# 640-864: Designing for Cisco Internetwork Solutions (DESGN) v2.1

## Course Introduction — 4m

Course Introduction

## Module 01 - Network Design Methodology Overview — 1hr 38m

**Understanding the Network Architectures for the Enterprise**

Forces Affecting Business
Technology-Related Forces Affecting Business
IT Challenges: Budget, Expertise, and Silos
Cisco Architectural Approach
Borderless Networks Architecture
Architecture of Borderless Network
Cisco Collaboration Architecture
Cisco Data Center/Virtualization Architecture
Benefits of Cisco Network Architectures Specifically for the Enterprise
Summary

**Identifying Design Requirements**

PPDIOO Network Life-Cycle Approach
Benefits of the Life-Cycle Approach
Design Methodology Under PPDIOO
Identifying Customer Requirements
Identifying Planned Applications
Example: Planned Applications
Identifying Planned Infrastructure Services
Example: Planned Infrastructure Services
Identifying Organizational Goals
Example: Organization Goals
Assessing Organizational Constraints
Example: Organizational Constraints
Identifying Technical Goals
Example: Technical Goals
Example: Technical Constraints
Summary

**Characterizing the Existing Network and Sites**

Identifying Major Features of the Network
Sample Site Contact Questions
Example: Customer Network Diagram
Network Audit Information Sources
Example: Network Audit
Network Assessment Tools
RSPAN with VACLs for Granular Traffic Analysis
Example: Automatic VoIP Information Collection-NetIQ Vivinet Assessor
Example: Automatic Information Collection-NetMRI Inventory
Example: Cisco IOS NetFlow Printout
Example: NBAR Printout
Network Traffic Analysis
Steps in Analyzing Network Traffic
Example: Traffic Analysis
Network Analysis Tools
Example: AirMagnet VoFi Graph
Example: SolarWinds Orion

Summary Report
Example: Equipment Summary Report
Example: Summary Report Problem Statement
Example: Summary Report Recommendations
Documenting an Existing Network
Network Characterization Hour Estimates
Summary
**Using a Top-Down Approach to Network Design**
Top-Down Design Practices
Top-Down and Bottom-Up Approach Comparison
Example: Top-Down Voice Design
Creating a Network Decision Table
Example: Selecting a Routing Protocol
Assessing the Scope of the Network Design Project
Example: Assessing the Scope of the Network Design Project
Structured Design Principles
Borderless Networks
Network Design Tools
Planning a Design Implementation
Major Implementation Components
Example: Summary Implementation Plan
Example: Detailed Implementation Plan
Pilot vs. Prototype Networks
Example: Pilot Network
Detailed Structure of a Design Document
Summary
Module 01 Review

## Module 02 - Structuring and Modularizing the Network 1hr 59m

**Designing the Network Hierarchy**
Layers in the Hierarchical Model
Example: Hierarchical Network
Access Layer
Access Layer Connectivity
Distribution Layer
Example: Distribution Layer in the Traditional Campus Network
Example: Distribution Layer in the Routed Campus Network
Providing Redundancy in the Distribution Layer with VSS
Core Layer
Example: Core Layer in the Traditional Campus Network
Example: Core Layer in the Routed Campus Network
Example: Collapsed Core in the Traditional Campus Network
Example: Collapsed Core in the Routed Campus Network
Summary
**Using a Modular Approach in Network Design**
Cisco Network Architectures for the Enterprise Functional Areas and Modules
Example: Dividing the Network into Areas
Enterprise Campus Infrastructure Module
Enterprise Campus Infrastructure Server Farm Module
Enterprise Edge Modules
E-Commerce Module
Internet Connectivity Module
Remote Access and VPN Module
WAN and MAN and Site-to-Site VPN Module
Enterprise Edge Guidelines
Service Provider Modules

Enterprise Remote Modules
Enterprise Branch Module
Enterprise Data Center Module
Enterprise Teleworker Module
Summary
**Supporting Services on Borderless Networks**
Explaining the Role of Borderless Network Services
Modularizing Internal Security
Reasons for Internal Security
External Threats
IP Communications
Voice Transport Overview
VOIP Components
Modular Approach in Voice Network Design
Example: Voice Network Solution
Evaluating the Existing Data Infrastructure for Voice Design
Wireless LAN Overview
Centralized WLAN Model Components
Application Networking Services Introduction
Cisco ANS Can Resolve Application Issues
Example: ANS Components
Designing High Availability
Designing Route Redundancy
Example: Campus Infrastructure Redundancy
Example: Enterprise Edge Redundancy
High Availability in the Server Farm Module
Example: Attachment Through a Redundant NIC
Summary
**Identifying Network Management Protocols and Features**
Network Management Overview
SNMP Overview
SNMPv1 Message Types
SNMP Version 2
SNMP Version 3
SNMP Security Models and Levels
MIB Definition
Example: Cisco Router MIB
Example: Variable Retrieval
RMON1 (RFC 1513 and 2819)
RMON2 (RFC 2021)
NetFlow Infrastructure
NetFlow vs. RMON Information
Applications Using NetFlow
Cisco Discovery Protocol
Discovering Neighbors with Cisco Discovery Protocol
Syslog Features
Example: Syslog Messages
Syslog Architecture
Summary
Module 02 Review

## Module 03 - Designing Basic Campus and Data Center Networks 1hr 46m

**Describing Campus Design Considerations**
Designing an Enterprise Campus
Overview of Network Application Types
Example: Peer-to-Peer Applications

Example: Client-Local Server Applications
Example: Client-Server Farm Applications
Example: Client-Enterprise Edge Applications
Relative Network Requirements by Application Type
Environmental Characteristics for Network Design
Intrabuilding Structure
Interbuilding Structure
Distant Remote Building Structure
Campus Transmission Media
Comparison of Campus Transmission Media
Example: Transmission Media
Infrastructure Device Characteristics
Example Network Service: QoS in LAN Switches
Summary

**Designing the Campus Infrastructure Module**

Relative Considerations for Campus Design
Building Access Layer Design Considerations
Overview of Recommendation Practices for the Building Access Layer
STP Considerations
Cisco STP Toolkit
Trunk Considerations
Layer 3 Access-to-Distribution Interconnection
Building Distribution Layer Design Considerations
Overview of Recommended Practices for the Building Distribution Layer
Recommended Practices-First-Hop Redundancy
Recommended Practices-Use Layer 3 Routing Protocols
Example: Build Redundant Triangles
Layer 3 Distribution Interconnection
Alternate: Layer 2 Distribution Interconnection
Virtual Switching System at the Distribution Layer
Campus Core Design Considerations
Example: Large Campus Multilayer Switched Backbone Design
Small and Medium Campus Collapsed Core Design Options
Edge Distribution Design
Summary

**Describing Enterprise Data Center Considerations**

The Evolution of Data Center "Architectures"
Cisco Data Center 3.0 Components
Example: Data Center Network 3.0 Topology Components Layout
Server Challenges
Data Center Facility Aspects
Space
Power
Cooling
Increasing Heat Production
Cabling
Enterprise Data Center Infrastructure Overview
Defining the Data Center Access Layer
Defining the Data Center Aggregation Layer
Defining the Data Center Core Layer
Summary

**Describing Enterprise Network Virtualization Tools**

Challenges
What is Virtualization?
Types of Virtualization
Virtualization Technologies
Network Virtualization Design Considerations

Summary
Enterprise Campus and Data Center Review
Module 03 Review

## Module 04 - Designing Remote Connectivity 1hr 35m

**Identifying WAN Technology Considerations**
Role of a WAN
Types of WAN Interconnections
WAN Transport Technology Comparison
Example: ADSL Implementation
Example: Data and Voice over Cable
Example: Three Uses of Wireless
Example: SONET/SDH
Example: DWDM
Example: Dark Fiber
WAN Transport Technology Pricing Considerations
WAN Transport Technology Contract Considerations
Methodology Used in Enterprise Edge Design
Identifying Application Requirements
Determining the Maximum Offered Traffic
Determining Physical Media Bandwidth
Evaluating Cost-Effectiveness of Design and Implementation
QoS Considerations for Bandwidth Constraints
Queuing to Improve Link Utilization
Traffic Shaping and Policing
Data Compression and QoS to Optimize Bandwidth Usage
Summary
**Designing the Enterprise WAN**
Traditional WAN Technologies
WAN Topologies
Designing the Remote-Access Network
Overview of VPNs
Enterprise-vs. Service Provider-Managed VPN
What is IPsec?
IPsec Direct Encapsulation
Cisco Easy VPN
Layer 3 Tunneling
IPsec VTI
L2TPv3 Design
Metro Ethernet
VPLS Design
Multiprotocol Label Switching (MPLS)
MPLS Layer 3 VPN
Benefits of VPNs
WAN Backup Technologies
Example: Permanent Secondary WAN Link
WAN Backup over the Internet
Enterprise WAN Architecture Considerations
Cisco Enterprise MAN and WAN Architecture
Cisco Enterprise WAN and MAN Architecture Comparison
Example: Cisco WAN Architectures in the Healthcare Environment
Selecting Enterprise Edge Hardware Components and Software Features
Hardware Selection: Cisco ISR G2
Comparing Router Platforms and Software Functions
Comparing Multilayer Switch Platforms and Software Functions
Summary

**Designing the Enterprise Branch**
Enterprise Branch Services
Enterprise Branch Architecture
Characterizing the Branch
Enterprise Branch Profiles
New Features on Cisco ISR G2
Small Branch Office Design
Medium Branch Office Design
Large Branch Office Design
Enterprise Teleworker: Cisco Virtual Office Solution
Cisco Virtual Office Architecture
New Integrated Services Routers for Small Offices and Teleworkers
Summary
Module 04 Review

## Module 05 - Designing IP Addressing and Selecting Routing Protocols 1hr 45m

**Designing IPv4 Addressing**
Prerequisite Knowledge
Private and Public IP Address Guidelines
Network Size and IP Addressing Planning
Determining General Network Topology
IP Address Requirements by Location
IP Addressing Hierarchy
Route Summarization Groups
Example: Address Blocks by Location
Example: Hierarchical IP Addressing Plan
IP Address Assignment Methods in an Enterprise Network
Static vs. Dynamic Name Resolution
Using DNS for Name Resolution
Example: Locating DHCP and DNS Servers in the Network
IP Address Space Planning Roadmap
Summary
**Designing IPv6 Addressing**
IPv6 Address Structure
Benefits of IPv6 Addressing
IPv6 Address Scope Types
IPv6 Address Types: Link-Local and Unique Local
IPv6 Address Types: Global Aggregatable
IPv6 Address Assignment Strategies
IPv6 Name Resolution
IPv4- and IPv6-Aware Applications and Name Resolution
IPv4-to-IPv6 Transition Mechanisms
IPv6 Deployment Models
Dual-Stack Model
Benefits and Drawbacks of Dual-Stack Model
Hybrid Model
Hybrid Model Example 1
Benefits and Drawbacks of Hybrid Model Example 1
Hybrid Model Example 2
Benefits and Drawbacks of Hybrid Model Example 2
Service Block Model
Benefits and Drawbacks of the Service Block Model
Summary
**Reviewing Enterprise Routing Protocols**
Distance Vector and Link-State Comparison
Example: Distance Vector Routing
Example: Link-State Routing

Interior vs. Exterior Routing Protocols
Example: Interior vs. Exterior Routing Protocols
Routing Protocol Convergence
Routing Protocol Convergence Comparison
Enhanced IGRP (EIGRP)
EIGRP Characteristics
Open Shortest Path First
Example: OSPF Multiarea Network
OSPF Characteristics
Border Gateway Protocol
BGP Network Implementation
Internal BGP
IPv6 Routing
Recommended Enterprise Routing Protocol Comparison
Summary
**Designing a Routing Protocol Deployment**
Routing Protocols
Route Redistribution
Route Redistribution Direction
Route Redistribution Planning
Route Filtering
Route Summarization
Recommended Practice: Summarize at the Distribution Layer
Recommended Practice: Passive Interfaces for IGP at Access Layer
IPv6 Route Summarization
Summary
Module 05 Review

## Module 06 - Evaluating Security Solutions for the Network 2h

**Defining Network Security**
Reasons for Network Security
Examples: Security Legislation and Directives
Threats and Risks
Reconnaissance and Vulnerability Scanning
Example: NetStumbler Screen
Vulnerability Assessment
Gaining System Access
Integrity and Confidentiality Threats
Availability Threats (DoS)
Everything is a Potential Target
Network Security in the System Lifecycle
What is a Security Policy?
Why is a Security Policy Needed?
Network Security and Risks
Risk Index Calculation
Example: Risk Index Calculation
Components of a Security Policy
Network Security Is a Continuous Process
Integrate Security Design and Network Design
Summary
**Evaluating Security Solutions for the Network**
Cisco SAFE Architecture
Network as a Platform for Security
Security Control Framework
Trust and Identity Management
Trust is the Root of Security
Domains of Trust

Example: Domains of Trust
Identity
Passwords
Tokens
Access Control in Networks
Example: Trust and Identity Management Technologies
Firewall Filtering Using ACLs
Cisco NAC Appliance
IEEE 802.1X Protocol
Identity and Access Control Deployment Locations
Threat Defense
Physical Security
Physical Security Guidelines
Infrastructure Protection
Infrastructure Protection Deployment Locations
Recommended Practices for Infrastructure Protection
Threat Detection and Mitigation
Example: Threat Detection and Mitigation Solutions
Threat Detection and Mitigation Solutions Deployment Locations
Cisco IronPort ESA
Cisco IronPort WSA
Secure Connectivity
Encryption Fundamentals
Encryption Fundamentals Encryption Keys
VPN Protocols
Transmission Confidentiality
Transmission Confidentiality Guidelines
Data Integrity
Data Integrity Guidelines
Security Management Overview
Security Management Solutions
Security Management Design
Summary
**Selecting Network Security Solutions**
Network Devices Supporting Integrated Security
Integrated Security for Cisco IOS
Example: Security Hardware Options for ISRs G2
Security Appliances
Intrusion Prevention System
Cisco Catalyst Services Modules
Endpoint Security Solution
Securing the Enterprise Network
Deploying Security in the Enterprise Campus - Identity and Access Control
Deploying Security in the Enterprise Campus - Threat Detection and Mitigation
Deploying Security in the Enterprise Campus - Infrastructure Protection
Deploying Security in the Enterprise Campus - Summary
Deploying Security in the Enterprise Data Center - Identity and Access Control
Deploying Security in the Enterprise Data Center - Threat Detection and Mitigation
Deploying Security in the Enterprise Data Center - Infrastructure Protection
Deploying Security in the Enterprise Data Center - Summary
Deploying Security in the Enterprise Edge - Identity and Access Control
Deploying Security in the Enterprise Edge - Threat Detection and Mitigation
Deploying Security in the Enterprise Edge - Infrastructure Protection
Deploying Security in the Enterprise Edge - Summary
Summary
Module 06 Review

## Module 07 - Identifying Voice and Video Networking Considerations 1h 51m

**Integrated Voice and Video Architectures**

Analog-to-Digital Conversion
Separate Voice and Data Networks
Example: Unified Network
Introducing H.323
H.323 Components
Example: H.323 Components and Their Interactions
The Importance of a Gatekeeper
Introducing H.264
VOIP Components
Design Goals of VOIP
Single-Site VOIP Design
Multisite WAN with Centralized Call Processing Design
Multisite WAN with Distributed Call Processing Design
Media Application Convergence Evolution
Media Application Models
Media Application Delivery
Architectural Framework for Media Services
Call Control and Transport Protocols
SCCP Control
SIP Control
MGCP Control
Summary

**Identifying the Requirements of Voice and Video Technologies**

Voice Quality Considerations
Fixed Network Delay Considerations
Variable Network Delay Considerations
Jitter
Packet Loss
Problem of Echo
Echo Cancellers Reduce the Level of Echo
Voice Coding and Compression
Example: Codec Complexity and Calls Per DSP on the Cisco AS54-PVDM2-64 Module
Bandwidth Availability
Calculating Voice Bandwidth
Example: Voice Codec Bandwidth Calculator for G.729 Codec
Voice Bandwidth and Codec Standards
Typical Video Resolution and Bandwidth
Bandwidth Requirements of H.264 Video Streams
Enterprise QoS Mechanisms for Voice and Video
Access Layer QoS Mechanisms for Voice and Video
Recommended Practice: Separate Voice and Data VLANs
Example: QoS Networking Mechanisms
Example: Low Latency Queuing
QoS Consideration for Voice and Video in the WAN
Call Admission Control
Example: Call Admission Control
Implementing CAC with RSVP
Traffic Engineering Terms
Erlang Tables
Example: Erlang B Table
Summary
Module 07 Review

## Module 08 - Identifying Design Considerations for Basic Wireless Networks — 1h 24m

**Cisco Unified Wireless Network Review**

Wireless LAN Background
Cisco Unified Wireless Network Elements
CAPWAP and LWAPP Fundamentals
Example: Layer 3 CAPWAP Architecture
Split MAC
Local MAC
Access Point Models
Wireless Infrastructure
Wireless Authentication
Example: Supported EAP Types
Important WLAN Controller Components
Summary of WLC Interfaces
Example: WLANs, Interfaces, and Ports
Cisco Unified Wireless LAN Access Points
Cisco Wireless LAN Controller Platforms
Access Point Scalability Considerations
Example: Multiple AP Manager Interfaces
Example: LAG with a Single AP Manager Interface
Summary

**Wireless Network Controller Technology**

Lightweight AP WLC Discovery
WLC Selection Algorithm
Access Point Operations
Mobility Defined
Intracontroller Roaming
Intercontroller Roaming - Layer 2
Intercontroller Roaming - Layer 3
Scaling the Architecture with Mobility Groups
Mobility Group Requirements
Supporting Roaming-Recommended Practices
Controller Redundancy Design
Deterministic Controller Redundancy
Example: Deterministic Controller Redundancy
Dynamic Controller Redundancy
Example: Dynamic Redundancy
Deterministic Redundancy Designs: N + 1
Deterministic Redundancy Designs: N + N
Deterministic Redundancy Designs: N + N + 1
Radio Resource Management
RF Grouping
Access Point Self-Healing
Summary

**Designing Wireless Networks Using Controllers**

Reasons for an RF Site Survey
RF Site Survey Process
RF Site Survey - Customer Requirements
RF Site Survey - Identifying Coverage Areas
Determining Preliminary Access Point Locations
Visualizing RF Coverage
Performing the Site Survey
Site Survey Report
Common Wireless Design Questions
Aironet Indoor Access Point Comparison

Controller Placement Design
Example: Centralized WLC Design
Example: Distributed WLC Design
Campus WLC Options
Branch Wireless Network Design Considerations
Hybrid REAP
Example: H-Reap Deployment
Branch Office WLC Options
OfficeExtend Access Point
Supporting Guest Access
Path Isolation with Ethernet in IP Tunnel
Outdoor Wireless Deployment Options
Outdoor Wireless Mesh Solution Components
Example: MAP-to-RAP Connectivity in a Square Mile
Mesh Design Recommendations
Summary
Module 08 Review

**Total Duration: 14hr 3m**