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| **Introduction:**  The assignment requires students to design and implement a network infrastructure for Rolling Storm Communications Ltd with headquarters in York and branches in London and Warsaw respectively. The objective is to create an efficient network which is secure and scalable using the VLSM approach for IP addressing, applicable routing protocols, and VLAN configurations. Students are expected to conduct network testing and explain their findings demonstrating reliability and applicability of the designed network.  **Task 1: Design an IP Addressing Scheme using VLSM** **(Total marks = 12)**  For the IP addressing scheme, assign unique subnets to the departments in branches (a department in a branch will have a unique subnet). Utilise a subnetting technique which enhances IP address distribution while allowing for future scalability. Each device in the network must be assigned an IP address.  Given an IP address and mask of 205.168.7.0/24, design an IP addressing scheme which fulfils the following requirements in the table below using the VLSM approach for efficient use of IP addresses.  The 0th subnet is used. No subnet calculators should be used.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Subnet** | **York**  **Headquarters** | **London**  **Branch** | **Warsaw**  **Branch** | **Number of Hosts** | | Marketing Department (Subnet A) | 4 | 6 | 6 | 16 | | Sales Department (Subnet B) | 4 | 4 | 4 | 12 | | IT Department (Subnet C) | 4 | 2 | 2 | 8 | | **Total** | **12** | **12** | **12** | **36** |        |  |  |  | | --- | --- | --- | | **Marketing Department**  **(Subnet A)** |  |  | | **Specification** | **Student Input** | **Marks (4 marks)** | | Default Subnet Mask (binary) | 11111111.11111111.11111111.00000000 |  | | Custom subnet mask (decimal) | 255.255.255.224 |  | | Total number of subnets | 2 |  | | Total number of host addresses | 96 |  | | Number of usable addresses | 94 |  | | Number of bits borrowed | 3 bits |  | | First IP host address | 205.168.7.1 |  | | Last IP host address | 205.168.7.94 |  |      |  |  |  | | --- | --- | --- | | **Sales Department**  **(Subnet B)** |  |  | | **Specification** | **Student Input** | **Marks (4 marks)** | | Default subnet mask (binary) | 11111111.11111111.11111111.00000000 |  | | Custom subnet mask (decimal) | 255.255.255.240 |  | | Total number of subnets | 1 |  | | Total Number of host addresses | 48 |  | | Number of usable addresses | 46 |  | | Number of bits borrowed | 4 bits |  | | First IP host address | 205.168.7.97 |  | | Last IP host address | 205.168.7.142 |  |        |  |  |  | | --- | --- | --- | | **IT Department**  **(Subnet C)** |  |  | | **Specification** | **Student Input** | **Marks (4 marks)** | | Default subnet mask (binary) | 11111111.11111111.11111111.00000000 |  | | Custom subnet mask (decimal) | 255.255.255.248 |  | | Total number of subnets | 1 |  | | Total number of host addresses | 24 |  | | Number of usable addresses | 22 |  | | Number of bits borrowed | 5 bits |  | | First IP host address | 205.168.7.145 |  | | Last IP host address | 205.168.7.166 |  |     **Task 2: Build and Configure the Network (Total marks = 18)**  Build the network infrastructure as depicted in the provided diagram using Cisco Packet Tracer. Connect Warsaw and London branches to the headquarters in York using appropriate network devices such as routers and switches. Configure the devices with the designated IP addresses from Task 1.    Step 1: Select all the devices such as PCs, servers, laptops, switches, and routers  Step 2: Cable the network as shown in the topology.  Step 3: Configure the IP addresses and default gateway for the end-user devices (PC). The network router will use the FIRST network host address. Host computers will use any address in the subnet.    After configuring each host computer, record the host network settings with the ipconfig /all command and write down the information using the table below.  **Warsaw Branch**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Marketing Department (Subnet A)** | | | | | | | **Device** | **IP address** | **Subnet Mask** | **Gateway** | **MAC Address** | **Marks (6 marks)** | | Mkt-01 | 205.168.7.2 | 255.255.255.224 | 205.168.7.1 | 00D0.BA37.56D8 |  | | Mkt-02 | 205.168.7.3 | 255.255.255.224 | 205.168.7.1 | 00D0.FF3C.E300 |  | | Mkt-03 | 205.168.7.4 | 255.255.255.224 | 205.168.7.1 | 0001.96AB.C440 |  | | Mkt-L04 | 205.168.7.5 | 255.255.255.224 | 205.168.7.1 | 00D0.58DE.07E4 |  | | Mkt-L05 | 205.168.7.6 | 255.255.255.224 | 205.168.7.1 | 00D0.FF3C.33B2 |  | | Mkt-L06 | 205.168.7.7 | 255.255.255.224 | 205.168.7.1 | 00E0.F9EB.5B6A |  | | **Sales Department (Subnet B)** | | | | | | | Sales-01 | 205.168.7.98 | 255.255.255.240 | 205.168.7.97 | 0001.9769.02D5 |  | | Sales-02 | 205.168.7.99 | 255.255.255.240 | 205.168.7.97 | 0001.63AE.BE36 |  | | Sales-03 | 205.168.7.100 | 255.255.255.240 | 205.168.7.97 | 0090.2B83.2102 |  | | Sales-04 | 205.168.7.101 | 255.255.255.240 | 205.168.7.97 | 0001.C7EB.84B8 |  | | **IT Department (Subnet C)** | | | | | | | IT-01 | 205.168.7.146 | 255.255.255.248 | 205.168.7.145 | 0090.211E.3D8E |  | | IT-02 | 205.168.7.147 | 255.255.255.248 | 205.168.7.145 | 00E0.F7B7.0CE6 |  |   **London Branch**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Marketing Department (Subnet A)** | | | | | | | **Device** | **IP address** | **Subnet Mask** | **Gateway** | **MAC Address** | **Marks (6 marks)** | | Mkt-07 | 205.168.7.34 | 255.255.255.224 | 205.168.7.33 | 0001.429C.2A03 |  | | Mkt-08 | 205.168.7.35 | 255.255.255.224 | 205.168.7.33 | 0090.2B7A.8B53 |  | | Mkt-09 | 205.168.7.36 | 255.255.255.224 | 205.168.7.33 | 0002.17BC.7CE7 |  | | Mkt-10 | 205.168.7.37 | 255.255.255.224 | 205.168.7.33 | 000D.BD54.0E5B |  | | Mkt-11 | 205.168.7.38 | 255.255.255.224 | 205.168.7.33 | 000A.41DC.3A9B |  | | Mkt-12 | 205.168.7.39 | 255.255.255.224 | 205.168.7.33 | 0050.0F7C.831B |  | | **Sale Department (Subnet B)** | | | | | | | Sales-05 | 205.168.7.114 | 255.255.255.240 | 205.168.7.113 | 0002.4A06.BE7B |  | | Sales-06 | 205.168.7.115 | 255.255.255.240 | 205.168.7.113 | 00E0.A3BC.17A9 |  | | Sales-07 | 205.168.7.116 | 255.255.255.240 | 205.168.7.113 | 00E0.8F61.3CE9 |  | | Sales-08 | 205.168.7.117 | 255.255.255.240 | 205.168.7.113 | 0060.5C66.150B |  | | **IT Department (Subnet C)** | | | | | | | IT-03 | 205.168.7.154 | 255.255.255.248 | 205.168.7.153 | 0002.178C.4E6B |  | | IT-04 | 205.168.7.155 | 255.255.255.248 | 205.168.7.153 | 0007.EC6B.B4C5 |  |   **York Headquarters**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Marketing Department (Subnet A)** | | | | | | | **Device** | **IP address** | **Subnet Mask** | **Gateway** | **MAC Address** | **Marks (6 marks)** | | Mkt-13 | 205.168.7.66 | 255.255.255.224 | 205.168.7.65 | 0001.9782.4E8C |  | | Mkt-14 | 205.168.7.67 | 255.255.255.224 | 205.168.7.65 | 0001.C726.A613 |  | | Mkt-15 | 205.168.7.68 | 255.255.255.224 | 205.168.7.65 | 0060.2F97.E19A |  | | Mkt-16 | 205.168.7.69 | 255.255.255.224 | 205.168.7.65 | 0060.5C57.EECC |  | | **Sale Department (Subnet B)** | | | | | | | Sales-09 | 205.168.7.130 | 255.255.255.240 | 205.168.7.129 | 0006.2A19.5B10 |  | | Sales-10 | 205.168.7.131 | 255.255.255.240 | 205.168.7.129 | 00E0.A31C.1D92 |  | | Sales-11 | 205.168.7.132 | 255.255.255.240 | 205.168.7.129 | 00D0.FF6E.A939 |  | | **IT Department (Subnet C)** | | | | | | | IT-05 | 205.168.7.162 | 255.255.255.248 | 205.168.7.161 | 000A.F361.B94B |  | | IT-06 | 205.168.7.163 | 255.255.255.248 | 205.168.7.161 | 0002.16C1.C8D1 |  | | IT-07 (HTTP) | 205.168.7.164 | 255.255.255.248 | 205.168.7.161 | 0001.96BE.437C |  | | IT-08 (DNS) | 205.168.7.165­ | 255.255.255.248 | 205.168.7.161 | 000C.8539.27CA |  |   Step 4: Configure VLANs for different departments as shown in the topology:   1. VLAN 10: Marketing 2. VLAN 20: Sales 3. VLAN 30: IT   **Task 3: Implement a routing protocol for communication (Total marks = 17)**  Implement a suitable dynamic routing protocol to facilitate communication between routers in the network. Ensure efficient routing of data packets between different subnets and branches.  **Step 1:** Configure the following routers and state the IP addresses of their interfaces using the table provided below: **(4 marks)**   |  |  | | --- | --- | | **Device** | **IP address** | | Router 1- Se0/1/0 | 205.168.7.169 | | Router 1- Se0/1/1 | 205.168.7.173 | | Router 2-Se0/1/0 | 205.168.7.170 | | Router 2-Se0/1/1 | 205.168.7.177 | | Router 3-Se0/1/0 | 205.168.7.174 | | Router 3-Se0/1/1 | 205.168.7.181 | | Router 4-Se0/1/0 | 205.168.7.178 | | Router 4-Se0/1/1 | 205.168.7.182 |     **Step 2:** Configure an IP address for the following routers and Layer 3 Switches interfaces using addressing scheme mentioned in Task 1.  **Record IP Address for interface indicated in the table below**. **(3 marks)**   |  |  |  | | --- | --- | --- | | **Device** | **IP address** | **Subnet Mask** | | Router 2-Gig 0/0 | 205.168.7.185 | 255.255.255.252 | | Router3-Gig 0/0 | 205.168.7.189 | 255.255.255.252 | | Router 4-Gig 0/0 | 205.168.7.193 | 255.255.255.252 | | Multilayer Switch1- Fa 0/3 | 205.168.7.186 | 255.255.255.252 | | Multilayer Switch2- Fa 0/3 | 205.168.7.190 | 255.255.255.252 | | Multilayer Switch3- Fa 0/3 | 205.168.7.194 | 255.255.255.252 |     **Step 3:** Configuration tasks for each router should also include the following: **(4 marks)**     |  |  | | --- | --- | | **Task** | **Specification** | | Router name | Router (number) | | Encrypted privileged exec password | cisco | | Console access password | class (number) | | Telnet access password | class (number) |     **Step 4:** Show the Routing Table for each Router. **(6 marks – 2 marks per column)**   |  |  |  |  | | --- | --- | --- | --- | | **Device** | **Protocol** | **Networks Advertised** | **Configuration Commands** | | Router1 | o OSPF | 205.168.0.0 | router1>  router1>en  router1>enable  Password:  router1#  router1#con  router1#conf  router1#configure te  router1#configure terminal  Enter configuration commands, one per line. End with CNTL/Z.  router1(config)#router ospf 1  router1(config-router)#ne  router1(config-router)#nert  router1(config-router)#net  router1(config-router)#network 205.168.0.0 0.0.255.255 area 0  router1(config-router)#  router1(config-router)#exit  router1(config)#exit  router1#  %SYS-5-CONFIG\_I: Configured from console by console | | Router2 | OSPF | 205.168.0.0 | Router2>  Router2>en  Router2>enable  Password:  Router2#  Router2#con  Router2#conf  Router2#configure te  Router2#configure terminal  Enter configuration commands, one per line. End with CNTL/Z.  Router2(config)#router ospf 1  Router2(config-router)#ne  Router2(config-router)#nert  Router2(config-router)#net  Router2(config-router)#network 205.168.0.0 0.0.255.255 area 0  Router2(config-router)#  Router2(config-router)#exit  Router2(config)#exit  Router2#  %SYS-5-CONFIG\_I: Configured from console by console | | Router3 | OSPF | 205.168.0.0 | Router3>  Router3>en  Router3>enable  Password:  Router3#  Router3#con  Router3#conf  Router3#configure te  Router3#configure terminal  Enter configuration commands, one per line. End with CNTL/Z.  Router3(config)#router ospf 1  Router3(config-router)#ne  Router3(config-router)#nert  Router3(config-router)#net  Router3(config-router)#network 205.168.0.0 0.0.255.255 area 0  Router3(config-router)#  Router3(config-router)#exit  Router3(config)#exit  Router3#  %SYS-5-CONFIG\_I: Configured from console by console | | Router4 | OSPF | 205.168.0.0 | Router4>  Router4>en  Router4>enable  Password:  Router4#  Router4#con  Router4#conf  Router4#configure te  Router4#configure terminal  Enter configuration commands, one per line. End with CNTL/Z.  Router4(config)#router os  Router4(config)#router ospf 1  Router4(config-router)#ne  Router4(config-router)#nert  Router4(config-router)#net  Router4(config-router)#network 205.168.0.0 0.0.255.255 area 0  Router4(config-router)#  Router4(config-router)#exit  Router4(config)#exit  Router4#  %SYS-5-CONFIG\_I: Configured from console by console |   **Task 4: Use ping and traceroute commands for basic network testing (Total marks = 6)**  Conduct network testing using the ping and traceroute commands for connectivity across devices. Troubleshoot and resolve any connectivity issues which may arise during testing.  Ping and traceroute are network testing commands to check the TCP/IP network connectivity. Ping is a network administration utility used to test the reachability of a device on a network. Traceroute utility is a network diagnostic tool for displaying the route and measuring the transit delays of packets travelling on a network.    **Step 1:** Use the ping command to verify network connectivity.  Network connectivity can be verified with the **ping** command.  Use the following table to methodically verify connectivity with each network device. Take corrective action to establish connectivity if a test fails: **(3 marks)**   |  |  |  |  | | --- | --- | --- | --- | | **From** | **To (Destination)** | **IP Address (Destination)** | **Ping results** | | IT-01 | IT-02 | 205.168.7.147 | Cisco Packet Tracer PC Command Line 1.0  C:\>ping 205.168.7.147  Pinging 205.168.7.147 with 32 bytes of data:  Reply from 205.168.7.147: bytes=32 time<1ms TTL=128  Reply from 205.168.7.147: bytes=32 time<1ms TTL=128  Reply from 205.168.7.147: bytes=32 time<1ms TTL=128  Reply from 205.168.7.147: bytes=32 time<1ms TTL=128  Ping statistics for 205.168.7.147:  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  Approximate round trip times in milli-seconds:  Minimum = 0ms, Maximum = 0ms, Average = 0ms  Success | | Sales-02 | Mkt-L04 | 205.168.7.5 | Cisco Packet Tracer PC Command Line 1.0  C:\>ping 205.168.7.5  Pinging 205.168.7.5 with 32 bytes of data:  Reply from 205.168.7.5: bytes=32 time=21ms TTL=127  Reply from 205.168.7.5: bytes=32 time=19ms TTL=127  Reply from 205.168.7.5: bytes=32 time=20ms TTL=127  Reply from 205.168.7.5: bytes=32 time=14ms TTL=127  Ping statistics for 205.168.7.5:  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  Approximate round trip times in milli-seconds:  Minimum = 14ms, Maximum = 21ms, Average = 18ms  Success | | Mkt-01 | IT-05 | 205.168.7.162 | Cisco Packet Tracer PC Command Line 1.0  C:\>ping 205.168.7.162  Pinging 205.168.7.162 with 32 bytes of data:  Request timed out.  Reply from 205.168.7.162: bytes=32 time=10ms TTL=123  Reply from 205.168.7.162: bytes=32 time=2ms TTL=123  Reply from 205.168.7.162: bytes=32 time=10ms TTL=123  Ping statistics for 205.168.7.162:  Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  Approximate round trip times in milli-seconds:  Minimum = 2ms, Maximum = 10ms, Average = 7ms  Success | | Sales-02 | Router1 se0/1/0 | 205.168.7.169 | C:\>ping 205.168.7.169  Pinging 205.168.7.169 with 32 bytes of data:  Reply from 205.168.7.169: bytes=32 time=15ms TTL=253  Reply from 205.168.7.169: bytes=32 time=18ms TTL=253  Reply from 205.168.7.169: bytes=32 time=22ms TTL=253  Reply from 205.168.7.169: bytes=32 time=1ms TTL=253  Ping statistics for 205.168.7.169:  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  Approximate round trip times in milli-seconds:  Minimum = 1ms, Maximum = 22ms, Average = 14ms  Success | | Router3 se/0/1/1 | Mkt-L06 | 205.168.7.7 | Router3>  Router3>en  Router3>enable  Password:  Router3#ping 205.168.7.7  Type escape sequence to abort.  Sending 5, 100-byte ICMP Echos to 205.168.7.7, timeout is 2 seconds:  .!!!!  Success rate is 80 percent (4/5), round-trip min/avg/max = 2/27/57 ms  Router3#  Success | | IT-01 | Multilayer Switch2- Fa 0/3 | 205.168.7.194 | C:\>ping 205.168.7.194  Pinging 205.168.7.194 with 32 bytes of data:  Reply from 205.168.7.194: bytes=32 time=3ms TTL=251  Reply from 205.168.7.194: bytes=32 time=2ms TTL=251  Reply from 205.168.7.194: bytes=32 time=34ms TTL=251  Reply from 205.168.7.194: bytes=32 time=2ms TTL=251  Ping statistics for 205.168.7.194:  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  Approximate round trip times in milli-seconds:  Minimum = 2ms, Maximum = 34ms, Average = 10ms  Success |     **Step 2:** Use the **“tracert”** command to verify network connectivity.  Use the **tracert** command to trace the path to a specific destination and write down the path to the destination. **(3 marks)**     |  |  |  |  | | --- | --- | --- | --- | | **From** | **To (Destination)** | **IP Address (Destination)** | **Path to destination** | | Sales-03 | Sales-01 | 205.168.7.98 | Cisco Packet Tracer PC Command Line 1.0  C:\>tracert 205.168.7.98  Tracing route to 205.168.7.98 over a maximum of 30 hops:  1 1 ms 0 ms 0 ms 205.168.7.98  Trace complete.  C:\> | | Mkt-L05 | Router4 se/0/1/1 | 205.168.7.182 | Cisco Packet Tracer PC Command Line 1.0  C:\>tracert 205.168.7.182  Tracing route to 205.168.7.182 over a maximum of 30 hops:  1 56 ms 23 ms 22 ms 205.168.7.1  2 6 ms 13 ms 14 ms 205.168.7.185  3 5 ms 16 ms 21 ms 205.168.7.182  Trace complete.  C:\> | | IT-01 | Router1 se0/1/0 | 205.168.7.169 | C:\>tracert 205.168.7.169  Tracing route to 205.168.7.169 over a maximum of 30 hops:  1 0 ms 0 ms 0 ms 205.168.7.145  2 0 ms 0 ms 0 ms 205.168.7.185  3 0 ms 18 ms 1 ms 205.168.7.169  Trace complete. | | Sales-05 | Mkt-02 | 205.168.7.3 | Cisco Packet Tracer PC Command Line 1.0  C:\>tracert 205.168.7.3  Tracing route to 205.168.7.3 over a maximum of 30 hops:  1 0 ms 0 ms 0 ms 205.168.7.113  2 0 ms 0 ms 0 ms 205.168.7.189  3 1 ms 14 ms 26 ms 205.168.7.177  4 20 ms 1 ms 1 ms 205.168.7.186  5 \* 1 ms 2 ms 205.168.7.3  Trace complete.  C:\> | | IT-01 | Multilayer Switch3- Fa 0/3 | 205.168.7.194 | C:\>tracert 205.168.7.194  Tracing route to 205.168.7.194 over a maximum of 30 hops:  1 0 ms 0 ms 0 ms 205.168.7.145  2 0 ms 0 ms 0 ms 205.168.7.185  3 16 ms 0 ms 1 ms 205.168.7.178  4 1 ms 3 ms 14 ms 205.168.7.181  5 16 ms 0 ms 2 ms 205.168.7.194  Trace complete. | | Mkt-01 | Router2 se0/1/0 | 205.168.7.170 | C:\>tracert 205.168.7.170  Tracing route to 205.168.7.170 over a maximum of 30 hops:  1 0 ms 0 ms 0 ms 205.168.7.1  2 0 ms 0 ms 0 ms 205.168.7.170  Trace complete.  C:\> |     **Task 5: Set Up and Configure Servers (Total marks = 7)**  Configure HTTP and DNS servers on designated devices within the network. Set up necessary resources such as websites for the HTTP server and DNS records for the DNS server. Ensure proper communication and access to these servers from devices within the network.  **Step 1:** Configure the IP address for DNS and HTTP Server, write down the IP addresses on the table below:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Device** | **IP address** | **Default Gateway** | **Subnet Mask** | **Marks (4 marks)** | | DNS Server | 205.168.7.165 | 205.168.7.161 | 255.255.255.248 |  | | HTTP Server | 205.168.7.164 | 205.168.7.161 | 255.255.255.248 |  |     **Step 2:** Complete the DNS address field for Mkt-01 and HTTP Server with the IP address of the DNS Server  **Step 3:** Open the DNS Server, then add the URL: [www.coventrylab.ac.uk](http://www.coventrylab.ac.uk/) as the domain name for the IP address of the HTTP Server  **Step 4:** Open the browser from Mkt-01, type in the URL: [www.coventrylab.ac.uk](http://www.coventrylab.ac.uk/) in the address bar and open the web page. Take a snapshot of what comes up on the webpage or landing page and paste it in the text box below:   |  |  | | --- | --- | | **Text box** | **Marks (3 marks)** | |  |  | |

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