CCNA Routing and Switching
Scope and Sequence

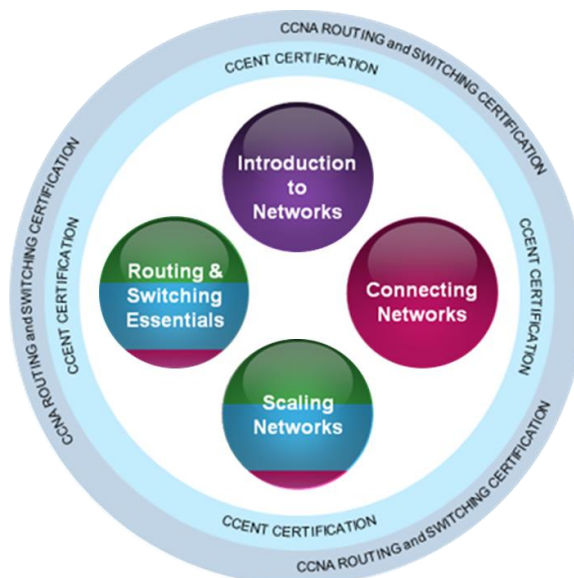**Last updated August 22, 2018**

Target Audience

The Cisco CCNA® Routing and Switching curriculum is designed for Cisco Networking Academy® students who are seeking entry-level jobs in the ICT industry or hope to fulfill prerequisites to pursue more specialized ICT skills. CCNA Routing and Switching provides an integrated and comprehensive coverage of networking topics, from fundamentals to advanced applications and services, while providing opportunities for hands-on practical experience and career skills development.

The curriculum is appropriate for students at many education levels and types of institutions, including high schools, secondary schools, universities, colleges, career and technical schools, and community centers.

Curriculum Overview

The CCNA Routing and Switching curriculum consists of four courses that make up the recommended learning path. Students will be prepared to take the Cisco CCENT® certification exam after completing a set of two courses and the CCNA Routing and Switching certification exam after completing a set of four courses. The curriculum also helps students develop workforce readiness skills and builds a foundation for success in networking-related careers and degree programs. Figure 1 shows the different courses included in the CCNA Routing and Switching curriculum.

Figure 1.   CCNA Routing and Switching Courses

In each course, Networking Academy™ students will learn technology concepts with the support of interactive media and apply and practice this knowledge through a series of hands-on and simulated activities that reinforce their learning.

CCNA Routing and Switching teaches comprehensive networking concepts and skills, from network applications to the protocols and services provided to those applications by the lower layers of the network. Students will progress from basic networking to more complex enterprise and theoretical networking models later in the curriculum.

CCNA Routing and Switching includes the following features:

- Students learn the basics of routing, switching, and advanced technologies to prepare for the Cisco CCENT and CCNA certification exams, networking related degree programs, and entry-level networking careers.
- The language used to describe networking concepts is designed to be easily understood by learners at all levels and embedded interactive activities help reinforce comprehension.
- Courses emphasize critical thinking, problem solving, collaboration, and the practical application of skills.
- Multimedia learning tools, including videos, games, and quizzes, address a variety of learning styles and help stimulate learning and promote increased knowledge retention.
- Hands-on labs and Cisco® Packet Tracer simulation-based learning activities help students develop critical thinking and complex problem solving skills.
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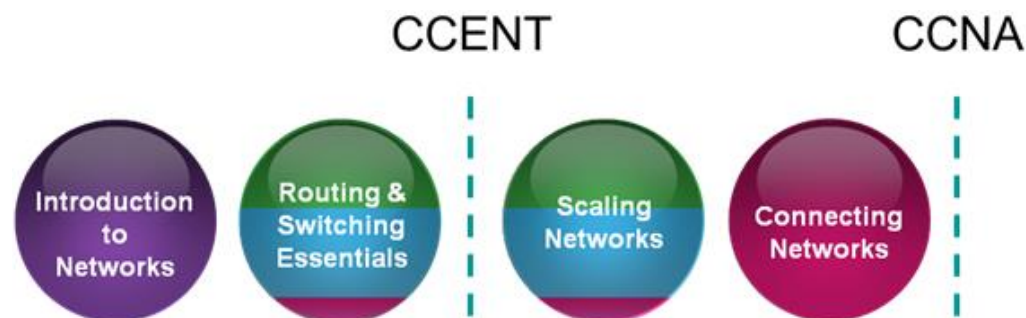## Course Structure and Sequences

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As a result of the changes to the certification exams, students can choose to pursue Cisco advanced technology certifications after achieving the prerequisite CCENT certification. The recommended CCNA Routing and Switching course flow supports student flexibility by helping students prepare for the CCENT certification exam after the first two courses, and helps them prepare for the CCNA certification exam after completing all four courses.

Figure 2 shows the four courses that make up the recommended CCNA Routing and Switching course sequence: **Introduction to Networks**, **Routing and Switching Essentials**, **Scaling Networks**, and **Connecting Networks**.

Networking Academy strongly encourages all academies to teach this recommended course sequence, since these courses may significantly enhance employment opportunities by enabling students to acquire skills they can immediately use in their jobs, and may accelerate their ability to pursue advanced technology certifications.

Figure 2. Recommended CCNA Routing and Switching Course Flow

Lab Equipment Requirements

Detailed equipment information, including descriptions and part numbers, is available in the CCNA Equipment List, which is located on the Cisco NetAcad Equipment Information site. Please refer to that document for the latest information, which includes specifications for the following minimum equipment required:

- 3 CISCO1941/K9 Integrated Services Routers Generation 2 (ISR-G2)
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- Assorted Ethernet and Serial cables

Introduction to Networks Course Outline

Table 1. Introduction to Networks Course Outlines

Chapter	Introduction to Networks
1	Explore the Network
2	Configure a Network Operating System
3	Network Protocols and Communications
4	Network Access
5	Ethernet
6	Network Layer
7	IP Addressing
8	Subnetting IP Networks
9	Transport Layer
10	Application Layer
11	Build a Small Network

Introduction to Networks

This course introduces the architecture, structure, functions, components, and models of the Internet and other computer networks. The principles and structure of IP addressing and the fundamentals of Ethernet concepts, media, and operations are introduced to provide a foundation for the curriculum. By the end of the course, students

will be able to build simple LANs, perform basic configurations for routers and switches, and implement IP addressing schemes.

Students who complete Introduction to Networks will be able to perform the following functions:

- Explain network technologies.
- Explain how devices access local and remote network resources.
- Implement basic network connectivity between devices.
- Design an IP addressing scheme to provide network connectivity for a small to medium-sized business network.
- Describe router hardware.
- Explain how switching operates in a small to medium-sized business network.
- Configure monitoring tools available for small to medium-sized business networks.
- Configure initial settings on a network device.

Introduction to Networks Detailed Course Outline

Table 2.   Introduction to Networks Course Outline

Ch.	Introduction to Networks		Objectives
1	**Explore the Network**		
	1.1	Globally Connected	Explain how multiple networks are used in everyday life.
	1.2	LANs, WANs, and the Internet	Explain how topologies and devices are connected in a small to medium-sized business network.
	1.3	The Network as a Platform	Explain the basic characteristics of a network that supports communication in a small to medium-sized business.
	1.4	The Changing Network Environment	Explain trends in networking that will affect the use of networks in small to medium-sized businesses.
2	Configure a Network Operating System		
	2.1	IOS Bootcamp	Explain the features and functions of the Cisco IOS Software.
	2.2	Basic Device Configuration	Configure initial settings on a network device using the Cisco IOS Software.
	2.3	Address Schemes	Given an IP addressing scheme, configure IP address parameters on devices to provide end-to-end connectivity in a small to medium-sized business network.
3	Network Protocols and Communications		
	3.1	Rules of Communication	Explain how rules facilitate communication.
	3.2	Network Protocols and Standards	Explain the role of protocols and standards organizations in facilitating interoperability in network communications.
	3.3	Data Transfer in the Network	Explain how devices on a LAN access resources in a small to medium-sized business network.
4	Network Access		
	4.1	Physical Layer Protocols	Explain how physical layer protocols and services support communications across data networks.

Ch.	Introduction to Networks		Objectives
	4.2	Network Media	Build a simple network using the appropriate media.
	4.3	Data Link Layer Protocols	Explain the role of the data link layer in supporting communications across data networks.
	4.4	Media Access Control	Compare media access control techniques and logical topologies used in networks.
5	Ethernet		
	5.1	Ethernet Protocol	Explain the operation of Ethernet.
	5.2	LAN Switches	Explain how a switch operates.
	5.3	Address Resolution Protocol	Explain how the address resolution protocol enables communication on a network.
6	Network Layer		
	6.1	Network Layer Protocols	Explain how network layer protocols and services support communications across data networks.
	6.2	Routing	Explain how routers enable end-to-end connectivity in a small to medium-sized business network
	6.3	Routers	Explain how devices route traffic in a small to medium-sized business network.
	6.4	Configuring a Cisco Router	Configure a router with basic configurations.
7	IP Addressing		
	7.1	IPv4 Network Addresses	Explain the use of IPv4 addresses to provide connectivity in small to medium-sized business networks.
	7.2	IPv6 Network Addresses	Configure IPv6 addresses to provide connectivity in small to medium-sized business networks.
	7.3	Connectivity Verification	Use common testing utilities to verify and test network connectivity.
8	Subnetting IP Networks		
	8.1	Subnetting an IPv4 Network	Implement an IPv4 addressing scheme to enable end-to-end connectivity in a small to medium-sized business network
	8.2	Addressing Schemes	Given a set of requirements, implement a VLSM addressing scheme to provide connectivity to end users in a small to medium-sized network.
	8.3	Design Considerations for IPv6	Explain design considerations for implementing IPv6 in a business network.
9	Transport Layer		
	9.1	Transport Layer Protocols	Explain how transport layer protocols and services support communications across data networks.
	9.2	TCP and UDP	Compare the operations of transport layer protocols in supporting end-to-end communication.
10	Application Layer		
	10.1	Application Layer Protocols	Explain the operation of the application layer in providing support to end-user applications.
	10.2	Well-Known Application Layer Protocols and Services	Explain how well-known TCP/IP application layer protocols operate.
11	Build a Small Network		

Ch.	Introduction to Networks	Objectives
	11.1 Network Design	Explain how a small network of directly connected segments is created, configured and verified.
	11.2 Network Security	Configure switches and routers with device hardening features to enhance security.
	11.3 Basic Network Performance	Use common show commands and utilities to establish a relative performance baseline for the network.
	11.4 Network Troubleshooting	Troubleshoot a network.

CCNA Routing and Switching Scope and Sequence

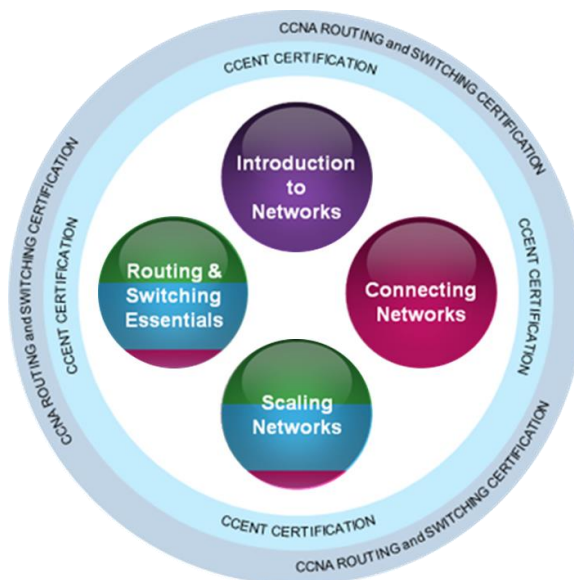**Last updated August 22, 2018**

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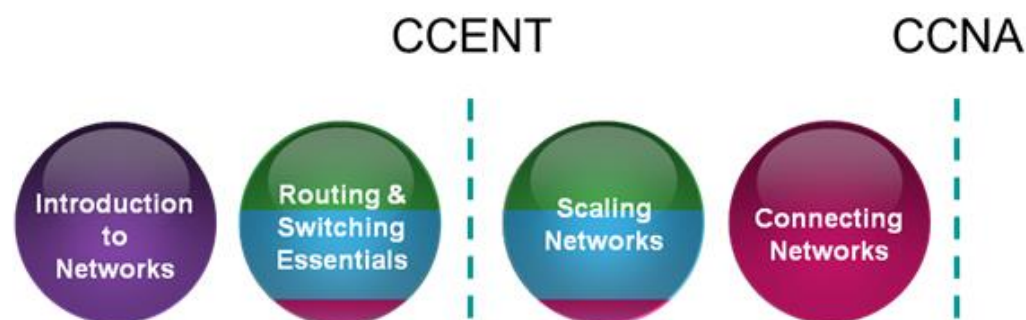
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Routing & Switching Essentials Course Outline

Table 1.   Routing & Switching Essentials Course Outlines

Chapter	Routing and Switching Essentials
1	Routing Concepts
2	Static Routing
3	Dynamic Routing
4	Switched Networks
5	Switch Configuration
6	VLANs
7	Access Control Lists
8	DHCP
9	NAT for IPv4
10	Device Discovery, Management, and Maintenance

Routing and Switching Essentials

This course describes the architecture, components, and operations of routers and switches in a small network. Students learn how to configure a router and a switch for basic functionality. By the end of this course, students will be able to configure and troubleshoot routers and switches and resolve common issues with virtual LANs and inter-VLAN routing in both IPv4 and IPv6 networks.

Students who complete the Routing and Switching Essentials course will be able to perform the following functions:

- Implement DHCP on a router.
- Implement network address translation (NAT).
- Implement access control lists (ACLs) to filter traffic.
- Determine how a router will forward traffic based on the contents of a routing table.
- Implement static routing.
- Explain how switching operates in a small to medium-sized business network.
- Configure Ethernet switch ports.
- Implement VLANs.
- Use monitoring tools and network management protocols to troubleshoot data networks.
- Configure monitoring tools available for small to medium-sized business networks.
- Configure initial settings on a network device.

Routing & Switching Essentials Detailed Course Outline

Table 2.　　Routing & Switching Essentials Course Outline

Ch.		Routing & Switching Essentials	Objectives
1		**Routing Concepts**	
	1.1	Router Initial Configuration	Configure a router to route between multiple directly-connected networks.
	1.2	Routing Decisions	Explain how routers use information in data packets to make forwarding decisions in a small to medium-sized business network.
	1.3	Router Operation	Explain how a router learns about remote networks when operating in a small to medium-sized business network.
2		**Static Routing**	
	2.1	Implement Static Routes	Explain how static routes are implemented in a small to medium-sized business network.
	2.2	Configure Static and Default Routes	Configure static routes to enable connectivity in a small to medium-sized business network.
	2.3	Troubleshoot Static and Default Routes	Troubleshoot static and default route configurations.
3		**Dynamic Routing**	
	3.1	Dynamic Routing Protocols	Explain the function of dynamic routing protocols.
	3.2	RIPv2	Implement RIPv2.
	3.3	The Routing Table	Determine the route source, administrative distance, and metric for a given route.
4		**Switched Networks**	
	4.1	LAN Design	Explain how switched networks support small to medium-sized businesses.
	4.2	The Switched Environment	Explain how Layer 2 switches forward data in a small to medium-sized LAN.
5		**Switch Configuration**	

Ch.	Routing & Switching Essentials		Objectives
	5.1	Basic Switch Configuration	Configure basic switch settings to meet network requirements.
	5.2	Switch Security	Configure a switch using security best practices in a small to medium-sized business network.
6	VLANs		
	6.1	VLAN Segmentation	Explain how VLANs segment broadcast domains in a small to medium-sized business network.
	6.2	VLAN Implementations	Implement VLANs to segment a small to medium-sized business network.
	6.3	Inter-VLAN Routing Using Routers	Configure routing between VLANs in a small to medium-sized business network.
7	Access Control Lists		
	7.1	ACL Operation	Explain the purpose and operation of ACLs in small to medium-sized business networks.
	7.2	Standard IPv4 ACLs	Configure standard IPv4 ACLs to filter traffic in a small to medium-sized business network.
	7.3	Troubleshoot ACLs	Troubleshoot IPv4 ACL issues.
8	DHCP		
	8.1	DHCPv4	Implement DHCPv4 to operate across multiple LANs in a small to medium-sized business network.
	8.2	DHCPv6	Implement DHCPv6 to operate across multiple LANs in a small to medium-sized business network.
9	NAT for IPv4		
	9.1	NAT Operation	Explain how NAT provides IPv4 address scalability in a small to medium-sized business network.
	9.2	Configure NAT	Configure NAT services on the edge router to provide IPv4 address scalability in a small to medium-sized business network.
	9.3	Troubleshoot NAT	Troubleshoot NAT issues in a small to medium-sized business network.
10	Device Discovery, Management, and Maintenance		
	10.1	Device Discovery	Use discovery protocols to map a network topology.
	10.2	Device Management	Configure NTP and Syslog in a small to medium-sized business network
	10.3	Device Maintenance	Maintain router and switch configuration and IOS files.

CCNA R&S: Scaling Networks
Scope and Sequence
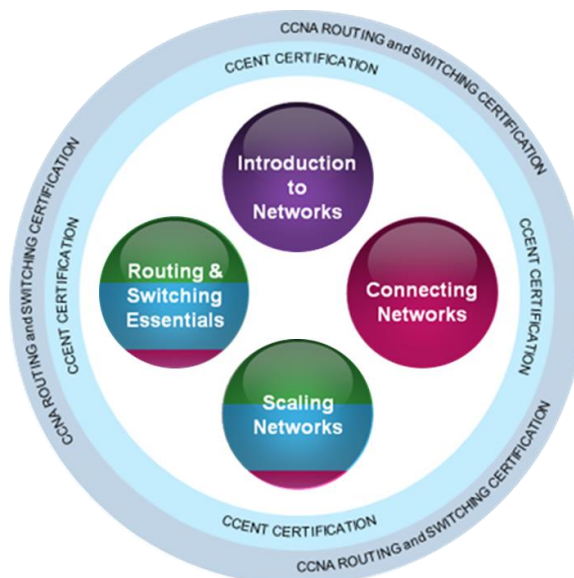
Last updated September 5, 2018

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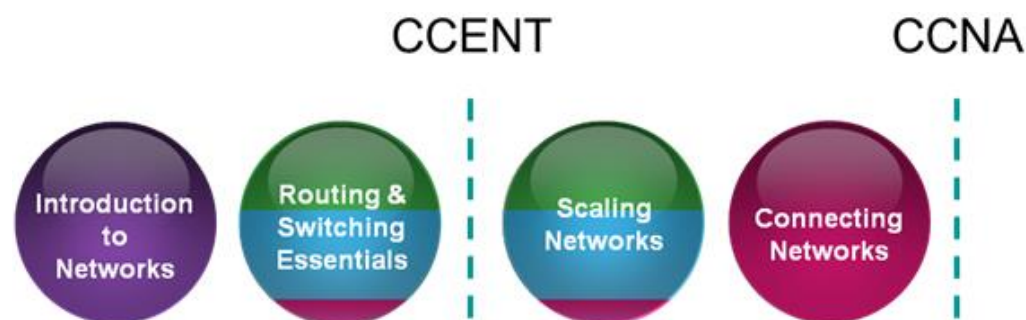## Course Structure and Sequences

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Scaling Networks 6.0 Course Outline

Table 1. Scaling Networks 6.0

Chapter	Scaling Networks
1	LAN Design
2	Scaling VLANs
3	STP
4	Etherchannel and HSRP
5	Dynamic Routing
6	EIGRP
7	EIGRP Tuning and Troubleshooting
8	Single-Area OSPF
9	Multiarea OSPF
10	OSPF Tuning and Troubleshooting

Scaling Networks

This course describes the architecture, components, and operations of routers and switches in larger and more complex networks. Students learn how to configure routers and switches for advanced functionality. By the end of this course, students will be able to configure and troubleshoot routers and switches and resolve common issues with OSPF, EIGRP, and STP in both IPv4 and IPv6 networks. Students will also develop the knowledge and skills needed to implement a WLAN in a small-to-medium network.

Students who complete the Scaling Networks course will be able to perform the following functions:

- Determine how a router will forward traffic based on the contents of a routing table.

- Implement EIGRP.

- Implement OSPF.

- Implement VLANs.

- Implement enhanced switching technologies and first hop redundancy protocols.

- Design a small multi-site business network.

Scaling Networks Detailed Course Outline

Table 2. Scaling Networks Course Outline

Ch.	Scaling Networks		Objectives
1	LAN Design		
	1.1	Campus Wired LAN Designs	Explain why it is important to design a scalable hierarchial network.
	1.2	Selecting Network Devices	Select network devices based on feature compatibility and network requirement.
2	Scaling VLANs		
	2.1	VTP, Extended VLANs, and DTP	Configure enhanced inter-switch connectivity technologies.
	2.2	Troubleshoot Multi-VLAN Issues	Troubleshoot issues in an inter-VLAN routing environment.
	2.3	Layer 3 Switching	Implement inter-VLAN routing using Layer 3 switching to forward data in a small to medium-sized business LAN.
3	STP		
	3.1	Spanning Tree Concepts	Build a simple switched network with redundant links.
	3.2	Varieties of Spanning Tree Protocols	Explain how different varieties of spanning tree protocols operate.
	3.3	Spanning Tree Configuration	Implement PVST+ and Rapid PVST+ in a switched LAN environment.
4	Enterchannel and HSRP		
	4.1	Link Aggregation Concepts	Explain link aggregation operation in a switched LAN environment.
	4.2	Link Aggregation Configuration	Implement link aggregation to improve performance on high-traffic switch links.
	4.3	First Hop Redundancy Protocols	Implement HSRP.
5	Dynamic Routing		
	5.1	Dynamic Routing Protocols	Explain the features and characteristics of dynamic routing protocols.
	5.2	Distance Vector Dynamic Routing	Explain how distance vector routing protocols operate.
	5.3	Link-State Dynamic Routing	Explain how link-state protocols operate.
6	EIGRP		
	6.1	EIGRP Characteristics	Explain the features and characteristics of EIGRP.

Ch.	Scaling Networks		Objectives
	6.2	Implement EIGRP for IPv4	Implement EIGRP for IPv4 in a small to medium-sized business network.
	6.3	EIGRP Operation	Explain how EIGRP operates in a small to medium-sized business network.
	6.4	Implement EIGRP for IPv6	Implement EIGRP for IPv6 in a small to medium-sized business network.
7	EIGRP Tuning and Troubleshooting		
	7.1	Tune EIGRP	Configure EIGRP to improve network performance.
	7.2	Troubleshoot EIGRP	Troubleshoot common EIGRP configuration issues in a small to medium-sized business network.
8	Single-Area OSPF		
	8.1	OSPF Characteristics	Explain how single-area OSPF operates.
	8.2	Single-Area OSPFv2	Implement single-area OSPFv2.
	8.3	Single-Area OSPFv3	Implement single-area OSPFv3.
9	Multiarea OSPF		
	9.1	Multiarea OSPF Operation	Explain how multiarea OSPF operates in a small to medium-sized business network.
	9.2	Configuring Multiarea OSPF	Implement multiarea OSPFv2 and OSPFv3.
10	OSPF Tuning and Troubleshooting		
	10.1	Advanced Single-Area OSPF Configurations	Configure OSPF to improve network performance.
	10.2	Troubleshooting Single-Area OSPF Implementations	Troubleshoot common OSPF configuration issues in a small to medium-sized business network.

CCNA R&S: Connecting Networks
Scope and Sequence

Last updated August 22, 2018
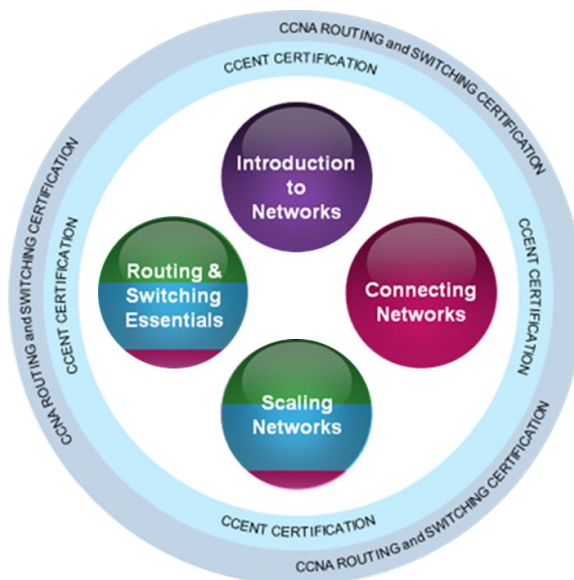
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- Embedded assessments provide immediate feedback to support the evaluation of knowledge and acquired skills.

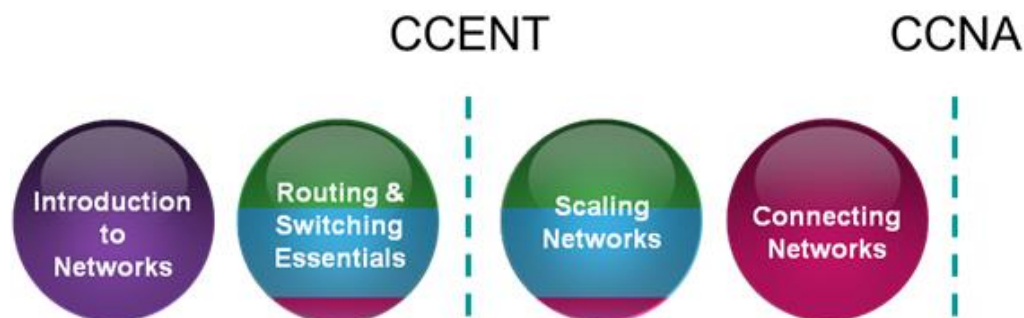## Course Structure and Sequences

Market research and global employers have consistently indicated that the skills gap for general networking skills is shrinking, while the skills gap for essential networking technologies such as security, voice, and wireless, and for emerging technologies, such as data center, cloud, and video, is growing. As a global leader in technology and networking, Cisco developed the new CCENT and CCNA Routing and Switching certifications and curriculum to remain aligned with the rapidly changing global job market and trends.

As a result of the changes to the certification exams, students can choose to pursue Cisco advanced technology certifications after achieving the prerequisite CCENT certification. The recommended CCNA Routing and Switching course flow supports student flexibility by helping students prepare for the CCENT certification exam after the first two courses, and helps them prepare for the CCNA certification exam after completing all four courses.

Figure 2 shows the four courses that make up the recommended CCNA Routing and Switching course sequence: **Introduction to Networks**, **Routing and Switching Essentials**, **Scaling Networks**, and **Connecting Networks**.

Networking Academy strongly encourages all academies to teach this recommended course sequence, since these courses may significantly enhance employment opportunities by enabling students to acquire skills they can immediately use in their jobs, and may accelerate their ability to pursue advanced technology certifications.

Figure 2.   Recommended CCNA Routing and Switching Course Flow

Lab Equipment Requirements

Detailed equipment information, including descriptions and part numbers, is available in the CCNA Equipment List, which is located on the Cisco NetAcad Equipment Information site. Please refer to that document for the latest information, which includes specifications for the following minimum equipment required:

- 3 CISCO1941/K9 Integrated Services Routers Generation 2 (ISR-G2)
- 3 HWIC-2T Serial WAN Interface Cards
- 3 WS-C2960-24TC-L Cisco Catalyst switches
- Assorted Ethernet and Serial cables

Connecting Networks 6.0 Course Outline

Table 1.   Connecting Networks 6.0

Chapter	Connecting Networks
1	WAN Concepts
2	Point-to-Point Connections
3	Branch Connections
4	Access Control Lists
5	Network Security and Monitoring
6	Quality of Service
7	Network Evolution
8	Network Troubleshooting

Connecting Networks

This course focuses on the WAN technologies and network services required by converged applications in a complex network. By the end of this course, students will be able to configure PPPoE, GRE, single-homed eBGP, extended IPv4 and IPv6 ACLs. Students will also develop the knowledge and skills needed to implement a WLAN in a small-to-medium network. For LANs, students will be able to configure SNMP and Cisco SPAN. Students will also develop knowledge about QoS and the trends in networking including Cloud, virtualization, and SDN.

Students who complete the Connecting Networks course will be able to perform the following functions:

- Explain network technologies.

- Implement access control lists (ACLs) to filter traffic.

- Configure Ethernet switch ports.

- Design a small multi-site business network.

- Select WAN access technologies.

- Configure a serial interface to enable WAN communication.

- Configure an Ethernet interface to enable broadband communication given service provider requirements.

- Implement remote access and site-to-site VPNs.

- Use monitoring tools and network management protocols to troubleshoot data networks.

- Configure monitoring tools available for small to medium-sized business networks.

- Configure initial settings on a network device.

- Explain how quality of service (QoS) mechanism support network communication requirements.

Connecting Networks Detailed Course Outline

Table 2.   Connecting Networks Course Outline

Ch.	Connecting Networks		Objectives
1	WAN Concepts		
	1.1	WAN Technologies Overview	Explain WAN access technologies available to small to medium-sized business networks.
	1.2	Selecting a WAN Technology	Select WAN access technologies to satisfy business requirements.
2	Point-to-Point Connections		
	2.1	Serial Point-to-Point Overview	Configure HDLC encapsulation.
	2.2	PPP Operation	Explain how PPP operates across a point-to-point serial link.
	2.3	Configure PPP	Configure PPP encapsulation.
	2.4	Troubleshooting PPP	Troubleshoot PPP.
3	Branch Connections		
	3.1	Remote Access Connections	Select broadband remote access technologies to support business requirements.
	3.2	PPPoE	Configure a Cisco router with PPPoE.
	3.3	VPNs	Explain how VPNs secure site-to-site and remote access connectivity.
	3.4	GRE	Implement a GRE tunnel.
	3.5	eBGP	Implement eBGP in a single-homed remote access network.
4	Access Control Lists		
	4.1	Standard ACL Operation and Configuration Review	Configure standard IPv4 ACLs.

	4.2	Extended IPv4 ACLs	Configure extended IPv4 ACLs.
	4.3	IPv6 ACLs	Configure IPv6 ACLs.
	4.4	Troubleshoot ACLs	Troubleshoot ACLs.
5	Network Security and Monitoring		
	5.1	LAN Security	Explain how to mitigate common LAN security attacks.
	5.2	SNMP	Configure SNMP to monitor network operations in a small to medium-sized business network.
	5.3	Cisco Switch Port Analyzer (SPAN)	Troubleshoot a network problem using SPAN.
6	Quality of Service		
	6.1	QoS Overview	Explain the purpose and characteristics of QoS.
	6.2	QoS Mechanisms	Explain how networking devices implement QoS.
7	Network Evolution		
	7.1	Internet of Things	Explain the value of the Internet of Things.
	7.2	Cloud and Virtualization	Explain why cloud computing and virtualization are necessary for evolving networks.
	7.3	Network Programming	Explain why network programmability is necessary for evolving networks.
8	Network Troubleshooting		
	8.1	Troubleshooting Methodology	Explain troubleshooting approaches for various network problems.
	8.2	Troubleshooting Scenarios	Troubleshoot end-to-end connectivity in a small to medium-sized business network, using a systematic approach.