1.0 Networking Fundamentals

1.1 Compare and contrast the Open Systems Interconnection (OSI) model layers and encapsulation concepts.

- OSI model
  - Layer 1 – Physical
  - Layer 2 – Data link
  - Layer 3 – Network
  - Layer 4 – Transport
  - Layer 5 – Session
  - Layer 6 – Presentation
  - Layer 7 – Application
- Data encapsulation and decapsulation within the OSI model context
  - Ethernet header
  - Internet Protocol (IP) header
  - Transmission Control Protocol (TCP)/ User Datagram Protocol (UDP) headers
  - TCP flags
  - Payload
  - Maximum transmission unit (MTU)

1.2 Explain the characteristics of network topologies and network types.

- **Mesh**
- **Star/hub-and-spoke**
- **Bus**
- **Ring**
- **Hybrid**
- **Network types and characteristics**
  - Peer-to-peer
  - Client-server
  - Local area network (LAN)
  - Metropolitan area network (MAN)
  - Wide area network (WAN)
  - Wireless local area network (WLAN)
  - Personal area network (PAN)
  - Campus area network (CAN)
  - Storage area network (SAN)
  - Software-defined wide area network (SDWAN)
  - Multiprotocol label switching (MPLS)
  - Multipoint generic routing encapsulation (mGRE)
- **Service-related entry point**
  - Demarcation point
  - Smartjack
- **Virtual network concepts**
  - vSwitch
  - Virtual network interface card (vNIC)
  - Network function virtualization (NFV)
  - Hypervisor
- **Provider links**
  - Satellite
  - Digital subscriber line (DSL)
  - Cable
  - Leased line
  - Metro-optical

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1.3 Summarize the types of cables and connectors and explain which is the appropriate type for a solution.

- **Copper**
  - Twisted pair
    - Cat 5
    - Cat 5e
    - Cat 6
    - Cat 6a
    - Cat 7
    - Cat 8
  - Coaxial/RG-6
  - Twinaxial
  - Termination standards
    - TIA/EIA-568A
    - TIA/EIA-568B
- **Fiber**
  - Single-mode
  - Multimode
- **Connector types**
  - Local connector (LC), straight tip (ST), subscriber connector (SC), mechanical transfer (MT), registered jack (RJ)
    - Angled physical contact (APC)
    - Ultra-physical contact (UPC)
  - RJ11

  - RJ45
  - F-type connector
  - Transceivers/media converters
  - Transceiver type
    - Small form-factor pluggable (SFP)
    - Enhanced form-factor pluggable (SFP+)
    - Quad small form-factor pluggable (QSFP)
    - Enhanced quad small form-factor pluggable (QSFP+)
- **Cable management**
  - Patch panel/patch bay
  - Fiber distribution panel
  - Punchdown block
    - 66
    - 110
    - Krone
    - Bix
- **Ethernet standards**
  - Copper
    - 10BASE-T
    - 100BASE-TX

      - 1000BASE-T
      - 10GBASE-T
      - 40GBASE-T
  - Fiber
    - 100BASE-FX
    - 100BASE-SX
    - 1000BASE-SX
    - 1000BASE-LX
    - 10GBASE-SR
    - 10GBASE-LR
    - Coarse wavelength division multiplexing (CWDM)
    - Dense wavelength division multiplexing (DWDM)
    - Bidirectional wavelength division multiplexing (WDM)

1.4 Given a scenario, configure a subnet and use appropriate IP addressing schemes.

- **Public vs. private**
  - RFC1918
  - Network address translation (NAT)
  - Port address translation (PAT)
- **IPv4 vs. IPv6**
  - Automatic Private IP Addressing (APIPA)
  - Extended unique identifier (EUI-64)
  - Multicast
  - Unicast
  - Anycast
  - Broadcast
  - Link local
  - Loopback
  - Default gateway
- **IPv4 subnetting**
  - Classless (variable-length subnet mask)

  - Classful
    - A
    - B
    - C
    - D
    - E
  - Classless Inter-Domain Routing (CIDR) notation
- **IPv6 concepts**
  - Tunneling
  - Dual stack
  - Shorthand notation
  - Router advertisement
  - Stateless address autoconfiguration (SLAAC)
- **Virtual IP (VIP)**
- **Subinterfaces**

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1.5 Explain common ports and protocols, their application, and encrypted alternatives.

Protocols	Ports
• File Transfer Protocol (FTP)	20/21
• Secure Shell (SSH)	22
• Secure File Transfer Protocol (SFTP)	22
• Telnet	23
• Simple Mail Transfer Protocol (SMTP)	25
• Domain Name System (DNS)	53
• Dynamic Host Configuration Protocol (DHCP)	67/68
• Trivial File Transfer Protocol (TFTP)	69
• Hypertext Transfer Protocol (HTTP)	80
• Post Office Protocol v3 (POP3)	110
• Network Time Protocol (NTP)	123
• Internet Message Access Protocol (IMAP)	143
• Simple Network Management Protocol (SNMP)	161/162
• Lightweight Directory Access Protocol (LDAP)	389
• Hypertext Transfer Protocol Secure (HTTPS) [Secure Sockets Layer (SSL)]	443
• HTTPS [Transport Layer Security (TLS)]	443
• Server Message Block (SMB)	445
• Syslog	514
• SMTP TLS	587
• Lightweight Directory Access Protocol (over SSL) (LDAPS)	636
• IMAP over SSL	993
• POP3 over SSL	995
• Structured Query Language (SQL) Server	1433
• SQLnet	1521
• MySQL	3306
• Remote Desktop Protocol (RDP)	3389
• Session Initiation Protocol (SIP)	5060/5061

- • IP protocol types
  - Internet Control Message Protocol (ICMP)
  - TCP
  - UDP
  - Generic Routing Encapsulation (GRE)
  - Internet Protocol Security (IPSec)
    - Authentication Header (AH)/Encapsulating Security Payload (ESP)
- • **Connectionless vs. connection-oriented**

1.6 Explain the use and purpose of network services.

- **DHCP**
  - Scope
  - Exclusion ranges
  - Reservation
  - Dynamic assignment
  - Static assignment
  - Lease time
  - Scope options
  - Available leases
  - DHCP relay
  - IP helper/UDP forwarding

- **DNS**
  - Record types
    - Address (A vs. AAAA)
    - Canonical name (CNAME)
    - Mail exchange (MX)
    - Start of authority (SOA)
    - Pointer (PTR)
    - Text (TXT)
    - Service (SRV)
    - Name server (NS)
  - Global hierarchy
    - Root DNS servers
  - Internal vs. external
  - Zone transfers
  - Authoritative name servers
  - Time to live (TTL)
  - DNS caching
  - Reverse DNS/reverse lookup/forward lookup
  - Recursive lookup/iterative lookup

- **NTP**
  - Stratum
  - Clients
  - Servers

1.7 Explain basic corporate and datacenter network architecture.

- **Three-tiered**
  - Core
  - Distribution/aggregation layer
  - Access/edge
- **Software-defined networking**
  - Application layer
  - Control layer
  - Infrastructure layer
  - Management plane

- **Spine and leaf**
  - Software-defined network
  - Top-of-rack switching
  - Backbone
- **Traffic flows**
  - North-South
  - East-West
- **Branch office vs. on-premises datacenter vs. colocation**

- **Storage area networks**
  - Connection types
    - Fibre Channel over Ethernet (FCoE)
    - Fibre Channel
    - Internet Small Computer Systems Interface (iSCSI)

1.8 Summarize cloud concepts and connectivity options.

- **Deployment models**
  - Public
  - Private
  - Hybrid
  - Community
- **Service models**
  - Software as a service (SaaS)
  - Infrastructure as a service (IaaS)
  - Platform as a service (PaaS)
  - Desktop as a service (DaaS)

- **Infrastructure as code**
  - Automation/orchestration
- **Connectivity options**
  - Virtual private network (VPN)
  - Private-direct connection to cloud provider
- **Multitenancy**
- **Elasticity**
- **Scalability**
- **Security implications**