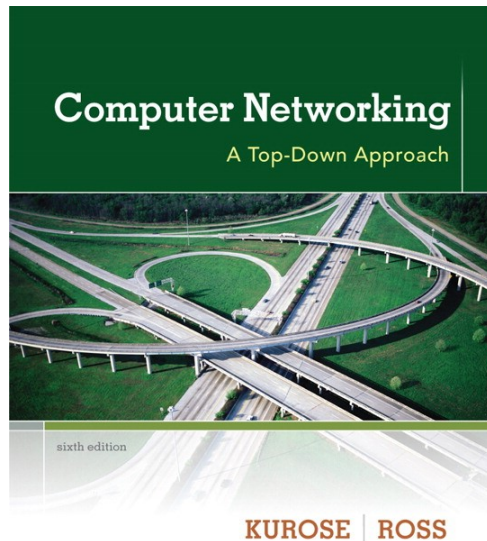


Network Layer



*Computer
Networking: A Top
Down Approach*
6th edition
Jim Kurose, Keith Ross
Addison-Wesley
March 2012

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Network layer

- ❖ Transport segment from sending to receiving host
- ❖ On sending side encapsulates segments into datagrams
- ❖ On receiving side, delivers segments to transport layer
- ❖ Network layer protocols in *every* host and router
- ❖ Router examines header fields in all IP datagrams passing through it

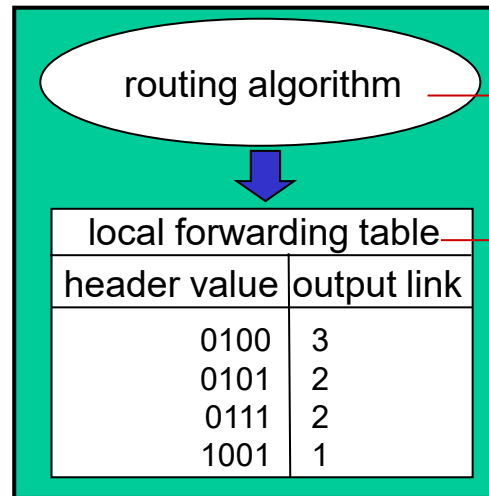
Two key network-layer functions

The role of the network layer is simple — to move packets from a sending host to a receiving host.

- ❖ *Forwarding*: When a packet arrives at a router's input link, the router must move the packet to the appropriate output link.
- ❖ *Routing*: Determine the route or path taken by packets as they flow from a sender to a receiver
 - The algorithms that calculate these paths are referred to as **Routing Algorithms**.

Interplay between routing and forwarding

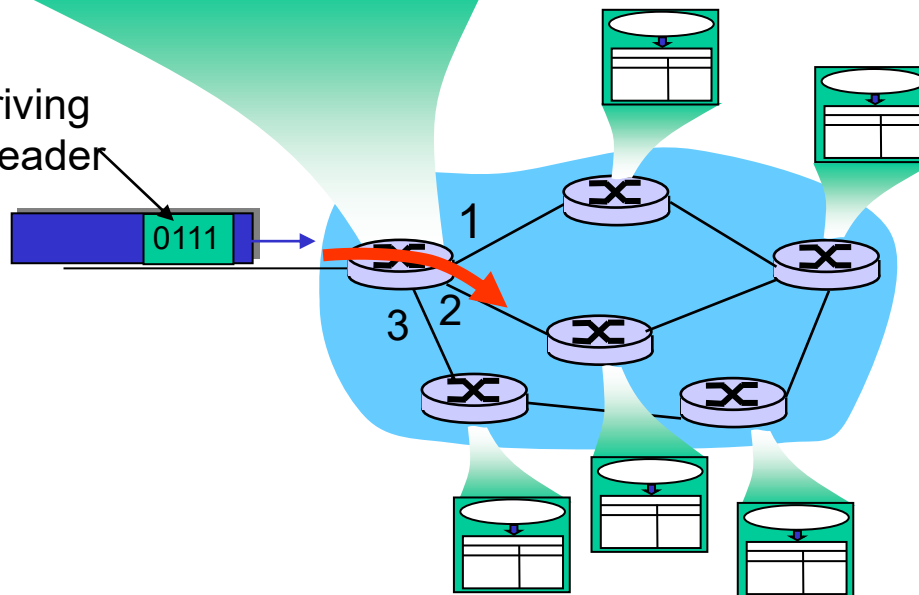
Every router has a forwarding table



routing algorithm determines end-end-path through network

forwarding table determines local forwarding at this router

value in arriving packet's header



IP addresses: how to get one?

Q: How does a *host* get IP address?

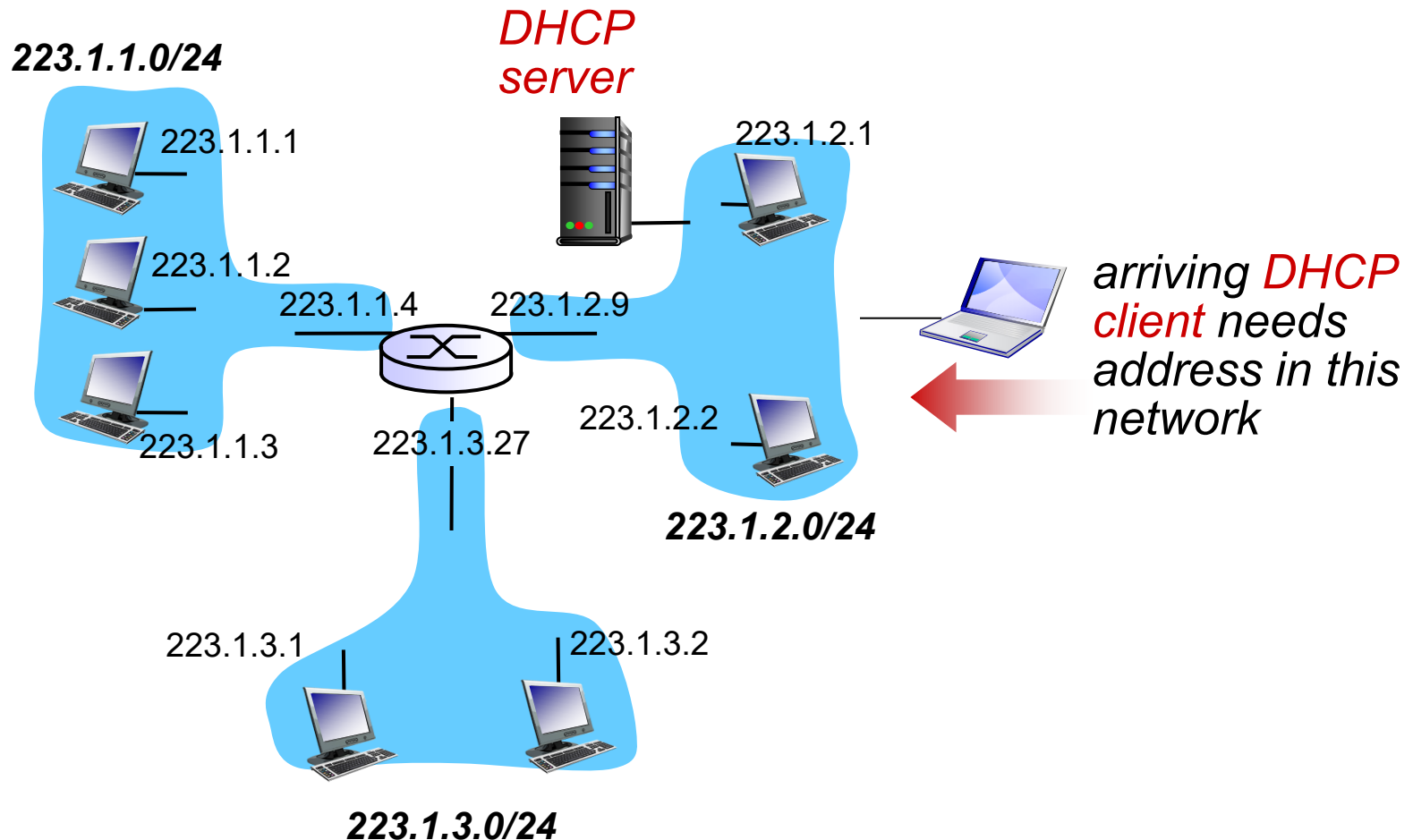
- ❖ hard-coded by system admin in a file
 - Windows: control-panel->network->configuration->tcp/ip->properties
 - UNIX: /etc/rc.config
- ❖ **DHCP: Dynamic Host Configuration Protocol:** dynamically get address from as server
 - “plug-and-play”

DHCP: Dynamic Host Configuration Protocol

Goal: allow host to *dynamically* obtain its IP address from network server when it joins network

- Can renew its lease on address in use
- Allows reuse of addresses (only hold address while connected/“on”)
- Support for mobile users who want to join network

DHCP Client-Server Scenario

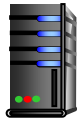


DHCP Client-Server Scenario

DHCP server: 223.1.2.5

DHCP discover

arriving
client



Broadcast: is there a
DHCP server out there?

DHCP offer

Broadcast: I'm a DHCP
server! Here's an IP
address you can use

DHCP request

Broadcast: OK. I'll take
that IP address!

DHCP ACK

Broadcast: OK. You've
got that IP address!

DHCP: more than IP addresses

DHCP can return more than just allocated IP address on subnet:

- address of first-hop router for client
- name and IP address of DNS sever
- network mask (indicating network versus host portion of address)

IP addressing: the last word...

Q: how does an ISP get block of addresses?

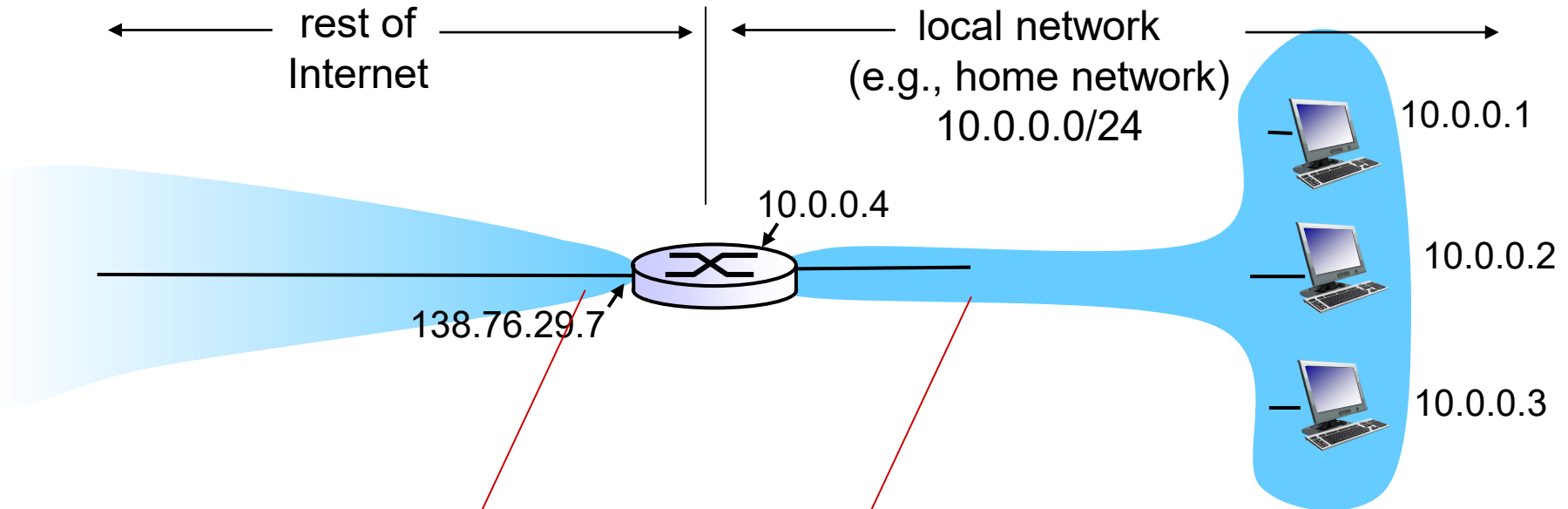
A: ICANN: Internet Corporation for Assigned Names and Numbers <http://www.icann.org/>

- allocates addresses
- manages DNS
- assigns domain names, resolves disputes

NAT: network address translation

- Network Address Translation (NAT) is designed for IP address conservation.
- A technology that can provide the mapping between the private and public (universal) addresses
- NAT operates on a router, usually connecting two networks together, and translates the private addresses in the internal network into legal addresses, before packets are forwarded to another network.

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 10.0.0.0/24 address for source, destination (as usual)

NAT: network address translation

implementation: NAT router must:

- *outgoing datagrams: replace* (source IP address, port #) of every outgoing datagram to (NAT IP address, new port #)
... remote clients/servers will respond using (NAT IP address, new port #) as destination addr
- *remember (in NAT translation table)* every (source IP address, port #) to (NAT IP address, new port #) translation pair
- *incoming datagrams: replace* (NAT IP address, new port #) in dest fields of every incoming datagram with corresponding (source IP address, port #) stored in NAT table

NAT: network address translation

