Core Networking Concepts – DHCP, ACLs, Ports, and IP Routing

1. DHCP and IP Helper Address

- DHCP automatically assigns IP addresses to devices.
- If the DHCP server is in a different network, routers don’t forward DHCP broadcasts.
- Use 'ip helper-address ' on router interface connected to clients.
- It converts broadcasts to unicasts, forwarding them to the DHCP server.

2. Unicast vs Broadcast vs Multicast

- Unicast: One-to-one communication (PC → DNS server).
- Broadcast: One-to-all in same network (DHCP Discover).
- Multicast: One-to-many (e.g., streaming).
- Routers block broadcasts; helper-address converts them to unicast.

3. Access Control Lists (ACLs)

- ACLs control which traffic is allowed or denied through a router.
- Applied in inbound ('in') or outbound ('out') directions on interfaces.

4. Standard ACL

- Uses numbers 1–99.
- Filters by source IP only.
- Example: access-list 10 deny 192.168.10.0 0.0.0.255 access-list 10 permit any ip access-group 10 in
- Placed near destination to avoid blocking too much traffic.

5. Extended ACL

- Uses numbers 100–199.
- Filters by source, destination, protocol, and port number.
- Example: access-list 100 permit tcp 192.168.10.10 0.0.0.0 192.168.20.2 0.0.0.0 eq 21 access-list 100 deny ip 192.168.10.0 0.0.0.255 any access-list 100 permit ip any any

6. Common Port Numbers

- HTTP (80/TCP), HTTPS (443/TCP), FTP (21/TCP), DNS (53/UDP), SMTP (25/TCP), POP3 (110/TCP), SSH (22/TCP), Telnet (23/TCP).
- Ports identify services, like departments in an office.

7. Testing ACLs

- Use ping or FTP to check connectivity.
- Use 'show access-lists' to verify packet matches or blocks.

8. ACL Logic

- ACLs are read top to bottom.
- First matching rule is applied.
- Unmatched traffic is implicitly denied at the end.

9. Combining ACLs and DHCP

- Clients in one subnet can get IPs from a remote DHCP server using 'ip helper-address'.
- ACLs can then restrict which clients access certain services.

10. IP Route – Static Routing

- Defines manual routes between networks.
- Syntax: ip route
- Example: ip route 192.168.2.0 255.255.255.0 192.168.1.2
- Used when no dynamic routing protocol is in place.

11. Summary Table

- DHCP → Assigns IPs automatically.
- ip helper-address → Forwards DHCP across subnets.
- Standard ACL → Filters by source IP.
- Extended ACL → Filters by service/port.
- ip route → Defines manual network paths.