实验 19：无线网络组网实验

姓名	学号	合作学生	指导教师	实验地点	实验时间
林继申	2250758	无	陈伟超	济事楼 330	2024/04/28

【实验目的】

1. 理解无线网络基本原理：通过实验，学生可以深入了解无线网络的工作原理，包括无线信号的传输、接收和数据处理。
2. 熟悉无线网络配置：实验涉及无线路由器和接入点的配置，使学生能够掌握无线网络设备的设置和管理技能。
3. 实践网络规划与管理：通过规划网络地址和拓扑图，配置路由器和 DHCP 服务器，学生可以实践网络设计和管理的技能，理解网络地址分配和路由选择的重要性。
4. 掌握故障排查和网络测试方法：实验中包括使用 Ping 测试等工具来验证网络配置的正确性和网络连通性，提高学生的网络故障诊断和解决问题的能力。
5. 增强实际操作能力：通过亲手配置和测试实际设备，学生可以将理论知识应用到实践中，增强实际操作能力和解决实际问题的能力。

【实验原理】

一、WIFI 简介

Wi-Fi（无线保真，Wireless Fidelity）是目前广泛使用的一种无线网络技术，它通过无线电波将有线网络信号转换为无线信号，使支持 Wi-Fi 的设备如电脑、手机、PDA 等能够接收并连接网络。使用 Wi-Fi 的设备在无线信号覆盖范围内可以无需通过移动或联通的数据网络上网，从而节省数据流量费用。

Wi-Fi 技术包含在无线局域网（WLAN）的范畴内，其核心是确保设备之间的兼容性和互操作性。Wi-Fi 联盟（Wi-Fi Alliance）是一个维护和推广 Wi-Fi 标准的组织，负责对产品进行 Wi-Fi 认证以确保其符合 IEEE 802.11 系列的标准。这些标准定义了无线网络的通信协议，使得不同制造商生产的设备能够相互通信。

在 Wi-Fi 网络的架设中，通常需要无线网卡和接入点（AP，Access Point），也称为无线访问接入点或桥接器。AP 在网络中充当无线工作站与有线局域网络之间的桥梁，位于媒体存取控制层（MAC）。简单的无线网络可以不使用 AP，通过每台电脑装配无线网卡直接建立对等网络（peer-to-peer network），以分享网

络资源，其成本和复杂性远低于传统有线网络。

在 Wi-Fi 覆盖区域内，一个无线路由器可以为多个设备提供网络连接服务，如果连接到互联网线路，则该无线路由器也被称作热点（Hotspot），为周围设备提供互联网接入服务。通过这种方式，Wi-Fi 技术极大地方便了日常的网络使用，无论是在家庭、办公室还是公共场所。

二、WIFI 协议

Wi-Fi 的主要协议是 IEEE 802.11，这是一个定义无线局域网通信标准的系列，由电气和电子工程师协会（IEEE）制定。IEEE 802.11 规定了无线网络设备应如何进行通信以确保互操作性和兼容性。以下是一些关于 IEEE 802.11 标准中定义的主要任务和服务的介绍。

1. 分配系统的任务
   - 联接（Association）：联接是无线设备（如笔记本电脑、智能手机）与无线网络（通过接入点，AP）建立连接的过程。这是设备加入网络开始通信的首步。
   - 结束联接（Disassociation）：当设备需要断开与无线网络的连接时，进行的操作。这可能是由于移动到另一个网络覆盖区或关闭设备引起。
   - 分配（Distribution）：分配是指在网络内部路由数据包的过程，确保数据从源正确地发送到目的地。
   - 集成（Integration）：在使用多种网络技术时，如将无线网络与有线网络结合，集成服务负责不同网络类型之间的数据传递和转换。
   - 再联接（Reassociation）：再联接是在无线设备从一个接入点移动到另一个接入点时，重新建立网络连接的过程。这是实现无线网络中的漫游功能的关键。
2. 站点的任务
   - 鉴权（Authentication）：在无线设备可以加入网络之前，必须通过身份验证过程。这是安全机制的一部分，防止未授权的访问。
   - 结束鉴权（Deauthentication）：当需要终止设备的网络访问权限时，执行的操作，通常是因为安全问题。
   - 隐私（Privacy）：隐私任务涉及加密技术，用于保护用户数据免受未经

授权的访问和监听。

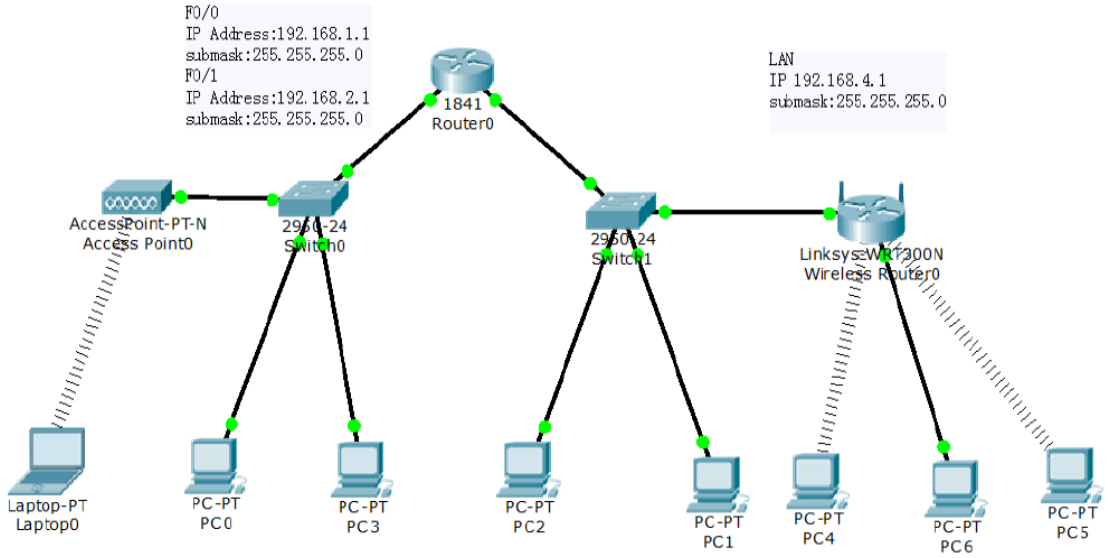
- MAC 数据传输（MSDU delivery）：MAC 子层数据单元（MSDU）传输是网络中进行数据帧传输的基本单位。这确保了有效和可靠的数据传输。

【实验设备】

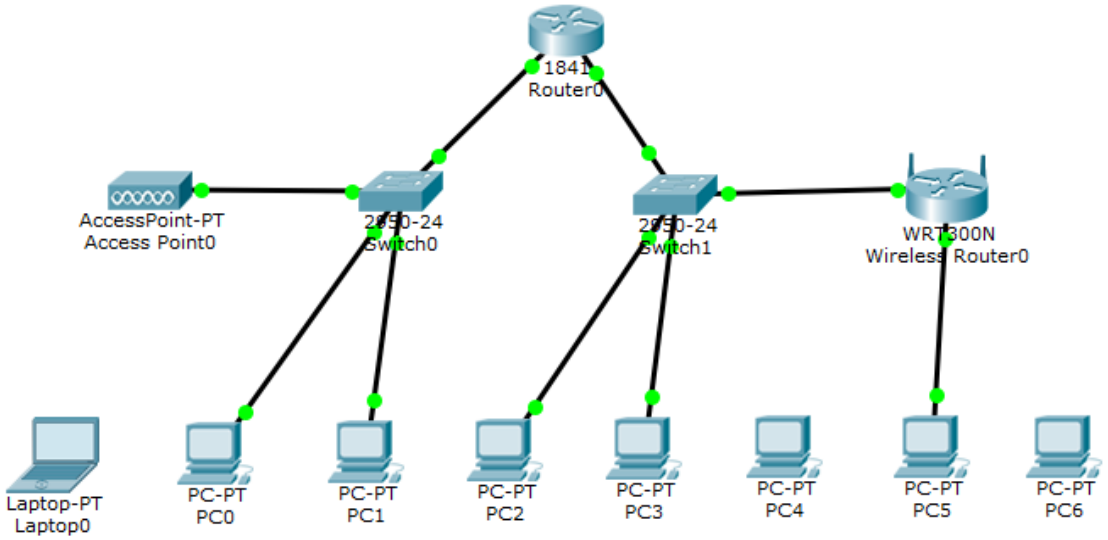
1. 操作系统：Windows 10
2. 网络环境：局域网
3. 应用程序：Cisco Packet Tracer 6.0

【实验步骤】

1. 规划网络地址及拓扑图。



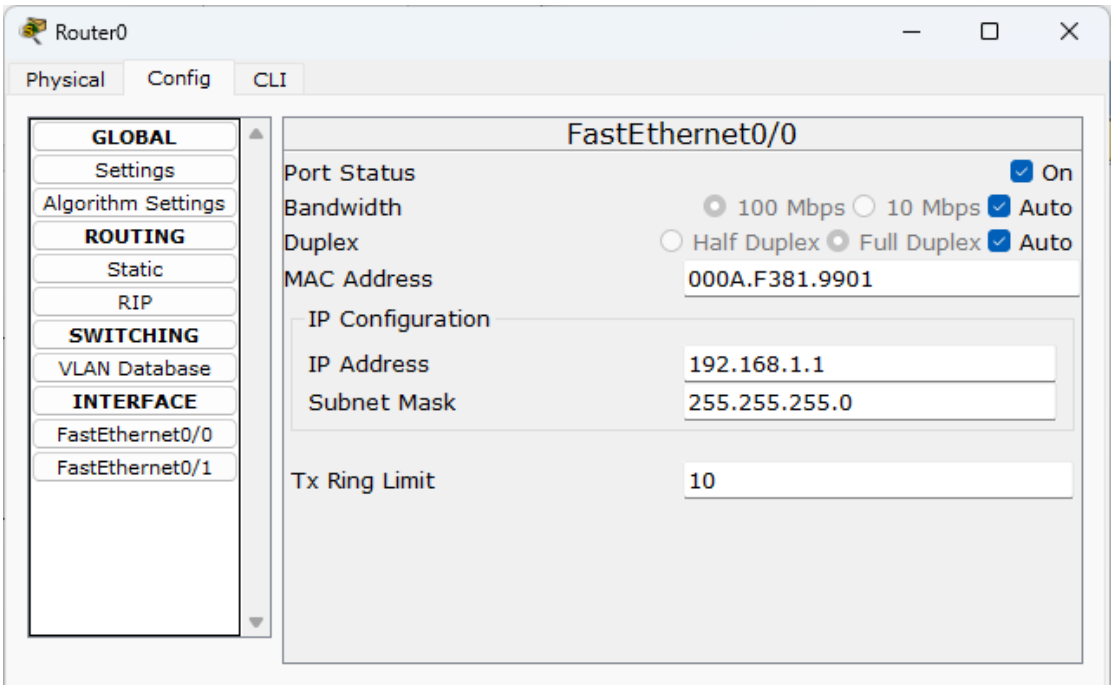
2. 启动 Cisco Packet Tracer，按照上图连接网络。

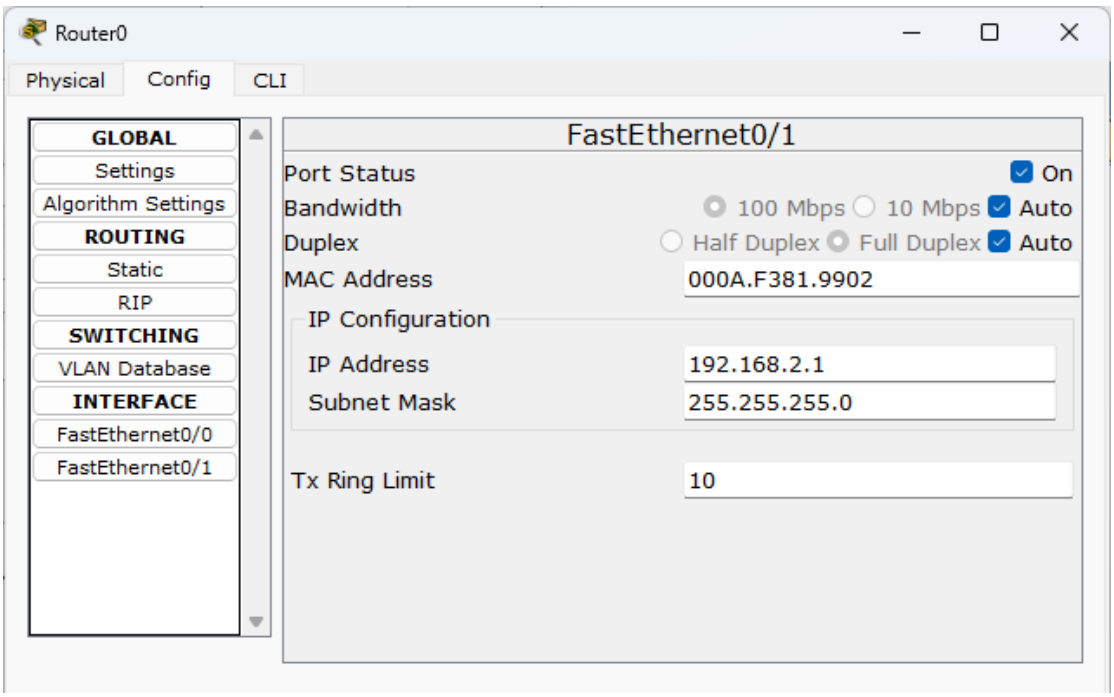


3. 配置路由器 Router0 的接口，可以通过在 CLI 中输入以下命令进行配置，也

可以通过图形化界面进行配置。

```
interface FastEthernet0/0
ip address 192.168.1.1 255.255.255.0
interface FastEthernet0/1
ip address 192.168.2.1 255.255.255.0
```





4. 在路由器 Router0 配置 DHCP。

- 在 CLI 输入以下命令配置路由器 DHCP 左边网络。

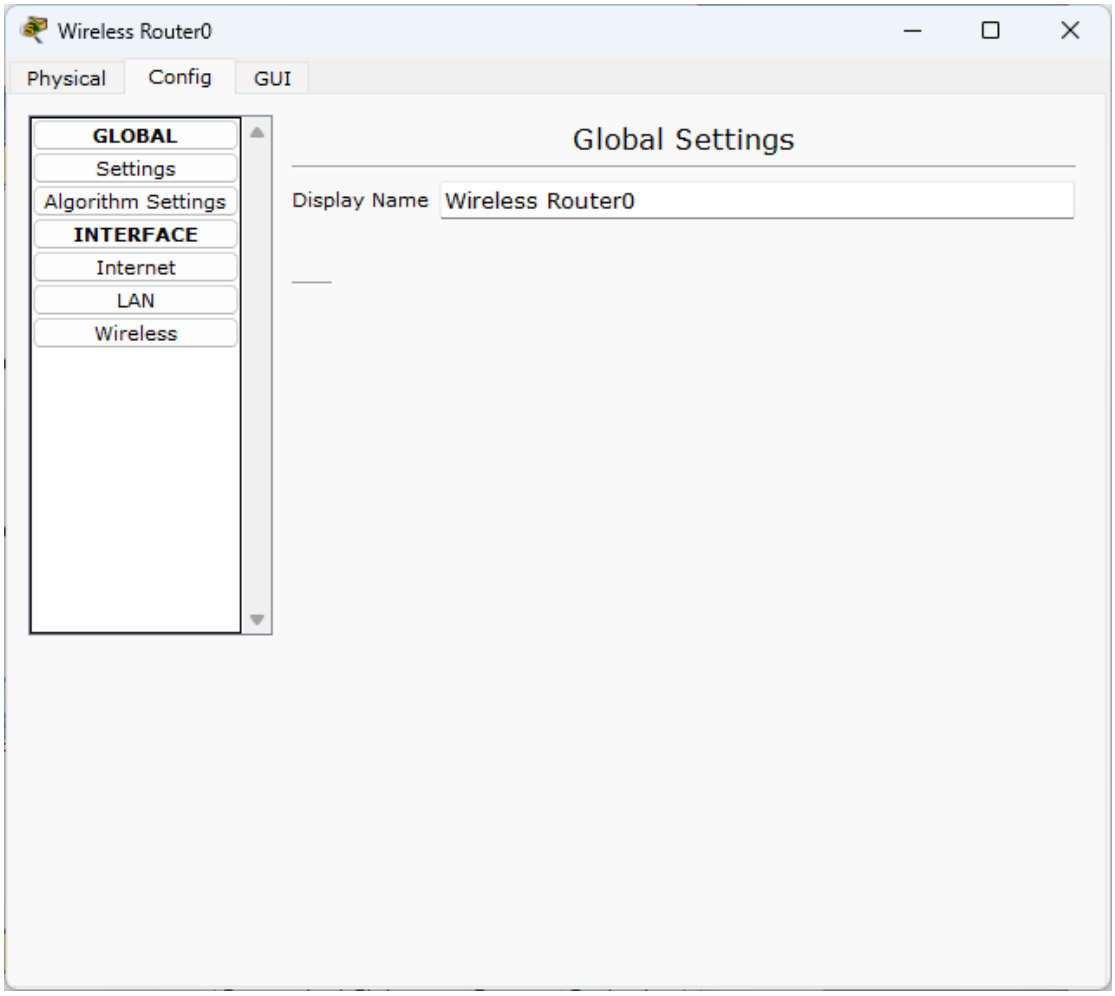
```
ip dhcp excluded-address 192.168.1.0 192.168.1.10
ip dhcp pool myleftnet
network 192.168.1.0 255.255.255.0
default-router 192.168.1.1
option 150 ip 192.168.1.3
dns-server 192.168.1.2
```

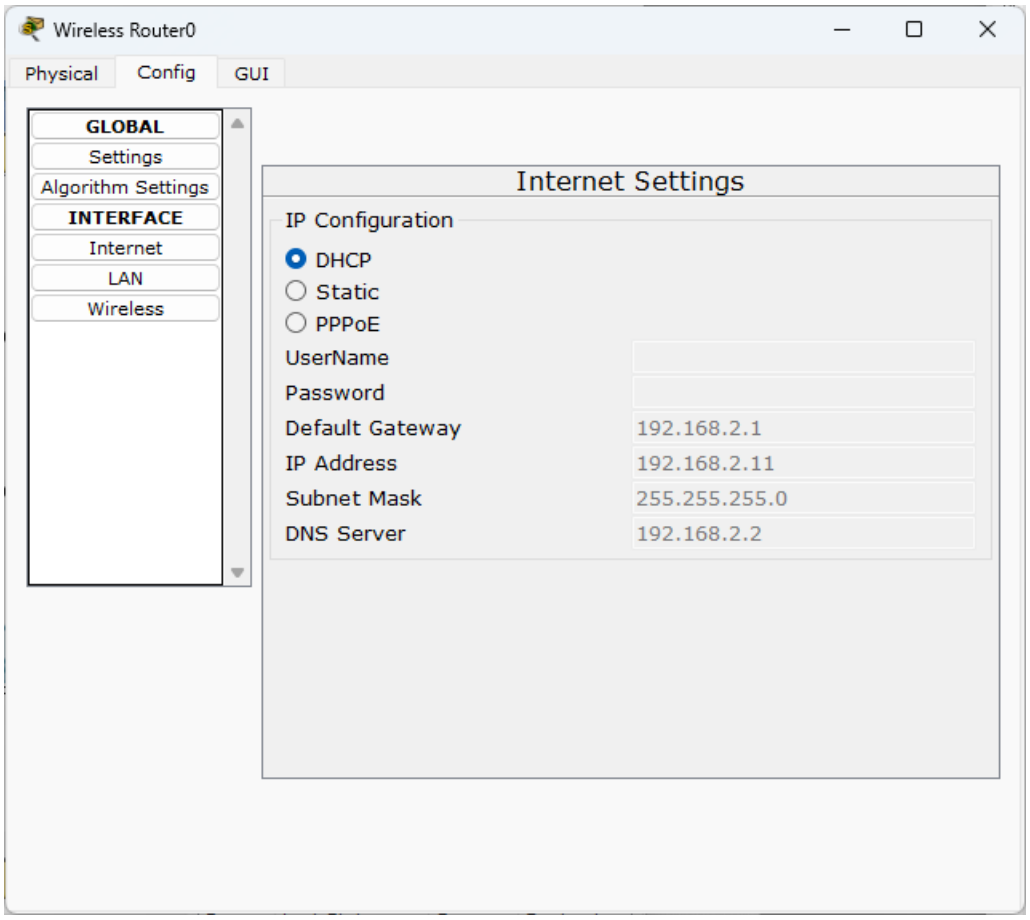
- 在 CLI 输入以下命令配置路由器 DHCP 右边网络。

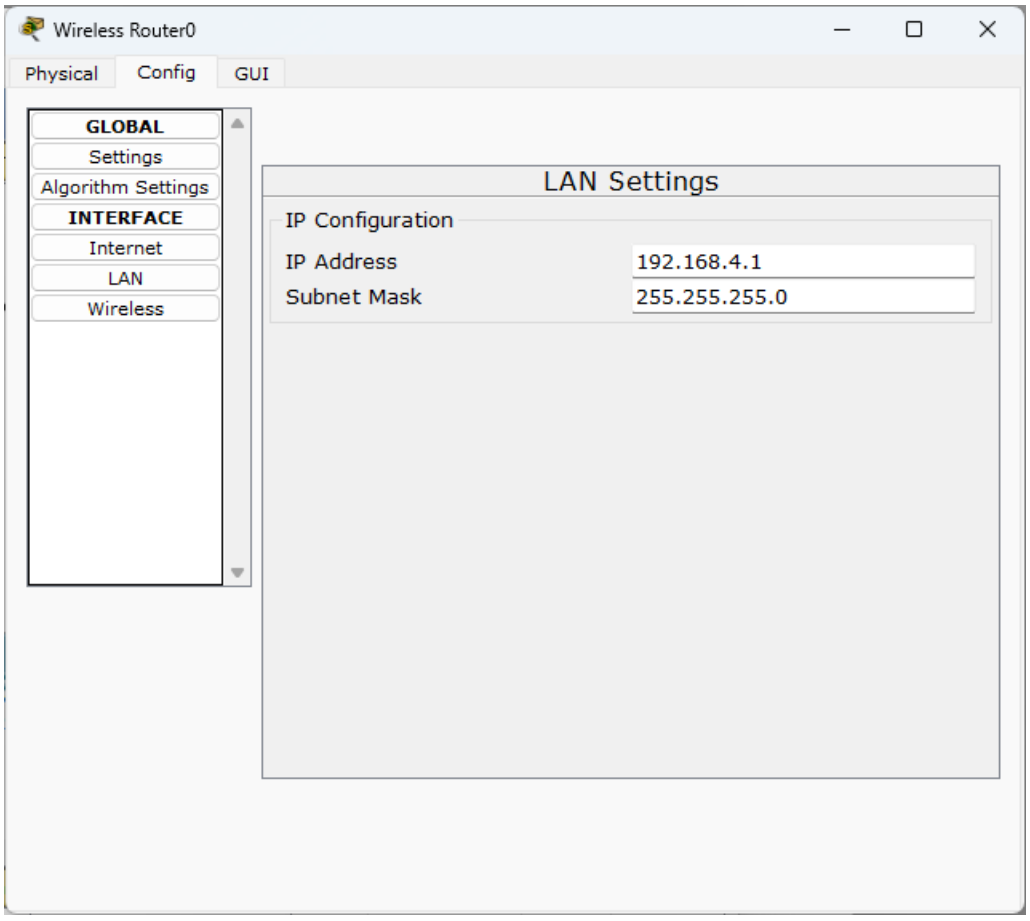
```
ip dhcp excluded-address 192.168.2.0 192.168.2.10
ip dhcp pool myrightnet
network 192.168.2.0 255.255.255.0
default-router 192.168.2.1
option 150 ip 192.168.2.3
dns-server 192.168.2.2
```

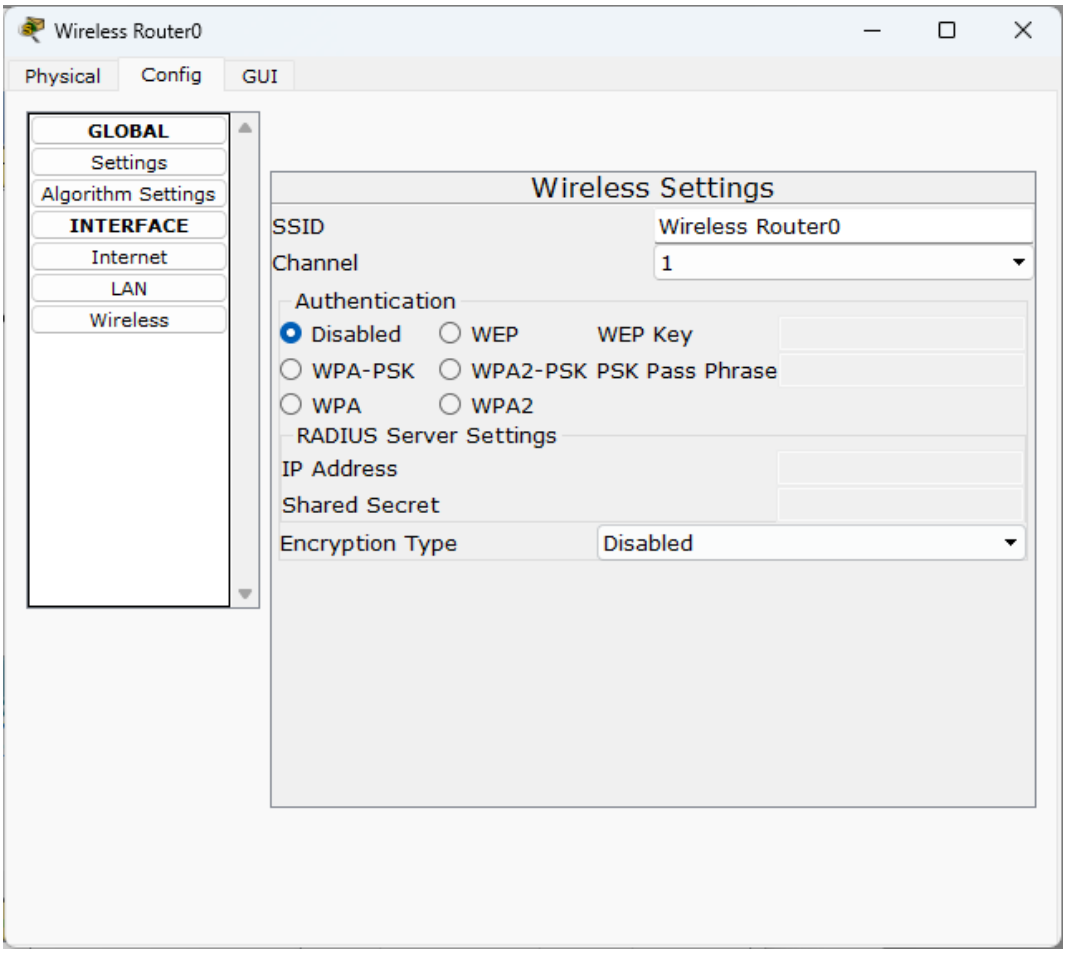
5. 验证主机之间的互通性。

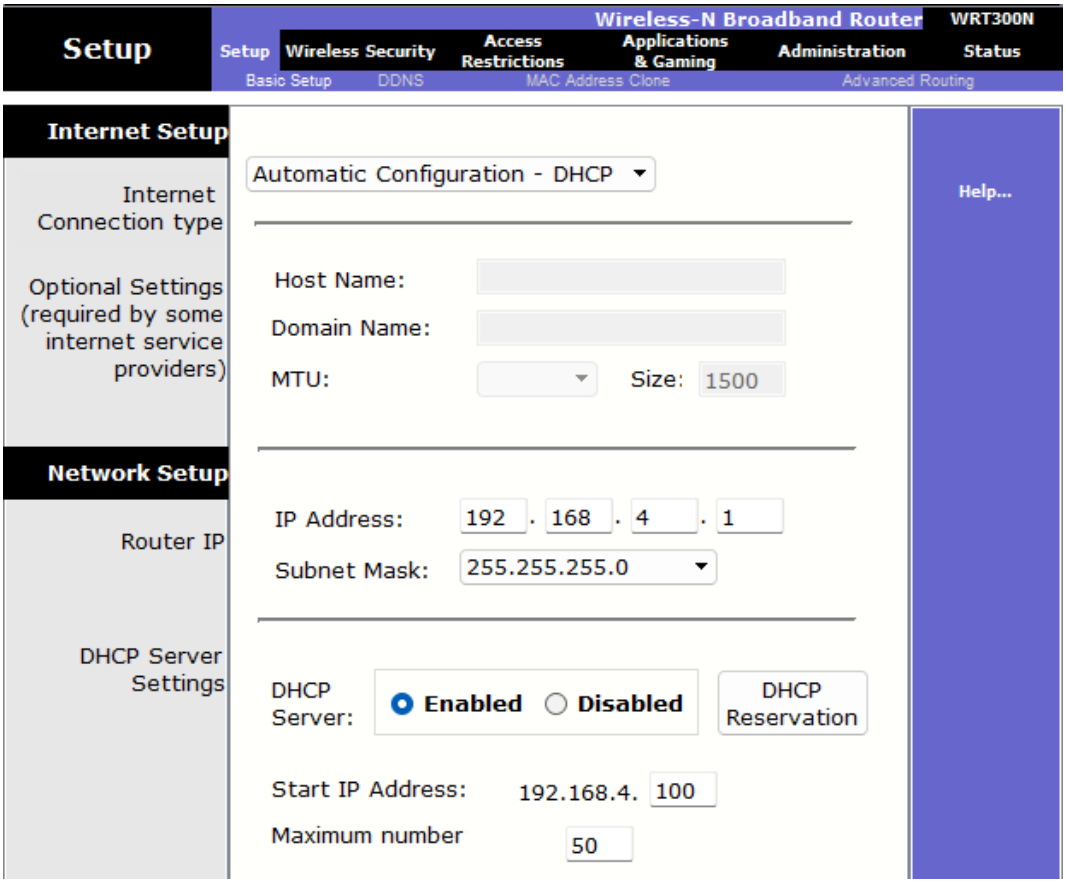
6. 配置 Wireless Router0。

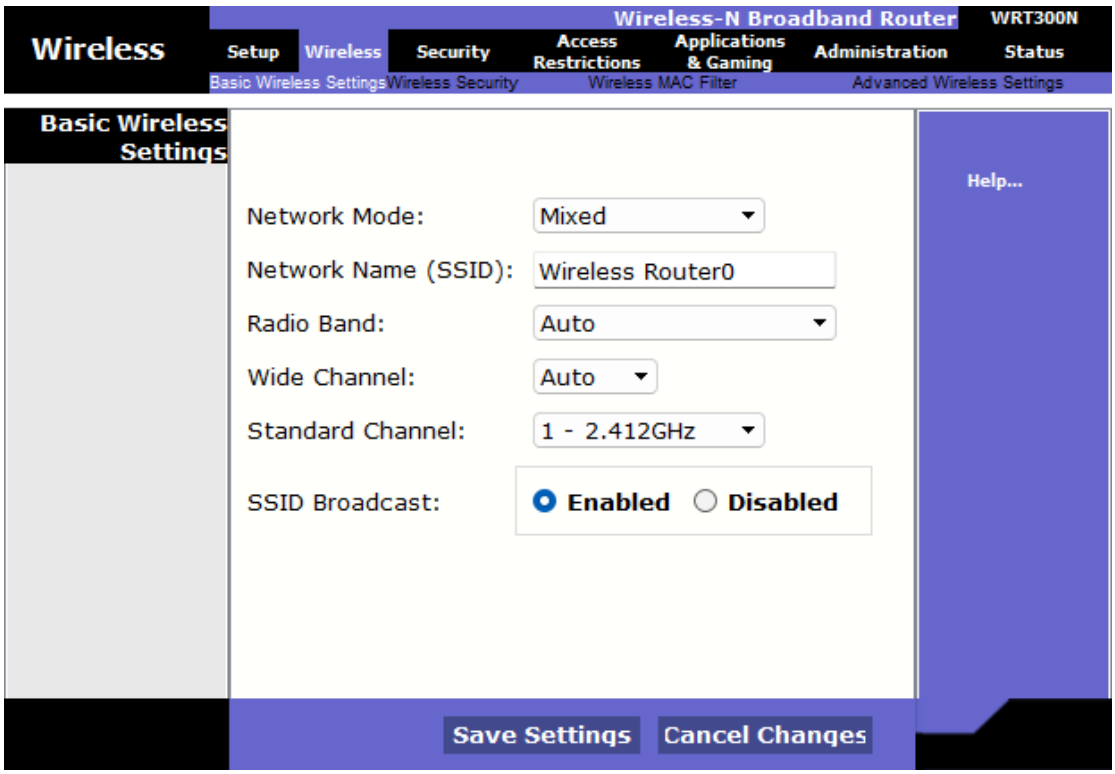



Wireless Router0
Physical
Config
GUI
GLOBAL
Settings
Algorithm Settings
INTERFACE
Internet
LAN
Wireless
Internet Settings
IP Configuration
DHCP
Static
PPPoE
UserName
Password
Default Gateway
192.168.2.1
IP Address
192.168.2.11
Subnet Mask
255.255.255.0
DNS Server
192.168.2.2

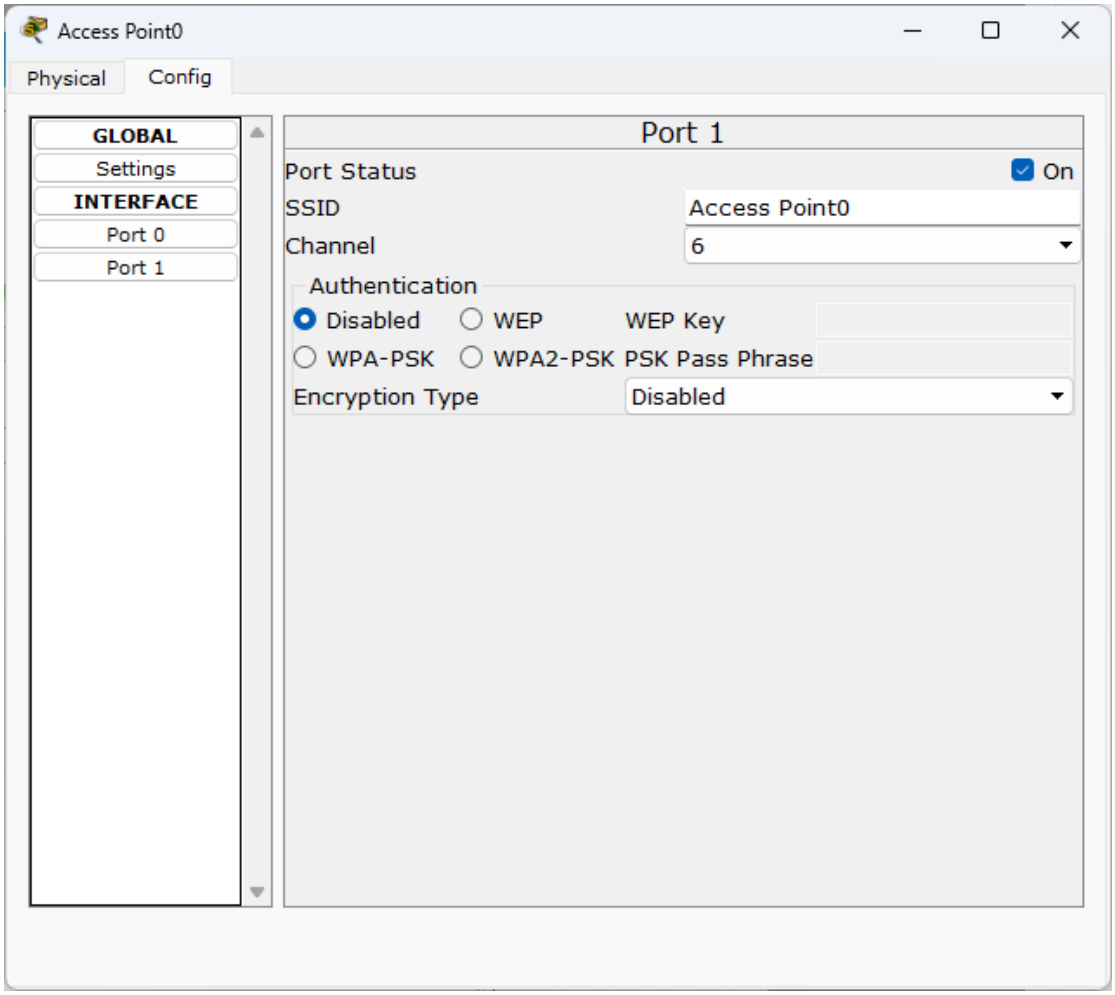

Wireless Router0
Physical
Config
GUI
GLOBAL
Settings
Algorithm Settings
INTERFACE
Internet
LAN
Wireless
LAN Settings
IP Configuration
IP Address
192.168.4.1
Subnet Mask
255.255.255.0


Wireless Router0
Physical
Config
GUI
GLOBAL
Settings
Algorithm Settings
INTERFACE
Internet
LAN
Wireless
Wireless Settings
SSID
Wireless Router0
Channel
1
Authentication
Disabled
WEP
WEP Key
WPA-PSK
WPA2-PSK
PSK Pass Phrase
WPA
WPA2
RADIUS Server Settings
IP Address
Shared Secret
Encryption Type
Disabled

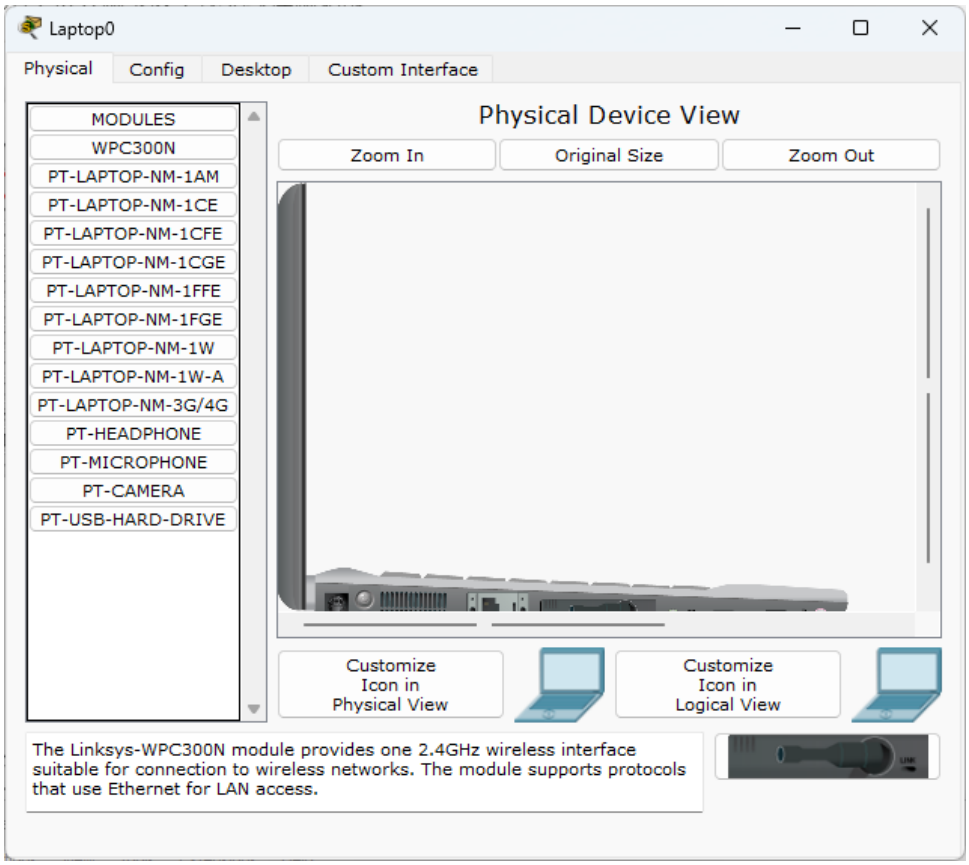

Setup
Wireless-N Broadband Router
WRT300N
Setup
Wireless
Security
Access Restrictions
Applications & Gaming
Administration
Status
Basic Setup
DDNS
MAC Address Clone
Advanced Routing
Internet Setup
Internet Connection type
Automatic Configuration - DHCP
Optional Settings (required by some internet service providers)
Host Name:
Domain Name:
MTU:
Size:
1500
Network Setup
Router IP
IP Address:
192
168
4
1
Subnet Mask:
255.255.255.0
DHCP Server Settings
DHCP Server:
Enabled
Disabled
DHCP Reservation
Start IP Address:
192.168.4.
100
Maximum number
50
Help...

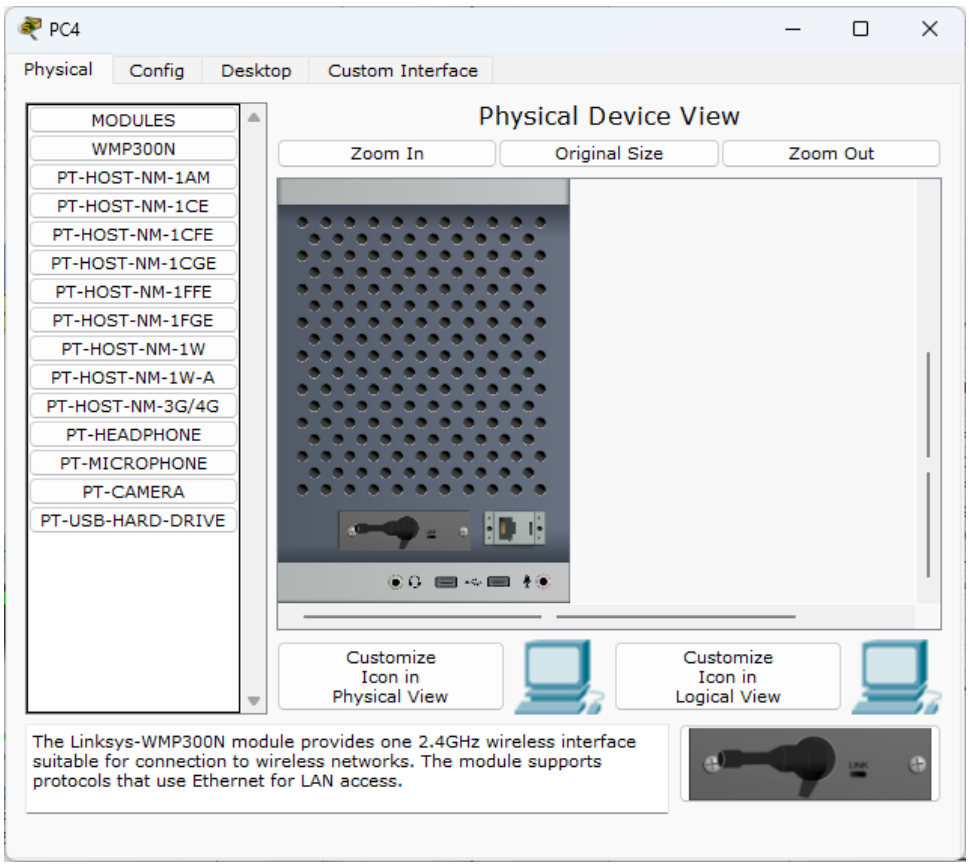


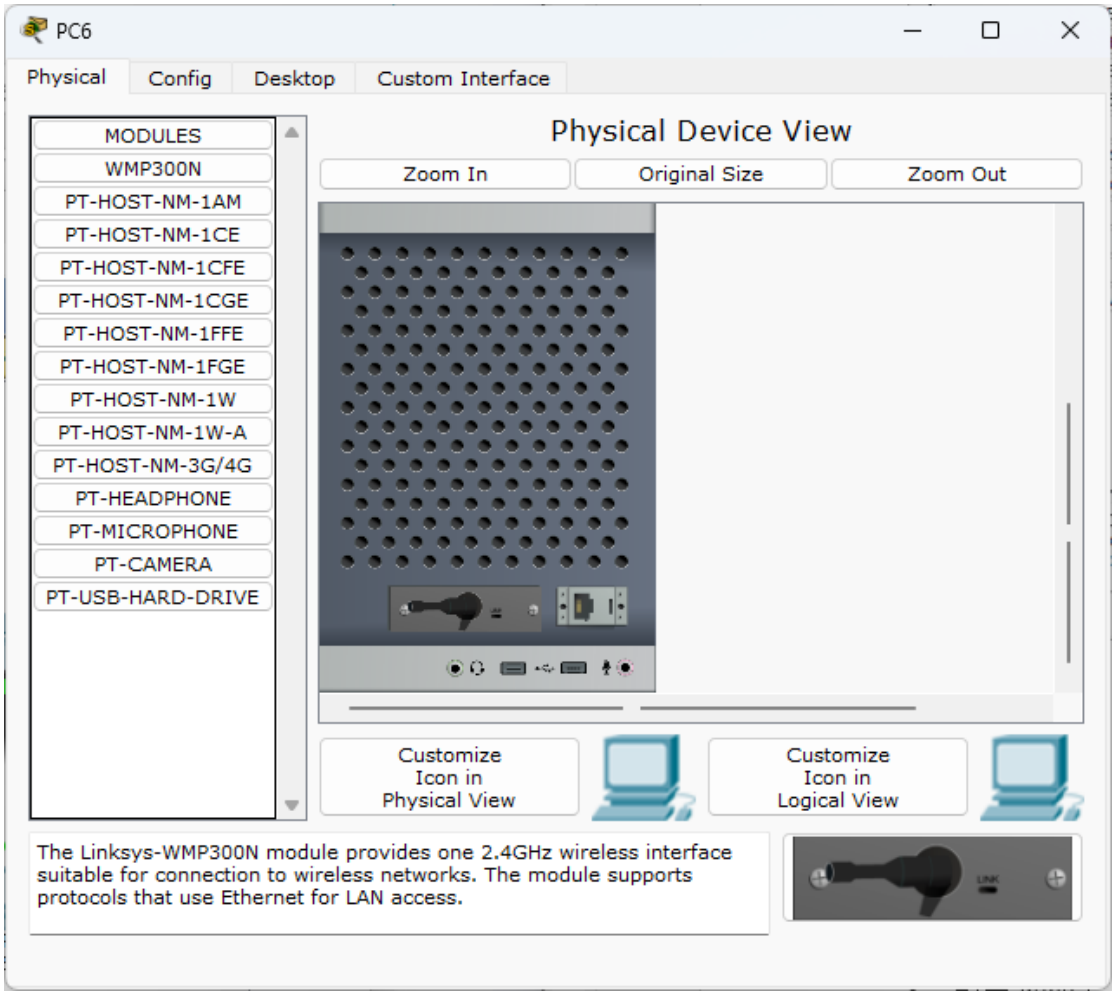
7. 配置 Access Point0。



8. 为 Laptop0、PC4、PC6 安装 WPC300N。

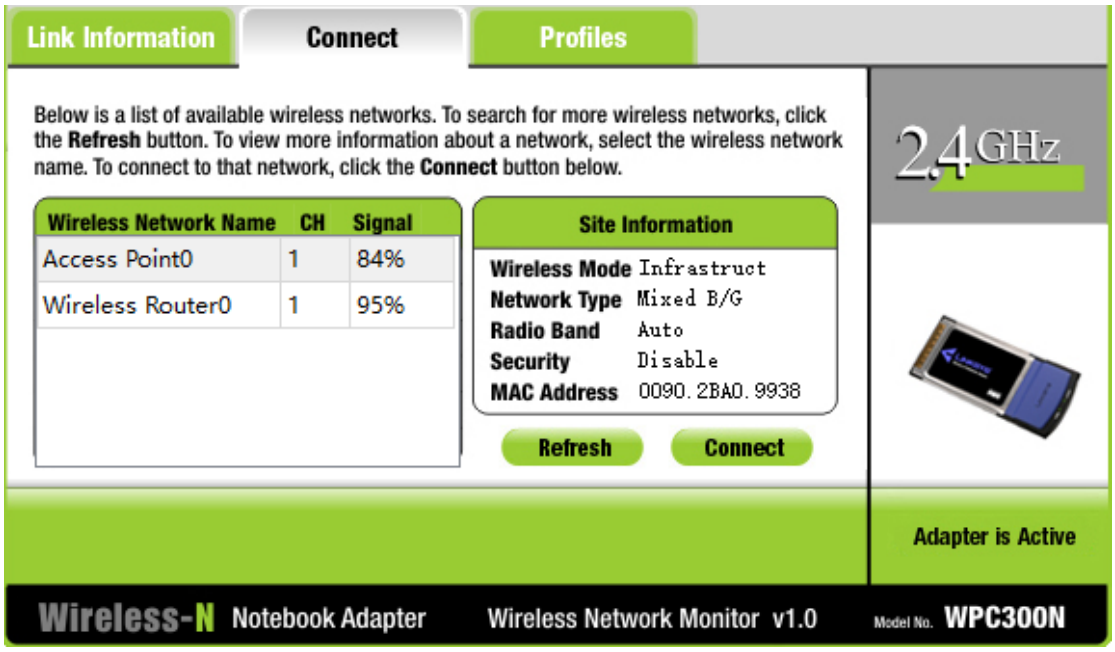




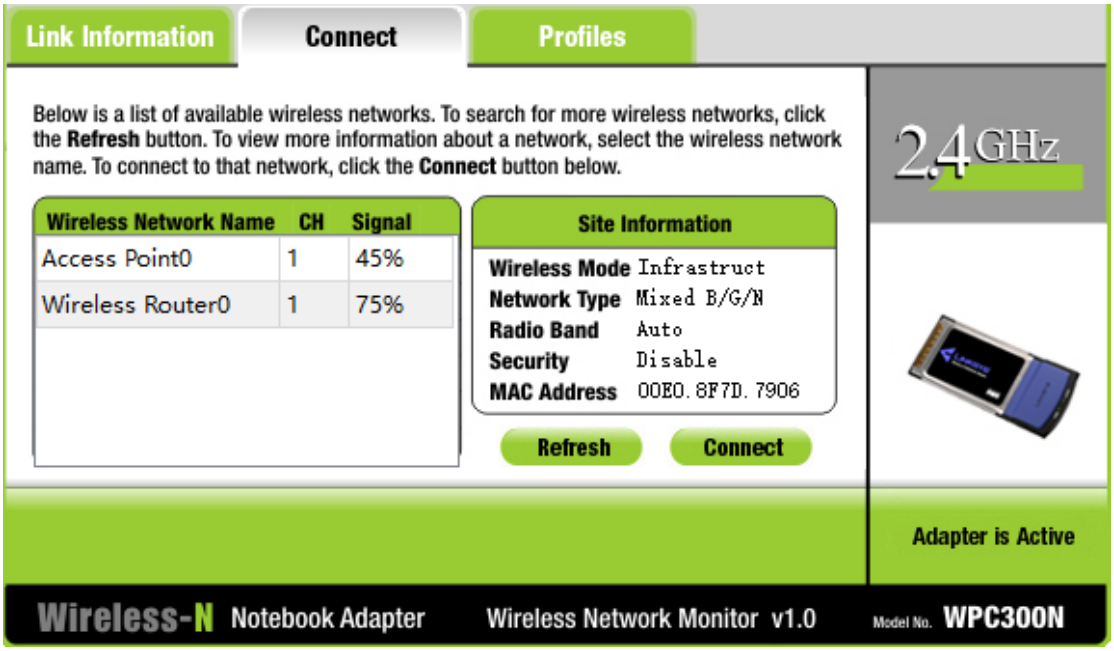


9. 在设备中打开“PC Wireless”。将 Laptop0 连接到 Access Point0 上，将 PC4、PC6 连接到 Wireless Router0 上。

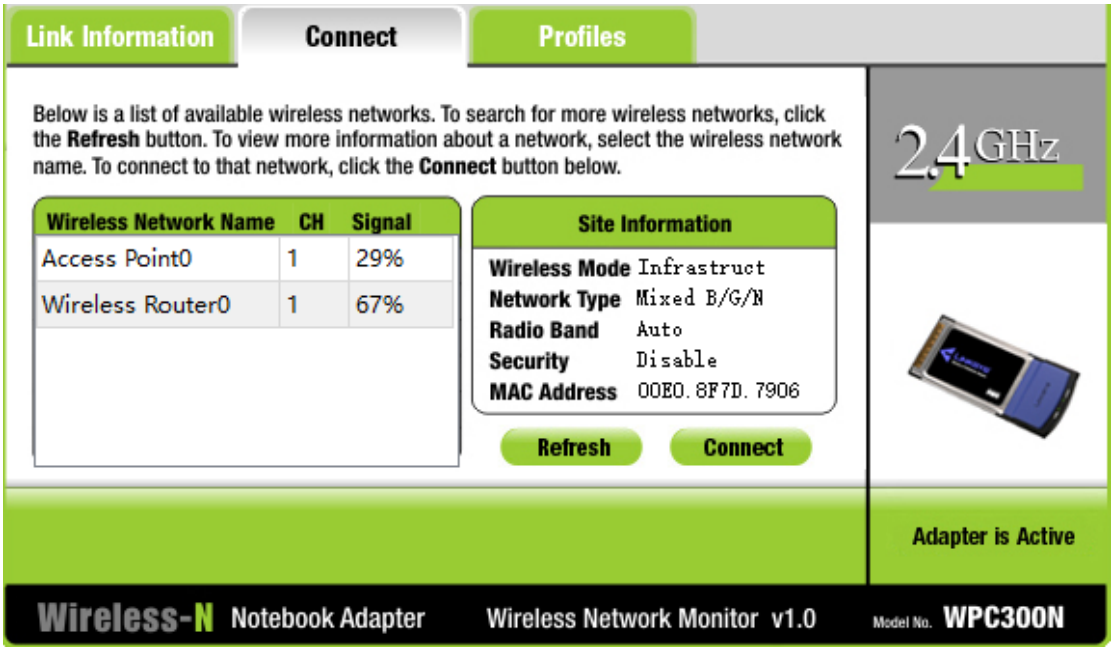
- 将 Laptop0 连接到 Access Point0 上。



- 将 PC4 连接到 Wireless Router0 上。



- 将 PC6 连接到 Wireless Router0 上。



10. Laptop0 连接到 Access Point0 上后，PC4、PC6 连接到 Wireless Router0 上后，可以观察到无线网络连接成功。

11. 配置无线路由器相关密码进行测试。

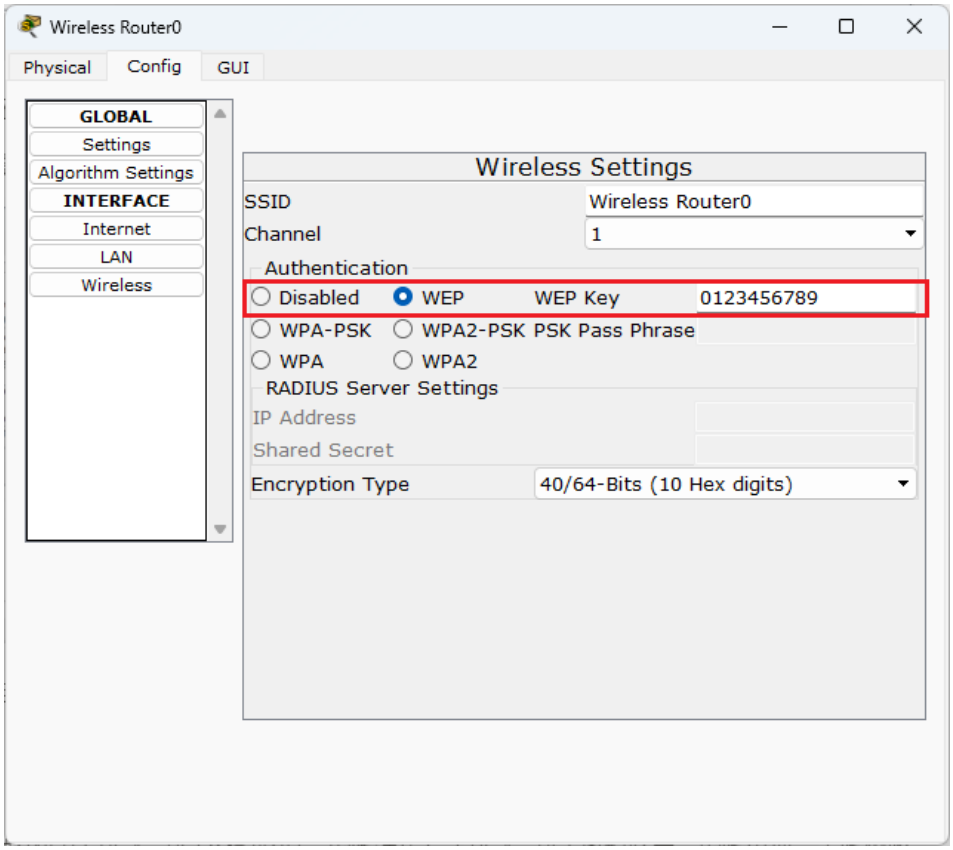
    11.1 为 Wireless Router0 配置 WEP 无线保护协议以及相应的密码。

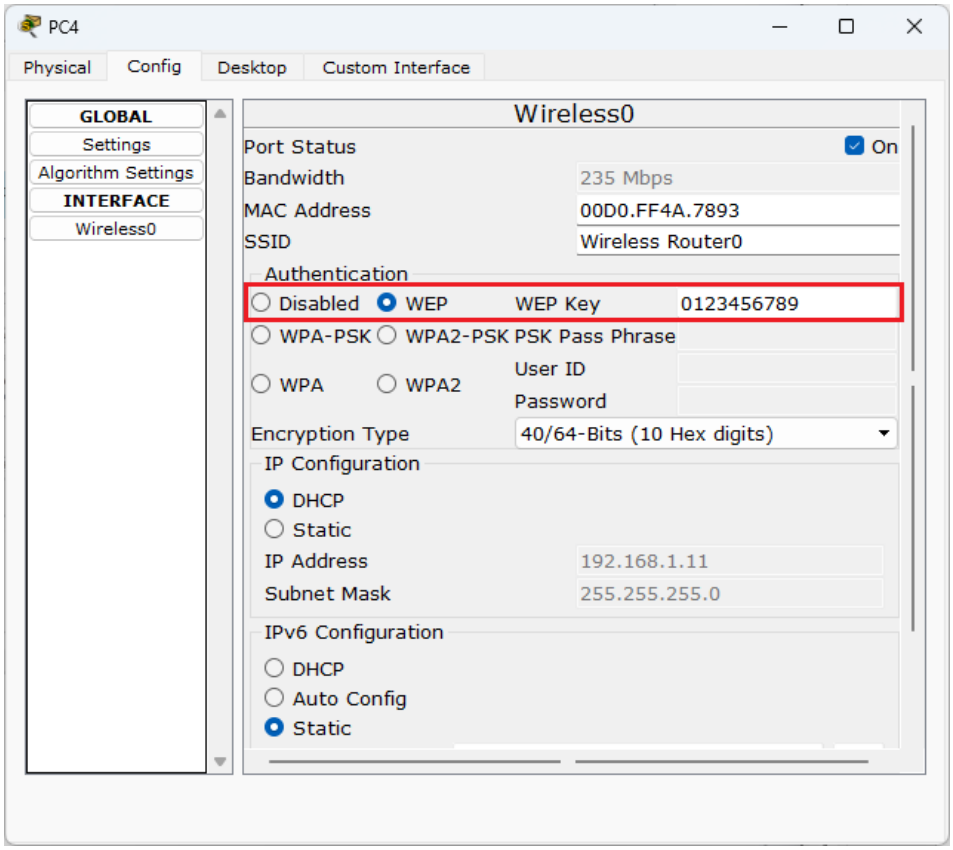
    11.2 为 PC4 配置 WEP 无线保护协议以及相应的密码。

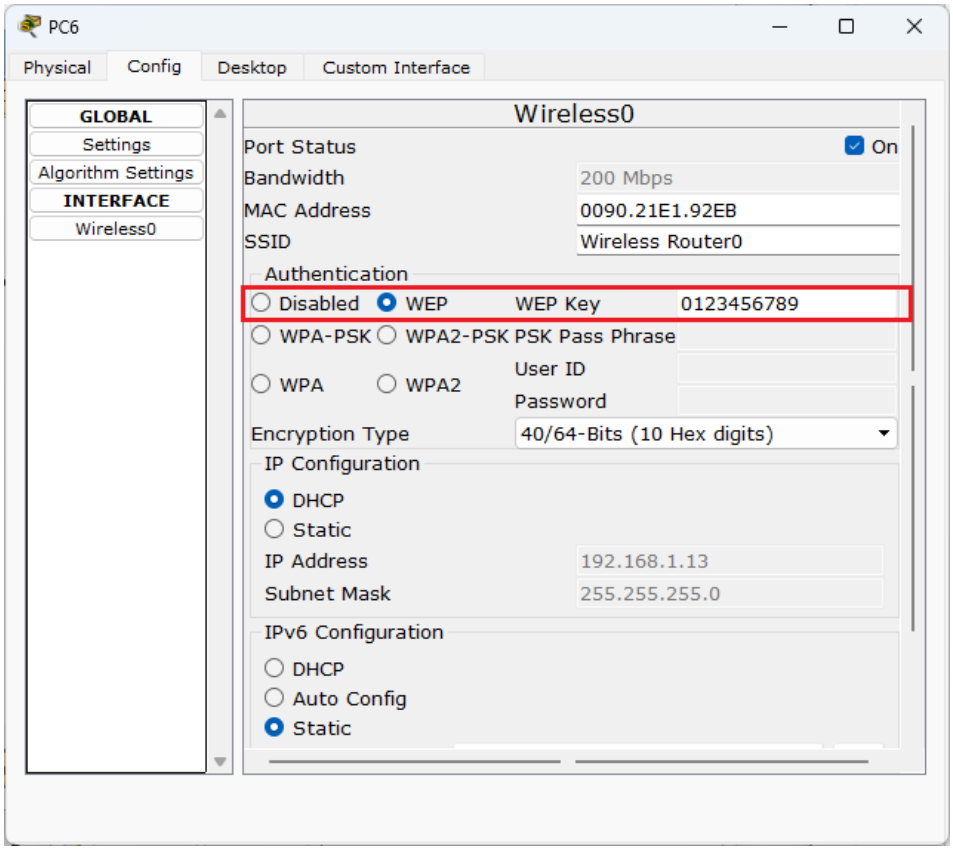
    11.3 将 PC4 连接到 Wireless Router0 上。

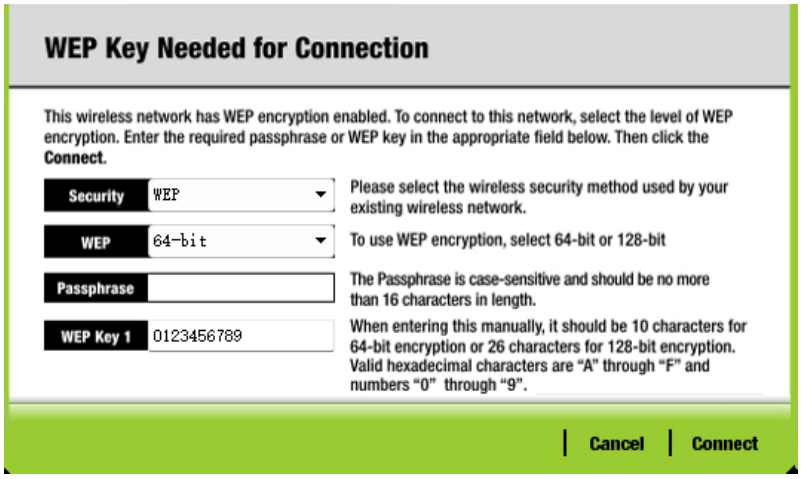
11.4 为 PC6 配置 WEP 无线保护协议以及相应的密码。

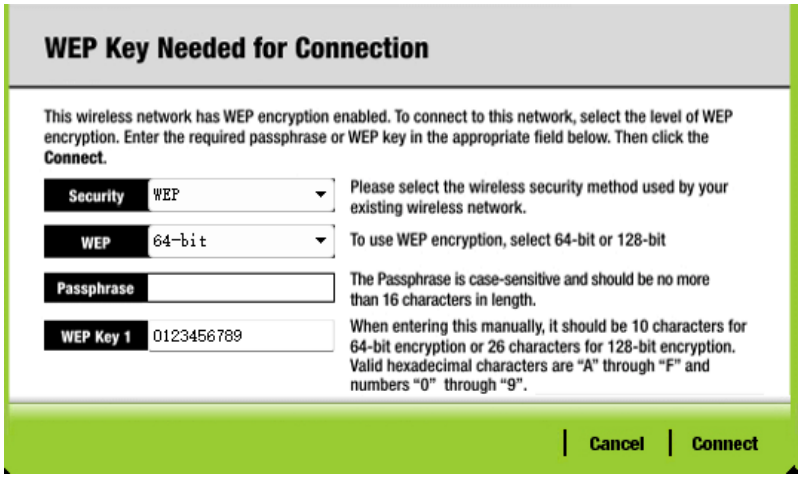
11.5 将 PC6 连接到 Wireless Router0 上。






PC6
Physical
Config
Desktop
Custom Interface
GLOBAL
Settings
Algorithm Settings
INTERFACE
Wireless0
Wireless0
Port Status
On
Bandwidth
200 Mbps
MAC Address
0090.21E1.92EB
SSID
Wireless Router0
Authentication
Disabled
WEP
WEP Key
0123456789
WPA-PSK
WPA2-PSK
PSK Pass Phrase
WPA
WPA2
User ID
Password
Encryption Type
40/64-Bits (10 Hex digits)
IP Configuration
DHCP
Static
IP Address
192.168.1.13
Subnet Mask
255.255.255.0
IPv6 Configuration
DHCP
Auto Config
Static


WEP Key Needed for Connection
This wireless network has WEP encryption enabled. To connect to this network, select the level of WEP encryption. Enter the required passphrase or WEP key in the appropriate field below. Then click the Connect.
Security
WEP
Please select the wireless security method used by your existing wireless network.
WEP
64-bit
To use WEP encryption, select 64-bit or 128-bit
Passphrase
The Passphrase is case-sensitive and should be no more than 16 characters in length.
WEP Key 1
0123456789
When entering this manually, it should be 10 characters for 64-bit encryption or 26 characters for 128-bit encryption. Valid hexadecimal characters are "A" through "F" and numbers "0" through "9".
Cancel
Connect


WEP Key Needed for Connection
This wireless network has WEP encryption enabled. To connect to this network, select the level of WEP encryption. Enter the required passphrase or WEP key in the appropriate field below. Then click the Connect.
Security
WEP
Please select the wireless security method used by your existing wireless network.
WEP
64-bit
To use WEP encryption, select 64-bit or 128-bit
Passphrase
The Passphrase is case-sensitive and should be no more than 16 characters in length.
WEP Key 1
0123456789
When entering this manually, it should be 10 characters for 64-bit encryption or 26 characters for 128-bit encryption. Valid hexadecimal characters are "A" through "F" and numbers "0" through "9".
Cancel
Connect

12. 观测各个 PC 机的连通情况（ping 测试）。

【实验现象】

1. 配置 DHCP 后，验证主机之间的互通性， 左右两边的 PC 机相互进行 ping 测试，均成功。

- PC0 ping PC1、PC2、PC3：

```
Pinging 192.168.1.14 with 32 bytes of data:

Reply from 192.168.1.14: bytes=32 time=0ms TTL=128
Reply from 192.168.1.14: bytes=32 time=0ms TTL=128
Reply from 192.168.1.14: bytes=32 time=0ms TTL=128
Reply from 192.168.1.14: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.1.14:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

```
Pinging 192.168.2.12 with 32 bytes of data:

Reply from 192.168.2.12: bytes=32 time=0ms TTL=127
Reply from 192.168.2.12: bytes=32 time=0ms TTL=127
Reply from 192.168.2.12: bytes=32 time=0ms TTL=127
Reply from 192.168.2.12: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.2.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

```
Pinging 192.168.2.14 with 32 bytes of data:

Request timed out.
Reply from 192.168.2.14: bytes=32 time=1ms TTL=127
Reply from 192.168.2.14: bytes=32 time=0ms TTL=127
Reply from 192.168.2.14: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.2.14:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

- PC1 ping PC0、PC2、PC3：

```
Pinging 192.168.1.12 with 32 bytes of data:

Reply from 192.168.1.12: bytes=32 time=0ms TTL=128
Reply from 192.168.1.12: bytes=32 time=0ms TTL=128
Reply from 192.168.1.12: bytes=32 time=3ms TTL=128
Reply from 192.168.1.12: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.1.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 0ms
```

```
Pinging 192.168.2.12 with 32 bytes of data:

Reply from 192.168.2.12: bytes=32 time=0ms TTL=127
Reply from 192.168.2.12: bytes=32 time=0ms TTL=127
Reply from 192.168.2.12: bytes=32 time=0ms TTL=127
Reply from 192.168.2.12: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.2.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

```
Pinging 192.168.2.14 with 32 bytes of data:

Request timed out.
Reply from 192.168.2.14: bytes=32 time=1ms TTL=127
Reply from 192.168.2.14: bytes=32 time=0ms TTL=127
Reply from 192.168.2.14: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.2.14:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

- PC2 ping PC0、PC1、PC3：

```
Pinging 192.168.1.12 with 32 bytes of data:

Reply from 192.168.1.12: bytes=32 time=0ms TTL=128
Reply from 192.168.1.12: bytes=32 time=0ms TTL=128
Reply from 192.168.1.12: bytes=32 time=3ms TTL=128
Reply from 192.168.1.12: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.1.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 0ms
```

```
Pinging 192.168.1.14 with 32 bytes of data:

Reply from 192.168.1.14: bytes=32 time=0ms TTL=128
Reply from 192.168.1.14: bytes=32 time=0ms TTL=128
Reply from 192.168.1.14: bytes=32 time=0ms TTL=128
Reply from 192.168.1.14: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.1.14:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

```
Pinging 192.168.2.14 with 32 bytes of data:

Request timed out.
Reply from 192.168.2.14: bytes=32 time=1ms TTL=127
Reply from 192.168.2.14: bytes=32 time=0ms TTL=127
Reply from 192.168.2.14: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.2.14:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

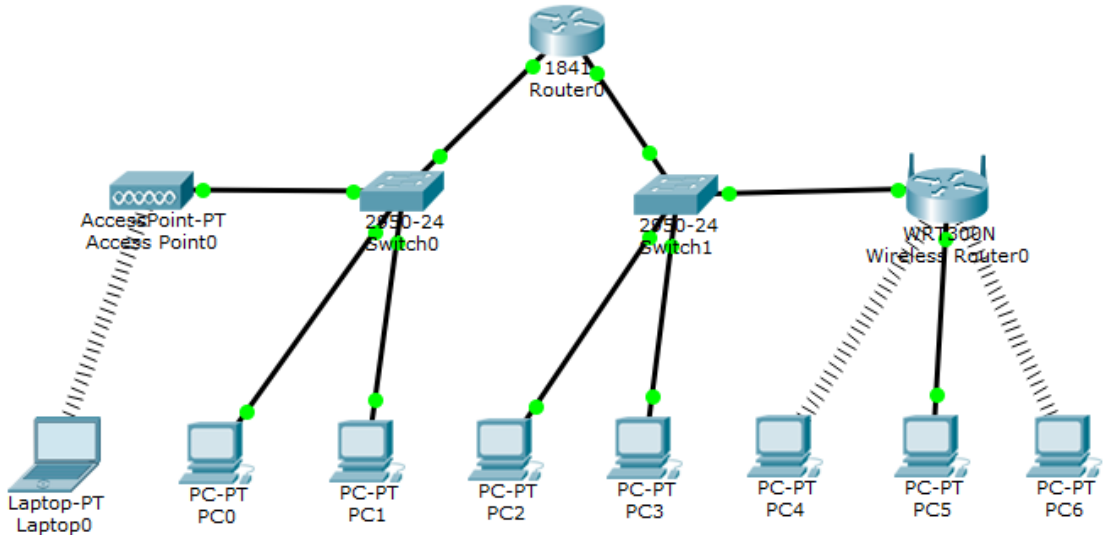
- PC3 ping PC0、PC1、PC2：

```
Pinging 192.168.1.12 with 32 bytes of data:

Reply from 192.168.1.12: bytes=32 time=0ms TTL=128
Reply from 192.168.1.12: bytes=32 time=0ms TTL=128
Reply from 192.168.1.12: bytes=32 time=3ms TTL=128
Reply from 192.168.1.12: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.1.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 0ms
```

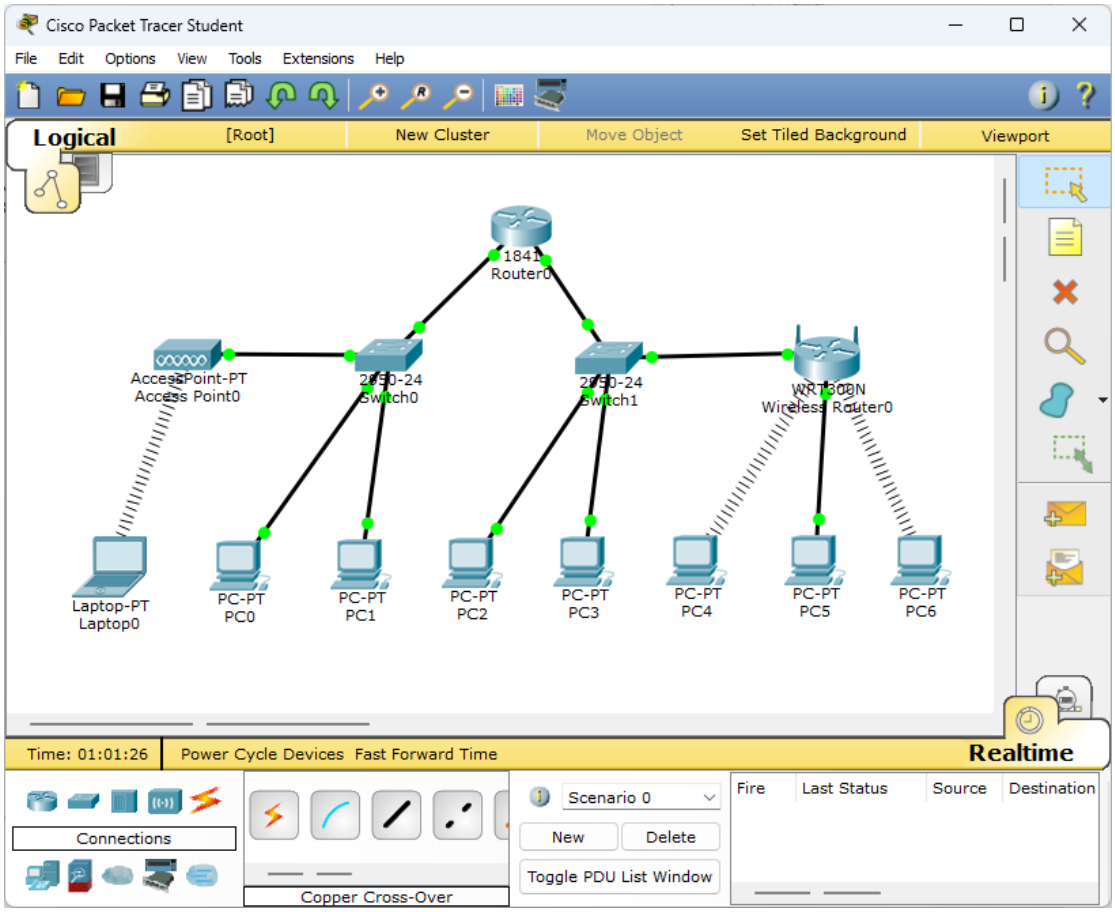
```
Pinging 192.168.1.14 with 32 bytes of data:

Reply from 192.168.1.14: bytes=32 time=0ms TTL=128
Reply from 192.168.1.14: bytes=32 time=0ms TTL=128
Reply from 192.168.1.14: bytes=32 time=0ms TTL=128
Reply from 192.168.1.14: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.1.14:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

```
Pinging 192.168.2.12 with 32 bytes of data:

Reply from 192.168.2.12: bytes=32 time=0ms TTL=127
Reply from 192.168.2.12: bytes=32 time=0ms TTL=127
Reply from 192.168.2.12: bytes=32 time=0ms TTL=127
Reply from 192.168.2.12: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.2.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

2. Laptop0 连接到 Access Point0 上后，PC4、PC6 连接到 Wireless Router0 上后，可以观察到无线网络连接成功。



3. 配置无线路由器相关密码进行测试，将 PC4 和 PC6 连接到 Wireless Router0 上，可以观察到无线网络连接成功。



4. 观测各个 PC 机的连通情况（ping 测试）。

- 外界 PC 机无法 ping 到通过无线网络连接的 PC 机。

```
Pinging 192.168.1.11 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.1.11:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

- 通过无线网络连接的 PC 机可以 ping 到外界 PC 机。

```
Pinging 192.168.1.13 with 32 bytes of data:

Reply from 192.168.1.13: bytes=32 time=36ms TTL=128
Reply from 192.168.1.13: bytes=32 time=14ms TTL=128
Reply from 192.168.1.13: bytes=32 time=12ms TTL=128
Reply from 192.168.1.13: bytes=32 time=15ms TTL=128

Ping statistics for 192.168.1.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 12ms, Maximum = 36ms, Average = 19ms
```

- 通过无线网络连接的 PC 机可以相互 ping。

```
Pinging 192.168.1.13 with 32 bytes of data:

Reply from 192.168.1.13: bytes=32 time=36ms TTL=128
Reply from 192.168.1.13: bytes=32 time=14ms TTL=128
Reply from 192.168.1.13: bytes=32 time=12ms TTL=128
Reply from 192.168.1.13: bytes=32 time=15ms TTL=128

Ping statistics for 192.168.1.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 12ms, Maximum = 36ms, Average = 19ms
```

- 其他的 ping 命令均成功连通。

```
Pinging 192.168.1.13 with 32 bytes of data:

Reply from 192.168.1.13: bytes=32 time=36ms TTL=128
Reply from 192.168.1.13: bytes=32 time=14ms TTL=128
Reply from 192.168.1.13: bytes=32 time=12ms TTL=128
Reply from 192.168.1.13: bytes=32 time=15ms TTL=128

Ping statistics for 192.168.1.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 12ms, Maximum = 36ms, Average = 19ms
```

【分析讨论】

一、如果再接入一台路由器如何配置

当在现有网络中再接入一台路由器时，需要注意避免 IP 地址冲突，并保证正确的路由配置：

1. IP 地址选择：选择一个未被现有网络使用的 IP 段，如 192.168.5.x，确保不会与现有设备冲突。
2. 物理连接：使用串口线或以太网线将两台路由器连接起来。
3. 路由配置：在两台路由器上配置 OSPF 或其他动态路由协议，确保数据可以在新旧路由器之间正确路由。

二、如果改为静态 IP 地址如何处理

将网络配置改为使用静态 IP 地址时，需要手动设置每个设备的 IP 地址，并确保路由器与所有设备的网络设置相符：

1. IP 地址规划：为每个设备分配一个唯一的静态 IP 地址，确保地址在子网内并避免冲突。
2. 设备配置：在每个 PC、笔记本及无线设备上手动配置 IP 地址、子网掩码、默认网关及 DNS。
3. 无线设备配置：无线路由器和接入点也需要配置在正确的子网，若有多个子网，需确保主路由器有适当的路由设置以便跨子网通信。

三、外界 PC 机无法 ping 到通过无线网络连接的 PC 机的原因

无线路由器位于 192.168.4.0/24 子网，而 DHCP 服务器配置的是 192.168.2.0/24 子网，所以连接到无线路由器的设备无法正确路由，因为它们被分配到了错误的子网。