C S 50D: CONNECTING NETWORKS-WANS (CCNA)

Foothill College Course Outline of Record

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

Student Learning Outcomes

- The student will demonstrate the ability to secure a local area and wide area network.
- The student will demonstrate knowledge of the design and configuration of Wide Area Networks utilizing point-to-point (PPP) and point-to-multipoint (Frame Relay) topologies.

Description

This course discusses the WAN technologies and network services required by converged applications in a complex network. The course enables students to understand the selection criteria of network devices and WAN technologies to meet network requirements. Students learn how to configure and troubleshoot network devices and resolve common issues with data link protocols. Students will also develop the knowledge and skills needed to implement IPsec and virtual private network (VPN) operations in a complex network.

Course Objectives

The student will be able to:
A. Understand and describe various WAN technologies and their benefits
B. Understand and describe the operations and benefits of virtual private networks (VPNs) and tunneling
C. Configure and troubleshoot serial point-to-point connections
D. Configure and troubleshoot Frame Relay connections
E. Understand and configure Network Address Translation (NAT) for IPv4
F. Compare and contrast broadband solutions
G. Describe the purpose of network monitoring and the available tools
H. Demonstrate the understanding and ability to trouble network failures

Course Content

A. WAN Technologies which Support Communications Between Local Area Networks in Different Geographic Locations
1. Characteristics
a. Link cost and performance
b. Security
c. Flexibility
d. Time to deploy
e. Hierarchical network design
f. Enterprise architectures
g. The evolving network architecture
B. Virtual Private Network (VPN) design and deployment
1. Virtual Private Networks
a. Benefits
1) Cost savings
2) Scalability
3) Compatibility with broadband technology
4) Security
2. Site-to-site VPNs
a. Connect entire networks to each other
b. Internal hosts have no knowledge that a VPN exists
c. Created when devices on both sides of the VPN connection are aware of the VPN configuration in advance
d. End hosts send and receive normal TCP/IP traffic through a VPN gateway
e. The VPN gateway then sends it through a VPN tunnel over the internet to a peer VPN gateway at the target site
f. Upon receipt, the peer VPN gateway strips the headers, decrypts the content, and relays the packet toward the target host inside its private network
3. Remote access VPNs
a. Secure Sockets Layer VPN (SSL)
1) Provides remote access by using a web browser and the web browser's native SSL encryption
2) Can provide remote access using the Cisco AnyConnect Secure Mobility Client software
b. IP security (IPsec)
1) Provides full IPsec functionality
2) Requires an IPsec client to connect
3) Site-to-site GRE tunnels
4. IPsec provides
a. Basic characteristics
1) Information from a private network is securely transported over a public network
2) Forms a virtual network instead of using a dedicated Layer 2 connection
3) The traffic is encrypted to keep the data confidential
4) Data integrity
5) Anti-replay protection
6) Authentication
C. The Serial Point-to-Point Communications
1. Overview
a. Serial vs. parallel communications
b. Time division multiplexing (TDM)
c. Demarcation point
d. DTE-DCE
e. Serial cables
f. Serial bandwidth
2. Serial communications protocols
a. HDLC
1) Description of HDLC
2) HDLC frame types
3) Configuring HDLC
4) Troubleshooting a serial connection problem
b. PPP
1) Define Point-to-Point Protocol (PPP)
a) Link Control Protocol (LCP)
b) Network Control Program (NCP) frames in PPP
2) PPP authentication
a) Password Authentication Protocol (PAP)
b) Challenge Handshake Authentication Protocol (CHAP)

c) Configuration and verification the configuration of PPP
d) Troubleshooting PPP connectivity
D. Frame Relay
1. Frame relay technology
a. LMI features
b. LMI types
c. Frame relay subinterfaces
d. Network topologies
e. DLCIs
2. Configuration of basic frame relay
a. Enable frame relay
b. PVC (Permanent Virtual Circuit) number
c. Address type
1) Static
2) Dynamic
d. Frame relay map
e. Reachability issues
f. Troubleshooting
E. Network Address Translation
1. Private IP addresses vs. public IP addresses
2. Which addresses are translated
3. Where does the translation occur
4. Configuration of NAT
a. Configure static NAT using the CLI
b. Configure dynamic NAT using the CLI
c. Configure PAT using the CLI
d. Configure port forwarding using the CLI
e. Configure NAT64
f. Use show commands to verify NAT operation
5. NAT vs. PAT
6. NAT for IPv6
7. Troubleshooting NAT
a. Show commands
b. Debug commands
F. Broadband Solutions
1. Teleworking
a. Teleworking is conducting work by connecting to a workplace from a remote location, using telecommunications
b. Efficient teleworking uses broadband internet connections, a Virtual Private Network (VPN), VoIP, and videoconferencing
c. Benefits: Improved employee productivity, reduced costs and expenses, easier recruitment and retention, reduced absenteeism, improved morale, improved corporate citizenship, improved customer service
d. Teleworker solution: Broadband connections, IPsec VPNs, traditional private WAN Layer 2 technologies
2. Cable
a. What is a cable system
b. Cable and the electromagnetic spectrum
c. Data-over-Cable Service Interface Specification (DOCSIS)
d. Cable components
3. DSL
a. DSL characteristics
1) DSL provides high-speed connections over installed copper wire system
2) Two basic types of DSL technologies are asymmetric (ADSL) and symmetric (SDSL)
3) ADSL uses a frequency range from approximately 20 kHz to 1 MHz
4) ADSL provides higher downstream bandwidth to the user than upload bandwidth
5) SDSL provides the same capacity in both directions
6) Local loop must be less than approximately 3.39 mi. (5.46 km) for ADSL

b. DSL connections
1) Transceiver
2) DSL access multiplexer
c. Other broadband wireless technology types
1) Municipal Wi-Fi (Mesh)
2) Worldwide Interoperability for Microwave Access (WiMAX)
d. Comparing broadband solutions
e. Configuring xDSL
1) PPPoE concepts and motivations
2) PPPoE configuration
G. Network Monitoring
1. Syslog operation in a small-to-medium-sized business network
a. Syslog operation
b. Syslog message format
c. Service timestamp
d. Syslog server
e. Default logging
f. Router and switch commands for Syslog clients
g. Verifying Syslog
2. Using SNMP to compile messages on a small-to-medium-sized business network
a. Introduction to SNMP
b. SNMP operation
c. SNMP Agent Traps
d. SNMP versions
e. Community strings
f. Management Information Base object ID
g. Configuring SNMP
1) Configure the community string and access level (read-only or read-write) with the snmp-server community string ro | rw command
2) Document the location of the device using the snmp-server location text command
3) Document the system contact using the snmp-server contact text command
4) Restrict SNMP access to NMS hosts (SNMP managers) that are permitted by an ACL. Define the ACL and then reference the ACL with the snmp-server community string access-list-number-or-name command
5) Specify the recipient of the SNMP trap operations with the snmp-server host host-id [version {1 | 2c | 3 [auth | noauth | priv]}] community-string command. By default, no trap manager is defined
6) Enable traps on an SNMP agent with the snmp-server enable traps notification-types command
3. NetFlow operation in a small-to-medium-sized business network
a. Purpose of NetFlow
b. Network flows
c. NetFlow configuration tasks
d. Verifying NetFlow
e. NetFlow collector functions
f. NetFlow analysis with a NetFlow collector

Lab Content

A. Design Network Hierarchy
1. A network administrator is tasked with designing an expanded network for the company
2. Use the internet to research the Cisco three-layer design model
3. Choose the appropriate design and select the required equipment
4. Document the design
B. Select WAN Access Technologies to Satisfy Business Requirements in a Small-to-Medium-Sized Business Network
1. Study and understand the lab scenario
2. Research the determine the components that to fulfill the requirements

3. Create a presentation of your results
C. Configure Basic PPP with Authentication
1. Configure basic device settings
2. Configure PPP encapsulation
3. Configure PPP CHAP authentication
D. Configure Frame Relay and Subinterfaces
1. Build the network and configure basic device settings
2. Configure a frame relay switch
3. Configure basic frame relay
4. Troubleshoot frame relay
5. Configure a frame relay subinterface
E. Configuring Dynamic and Static NAT
1. Build the network and verify connectivity
2. Configure and verify static NAT
3. Configure and verify dynamic NAT
F. Configure a Router as a PPPoE Client for DSL Connectivity
1. Build the network
2. Configure the ISP router
3. Configure the Cust1 router
G. Configure a Point-to-Point GRE VPN Tunnel
1. Configure basic device settings
2. Configure a GRE tunnel
3. Enable routing over the GRE tunnel
H. Configure SNMP
1. Build the network and configure basic device settings
2. Configure an SNMP Manager and Agents
3. Convert OID Codes with the Cisco SNMP Object Navigator
I. Network Failure
1. Gather documentation
2. Test connectivity
3. Gather data and implement solutions
4. Test connectivity

Special Facilities and/or Equipment

A. The college will provide access to a network laboratory with current Cisco network equipment and host computers required to support the class.
B. The college will provide 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

Tests and quizzes
Written laboratory assignments
Final examination

Method(s) of Instruction

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