Course Name: CCIE Service Provider

Version: v3.0

Course Time: 100 Hrs.

Course Prerequisites: CCNP Routing and Switching

Course Outline:

- **Implement, Optimize and Troubleshoot Core IP Technologies**
  - Packet over SONET
    - Cisco HDLC encapsulation
    - PPP encapsulation
    - Frame Relay encapsulation
    - transmission unit (MTU)
    - Cyclic redundancy check (CRC)
    - Keepalive timer
    - Frame Relay DLCI on point to point sub-interface
    - SONET Controller
    - POS channel
    - Channelized SONETSONET APS
  - IP over DWDM
    - Optical channel payload unit (OPU)
    - Optical channel data unit (ODU)
    - Optical channel transport unit (OTU)
    - Optical channel (OCh)
    - Shared Risk Link Group (SRLG)
    - Virtual Transponder (VTXP)
    - FEC-FRR Triggering
    - Optical Parameters- Rx-los-threshold, Wavelength and Transmit-power
    - G.709 Parameters
  - GE/10GE in the Core
    - Gigabit Ethernet standards
    - 10 Gigabit Ethernet standards
    - Duplex mode
    - MTU
    - Flow control
    - Link Aggregation Control Protocol (LACP)
    - 802.1Q VLAN sub-interface
  - SP high end product
    - IOS-XR structure
    - Install IOS-XR software
    - Upgrade and manage IOS-XR software
    - Secure domain router (SDR)
    - CRS-1/3 structure
    - CRS-1/3 Multi chassis
    - Redundant Route Processors
    - RP switchover
    - MSC Architecture
    - Switch Fabric Architecture
  - IGP routing
    - Network Service Access Point (NSAP)
    - IS-IS Packet data unit (PDU)
    - IS-IS hello
    - IS-IS Link-state packets

- IS-IS Sequence Number Packets
- IS-IS area type
- IS-IS level
- IS-IS circuit type
- IS-IS Type Length Values (TLV)
- IS-IS Pseudo node
- IS-IS Designated Intermediate Systems
- IS-IS SPF
- IS-IS LSP attached bit
- IS-IS LSP overload bit
- IS-IS Multi topology
- IS-IS Metric
- IS-IS support for IPv6
- OSPF multi instance
- OSPF router-ID
- OSPF router type
- OSPF area
- OSPF hello
- OSPF LSA
- OSPF media type
- OSPF Designated Routers
- OSPF interface cost
- OSPF interface type
- OSPFv3 support for IPv6
- EIGRP Diffusing Update Algorithm (DUAL)
- EIGRP Composite Metrics
- EIGRP Hello
- EIGRP neighbor
- EIGRP Unequal Cost Load Sharing
- RIP v2
- RIP support for IPv6
- Redistribution between OSPF,IS-IS and EIGRP
- Redistribution of Directly connected routes
- Redistribution of Static routes
- Route summary
- IOS-XR routing policy language (RPL)
- Routing policy using route-map
- MPLS and LDP
- MPLS network component (P, PE, CE)
- MPLS label format
- MPLS label encapsulation
- MPLS label stack
- MPLS label operation
- Forwarding Equivalence Class
- Label Distribution Protocol (LDP)
- Label advisement model
- MPLS LDP—Local Label Allocation Filtering
- MPLS LDP-IGP synchronization
- MPLS LDP Inbound/outbound Label Binding Filtering
- Label Merging

- MPLS over ATM
- P2MP MPLS
- Multicast LDP(mLDP)

❖ MPLS Traffic Engineering
- TE Path calculation Constrained-Based Shortest Path First (CSPF)
- TE link information distribution
- RSVP support for TE path setup
- IS-IS support for TE
- OSPF support for TE
- Forwarding Traffic down Tunnel
- MPLS-TE Automatic Bandwidth
- MPLS-TE Static route
- MPLS-TE Auto route
- MPLS-TE Policy route
- MPLS-TE Forwarding adjacency
- MPLS-TE path metric
- MPLS-TE LSP attributes
- MPLS-TE Class-based Tunnel selection
- Pseudowire Tunnel Selection
- Point to multi point (P2MP) MPLS TE
- Shared Risk Link Group (SRLG)
- Inter-Domain MPLS TE
- Inter-Area MPLS TE

❖ BGP
- BGP messages
- BGP neighbor
- BGP update
- BGP attributes
- BGP synchronization
- BGP routes aggregation
- BGP route reflector
- BGP confederation
- BGP Communites
- BGP Cluster list
- BGP Peer Groups
- IBGP IPv4/IPv6 Peering
- EBGP IPv4/IPv6 Peering
- EBGP IPv4/IPv6 multi hop peering
- BGP IPv4/IPv6 routes advertising
- EBGP IPv4/IPv6 peering using local-AS
- EBGP IPv4/IPv6 peering using AS-override
- BGP IPv4/IPv6 using private AS number
- Dual AS configuration for Network AS migration
- BGP Routing policy
- Redistributing IGP, static and connected route into BGP
- BGP Multi-path Load Sharing
- BGP Link Bandwidth

❖ Multicast
- IPv4/IPv6 Multicast addressing
- Multicast distribution tree

- Multicast forwarding
- Multicast Reverse Path Forwarding (RPF)
- Multicast Administrative Boundaries
- PIM sparse mode for IPv4/IPv6
- IPv4/IPv6 Multicast routing
- PIM Sparse Mode for IPv4/IPv6
- IGMP V2/V3
- IPV6 Multicast Listener Discover (MLD)
- PIM Source Specific Multicast (SSM) for IPv4/IPv6
- Multicast Rate-limiting
- PIM Bidirectional (BiDir)
- PIM Static RP
- PIM Bootstrap Router (BSR)
- PIM Auto RP
- PIM Anycast RP
- Multicast Administrative Boundaries
- MSDP
- MP-BGP peer for Multicast
- MP-BGP Multicast route advertising
- Label switch multicast

❖ High Availability
- NSF/SSO for IGP routing
- NSF/SSO for BGP routing
- NSF/SSO for LDP, TE, Multicast
- HSRP, VRRP, GLBP
- Graceful Restart
- Control Plane Policing (CPP)
- Bidirectional forwarding detection (BFD)
- IP event dampening
- IGP Fast Re-route
- MPLS TE Fast Re-route (FRR)
- Link Protection using MPLS-TE
- Node Production using MPLS-TE
- Embedded event management (EEM)
- Hold-off Timer to Prevent Fast Reroute from Being Triggered (SONET)

❖ Convergence
- IS-IS fast convergence
- IS-IS to utilize the Overload Bit
- OSPF fast convergence
- BGP fast convergence
- BGP Route Dampening
- BGP Fast Peering Session Deactivation
- BGP Prefix Independent Convergence (PIC)
- BGP next hop tracking
- BGP address tracking filter
- BGP path MTU discovery
- IP fast reroute (IPFRR)
- Multicast-only Fast Re-Route (MoFRR)
- MPLS LDP convergence

- SP QoS
  - Marking using DSCP, IP precedence and CoS
  - Priority Queuing
  - Custom Queuing
  - Weighted Fair Queuing
  - WRED
  - Policing
  - Class-based Weighted Faire Queuing (CB-WFQ)
  - Low-Latency Queuing (LLQ)
  - Random-Detect using MQC
  - NBAR for QoS
  - MPLS EXP
  - Differentiated Services Traffic Engineering (DS-TE)
  - Maximum Allocation Model (MAM)
  - Russian Dolls Model (RDM)
  - Class-Based Tunnel Selection: CBTSPolicy-based Tunnel Selection: PBTS
- Security in core
  - Standard Access-lists
  - Extended Access-lists
  - Routing Protocol Authentication for RIP V2
  - Routing Protocol Authentication for EIGRP
  - Routing Protocol Authentication for OSPF
  - Routing Protocol Authentication for IS-IS
  - Routing Protocol Authentication for BGP
  - BGP TTL Security Check
  - Infrastructure ACL
  - Anti Fragment Attacks
  - Filtering RFC 1918 Routes
  - uRPF for Anti-Spoofinng
  - Selective packet discard (SPD)
  - LDP authentication
  - Remote triggered black hole (RTBH)
  - NTP
  - Attack mitigation
  - SNMP Management
  - IP packet Accounting
  - Syslog

Implement, Optimize and Troubleshoot Edge/Access Technologies

- FE/GE and Ethernet Trunk connections
  - Ethernet Wire Service (EWS)
  - Ethernet Relay Service (ERS)
  - Ethernet Multipoint Service (EMS)
  - Ethernet Flow Point (EFP)
  - Ethernet Virtual Circuit (EVC)
  - 802.1Q standard
  - 802.1QinQ
  - 802.1ad Provider Bridges (PB)
  - 802.1ah Provider Backbone Bridge (PBB)
  - Spanning Tree Protocol (STP)
  - Resilient Ethernet Protocol (REP)

- Virtual Trunking Protocol (VTP)
- Flexible Service Mapping/Forwarding
- Ethernet Connectivity Fault Management (CFM)
- Ethernet channel

❖ PPP connections
- LCP
- NCP
- PPP encapsulation
- PPP multilink
- PPP Multi chassis multilink
- PPPoE client
- PPPoE server
- PPP authentication

❖ SONET/SDH connections
- SONET/SDH frame
- Automatic protection switching (APS), Timing
- Channelized SDH, channelized interface,

❖ Frame-relay connections
- Frame Relay PVC, SVC, DLCI
- Congestion-Control Mechanisms, FECN, BECN
- Discard Eligibility (DE) bit
- Frame Relay Fragmentation (FRF.12)
- Frame Relay FRF.9 Payload Compression
- Frame Relay Multilink (MLFR-FRF.16)
- Frame Relay Switching
- Frame-Relay LMI-Type
- PPP over Frame-Relay

❖ ATM connections
- ATM cell
- Virtual Path Identifier (VPI), Virtual Channel Identifier (VCI)
- Payload Type (PT), Cell Loss Priority (CLP)
- ATM adaptation layer (AAL)
- ATM addressing
- ATM PVC/SVC
- ATM Cell Loss Priority (CLP) Setting
- IP over ATM (RFC1483)

❖ T1/T3 and E1/E3 services
- Multiplexing
- Framing
- Timing
- Chanel group

➢ **Describe, Implement, Optimize and Troubleshoot Remote Access Technologies**

❖ IP over DSL to the customer
- PPPoA
- PPPoE over ATM
- L2TP between LAC and LNS
- RA (PPPoA,PPPoE over ATM) to VRF and MPLS VPN
- PPP authentication (Radius, TACACS)
- DHCP and options 82

- ❖ IP over wire line to the customer
  - PPP
  - PPPoE
  - L2TP between LAC and LNS
  - PPPoE to VRF and MPLS VPN
  - PPP authentication (Radius, TACACS)
  - DHCP and options 82
  - Broadband network gateway (BNG)
- ❖ IP over Cable to the customer
  - DOCSIS 3.0
  - PPPoE
  - L2TP between LAC and LNS

➢ **Implement, Optimize and Troubleshoot Layer 3 VPN**

- ❖ Intra AS L3 MPLS VPN
  - MP-IBGP VPNv4/VPNv6 peering
  - MP-IBGP peering using loopback interface
  - VPNv4/VPNv6 Route Reflector
  - VRF definition
  - Route Distinguisher
  - Route Target
  - Route Target import/export
  - Intra AS MPLS VPNV4/VPNV6 load balancing
  - SOO Community
  - PE-CE – RIP V2
  - PE-CE – IS-IS
  - PE-CE – OSPF
  - PE-CE – EBGP
  - PE-CE – Static Routes
  - Redistributing dynamic PE-CE routes into VPNv4/VPNv6
  - Redistributing static PE-CE routes into VPNv4/VPNv6
  - Redistributing VPN4/VPNv6 routes into PE-CE routing table
  - Intra-AS MPLS VPN multipath
  - Intra-AS MPLS VPN path selection
- ❖ Inter AS L3 MPLS VPN
  - MP-EBGP VPNv4/VPNv6 peering using direct interface
  - MP-EBGP VPNv4/VPNv6 peer using multi-hop interface
  - MP-EBGP VPNv4/VPNv6 peer between RRs
  - VPNV4/VPNv6 next-hop unchanged
  - VPNV4/VPNv6 next-hop self
  - Multi VRF between ASPEs
  - Inter-AS MPLS VPNV4/VPNv6 multipath
  - Route target rewrite
  - Inter-AS MPLS VPN path selection
- ❖ Carrier supporting carrier
  - MPLS LDP in customer carrier site
  - EBGPv4 + label between CSC-PE and CSC-CE
  - IGP + LDP between CSC-PE and CSC-CE
  - MPLS VPNv4 between customer carrier sites PEs
  - CSC VPN load balancing
  - VRF definition in customer carrier site
  - Customer carrier site PE-CE routing

- VPN Extranet and internet access
  - MP-BGP VPNv4/VPNv6 Extra-Net
  - MP-BGP VPNv4/VPNv6 internet access
  - VRF service
  - Multiple VRF
  - Multiple VRF routing
  - VRF Selection based on Source IP Address
- Multicast VPN
  - Default MDT
  - Data MDT
  - MP-BGP mdt peering
  - Multicast routing in VPN site
  - PM-SM in VPN site
  - RP in VPN site
  - Multicast VPN extranet
- GRE L3 VPN
  - MPLS VPN—L3VPN over GRE

Implement, Optimize and Troubleshoot Layer 2 VPN

- Atom
  - Psuedowire-class
  - EoMPLS –Ethernet over MPLS
  - FRoMPLS –Frame Relay over MPLS
  - HDLCoMPLS-HDLC over MPLS
  - PPPoMPLS-PPP over MPLS
  - AAL5oMPLS-ATM AAL5 over MPLS
  - L2TPv3
  - FR/PPP/HDLC/Ethernet interworking over MPLS
  - FR/PPP/HDLC/Ethernet interworking over L2TPv3
  - L2VPN local switching
- VPLS and Carrier Ethernet
  - VPLS
  - H-VPLS
  - VFI definition
  - VPLS BGP auto discovery
  - VLAN attached circuit
  - QinQ attached circuit
  - 802.1ad attached circuit
  - 802.1ah attached circuit
  - VPLS/H-VPLS redundancy
- L2TPV3 for L2VPN
  - L2TPv3
  - L2TPv3 VPN local switching
  - L2TPv3 VPN interworking
- GRE L2VPN
  - L2VPN over GRE

Implement, Optimize and Troubleshoot Managed Services Traversing the Core

- Managed Voice/Video services traversing the core
  - Traverse Voice/video packet
  - Traverse call signal packet
- Managed Security services traversing the core
  - Traverse IKE packet
  - Traverse ESP, AH packet
  - Traverse SSL packet

- ❖ Service Level Agreements for managed services
  - IP SLA sender
  - IP SLA responder
  - IP SLA for MPLS VPN
  - Netflow
  - Netflow for MPLS
  - Netflow for Multicast

➢ **Describe Service Provider Network implementing principle**

- ❖ Given a Service Provider network design change or new service, identify the success criteria
- ❖ Given a Service Provider network design change or new service, identify appropriate routing protocol
- ❖ Given a Service Provider network design change or new service, identify appropriate tunneling protocol
- ❖ Given a Service Provider network design change or new service, identify improving convergence method
- ❖ Given a Service Provider network design change or new service, identify improving stability method
- ❖ Given a Service Provider network design change or new service, identify improving reliability method
- ❖ Given a Service Provider network design change or new service, identify improving management method
- ❖ Given a Service Provider network design change or new service, identify improving QOS method
- ❖ Given a Service Provider network design change or new service, identify improving security