About the Exam

Candidates are encouraged to use this document to help prepare for the CompTIA Network+ (N10-008) certification exam. The CompTIA Network+ certification exam will verify the successful candidate has the knowledge and skills required to:

- Establish network connectivity by deploying wired and wireless devices
- Understand and maintain network documentation
- Understand the purpose of network services
- Understand basic datacenter, cloud, and virtual networking concepts
- Monitor network activity, identifying performance and availability issues
- Implement network hardening techniques
- Manage, configure, and troubleshoot network infrastructure

This is equivalent to 9–12 months of hands-on experience working in a junior network administrator/network support technician job role. These content examples are meant to clarify the test objectives and should not be construed as a comprehensive listing of all the content of this examination.

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CompTIA exams result from subject matter expert workshops and industry-wide survey results regarding the skills and knowledge required of an entry-level IT professional.

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TEST DETAILS
Required exam: N10-008
Number of questions: Maximum of 90
Types of questions: Multiple-choice and performance-based
Length of test: 90 minutes
Recommended experience:
• CompTIA A+ certified, or equivalent
• Minimum of 9–12 months of hands-on experience working in a junior network administrator/network support technician job role
Passing score: 720 (on a scale of 100-900)

EXAM OBJECTIVES (DOMAINS)
The table below lists the domains measured by this examination and the extent to which they are represented.

<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>PERCENTAGE OF EXAMINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Networking Fundamentals</td>
<td>24%</td>
</tr>
<tr>
<td>2.0 Network Implementations</td>
<td>19%</td>
</tr>
<tr>
<td>3.0 Network Operations</td>
<td>16%</td>
</tr>
<tr>
<td>4.0 Network Security</td>
<td>19%</td>
</tr>
<tr>
<td>5.0 Network Troubleshooting</td>
<td>22%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>
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
1.0 Networking Fundamentals

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

- **Transceivers/media converters**
  - 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
  - Fiber
    - 100BASE-FX
    - 100BASE-SX
    - 100BASE-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)

- **IPv6 concepts**
  - Tunneling
  - Dual stack
  - Shorthand notation
  - Router advertisement
  - Stateless address autoconfiguration (SLAAC)

- **Virtual IP (VIP)**

- **Subinterfaces**

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CompTIA Network+ N10-008 Certification Exam: Exam Objectives 5.0
Explain common ports and protocols, their application, and encrypted alternatives.

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

- **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

- **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**
2.0 Network Implementations

2.1 Compare and contrast various devices, their features, and their appropriate placement on the network.

- **Networking devices**
  - Layer 2 switch
  - Layer 3 capable switch
  - Router
  - Hub
  - Access point
  - Bridge
  - Wireless LAN controller
  - Load balancer
  - Proxy server
  - Cable modem
  - DSL modem
  - Repeater

- **Voice gateway**
- **Media converter**
- **Intrusion prevention system (IPS)/intrusion detection system (IDS) device**
- **Firewall**
- **VPN headend**

- **Networked devices**
  - Voice over Internet Protocol (VoIP) phone
  - Printer
  - Physical access control devices
  - Cameras
  - Heating, ventilation, and air conditioning (HVAC) sensors
  - Internet of Things (IoT)
    - Refrigerator
    - Smart speakers
    - Smart thermostats
    - Smart doorbells
  - Industrial control systems/supervisory control and data acquisition (SCADA)

2.2 Compare and contrast routing technologies and bandwidth management concepts.

- **Routing**
  - Dynamic routing
    - Protocols [Routing Internet Protocol (RIP), Open Shortest Path First (OSPF), Enhanced Interior Gateway Routing Protocol (EIGRP), Border Gateway Protocol (BGP)]
    - Link state vs. distance vector vs. hybrid

- **Static routing**
- **Default route**
- **Administrative distance**
- **Exterior vs. interior**
- **Time to live**

- **Bandwidth management**
  - Traffic shaping
  - Quality of service (QoS)
Given a scenario, configure and deploy common Ethernet switching features.

- Data virtual local area network (VLAN)
- Voice VLAN
- Port configurations
  - Port tagging/802.1Q
  - Port aggregation
  - Link Aggregation Control Protocol (LACP)
- Duplex
- Speed
- Flow control
- Port mirroring
- Port security
- Jumbo frames
- Auto-medium-dependent interface crossover (MDI-X)
- Media access control (MAC) address tables
- Power over Ethernet (PoE)/Power over Ethernet plus (PoE+)
- Spanning Tree Protocol
- Carrier-sense multiple access with collision detection (CSMA/CD)
- Address Resolution Protocol (ARP)
- Neighbor Discovery Protocol

Given a scenario, install and configure the appropriate wireless standards and technologies.

- **802.11 standards**
  - a
  - b
  - g
  - n (WiFi 4)
  - ac (WiFi 5)
  - ax (WiFi 6)

- **Frequencies and range**
  - 2.4GHz
  - 5GHz

- **Channels**
  - Regulatory impacts

- **Channel bonding**

- **Service set identifier (SSID)**
  - Basic service set
  - Extended service set
  - Independent basic service set (Ad-hoc)
  - Roaming

- **Antenna types**
  - Omni
  - Directional

- **Encryption standards**
  - WiFi Protected Access (WPA)/WPA2 Personal [Advanced Encryption Standard (AES)/Temporal Key Integrity Protocol (TKIP)]
  - WPA/WPA2 Enterprise (AES/TKIP)

- **Cellular technologies**
  - Code-division multiple access (CDMA)
  - Global System for Mobile Communications (GSM)
  - Long-Term Evolution (LTE)
  - 3G, 4G, 5G

- **Multiple input, multiple output (MIMO) and multi-user MIMO (MU-MIMO)**
3.0 Network Operations

3.1 Given a scenario, use the appropriate statistics and sensors to ensure network availability.

- **Performance metrics/sensors**
  - Device/chassis
  - Temperature
  - Central processing unit (CPU) usage
  - Memory
  - Network metrics
  - Bandwidth
  - Latency
  - Jitter

- **SNMP**
  - Traps
  - Object identifiers (OIDs)
  - Management information bases (MIBs)

- **Network device logs**
  - Log reviews
  - Traffic logs
  - Audit logs
  - Syslog
  - Logging levels/severity levels

- **Interface statistics/status**
  - Link state (up/down)
  - Speed/duplex
  - Send/receive traffic
  - Cyclic redundancy checks (CRCs)
  - Protocol packet and byte counts

- **Interface errors or alerts**
  - CRC errors
  - Giants
  - Runts
  - Encapsulation errors

- **Environmental factors and sensors**
  - Temperature
  - Humidity
  - Electrical
  - Flooding

- **Baselines**
  - NetFlow data
  - Uptime/downtime

3.2 Explain the purpose of organizational documents and policies.

- **Plans and procedures**
  - Change management
  - Incident response plan
  - Disaster recovery plan
  - Business continuity plan
  - System life cycle
  - Standard operating procedures

- **Hardening and security policies**
  - Password policy
  - Acceptable use policy
  - Bring your own device (BYOD) policy
  - Remote access policy
  - Security policy
  - Data loss prevention

- **Common documentation**
  - Physical network diagram
  - Floor plan
  - Rack diagram
  - Intermediate distribution frame (IDF)/main distribution frame (MDF) documentation
  - Logical network diagram
  - Wiring diagram

- **Onboarding and offboarding policy**

- **Site survey report**
  - Audit and assessment report
  - Baseline configurations

- **Common agreements**
  - Non-disclosure agreement (NDA)
  - Service-level agreement (SLA)
  - Memorandum of understanding (MOU)
3.3 Explain high availability and disaster recovery concepts and summarize which is the best solution.

- Load balancing
- Multipathing
- Network interface card (NIC) teaming
- Redundant hardware/clusters
  - Switches
  - Routers
  - Firewalls
- Facilities and infrastructure support
  - Uninterruptible power supply (UPS)
  - Power distribution units (PDUs)
  - Generator
  - HVAC
  - Fire suppression

- Redundancy and high availability (HA) concepts
  - Cold site
  - Warm site
  - Hot site
  - Cloud site
  - Active-active vs. active-passive
    - Multiple Internet service providers (ISPs)/diverse paths
  - Virtual Router Redundancy Protocol (VRRP)/First Hop Redundancy Protocol (FHRP)
  - Mean time to repair (MTTR)
  - Mean time between failure (MTBF)
  - Recovery time objective (RTO)
  - Recovery point objective (RPO)

- Network device backup/restore
  - State
  - Configuration
4.0 Network Security

4.1 Explain common security concepts.

- Confidentiality, integrity, availability (CIA)
- Threats
  - Internal
  - External
- Vulnerabilities
  - Common vulnerabilities and exposures (CVE)
  - Zero-day
- Exploits
- Least privilege
- Role-based access
- Zero Trust
- Defense in depth
  - Network segmentation enforcement
  - Perimeter network [previously known as demilitarized zone (DMZ)]
  - Separation of duties
  - Network access control
  - Honeypot
- Authentication methods
  - Multifactor
  - Terminal Access Controller Access-Control System Plus (TACACS+)
  - Single sign-on (SSO)
  - Remote Authentication Dial-in User Service (RADIUS)
  - LDAP
  - Kerberos
  - Local authentication
  - 802.1X
  - Extensible Authentication Protocol (EAP)
- Risk Management
  - Security risk assessments
  - Threat assessment
  - Vulnerability assessment
  - Penetration testing
  - Posture assessment
  - Business risk assessments
  - Process assessment
  - Vendor assessment
- Security information and event management (SIEM)

4.2 Compare and contrast common types of attacks.

- Technology-based
  - Denial-of-service (DoS)/distributed denial-of-service (DDoS)
    - Botnet/command and control
  - On-path attack (previously known as man-in-the-middle attack)
  - DNS poisoning
  - VLAN hopping
  - ARP spoofing
  - Rogue DHCP
  - Rogue access point (AP)
  - Evil twin
  - Ransomware
  - Password attacks
    - Brute-force
    - Dictionary
  - MAC spoofing
  - IP spoofing
  - Deauthentication
  - Malware
- Human and environmental
  - Social engineering
    - Phishing
    - Tailgating
    - Piggybacking
    - Shoulder surfing

CompTIA Network+ N10-008 Certification Exam: Exam Objectives 5.0
4.3 Given a scenario, apply network hardening techniques.

- **Best practices**
  - Secure SNMP
  - Router Advertisement (RA) Guard
  - Port security
  - Dynamic ARP inspection
  - Control plane policing
  - Private VLANs
  - Disable unneeded switchports
  - Disable unneeded network services
  - Change default passwords
  - Password complexity/length

- **Wireless security**
  - MAC filtering
  - Antenna placement

- **Power levels**
- **Secure SNMP**
- **Change default VLAN**
- **Patch and firmware management**
- **Access control list**
- **Role-based access**
- **Firewall rules**
  - Explicit deny
  - Implicit deny
- **Private VLANs**
- **Disable unneeded switchports**
- **Disable unneeded network services**
- **Change default passwords**
- **Password complexity/length**
- **Enable DHCP snooping**
- **Router Advertisement (RA) Guard**
- **Port security**
- **Dynamic ARP inspection**
- **Control plane policing**
- **Private VLANs**
- **Disable unneeded switchports**
- **Disable unneeded network services**
- **Change default passwords**
- **Password complexity/length**

4.4 Compare and contrast remote access methods and security implications.

- **Site-to-site VPN**
- **Client-to-site VPN**
  - Clientless VPN
  - Split tunnel vs. full tunnel
- **Remote desktop connection**
- **Remote desktop gateway**
- **SSH**

- **Virtual network computing (VNC)**
- **Virtual desktop**
- **Authentication and authorization considerations**
- **In-band vs. out-of-band management**

4.5 Explain the importance of physical security.

- **Detection methods**
  - Camera
  - Motion detection
  - Asset tags
  - Tamper detection

- **Prevention methods**
  - Employee training
  - Access control hardware
    - Badge readers
    - Biometrics
  - Locking racks

- **Asset disposal**
  - Factory reset/wipe configuration
  - Sanitize devices for disposal

- **Locking cabinets**
- **Access control vestibule**
  (previously known as a mantrap)
- **Smart lockers**

CompTIA Network+ N10-008 Certification Exam: Exam Objectives 5.0
5.0 Network Troubleshooting

5.1 Explain the network troubleshooting methodology.

- Identify the problem
  - Gather information
  - Question users
  - Identify symptoms
  - Determine if anything has changed
  - Duplicate the problem, if possible
  - Approach multiple problems individually
- Establish a theory of probable cause
  - Question the obvious
- Consider multiple approaches
  - Top-to-bottom/bottom-to-top OSI model
  - Divide and conquer
- Test the theory to determine the cause
  - If the theory is confirmed, determine the next steps to resolve the problem
  - If the theory is not confirmed, reestablish a new theory or escalate

5.2 Given a scenario, troubleshoot common cable connectivity issues and select the appropriate tools.

- Specifications and limitations
  - Throughput
  - Speed
  - Distance
- Cable considerations
  - Shielded and unshielded
  - Plenum and riser-rated
- Cable application
  - Rollover cable/console cable
  - Crossover cable
  - Power over Ethernet
- Common issues
  - Attenuation
  - Interference
  - Decibel (dB) loss
- Incorrect pinout
- Bad ports
- Open/short
- Light-emitting diode (LED) status indicators
- Incorrect transceivers
- Duplexing issues
- Transmit and receive (TX/RX) reversed
- Dirty optical cables
- Common tools
  - Cable crimper
  - Punchdown tool
  - Tone generator
  - Loopback adapter
  - Optical time-domain reflectometer (OTDR)
  - Multimeter
  - Cable tester
  - Wire map
  - Tap
  - Fusion splicers
  - Spectrum analyzers
  - Snips/cutters
  - Cable stripper
  - Fiber light meter

Explain the network troubleshooting methodology.

- Establish a plan of action to resolve the problem and identify potential effects
- Implement the solution or escalate as necessary
- Verify full system functionality and, if applicable, implement preventive measures
- Document findings, actions, outcomes, and lessons learned
5.3 Given a scenario, use the appropriate network software tools and commands.

- **Software tools**
  - WiFi analyzer
  - Protocol analyzer/packet capture
  - Bandwidth speed tester
  - Port scanner
  - iperf
  - NetFlow analyzers
  - Trivial File Transfer Protocol (TFTP) server
  - Terminal emulator
  - IP scanner
- **Command line tool**
  - ping
  - ipconfig/ifconfig/ip
  - nslookup/dig
  - traceroute/tracert
  - arp
  - netstat
- **Basic network platform commands**
  - hostname
  - route
  - telnet
  - tcpdump
  - nmap

5.4 Given a scenario, troubleshoot common wireless connectivity issues.

- **Specifications and limitations**
  - Throughput
  - Speed
  - Distance
  - Received signal strength indication (RSSI) signal strength
  - Effective isotropic radiated power (EIRP)/power settings
- **Considerations**
  - Antennas
  - Placement
  - Type
  - Polarization
  - Channel utilization
  - AP association time
  - Site survey
- **Common issues**
  - Interference
  - Channel overlap
  - Antenna cable attenuation/signal loss
  - RF attenuation/signal loss
  - Wrong SSID
  - Incorrect passphrase
  - Encryption protocol mismatch
  - Insufficient wireless coverage
  - Captive portal issues
  - Client disassociation issues

5.5 Given a scenario, troubleshoot general networking issues.

- **Considerations**
  - Device configuration review
  - Routing tables
  - Interface status
  - VLAN assignment
  - Network performance baselines
- **Common issues**
  - Collisions
  - Broadcast storm
  - Duplicate MAC address
  - Duplicate IP address
  - Multicast flooding
  - Asymmetrical routing
  - Switching loops
  - Routing loops
  - Rogue DHCP server
  - DHCP scope exhaustion
  - IP setting issues
    - Incorrect gateway
    - Incorrect subnet mask
    - Incorrect IP address
    - Incorrect DNS
  - Missing route
  - Low optical link budget
  - Certificate issues
  - Hardware failure
  - Host-based/network-based firewall settings
  - Blocked services, ports, or addresses
  - Incorrect VLAN
  - DNS issues
  - NTP issues
  - BYOD challenges
  - Licensed feature issues
  - Network performance issues
# Network+ (N10-008) Acronym List

The following is a list of acronyms that appear on the CompTIA Network+ exam. Candidates are encouraged to review the complete list and attain a working knowledge of all listed acronyms as part of a comprehensive exam preparation program.

<table>
<thead>
<tr>
<th>ACRONYM</th>
<th>SPelled Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAAA</td>
<td>Authentication, Authorization, Accounting, Auditing</td>
</tr>
<tr>
<td>ACL</td>
<td>Access Control List</td>
</tr>
<tr>
<td>AES</td>
<td>Advanced Encryption Standard</td>
</tr>
<tr>
<td>AH</td>
<td>Authentication Header</td>
</tr>
<tr>
<td>AP</td>
<td>Access Point</td>
</tr>
<tr>
<td>APC</td>
<td>Angled Physical Contact</td>
</tr>
<tr>
<td>APIPA</td>
<td>Automatic Private Internet Protocol Addressing</td>
</tr>
<tr>
<td>ARP</td>
<td>Address Resolution Protocol</td>
</tr>
<tr>
<td>AUP</td>
<td>Acceptable Use Policy</td>
</tr>
<tr>
<td>BGP</td>
<td>Border Gateway Protocol</td>
</tr>
<tr>
<td>BNC</td>
<td>British Naval Connector/Bayonet Neill-Concelman</td>
</tr>
<tr>
<td>BYOD</td>
<td>Bring Your Own Device</td>
</tr>
<tr>
<td>CAM</td>
<td>Content Addressable Memory (table)</td>
</tr>
<tr>
<td>CAN</td>
<td>Campus Area Network</td>
</tr>
<tr>
<td>CDMA</td>
<td>Code Division Multiple Access</td>
</tr>
<tr>
<td>CIA</td>
<td>Confidentiality, Integrity, and Availability</td>
</tr>
<tr>
<td>CIDR</td>
<td>Classless Inter-Domain Routing</td>
</tr>
<tr>
<td>CLI</td>
<td>Command-Line Interface</td>
</tr>
<tr>
<td>CNAME</td>
<td>Canonical Name</td>
</tr>
<tr>
<td>CPU</td>
<td>Central Processing Unit</td>
</tr>
<tr>
<td>CRC</td>
<td>Cyclic Redundancy Check</td>
</tr>
<tr>
<td>CSMA/CA</td>
<td>Carrier-Sense Multiple Access with Collision Avoidance</td>
</tr>
<tr>
<td>CSMA/CD</td>
<td>Carrier-Sense Multiple Access with Collision Detection</td>
</tr>
<tr>
<td>CSU</td>
<td>Channel Service Unit</td>
</tr>
<tr>
<td>CVE</td>
<td>Common Vulnerabilities and Exposures</td>
</tr>
<tr>
<td>CWDM</td>
<td>Coarse Wavelength Division Multiplexing</td>
</tr>
<tr>
<td>Daas</td>
<td>Desktop as a Service</td>
</tr>
<tr>
<td>dB</td>
<td>Decibel</td>
</tr>
<tr>
<td>DoS</td>
<td>Distributed Denial-of-Service</td>
</tr>
<tr>
<td>DHCP</td>
<td>Dynamic Host Configuration Protocol</td>
</tr>
<tr>
<td>DLP</td>
<td>Data Loss Prevention</td>
</tr>
<tr>
<td>DNS</td>
<td>Domain Name System</td>
</tr>
<tr>
<td>DoS</td>
<td>Denial-of-Service</td>
</tr>
<tr>
<td>DSL</td>
<td>Digital Subscriber Line</td>
</tr>
<tr>
<td>DSU</td>
<td>Data Service Unit</td>
</tr>
<tr>
<td>DWDM</td>
<td>Dense Wavelength Division Multiplexing</td>
</tr>
<tr>
<td>EAP</td>
<td>Extensible Authentication Protocol</td>
</tr>
<tr>
<td>EIA</td>
<td>Electronic Industries Association</td>
</tr>
<tr>
<td>EIGRP</td>
<td>Enhanced Interior Gateway Routing Protocol</td>
</tr>
<tr>
<td>EIRP</td>
<td>Effective Isotropic Radiated Power</td>
</tr>
<tr>
<td>ESP</td>
<td>Encapsulating Security Payload</td>
</tr>
<tr>
<td>EUI</td>
<td>Extended Unique Identifier</td>
</tr>
<tr>
<td>FCoE</td>
<td>Fibre Channel over Ethernet</td>
</tr>
<tr>
<td>FHRP</td>
<td>First Hop Redundancy Protocol</td>
</tr>
<tr>
<td>FTP</td>
<td>File Transfer Protocol</td>
</tr>
<tr>
<td>GBIC</td>
<td>Gigabit Interface Converter</td>
</tr>
<tr>
<td>GRE</td>
<td>Generic Routing Encapsulation</td>
</tr>
<tr>
<td>GSM</td>
<td>Global System for Mobile Communications</td>
</tr>
<tr>
<td>HA</td>
<td>High Availability</td>
</tr>
<tr>
<td>HDMI</td>
<td>High-Definition Multimedia Interface</td>
</tr>
<tr>
<td>HTTP</td>
<td>Hypertext Transfer Protocol</td>
</tr>
<tr>
<td>HTTPS</td>
<td>Hypertext Transfer Protocol Secure</td>
</tr>
<tr>
<td>HVAC</td>
<td>Heating, Ventilation, and Air Conditioning</td>
</tr>
<tr>
<td>IaaS</td>
<td>Infrastructure as a Service</td>
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<tr>
<td>ICMP</td>
<td>Internet Control Message Protocol</td>
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<tr>
<td>ICS</td>
<td>Industrial Control System</td>
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<tr>
<td>IDF</td>
<td>Intermediate Distribution Frame</td>
</tr>
<tr>
<td>IDS</td>
<td>Intrusion Detection System</td>
</tr>
<tr>
<td>IGMP</td>
<td>Internet Group Management Protocol</td>
</tr>
<tr>
<td>IMAP</td>
<td>Internet Message Access Protocol</td>
</tr>
<tr>
<td>IoT</td>
<td>Internet of Things</td>
</tr>
<tr>
<td>IP</td>
<td>Internet Protocol</td>
</tr>
<tr>
<td>IPS</td>
<td>Intrusion Prevention System</td>
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<tr>
<td>IPSec</td>
<td>Internet Protocol Security</td>
</tr>
<tr>
<td>IPv4</td>
<td>Internet Protocol version 4</td>
</tr>
<tr>
<td>IPv6</td>
<td>Internet Protocol version 6</td>
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<tr>
<td>iSCSI</td>
<td>Internet Small Computer Systems Interface</td>
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<td>ISP</td>
<td>Internet Service Provider</td>
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<td>LACP</td>
<td>Link Aggregation Control Protocol</td>
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<td>LAN</td>
<td>Local Area Network</td>
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<tr>
<td>LC</td>
<td>Local Connector</td>
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<tr>
<td>LDAP</td>
<td>Lightweight Directory Access Protocol</td>
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<tr>
<td>LDAPS</td>
<td>Lightweight Directory Access Protocol (over SSL)</td>
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<td>LED</td>
<td>Light-Emitting Diode</td>
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<tr>
<td>LTE</td>
<td>Long-Term Evolution</td>
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<tr>
<td>MAC</td>
<td>Media Access Control/Medium Access Control</td>
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<tr>
<td>MAN</td>
<td>Metropolitan Area Network</td>
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<tr>
<td>MDF</td>
<td>Main Distribution Frame</td>
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<tr>
<td>MDIX</td>
<td>Medium Dependent Interface Crossover</td>
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<tr>
<td>mGRE</td>
<td>Multipoint Generic Routing Encapsulation</td>
</tr>
<tr>
<td>MIB</td>
<td>Management Information Base</td>
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<tr>
<td>ACRONYM</td>
<td>SPELLED OUT</td>
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</tr>
<tr>
<td>MIMO</td>
<td>Multiple Input, Multiple Output</td>
</tr>
<tr>
<td>MU-MIMO</td>
<td>Multiuser - Multiple Input, Multiple Output</td>
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<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
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<tr>
<td>MPLS</td>
<td>Multiprotocol Label Switching</td>
</tr>
<tr>
<td>MTBF</td>
<td>Mean Time Between Failure</td>
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<tr>
<td>MT-RJ</td>
<td>Mechanical Transfer - Registered Jack</td>
</tr>
<tr>
<td>MTTR</td>
<td>Mean Time to Repair</td>
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<tr>
<td>MTU</td>
<td>Maximum Transmission Unit</td>
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<tr>
<td>MX</td>
<td>Mail Exchange</td>
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<tr>
<td>NAC</td>
<td>Network Access Control</td>
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<td>NAS</td>
<td>Network Attached Storage</td>
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<td>NAT</td>
<td>Network Address Translation</td>
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<tr>
<td>NDA</td>
<td>Non-Disclosure Agreement</td>
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<tr>
<td>NFV</td>
<td>Network Function Virtualization</td>
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<td>NGFW</td>
<td>Next-Generation Firewall</td>
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<tr>
<td>NIC</td>
<td>Network Interface Card</td>
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<tr>
<td>NS</td>
<td>Name Server</td>
</tr>
<tr>
<td>NTP</td>
<td>Network Time Protocol</td>
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<tr>
<td>OID</td>
<td>Object Identifier</td>
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<tr>
<td>OSI</td>
<td>Open Systems Interconnection</td>
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<tr>
<td>OSPF</td>
<td>Open Shortest Path First</td>
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<tr>
<td>OTDR</td>
<td>Optical Time Domain Reflectometer</td>
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<td>PaaS</td>
<td>Platform as a Service</td>
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<tr>
<td>PAN</td>
<td>Personal Area Network</td>
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<tr>
<td>PAT</td>
<td>Port Address Translation</td>
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<tr>
<td>PDU</td>
<td>Power Distribution Unit</td>
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<tr>
<td>PoE</td>
<td>Power over Ethernet</td>
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<tr>
<td>POP3</td>
<td>Post Office Protocol version 3</td>
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<tr>
<td>PSK</td>
<td>Pre-Shared Key</td>
</tr>
<tr>
<td>PTR</td>
<td>Pointer Record</td>
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<tr>
<td>QoS</td>
<td>Quality of Service</td>
</tr>
<tr>
<td>QSFP</td>
<td>Quad Small Form-factor Pluggable</td>
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<tr>
<td>RA</td>
<td>Router Advertisements</td>
</tr>
<tr>
<td>RADIUS</td>
<td>Remote Authentication Dial-In User Service</td>
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<tr>
<td>RAID</td>
<td>Redundant Array of Inexpensive (or Independent) Disks</td>
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<tr>
<td>RDP</td>
<td>Remote Desktop Protocol</td>
</tr>
<tr>
<td>RF</td>
<td>Radio Frequency</td>
</tr>
<tr>
<td>RFC</td>
<td>Request for Comment</td>
</tr>
<tr>
<td>RG</td>
<td>Radio Guide</td>
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<tr>
<td>RIP</td>
<td>Routing Internet Protocol</td>
</tr>
<tr>
<td>RJ</td>
<td>Registered Jack</td>
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<tr>
<td>RPO</td>
<td>Recovery Point Objective</td>
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<tr>
<td>RSSI</td>
<td>Received Signal Strength Indication</td>
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<tr>
<td>RTO</td>
<td>Recovery Time Objective</td>
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<td>RTSP</td>
<td>Real Time Streaming Protocol</td>
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<td>SaaS</td>
<td>Software as a Service</td>
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<tr>
<td>SAN</td>
<td>Storage Area Network</td>
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<tr>
<td>SC</td>
<td>Standard Connector/Subscriber Connector</td>
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<tr>
<td>SCADA</td>
<td>Supervisory Control and Data Acquisition</td>
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<tr>
<td>SDN</td>
<td>Software-Defined Network</td>
</tr>
<tr>
<td>SDWAN</td>
<td>Software-Defined WAN</td>
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<tr>
<td>SFP</td>
<td>Small Form-factor Pluggable</td>
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<tr>
<td>SFTP</td>
<td>Secure File Transfer Protocol</td>
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<tr>
<td>SIEM</td>
<td>Security Information and Event Management</td>
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<tr>
<td>SIP</td>
<td>Session Initiation Protocol</td>
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<tr>
<td>SLA</td>
<td>Service Level Agreement</td>
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<tr>
<td>SLAAC</td>
<td>Stateless Address Auto-Configuration</td>
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<tr>
<td>SMB</td>
<td>Server Message Block</td>
</tr>
<tr>
<td>SMTP</td>
<td>Simple Mail Transfer Protocol</td>
</tr>
<tr>
<td>SNMP</td>
<td>Simple Network Management Protocol</td>
</tr>
<tr>
<td>SOA</td>
<td>Start of Authority</td>
</tr>
<tr>
<td>SOHO</td>
<td>Small Office Home Office</td>
</tr>
<tr>
<td>SQL</td>
<td>Structured Query Language</td>
</tr>
<tr>
<td>SRV</td>
<td>Service Record</td>
</tr>
<tr>
<td>SSO</td>
<td>Solid-State Drive</td>
</tr>
<tr>
<td>SSH</td>
<td>Secure Shell</td>
</tr>
<tr>
<td>SSID</td>
<td>Service Set Identifier</td>
</tr>
<tr>
<td>SSL</td>
<td>Secure Sockets Layer</td>
</tr>
<tr>
<td>SSO</td>
<td>Single Sign-On</td>
</tr>
<tr>
<td>ST</td>
<td>Straight Tip or Snap Twist</td>
</tr>
<tr>
<td>STP</td>
<td>Spanning Tree Protocol</td>
</tr>
<tr>
<td>SYSLOG</td>
<td>System Log</td>
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<tr>
<td>TACACS+</td>
<td>Terminal Access Controller Access Control System Plus</td>
</tr>
<tr>
<td>TCP</td>
<td>Transmission Control Protocol</td>
</tr>
<tr>
<td>TFTP</td>
<td>Trivial File Transfer Protocol</td>
</tr>
<tr>
<td>TIA/EIA</td>
<td>Telecommunications Industry Association/Electronic Industries Alliance</td>
</tr>
<tr>
<td>TKIP</td>
<td>Temporal Key Integrity Protocol</td>
</tr>
<tr>
<td>TLS</td>
<td>Transport Layer Security</td>
</tr>
<tr>
<td>TTL</td>
<td>Time to Live</td>
</tr>
<tr>
<td>TX/RX</td>
<td>Transmit and Receive</td>
</tr>
<tr>
<td>UDP</td>
<td>User Datagram Protocol</td>
</tr>
<tr>
<td>UPC</td>
<td>Ultra-Physical Contact</td>
</tr>
<tr>
<td>UPS</td>
<td>Uninterruptible Power Supply</td>
</tr>
<tr>
<td>URL</td>
<td>Uniform Resource Locator</td>
</tr>
<tr>
<td>USB</td>
<td>Universal Serial Bus</td>
</tr>
<tr>
<td>UTP</td>
<td>Unshielded Twisted Pair</td>
</tr>
<tr>
<td>VIP</td>
<td>Virtual IP</td>
</tr>
<tr>
<td>VLAN</td>
<td>Virtual Local Area Network</td>
</tr>
<tr>
<td>VM</td>
<td>Virtual Machine</td>
</tr>
<tr>
<td>VNC</td>
<td>Virtual Network Computing</td>
</tr>
<tr>
<td>vNIC</td>
<td>virtual Network Interface Card</td>
</tr>
<tr>
<td>VoIP</td>
<td>Voice over Internet Protocol</td>
</tr>
<tr>
<td>VPN</td>
<td>Virtual Private Network</td>
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<tr>
<td>VRRP</td>
<td>Virtual Router Redundancy Protocol</td>
</tr>
<tr>
<td>WAN</td>
<td>Wide Area Network</td>
</tr>
<tr>
<td>WAP</td>
<td>Wireless Access Point</td>
</tr>
<tr>
<td>WDM</td>
<td>Wavelength Division Multiplexing</td>
</tr>
<tr>
<td>WLAN</td>
<td>Wireless Local Area Network</td>
</tr>
<tr>
<td>WPA</td>
<td>WiFi Protected Access</td>
</tr>
</tbody>
</table>
Network+ Proposed Hardware and Software List

CompTIA has included this sample list of hardware and software to assist candidates as they prepare for the Network+ exam. This list may also be helpful for training companies that wish to create a lab component for their training offering. The bulleted lists below each topic are sample lists and are not exhaustive.

**EQUIPMENT**
- Optical and copper patch panels
- Punchdown blocks
- Layer 2 switch
- Layer 3 switch
- PoE switch
- Router
- Firewall
- VPN headend
- Wireless access point
- Basic laptops that support virtualization
- Tablet/cell phone
- Media converters
- VoIP system (including a phone)

**SPARE HARDWARE**
- NICs
- Power supplies
- GBICs
- SFPs
- Managed switch
- Wireless access point
- UPS
- PoE injector

**SPARE PARTS**
- Patch cables
- RJ11 connectors
- RJ45 connectors, modular jacks
- Unshielded twisted pair cable spool
- Coaxial cable spool
- F connectors
- Fiber connectors
- Antennas
- Bluetooth/wireless adapters
- Console cables (RS-232 to USB serial adapter)

**TOOLS**
- Telco/network crimper
- Cable tester
- Punchdown tool
- Cable stripper
- Coaxial crimper
- Wire cutter
- Tone generator
- Fiber termination kit
- Optical power meter

**SOFTWARE**
- Protocol analyzer/packet capture
- Terminal emulation software
- Linux OS/Windows OS
- Software firewall
- Software IDS/IPS
- Network mapper
- Hypervisor software
- Virtual network environment
- WiFi analyzer
- Spectrum analyzer
- Network monitoring tools
- DHCP service
- DNS service
- NetFlow analyzer
- TFTP server
- Firmware backups for upgrades

**OTHER**
- Sample network documentation
- Sample logs
- Defective cables
- Cloud network diagrams