**Documentation**

**Project Overview:**

This project involved the design and implementation of a computer network using a step-by-step approach. The main tasks included creating the topology, subnetting, configuring DHCP server pools, setting up routing protocols (OSPF, EIGRP, and RIP), implementing NAT, configuring access control lists (ACLs), and setting up an SMTP mail server with email accounts.

**Step-by-Step Execution:**

**1. Network Topology Design:**

* I designed the network topology based on the project requirements, identifying the connections between routers, switches, and end devices such as PCs, smartphones, and servers.
* Specific networks were labeled (e.g., Network A, Network D, Network E, Network J).

**2. Subnetting:**

* I calculated subnets from the provided public and private IP addresses.
* Ensured efficient IP address allocation to each network segment while avoiding overlaps.
* Verified subnet ranges and reserved appropriate addresses for network and broadcast purposes.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Hosts Needed | Hosts Available | Unused Hosts | Network Address | Slash | Mask | Usable Range | Wildcard |
| G | 94145 | 131070 | 36925 | 203.0.0.0 | /15 | 255.254.0.0 | 203.0.0.1 - 203.1.255.254 | 0.1.255.255 |
| F | 83034 | 131070 | 48036 | 203.2.0.0 | /15 | 255.254.0.0 | 203.2.0.1 - 203.3.255.254 | 0.1.255.255 |
| D | 61812 | 65534 | 3722 | 203.4.0.0 | /16 | 255.255.0.0 | 203.4.0.1 - 203.4.255.254 | 0.0.255.255 |
| C | 50701 | 65534 | 14833 | 203.5.0.0 | /16 | 255.255.0.0 | 203.5.0.1 - 203.5.255.254 | 0.0.255.255 |
| B | 49690 | 65534 | 15844 | 203.6.0.0 | /16 | 255.255.0.0 | 203.6.0.1 - 203.6.255.254 | 0.0.255.255 |
| A | 38589 | 65534 | 26945 | 203.7.0.0 | /16 | 255.255.0.0 | 203.7.0.1 - 203.7.255.254 | 0.0.255.255 |
| K | 38589 | 65534 | 26945 | 203.8.0.0 | /16 | 255.255.0.0 | 203.8.0.1 - 203.8.255.254 | 0.0.255.255 |
| I | 16367 | 16382 | 15 | 203.9.0.0 | /18 | 255.255.192.0 | 203.9.0.1 - 203.9.63.254 | 0.0.63.255 |
| H | 5256 | 8190 | 2934 | 203.9.64.0 | /19 | 255.255.224.0 | 203.9.64.1 - 203.9.95.254 | 0.0.31.255 |
| E (Router 8 and 9) | 5 | 6 | 1 | 203.9.96.0 | /29 | 255.255.255.248 | 203.9.96.1 - 203.9.96.6 | 0.0.0.7 |
| J (Router 16 and 20) | 4 | 6 | 2 | 203.9.96.8 | /29 | 255.255.255.248 | 203.9.96.9 - 203.9.96.14 | 0.0.0.7 |
| Router 1 and 0 | 2 | 2 | 0 | 203.9.96.16 | /30 | 255.255.255.252 | 203.9.96.17 - 203.9.96.18 | 0.0.0.3 |
| Router 1 and 2 | 2 | 2 | 0 | 203.9.96.20 | /30 | 255.255.255.252 | 203.9.96.21 - 203.9.96.22 | 0.0.0.3 |
| Router 1 and 3 | 2 | 2 | 0 | 203.9.96.24 | /30 | 255.255.255.252 | 203.9.96.25 - 203.9.96.26 | 0.0.0.3 |
| Router 2 and 3 | 2 | 2 | 0 | 203.9.96.28 | /30 | 255.255.255.252 | 203.9.96.29 - 203.9.96.30 | 0.0.0.3 |
| Router 3 and 4 | 2 | 2 | 0 | 203.9.96.32 | /30 | 255.255.255.252 | 203.9.96.33 - 203.9.96.34 | 0.0.0.3 |
| Router 4 and 5 | 2 | 2 | 0 | 203.9.96.36 | /30 | 255.255.255.252 | 203.9.96.37 - 203.9.96.38 | 0.0.0.3 |
| Router 5 and 6 | 2 | 2 | 0 | 203.9.96.40 | /30 | 255.255.255.252 | 203.9.96.41 - 203.9.96.42 | 0.0.0.3 |
| Router 6 and 7 | 2 | 2 | 0 | 203.9.96.44 | /30 | 255.255.255.252 | 203.9.96.45 - 203.9.96.46 | 0.0.0.3 |
| Router 6 and 8 | 2 | 2 | 0 | 203.9.96.48 | /30 | 255.255.255.252 | 203.9.96.49 - 203.9.96.50 | 0.0.0.3 |
| Router 7 and 9 | 2 | 2 | 0 | 203.9.96.52 | /30 | 255.255.255.252 | 203.9.96.53 - 203.9.96.54 | 0.0.0.3 |
| Router 8 and 11 | 2 | 2 | 0 | 203.9.96.56 | /30 | 255.255.255.252 | 203.9.96.57 - 203.9.96.58 | 0.0.0.3 |
| Router 9 and11 | 2 | 2 | 0 | 203.9.96.60 | /30 | 255.255.255.252 | 203.9.96.61 - 203.9.96.62 | 0.0.0.3 |
| Router 11 and 12 | 2 | 2 | 0 | 203.9.96.64 | /30 | 255.255.255.252 | 203.9.96.65 - 203.9.96.66 | 0.0.0.3 |
| Router 12 and 13 | 2 | 2 | 0 | 203.9.96.68 | /30 | 255.255.255.252 | 203.9.96.69 - 203.9.96.70 | 0.0.0.3 |
| Router 12 and 14 | 2 | 2 | 0 | 203.9.96.72 | /30 | 255.255.255.252 | 203.9.96.73 - 203.9.96.74 | 0.0.0.3 |
| Router 12 and 15 | 2 | 2 | 0 | 203.9.96.76 | /30 | 255.255.255.252 | 203.9.96.77 - 203.9.96.78 | 0.0.0.3 |
| Router 15 and 16 | 2 | 2 | 0 | 203.9.96.80 | /30 | 255.255.255.252 | 203.9.96.81 - 203.9.96.82 | 0.0.0.3 |
| Router 16 and 17 | 2 | 2 | 0 | 203.9.96.84 | /30 | 255.255.255.252 | 203.9.96.85 - 203.9.96.86 | 0.0.0.3 |
| Router 17 and 19 | 2 | 2 | 0 | 203.9.96.88 | /30 | 255.255.255.252 | 203.9.96.89 - 203.9.96.90 | 0.0.0.3 |
| Router 17 and 20 | 2 | 2 | 0 | 203.9.96.92 | /30 | 255.255.255.252 | 203.9.96.93 - 203.9.96.94 | 0.0.0.3 |
| Router 19 and 20 | 2 | 2 | 0 | 203.9.96.96 | /30 | 255.255.255.252 | 203.9.96.97 - 203.9.96.98 | 0.0.0.3 |

**3. DHCP Server Configuration:**

* Created DHCP pools for each network to automate IP address assignment.
* Configured the DHCP server to allocate addresses dynamically, ensuring proper IP distribution within each subnet.

**4. Network Device Configuration:**

* Started configuration from the network closest to the DHCP server and proceeded outward.
* Implemented the following routing protocols based on the requirements for each section:
  + **OSPF Area 1**: Configured for networks requiring hierarchical segmentation.
  + **OSPF Area 2**: Used for additional OSPF-enabled sections.
  + **EIGRP**: Configured for certain networks requiring efficient routing with fewer resources.
  + **RIP**: Set up for legacy networks as specified.

**5. NAT Configuration:**

* Implemented Network Address Translation (NAT) to enable private IP addresses to access external resources.
* Configured static and dynamic NAT as needed to optimize connectivity and security.

**6. Access Control Lists (ACLs):**

* Configured ACLs on the router connected to the Web Server to enforce access restrictions:
  + One PC from **Network A** was restricted from accessing the Web Server.
  + One smartphone each from **Network E** and **Network J** was denied Web Server access.
  + All hosts connected to **Network D** were blocked from accessing the Web Server.
* Applied ACLs to the appropriate interfaces to control traffic effectively.

**7. SMTP Mail Server Setup:**

* Configured an SMTP mail server within the network.
* Created and tested multiple email accounts for communication within the network.

**Final Testing and Validation:**

* Verified connectivity across all networks using ping and tracert commands.
* Tested DHCP assignments to ensure proper IP address allocation.
* Confirmed routing protocols functioned as expected by checking routing tables and path selections.
* Validated ACL restrictions by attempting access from blocked and unblocked devices.
* Ensured NAT translations were functioning correctly by accessing external resources from internal hosts.
* Tested the mail server functionality by sending and receiving emails between configured accounts.

**Conclusion:**

The project successfully achieved its objectives, showcasing the integration of various networking concepts. The final configuration ensured efficient routing, secure access control, and seamless communication within the network. The hands-on implementation provided valuable insights into designing and managing complex network infrastructures.