ADVENTIST UNIVERSITY
OF CENTRAL AFRICA

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Course Name: Computer Networks

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Contents

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

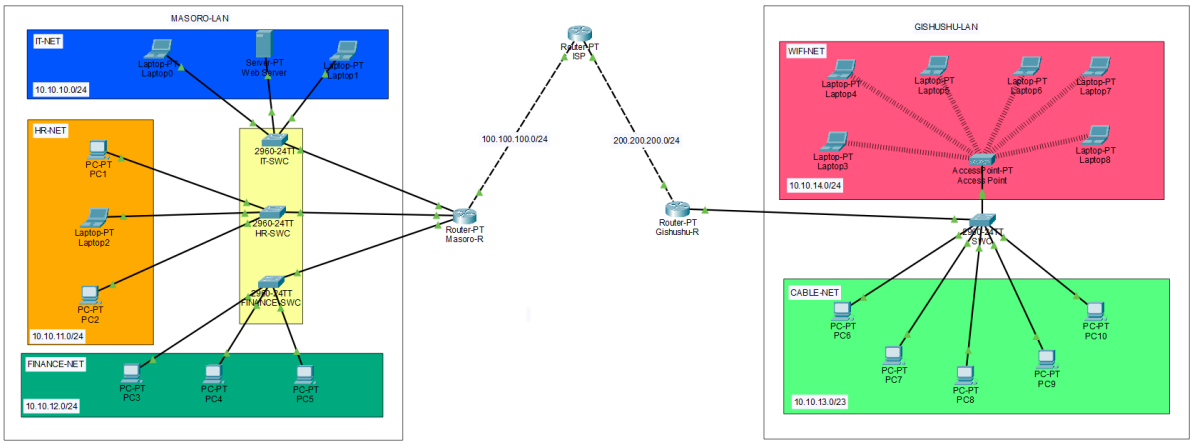
Design, configure, and test a network topology for AUCA to enable communication between Masoro and Gishushu LANs. Implement IP addressing, NAT, routing, DHCP, security, and server setups while verifying connectivity.

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"

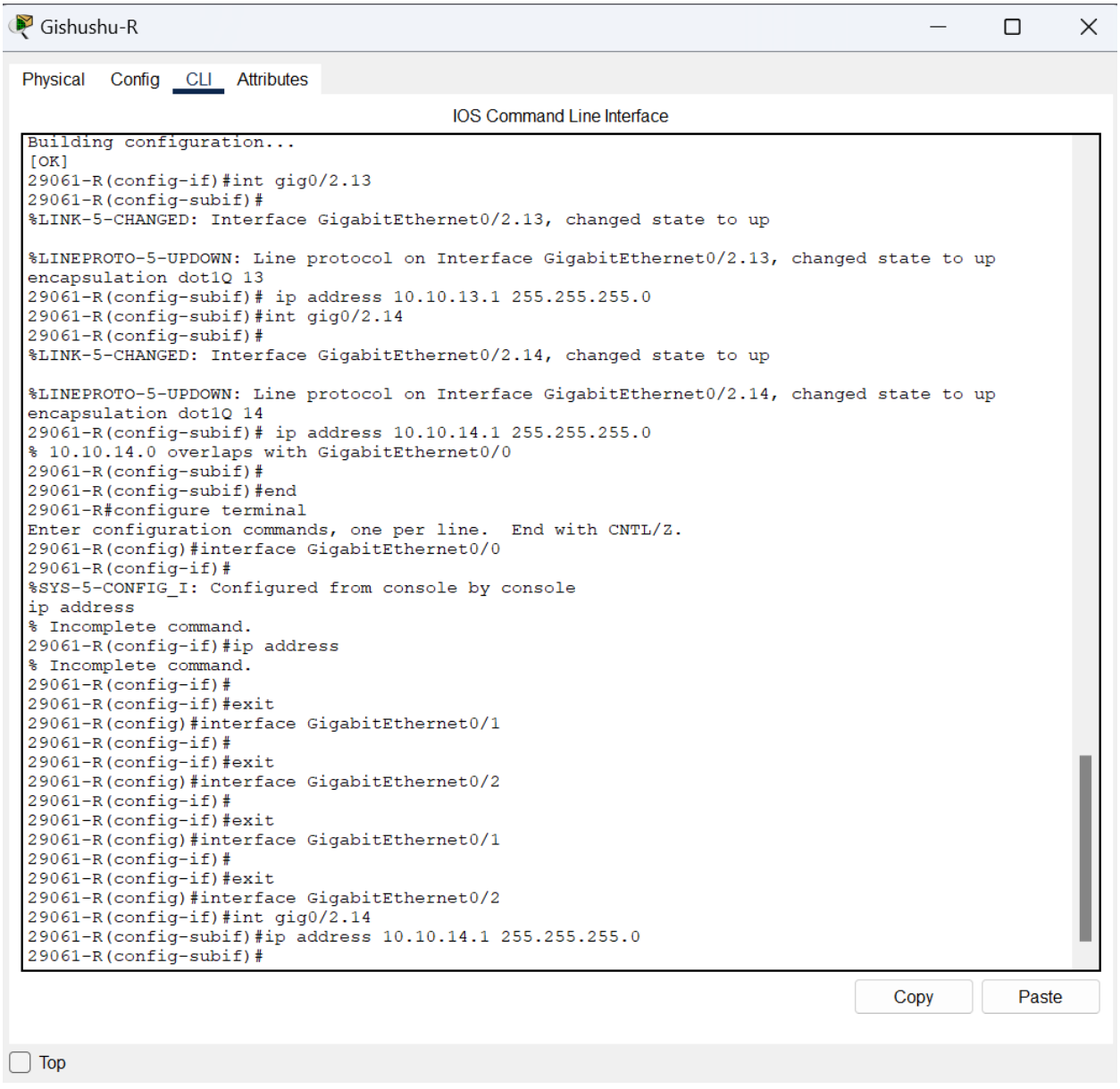
4. Network Topology Design

- 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.



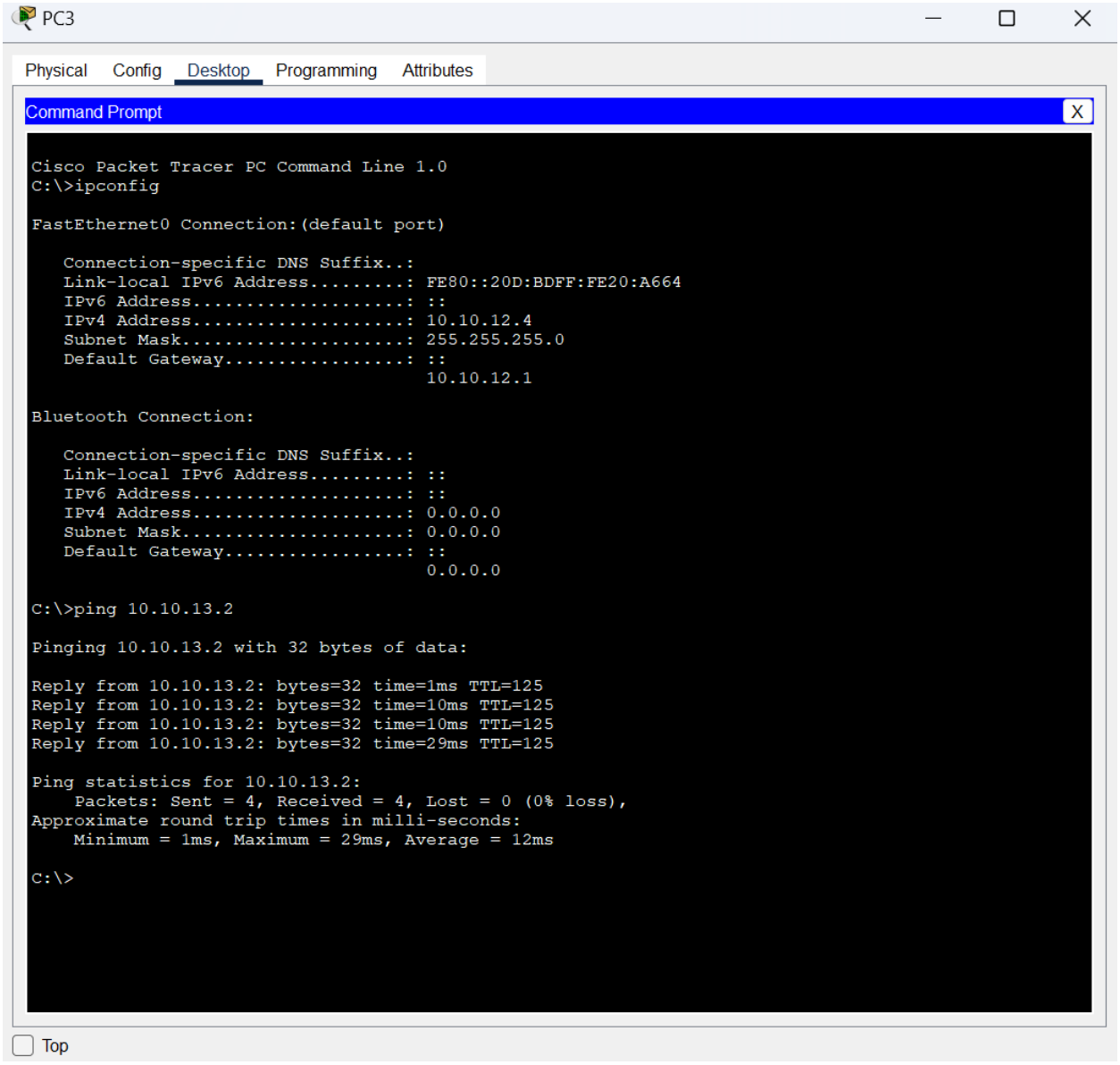
5. IP Addressing Scheme

- 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.

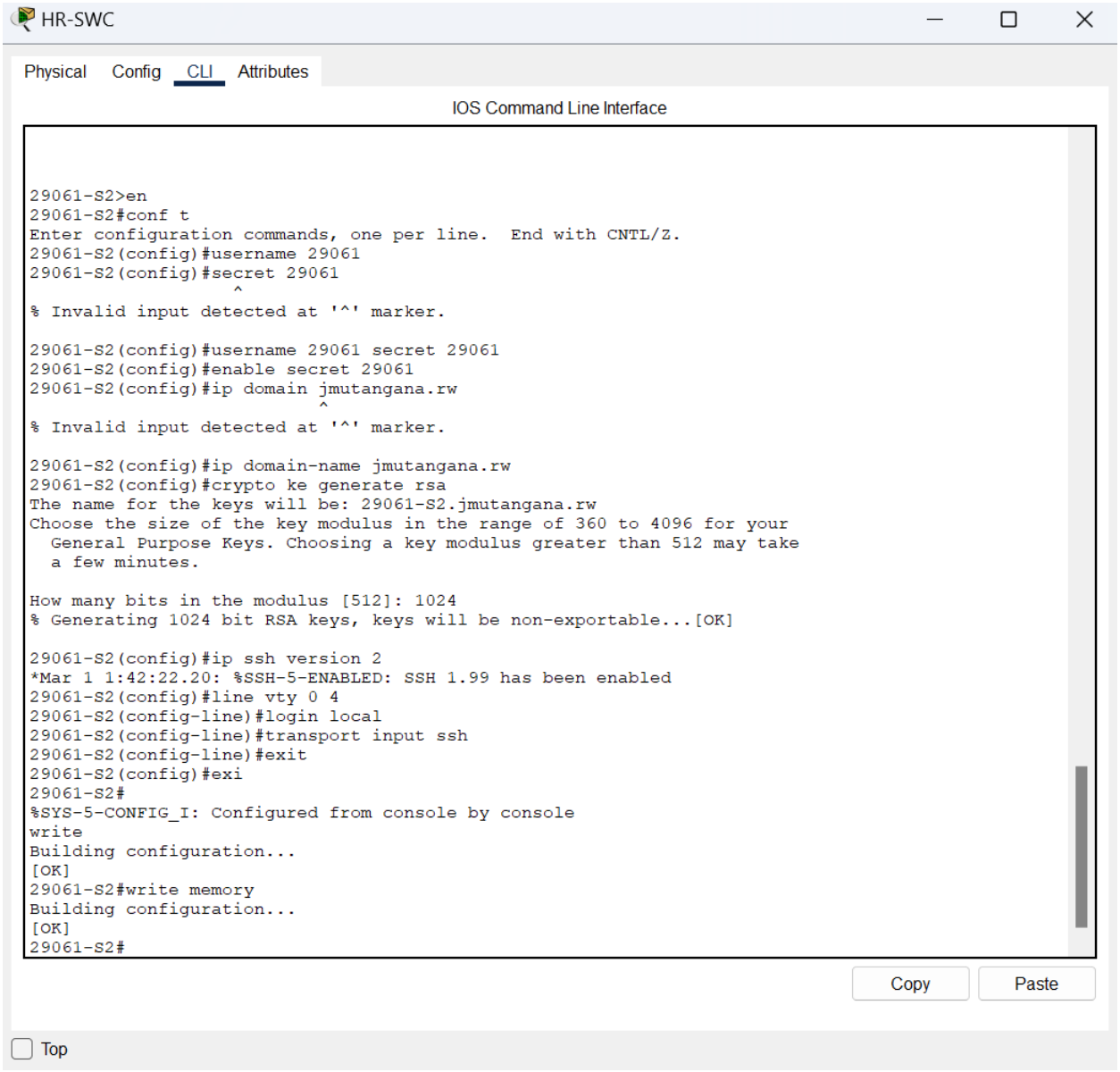


7. Hostname Configuration

- 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.

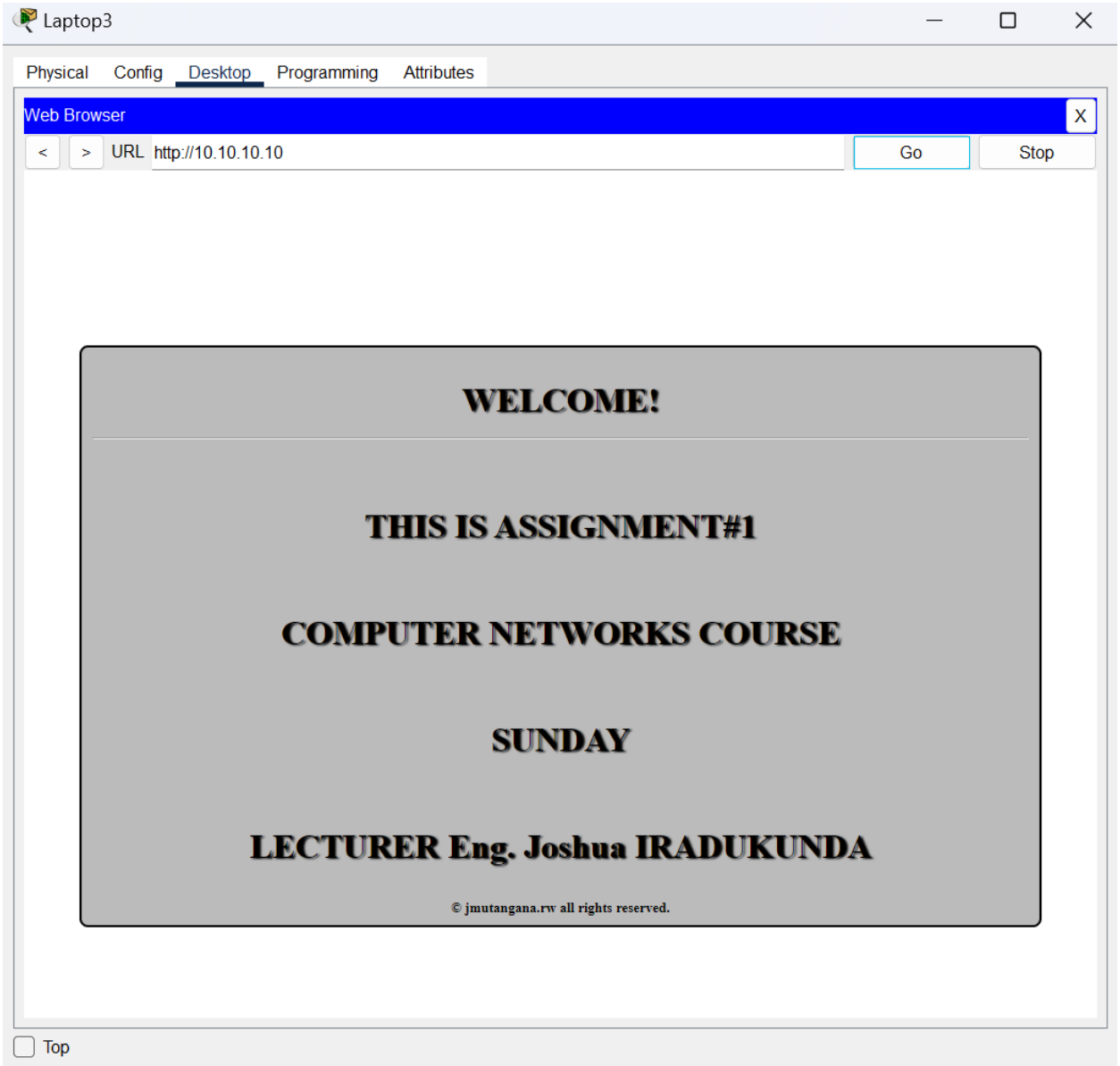
10.3 STP/RSTP and Port Security

- 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.

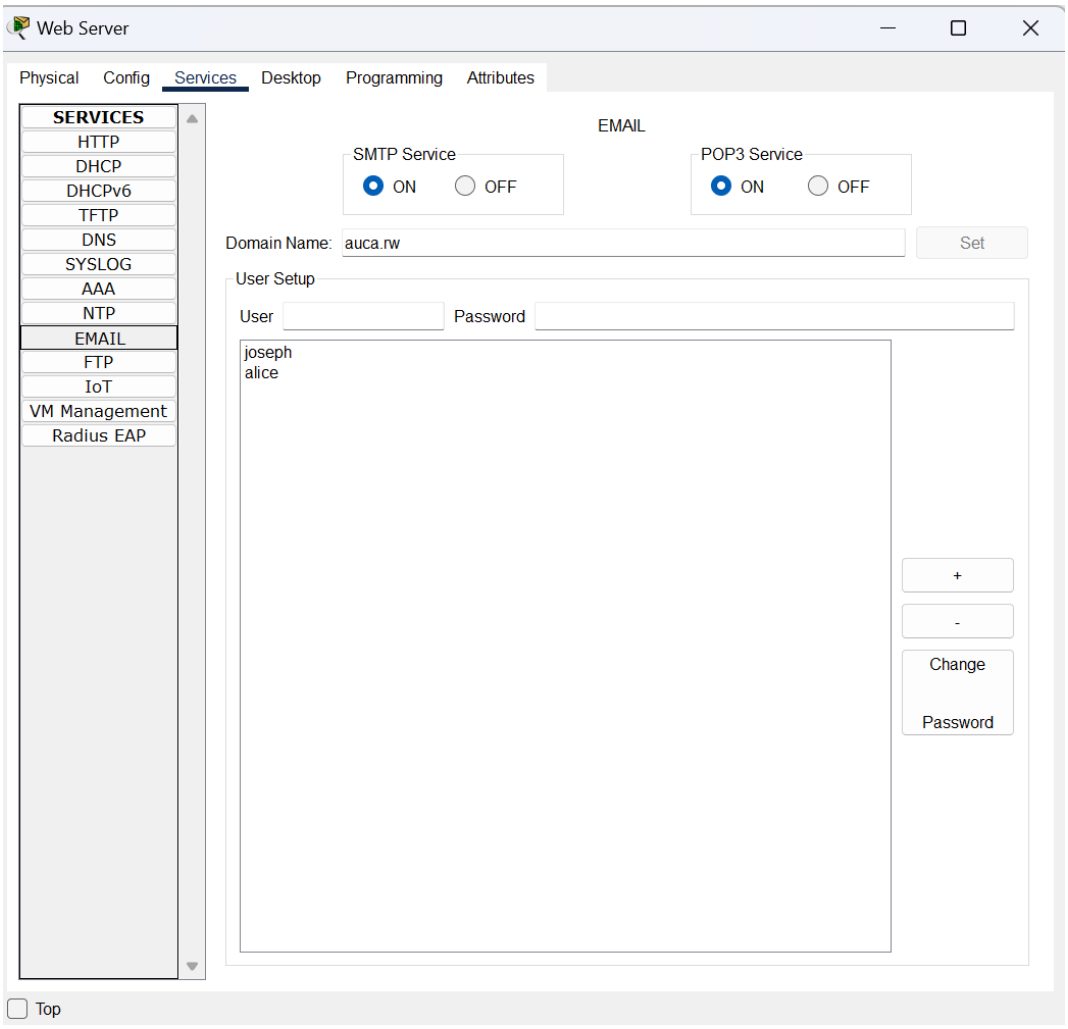
10.4 HTTP Web Server Setup

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

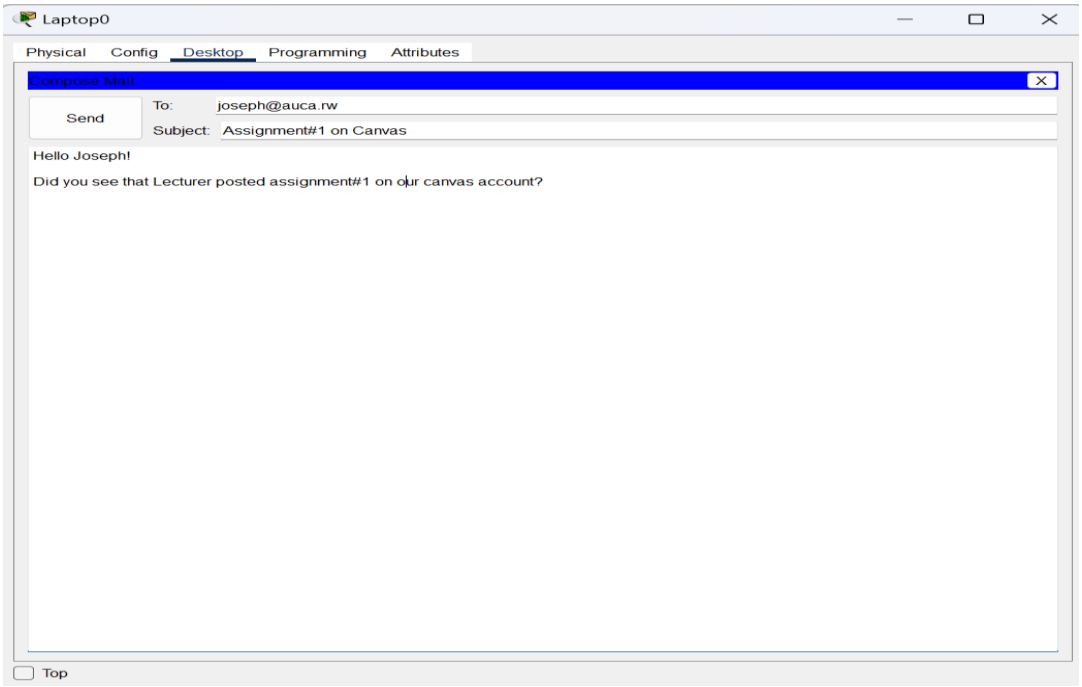


10.5 Mail Server Configuration

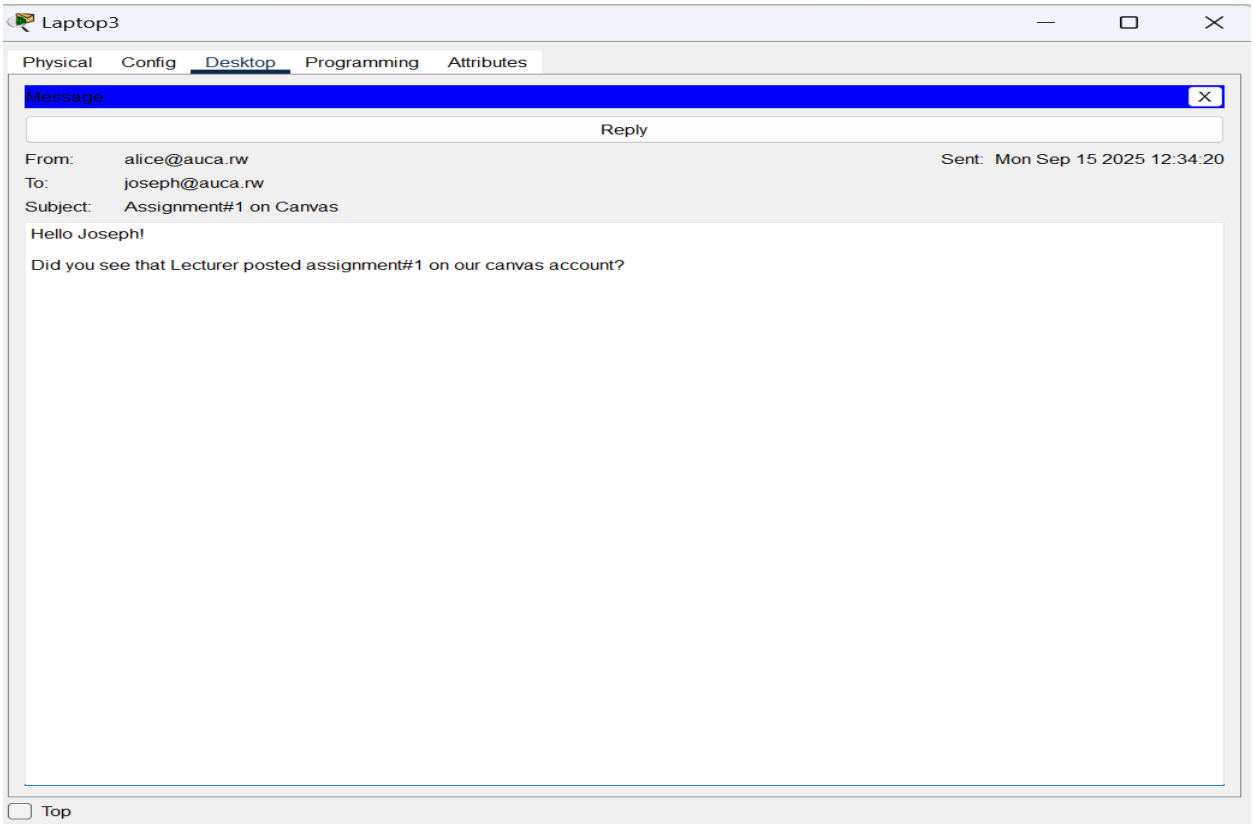
- Built-in mail server configured.
- Accounts created for two users across campuses.
- SMTP/POP3 configured.
- Successful sending/receiving tested between campuses.



Compose Email & Send



Email Received



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

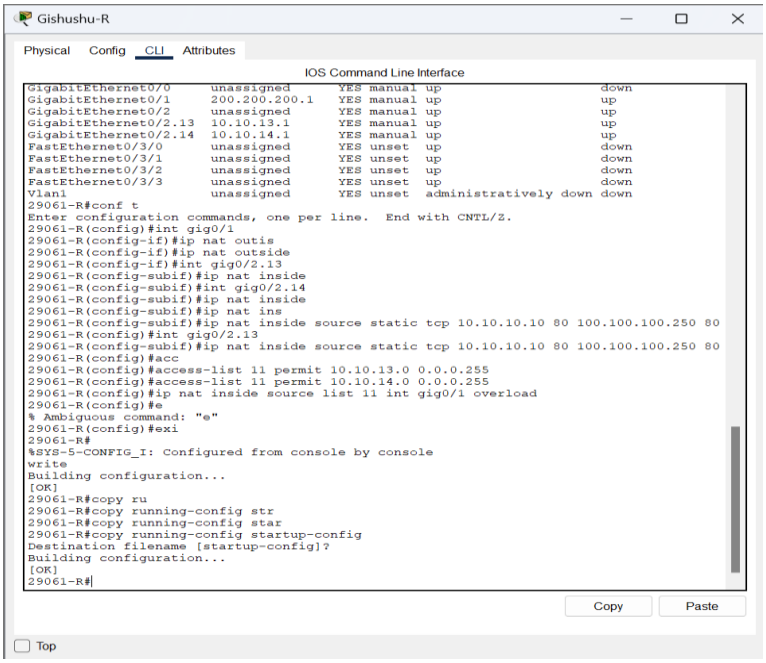
- Connectivity Masoro ↔ Gishushu achieved.
- Web server reachable on all clients.
- Mail server operational across campuses.
- Secure management via SSH.
- VLANs, STP, and port security correctly configured.

14. Conclusion

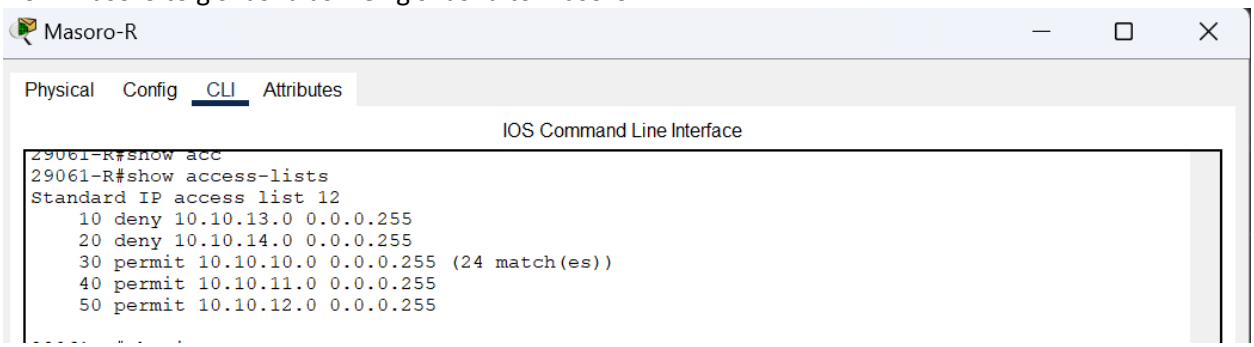
This assignment provided hands-on experience in:

- 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.

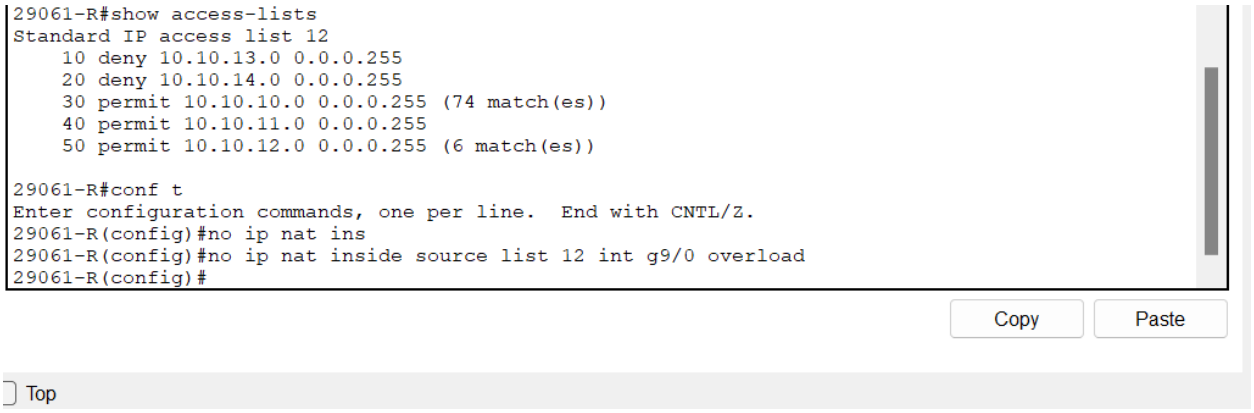
Challenges: NAT interfering with inter-campus after configure NAT connectivity stopped.



Second Attempt: Challenges still on NAT but now I disabled NAT on Masoro then connectivity is there from masoro to gishushu as well gishushu to masoro



No IP nat on Masoro-Router



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
49	Show access-lists	Masoro and Gishushu Router	Check IP allowed to be NATed	Show access-lists
50	Show ip nat translations	Masoro and Gishushu Router	To check private IP address translated to public	Show ip nat translations
51	Ip nat inside source list 15 int g9/0 overload	Gishushu Router	Translate the address from inside the network	Ip nat inside source list 15 int GigabitEthernet9/0 overload
52	no ip nat inside source list 12 int g9/0 overload	Masoro router	No translating addres	Ip nat inside source list 12 int GigabitEthernet9/0 overload

16. Table of Figures