

Lecture 13: Naming (cont.)

CSE 123: Computer Networks
Alex C. Snoeren



Midterm FRIDAY



Lecture 13 Overview



- Discovering addresses (DHCP/ARP)
- Network address translation (NAT)



Private Address Space

- Sometimes you can't get/don't want IP addresses
 - ♦ An organization wants to change service providers without having to renumber its entire network
 - ♦ A network may be unable obtain (or cannot afford) enough IP addresses for all of its hosts
- IP provides **private address space** anyone can use
 - ♦ 10/8, 192.168/16, 172.16.0/20
 - ♦ These addresses are not routable—Internet routers should drop packets destined to these so-called **bogons**
- What good are they if can't use them on the Internet?



Address Resolution Protocol

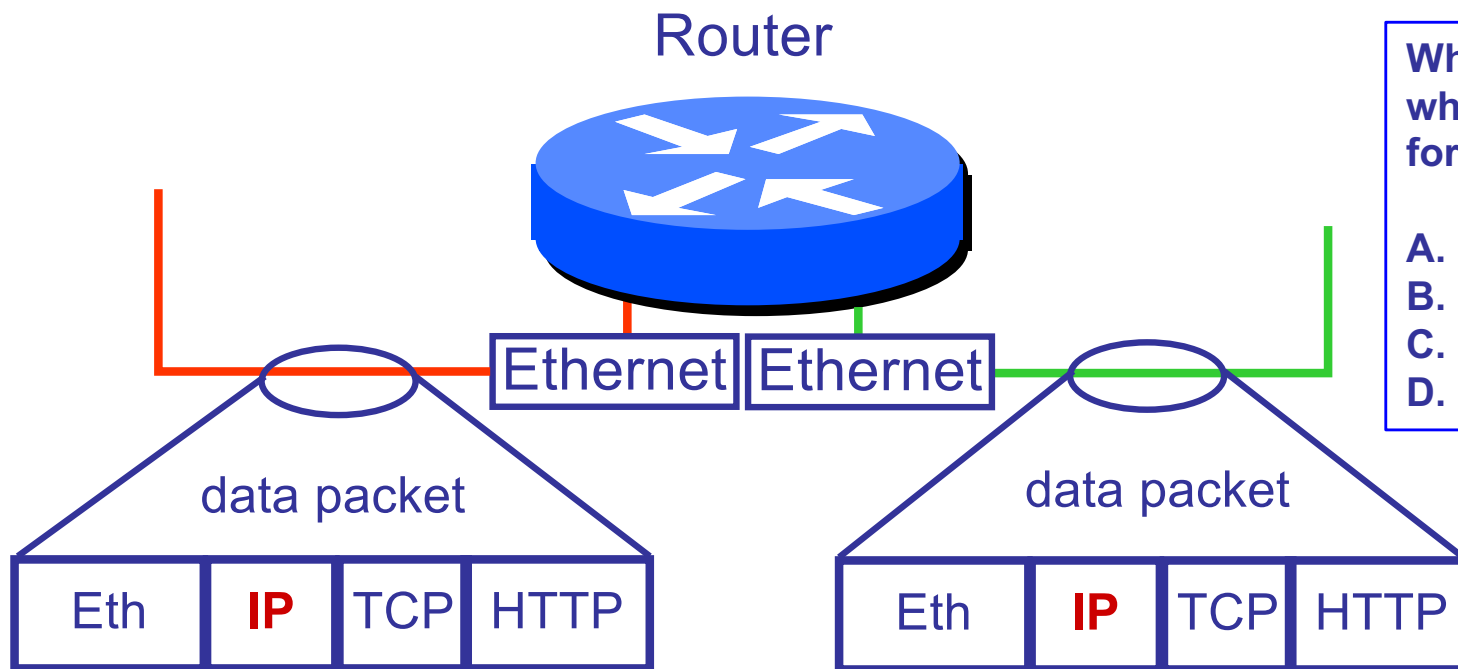
- Every node maintains an **ARP table**
 - ◆ (IP address, MAC address) pair
- Consult the table when sending a packet
 - ◆ Map destination IP address to MAC address
 - ◆ Encapsulate the packet and transmit in a frame
- What if the IP address is not in the table?
 - ◆ (Link-layer) Broadcast: “Who has IP address x.x.x.x?”
 - ◆ Response: “I do! MAC address yy:yy:yy:yy:yy:yy”
 - ◆ Sender caches the result in its ARP table

Out which ports does a router send ARP requests?

- A. The port a packet came in on**
- B. The port a packet will go out on**
- C. All ports**
- D. All but A**



Addresses in IP forwarding

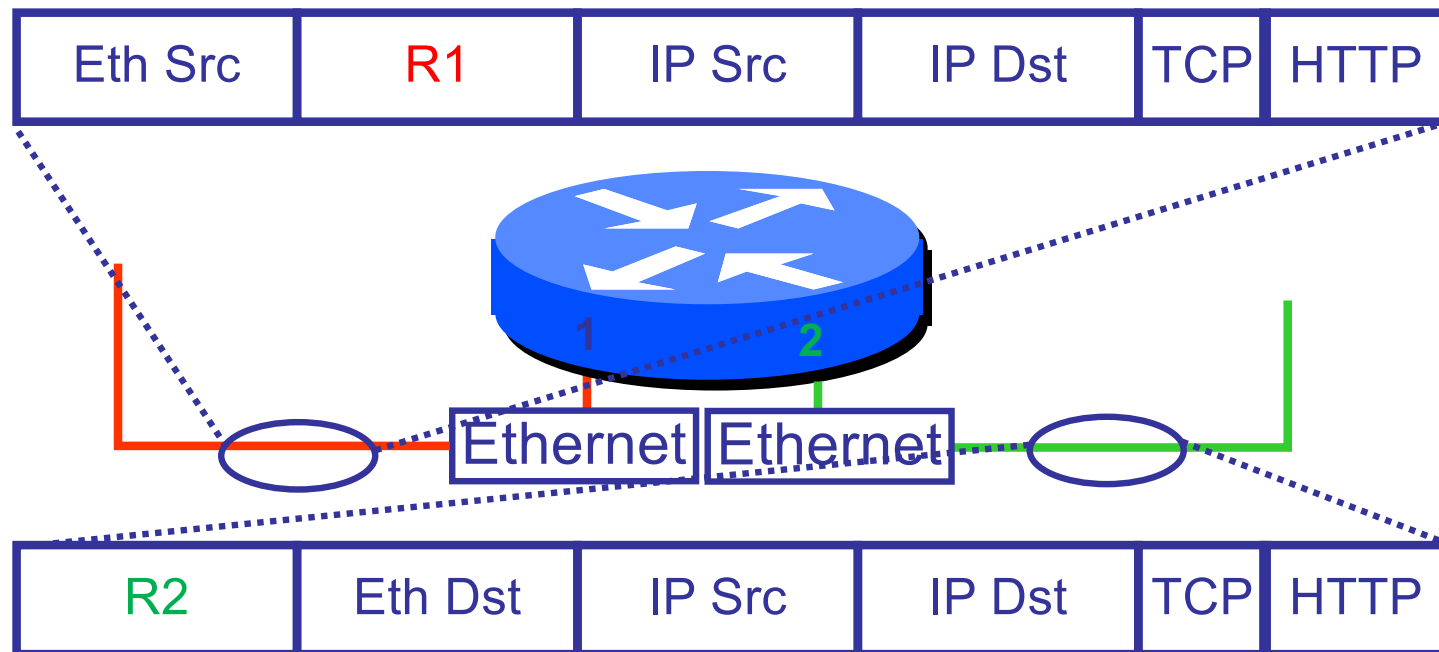


Which fields change when packet is forwarded?

- A. IP src/dst
- B. Eth src/dst
- C. Both A & B
- D. None of the above



Addresses in IP forwarding



Network Address Translation



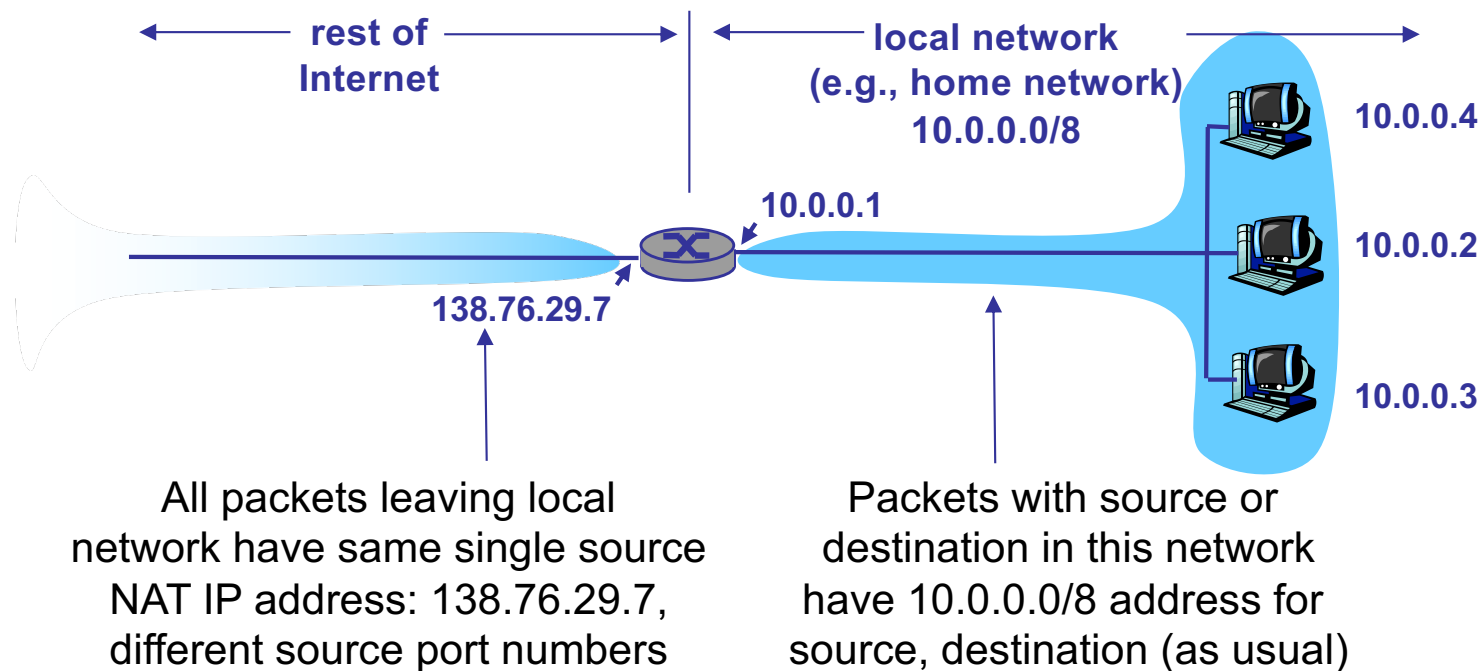
- Gateway router can rewrite IP addresses as packets leave or enter a given network
 - ◆ I.e., replace private addresses with public ones
 - ◆ Router needs to see and update every packet
- Maintains a mapping of private-to-public addresses
 - ◆ Simple case is a one-to-one mapping
 - ◆ Anytime network changes provider, just update mapping table
 - ◆ In more clever scenarios, can map a set of private addresses to a smaller set of public addresses
 - ◆ In the extreme map the entire private network to one public IP!



IP Masquerading

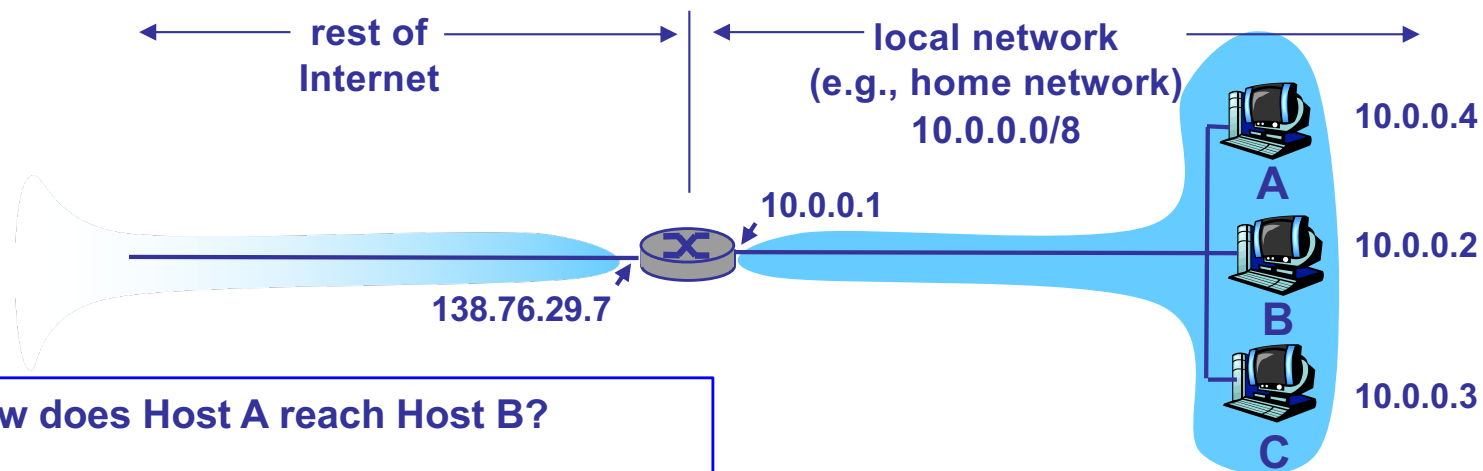
- A.K.A. Network Address and port Translation (NAPt), Port Address Translation (PAT), or, colloquially, just NAT.
- Entire local network uses just one IP address as far as outside world is concerned:
 - ◆ can change addresses of devices in local network without notifying outside world
 - ◆ can change ISP without changing addresses of devices in local network
 - ◆ devices inside local net not explicitly addressable, visible by outside world (a security plus).

A NAT'd Network





Inside a NAT'd Network

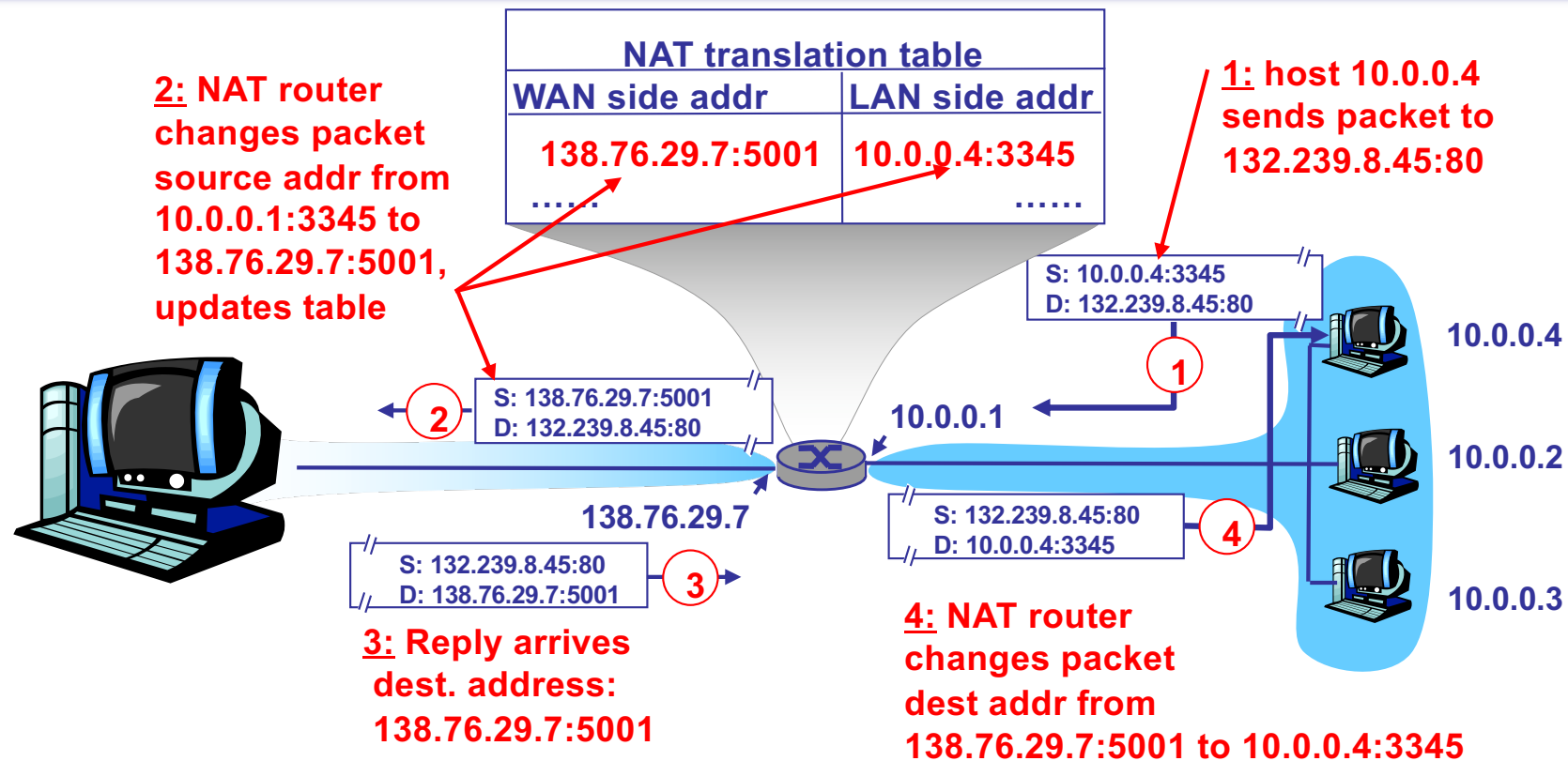


How does Host A reach Host B?

- A. By routing through 10.0.0.1
- B. By going through the NAT
- C. By going to the Internet and back
- D. By going directly to 10.0.0.2



NA(p)T Example





NAT Challenges

- End hosts may not be aware of external IP address
 - ◆ Some applications include IP addresses in application data
 - ◆ Packets will contain private IP addresses inside payload
 - ◆ Many NATs will inspect/rewrite certain protocols, e.g., FTP
- NAT'd end hosts are not reachable from the Internet
 - ◆ All connections must be initiated from within private network
 - ◆ Alternative is to configure fixed forwarding in NAT
 - ◆ Many protocols for [NAT traversal](#) to get around this

Summary



- IP to MAC Address mapping
 - ◆ Dynamic Host Configuration Protocol (DHCP)
 - ◆ Address Resolution Protocol (ARP)
- Domain Name System
 - ◆ Distributed, hierarchical database
 - ◆ Distributed collection of servers
 - ◆ Caching to improve performance

For Next Time



- Midterm FRIDAY
 - Bring your ID, a mask, and a writing implement
- You can bring 8.5x11" crib sheet with your name on it
 - You must turn this in with your exam