result of the interplay of policies multiple ASes.
- In some cases, the interplay of policies of various ASes can lead to traffic distributions that **do not satisfy** the network operators.

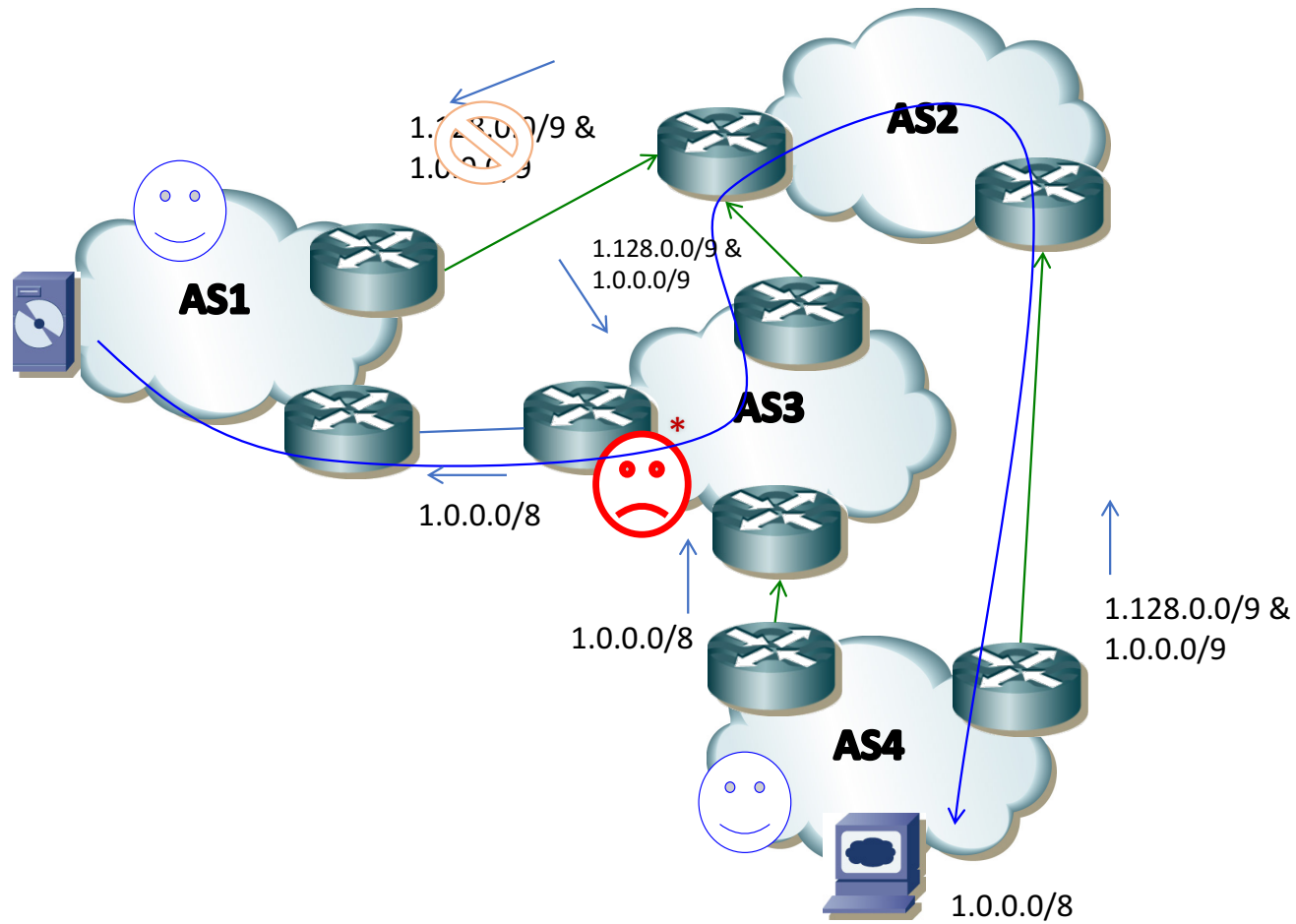
Policy conflicts



Policy conflicts

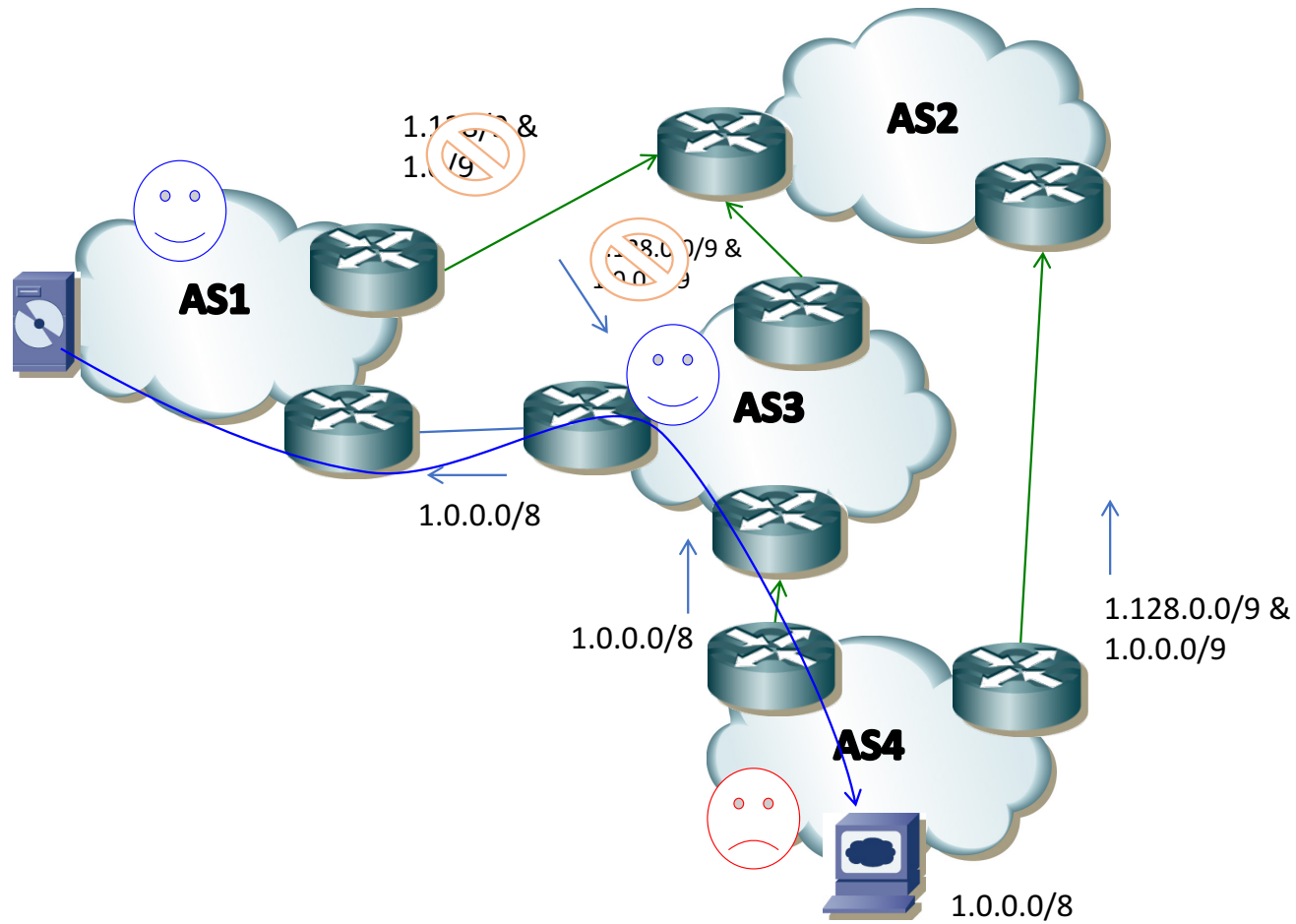


Policy conflicts



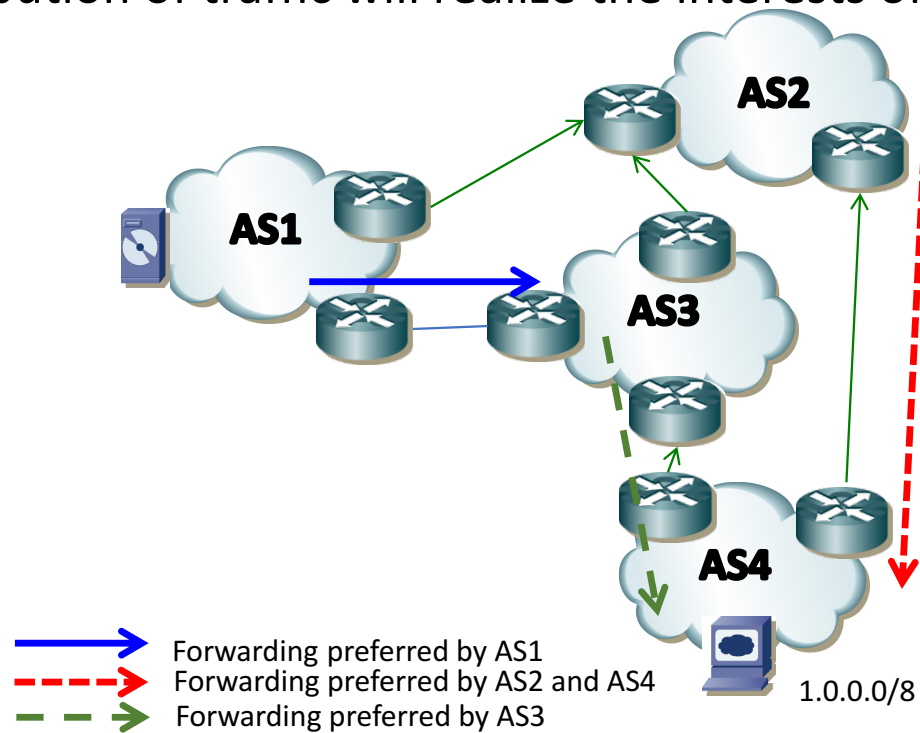
*<https://tools.ietf.org/html/rfc7789>

Policy conflicts



Unsatisfied interests

- These interests are actually *incompatible*
 - No valid distribution of traffic will realize the interests of all the ASes involved

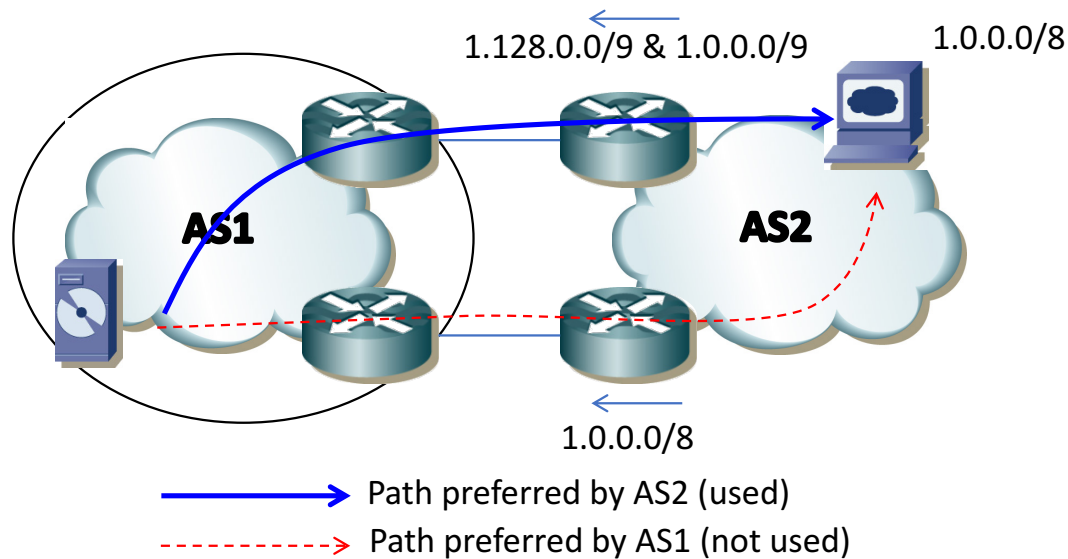


Detection of unsatisfied interests

- We proposed algorithms to detect unsatisfied interests
- We designed a prototype of a warning system implementing them
- We used data from two networks to test the system
 - European Tier-2 commercial SP
 - BGP routing tables and traffic data from an European Tier-2 network for the month of June 2014
 - RedIRIS
 - One month in 2013 of NetFlow traffic data
 - Routing tables

Outbound unsatisfied interests

- An AS X suffers from an outbound unsatisfied interest if X is prevented from sending a traffic flows through an intended inter-domain link (next-hop).



Detecting Outbound unsatisfied interests

- External ASes influence the outbound traffic of a network by not sending their (best) control-plane paths
- Algorithm:
 - Evaluate the state of the network if these [missing paths](#) where actually received.
 - Compare with current state
 - If there are improvements:
 - Report the case
- How to find missing paths?
- How to evaluate improvement?

Detecting Outbound unsatisfied interests

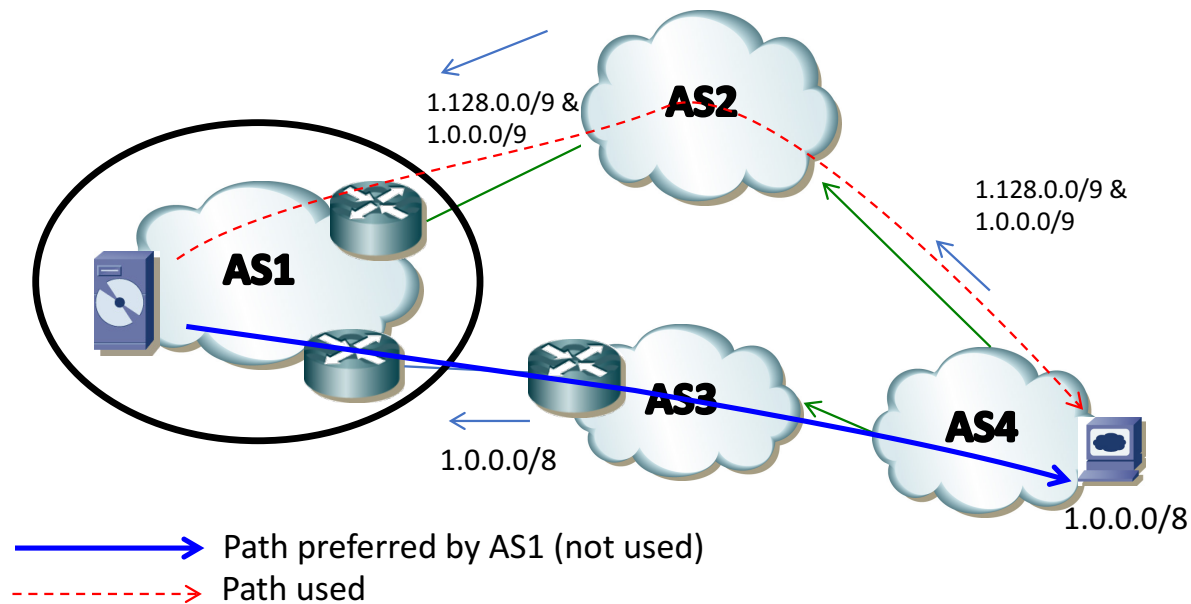
How to find missing paths?

- Missing paths:
 - Inconsistent advertisements
 - Identify BGP paths filtered or with different attributes from the same neighboring AS over different inter-domain links.
 - Incomplete sets of routes
 - Find cases in which a neighboring AS does not announce routes to some prefixes while it was supposed to.
 - E.g. A peer is not sending me a path to one of its customers
 - E.g. A customer is not sending me a path to a prefix

Detecting Outbound unsatisfied interests

How to evaluate improvement?

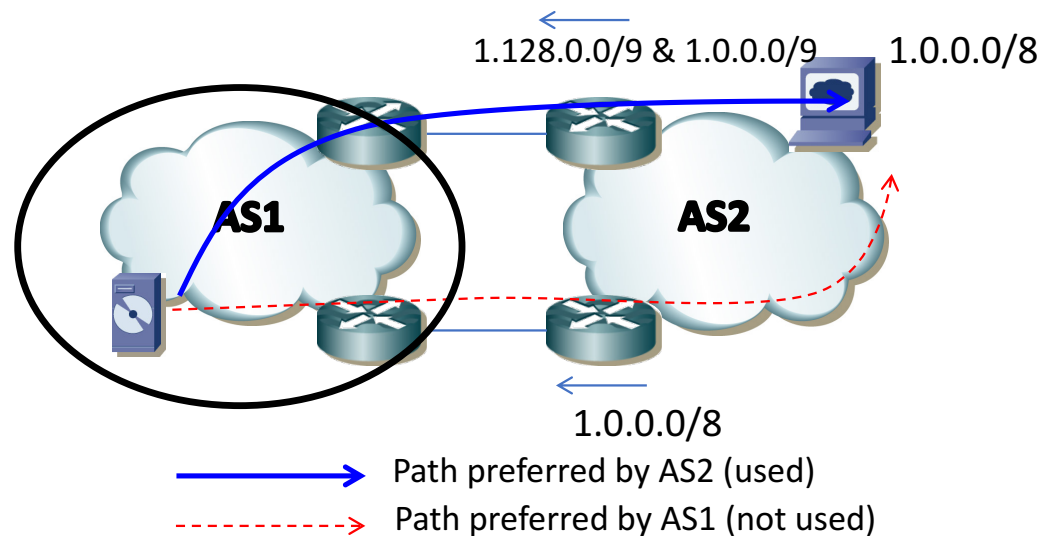
- We identified four main effects of unsatisfied interests on outbound traffic
 - Neighbor preference dissatisfaction (e.g. a peer does not send a path that is received through a transit provider)



Detecting Outbound unsatisfied interests

How to evaluate improvement?

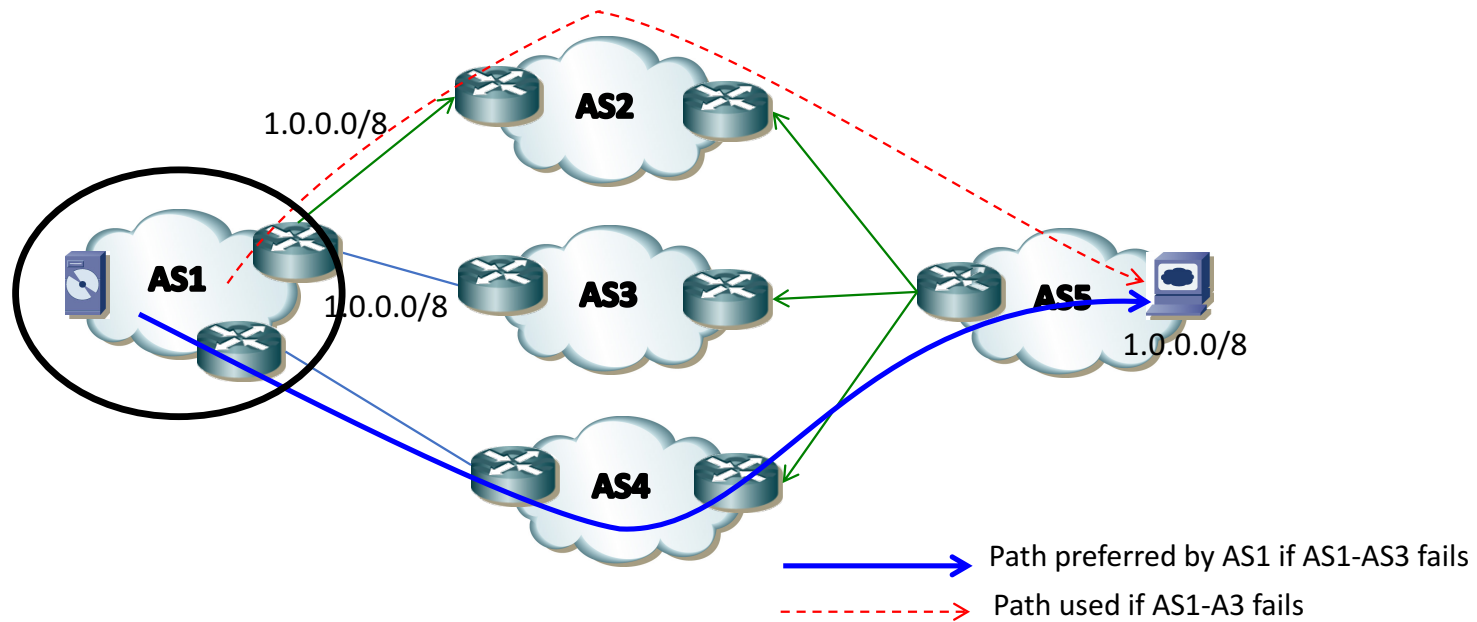
- We identified four main effects of unsatisfied interests on outbound traffic
 - Next-hop diversity dissatisfaction. (e.g. inconsistent advertisement from a peer)



Detecting Outbound unsatisfied interests

How to evaluate improvement?

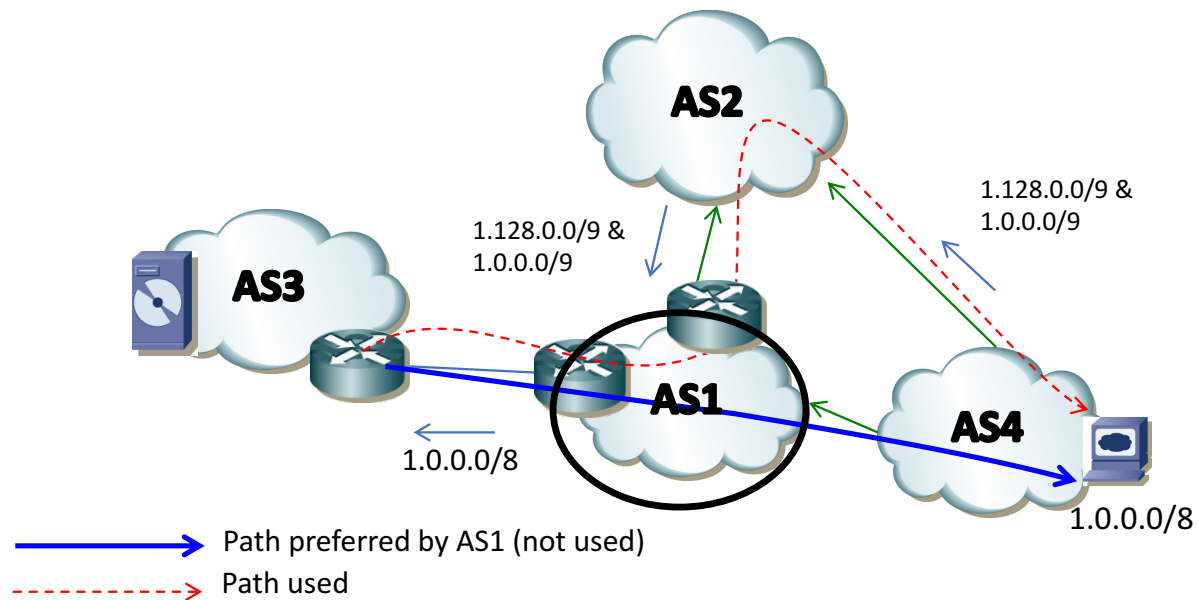
- We identified four main effects of unsatisfied interests on outbound traffic
 - Back-up path dissatisfaction. (e.g. a peer does not send a path which is only supported by a single peering path)



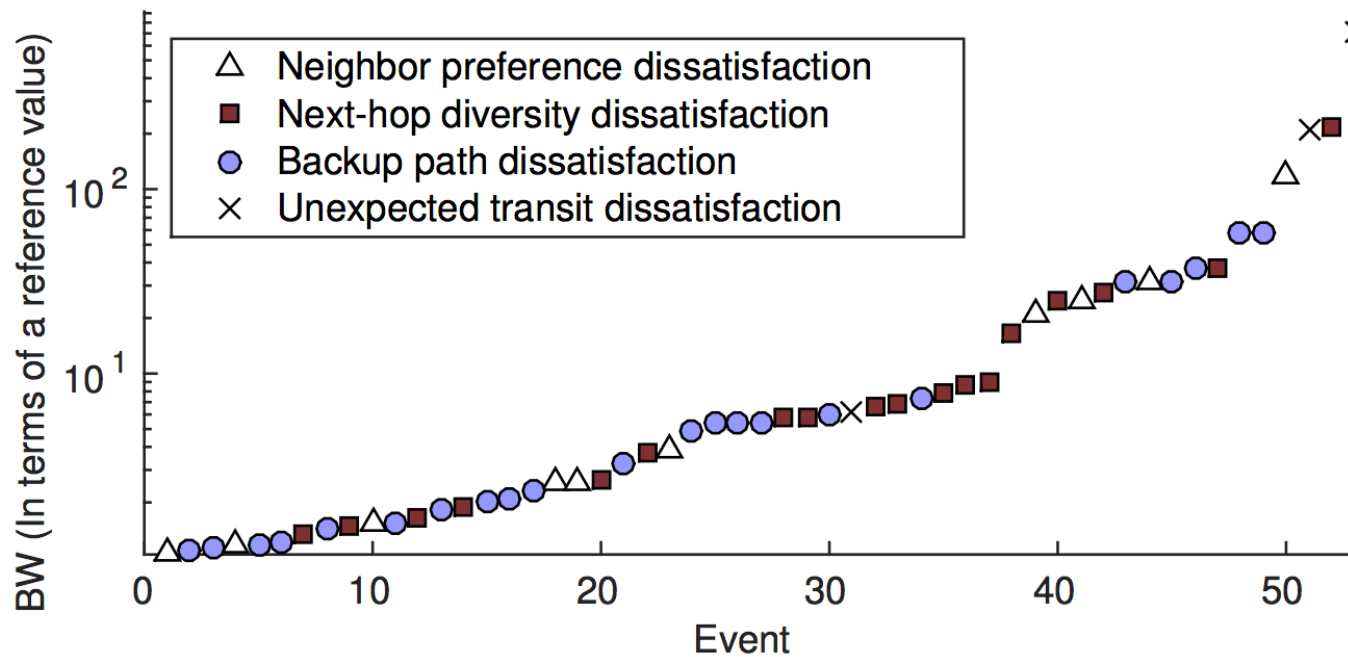
Detecting Outbound unsatisfied interests

How to evaluate improvement?

- We identified four main effects of unsatisfied interests on outbound traffic
 - Unexpected transit dissatisfaction. (e.g. detecting flows between peers and transit providers due to more specifics)

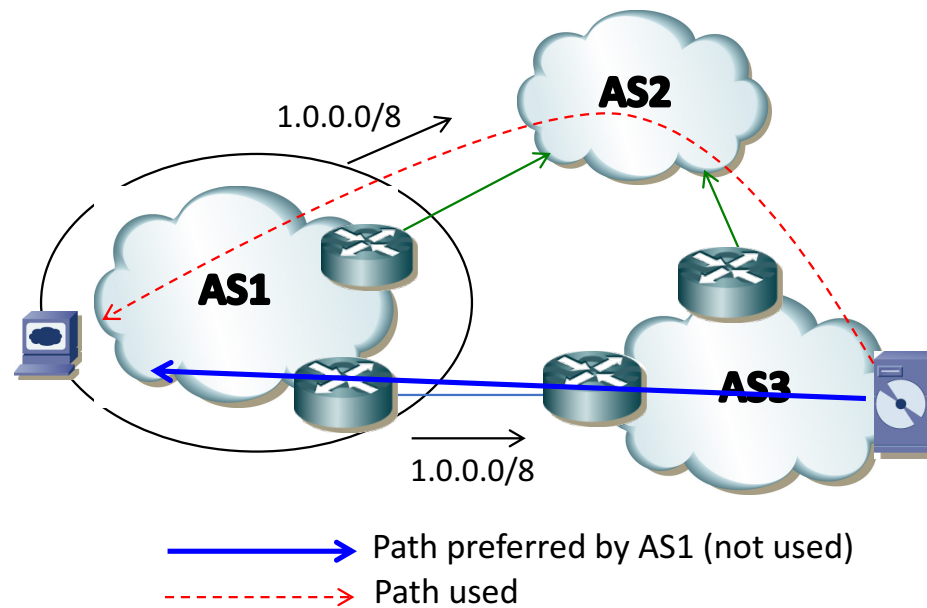


Detecting Outbound unsatisfied interests (Tier-2)



Inbound unsatisfied interests

- An AS X is subject to an *inbound unsatisfied interest* if X is prevented from *receiving a traffic flow* over an intended inter-domain link.



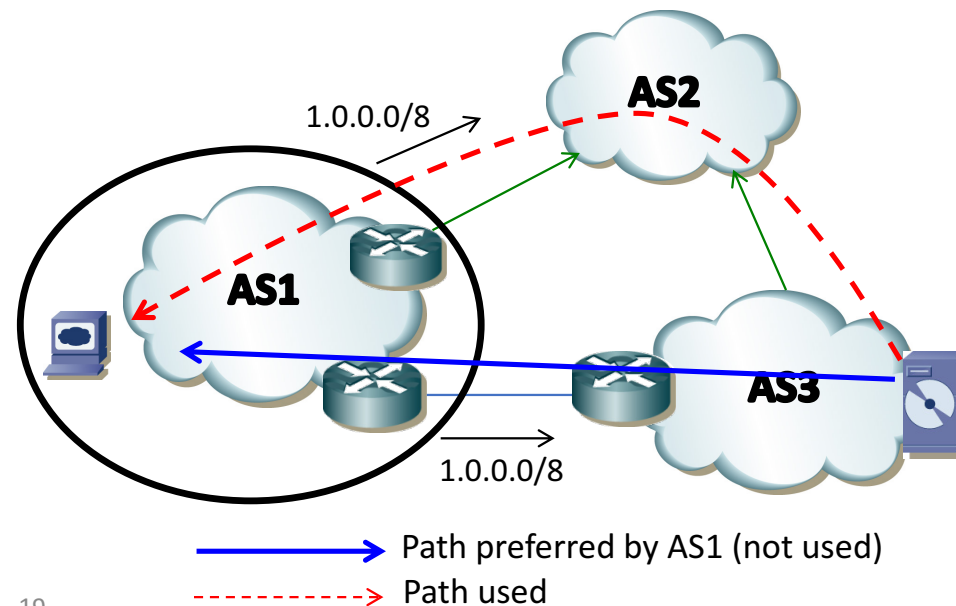
Detection of Inbound unsatisfied interests

- Policies or Control Plane data of external ASes are rarely known
- We rely only in data plane information to detect these cases
- Algorithm:
 - For each ingress flow in the network
 - Check if the flow is **undesired**
 - If it is, report it
- When is a ingress flow undesired?

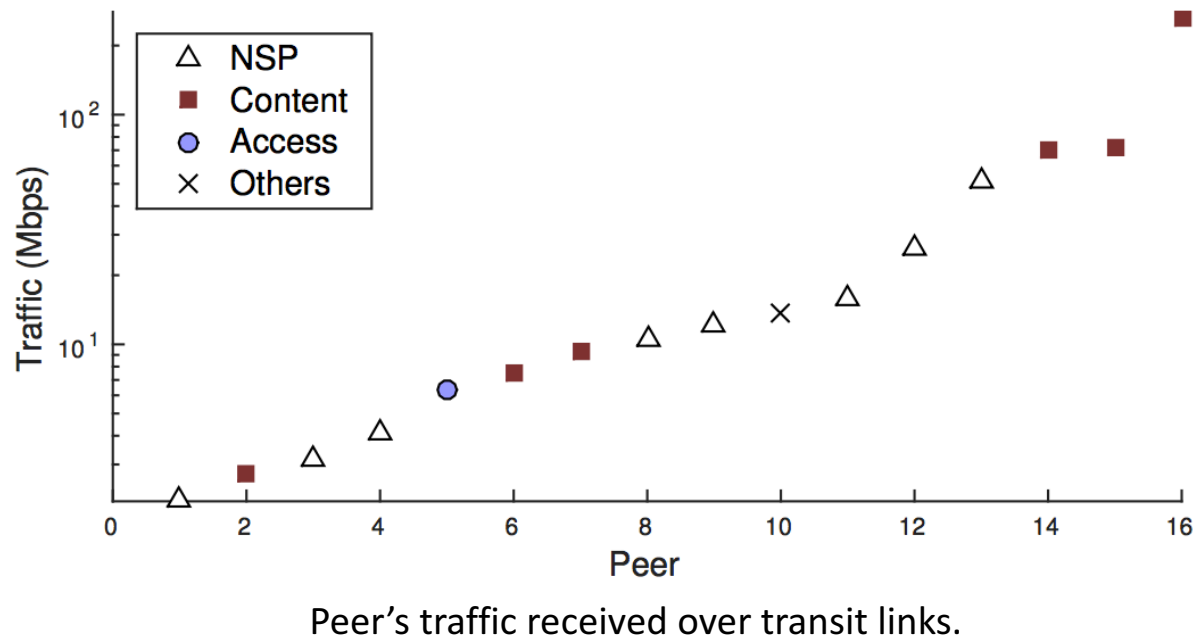
Detection of inbound unsatisfied interests

When is a ingress flow undesired?

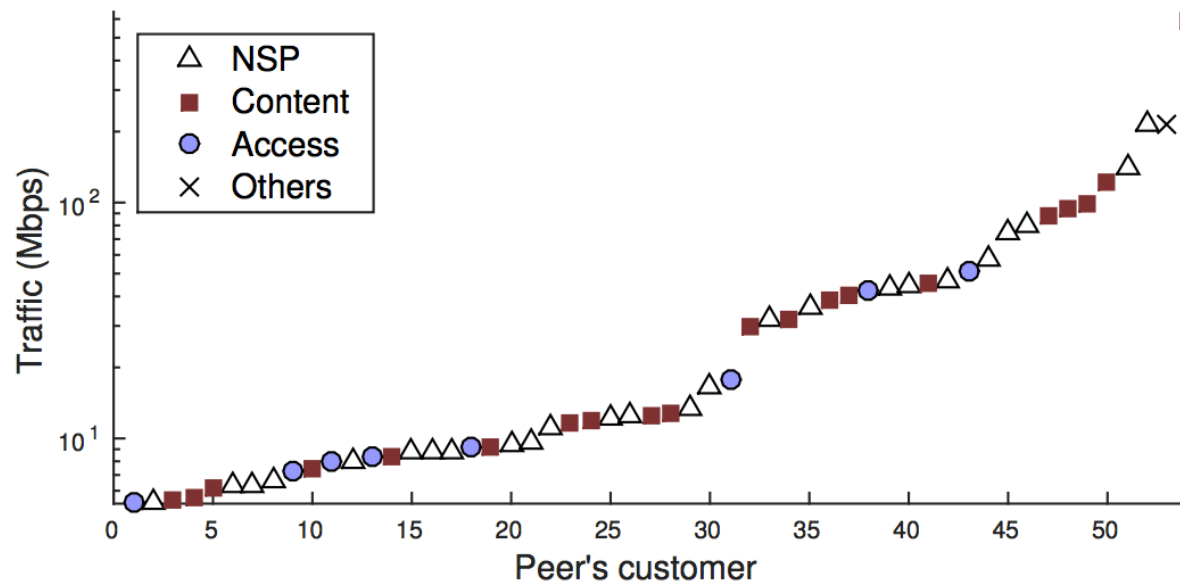
- In a simple case, check whether the origin AS of the flow is not connected through a more preferred neighbor
- E.g. traffic from a peering content provider is coming through the link of a transit provider.



Detection of inbound unsatisfied interests (RedIRIS)



RedIRIS - Peers customers traffic received over transit links.



Inter-domain traffic management

Conclusions

- The distributed nature of the Internet makes it feasible for different ASes to have incompatible policies
- We recommend operators to implement tools to detect the unsatisfied interests with larger impact on their networks

How to do it?

- Data collection
 - Traffic
 - Netflow / Sflow
 - Control plane (BGP)
 - BGP (ADD-PATH)
 - BMP
 - Policy
 - LP / MED / comms on BGP paths could reflect the policy
 - Router configuration

How to do it?

- Policy traffic tests using pmacct (netflow and BGP/BMP collector):
 - <https://github.com/pmacct/pmacct/wiki/Finding-settlement-free-peers-traffic-over-transit-links>
 - <https://github.com/pmacct/pmacct/wiki/Detecting-unexpected-traffic-flows>
- More information in the paper
 - <http://eprints.networks.imdea.org/1327/>

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Remember SDN meetup tomorrow!

<https://www.meetup.com/es-ES/SDN-and-Network-Programmability-Meetup-in-Barcelona/events/238272205/>