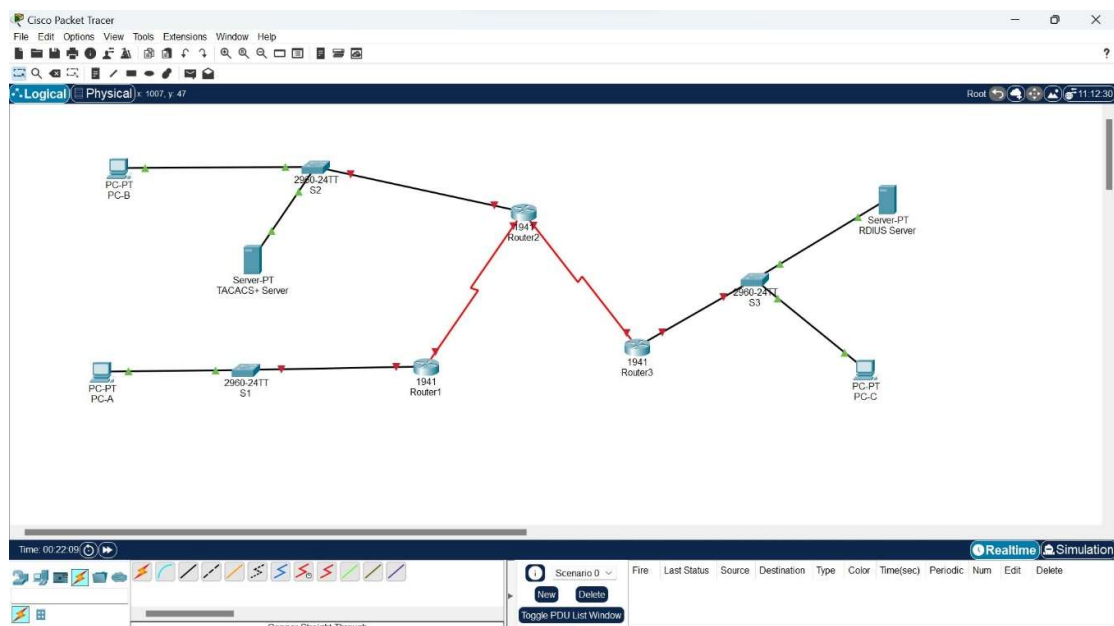
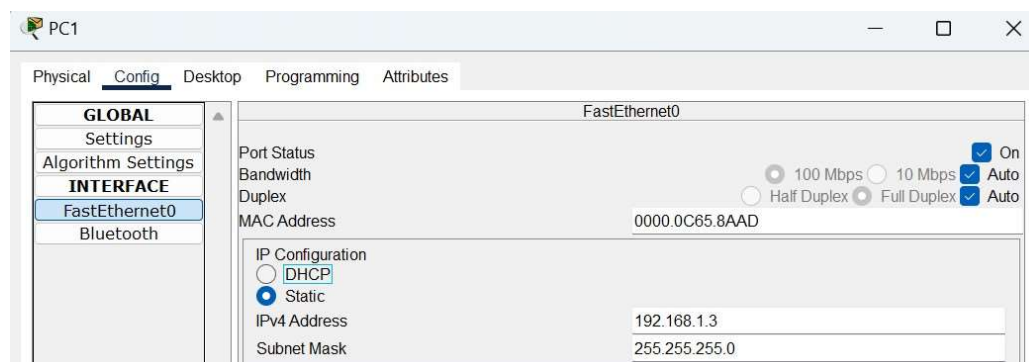


**Date: 29/01/2024****Security in Computing****Practical 2:**

- **Aim: Configure AAA Authentication.**
  - a. Configure a local user account on Router and configure authentication on the console and vty lines using local AAA.
  - b. Verify local AAA authentication from the Router console and the PC-A client.
- **Topology Diagram:**

➤ **Assigning IP Address:****1. PC1**

## 2. PC2



The screenshot shows the configuration window for PC2. The 'Config' tab is selected. On the left, the 'INTERFACE' section is expanded, showing 'FastEthernet0' and 'Bluetooth'. The 'FastEthernet0' interface is selected. The configuration details for 'FastEthernet0' are as follows:

Parameter	Value
Port Status	<input checked="" type="checkbox"/> On
Bandwidth	<input checked="" type="radio"/> 100 Mbps <input type="radio"/> 10 Mbps <input checked="" type="checkbox"/> Auto
Duplex	<input type="radio"/> Half Duplex <input checked="" type="radio"/> Full Duplex <input checked="" type="checkbox"/> Auto
MAC Address	0030.A3C0.AEC9
IP Configuration	<input type="radio"/> DHCP <input checked="" type="radio"/> Static
IPv4 Address	192.168.2.3
Subnet Mask	255.255.255.0

## 3. PC3



The screenshot shows the configuration window for PC3. The 'Config' tab is selected. On the left, the 'INTERFACE' section is expanded, showing 'FastEthernet0' and 'Bluetooth'. The 'FastEthernet0' interface is selected. The configuration details for 'FastEthernet0' are as follows:

Parameter	Value
Port Status	<input checked="" type="checkbox"/> On
Bandwidth	<input checked="" type="radio"/> 100 Mbps <input type="radio"/> 10 Mbps <input checked="" type="checkbox"/> Auto
Duplex	<input type="radio"/> Half Duplex <input checked="" type="radio"/> Full Duplex <input checked="" type="checkbox"/> Auto
MAC Address	00D0.D358.25AB
IP Configuration	<input type="radio"/> DHCP <input checked="" type="radio"/> Static
IPv4 Address	192.168.3.3
Subnet Mask	255.255.255.0

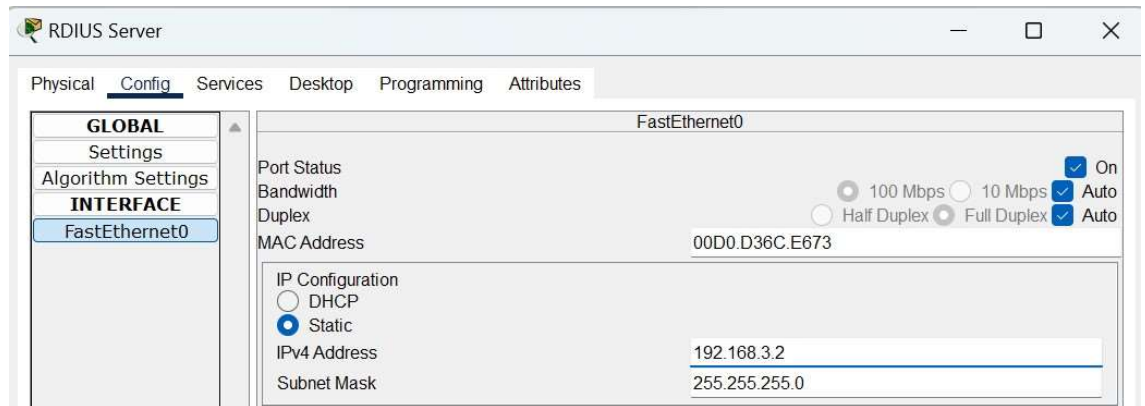
## 4. TACACS+ Server



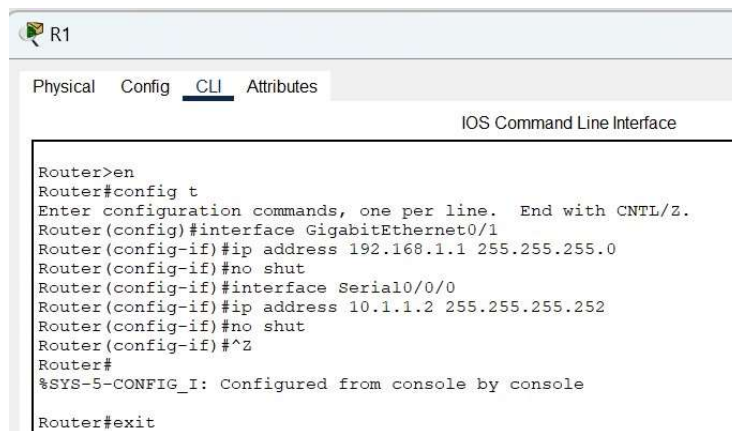
The screenshot shows the configuration window for the TACACS+ Server. The 'Config' tab is selected. On the left, the 'INTERFACE' section is expanded, showing 'FastEthernet0'. The 'FastEthernet0' interface is selected. The configuration details for 'FastEthernet0' are as follows:

Parameter	Value
Port Status	<input checked="" type="checkbox"/> On
Bandwidth	<input checked="" type="radio"/> 100 Mbps <input type="radio"/> 10 Mbps <input checked="" type="checkbox"/> Auto
Duplex	<input type="radio"/> Half Duplex <input checked="" type="radio"/> Full Duplex <input checked="" type="checkbox"/> Auto
MAC Address	0009.7CC2.2327
IP Configuration	<input type="radio"/> DHCP <input checked="" type="radio"/> Static
IPv4 Address	192.168.2.2
Subnet Mask	255.255.255.0

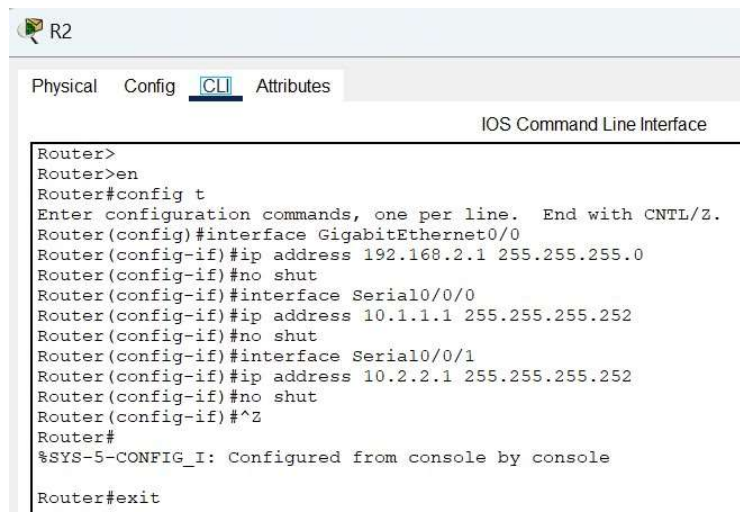
## 5. RADIUS Server



## 6. R1



## 7. R2



## 8. R3



```

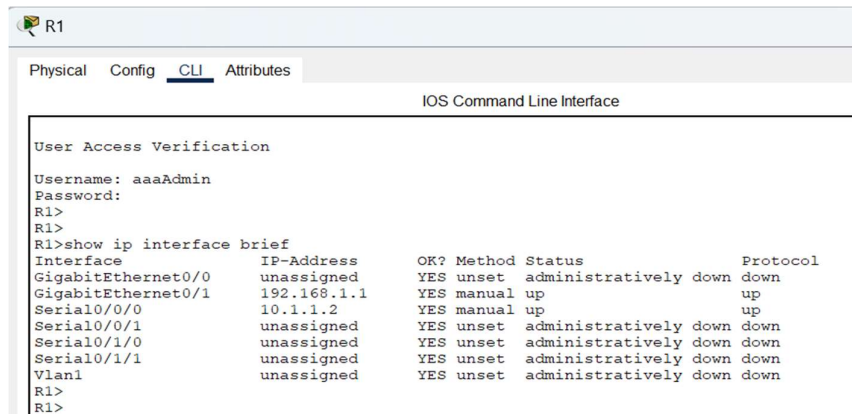
R3
Physical Config CLI Attributes
IOS Command Line Interface

Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/1
Router(config-if)#ip address 192.168.3.1 255.255.255.0
Router(config-if)#no shut
Router(config-if)#interface Serial0/0/1
Router(config-if)#ip address 10.2.2.2 255.255.255.252
Router(config-if)#^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
exit

```

### ➤ Displaying IP Address Details of Routers

#### 1. R1



```

R1
Physical Config CLI Attributes
IOS Command Line Interface

User Access Verification
Username: aaaAdmin
Password:
R1>
R1>
R1>show ip interface brief

```

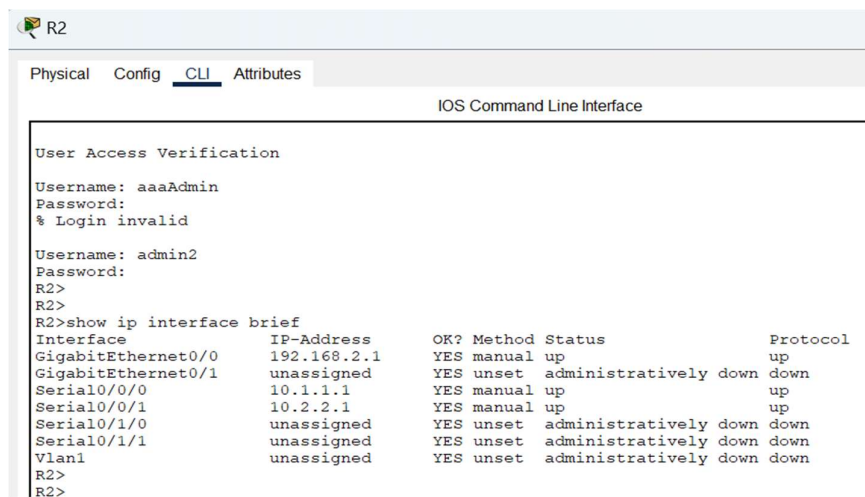
Interface	IP-Address	OK?	Method	Status	Protocol
GigabitEthernet0/0	unassigned	YES	unset	administratively down	down
GigabitEthernet0/1	192.168.1.1	YES	manual	up	up
Serial0/0/0	10.1.1.2	YES	manual	up	up
Serial0/0/1	unassigned	YES	unset	administratively down	down
Serial0/1/0	unassigned	YES	unset	administratively down	down
Serial0/1/1	unassigned	YES	unset	administratively down	down
Vlan1	unassigned	YES	unset	administratively down	down

```

R1>
R1>

```

#### 2. R2



```

R2
Physical Config CLI Attributes
IOS Command Line Interface

User Access Verification
Username: aaaAdmin
Password:
% Login invalid

Username: admin2
Password:
R2>
R2>
R2>show ip interface brief

```

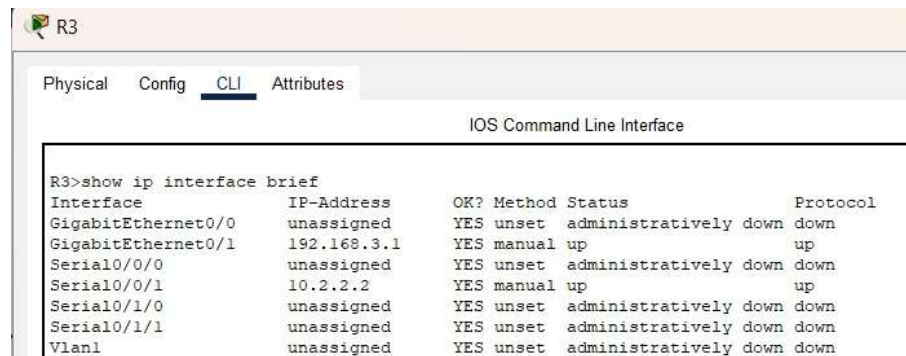
Interface	IP-Address	OK?	Method	Status	Protocol
GigabitEthernet0/0	192.168.2.1	YES	manual	up	up
GigabitEthernet0/1	unassigned	YES	unset	administratively down	down
Serial0/0/0	10.1.1.1	YES	manual	up	up
Serial0/0/1	10.2.2.1	YES	manual	up	up
Serial0/1/0	unassigned	YES	unset	administratively down	down
Serial0/1/1	unassigned	YES	unset	administratively down	down
Vlan1	unassigned	YES	unset	administratively down	down

```

R2>
R2>

```

### 3. R3



R3

Physical Config CLI Attributes

IOS Command Line Interface

```
R3>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0 unassigned      YES unset   administratively down down
GigabitEthernet0/1 192.168.3.1     YES manual   up          up
Serial0/0/0         unassigned      YES unset   administratively down down
Serial0/0/1         10.2.2.2        YES manual   up          up
Serial0/1/0         unassigned      YES unset   administratively down down
Serial0/1/1         unassigned      YES unset   administratively down down
Vlan1               unassigned      YES unset   administratively down down
```

## ➤ Configure RIP on routers

### 1. R1



R1

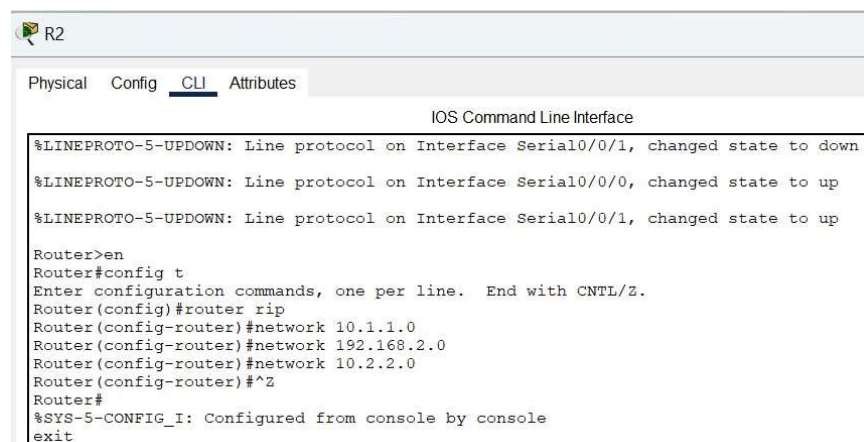
Physical Config CLI Attributes

IOS Command Line Interface

```
Press RETURN to get started!

Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 192.168.1.0
Router(config-router)#network 10.1.1.0
Router(config-router)#^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

### 2. R2



R2

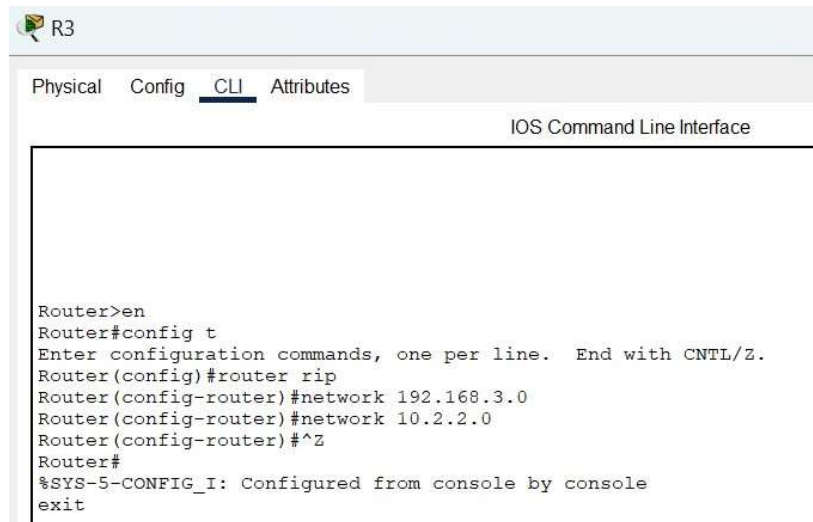
Physical Config CLI Attributes

IOS Command Line Interface

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1, changed state to up

Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 10.1.1.0
Router(config-router)#network 192.168.2.0
Router(config-router)#network 10.2.2.0
Router(config-router)#^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
exit
```

### 3. R3



The screenshot shows the CLI interface of router R3. The tabs at the top are Physical, Config, CLI (selected), and Attributes. The title bar says 'IOS Command Line Interface'. The command history shows the following sequence:

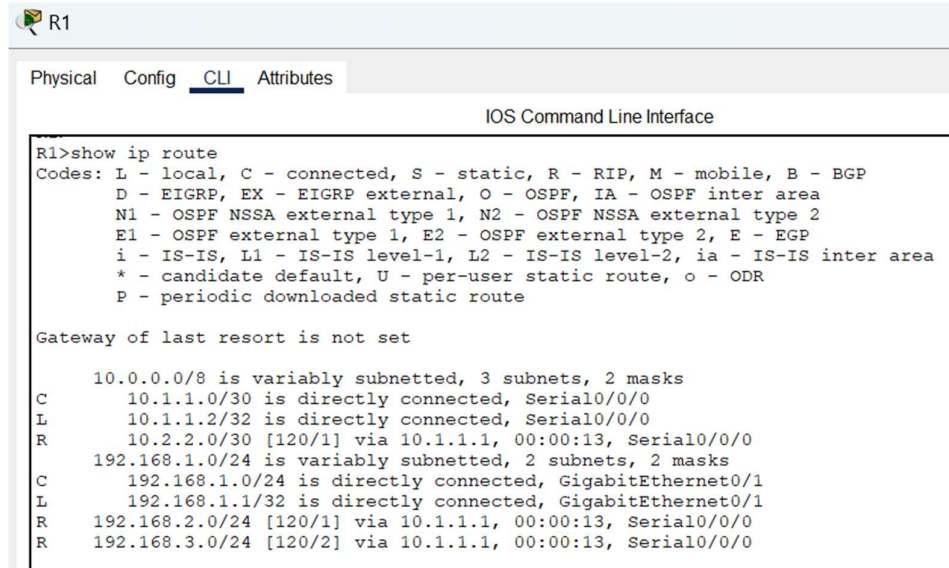
```

Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 192.168.3.0
Router(config-router)#network 10.2.2.0
Router(config-router)#^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
exit

```

## ➤ Displaying routing tables of routers

### 1. R1



The screenshot shows the CLI interface of router R1. The tabs at the top are Physical, Config, CLI (selected), and Attributes. The title bar says 'IOS Command Line Interface'. The command history shows the following sequence:

```

R1>show 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

      10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C       10.1.1.0/30 is directly connected, Serial0/0/0
L       10.1.1.2/32 is directly connected, Serial0/0/0
R       10.2.2.0/30 [120/1] via 10.1.1.1, 00:00:13, Serial0/0/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.1.0/24 is directly connected, GigabitEthernet0/1
L       192.168.1.1/32 is directly connected, GigabitEthernet0/1
R       192.168.2.0/24 [120/1] via 10.1.1.1, 00:00:13, Serial0/0/0
R       192.168.3.0/24 [120/2] via 10.1.1.1, 00:00:13, Serial0/0/0

```



## 2. R2

 R2
 

Physical Config CLI Attributes

IOS Command Line Interface


```

R2>show 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

    10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C       10.1.1.0/30 is directly connected, Serial0/0/0
L       10.1.1.1/32 is directly connected, Serial0/0/0
C       10.2.2.0/30 is directly connected, Serial0/0/1
L       10.2.2.1/32 is directly connected, Serial0/0/1
R       192.168.1.0/24 [120/1] via 10.1.1.2, 00:00:23, Serial0/0/0
        192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, GigabitEthernet0/0
L       192.168.2.1/32 is directly connected, GigabitEthernet0/0
R       192.168.3.0/24 [120/1] via 10.2.2.2, 00:00:22, Serial0/0/1
  
```

## 3. R3

 R3
 

Physical Config CLI Attributes

IOS Command Line Interface

```

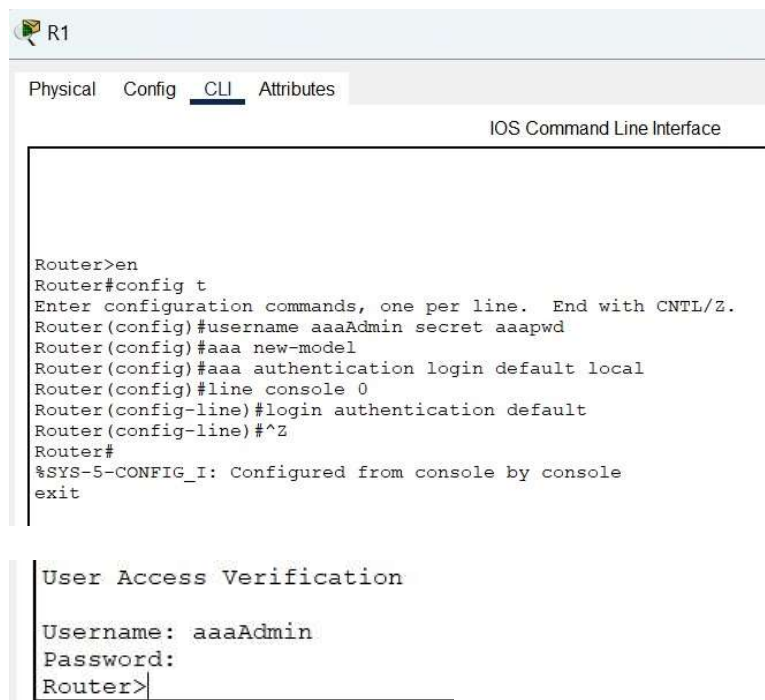
R3>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       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

    10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
R       10.1.1.0/30 [120/1] via 10.2.2.1, 00:00:21, Serial0/0/1
C       10.2.2.0/30 is directly connected, Serial0/0/1
L       10.2.2.2/32 is directly connected, Serial0/0/1
R       192.168.1.0/24 [120/2] via 10.2.2.1, 00:00:21, Serial0/0/1
R       192.168.2.0/24 [120/1] via 10.2.2.1, 00:00:21, Serial0/0/1
        192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.3.0/24 is directly connected, GigabitEthernet0/1
L       192.168.3.1/32 is directly connected, GigabitEthernet0/1
  
```

## ➤ Configure Local AAA Authentication for Console Line on R1

### 1. R1



The screenshot shows the R1 CLI interface with the 'CLI' tab selected. The command history shows the following steps:

```

Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#username aaaAdmin secret aaapwd
Router(config)#aaa new-model
Router(config)#aaa authentication login default local
Router(config)#line console 0
Router(config-line)#login authentication default
Router(config-line)#^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
exit

```

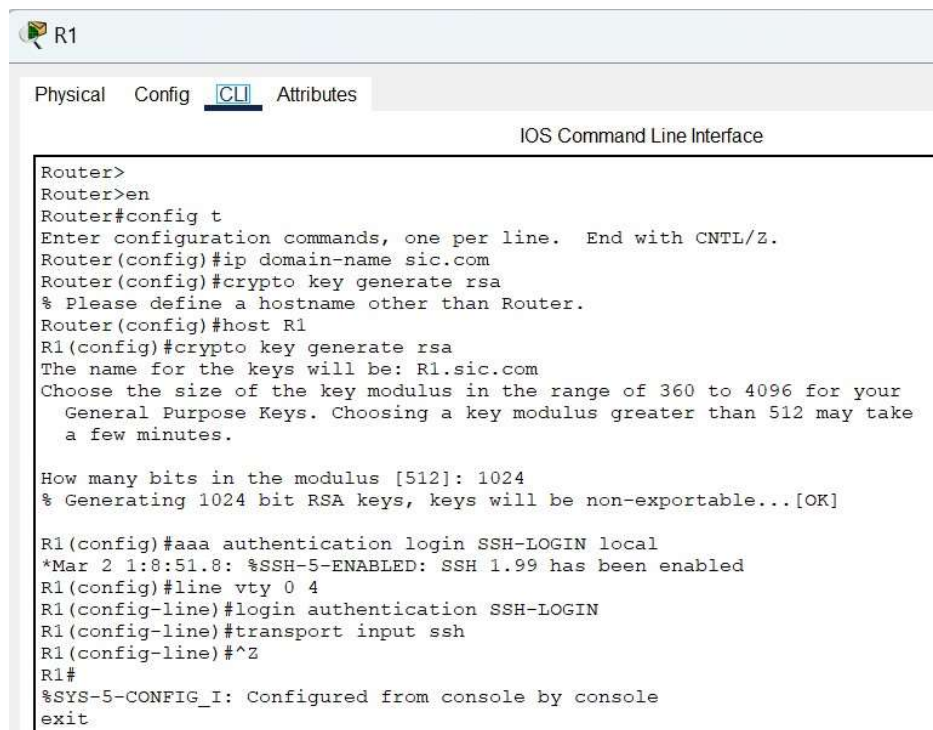
Below the command history, there is a 'User Access Verification' section showing the login process:

```

Username: aaaAdmin
Password:
Router>

```

## ➤ Configure Local AAA Authentication for vty Lines on R1



The screenshot shows the R1 CLI interface with the 'CLI' tab selected. The command history shows the following steps:

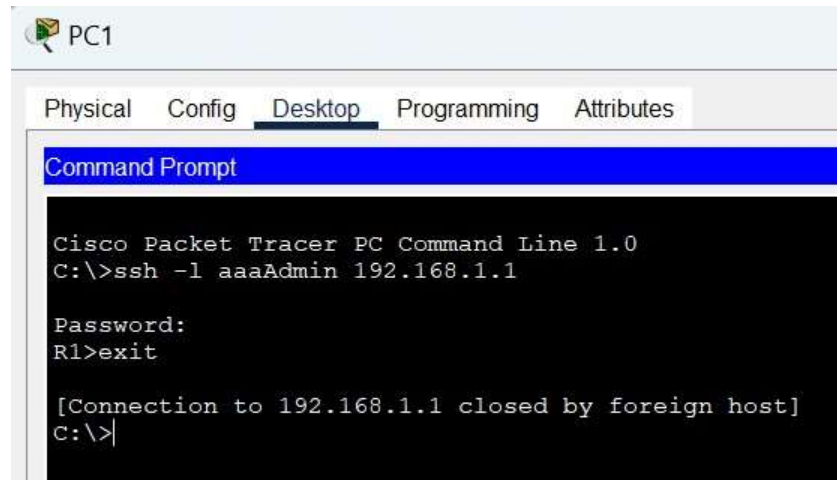
```

Router>
Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip domain-name sic.com
Router(config)#crypto key generate rsa
% Please define a hostname other than Router.
Router(config)#host R1
R1(config)#crypto key generate rsa
The name for the keys will be: R1.sic.com
Choose the size of the key modulus in the range of 360 to 4096 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take
a few minutes.
How many bits in the modulus [512]: 1024
% Generating 1024 bit RSA keys, keys will be non-exportable...[OK]

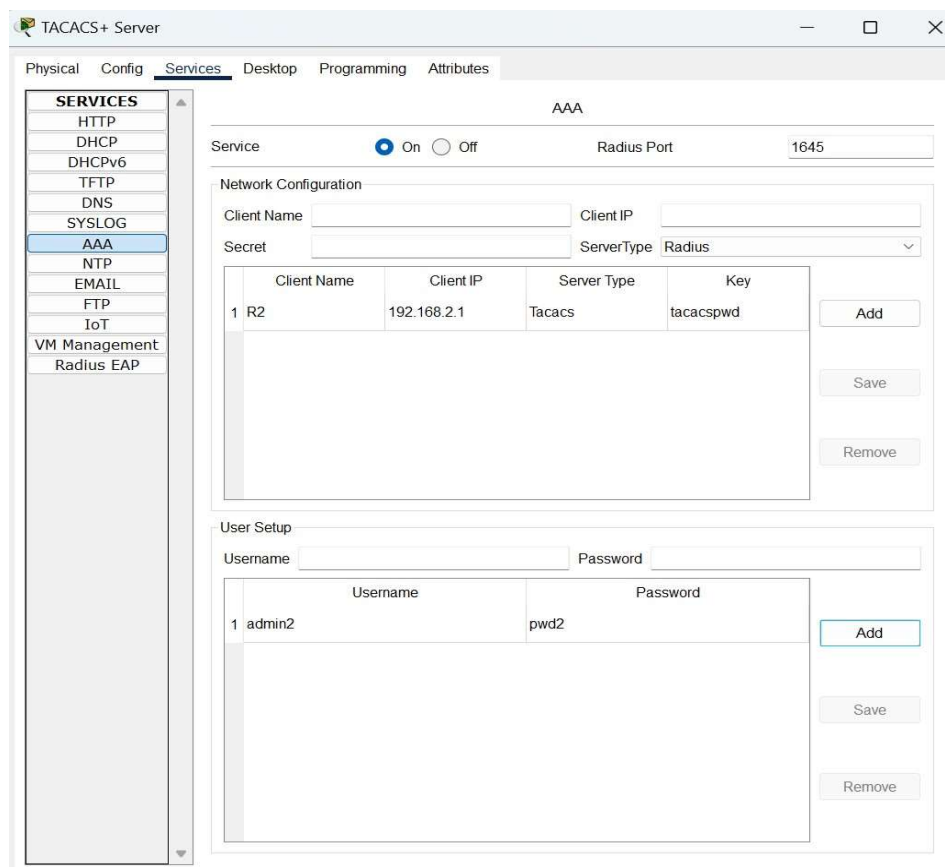
R1(config)#aaa authentication login SSH-LOGIN local
*Mar 2 1:8:51.8: %SSH-5-ENABLED: SSH 1.99 has been enabled
R1(config)#line vty 0 4
R1(config-line)#login authentication SSH-LOGIN
R1(config-line)#transport input ssh
R1(config-line)#^Z
R1#
%SYS-5-CONFIG_I: Configured from console by console
exit

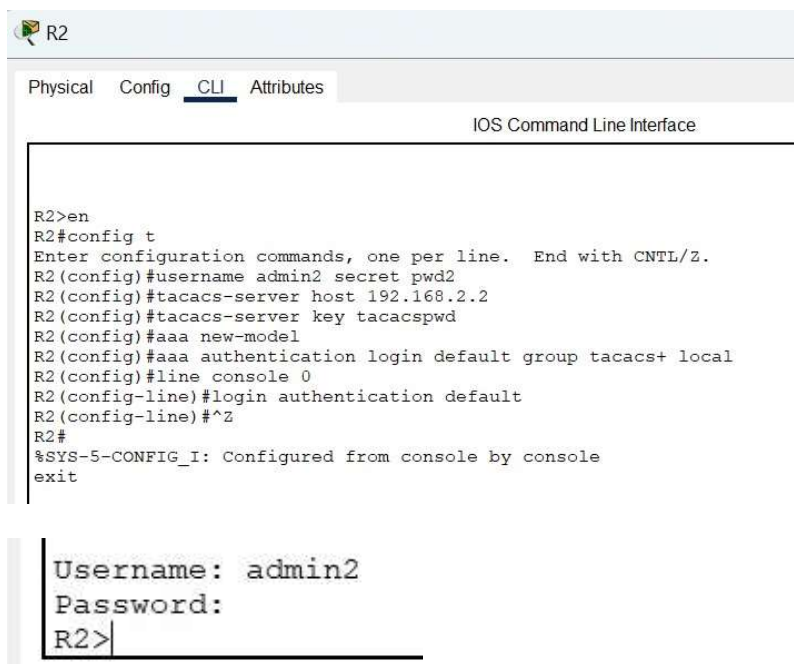
```



**PC1**

➤ **Configure Server-Based AAA Authentication Using TACACS+ on R2**





R2

Physical Config **CLI** Attributes

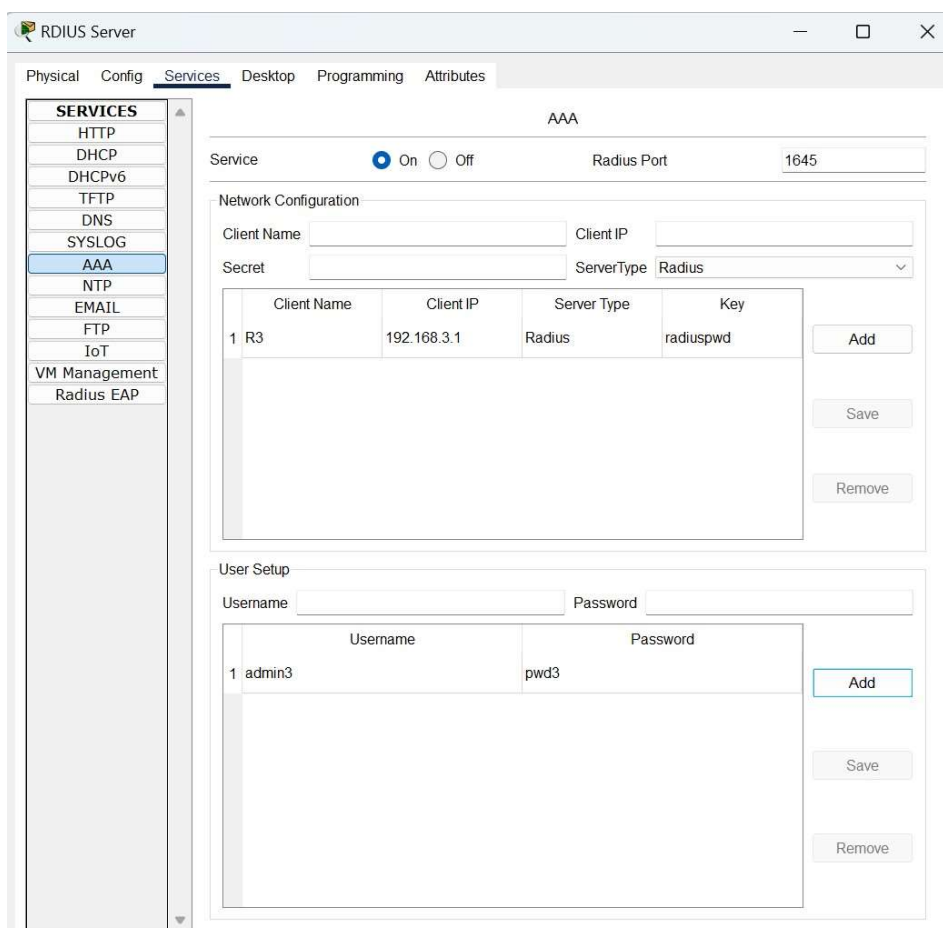
IOS Command Line Interface

```

R2>en
R2#config t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#username admin2 secret pwd2
R2(config)#tacacs-server host 192.168.2.2
R2(config)#tacacs-server key tacacspwd
R2(config)#aaa new-model
R2(config)#aaa authentication login default group tacacs+ local
R2(config)#line console 0
R2(config-line)#login authentication default
R2(config-line)#^Z
R2#
%SYS-5-CONFIG_I: Configured from console by console
exit
  
```

Username: admin2  
Password:  
R2>

### ➤ Configure Server-Based AAA Authentication Using RADIUS on R3



RADIUS Server

Physical Config **Services** Desktop Programming Attributes

**SERVICES**

- HTTP
- DHCP
- DHCPv6
- TFTP
- DNS
- SYSLOG
- AAA**
- NTP
- EMAIL
- FTP
- IoT
- VM Management
- Radius EAP

**AAA**

Service ☒ On ☐ Off Radius Port 1645

**Network Configuration**

Client Name  Client IP

Secret  ServerType Radius

	Client Name	Client IP	Server Type	Key	
1	R3	192.168.3.1	Radius	radiuspwd	Add

Save Remove

**User Setup**

Username  Password

	Username	Password	
1	admin3	pwd3	Add

Save Remove

```

R3
Physical Config CLI Attributes
IOS Command Line Interface

R3>en
R3#config t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#username admin3 secret pwd3
R3(config)#radius-server host 192.168.3.2
R3(config)#radius-server key radiuspwd
R3(config)#aaa new-model
R3(config)#aaa authentication login default group radius local
R3(config)#line console 0
R3(config-line)#login authentication default
R3(config-line)#^Z
R3#
%SYS-5-CONFIG_I: Configured from console by console
exit

```

## User Access Verification

Username: admin3

Password:

