**A. Background**

The Student Central Department's network is designed to support various functions related to student services, staff operations, and wireless access for both students and staff. The network layout includes four distinct areas, each serving a specific purpose, with appropriate network devices and connectivity to ensure seamless operation across all services.

* **Student Service Area**:  
  The Student Service Area is dedicated to student-facing services, such as document printing, information searches, and general support. This area includes 1 router, 2 switches, and 6 end devices (4 PCs and 2 printers). These devices allow students to access network resources for tasks such as printing and online searches, and the network ensures sufficient connectivity between all devices in this area and other departments.
* **Information Counter Area**:  
  The Information Counter Area is responsible for managing administrative and financial services, handling student inquiries, and supporting administrative tasks. This area is equipped with 1 router, 2 switches, and 6 end devices (4 PCs and 2 printers). The wired setup ensures secure and reliable communication for staff members who require continuous access to internal systems for processing financial transactions and other administrative tasks.
* **Wireless Zone Area**:  
  The Wireless Zone provides internet access for both staff and students via wireless connections. It features separate SSIDs to segregate student and staff traffic, enhancing security and privacy. This area includes 1 router, 1 switch, 2 access points, and 5 wireless devices (personal devices from staff and students). The network offers high-speed internet access while maintaining security and control through network segmentation and secure access controls.
* **Staff Area**:  
  The Staff Area supports internal operations and administrative work within the department. This area includes 1 router, 1 switch, and 6 end devices (4 PCs, 1 printer, and 1 DNS server). The DNS server is crucial for resolving internal network names, ensuring smooth network operations. The staff devices are securely connected to the network, with appropriate access control to protect sensitive administrative information.

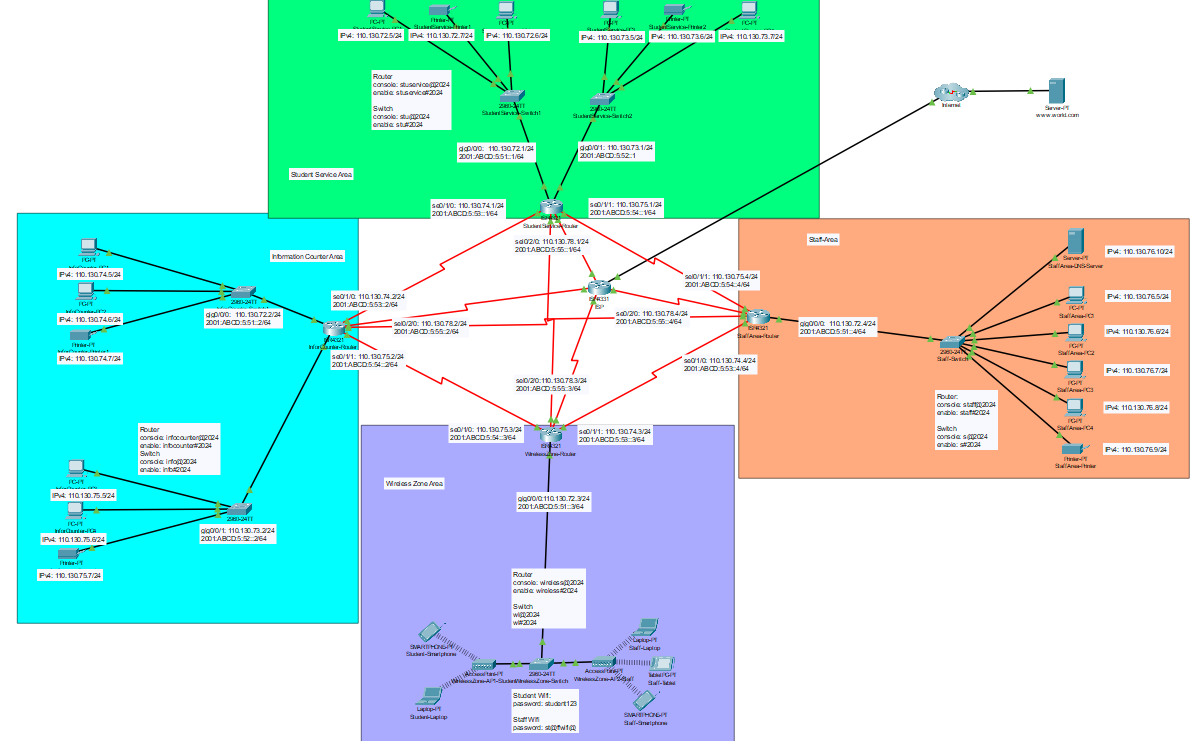


Figure 1: Overall network layout of Student Central Department

**B. Redudancies:**

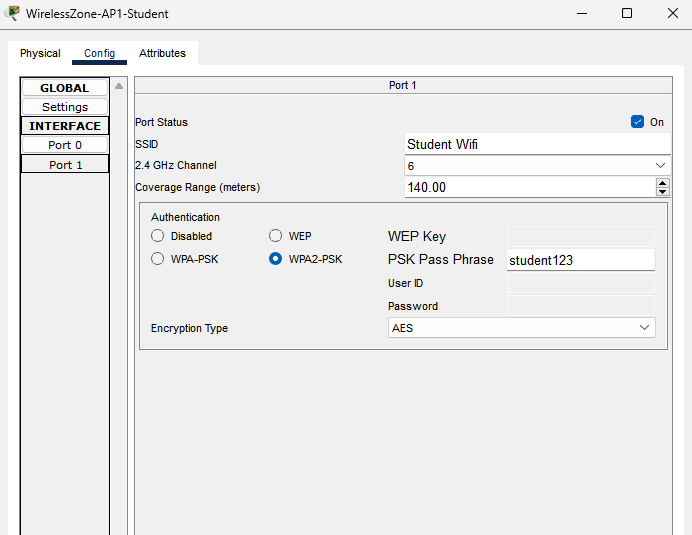
To ensure high availability and resilience within the Student Central Department's network, multiple redundant paths between routers have been configured. Each router in the network is connected to the other three routers, creating multiple pathways between the Student Service Area, Information Counter Area, Wireless Zone Area, and Staff Area. This redundant connection scheme achieves two main objectives, fault tolerance and load balancing. This redundancy approach enhances the network's resilience, reliability, and performance, contributing to a robust infrastructure that meets the Student Central Department's operational requirements.

**C. Routing:**

The routing configuration in the Student Central Department network ensures efficient and seamless communication between the Student Service Area, Information Counter Area, Wireless Zone, and Staff Area. Both IPv4 and IPv6 static routes are implemented across all routers to facilitate the proper flow of data between areas. Moreover, Wireless Zone, where students and staff connect using personal devices, DHCP is employed to dynamically allocate IP addresses. This dynamic approach is necessary due to the high volume of daily connections from personal devices that are not university-owned, ensuring scalability and efficient network access management.

**D. Wireless**

In the Wireless Zone, two separate SSIDs have been configured to provide isolated access for staff and students, ensuring both security and proper traffic management. The Staff Wifi network is designated for staff members, providing a secure and private connection. This network ensures that sensitive staff operations remain isolated from student traffic. Both the Staff Wifi and Student Wifi are secured with WPA2-PSK encryption and unique passphrases: staffwifi@ for staff and student123 for students. AES encryption further protects these networks, ensuring strong defense against unauthorized access.

A screenshot of a computer

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Figure 2: Staff Wifi and Student Wifi access point

**E. Security**

In the security configuration of my network, I implemented password protection on both the console and enable modes for all routers and switches. This security setup ensures that only authorized users can gain access to network devices for configuration purposes. By using both the console and enable passwords, I safeguard the network infrastructure from potential internal threats, ensuring that only authorized personnel can alter the router or switch settings.

A close up of a message

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Figure 3: Console password and enable password set up

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Figure 4: Testing the console and enable modes

**F. IP Addressing**

IPv4 Range: 110.130.72.0/24 – 110.130.79.255

IPv6 Range: 2001:ABCD:5:51::/64

I break down the subnets and addressing plans for each area, ensuring that all configurations are free from overlap and that the subnetting appropriately supports communication between devices and areas.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Department** | **Network Address** | **Prefix** | **First Host Address** | **Last Host Address** | **Broadcast Address** |
| **Student Service Area** | 110.130.72.0 | /24 | 110.130.72.1 | 110.130.72.254 | 110.130.72.255 |
| Gig0/0/0 (Connects to StudentService-Switch1) | 110.130.72.0 | /24 | 110.130.72.1 | 110.130.72.254 | 110.130.72.255 |
| Gig0/0/1 (Connects to StudentService-Switch2) | 110.130.73.0 | /24 | 110.130.73.1 | 110.130.73.254 | 110.130.73.255 |
| Se0/1/0 (Connects to InfoCounter-Router) | 110.130.74.0 | /24 | 110.130.74.1 | 110.130.74.254 | 110.130.74.255 |
| Se0/1/1 (Connects to StaffArea-Router) | 110.130.75.0 | /24 | 110.130.75.1 | 110.130.75.254 | 110.130.75.255 |
| Se0/2/0 (Connects to ISP Router) | 110.130.78.0 | /24 | 110.130.78.1 | 110.130.78.254 | 110.130.78.255 |
| **Information Counter Area** | 110.130.74.0 | /24 | 110.130.74.1 | 110.130.74.254 | 110.130.74.255 |
| Gig0/0/0 (Connects to InfoCounter-Switch1) | 110.130.72.0 | /24 | 110.130.72.2 | 110.130.72.254 | 110.130.72.255 |
| Gig0/0/1 (Connects to InfoCounter-Switch2) | 110.130.73.0 | /24 | 110.130.73.2 | 110.130.73.254 | 110.130.73.255 |
| Se0/1/0 (Connects to StudentService-Router) | 110.130.74.0 | /24 | 110.130.74.2 | 110.130.74.254 | 110.130.74.255 |
| Se0/1/1 (Connects to WirelessZone-Router) | 110.130.75.0 | /24 | 110.130.75.2 | 110.130.75.254 | 110.130.75.255 |
| Se0/2/0 (Connects to ISP Router) | 110.130.78.0 | /24 | 110.130.78.2 | 110.130.78.254 | 110.130.78.255 |
| **WirelessZone Area** | DHCP Assigned (For Staff and Student Devices) | DHCP | DHCP Assigned | DHCP Assigned | DHCP Assigned |
| Gig0/0/0 (Connects to WirelessZone Access Point) | 110.130.72.0 | /24 | 110.130.72.3 | 110.130.72.254 | 110.130.72.255 |
| Se0/1/0 (Connects to InfoCounter-Router) | 110.130.75.0 | /24 | 110.130.75.3 | 110.130.75.254 | 110.130.75.255 |
| Se0/1/1 (Connects to StaffArea-Router) | 110.130.74.0 | /24 | 110.130.74.3 | 110.130.74.254 | 110.130.74.255 |
| Se0/2/0 (Connects to ISP Router) | 110.130.78.0 | /24 | 110.130.78.3 | 110.130.78.254 | 110.130.78.255 |
| **Staff Area** | 110.130.76.0 | /24 | 110.130.76.1 | 110.130.76.254 | 110.130.76.255 |
| Gig0/0/0 (Connects to Staff-Switch1) | 110.130.72.0 | /24 | 110.130.72.4 | 110.130.72.254 | 110.130.72.255 |
| Se0/1/0 (Connects to WirelessZone-Router) | 110.130.74.0 | /24 | 110.130.74.4 | 110.130.74.254 | 110.130.74.255 |
| Se0/1/1 (Connects to StudentService-Router) | 110.130.75.0 | /24 | 110.130.75.4 | 110.130.75.254 | 110.130.75.255 |
| Se0/2/0 (Connects to ISP Router) | 110.130.78.0 | /24 | 110.130.78.4 | 110.130.78.254 | 110.130.78.255 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Department** | **Network Address** | **Prefix** | **First Host Address** | **Last Host Address** | **Multicast Address** |
| **Student Service Area** |  |  | |  | | --- | |  |  |  | | --- | |  | |  |  |
| Gig0/0/0 (Connects to StudentService-Switch1) | 2001:ABCD:5:51::/64 | /64 | |  | | --- | | 2001:ABCD:5:51::1 | | 2001:ABCD:5:51::FFFF | FF02::1:FF51:1 |
| Gig0/0/1 (Connects to StudentService-Switch2) | 2001:ABCD:5:52::/64 | /64 | 2001:ABCD:5:52::1 | 2001:ABCD:5:52::FFFF | FF02::1:FF52:1 |
| Se0/1/0 (Connects to InfoCounter-Router) | 2001:ABCD:5:53::/64 | /64 | 2001:ABCD:5:53::1 | 2001:ABCD:5:53::FFFF | FF02::1:FF53:1 |
| Se0/1/1 (Connects to StaffArea-Router) | 2001:ABCD:5:54::/64 | /64 | 2001:ABCD:5:54::1 | 2001:ABCD:5:54::FFFF | FF02::1:FF54:1 |
| Se0/2/0 (Connects to ISP Router) | 2001:ABCD:5:55::/64 | /64 | 2001:ABCD:5:55::1 | 2001:ABCD:5:55::FFFF | FF02::1:FF55:1 |
| **Information Counter Area** |  |  |  |  |  |
| Gig0/0/0 (Connects to InfoCounter-Switch1) | 2001:ABCD:5:51::/64 | /64 | 2001:ABCD:5:51::2 | 2001:ABCD:5:51::FFFF | FF02::1:FF51:2 |
| Gig0/0/1 (Connects to InfoCounter-Switch2) | 2001:ABCD:5:52::/64 | /64 | 2001:ABCD:5:52::2 | |  | | --- | | 2001:ABCD:5:52::FFFF |  |  | | --- | |  | | FF02::1:FF52:2 |
| Se0/1/0 (Connects to StudentService-Router) | 2001:ABCD:5:53::/64 | /64 | 2001:ABCD:5:53::2 | 2001:ABCD:5:53::FFFF | FF02::1:FF53:2 |
| Se0/1/1 (Connects to WirelessZone-Router) | 2001:ABCD:5:54::/64 | /64 | 2001:ABCD:5:54::2 | 2001:ABCD:5:54::FFFF | FF02::1:FF54:2 |
| Se0/2/0 (Connects to ISP Router) | 2001:ABCD:5:55::/64 | /64 | 2001:ABCD:5:55::2 | 2001:ABCD:5:55::FFFF | FF02::1:FF55:2 |
| **WirelessZone Area** | DHCP Assigned | DHCP Assigned | DHCP Assigned | DHCP Assigned | DHCP Assigned |
| Gig0/0/0 (Connects to WirelessZone Access Point) | 2001:ABCD:5:51::/64 | /64 | 2001:ABCD:5:51::3 | 2001:ABCD:5:51::FFFF | FF02::1:FF51:3 |
| Se0/1/0 (Connects to InfoCounter-Router) | 2001:ABCD:5:54::/64 | /64 | 2001:ABCD:5:54::3 | 2001:ABCD:5:54::FFFF | FF02::1:FF54:3 |
| Se0/1/1 (Connects to StaffArea-Router) | 2001:ABCD:5:53::/64 | /64 | 2001:ABCD:5:53::3 | 2001:ABCD:5:53::FFFF | FF02::1:FF53:3 |
| Se0/2/0 (Connects to ISP Router) | |  | | --- | | 2001:ABCD:5:55::/64 |  |  | | --- | |  | | /64 | 2001:ABCD:5:55::3 | 2001:ABCD:5:55::FFFF | FF02::1:FF55:3 |
| **Staff Area** |  |  |  |  |  |
| Gig0/0/0 (Connects to Staff-Switch1) | 2001:ABCD:5:51::/64 | /64 | 2001:ABCD:5:51::4 | 2001:ABCD:5:51::FFFF | FF02::1:FF51:4 |
| Se0/1/0 (Connects to WirelessZone-Router) | 2001:ABCD:5:53::/64 | /64 | 2001:ABCD:5:53::4 | 2001:ABCD:5:53::FFFF | FF02::1:FF52:4 |
| Se0/1/1 (Connects to StudentService-Router) | 2001:ABCD:5:54::/64 | /64 | 2001:ABCD:5:54::4 | 2001:ABCD:5:54::FFFF | FF02::1:FF54:4 |
| Se0/2/0 (Connects to ISP Router) | 2001:ABCD:5:55::/64 | /64 | 2001:ABCD:5:55::4 | 2001:ABCD:5:55::FFFF | FF02::1:FF55:4 |

**G. Connectivity:**

The designed network ensures robust communication internally between areas: the Student Service Area, Information Counter Area, Wireless Zone Area, and Staff Area. Each router in these areas is interconnected through the configured static routes, ensuring efficient data transfer across the entire network. The routers now communicate with one another over IPv4 addresses, confirming that data packets are successfully routed across various subnets.

The Staff Area is the only department permitted to access the external WWW server (world.com). This configuration enhances security by ensuring that only authorized staff can access external resources, while internal communication remains secure and isolated from external threats. Additionally, given the nature of the Wireless Zone, which accommodates personal devices from students and staff, DHCP is deployed for automatic IP address allocation. This dynamic approach is particularly effective for managing a high volume of daily connections without manual configuration, ensuring efficient and scalable network access. Specially, the DNS server resides in the Staff Area, facilitating both IPv4 and IPv6 name resolution. This ensures that the Staff Area can resolve both internal network addresses and external domain names, further enhancing the operational capabilities of the department.

A screenshot of a computer

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Figure 5: Connect to world.com by StaffPC

Figure 6: DNS server service

A computer screen shot of a computer program

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Figure 7: Testing ping PCs in Staff Area

A screenshot of a computer

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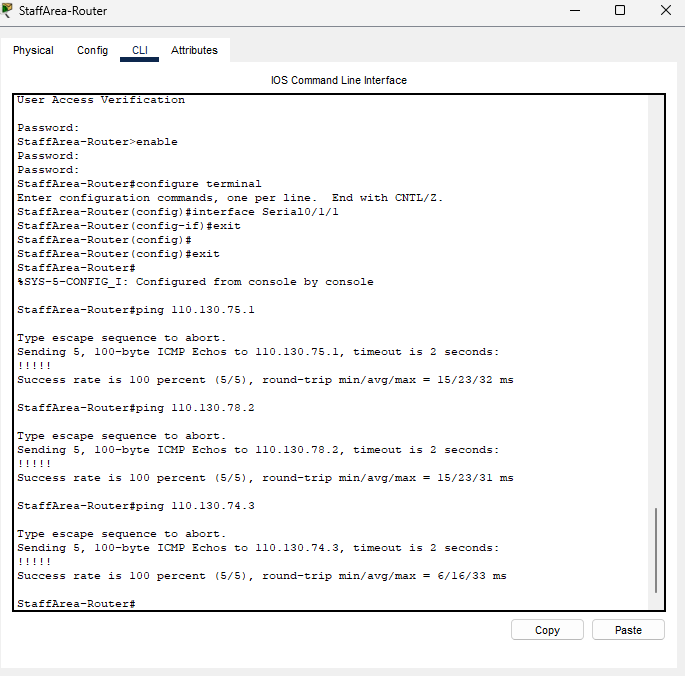
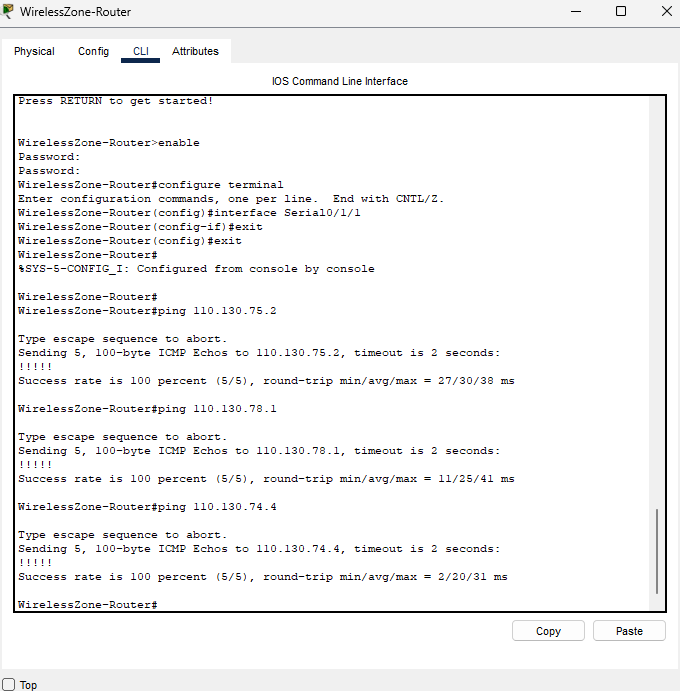
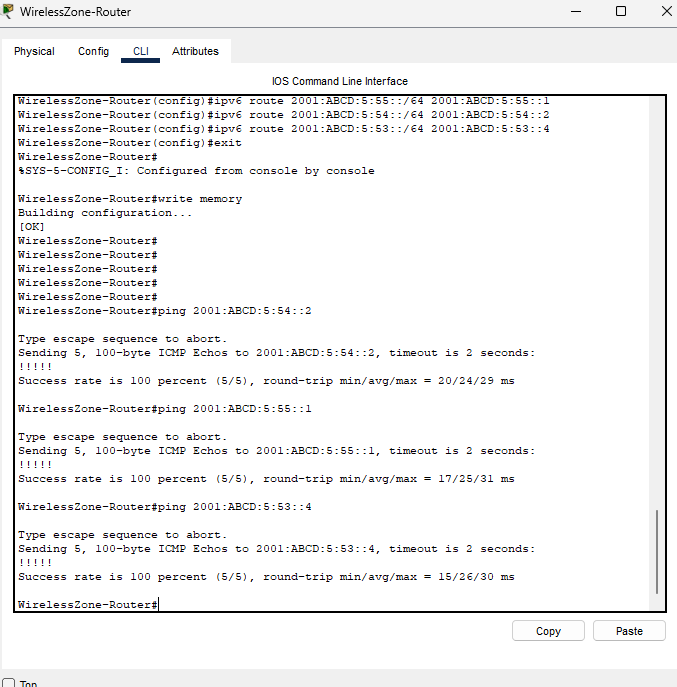


Figure 8: These are the connectivity of 4 areas' routers in IPv4

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Figure 9: These are connectivity of 4 areas' routers by IPv6