Softwarica
COLLEGE OF IT & E-COMMERCE

in collaboration with

Coventry University

ST4065CEM COMPUTER SYSTEMS AND NETWORKS
ETHICAL HACKING AND CYBERSECURITY

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Abstracts

This document analyzes other significant topics on networking like network design, security threats and comparison of protocols. Advantages, disadvantages, and counteractive steps of the TCP and UDP have been compared to each other. Network security is investigated through practical protections and attacks like STP, DHCP spoofing and MITM. The aim of a three tier network architecture was to service a total of five departments using the 172.16.99.0/16 IP block with DHCP and DNS facilitated and VLANs blocked to separate traffic. The device configuration has hostnames, user account, password encryption, access through Telnet/SSH, EtherChannel, redundancy, RSTP, and disabling DTP. Finally the topic on secure and efficient network management is addressed as well as the use of Linux firewall configuration via iptables, VPN concepts including the use of network operating systems they include windows server operating system and Linux.

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Introduction

This assignment covers core networking and security principles. It initially compared TCP and UDP. UDP is faster but less reliable, whereas TCP is more reliable because it makes connections and checks for errors. The release addresses vulnerabilities that could jeopardize network integrity, such as flooding and session hijacking. Furthermore, it discusses common attacks like as Man-in-the-Middle, DHCP spoofing, and STP exploits, as well as suggestions for how to defend against them. This network design is appropriate for smaller enterprises. It uses VLANs, DHCP, and DNS to provide efficient business-to-business communication, thanks to its three-tier design and exceptional subnetting. There are also protocols for protecting network devices, such as specifying permission levels, using encrypted passwords, and allowing external access via SSH and Telnet. Finally, it shows how to set up a firewall with iptables and how to use virtual private networks (VPNs) to securely connect to the internet from a distance. This study usually links fundamental theory with experience to ensure network security.

1.1. Comparison of TCP and UDP

Overview

Transmission Control Protocol (TCP) and User Data-gram Protocol (UDP) are two core protocols at the transport layer of the Internet protocol suite. They enable communication between devices but differ significantly in their design, reliability, speed, and use cases. (BasuMallick, 2022)

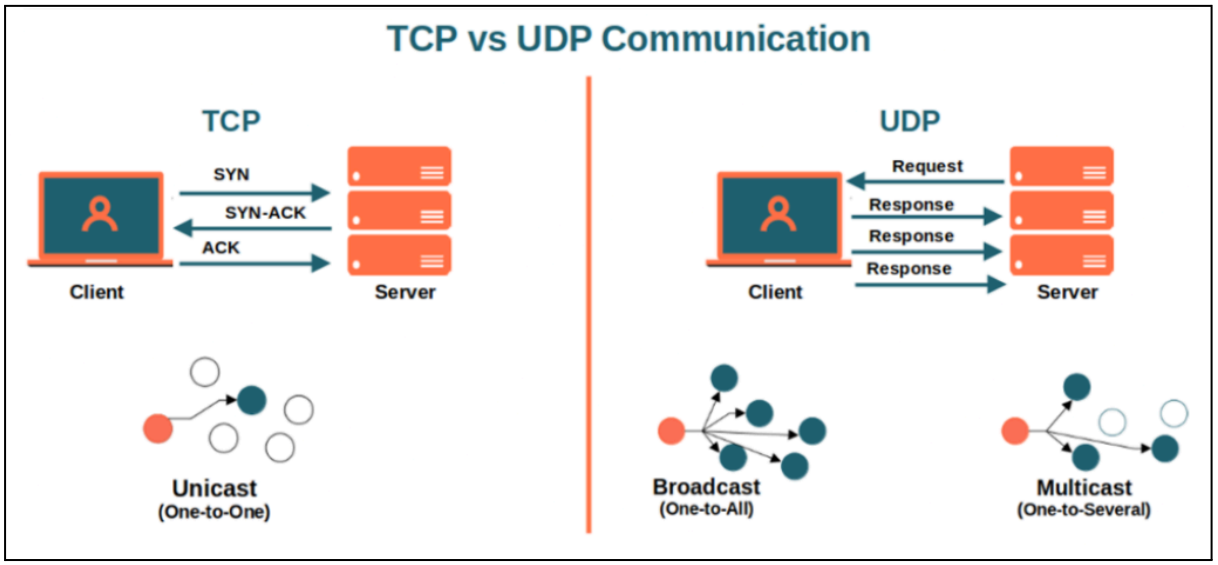

Figure 1: TCP VS UDP

Key Differences: TCP and UDP

Feature	TCP	UDP
Connection Type	Connection-oriented — The device must establish a connection before transmitting data (handshake included) and close the connection after transmission.	Connectionless — No connection and no handshake are required to send data.
Reliability	Reliable — Data packet delivery is guaranteed.	Unreliable — Datagram delivery isn't guaranteed.
Speed	Slower than UDP as it follows many steps to ensure accuracy.	Faster than TCP as it's a much simpler protocol.
Header Size	Variable — 20-60 bytes header length.	Fixed — 8 bytes.
Suitability	Web browsing. File transfer. Email (SMTP, IMAP/POP)	VPN. Video and music streaming. Online games, multiplayer games. Live broadcasts and video conferencing. Domain name system (DNS) queries. Voice over IP (VoIP).
Communication Information Type	Stateful —The client and the server keep the information about the session.	Stateless — The server doesn't keep any information about the session.

Figure 2: Key Difference between TCP and UDP

Strength and Weakness

TCP

Strength:

1. Guarantees reliable, in-order delivery of data.
2. Provides flow and congestion control to manage network traffic.
3. Suitable for applications where data integrity and accuracy are critical, such as web browsing, email, and file transfers.

Weaknesses:

1. Higher latency due to connection setup (three-way handshake) and error correction mechanisms.
2. More resource-intensive, leading to slower performance compared to UDP.
3. Less suitable for real-time or latency-sensitive applications like live streaming or online gaming.

UDP

Strength:

1. Low latency and minimal protocol overhead, resulting in faster data transmission.
2. Well-suited for real-time applications where speed is prioritized over reliability, such as video streaming, online gaming, and VoIP.
3. Simple protocol design, making it efficient for broadcast and multi-cast communications.

Weaknesses:

1. No guarantee of delivery, order, or error correction data may be lost, duplicated, or received out of order.
2. Lacks congestion and flow control, which can lead to network congestion.
3. Not suitable for applications that require reliable and accurate data delivery.

Sustainability for Application

TCP and UDP are both widely used transport layer protocols, but their differing characteristics make each more suitable for specific types of applications.

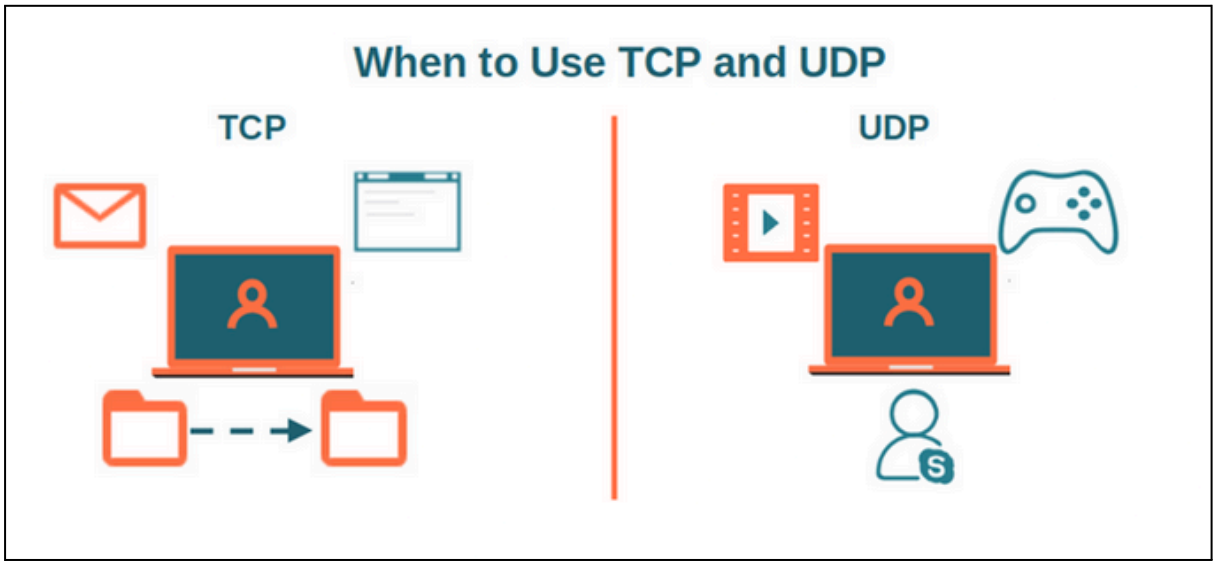

Figure 3: When to Use TCP and UDP

TCP: Best for Reliability

1. Rate limiting.
2. Firewalls and intrusion detection systems.
3. Application-level request validation.
4. Network-level anti-DDoS solutions.

UPD: Best for Speed and Real-Time Communication

1. Streaming Media(Audio, Video):Supports real-time playback even if some data packets are lost.
2. Domain Name System(DNS): Queries:Allows rapid, lightweight requests and responses.
3. Voice Over IP(VoIP): Delivers voice data quickly for real-time conversations.
4. Online Gaming: Prioritizes fast updates and minimal lag over perfect accuracy.

Security Vulnerabilities

TCP: Session Hijacking

TCP's connection-oriented nature requires a handshake to establish a session. Attackers can exploit this by intercepting or predicting session information, enabling them to hijack an active session and inject malicious data or commands. (TCP Session Hijacking, 2009)

UDP: Flooding Attack

UDP's connectionless design makes it susceptible to flooding attacks, such as UDP flood or amplification attacks. Attackers can overwhelm a target by sending large volumes of UDP packets, causing denial of service. ("What is a UDP flood DDoS attack?," 2022)

Mitigation Measures

TCP: Session Hijacking can be mitigated through several key measures. Using SSL/TLS encryption secures data in transit, making it unreadable to attackers. Randomizing sequence numbers prevents prediction and unauthorized session control. Session timeouts help close inactive sessions, reducing exposure time. Lastly, multi-factor authentication adds an extra verification layer, making unauthorized access more difficult.

UDP: Flooding Attack can be reduced by applying rate limiting, using firewalls and IDS to block suspicious traffic, enabling application-level request validation, and deploying network-level anti-DDoS solutions to filter out attacks.

1.2. Network Security Mechanisms Against Common Network Attacks

Network security is crucial in today's interconnected digital world to secure personal information and sustain trustworthy communication. Cybercriminals utilize flaws in network setups and protocols to undertake illicit acts. This study explores three key sorts of network assaults: **STP attacks**, **DHCP spoofing**, and **Man-in-the-Middle** (MITM) attacks. It also explains how network security technologies can aid in resisting these risks. (GeeksforGeeks, 2023)

Man-in-the-Middle (MITM) Attack

Attack Overview

An MITM is a general team where threat actor position himself between user and application ether to eavesdrop or to impersonate one of other parties, making it appear as if a normal exchange of information is underway. Two instances of vulnerabilities that are misused include inadequate encryption and insufficient protocol authentication. (Imperva, 2019)

Preventive Measures

1. Use robust encryption technologies like TLS/SSL.
2. Verify the identification of communication endpoints by using mutual authentication.
3. Use network segmentation and secure Wi-Fi settings.
4. To monitor anomalous traffic, install intrusion detection systems (IDS).

DHCP Spoofing Attack

Attack Overview

In a DHCP spoofing attack, an attacker sets up a rogue DHCP server on the network. The rogue server provides incorrect network configuration details (such as IP addresses or DNS servers) to clients, redirecting traffic for eavesdropping or further attacks. (*What Is DHCP Spoofing? How It Works & Examples | Twingate*, 2020)

Preventive Measures

1. Set up network switches with DHCP snooping to filter unwanted DHCP packets.
2. Only set up network ports for trusted devices.
3. For sensitive systems, use static IP addressing whenever possible.
4. Monitor DHCP logs for anomalies.

STP (Spanning Tree Protocol) Attacks

Attack Overview

STP attacks target the Spanning Tree Protocol, which is used to prevent loops in network topologies. By sending malicious Bridge Protocol Data Units (BPDUs), an attacker can manipulate the STP process to take over the role of the root bridge, causing traffic redirection or network disruptions. (Danielsekot, 2019)

Preventive Measures

1. Disable unused switch ports.
2. Use BPDU guard and root guard.
3. Configure STP parameters carefully.
4. Monitor the network for suspicious activity.

Demonstration of MITM

Objective: To demonstrate an ARP -based Man-in-the-Middle (MITM) attack using **Ettercap**.The goal is to intercept and analyze network packets exchanged between a target device and the gateway, showcasing how an attacker can eavesdrop on or manipulate communication within a local network.

Attacker IP : 192.168.1.80

Target IP : 192.168.1.82

Gateway : 192.168.1.254

Step 1: Scan a network to find targets.

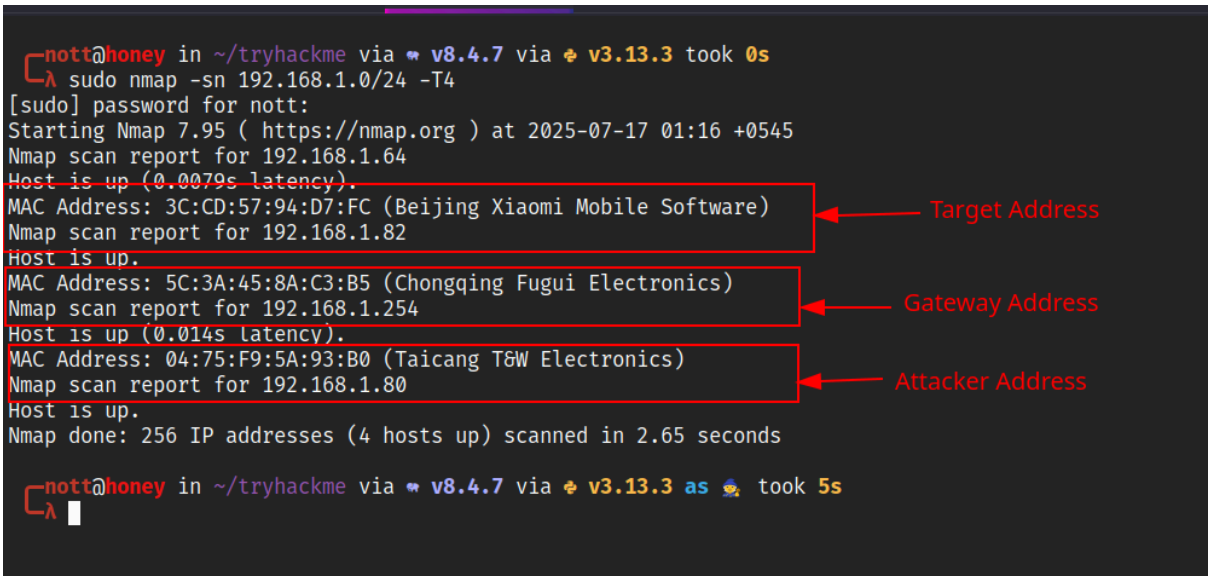

Figure 4: Network Scanning

Step 2: Launching ARP Spoofing using ettercap

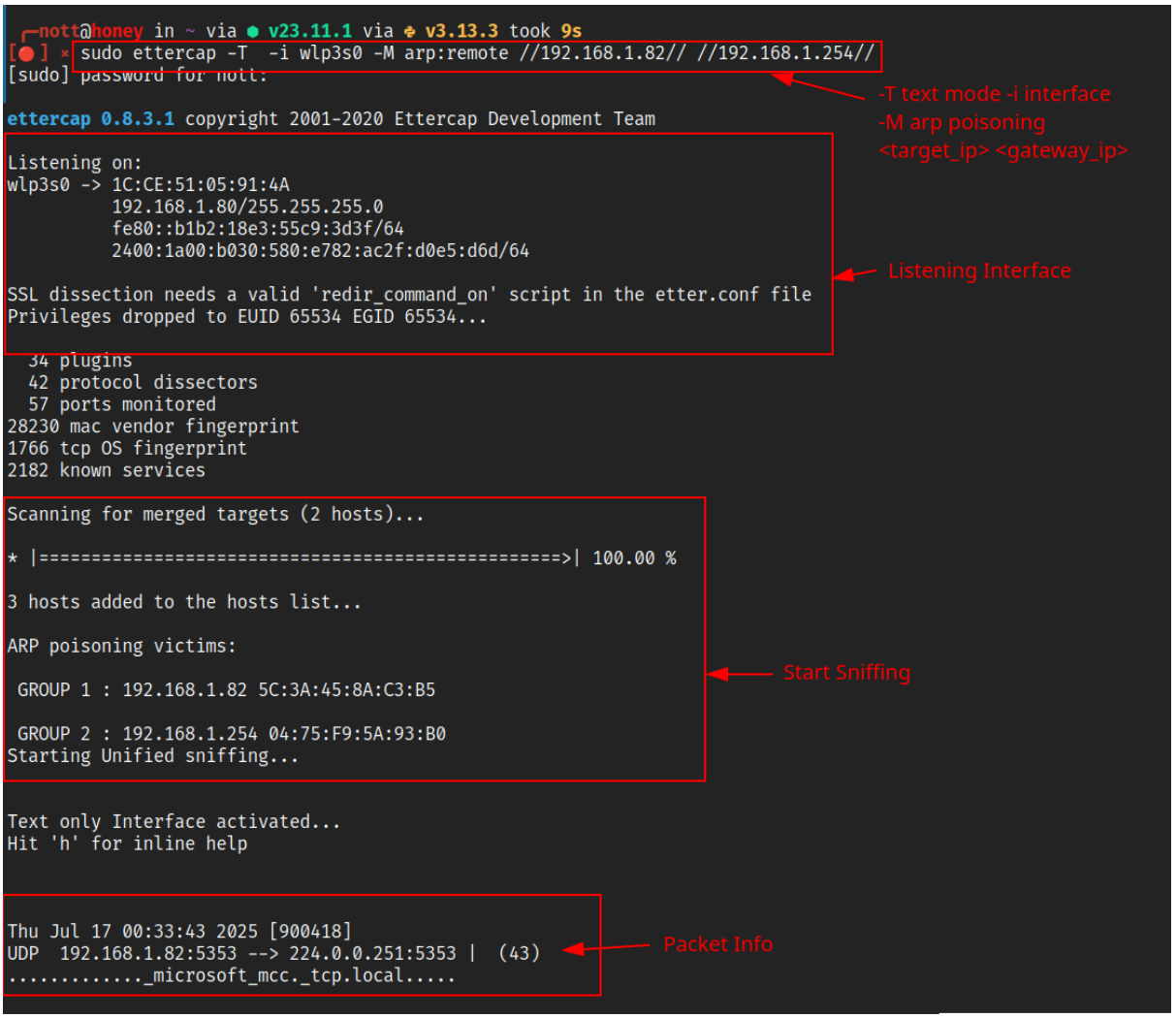

Figure 5: ARP Spoofing and Packet spoofing

Step 3: Viewing target traffics in wireshark

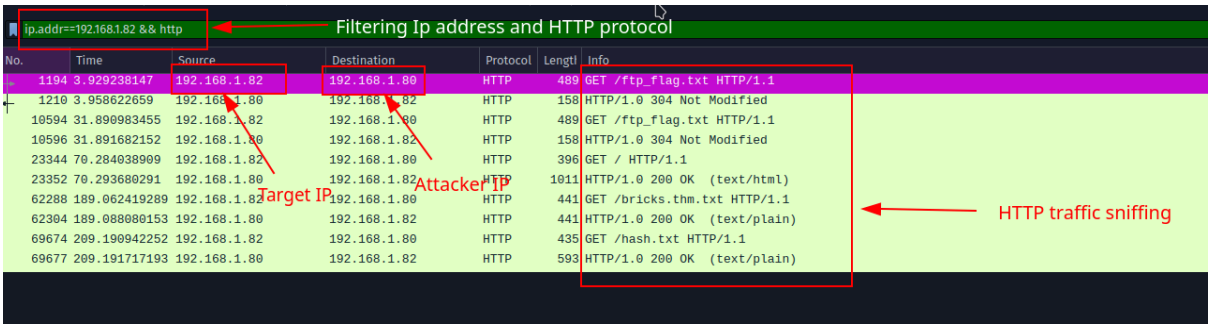

Figure 6: Traffic Sniffing

Step 4: Analyzing target request files.

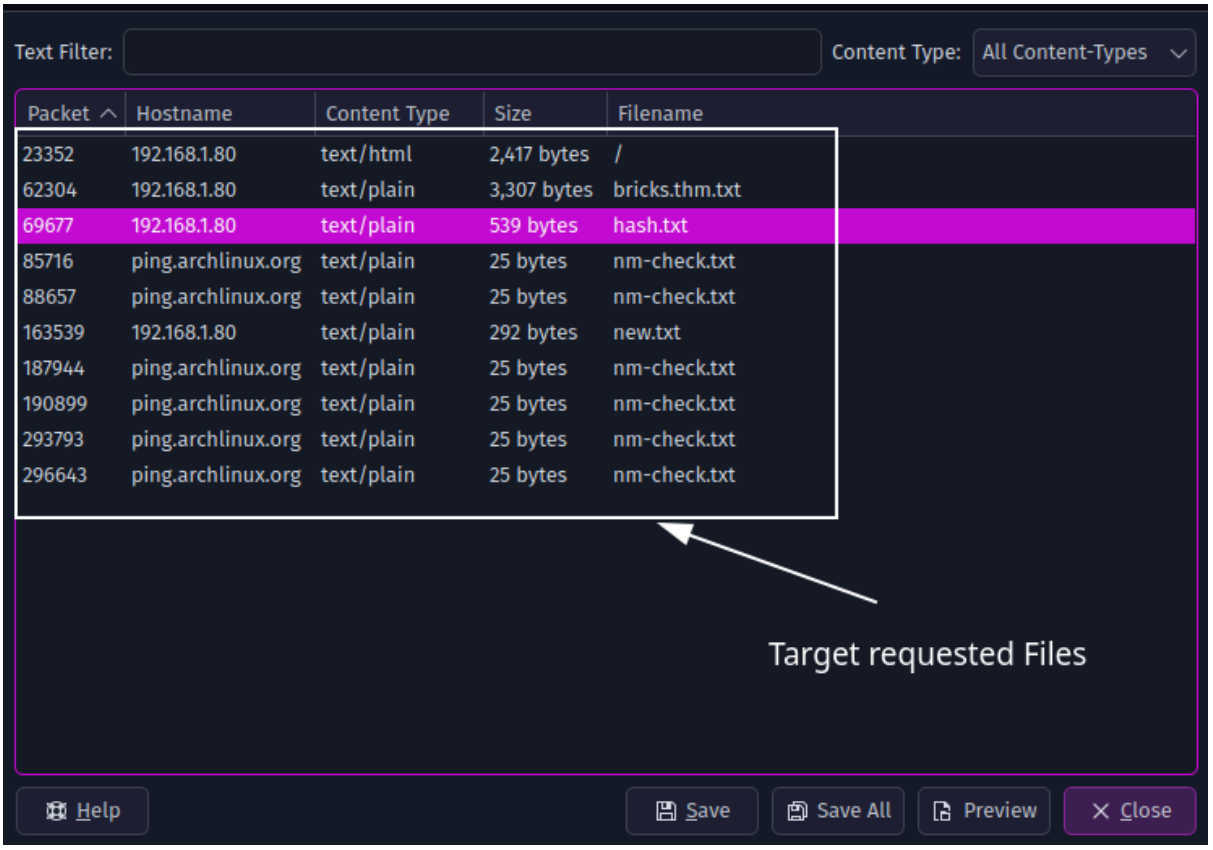

Figure 7: Target Interacted Files

Mitigation

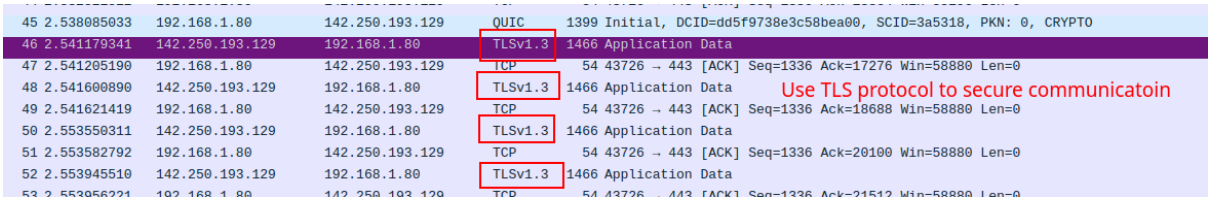

Figure 8: Mitigation Measure against MITM

2. Three-Tier Network Deployment

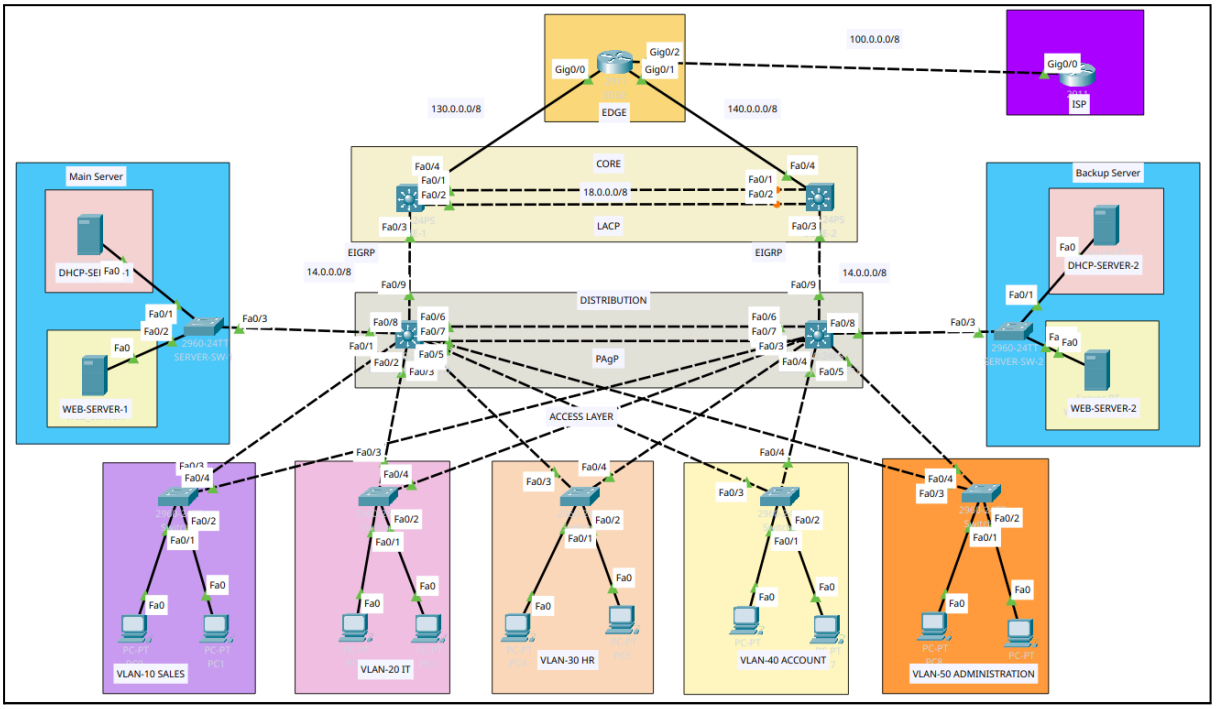

Figure 9: Three Tier Network Architecture

Subnetting and VLAN Allocation Table

VLAN NAME	NETWORK ADDRESS	SUBNET MASK	FIRST USABLE IP	LAST USABLE IP	BROADCAST ADDRESS	USABLE IPS	MAX DHCP USERS
VLAN-10_SALES	172.16.99.0	255.255.255.128 (/25)	172.16.99.1	172.16.99.126	172.16.99.127	126	125
VLAN-20_IT	172.16.99.128	255.255.255.128 (/25)	172.16.99.129	172.16.99.254	172.16.99.255	126	125
VLAN-30_HR	172.16.100.0	255.255.255.224 (/27)	172.16.100.1	172.16.100.30	172.16.100.31	30	29
VLAN-40_ACCOUNT	172.16.100.32	255.255.255.240 (/28)	172.16.100.33	172.16.100.46	172.16.100.47	14	13
VLAN-50_ADMINISTRATION	172.16.100.64	255.255.255.192 (/26)	172.16.100.65	172.16.100.126	172.16.100.127	62	61

2.1. Access Layer Switch Configuration (Layer 2 Switch)

In this layer five switches are configured for each five departments i.e, Sales, IT, HR, Account and Administration. Each switch are given unique VLANs id 10, 20, 30, 40, 50, according to five departments. Interface which are connected to end devices, configured as Access mode with respective VLANs and interface which are connected to distribution layer, configured as Trunk mode to carry multiple VLANs traffic.

ACCESS-1_bitter!honey (SALES)

```
ACCESS-1_bitter!honey(config)#
ACCESS-1_bitter!honey(config)#do sh vlan bri

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                 Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                 Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                 Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                 Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                                 Gig0/1, Gig0/2
10   SALES                             active    Fa0/1, Fa0/2
20   IT                                active
30   HR                                active
40   ACCOUNT                           active
50   ADMINISTRATION                    active
100  SERVER-1                          active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
ACCESS-1_bitter!honey(config)#
```

Figure 10: VLAN 10 Sales

In this layer 2 switch, VLAN was configured with id 10 and name as SALES. Then assigned a port to carry single VLAN traffic which is using access mode. Similarly all the layer 2 switches with VLANs i.e IT, HR, Account and Administration are configured respectively.

Once the individual VLANs are configured on each switch, trunking is implemented on interconnecting links Fa0/1 and Fa0/2. Trunk link are network connecting configured to carry traffic from multiple VLANs simultaneously. These link use 802.1q encapsulation to insert VLAN tags to Ethernet frames, thus maintaining VLAN separation across the network.

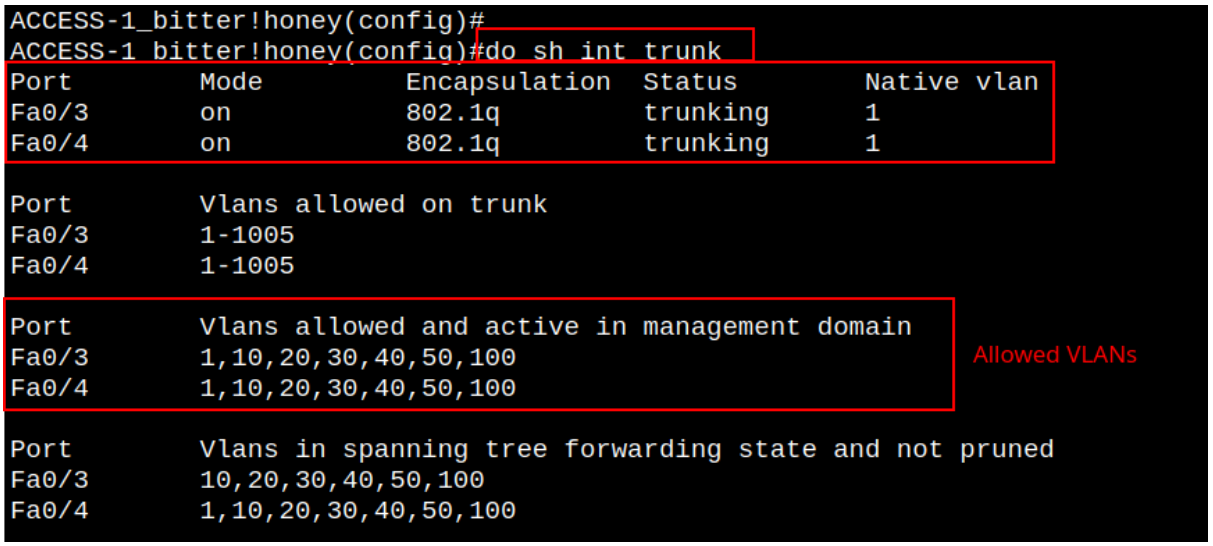

Figure 11: Trunk VLAN 10 SALES

2.2. Distribution Layer Switch Configuration (Layer 3 Switch)

Trunk and VTP Configuration

The DIST-1_bitter!honey and DIST-2_bitter!honey switch connected to access layer switch via interface F0a/1-5. These multilayer switch are configured to support 802.1Q trunking and manage VLANs by joining to VTP domain name DINESH operating in version 2. This configuration ensures effective handling of VLAN traffic and maintains consistent VLAN information across the entire network.

```
DIST-1_bitter!honey(config)#do sh int trunk
Port        Mode         Encapsulation  Status        Native vlan
Fa0/1       on           802.1q         trunking      1
Fa0/2       on           802.1q         trunking      1
Fa0/3       on           802.1q         trunking      1
Fa0/4       on           802.1q         trunking      1
Fa0/5       on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/1       1-1005
Fa0/2       1-1005
Fa0/3       1-1005
Fa0/4       1-1005
Fa0/5       1-1005

Port        Vlans allowed and active in management domain
Fa0/1       1,10,20,30,40,50,100
Fa0/2       1,10,20,30,40,50,100
Fa0/3       1,10,20,30,40,50,100
Fa0/4       1,10,20,30,40,50,100
Fa0/5       1,10,20,30,40,50,100

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/1       1
Fa0/2       1
Fa0/3       1,10,20,30,40,50,100
Fa0/4       1
Fa0/5       1
```

Figure 12: trunk in DIST-1_bitter!honey

```
DIST-1_bitter!honey(config)#do sh vtp status
VTP Version capable             : 1 to 2
VTP version running             : 2
VTP Domain Name                 : DINESH
VTP Pruning Mode                : Disabled
VTP Traps Generation            : Disabled
Device ID                       : 0001.4392.2600
Configuration last modified by 0.0.0.0 at 3-1-93 00:00:00
Local updater ID is 172.16.99.126 on interface Vl10 (lowest numbered VLAN interface found)

Feature VLAN :
--------------
VTP Operating Mode                : Server
Maximum VLANs supported locally   : 1005
Number of existing VLANs          : 11
Configuration Revision            : 117
MD5 digest                        : 0x4E 0x34 0x60 0x01 0x37 0x34 0x99 0xF0
                                    0x63 0xD3 0x17 0xBD 0x84 0xD8 0x0E 0x02
DIST-1_bitter!honey(config)#
```

Figure 13: VTP Status

Etherchannel Configuration using PAgP in Distribution layer

```
DIST-1_bitter!honey(config)#
DIST-1_bitter!honey(config)#do sh etherchannel su
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------

1      Po1(SU)           PAgP    Fa0/6(P) Fa0/7(P)
DIST-1_bitter!honey(config)#
```

Figure 14: Etherchannel Status in Distribution layer

Next, EtherChannel is set up between the DIST-1_bitter!honey and DIST-2_bitter!honey switches by bundling interfaces Fa0/6 and Fa0/7. The configuration uses PAgP, with auto mode on one switch and desirable mode on the other, allowing the EtherChannel to form dynamically. The primary benefits of implementing etherchannel to maintain redundancy and load balancing to prevent from fail over.

Configuration Default Gateways (SVIs)

```
DIST-1_bitter!honey(config)#do sh ip int bri | exclude un
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/8        10.0.0.1        YES manual up                    up
FastEthernet0/9        14.0.0.1        YES manual up                    up
Vlan10                 172.16.99.126   YES manual up                    up
Vlan20                 172.16.99.254   YES manual up                    up
Vlan30                 172.16.100.30   YES manual up                    up
Vlan40                 172.16.100.46   YES manual up                    up
Vlan50                 172.16.100.110  YES manual up                    up
DIST-1_bitter!honey(config)#
```

Figure 15: VLANs Default Gateways

On DIST-1_bitter!honey, IP addresses are assigned to each VLAN interface using VLSM, ensuring that each department receives just enough addresses for its host requirements. These

IPs act as the default gateways for the devices within each department. The Fa0/8 port is specifically set up as the gateway for the DHCP and web servers, while Fa0/9 connects the switch to the core network. A similar setup is implemented on DIST-2_bitter!honey, with the only variation being the use of a different server gateway address.

```
interface Vlan10
 mac-address 0060.4794.b801
 ip address 172.16.99.126 255.255.255.128
 ip helper-address 10.0.0.2
 ip helper-address 11.0.0.2
!
interface Vlan20
 mac-address 0060.4794.b802
 ip address 172.16.99.254 255.255.255.128
 ip helper-address 10.0.0.2
 ip helper-address 11.0.0.2
!
interface Vlan30
 mac-address 0060.4794.b803
 ip address 172.16.100.30 255.255.255.224
 ip helper-address 10.0.0.2
 ip helper-address 11.0.0.2
!
interface Vlan40
 mac-address 0060.4794.b804
 ip address 172.16.100.46 255.255.255.240
 ip helper-address 10.0.0.2
 ip helper-address 11.0.0.2
!
interface Vlan50
 mac-address 0060.4794.b805
 ip address 172.16.100.110 255.255.255.192
 ip helper-address 10.0.0.2
 ip helper-address 11.0.0.2
!
```

Figure 16: VLANs Interface Configuration

In addition to assigning IP addresses to VLAN interfaces, IP helper-addresses are set up to function as **DHCP relay agents**, enabling devices within each VLAN to reach internal servers across different subnets. In this configuration, 10.0.0.2 serves as the primary helper address, while 11.0.0.2 acts as the secondary. An identical setup has been applied on DIST-2-bitter!honey to maintain consistent DHCP relay support across both distribution switches.

Configuration of Routing Protocol

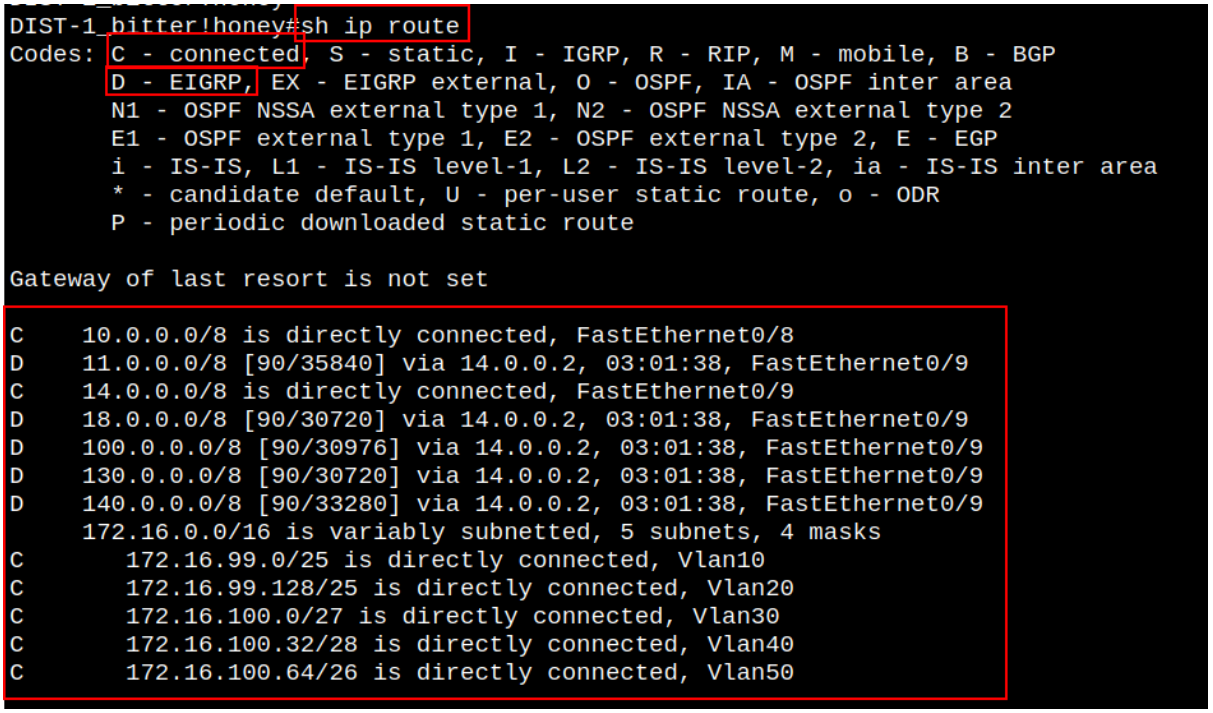

Figure 17: Routing Protocol Status in Distribution layer

DIST-1_bitter!honey uses the EIGRP routing protocol to manage big networks in a smart way. It has directly connected networkre 17: Routing Protocol Status in Distribution layers in its routing table, like 10.0.0.0/8 and 14.0.0.0/8. It learns about new routes, like 11.0.0.0/8, 18.0.0.0/8, 100.0.0.0/8, 130.0.0.0/8, and 140.0.0.0/8, from a neighbor at 14.0.0.2. There are also different subnets in the 172.16.0.0/16 network. DIST-2_bitter!honey uses a similar EIGRP setup to make sure that routing is always the same on the network.

2.3. Core Layer Switch Configuration

Etherchannel Configuration using LACP

```
CORE-1_bitter!honey(config)#do sh etherchannel su
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------

2      Po2(RU)           LACP    Fa0/1(P) Fa0/2(P)
```

Figure 18: Core layer etherchannel configuration

Both CORE-1_bitter!honey and CORE-2_bitter!honey are configured to bundle their Fa0/1 and Fa0/2 interfaces into a single EtherChannel using the Link Aggregation Control Protocol (LACP), with both sides set to active mode to ensure dynamic negotiation and link redundancy.

Configuration IP Addresses

```
CORE-1_bitter!honey(config)#do sh ip int bri | ex un
Interface              IP-Address      OK? Method Status                Protocol
Port-channel2          18.0.0.1        YES manual up                    up
FastEthernet0/3        14.0.0.2        YES manual up                    up
FastEthernet0/4        130.0.0.1       YES manual up                    up
CORE-1_bitter!honey(config)#
```

Figure 19: Configure IP Addresses in Core layer

CORE-1_bitter!honey switch, interface Po2, Fa0/3 and Fa0/4 are configured to assign IP addresses to forward traffic and IP routing. In layer 3 switch to assign IPs need to disable

switchport mode, all the interfaces are disabled with switchport mode. And then ip routing was enabled. Afterward IP addresses are assigned to IP addresses.

Configuring Routing Protocol in Core layer

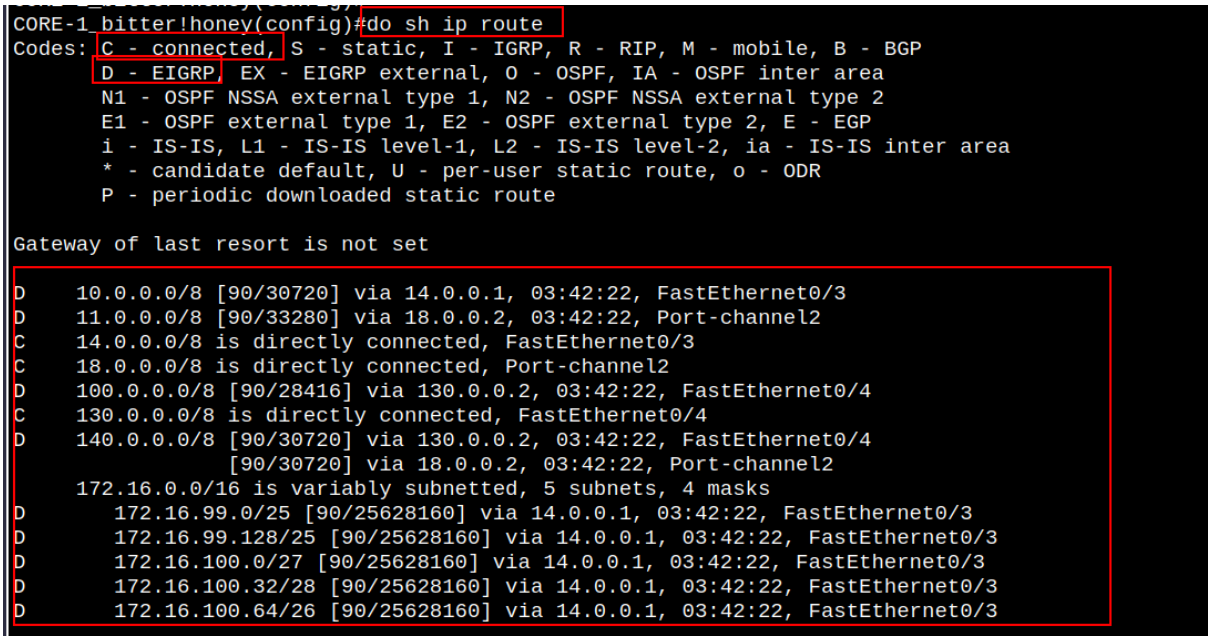

Figure 20: IP routing in Core layer

CORE-1_bitter!honey uses the EIGRP routing protocol to manage big networks in a smart way. It has directly connected networks in its routing table, like 10.0.0.0/8 and 14.0.0.0/8. It learns about new routes, like 11.0.0.0/8, 18.0.0.0/8, 100.0.0.0/8, 130.0.0.0/8, and 140.0.0.0/8, from a neighbor at 14.0.0.2. There are also different subnets in the 172.16.0.0/16 network. CORE-2_bitter!honey uses a similar EIGRP setup to make sure that routing is always the same on the network.

2.4. Configuring EDGE and ISP (Router)

Configuring IP Addresses in EDGE and ISP

```
EDGE_ROUTER_bitter!honey(config)#do sh ip int bri | ex un
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     130.0.0.2       YES manual up                    up
GigabitEthernet0/1     140.0.0.2       YES manual up                    up
GigabitEthernet0/2     100.0.0.1       YES manual up                    up
EDGE_ROUTER_bitter!honey(config)#
```

Figure 21: EDGE_ROUTER_bitter!honey IP Addresses Configuration

The EDGE_ROUTER_bitter!honey connects the internal network to the internet. Interfaces Gig0/0 and Gig0/1 are linked to the internal network through the core layer, while Gig0/2 connects to the ISP_bitter!honey for external traffic. All interfaces are active with assigned IPs for proper routing.

```
ISP_bitter!honey(config)#
ISP_bitter!honey(config)#do sh ip int br | ex un
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     100.0.0.2       YES manual up                    up
ISP_bitter!honey(config)#
```

Figure 22: ISP_bitter!honey IP Address Configuration

The ISP_bitter!honey router has one active interface, GigabitEthernet0/0, with IP 100.0.0.2. It is manually configured and fully operational. This interface connects to the EDGE_ROUTER_bitter!honey, providing internet access to the internal network.

Configuring Routing Protocol in EDGP and ISP

```
ISP_bitter!honey(config)#do sh ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

D    10.0.0.0/8 [90/33536] via 100.0.0.1, 05:03:00, GigabitEthernet0/0
D    11.0.0.0/8 [90/33536] via 100.0.0.1, 05:03:00, GigabitEthernet0/0
D    14.0.0.0/8 [90/30976] via 100.0.0.1, 05:03:00, GigabitEthernet0/0
D    18.0.0.0/8 [90/30976] via 100.0.0.1, 05:03:00, GigabitEthernet0/0
     100.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       100.0.0.0/8 is directly connected, GigabitEthernet0/0
L       100.0.0.2/32 is directly connected, GigabitEthernet0/0
D    130.0.0.0/8 [90/5376] via 100.0.0.1, 05:03:00, GigabitEthernet0/0
D    140.0.0.0/8 [90/5376] via 100.0.0.1, 05:03:00, GigabitEthernet0/0
     172.16.0.0/16 is variably subnetted, 5 subnets, 4 masks
D       172.16.99.0/25 [90/25630976] via 100.0.0.1, 05:03:00, GigabitEthernet0/0
D       172.16.99.128/25 [90/25630976] via 100.0.0.1, 05:03:00, GigabitEthernet0/0
D       172.16.100.0/27 [90/25630976] via 100.0.0.1, 05:03:00, GigabitEthernet0/0
D       172.16.100.32/28 [90/25630976] via 100.0.0.1, 05:03:00, GigabitEthernet0/0
D       172.16.100.64/26 [90/25630976] via 100.0.0.1, 05:03:00, GigabitEthernet0/0

ISP_bitter!honey(config)#
```

Figure 23: Routing Protocol of ISP_bitter!honey

To facilitate smooth routing, data forwarding, and inter-VLAN operations, the show ip route command on ISP_bitter!honey displays a combination of directly connected routes and EIGRP-learned paths. For reliable and effective network communication, EDGE_ROUTER_bitter!honey is set up similarly.

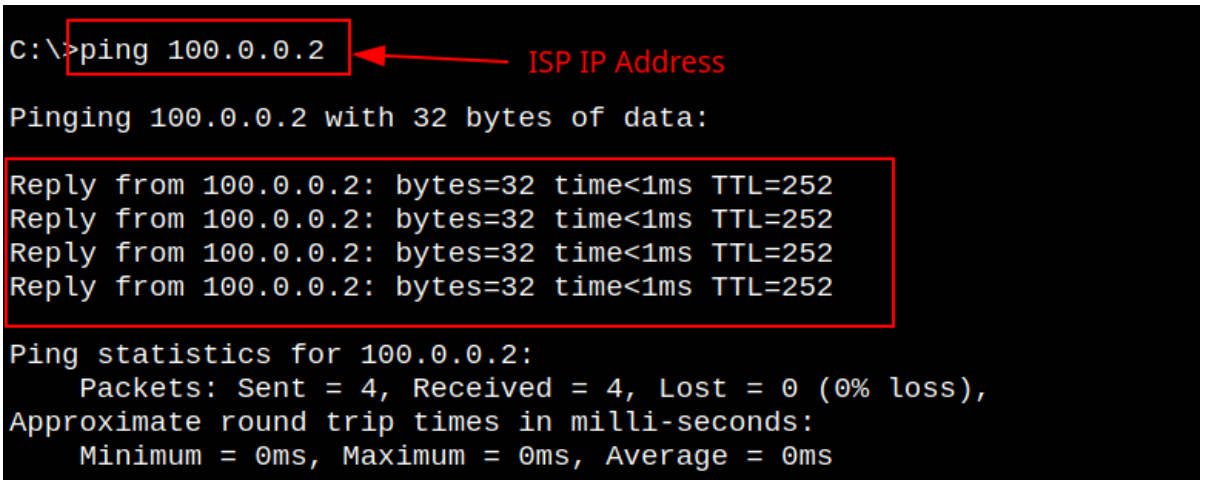

Figure 24: Pinging ISP from end device.

2.5. Configuration of Internal Servers

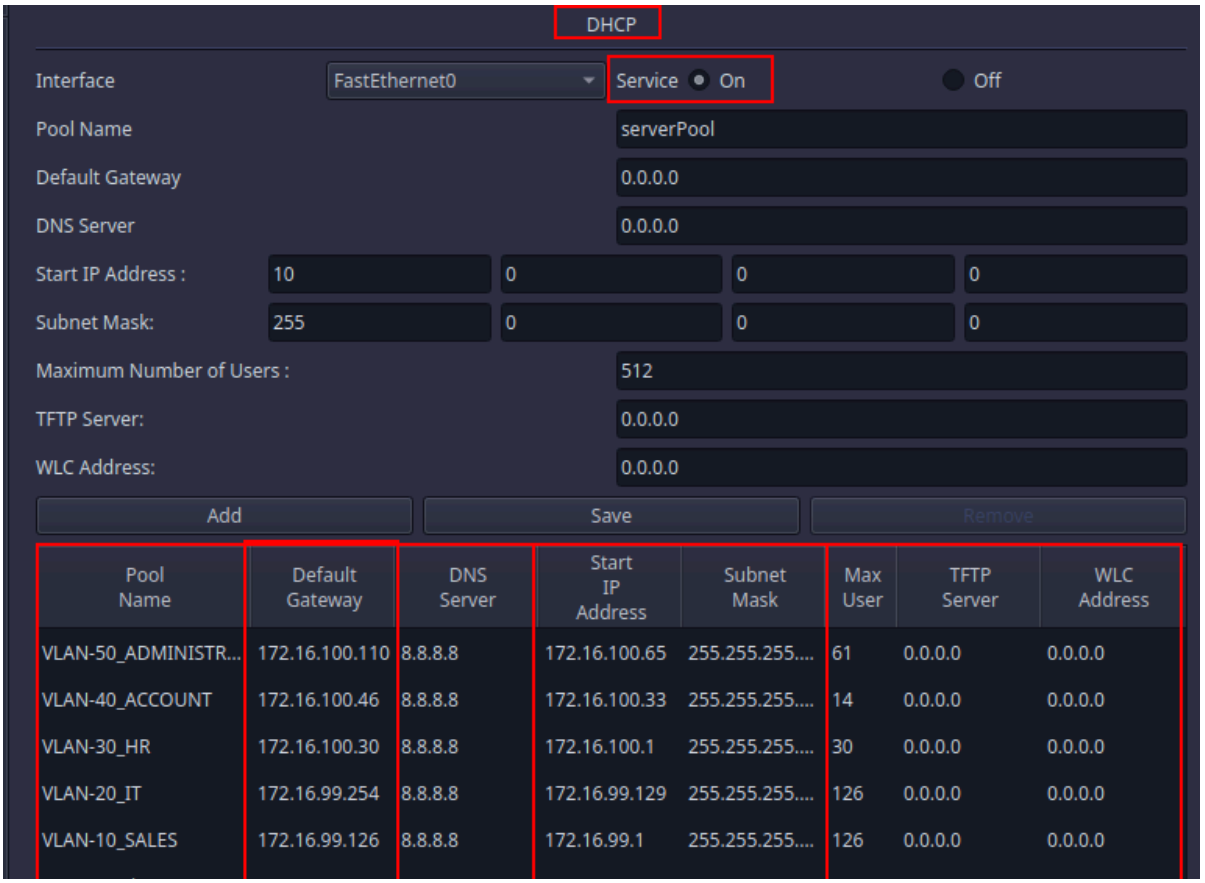

Figure 25: DHCP Configuration

DHCP (Dynamic Host Configuration Protocol) automatically assigns IP addresses and network settings to devices, eliminating manual configuration and reducing errors. In our design, the DHCP server is configured with five pools, one per departmental VLAN using VLSM-derived subnets from the 172.16.99.0/16 block. This ensures efficient IP utilization and consistent gateway and DNS settings for Sales (VLAN 10), IT (VLAN 20), , HR (VLAN 30), Account (VLAN 40) and Administration (VLAN 50).

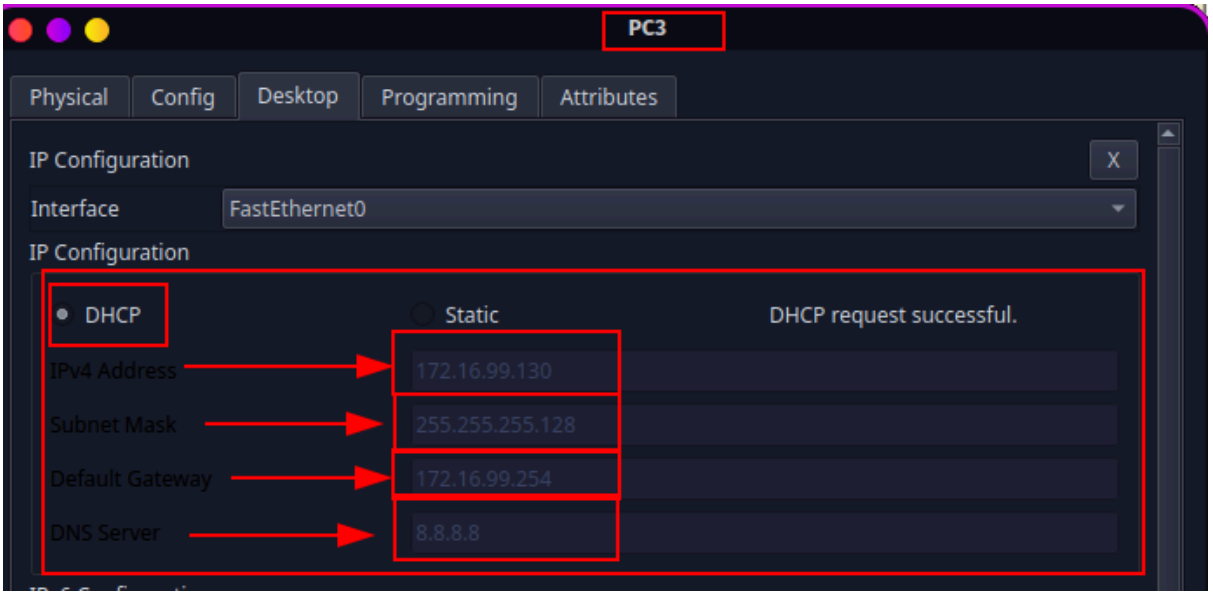

Figure 26: Dynamically assigned IP to PC3 via DHCP Server

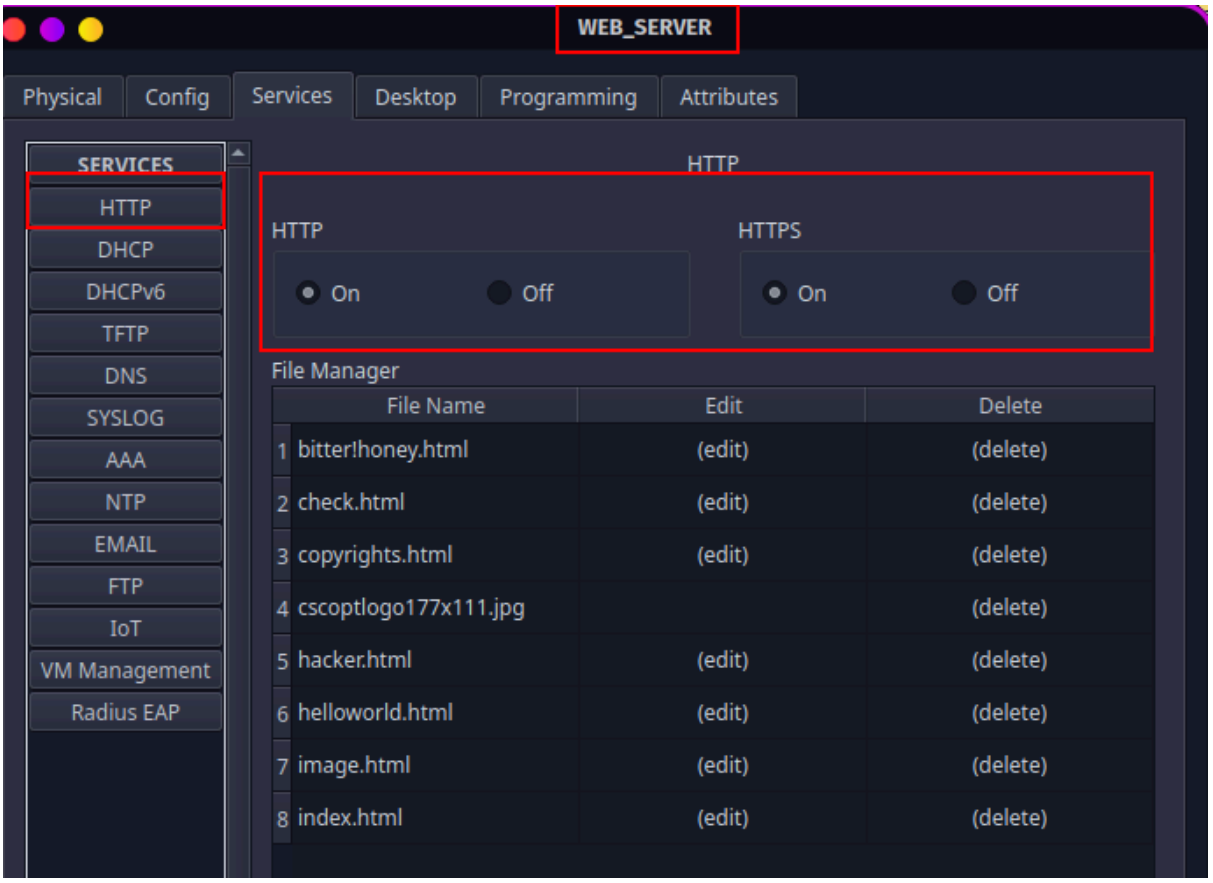

Figure 27: Web Server

The web server is properly configured and currently operational, providing access to all departments. It supports both HTTP and HTTPS protocols. Identical configurations are applied to the backup web server to ensure consistency and reliability.

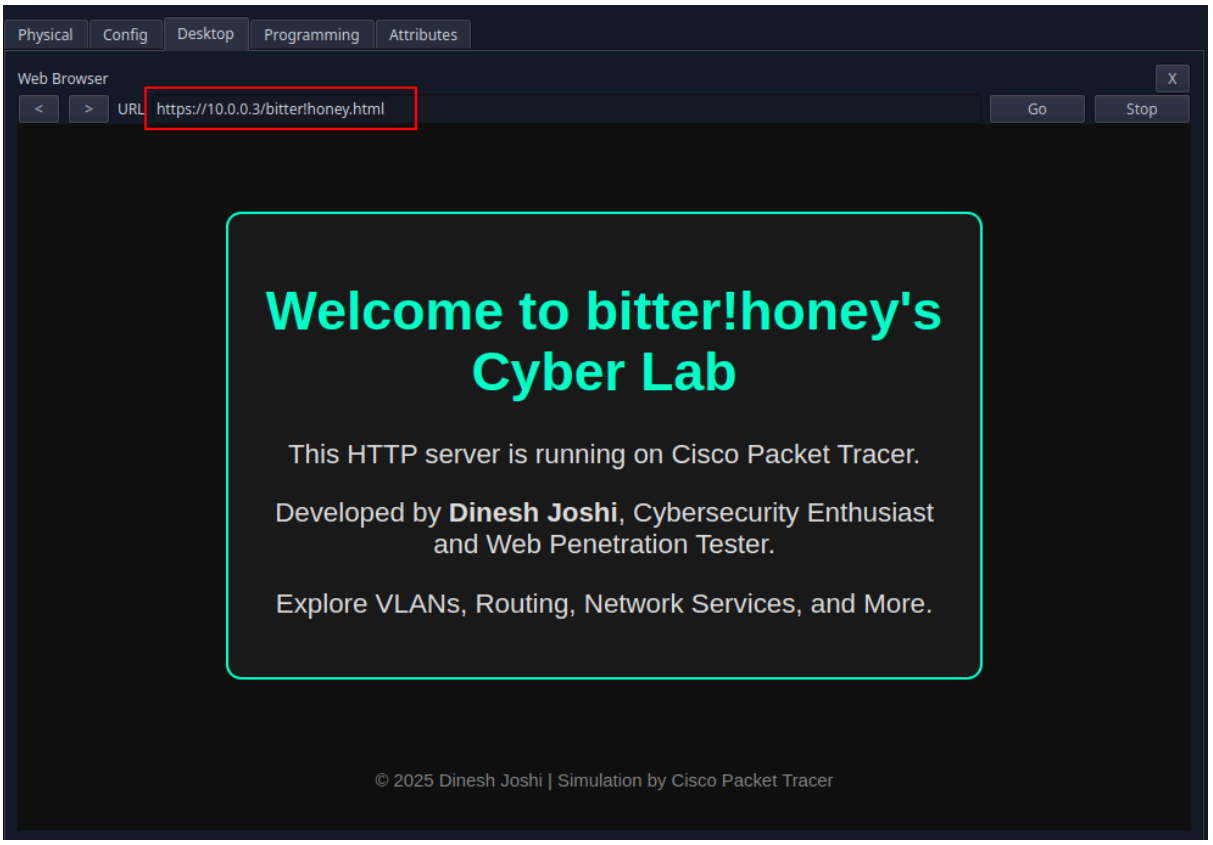

Figure 28: Accessing Web Page

3. Secure Network Deployment

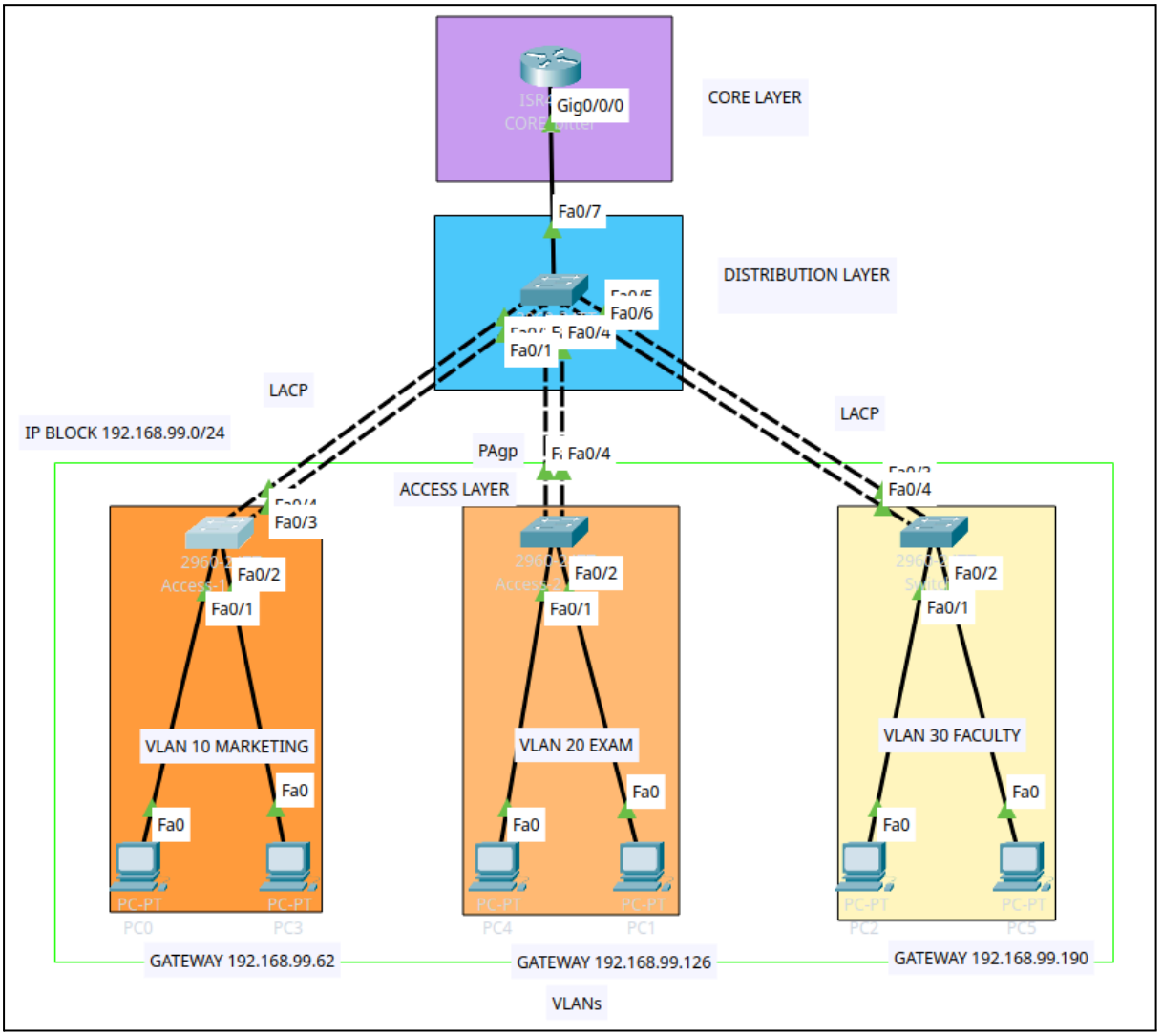

Figure 29: Network Architecture

The three-tier network topology is implemented to provide scalable, modular and resilient network design that separate functions across different layers. At the core layer (ISR4331) router interface gig0/0/0 provides a gateway to the external network. The middle distribution layer features a Layer 3 switch that terminates the core link, enforces policies, and performs inter-VLAN routing. Finally, the access layer comprises three 2960 switches, each dedicated to a single departmental VLAN Marketing, Exam, and Faculty with each VLAN in its own /26 subnet and the distribution switch's SVI as its default gateway. By separating core

routing, distribution policy management, and user-facing access, this design optimizes performance, simplifies debugging, and maintains uninterrupted connectivity.

3.1. Assigning Hostname and Description to Interface

```
ACCESS-SW-1_bitter!honey(config)#hostname ACCESS-SW-1_bitter!honey
ACCESS-SW-1_bitter!honey(config)#
ACCESS-SW-1_bitter!honey(config)#
ACCESS-SW-1_bitter!honey(config)#int r f0/1-2
ACCESS-SW-1_bitter!honey(config-if-range)#description "CONNECTED TO THE END DEVICES"
ACCESS-SW-1_bitter!honey(config-if-range)#
ACCESS-SW-1_bitter!honey(config-if-range)#int r f0/3-4
ACCESS-SW-1_bitter!honey(config-if-range)#description "CONNECTED TO DISTRIBUTION LAYER"
ACCESS-SW-1_bitter!honey(config-if-range)#
ACCESS-SW-1_bitter!honey(config-if-range)#
```

```
DIST-SW_bitter!honey(config-if-range)#hostname DIST-SW_bitter!honey
DIST-SW_bitter!honey(config)#int r f0/1-6
DIST-SW_bitter!honey(config-if-range)#description "CONNECTED TO ACCESS LAYER"
DIST-SW_bitter!honey(config-if-range)#
```

```
Current configuration : 2384 bytes
!
version 15.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname CORE_bitter!honey
!
!
```

```
!
interface GigabitEthernet0/0/0
 description "CONNECTED TO DIST-SW-bitter!honey"
 no ip address
 duplex auto
 speed auto
!
interface GigabitEthernet0/0/0.10
 description "DEFAULT GATEWAY FOR VLAN10"
 encapsulation dot1Q 10
 ip address 192.168.99.62 255.255.255.192
!
interface GigabitEthernet0/0/0.20
 description "DEFAULT GATEWAY FOR VLAN20"
 encapsulation dot1Q 20
 ip address 192.168.99.126 255.255.255.192
!
interface GigabitEthernet0/0/0.30
 description "DEFAULT GATEWAY FOR VLAN30"
 encapsulation dot1Q 30
 ip address 192.168.99.190 255.255.255.192
!
```

Figure 30: Assigned Hostname and Description to Interface

Each device in the network was allocated a descriptive hostname, such as CORE_bitter!honey, to ensure that logs, configurations, and monitoring outputs are easily recognized. Additionally, interface descriptions were applied to all active ports, explicitly stating their purpose and the linked segment. This organized naming and annotation method greatly enhances network visibility, troubleshooting efficiency, and change management, especially in larger or layered network settings.

3.2. Assigning IP Address

```
CORE_bitter!honey#
CORE_bitter!honey#sh ip int bri | exclude unassigned
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0.10192.168.99.62   YES manual up                    up
GigabitEthernet0/0/0.20192.168.99.126  YES manual up                    up
GigabitEthernet0/0/0.30192.168.99.190  YES manual up                    up
CORE_bitter!honey#
```

Figure 31: Assigning IP Address

All devices on the 192.168.99.0/24 network, which was divided into smaller subnets for the VLAN of each department, were assigned IP addresses. In order to facilitate inter-VLAN

communication and preserving organized and segregated traffic between departments, router subinterfaces were configured.

3.3. Creating User Account with Secure Password

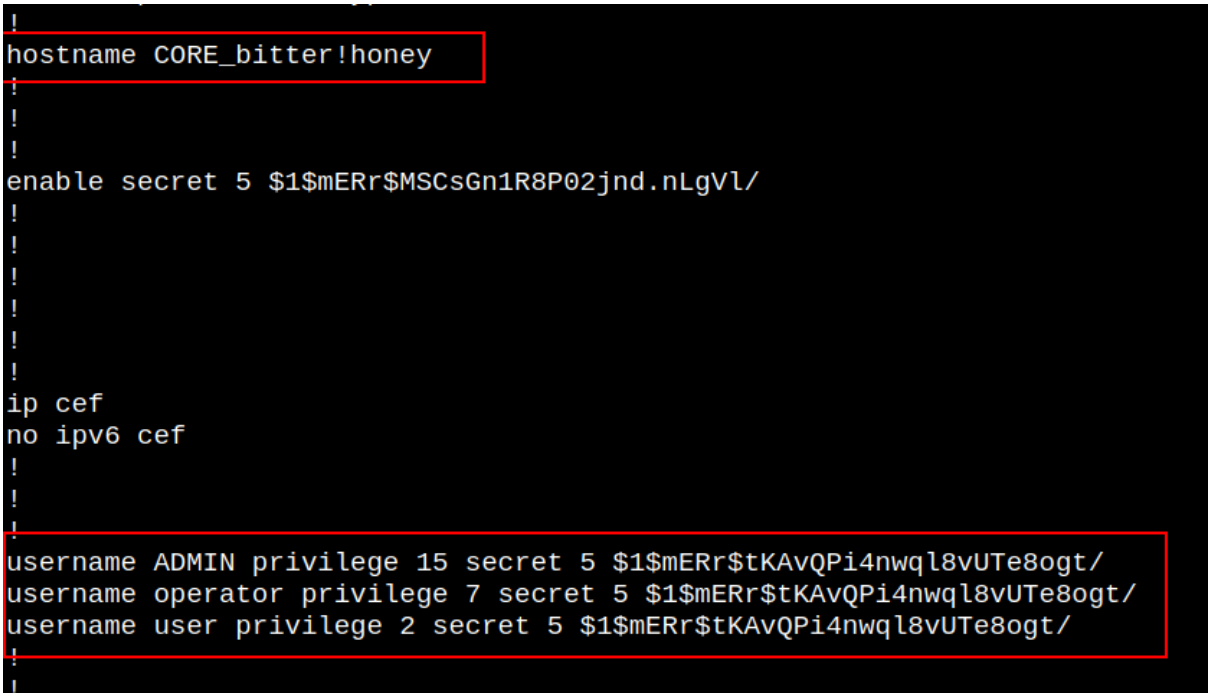

Figure 32: Creating User with secure password

Three user are created in CORE_bitter!honey and other devices as well with different privilege level. This helps maintain operational integrity while enabling team collaboration.

3.4. Implementing Telnet and SSH with Local Credentials

```
CORE_bitter!honey(config-line)#ip domain-name dinesh.com
CORE_bitter!honey(config)#crypto key generate rsa general-keys modulus 2048
% You already have RSA keys defined named CORE_bitter!honey.dinesh.com
% They will be replaced.

% The key modulus size is 2048 bits
% Generating 2048 bit RSA keys, keys will be non-exportable...[OK]
*Mar 2 2:58:17.373: %SSH-5-ENABLED: SSH 2 has been enabled
CORE_bitter!honey(config)#
CORE_bitter!honey(config)#ip ssh version 2
CORE_bitter!honey(config)#ip ssh time-out 60
CORE_bitter!honey(config)#ip ssh authentication-retries 2
CORE_bitter!honey(config)#
CORE_bitter!honey(config)#line vty 0 15
CORE_bitter!honey(config-line)#login local
CORE_bitter!honey(config-line)#transport input ssh
CORE_bitter!honey(config-line)#transport input telnet
CORE_bitter!honey(config-line)#exec-timeout 10 0
CORE_bitter!honey(config-line)#logging synchronous
CORE_bitter!honey(config-line)#
```

Figure 33: Implementing SSH and Telnet

On the VTY lines, both SSH and Telnet remote-access techniques were enabled; however, SSH version 2 was required to ensure encrypted sessions. To ensure that login credentials are centrally managed on each switch and router, devices authenticate using the local user database. In order to prevent unwanted local access, console access also requires login authentication.

3.5. Configuring MOTD

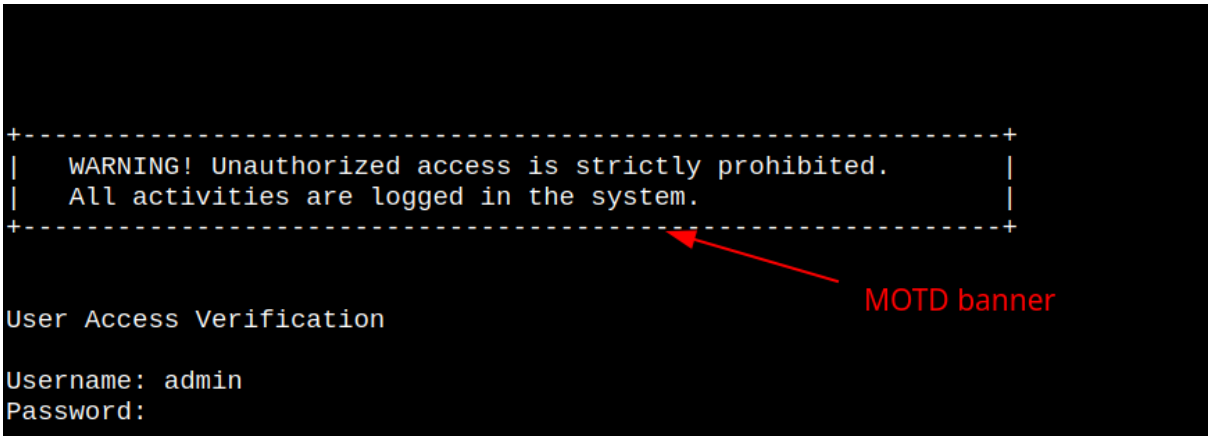

Figure 34: MOTD banner

A standardized MOTD banner was configured on every device to warn unauthorized users that access is monitored and strictly prohibited. This legal notice serves to remind administrators of the significance of using the correct login credentials, discourage casual intruders, and fortify the organization's position in the event of unauthorized access.

3.6. Difference Between SSH and Telnet

Feature	Telnet	SSH (Secure Shell)
Protocol & Port	TCP port 23; communicates in clear text	TCP port 22; uses encrypted communication
Security & Encryption	No encryption; data and credentials are exposed	Uses strong encryption (symmetric + asymmetric)
Authentication	Plain-text passwords sent over the network	Supports password-based and key-based authentication
Session Capabilities	Basic terminal access only	Offers remote shell, SFTP, port forwarding, etc.
Vulnerabilities	Susceptible to packet sniffing and MITM attacks	Resistant to attacks when using SSHv2 and secure ciphers
Additional Capabilities	Supports secure features like SCP, SFTP, and port forwarding	Limited to basic terminal access only

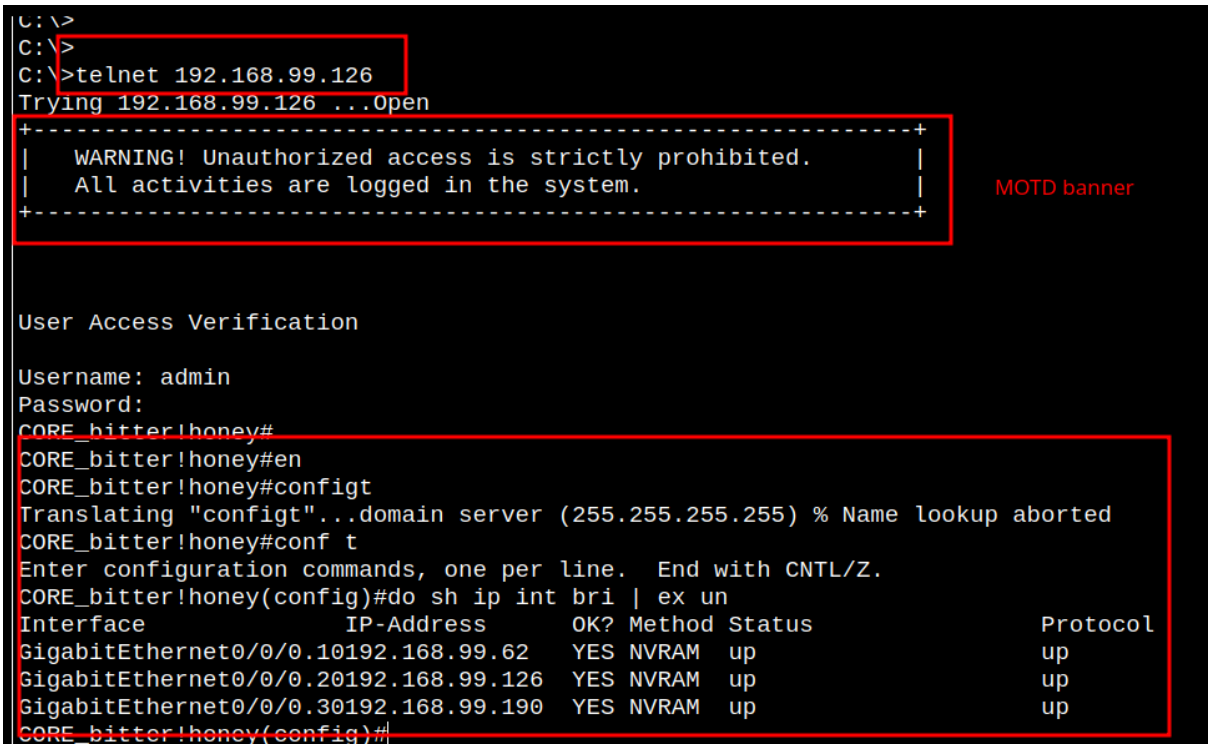

Figure 35: Telnet Login

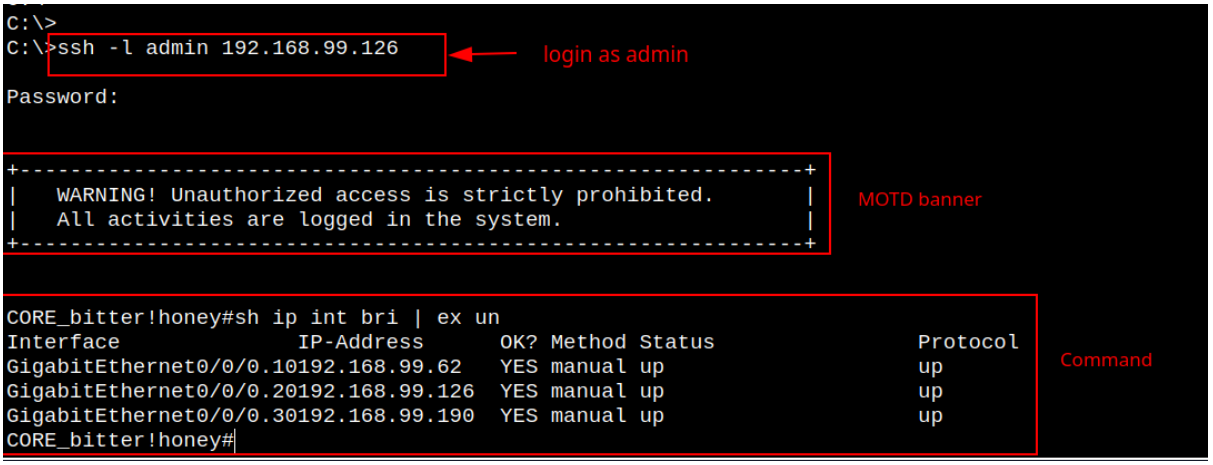

Figure 36: SSH Login

3.7. Implementing Encryption Techniques

```
CORE_bitter!honey(config)#enable secret 0 dinesh
CORE_bitter!honey(config)#
CORE_bitter!honey(config)#
CORE_bitter!honey(config)#service password-encryption
CORE_bitter!honey(config)#
CORE_bitter!honey(config)#
```

Figure 37: Encrypted Password

3.8. Implementing RSTP

```
DIST-SW_bitter!honey(config)#do sh spanning-tree su
Switch is in rapid-pvst mode
Root bridge for: default MARKETING EXAM FACULTY
Extended system ID           is enabled
Portfast Default             is disabled
PortFast BPDU Guard Default  is disabled
Portfast BPDU Filter Default is disabled
Loopguard Default            is disabled
EtherChannel misconfig guard is disabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Configured Pathcost method used is short

Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
VLAN0001                     7         0        0          3         10
VLAN0010                     6         0        0          4         10
VLAN0020                     6         0        0          4         10
VLAN0030                     6         0        0          4         10

---------------------- -------- --------- -------- ---------- ----------
4 vlans                     25         0        0         15         40
```

Figure 38: RSPT Implemention

Rapid-PVST is used by the switch to prevent loops and to accelerate convergence in each VLAN. It is the root bridge for VLANs 1, 10, 20, and 30 and has 40 active STP ports. Some of these ports forward traffic, while others are blocked to prevent loops. RSTP ensures speedy recovery during network disruptions by avoiding the delays connected with regular STP. For improved security, it is recommended to turn on technologies like PortFast and BPDU Guard to protect against STP-related threats and unauthorized devices.

3.9. Configuring Etherchannel

```
ACCESS-SW-1_bitter!honey#sh etherchannel su
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------

1      Po1(SU)           LACP    Fa0/3(P) Fa0/4(P)
```

```
DIST-SW_bitter!honey(config)#do sh etherchannel su
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 3
Number of aggregators:           3

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------

1      Po1(SU)           LACP    Fa0/1(P) Fa0/2(P)
2      Po2(SU)           PAgP    Fa0/3(P) Fa0/4(P)
3      Po3(SU)           LACP    Fa0/5(P) Fa0/6(P)
```

Figure 39: Configuration of Etherchannel

Etherchannel offers link redundancy and enhances bandwidth by integrating numerous physical Ethernet connections into a single logical interface. Using load-balancing methods that may be altered, it distributes traffic among member links as effectively as feasible. In the event of a link breakdown, it rapidly switches over to provide high availability.

3.10. Disabling DTP

```
DIST-SW_bitter!honey(config-if-range)#int r f0/1-7
DIST-SW_bitter!honey(config-if-range)#switchport mode trunk
DIST-SW_bitter!honey(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

%LINK-3-UPDOWN: Interface Port-channel1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up

%LINK-3-UPDOWN: Interface Port-channel2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to up

%LINK-5-CHANGED: Interface Port-channel2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel2, changed state to up

DIST-SW_bitter!honey(config-if-range)#switchport nonegotiate
DIST-SW_bitter!honey(config-if-range)#
%LINK-5-CHANGED: Interface Port-channel1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel1, changed state to up
```

Figure 40: Turning off DTP

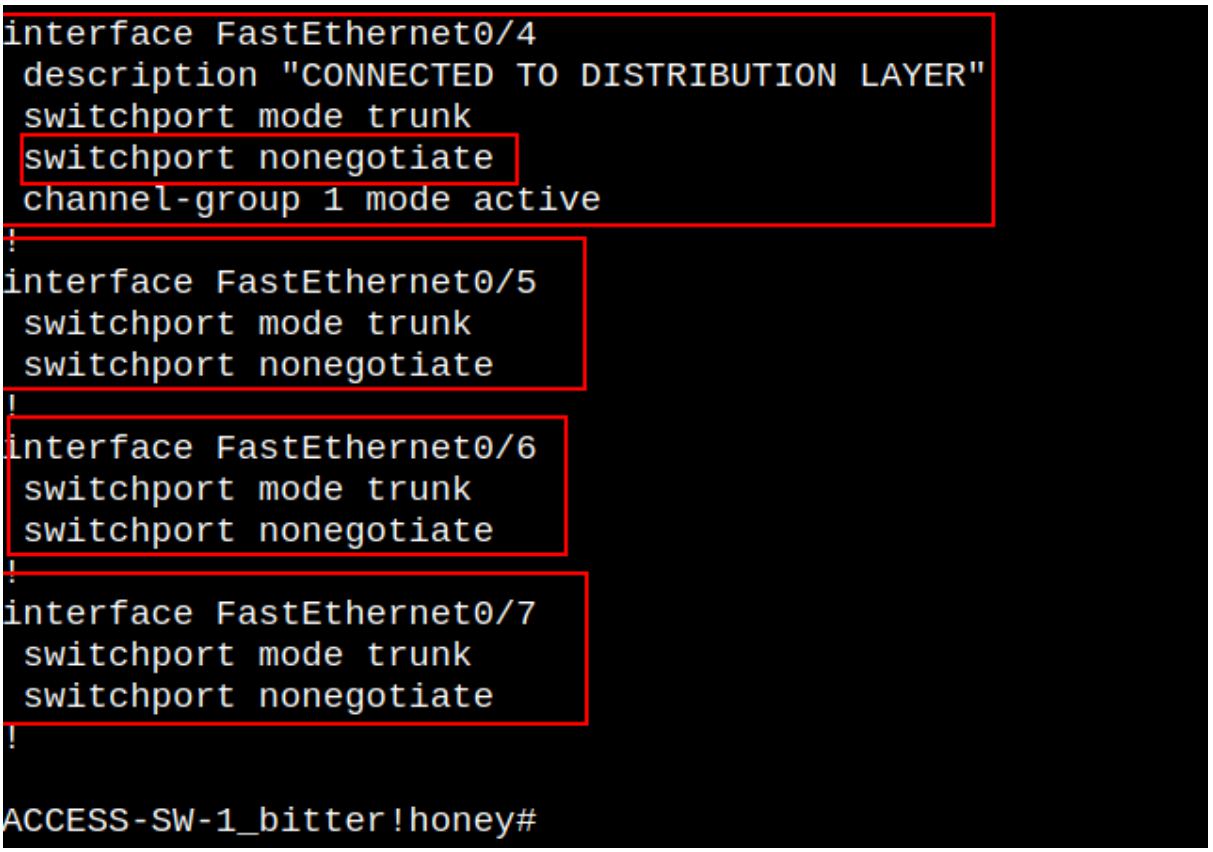

Figure 41: Disabled DTP

Dynamic Trunking Protocol (DTP) is used by Cisco switches to make trunk connections automatically. By avoiding VLAN-hopping and unauthorized trunking, administrators can increase network security by disabling DTP and making sure that trunk links are only manually set.

4. Network Security Practices and Technologies in Linux and Enterprise Environments

4.1. IPtables Configuration

iptables is a command-line firewall utility in Linux used to configure the kernel's **netfilter** framework. It manages incoming and outgoing traffic using rules that specify what to do with packets (ACCEPT, DROP, etc.). (What Is Network Security? Definition and Types | Fortinet, 2022)

Set Default Policies

Figure 42: Setting Default Policies

Set Inbound Rules

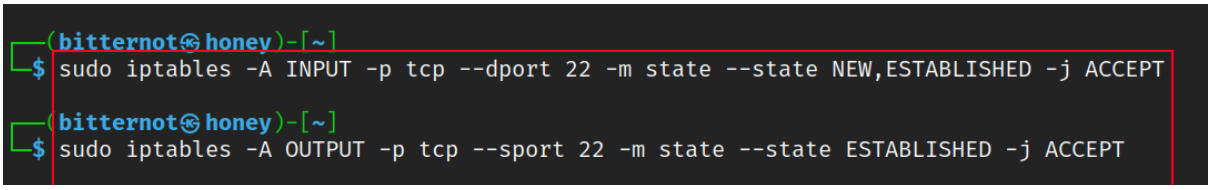

Figure 43: Setting up Inbound Rules

Set Outbound Rules

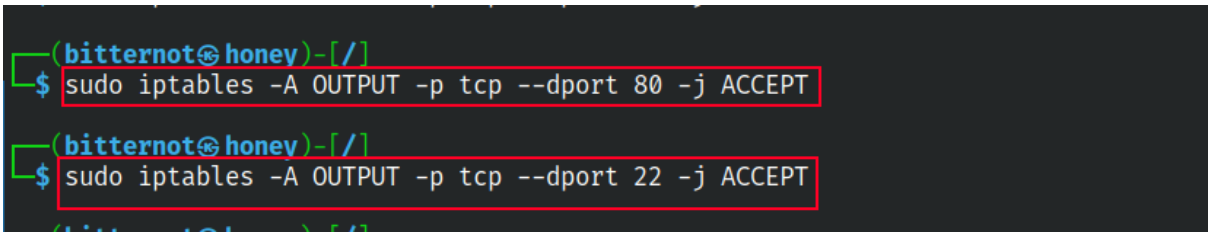

Figure 44: Setting up Outbound Rules

Enable Logs

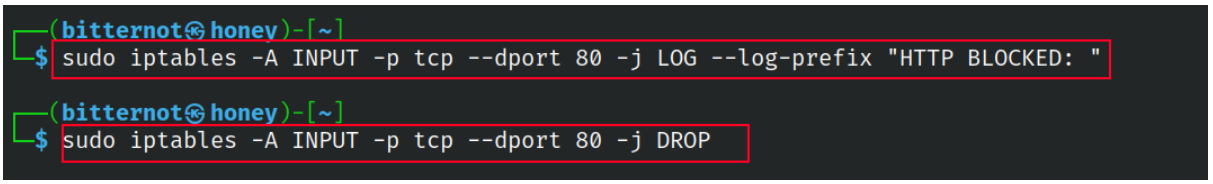

Figure 45: Enabling logs

Best Practices for Firewall Configuration

The ideal way to set up a firewall is to allow only the most necessary connections and utilize the basic settings that halt all traffic. The rules for your firewall should be looked over and adjusted often to keep up with the current security needs. By permitting logging, you can maintain an eye on actions that seem unusual, and fail2ban and other tools can give further safety. It is also necessary to execute stateful inspection, protect access to the firewall, and keep track of any rule revisions in order to maintain a network environment safe and under control.

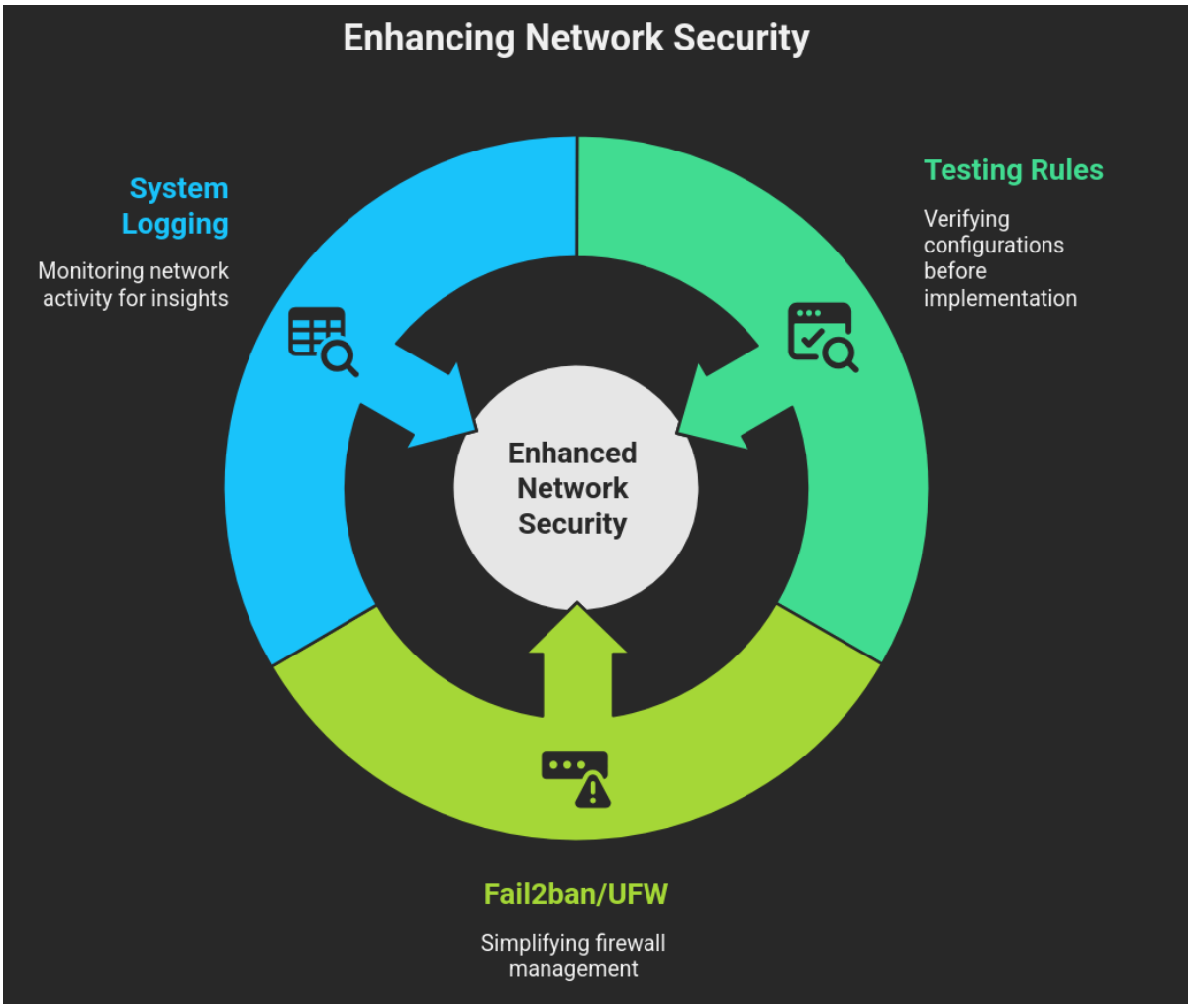

Figure 46: Best Practice

iptables Configuration Showcase

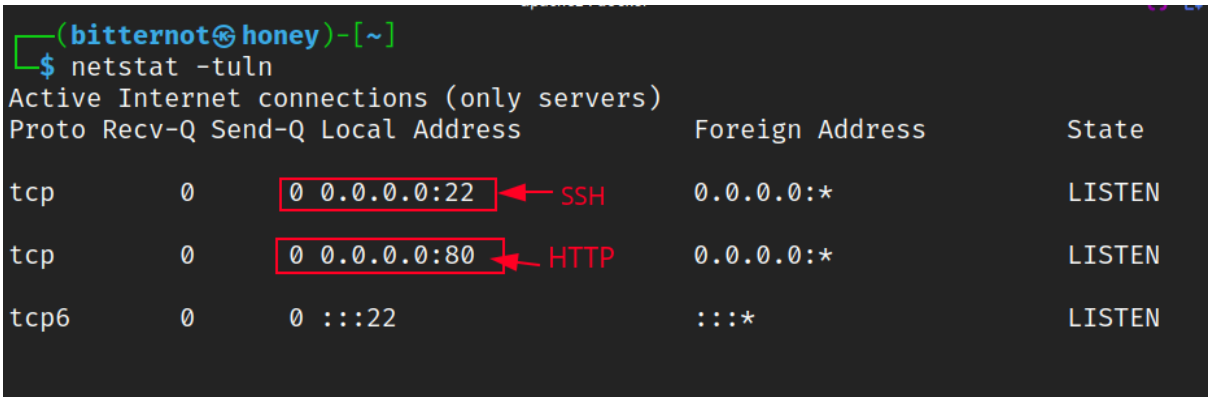

Figure 47: Opening Ports

The SSH connection is successful because the iptable rules allow inbound SSH traffic.

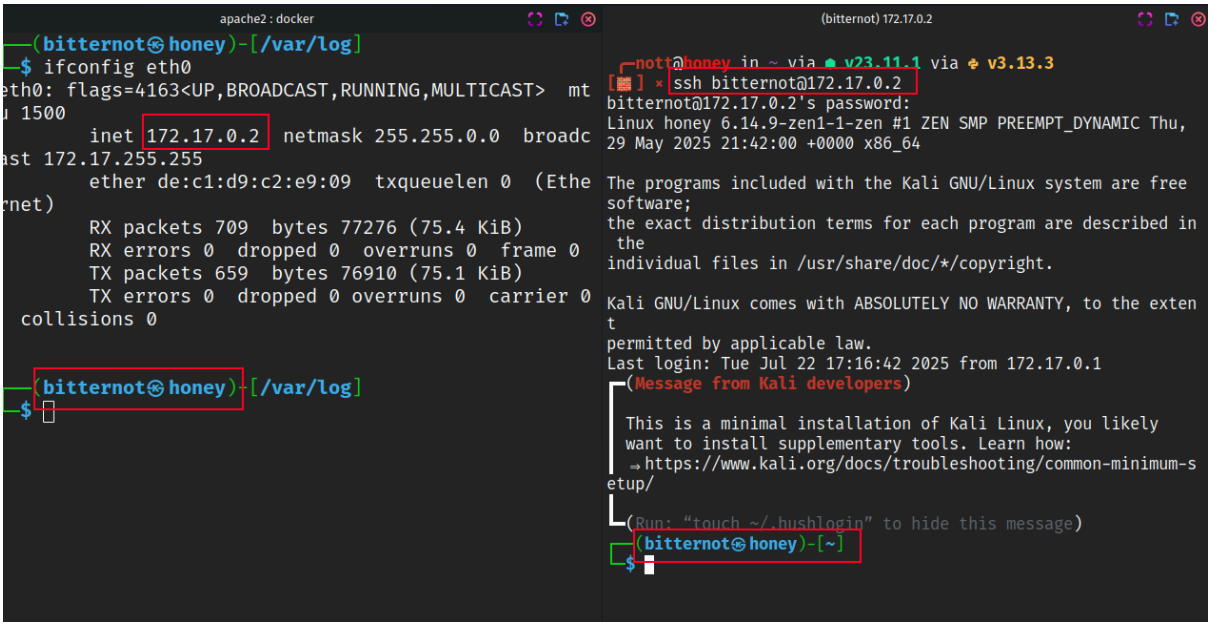

Figure 48: SSH Connection Successful

HTTP connection fails and logged because the iptable drop inbound HTTP traffic.

Figure 49: Failed HTTP Connection

4.2. VPN Components and Security

VPN stands for "Virtual Private Network" and describes the opportunity to establish a protected network connection when using public networks. VPNs encrypt your internet traffic and disguise your online identity. This makes it more difficult for third parties to track your activities online and steal data. The encryption takes place in real time. (Kaspersky, 2023)

Working Mechanism of VPN

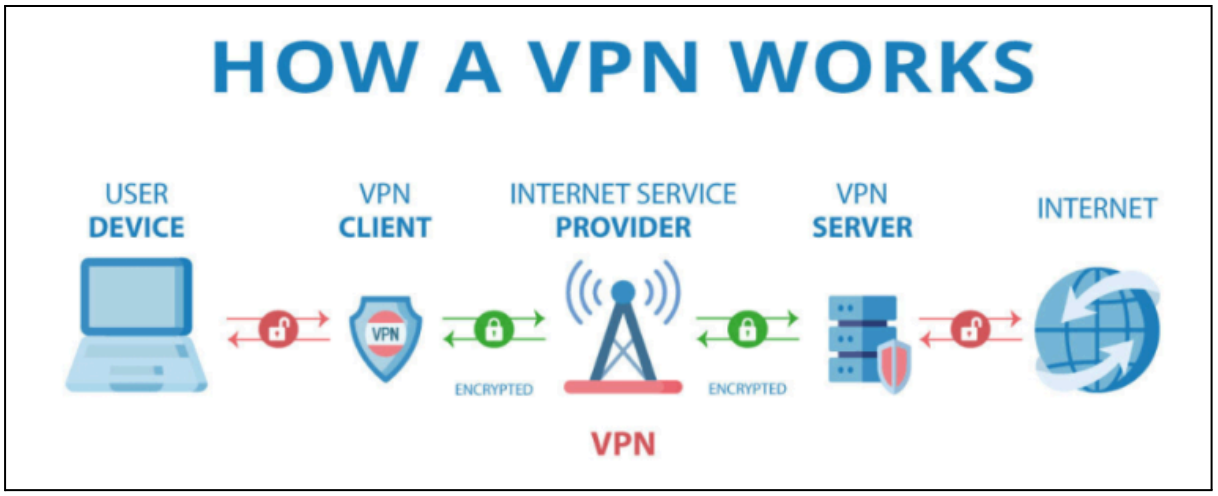

Figure 50: How VPN Works

Between a device and a remote server, a virtual private network (VPN) builds an encrypted tunnel. This tunnel protects data from interception, masks the originating IP address, and secures internet contact. After going over the VPN server, encrypted data is decrypted and sent on to its final position.

Key Components and Technologies in VPN

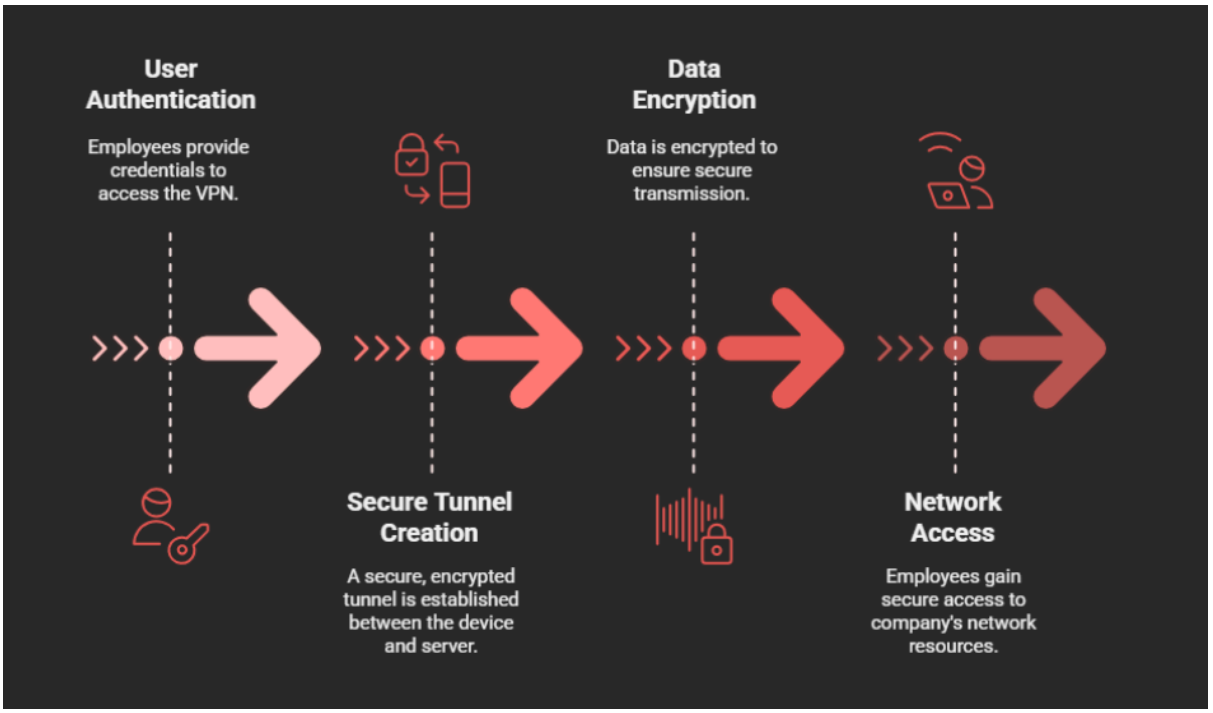

Figure 51: VPN Components and Technologies

A virtual private network, or VPN, creates a protected, encrypted connection over a public network between a device and a remote server. By masking data from hackers and illegal access, it facilitates safe communication. VPNs transfer data securely using **tunneling** protocols like OpenVPN, L2TP/IPsec, and PPTP. External parties cannot read the data thanks to **encryption** methods like AES and 3DES. User identification is proven using **authentication** measures such as digital certificates or passwords. These technologies work together to ensure safe and confidential internet data delivery. (Netalit, 2023)

4.3. Understanding Network Operating Systems

Overview

The network operating system (NOS) in a network regulates communication and resource sharing among linked devices. It manages file or printer sharing, user access, and security. By leveraging common protocols to link hardware and software, NOS aids organizations in efficiently administering and preserving their networks. (Yasar & Lewis, 2023)

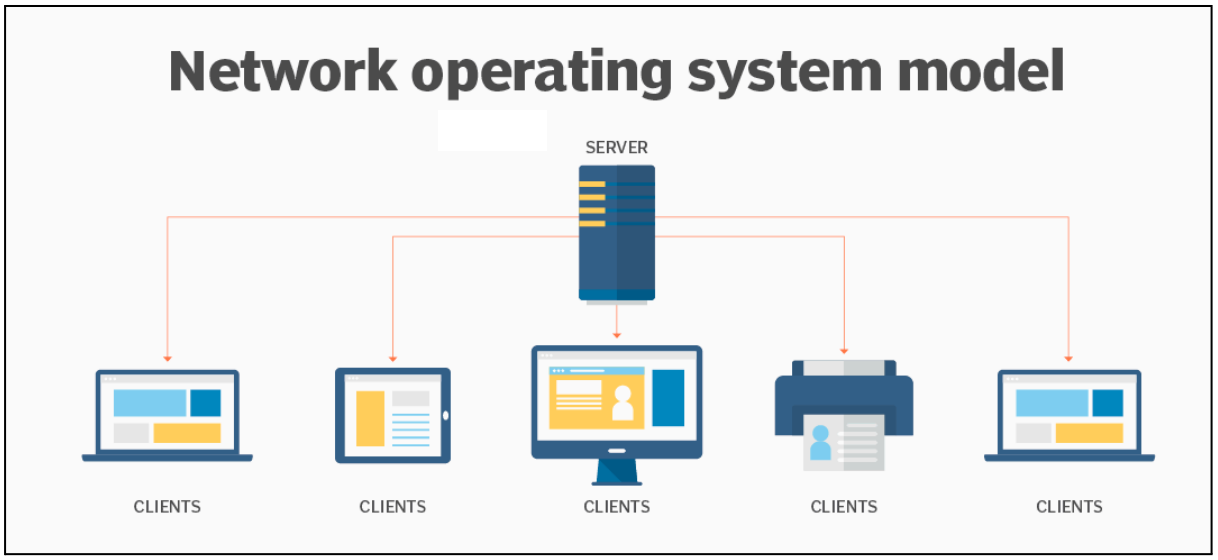

Figure 52: NOS Model

Popular NOS

Microsoft Windows Server is a popular network operating system that offers centralized management, file sharing, and remote access. Linux-based systems like Red Hat and Ubuntu are open-source, scalable, and highly configurable for enterprise use.

Key Feature

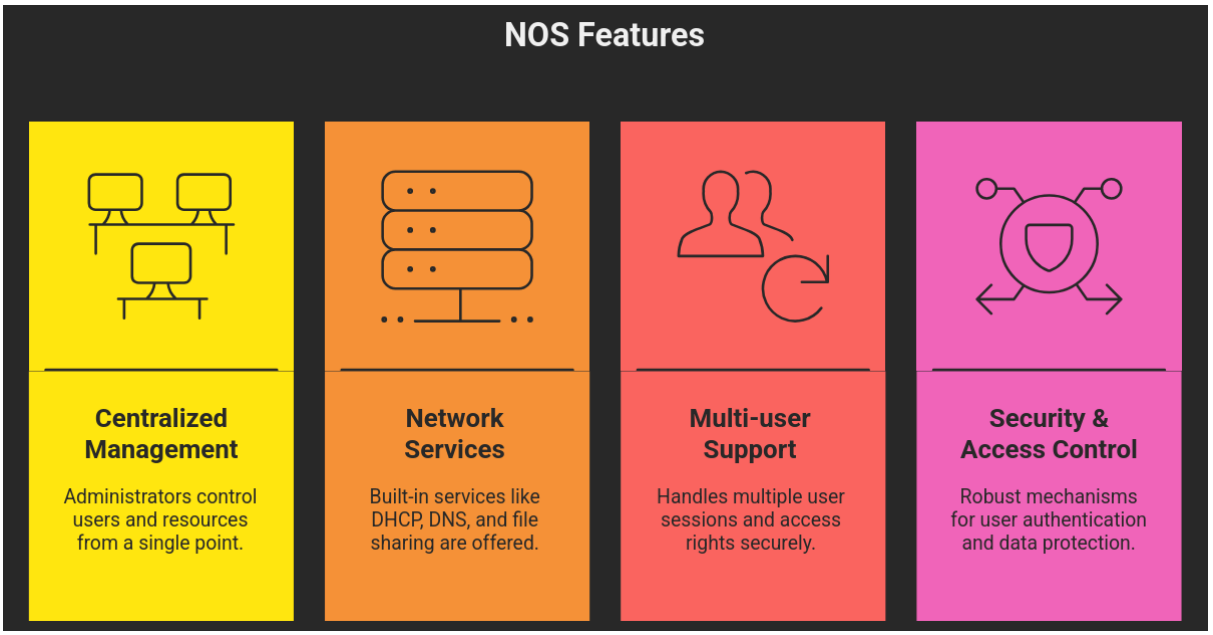

Figure 53: Key Feature Distinguishing NOS from Traditional OS

Common Protocol

The core set of protocols that facilitates communication between devices on a network is dubbed TCP/IP (Transmission Control Protocol/Internet Protocol). File and printer sharing is the major role of SMB (Server Message Block) in Windows environments, whereas NFS (Network File System) fulfills the same duty on Unix/Linux systems. User credentials and other distributed directory information are retrieved and processed by LDAP (Lightweight Directory Access Protocol). Furthermore, to assist flawless network operations, the DNS and DHCP protocols govern hostname resolution and dynamic IP address assignment, respectively. (Yasar, 2025)

Conclusion

In summary, the use of effective design concepts, robust security mechanisms, and appropriate communication protocols are crucial to establishing a safe and trustworthy network configuration. One can preserve both performance and security by learning the distinctions between protocols, addressing weaknesses, and establishing efficient configurations. VLANs, firewalls, encryption, tunneling, authentication, and redundancy are some of the technologies that provide safe and uninterrupted communication. As a result, a well-designed network preserves essential information from new hazards while concurrently boosting operating efficiency.

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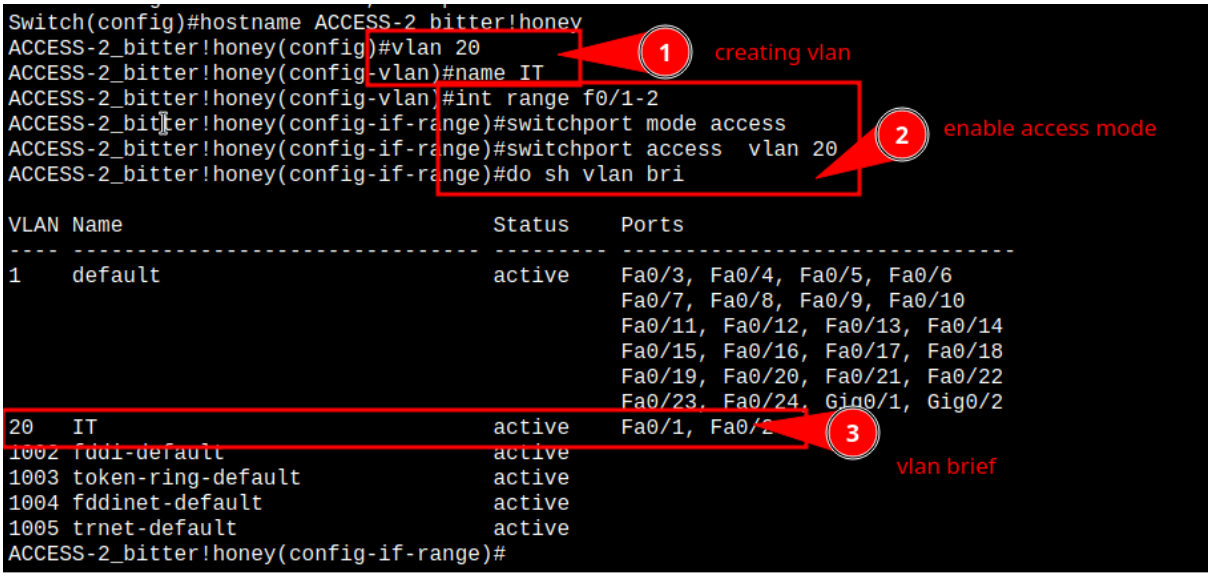
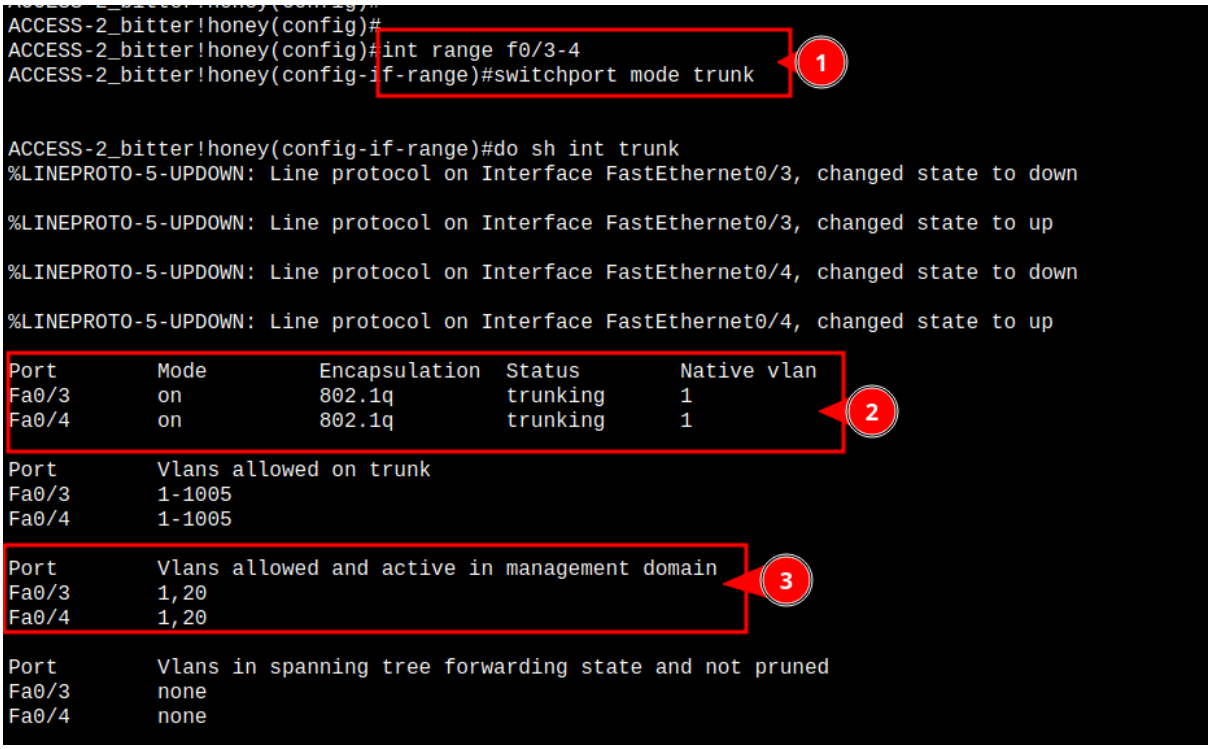
Appendix

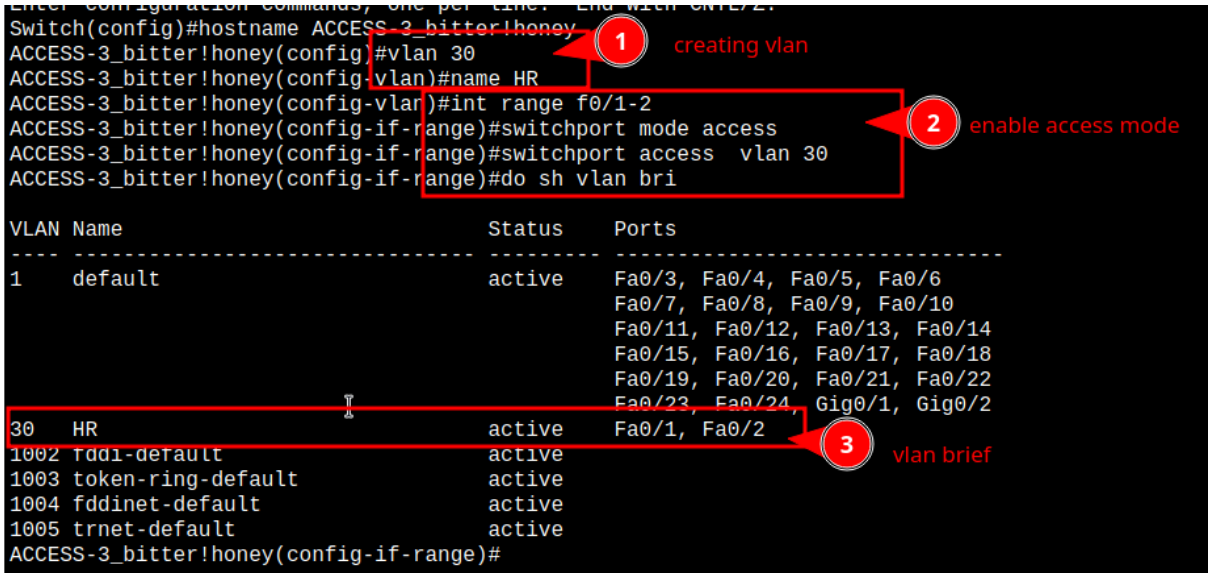
Task-2

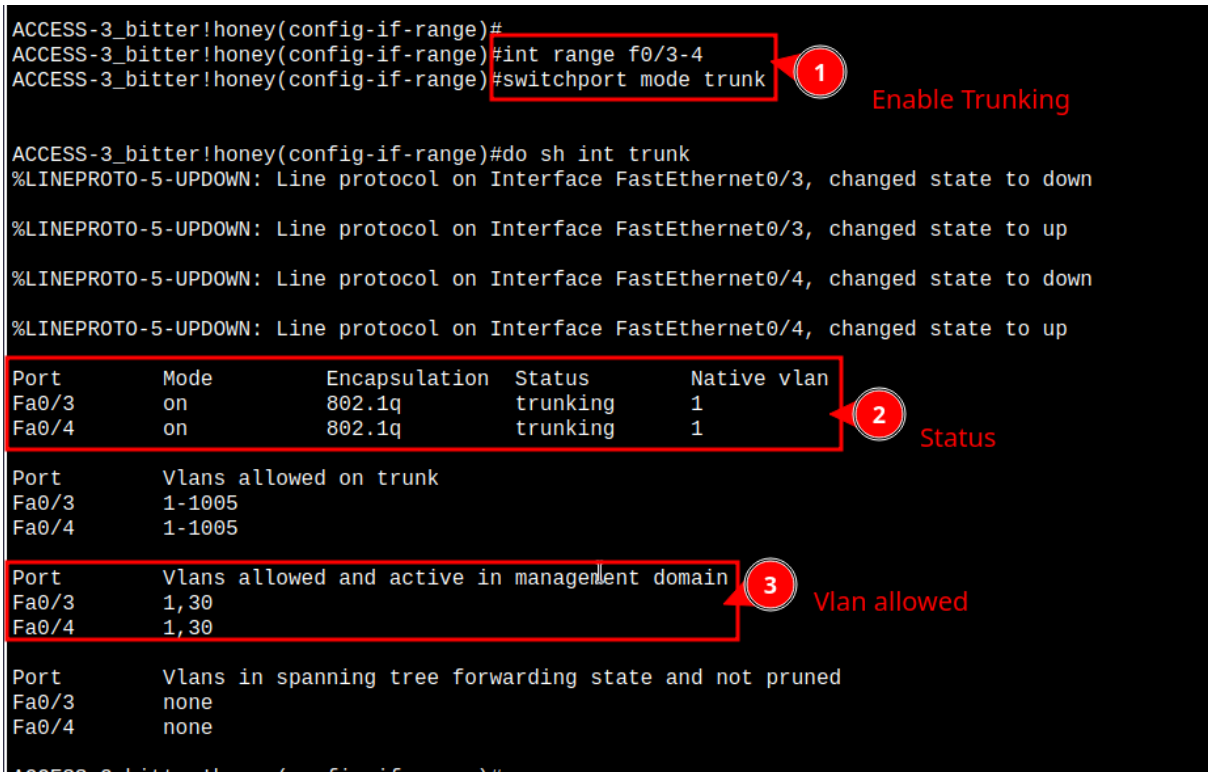
Access-2_bitter!honey



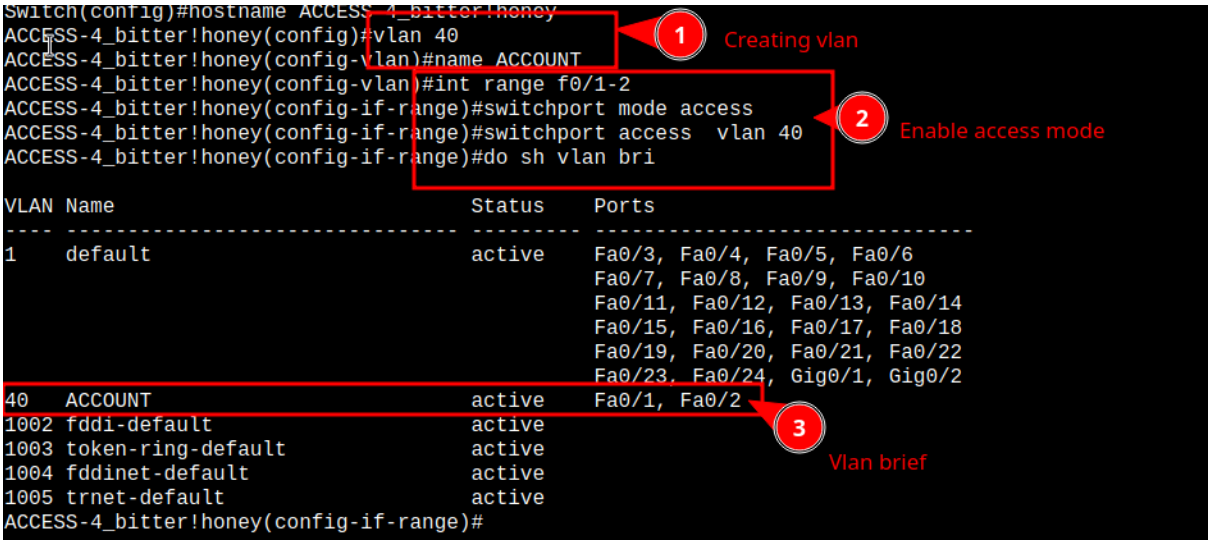


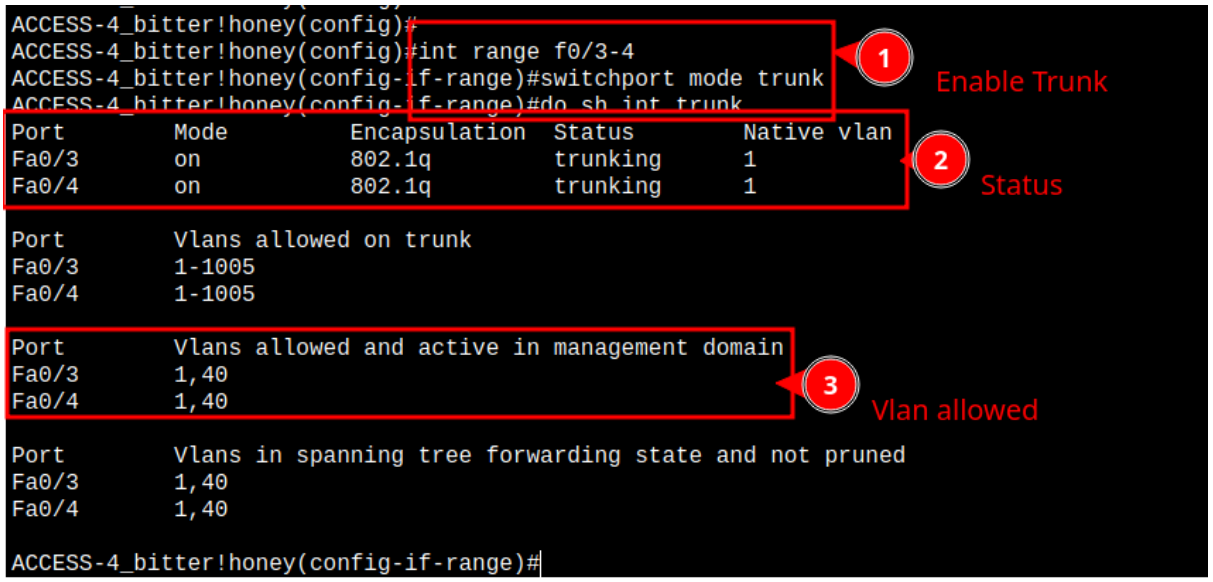
Access-3_bitter!honey





Access-4_bitter!honey





Access-5_bitter!honey

```
Switch(config)#hostname ACCESS-5_bitter!honey
ACCESS-5_bitter!honey(config)#vlan 50
ACCESS-5_bitter!honey(config-vlan)#name ADMINISTRATION
ACCESS-5_bitter!honey(config-vlan)#int range f0/1-2
ACCESS-5_bitter!honey(config-if-range)#switchport mode access
ACCESS-5_bitter!honey(config-if-range)#switchport access  vlan 50
ACCESS-5_bitter!honey(config-if-range)#do sh vlan bri

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/3, Fa0/4, Fa0/5, Fa0/6
                                                 Fa0/7, Fa0/8, Fa0/9, Fa0/10
                                                 Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                                 Fa0/15, Fa0/16, Fa0/17, Fa0/18
                                                 Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                                 Fa0/23, Fa0/24, Gig0/1, Gig0/2
50   ADMINISTRATION                    active    Fa0/1, Fa0/2
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
ACCESS-5_bitter!honey(config-if-range)#
```

1 Creating Vlan

2 Enable access mode

3 Vlan brief

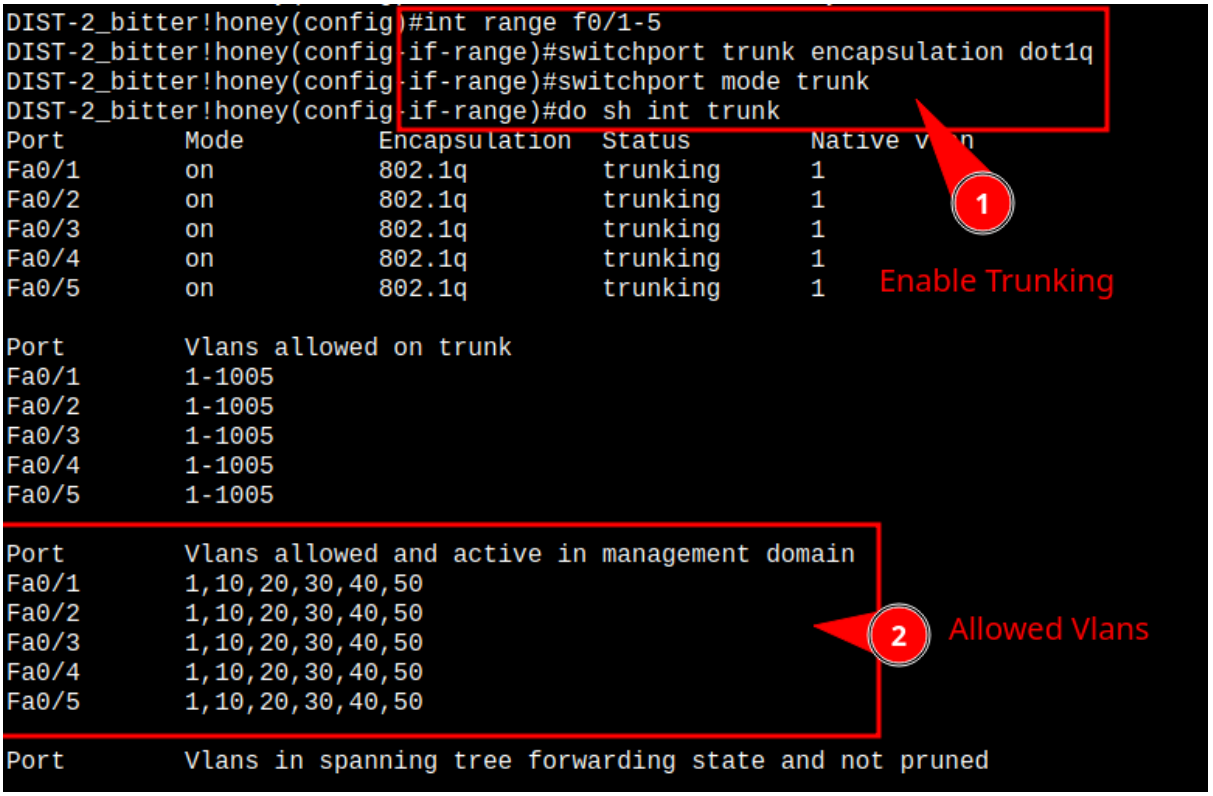
```
ACCESS-5_bitter!honey(config)#int range f0/3-4
ACCESS-5_bitter!honey(config-if-range)#switchport mode trunk
ACCESS-5_bitter!honey(config-if-range)#do sh int trunk
Port        Mode         Encapsulation  Status        Native vlan
Fa0/3       on           802.1q         trunking      1
Fa0/4       on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/3       1-1005
Fa0/4       1-1005

Port        Vlans allowed and active in management domain
Fa0/3       1,50
Fa0/4       1,50

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/3       1,50
Fa0/4       1,50
```

1 Enable Trunking

2 Status

3 Allowed Vlan

Dist-2_bitter!honey



```
interface Vlan10
 mac-address 0001.638e.9a01
 ip address 172.16.99.126 255.255.255.128
 ip helper-address 11.0.0.2
 ip helper-address 10.0.0.2
!
interface Vlan20
 mac-address 0001.638e.9a02
 ip address 172.16.99.254 255.255.255.128
 ip helper-address 11.0.0.2
 ip helper-address 10.0.0.2
!
interface Vlan30
 mac-address 0001.638e.9a03
 ip address 172.16.100.30 255.255.255.224
 ip helper-address 11.0.0.2
 ip helper-address 10.0.0.2
!
interface Vlan40
 mac-address 0001.638e.9a04
 ip address 172.16.100.46 255.255.255.240
 ip helper-address 11.0.0.2
 ip helper-address 10.0.0.2
!
interface Vlan50
 mac-address 0001.638e.9a05
 ip address 172.16.100.110 255.255.255.192
 ip helper-address 11.0.0.2
 ip helper-address 10.0.0.2
!
router eigrp 30
 network 172.16.0.0
 network 11.0.0.0
 network 14.0.0.0
 no auto-summary
!
```

Core-2_bitter!honey

```
CORE-2_bitter!honey#sh etherchannel su
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------

2      Po2(RU)          LACP    Fa0/1(P) Fa0/2(P)
```

```
CORE-2_bitter!honey#sh ip int br | ex un
Interface              IP-Address      OK? Method Status                Protocol
Port-channel2          18.0.0.2        YES manual up                    up
FastEthernet0/3        14.0.0.3        YES manual up                    up
FastEthernet0/4        140.0.0.1       YES manual up                    up
CORE-2_bitter!honey#
```

```
router eigrp 30
 network 14.0.0.0
 network 18.0.0.0
 network 140.0.0.0
 auto-summary
!
```

DHCP-1_SERVER

DHCP-2_SERVER

Task-3

Access-SW-2_bitter!honey

```
ACCESS-SW-2_bitter!honey#sh vlan  br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                 Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                 Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                 Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                 Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                                 Gig0/1, Gig0/2
10   MARKETING                         active
20   EXAM                              active    Fa0/1, Fa0/2
30   FACULTY                           active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
ACCESS-SW-2_bitter!honey#
```

```
ACCESS-SW-2_bitter!honey#sh int trunk
Port        Mode         Encapsulation  Status        Native vlan
Po2         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po2         1-1005

Port        Vlans allowed and active in management domain
Po2         1,10,20,30

Port        Vlans in spanning tree forwarding state and not pruned
Po2         1,10,20,30
```

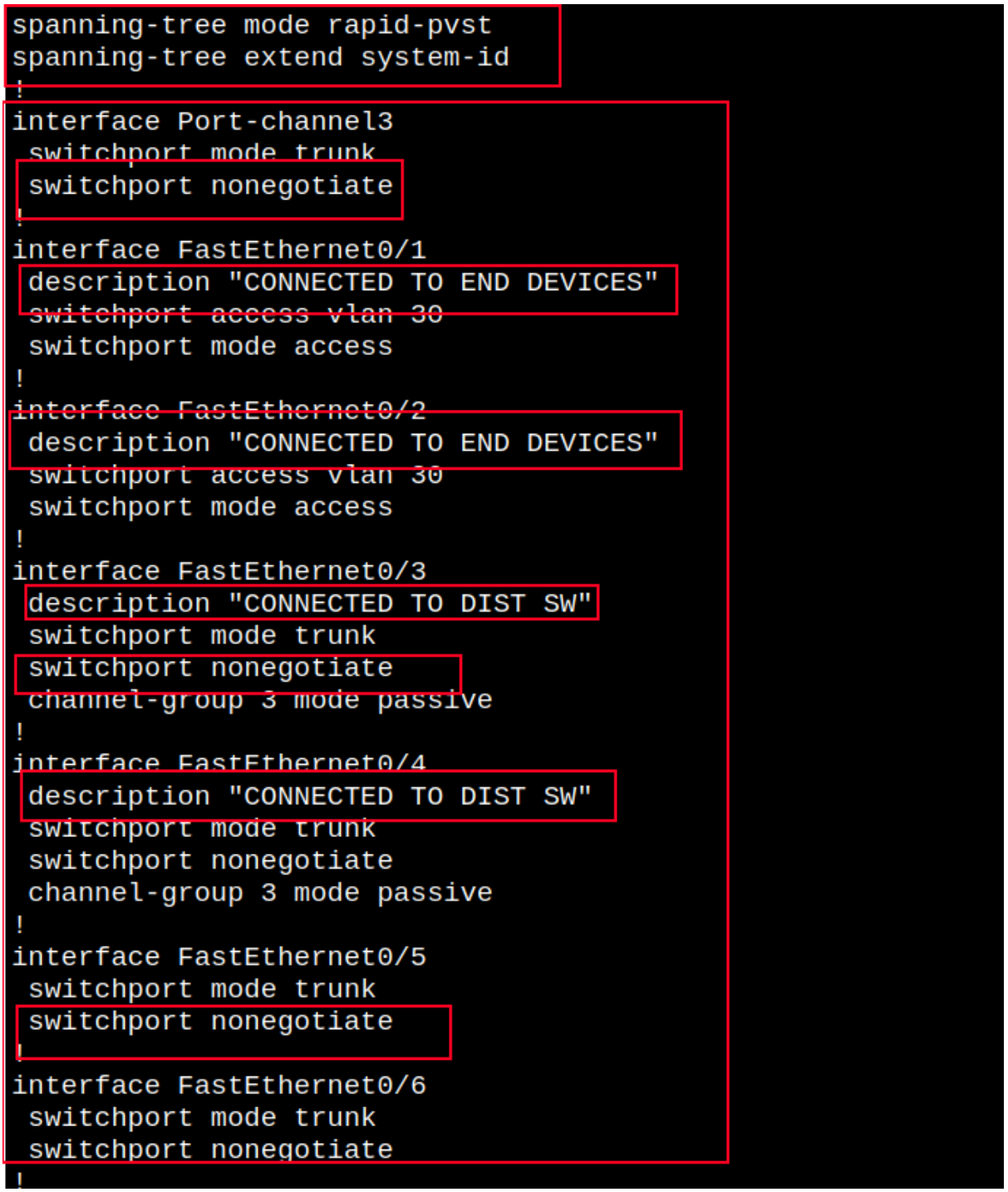
```
ACCESS-SW-2_bitter!honey#sh etherchannel su
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------

2      Po2(SU)           PAgP   Fa0/3(P) Fa0/4(P)
ACCESS-SW-2_bitter!honey#
```

```
spanning-tree mode rapid-pvst
spanning-tree extend system-id
!
interface Port-channel2
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/1
 description "CONNECTED TO END DEVICES"
 switchport access vlan 20
 switchport mode access
!
interface FastEthernet0/2
 description "CONNECTED TO END DEVICES"
 switchport access vlan 20
 switchport mode access
!
interface FastEthernet0/3
 description "CONNECTED TO DIST-SW"
 switchport mode trunk
 switchport nonegotiate
 channel-group 2 mode auto
!
interface FastEthernet0/4
 description "CONNECTED TO DIST-SW"
 switchport mode trunk
 switchport nonegotiate
 channel-group 2 mode auto
!
interface FastEthernet0/5
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/6
 switchport mode trunk
 switchport nonegotiate
```

Access-SW-3_bitter!honey

```
ACCESS-SW-3_bitter!honey#sh vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                 Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                 Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                 Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                 Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                                 Gig0/1, Gig0/2
10   MARKETING                         active
20   EXAM                              active
30   FACULTY                           active    Fa0/1, Fa0/2
1002 fddi-default                      active
1003 token-ring-default                active
```

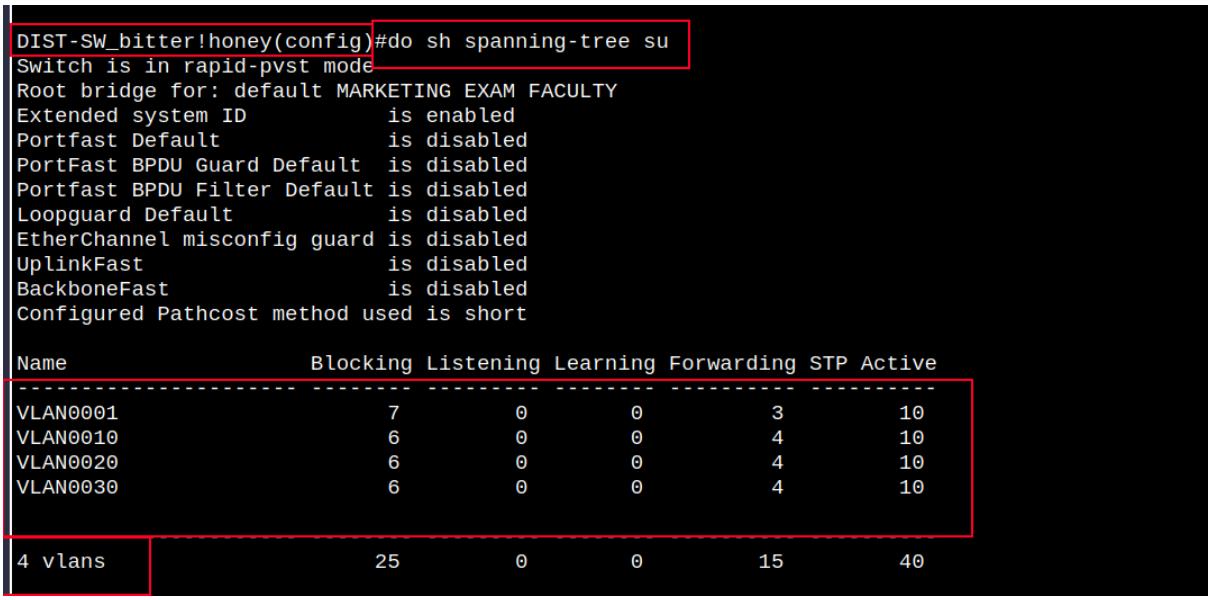
```
ACCESS-SW-3_bitter!honey#sh int trunk
Port        Mode         Encapsulation  Status        Native vlan
Po3         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po3         1-1005

Port        Vlans allowed and active in management domain
Po3         1,10,20,30

Port        Vlans in spanning tree forwarding state and not pruned
Po3         1,10,20,30

ACCESS-SW-3_bitter!honey#
ACCESS-SW-3_bitter!honey#
ACCESS-SW-3_bitter!honey#
ACCESS-SW-3_bitter!honey#sh etherchannel su
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------

3      Po3(SU)           LACP    Fa0/3(P) Fa0/4(P)
```


spanning-tree mode rapid-pvst
spanning-tree extend system-id
!
interface Port-channel3
switchport mode trunk
switchport nonegotiate
!
interface FastEthernet0/1
description "CONNECTED TO END DEVICES"
switchport access vlan 30
switchport mode access
!
interface FastEthernet0/2
description "CONNECTED TO END DEVICES"
switchport access vlan 30
switchport mode access
!
interface FastEthernet0/3
description "CONNECTED TO DIST SW"
switchport mode trunk
switchport nonegotiate
channel-group 3 mode passive
!
interface FastEthernet0/4
description "CONNECTED TO DIST SW"
switchport mode trunk
switchport nonegotiate
channel-group 3 mode passive
!
interface FastEthernet0/5
switchport mode trunk
switchport nonegotiate
!
interface FastEthernet0/6
switchport mode trunk
switchport nonegotiate
!

DIST-SW_bitter!honey

```
DIST-SW_bitter!honey(config)#do  sh vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                                 Fa0/12, Fa0/13, Fa0/14, Fa0/15
                                                 Fa0/16, Fa0/17, Fa0/18, Fa0/19
                                                 Fa0/20, Fa0/21, Fa0/22, Fa0/23
                                                 Fa0/24, Gig0/1, Gig0/2
10   MARKETING                         active
20   EXAM                              active
30   FACULTY                           active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

```
DIST-SW_bitter!honey(config)# do sh int trunk
Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      1
Po2         on           802.1q         trunking      1
Po3         on           802.1q         trunking      1
Fa0/7       on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po1         1-1005
Po2         1-1005
Po3         1-1005
Fa0/7       1-1005

Port        Vlans allowed and active in management domain
Po1         1,10,20,30
Po2         1,10,20,30
Po3         1,10,20,30
Fa0/7       1,10,20,30

Port        Vlans in spanning tree forwarding state and not pruned
Po1         10,20,30
Po2         1,10,20,30
Po3         1,10,20,30
Fa0/7       1,10,20,30
```


DIST-SW_bitter!honey(config)#do sh spanning-tree su
Switch is in rapid-pvst mode
Root bridge for: default MARKETING EXAM FACULTY
Extended system ID is enabled
Portfast Default is disabled
PortFast BPDU Guard Default is disabled
Portfast BPDU Filter Default is disabled
Loopguard Default is disabled
EtherChannel misconfig guard is disabled
UplinkFast is disabled
BackboneFast is disabled
Configured Pathcost method used is short
Name Blocking Listening Learning Forwarding STP Active
VLAN0001 7 0 0 3 10
VLAN0010 6 0 0 4 10
VLAN0020 6 0 0 4 10
VLAN0030 6 0 0 4 10
4 vlans 25 0 0 15 40

```
spanning-tree mode rapid-pvst
spanning-tree extend system-id
!
interface Port-channel1
 switchport mode trunk
 switchport nonegotiate
!
interface Port-channel2
 switchport mode trunk
 switchport nonegotiate
!
interface Port-channel3
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/1
 description "CONNECTED TO ACCESS LAYER"
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode passive
!
interface FastEthernet0/2
 description "CONNECTED TO ACCESS LAYER"
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode passive
!
interface FastEthernet0/3
 description "CONNECTED TO ACCESS LAYER"
 switchport mode trunk
 switchport nonegotiate
 channel-group 2 mode desirable
!
interface FastEthernet0/4
 description "CONNECTED TO ACCESS LAYER"
 switchport mode trunk
 switchport nonegotiate
 channel-group 2 mode desirable
```

```
banner motd ^C
+---------------------------------------------------------------+
|   WARNING! Unauthorized access is strictly prohibited.        |
|   All activities are logged in the system.                    |
+---------------------------------------------------------------+
^C
```

CORE_bitter!honey

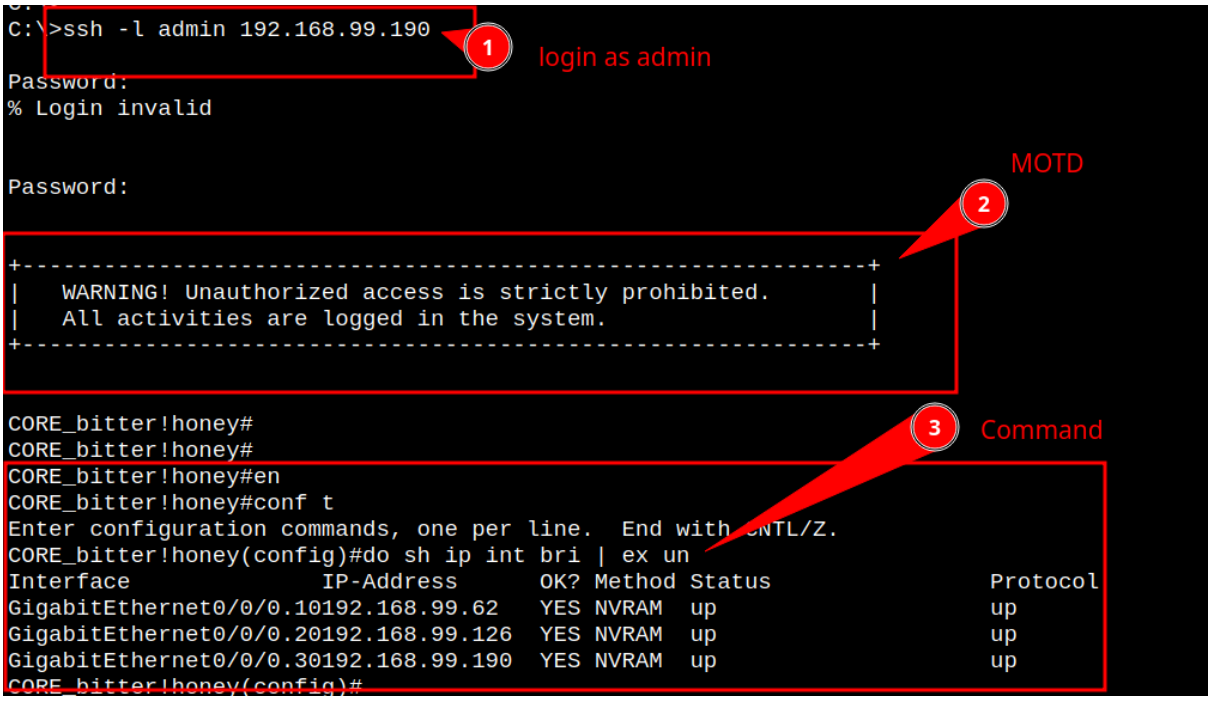
```
!
hostname CORE_bitter!honey
!
!
!
enable secret 5 $1$mERr$MSCsGn1R8P02jnd.nLgVl/
!
!
!
!
!
!
ip cef
no ipv6 cef
!
!
!
username ADMIN privilege 15 secret 5 $1$mERr$tKAvQPi4nwql8vUTe8ogt/
username operator privilege 7 secret 5 $1$mERr$tKAvQPi4nwql8vUTe8ogt/
username user privilege 2 secret 5 $1$mERr$tKAvQPi4nwql8vUTe8ogt/
!
!
!
!
!
!
!
!
!
ip ssh version 2
ip ssh authentication-retries 2
ip ssh time-out 60
ip domain-name dinesh.com
!
!
spanning-tree mode rapid-pvst
!
!
!
```

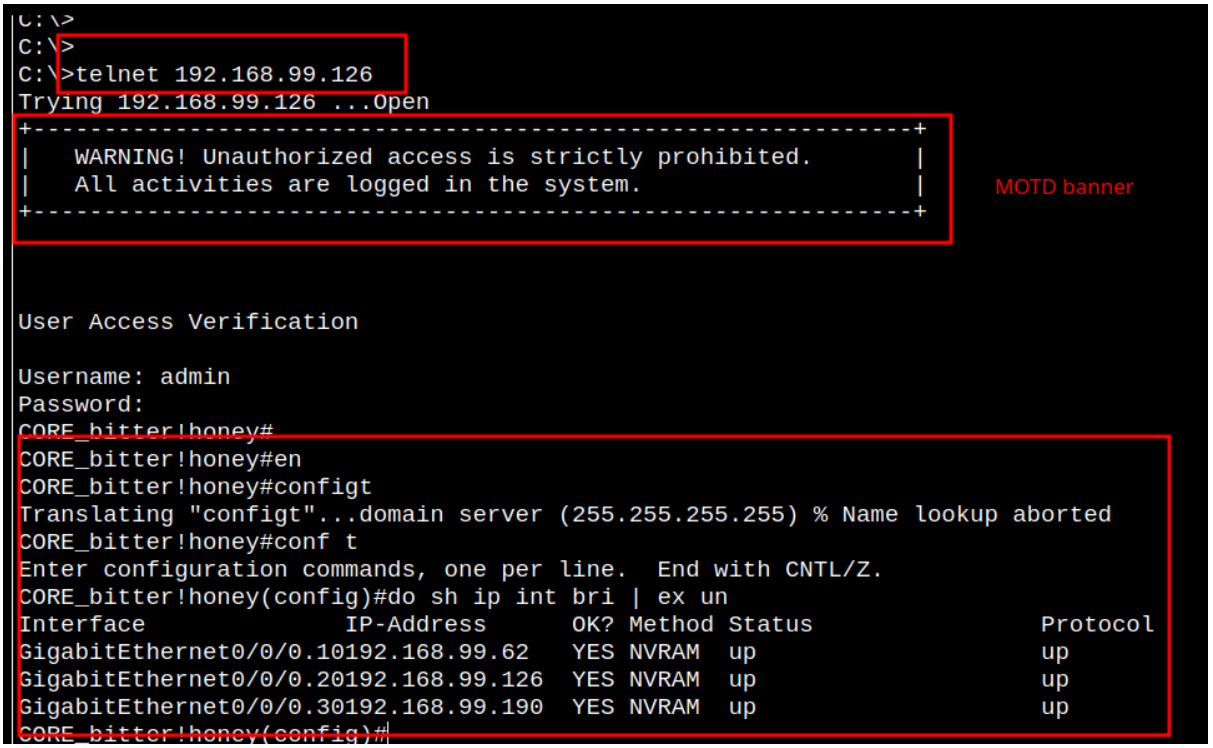
```
!
interface GigabitEthernet0/0/0
 description "CONNECTED TO DIST-SW-bitter!honey"
 no ip address
 duplex auto
 speed auto
!
interface GigabitEthernet0/0/0.10
 description "DEFAULT GATEWAY FOR VLAN10"
 encapsulation dot1Q 10
 ip address 192.168.99.62 255.255.255.192
!
interface GigabitEthernet0/0/0.20
 description "DEFAULT GATEWAY FOR VLAN20"
 encapsulation dot1Q 20
 ip address 192.168.99.126 255.255.255.192
!
interface GigabitEthernet0/0/0.30
 description "DEFAULT GATEWAY FOR VLAN30"
 encapsulation dot1Q 30
 ip address 192.168.99.190 255.255.255.192
!
interface GigabitEthernet0/0/1
 no ip address
 duplex auto
 speed auto
 shutdown
```

```
!
banner motd ^C
+------------------------------------------------------------------+
|   WARNING! Unauthorized access is strictly prohibited.           |
|   All activities are logged in the system.                       |
+------------------------------------------------------------------+
^C
```

```
privilege exec level 2 ping
privilege exec level 7 show
privilege exec level 2 show cdp
privilege exec level 2 show cdp neighbors
privilege exec level 7 show interfaces
privilege exec level 7 show interfaces trunk
privilege exec level 2 show ip
privilege exec level 2 show ip interface
privilege exec level 2 show ip interface brief
privilege exec level 7 show running-config
privilege exec level 7 show startup-config
privilege exec level 2 show version
privilege exec level 7 show vlan-switch
privilege exec level 7 show vlan-switch brief
privilege exec level 7 show vtp
privilege exec level 7 show vtp status
privilege exec level 7 traceroute
!
!
!
!
line con 0
 logging synchronous
 login local
!
line aux 0
!
line vty 0 4
 logging synchronous
 login local
 transport input telnet
line vty 5 15
 logging synchronous
 login local
 transport input ssh
!
!
```

```
CORE_bitter!honey(config)#do sh ip int br | ex un
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0.10192.168.99.62   YES manual up                    up
GigabitEthernet0/0/0.20192.168.99.126  YES manual up                    up
GigabitEthernet0/0/0.30192.168.99.190  YES manual up                    up
```


C:\>ssh -l admin 192.168.99.190
1
login as admin
Password:
% Login invalid
Password:
MOTD
2
+--+
| WARNING! Unauthorized access is strictly prohibited. |
| All activities are logged in the system. |
+--+
CORE_bitter!honey#
CORE_bitter!honey#
3
Command
CORE_bitter!honey#en
CORE_bitter!honey#conf t
Enter configuration commands, one per line. End with CNTL/Z.
CORE_bitter!honey(config)#do sh ip int bri | ex un
Interface IP-Address OK? Method Status Protocol
GigabitEthernet0/0/0.10192.168.99.62 YES NVRAM up up
GigabitEthernet0/0/0.20192.168.99.126 YES NVRAM up up
GigabitEthernet0/0/0.30192.168.99.190 YES NVRAM up up
CORE_bitter!honey(config)#


C:\>
C:\>
C:\>telnet 192.168.99.126
Trying 192.168.99.126 ...Open
+--+
| WARNING! Unauthorized access is strictly prohibited. |
| All activities are logged in the system. |
+--+
MOTD banner
User Access Verification
Username: admin
Password:
CORE_bitter!honey#
CORE_bitter!honey#en
CORE_bitter!honey#configt
Translating "configt"...domain server (255.255.255.255) % Name lookup aborted
CORE_bitter!honey#conf t
Enter configuration commands, one per line. End with CNTL/Z.
CORE_bitter!honey(config)#do sh ip int bri | ex un
Interface IP-Address OK? Method Status Protocol
GigabitEthernet0/0/0.10192.168.99.62 YES NVRAM up up
GigabitEthernet0/0/0.20192.168.99.126 YES NVRAM up up
GigabitEthernet0/0/0.30192.168.99.190 YES NVRAM up up
CORE_bitter!honey(config)#