

CCNP: ENCOR - Implementing and Operating Cisco Enterprise Network Core Technologies (Exam 350-401)

Course Overview

This course teaches students about working with network core technologies. Topics covered include enterprise architecture, VLANs, EtherChannels, OSPF, Spanning-Tree Protocol, multicast protocols, Python, and more.

Chapter 1 - Enterprise Architecture

26m

Instructor Introduction
Cisco Enterprise Architecture Model
Campus LAN Design Fundamentals
Layers in the Hierarchical Model
Routed vs. Switched Campus Architecture
Traditional Multilayer Campus Layer Design
Access Layer
Distribution Layer
Core Layer
When the Core Layer is Needed
When the Core Layer is Needed (Cont.)
Campus Distribution Layer Design
Campus Distribution Layer Design (Cont.)
Campus Distribution Layer Design (Cont.)
Campus Distribution Layer Design (Cont.)

Chapter 2 – VLANs and 802.1Q Trunking

25m

Revisiting VLANs
Creating a VLAN
Assigning a Port to a VLAN
Creating a VLAN
Creating a VLAN (Cont.)
Creating a VLAN (Cont.)
Trunking with 802.1Q
Trunking with 802.1Q (Cont.)
VLAN Tagging
IEEE 802.1Q
Native VLAN
Configuring an 802.1Q Trunk
Configuring an 802.1Q Trunk (Cont.)
Configuring an 802.1Q Trunk (Cont.)
Inter-VLAN Routing
Option 1: Router with a Separate Interface in Each VLAN

Option 2: Layer 3 Switch
Demo - Troubleshooting

Chapter 3 – Switching

20m

Layer 2 Switch Operation
Layer 2 Switch Operation (Cont.)
MAC-Address Table and TCAM
Demo - The CAM
Control and Data Plane
Cisco Switching Mechanisms
Cisco Switching Mechanisms (Cont.)
Cisco Switching Mechanisms (Cont.)
Process Switching and Fast Switching
Cisco Express Forwarding
Demo - Cisco Express Forwarding

Chapter 4 – EtherChannels

19m

Need for EtherChannel
Need for EtherChannel (Cont.)
Need for EtherChannel (Cont.)
EtherChannel Mode Interactions
Layer 2 EtherChannel Configuration Guidelines
Layer 2 EtherChannel Configuration Guidelines (Cont.)
EtherChannel Load-Balancing Options
EtherChannel Load-Balancing Operation
Troubleshoot EtherChannel Issues
Troubleshoot EtherChannel Issues (Cont.)
Troubleshoot EtherChannel Issues (Cont.)
Demo - Troubleshoot EtherChannel Issues

Chapter 5 – EIGRP

33m

EIGRP Features
EIGRP Reliable Transport
EIGRP Operation Overview
EIGRP Packet Format
Establishing EIGRP Neighbor Adjacency
EIGRP Metrics
EIGRP Classic Metric Calculation
EIGRP-Wide Metrics
EIGRP Path Selection
Loop Free Path Selection
EIGRP Load Balancing
Equal Cost Load Balancing
Unequal Cost Load Balancing
Traffic Sharing
Traffic Sharing (Cont.)
EIGRP for IPv6

EIGRP Components
Compare EIGRP and OSPF Routing Protocols
Demo - EIGRP Stub
Demo - EIGRP Load Balancing and Authentication

Chapter 6 – BGP

24m

Inter-domain Routing with BGP
BGP Characteristics
Path Vector Functionality in BGP
BGP Routing Policies
BGP Operations
BGP Message Types
Types of BGP Neighbor Relationships
eBGP Neighbor Relationships
BGP Path Selection
BGP Best Path Selection Algorithm
BGP Path Attributes
BGP Path Attributes (Cont.)
Weight Attribute
Local Preference Attribute
AS-Path Attribute
MED Attribute
Demo - eBGP

Chapter 7 – OSPF

45m

Describe OSPF
Describe OSPF (Cont.)
The OSPF Process
The OSPF Process (Cont.)
The OSPF Process (Cont.)
The OSPF Process (Cont.)
The OSPF Process (Cont.)
OSPF Neighbor Adjacencies
OSPF Neighbor Adjacencies (Cont.)
Building a Link-State Database
OSPF Packet Types
OSPF Packet Header Format
OSPF LSA Types
OSPF LSA Types (Cont.)
Compare Single-Area and Multi-Area OSPF
Compare Single-Area and Multi-Area OSPF (Cont.)
OSPF Area Structure
OSPF Area Structure (Cont.)
OSPF Network Types
Demo - Configuring OSPFv3 using the Newer Syntax
OSPF Cost
OSPF Cost (Cont.)

OSPF Cost (Cont.)
OSPF Route Summarization
Route Summarization Benefits
Distribute List Example
Prefix List Example
Explore Route Maps
Route Map Applications
Route Map Operation
Route Match Statement
Route Map Configuration
Demo - OSPF Stub and Totally Stubby

Chapter 8 – Network Address Translation

15m

Define Network Address Translation
NAT Address Types
Explore NAT Implementations
Understanding Static NAT
Understanding Dynamic NAT
Understanding PAT
NAT Virtual Interface
NAT Virtual Interface (Cont.)
Demo - Configuring Network Address Translation

Chapter 9 – Redundancy

21m

Need for Default Gateway Redundancy
Define FHRP
Define FHRP (Cont.)
HSRP Interface Tracking
HSRP Interface Tracking (Cont.)
HSRP Interface Tracking (Cont.)
HSRP Load Sharing with HSRP Multigroup
HSRP Load Sharing with HSRP Multigroup (Cont.)
HSRP Load Sharing with HSRP Multigroup (Cont.)
HSRP Authentication
HSRP Versions
Cisco Switch High Availability Features
Nonstop Forwarding with Stateful Switchover on Catalyst 9400
Demo - HSRP
Demo – VRRP

Chapter 10 – Spanning-Tree Protocol

30m

Spanning-Tree Protocol Overview
Spanning-Tree Protocol Overview (Cont.)
BPDU
BPDU (Cont.)
Root Bridge Election
Root Bridge Election (Cont.)

Designated Port Election
STP Port States
Spanning-Tree Protocol Types and Features
Comparison of STP Protocols
Default Spanning-Tree Configuration
Multiple Spanning Tree Protocol
Multiple Spanning Tree Protocol Recommended Practices
Multiple Spanning Tree Protocol Recommended Practices (Cont.)
Demo - Multiple Spanning Tree Protocol
PortFast and BPDU Guard
PortFast and BPDU Guard (Cont.)
Configuring PortFast and BPDU Guard
Verifying PortFast and BPDU Guard
Verifying PortFast and BPDU Guard (Cont.)
Verifying PortFast and BPDU Guard (Cont.)
Verifying PortFast and BPDU Guard (Cont.)

Chapter 11 – Virtualization and VPNs

47m

Server Virtualization
Physical Server
Virtualized Server
Basic Virtualized Server Environment
Server Virtualization Benefits
Hypervisor: Abstraction Layer
VM Definition
Accessing vSphere Hosts Directly
Centralized Control of vSphere Hosts
Need for Network Virtualization
Need for Network Virtualization (Cont.)
Path Isolation Overview
Device Virtualization
Data Path Virtualization
Introducing VRF
Demo - VRF
Introducing Generic Routing Encapsulation
Site-to-Site VPN Technologies
Site-to-Site VPN Technologies (Cont.)
IPsec VPN Overview
IPSec Security Associations
IPsec: IKE
IPsec Modes
IPsec VPN Types
Dynamic Multipoint VPN
Cisco IOS FlexVPN
Cisco IOS VTI
Cisco IOS VTI (Cont.)
Cisco IOS VTI (Cont.)

Basic IKE Peering
Basic IKE Peering (Cont.)
Configuring Basic IKE Peering
Configuring Basic IKE Peering (Cont.)
Verifying IKE Peering
Verifying IKE Peering (Cont.)
Demo - VTI

Chapter 12 – Wireless Options and Services

1h 44m

RF Principles
Frequency
Watts and Decibels
Watts and Decibels (Cont.)
Antenna Power
Effective Isotropic-Radiated Power (EIRP)
Antenna Types
Omni-directional Antennas
Omni-directional Antennas (Cont.)
Omni-directional Antennas (Cont.)
Omni-directional Antennas (Cont.)
Directional Antennas
Directional Antennas (Cont.)
Directional Antennas (Cont.)
802.11n/802.11ac MIMO
802.11n/802.11ac MIMO – MRC
802.11n/802.11ac MIMO – Beamforming
802.11n/802.11ac MIMO – Spatial Multiplexing
802.11ac MU-MIMO
Client and AP Association
Split MAC
CAPWAP
MC and MA Functions
PoP and PoA Functions
Wireless Deployment Overview
Autonomous AP Deployment
Autonomous Deployment Traffic Flow
Cisco Autonomous Deployment Overview
Centralized Cisco WLC Deployment
Centralized Control and Provisioning of APs
Centralized Deployment Traffic
FlexConnect Deployment
FlexConnect Deployment Traffic Flow
FlexConnect Deployment Traffic Flow (Cont.)
FlexConnect Deployment Traffic Flow
FlexConnect Deployment
FlexConnect Deployment (Cont.)
Cloud Deployment and Its Effect on Enterprise Networks

Cloud Deployment and Its Effect on Enterprise Networks (Cont.)

Cloud Computing Services

Cloud-Managed Meraki Solution

Cisco Meraki Deployment Traffic Flow

Demo - Meraki

Cisco Catalyst 9800 Series Controller Deployment Options

Catalyst 9800 Embedded Wireless Controller

Catalyst 9800 Cloud Controller

Cisco Mobility Express

Wireless Roaming Overview

Scanning for a new AP

Mobility Groups and Domains

Wireless Roaming Types

Layer 2 Inter-Controller Roaming

Layer 2 Inter-Controller Roaming (Cont.)

Network Analytics

Cisco CMX

Cisco CMX Analytics Tools

Location Accuracy

Surveying Location-Based Services

Universal AP Priming

CAPWAP Discovery

AP Join Order

AP Join Phase with Master

AP Join Phase without Master

AP Fail-over

AP-Specific High Availability

N + 1 WLC High Availability

AP SSO High Availability

AP SSO High Availability (Cont.)

Local Mode

FlexConnect Mode

FlexConnect Mode (Cont.)

Bridge Mode

Bridge Mode (Cont.)

Other Modes

Chapter 13 – Authenticating and Troubleshooting Wireless Clients

52m

Authentication Methods

Pre-Shared Key (PSK) Authentication

PSK Authentication Process

802.1X User Authentication

802.1X User Authentication (Cont.)

PKI and 802.1X Certificate-Based Authentication

Asymmetric Encryption of User Credentials

Digital Signatures

Certificates and Certificate Authorities (CA)

Retrieving CA Certificates
Authentication Using Certificates
Introduction to Extensible Authentication Protocol (EAP)
EAP Frame Format
EAP Authentication Types
EAP-Transport Layer Security (EAP-TLS)
Protected Extensible Authentication Protocol (PEAP)
EAP-FAST
PAC Creation
PAC Exchange
EAP-FAST Authentication
Guest Access with Web Auth
Local Web Authentication
Local Web Authentication with Auto-Anchor
Local Web Portal with External Authentication
Centralized Web Authentication
Wireless Troubleshooting Tools
Spectrum Analysis
Spectrum Analysis (Cont.)
Wi-Fi Scanning
Packet Analysis
Cisco AireOS GUI and CLI Tools
Cisco AireOS GUI and CLI Tools (Cont.)
Cisco Wireless Config Analyzer Express
Common Wireless Client Connectivity Issues
Client to AP Connectivity
Client Association with AP
Client Association with AP (Cont.)
WLAN Configuration
Infrastructure Configuration

Chapter 14 – QoS

21m

Batch Applications
Interactive Applications
Real-Time Applications
IPv4 Header Address Fields
Traffic Characteristics
Need for Quality of Service (QoS)
QoS Mechanisms
Trust Boundary
Classification and Markings
Classification Tools
NBAR Advanced Classification Tool
Policing, Shaping, and Re-Marking
Policing, Shaping, and Re-Marking (Cont.)
Managing Congestion
Class Based Weighted Fair Queuing

Tools for Congestion Avoidance
Define and Interpret a QoS Policy
Method for Implementing a QoS Policy
MQC QoS Scenario

Chapter 15 – Multicast Protocols

22m

Multicast Overview
Multicast Overview
Unicast vs. Multicast
How Does IP Multicast Work?
Multicast Advantages and Disadvantages
IP Multicast Applications
IP Multicast Group Address
IP Multicast Group Address
IP Multicast Service Model
IP Multicast Service Model (Cont.)
Internet Group Management Protocol
IGMPv1
IGMPv2
IGMPv3
Source Trees
Shared Trees
IP Multicast Routing
PIM-DM
PIM-SM
PIM-SM Shared Tree Join
PIM-SM Sender Registration
PIM-SM Sender Registration (Cont.)
PIM-SM Sender Registration (Cont.)
Rendezvous Point
Static RP
BSR
Auto-RP

Chapter 16 – Cisco DNA

29m

Need for Digital Transformation
Need for Digital Transformation (Cont.)
Cisco Digital Network Architecture
Cisco Intent-Based Network
Building Blocks of Intent-Based Enterprise Networks
Assurance
Cisco DNA Center
Cisco DNA Center (Cont.)
Cisco DNA Assurance
Cisco DNA Assurance (Cont.)
Cisco DNA Assurance (Cont.)
Network Discovery and Management

Inventory Management
Manage Software Image
Network Hierarchy
IP Address Pools
Day 0 Network Provisioning
Day N Network Automation
Cisco DNA Assurance Workflow
Demo - DNA Center

Chapter 17 – APIs

12m

Application Programming Interfaces
Application Programming Interfaces (Cont.)
Application Programming Interfaces (Cont.)
REST API Response Codes and Results
REST API Response Codes and Results (Cont.)
REST API Success Codes
REST API Client Error Codes
REST API Server Error Codes
REST API Security
REST API Security (Cont.)
API in DNA-Center
REST API in vManage
vManage REST API Resources
vManage REST API Resources (Cont.)
vManage REST Methods

Chapter 18 – Python

23m

Python Concepts
Python Concepts (Cont.)
Executing Python Code
Python Scripts
Python Helper Utilities and Functions
Write Idiomatic Python
Common Python Data Types
String Data Types
Printing Strings
Concatenating Strings
String Built in Methods
Variable Assignment
Numbers Data Types
Boolean Data Types
Conditionals
Conditionals (Cont.)
Script Writing and Execution
Executing Scripts
Analyzing Code
Analyzing Code (Cont.)

Analyzing Code (Cont.)
Analyzing Code (Cont.)
Analyzing Code (Cont.)
Analyzing Code (Cont.)

Chapter 19 – Network Tools and Services

1h 18m

Troubleshooting Concepts
Diagnostic Principles
Network Troubleshooting Procedures: Overview
Defining the Problem
Gathering Information
Analyzing Information
Eliminating Potential Causes and Proposing a Hypothesis
Testing a Hypothesis
Solving the Problem and Documenting the Solution
Demo - Troubleshooting
Basic Hardware Diagnostics
Basic Hardware Diagnostics (Cont.)
Basic Hardware Diagnostics (Cont.)
Basic Hardware Diagnostics (Cont.)
Basic Hardware Diagnostics (Cont.)
Basic Hardware Diagnostics (Cont.)
Basic Hardware Diagnostics (Cont.)
Filtered Show Commands
Exclude Filter
Include Filter
Begin Filter
Section Filter
Regular Expressions in Filters
Regular Expressions in Filters (Cont.)
Cisco IOS IP SLAs
IP SLA Source and Responder
Demo - IP SLAs
Switch Port Analyzer (SPAN)
Local SPAN
Local SPAN Configuration
Validating Local SPAN Configuration
Remote SPAN (RSPAN)
RSPAN Configuration
RSPAN Configuration (Cont.)
Verifying RSPAN Configuration
Verifying RSPAN Configuration (Cont.)
Encapsulated Remote Switch Port Analyzer (ERSPAN)
ERSPAN Configuration
ERSPAN Source Configuration
ERSPAN Destination Configuration
ERSPAN Verification

Cisco Packet Capture Tools
Network Time Protocol (NTP)
Network Time Protocol (NTP) (Cont.)
NTP Modes
Securing NTP
Securing NTP (Cont.)
Logging Services
Understanding Syslog
Syslog
Syslog Messages
Demo - Logging
Simple Network Management Protocol (SNMP)
SNMP Operations
NetFlow
Analyzing NetFlow Data
Format of Export Data
Where Can NetFlow Be Implemented in the Network?
NetFlow Applications
Traditional NetFlow Configuration and Verification
Traditional NetFlow Configuration and Verification (Cont.)
Flexible NetFlow
Traditional vs. Flexible NetFlow
Demo - Flexible NetFlow
Cisco IOS Embedded Event Manager (EEM)
Demo - EEM

Chapter 20 – Security

1h 50m

ACL
ACL (Cont.)
ACL (Cont.)
ACL Wildcard Masking
ACL Wildcard Masking (Cont.)
ACL Wildcard Masking (Cont.)
Wildcard Bit Mask Abbreviations
Types of ACLs
Types of ACLs (Cont.)
Configure Numbered Standard IPv4 ACLs
Configure Numbered Standard IPv4 ACLs (Cont.)
Configure Numbered Standard IPv4 ACLs (Cont.)
Configure Numbered Standard IPv4 ACLs (Cont.)
Configure Numbered Extended IPv4 ACLs
Configure Numbered Extended IPv4 ACLs (Cont.)
Configure Numbered Extended IPv4 ACLs (Cont.)
Use ACLs to Filter Network Traffic
Use ACLs to Filter Network Traffic (Cont.)
Apply ACLs to Interfaces
Apply ACLs to Interfaces (Cont.)

Apply ACLs to Interfaces (Cont.)
Configure Named Access Lists
Configure Named Access Lists (Cont.)
Configure Named Access Lists (Cont.)
Configure Named Extended ACLs
Demo - ACLs
Control Plane Overview
Control Plane Policing
Control Plane Policing (Cont.)
Control Plane Policing (Cont.)
Control Plane Policing Configuration
Control Plane Policing Configuration (Cont.)
Control Plane Policing Configuration (Cont.)
Control Plane Policing Verification
Control Plane Policing Verification (Cont.)
Control Plane Policing Verification (Cont.)
Control Plane Policing Verification (Cont.)
Demo - CoPP
Threatscape
Intrusion Prevention Systems
Virtual Private Networks
Content Security
Content Security (Cont.)
Logging
Endpoint Security
Personal Firewalls
Antivirus and Antispyware
Centralized Endpoint Policy Enforcement
Cisco AMP for Endpoints
Cisco AMP for Endpoints (Cont.)
Firewall Concepts
Firewall Concepts (Cont.)
Firewall Concepts (Cont.)
Firewall Concepts (Cont.)
TrustSec
SGT Classification
Inline SGT Support
Enforcement Using SGFW
Enforcement Using SGFW with the ASA
MACsec
Identify Management
Identify Management (Cont.)
802.1X for Wired and Wireless Endpoint Authentication
802.1X Message Flow
802.1X Authorization
802.1X VLAN Assignment
802.1X Named ACLs
802.1X Downloadable ACLs

802.1X Host Modes
802.1X Host Modes
Change of Authorization
802.1X Implementation Guidelines
MAC Authentication Bypass
MAC Authentication Bypass: Benefits and Limitations
MAC Authentication Bypass Behavior
Web Authentication
Web Authentication (Cont.)
Web Authentication Process
Web Authentication Scenarios
Demo - Email Security
Securing Device Access
Securing Device Access (Cont.)
Securing Device Access (Cont.)
Line Password
Username and Password
Device Hardening Options
AAA Framework Overview
Benefits of AAA
Authentication Options
RADIUS and TACACS+
RADIUS and TACACS+ (Cont.)
RADIUS AAA Communications
TACACS+ AAA Communications
Enabling AAA and Configuring a Local User for Fallback
Configuring RADIUS for Console and VTY Access
Configuring RADIUS for Console and VTY Access (Cont.)
Configuring TACACS+ for Console and VTY Access
Configure Authorization and Accounting
Configure Authorization and Accounting (Cont.)

Chapter 21 – Software-Defined Access and WANs

54m

Customer Challenges in Campus Network
Cisco Digital Network Architecture
Need for Cisco SD-Access
Need for Cisco SD-Access (Cont.)
Need for Cisco SD-Access (Cont.)
Need for Cisco SD-Access (Cont.)
Cisco SD-Access Fabric Overview
Types of Overlay
Why Overlays
Fabric Underlay - Manual vs. Automated
LISP and the Cisco SD-Access Fabric Control Plane
LISP and the Cisco SD-Access Fabric Control Plane (Cont.)
LISP Terms and Components
LISP Packet Flow

LISP Packet Flow (Cont.)
LISP Host Mobility Deployment Models
LISP Host Mobility Deployment Models (Cont.)
Host Mobility in LISP
Host Mobility in LISP (Cont.)
Cisco SD-Access Fabric Data Plane Based on VXLAN
Understanding VXLAN
VXLAN Encapsulation
VXLAN Encapsulation (Cont.)
VXLAN Gateways
VXLAN-GPO Header
Cisco SD-Access Fabric Policy Plane
Traditional Access Control
Role of Cisco TrustSec
Cisco TrustSec and Cisco ISE
Cisco SD-Access Fabric Policy Plane
Cisco SD-Access Fabric Nodes
Cisco SD-Access Control Plane Node
Cisco SD-Access Edge Node
Cisco SD-Access Border Node
Wireless LAN Controller and Fabric Mode APs
DNA Center and ISE Integration
DNA Center SD-Access Workflow
Cisco SD-Access Wireless Integration
Cisco SD-Access Wireless Integration (Cont.)
Cisco SD-Access Wireless Workflow – Adding WLC to Fabric
Cisco SD-Access Wireless Workflow – AP Join Process
Cisco SD-Access Wireless Workflow – Client Onboarding
Cisco SD-Access Wireless Workflow – Client Roaming
Traditional Campus Inter-operating with Cisco SD-Access
Traditional Campus Inter-operating with Cisco SD-Access (Cont.)
Need for Software Defined Networking for WAN
Need for Software Defined Networking for WAN (Cont.)
SD-WAN Components
SD-WAN Orchestration Plane
SD-WAN Management Plane
SD-WAN Management Plane (Cont.)
SD-WAN Management Plane (Cont.)
SD-WAN Control Plane
SD-WAN Data Plane
SD-WAN Automation and Analytics
SD-WAN vAnalytics
SD-WAN vAnalytics (Cont.)
Demo - SD-WAN

Chapter 22 – Network Programming

31m

Configuration Management

Configuration Management (Cont.)

Evolution of Device Management and Programmability

Evolution of Device Management and Programmability (Cont.)

Evolution of Device Management and Programmability (Cont.)

Evolution of Device Management and Programmability (Cont.)

Evolution of Device Management and Programmability (Cont.)

Data Encoding Formats

JSON

JSON (Cont.)

JSON (Cont.)

JSON (Cont.)

JSON (Cont.)

JSON (Cont.)

JSON (Cont.)

JSON (Cont.)

JSON (Cont.)

JSON (Cont.)

JSON (Cont.)

JSON (Cont.)

JSON (Cont.)

JSON (Cont.)

JSON (Cont.)

YANG Models

Model Driven Programmability Stack

Model Driven Programmability Stack (Cont.)

Describe YANG

YANG Overview

REST

REST (Cont.)

REST (Cont.)

REST (Cont.)

REST (Cont.)

Common HTTP Response Codes

Common HTTP Response Codes (Cont.)

Common HTTP Response Codes (Cont.)

REST Tools

NETCONF

NETCONF Protocol Stack

NETCONF Data Stores

NETCONF over SSH

NETCONF over SSH (Cont.)

NETCONF over SSH (Cont.)

NETCONF over SSH (Cont.)

NETCONF over SSH (Cont.)

XML Encoding

XML Encoding (Cont.)
Utilities and Tools
NETCONF and YANG
NETCONF and YANG Side by Side
NETCONF Protocol Operations
NETCONF Protocol Operations (Cont.)
NETCONF Configuration Datastores
Describe RESTCONF
RESTCONF Methods
RESTCONF Sample: GET Interface
RESTCONF Sample: GET Interface Description
RESTCONF Sample: GET YANG Library Version
RESTCONF Sample: Invoke RPC
Cisco IOS XE and IOS XR Systems Overview

Total Duration: 14h 2m