

《计算机网络》实验报告

信息学院 智能科学与技术 专业 2020 级

实验时间 2022 年 12 月 14 日

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实验名称 校园网设计规划

实验成绩

一、实验目的

熟练使用常用的网络搭建中的技术
熟悉掌握模拟软件 Packet Tracer 的使用

二、实验仪器设备及软件

Packet Tracer 8.2.0

三、实验方案

首先搭建起完整的网络拓扑，随后依次划分子网、划分 vlan、分配 IP 地址，将基本的网络框架搭建起来。随后在此基础上增添各项功能与约束，使各项功能都完备起来，完成校园网的搭建。

四、实验步骤

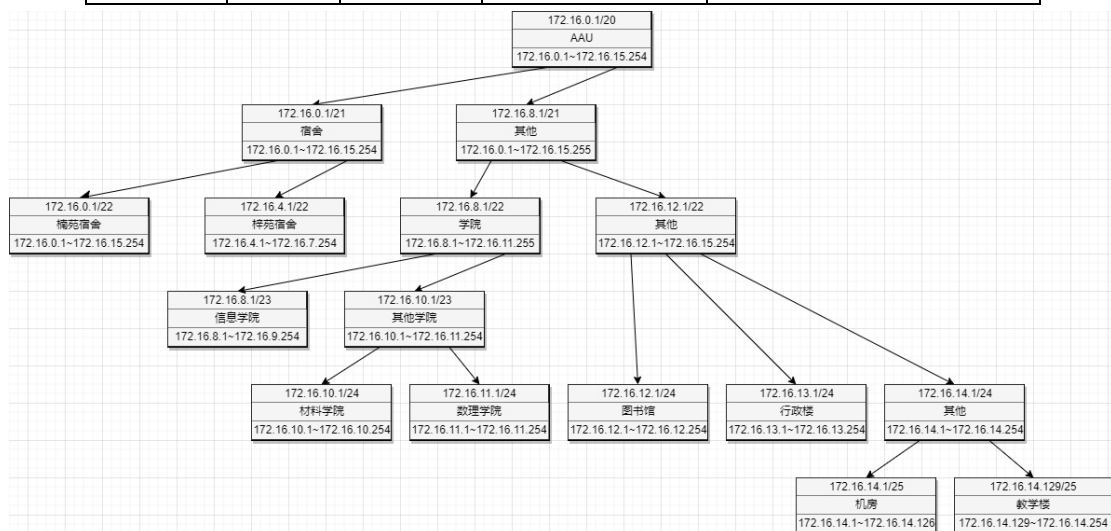
1. 搭建网络拓扑

过程略

2. 划分校园网的子网与 VLAN 划分

区域	主机数	VLAN 号	子网网段	IP 地址范围
机房	100	VLAN10	172.16.14.0/25	172.16.14.1-172.16.14.126
行政楼	200	VLAN20	172.16.13.0/24	172.16.13.1-172.16.13.254
教学楼	100	VLAN30	172.16.14.128/25	172.16.14.129-172.14.254
图书馆	200	VLAN40	172.16.12.0/24	172.16.12.1-172.16.12.254
信息学院	500	VLAN50	172.16.8.0/23	172.16.8.1-172.16.9.254
材料学院	200	VLAN60	172.16.10.0/24	172.16.10.1-172.16.10.254

数理学院	200	VLAN70	172.16.11.0/24	172.16.11.1-172.16.11.254
楠苑宿舍	850	VLAN80	172.16.0.0/22	172.16.0.1-172.16.3.254
梓苑宿舍	850	VLAN90	172.16.4.0/22	172.16.4.1-172.16.7.254



子网划分的规划如上图所示。

(1) 核心三层交换机 1 配置 VLAN

```

SwitchCore1(config-if)#standby 40 track f0/2
SwitchCore1(config-if)#ex
SwitchCore1(config)#
SwitchCore1(config)#int vlan 50
SwitchCore1(config-if)#ip address 172.16.8.1 255.255.255.0
SwitchCore1(config-if)#standby 50 ip 172.16.9.254
SwitchCore1(config-if)#standby 50 track f0/1
SwitchCore1(config-if)#standby 50 track f0/2
SwitchCore1(config-if)#ex
SwitchCore1(config)#
SwitchCore1(config)#int vlan 60
SwitchCore1(config-if)#ip address 172.16.10.1 255.255.255.0
SwitchCore1(config-if)#standby 60 ip 172.16.10.254
SwitchCore1(config-if)#standby 60 track f0/1
SwitchCore1(config-if)#standby 60 track f0/2
SwitchCore1(config-if)#ex
SwitchCore1(config)#
SwitchCore1(config)#int vlan 70
SwitchCore1(config-if)#ip address 172.16.11.1 255.255.255.0
SwitchCore1(config-if)#standby 70 ip 172.16.11.254
SwitchCore1(config-if)#standby 70 track f0/1
SwitchCore1(config-if)#standby 70 track f0/2
SwitchCore1(config-if)#ex
SwitchCore1(config)#
SwitchCore1(config)#int vlan 80
SwitchCore1(config-if)#ip address 172.16.0.1 255.255.252.0
SwitchCore1(config-if)#standby 80 ip 172.16.3.254
SwitchCore1(config-if)#standby 80 track f0/1
SwitchCore1(config-if)#standby 80 track f0/2
SwitchCore1(config-if)#ex
SwitchCore1(config)#
SwitchCore1(config)#int vlan 90
SwitchCore1(config-if)#ip address 172.16.4.1 255.255.252.0
SwitchCore1(config-if)#standby 90 ip 172.16.7.254
SwitchCore1(config-if)#standby 90 track f0/1
SwitchCore1(config-if)#standby 90 track f0/2
SwitchCore1(config-if)#ex

```

(2) 核心三层交换机 2 配置 VLAN

```

SwitchCore2(config)#
SwitchCore2(config)#int vlan 60
SwitchCore2(config-if)#ip address 172.16.10.2 255.255.255.0
SwitchCore2(config-if)#standby 60 ip 172.16.10.254
SwitchCore2(config-if)#standby 60 priority 120
SwitchCore2(config-if)#standby 60 preempt
SwitchCore2(config-if)#standby 60 track f0/1
SwitchCore2(config-if)#standby 60 track f0/2
SwitchCore2(config-if)#ex
SwitchCore2(config)#
SwitchCore2(config)#int vlan 70
SwitchCore2(config-if)#ip address 172.16.11.2 255.255.255.0
SwitchCore2(config-if)#standby 70 ip 172.16.11.254
SwitchCore2(config-if)#standby 70 priority 120
SwitchCore2(config-if)#standby 70 preempt
SwitchCore2(config-if)#standby 70 track f0/1
SwitchCore2(config-if)#standby 70 track f0/2
SwitchCore2(config-if)#ex
SwitchCore2(config)#
SwitchCore2(config)#int vlan 80
SwitchCore2(config-if)#ip address 172.16.0.2 255.255.252.0
SwitchCore2(config-if)#standby 80 ip 172.16.3.254
SwitchCore2(config-if)#standby 80 priority 120
SwitchCore2(config-if)#standby 80 preempt
SwitchCore2(config-if)#standby 80 track f0/1
SwitchCore2(config-if)#standby 80 track f0/2
SwitchCore2(config-if)#ex
SwitchCore2(config)#
SwitchCore2(config)#int vlan 90
SwitchCore2(config-if)#ip address 172.16.4.2 255.255.252.0
SwitchCore2(config-if)#standby 90 ip 172.16.7.254
SwitchCore2(config-if)#standby 90 priority 120
SwitchCore2(config-if)#standby 90 preempt
SwitchCore2(config-if)#standby 90 track f0/1
SwitchCore2(config-if)#standby 90 track f0/2
SwitchCore2(config-if)#ex
SwitchCore2(config)#

```

(3) 核心三层交换机 1 配置各下游端口

```

SwitchCore1(config)#int range fastEthernet 0/5-10
SwitchCore1(config-if-range)#switchport trunk encapsulation dot1q
SwitchCore1(config-if-range)#switchport mode trunk
SwitchCore1(config-if-range)#ex
SwitchCore1(config)#

```

(4) 核心三层交换机 2 配置各下游端口

```

SwitchCore2(config)#int range fastEthernet 0/5-10
SwitchCore2(config-if-range)#switchport trunk encapsulation dot1q
SwitchCore2(config-if-range)#switchport mode trunk
SwitchCore2(config-if-range)#ex
SwitchCore2(config)#

```

(5) 机房交换机配置 VLAN

```

Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#ex
Switch(config)#
Switch(config)#int range fastEthernet 0/4-5
Switch(config-if-range)#switchport mode trunk
Switch(config-if-range)#ex
Switch(config)#int range fastEthernet 0/1-3
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 10
Switch(config-if-range)#

```

(6) 行政楼交换机配置 VLAN

```
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 20
Switch(config-vlan)#ex
Switch(config)#
Switch(config)#int range fastEthernet 0/1-2
Switch(config-if-range)#switchport mode trunk
Switch(config-if-range)#ex
Switch(config)#int range fastEthernet 0/3-4
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 20
Switch(config-if-range)#
```

(7) 教学楼交换机配置 VLAN

```
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 30
Switch(config-vlan)#ex
Switch(config)#
Switch(config)#int range fastEthernet 0/1-2
Switch(config-if-range)#switchport mode trunk
Switch(config-if-range)#ex
Switch(config)#int range fastEthernet 0/3-4
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 30
Switch(config-if-range)#end
Switch#
```

(8) 图书馆交换机配置 VLAN

```
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 40
Switch(config-vlan)#ex
Switch(config)#
Switch(config)#int range fastEthernet 0/1-2
Switch(config-if-range)#switchport mode trunk
Switch(config-if-range)#ex
Switch(config)#int range fastEthernet 0/3-4
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 40
Switch(config-if-range)#
```

(9) 学院交换机配置 VLAN

```
SwitchDepart>en
SwitchDepart#conf t
Enter configuration commands, one per line. End with CNTL/Z.
SwitchDepart(config)#vlan 50
SwitchDepart(config-vlan)#ex
SwitchDepart(config)#vlan 60
SwitchDepart(config-vlan)#ex
SwitchDepart(config)#vlan 70
SwitchDepart(config-vlan)#ex
SwitchDepart(config)#
SwitchDepart(config)#int range fastEthernet 0/1-2
SwitchDepart(config-if-range)#switchport mode trunk
SwitchDepart(config-if-range)#ex
SwitchDepart(config)#
SwitchDepart(config)#int range fastEthernet 0/3-4
SwitchDepart(config-if-range)#switchport access vlan 50
SwitchDepart(config-if-range)#ex
SwitchDepart(config)#
SwitchDepart(config)#int range fastEthernet 0/5-6
SwitchDepart(config-if-range)#switchport access vlan 60
SwitchDepart(config-if-range)#ex
SwitchDepart(config)#
SwitchDepart(config)#int range fastEthernet 0/7-8
SwitchDepart(config-if-range)#switchport access vlan 70
SwitchDepart(config-if-range)#ex
SwitchDepart(config)#|
```

(10) 宿舍交换机配置 VLAN

```
SwitchDorm>en
SwitchDorm#conf t
Enter configuration commands, one per line. End with CNTL/Z.
SwitchDorm(config)#vlan 80
SwitchDorm(config-vlan)#ex
SwitchDorm(config)#vlan 90
SwitchDorm(config-vlan)#ex
SwitchDorm(config)#
SwitchDorm(config)#int range fastEthernet 0/1-2
SwitchDorm(config-if-range)#switchport mode trunk
SwitchDorm(config-if-range)#ex
SwitchDorm(config)#
SwitchDorm(config)#int range fastEthernet 0/3-4
SwitchDorm(config-if-range)#switchport access vlan 80
SwitchDorm(config-if-range)#ex
SwitchDorm(config)#
SwitchDorm(config)#int range fastEthernet 0/5-6
SwitchDorm(config-if-range)#switchport access vlan 90
SwitchDorm(config-if-range)#ex
SwitchDorm(config)#
```

3. 分配 IP 地址

(1) 核心路由器 1 分配各端口 IP

```
RouterCore1(config)#conf t
%Invalid hex value
RouterCore1(config)#int f0/0
RouterCore1(config-if)#ip address 172.16.15.2 255.255.255.252
RouterCore1(config-if)#no shutdown
RouterCore1(config-if)#ex
RouterCore1(config)#
RouterCore1(config)#int f0/1
RouterCore1(config-if)#ip address 172.16.15.9 255.255.255.252
RouterCore1(config-if)#no shutdown
RouterCore1(config-if)#ex
RouterCore1(config)#
RouterCore1(config)#int f1/1
RouterCore1(config-if)#ip address 172.16.15.21 255.255.255.252
RouterCore1(config-if)#no shutdown
RouterCore1(config-if)#ex
RouterCore1(config)#
RouterCore1(config)#int f1/0
RouterCore1(config-if)#ip address 172.16.15.13 255.255.255.252
RouterCore1(config-if)#no shutdown
RouterCore1(config-if)#ex
RouterCore1(config)#
```

(2) 核心路由器 2 分配各端口 IP

```
RouterCore2>en
RouterCore2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
RouterCore2(config)#int f0/0
RouterCore2(config-if)#ip address 172.16.15.6 255.255.255.252
RouterCore2(config-if)#no shutdown
RouterCore2(config-if)#ex
RouterCore2(config)#
RouterCore2(config)#int f0/1
RouterCore2(config-if)#ip address 172.16.15.10 255.255.255.252
RouterCore2(config-if)#no shutdown
RouterCore2(config-if)#ex
RouterCore2(config)#
RouterCore2(config)#int f1/1
RouterCore2(config-if)#ip address 172.16.15.25 255.255.255.252
RouterCore2(config-if)#no shutdown
RouterCore2(config-if)#ex
RouterCore2(config)#
RouterCore2(config)#int f1/0
RouterCore2(config-if)#ip address 172.16.15.17 255.255.255.252
RouterCore2(config-if)#ex
RouterCore2(config)#
```


(3) 出口路由器分配各端口 IP

```
RouterOut>en
RouterOut#conf t
Enter configuration commands, one per line. End with CNTL/Z.
RouterOut(config)#int f0/0
RouterOut(config-if)#ip address 172.16.15.1 255.255.255.252
RouterOut(config-if)#no shutdown
RouterOut(config-if)#ex
RouterOut(config)#
RouterOut(config)#int f0/1
RouterOut(config-if)#ip address 172.16.15.5 255.255.255.252
RouterOut(config-if)#no shutdown
RouterOut(config-if)#ex
RouterOut(config)#
RouterOut(config)#int s0/0/0
RouterOut(config-if)#ip address 200.10.1.1 192.0.0.0
RouterOut(config-if)#clock rate 64000
RouterOut(config-if)#no shutdown
RouterOut(config-if)#
```

(4) 核心三层交换机 1，配置连接两个核心路由器的 FastEthernet 端口的 IP

```
SwitchCore1(config)#int f0/1
SwitchCore1(config-if)#no switchport
SwitchCore1(config-if)#ip address 172.16.15.14 255.255.255.252
SwitchCore1(config-if)#ex
SwitchCore1(config)#int f0/2
SwitchCore1(config-if)#no switchport
SwitchCore1(config-if)#ip address 172.16.15.26 255.255.255.252
SwitchCore1(config-if)#exit
SwitchCore1(config)#
```

(5) 核心三层交换机 2，配置连接两个核心路由器的 FastEthernet 端口的 IP

```
SwitchCore2(config)#int f0/1
SwitchCore2(config-if)#no switchport
SwitchCore2(config-if)#ip address 172.16.15.18 255.255.255.252
SwitchCore2(config-if)#ex
SwitchCore2(config)#int f0/2
SwitchCore2(config-if)#no switchport
SwitchCore2(config-if)#ip address 172.16.15.22 255.255.255.252
SwitchCore2(config-if)#exit
SwitchCore2(config)#
```

4. 配置链路捆绑与生成树协议

(1) 核心三层交换机 1 配置链路捆绑和生成树

```
SwitchCore1(config)#int port-channel 1
SwitchCore1(config-if)#switchport trunk encapsulation dot1q
SwitchCore1(config-if)#switchport mode trunk
SwitchCore1(config-if)#ex
SwitchCore1(config)#int range fastEthernet 0/3-4
SwitchCore1(config-if-range)#switchport trunk encapsulation dot1q
SwitchCore1(config-if-range)#switchport mode trunk
SwitchCore1(config-if-range)#channel-group 1 mode on
SwitchCore1(config-if-range)#ex
SwitchCore1(config)#
SwitchCore1(config)#spanning-tree mode pvst
SwitchCore1(config)#spanning-tree vlan 10,20,30,40 root primary
SwitchCore1(config)#spanning-tree vlan 50,60 root secondary
```

(2) 核心三层交换机 2 配置链路捆绑和生成树

```

SwitchCore2(config)#int port-channel 1
SwitchCore2(config-if)#switchport trunk encapsulation dot1q
SwitchCore2(config-if)#switchport mode trunk
SwitchCore2(config-if)#ex
SwitchCore2(config)#int range fastEthernet 0/3-4
SwitchCore2(config-if-range)#switchport trunk encapsulation dot1q
SwitchCore2(config-if-range)#switchport mode trunk
SwitchCore2(config-if-range)#channel-group 1 mode on
SwitchCore2(config-if-range)#ex
SwitchCore2(config)#
SwitchCore2(config)#spanning-tree mode pvst
SwitchCore2(config)#spanning-tree vlan 50,60,70,80,90 root primary
SwitchCore2(config)#spanning-tree vlan 10,20,30,40 root secondary
SwitchCore2(config)#

```

5. 配置 OSPF

(1) 两个核心三层交换机上设置 OSPF

```

SwitchCore1(config)#ip routing
SwitchCore1(config)#router ospf 1
SwitchCore1(config-router)#network 172.16.8.0 0.0.3.255 area 0
SwitchCore1(config-router)#network 172.16.15.96 0.0.0.3 area 0
SwitchCore1(config-router)#network 172.16.15.192 0.0.0.3 area 0
SwitchCore1(config-router)#ex
SwitchCore1(config)#

SwitchCore2(config)#ip routing
SwitchCore2(config)#router ospf 2
SwitchCore2(config-router)#network 172.16.8.0 0.0.3.255 area 0
SwitchCore2(config-router)#network 172.16.15.160 0.0.0.3 area 0
SwitchCore2(config-router)#network 172.16.15.128 0.0.0.3 area 0
SwitchCore2(config-router)#|

```

(2) 两个核心路由器上设置 OSPF

```

RouterCore1(config)#router ospf 3
RouterCore1(config-router)#network 172.16.15.0 0.0.0.3 area 0
RouterCore1(config-router)#network 172.16.15.64 0.0.0.3 area 0
RouterCore1(config-router)#network 172.16.15.160 0.0.0.3 area 0
RouterCore1(config-router)#network 172.16.15.96 0.0.0.3 area 0
RouterCore1(config-router)#|

RouterCore2(config)#router ospf 4
RouterCore2(config-router)#network 172.16.15.32 0.0.0.3 area 0
RouterCore2(config-router)#network 172.16.15.64 0.0.0.3 area 0
RouterCore2(config-router)#network 172.16.15.192 0.0.0.3 area 0
RouterCore2(config-router)#network 172.16.15.128 0.0.0.3 area 0
RouterCore2(config-router)#|

```

(3) 出口路由器上设置 OSPF

```

RouterOut>en
RouterOut#conf t
Enter configuration commands, one per line. End with CNTL/Z.
RouterOut(config)#router ospf 5
RouterOut(config-router)#network 172.16.15.0 0.0.0.3 area 0
RouterOut(config-router)#network 172.16.15.32 0.0.0.3 area 0
RouterOut(config-router)#

```

6. 配置 NAT 服务和静态路由

主要通过出口路由器配置 NAT 和静态路由

```
RouterOut#conf t
Enter configuration commands, one per line. End with CNTL/Z.
RouterOut(config)#int range fastEthernet 0/0-1
RouterOut(config-if-range)#ip nat inside
RouterOut(config-if-range)#ex
RouterOut(config)#int serial 0/0/0
RouterOut(config-if)#ip nat outside
RouterOut(config-if)#ex
RouterOut(config)#ip route 0.0.0.0 0.0.0.0 200.10.1.2
RouterOut(config)#router ospf 5
RouterOut(config-router)#default-information originate
RouterOut(config-router)#ex
RouterOut(config)#ip nat pool DZC 200.10.1.3 200.10.1.6 netmask 255.255.255.240
RouterOut(config)#access-list 1 permit 172.16.0.0 0.0.15.255
RouterOut(config)#ip nat inside source list 1 pool DZC
RouterOut(config)#
```

7. 配置校园网、DNS 和邮箱服务

按照下图所示，首先配置三个服务器的 IP 地址、网关、DNS 服务器等基础信息，随后分别配置 HTTP 服务、DNS 服务、E-mail 服务

(1) 配置校园网服务器

The screenshot displays a network configuration interface with two main sections. The top section, titled 'IP配置' (IP Configuration), shows the '静态' (Static) option selected for IP addressing. The fields are filled with: IPv4 Address: 172.16.14.3, Subnet Mask: 255.255.255.128, Default Gateway: 172.16.14.1, and DNS Server: 172.16.14.4. The bottom section, titled '服务' (Services), shows the 'HTTP' service enabled. Below the service settings is a '文件管理器' (File Manager) table listing five files for management.

File Name	Edit	Delete
1 copyrights.html	(edit)	(delete)
2 cscoptlogo177x111.jpg		(delete)
3 helloworld.html	(edit)	(delete)
4 image.html	(edit)	(delete)
5 index.html	(edit)	(delete)

(2) 配置 DNS 服务器

物理 配置 服务 桌面 编程 属性

IP配置

IP配置

☐ DHCP ☒ 静态

IPv4 Address: 172.16.14.4

子网掩码: 255.255.255.128

默认网关: 172.16.14.1

DNS服务器: 172.16.14.4

物理 配置 服务 桌面 编程 属性

DNS

DNS服务 ☒ 开 ☐ 关

资源记录

名称: 类型: A Record

地址:

添加 保存 移除

No.	Name	Type	Detail
0	mail.aau.edu.cn	A Record	172.16.14.5
1	www.aau.edu.cn	A Record	172.16.14.3
2	www.baidu.com	A Record	100.10.1.3

(3) 配置电子邮件服务器

物理 配置 服务 桌面 编程 属性

IP配置

IP配置

☐ DHCP ☒ 静态

IPv4 Address: 172.16.14.5

子网掩码: 255.255.255.128

默认网关: 172.16.14.1

DNS服务器: 172.16.14.4

物理 配置 服务 桌面 编程 属性

电子邮件

SMTP服务 ☒ 开 ☐ 关

POP3服务 ☒ 开 ☐ 关

域名: aau.edu.cn 设置

用户设置

用户: 密码:

admin
test1
test2

8. 配置无线网络

(1) 核心三层交换机上为其配置 OSPF

```
SwitchCore1(config)#int FastEthernet0/11
SwitchCore1(config-if)#no switchport
SwitchCore1(config-if)#ip address 172.16.15.29 255.255.255.252
SwitchCore1(config-if)#ex
SwitchCore1(config)#router ospf 1
SwitchCore1(config-router)#network 172.16.15.29 0.0.0.3 area 0
SwitchCore1(config-router)#

SwitchCore2(config)#interface FastEthernet0/11
SwitchCore2(config-if)#no switchport
SwitchCore2(config-if)#ip address 172.16.15.33 255.255.255.252
SwitchCore2(config-if)#ex
SwitchCore2(config)#router ospf 2
SwitchCore2(config-router)#network 172.16.15.33 0.0.0.3 area 0
SwitchCore2(config-router)#
```

(2) 无线路由器上相关配置

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int f1/0
Router(config-if)#ip address 172.16.15.30 255.255.255.252
Router(config-if)#no shutdown
Router(config-if)#ex
Router(config)#int f1/1
Router(config-if)#ip address 172.16.15.34 255.255.255.252
Router(config-if)#no shutdown
Router(config-if)#ex
Router(config)#int f0/0
Router(config-if)#ip address 172.16.15.37 255.255.255.252
Router(config-if)#no shutdown
Router(config-if)#ex
Router(config)#ip routing
Router(config)#router ospf 6
Router(config-router)#network 172.16.15.37 0.0.0.3 area 0
Router(config-router)#network 172.16.15.34 0.0.0.3 area 0
Router(config-router)#network 172.16.15.30 0.0.0.3 area 0
Router(config-router)#
```

(3) WiFi 相关配置

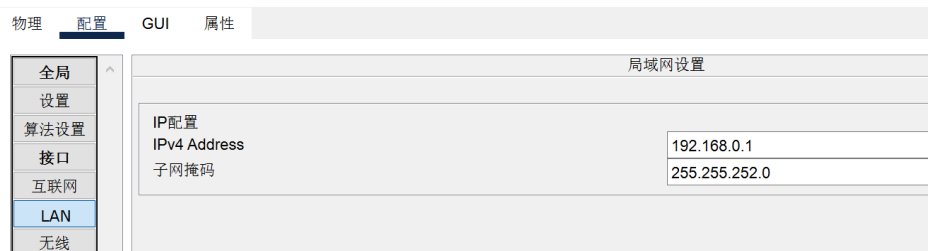
The screenshot shows a network configuration interface with two main sections: '互联网设置' (Internet Settings) and '网络设置' (Network Settings).

互联网设置 (Internet Settings):

- Internet Connection type:** Static IP (selected).
- 互联网IP地址 (Internet IP Address):** 172.16.15.38
- 子网掩码 (Subnet Mask):** 255.255.255.252
- 默认网关 (Default Gateway):** 172.16.15.37
- DNS 1:** 172.16.14.4
- DNS 2 (可选):** 0.0.0.0
- DNS 3 (可选):** 0.0.0.0
- Optional Settings (required by some internet service providers):**
 - 主机名称 (Host Name):** (empty)
 - 域名 (Domain):** (empty)
 - MTU:** (dropdown menu) 大小: 1500

网络设置 (Network Settings):

- 路由器IP (Router IP):**
 - IP地址 (IP Address):** 192.168.0.1
 - 子网掩码 (Subnet Mask):** 255.255.255.0
- DHCP Server Settings:**
 - DHCP服务器 (DHCP Server):** ☒ 使能的 (Enabled) ☐ 未使能的 (Disabled)
 - DHCP 预留 (DHCP Reservation):** (button)



9. 配置 VPN

(1) ISP 路由器相关配置

```
RouterISP>en
RouterISP#conf t
Enter configuration commands, one per line. End with CNTL/Z.
RouterISP(config)#crypto isakmp policy 1
RouterISP(config-isakmp)#encryption aes
RouterISP(config-isakmp)#hash sha
RouterISP(config-isakmp)#authentication pre-share
RouterISP(config-isakmp)#group 2
RouterISP(config-isakmp)#crypto isakmp key aau address 200.10.1.1
RouterISP(config)#access-list 100 permit ip 100.10.1.0 0.0.0.15 172.16.0.0 0.0.15.255
RouterISP(config)#crypto ipsec transform-set yf-set esp-aes
RouterISP(config)#crypto map yf-map 1 ipsec-isakmp
% NOTE: This new crypto map will remain disabled until a peer
        and a valid access list have been configured.
RouterISP(config-crypto-map)#set peer 200.10.1.1
RouterISP(config-crypto-map)#set transform-set yf-set
RouterISP(config-crypto-map)#match address 100
RouterISP(config-crypto-map)#ex
RouterISP(config)#int s0/0/0
RouterISP(config-if)#crypto map yf-map
*Jan 3 07:16:26.785: %CRYPTO-6-ISAKMP_ON_OFF: ISAKMP is ON
RouterISP(config-if)#ex
RouterISP(config)#
```

(2) 出口路由器相关配置

```
RouterOut(config)#crypto isakmp policy 1
RouterOut(config-isakmp)#encryption aes
RouterOut(config-isakmp)#hash sha
RouterOut(config-isakmp)#authentication pre-share
RouterOut(config-isakmp)#group 2
RouterOut(config-isakmp)#crypto isakmp key aac address 200.10.1.2
RouterOut(config)#access-list 100 permit ip 172.16.0.0 0.0.15.255 100.10.1.0 0.0.0.15
RouterOut(config)#crypto ipsec transform-set yf-set esp-aes
RouterOut(config)#crypto map yf-map 1 ipsec-isakmp
% NOTE: This new crypto map will remain disabled until a peer
        and a valid access list have been configured.
RouterOut(config-crypto-map)#set peer 200.10.1.2
RouterOut(config-crypto-map)#set transform-set yf-set
RouterOut(config-crypto-map)#match address 100
RouterOut(config-crypto-map)#ex
RouterOut(config)#int s0/0/0
RouterOut(config-if)#crypto map yf-map
*Jan 3 07:16:26.785: %CRYPTO-6-ISAKMP_ON_OFF: ISAKMP is ON
RouterOut(config-if)#ex
RouterOut(config)#
```

10. 配置 ACL 访问控制

(1) 核心三层交换机上限制宿舍楼访问行政楼和教学楼

```
SwitchCore1(config)#access-list 10 deny 172.0.0.1 0.0.7.255
SwitchCore1(config)#int vlan 20
SwitchCore1(config-if)#ip access-group 10 out
SwitchCore1(config-if)#int vlan 30
SwitchCore1(config-if)#ip access-group 10 out
SwitchCore1(config-if)#end
SwitchCore1#
```

```
SwitchCore2(config)#access-list 20 deny 172.0.0.1 0.0.7.255
SwitchCore2(config)#int vlan 20
SwitchCore2(config-if)#ip access-group 20 out
SwitchCore2(config-if)#int vlan 30
SwitchCore2(config-if)#ip access-group 20 out
SwitchCore2(config-if)#end
SwitchCore2#
```

(2) 核心交换机上限制外部访问

```
SwitchCore1(config)#access-list 30 permit 172.16.8.1 0.0.7.255
SwitchCore1(config)#int vlan 30
SwitchCore1(config-if)#ip access-group 30 out
SwitchCore1(config-if)#end
SwitchCore1#
```

```
SwitchCore2(config)#access-list 40 permit 172.16.8.1 0.0.7.255
SwitchCore2(config)#int vlan 30
SwitchCore2(config-if)#ip access-group 40 out
SwitchCore2(config-if)#end
SwitchCore2#
```

11. 配置 IP 电话

(1) 行政楼 IP 电话的路由器上的配置

```
RouterAdministration(config)#ip dhcp pool ip-phone
RouterAdministration(dhcp-config)#network 172.16.13.0 255.255.255.0
RouterAdministration(dhcp-config)#default-router 172.16.13.5
RouterAdministration(dhcp-config)#option 150 ip 172.16.13.5
RouterAdministration(dhcp-config)#
RouterAdministration(dhcp-config)#int f0/0
RouterAdministration(config-if)#ip address 172.16.13.5 255.255.255.0
RouterAdministration(config-if)#duplex auto
RouterAdministration(config-if)#speed auto
RouterAdministration(config-if)#
RouterAdministration(config-if)#int f0/1
RouterAdministration(config-if)#no ip address
RouterAdministration(config-if)#duplex auto
RouterAdministration(config-if)#speed auto
RouterAdministration(config-if)#shutdown
RouterAdministration(config-if)#
RouterAdministration(config-if)#int Vlan1
RouterAdministration(config-if)#no ip address
RouterAdministration(config-if)#shutdown
RouterAdministration(config-if)#
RouterAdministration(config-if)#telephony-service
RouterAdministration(config-telephony)#max-ephones 5
RouterAdministration(config-telephony)#max-dn 5
RouterAdministration(config-telephony)#ip source-address 172.16.13.5 port 2000
RouterAdministration(config-telephony)#auto assign 1 to 5
RouterAdministration(config-telephony)#
RouterAdministration(config-telephony)#ephone-dn 1
RouterAdministration(config-ephone-dn)#number 94202314
RouterAdministration(config-ephone-dn)#ephone-dn 2
RouterAdministration(config-ephone-dn)#number 94202315
RouterAdministration(config-ephone-dn)#|
```

(2) 核心三层交换机 1 上的配置

```
SwitchCore1(config)#int f0/13
SwitchCore1(config-if)#switchport trunk encapsulation dot1q
SwitchCore1(config-if)#switchport mode trunk
SwitchCore1(config-if)#switchport voice vlan 1
SwitchCore1(config-if)#
SwitchCore1(config-if)#int f0/14
SwitchCore1(config-if)#switchport trunk encapsulation dot1q
SwitchCore1(config-if)#switchport mode trunk
SwitchCore1(config-if)#switchport voice vlan 1
SwitchCore1(config-if)#ex
SwitchCore1(config)#|
```

(3) 学院 IP 电话的路由器上的配置

```
RouterDepart(config)#ip dhcp pool ip-phone
RouterDepart(dhcp-config)#network 172.16.8.0 255.255.252.0
RouterDepart(dhcp-config)#default-router 172.16.8.5
RouterDepart(dhcp-config)#option 150 ip 172.16.8.5
RouterDepart(dhcp-config)#
RouterDepart(dhcp-config)#int f0/0
RouterDepart(config-if)#ip address 172.16.8.5 255.255.252.0
RouterDepart(config-if)#duplex auto
RouterDepart(config-if)#speed auto
RouterDepart(config-if)#
RouterDepart(config-if)#int f0/1
RouterDepart(config-if)#no ip address
RouterDepart(config-if)#duplex auto
RouterDepart(config-if)#speed auto
RouterDepart(config-if)#shutdown
RouterDepart(config-if)#int Vlan1
RouterDepart(config-if)#no ip address
RouterDepart(config-if)#shutdown
RouterDepart(config-if)#
RouterDepart(config-if)#telephony-service
RouterDepart(config-telephony)#max-ephones 5
RouterDepart(config-telephony)#max-dn 5
RouterDepart(config-telephony)#ip source-address 172.16.8.5 port 2000
RouterDepart(config-telephony)#auto assign 1 to 5
RouterDepart(config-telephony)#ephone-dn 1
RouterDepart(config-ephone-dn)#number 94202316
RouterDepart(config-ephone-dn)#ephone-dn 2
RouterDepart(config-ephone-dn)#number 94202317
RouterDepart(config-ephone-dn)#
```

(4) 核心三层交换机 1 上的配置

```
SwitichCore1(config)#int f0/16
SwitichCore1(config-if)#switchport trunk encapsulation dot1q
SwitichCore1(config-if)#switchport mode trunk
SwitichCore1(config-if)#switchport voice vlan 1
SwitichCore1(config-if)#
SwitichCore1(config-if)#int f0/17
SwitichCore1(config-if)#switchport trunk encapsulation dot1q
SwitichCore1(config-if)#switchport mode trunk
SwitichCore1(config-if)#switchport voice vlan 1
SwitichCore1(config-if)#ex
SwitichCore1(config)#
```

12. 配置防火墙

(1) 配置防火墙 1

```
Firewall1#conf t
Firewall1(config)#int vlan 1
Firewall1(config-if)#nameif inside
Firewall1(config-if)#ip address 192.168.1.1 255.255.255.0
Firewall1(config-if)#Security-level 100
Firewall1(config-if)#
Firewall1(config-if)#int vlan 2
Firewall1(config-if)#nameif outside
Firewall1(config-if)#ip address 192.168.10.100
Firewall1(config-if)#Security-level 0
Firewall1(config-if)#exit
Firewall1(config)#int e0/1
Firewall1(config-if)#switchport access vlan 2
Firewall1(config-if)#no shutdown
Firewall1(config-if)#switchport mode access
```

(2) 配置防火墙 2

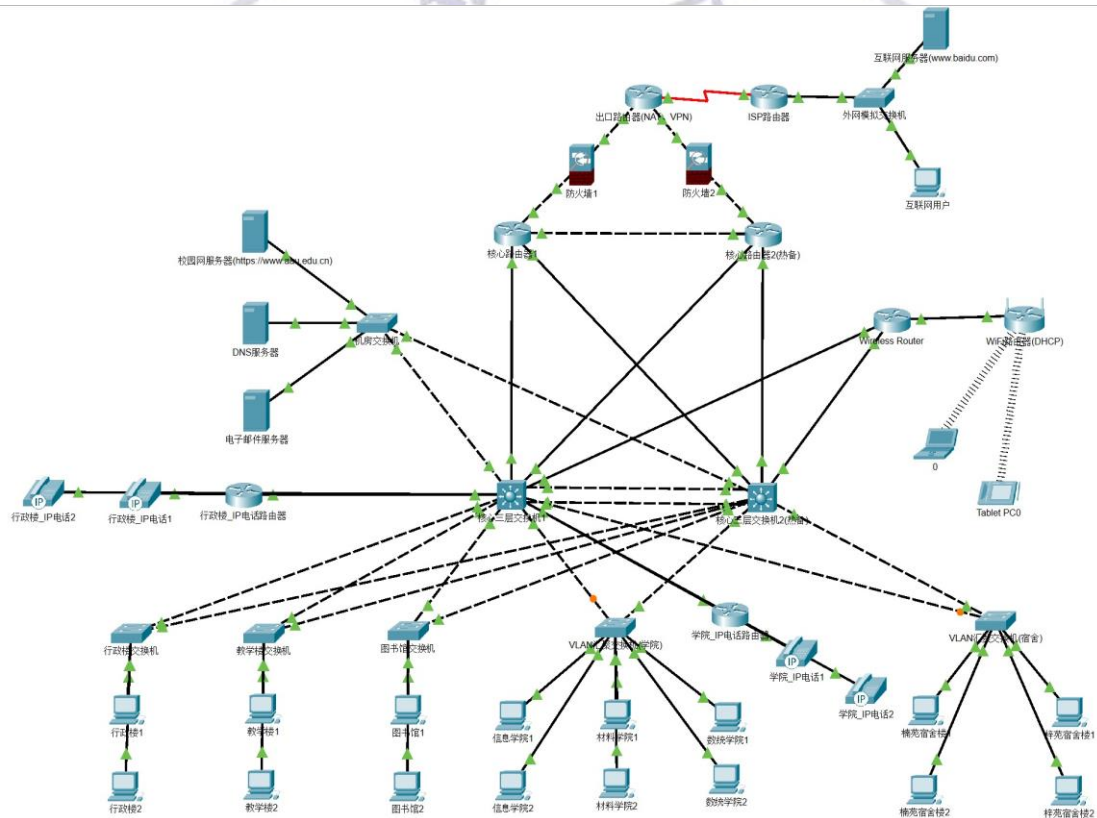

```

Firewall2#conf t
Firewall2(config)#int vlan 1
Firewall2(config-if)#nameif inside
Firewall2(config-if)#ip address 192.168.1.1 255.255.255.0
Firewall2(config-if)#Security-level 100
Firewall2(config-if)#
Firewall2(config-if)#int vlan 2
Firewall2(config-if)#ip address 192.168.10.100
Firewall2(config-if)#Security-level 0
Firewall2(config-if)#exit
Firewall2(config)#
Firewall2(config)#int e0/1
Firewall2(config-if)#switchport access vlan 2
Firewall2(config-if)#no shutdown
Firewall2(config-if)#switchport mode access

```

五、实验结果及分析

1. 搭建网络拓扑



搭建的网络拓扑如上图所示。

2. 划分校园网的子网与 VLAN 划分

4. 配置链路捆绑与生成树协议

链路捆绑即是实现双机热备的过程之一，在此过程中使用 `trunk encapsulation dot1q` 指令，将 `vlan` 进行封装以实现不同 VLAN 之间数据互通。

生成树协议 STL 就是 Spanning Tree Protocol 的简称，在各个交换机指令的最后将其设置为 `pvst` 模式，并且让两个交换机分别作为不同 VLAN 的核心交换机，实现负载均衡。

5. 配置 OSPF

```
SwitchCore1#show ip ospf
Routing Process "ospf 1" with ID 172.16.15.29
Supports only single TOS(TOS0) routes
Supports opaque LSA
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 1. Checksum Sum 0x00b14c
Number of opaque AS LSA 0. Checksum Sum 0x000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
External flood list length 0
Area BACKBONE(0)
Number of interfaces in this area is 6
Area has no authentication
SPF algorithm executed 6 times
Area ranges are
Number of LSA 18. Checksum Sum 0x097c54
Number of opaque link LSA 0. Checksum Sum 0x000000
Number of DCbitless LSA 0
Number of indication LSA 0
Number of DoNotAge LSA 0
Flood list length 0
```

(核心三层交换机 1)

```
SwitchCore2#show ip ospf
Routing Process "ospf 2" with ID 172.16.15.33
Supports only single TOS(TOS0) routes
Supports opaque LSA
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 1. Checksum Sum 0x00b14c
Number of opaque AS LSA 0. Checksum Sum 0x000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
External flood list length 0
Area BACKBONE(0)
Number of interfaces in this area is 6
Area has no authentication
SPF algorithm executed 6 times
Area ranges are
Number of LSA 18. Checksum Sum 0x097c54
Number of opaque link LSA 0. Checksum Sum 0x000000
Number of DCbitless LSA 0
Number of indication LSA 0
Number of DoNotAge LSA 0
Flood list length 0
```

(核心三层交换机 2)

```

RouterCore1#show ip ospf
Routing Process "ospf 30" with ID 172.16.15.21
Supports only single TOS(TOS0) routes
Supports opaque LSA
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 0. Checksum Sum 0x000000
Number of opaque AS LSA 0. Checksum Sum 0x000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 0. 0 normal 0 stub 0 nssa
External flood list length 0

Routing Process "ospf 3" with ID 172.16.15.13
Supports only single TOS(TOS0) routes
Supports opaque LSA
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 1. Checksum Sum 0x00b14c
Number of opaque AS LSA 0. Checksum Sum 0x000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
External flood list length 0

```

(核心路由器 1)

```

RouterCore2#show ip ospf
Routing Process "ospf 4" with ID 172.16.15.25
Supports only single TOS(TOS0) routes
Supports opaque LSA
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 1. Checksum Sum 0x00b14c
Number of opaque AS LSA 0. Checksum Sum 0x000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
External flood list length 0
  Area BACKBONE(0)
    Number of interfaces in this area is 4
    Area has no authentication
    SPF algorithm executed 8 times
    Area ranges are
    Number of LSA 18. Checksum Sum 0x097c54
    Number of opaque link LSA 0. Checksum Sum 0x000000
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0

```

(核心路由器 2)

```

RouterOut#show ip ospf
Routing Process "ospf 5" with ID 200.10.1.1
Supports only single TOS(TOS0) routes
Supports opaque LSA
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 1. Checksum Sum 0x00b14c
Number of opaque AS LSA 0. Checksum Sum 0x000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
External flood list length 0
  Area BACKBONE(0)
    Number of interfaces in this area is 2
    Area has no authentication
    SPF algorithm executed 8 times
    Area ranges are
    Number of LSA 18. Checksum Sum 0x097c54
    Number of opaque link LSA 0. Checksum Sum 0x000000
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0

```

RouterOut#|

(出口路由器)

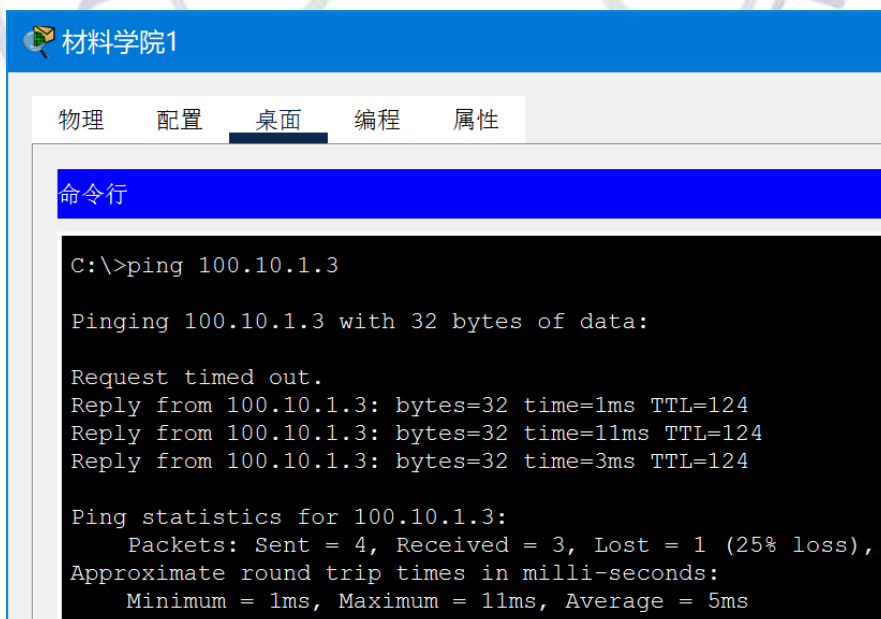
在上述设备中使用 `show ip ospf` 指令，均可查看到已定义的 OSPF，说明配置成功。

6. 配置 NAT 服务与静态路由

该段指令中，首先选中 f0/1 和 f0/2，将其设为 NAT 内网端口，然后选中 S0/0/0，将其设为 NAT 外网端口，即完成了 NAT 的配置；

后半段指令中，使用 `ip route` 指令，添加一条路由规则，将任意 IP 的数据报的下一跳都设为 200.10.1.2 即 ISP 服务器上，完成静态路由的配置。

此时使用学院电脑测试，可以 ping 通互联网服务器（100.10.1.3 为互联网服务器的 IP 地址），说明配置成功。



7. 配置校园网、DNS 和邮箱服务

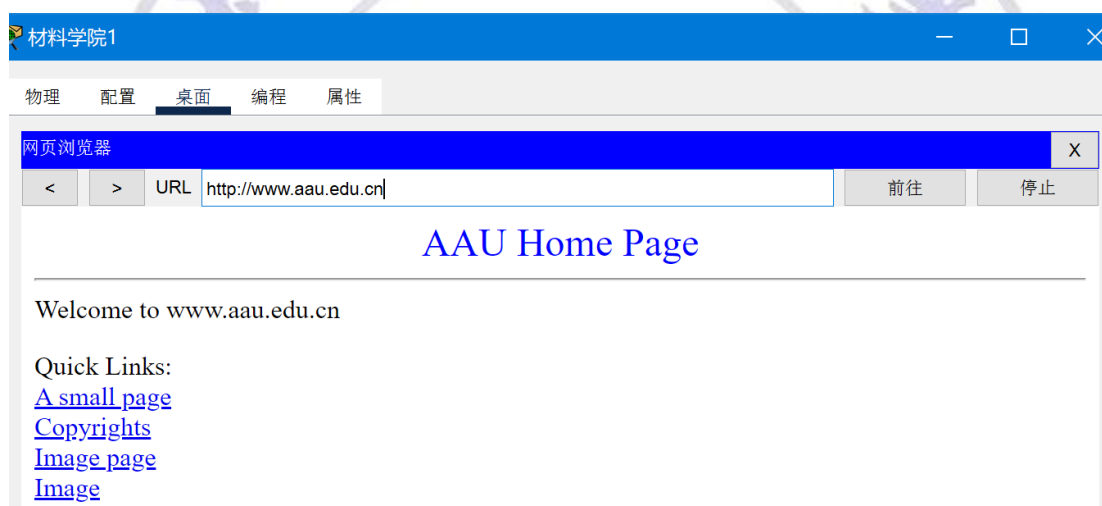
(1) 配置校园网服务器

此时使用任意一台主机，配置好 IP 之后，使用 Web Browser 访问学校官网，访问成功。



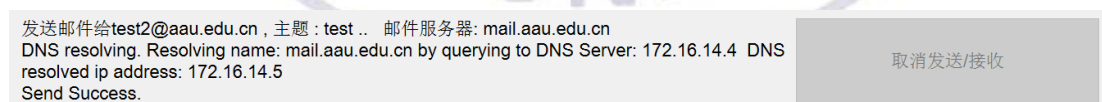
(2) 配置 DNS 服务器

此时使用任意一台主机，配置好 IP 和 DNS 服务器之后，使用域名访问学校官网，访问成功。

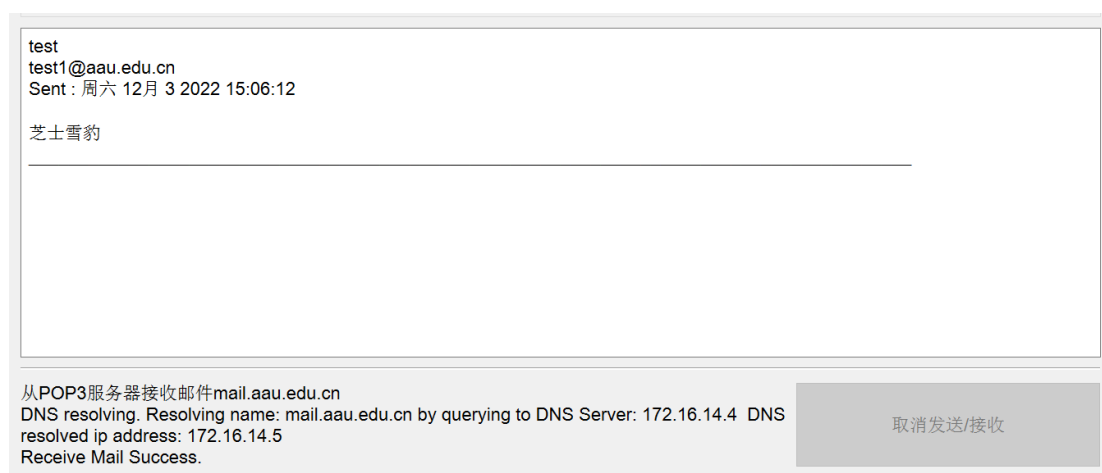


(3) 配置电子邮件服务器

配置好后，任意打开两台电脑，分别登录两个已经在电子邮件服务器上配置好的用户进行收发信测试。



(发信成功)



(收信成功, 偶然发现邮件中可以包含中文)

8. 配置无线网络

不知什么原因, 在 WiFi 的 GUI 界面, 子网掩码是选择的, 且最小只能到 255.255.255.0, 所以要在配置界面将其手动设置到 255.255.255.252。

Device Name: WiFi路由器 (DHCP)			
Device Model: Linksys-WRT300N			
端口	链接	IP地址	MAC地址
Internet	开启	172.16.15.38/30	00E0.F75E.C801
Virtual-Access1	关闭	<未设置>	0050.0F66.A333
Dialer1	开启	<未设置>	00D0.5808.38DA
LAN	开启	192.168.0.1/22	0007.ECB3.1340
Ethernet 1	关闭	--	00E0.F75E.C802
Ethernet 2	关闭	--	00E0.F75E.C803
Ethernet 3	关闭	--	00E0.F75E.C804
Ethernet 4	关闭	--	00E0.F75E.C805
Wireless	开启	--	00E0.F75E.C806
物理位置: Intercity > Home City > Corporate Office > WiFi路由器 (DHCP)			

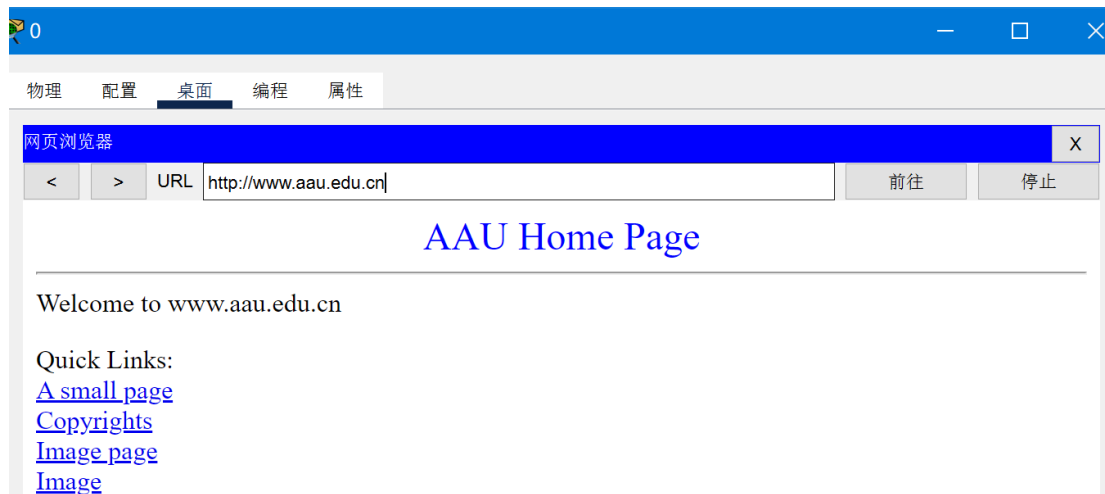
(此时 WiFi 的状态信息, LAN IP 处的 CIDR 记为 22, 说明子网掩码配置正常)

使用手机或电脑(添加无线模块后)连接上 WiFi, 等待一段时间后, DHCP 会自动为其分配 LAN 的 IP 地址等信息。



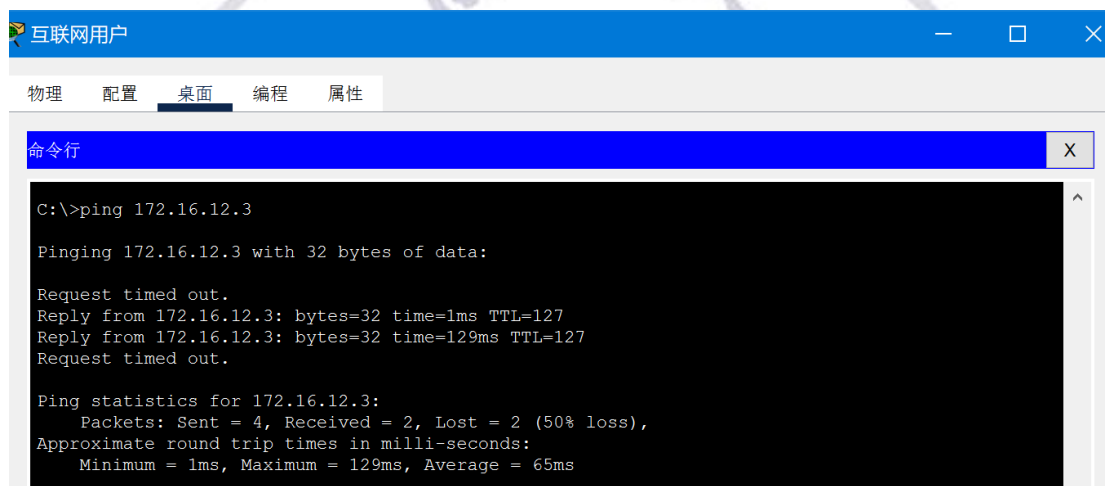
(使用 DHCP 自动分配了网络地址等信息)

现在使用无线局域网中的设备访问校园网, 仍然可以访问, 说明无线局域网配置成功。



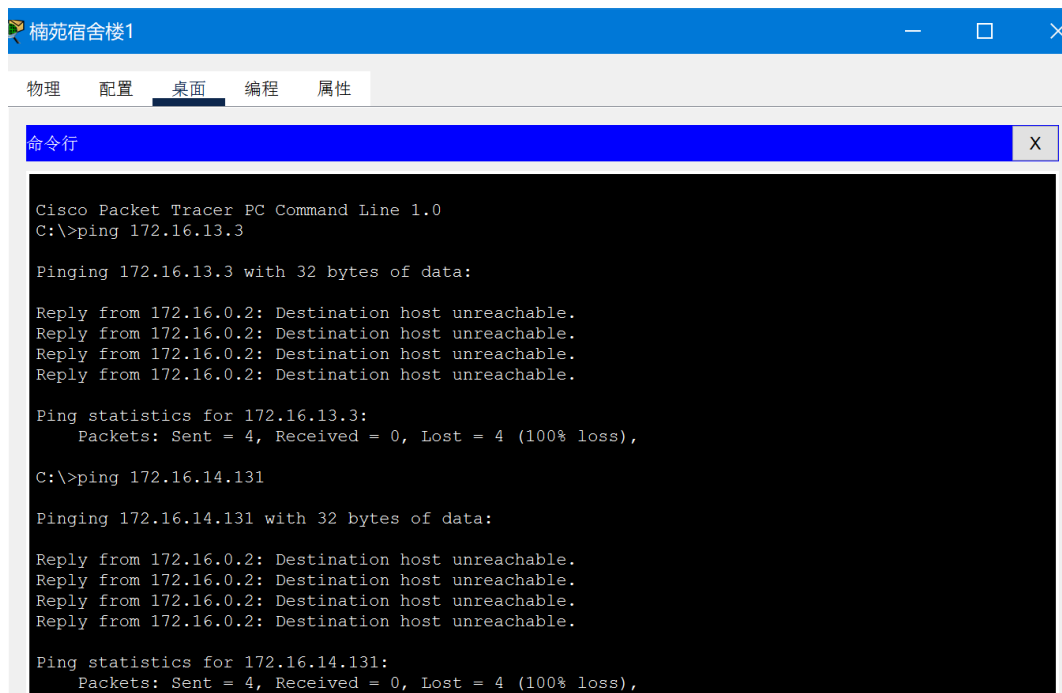
9. 配置 VPN

配置完成后，多试几次就能 ping 连接成功了，以下 ping 了一台图书馆主机成功。



10. 配置 ACL 访问控制

(1) 验证宿舍-行政楼、宿舍-教学楼访问控制：



```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.16.13.3

Pinging 172.16.13.3 with 32 bytes of data:

Reply from 172.16.0.2: Destination host unreachable.
Reply from 172.16.0.2: Destination host unreachable.
Reply from 172.16.0.2: Destination host unreachable.
Reply from 172.16.0.2: Destination host unreachable.

Ping statistics for 172.16.13.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 172.16.14.131

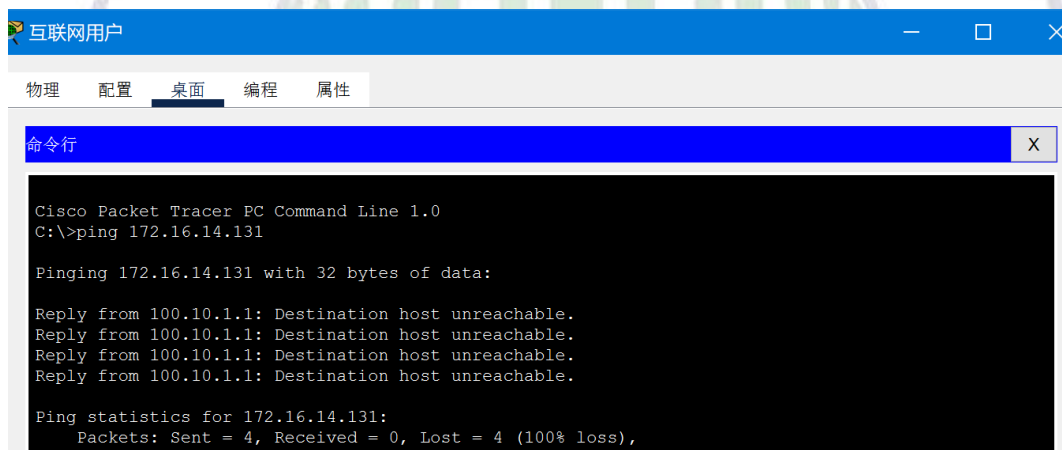
Pinging 172.16.14.131 with 32 bytes of data:

Reply from 172.16.0.2: Destination host unreachable.
Reply from 172.16.0.2: Destination host unreachable.
Reply from 172.16.0.2: Destination host unreachable.
Reply from 172.16.0.2: Destination host unreachable.

Ping statistics for 172.16.14.131:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

使用任选的一台宿舍楼主机，先后 ping 一台行政楼和一台教学楼的主机，均提示 Destination host unreachable，表示 ACL 生效。

(2) 验证外网-教学楼访问控制：



```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.16.14.131

Pinging 172.16.14.131 with 32 bytes of data:

Reply from 100.10.1.1: Destination host unreachable.
Reply from 100.10.1.1: Destination host unreachable.
Reply from 100.10.1.1: Destination host unreachable.
Reply from 100.10.1.1: Destination host unreachable.

Ping statistics for 172.16.14.131:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

由于通常来说外网网段比内网丰富的多，所以将“禁止外网访问教学楼”转换为其等价条件更合适，其等价条件为“仅允许内网非宿舍区访问教学楼”（为了避免与前一个 ACL 冲突），而这部分的网段恰好就为 172.16.8.1/21，所以使用的 ACL 类型为 permit。

使用“互联网用户” ping 一台教学楼主机，提示 Destination host unreachable，表示 ACL 生效。

11. 配置 IP 电话

配置完成后需要等待一会 DHCP 自动分配，完成后可查看该机的 IP 地址和设置的 IP 电话号码。

端口状态汇总表 for 行政楼_IP电话1				端口状态汇总表 for 行政楼_IP电话2			
Device Name: 行政楼_IP电话1 Device Model: 7960				Device Name: 行政楼_IP电话2 Device Model: 7960			
端口	链接	IP地址	MAC地址	端口	链接	IP地址	MAC地址
Vlan1	开启	172.16.13.6/24	0060.5C6D.B00C	Vlan1	开启	172.16.13.3/24	0002.1758.26A7
Switch	开启	<未设置>	00E0.F99B.0A01	Switch	开启	<未设置>	0090.2BE2.C701
PC	关闭	<未设置>	00E0.F99B.0A02	PC	关闭	<未设置>	0090.2BE2.C702
网关: 172.16.13.5 线号: 94202315				网关: 172.16.13.5 线号: 94202314			
物理位置: Intercity > Home City > Corporate Office				物理位置: Intercity > Home City > Corporate Office			
Refresh				Refresh			

随后进行拨号，测试是否可用。



（右侧电话拨号时，左侧电话能同步提示电话响，说明配置成功）

12. 配置防火墙

使用任意一台内网主机去访问互联网服务器，以测试添加了防火墙是否阻碍了外网访问。



仍然能够访问成功，说明防火墙配置正常。

六、实验总结及体会

本次实验中要综合运用一些先前学过的和没学过的技术部署方法。由于之

前完成的多是验证性实验，网络拓扑较为简单，而这次实验复杂许多，必须一开始就规划好整个网络的总体结构。

此外，这次通过看相关视频、查博客、查找官方文档等方式，学了许多课外的技巧和方法，对我深入理解计算机网络有很大帮助

七、教师评语

