**Chapter Five Review**

**OSPF route only sends its link state information to those nodes directly attached neighbors.**

**What is meant by an area in a OSPF autonomous system? Why was the concept of an area introduced?**

In OSPF, a single autonomous system (AS) can be divided into smaller groups called areas. This reduces the number of link-state advertisements (LSAs) and other OSPF overhead traffic sent on the network, and it reduces the size of the topology database that each router must maintain. The routing devices that participate in OSPF routing perform one or more functions based on their location in the network.

**Subnet** - A subnet is a portion of a larger network; a subnet does not contain a router; its boundaries are defined by the router and host interfaces

**Prefix** - A prefix is the network portion of a CDIRized address; it is written in the form a.b.c.d/x ; A prefix covers one or more subnets.

**BGP route** - When a router advertises a prefix across a BGP session, it includes with the prefix a number of BGP attributes. In BGP jargon, a prefix along with its attributes is a BGP route (or simply a route

**OSPF –** Open Shortest Path First – uses link-state algorithm via Dijkstras. Router floods OSPF link-state advertisements to all other routers in entire AS

**BGP –** Border Gateway Protocol “the glue that holds the internet together”

**BGP Route Selection –** router prefers: local preference attribute, shortest AS-PATH, closests NEXT-HOP, in that order

**Hot Potato Routing – choose local gateway that has least intra-domain cost**

**SDN –** Software defined networking – OpenFlow API (table based forwarding)

**ICMP –** internet control message protocol – used by hosts and routers to communicate network-level information

**How does BGP use the NEXT-HOP attribute?**

The NEXT-HOP attribute indicates the IP address of the first router along an advertised path (outside of the AS receiving the advertisement) to a given prefix. When configuring its forwarding table, a router uses the NEXT-HOP attribute.

**Describe the main role of the communication layer, the network-wide state management layer, and the network-control application layer in an SDN controller.**

The Management Plane handles functions such device management, firmware updates, SNMP and external configuration via the CLI. The Data Plane refers to packet and frame forwarding through the device. The Control Plane is routing protocols such as BGP & OSPF and switching protocols such as STP & TRILL. The control plane will use the routing table to build the forwarding table used by data plane. The forwarding table is delivered to the data plane by the management plane as part of the device operating system. Thus when an Ethernet frame arrives on the switch interface, the data plane then forwards it to output port.

**Suppose you wanted to implement a new routing protocol in the SDN control plane. At which layer would you implement that protocol? Explain.**

Routing would occur in the management layer. The management layer is the one that interacts with SNMP, SSH, Telnet, and TFTP.

**What types of messages flow across an SDN controller’s northbound and southbound APIs?**

**Northbound API -** In the area of SDN, a reference to the APIs that a controller supports that gives outside programs access to the services of the controller; for instance, to supply information about the network or to program flows into the network. Also called a Northbound Interface.

**Southbound API -** In the area of SDN, a reference to the APIs used between a controller and the network elements for the purpose of learning information from the elements and for programming (controlling) the forwarding behavior of the elements. Also called a Southbound Interface

**Describe the purpose of two types of OpenFlow messages (of your choosing) that are sent from a controlled device to the controller.**

BGP messages –

* UPDATE – advertises new path
* KEEPALIVE – ke3eps connection alive in absence of UPDATES
* NOTIFICATION – reports errors in previous message
* OPEN – Opens TCP connection to remote BGP peer

**Names four different types of ICMP messages.** Echo request, Echo Relpy, Router Advertisement, bad IP header

**Chapter SIX**

**Link layer is implemented in the ‘adapter’ such as a NIC (network interface card : ethernet card, 802.11 card, etc)**

**Parity checking: single bit and multibit party checking.**

Single bit partity will detect single bit errors but can't correct them, single bit parity will catch any odd number of bits errors

Two-dimensional bit parity will detect and correct single bit errors.

Type of Error DETECT CORRECT

1-BIT YES YES

2-BIT YES NO

3-BIT YES NO

4-BIT NO NO

5-BIT YES NO

**Cyclic Redundancy Check –** CRC – more powerful error-detection, widely used in Ethernet, 802.11,

**Multiple access protocols –** point to point (dialup), broadcast (old fashioned Ethernet)

**MAC protocols – channel partitioning, random access, taking turns**

**Channel partitioning –**

Time Division Multiple Access – TDMA, access to channel in ‘rounds’ with a fixed length

Frequency Division Multiple Access – FDMA – channel spectrum in frequency bands

**Random Access Protocols –**

ALOHA – no synchronization, 18% efficient

Slotted ALOHA - all frames same size, time divided equally 37% efficient

Carrier Sense Multiple Access (CSMA) - Listen before idle, way better efficiency

**Taking Turns –**

Polling – polling from central site, token passing

Bluetooth, FDDI, token ring

**MAC addresses –** 48 bit, used “locally” to get frame from one interface to another physically connected interface

**LAN addresses** – 32 bit, used for network layer forwarding

**Address Resolution Protocol (ARP) –** how to determine MAC address knowing the IP (Same lan different than routing to another lan)

**Ethernet Switch –** link-layer device, takes an active role to store and forward Ethernet frames

**Switches vs Routers**

**Virtual Local Area Network (VLAN) –** switches supporting VLAN capabilities can be configured to define multiple VLANS over single physical LAN structure

**Multi protocol label switching (MPLS) –** high speed IP forwarding using fixed length label instead of IP address

**What is framing in link layer?**

**If all the links in the Internet were to provide reliable delivery service, would the TCP reliable delivery service be redundant? Why or why not?**

**Name three error-detection strategies employed by link layer.**

**Suppose two nodes start to transmit at the same time a packet of length L over a broadcast channel of rate R. Denote the propagation delay between the two nodes as dprop. Will there be a collision if dprop 6 L/R? Why or why not?**

**In Section 6.3, we listed four desirable characteristics of a broadcast channel. Which of these characteristics does slotted ALOHA have? Which of these characteristics does token passing have?**

**In CSMA/CD, after the fifth collision, what is the probability that a node chooses K = 4? The result K = 4 corresponds to a delay of how many seconds on a 10 Mbps Ethernet?**

**While TDM and FDM assign time slots and frequencies, CDMA assigns a different code to each node. Explain the basic principle in which CDMA works.**

**Why does collision occur in CSMA, if all nodes perform carrier sensing before transmission?**

**How big is the MAC address space? The IPv4 address space? The IPv6 address space?**

**R10. Suppose nodes A, B, and C each attach to the same broadcast LAN (through their adapters). If A sends thousands of IP datagrams to B with each encapsulating frame addressed to the MAC address of B, will C’s adapter process these frames? If so, will C’s adapter pass the IP datagrams in these frames to the network layer C? How would your answers change if A sends frames with the MAC broadcast address?**

**R11. Why is an ARP query sent within a broadcast frame? Why is an ARP response sent within a frame with a specific destination MAC address?**

**R12. For the network in Figure 6.19, the router has two ARP modules, each with its own ARP table. Is it possible that the same MAC address appears in both tables?**

**R13. What is a hub used for?**

**R14. Consider Figure 6.15. How many subnetworks are there, in the addressing sense of Section 4.3?**

**R15. Each host and router has an ARP table in its memory. What are the contents of this table? R16. The Ethernet frame begins with an 8-byte preamble field. The purpose of the first 7 bytes is to “wake up” the receiving adapters and to synchronize their clocks to that of the sender’s clock. What are the contents of the 8 bytes? What is the purpose of the last byte?**