ISP provides transit service to its customer.

Transit vs. Nontransit Services

Multi-homing to a Single Provider: Case 1

Issues With Multi-homing

Static Routing May Not Work

BGP cannot do load balancing but not load balancing

Multi-homed connections provide load sharing but not load balancing

Bandwidth is sum of links to Internet

Can accommodate link failure

Improves reliability and performance:

connections to the Internet

Configuration of Multi-homing: BGP CSCI 551
Multi-homing to a Single Provider: Case 2

For ISP-> Customer traffic:
- Use MED in Customer or LOCAL-PREF in ISP
- To resolve internal issues
- ISP aggregates to /16 at border router
- ISP advertises /16 aggregate
- 138.39/16 204.70/16

For Customer->ISP traffic:
- Same as before:
- Use MED in Customer or LOCAL-PREF in ISP

Customer: R2
ISP: R1, R3

Good if traffic load to/from prefixes is equal
- No single prefix in Customer
- Most reliable approach

Multi-homing to Multiple Providers

Aggregation
- Delegated by ISP1
- Delegated by ISP2
- Delegated by ISP1 and ISP2

Customer address space obtained independently
- ISP1 aggregates /19 at border router

ISP1 still announces /16 route
ISP1 hears /24 from ISP2
ISP1 routes packets for customer to ISP2!

Workaround:
ISP1 must inject /24 into I-BGP
ISP1 and ISP2 continue to announce aggregates.

Case 2: Customer Uses Address Space From Both ISPs

Computer Communications - CSCI 551

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ISP1
ISP2
ISP3
Customer

138.39.1/24 204.70.1/24

Load sharing depends on traffic to two prefixes.

Lack of reliability: if ISP1 link goes down, part of customer becomes inaccessible.

Customer may announce prefixes to both ISPs, but still problems with longest match as in case 1.

Suppose ISP1 large, ISP2-3 small.

Offers the most control, but at the cost of aggregation.

Suppose ISP1 large, ISP2 small.

Offers more control but at the cost of aggregation.

Offer the most control, but at the cost of aggregation.

Customer uses its own address space:

Still need to control paths: customer advertises long path to ISP1, but LOCAL-PREF attribute is used to override ISP3.

ISP1 learns shorter path from ISP2.

Bottom line: no good and general solution for multi-homing to multiple providers.

ISP1 offers more control than ISP2.

Attribute used is equivalent to metric.

Customer expresses long metric.

Suppose ISP1 large, ISP2 small.

ISP1 will use the blue path for packets destined to 4 and the red for packets destined to 5.

ISP1 will not act as transit to 3.

ISP1 will not accept packets sourced in 1.

Route Flap Dampening

Route Flap Dampening (Cont...)

BGP sessions disappear and reappear.

Problem: route flap when a flaky link consistently goes up and down.

Route Flap Dampening

How Can BGP Express the Following Policies:

ISP1 and ISP2 announce aggregates. When path changes, they suppress route. BGP session disappears and reappears.

ISP1 offers more control than ISP2.

Attribute is used to override path.

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Tricky Issues

- Synchronizing intra and inter-domain routing
- Getting packets to the right exit router without introducing too much flux into intra-domain routing

Multi-homing

- How much policy should we actually be able to support???

Other BGP-related Issues

- Convergence Time [Labovitz00a]
- Congestion [Shaikh00a]
- Policy and convergence [Gao00a, Tangmunarunkit01a]
- Misconfiguration [Thurmond]
- Misconfiguration (intra自治域)
- Misconfiguration (inter自治域)
- Other other issues

- Robustness in the face of router resource exhaustion
- Routing mistakes - central DB of policies

BGP Limitations: Policy

- The above: Central DB of policies

Other BGP-related Issues

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