



# Network Fundamentals

## **EXAM INFORMATION**

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**Items**

77

**Points**

77

**Prerequisites**

COMPUTER MECHANICS AND REPAIR

**Grade Level**

10-12

**Course Length**

ONE SEMESTER OR ONE YEAR

**Career Cluster**

INFORMATION TECHNOLOGY

**Performance Standards**

YES

**Certificate Available**

YES

## **DESCRIPTION**

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The knowledge and skills contained in these Network Fundamentals standards cover the necessary competencies for an entry-level Network professional. These include an understanding of the purpose of different networking equipment and tools, and the ability to install, configure, maintain, and troubleshoot standard network architecture, configurations, equipment, and protocols.

## **EXAM BLUEPRINT**

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**STANDARD**

**PERCENTAGE OF EXAM**

1- Network Administration	38%
2- Installing and Configuring Networks	7%
3- Network Media and Topologies	27%
4- Troubleshooting Connectivity Issues	13%
5- Securing Networks	10%
6- Troubleshooting Strategies	5%



## STANDARD I

STUDENTS WILL IDENTIFY AND UNDERSTAND KEY TERMS AND CONCEPTS RELATING TO NETWORK ADMINISTRATION

**Objective 1** Show competency in your understanding of the differences between OSI and TCP/IP layers and models

1. OSI
  1. Explain Physical Layer
  2. Explain Data Link Layer
  3. Explain Network Layer
  4. Explain Transport Layer
  5. Explain Session Layer
  6. Explain Presentation Layer
  7. Explain Application Layer
2. TCP/IP
  1. Explain Network Interface Layer
  2. Explain Internet Layer
  3. Explain Transport Layer
  4. Explain Application Layer

**Objective 2** Show competency in your ability to describe the relationship between network devices, applications and protocols and the OSI model.

1. Identify hub
2. Identify bridge
3. Identify NIC (Network Interface Card)
4. Identify various encryption devices
5. Identify switch
6. Identify multilayer switch
7. Identify router
8. Identify MAC address and its components
9. Identify IP address
10. Explain EUI-64
11. Explain frames
12. Explain packets

**Objective 3** Show competency in your ability to describe the purposes and properties of IP addressing.

1. Identify address classes
  1. A, B, C and D
  2. Public vs. Private
1. Explain Classless (CIDR) (Classless Inter-Domain Routing)
2. Explain IPv4 vs. IPv6 (formatting)
3. Explain Subnetting



4. Explain MAC address format
5. Explain Multicast vs. unicast vs. broadcast
6. Explain APIPA (Automatic Private IP Addressing)

## Objective 4

Show competency in your ability to describe the purposes and properties of routing and switching.

1. Define routing metrics
  1. Hop counts
  2. MTU (Maximum Transition Unit), bandwidth
  3. Costs
  4. Latency
2. Routing tables
3. RIP (Routing Information Protocol)
4. Link state vs. distance vector vs. hybrid
5. Static vs. dynamic
6. Next hop
7. Spanning Tree Protocol
8. VLAN (802.1q) (Virtual Local Area Network)
9. Port mirroring
10. Broadcast domain vs. collision domain
11. IGP (Internet Gateway Protocol) vs. EGP (Exterior Gateway Protocol)
12. Convergence (steady state)

## Objective 5

Show competency in identifying TCP and UDP ports and their numbers.

1. FTP (File Transfer Protocol) – 20, 21
  1. SSH (Secure Shell) – 22
  2. TELNET – 23
  3. SMTP (Simple Mail Transfer Protocol) – 25
  4. DNS (Domain Name System) – 53
  5. DHCP (Dynamic Host Configuration Protocol) – 67, 68
  6. HTTP (Hypertext Transfer Protocol) – 80
  7. POP3 (Post Office Protocol) - 110
  8. IMAP (Internet Message Access Protocol) – 143
  9. HTTPS (Hypertext Transfer Protocol Secure) – 443
  10. RDP (Remote Desktop Protocol) – 3389

## Objective 6

Show competency in understanding networking protocols and DNS components.

1. Networking Protocols
  1. Explain TCP (Transmission Control Protocol)
  2. Explain TCP/IP suite
  3. Explain UDP (User Datagram Protocol)
  4. Explain FTP (File Transfer Protocol)
  5. Explain TFTP (Trivial File Transfer Protocol)



6. Explain DHCP (Dynamic Host Configuration Protocol)
  7. Explain DNS (Domain Name System)
  8. Explain HTTP (Hypertext Transfer Protocol)
  9. Explain HTTPS (Hypertext Transfer Protocol Secure)
  10. Explain ARP (Address Resolution Protocol)
  11. Explain SIP (Session Initiation Protocol) (VoIP) (Voice Over Internet Protocol)
  12. Explain RTP (Real-Time Transfer Protocol) (VoIP)
  13. Explain SSH (Secure Shell)
  14. Explain POP3 (Post Office Protocol)
  15. Explain IMAP4 (Internet Message Access Protocol)
  16. Explain NTP (Network Time Protocol)
  17. Explain Telnet
  18. Explain SMTP (Simple Mail Transfer Protocol)
  19. Explain SNMP2/3 (Simple Network Management Protocol)
  20. Explain ICMP (Internet Control Message Protocol)
  21. Explain IGMP (Internet Group Management Protocol)
  22. Explain TLS (Transport Layer Security)
2. DNS Components
    1. Explain DNS servers
    2. Explain DNS records
      1. A
      2. AAAA
      3. MX
      4. CNAME
      5. PTR
    3. Explain Dynamic DNS

Standard 1 Performance Evaluation included below (Optional)

## **STANDARD 2**

STUDENTS WILL UNDERSTAND HOW TO INSTALL AND CONFIGURE NETWORKS

- Objective 1** Show competency in your ability to install and configure routers and switches.
1. Explain routing tables
  2. Explain NAT (Network Address Translation)
  3. Explain PAT (Port Address Translation)
  4. Explain VLAN (Virtual Local Area Network) (trunking)
  5. Explain managed vs. unmanaged switches
  6. Interface configurations
    1. Identify full duplex



2. Identify half duplex
3. Identify IP addressing
4. Identify port speeds
5. Identify MAC filtering

**Objective 2** Show competency in installing and configuring a SOHO network.

1. Basic requirements
  1. Identify list of requirements
  2. Identify cable length
  3. Identify device types/requirements
  4. Identify environment limitations
  5. Identify equipment limitations
  6. Identify compatibility requirements
2. Wireless requirements
  1. Identify WAP (Wireless Application Protocol) placement
  2. Identify antenna types
  3. Identify interference
  4. Identify Frequencies
  5. Identify channels
  6. Identify wireless standards
  7. Identify SSID (Service Set Identifier) (enable/disable)
  8. Identify compatibility (802.11 a/b/g/n)

**Objective 3** Show competency in understanding the purpose of DHCP.

1. Compare static vs. dynamic IP addressing
2. Explain reservations
3. Explain scopes
4. Explain leases
5. Explain options (DNS servers, suffixes)

**Objective 4** Show competency in troubleshooting routers and switches.

1. Recognize switching loop
2. Recognize bad cables/improper cable types
3. Recognize VLAN assignment
4. Recognize port configuration
5. Recognize mismatched MTU/MUT black hole
6. Recognize power failure
7. Recognize bad modules (SFPs, GBICs)
8. Recognize bad/missing routes
9. Recognize incorrect gateway
10. Recognize incorrect subnet mask
11. Recognize duplicate
12. IP address
13. Recognize incorrect DNS



## STANDARD 3

### STUDENTS WILL UNDERSTAND VARIOUS NETWORK MEDIA AND TOPOLOGIES

Objective 1 Show competency in your ability to recognize network media types and connectors.

1. Media Types
  1. Identify fiber cable:
    1. Multimode
    2. Singlemode
  2. UTP (Unshielded Twisted Pair)
    1. STP (Shielded Twisted Pair)
    2. CAT3 (Category 3)
    3. CAT5 (Category 5)
    4. CAT5e (Category 5e)
    5. CAT6 (Category 6)
    6. CAT6a (Category 6a)
    7. Coaxial
    8. Crossover
    9. T1 Crossover
    10. Straight-through
  3. Identify plenum vs. non-plenum
  4. Identify media converters:
    1. Singlemode fiber-to-Ethernet
    2. Multimode fiber-to-Ethernet
    3. Fiber-to-Coaxial
    4. Singlemode-to-multimode fiber
  5. Explain distance limitations and speed limitations
  6. Explain broadband over powerline
2. Connectors
  1. Identify Fiber:
    1. ST (Straight Tip)
    2. SC (Standard Connector)
    3. LC (Local Connector)
    4. MTRJ (Mechanical Transfer Registered Jack)
  2. Identify Copper:
    1. RJ-45 (Registered Jack-45)
    2. RJ-11 (Registered Jack-11)
    3. BNC (Bayonet Neill–Concelman)
    4. F-connector
    5. DB-9 (RS-232)
    6. Patch panel



## 7. I10 block (T568A, T568B)

Objective 2 Show competency in your ability to explain different network topologies and technologies.

### I. Foundational

1. Recognize MPLS (Multi-protocol Label Switching)
2. Recognize point-to-point
3. Recognize point-to-multipoint
4. Recognize ring
5. Recognize star
6. Recognize mesh
7. Recognize bus
8. Recognize peer-to-peer
9. Recognize client-server
10. Recognize hybrid

### 2. WAN (Wide Area Network) Technologies

#### I. Types:

1. Explain T1/E1
2. Explain T3/E3
3. Explain DS (Digital Signal) 3
4. Explain OC (Optical Carrier) x
5. Explain SONET (Synchronous Optical Network)
6. Explain SDH (Synchronous Digital Hierarchy)
7. Explain DWDM (Dense Wavelength Division Multiplexing)
8. Explain satellite
9. Explain ISDN (Integrated Service Digital Network)
10. Explain cable
11. Explain DSL (Digital Subscriber Line)
12. Explain cellular
13. Explain WiMAX
14. Explain LTE (Long-Term Evolution)
15. Explain HSPA+ (High Speed Packet Access)
16. Explain fiber
17. Explain dial-up
18. Explain PON (Passive Optical Network)
19. Explain frame relay
20. Explain ATMs (Asynchronous Transfer Mode)

#### 2. Properties:

1. Explain circuit switch
2. Explain packet switch
3. Explain speed
4. Explain transmission media



5. Explain distance
3. LAN Technologies
  1. Explain types of LAN technologies:
    1. Ethernet
    2. 10BaseT
    3. 100BaseT
    4. 1000BaseT
    5. 100BaseTX
    6. 100BaseFX
    7. 1000BaseX
    8. 10GBaseSR
    9. 10GBaseLR
    10. 10GBaseER
    11. 10GBaseSW
    12. 10GBaseLW
    13. 10GBaseEW
    14. 10GBaseT
  2. Explain properties of LAN technologies:
    1. CSMA/CD (Carrier Sense Multiple Access with Collision Detection)
    2. CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
    3. Broadcast
    4. Collision
    5. Bonding
    6. Speed
    7. Distance

**Objective 3** Show competency in identifying wiring distribution components.

1. Identify IDF (Intermediate Distribution Frame)
2. Identify MDF (Main Distribution Frame)
3. Identify Demarc
4. Identify Demarc extension
5. Identify Smart jack
6. Identify CSU/DSU (Channel Service Unit/Data Service Unit)

Standard 3 Performance Evaluation included below (Optional)

## **STANDARD 4**

STUDENTS WILL UNDERSTAND HOW TO TROUBLESHOOT CONNECTIVITY PROBLEMS

**Objective 1** Show competency in your ability to troubleshoot hardware connectivity problems.

1. Identify cable tester





2. Identify cable certifier
3. Identify crimper
4. Identify butt set
5. Identify toner probe
6. Identify punch down tool
7. Identify protocol analyzer
8. Identify loop back plug
9. Identify TDR (Time-Domain Reflectometer)
10. Identify OTDR (Optical Time-Domain Reflectometer)
11. Identify multimeter
12. Identify environmental monitor

**Objective 2** Show competency in your ability to troubleshoot software connectivity problems.

1. Identify protocol analyzer
2. Identify throughput testers
3. Identify connectivity software
4. Identify Ping
5. Identify Tracert/Traceroute
6. Identify Dig
7. Identify Ipconfig/Iffconfig
8. Identify Nslookup
9. Identify Arp
10. Identify Nbtstat
11. Identify Netstat
12. Identify Route

Standard 4 Performance Evaluation included below (Optional)

## **STANDARD 5**

STUDENTS WILL UNDERSTAND HOW TO SECURE A NETWORK

**Objective 1** Show competency in your ability to implement wireless security.

1. Encryption protocols:
  1. WEP (Wired Equivalent Privacy)
  2. WPA, WPA2, WPA Enterprise (Wi-Fi Protected Access)
1. MAC address filtering
2. Device placement
3. Signal strength

**Objective 2** Show competency in identifying network access security methods.

1. ACL (Access Control List):
  1. Explain MAC filtering



2. Explain IP filtering
3. Explain Port filtering
2. Remote access:
  1. Explain RAS (Remote Access Services)
  2. Explain RDP (Remote Desktop Protocol)
  3. Explain PPPoE (Point-to-Point Protocol over Ethernet)
  4. Explain PPP (Point-to-Point Protocol)
  5. Explain ICA (Independent Computing Architecture)
  6. Explain SSH (Secure Shell)

## Objective 3

Show competency in identifying user authentication methods.

1. Explain MS-CHAP (Microsoft-Challenge-Handshake Authentication Protocol)
2. Explain CHAP (Challenge-Handshake Authentication Protocol)
3. Mitigation techniques:
  1. Explain MS-CHAP (Microsoft-Challenge-Handshake Authentication Protocol)
  2. Explain CHAP (Challenge-Handshake Authentication Protocol)
  3. Mitigation techniques:

## Objective 4

Show competency in installing a basic firewall.

1. Types:
  1. Identify software and hardware firewalls
2. Explain port security
3. Explain stateful inspection vs. packet filtering
4. Explain firewall rules:
  1. Block/allow
  2. Implicit deny
  3. ACL (Access Control List)
5. Explain NAT/PAT (Network Address Translation)/(Port Address Translation)
6. Explain DMZ (Demilitarized Zone)

Standard 5 Performance Evaluation included below (Optional)

## STANDARD 6

STUDENTS WILL IDENTIFY AND UNDERSTAND GENERAL TROUBLESHOOTING STRATEGIES FOR NETWORKS

## Objective 1

Show competency in identifying the problem by knowing and doing the following:

1. Gathering information
2. Recognize symptoms
3. Question users
4. Establish a probable cause
5. Test the probable cause
6. Determine next steps to resolve problem



7. If problem is not resolved, establish a plan of action to resolve the problem and identify potential effects
8. Implement the solution or start the process over as necessary
9. Verify full system functionality
10. Implement preventative measures, if necessary
11. Document findings, actions and outcome



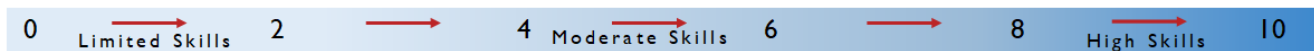
## Network Fundamentals Performance Standards (Optional)

Performance assessments may be completed and evaluated at any time during the course. The following performance skills are to be used in connection with the associated standards and exam. To pass the performance standard the student must attain a performance standard average of **8 or higher** on the rating scale. Students may be encouraged to repeat the objectives until they average **8 or higher**.

Students Name \_\_\_\_\_

Class \_\_\_\_\_

### PERFORMANCE RATING SCALE



#### STANDARD 1 Network Administration

Score:

- Explain the differences between OSI and TCP/IP layers and models
- Identify TCP and UDP ports and their numbers
- Describe the relationship between network devices, applications and protocols and the OSI model
- Explain networking protocols and DNS components

#### STANDARD 3 Network Media and Topologies

Score:

- Identify the different network media types and connectors
- Identify wiring distribution components

#### STANDARD 4 Troubleshooting Connectivity Issues

Score:

- Troubleshoot hardware connectivity problems
- Troubleshoot software connectivity problems

#### STANDARD 5 Securing Networks

Score:

- Identify network access security methods
- Demonstrate how remote access works
- Explain the different user authentication methods
- Install a basic firewall

### PERFORMANCE STANDARD AVERAGE SCORE: