

# Applied Networks & Security

## Routing

<http://condor.depaul.edu/~jkristof/it263/>

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# IPv4 unicast routing

- All Internet hosts perform basic routing
  - for local net destinations, forward to local host
  - for non-local nets, forward to default router
- Dedicated routers often used between networks
- Routing tables maintain next hop information
- Forwarding decision based on destination address
  - routers can use other info to influence decision
- Routers forward to next-hop if not locally attached

# Basic IPv4 forwarding process

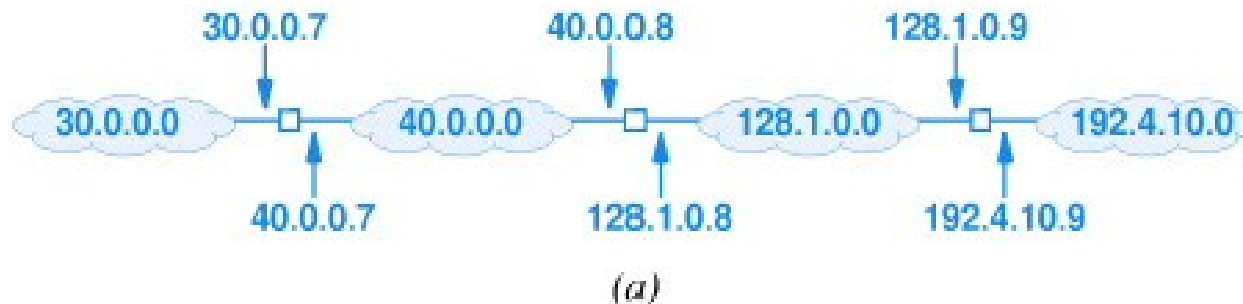
- For an IP datagram received on an interface...
- remove layer 2 information,
- extract destination IP address (D),
- find best match for (D) in routing table,
- extract forwarding address (F) for next hop,
- create layer 2 info on outgoing interface,
- send datagram to (F).

# IP routing tables

Since each row in a routing table represents an entry associated with one IP network, the size of the routing table is directly proportional to the number of IP networks known throughout the entire internetwork.

# IP routing table illustrated

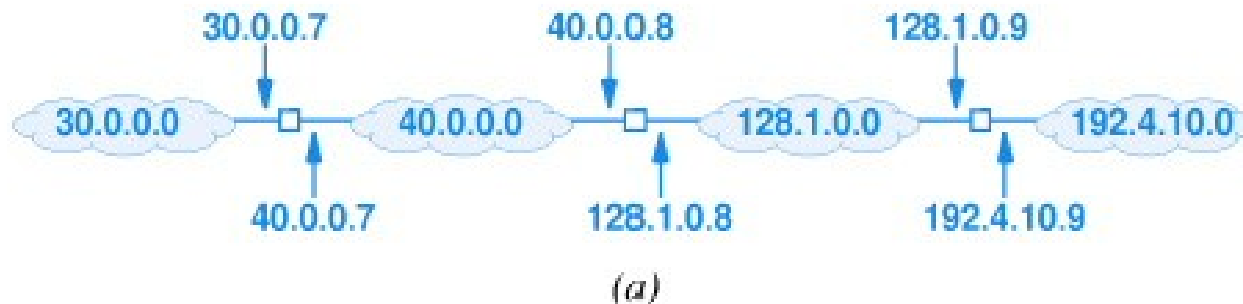
\*diagrams courtesy of <http://www.netbook.cs.purdue.edu>



Destination	Mask	Next Hop
30.0.0.0	255.0.0.0	40.0.0.7
40.0.0.0	255.0.0.0	deliver direct
128.1.0.0	255.255.0.0	deliver direct
192.4.10.0	255.255.255.0	128.1.0.9

(b)

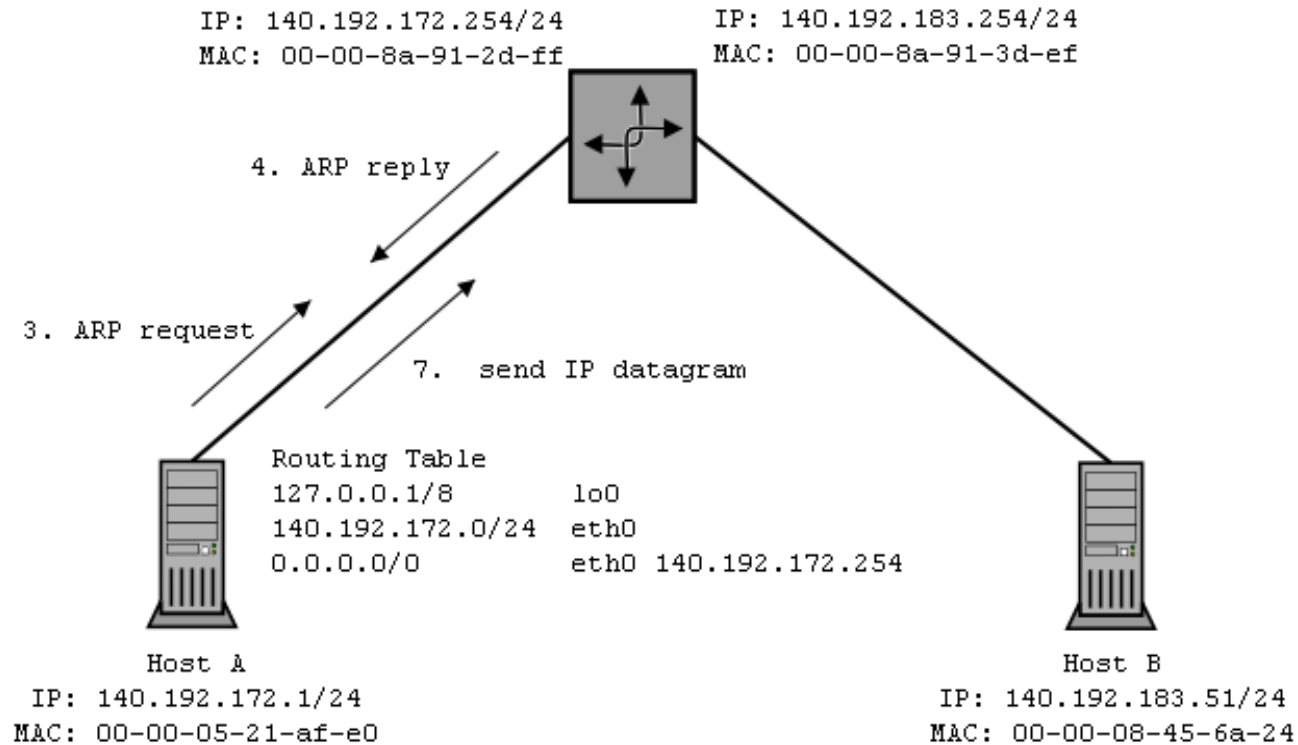
# IP routing table illustrated



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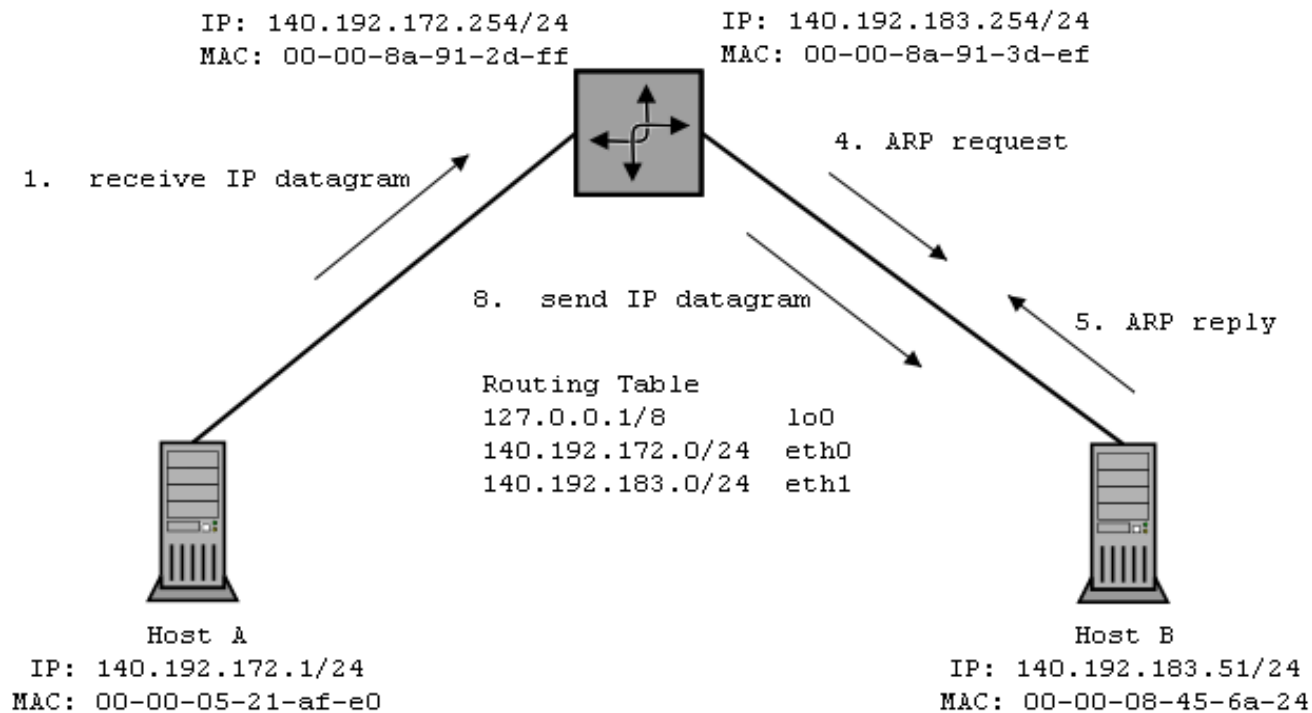
# IP routing illustrated



Host A sends an IP datagram to Host B

1. Host A examines destination IP network
2. No match in its routing table, chooses default gateway
3. ARPs for default gateway's MAC address
4. Receives ARP reply from 00-00-8a-91-2d-ff
5. Builds layer 2 frame with destination to 00-00-8a-91-2d-ff
6. Adds IP info with destination IP of 140.192.183.51
7. Sends datagram on local link

# IP routing illustrated (continued)



Host A sends an IP datagram to Host B

1. Router receives frame with IP datagram inside
2. Examines layer 3 destination address/network
3. Matches destination network to attached link's network
4. ARPs for destination 140.192.183.51 on local network link
5. Receives ARP reply from 00-00-08-45-6a-24
6. Builds layer 2 frame with destination 00-00-08-45-6a-24
7. Adds IP info with destination IP of 140.192.183.51
8. Sends datagram on local network link

# Routing metrics

- Shortest/longest hop path
- Lowest/highest cost path
- Lowest/highest reliable path
- Best/worst latency/delay
- Site specific path policy decision

# Some routing terminology

- Autonomous system (AS)
  - Network(s) set administered by a single entity
- Interior gateway protocol (IGP)
  - distributed routing protocol used within an AS
- Exterior gateway protocol (EGP)
  - distributed routing protocol used between ASes

# Intradomain routing

- Routing domains under central control and policy
- Static routing
- RIP (v1 and RIPv2) – simple distance vector (DV)
- IGRP - early Cisco DV protocol, little used today
- EIGRP - newer Cisco protocol, still deployed
- OSPF - “IETF-approved” link state protocol
- IS-IS – one of the few successful OSI protocols

# Interdomain routing

- Routing domains are independently funded
- Routing domains do not trust each other
- Different routing domains have different policies
- Static routing
- EGP – first interdomain routing protocol
- BGP – current path vector routing protocol

# Peering

- Let's play the peering game
- If you're just looking at these slides outside of class with no video, well, you should have been here