

Chapter 4 (Data Plane)

(i) *What is the Internet service model?*

Best effort

(ii) *Compare VC and datagram networks*

Virtual Circuit switching is a connection-oriented switching mechanism that provides a predetermined path between sender and receiver. Datagram networks are a connectionless switching mechanism that dynamically finds the most efficient path from sender to receiver.

(iii) *How does a router decide which next hop to forward when a packet arrives?*

Each router has a forwarding table which is used to determine the next hop router using intra/inter-AS routing algorithms (e.g. BGP, OSPF, etc.). In the forwarding table, we use longest prefix matching to determine which router to send the packet to.

(iv) *What is the rationale for each field in the IP packet header?*

- (a) Version: Gives the IP version number.
- (b) Header length: We have a variable length header due to Options.
- (c) Type of service: Determines the type of datagram (e.g. non/real-time) for efficient packet handling.
- (d) Datagram length (bytes): Length of the IP datagram.
- (e) 16-bit Identifier: For fragmentation
- (f) Flags: For fragmentation
- (g) 13-bit Fragmentation offset: For fragmentation.
- (h) TTL: So we don't have forwarding loops. Measured in hop count.
- (i) Upper-layer protocol: How to parse the payload (UDP/TCP/ICMP).
- (j) Header checksum: For bit errors.
- (k) Source/Destination IP address: We need to know the IP addresses.
- (l) Options: Variable length.

(v) *What is a subnet? What is CIDR? How do we use a network mask to identify a subnet?*

- (a) A subnet is a set of devices that are physically connected (via the link layer) without passing through an intervening router.
- (b) CIDR: Classless Inter-Domain Routing. It replaced the classless IP addressing because it is more space efficient. CIDR defines the subnet portion of the IP address.

(c) We set the upper N bits to 1 and bitwise-and them together with the IP address to get the subnet mask.

(vi) *How does NAT work?*

NAT translates (public) WAN addresses to (private) LAN addresses + port number and vice versa.

(vii) *What are the limitations of NAT?*

Traversal problem.

(viii) *What issues does NAT address?*

NAT addresses the issue of running out of IP addresses in IPv4.

(ix) *What are common solutions to NAT traversal problem?*

The server should not sit behind a NAT.

(x) *How does DHCP work?*

DISCOVER, OFFER, REQUEST, and ACK.

(xi) *What other info can DHCP provide to a host, in addition to a new IP address?*

IP of next hop router, IP of DNS server, subnet mask.

(xii) *How does tunneling work*

Encapsulate IP datagram in an IP datagram.