

实验8：PPPoE服务器的配置和应用

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实验要求

PPPoE服务器配置和应用实验在虚拟仿真环境下完成，要求如下：

(1) 仿真有线局域网接入互联网的场景，正确配置PPPoE服务器的认证协议、地址池、虚拟模板和物理接口，使内网用户经认证后才能正常访问外部互联网。

(2) 仿真家庭网络中，无线和有线终端（主机、智能电话等）连入小型路由器，由小型路由器统一接入互联网服务运营商PPPoE服务器的场景。对小型路由器和PPPoE服务器进行设置，使家庭网络中的用户经认证后才能正常访问外部互联网。

实验过程

关于PPPoE协议：

制定PPPoE协议的主要目的是希望在以太网上为每一个用户建立一条类似于点到点的通信链路，以方便对以太网用户进行控制。为此，整个PPPoE协议分成了发现和PPP会话两个阶段。其中发现阶段在以太网用户与PPPoE服务器之间建立一条点到点的会话连接，PPP会话阶段利用这些点到点的会话连接传送PPP数据。

PPPoE的建立有两个主要阶段：

发现阶段：这一阶段包括客户端（PPPoE客户端或者拨号者）在网络中查找PPPoE服务器的过程。它在

PPPoE会话发现：客户端向目标服务器发送PADI数据包，以发现位于网络中的PPPoE服务器。

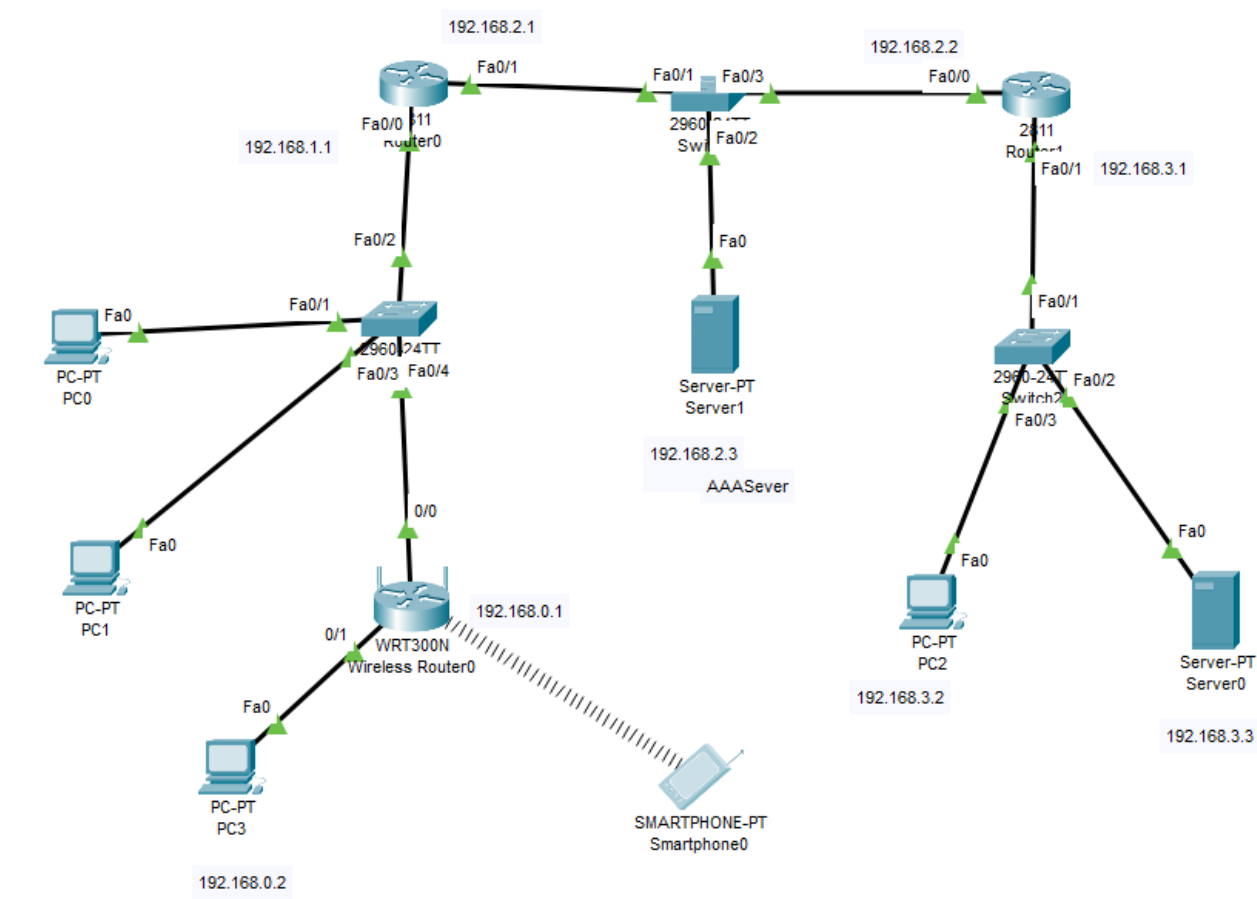
PPPoE服务器的响应：服务器收到PADI请求后，会发送PADO数据包，向客户端提供可用的连接服

会话阶段：在发现阶段之后，客户端与服务器之间建立实际的会话连接。这个阶段包括以下步骤：

PPPoE会话建立：客户端发送PADR数据包，选择合适的服务器以建立连接。


PPPoE服务器确认：服务器收到PADR请求后，会发送PADS数据包，确认连接的建立，开始PPP会话

网络拓扑图如下：



基本配置

按照上图连接网络，配置除PC0和PC1以外的设备的IP地址和路由器的路由表，启动Server-PT的WEB服务。因为PPPoE接入服务器会在PC0和PC1接入时自动为它们分配IP地址，所以在此可不对PC0和PC1的IP地址进行配置。

 Router0

Physical

Config

CLI

Attributes

IOS Command Line Interface

```
Enter interface name used to connect to the
management network from the above interface summary:
% No defaulting allowed
Enter interface name used to connect to the
management network from the above interface summary:
% No defaulting allowed
Enter interface name used to connect to the
management network from the above interface summary:
% No defaulting allowed
Enter interface name used to connect to the
management network from the above interface summary:
% No defaulting allowed
Enter interface name used to connect to the
management network from the above interface summary:
% No defaulting allowed

Press RETURN to get started!

Router>enable
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#exit
Router(config)#interface fa0/0
Router(config-if)#ip address 192.168.1.1
% Incomplete command.
Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#
```

Copy

Paste

☐ Top

Router1

PhysicalConfigCLIAttributes

IOS Command Line Interface

Press RETURN to get started!

Press RETURN to get started!

Router>enable
Router#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface fa0/0
Router(config-if)#ip address 192.168.2.2 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#interface fa0/1
Router(config-if)#ip address 192.168.3.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

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

Router(config-if)#exit
Router(config)#

CopyPaste

Top

Router0

Physical Config CLI Attributes

IOS Command Line Interface

management network from the above interface summary:

Press RETURN to get started!

```
Router>enable
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#exit
Router(config)#interface fa0/0
Router(config-if)#ip address 192.168.1.1
% Incomplete command.
Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#interface fa0/1
Router(config-if)#ip address 192.168.2.1 255.255.255.0
Router(config-if)#no shutdown

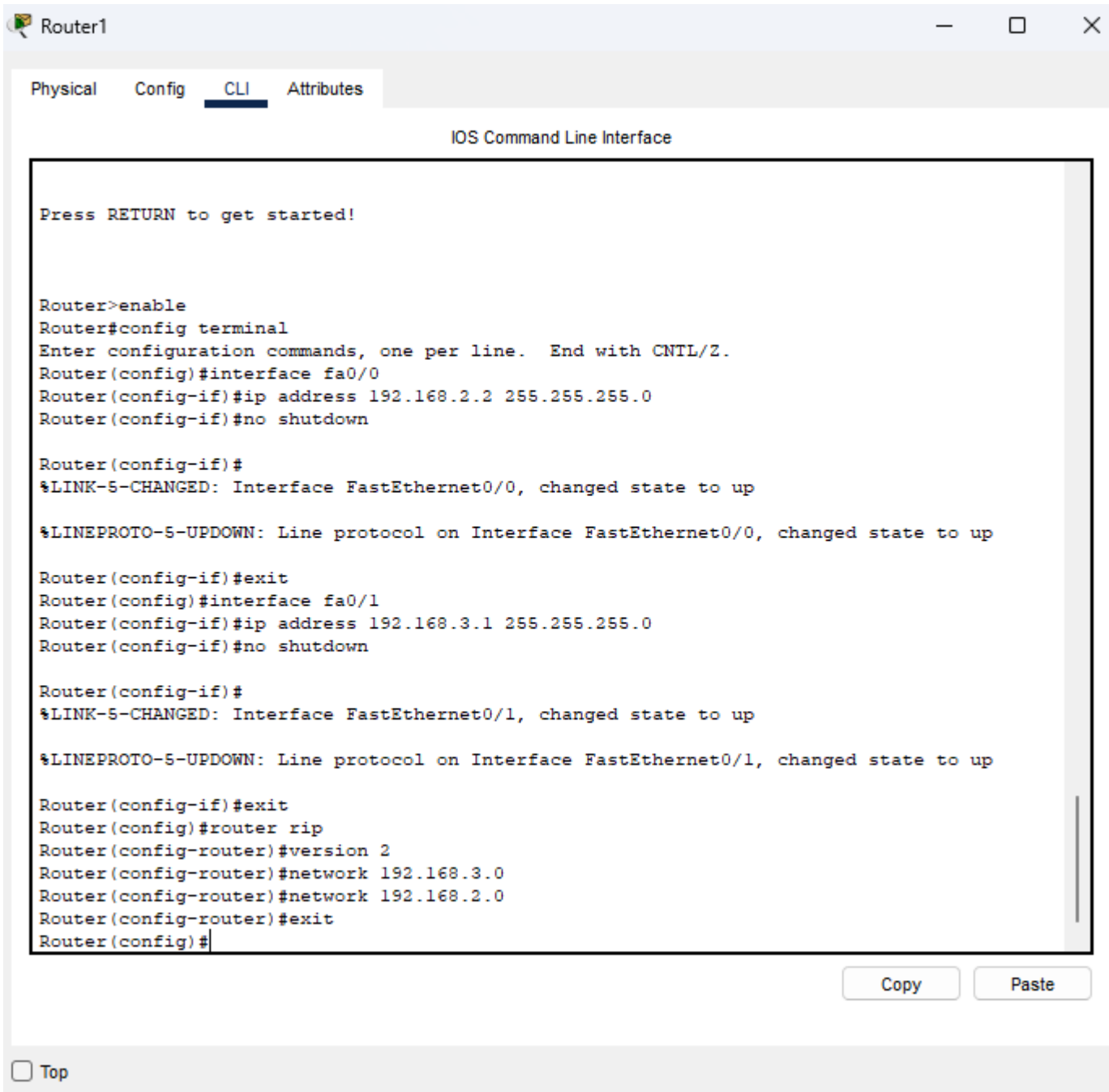
Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

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

Router(config-if)#exit
Router(config)#
```

Copy Paste

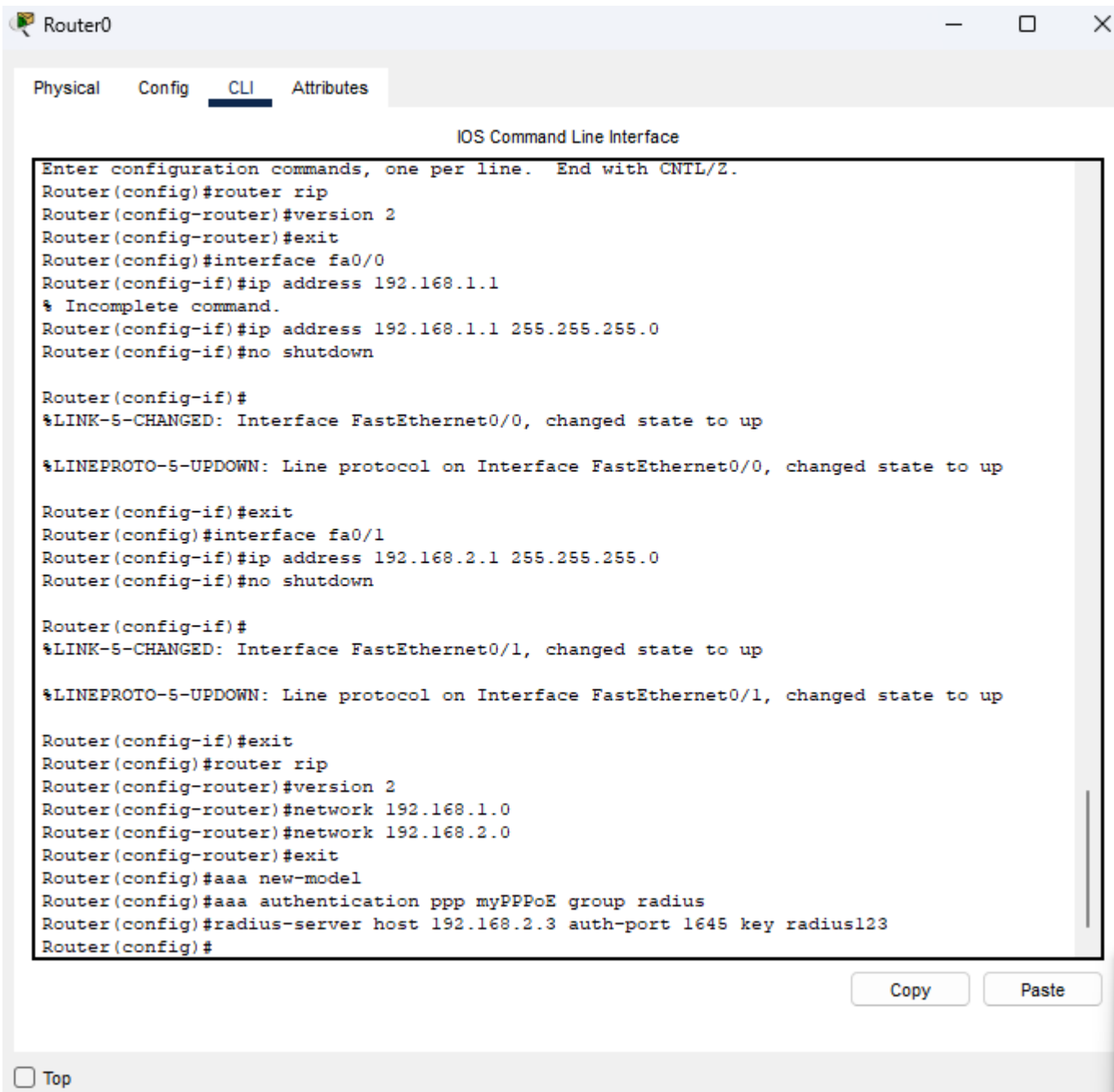
☐ Top



配置认证协议和用户

为了鉴别接入用户的合法性，需要在接入服务器启动和配置认证服务。在Cisco路由器中，aaa命令是在全局配置模式下使用的命令，用于认证、授权和计费服务的相关设置。

在Router的全局配置模式下使用如下命令配置PPPoE服务器的认证方式，启动认证、授权和计费服务，建立一个标号为myPPPoE的认证方式，使用的是协议radius：



The screenshot shows a window titled "Router0" with tabs for "Physical", "Config", "CLI", and "Attributes". The "CLI" tab is active, displaying the "IOS Command Line Interface". The terminal text is as follows:

```
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#exit
Router(config)#interface fa0/0
Router(config-if)#ip address 192.168.1.1
% Incomplete command.
Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#interface fa0/1
Router(config-if)#ip address 192.168.2.1 255.255.255.0
Router(config-if)#no shutdown

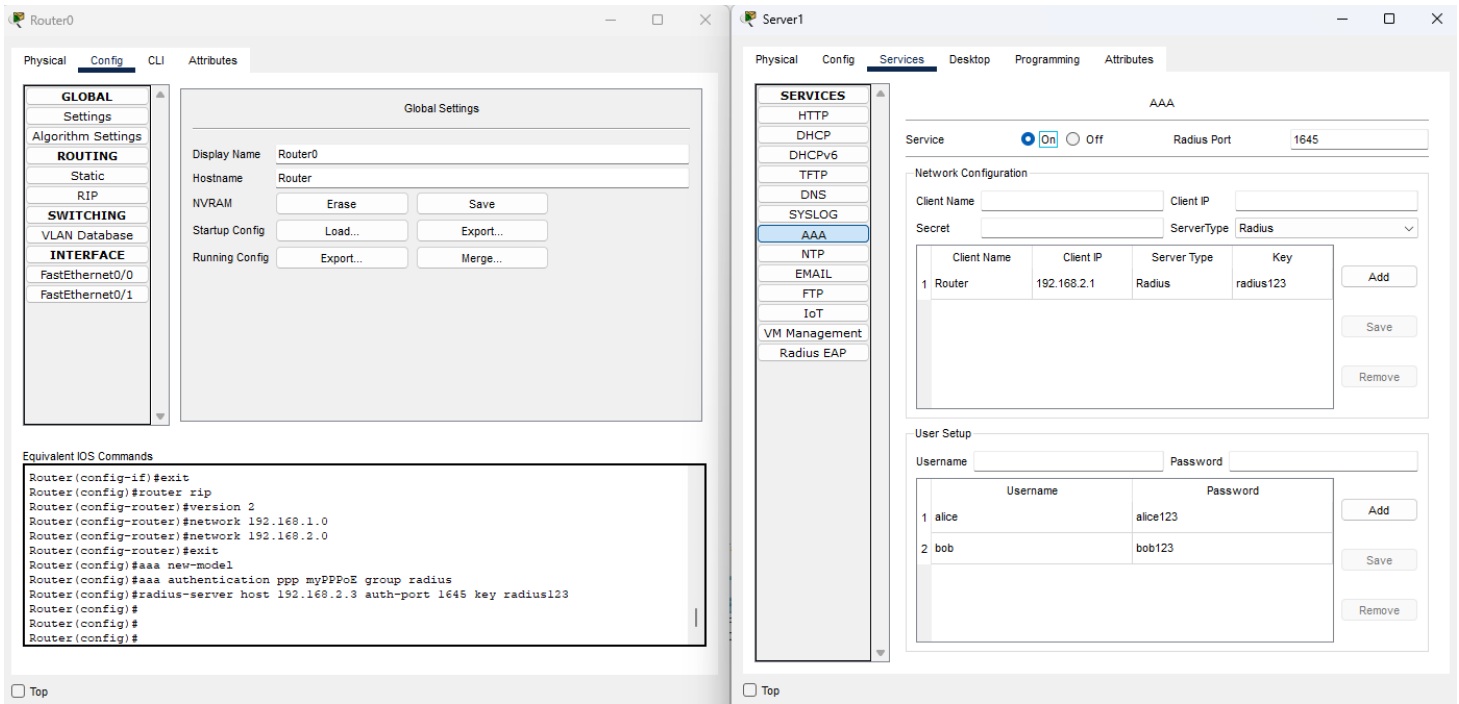
Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

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

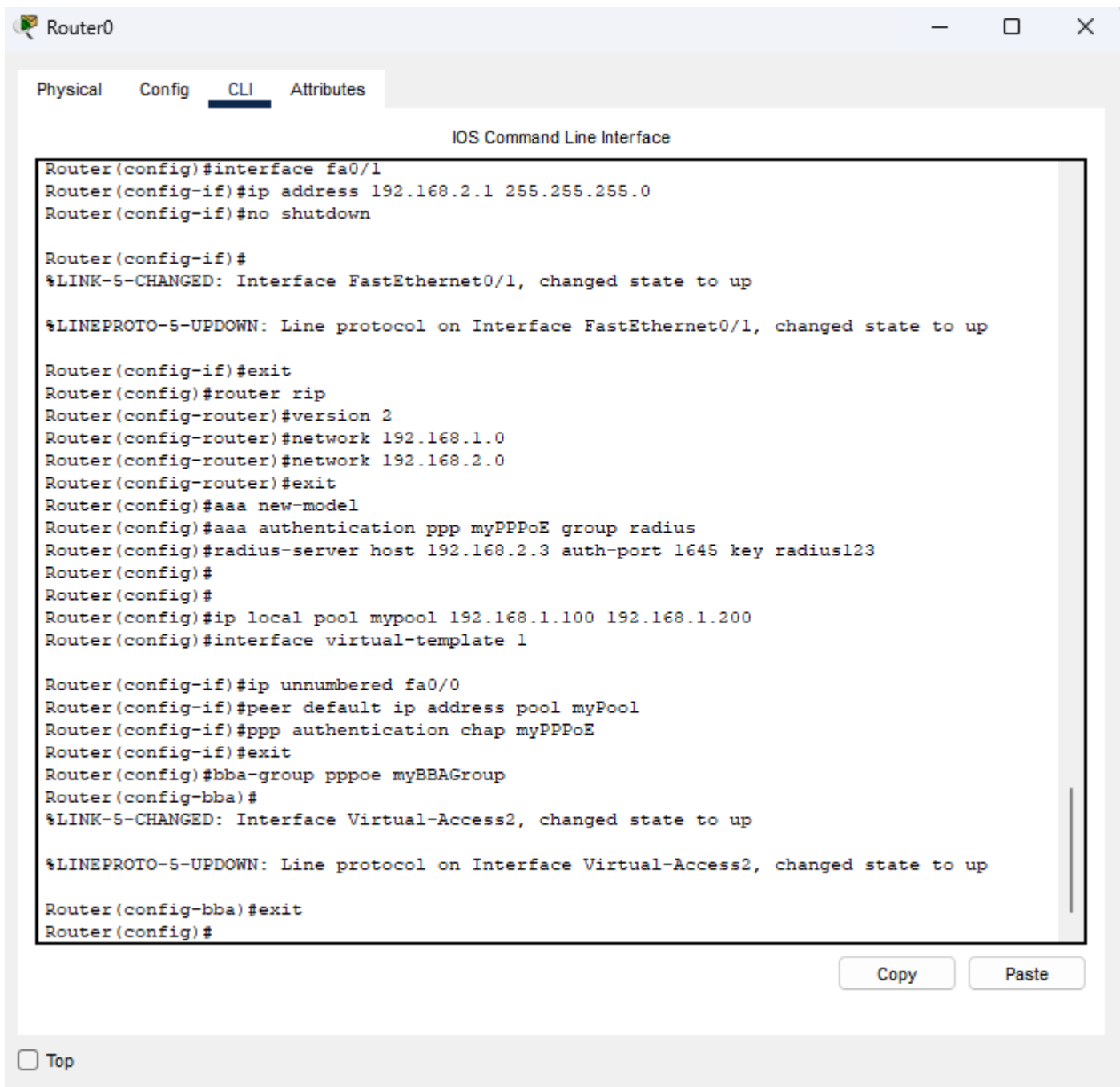
Router(config-if)#exit
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#network 192.168.1.0
Router(config-router)#network 192.168.2.0
Router(config-router)#exit
Router(config)#aaa new-model
Router(config)#aaa authentication ppp myPPPoE group radius
Router(config)#radius-server host 192.168.2.3 auth-port 1645 key radius123
Router(config)#
```

At the bottom right of the CLI window, there are "Copy" and "Paste" buttons. At the bottom left, there is a "Top" button.

- `aaa new-model` 用于启动路由器的认证、授权和计费服务
- `aaa authentication ppp myPPPoE group radius` 建立了一个标号为myPPPoE的认证方式，myPPPoE可以对ppp接入进行认证，并且在认证时采用本地（local）方式，即用户在登录PPPoE服务器时的用户名和密码都保存到本地路由器本地。
- `radius-server host 192.168.2.3 auth-port 1645 key radius123` 配置AAA服务器，启动AAA服务，端口设置为1645，客户端为Router0的名字Router，输入IP、密码和类型，添加。创建alice和bob两个用户，他们的密码分别为alice123和bob123。



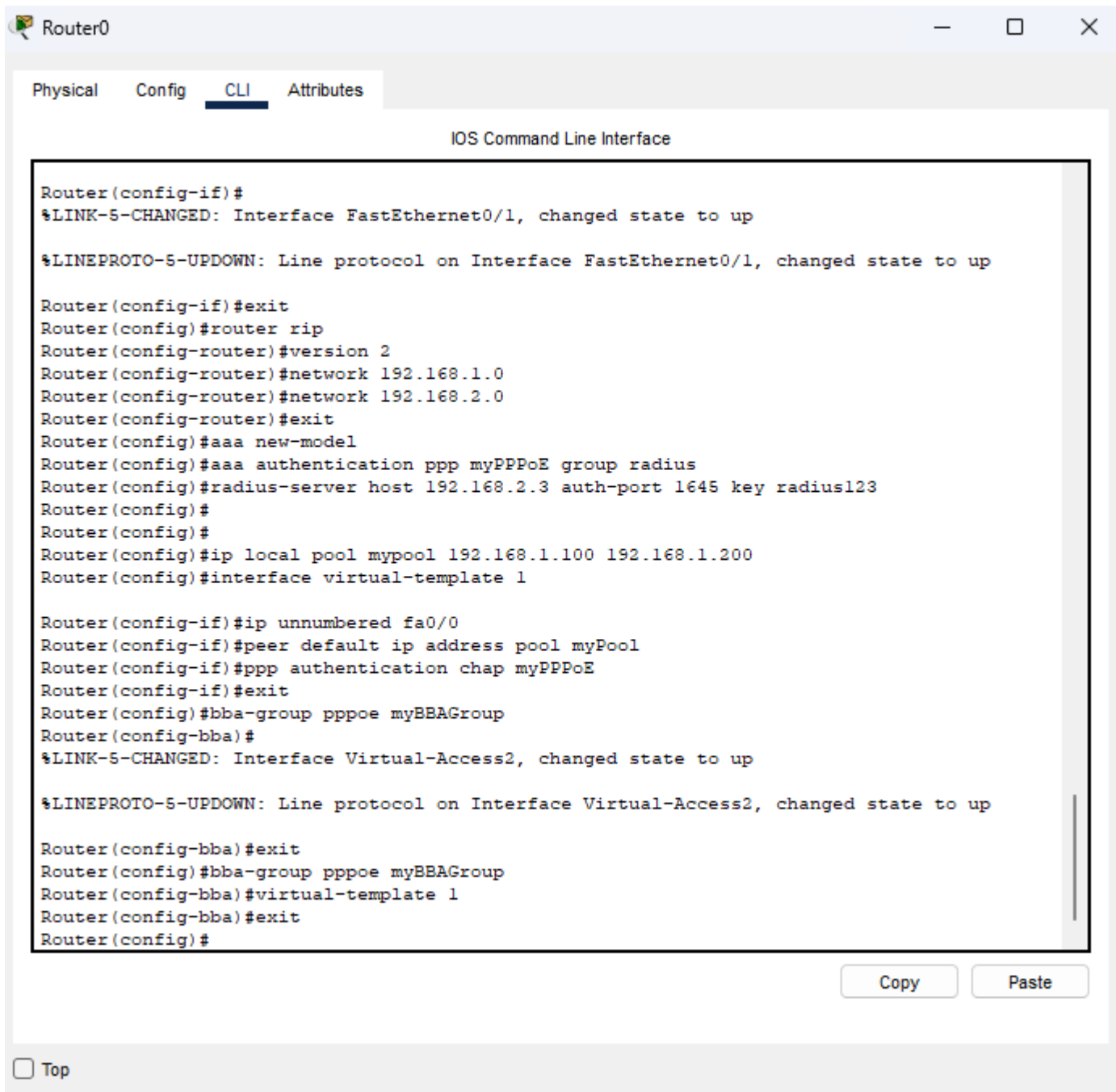
建立一个地址池，用于指定分配给登陆用户的IP地址范围。在全局模式下使用 ip local pool MyPool 192.168.1.100 192.168.1.200 配置地址池



配置虚拟模板

网络设备中通常具有接口，通过接口连接网络或其他设备。网络接口可以进行配置，使用PPPoE服务时，PPPoE服务器会为每个请求接入的用户创建一个“逻辑”接口，让用户感觉他们连入了一个真实存在的接口。每次用户请求PPPoE服务时，PPPoE服务器都会按照一个虚拟模板创建新的逻辑接口，该虚拟模板规定了每次创建的新逻辑接口使用的IP地址，为对方分配的IP地址池等通用参数。使用如下命令配置虚拟接口模板：

```
interface virtual-template 1
ip unnumbered fa0/0
peer default ip address pool myPool
ppp authentication chap myPPPoE
exit
```



```
Router0
Physical Config CLI Attributes
IOS Command Line Interface

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

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

Router(config-if)#exit
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#network 192.168.1.0
Router(config-router)#network 192.168.2.0
Router(config-router)#exit
Router(config)#aaa new-model
Router(config)#aaa authentication ppp myPPPoE group radius
Router(config)#radius-server host 192.168.2.3 auth-port 1645 key radius123
Router(config)#
Router(config)#
Router(config)#ip local pool mypool 192.168.1.100 192.168.1.200
Router(config)#interface virtual-template 1

Router(config-if)#ip unnumbered fa0/0
Router(config-if)#peer default ip address pool myPool
Router(config-if)#ppp authentication chap myPPPoE
Router(config-if)#exit
Router(config)#bba-group pppoe myBBAGroup
Router(config-bba)#
%LINK-5-CHANGED: Interface Virtual-Access2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Virtual-Access2, changed state to up

Router(config-bba)#exit
Router(config)#bba-group pppoe myBBAGroup
Router(config-bba)#virtual-template 1
Router(config-bba)#exit
Router(config)#

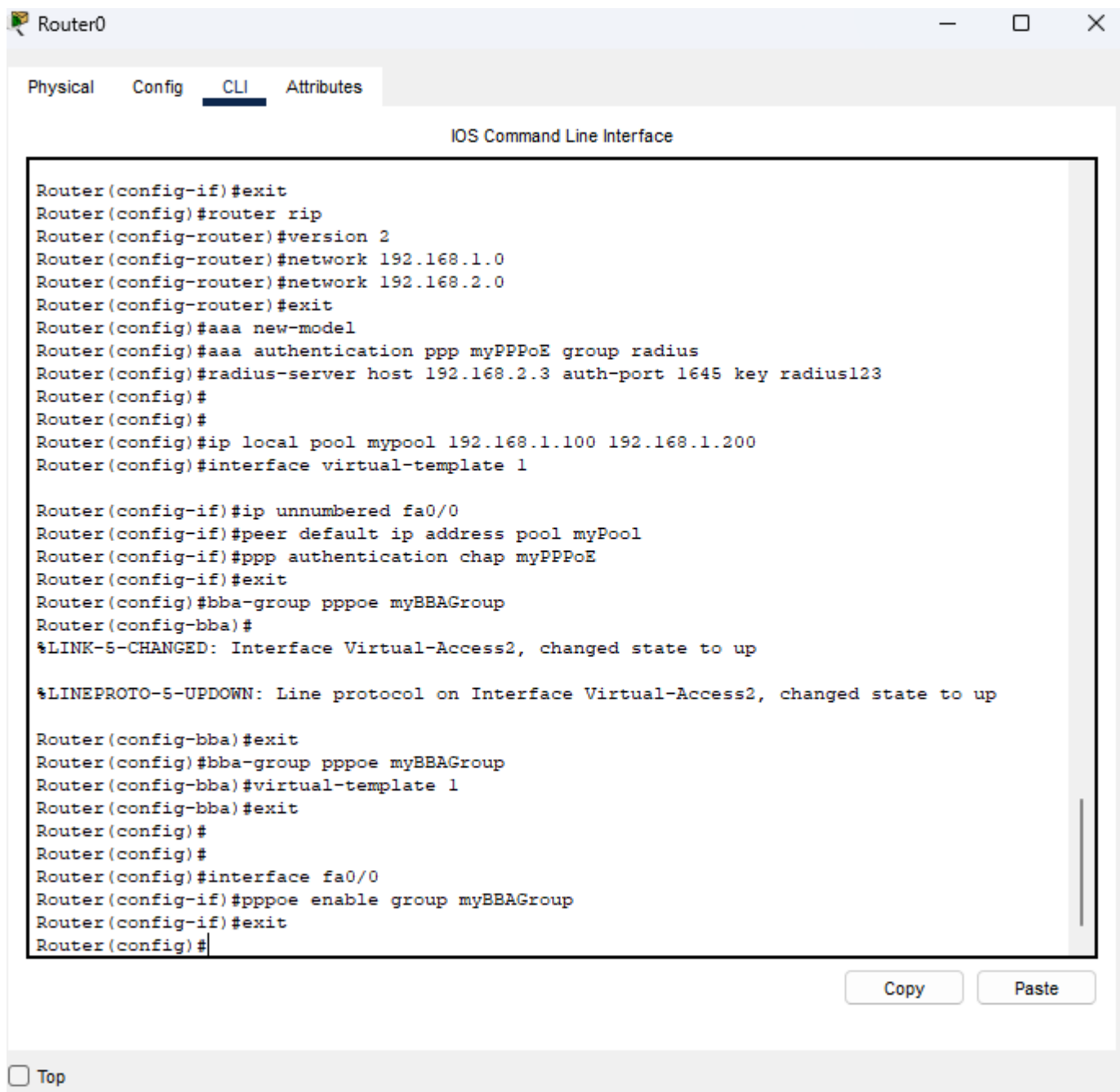
Copy Paste

Top
```

创建配置BBA组

使用如下命令：

```
bba-group pppoe myBBAGroup
virtual-template 1
exit
```



The screenshot shows the Router0 CLI interface with the following configuration commands entered:

```
Router(config-if)#exit
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#network 192.168.1.0
Router(config-router)#network 192.168.2.0
Router(config-router)#exit
Router(config)#aaa new-model
Router(config)#aaa authentication ppp myPPPoE group radius
Router(config)#radius-server host 192.168.2.3 auth-port 1645 key radius123
Router(config)#
Router(config)#
Router(config)#ip local pool mypool 192.168.1.100 192.168.1.200
Router(config)#interface virtual-template 1

Router(config-if)#ip unnumbered fa0/0
Router(config-if)#peer default ip address pool myPool
Router(config-if)#ppp authentication chap myPPPoE
Router(config-if)#exit
Router(config)#bba-group pppoe myBBAGroup
Router(config-bba)#
%LINK-5-CHANGED: Interface Virtual-Access2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Virtual-Access2, changed state to up

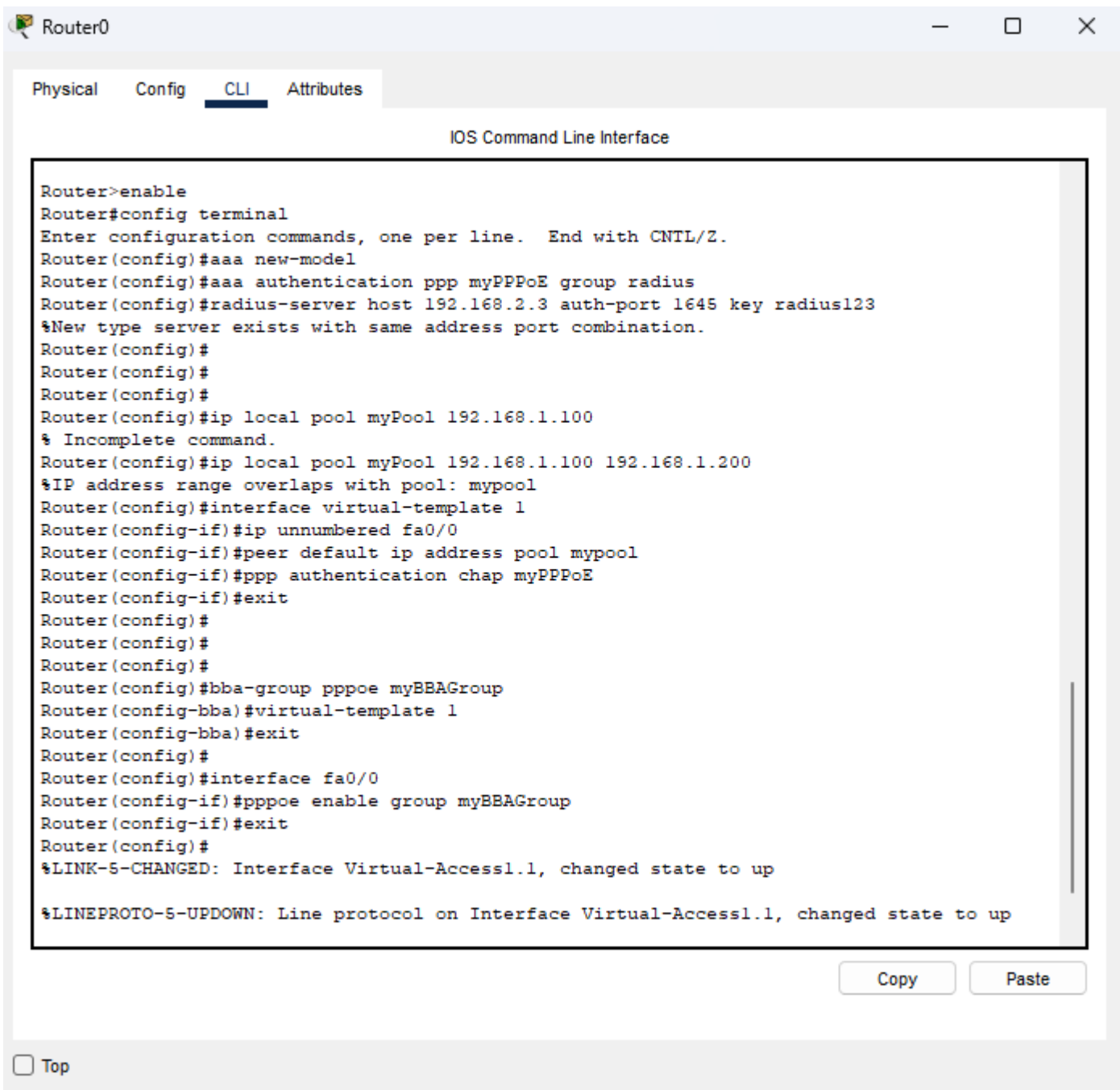
Router(config-bba)#exit
Router(config)#bba-group pppoe myBBAGroup
Router(config-bba)#virtual-template 1
Router(config-bba)#exit
Router(config)#
Router(config)#
Router(config)#interface fa0/0
Router(config-if)#pppoe enable group myBBAGroup
Router(config-if)#exit
Router(config)#
```

At the bottom of the CLI window, there are "Copy" and "Paste" buttons, and a "Top" link.

配置物理接口

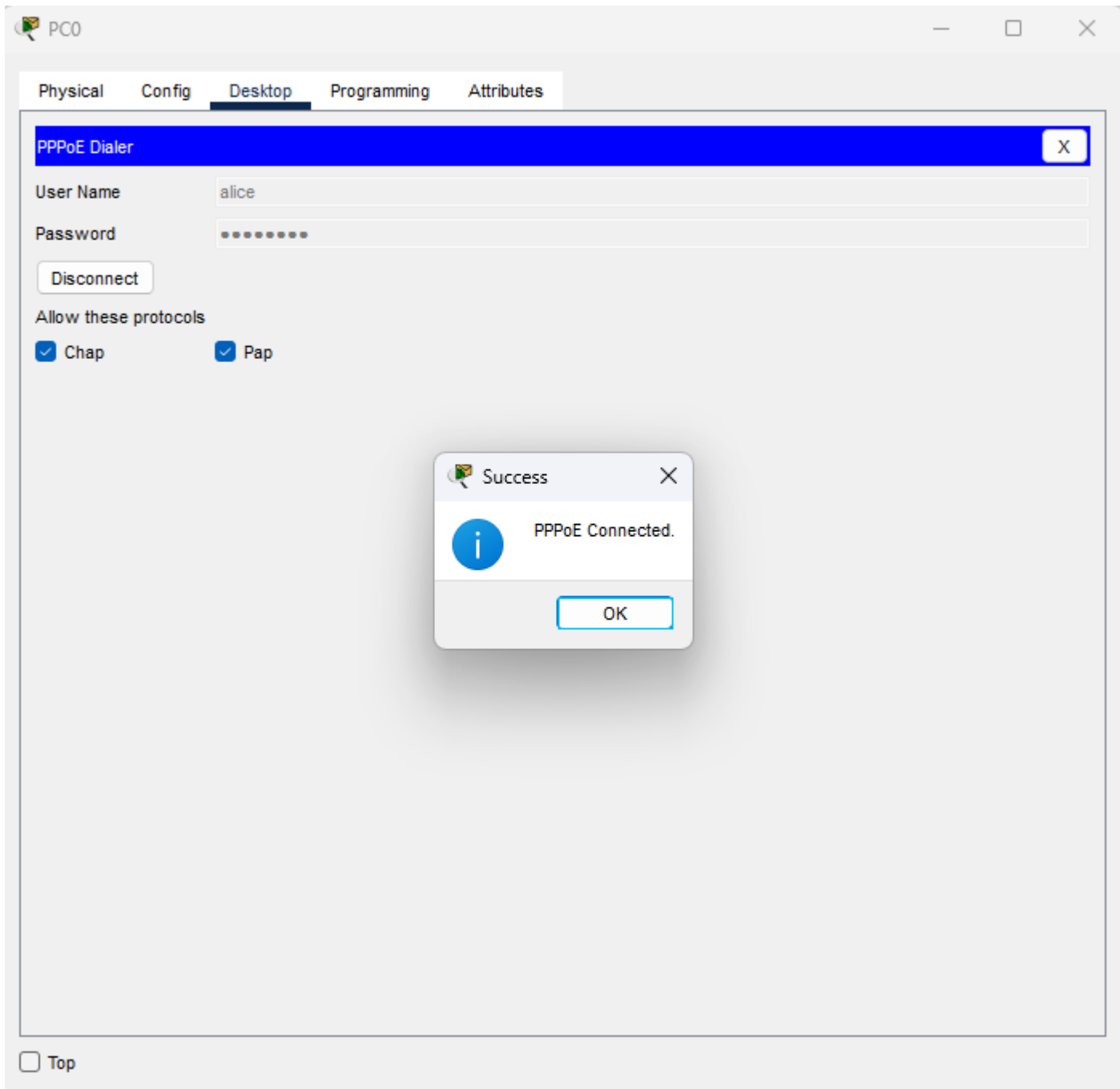
PPPoE协议最终要运行在一个物理接口上，因此需要在发送、接收PPPoE报文的接口上启动PPPoE功能。在Router0中配置物理接口的命令如下：

```
interface fa0/0
pppoe enable group myBBAGroup
```



验证配置的PPPoE接入服务器

用PC0进行PPPoE拨号功能，输入用户名alice和密码alice123，连接成功，可以使用外网的服务。尝试用PC0 ping 外网一台主机，成功；浏览一台Web服务器，也成功。



验证测试

PC0 ping PC2

PC0

Physical

Config

Desktop

Programming

Attributes

Command Prompt

X

```
Reply from 192.168.2.2: bytes=32 time<1ms TTL=254
Reply from 192.168.2.2: bytes=32 time=1ms TTL=254

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.3.1

Pinging 192.168.3.1 with 32 bytes of data:

Reply from 192.168.3.1: bytes=32 time<1ms TTL=254
Reply from 192.168.3.1: bytes=32 time=1ms TTL=254
Reply from 192.168.3.1: bytes=32 time<1ms TTL=254
Reply from 192.168.3.1: bytes=32 time=1ms TTL=254

Ping statistics for 192.168.3.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.3.2

Pinging 192.168.3.2 with 32 bytes of data:

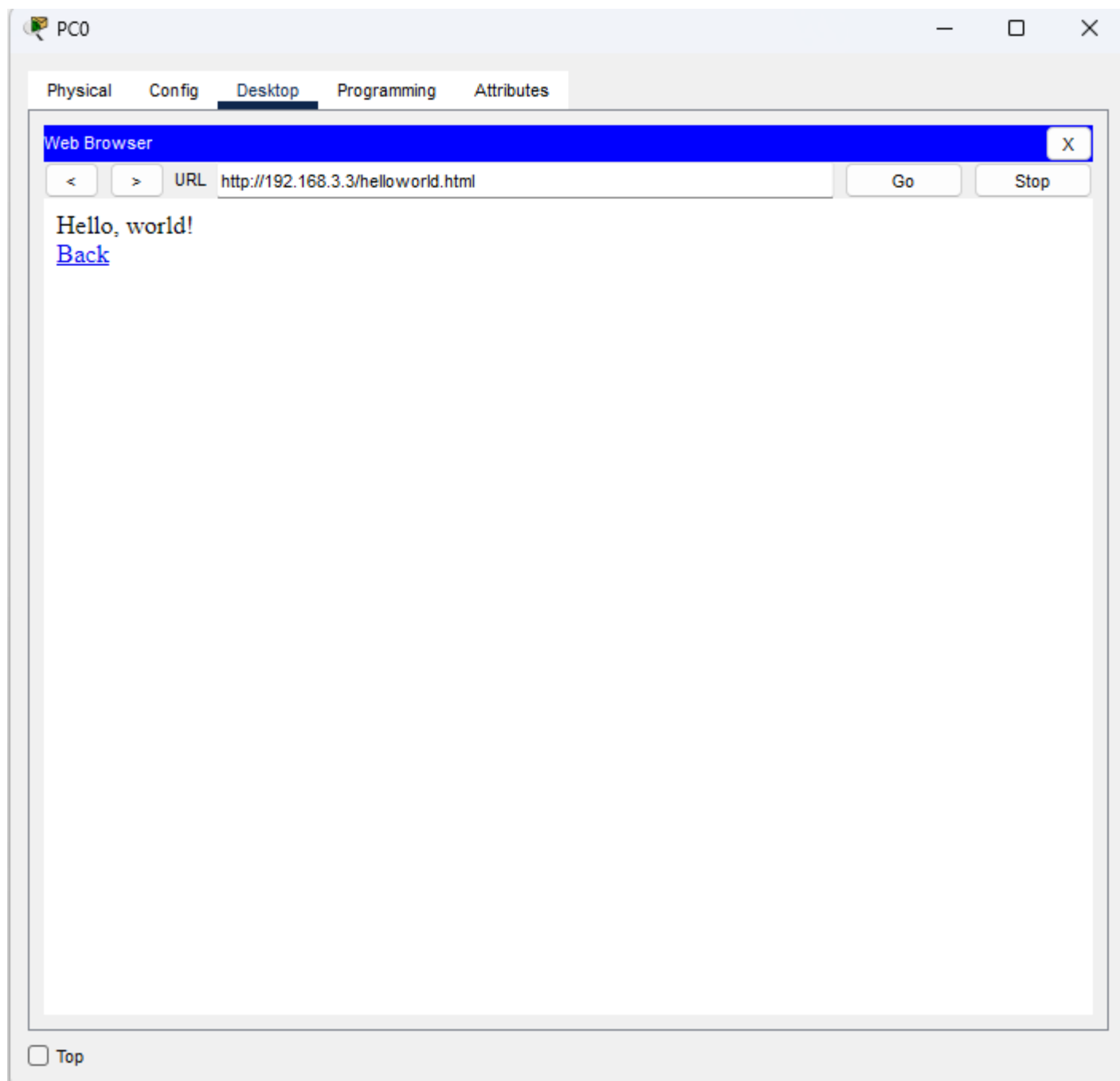
Reply from 192.168.3.2: bytes=32 time<1ms TTL=126
Reply from 192.168.3.2: bytes=32 time=15ms TTL=126
Reply from 192.168.3.2: bytes=32 time=1ms TTL=126
Reply from 192.168.3.2: bytes=32 time=1ms TTL=126

Ping statistics for 192.168.3.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 15ms, Average = 4ms

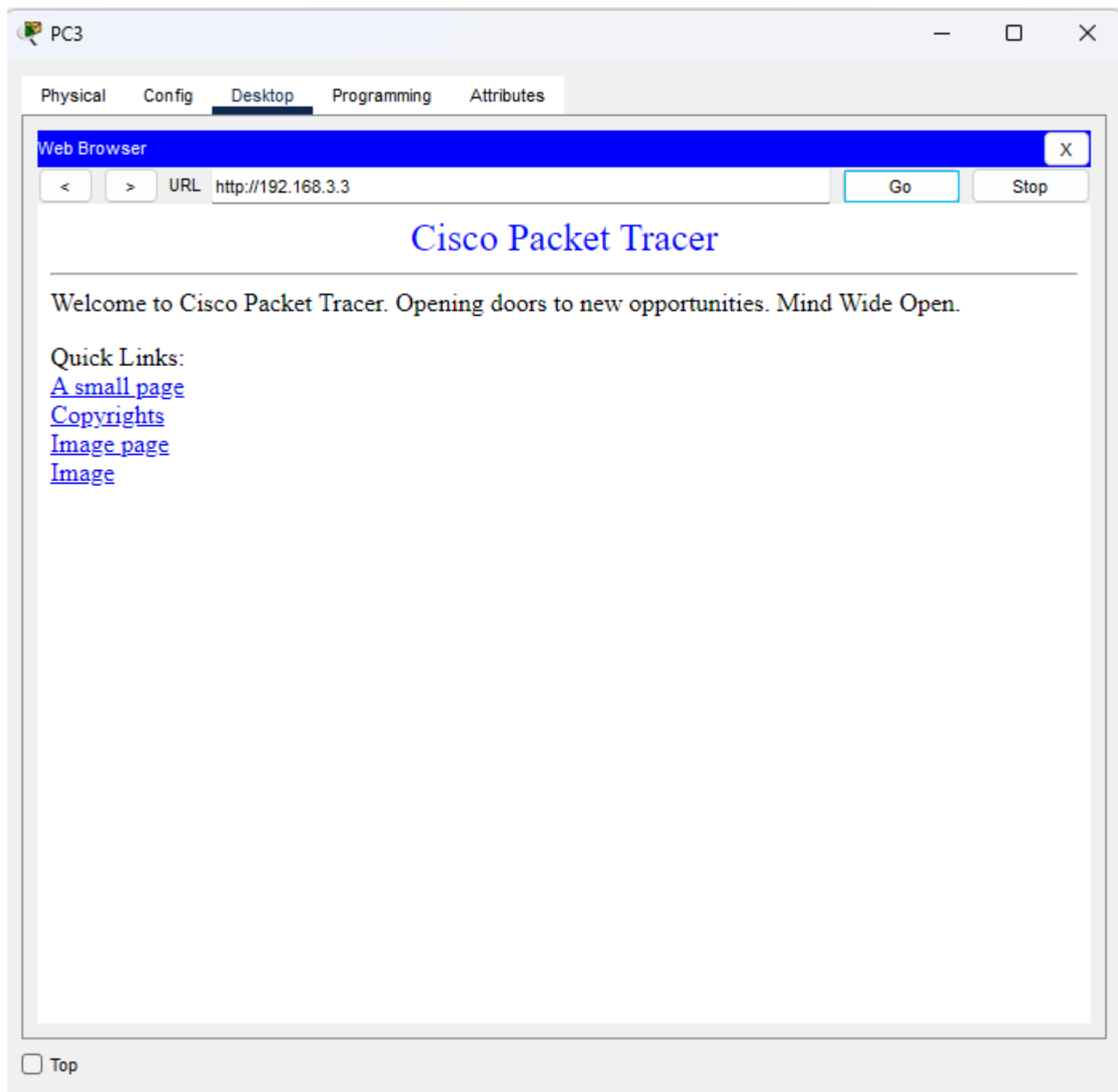
C:\>ping 192.168.3.2
```

☐ Top

PC0 访问 server0 的web服务



PC3 访问 server0 的web服务



手机访问 server0 的web服务

