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

Camilo Cardona, Cisco Systems
Stefano Vissicchio, UCL
Paolo Lucente, NTT
Pierre Francois, Cisco Systems
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
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 were 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)

Peer’s traffic received over transit links.
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!