CS 557
Internet Routing Policies

On Inferring and Characterizing Internet Routing Policies
Feng Wang and Lixin Gao, 2003

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Characterizing Routing Policies

• **Objective:**
  – Infer and characterize BGP routing policies used in the Internet.

• **Approach:**
  – Classify AS by Tier level
  – Classify links as (customer-provider), (provider-customer), or (peer, peer).
  – Analyze routing tables to infer tiers, relationships, and policies

• **Contributions:**
  – First study of routing policies used in the Internet
Recall BGP Route Selection

1. Select route with the highest local pref
   - Local AS policy will set the local pref
   - What is a typical policy??

2. Select route with the shortest AS path
   - Recall AS may pad the path by including its AS number many times.

3. If multiple routes from the same AS, select route with the smallest MED
   - Allows neighbor AS to suggest the best entry point

4. Other rules…
Implications of Policy

- Important to have global information
  - Each AS knows its own policies.
  - But policies interact (perhaps badly)
- Large Impact on Usable Topology
  - Due to policy, many physical paths may not be considered.
  - Can change results for convergence, damping, etc.
- Inference Can Improve Traffic Engineering
  - Local AS may be able to better manipulate routing
    - But assumes there is a common goal… some other local AS may try to manipulate routing in the opposite way.
Peer Based Policy Configuration

- Sample BGP configuration:
  router bgp 65503
  neighbor 192.1.250.23 remote-as 65504
  neighbor 192.1.250.23 route-map isp1 in
  access-list 1 permit 0.0.0.0 255.255.255.255
  route-map isp1 permit
    match ip address 1
    set local-preference 90

- Establishes an e-BGP peer with neighbor in AS 65504 and sets local pref for all routes from that neighbor.
Prefix Based Policy Configuration

• Sample BGP configuration:
  router bgp 65503
  neighbor 192.1.250.23 remote-as 65504
  neighbor 192.1.250.23 route-map isp1 in
  ip prefix-list 1 permit 128.82.0.0/16
  route-map isp1 permit
    match ip address prefix-list 1
  set local-preference 80

• Establishes an e-BGP peer with neighbor in AS 65504 and sets local pref for a particular prefix from that neighbor.
Import Policies

• Import policy assigns a Local Preference to routes received from a neighbor.
  – Previous two slides are examples of import policies
  – One set local pref =90, other set local pref=80

• Typical Local Pref Rule:
  – Customer routes have higher local pref than peer/provider routes.
Example Import Rule

Update from AS1: Prefix 10.0.0.0/8
Path AS1, AS1, AS1

Update from AS3: Prefix 10.0.0.0/8
Path AS3, AS1

Without policy route via AS3 is preferred (shorter path)

With policy, route via AS1 (customer) is preferred over route via AS3 (peer)
Typical Local Preference

- Data from Routing Tables and IRR show typical local preference is dominate policy
  - High 90% for 77 AS measured.
  - See Table 2 and 3
Peer vs. Prefix Local Pref

• Data shows most AS set local preference based on peer (not on prefix).
  – See Figure 2
Export Policies

• Export policy determines which routes are announced to neighbors.

• Neighbor is your customer:
  – Announce all the routes you know

• Neighbor is your provider:
  – Announce your local prefixes and routes learned from your customers

• Neighbor is your peer
  – Announce your routes and routers learned from your customer
**Example Export To Provider/Peer**

Verio to ATT:
announce 12/8, 14/8

Sprint to ATT:
announce 10/8, 13/8

AS1 to ATT:
announce 10/8

Prefix 11/8

Prefix 12/8

Prefix 13/8

Prefix 14/8

AS1 can reach 13/8, Why not announce this to ATT?

Sprint can reach 14/8, Why not announce this to ATT?
Example Export To Customer

ATT to AS 1:
- announce 11/8
- announce 12/8
- announce 13/8
- announce 14/8

Sprint to AS 1:
- announce 11/8, 12/8, 13/8, 14/8

Prefixes:
- Prefix 10/8
- Prefix 11/8
- Prefix 12/8
- Prefix 13/8
- Prefix 14/8

AS1

Sprint

Verio

AS2
Selective Announcement

• Provider should use customer links to reach customer destinations.
  – Based on previous observations that customer routers are preferred.

• High number Tier 1 AS do not use customer routes to reach customer prefixes.
  – Table shows percentages
  – Explanation proposed is that customers don’t advertise all their prefixes to the providers.
  – Instead, customers selectively announce prefixes to some providers
  – Allows customer to traffic engineer inbound traffic.
  – Data shows that Selective Announcements are prevalent and persistent.
ColoISP announces only the aggregate 129/8 prefix to Qwest. Data shows this is not the main cause.
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Data shows this is not the main cause.
Selective Advertisement Prefix

CSU Only Announces Its prefix to Sprint

Or

Announces its prefix to ColoISP with a no_export community tag

Prefix 129.82/16
A Large Scale BGP Outage

The outage began about 1.40pm AEDT, lasted about 45 minutes, and affected customers nationwide

The CommBank website and NetBank were also affected by the outage but were now back online, a Commonwealth Bank spokesman said.

Internet users said on Whirlpool that their connections were out in Sydney, Brisbane, Melbourne, Adelaide, Townsville, Tasmania, Canberra, the Gold Coast and Perth.

"Okay, who broke the internet? @iiNet and @Telstra both down."
Australia to US DoD
Feb 23, 2012  13:00 AEDT

NextGen
AS 38809

703

2556

Century
Link
AS 209

Route from the 13:00 route table
Collected in Sydney by RouteViews

US DOD
AS 5800

214.26.32.0/20

02/19/2013
Australia to US DoD
Feb 23, 2012 13:59:52 AEDT

NextGen
AS 38809

Century
Link
AS 209

US DOD
AS 5800

Telstra
AS 1221

DoDo
AS 38285

Optus
7474

214.26.32.0/20
Summary

- **Customer/Provider/Peer relationships Dominate Policy**
  - Actual physical topology has much more redundancy than policy allows
  - Reduces path exploration, false damping
  - Reduces survivability in the event links go down

- **Selective Advertisement used for traffic engineering**
  - Often customers don’t announce all prefixes to all providers
  - Has implications for robustness, analysis, fault detection, etc.