

# C S 50C: SCALING LOCAL AREA NETWORKS (CCNA)

## Foothill College Course Outline of Record

Heading	Value
<b>Effective Term:</b>	Summer 2021
<b>Units:</b>	4.5
<b>Hours:</b>	4 lecture, 2 laboratory per week (72 total per quarter)
<b>Advisory:</b>	C S 50A.
<b>Degree &amp; Credit Status:</b>	Degree-Applicable Credit Course
<b>Foothill GE:</b>	Non-GE
<b>Transferable:</b>	CSU
<b>Grade Type:</b>	Letter Grade (Request for Pass/No Pass)
<b>Repeatability:</b>	Not Repeatable

## Student Learning Outcomes

- The student will demonstrate knowledge of the Composite LAN Design Model.
- The student will demonstrate knowledge of the Spanning Tree and Rapid Spanning Tree protocols.

## Description

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.

## Course Objectives

The student will be able to:

- Understand, configure and troubleshoot enhanced switching technologies such as VLANs, Rapid Spanning Tree Protocol (RSTP), Per VLAN Spanning Tree Plus Protocol (PVST+).
- Understand, configure and troubleshoot EtherChannel.
- Understand, configure, and troubleshoot first hop redundancy protocols (HSRP) in a switched network.
- Understand, configure, and troubleshoot wireless routers and wireless clients.
- Configure and troubleshoot routers in a complex routed IPv4 or IPv6 network using single-area OSPF, multiarea OSPF, and Enhanced Interior Gateway Routing Protocol (EIGRP).
- Manage Cisco IOS software licensing and configuration files.

## Course Content

### A. LAN Redundancy

- Spanning Tree protocol
  - Purpose of Spanning Tree
    - Redundancy at OSI Layers 1 and 2
  - STP operation
    - Spanning Tree algorithm

- Purpose
  - Port roles
  - Root bridge
  - Path cost
  - 802.1D BPDU frame format
  - BPDU propagation and process
  - Extended System ID
- Spanning Tree protocol types
    - PVST+
    - Rapid PVST+
  - BPDU types
    - Rapid PVST+
    - PVST+
  - Edge ports
  - Link types
    - Configuring PVST+
    - Configuring Rapid PVST+
  - Load balancing
  - Convergence
    - Configuration issues
- EtherChannel and Link Aggregation
    - Introduction
      - Link aggregation allows the creation of logical links comprised of several physical links
      - EtherChannel is a form of link aggregation used in switched networks
      - Advantages of EtherChannel
      - EtherChannel operation
        - Implementation restrictions
        - Port Aggregation Protocol (PAgP)
        - Link Aggregation Control Protocol (LACP)
      - Link aggregation
        - Configuration
          - Guidelines
            - EtherChannel must be supported
            - Speed and duplex must match
            - VLAN match all interfaces in same VLAN
            - Range of VLAN same range on all interfaces
          - Configuring EtherChannel
          - Configuring interfaces
          - Configuring LACP
          - Verifying EtherChannel
        - First-Hop Redundancy Protocols
          - Default gateway limitations
          - Router redundancy
          - Steps for router failover
          - First-Hop Redundancy Protocols
            - Hot Standby Router Protocol (HSRP)
            - HSRP for IPv6
            - Virtual Router Redundancy Protocol version 2 (VRRPv2)
            - VRRPv3
          - Gateway Load Balancing Protocol (GLBP)
            - GLBP for IPv6
            - ICMP Router Discovery Protocol (IRDP)
        - Wireless LANS
          - The 802.11 protocol suite
          - Access points
            - Operation
            - Security configuration
          - Wireless LAN controllers
            - Thick access point vs. thin access points
          - Managing a wireless network
          - Configuring wireless devices

### E. Single-Area OSPF, Multiarea OSPF, and Enhanced Interior Gateway Routing Protocol (EIGRP) in a Complex Environment

#### 1. OSPF

##### a. Advanced configuration

- 1) OSPF network types
- 2) Virtual links
- 3) OSPF priority
- 4) DR and BDR election
- 5) Propagating a default static route
- 6) Advanced interface commands

##### a) OSPF Hello and Dead Intervals

##### b. OSPF troubleshooting

- 1) OSPF states
- 2) Neighbor issues
- 3) Routing table issues

#### 2. EIGRP

##### a. Advanced configuration

- 1) Automatic and manual summarization
- 2) Propagation of default routes
- 3) Interface setting to improve performance
- a) Bandwidth command
- b) Bandwidth utilization
- c) Hello and dead timers
- 4) Load balancing
- 5) Authentication

##### b. Troubleshooting

##### 1) Basic troubleshooting commands

- a) Verifying adjacencies
- b) Passive interfaces

### F. IOS Licensing and Configuration Files

#### 1. IOS naming conventions

- a. Cisco IOS software release families and trains
- b. Cisco IOS 12.4 mainline and T trains
- c. Cisco IOS 12.4 system image packaging
- d. Cisco IOS 15.x train numbering

#### 2. Managing Cisco IOS images

- a. IOS image filenames
- b. IOS 15 system image packaging
- c. Creating Cisco IOS image backup
- d. Copying a system IOS image
- e. Boot system

#### 3. Software licensing

- a. Licensing overview
- b. Licensing process
- 1) Purchase the software package
- 2) Obtain a license
- c. License verification and management

##### 1) License verification

- 2) Activate an evaluation right-to-use license
- 3) Back up the license
- 4) Uninstall the license

## Lab Content

### A. Basic Router Configuration

1. Subnet an address space given requirements
2. Assign appropriate addresses to interfaces and document
3. Cable a network according to the topology diagram
4. Erase the startup configuration and reload a router to the default state
5. Perform basic configuration tasks on a router
6. Configure and activate Serial and Ethernet interfaces
7. Test and verify configurations

### 8. Reflect upon and document the network implementation

### B. Basic Static Route Configuration

1. Cable a network according to the topology diagram
2. Erase the startup configuration and reload a router to the default state
3. Perform basic configuration tasks on a router
4. Interpret debug ip routing output
5. Configure and activate Serial and Ethernet interfaces
6. Test connectivity
7. Gather information to discover causes for lack of connectivity between devices
8. Configure a static route using an intermediate address
9. Configure a static route using an exit interface
10. Compare a static route with intermediate address to a static route with exit interface
11. Configure a default static route
12. Configure a summary static route
13. Document the network implementation

### C. Routing Table Interpretation Lab

1. Interpret router outputs
2. Identify the IP addresses for each router
3. Draw a diagram of the network topology
4. Cable and configure a network based on the topology diagram
5. Test and verify full connectivity

### D. RIP Troubleshooting

1. Cable a network according to the topology diagram
2. Erase the startup configuration and reload a router to the default state
3. Load the routers with supplied scripts
4. Discover where convergence is not complete
5. Gather information about the non-converged portion of the network along with any other errors
6. Analyze information to determine why convergence is not complete
7. Propose solutions to network errors
8. Implement solutions to network errors
9. Document the corrected network

### E. Configure VLANs, VTP and Inter-VLAN Routing on Switches and Routers

### F. Configure and Test Switchport Security

### G. Describe the Benefits of Virtual LANs and Demonstrate their Configuration and Operation

### H. Investigating the Routing Table Lookup Process

1. Cable a network according to the topology diagram
2. Erase the startup configuration and reload a router to the default state
3. Perform basic configuration tasks on a router
4. Determine level 1 and level 2 routes
5. Modify the configuration to reflect static and default routing
6. Enable classful routing and investigate classful routing behavior
7. Enable classless routing and investigate classless routing behavior

### I. Basic OSPF Configuration Lab

1. Cable a network according to the topology diagram
2. Erase the startup configuration and reload a router to the default state
3. Perform basic configuration tasks on a router
4. Configure and activate interfaces
5. Configure OSPF routing on all routers
6. Configure OSPF router IDs
7. Verify OSPF routing using show commands
8. Configure a static default route
9. Propagate default route to OSPF neighbors
10. Configure OSPF Hello and Dead Timers
11. Configure OSPF on a multi-access network
12. Configure OSPF priority
13. Understand the OSPF election process
14. Document the OSPF configuration

J. Analyze the Advantages of LAN Segmentation, and LAN Segmentation using Bridges, Switches, and Routers

## Special Facilities and/or Equipment

- A. Access to a network laboratory with current Cisco network equipment host computers required to support the class.
- B. A website or course management system with an assignment posting component (through which all lab assignments are to be submitted) and a forum component (where students can discuss course material and receive help from the instructor). This applies to all sections, including on-campus (i.e., face-to-face) offerings.
- C. When taught via Foothill Global Access on the Internet, the college will provide a fully functional and maintained course management system through which the instructor and students can interact.
- D. When taught via Foothill Global Access on the Internet, students must have currently existing email accounts and ongoing access to computers with internet capabilities.

## Method(s) of Evaluation

Methods of Evaluation may include but are not limited to the following:

- Tests and quizzes
- Written laboratory assignments
- Final examination

## Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

- Lectures which include motivation for the architecture of the specific topics being discussed
- In-person or online labs (for all sections, including those meeting face-to-face/on-campus), consisting of:
  1. An assignment webpage located on a college-hosted course management system or other department-approved internet environment. Here, the students will review the specification of each assignment and submit their completed lab work
  2. A discussion webpage located on a college-hosted course management system or other department-approved internet environment. Here, students can request assistance from the instructor and interact publicly with other class members
- Detailed review of laboratory assignments which includes model solutions and specific comments on the student submissions
- In person or online discussion which engages students and instructor in an ongoing dialog pertaining to all aspects of designing, implementing and analyzing programs
- When course is taught fully online:
  1. Instructor-authored lecture materials, handouts, syllabus, assignments, tests, and other relevant course material will be delivered through a college-hosted course management system or other department-approved internet environment
  2. Additional instructional guidelines for this course are listed in the attached addendum of CS department online practices

## Representative Text(s) and Other Materials

Odom, Wendall. CCNA 200-301 Official Cert Guide, Volume 1. 2019.

## Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

- A. Reading
  1. Textbook assigned reading averaging 30 pages per week.
  2. Online curriculum averaging 20 pages per week.
  3. Online resources as directed by instructor though links pertinent to networking.
  4. Library and reference material directed by instructor through course handouts.
- B. Writing
  1. Technical prose documentation that supports and describes the laboratory exercises that are submitted for grades.

## Discipline(s)

Computer Science