Computer Networks (ICE 321)

Preparatory questions and answers for the final exam for students.

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1. What is the primary function of routing in computer networks?
    - **Answer:** Routing determines the best path for network traffic from a source to its destination.
2. Explain the difference between static and dynamic routing protocols.
    - **Answer:** Static routing requires manual configuration of routes, while dynamic routing protocols automatically update routing tables based on network changes.
3. How does VLSM (Variable Length Subnet Masking) optimize IP address allocation in network design?
    - **Answer:** VLSM allows the allocation of subnet masks of varying lengths to different subnets within the same network, optimizing IP address utilization.
4. Compare and contrast distance vector and link-state routing protocols.
    - **Answer:** Distance vector routing protocols use hop count as a metric and periodically exchange routing updates. Link-state routing protocols build a topology map of the network and calculate the shortest path to each destination.
5. What are the key features of RIP (Routing Information Protocol) version 2 compared to version 1?
    - **Answer:** RIP version 2 supports classless routing, uses multicast instead of broadcast for updates, and includes authentication mechanisms.
6. What are the key advantages of EIGRP (Enhanced Interior Gateway Routing Protocol)?
    - **Answer:** EIGRP provides rapid convergence, reduced bandwidth usage, and support for both distance vector and link-state characteristics.
7. What is auto-summary in routing protocols, and what issues can it cause?
    - **Answer:** Auto-summary is a feature that summarizes routing information at network boundaries. It can cause issues in discontiguous networks by aggregating routes incorrectly.
8. Identify two common routing issues in a network and explain how you would troubleshoot them.

- **Answer:** Common routing issues include incorrect routing table entries and routing loops. Troubleshooting steps may involve verifying router configurations, checking routing protocol neighborships, and analyzing routing updates.

9. Discuss the steps involved in resolving a routing loop.

    - **Answer:** Steps for resolving a routing loop may include identifying the routers involved, analyzing routing protocol updates, adjusting routing metrics or administrative distances, and implementing route summarization.

10. What is the purpose of Access Control Lists (ACLs) in network security?

    - **Answer:** ACLs are used to control traffic flow by permitting or denying packets based on specified criteria such as source or destination IP addresses, ports, or protocols.

11. Explain the importance of password protection on routers and how it can be implemented.

    - **Answer:** Password protection prevents unauthorized access to router configurations. It can be implemented by setting passwords for privileged EXEC mode, console access, and remote access protocols like SSH.

12. Describe techniques for securing routing protocols against unauthorized access and attacks.

    - **Answer:** Techniques for securing routing protocols include using authentication mechanisms like MD5 or SHA, enabling encryption for protocol packets, configuring route filters to allow only trusted neighbors, and implementing control plane policing to limit the rate of routing protocol traffic.

13. How does NAT (Network Address Translation) enhance network security? Provide examples.

    - **Answer:** NAT hides internal IP addresses from external networks, enhancing security by obscuring internal network topologies. It can also allow multiple devices to share a single public IP address, providing a level of anonymity and protection against direct attacks.

14. Discuss the role of firewalls in network security and the different types of firewalls available.

    - **Answer:** Firewalls are network security devices that monitor and control incoming and outgoing network traffic based on predetermined security rules. Types of firewalls include packet-filtering firewalls, stateful inspection firewalls, and application-layer firewalls.

15. What is VPN (Virtual Private Network), and how does it enhance network security?

- **Answer:** VPNs provide secure communication over a public network (such as the internet) by encrypting data packets. They enhance network security by creating a private, encrypted tunnel between two endpoints, ensuring confidentiality, integrity, and authenticity of transmitted data.

16. Explain the concept of VLAN (Virtual Local Area Network) and its role in network segmentation and security.

    - **Answer:** VLANs are logical groupings of devices within a network, typically based on factors such as department, function, or security requirements. They enable network segmentation, which improves security by restricting communication between devices based on VLAN membership and access control lists.

17. Describe the operation of OSPF (Open Shortest Path First) routing protocol.

    - **Answer:** OSPF is a link-state routing protocol that uses Dijkstra's algorithm to calculate the shortest path to each destination based on a database of network topology.

18. What are the advantages of using OSPF over RIP in large-scale networks?

    - **Answer:** OSPF offers faster convergence, support for variable-length subnet masks (VLSM), and hierarchical design, making it more scalable and efficient than RIP in large networks.

19. How can auto-summary-related problems be mitigated in EIGRP?

    - **Answer:** Auto-summary problems in EIGRP can be mitigated by disabling auto-summary and configuring manual summarization at network boundaries.

20. Discuss the significance of subnetting in network design and provide an example of its application.

    - **Answer:** Subnetting divides a larger network into smaller, manageable subnetworks. It allows for efficient use of IP address space and reduces network congestion. An example of subnetting is dividing a Class C network into smaller subnets to accommodate different departments within an organization.

21. What is the purpose of administrative distance in routing protocols?

    - **Answer:** Administrative distance is a measure used by routers to select the best path when there are multiple routes to the same destination. It represents the trustworthiness of a routing source, with lower values indicating more trusted routes.

22. Explain the difference between classful and classless routing protocols.

- **Answer:** Classful routing protocols do not carry subnet mask information in their routing updates and assume a default subnet mask based on the class of the IP address. Classless routing protocols include subnet mask information in their updates and support Variable Length Subnet Masking (VLSM).

23. What are the advantages of using VLSM (Variable Length Subnet Masking) in network design?

    - **Answer:** VLSM allows for more efficient use of IP address space by using different subnet masks within the same network. It reduces wasted IP addresses and simplifies network management.

24. Describe the operation of BGP (Border Gateway Protocol) and its role in the internet.

    - **Answer:** BGP is an exterior gateway protocol used to exchange routing information between different autonomous systems (ASes) on the internet. It enables routers in different ASes to dynamically learn and advertise routes to reach networks in other ASes.

25. Explain the concept of route summarization and its benefits in reducing routing table size.

    - **Answer:** Route summarization aggregates multiple contiguous network addresses into a single summary route, reducing the number of entries in the routing table. It helps conserve memory and processing resources on routers and improves routing efficiency.

26. What is the purpose of a default route in routing tables?

    - **Answer:** A default route, also known as the gateway of last resort, is used by routers to forward packets when no specific route matches the destination IP address. It provides a path for traffic destined for networks not explicitly listed in the routing table.

27. Discuss the advantages and disadvantages of dynamic routing protocols compared to static routing.

    - **Answer:** Dynamic routing protocols offer automatic route updates and adaptability to network changes, but they require additional network resources and may introduce security risks. Static routing is simpler to configure and offers better control over routing decisions but requires manual configuration and does not adapt to network changes automatically.

28. Explain the purpose of loopback interfaces on routers and how they are used in network configurations.

- **Answer:** Loopback interfaces are virtual interfaces on routers that simulate physical network interfaces. They are used for management purposes, such as router identification, testing, and providing a stable source IP address for routing protocols and services like OSPF and BGP.

29. What is the difference between symmetric and asymmetric encryption algorithms?

    - **Answer:** Symmetric encryption algorithms use the same key for both encryption and decryption, while asymmetric encryption algorithms use different keys for these operations. Symmetric encryption is typically faster and more efficient, while asymmetric encryption provides better security for key exchange and digital signatures.

30. Describe the process of subnetting and provide an example subnetting scenario.

    - **Answer:** Subnetting involves dividing a larger network into smaller subnetworks to improve network efficiency and address allocation. An example subnetting scenario could involve dividing a Class B network into multiple subnets to accommodate different departments or segments within an organization.

31. What is the purpose of a routing protocol and how does it differ from a routed protocol?

    - **Answer:** A routing protocol is used by routers to exchange routing information and determine the best path for forwarding packets in a network. A routed protocol, on the other hand, is used to carry user data across the network and is independent of the routing process.

32. Explain the difference between interior gateway protocols (IGPs) and exterior gateway protocols (EGPs).

    - **Answer:** Interior gateway protocols (IGPs) are used to exchange routing information within an autonomous system (AS), while exterior gateway protocols (EGPs) are used to exchange routing information between different ASes on the internet.

33. What is the purpose of network segmentation, and how can it enhance network security?

    - **Answer:** Network segmentation involves dividing a larger network into smaller, isolated segments to improve performance, manageability, and security. It enhances network security by containing security breaches within isolated segments and limiting the impact of potential attacks.

34. Describe the operation of VLANs (Virtual Local Area Networks) and their benefits in network design.

- **Answer:** VLANs are logical groupings of devices within a network that can communicate with each other as if they were connected to the same physical network segment, regardless of their physical location. They provide flexibility, scalability, and security by segregating network traffic into separate broadcast domains.

35. What is the purpose of Quality of Service (QoS) in network design, and how is it implemented?

    - **Answer:** Quality of Service (QoS) is used to prioritize certain types of network traffic over others to ensure that critical applications receive sufficient bandwidth and low latency. It is implemented using techniques such as traffic classification, traffic shaping, and traffic policing.

36. Discuss the advantages and disadvantages of using static routing in network configurations.

    - **Answer:** Static routing offers simplicity, predictability, and reduced resource overhead but lacks scalability, flexibility, and adaptability to network changes. It is suitable for small, stable networks with simple topologies but may become cumbersome to manage in larger or dynamic environments.

37. Explain the purpose of routing metrics in dynamic routing protocols and provide examples of common routing metrics.

    - **Answer:** Routing metrics are used to determine the best path for forwarding packets in dynamic routing protocols. Examples of common routing metrics include hop count, bandwidth, delay, reliability, and cost.

38. What is the significance of convergence in routing protocols, and how is it achieved?

    - **Answer:** Convergence refers to the process of routers agreeing on the network topology and updating their routing tables to reflect changes in network conditions. It is achieved through mechanisms such as routing protocol messages, timers, and triggered updates.

39. Describe the concept of route redistribution in dynamic routing protocols and its potential challenges.

    - **Answer:** Route redistribution involves exchanging routing information between different routing domains or protocols. Challenges associated with route redistribution include route selection conflicts, routing loops, and suboptimal routing paths.

40. Explain the purpose of multicast routing protocols and provide examples of multicast routing protocols.

- **Answer:** Multicast routing protocols are used to efficiently distribute multicast traffic to multiple recipients in a network. Examples of multicast routing protocols include Protocol Independent Multicast (PIM), Distance Vector Multicast Routing Protocol (DVMRP), and Multicast Source Discovery Protocol (MSDP).

41. What is the purpose of network address translation (NAT) in network configurations, and how does it work?

    - **Answer:** Network address translation (NAT) is used to translate private IP addresses to public IP addresses and vice versa to facilitate communication between devices on different network segments. It works by modifying the source or destination IP addresses in packet headers as they traverse a NAT-enabled device.

42. Describe the operation of PAT (Port Address Translation) in NAT implementations and its benefits.

    - **Answer:** PAT (Port Address Translation) is a variant of NAT that maps multiple private IP addresses to a single public IP address using unique port numbers to distinguish between different sessions. It conserves public IP addresses and enables multiple devices to share a single public IP address.

43. What is the purpose of tunneling protocols in network configurations, and how are they used?

    - **Answer:** Tunneling protocols encapsulate one network protocol within another for transmission over a different network. They are used to create virtual private networks (VPNs), establish secure communication channels, and traverse network boundaries with incompatible protocols.

44. Discuss the importance of network documentation in network management and troubleshooting.

    - **Answer:** Network documentation provides a comprehensive record of network configurations, topology, and procedures, facilitating network management, troubleshooting, and disaster recovery efforts. It helps ensure consistency, compliance, and accountability in network operations.

45. What is the purpose of SNMP (Simple Network Management Protocol) in network management, and how does it work?

    - **Answer:** SNMP (Simple Network Management Protocol) is used to monitor and manage network devices and applications by collecting and exchanging management information between network elements and management systems. It works by querying managed devices using SNMP requests and receiving responses containing management data.

46. Describe the operation of DHCP (Dynamic Host Configuration Protocol) in network configurations and its benefits.

    - **Answer:** DHCP (Dynamic Host Configuration Protocol) automates the assignment of IP addresses, subnet masks, default gateways, and other network parameters to client devices on a network. It simplifies network administration, reduces configuration errors, and conserves IP address space.

47. What is the purpose of a routing protocol's administrative distance, and how is it used in route selection?

    - **Answer:** A routing protocol's administrative distance is a measure of the trustworthiness of a route learned from that protocol. Lower administrative distances indicate more preferred routes, and routers use this metric to select the best path when multiple routes to the same destination exist.

48. Explain the concept of route summarization and how it helps optimize routing table size.

    - **Answer:** Route summarization involves aggregating multiple contiguous network addresses into a single summary route, reducing the number of entries in the routing table. It helps conserve memory and processing resources on routers and improves routing efficiency.

49. Describe the purpose of ICMP (Internet Control Message Protocol) in network communications and provide examples of ICMP message types.

    - **Answer:** ICMP (Internet Control Message Protocol) is used to send error messages and control information between network devices. Examples of ICMP message types include echo request/reply (ping), destination unreachable, time exceeded, and parameter problem.

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    - **Answer:** NAT (Network Address Translation) is used to translate private IP addresses to public IP addresses and vice versa to facilitate communication between devices on different network segments. It works by modifying the source or destination IP addresses in packet headers as they traverse a NAT-enabled device.

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59. What is the role of subnetting in network design, and how is it implemented?

    - **Answer:** Subnetting divides a larger network into smaller, more manageable subnetworks to improve address allocation, routing efficiency, and network performance. It is implemented by borrowing bits from the host portion of IP addresses to create subnet addresses and subnet masks.

60. Discuss the advantages and disadvantages of using dynamic routing protocols compared to static routing.

    - **Answer:** Dynamic routing protocols offer automatic route updates, adaptability to network changes, and scalability but require additional network resources and may introduce security risks. Static routing is simpler to configure, offers better control over routing decisions, and consumes fewer resources but lacks adaptability to network changes and may become cumbersome to manage in larger environments.