# Level 6 Advanced Diploma in Routing & Switching (112)
# 151 Credits

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| **Unit:** Advanced LAN, WAN & Switching Configuration<br><br>**Exam Paper No.:** 3 | **Guided Learning Hours:** 320<br><br>**Number of Credits:** 32 |
| **Prerequisites:** Networking knowledge. | **Corequisites:** A pass or higher in Diploma in IP Routing or equivalence. |
| **Aim:** This unit is divided into two sections; Part I (Implementing Complex Internetworks) looks at network design components (access servers, LAN hardware; switches, hubs and cables; WAN technologies; routers and cables. The unit also covers LAN and WAN protocols and Interior Gateway Protocols. Part II (Modelling Ethernet Switching, Quality of Service Techniques and Border Gateway Protocol) looks at Exterior Gateway Protocol, Border Gateway Protocol and Ethernet Switching. Also covered is quality of service techniques and VOIP. Learners have to be conversant in configuring hardware, networks and protocols in each topic. | |
| **Required Materials:** Recommended Learning Resources. | **Supplementary Materials:** Lecture notes and tutor extra reading recommendations. |
| **Special Requirements:** The course requires a combination of lectures, demonstrations, discussions, and hands-on labs. | |
| **Intended Learning Outcomes:**<br>Part I **Implementing Complex Internetworks** | **Assessment Criteria:**<br>Part I **Implementing Complex Internetworks** |
| 1 The assembling and configuring of all the necessary hardware and software components required in an internetwork; including how internetwork model provide functionality. | 1.1 Describe access server, LAN switches, hubs and cables, WAN connection cables and routers<br>1.2 Identify the application used in a LAN<br>1.3 Examine the Cisco IOS software and memory requirements<br>1.4 Demonstrate the configuration of a Frame Relay switch<br>1.5 Demonstrate how to perform password recovery on (i) router (ii) catalyst switch<br>1.6 Demonstrate how to upgrade and restore IOS<br>1.7 Demonstrate how to configure an access server |
| 2 The LAN technology Ethernet standards; Spanning Tree, Fast Ethernet, Gigabit Ethernet and Ethernet/Token Switching. | 2.1 Explain Ethernet technology<br>2.2 Describe the Spanning Tree Protocol and its importance in switched Ethernet<br>2.3 Define Ethernet Switching and analyse the advantages and disadvantages<br>2.4 Define Token Ring LAN IEEE 802.5<br>2.5 Demonstrate how to configure an Ethernet switch<br>2.6 Demonstrate how to configure VTP domain throughout a network<br>2.7 Demonstrate how to configure VLANs and VLAN Trunking<br>2.8 Demonstrate how to configure a Token Ring Switched network |
| 3 The purpose of WAN, WAN protocols technologies; common WAN protocols and their corresponding OSI layers. | 3.1 Define HDLC and describe its characteristics<br>3.2 Demonstrate how to configure a WAN network |

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| | 3.3 Demonstrate how to configure HDLC on DTE/DCE<br>3.4 Outline the functions and characteristics of Point-to-Point Protocol (PPP)<br>3.5 Demonstrate how to configure and enable PPP<br>3.6 Describe and be able to configure PPP Chap |
| 4 Frame Relay network terminology, the overview of Frame Relay, LMI operations and the configuration of Frame Relay. | 4.1 Explain common Frame Relay terminology<br>4.2 Examine Frame Relay implementation strategies and describe its advantages<br>4.3 Identify the steps and components needed to configure Frame Relay<br>4.4 Describe Frame Relay ARP responses<br>4.5 Describe Frame Relay traffic shaping and demonstrate its configuration |
| 5 The voice-over technology solutions; the advantages of voice-over solutions; design implementation, integration and configuration of voice over technology. | 5.1 Describe analogy telephone system<br>5.2 Describe digital voice technology<br>5.3 Examine Cisco voice-capable routers<br>5.4 Demonstrate how to configure voice over frame-relay<br>5.5 Demonstrate how to configure voice over IP<br>5.6 Demonstrate how to configure voice over ATM |
| 6 The importance of ISDN in the business market; how ISDN carries a variety of traffic over the network and ISDN architecture. | 6.1 Describe the ISDN development, components and mechanics<br>6.2 Demonstrate how to configure a Cisco router to use ISDN<br>6.3 Analyse ISDN troubleshooting techniques<br>6.4 Demonstrate PPP authentication over ISDN configuration<br>6.5 Demonstrate callback over ISDN configuration<br>6.6 Demonstrate configuration multilink over ISDN configuration<br>6.7 Demonstrate configuration of OSPF demand circuits over ISDN |
| 7 The Asynchronous Transfer Mode (ATM) technology; cell format and the objective of ATM internetworking. | 7.1 Describe FRC 2684<br>7.2 Describe RFC 2225<br>7.3 Demonstrate PVC configuration<br>7.4 Demonstrate SVC configuration<br>7.5 Describe ATP technology and its implementation |
| 8 Protocols without explicit network layer addresses; the different ways of transporting non-routable protocols. | 8.1 Define transparent bridging and functions of a bridge<br>8.2 Describe integrated routing and bridging<br>8.3 Describe source route bridging<br>8.4 Describe Data Link Switching plus<br>8.5 Describe the types of filters for filtering traffic in bridged environments<br>8.6 Demonstrate configuration of Transport Bridging, Remote Source-Route |

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| | Bridging and LSAP filtering<br>8.7 Demonstrate configuration of DLSw |
| 9 Understand how Network Address Translation (NAT) works; the implementations of NAT and how NTP provides the use of stratum information ; Network Time Protocol (SNTP) and SNTP server configuration. | 9.1 Describe NAT translations<br>9.2 Define RFC 1918<br>9.3 Analyse the different ways of configuring NAT<br>9.4 Describe NAT translation time out clearing<br>9.5 Describe advantages and disadvantages of NAT<br>9.6 Demonstrate configuration of dynamic NAT<br>9.7 Demonstrate configuration of NAT using non-standard FTP port numbers<br>9.8 Demonstrate configuration of static NAT<br>9.9 Describe the implementation of NTP<br>9.10 Outline the implementation of SNTP<br>9.11 Demonstrate the configuration of NTP servers, clients and authentication |
| Part II **Modelling Ethernet Switching, Quality of Service Techniques and Border Gateway Protocol**. | Part II **Modelling Ethernet Switching, Quality of Service Techniques and Border Gateway Protocol**. |
| 10 The configuration of advanced switching and software configuration of the Cisco Catalyst 3550 Intelligent Ethernet Switch. | 10.1 Analyse and identify the features of the Catalyst 3550<br>10.2 Compare broadcast domain and VLAN design rules<br>10.3 Describe VTP and trunking protocols<br>10.4 Illustrate Spanning Tree Protocol (STP)<br>10.5 Analyse the advanced features of Catalyst 3550 Ethernet Switch<br>10.6 Demonstrate the configuration of EtherChannel, Layer 3 Switching, routed ports and SVI<br>10.7 Demonstrate the configuration of 802.1w RSTP/802.1s MST, Layer 3 switching and VLAN maps |
| 11 The different applications of route maps including route filtering, route control, route metric modification (tagging) and Policy Based Routing (PBR). | 11.1 Describe route maps<br>11.2 Analyse the route-map, match and set commands<br>11.3 Explain the benefits of policy-based routing<br>11.4 Examine how policy routing controls traffic in the internetwork<br>11.5 Demonstrate the configuration of route maps for redistribution<br>11.6 Demonstrate the configuration of route maps using packet size<br>11.7 Describe how to configure and use route maps. |
| 12 Multicast network design; maintenance concepts, best practices, control and troubleshooting. | 12.1 Describe the IP multicast addressing<br>12.2 Explain the multicast distribution trees<br>12.3 Describe Protocol Independent Multicasting (PIM)<br>12.4 Demonstrate configuration of a multicast group |

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| | 12.5 Demonstrate configuration of frame-relay multicast routing<br>12.6 Demonstrate configuration of multicast joining group<br>12.7 Demonstrate how to control rate limit of multicast traffic<br>12.8 Demonstrate DVMRP multicast routing<br>12.9 Examine the efficiency of multicasting, advantages and disadvantages |
| 13 Quality-control issues; troubleshooting resolutions; ATM Quality of Service (QoS) technologies, the different Cisco IOS switching methods and how they can be used to improve network interface performance. | 13.1 Outline Cisco IOS software QoS features<br>13.2 Analyse ATM concepts, differences between ATM and frame-relay, ATM performance management and the application of ATM QoS<br>13.3 Describe how QoS can be configured to improve network performance<br>13.4 Outline software compression techniques<br>13.5 Demonstrate the configuration of ATM QoS |
| 14 QoS techniques provided by integrated and differentiated services; how to provide a guaranteed level of services, mark traffic with priority levels and prioritise traffic. | 14.1 Describe the IntServ architecture<br>14.2 Describe the Resource Reservation Setup Protocol (RSVP)<br>14.3 Demonstrate the configuration of VoIP and RSVP<br>14.4 Describe the DiffServ architecture<br>14.5 Demonstrate the configuration of integrated and differentiated services |
| 15 The various queuing methods, their applications including First-In First-Out, Weighted Fair, Priority and Custom; including advanced traffic shaping, queuing, policy and marking technologies. | 15.1 Describe First-In, First-Out (FIFO) queuing principles<br>15.2 Describe the Weighted Fair Queuing<br>15.3 Describe the Priority queuing<br>15.4 Demonstrate configuration Priority queuing<br>15.5 Describe custom queuing<br>15.6 Describe traffic shaping<br>15.7 Outline prioritisation of real-time traffic<br>15.8 Describe the Class-Based Weighted Fair Queuing technology<br>15.9 Explain the low latency queuing technique<br>15.10 Demonstrate configuration of custom-queuing<br>15.11 Demonstrate configuration of management internet traffic with CBWFQ and NBAR |
| 16 BGP configuration pre-requisites; processes that run on a Cisco router; analysing BGP neighbour configuration, network advertisement and how to verify BGP configuration. | 16.1 Analyse router's capacity for running BGP<br>16.2 Explain the tasks to be completed before BGP configuration<br>16.3 Outline how BGP can be configured to support different network topologies<br>16.4 Describe the BGP and IGP interaction synchronisation<br>16.5 Explain how BGP enables control of advertised networks<br>16.6 Demonstrate the configuration of E-BGP |

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| | and I-BGP<br>16.7 Describe ways used to support BGP larger networks and how to implement advanced routing policies.<br>16.8 Analyse BGP neighbour authentication<br>16.9 Analyse the simplification of larger network configuration with route reflectors and confederations<br>16.10 Outline how to effectively use BGP peer groups<br>16.11 Explore advanced BGP redistribution methods<br>16.12 Analyse route dampening, aggregation and policies<br>16.13 Demonstrate how to configure BGP to support different route table sizes and symmetric routing |
| **Methods of Evaluation:** A 3-hour essay written paper with 5 questions, each carrying 20 marks. Candidates are required to answer all questions. Candidates also undertake project/coursework in Advanced LAN, WAN & Switching Configuration with a weighting of 100%. | |

**Recommended Learning Resources: Advanced LAN, WAN & Switching Configuration**

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| **Text Books** | • Cisco BGP-4 Command and Configuration Handbook by William R. Parkhurst Ph.D. ISBN-10: 1587055732<br>• Routing TCP/IP Volume 1 (CCIE Professional Development Routing TCP/IP) by Jeff Doyle and Jennifer Carroll. ISBN-10: 1587052024<br>• Routing TCP/IP Volume 2 (CCIE Professional Development) by Jeff Doyle and Jennifer DeHaven Carroll. ISBN-10: 1578700892<br>• CCIE Routing and Switching Certification Guide by Wendell Odom, Rus Healy and Denise Donohue. ISBN-10: 1587059800 |
| **Study Manuals**  | BCE produced study packs |
| **CD ROM**  | Power-point slides |
| **Software**  | Cisco IOS |