



## 计算机网络课程报告

### 仿真实验三 综合组网设计实验 (新老校区网络模拟)

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## 一、实验名称

仿真实验三：综合组网设计实验(新老校区网络模拟)

## 二、实验内容

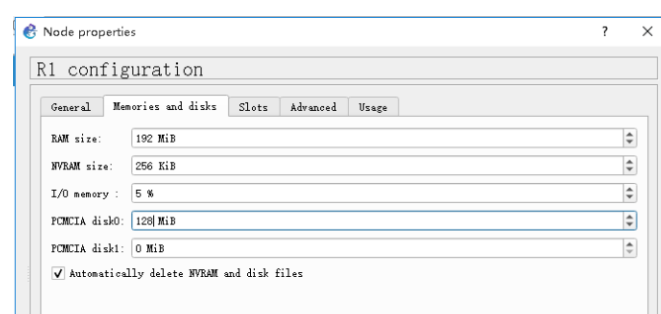
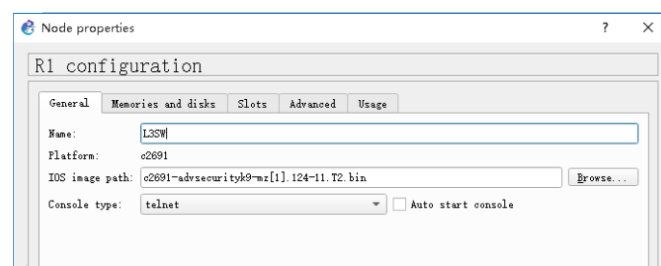
- 1、熟悉 GNS3 操作环境;
- 2、根据标准实验“路由实验 v2”“交换实验 v2”“综合实验一 v2”“综合实验二 v2”“防火墙实验 v2”熟悉配置方法，设计并模拟实现天津大学两个校区之间的校园网连接。

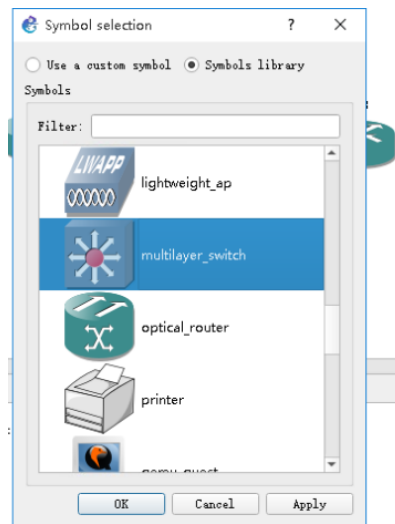
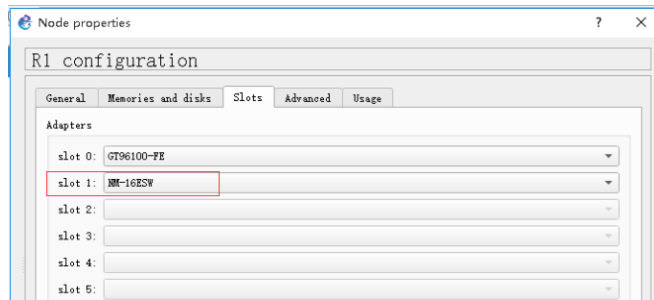
要求：每个校区需支持 4 个学院使用校园网，老校区学院 1 至 4 最多支持的设备数为 2000、4000、4000、6000，新校区学院 5 至 8 最多支持的设备数为 1000、2000、4000、8000，请给出两个校区 IP block 区间。在新校区，学院 5 与学院 6 两个学院物理位置相邻共享一个路由器，使用 VLAN 技术设置为不同的子网，并给出每个学院的地址块。给出每个路由器、交换机的端口数。测试网络连通性后，在老校区架设一台 HTTP 服务器，指定域名(www.tju.edu.cn)、IP，在新老校区各架设一台 DNS 服务器，实现新老校区均可以使用 www.tju.edu.cn 访问 HTTP 服务器。

## 三、实验步骤

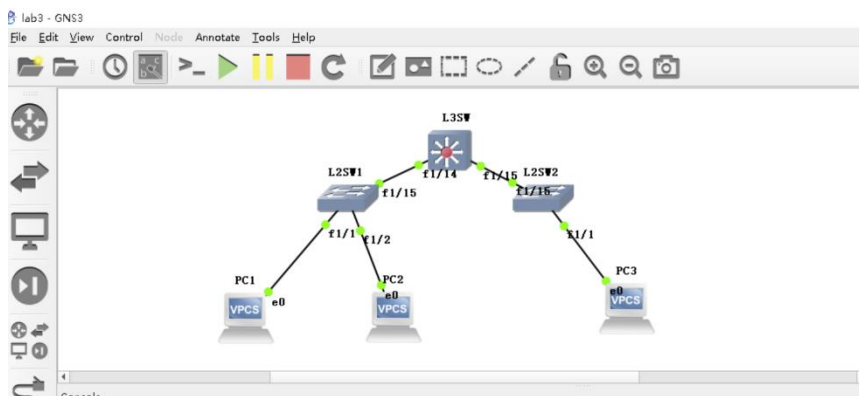
- 1、用多台交换机组成局域网，并熟悉三层交换机配置、vlan 配置

1.1 使用 c2691 路由器模拟交换机的方法，以三层交换机为例。





2、建立如下图所示拓扑，并为 PC 配置 IP 地址、掩码、网关。



PC1 的配置为:

IP: 172.16.1.100

Mask: 255.255.128.0

Gateway: 172.16.0.1

PC2 的配置为:

IP: 172.16.128.100

Mask: 255.255.128.0

Gateway: 172.16.128.1

PC3 的配置为:

IP: 172.16.129.100

Mask: 255.255.128.0

Gateway: 172.16.128.1

```
PC1> ip 172.16.1.100 255.255.128.0 172.16.0.1
Checking for duplicate address...
PC1 : 172.16.1.100 255.255.128.0 gateway 172.16.0.1

PC1> save
Saving startup configuration to startup.vpc
. done

PC1> █
```

```
PC2> ip 172.16.128.100 255.255.128.0 172.16.128.1
Checking for duplicate address...
PC1 : 172.16.128.100 255.255.128.0 gateway 172.16.128.1

PC2> save
Saving startup configuration to startup.vpc
. done

PC2> █
```

```
PC3> ip 172.16.129.100 255.255.128.0 172.16.128.1
Checking for duplicate address...
PC1 : 172.16.129.100 255.255.128.0 gateway 172.16.128.1

PC3> save
Saving startup configuration to startup.vpc
. done

PC3> █
```

这里使用了三层交换机进行 vlan 间路由。由于端口没有接入外网，因此配置回环地址进行联通测试。配置方法如下：

```
L3SW#
L3SW#conf t
Enter configuration commands, one per line. End with CNTL/Z.
L3SW(config)#int loopback 0
L3SW(config-if)#
*Mar 1 00:00:51.415: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up
L3SW(config-if)#ip add 100.100.100.100 255.255.255.0
L3SW(config-if)#exit
L3SW(config)#exit
L3SW#
*Mar 1 00:01:20.551: %SYS-5-CONFIG_I: Configured from console by console
L3SW#wr
Building configuration...
[OK]
L3SW#
```

输入命令查看配置结果，配置结果如下图所示：

```
L3SW#wr
Building configuration...
[OK]
L3SW#show ip int b
Interface                IP-Address      OK? Method Status              Protocol
FastEthernet0/0          unassigned      YES unset              administratively down down
Serial0/0                 unassigned      YES unset              administratively down down
FastEthernet0/1          unassigned      YES unset              administratively down down
Serial0/1                 unassigned      YES unset              administratively down down
FastEthernet1/0           unassigned      YES unset              up                  down
FastEthernet1/1           unassigned      YES unset              up                  down
FastEthernet1/2           unassigned      YES unset              up                  down
FastEthernet1/3           unassigned      YES unset              up                  down
FastEthernet1/4           unassigned      YES unset              up                  down
FastEthernet1/5           unassigned      YES unset              up                  down
FastEthernet1/6           unassigned      YES unset              up                  down
FastEthernet1/7           unassigned      YES unset              up                  down
FastEthernet1/8           unassigned      YES unset              up                  down
FastEthernet1/9           unassigned      YES unset              up                  down
FastEthernet1/10          unassigned      YES unset              up                  down
FastEthernet1/11          unassigned      YES unset              up                  down
FastEthernet1/12          unassigned      YES unset              up                  down
FastEthernet1/13          unassigned      YES unset              up                  down
FastEthernet1/14          unassigned      YES unset              up                  up
FastEthernet1/15          unassigned      YES unset              up                  up
Vlan1                     unassigned      YES unset              up                  up
Loopback0                 100.100.100.100 YES manual          up                  up
L3SW#
L3SW#
```

### 3、在三层交换机中配置 vlan

首先，进入命令行界面，先在 vlan 数据库中建立 vlan100 和 vlan200。

```
L3SW#vlan data
% Warning: It is recommended to configure VLAN from config mode,
as VLAN database mode is being deprecated. Please consult user
documentation for configuring VTP/VLAN in config mode.

L3SW(vlan)#vlan 100
VLAN 100 added:
    Name: VLAN0100
L3SW(vlan)#vlan 200
VLAN 200 added:
    Name: VLAN0200
L3SW(vlan)#exit
APPLY completed.
Exiting....
L3SW#
```

然后，进入配置模式，对 vlan100 与 vlan200 接口配置 IP 地址，并开启端口。

```
Exiting....
L3SW#
L3SW#conf t
Enter configuration commands, one per line. End with CNTL/Z.
L3SW(config)#int vlan 100
L3SW(config-if)#ip add 172.16.0.1 255.255.128.0
L3SW(config-if)#no sh
L3SW(config-if)#int vlan 200
L3SW(config-if)#exit
L3SW(config)#int vlan 200
L3SW(config-if)#ip add 172.16.128.1 255.255.128.0
L3SW(config-if)#no sh
L3SW(config-if)#exit
L3SW(config)#exit
L3SW#
*Mar 1 00:07:52.547: %SYS-5-CONFIG_I: Configured from console by console
L3SW#wr
Building configuration...
[OK]
L3SW#
```

正确配置结果如下图所示：

```
[OK]
L3SW#
L3SW#show ip int b
```

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	unassigned	YES	unset	administratively down	down
Serial0/0	unassigned	YES	unset	administratively down	down
FastEthernet0/1	unassigned	YES	unset	administratively down	down
Serial0/1	unassigned	YES	unset	administratively down	down
FastEthernet1/0	unassigned	YES	unset	up	down
FastEthernet1/1	unassigned	YES	unset	up	down
FastEthernet1/2	unassigned	YES	unset	up	down
FastEthernet1/3	unassigned	YES	unset	up	down
FastEthernet1/4	unassigned	YES	unset	up	down
FastEthernet1/5	unassigned	YES	unset	up	down
FastEthernet1/6	unassigned	YES	unset	up	down
FastEthernet1/7	unassigned	YES	unset	up	down
FastEthernet1/8	unassigned	YES	unset	up	down
FastEthernet1/9	unassigned	YES	unset	up	down
FastEthernet1/10	unassigned	YES	unset	up	down
FastEthernet1/11	unassigned	YES	unset	up	down
FastEthernet1/12	unassigned	YES	unset	up	down
FastEthernet1/13	unassigned	YES	unset	up	down
FastEthernet1/14	unassigned	YES	unset	up	up
FastEthernet1/15	unassigned	YES	unset	up	up
Vlan1	unassigned	YES	unset	up	up
Vlan100	172.16.0.1	YES	manual	up	down
Vlan200	172.16.128.1	YES	manual	up	down
Loopback0	100.100.100.100	YES	manual	up	up

```
L3SW#
L3SW#
```

#### 4、为三层交换机配置路由

首先进入配置模式，开启路由功能，如下图所示：

开启路由功能后，配置 RIPv2 协议，这样 vlan100 与 vlan200 才能通信。

```
L3SW#enable
L3SW#conf t
Enter configuration commands, one per line. End with CNTL/Z.
L3SW(config)#ip routing
L3SW(config)#router rip
L3SW(config-router)#version 2
L3SW(config-router)#network 172.16.0.0
L3SW(config-router)#network 100.100.100.0
L3SW(config-router)#exit
L3SW(config)#
L3SW(config)#
```

#### 5、为三层交换机封装 trunk 链路

将三层交换机的 f1/14 -15 端口封装为 trunk 链路，如下图所示：

```
L3SW(config-router)#exit
L3SW(config)#
L3SW(config)#int range f1/14 - 15
L3SW(config-if-range)#sw tr en dot
L3SW(config-if-range)#sw mo tr
L3SW(config-if-range)#
*Mar 1 00:13:05.955: %DTP-5-TRUNKPORTON: Port Fa1/14-15 has become dot1q trunk
*Mar 1 00:13:06.459: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan100, changed state to up
*Mar 1 00:13:06.467: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan200, changed state to up
L3SW(config-if-range)#
```

#### 6、配置二层交换机

1) 为二层交换机添加 vlan100 与 vlan200，并将 ‘L2SW1’ 的 f1/1 端口分配给 vlan100，将 ‘L2SW1’ 的 f1/2 端口分配给 vlan200，将 ‘L2SW2’ 的 f1/1 端口分配给 vlan200。

以 L2SW1 为例，配置如下：

```

L2SW1#vlan data
% Warning: It is recommended to configure VLAN from config mode,
as VLAN database mode is being deprecated. Please consult user
documentation for configuring VTP/VLAN in config mode.

L2SW1(vlan)#vlan 100
VLAN 100 added:
    Name: VLAN0100
L2SW1(vlan)#vlan 200
VLAN 200 added:
    Name: VLAN0200
L2SW1(vlan)#exit
APPLY completed.
Exiting...
L2SW1#

```

```

L2SW1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
L2SW1(config)#no ip routing
L2SW1(config)#int f1/1
L2SW1(config-if)#sw acc vlan 100
L2SW1(config-if)#exit
L2SW1(config)#int f1/2
L2SW1(config-if)#sw acc vlan 200
L2SW1(config-if)#exit
L2SW1(config)#

```

注释：交换机是用路由器模拟的，所以要关掉 routing。

查看是否配置成功：do show vlan-sw b

```

L2SW1(config)#
L2SW1(config)#do show vlan-sw b

```

VLAN	Name	Status	Ports
1	default	active	Fa1/0, Fa1/3, Fa1/4, Fa1/5 Fa1/6, Fa1/7, Fa1/8, Fa1/9 Fa1/10, Fa1/11, Fa1/12, Fa1/13 Fa1/14, Fa1/15
100	VLAN0100	active	Fa1/1
200	VLAN0200	active	Fa1/2
1002	fddi-default	act/unsup	
1003	token-ring-default	act/unsup	
1004	fddinet-default	act/unsup	
1005	trnet-default	act/unsup	

```

L2SW1(config)#

```

2) 为二层交换机封装 trunk 链路。

将二层交换机 L2SW1 的 f1/15 端口封装为 trunk 链路，将二层交换机 L2SW2 的 f1/15 端口封装为 trunk 链路。

```

L2SW1(config)#
L2SW1(config)#int f1/15
L2SW1(config-if)#sw mo t
L2SW1(config-if)#
*Mar 1 00:12:16.119: %DTP-5-TRUNKPORTON: Port Fa1/15 has become dot1q trunk
L2SW1(config-if)#sw t en
% Incomplete command.

L2SW1(config-if)#sw t en dot
L2SW1(config-if)#do show int f1/15 switchport
Name: Fa1/15
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: Disabled
Access Mode VLAN: 0 ((Inactive))
Trunking Native Mode VLAN: 1 (default)
Trunking VLANs Enabled: ALL
Trunking VLANs Active: 1,100,200
Priority for untagged frames: 0
Override vlan tag priority: FALSE
Voice VLAN: none
Appliance trust: none
L2SW1(config-if)#

```

## 7. 测试网络连通性

sh ip route 查看三层交换机的路由表:

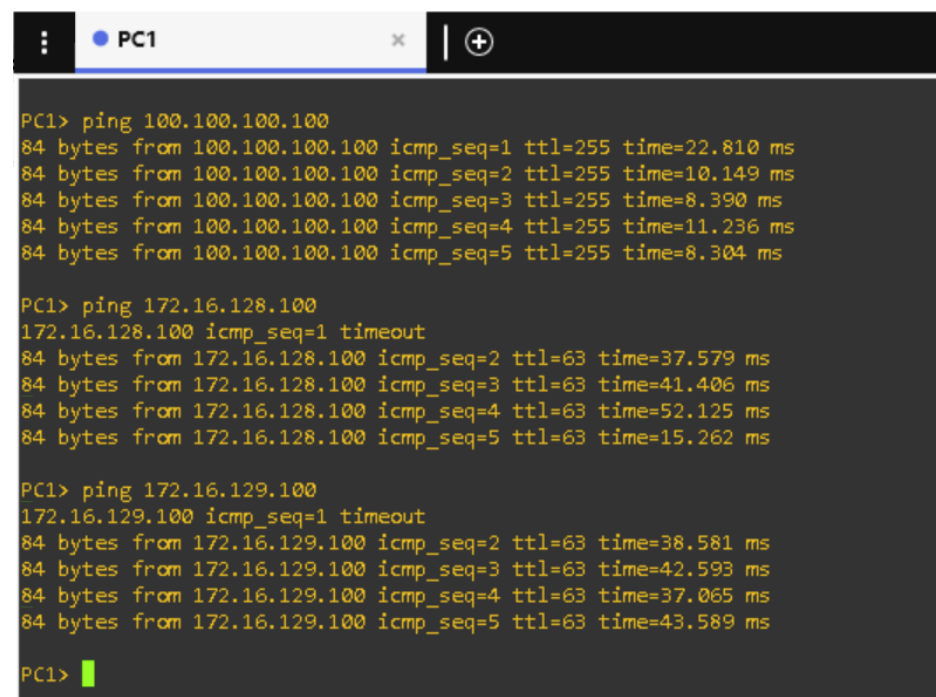
```
100.24.152.403: 3513-3-Com ID_1: Configured from console by console
L3SW#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, 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

100.0.0.0/24 is subnetted, 1 subnets
C       100.100.100.0 is directly connected, Loopback0
172.16.0.0/17 is subnetted, 2 subnets
C       172.16.128.0 is directly connected, Vlan200
C       172.16.0.0 is directly connected, Vlan100
L3SW#
```

PC1 上 ping 测试:

ping 100.100.100.100, ping 172.16.128.100, ping 172.16.129.100 均能 ping 通



```
PC1> ping 100.100.100.100
84 bytes from 100.100.100.100 icmp_seq=1 ttl=255 time=22.810 ms
84 bytes from 100.100.100.100 icmp_seq=2 ttl=255 time=10.149 ms
84 bytes from 100.100.100.100 icmp_seq=3 ttl=255 time=8.390 ms
84 bytes from 100.100.100.100 icmp_seq=4 ttl=255 time=11.236 ms
84 bytes from 100.100.100.100 icmp_seq=5 ttl=255 time=8.304 ms

PC1> ping 172.16.128.100
172.16.128.100 icmp_seq=1 timeout
84 bytes from 172.16.128.100 icmp_seq=2 ttl=63 time=37.579 ms
84 bytes from 172.16.128.100 icmp_seq=3 ttl=63 time=41.406 ms
84 bytes from 172.16.128.100 icmp_seq=4 ttl=63 time=52.125 ms
84 bytes from 172.16.128.100 icmp_seq=5 ttl=63 time=15.262 ms

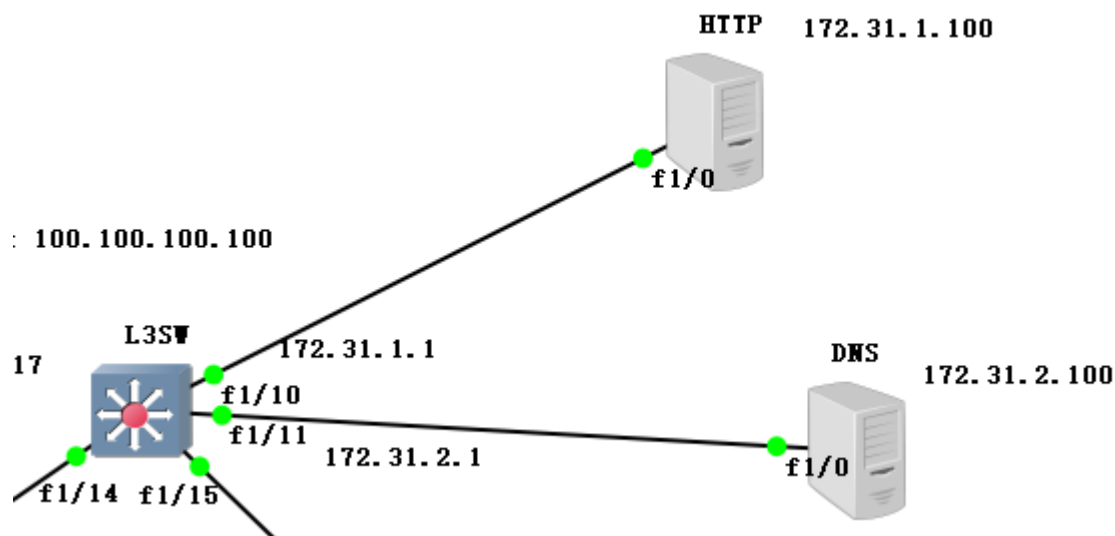
PC1> ping 172.16.129.100
172.16.129.100 icmp_seq=1 timeout
84 bytes from 172.16.129.100 icmp_seq=2 ttl=63 time=38.581 ms
84 bytes from 172.16.129.100 icmp_seq=3 ttl=63 time=42.593 ms
84 bytes from 172.16.129.100 icmp_seq=4 ttl=63 time=37.065 ms
84 bytes from 172.16.129.100 icmp_seq=5 ttl=63 time=43.589 ms

PC1>
```

测试成功。



## 4.2 熟悉 DNS 服务器与 HTTP 服务器的配置



(HTTP 服务器和 DNS 服务器使用路由器 c2691 来模拟)

已按上图成功搭建模型。

1. 添加两台服务器，将其连接到三层交换机上，并按上图所示配置 IP 地址，三层交换机对应端口配置如下(以 f1/10 为例):

```
L3SW#conf t
Enter configuration commands, one per line. End with CNTL/Z.
L3SW(config)#int f1/10
L3SW(config-if)#no sw
L3SW(config-if)#
*Mar 1 03:21:05.015: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/10, changed state to up
*Mar 1 03:21:05.155: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/11, changed state to up
L3SW(config-if)#ip add 172.31.1.1 255.255.255.0
L3SW(config-if)#no sh
L3SW(config-if)#exit
L3SW(config)#int f1/11
L3SW(config-if)#no sw
L3SW(config-if)#ip add
*Mar 1 03:21:40.899: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/11, changed state to up
L3SW(config-if)#ip add 172.31.2.1 255.255.255.0
L3SW(config-if)#no sh
L3SW(config-if)#exit
L3SW(config)#exit
L3SW#wr
*Mar 1 03:22:12.815: %SYS-5-CONFIG_I: Configured from console by console
L3SW#wr
Building configuration...
[OK]
L3SW#
```

三层交换机 ip 配置完成。

2. 配置 HTTP 服务器，配置其 ip、路由，开启 HTTP 服务。如下图所示:

```

HTTP#conf t
Enter configuration commands, one per line. End with CNTL/Z.
HTTP(config)#int f1/0
HTTP(config-if)#no sw
HTTP(config-if)#
*Mar 1 00:18:54.907: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to down
HTTP(config-if)#ip ad
*Mar 1 00:18:56.999: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0, changed state to up
HTTP(config-if)#ip address 172.31.1.100 255.255.255.0
HTTP(config-if)#no sh
HTTP(config-if)#exit
HTTP(config)#
HTTP(config)#ip route 0.0.0.0 0.0.0.0 172.31.1.1
HTTP(config)#ip http server
HTTP(config)#ip http secure-server
^
% Invalid input detected at '^' marker.

HTTP(config)#ip http secure-server
% Generating 1024 bit RSA keys, keys will be non-exportable...[OK]

HTTP(config)#
*Mar 1 00:21:14.667: %SSH-5-ENABLED: SSH 1.99 has been enabled
HTTP(config)#
*Mar 1 00:21:15.627: %PKI-4-NOAUTOSAVE: Configuration was modified. Issue "write memory" to save new certificate
HTTP(config)#end
HTTP#wr
Building configuration...

*Mar 1 00:21:39.675: %SYS-5-CONFIG_I: Configured from console by console[OK]
HTTP#

```

HTTP 配置完成。

3. 配置 DNS 服务器，配置其 ip、路由，开启 DNS 服务，并添加一条 IP 为 172.31.1.100 到域名 www.tju.edu.cn 的 DNS 映射。

1) 配置 ip、路由命令同上。

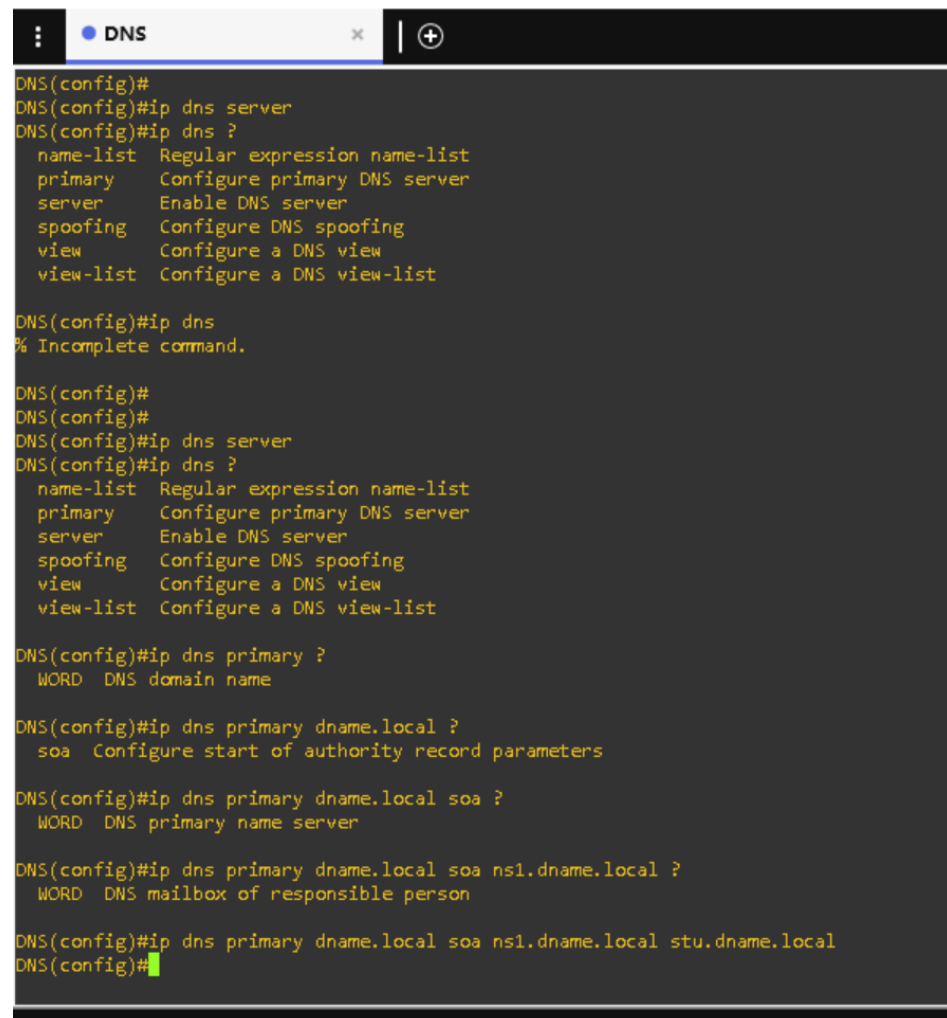
```

DNS#
DNS#enable
DNS#conf t
Enter configuration commands, one per line. End with CNTL/Z.
DNS(config)#int f1/0
DNS(config-if)#no sw
DNS(config-if)#
*Mar 1 00:12:43.859: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to down
DNS(config-if)#ip
*Mar 1 00:12:46.039: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0, changed state to up
DNS(config-if)#ip add 172.31.2.100 255.255.255.0
DNS(config-if)#no sh
DNS(config-if)#exit
DNS(config)#

```

2) 开启 DNS 服务方法如下所示:

结果如下:



```
DNS(config)#
DNS(config)#ip dns server
DNS(config)#ip dns ?
  name-list  Regular expression name-list
  primary    Configure primary DNS server
  server      Enable DNS server
  spoofing   Configure DNS spoofing
  view       Configure a DNS view
  view-list  Configure a DNS view-list

DNS(config)#ip dns
% Incomplete command.

DNS(config)#
DNS(config)#
DNS(config)#ip dns server
DNS(config)#ip dns ?
  name-list  Regular expression name-list
  primary    Configure primary DNS server
  server      Enable DNS server
  spoofing   Configure DNS spoofing
  view       Configure a DNS view
  view-list  Configure a DNS view-list

DNS(config)#ip dns primary ?
  WORD       DNS domain name

DNS(config)#ip dns primary dname.local ?
  soa        Configure start of authority record parameters

DNS(config)#ip dns primary dname.local soa ?
  WORD       DNS primary name server

DNS(config)#ip dns primary dname.local soa ns1.dname.local ?
  WORD       DNS mailbox of responsible person

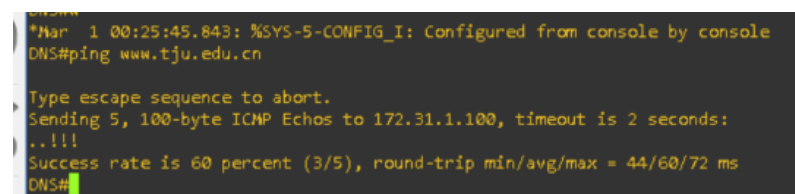
DNS(config)#ip dns primary dname.local soa ns1.dname.local stu.dname.local
DNS(config)#
```

3) 添加域名映射

DNS(config)#ip host www.tju.edu.cn 172.31.1.100

添加成功后可以 ping 通, 如下所示:

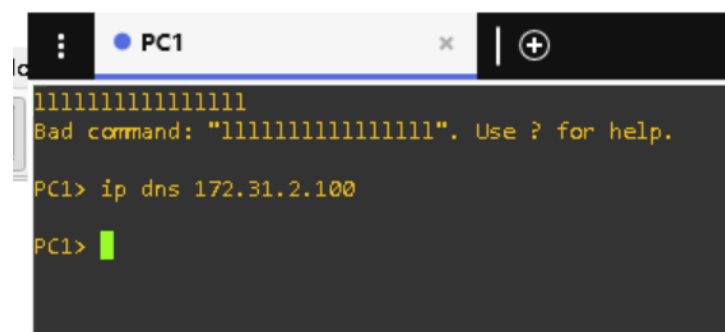
测试成功。



```
*Mar 1 00:25:45.843: %SYS-5-CONFIG_I: Configured from console by console
DNS#ping www.tju.edu.cn

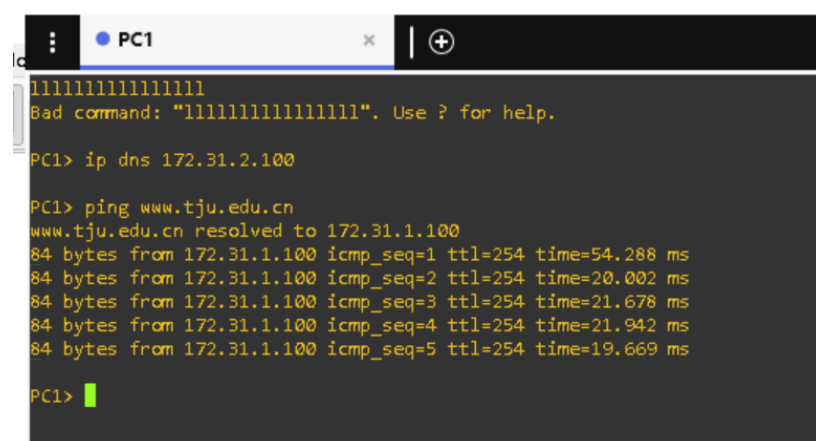
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.31.1.100, timeout is 2 seconds:
.....
Success rate is 60 percent (3/5), round-trip min/avg/max = 44/60/72 ms
DNS#
```

4. 为 PC1 添加 DNS 服务器地址，如下图所示：



```
PC1> ip dns 172.31.2.100
PC1>
```

测试 DNS 服务是否正常：

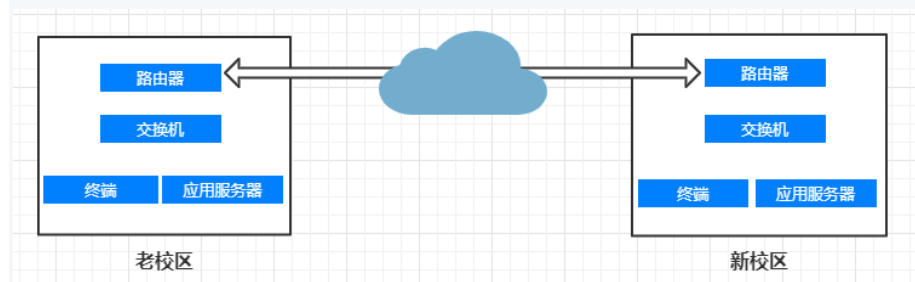


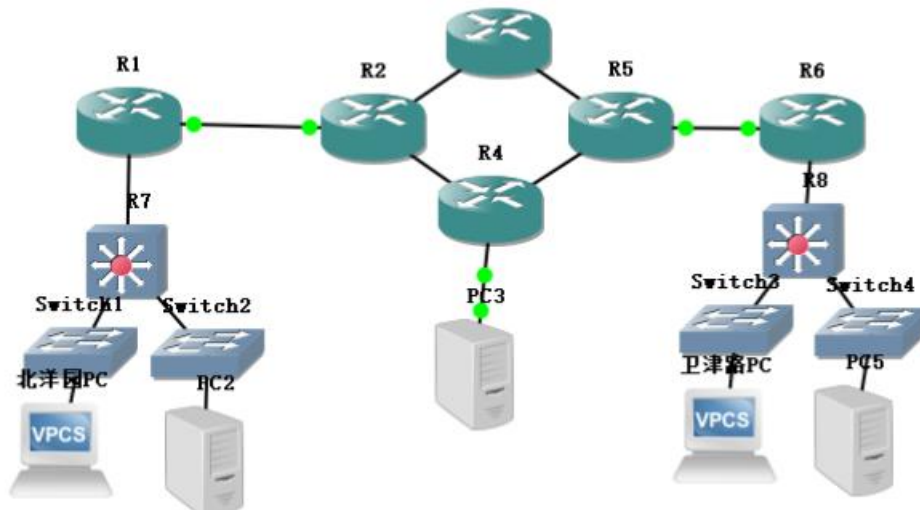
```
PC1> ip dns 172.31.2.100
PC1> ping www.tju.edu.cn
www.tju.edu.cn resolved to 172.31.1.100
84 bytes from 172.31.1.100 icmp_seq=1 ttl=254 time=54.288 ms
84 bytes from 172.31.1.100 icmp_seq=2 ttl=254 time=20.002 ms
84 bytes from 172.31.1.100 icmp_seq=3 ttl=254 time=21.678 ms
84 bytes from 172.31.1.100 icmp_seq=4 ttl=254 time=21.942 ms
84 bytes from 172.31.1.100 icmp_seq=5 ttl=254 time=19.669 ms
PC1>
```

可以 ping 通。

### 4.3 设计并模拟实现天津大学两个校区之间的校园网连接

建立如下网络拓扑并正确配置路由器、交换机、应用服务器的参数，两个校区的 PC 可相互访问，两个校区的 PC 均可通过域名访问放在老校区的 HTTP 服务器，并用 Trace Route 命令查看访问 HTTP 服务器所经过的路由。查看路由器上的路由表。





如图所示。建立模型完毕。

再对新老校区的 PC 机进行 ping 测试，过程如下：

<pre>北洋园PC&gt; ping 172.16.129.1 172.16.129.1 icmp_seq=1 timeout 172.16.129.1 icmp_seq=2 timeout 84 bytes from 172.16.129.1 icmp_seq=3 ttl=63 time=26.431 ms 84 bytes from 172.16.129.1 icmp_seq=4 ttl=63 time=14.820 ms 84 bytes from 172.16.129.1 icmp_seq=5 ttl=63 time=25.616 ms</pre>	<pre>卫津路PC&gt; ping 172.16.128.1 172.16.128.1 icmp_seq=1 timeout 172.16.128.1 icmp_seq=2 timeout 84 bytes from 172.16.128.1 icmp_seq=3 ttl=63 time=29.560 ms 84 bytes from 172.16.128.1 icmp_seq=4 ttl=63 time=30.463 ms 84 bytes from 172.16.128.1 icmp_seq=5 ttl=63 time=26.700 ms</pre>
<pre>北洋园PC&gt; ping vpn.tju.edu.cn vpn.tju.edu.cn resolved to 172.16.129.3 vpn.tju.edu.cn icmp_seq=1 timeout 84 bytes from 172.16.129.3 icmp_seq=2 ttl=63 time=28.481 ms 84 bytes from 172.16.129.3 icmp_seq=3 ttl=63 time=24.322 ms 84 bytes from 172.16.129.3 icmp_seq=4 ttl=63 time=22.742 ms 84 bytes from 172.16.129.3 icmp_seq=5 ttl=63 time=19.924 ms</pre>	<pre>卫津路PC&gt; ping www.tju.edu.cn www.tju.edu.cn resolved to 172.16.128.3 www.tju.edu.cn icmp_seq=1 timeout www.tju.edu.cn icmp_seq=2 timeout 84 bytes from 172.16.128.3 icmp_seq=3 ttl=63 time=21.564 ms 84 bytes from 172.16.128.3 icmp_seq=4 ttl=63 time=15.911 ms 84 bytes from 172.16.128.3 icmp_seq=5 ttl=63 time=27.461 ms</pre>

实验到此结束，成功。