

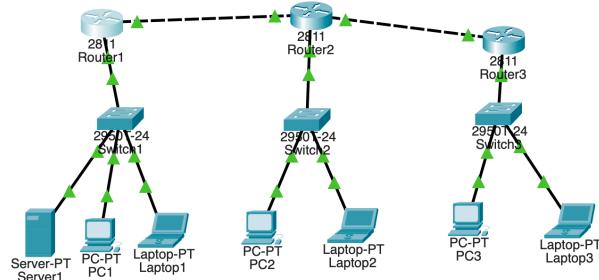
Lab1 实验报告

1. 破旧的莎草纸

Device	Port	IP	Mask	Gateway
Router1	端口 1	192.168.1.1	/24	-
	端口 2	10.0.1.1	/24	-
Router2	端口 1	10.0.1.2	/24	-
	端口 2	10.0.2.2	/24	-
	端口 3	192.168.2.1	/24	-
Router3	端口 1	10.0.2.1	/24	-
	端口 2	192.168.3.1	/24	-
PC1	端口 1	192.168.1.2	/24	192.168.1.1
PC2	端口 1	192.168.2.2	/24	192.168.2.1
PC3	端口 1	192.168.3.2	/24	192.168.3.1
Server1	端口 1	192.168.1.3	/24	192.168.1.1
Laptop1	端口 1	192.168.1.4	/24	192.168.1.1
Laptop2	端口 1	192.168.2.3	/24	192.168.2.1
Laptop3	端口 1	192.168.3.3	/24	192.168.3.1

2. “一天建起的罗马城”

网络拓扑图



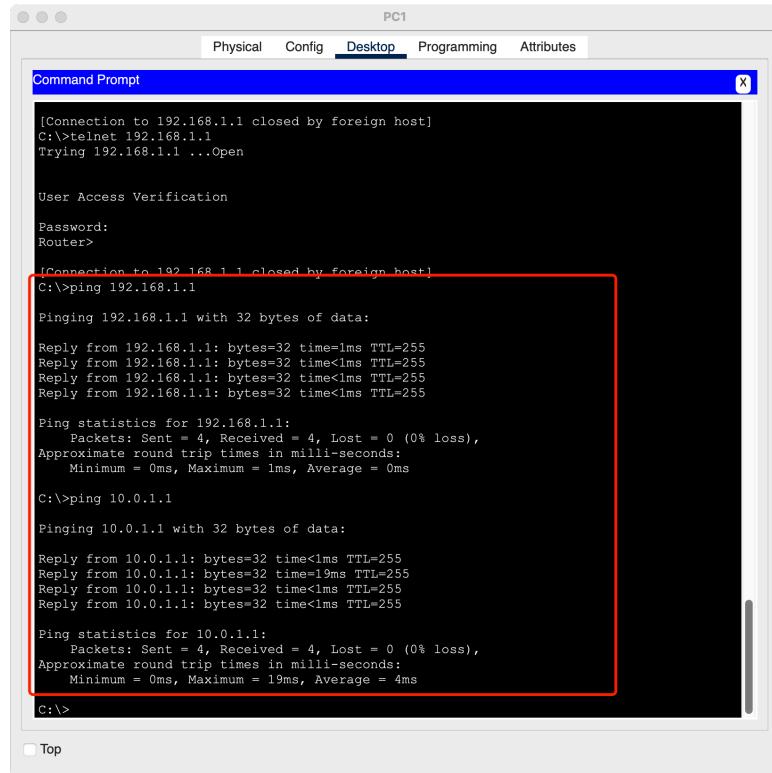
各路由器端口配置

以元老院子网为例，展示路由器及PC的配置（为了节省报告的空间，元老院的服务器、Laptop，以及其他子网配置类似）：

- Router1

- PC1

然后，我们便可以在PC1上尝试Ping路由器：



```

[Connection to 192.168.1.1 closed by foreign host]
C:>telnet 192.168.1.1 ...Open
User Access Verification
Password:
Router>
[Connection to 192.168.1.1 closed by foreign host]
C:>ping 192.168.1.1
Pinging 192.168.1.1 with 32 bytes of data:
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:>ping 10.0.1.1
Pinging 10.0.1.1 with 32 bytes of data:
Reply from 10.0.1.1: bytes=32 time<1ms TTL=255
Reply from 10.0.1.1: bytes=32 time=19ms TTL=255
Reply from 10.0.1.1: bytes=32 time<1ms TTL=255
Reply from 10.0.1.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.0.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 19ms, Average = 4ms

C:>

```

也可以ping通同一子网的其他设备（如Server1）：

```

C:>ping 10.0.1.1
Pinging 10.0.1.1 with 32 bytes of data:
Reply from 10.0.1.1: bytes=32 time<1ms TTL=255
Reply from 10.0.1.1: bytes=32 time=19ms TTL=255
Reply from 10.0.1.1: bytes=32 time<1ms TTL=255
Reply from 10.0.1.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.0.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 19ms, Average = 4ms

C:>ping 10.0.1.2
Pinging 10.0.1.2 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.0.1.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:>ping 192.168.1.3
Pinging 192.168.1.3 with 32 bytes of data:
Reply from 192.168.1.3: bytes=32 time=1ms TTL=128
Reply from 192.168.1.3: bytes=32 time<1ms TTL=128
Reply from 192.168.1.3: bytes=32 time<1ms TTL=128
Reply from 192.168.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:>

```

3. 要点防卫

YHQL, YLGL, YLFL 是加密后的 VENI, VIDI, VICI (I came, I saw, I conquered), 加密方式是 Caesar密码的加密方式 ($c = (m + 3) \bmod 26$)。

与作业要求的对应关系一致，将**Router1**的三个密码设置为（且都为密文储存）：

```
1 password1=venividivici
2 password2=VENIVIDIVICI
3 password3=VeniVidiVici
```

利用 show running-config , 可以看到:

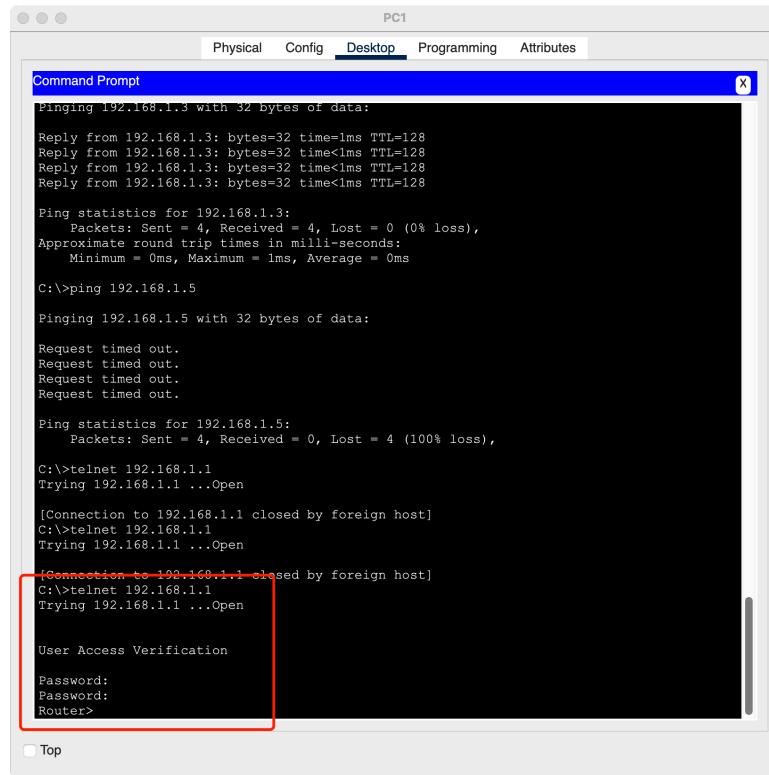
```
enable secret 5 $1$mEr$SKFV/oW/sAldSseZvEUESY0

line con 0
password 7 08374940000F0C131B1D050723
login
!
line aux 0
!
line vty 0
password 7 08174940002F0C131B3D050723
login
line vty 1 4
login
!
```

利用Console登陆Router1时，需要输入密码：



利用telnet访问Router1时，需要输入密码：



开启特权模式时，也需要输入密码：

```
Router>enable
Password:
Router#
```

如果路由器配置文件可能泄露，你的设置是否有所变化？

由于配置文件中的密码是以密文存储的，故（在密文不被破译的情况下），我们的设置可以不变。

复杂度分析

首先，字条上的内容经过RSA解密后是：“注意题目中的混合，考虑容斥原理”。

- 总长六位的纯数字密码
 - 每个位有10种可能，故总共是 10^6 个时间单位。
- 总长六位的混合有数字及小写字母的密码
 - 总长六位的只有数字的密码共 10^6 个可能，总长六位的只有小写字母的密码共 26^6 个可能，总长六位的由数字和小写字母的密码（即每一位既可以是数字，也可以是小写字母）共 36^6 个可能。
 - 前两个集合不相交，故总长六位的混合有数字及小写字母的密码共有 $36^6 - 10^6 - 26^6 = 1866866550 \approx 1.87 \times 10^9$ 种可能。
- 总长六位的混合有数字、大写字母、小写字母的密码
 - 记 U = 总长为六位的由数字、大写字母、小写字母的密码（每一位有62种可能）， $|U| = 62^6$ 。
 - 记 S = 总长六位的混合有数字、大写字母、小写字母的密码，
 A = 总长六位的不含数字的密码， B = 总长六位不含大写字母的密码，
 C = 总长六位不含小写字母的密码。 $|S| = |U| - |A \cup B \cup C|$ 。
 - 由容斥原理，
$$|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |A \cap C| - |B \cap C| + |A \cap B \cap C| \\ = 52^6 + 36^6 + 36^6 - 26^6 - 26^6 - 10^6 + 0 = 23505342784 \quad (1)$$
 - 故 $|S| = 62^6 - 23505342784 = 33294892800 \approx 3.33 \times 10^{10}$ 。
- 总长八位的混合有数字、大写字母、小写字母的密码
 - 计算方式与上一样， $|S| = 62^8 - (52^8 + 36^8 + 36^8 - 26^8 - 26^8 - 10^8) = 159655911367680 \approx 1.60 \times 10^{14}$ 。

4. “三权”间的初步通信

为Router1增加的静态路由为：

```
1 ip route 192.168.2.0 255.255.255.0 10.0.1.2
2 ip route 192.168.3.0 255.255.255.0 10.0.1.2
```

Router2:

```
1 ip route 192.168.1.0 255.255.255.0 10.0.1.1  
2 ip route 192.168.3.0 255.255.255.0 10.0.2.1
```

Router3:

```
1 ip route 192.168.1.0 255.255.255.0 10.0.2.2  
2 ip route 192.168.2.0 255.255.255.0 10.0.2.2
```

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```
PC1  
Physical Config Desktop Programming Attributes  
Command Prompt  
Pinging 192.168.3.3 with 32 bytes of data:  
Request timed out.  
Reply from 192.168.3.3: bytes=32 time<1ms TTL=125  
Reply from 192.168.3.3: bytes=32 time<1ms TTL=125  
Reply from 192.168.3.3: bytes=32 time<1ms TTL=125  
Ping statistics for 192.168.3.3:  
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 0ms, Maximum = 0ms, Average = 0ms  
C:\>ping 192.168.3.3  
Pinging 192.168.3.3 with 32 bytes of data:  
Reply from 192.168.3.3: bytes=32 time=34ms TTL=125  
Reply from 192.168.3.3: bytes=32 time<1ms TTL=125  
Reply from 192.168.3.3: bytes=32 time<1ms TTL=125  
Reply from 192.168.3.3: bytes=32 time=1ms TTL=125  
Ping statistics for 192.168.3.3:  
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 0ms, Maximum = 34ms, Average = 8ms  
C:\>ping 192.168.2.3  
Pinging 192.168.2.3 with 32 bytes of data:  
Reply from 192.168.2.3: bytes=32 time=9ms TTL=126  
Reply from 192.168.2.3: bytes=32 time<1ms TTL=126  
Reply from 192.168.2.3: bytes=32 time=1ms TTL=126  
Reply from 192.168.2.3: bytes=32 time<1ms TTL=126  
Ping statistics for 192.168.2.3:  
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 0ms, Maximum = 9ms, Average = 2ms  
C:\>  
Top
```

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PC2

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:>ping 192.168.3.2

Pinging 192.168.3.2 with 32 bytes of data:

Request timed out.
Reply from 192.168.3.2: bytes=32 time=1ms TTL=126
Reply from 192.168.3.2: bytes=32 time=31ms 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 = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 31ms, Average = 10ms

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=1ms 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 = 1ms, Average = 0ms

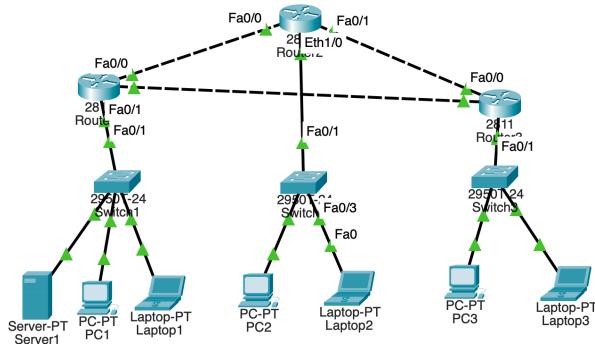
C:>
```

Top

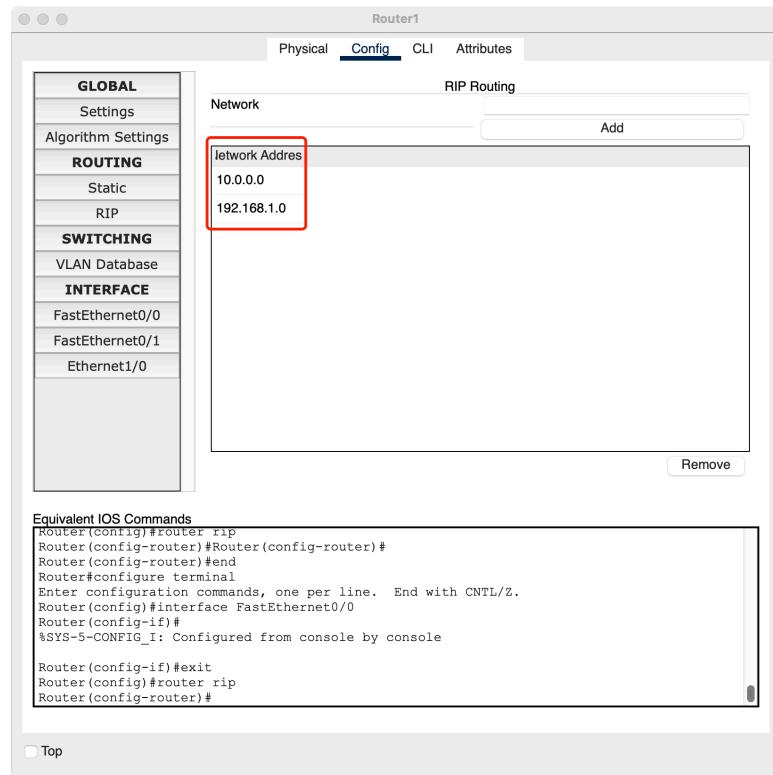
5. 三权间的高效通信

我最终决定选择动态路由协议维护“共和国”目前的局域网。

拓扑结构



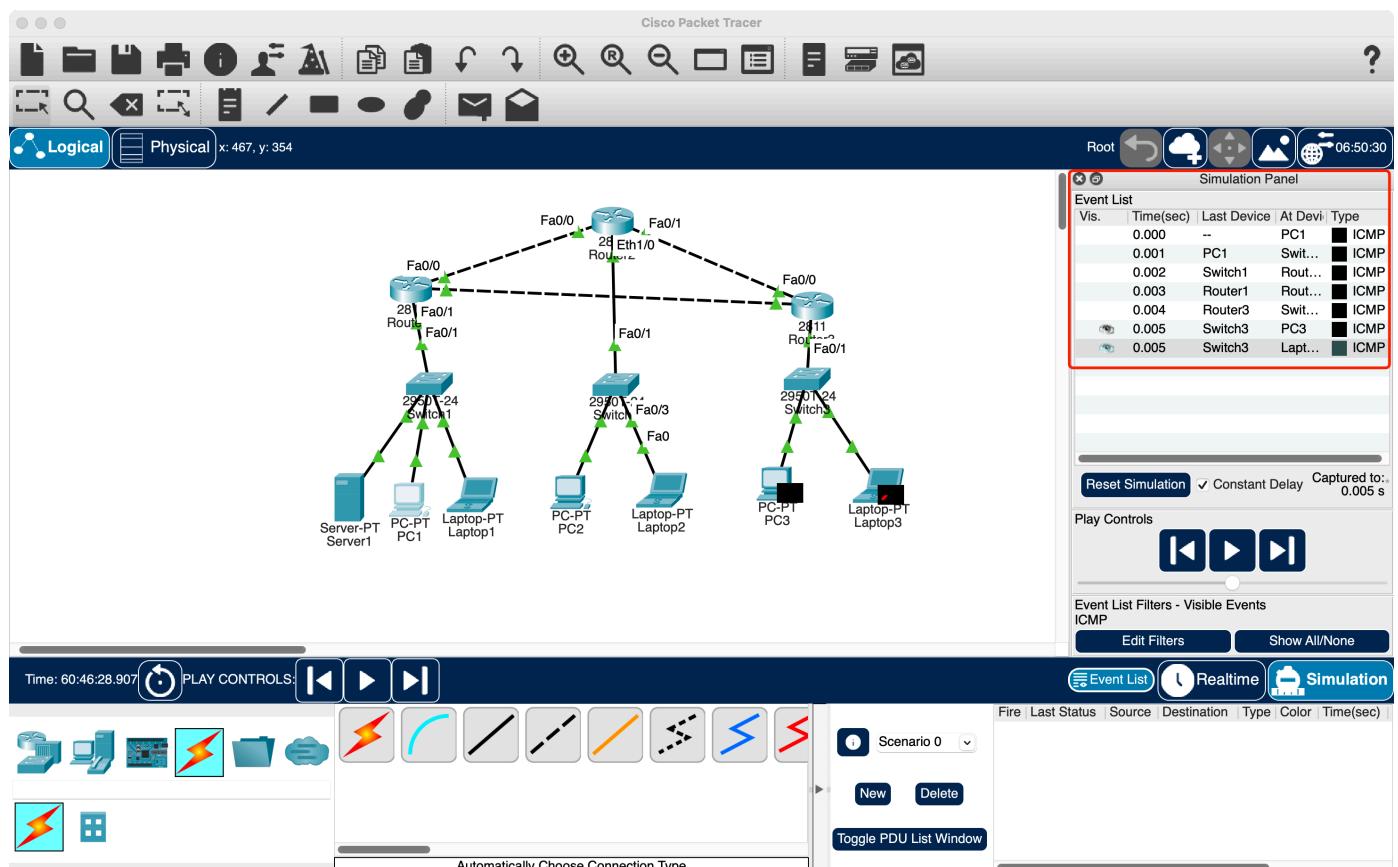
增加的动态路由设置如下（删去了先前的静态路由设置）：



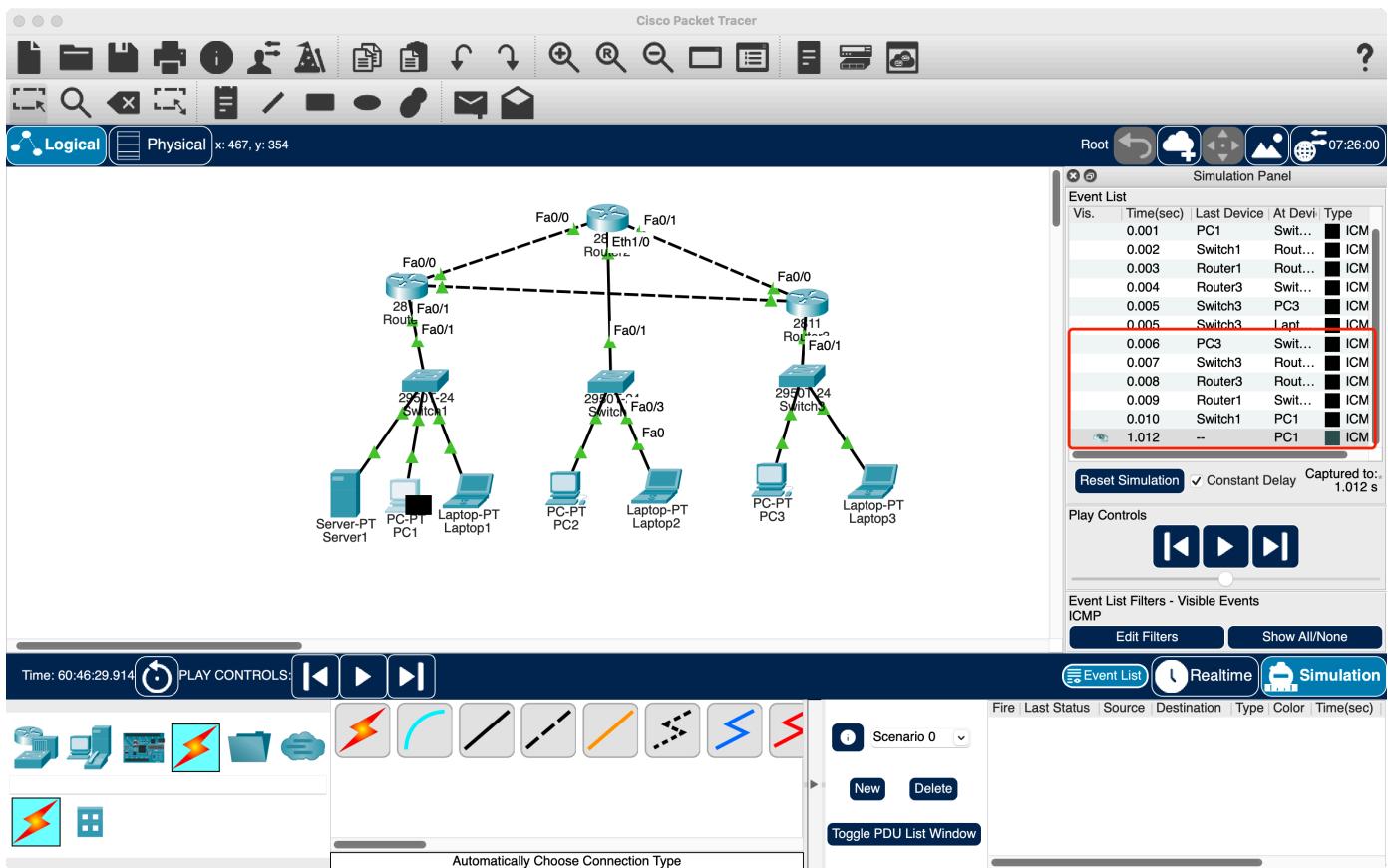
Router2, Router3类似。

实际路径

打开simulation mode之后，从192.168.1.2 ping 192.168.3.2，如下图：



可以看到，路径是PC1 -> Router1 -> Router3 -> PC3。从PC3发回来的包也是如此：



包的路径为 $PC3 \rightarrow Router3 \rightarrow Router1 \rightarrow PC1$ 。

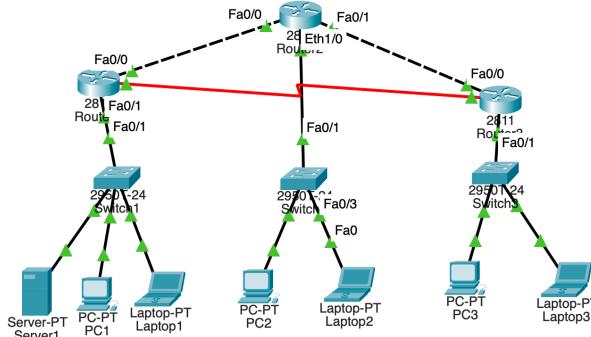
凯撒的观点

凯撒的观点存在问题：只要路径跳数小于16条，那么就可以使用RIP协议。这与总的设备数无关，只和经过的路由器数目有关。

当前可以使用RIP作为路由协议，因为路由器数目为3，最长跳数不可能超过16。

Bonus：布鲁托的要求

我们利用OSPF技术实现这里的要求。首先，我们将连接Router1和Router3改为使用串口连接。



然后，我们对三个路由器都设置OSPF协议（RIP协议已删除）：

Router1

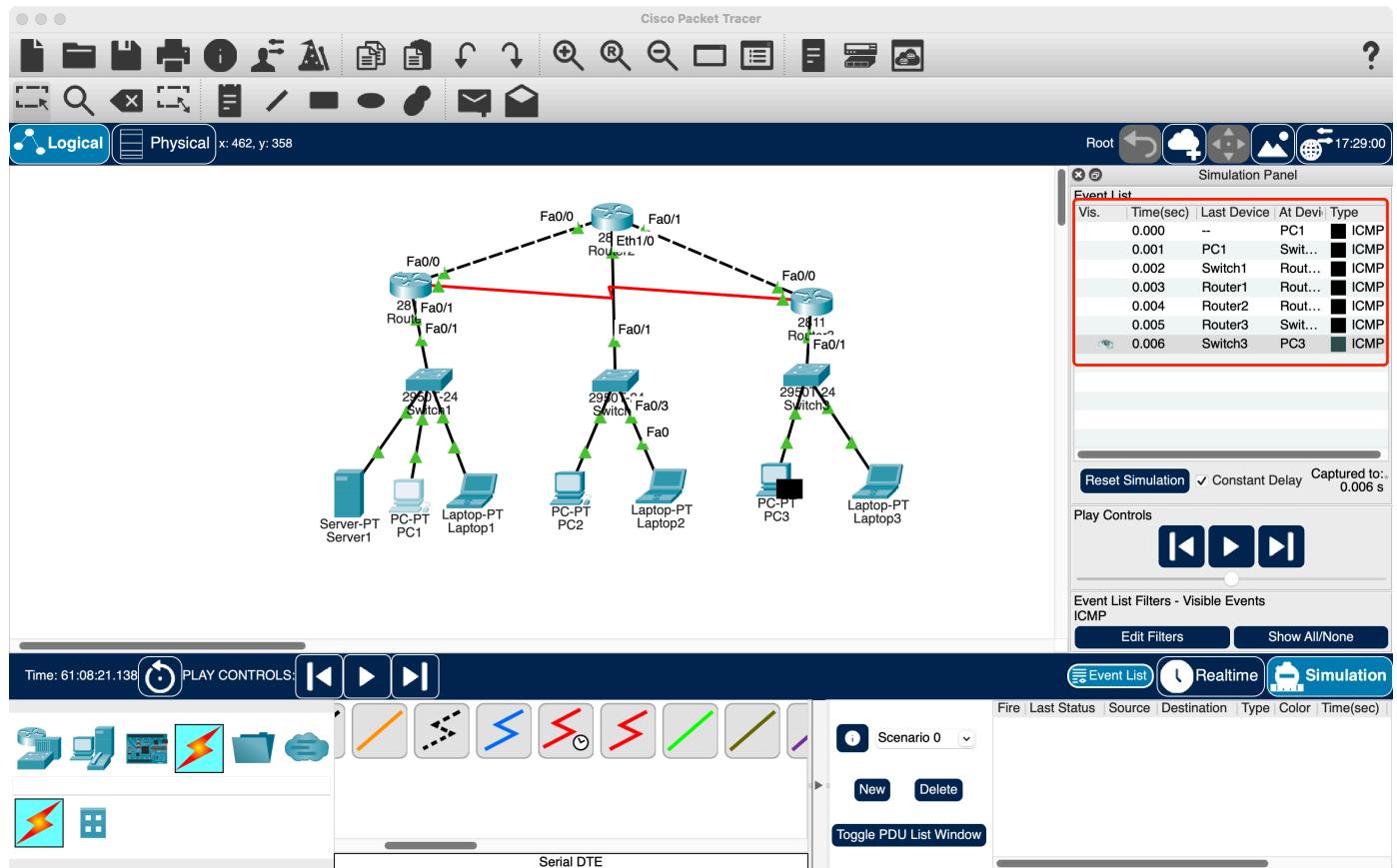
Physical Config **CLI** Attributes

IOS Command Line Interface

```
Router(config-if)#  
Router(config-if)#exit  
Router(config)#interface FastEthernet0/1  
Router(config-if)#  
Router(config-if)#exit  
Router(config)#interface FastEthernet0/0  
Router(config-if)#  
Router(config-if)#exit  
Router(config)#interface FastEthernet0/1  
Router(config-if)#  
Router(config-if)#exit  
Router(config)#interface Serial1/0  
Router(config-if)#  
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/0, changed state to up  
ip address 10.0.3.1 255.255.255.0  
Router(config-if)#Router(config-if)#  
Router(config-if)#exit  
Router(config)#interface Serial1/0  
Router(config-if)%# Bad secrets  
  
Router(config-if)#  
Router(config-if)#exit  
Router(config)#router rip  
Router(config-router)#no network 10.0.0.0  
Router(config-router)#no network 192.168.1.0  
Router(config-router)%# Bad secrets  
  
Router(config-router)#exit  
Router(config)#router ospf 1  
Router(config-router)#network 192.168.1.0 255.255.255.0 area 0  
Router(config-router)#network 10.0.0.0 255.0.0.0 area 0  
Router(config-router)#  
00:12:50: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.2.1 on FastEthernet0/0 from LOADING to  
FULL, Loading Done  
  
00:13:40: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.3.1 on Serial1/0 from LOADING to FULL,  
Loading Done
```

这里以Router1为例，其他两个路由器类似。

最后，我们观察从PC1 ping PC3的过程：



可以看到，这时包的路线是PC1 -> Router1 -> Router2 -> Router3（而不是直接从Router1到Router3），执政官首府可以获取元老院和部族会议所之间的消息。