

Computer Networking Hardware Operations III

8544/18 weeks

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Course Description

Suggested Grade Level: 11 or 12

The second of the Cisco Networking Academy CCNAv7 courses, this curriculum is designed for students who are seeking entry-level jobs in the information technology (IT) industry or who hope to fulfill prerequisites to pursue more specialized IT skills. This course covers the architecture, components, and operations of routers and switches in small networks and introduces wireless local area networks (WLAN) and security concepts. Students learn how to configure and troubleshoot routers and switches for advanced functionality using security best practices and resolve common issues with protocols in both IPv4 and IPv6 networks.

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 Basic Device Configuration	
39 (+)	Configure a switch.
40 (+)	Configure switch ports.
41 (+)	Secure remote access.
42 (+)	Configure a basic router.
43 (+)	Verify directly connected networks.
Describing Switching Concepts	
44 (+)	Describe frame forwarding.
45 (+)	Compare switching domains.
Understanding Virtual Local Area Networks (VLANs)	
46 (+)	Describe VLANs.
47 (+)	Describe VLANs in a multi-switched environment.
48 (+)	Configure VLAN.
49 (+)	Configure VLAN trunks.
50 (+)	Describe Dynamic Trunking Protocol (DTP).

Task No.	Task
Troubleshooting Inter-VLAN Routing	
51 ⊕	Describe inter-VLAN routing operation.
52 ⊕	Configure router-on-a-stick inter-VLAN routing.
53 ⊕	Configure inter-VLAN routing using Layer 3 switches.
54 ⊕	Troubleshoot inter-VLAN routing.
Describing Spanning Tree Protocol (STP)	
55 ⊕	Identify the purpose of STP.
56 ⊕	Describe STP operations.
57 ⊕	Describe the evolution of STP.
Exploring EtherChannel	
58 ⊕	Describe EtherChannel operation.
59 ⊕	Configure EtherChannel.
60 ⊕	Verify EtherChannel.
Describing Dynamic Host Configuration Protocol (DHCP)v4	
61 ⊕	Describe DHCPv4 concepts.
62 ⊕	Configure DHCPv4 server.
63 ⊕	Configure DHCPv4 client.
Understanding Stateless Address Autoconfiguration (SLAAC) and DHCPv6 Concepts	
64 ⊕	Describe Internet Protocol (IP)v6 global unicast address assignment.
65 ⊕	Describe SLAAC.
66 ⊕	Describe DHCPv6.
67 ⊕	Configure DHCPv6 server.
Describing First Hop Redundancy Protocol (FHRP) Concepts	
68 ⊕	Describe first hop redundancy protocols (FHRPs).
69 ⊕	Describe Hot Standby Router Protocol (HSRP).
Exploring Local Area Network (LAN) Security Concepts	
70 ⊕	Describe endpoint security.
71 ⊕	Identify access control.
72 ⊕	Identify Layer 2 security threats.
73 ⊕	Describe media access control (MAC) address table attack.
74 ⊕	Describe LAN attacks.

Task No.	Task
Implementing Switch Security Configuration to Mitigate LAN Attacks	
75 ⊕	Implement port security.
76 ⊕	Mitigate VLAN attacks.
77 ⊕	Mitigate DHCP attacks.
78 ⊕	Mitigate Address Resolution Protocol (ARP) attacks.
79 ⊕	Mitigate Spanning Tree Protocol (STP) attacks.
Describing Wireless Local Area Network (WLAN) Concepts	
80 ⊕	Describe how WLANs enable network connectivity.
81 ⊕	Describe WLANs.
82 ⊕	Describe WLAN operation.
83 ⊕	Describe control and provisioning of wireless access points (CAPWAP) operation.
84 ⊕	Describe channel management.
85 ⊕	Describe WLAN threats.
86 ⊕	Secure WLANs.
Implementing WLAN	
87 ⊕	Configure WLAN.
88 ⊕	Configure a basic WLC on the WLC.
89 ⊕	Configure a WPA2 enterprise WLAN on the WLC.
90 ⊕	Troubleshoot WLAN issues.
Describing Routing Concepts	
91 ⊕	Describe path determination.
92 ⊕	Describe packet forwarding.
93 ⊕	Configure a basic router.
94 ⊕	Describe IP routing table.
95 ⊕	Compare static and dynamic routing.
Configuring Internet Protocol (IP) Static Routes	
96 ⊕	Describe static routes.
97 ⊕	Configure IP static routes.
98 ⊕	Configure IP default static routes.
99 ⊕	Configure floating static routes.
100 ⊕	Configure static host routes.

Task No.	Task
Troubleshooting Static and Default Routes	
101 ⊕	Explain packet processing with static routes.
102 ⊕	Troubleshoot IPv4 static and default route configuration.

Legend: ⊕ Essential ○ Non-essential ⊖ Omitted

Curriculum Framework

Exploring Basic Device Configuration

Task 39

Configure a switch.

Definition

Configuration should include initial settings on a Cisco switch, using security best practices.

Task 40

Configure switch ports.

Definition

Configuration should meet network requirements, using security best practices.

Task 41

Secure remote access.

Definition

Securing should include configuration of secure management access on a switch, using security best practices.

Task 42

Configure a basic router.

Definition

Configuration should include basic settings on a router, using command-line interface (CLI), to route between two directly connected networks.

Task 43

Verify directly connected networks.

Definition

Verification should include connectivity between two networks that are directly connected to a router.

Describing Switching Concepts

Task 44

Describe frame forwarding.

Definition

Description should include how

- Layer 2 switches forward data
- frames are forwarded in a switched network
- the media access control table/content addressable memory is used by a switch.

Task 45

Compare switching domains.

Definition

Comparison should include

- collision domain

- broadcast domain.

Understanding Virtual Local Area Networks (VLANs)

Task 46

Describe VLANs.

Definition

Description should include the purpose of VLANs on a switched network.

Task 47

Describe VLANs in a multi-switched environment.

Definition

Description should include how a switch forwards frames based on VLAN configuration in a multi-switch environment.

Task 48

Configure VLAN.

Definition

Configuration should include a switch port to be assigned to a VLAN based on requirements.

Task 49

Configure VLAN trunks.

Definition

Configuration should include a trunk port on a VLAN switch.

Task 50

Describe Dynamic Trunking Protocol (DTP).

Definition

Description should include configuration of DTP.

Troubleshooting Inter-VLAN Routing

Task 51

Describe inter-VLAN routing operation.

Definition

Description should include options for configuring inter-VLAN routing.

Task 52

Configure router-on-a-stick inter-VLAN routing.

Definition

Configuration should include troubleshooting.

Task 53

Configure inter-VLAN routing using Layer 3 switches.

Definition

Configuration should include troubleshooting.

Task 54

Troubleshoot inter-VLAN routing.

Definition

Troubleshooting should include addressing common inter-VLAN configuration issues.

Describing Spanning Tree Protocol (STP)

Task 55

Identify the purpose of STP.

Definition

Identification should include

- how STP enables redundancy in a Layer 2 network
- common problems in a redundant Layer 2 switched network.

Task 56

Describe STP operations.

Definition

Description should include how STP operates in a simple, switched network.

Task 57

Describe the evolution of STP.

Definition

Description should include an identification of the different types of spanning tree and how Rapid PVST+ operates.

Exploring EtherChannel

Task 58

Describe EtherChannel operation.

Definition

Description should include EtherChannel technology.

Task 59

Configure EtherChannel.

Definition

Configuration should include troubleshooting.

Task 60

Verify EtherChannel.

Definition

Verification should include troubleshooting.

Describing Dynamic Host Configuration Protocol (DHCP)v4

Task 61

Describe DHCPv4 concepts.

Definition

Description should include how DHCPv4 operates across multiple LANs. Description should also include implementation.

Task 62

Configure DHCPv4 server.

Definition

Configuration should include configuring a router as a DHCPv4 server.

Task 63

Configure DHCPv4 client.

Definition

Process should include configuring a router as a DHCPv4 client.

Understanding Stateless Address Autoconfiguration (SLAAC) and DHCPv6 Concepts

Task 64

Describe Internet Protocol (IP)v6 global unicast address assignment.

Definition

Description should include how an IPv6 host can acquire its IPv6 configuration.

Task 65

Describe SLAAC.

Definition

Description should include the operation of SLAAC.

Task 66

Describe DHCPv6.

Definition

Description should include the operation of DHCPv6.

Task 67

Configure DHCPv6 server.

Definition

Configuration should include a stateful and stateless DHCPv6 server.

Describing First Hop Redundancy Protocol (FHRP) Concepts

Task 68

Describe first hop redundancy protocols (FHRPs).

Definition

Description should include how FHRPs provide default gateway services in a redundant network. Explanation should include purpose and operation of FHRPs.

Task 69

Describe Hot Standby Router Protocol (HSRP).

Definition

Description should include how HSRP operates.

Exploring Local Area Network (LAN) Security Concepts

Task 70

Describe endpoint security.

Definition

Description should include how to use endpoint security to mitigate attacks.

Task 71

Identify access control.

Definition

Identification should include how authentication, authorization, and accounting (AAA) and 802.1X are used to authenticate LAN endpoints and devices.

Task 72

Identify Layer 2 security threats.

Definition

Identification should include Layer 2 vulnerabilities and how these compromise LAN security.

Task 73

Describe media access control (MAC) address table attack.

Definition

Description should include how a MAC address table attack compromises LAN security.

Task 74

Describe LAN attacks.

Definition

Description should include how LAN attacks compromise LAN security.

Implementing Switch Security Configuration to Mitigate LAN Attacks

Task 75

Implement port security.

Definition

Implementation should include port security to mitigate MAC address table attacks.

Task 76

Mitigate VLAN attacks.

Definition

Mitigation should include an explanation of how to configure DTP and native VLAN.

Task 77

Mitigate DHCP attacks.

Definition

Mitigation should include an explanation of how to configure DHCP snooping.

Task 78

Mitigate Address Resolution Protocol (ARP) attacks.

Definition

Mitigation should include an explanation of how to configure ARP inspection.

Task 79

Mitigate Spanning Tree Protocol (STP) attacks.

Definition

Mitigation should include an explanation of how to configure Portfast and bridge protocol data unit (BPDU) Guard.

Describing Wireless Local Area Network (WLAN) Concepts

Task 80

Describe how WLANs enable network connectivity.

Definition

Description should include WLAN technology and standards.

Task 81

Describe WLANs.

Definition

Description should include the components of the WLAN infrastructure.

Task 82

Describe WLAN operation.

Definition

Description should include how wireless technology enables WLAN operation.

Task 83

Describe control and provisioning of wireless access points (CAPWAP) operation.

Definition

Description should include how a wireless LAN controller (WLC) uses CAPWAP to manage multiple access points (APs).

Task 84

Describe channel management.

Definition

Description should include channel management in a WLAN.

Task 85

Describe WLAN threats.

Definition

Description should include examples of threats to WLANs.

Task 86

Secure WLANs.

Definition

Securing should include a description of WLAN security mechanisms.

Implementing WLAN

Task 87

Configure WLAN.

Definition

Configuration should include implementing a WLAN to support a remote site.

Task 88

Configure a basic WLC on the WLC.

Definition

Configuration should include a WLC WLAN to use the management interface and Wi-Fi protected access (WPA)2 pre-shared key (PSK) authentication.

Task 89

Configure a WPA2 enterprise WLAN on the WLC.

Definition

Configuration includes a WLC WLAN to use a VLAN interface, a DHCP server, and a WPA2 enterprise authentication.

Task 90

Troubleshoot WLAN issues.

Definition

Troubleshooting should include common wireless configuration issues.

Describing Routing Concepts

Task 91

Describe path determination.

Definition

Description should include how routers determine the best path.

Task 92

Describe packet forwarding.

Definition

Description should include how routers forward packets to the destination.

Task 93

Configure a basic router.

Definition

Configuration should include basic settings on a Cisco Internetwork Operating System (IOS) router.

Task 94

Describe IP routing table.

Definition

Description should include the structure of a routing table.

Task 95

Compare static and dynamic routing.

Definition

Comparison should include static and dynamic routing concepts.

Configuring Internet Protocol (IP) Static Routes

Task 96

Describe static routes.

Definition

Description should include the command syntax for static routes.

Task 97

Configure IP static routes.

Definition

Configuration should include IPv4 and IPv6 static routes.

Task 98

Configure IP default static routes.

Definition

Configuration should include IPv4 and IPv6 default static routes.

Task 99

Configure floating static routes.

Definition

Configuration should include a floating static route to provide a backup connection.

Task 100

Configure static host routes.

Definition

Configuration should include IPv4 and IPv6 static host routes that direct traffic to a specific host.

Troubleshooting Static and Default Routes

Task 101

Explain packet processing with static routes.

Definition

Explanation should include how a router processes packets when a static route is configured.

Task 102

Troubleshoot IPv4 static and default route configuration.

Definition

Troubleshooting should include common static and default route configuration issues.

SOL Correlation by Task

Task No.	Task	SOL Correlations
Exploring Basic Device Configuration		
39	Configure a switch.	
40	Configure switch ports.	
41	Secure remote access.	
42	Configure a basic router.	
43	Verify directly connected networks.	
Describing Switching Concepts		
44	Describe frame forwarding.	English: 11.5, 12.5
45	Compare switching domains.	English: 11.5, 12.5
Understanding Virtual Local Area Networks (VLANs)		
46	Describe VLANs.	English: 11.5, 12.5
47	Describe VLANs in a multi-switched environment.	English: 11.5, 12.5
48	Configure VLAN.	
49	Configure VLAN trunks.	
50	Describe Dynamic Trunking Protocol (DTP).	English: 11.5, 12.5
Troubleshooting Inter-VLAN Routing		
51	Describe inter-VLAN routing operation.	English: 11.5, 12.5
52	Configure router-on-a-stick inter-VLAN routing.	
53	Configure inter-VLAN routing using Layer 3 switches.	
54	Troubleshoot inter-VLAN routing.	
Describing Spanning Tree Protocol (STP)		
55	Identify the purpose of STP.	English: 11.5, 12.5
56	Describe STP operations.	English: 11.5, 12.5
57	Describe the evolution of STP.	English: 11.5, 12.5
Exploring EtherChannel		
58	Describe EtherChannel operation.	English: 11.5, 12.5
59	Configure EtherChannel.	
60	Verify EtherChannel.	
Describing Dynamic Host Configuration Protocol (DHCP)v4		

Task No.	Task	SOL Correlations
61	Describe DHCPv4 concepts.	English: 11.5, 12.5
62	Configure DHCPv4 server.	
63	Configure DHCPv4 client.	
Understanding Stateless Address Autoconfiguration (SLAAC) and DHCPv6 Concepts		
64	Describe Internet Protocol (IP)v6 global unicast address assignment.	English: 11.5, 12.5
65	Describe SLAAC.	English: 11.5, 12.5
66	Describe DHCPv6.	English: 11.5, 12.5
67	Configure DHCPv6 server.	
Describing First Hop Redundancy Protocol (FHRP) Concepts		
68	Describe first hop redundancy protocols (FHRPs).	English: 11.5, 12.5
69	Describe Hot Standby Router Protocol (HSRP).	English: 11.5, 12.5
Exploring Local Area Network (LAN) Security Concepts		
70	Describe endpoint security.	English: 11.5, 12.5
71	Identify access control.	English: 11.5, 12.5
72	Identify Layer 2 security threats.	English: 11.5, 12.5
73	Describe media access control (MAC) address table attack.	English: 11.5, 12.5
74	Describe LAN attacks.	English: 11.5, 12.5
Implementing Switch Security Configuration to Mitigate LAN Attacks		
75	Implement port security.	
76	Mitigate VLAN attacks.	
77	Mitigate DHCP attacks.	
78	Mitigate Address Resolution Protocol (ARP) attacks.	
79	Mitigate Spanning Tree Protocol (STP) attacks.	
Describing Wireless Local Area Network (WLAN) Concepts		
80	Describe how WLANs enable network connectivity.	English: 11.5, 12.5
81	Describe WLANs.	English: 11.5, 12.5
82	Describe WLAN operation.	English: 11.5, 12.5
83	Describe control and provisioning of wireless access points (CAPWAP) operation.	English: 11.5, 12.5

Task No.	Task	SOL Correlations
84	Describe channel management.	English: 11.5, 12.5
85	Describe WLAN threats.	English: 11.5, 12.5
86	Secure WLANs.	
Implementing WLAN		
87	Configure WLAN.	
88	Configure a basic WLC on the WLC.	
89	Configure a WPA2 enterprise WLAN on the WLC.	
90	Troubleshoot WLAN issues.	
Describing Routing Concepts		
91	Describe path determination.	English: 11.5, 12.5
92	Describe packet forwarding.	English: 11.5, 12.5
93	Configure a basic router.	
94	Describe IP routing table.	English: 11.5, 12.5
95	Compare static and dynamic routing.	English: 11.5, 12.5
Configuring Internet Protocol (IP) Static Routes		
96	Describe static routes.	English: 11.5, 12.5
97	Configure IP static routes.	
98	Configure IP default static routes.	
99	Configure floating static routes.	
100	Configure static host routes.	
Troubleshooting Static and Default Routes		
101	Explain packet processing with static routes.	English: 11.5, 12.5
102	Troubleshoot IPv4 static and default route configuration.	

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 II (8543/18 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

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