CPS 514
Day 4
Cool Bit Coin attack using BGP Prefix-Hijacking
“Shutting off” the Internet

- Starting from Jan 27th, 2011, Egypt was disconnected from the Internet
  - 2769/2903 networks withdrawn from BGP
Agenda

• Routing
  • BGP: iBGP v. eBGP
  • OSPF+BGP
  • Hot-Potato routing
  • Tools for Understanding BGP
  • Implications of BGP
IGP v. EGP

- **IGP** = Interior gateway protocol (e.g. OSPF)
  - How does A learn to get to C

- **EGP** = Exterior Gateway protocol (e.g. BGP)
  - How does A learn to get to Z
IGP: OSPF (open shortest path first)

- Flooding based IGP
  - Each router creates an advertisement of its adjacency
  - This Advertisement is flooded through the whole ISP
- Each Router has ENTIRE topology (GRAPH)
  - Runs shortest path on its copy of the topology (Graph)
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Flooding based IGP

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OSPF: Scaling Issues
OSPF: Scaling Issues

- Each node stores the entire topology
  - Memory overheads
- Each node computes shortest paths
  - CPU overheads
- Large ISPs can have 3000-4000 notes
  - This does not scale
Each router in Area 0 must maintain:
- Routes to every other router in the area 0
- Treat other areas as a single node
- Must know how to get to every Area
• Each router in Area X (X≠0)
  – Shortest path to each router in the same area. Route must stay in area (even if shortest route goes outside of the area)
  – To get to router not in Area-X go ALWAYS go through Area 0
  – Area-0 must figure out how to get the packet to the correct area
EGP: Routing over the WAN

- IGP exposes too much information
- Peering: AS-to-AS routes cost money.
- An AS may not want to expose expensive routes.
Terms

- **Route**: a network prefix plus path attributes

- **Customer/provider/peer routes**: 
  - Route advertisements heard from customers/providers/peers

- **Transit service**: If A advertises a route to B, it implies that A will forward packets coming from B to any destination in the advertised prefix
BGP: Border Gateway Protocol

- AS = Autonomous System (ISP)
- Path Vector Protocol
  - Prevents loops!
- Creates end-to-end reachability
- Allows AS to privately enforce policies
Two types of BGP sessions

- All BGP sessions are TCP connections between two or more routers

- eBGP session is a BGP session between two routers in different ASes
  - Learn routes from other people

- iBGP session is a BGP session between internal routers of an AS.
  - Distribute routes within the AS.
  - Traditionally iBGP mesh is between all routers in the AS
Scalability of iBGP Mesh

- All to All connectivity does not scale
- Create a hierarchy!! Consistency issues discussed in next class.
Convergence of Bad News Takes Time

- Each AS has multiple Advertisements for the same destination
- When an AS goes down. Takes time for information to propagate.
- Potentially $O(N)$ amount of time. May need to explore all alternatives
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C-A link goes down!!!

Diagram:
- C
- D
- Z
- A
- C:DC
- C:ZDC

Diagram shows connectivity with links C-A, C-D, C-Z, and A-D.
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C-A link goes down!!!
Two types of BGP sessions:

- eBGP
- iBGP

AT&T and Sprint are AS23.

IGP Routing Table:
- **destination**: C
- **next hop**: B

BGP:
- **destination**: Z
- **next hop**: C

Forwarding Table:
- **destination**: Z
  - **next hop**: C
- **destination**: Z
  - **next hop**: C
Why is Hot-Potato Bad?

• Forward and reverse paths have different properties
  – Different latencies and loss rates affect TCP
  – Inaccuracies in measurements of the forwarding system

• Packet loss due to forwarding loops
How do you Under Impact Implications of Routing?

• To understand latency: Ping

• To understand throughput: Ipref

• To understand network paths: traceroute

• To understand BGP advertisements: Routeview
Issues with BGP+OSPF

• BGP Issues:
  – Takes a while for information to propagate
  – Convergence takes a long time

• User has no control over routes (ISP does)
  – Classes Next week!!!

• BGP+OSPF (NEXT CLASS RCP)
  – Small change in OSPF lead to BGP changes
  – Impacts the Internets