EECS 489 Discussion 8

Announcements

- Project 2 grades are out
- Project 3 is due in a week

Rough Project 3 Testing Checklist

- Does your program compile?
- Does your program run?
- Do you send the packet in the correct format?
- Does your program correctly slide the window?
- Does your program work with reordered packets?
- Does your program work with packet loss?
- Is your program able to fully receive a file? Is this file exactly the same as the file you originally sent?
- Is your program able to handle multiple consecutive connections and store the files correctly?
- Are you creating a log?

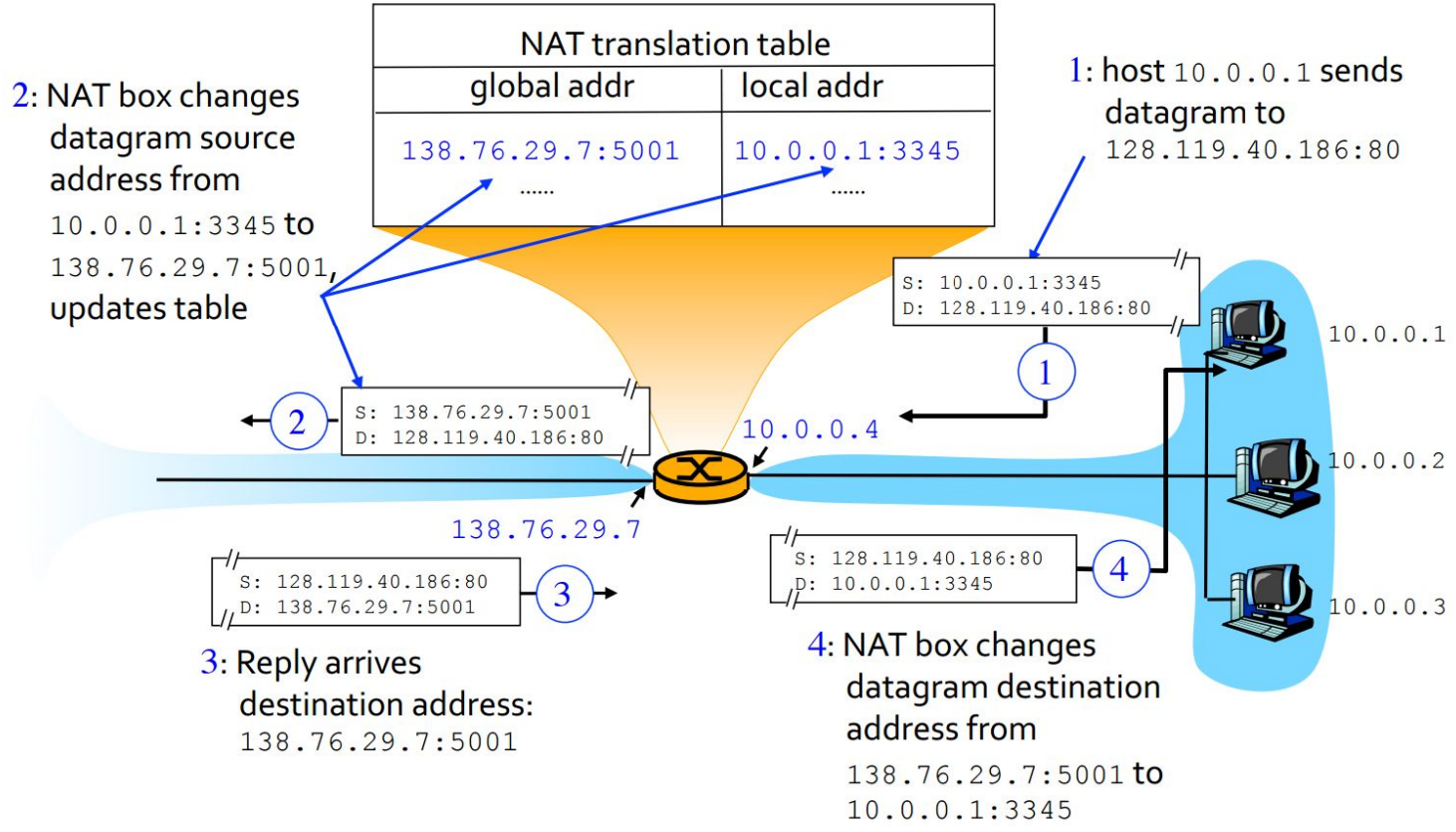
NAT: Network Address Translation

Motivation: handle IPv4 address exhaustion problem

Solution:

- Share a limited number of address among a larger number of hosts
- Local to global address binding done per connection

NAT: Example


NAT translation table
global addr
local addr
138.76.29.7:5001
10.0.0.1:3345
2: NAT box changes datagram source address from 10.0.0.1:3345 to 138.76.29.7:5001, updates table
1: host 10.0.0.1 sends datagram to 128.119.40.186:80
S: 10.0.0.1:3345
D: 128.119.40.186:80
1
2
S: 138.76.29.7:5001
D: 128.119.40.186:80
10.0.0.4
138.76.29.7
10.0.0.1
10.0.0.2
10.0.0.3
S: 128.119.40.186:80
D: 138.76.29.7:5001
3
3: Reply arrives destination address: 138.76.29.7:5001
S: 128.119.40.186:80
D: 10.0.0.1:3345
4
4: NAT box changes datagram destination address from 138.76.29.7:5001 to 10.0.0.1:3345

NAT Box Functions

- Replace <sourceIP, port#> of every outgoing datagram to <NATIP, newport#>
- In NAT table, record every mapping of
  - <sourceIP, port#> to <NATIP, newport#>
- Replaces <NATIP, newport#> in destination field of every incoming datagram with corresponding <sourceIP, port#> stored in the NAT table
- Forward modified datagram into the local network

Types of NAT

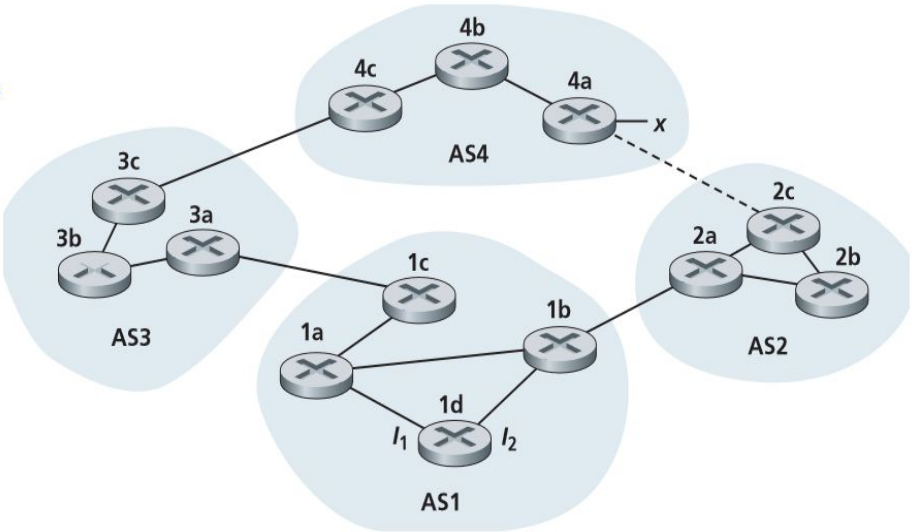
NAT table maps iAddr+iPort of a local host toits eAddr+ePort

- Full-cone NAT:
  - Any remote host can send packets intended for iAddr+iPort to eAddr+ePort
- IP-restricted NAT:
  - A remote host (rAddr) can send packets to eAddr+ePort only if iAddr+iPort has contacted rAddr previously (at any remote port, rPort)
- Port-restricted NAT:
  - A remote host can send packets to eAddr+ePort only using an rPort that iAddr+iPort has contacted at rAddr

Final Thoughts on NAT

- Pros
  - Can change address of hosts without notifying outside entities
  - Devices inside local network not explicitly addressable by outside world
- Cons
  - Address shortage should be solved by IPv6 (NAT hinders this)
  - Port numbers were meant to identify sockets, not end hosts
  - P2P networking becomes harder

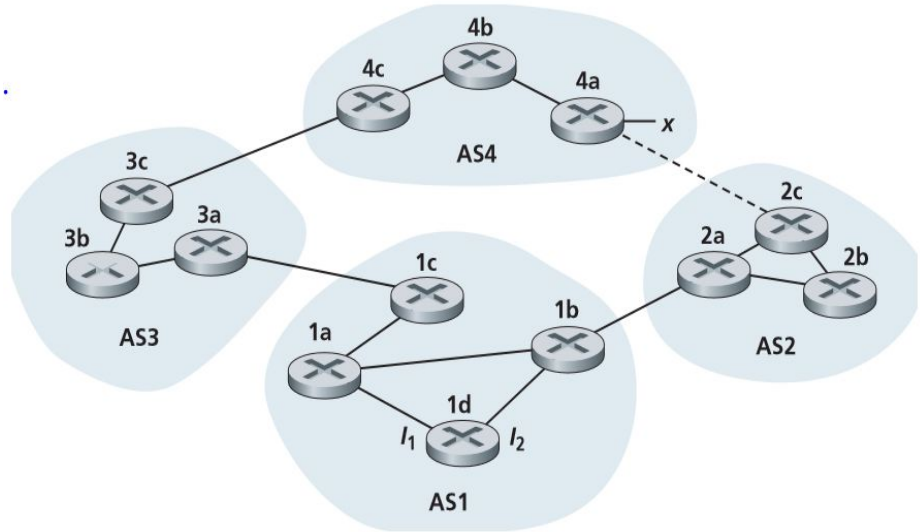
Q1



Consider the network shown below. Suppose AS3 and AS2 are running OSPF for their intra-AS routing protocol. Suppose AS1 and AS4 are running RIP for their intra-AS routing protocol. Suppose eBGP and iBGP are used for the inter-AS routing protocol. Initially suppose there is no physical link between AS2 and AS4

- Router 3c learns about prefix x from which routing protocol?
- Router 3a learns about x from which routing protocol?
- Router 1d learns about x from which routing protocol?

Q1



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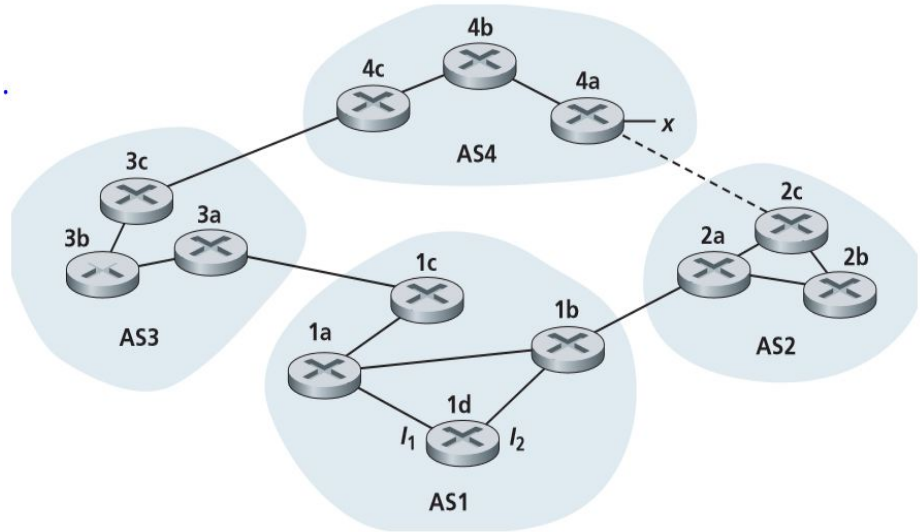
- Router 3c learns about prefix x from which routing protocol? eBGP
- Router 3a learns about x from which routing protocol? iBGP
- Router 1d learns about x from which routing protocol? iBGP

Q2



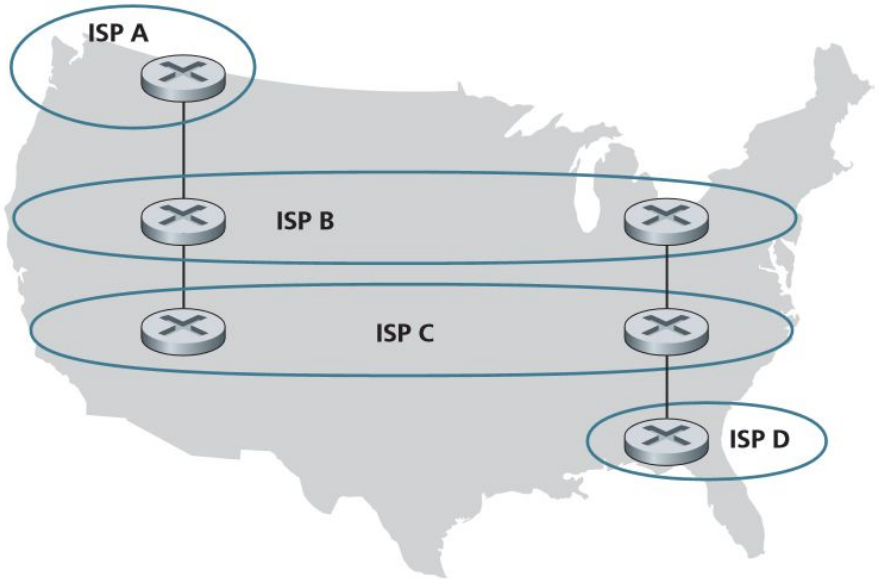
Once router 1d learns about x it will put an entry (x, I) in its forwarding table.

- Will I be equal to I1 or I2 for this entry?
- Now suppose that there is a physical link between AS2 and AS4, shown by the dotted line. Suppose router 1d learns that x is accessible via AS2 as well as via AS3. Will I be set to I1 or I2
- Now suppose there is another AS, called AS5, which lies on the path between AS2 and AS4 (not shown in diagram). Suppose router 1d learns that x is accessible via AS2 AS5 AS4 as well as via AS3 AS4. Will I be set to I1 or I2

Q3

Suppose ASs X and Z are not directly connected but instead are connected by AS Y. Further suppose that X has a peering agreement with Y, and that Y has a peering agreement with Z. Finally, suppose that Z wants to transit all of Y’s traffic but does not want to transit X’s traffic. Does BGP allow Z to implement this policy?

Q4



Consider the following network. ISP B provides national backbone service to regional ISP A. ISP C provides national backbone service to regional ISP D. Each ISP consists of one AS. B and C peer with each other in two places using BGP.
Consider traffic going from A to D. B would prefer to hand that traffic over to C on the West Coast (so that C would have to absorb the cost of carrying the traffic cross-country), while C would prefer to get the traffic via its East Coast peering point with B (so that B would have carried the traffic across the country). Can C force B to hand over A-to-D traffic at its East Coast peering point?

Acknowledgements

http://web.eecs.umich.edu/~sugih/courses/eecs489/lectures/07-Fragmentation+IPv6+NAT.pdf