

Network Technologies (TCP/IP Suite)

Umar Kalim
Dept. of Communication Systems Engineering

umar.kalim@niit.edu.pk
<http://www.niit.edu.pk/~umarkalim>

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Outline

▲ DHCP

▲ NAT

IP addresses: how to get one?

Q: How does host get IP address?

▲ hard-coded by system admin in a file

- Wintel: control-panel->network->configuration->tcp/ip->properties
- UNIX: /etc/rc.config

▲ RARP

▲ BOOTP

- Static binding
- Well known port – 67
- Client uses well known – 68

▲ DHCP: Dynamic Host Configuration Protocol

- dynamically get address: “plug-and-play”

▲ NAT: Network Address Translation

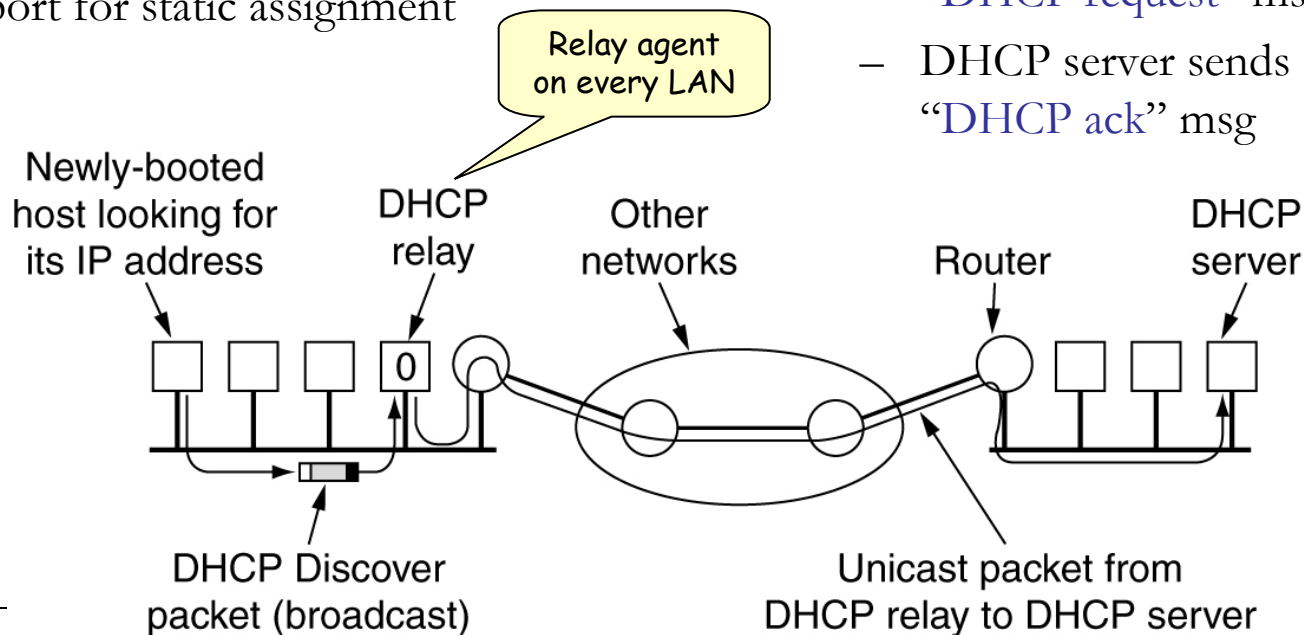
DHCP: Dynamic Host Configuration Protocol

Goal: *dynamically* obtain an IP address from network server

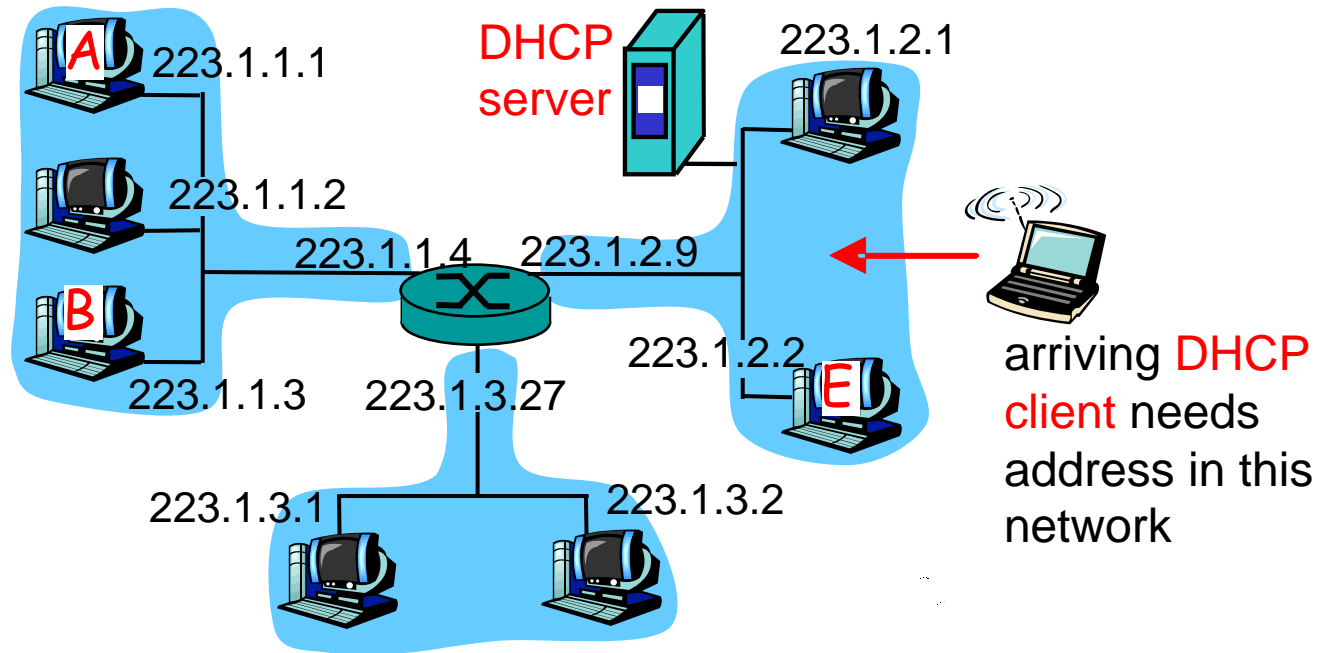
- ✦ Can renew its **lease** on address in use
- ✦ Allows reuse of addresses
- ✦ Support for mobile users
- ✦ Support for static assignment

DHCP overview:

- host **broadcasts** “DHCP **discover**” msg
- DHCP server responds with “DHCP **offer**” msg
- host requests IP address: “DHCP **request**” msg
- DHCP server sends address: “DHCP **ack**” msg

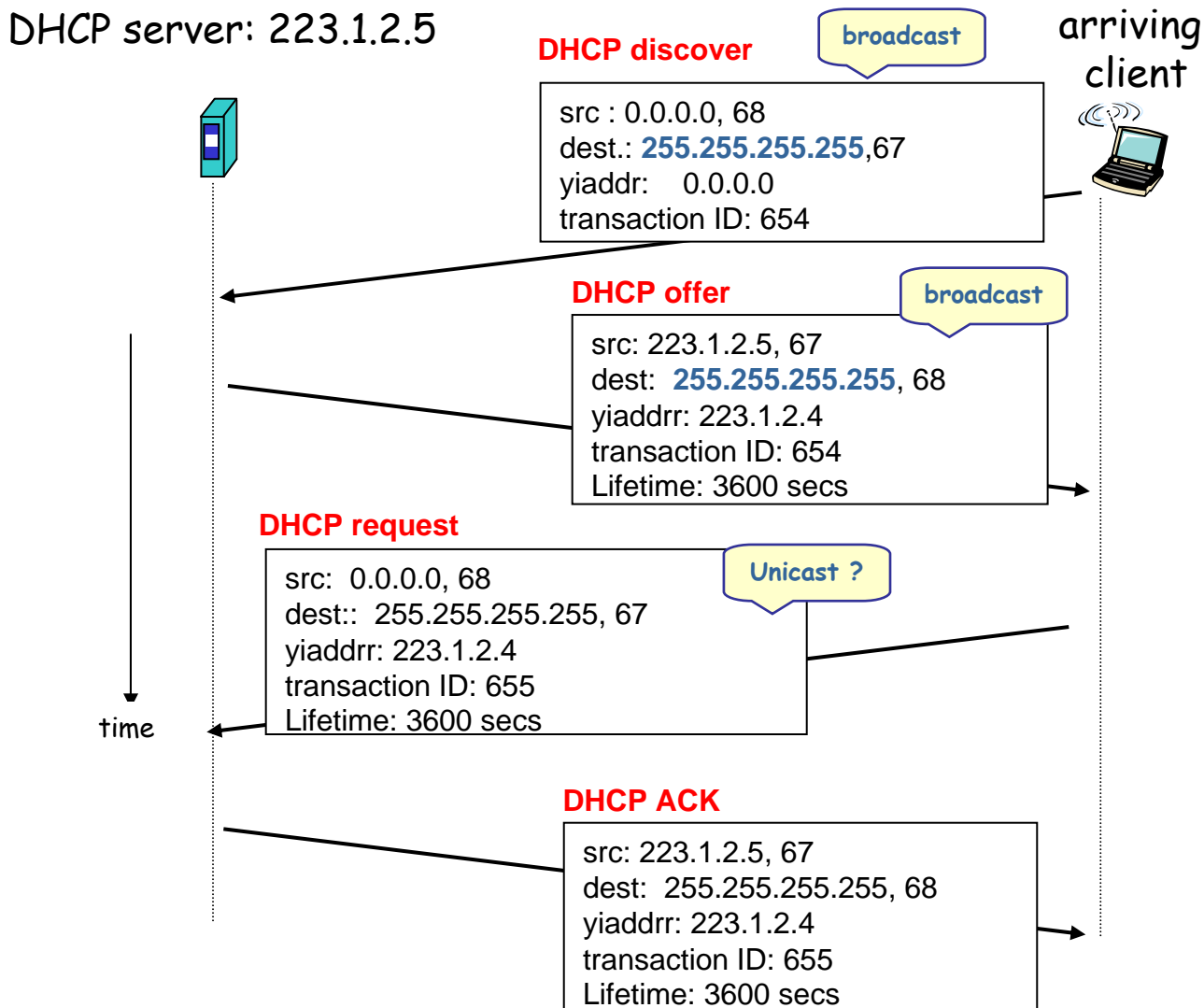


DHCP client-server scenario



Router sometimes works as “DHCP relay agent”

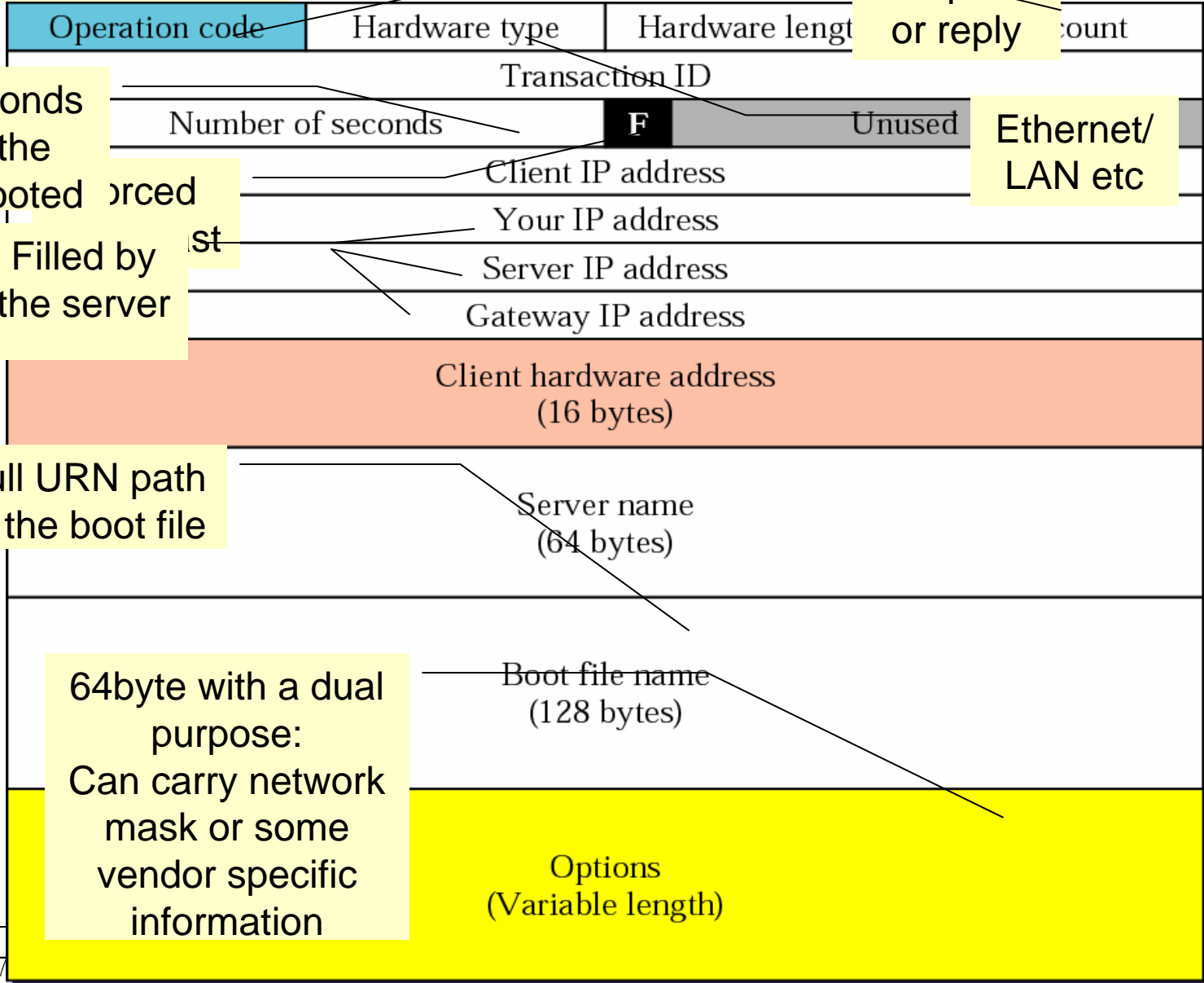
DHCP client-server scenario **Protocol Overview**



Max hops the packet can travel

Packet Format

Request or reply



of seconds since the client booted

Filled by the server

Full URN path of the boot file

64byte with a dual purpose:
Can carry network mask or some vendor specific information

RFC?

DHCP – RFC 2131

NAT – RFC 2663; RFC 3022

NAT: Network Address Translation

▲ **Motivation:** demand for IP addresses increases with the arrival of smart devices.

▲ **NAT enabled router:**

– local network is connected to the outside world

NAT enabled router doesn't run an inter-AS routing protocol with the attached ISP router.

– can't be seen by devices in local network

Doesn't even look like a router!

– not visible, visible by outside world

– widespread

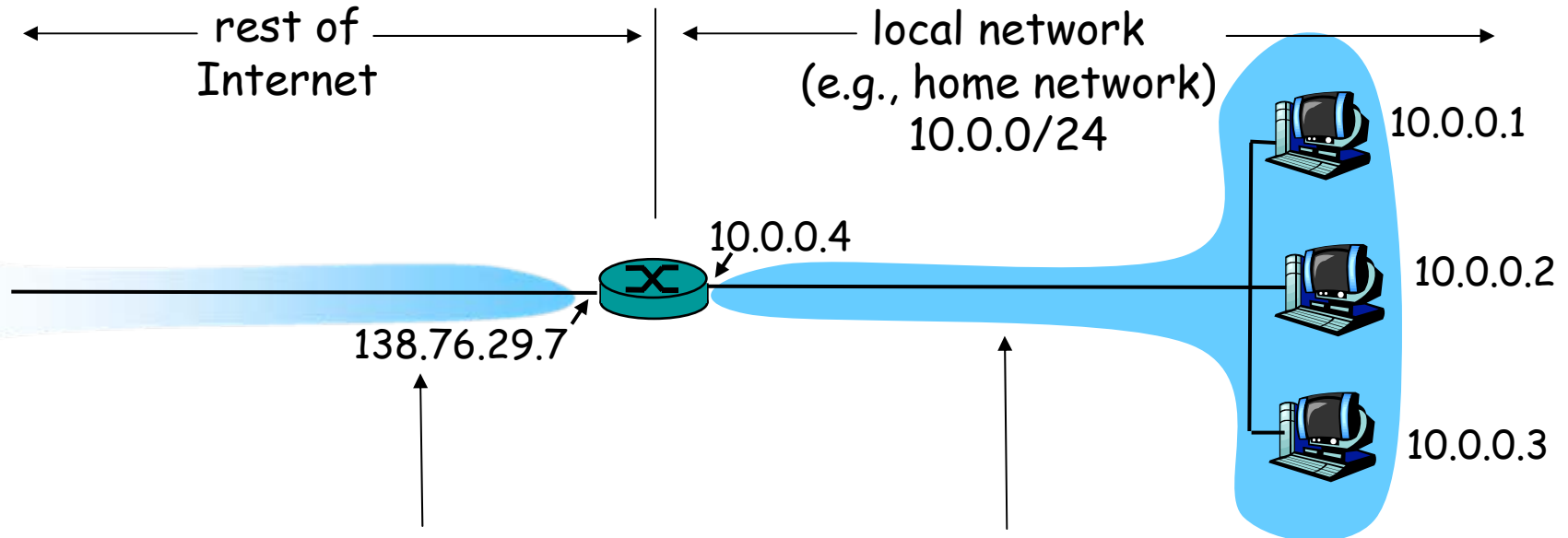
▲ **Private IP addresses:**

– 10.0.0.0 - 10.255.255.255

172.16.0.0 - 172.31.255.255

192.168.0.0 - 192.168.255.255

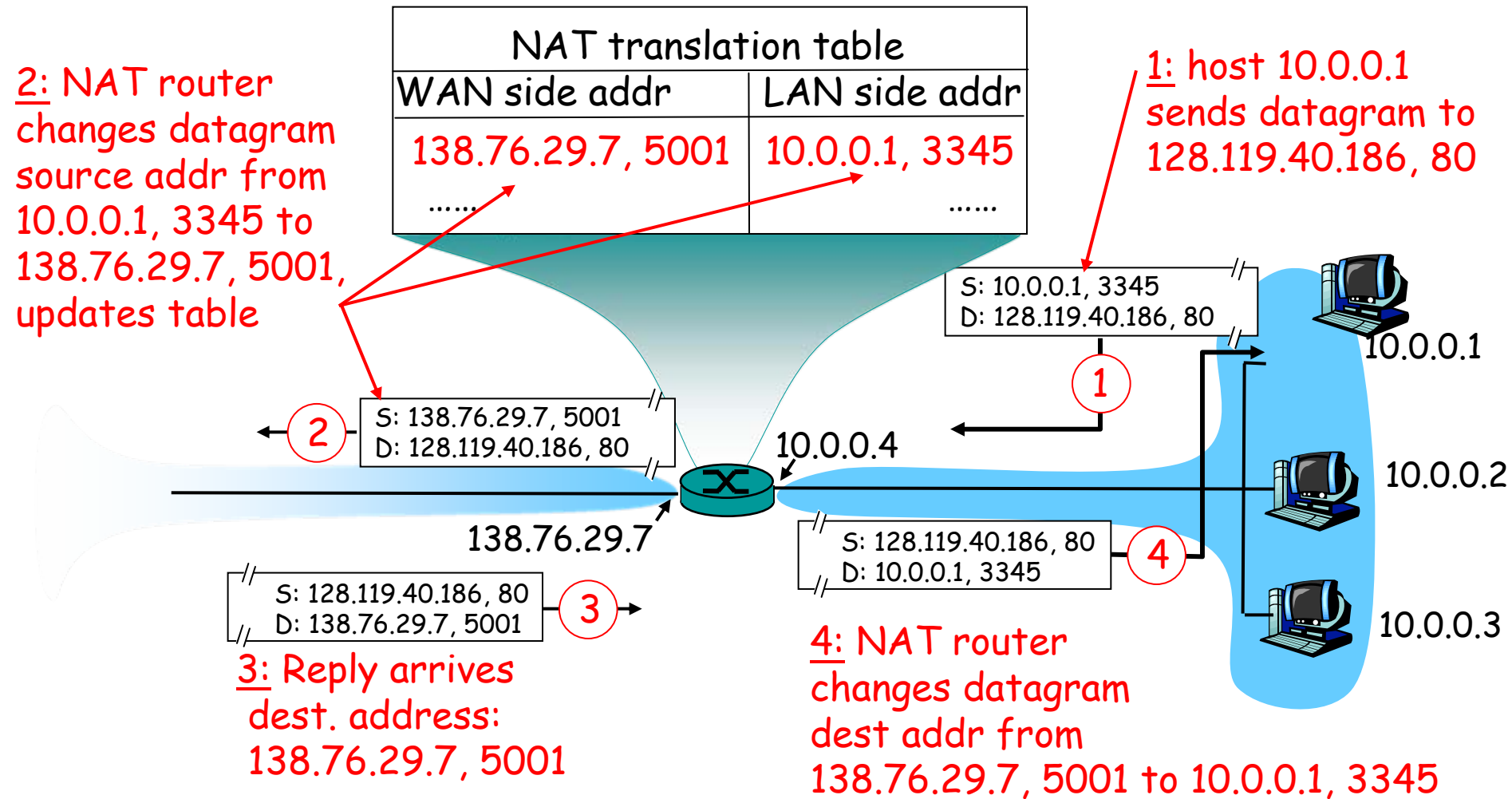
NAT: Network Address Translation



All datagrams *leaving* local network have *same* single source NAT IP address: 138.76.29.7, different source port numbers

Datagrams with source or destination in this network have 10.0.0/24 address for source, destination (as usual)

NAT: Network Address Translation



NAT Implementation

Private Addr	Private Port	External Addr	External Port	NAT Addr	NAT Port	Protocol
nb-addr	nb-port1	yahoo	80	gw-addr	3001	tcp
nb-addr	nb-port2	dns.sjsu	53	gw-addr	3002	udp
nb-addr	nb-port3	yahoo	80	gw-addr	3003	tcp
pc-addr	pc-port1	yahoo	80	gw-addr	3004	tcp

16 bit port#

outgoing: replace (src IP addr, port #) to (NAT addr, NAT port #)

... remote will respond to (NAT addr, NAT port #)

remember (in NAT translation table) every (src IP addr, port #) to (NAT addr, NAT port #) translation pair

incoming: replace (NAT addr, NAT port #) in dest fields of every incoming datagram with corresponding (src IP addr, port #) stored in NAT table

IETF community doesn't approve of NAT

- ▲ Port numbers are for addressing processes, NAT uses port numbers to address hosts
 - What if a node resides within the private network?
 - ◆ Servers listen on well-known port numbers
 - Routers are supposed to process packets at layer 3 only. NAT violates the “end-to-end argument”
 - ◆ [SRC84] J. Saltzer, D. Reed, and D. Clark , End-to-end Arguments in System Design. [ACM Transactions on Computer Systems \(TOCS\)](#), Vol. 2, No. 4, pp. 195-206, 1984.
 - IPv6 should be used to deal with shortage of IP addresses

Other issues

- ▲ Static VS Dynamic NAT
 - Other types: symmetric, port restricted, full cone
- ▲ Effects of NAT on higher protocols
- ▲ Effects of NAT on security

Questions?

That's all for today!