kenet
Kenya Education Network

IP Routing

Presented by:

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Routing Concepts

- IPv6
- IPv4
- Routing
- Forwarding
- Some definitions
- Policy options
- Routing Protocols

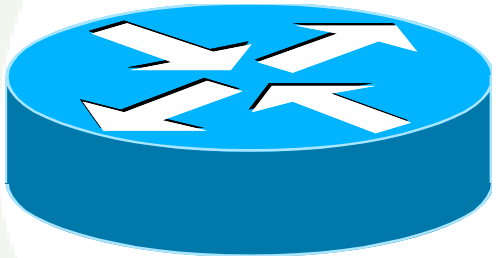
IPv4

- Internet still uses IPv4
  - (legacy protocol)
  - Addresses are 32 bits long
  - Addresses are written as decimal with each 8-bit range separated by a “.”
  - Range from 1.0.0.0 to 223.255.255.255
  - 0.0.0.0 to 0.255.255.255 and 224.0.0.0 to 255.255.255.255 have “special” uses
- IPv4 address has a network portion and a host portion

IP address format

- Address and subnet mask
  - IPv4 written as
    - 12.34.56.78 255.255.255.0 *or*
    - 12.34.56.78/24
  - IPv6 written as
    - 2001:DB8:A::1/120
  - mask represents the number of network bits in the address
    - Usually referred to as the subnet size
  - The remaining bits are the host bits

What does a router do?



A day in a life of a router

find path

forward packet, forward packet, forward packet, forward packet…

find alternate path

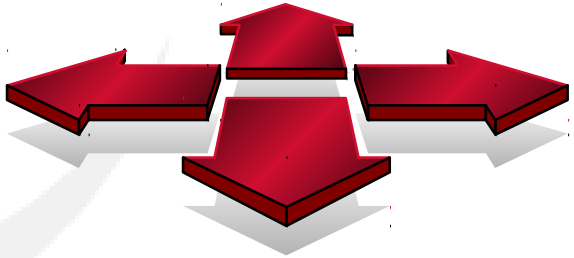
forward packet, forward packet, forward packet, forward packet…

repeat until powered off

Routing versus Forwarding

- Routing = building maps and giving directions

- Forwarding = moving packets between interfaces according to the “directions”



RIBs and FIBs

- FIB is the Forwarding Table
  - It contains destinations and the interfaces to get to those destinations
  - Used by the router to figure out where to send the packet
  - Careful! Some people still call this a route!
  - Cisco IOS: “show ip cef”
- RIB is the Routing Table
  - It contains a list of all the destinations and the various next hops used to get to those destinations – and lots of other information too!
  - One destination can have lots of possible next-hops – only the best next-hop goes into the FIB
  - Cisco IOS: “show ip route”

Routing

1: How Does Routing Work?

- Internet is made up of the ISPs who connect to each other's networks
- How does an ISP in Kenya tell an ISP in Japan what customers they have?
- And how does that ISP send data packets to the customers of the ISP in Japan, and get responses back
  - After all, as on a local ethernet, two way packet flow is needed for communication between two devices

2: How Does Routing Work?

- ISP in Kenya could buy a direct connection to the ISP in Japan
  - But this doesn't scale – thousands of ISPs, would need thousands of connections, and cost would be astronomical
- Instead, ISP in Kenya tells his neighbouring ISPs what customers he has
  - And the neighbouring ISPs pass this information on to their neighbours, and so on
  - This process repeats until the information reaches the ISP in Japan

3: How Does Routing Work?

- This process is called “Routing”
- The mechanisms used are called “Routing Protocols”
- Routing and Routing Protocols ensures that
  - The Internet can scale
  - Thousands of ISPs can provide connectivity to each other
  - We have the Internet we see today

Routing Protocols

- Routers use “routing protocols” to exchange routing information with each other
  - IGP is used to refer to the process running on routers inside an ISP’s network
  - EGP is used to refer to the process running between routers bordering directly connected ISP networks

OSPF

- Link State Routing Protocol
  - The other link state routing protocol is ISIS
  - Each node in the network computes the map of connectivity through the network
- Distance Vector
  - Like EIGRP or RIP
  - Each node shares its view of the routing table with other nodes

What Is an IGP?

- Interior Gateway Protocol
- Within an Autonomous System
- Carries information about internal infrastructure prefixes
- Widely used IGPs:
  - OSPF
  - IS-IS
  - EIGRP

TYPES OF ROUTING PROTOCOLS

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ADJACENCIES

A relationship is formed between selected neighbouring routers for the purpose of exchanging routing information

This is called an ADJACENCY

EIGRP

- **Neighbor table** – Each EIGRP router maintains a neighbor table that lists adjacent routers. This table is comparable to the adjacency database used by OSPF. There is a neighbor table for each protocol that EIGRP supports.
- **Topology table** – Every EIGRP router maintains a topology table for each configured network protocol. This table includes route entries for all destinations that the router has learned. All learned routes to a destination are maintained in the topology table.
- **Routing table** – EIGRP chooses the best routes to a destination from the topology table and places these routes in the routing table. Each EIGRP router maintains a routing table for each network protocol.
- **Successor** – A successor is a route selected as the primary route to use to reach a destination. Successors are the entries kept in the routing table. Multiple successors for a destination can be retained in the routing table.
- **Feasible successor** – A feasible successor is a backup route. These routes are selected at the same time the successors are identified, but are kept in the topology table. Multiple feasible successors for a destination can be retained in the topology table.

Command	Description
show ip eigrp neighbors [type number] **[details]**	Displays EIGRP neighbor table. Use the type and number options to specify an interface. The details keyword expands the output.
show ip eigrp interfaces [type number] [as-number] **[details]**	Shows EIGRP information for each interface. The optional keywords limit the output to a specific interface or AS. The details keyword expands the output.
show ip eigrp topology [**as-number** | [[**ip-address**] mask]]	Displays all feasible successors in the EIGRP topology table. Optional keywords can filter output based on AS number or specific network address.
show ip eigrp topology [active | pending | zero-successors	Depending on which keyword is used, displays all routes in the topology table that are either active, pending, or without successors.
show ip eigrp topology all-links	Displays all routes, not just feasible successors, in the EIGRP topology.
show ip eigrp traffic [as-number]	Displays the number of EIGRP packets sent and recieved. Command output can be filtered by including an optional AS number.

Links in OSPF

- Two types of links in OSPF:
  - Point-to-point link
    - Only one other router on the link, forming a point-to-point adjacency
  - Multi-access network (e.g. ethernet)
    - Potential for many other routers on the network, with several other adjacencies
- OSPF in multi-access networks has optimisations to aid scaling
  - Two routers are elected to originate the LSAs for the whole multi-access network
  - Called "Designated Router" and "Backup Designated Router"
  - Other routers on the multi-access network form adjacencies with the DR and BDR

NSRC
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QUESTIONS?

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Transforming education through ICT

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