Inter-Domain Routing (Continued)

Announcements
- Assignment #2 due at 11pm today
- Quiz #3 on Thursday

Overview
- Inter-Domain Routing Issues

Other Inter-Domain Routing Issues
- **What are the benefits of path vector routing (i.e. BGP)?**
  - Loop free -- if receive a path that already contains your ASN, discard the advertisement
  - No count to infinity
  - Path selection based on local policy -- no need to tell neighbors all possible paths
    - Important for AS to choose, because certain path selections cost AS money!
  - Scalable -- there is no flooding
- Convergence
  - Internet is always in flux -- convergence is important
  - Go through path exploration (series of temporary routes) before convergence
  - Example
    - To get to AS 0
      AS 1 has possible routes: (0), (2, 0), (3, 0)
      AS 2 has possible routes: (0), (1, 0), (3, 0)
      AS 3 has possible routes: (0), (1, 0), (2, 0)
    - If AS 0 fails, each AS will withdraw first route and resort to alternate route
      AS 1 -> AS 2: withdraw (1, 0)
      AS 1 -> AS 3: withdraw (1, 0), announce (1, 2, 0)
      AS 2 -> AS 1: withdraw (2, 0)
      AS 2 -> AS 3: withdraw (2, 0), announce (2, 1, 0)
      AS 3 -> AS 1: withdraw (3, 0)
      AS 3 -> AS 2: withdraw (3, 0), announce (3, 1, 0)
    - Depending on message ordering, it is possible
      AS 3 -> AS 2: new route (3, 1, 2, 0) -- AS 2 discards
      AS 2 -> AS 1: new route (2, 3, 1, 0) -- AS 1 discards
- Eventually all routes get withdrawn
- Route flapping
  - Faulty links can cause series of announce/withdraw advertisements
  - Convergence is on the order of minutes => flapping is bad!
  - Causes lots of BGP messages, and high router load to deal with these
  - Solution: add damping mechanism
- Hot potato routing
  - Transit AS wants to carry traffic through their network as little as possible
  - Prefer to hand off to another AS as soon as possible
  - Example

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**How does AS 2 convince AS 1 to handoff traffic in New York?**
- Only AS 2’s BGP speaker in New York advertises 2.2.2.0/24 to AS 1
  - AS 1 will never use the link to AS 2 in Los Angeles
  - If the link in New York fails, no traffic can reach 2.2.2.0/24 until AS 2 detects
    the failure and advertises from the BGP speaker in Los Angeles
- Multi-exit discriminator (MED)
  - Optional attribute included in a BGP advertisement to tell neighboring AS which
    link is preferred
  - It’s still up to AS 1 to obey AS 2’s hint
- Prepending
  - Generally, ASes prefer advertisements with shorter paths
  - Add your own AS number to the path a few times so the path appears longer
  - AS 2 will advertise path (2,2,2) in Los Angeles and (2) in New York
  - It’s still up to AS 1 to prefer the shorter path
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**Routing worksheet**