

Computer Networking Hardware Operations II

8543/18 weeks

Table of Contents

Acknowledgments	2
Course Description	3
Task Essentials Table	3
Curriculum Framework	7
Exploring Networking Today	7
Configuring Basic Switch and End Devices	9
Explaining Network Protocols and Models	10
Describing Physical Layer Protocols, Services, and Network Media	12
Using Number Systems	13
Exploring the Data Link Layer	14
Describing Ethernet Switching	15
Using Network Layer Protocols and Services.....	15
Understanding Address Resolution	17
Configuring Basic Router Settings.....	17
Describing IPv4 Addressing	18
Implementing an IPv6 Addressing Scheme.....	20
Testing Network Connectivity	22
Comparing the Operations of Transport Layer Protocols in Supporting End-to-end Communication	22
Describing the Operation of Application Layer Protocols in Providing Support to End-user Applications	24
Exploring Network Security Fundamentals.....	25
Building a Small Network	26
SOL Correlation by Task.....	28
Teacher Resources.....	32
Appendix: Credentials, Course Sequences, and Career Cluster Information.....	35

Acknowledgments

The components of this instructional framework were developed by the following curriculum development panelists:

- Peyton Chichester, Chesterfield Career and Technical Center at Courthouse, Chesterfield County Public Schools
- Kelly Caudle, Program Head: Cisco Academy Support Center (ASC), Instructor Training Center (ITC), VMware Academy, IT Academy Lead Instructor, ITC, Stanly Community College, Albemarle, NC
- Kristen Hudson, Technical Manager US/CAN, Cisco Networking Academy, Buford, GA
- Iris Kutch, Cisco Academy Training and Support Manager, Towson University, Towson, MD
- Brian Stokes, Academies of Loudoun, Loudoun County Public Schools
- Marie Zwickert, Business Development Manager, Cisco Systems, Inc., Monkton, Maryland

Correlations to the Virginia Standards of Learning were reviewed and updated by the following:

- Leslie R. Bowers, English Teacher (ret.), Newport News Public Schools
- Vickie L. Inge, Mathematics Committee Member, Virginia Mathematics and Science Coalition
- Anne F. Markwith, New Teacher Mentor (Science), Gloucester County Public Schools
- Michael L. Nagy, Social Studies Department Chair, Rustburg High School, Campbell County Public Schools

The framework was edited and produced by the CTE Resource Center:

- Heather A. Widener, Writer/Editor
- Kevin P. Reilly, Administrative Coordinator

Virginia Department of Education Staff

Lauren-Anne Sledzinski, Specialist, Trade and Industrial Education and Related Clusters
Dr. J. Anthony Williams, Curriculum and Instruction Coordinator
Dr. David S. Eshelman, Director, Workforce Development and Initiatives
George R. Willcox, Director, Operations and Accountability
Office of Career, Technical, and Adult Education
Virginia Department of Education

Course Description

Suggested Grade Level: 10 or 11

The first of the Cisco Networking Academy CCNAv7 courses, this course will help students develop workplace readiness skills and build a foundation for success in networking-related degree programs and careers. This course covers the architecture, structure, functions, and components of the Internet and other computer networks. With the support of video and rich interactive media, students achieve a basic understanding of how networks operate and how to build simple local area networks (LAN), perform basic configurations for routers and switches, and implement Internet Protocol (IP).

Upon completion of all Cisco Networking Academy CCNAv7 course offerings, learners will be prepared to take the Cisco CCNA Unified certification exam. CCNAv7 teaches comprehensive networking concepts and skills, from network applications to the protocols and services provided to those applications. Learners will progress from basic networking to more complex enterprise and theoretical networking models later in the curriculum.

Task Essentials Table

- Tasks/competencies designated by plus icons (+) in the left-hand column(s) are essential.
- Tasks/competencies designated by empty-circle icons (○) are optional.
- Tasks/competencies designated by minus icons (−) are omitted.
- Tasks marked with an asterisk (*) are sensitive.

Task No.	Task
Exploring Networking Today	
39 (+)	Describe how networks affect daily life.
40 (+)	Describe networks.
41 (+)	Describe network representations and topologies.
42 (+)	Compare common network types.
43 (+)	Describe Internet connections.
44 (+)	Describe reliable networks.
45 (+)	Describe network trends.
46 (+)	Identify network security issues.
47 (+)	Describe professional opportunities.
Configuring Basic Switch and End Devices	
48 (+)	Access a Cisco Internetwork Operating System (IOS) device.

Task No.	Task
49 ⊕	Navigate IOS.
50 ⊕	Describe command structure.
51 ⊕	Enact basic configuration commands on a networking device.
52 ⊕	Save configurations.
53 ⊕	Describe ports and addresses.
54 ⊕	Configure Internet Protocol (IP) addressing.
55 ⊕	Verify connectivity.
Explaining Network Protocols and Models	
56 ⊕	Describe communication rules.
57 ⊕	Describe the reasons for protocols.
58 ⊕	Identify protocol suites.
59 ⊕	Identify standards organizations.
60 ⊕	Describe reference models.
61 ⊕	Identify data encapsulation.
62 ⊕	Describe data access.
Describing Physical Layer Protocols, Services, and Network Media	
63 ⊕	Define the purpose of the physical layer.
64 ⊕	Describe the physical layer.
65 ⊕	Identify copper cabling.
66 ⊕	Describe unshielded twisted pair (UTP) cabling.
67 ⊕	Describe fiber-optic cabling.
68 ⊕	Describe wired and wireless media.
Using Number Systems	
69 ⊕	Use the binary number system.
70 ⊕	Use the hexadecimal number system.
Exploring the Data Link Layer	
71 ⊕	Describe the data link layer.
72 ⊕	Compare topologies.
73 ⊕	Describe the data link frame.
Describing Ethernet Switching	
74 ⊕	Describe the Ethernet frame.

Task No.	Task
75 ⊕	Describe the Ethernet media access control (MAC) address.
76 ⊕	Describe the MAC address table.
77 ⊕	Describe switch speeds and forwarding methods.
Using Network Layer Protocols and Services	
78 ⊕	Identify network layer characteristics.
79 ⊕	Identify the IPv4 packet.
80 ⊕	Identify the IPv6 packet.
81 ⊕	Describe how a host routes.
82 ⊕	Describe router routing tables.
Understanding Address Resolution	
83 ⊕	Compare MAC and IP.
84 ⊕	Describe address resolution protocol (ARP).
85 ⊕	Describe neighbor discovery.
Configuring Basic Router Settings	
86 ⊕	Configure initial router settings.
87 ⊕	Configure interfaces.
88 ⊕	Configure the default gateway.
Describing IPv4 Addressing	
89 ⊕	Describe the structure of an IPv4 address.
90 ⊕	Compare IPv4 unicast, broadcast, and multicast.
91 ⊕	Describe types of IPv4 addresses.
92 ⊕	Describe network segmentation.
93 ⊕	Subnet an IPv4 network.
94 ⊕	Subnet a /16 and /8 prefix.
95 ⊕	Subnet to meet requirements.
96 ⊕	Use variable-length subnet masking (VLSM).
97 ⊕	Implement a VLSM addressing scheme.
Implementing an IPv6 Addressing Scheme	
98 ⊕	Explain the need for IPv6 addressing.
99 ⊕	Describe IPv6 addressing.
100 ⊕	Compare IPv6 address types.
101 ⊕	Configure static global unicast addresses (GUA) and link-local addresses (LLA).

Task No.	Task
102 ⊕	Describe dynamic addressing for IPv6 GUAs.
103 ⊕	Describe dynamic addressing for IPv6 LLAs.
104 ⊕	Identify IPv6 addresses.
105 ⊕	Subnet an IPv6 network.
Testing Network Connectivity	
106 ⊕	Describe Internet Control Message Protocol (ICMP) messages.
107 ⊕	Test network connectivity.
Comparing the Operations of Transport Layer Protocols in Supporting End-to-end Communication	
108 ⊕	Describe transportation of data.
109 ⊕	Identify transmission control protocol (TCP).
110 ⊕	Identify user datagram protocol (UDP).
111 ⊕	Describe port numbers.
112 ⊕	Outline the TCP communication process.
113 ⊕	Describe reliability and flow control.
114 ⊕	Describe UDP communication.
Describing the Operation of Application Layer Protocols in Providing Support to End-user Applications	
115 ⊕	Describe application, presentation, and session layers.
116 ⊕	Describe a peer-to-peer network.
117 ⊕	Describe web and email protocols.
118 ⊕	Describe Internet Protocol (IP) addressing services.
119 ⊕	Describe file sharing services.
Exploring Network Security Fundamentals	
120 ⊕	Justify security measures.
121 ⊕	Identify network attacks.
122 ⊕	Identify network attack mitigation.
123 ⊕	Implement device security.
Building a Small Network	
124 ⊕	Identify devices.
125 ⊕	Identify applications and protocols.
126 ⊕	Scale to larger networks.
127 ⊕	Verify connectivity and relative network performance.

Task No.	Task
128 ⊕	Use host and IOS commands.
129 ⊕	Describe troubleshooting.
130 ⊕	Troubleshoot scenarios.

Legend: ⊕ Essential ○ Non-essential ⊖ Omitted

Curriculum Framework

Exploring Networking Today

Task 39

Describe how networks affect daily life.

Definition

Description should include a discussion of advances in modern network technologies.

Task 40

Describe networks.

Definition

Description should include how host and network devices are used.

Task 41

Describe network representations and topologies.

Definition

Description should include how network representations are used in network topologies.

Task 42

Compare common network types.

Definition

Comparison should include the characteristics of some common types of networks.

Task 43

Describe Internet connections.

Definition

Description should include how local area networks (LANs) and wide area networks (WANs) interconnect to the Internet.

Task 44

Describe reliable networks.

Definition

Description should include the four basic requirements of a reliable network.

Task 45

Describe network trends.

Definition

Describe should include how trends such as bring-your-own-device (BYOD), online collaboration, video, and cloud computing are changing the way we interact.

Task 46

Identify network security issues.

Definition

Identification should include examples of basic security threats and solutions for all networks.

Task 47

Describe professional opportunities.

Definition

Description should include employment opportunities in the networking field.

Configuring Basic Switch and End Devices

Task 48

Access a Cisco Internetwork Operating System (IOS) device.

Definition

Accessing should include the steps involved in establishing in-band and out-of-band connections for configuration purposes.

Task 49

Navigate IOS.

Definition

Navigation should include the steps involved to configure network devices.

Task 50

Describe command structure.

Definition

Description should include the command structure of Cisco IOS software.

Task 51

Enact basic configuration commands on a networking device.

Definition

Configuration should include a Cisco IOS device using command-line interface (CLI).

Task 52

Save configurations.

Definition

Saving should include using IOS commands to save the running configuration.

Task 53

Describe ports and addresses.

Definition

Description should include how devices communicate across network media.

Task 54

Configure Internet Protocol (IP) addressing.

Definition

Configuration should include a host device with an IP address.

Task 55

Verify connectivity.

Definition

Verification should include connectivity between two end devices.

Explaining Network Protocols and Models

Task 56

Describe communication rules.

Definition

Description should include the types of rules necessary to communicate.

Task 57

Describe the reasons for protocols.

Definition

Description should include an explanation of why protocols are necessary in network communication.

Task 58

Identify protocol suites.

Definition

Identification should include the advantages of a protocol suite.

Task 59

Identify standards organizations.

Definition

Identification should include the role of standards organizations in establishing protocols for network interoperability.

Task 60

Describe reference models.

Definition

Description should include how the Transmission Control Protocol (TCP)/IP model and the Open Systems Interconnection (OSI) model are used to facilitate standardization in the communication process.

Task 61

Identify data encapsulation.

Definition

Identification should include how data encapsulation allows data to be transported across the network and the protocol data unit (PDUs) at each layer.

Task 62

Describe data access.

Definition

Description should include how local hosts access local resources on a network.

Describing Physical Layer Protocols, Services, and Network Media

Task 63

Define the purpose of the physical layer.

Definition

Definition should include the purpose and functions of the physical layer in the network.

Task 64

Describe the physical layer.

Definition

Description should include characteristics of the physical layer.

Task 65

Identify copper cabling.

Definition

Identification should include basic characteristics of copper cabling.

Task 66

Describe unshielded twisted pair (UTP) cabling.

Definition

Description should include how UTP cable is used in Ethernet networks.

Task 67

Describe fiber-optic cabling.

Definition

Description should include the advantages of fiber-optic cabling over other media.

Task 68

Describe wired and wireless media.

Definition

Description should include the types and properties of wired and wireless devices and the process for connecting them.

Using Number Systems

Task 69

Use the binary number system.

Definition

Use should include calculation of numbers between the decimal and binary systems.

Task 70

Use the hexadecimal number system.

Definition

Use should include calculation of numbers between the decimal and hexadecimal systems.

Exploring the Data Link Layer

Task 71

Describe the data link layer.

Definition

Description should include the purpose and function of the data link layer in preparing communication for transmission on specific media.

Task 72

Compare topologies.

Definition

Comparison should include characteristics of media access control methods on WAN and LAN topologies.

Task 73

Describe the data link frame.

Definition

Description should include characteristics and functions.

Describing Ethernet Switching

Task 74

Describe the Ethernet frame.

Definition

Description should include how Ethernet sublayers are related to the frame fields.

Task 75

Describe the Ethernet media access control (MAC) address.

Definition

Description should include characteristics.

Task 76

Describe the MAC address table.

Definition

Description should include how a switch builds its MAC address table and forwards frames.

Task 77

Describe switch speeds and forwarding methods.

Definition

Description should include switch forwarding methods and port settings available on Layer 2 switch ports.

Using Network Layer Protocols and Services

Task 78

Identify network layer characteristics.

Definition

Identification should include how the network layer uses IP protocols for reliable communications.

Task 79

Identify the IPv4 packet.

Definition

Identification should include the role of header fields in the IPv4 packet.

Task 80

Identify the IPv6 packet.

Definition

Identification should include the role of header fields in the IPv6 packet.

Task 81

Describe how a host routes.

Definition

Description should include how network devices use routing tables to direct packets to a destination network.

Task 82

Describe router routing tables.

Definition

Description should include the function of fields in the routing table of a router.

Understanding Address Resolution

Task 83

Compare MAC and IP.

Definition

Comparison should include the roles of the MAC address and the IP address.

Task 84

Describe address resolution protocol (ARP).

Definition

Description should include the purpose of ARP.

Task 85

Describe neighbor discovery.

Definition

Description should include the operation of IPv6 neighbor discovery.

Configuring Basic Router Settings

Task 86

Configure initial router settings.

Definition

Configuration should include verifying the commands used on a Cisco IOS router.

Task 87

Configure interfaces.

Definition

Configuration should include verifying two active interfaces on a Cisco IOS router.

Task 88

Configure the default gateway.

Definition

Configuration should include verifying that the default gateway is set on a device.

Describing IPv4 Addressing

Task 89

Describe the structure of an IPv4 address.

Definition

Description should include

- network portion
- host portion
- subnet mask.

Task 90

Compare IPv4 unicast, broadcast, and multicast.

Definition

Comparison should include characteristics and uses of the unicast, broadcast, and multicast IPv4 addresses.

Task 91

Describe types of IPv4 addresses.

Definition

Description should include

- public
- private
- reserved.

Task 92

Describe network segmentation.

Definition

Description should include how subnetting segments a network to enable better communication and security.

Task 93

Subnet an IPv4 network.

Definition

Subnetting should include calculating IPv4 subnets for a /24 prefix.

Task 94

Subnet a /16 and /8 prefix.

Definition

Subnetting should include calculating IPv4 subnets for a /16 and /8 prefix.

Task 95

Subnet to meet requirements.

Definition

Subnetting should include a set of requirements and implementation of an IPv4 addressing scheme.

Task 96

Use variable-length subnet masking (VLSM).

Definition

Use should include describing how to create a flexible addressing scheme.

Task 97

Implement a VLSM addressing scheme.

Definition

Implementation should include structured design.

Implementing an IPv6 Addressing Scheme

Task 98

Explain the need for IPv6 addressing.

Definition

Explanation should include IPv4 issues.

Task 99

Describe IPv6 addressing.

Definition

Description should include how IPv6 addresses are represented.

Task 100

Compare IPv6 address types.

Definition

Comparison should include types of IPv6 network addresses.

Task 101

Configure static global unicast addresses (GUA) and link-local addresses (LLA).

Definition

Configuration should include an explanation of steps involved.

Task 102

Describe dynamic addressing for IPv6 GUAs.

Definition

Description should include how to configure GUAs dynamically.

Task 103

Describe dynamic addressing for IPv6 LLAs.

Definition

Description should include how to configure LLAs dynamically.

Task 104

Identify IPv6 addresses.

Definition

Identification should include IPv6 multicast addresses.

Task 105

Subnet an IPv6 network.

Definition

Subnetting should include implementing an IPv6 addressing scheme.

Testing Network Connectivity

Task 106

Describe Internet Control Message Protocol (ICMP) messages.

Definition

Description should include how ICMP is used to test network connectivity.

Task 107

Test network connectivity.

Definition

Testing should include using ping and traceroute utilities.

Comparing the Operations of Transport Layer Protocols in Supporting End-to-end Communication

Task 108

Describe transportation of data.

Definition

Description should include the purpose of the transport layer in managing the transportation of data in end-to-end communication.

Task 109

Identify transmission control protocol (TCP).

Definition

Identification should include characteristics of TCP.

Task 110

Identify user datagram protocol (UDP).

Definition

Identification should include characteristics of UDP.

Task 111

Describe port numbers.

Definition

Description should include how TCP and UDP use port numbers.

Task 112

Outline the TCP communication process.

Definition

Outline should include how TCP session establishment and termination processes facilitate reliable communication.

Task 113

Describe reliability and flow control.

Definition

Description should include how TCP protocol data units are transmitted and acknowledged to guarantee delivery.

Task 114

Describe UDP communication.

Definition

Description should include the UDP client processes to establish communication with a server.

Describing the Operation of Application Layer Protocols in Providing Support to End-user Applications

Task 115

Describe application, presentation, and session layers.

Definition

Description should include how the functions of the application layer, session layer, and presentation layer work together to provide network services to end-user applications.

Task 116

Describe a peer-to-peer network.

Definition

Description should include how end-user applications operate in a peer-to-peer network.

Task 117

Describe web and email protocols.

Definition

Description should include the operation of web and email protocols.

Task 118

Describe Internet Protocol (IP) addressing services.

Definition

Description should include the operation of

- Domain Name System (DNS)
- dynamic host configuration protocol (DHCP).

Task 119

Describe file sharing services.

Definition

Description should include the operation of file transfer protocols (e.g., file transfer protocol [FTP], service message block [SMB]).

Exploring Network Security Fundamentals

Task 120

Justify security measures.

Definition

Justification should identify security threats and vulnerabilities and explain why basic security measures are necessary on network devices.

Task 121

Identify network attacks.

Definition

Identification should include security vulnerabilities.

Task 122

Identify network attack mitigation.

Definition

Identification should include general mitigation techniques.

Task 123

Implement device security.

Definition

Implementation should include configuring network devices with device hardening features to mitigate security threats.

Building a Small Network

Task 124

Identify devices.

Definition

Identification should include devices appropriate to a small network.

Task 125

Identify applications and protocols.

Definition

Identification should include protocols and applications used in a small network.

Task 126

Scale to larger networks.

Definition

Scaling should include an explanation of how a small network serves as the basis of larger networks.

Task 127

Verify connectivity and relative network performance.

Definition

Verification should include using the output of the ping and tracert commands to check connectivity and establish relative network performance.

Task 128

Use host and IOS commands.

Definition

Use should include acquiring information about the devices in a network.

Task 129

Describe troubleshooting.

Definition

Description should include common troubleshooting methodologies.

Task 130

Troubleshoot scenarios.

Definition

Troubleshooting should include addressing issues with devices in the network.

SOL Correlation by Task

Task No.	Task	SOL Correlations
Exploring Networking Today		
39	Describe how networks affect daily life.	English: 10.5, 11.5 History and Social Sciences: WG 17; WHII 14; VUS 14; Govt 9, 12, 16
40	Describe networks.	English: 10.5, 11.5
41	Describe network representations and topologies.	English: 10.5, 11.5
42	Compare common network types.	English: 10.5, 11.5
43	Describe Internet connections.	English: 10.5, 11.5
44	Describe reliable networks.	English: 10.5, 11.5
45	Describe network trends.	English: 10.5, 11.5 History and Social Sciences: WG 17; WHII 14; VUS 14; Govt 9, 12, 16
46	Identify network security issues.	English: 10.5, 11.5 History and Social Sciences: WG 17; WHII 14; VUS 14; Govt 9, 12, 16
47	Describe professional opportunities.	English: 10.5, 11.5 History and Social Sciences: Govt 9, 12, 16
Configuring Basic Switch and End Devices		
48	Access a Cisco Internetwork Operating System (IOS) device.	English: 10.5, 11.5
49	Navigate IOS.	English: 10.5, 11.5
50	Describe command structure.	English: 10.5, 11.5
51	Enact basic configuration commands on a networking device.	
52	Save configurations.	
53	Describe ports and addresses.	English: 10.5, 11.
54	Configure Internet Protocol (IP) addressing.	
55	Verify connectivity.	

Task No.	Task	SOL Correlations
Explaining Network Protocols and Models		
56	Describe communication rules.	English: 10.5, 11.5
57	Describe the reasons for protocols.	English: 10.5, 11.5
58	Identify protocol suites.	English: 10.5, 11.5
59	Identify standards organizations.	English: 10.5, 11.5
60	Describe reference models.	English: 10.5, 11.5
61	Identify data encapsulation.	English: 10.5, 11.5
62	Describe data access.	English: 10.5, 11.5
Describing Physical Layer Protocols, Services, and Network Media		
63	Define the purpose of the physical layer.	English: 10.3, 10.5, 11.3, 11.5
64	Describe the physical layer.	English: 10.5, 11.5
65	Identify copper cabling.	English: 10.5, 11.5
66	Describe unshielded twisted pair (UTP) cabling.	English: 10.5, 11.5
67	Describe fiber-optic cabling.	English: 10.5, 11.5
68	Describe wired and wireless media.	English: 10.5, 11.5
Using Number Systems		
69	Use the binary number system.	
70	Use the hexadecimal number system.	
Exploring the Data Link Layer		
71	Describe the data link layer.	English: 10.5, 11.5
72	Compare topologies.	English: 10.5, 11.5
73	Describe the data link frame.	English: 10.5, 11.5
Describing Ethernet Switching		
74	Describe the Ethernet frame.	English: 10.5, 11.5
75	Describe the Ethernet media access control (MAC) address.	English: 10.5, 11.
76	Describe the MAC address table.	English: 10.5, 11.5
77	Describe switch speeds and forwarding methods.	English: 10.5, 11.5
Using Network Layer Protocols and Services		
78	Identify network layer characteristics.	English: 10.5, 11.5
79	Identify the IPv4 packet.	English: 10.5, 11.5

Task No.	Task	SOL Correlations
80	Identify the IPv6 packet.	English: 10.5, 11.5
81	Describe how a host routes.	English: 10.2, 10.5, 11.2, 11.5
82	Describe router routing tables.	English: 10.5, 11.5
Understanding Address Resolution		
83	Compare MAC and IP.	English: 10.5, 11.5
84	Describe address resolution protocol (ARP).	English: 10.5, 11.5
85	Describe neighbor discovery.	English: 10.5, 11.5
Configuring Basic Router Settings		
86	Configure initial router settings.	
87	Configure interfaces.	
88	Configure the default gateway.	
Describing IPv4 Addressing		
89	Describe the structure of an IPv4 address.	English: 10.5, 11.5
90	Compare IPv4 unicast, broadcast, and multicast.	English: 10.5, 11.5
91	Describe types of IPv4 addresses.	English: 10.5, 11.5
92	Describe network segmentation.	English: 10.5, 11.5
93	Subnet an IPv4 network.	
94	Subnet a /16 and /8 prefix.	
95	Subnet to meet requirements.	
96	Use variable-length subnet masking (VLSM).	
97	Implement a VLSM addressing scheme.	
Implementing an IPv6 Addressing Scheme		
98	Explain the need for IPv6 addressing.	English: 10.5, 11.5
99	Describe IPv6 addressing.	English: 10.5, 11.5
100	Compare IPv6 address types.	English: 10.5, 11.5
101	Configure static global unicast addresses (GUA) and link-local addresses (LLA).	
102	Describe dynamic addressing for IPv6 GUAs.	English: 10.5, 11.5
103	Describe dynamic addressing for IPv6 LLAs.	English: 10.5, 11.5
104	Identify IPv6 addresses.	English: 10.5, 11.5
105	Subnet an IPv6 network.	
Testing Network Connectivity		

Task No.	Task	SOL Correlations
106	Describe Internet Control Message Protocol (ICMP) messages.	English: 10.5, 11.
107	Test network connectivity.	English: 10.5, 11.5
Comparing the Operations of Transport Layer Protocols in Supporting End-to-end Communication		
108	Describe transportation of data.	English: 10.5, 11.5
109	Identify transmission control protocol (TCP).	English: 10.5, 11.5
110	Identify user datagram protocol (UDP).	English: 10.5, 11.5
111	Describe port numbers.	English: 10.5, 11.5
112	Outline the TCP communication process.	English: 10.5, 10.6, 10.7, 11.5, 11.6, 11.7
113	Describe reliability and flow control.	English: 10.5, 11.5
114	Describe UDP communication.	English: 10.5, 11.5
Describing the Operation of Application Layer Protocols in Providing Support to End-user Applications		
115	Describe application, presentation, and session layers.	English: 10.5, 11.5
116	Describe a peer-to-peer network.	English: 10.5, 11.5
117	Describe web and email protocols.	English: 10.2, 10.5, 11.2, 11.5
118	Describe Internet Protocol (IP) addressing services.	English: 10.5, 11.5
119	Describe file sharing services.	English: 10.5, 11.5
Exploring Network Security Fundamentals		
120	Justify security measures.	English: 10.5, 11.5
121	Identify network attacks.	English: 10.5, 11.5
122	Identify network attack mitigation.	English: 10.5, 11.5
123	Implement device security.	
Building a Small Network		
124	Identify devices.	English: 10.5, 11.5
125	Identify applications and protocols.	English: 10.5, 11.5
126	Scale to larger networks.	English: 10.5, 11.5
127	Verify connectivity and relative network performance.	
128	Use host and IOS commands.	English: 10.5, 11.5

Task No.	Task	SOL Correlations
129	Describe troubleshooting.	English: 10.5, 11.5
130	Troubleshoot scenarios.	English: 10.5, 11.5

Teacher Resources

Acronym Glossary

AAA	authentication, authorization, and accounting
ACL	access control list
API	application programming interfaces
ARP	Address Resolution Protocol
BIOS	basic input/output system
BPDU	bridge protocol data unit
BYOD	bring your own device
CAPWAP	control and provisioning of wireless access points
CDP	Cisco Discovery Protocol
CLI	command-line interface
DHCP	dynamic host configuration protocol
DNA	(Cisco) Digital Network Architecture
DNS	Domain Name Service
DR/BDR	designated router/backup designated router
DTP	Dynamic Trunking Protocol
FHRP	first hop redundancy protocol
FTP	file transfer protocol
GUA	global unicast address
HSRP	Hot Standby Router Protocol
IBN	intent-based networking
ICMP	Internet Control Messaging Protocol

ICT	information and communications technology
IOS	(Cisco) Internetwork Operating System
IoT	Internet of Things
IP	Internet Protocol
IPsec	IP security
IT	information technology
JSON	JavaScript object notation
LAN	local area network
LLA	link-local address
LLDP	link layer discovery protocol
LSA	link state advertisement
LSU	link state update
MAC	media access control
NAT	network address translation
NTP	network time protocol
OSI	Open Systems Interconnection
OSPF	open shortest path first
PAT	port address translation
PC	personal computer
PDU	protocol data unit
PSK	pre-shared key
QoS	quality of service
REST	representational state transfer
SLAAC	stateless address autoconfiguration
SMB	service message block
SNMP	simple network management protocol
STP	spanning tree protocol
STP	Shielded Twisted Pair

syslog	System Logging Protocol
TCP	transmission control protocol
UDP	user datagram protocol
UEFI	Unified Extensible Firmware Interface
UTP	unshielded twisted pair
VLAN	virtual local area network
VLSM	variable-length subnet masking
VPN	virtual private network
VTY	virtual terminal line
WAN	wide area network
WLAN	wireless local area network
WLC	wireless LAN controller
WPA	Wi-Fi protected access
XML	extensible markup language
YAML	yet another markup language

Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- A+ Certification Examination
- Business Information Processing Assessment
- Cisco Certified CyberOps Associate Examination
- Cisco Certified DevNet Associate Examination
- Cisco Certified Networking Associate (CCNA) Examination
- Cisco Certified Networking Professional (CCNP) Automation for Cisco Enterprise Solutions Examination
- Cisco Certified Networking Professional (CCNP) Cisco Enterprise Networks Examination
- Cisco Certified Networking Professional (CCNP) Cisco SD-WAN Solutions Examination
- Cisco Certified Networking Professional (CCNP) Designing Enterprise Wireless Networks Examination
- Cisco Certified Networking Professional (CCNP) Enterprise Advanced Routing and Services Examination
- Cisco Certified Networking Professional (CCNP) Enterprise Network Core Technologies Examination
- Cisco Certified Networking Professional (CCNP) Implementing Enterprise Wireless Networks Examination
- College and Work Readiness Assessment (CWRA+)
- Computer Networking Fundamentals Assessment
- Customer Service Specialist (CSS) Examination
- Internetworking Examination
- IT Fundamentals+ Certification Examination
- Microsoft 365 Fundamentals Examination
- Microsoft Certified Azure Fundamentals Examination
- Microsoft Dynamics 365 Fundamentals Examination
- Microsoft Office Specialist (MOS) Examinations
- Microsoft Technology Associate (MTA) Examinations
- Network Administration Certification Tests
- Network+ Certification Examination
- Professional Communications Certification Examination
- Security+ Certification Examination
- Technical Support Certification Tests
- Workplace Readiness Skills for the Commonwealth Examination

Concentration Sequences

A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the

requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.

- Computer Networking Hardware Operations I (8542/18 weeks, 70 hours)
- Computer Networking Hardware Operations III (8544/18 weeks, 70 hours)
- Computer Networking Hardware Operations IV (8545/18 weeks, 70 hours)

Career Clusters, Pathways, and Occupations

Career Cluster: Information Technology	
Pathway	Occupations
Information Support and Services	Applications Integrator Computer Support Specialist Computer Systems Engineer, Architect Database Administrator Database Analyst Information Systems Analyst Information Systems Security Developer Information Systems Security Manager Maintenance Technician Network Systems and Data Communication Analyst Software Test Engineer Systems Analyst Technical Writer
Network Systems	Computer and Information Systems Administrator Computer Operator Computer Security Specialist Computer Software Engineer Computer Support Specialist Computer Systems Engineer, Architect Database Analyst Information Security Analyst Network and Computer Systems Administrator Network Architect Network Systems and Data Communication Analyst Software Test Engineer Systems Analyst Telecommunications Equipment Installer, Repairer

	Telecommunications Specialist
Programming and Software Development	Computer Software Engineer Information Security Analyst Network Systems and Data Communication Analyst Programmer Project Manager Software Applications Engineer Software Test Engineer Systems Analyst
Web and Digital Communications	Computer Support Specialist Computer Systems Engineer, Architect Project Manager Software Test Engineer Systems Analyst