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# 1. Executive Summary

This assignment focused on designing, configuring, and verifying a multi-campus network for AUCA, connecting the Masoro and Gishushu LANs. The main goals were to implement IP addressing, NAT, routing, secure remote access, DHCP services, server functionality, and network security features.

Key outcomes include:

* Seamless inter-campus communication.
* HTTP and mail server accessibility across both campuses.
* Secure management using Telnet and SSH.
* Port security and STP implementation for stability and loop prevention.

# 2. Objective

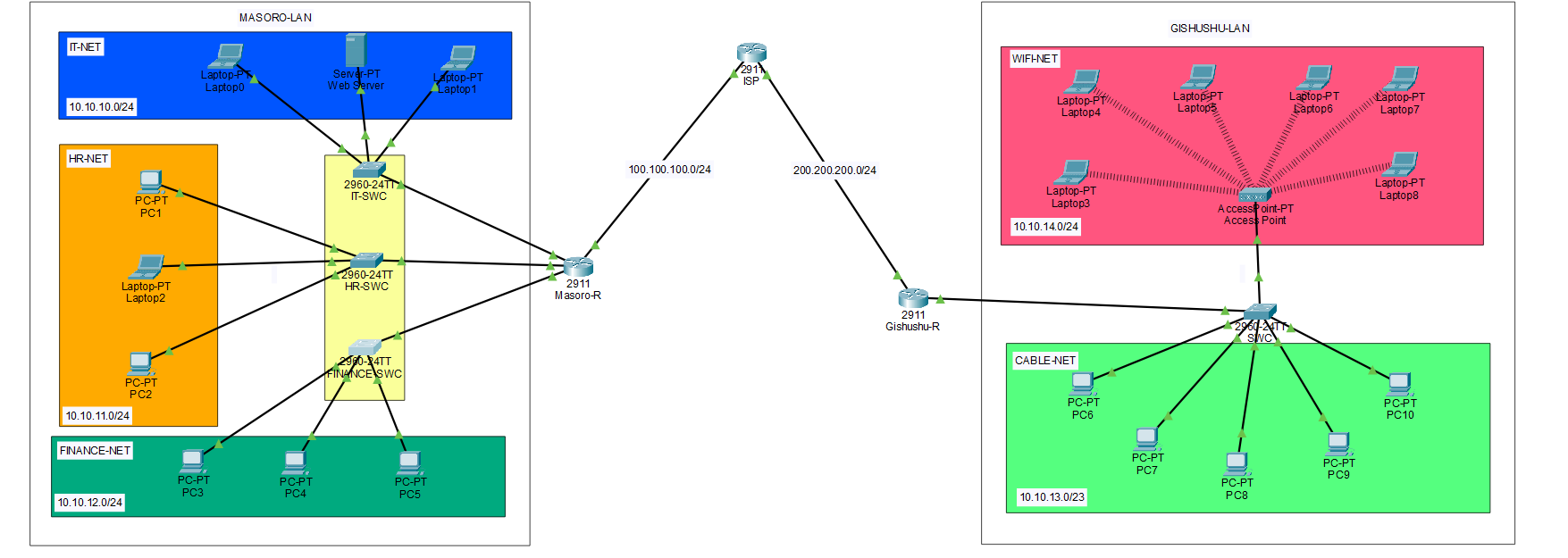
Design, configure, and test a network topology for AUCA to enable communication between Masoro and Gishushu LANs. Implement IP addressing, NAT, routing, DHCP, security, and server setups while verifying connectivity.

# 3. Required Resources

* **Software:** Cisco Packet Tracer (latest version)
* **Reference Materials:** Canvas LMS videos: “Packet Tracer Labs [v1–v3]”
* **Topology Diagram**: "AUCA Masoro+Gishushu LANs.png"

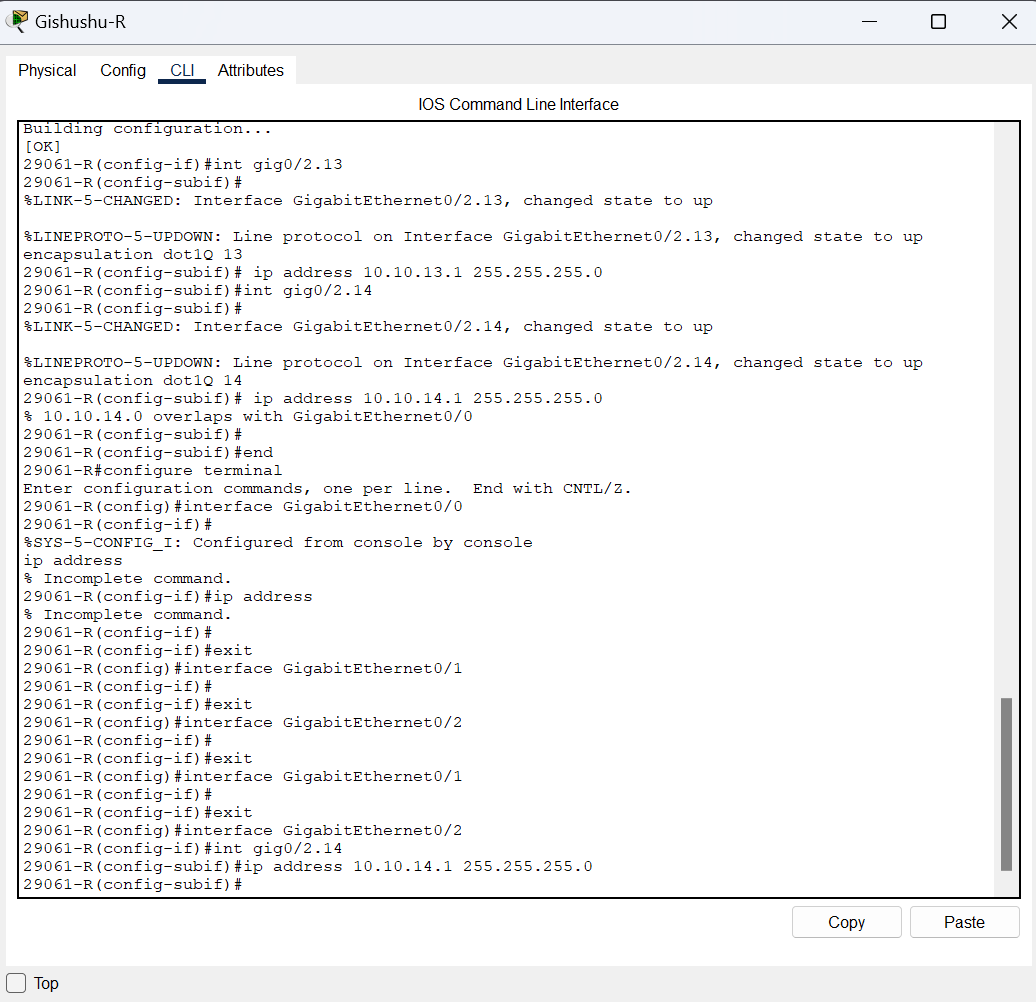
# 4. Network Topology Design

* Redesigned to separate departments (Administration, IT, Academic).
* Masoro and Gishushu connected via routers using Gigabit links.
* Each department assigned a unique VLAN/subnet.
* Labeling of all routers, switches, servers, PCs, laptops, and connections.



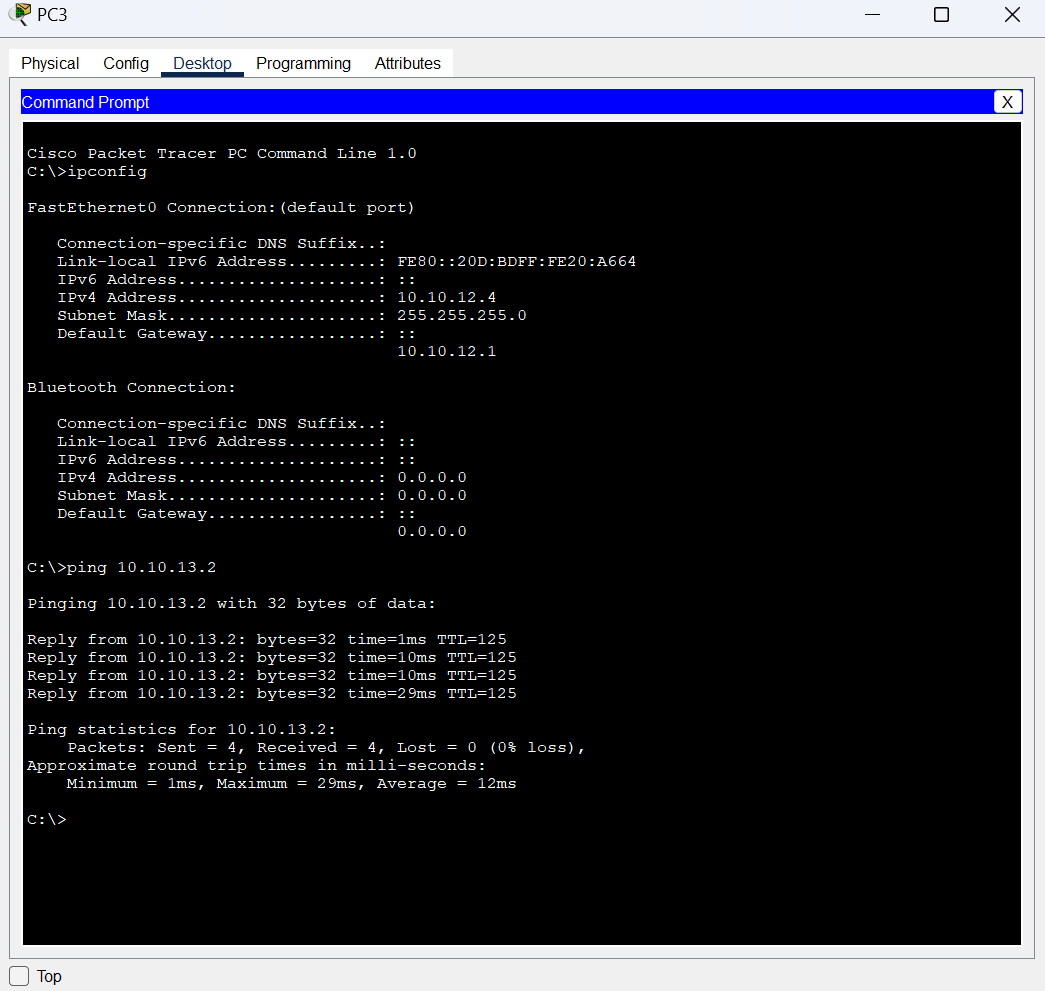
# 5. IP Addressing Scheme

* Sub-netting applied based on department and LAN size.
* Router interfaces assigned **last valid IP in subnet** as default gateway.
* Servers assigned **static IPs** for reliability.
* PCs/Laptops configured for **dynamic DHCP assignment**.
* DNS server set to **10.10.10.10**.



# 6. Device Connections and Interface Types

* Servers connected via FastEthernet interfaces.
* Switches interconnected via GigabitEthernet interfaces.
* Straight-through cables used for PC to Switch, Router to router.
* Connectivity tested using ping and traceroute commands.

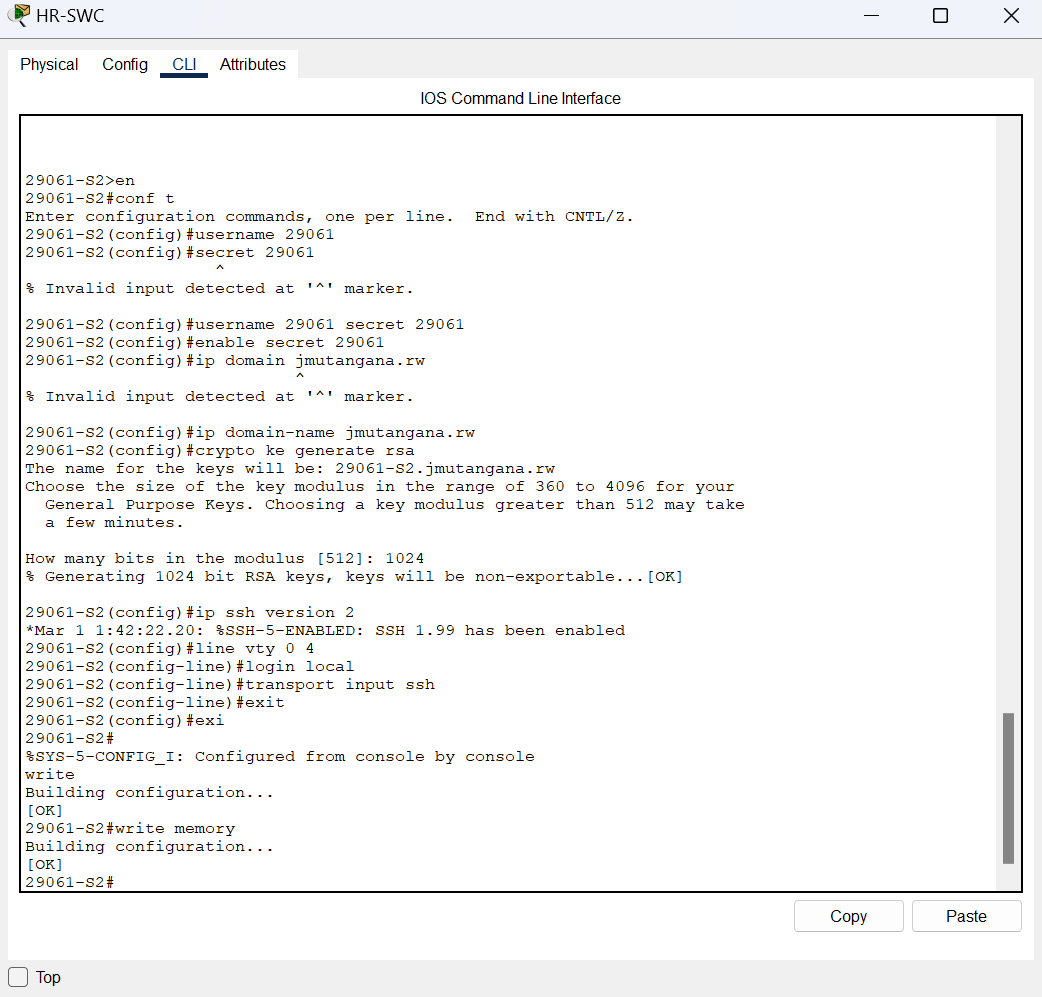


# 7. Hostname Configuration

* Routers named: 29061-R
* Switches named: 29061-S1, 29061-S2, etc.

# 8. Remote Access Configuration (SSH)

* SSH enabled on all routers and switches.
* Username/password set to **29061**
* Domain name configured: jmutangana.rw



# 9. DHCP Configuration

* DHCP pools configured per campus VLAN.
* Default gateway, subnet mask, and DNS included in DHCP assignments.
* Server IPs excluded from pools.
* PCs and laptops verified to receive IP dynamically.

# 10. Advanced Configuration Requirements

## 10.1 NAT (PAT & Static NAT)

* PAT configured to allow multiple LAN IPs to access internet using single public IP.
* Static NAT applied to Masoro web server (10.10.10.10) to allow public access:

**ip nat inside source static tcp 10.10.10.10 80 100.100.100.1 80**

* NAT configured but **interfere with inter-campus communication** because after applying it connectivity stopped.

## 10.2 Routing

* Static routes defined for remote LAN networks.
* Default routes for unknown destinations configured.
* EIGRP enabled for automatic route discovery and redundancy.

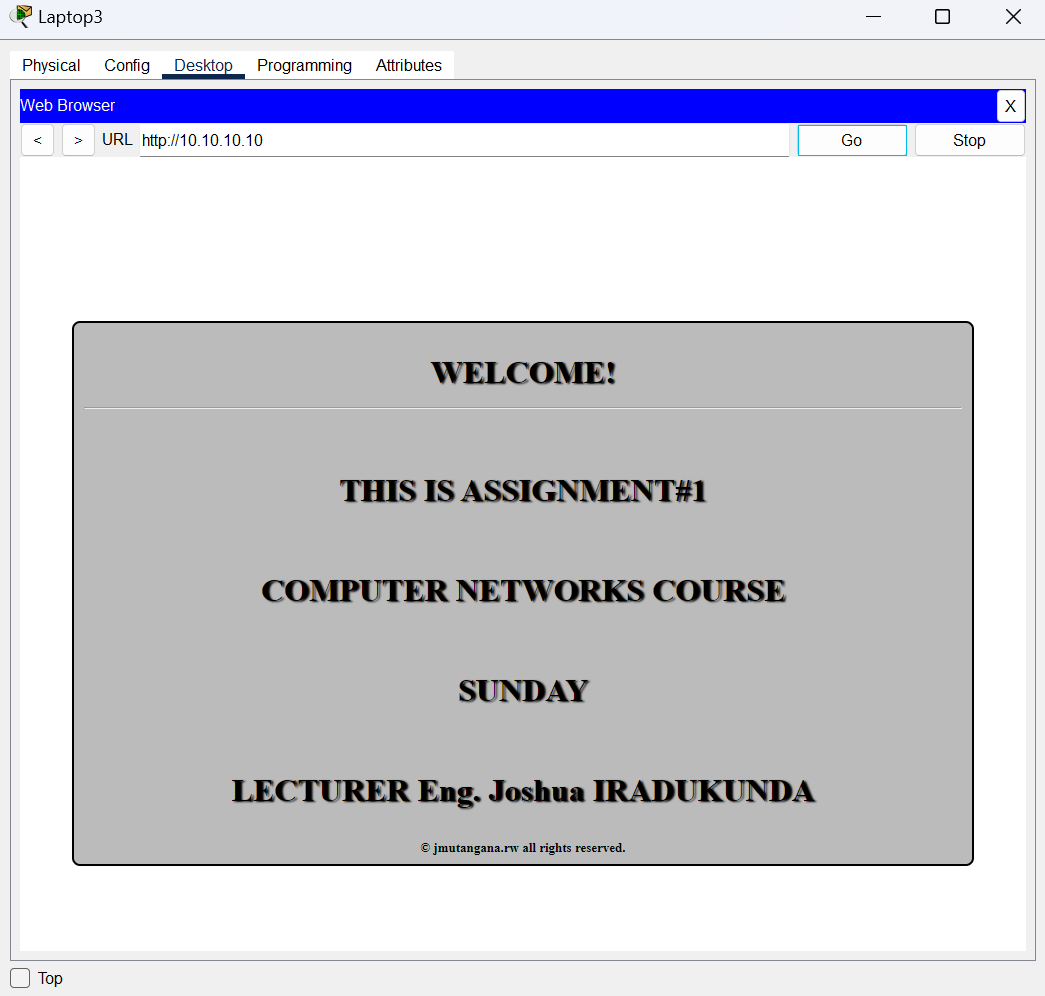
## 10.3 STP/RSTP and Port Security

* STP/RSTP enabled to prevent network loops.
* Port security applied to switch ports connecting to end devices:

MAC address limit, sticky learning, and violation action = shutdown.

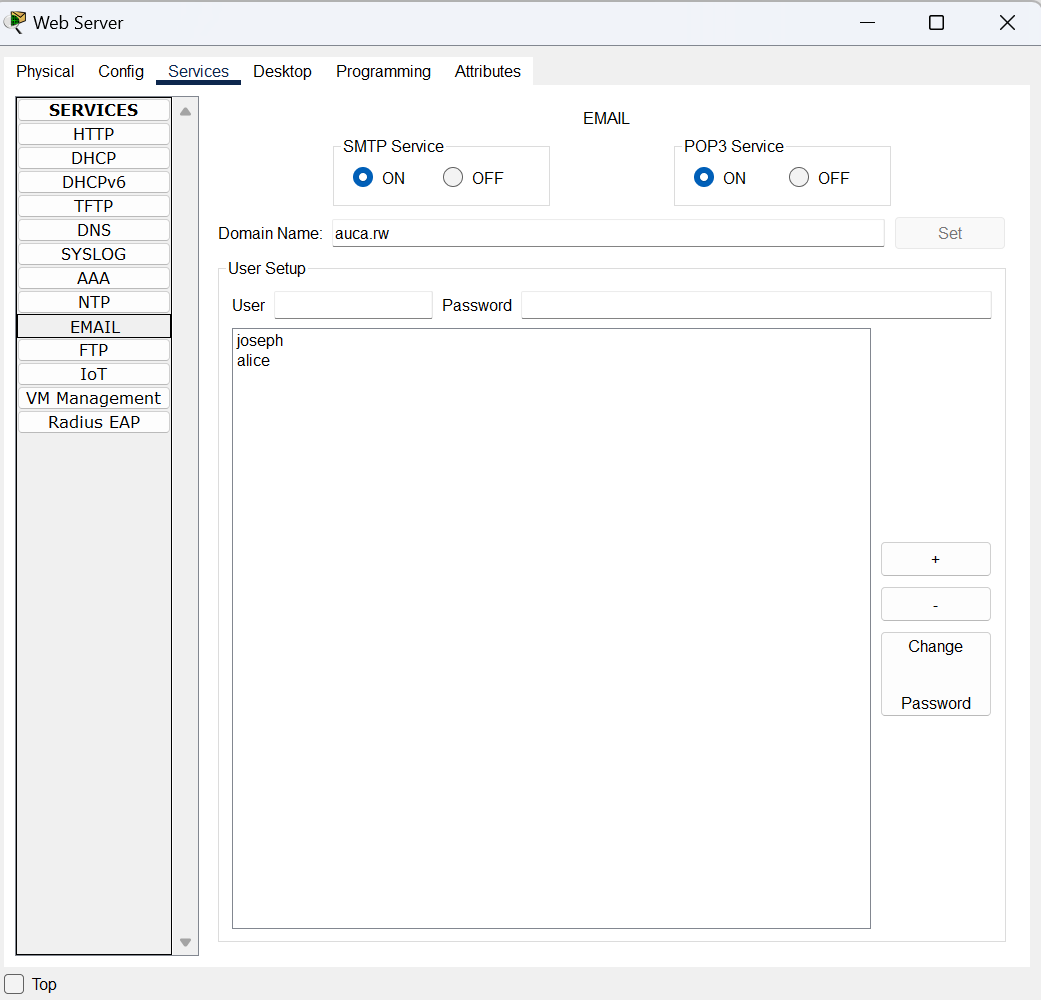
## 10.4 HTTP Web Server Setup

* Masoro web server configured with static IP (10.10.10.10).
* Access tested from Gishushu LAN and simulated internet.

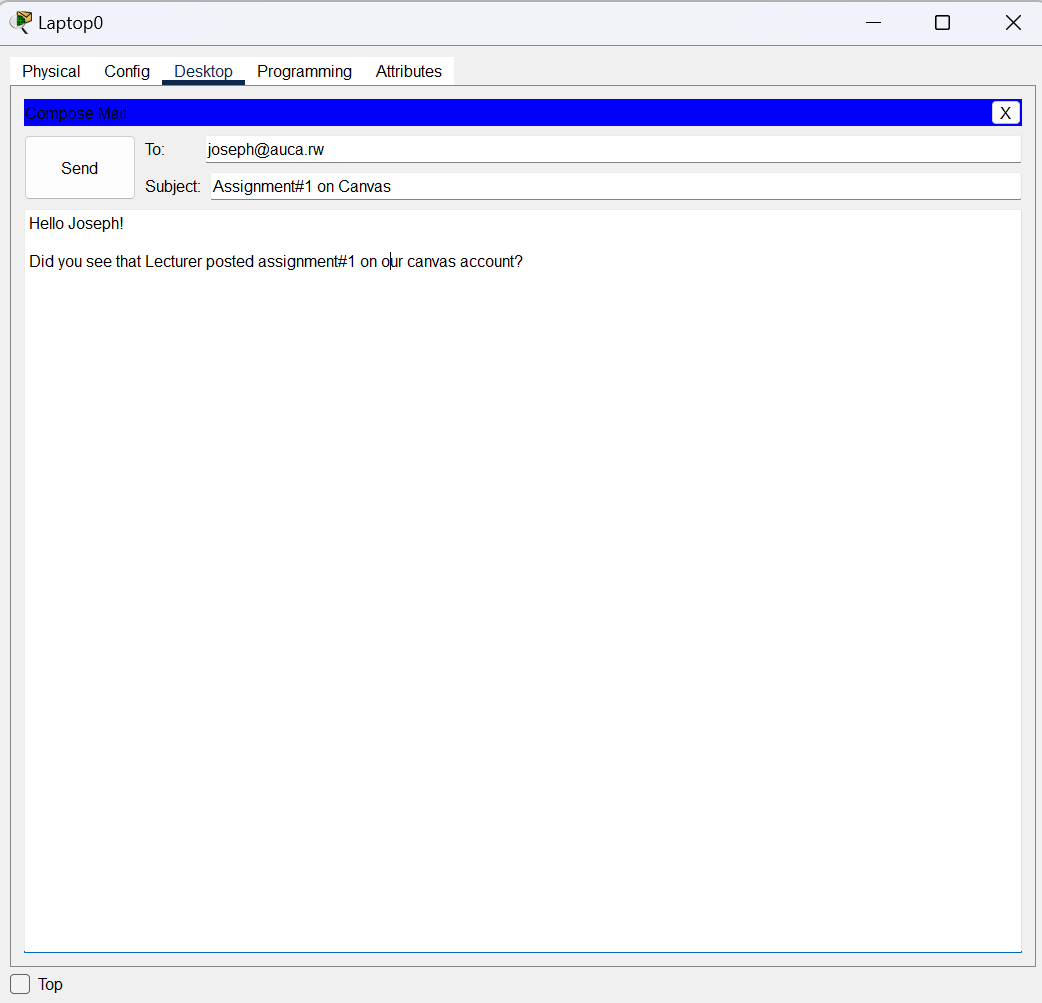


## 10.5 Mail Server Configuration

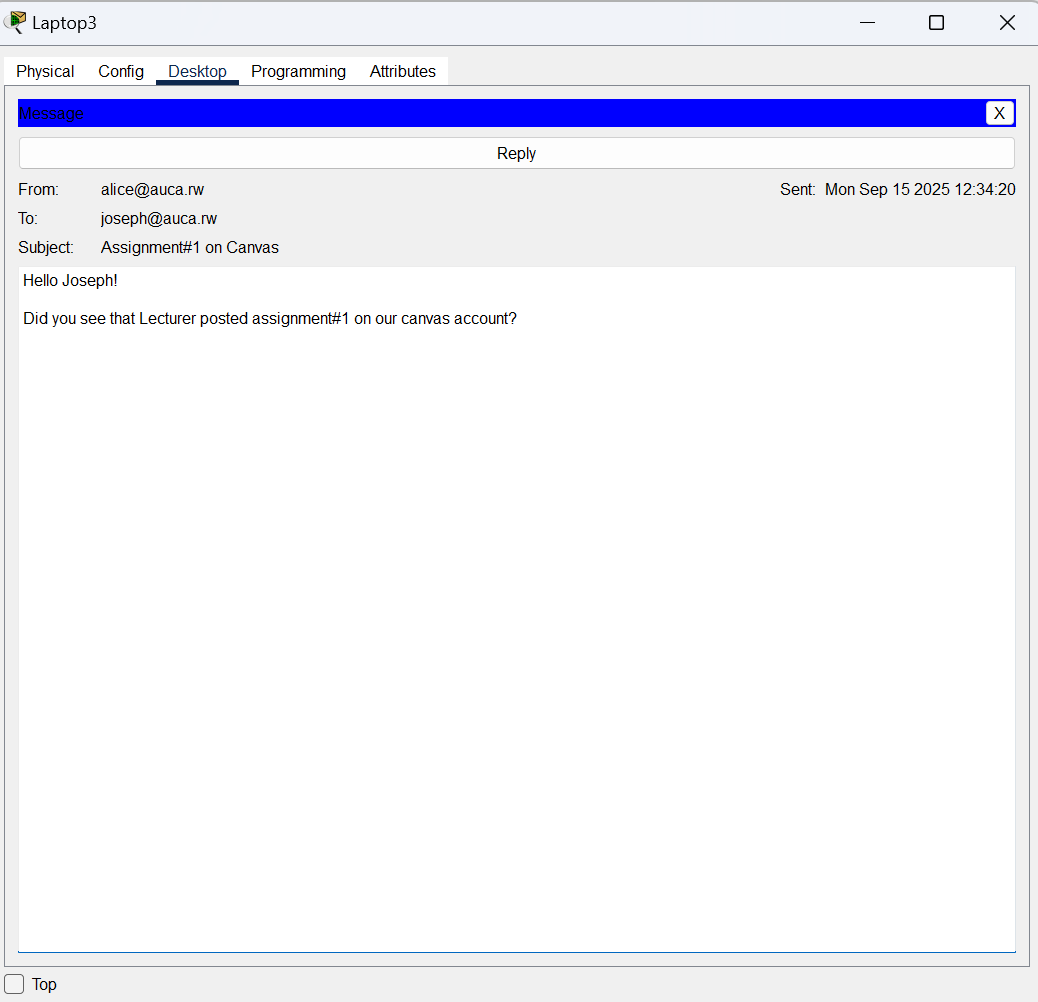
* Built-in mail server configured.
* Accounts created for two users across campuses.
* SMTP/POP3 configured.
* Successful sending/receiving tested between campuses.



**Compose Email & Send**



**Email Received**

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# 11. Verification and Troubleshooting

Key commands used for verification:

* show ip interface brief → check IP assignment.
* show running-config → review full configuration.
* show vlan brief → verify VLAN setup.
* show ip dhcp binding → check DHCP leases.
* show ip nat translations → confirm NAT entries.
* show ip route → verify routing tables.
* show spanning-tree → confirm STP status.
* show port-security → verify port security settings.

# 12. Saving Configuration

* All devices saved using: **copy running-config startup-config**
* I Reloaded routers/switches verified persistent configurations.

# 13. Achieved Outcomes

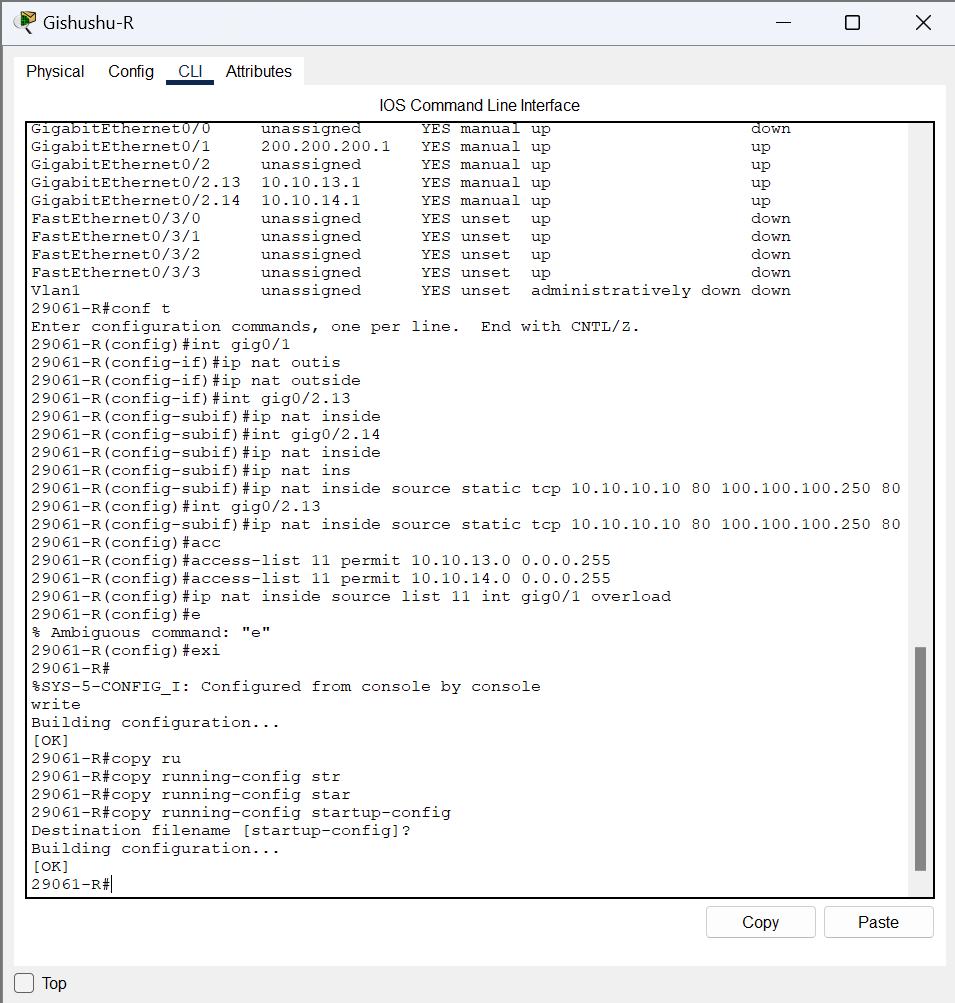
* Connectivity Masoro ↔ Gishushu communication.
* Web server publicly reachable.
* Mail server operational across campuses.
* Secure management via SSH.
* VLANs, STP, and port security correctly configured.

# 14. Conclusion

This assignment provided hands-on experience in:

* Designing multi-campus networks.
* Configuring routers, switches, DHCP, and experience of routing .
* Implementing network security (SSH, port security, STP).
* Deploying servers and testing service availability.

**Challenges:** NAT interfering with inter-campus after configure NAT connectivity stopped.



# 15. Table of All Used Commands

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NO** | **Cisco command** | **Device applied to** | **Purpose** | **Full command** |
| 1 | en | All Switches & Routers | Enter EXEC mode | enable |
| 2 | Conf t | All Switches & Routers | Enter grobal c | Configure terminal |
| 3 | Int fa0/1 | All Switches | Configure specific fastethernet port | Interface fastEthener0/1 |
| 4 | Int fa0/2 | All Switches | Configure specific fastethernet port | Interface fastEthener0/2 |
| 5 | Int fa0/3 | All Switches | Configure specific fastethernet port | Interface fastEthener0/3 |
| 6 | Int fa0/4 | All Switches | Configure specific fastethernet port | Interface fastEthener0/4 |
| 7 | Int fa0/5 | All Switches | Configure specific fastethernet port | Interface fastEthener0/5 |
| 8 | Int fa0/6 | Gishuhsu Switches | Configure specific fastethernet port | Interface fastEthener0/6 |
| 9 | Int gig0/0 | On ISP & Masoro Routers | Configure specific gigabitEthernet port | Interface GigabitEthernet0/0 |
| 10 | Int gig0/1 | All Routers | Configure specific gigabitEthernet port | Interface GigabitEthernet0/1 |
| 11 | Int gig0/2 | All Routers | Configure specific gigabitEthernet port | Interface GigabitEthernet0/2 |
| 12 | Hostname | All Switches & Routers | Assign hostname for identification | Hostname 29061-R/ Hostname 29061-S1 |
| 13 | ip address | All routers, Switch VLAns | Assign IP to an interface | Ip address 10.10.10.1 255.255.255.0 |
| 14 | no shutdown | All routers, Switch VLAns | Enable interface | no shutdown |
| 15 | Ip dhcp pool | Routers | Create DHCP pool | Ip dhcp pool IT-NET |
| 16 | default-router | Routers | Define default gateway for dhcp clients | default-router 10.10.10.1 |
| 17 | Dns server | Routers | Define DNS server for dhcp clients | dns-server 10.10.10.10 |
| 18 | username | All routers, Switches | Create login account for Telnet/SSH | Username 29061 secret 29061 |
| 19 | ip domain-name | Routers,Switches | Set domain-name for SSH | ip domain-name jmutangana.rw |
| 20 | crypto key generate rsa | Routers, Switches | Generate keys for SSH | crypto key generate rsa |
| 21 | Line vty 0 4 | Routers & Switches | Configure Telnet/SSH lines | line vty 0 4 |
| 22 | Login local | Routers & Switches | Use local credential for login | login local |
| 23 | transport input ssh | Routers & Switches | Force SSH login only | transport input ssh |
| 24 | switchport port-security | Switches | Enable port security on an interface | switchport port-security |
| 25 | switchport port-security maximum 1 | Switches | Allow only one MAC per port | switchport port-security maximum 1 |
| 26 | switchport port-security violation shutdown | Switches | Set action on violation | switchport port-security violation shutdown |
| 27 | Switport mode access | Switches | Enable Access mode on specific port | Switchport mode access |
|  | Switch mode trunk | Gishushu SWC | Enable trunk on port | Switch mode trunk |
| 28 | Switchport access vlan | Switches | Creating VLAN on switch port | Switchport vlan 13 |
| 29 | Switchport trunk allowed vlan | Gishushu-SWC | Uplink swicthport to a router by VLANs | Switcheport trunk allowed vlan 13,14 |
| 30 | Interface gig0/2.13 | Routers | Create subinterface for vlan 13 | Interface gig0/2.13 |
| 31 | Interface gig0/2.14 | Routers | Create subinterface for vlan 14 | Interface gig0/2.14 |
| 32 | encapsulation dotQ13 | Routers | Tags subinterfce g0/2.13 for vlan 13 | encapsulation dotQ13 |
| 33 | encapsulation dotQ14 | Routers | Tags subinterfce g0/2.13 for vlan 13 | encapsulation dotQ13 |
| 34 | Interface gig0/2.13 | Routers | Enter in subinterface 13 | Interface gig0/2.13 |
| 35 | Interface gigo/2.14 | Routers | Enter subinterface 14 | Interface gig0/2.14 |
| 36 | ip nat inside | Routers | Define inside NAT interface | ip nat inside |
| 37 | ip nat outside | Routers | Define outside NAT | ip nat outside |
| 38 | access-list 1 permit | Routers | Define traffic allowed | access-list 1 permit 10.10.10.0 0.0.0.255 |
| 39 | ip nat inside source list 1 interface s0/0/0 overload | Routers | Configure PAT | ip nat inside source list 1 interface gig0/0 overload |
| 40 | copy running-config startup-config | Routers and Switches | Save configurations | copy running-config startup-config |
| 41 | ipconfig | All client and server | Check ip configuration info | ipconfig |
| 42 | ping | All client and server | Check connectivity | ping 10.10.10.10 |
| 43 | Show int ip brief | Routers and Switches | Check ip address assigned to port | Show ip interface brief |
| 44 | Write memory | Routers and switch | Writing/save configurations | Write memory |
| 45 | Show ip nat translation | Masoro router and Gishushu router | To confirm NAT entries | Show ip nat translation |
| 46 | no access-list 11 permit |  | Disable access list | no access-list 11 permit |
| 47 | Show vlan brief | Routers & switches | Verify VLAN configuration | Show vlan brief |
| 48 | Show running-configuration | Routers & switches | Check active configurations | Show running-configuration |

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