哈尔滨工业大学

<<计算机网络>>

实验报告

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实验名称	简单网络组建及配置

目录

一、 实验目的

1. 了解网络建设的相关过程，通过分析用户需求，结合自己掌握到的网络知识，规划设计网络实施方案；
2. 掌握基本的网络设备运行原理和配置技术；
3. 独立完成一个简单校园网的基本建设、配置工作，并能发现、分析并解决简单的网络问题；
4. 理论结合实践，深刻理解网络运行原理和相关技术，提高动手能力和应用技巧；
5. 引导学生对相关知识的探索和研究，促进学生的主动学习热情。

二、 实验环境

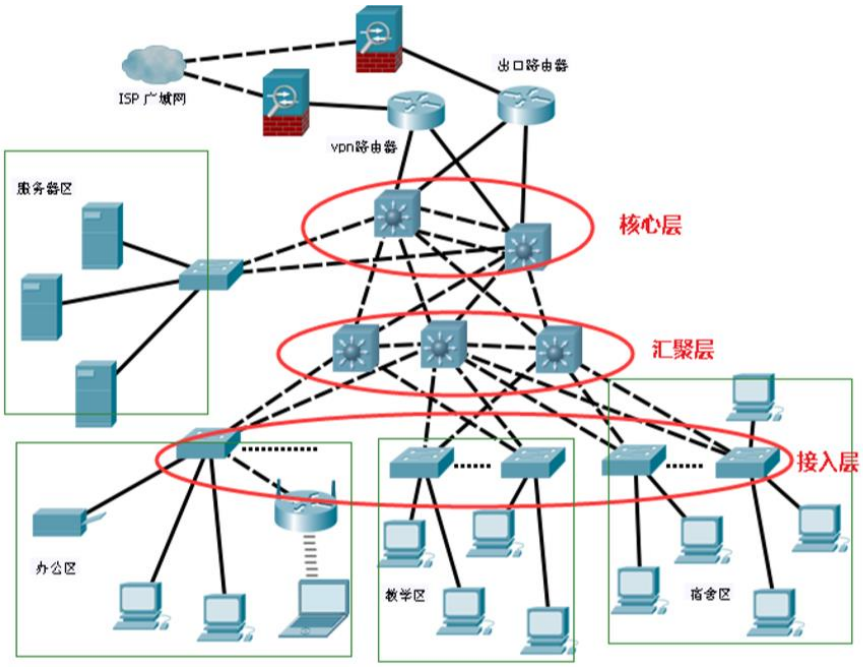
1. 接入 Internet 的实验主机；
2. Windows xp 或 Windows 7/8 或 Windows 10；
3. 网络模拟工具：Cisco packet tracer 6.2。

三、 实验内容

3.1 实验项目

(1) 某职业技术学校决定新建校园网，网络规划设计师已经完成该项目的总体规划和设计，部分具体项目规划和设计还未完成；请根据所学到的网络知识帮助该网络规划设计师完成剩余的工作内容，并承担整个项目的实施建设工作。

(2) 如下图所示，该网络拓扑采用通用的三层架构设计，分别为接入层、汇聚层和核心层。汇聚层、核心层均采用了冗余链路设计，防止单点故障影响到系统的核心服务。校园网通过购买的 ISP 服务同 Internet 互联，通过有限的公网 IP 地址，利用地址翻译技术（NAT）提供对 Internet 的访问服务支持；通过端口映射技术提供对学校 WEB、数据等服务器的外部访问支持。校园网出口布置了防火墙和入侵检测系统，同时提供了 VPN 访问支持。



网络结构

3.2 实验需求

在不考虑对外服务（即校园网用户访问 Internet 和 Internet 用户访问校园对外服务器）及冗余链路的前提下，请按用户需求设计出该校园网的局域网部署规划设计，并最终完成各相关区域的各设备连通任务。用户的相关需求如下，请给出具体的规划设计和实施过程：

(1) 校园中心机房：存放网络核心设备、WEB 服务器、数据库服务器、流媒体服务器等相关服务器， 服务器数量在 10 台以内， 未来可扩展到 20 台。对全部校园网用户开放，提供 7*24 小时不间断服务支持；

(2) 办公区：教师和校领导办公区，存放日常办公设备和相关耗材；目前用户数量 80 左右，未来可以扩展到 200；提供无线接入服务，禁止宿舍区用户访问该区资源，允许教学区用户访问该区资源；

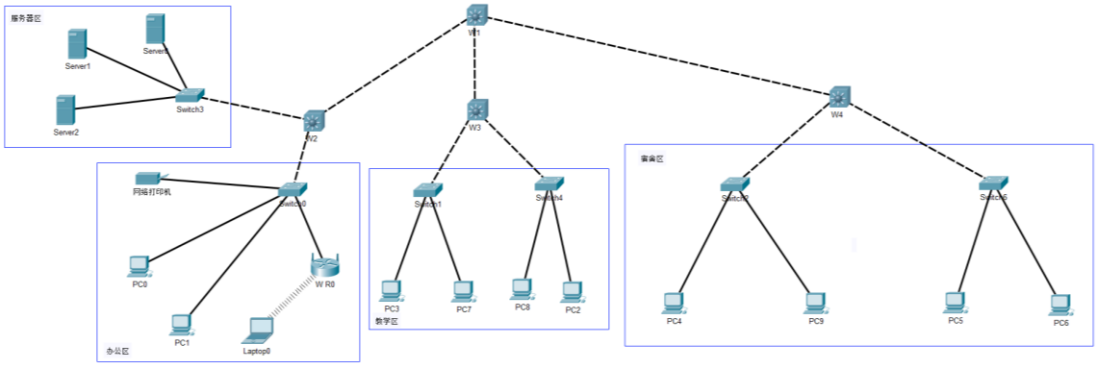
(3) 教学区：提供各教学设备网络连接支持。目前，需联网的有线设备数为 120，未来可扩展到 240；

(4) 宿舍区：可以提供学生上网服务。目前的用户共计 700 人，未来可扩展到 1000 人。

四、 实验过程与结果

4.1 局域网结构与正确性验证

(1) 局域网总结构



(2) 同一子网内连通正常

a) 服务器子网内

```
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Link-local IPv6 Address.....: FE80::201:C9FF:FE5A:1938
   IP Address.....: 192.168.16.1
   Subnet Mask.....: 255.255.255.224
   Default Gateway.....: 192.168.16.30

C:\>ping 192.168.16.2

Pinging 192.168.16.2 with 32 bytes of data:

Reply from 192.168.16.2: bytes=32 time<1ms TTL=128
Reply from 192.168.16.2: bytes=32 time<1ms TTL=128
Reply from 192.168.16.2: bytes=32 time<1ms TTL=128
Reply from 192.168.16.2: bytes=32 time=1ms TTL=128
```

b) 办公区子网内（两个虚拟局域网）

```
C:\>ping 192.168.17.17

Pinging 192.168.17.17 with 32 bytes of data:

Reply from 192.168.17.17: bytes=32 time=5ms TTL=128
Reply from 192.168.17.17: bytes=32 time<1ms TTL=128
Reply from 192.168.17.17: bytes=32 time=6ms TTL=128
Reply from 192.168.17.17: bytes=32 time<1ms TTL=128
```

```
C:\>ping 192.168.18.1

Pinging 192.168.18.1 with 32 bytes of data:

Request timed out.
Reply from 192.168.18.1: bytes=32 time=25ms TTL=127
Reply from 192.168.18.1: bytes=32 time=117ms TTL=127
Reply from 192.168.18.1: bytes=32 time=124ms TTL=127
```

c) 教学区子网内

```
C:\>ping 192.168.19.2

Pinging 192.168.19.2 with 32 bytes of data:

Reply from 192.168.19.2: bytes=32 time=7ms TTL=128
Reply from 192.168.19.2: bytes=32 time=1ms TTL=128
Reply from 192.168.19.2: bytes=32 time=2ms TTL=128
Reply from 192.168.19.2: bytes=32 time=1ms TTL=128
```

d) 宿舍区子网内（两个交换机划分为四个虚拟局域网）

```
C:\>ping 192.168.25.1

Pinging 192.168.25.1 with 32 bytes of data:

Request timed out.
Reply from 192.168.25.1: bytes=32 time=3ms TTL=127
Reply from 192.168.25.1: bytes=32 time<1ms TTL=127
Reply from 192.168.25.1: bytes=32 time<1ms TTL=127
```

```
C:\>ping 192.168.24.1

Pinging 192.168.24.1 with 32 bytes of data:

Reply from 192.168.24.1: bytes=32 time=1ms TTL=127
Reply from 192.168.24.1: bytes=32 time=1ms TTL=127
Reply from 192.168.24.1: bytes=32 time<1ms TTL=127
Reply from 192.168.24.1: bytes=32 time<1ms TTL=127
```

(3) 服务器区与办公区连通正常（服务器区执行 ping 操作）

```
Pinging 192.168.17.1 with 32 bytes of data:

Reply from 192.168.17.1: bytes=32 time=3ms TTL=127
Reply from 192.168.17.1: bytes=32 time<1ms TTL=127
Reply from 192.168.17.1: bytes=32 time<1ms TTL=127
Reply from 192.168.17.1: bytes=32 time<1ms TTL=127
```

```
Pinging 192.168.18.1 with 32 bytes of data:

Reply from 192.168.18.1: bytes=32 time=65ms TTL=127
Reply from 192.168.18.1: bytes=32 time=27ms TTL=127
Reply from 192.168.18.1: bytes=32 time=29ms TTL=127
Reply from 192.168.18.1: bytes=32 time=50ms TTL=127
```

(4) 服务器区与教学区连通正常（服务器区执行 ping 操作）

```
Pinging 192.168.19.2 with 32 bytes of data:

Reply from 192.168.19.2: bytes=32 time<1ms TTL=125
Reply from 192.168.19.2: bytes=32 time=1ms TTL=125
Reply from 192.168.19.2: bytes=32 time=1ms TTL=125
Reply from 192.168.19.2: bytes=32 time=1ms TTL=125
```

```
Pinging 192.168.19.4 with 32 bytes of data:

Request timed out.
Reply from 192.168.19.4: bytes=32 time<1ms TTL=125
Reply from 192.168.19.4: bytes=32 time=1ms TTL=125
Reply from 192.168.19.4: bytes=32 time<1ms TTL=125
```

(5) 办公区与教学区连通正常（教学区执行 ping 操作）

```
Pinging 192.168.17.1 with 32 bytes of data:

Reply from 192.168.17.1: bytes=32 time<1ms TTL=125
Reply from 192.168.17.1: bytes=32 time<1ms TTL=125
Reply from 192.168.17.1: bytes=32 time<1ms TTL=125
Reply from 192.168.17.1: bytes=32 time<1ms TTL=125
```

```
Pinging 192.168.18.1 with 32 bytes of data:

Reply from 192.168.18.1: bytes=32 time=11ms TTL=125
Reply from 192.168.18.1: bytes=32 time=16ms TTL=125
Reply from 192.168.18.1: bytes=32 time=13ms TTL=125
Reply from 192.168.18.1: bytes=32 time=16ms TTL=125
```

(6) 宿舍区与服务器区连通正常（服务器区执行 ping 操作）

```
Pinging 192.168.24.1 with 32 bytes of data:

Reply from 192.168.24.1: bytes=32 time<1ms TTL=125
Reply from 192.168.24.1: bytes=32 time=1ms TTL=125
Reply from 192.168.24.1: bytes=32 time<1ms TTL=125
Reply from 192.168.24.1: bytes=32 time<1ms TTL=125
```

```
Pinging 192.168.25.1 with 32 bytes of data:

Request timed out.
Reply from 192.168.25.1: bytes=32 time=1ms TTL=125
Reply from 192.168.25.1: bytes=32 time<1ms TTL=125
Reply from 192.168.25.1: bytes=32 time<1ms TTL=125
```

(7) 宿舍区与其他区不可连通（宿舍区执行 ping 操作）

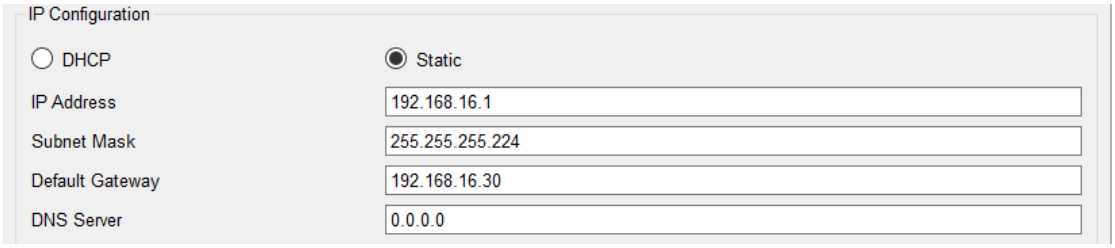
```
Pinging 192.168.17.1 with 32 bytes of data:

Reply from 192.168.24.254: Destination host unreachable.
Reply from 192.168.24.254: Destination host unreachable.
Request timed out.
Reply from 192.168.24.254: Destination host unreachable.
```

```
Pinging 192.168.18.1 with 32 bytes of data:

Reply from 192.168.25.254: Destination host unreachable.
Request timed out.
Reply from 192.168.25.254: Destination host unreachable.
Reply from 192.168.25.254: Destination host unreachable.
```

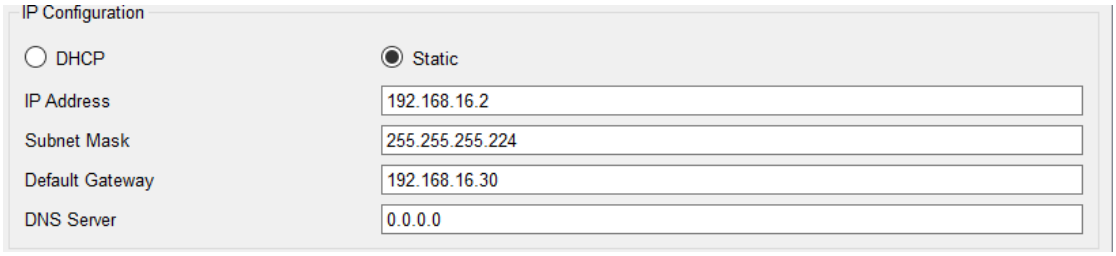
```
Pinging 192.168.19.1 with 32 bytes of data:

Reply from 192.168.26.254: Destination host unreachable.
Request timed out.
Reply from 192.168.26.254: Destination host unreachable.
Reply from 192.168.26.254: Destination host unreachable.
```

4.2 终端设备配置

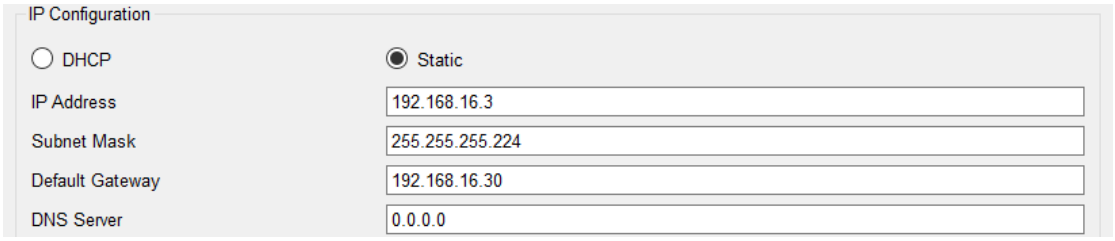
(1) 服务器区服务器配置



服务器区服务器 0

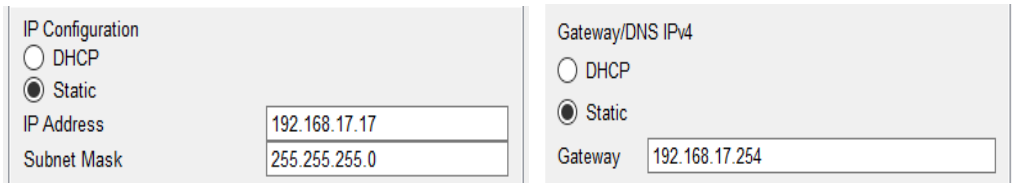


服务器区服务器 1

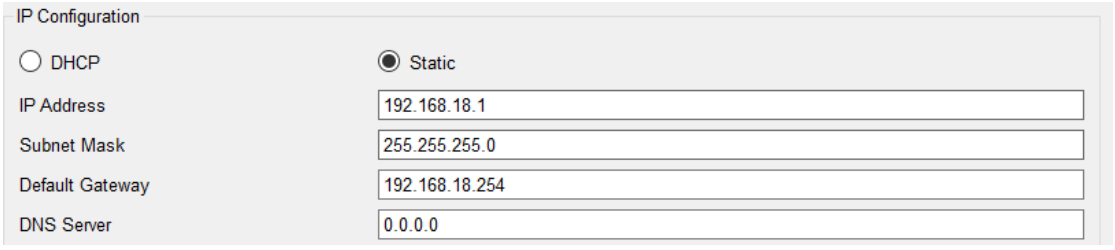


服务器区服务器 2

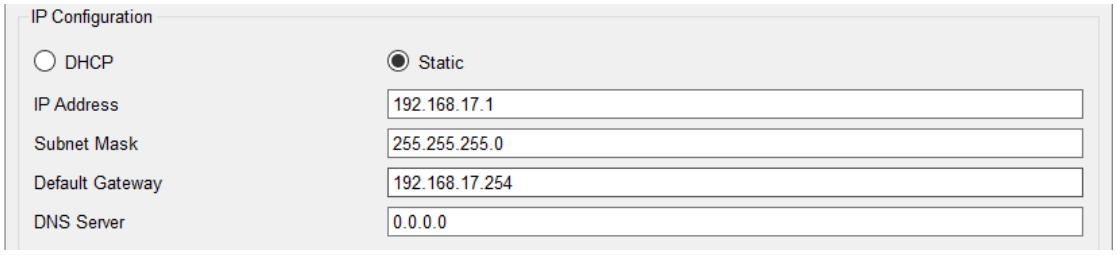
(2) 办公区打印机配置



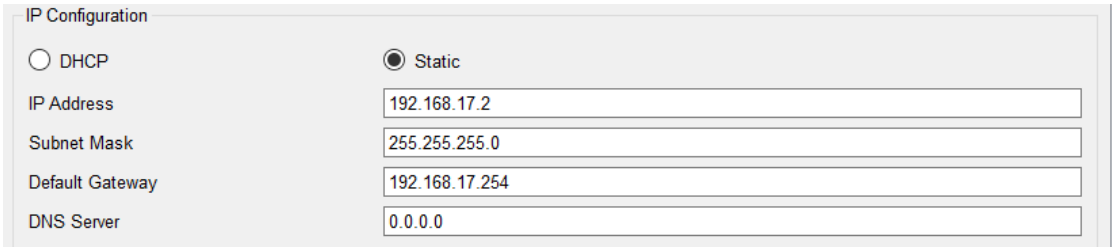
(3) 办公区笔记本配置



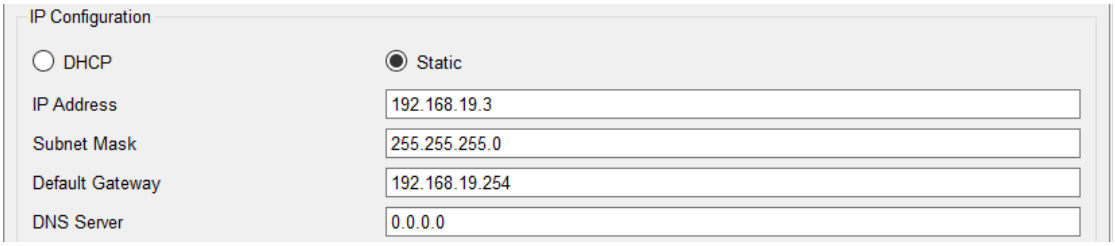
(4) 台式机配置



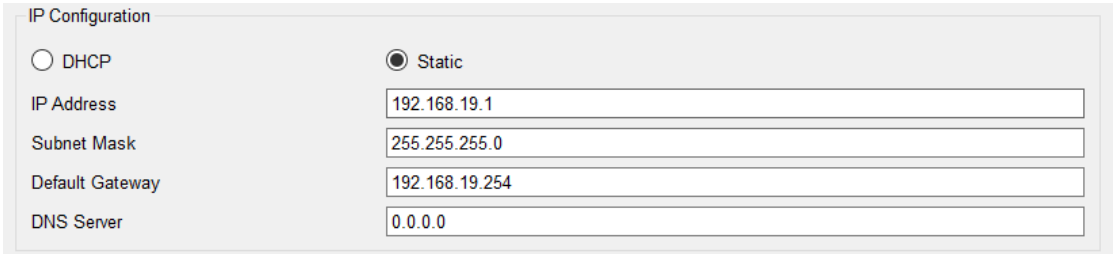
办公区台式机 0



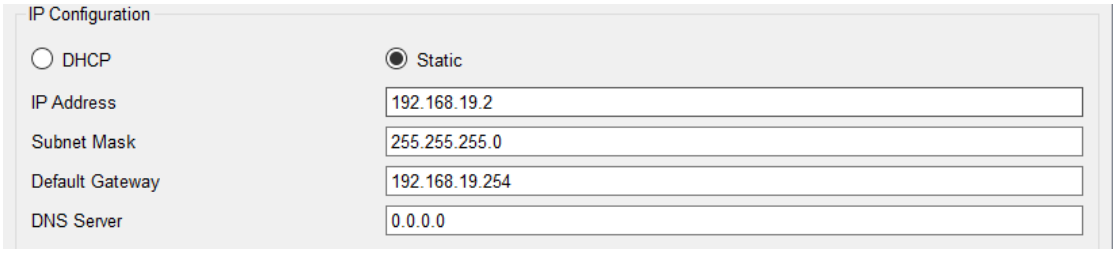
办公区台式机 1



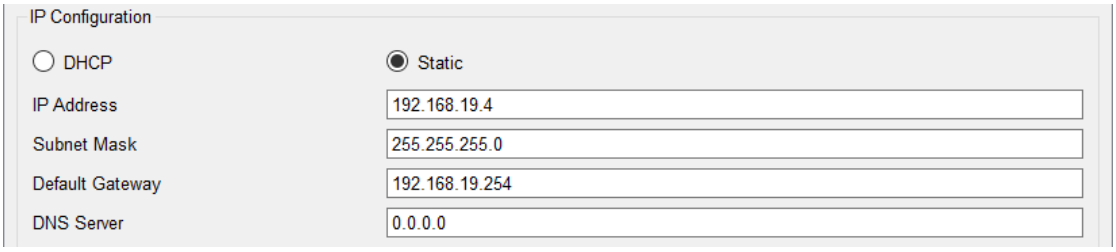
教学区台式机 2



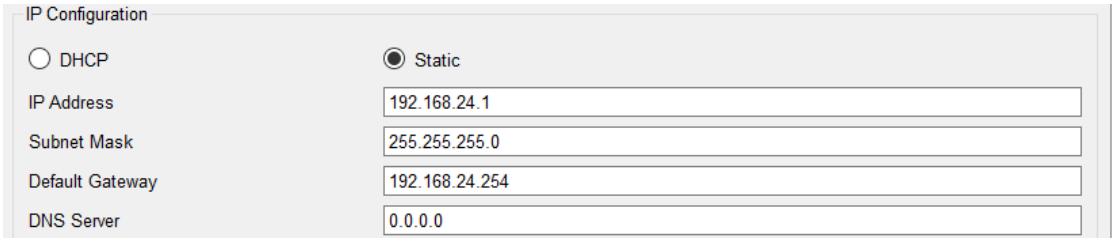
教学区台式机 3



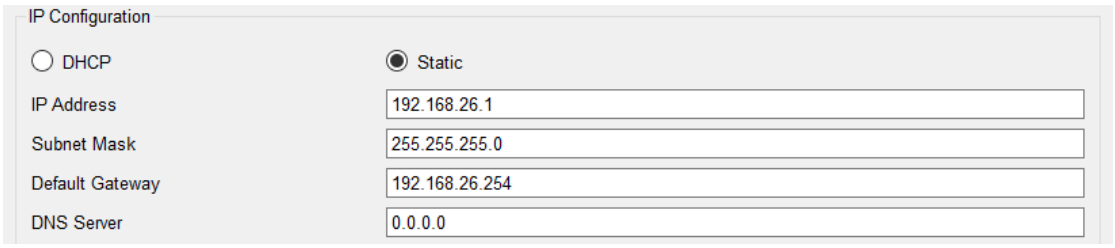
教学区台式机 7



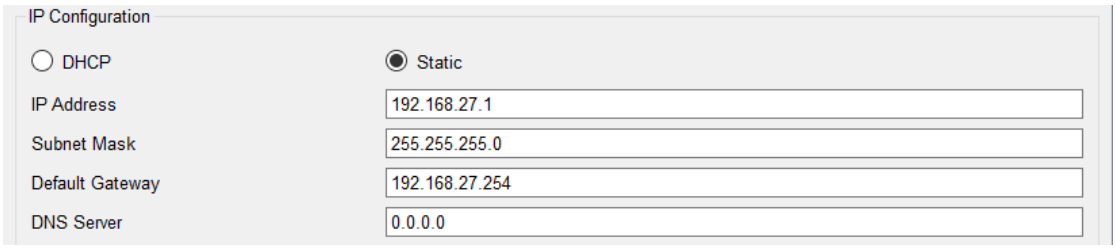
教学区台式机 8



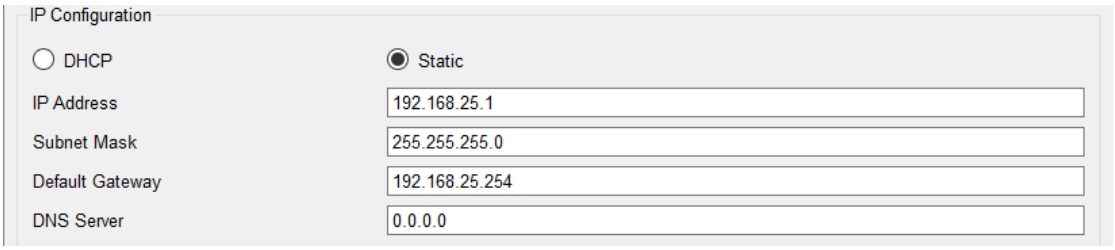
宿舍区台式机 4



宿舍区台式机 5



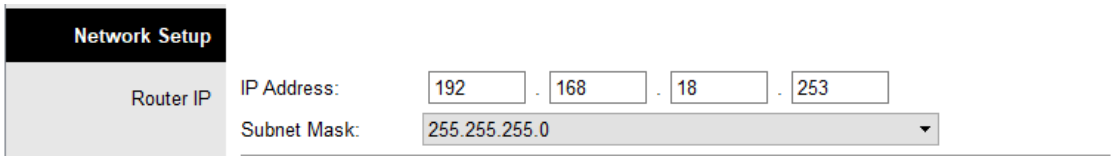
宿舍区台式机 6



宿舍区台式机 9

4.3 接入层设备配置

(1) 办公区无线路由器配置



(2) 服务器区交换机配置

```
Port              Link   VLAN   IP Address         MAC Address
FastEthernet0/1   Up     1      --                 0001.974B.4575
FastEthernet1/1   Up     1      --                 00D0.FF3A.5637
FastEthernet2/1   Up     1      --                 0004.9A55.D6E7
FastEthernet3/1   Up     1      --                 00E0.F96C.92CE
FastEthernet4/1   Down   1      --                 000C.859B.6CE6
FastEthernet5/1   Down   1      --                 0002.1711.094B
Vlan1             Up     1      192.168.16.29/27   0005.5E91.3AAE
Hostname: B10101_J2960
```

(3) 办公区交换机配置

```
Port                Link   VLAN   IP Address          MAC Address
FastEthernet0/1     Up     --     --                  0009.7C95.B201
FastEthernet0/2     Up     2      --                  0009.7C95.B202
FastEthernet0/3     Up     2      --                  0009.7C95.B203
FastEthernet0/4     Up     2      --                  0009.7C95.B204
FastEthernet0/5     Up     3      --                  0009.7C95.B205
FastEthernet0/6     Down   3      --                  0009.7C95.B206
FastEthernet0/7     Down   1      --                  0009.7C95.B207
FastEthernet0/8     Down   1      --                  0009.7C95.B208
FastEthernet0/9     Down   1      --                  0009.7C95.B209
FastEthernet0/10    Down   1      --                  0009.7C95.B20A
FastEthernet0/11    Down   1      --                  0009.7C95.B20B
FastEthernet0/12    Down   1      --                  0009.7C95.B20C
FastEthernet0/13    Down   1      --                  0009.7C95.B20D
FastEthernet0/14    Down   1      --                  0009.7C95.B20E
FastEthernet0/15    Down   1      --                  0009.7C95.B20F
FastEthernet0/16    Down   1      --                  0009.7C95.B210
FastEthernet0/17    Down   1      --                  0009.7C95.B211
FastEthernet0/18    Down   1      --                  0009.7C95.B212
FastEthernet0/19    Down   1      --                  0009.7C95.B213
FastEthernet0/20    Down   1      --                  0009.7C95.B214
FastEthernet0/21    Down   1      --                  0009.7C95.B215
FastEthernet0/22    Down   1      --                  0009.7C95.B216
FastEthernet0/23    Down   1      --                  0009.7C95.B217
FastEthernet0/24    Down   1      --                  0009.7C95.B218
GigabitEthernet0/1  Down   1      --                  0009.7C95.B219
GigabitEthernet0/2  Down   1      --                  0009.7C95.B21A
Vlan1               Down   1      <not set>           0002.1691.A326
Vlan2               Up     2      192.168.17.253/24   0002.1691.A301
Vlan3               Up     3      192.168.18.253/24   0002.1691.A302
Hostname: B10102_B2960
```

(4) 教学区交换机配置

```
Port                Link   VLAN   IP Address          MAC Address
FastEthernet0/1     Up     4      --                  0030.A364.E001
FastEthernet0/2     Up     4      --                  0030.A364.E002
FastEthernet0/3     Up     4      --                  0030.A364.E003
FastEthernet0/4     Down   4      --                  0030.A364.E004
FastEthernet0/5     Down   1      --                  0030.A364.E005
FastEthernet0/6     Down   1      --                  0030.A364.E006
FastEthernet0/7     Down   1      --                  0030.A364.E007
FastEthernet0/8     Down   1      --                  0030.A364.E008
FastEthernet0/9     Down   1      --                  0030.A364.E009
FastEthernet0/10    Down   1      --                  0030.A364.E00A
FastEthernet0/11    Down   1      --                  0030.A364.E00B
FastEthernet0/12    Down   1      --                  0030.A364.E00C
FastEthernet0/13    Down   1      --                  0030.A364.E00D
FastEthernet0/14    Down   1      --                  0030.A364.E00E
FastEthernet0/15    Down   1      --                  0030.A364.E00F
FastEthernet0/16    Down   1      --                  0030.A364.E010
FastEthernet0/17    Down   1      --                  0030.A364.E011
FastEthernet0/18    Down   1      --                  0030.A364.E012
FastEthernet0/19    Down   1      --                  0030.A364.E013
FastEthernet0/20    Down   1      --                  0030.A364.E014
FastEthernet0/21    Down   1      --                  0030.A364.E015
FastEthernet0/22    Down   1      --                  0030.A364.E016
FastEthernet0/23    Down   1      --                  0030.A364.E017
FastEthernet0/24    Down   1      --                  0030.A364.E018
GigabitEthernet0/1  Down   1      --                  0030.A364.E019
GigabitEthernet0/2  Down   1      --                  0030.A364.E01A
Vlan1               Down   1      <not set>           0002.4A0A.5B1E
Vlan4               Up     4      192.168.19.253/24   0002.4A0A.5B01
Hostname: B1004_switch1
```

```
Port                Link   VLAN   IP Address          MAC Address
FastEthernet0/1     Up     4      --                  0004.9AB4.DC01
FastEthernet0/2     Up     4      --                  0004.9AB4.DC02
FastEthernet0/3     Up     4      --                  0004.9AB4.DC03
FastEthernet0/4     Down   4      --                  0004.9AB4.DC04
FastEthernet0/5     Down   1      --                  0004.9AB4.DC05
FastEthernet0/6     Down   1      --                  0004.9AB4.DC06
FastEthernet0/7     Down   1      --                  0004.9AB4.DC07
FastEthernet0/8     Down   1      --                  0004.9AB4.DC08
FastEthernet0/9     Down   1      --                  0004.9AB4.DC09
FastEthernet0/10    Down   1      --                  0004.9AB4.DC0A
FastEthernet0/11    Down   1      --                  0004.9AB4.DC0B
FastEthernet0/12    Down   1      --                  0004.9AB4.DC0C
FastEthernet0/13    Down   1      --                  0004.9AB4.DC0D
FastEthernet0/14    Down   1      --                  0004.9AB4.DC0E
FastEthernet0/15    Down   1      --                  0004.9AB4.DC0F
FastEthernet0/16    Down   1      --                  0004.9AB4.DC10
FastEthernet0/17    Down   1      --                  0004.9AB4.DC11
FastEthernet0/18    Down   1      --                  0004.9AB4.DC12
FastEthernet0/19    Down   1      --                  0004.9AB4.DC13
FastEthernet0/20    Down   1      --                  0004.9AB4.DC14
FastEthernet0/21    Down   1      --                  0004.9AB4.DC15
FastEthernet0/22    Down   1      --                  0004.9AB4.DC16
FastEthernet0/23    Down   1      --                  0004.9AB4.DC17
FastEthernet0/24    Down   1      --                  0004.9AB4.DC18
GigabitEthernet0/1  Down   1      --                  0004.9AB4.DC19
GigabitEthernet0/2  Down   1      --                  0004.9AB4.DC1A
Vlan1               Down   1      <not set>           000B.BE69.A8AC
Vlan4               Up     4      192.168.19.253/24   000B.BE69.A801
Hostname: B1004_switch2
```

(5) 宿舍区交换机设置

```
Port                Link   VLAN   IP Address          MAC Address
FastEthernet0/1     Up     --     --                  0006.2A8D.0D01
FastEthernet0/2     Up     11     --                  0006.2A8D.0D02
FastEthernet0/3     Up     12     --                  0006.2A8D.0D03
FastEthernet0/4     Down   13     --                  0006.2A8D.0D04
FastEthernet0/5     Down   14     --                  0006.2A8D.0D05
FastEthernet0/6     Down   1      --                  0006.2A8D.0D06
FastEthernet0/7     Down   1      --                  0006.2A8D.0D07
FastEthernet0/8     Down   1      --                  0006.2A8D.0D08
FastEthernet0/9     Down   1      --                  0006.2A8D.0D09
FastEthernet0/10    Down   1      --                  0006.2A8D.0D0A
FastEthernet0/11    Down   1      --                  0006.2A8D.0D0B
FastEthernet0/12    Down   1      --                  0006.2A8D.0D0C
FastEthernet0/13    Down   1      --                  0006.2A8D.0D0D
FastEthernet0/14    Down   1      --                  0006.2A8D.0D0E
FastEthernet0/15    Down   1      --                  0006.2A8D.0D0F
FastEthernet0/16    Down   1      --                  0006.2A8D.0D10
FastEthernet0/17    Down   1      --                  0006.2A8D.0D11
FastEthernet0/18    Down   1      --                  0006.2A8D.0D12
FastEthernet0/19    Down   1      --                  0006.2A8D.0D13
FastEthernet0/20    Down   1      --                  0006.2A8D.0D14
FastEthernet0/21    Down   1      --                  0006.2A8D.0D15
FastEthernet0/22    Down   1      --                  0006.2A8D.0D16
FastEthernet0/23    Down   1      --                  0006.2A8D.0D17
FastEthernet0/24    Down   1      --                  0006.2A8D.0D18
GigabitEthernet0/1  Down   1      --                  0006.2A8D.0D19
GigabitEthernet0/2  Down   1      --                  0006.2A8D.0D1A
Vlan1               Down   1      <not set>           0003.E42D.D900
Vlan11              Up     11     192.168.24.253/24   0003.E42D.D901
Vlan12              Up     12     192.168.25.253/24   0003.E42D.D902
Vlan13              Up     13     192.168.26.253/24   0003.E42D.D903
Vlan14              Up     14     192.168.27.253/24   0003.E42D.D904
Hostname: Dorm_switch0
```

Port	Link	VLAN	IP Address	MAC Address
FastEthernet0/1	Up	--	--	0002.4A6D.B701
FastEthernet0/2	Down	11	--	0002.4A6D.B702
FastEthernet0/3	Down	12	--	0002.4A6D.B703
FastEthernet0/4	Up	13	--	0002.4A6D.B704
FastEthernet0/5	Up	14	--	0002.4A6D.B705
FastEthernet0/6	Down	1	--	0002.4A6D.B706
FastEthernet0/7	Down	1	--	0002.4A6D.B707
FastEthernet0/8	Down	1	--	0002.4A6D.B708
FastEthernet0/9	Down	1	--	0002.4A6D.B709
FastEthernet0/10	Down	1	--	0002.4A6D.B70A
FastEthernet0/11	Down	1	--	0002.4A6D.B70B
FastEthernet0/12	Down	1	--	0002.4A6D.B70C
FastEthernet0/13	Down	1	--	0002.4A6D.B70D
FastEthernet0/14	Down	1	--	0002.4A6D.B70E
FastEthernet0/15	Down	1	--	0002.4A6D.B70F
FastEthernet0/16	Down	1	--	0002.4A6D.B710
FastEthernet0/17	Down	1	--	0002.4A6D.B711
FastEthernet0/18	Down	1	--	0002.4A6D.B712
FastEthernet0/19	Down	1	--	0002.4A6D.B713
FastEthernet0/20	Down	1	--	0002.4A6D.B714
FastEthernet0/21	Down	1	--	0002.4A6D.B715
FastEthernet0/22	Down	1	--	0002.4A6D.B716
FastEthernet0/23	Down	1	--	0002.4A6D.B717
FastEthernet0/24	Down	1	--	0002.4A6D.B718
GigabitEthernet0/1	Down	1	--	0002.4A6D.B719
GigabitEthernet0/2	Down	1	--	0002.4A6D.B71A
Vlan1	Down	1	<not set>	0001.97A4.0E67
Vlan11	Up	11	192.168.24.253/24	0001.97A4.0E01
Vlan12	Up	12	192.168.25.253/24	0001.97A4.0E02
Vlan13	Up	13	192.168.26.253/24	0001.97A4.0E03
Vlan14	Up	14	192.168.27.253/24	0001.97A4.0E04

Hostname: Dorm_switch1

4.4 路由器路由表项

(1) 办公室和服务器交换机

Network Address
0.0.0.0/0 via 192.168.21.2

(2) 教学区交换机

Network Address
0.0.0.0/0 via 192.168.22.2

(3) 宿舍区交换机

Network Address
192.168.16.0/27 via 192.168.23.2

(4) 核心层交换机

```
     192.168.16.0/27 is subnetted, 1 subnets
S       192.168.16.0 [1/0] via 192.168.21.1
S    192.168.17.0/24 [1/0] via 192.168.21.1
S    192.168.18.0/24 [1/0] via 192.168.21.1
S    192.168.19.0/24 [1/0] via 192.168.22.1
     192.168.21.0/30 is subnetted, 1 subnets
C       192.168.21.0 is directly connected, Vlan6
     192.168.22.0/30 is subnetted, 1 subnets
C       192.168.22.0 is directly connected, Vlan7
     192.168.23.0/30 is subnetted, 1 subnets
C       192.168.23.0 is directly connected, Vlan8
S    192.168.24.0/21 [1/0] via 192.168.23.1
                     [1/0] via 192.168.21.1
```

4.5 汇聚层设备配置

(1) 办公室和服务器区交换机配置

```
Port                Link   VLAN   IP Address          IPv6 Address                              MAC Address
FastEthernet0/1     Up     1      <not set>           <not set>                                 0005.5E1B.2701
FastEthernet0/2     Up     --     <not set>           <not set>                                 0005.5E1B.2702
FastEthernet0/3     Up     6      <not set>           <not set>                                 0005.5E1B.2703
FastEthernet0/4     Down   1      <not set>           <not set>                                 0005.5E1B.2704
FastEthernet0/5     Down   1      <not set>           <not set>                                 0005.5E1B.2705
FastEthernet0/6     Down   1      <not set>           <not set>                                 0005.5E1B.2706
FastEthernet0/7     Down   1      <not set>           <not set>                                 0005.5E1B.2707
FastEthernet0/8     Down   1      <not set>           <not set>                                 0005.5E1B.2708
FastEthernet0/9     Down   1      <not set>           <not set>                                 0005.5E1B.2709
FastEthernet0/10    Down   1      <not set>           <not set>                                 0005.5E1B.270A
FastEthernet0/11    Down   1      <not set>           <not set>                                 0005.5E1B.270B
FastEthernet0/12    Down   1      <not set>           <not set>                                 0005.5E1B.270C
FastEthernet0/13    Down   1      <not set>           <not set>                                 0005.5E1B.270D
FastEthernet0/14    Down   1      <not set>           <not set>                                 0005.5E1B.270E
FastEthernet0/15    Down   1      <not set>           <not set>                                 0005.5E1B.270F
FastEthernet0/16    Down   1      <not set>           <not set>                                 0005.5E1B.2710
FastEthernet0/17    Down   1      <not set>           <not set>                                 0005.5E1B.2711
FastEthernet0/18    Down   1      <not set>           <not set>                                 0005.5E1B.2712
FastEthernet0/19    Down   1      <not set>           <not set>                                 0005.5E1B.2713
FastEthernet0/20    Down   1      <not set>           <not set>                                 0005.5E1B.2714
FastEthernet0/21    Down   1      <not set>           <not set>                                 0005.5E1B.2715
FastEthernet0/22    Down   1      <not set>           <not set>                                 0005.5E1B.2716
FastEthernet0/23    Down   1      <not set>           <not set>                                 0005.5E1B.2717
FastEthernet0/24    Down   1      <not set>           <not set>                                 0005.5E1B.2718
GigabitEthernet0/1  Down   1      <not set>           <not set>                                 0005.5E1B.2719
GigabitEthernet0/2  Down   1      <not set>           <not set>                                 0005.5E1B.271A
Vlan1               Up     1      192.168.16.30/27    <not set>                                 0001.64C9.8DA3
Vlan2               Up     2      192.168.17.254/24   <not set>                                 0001.64C9.8D01
Vlan3               Up     3      192.168.18.254/24   <not set>                                 0001.64C9.8D02
Vlan4               Down   4      <not set>           <not set>                                 0001.64C9.8D03
Vlan6               Up     6      192.168.21.1/30     <not set>                                 0001.64C9.8D04
Hostname: Conver_switch0
```

(2) 教学区交换机配置

Port	Link	VLAN	IP Address	IPv6 Address	MAC Address
FastEthernet0/1	Up	7	<not set>	<not set>	0001.C727.1A01
FastEthernet0/2	Up	4	<not set>	<not set>	0001.C727.1A02
FastEthernet0/3	Up	4	<not set>	<not set>	0001.C727.1A03
FastEthernet0/4	Down	1	<not set>	<not set>	0001.C727.1A04
FastEthernet0/5	Down	1	<not set>	<not set>	0001.C727.1A05
FastEthernet0/6	Down	1	<not set>	<not set>	0001.C727.1A06
FastEthernet0/7	Down	1	<not set>	<not set>	0001.C727.1A07
FastEthernet0/8	Down	1	<not set>	<not set>	0001.C727.1A08
FastEthernet0/9	Down	1	<not set>	<not set>	0001.C727.1A09
FastEthernet0/10	Down	1	<not set>	<not set>	0001.C727.1A0A
FastEthernet0/11	Down	1	<not set>	<not set>	0001.C727.1A0B
FastEthernet0/12	Down	1	<not set>	<not set>	0001.C727.1A0C
FastEthernet0/13	Down	1	<not set>	<not set>	0001.C727.1A0D
FastEthernet0/14	Down	1	<not set>	<not set>	0001.C727.1A0E
FastEthernet0/15	Down	1	<not set>	<not set>	0001.C727.1A0F
FastEthernet0/16	Down	1	<not set>	<not set>	0001.C727.1A10
FastEthernet0/17	Down	1	<not set>	<not set>	0001.C727.1A11
FastEthernet0/18	Down	1	<not set>	<not set>	0001.C727.1A12
FastEthernet0/19	Down	1	<not set>	<not set>	0001.C727.1A13
FastEthernet0/20	Down	1	<not set>	<not set>	0001.C727.1A14
FastEthernet0/21	Down	1	<not set>	<not set>	0001.C727.1A15
FastEthernet0/22	Down	1	<not set>	<not set>	0001.C727.1A16
FastEthernet0/23	Down	1	<not set>	<not set>	0001.C727.1A17
FastEthernet0/24	Down	1	<not set>	<not set>	0001.C727.1A18
GigabitEthernet0/1	Down	1	<not set>	<not set>	0001.C727.1A19
GigabitEthernet0/2	Down	1	<not set>	<not set>	0001.C727.1A1A
Vlan1	Down	1	<not set>	<not set>	00D0.97C8.58AD
Vlan4	Up	4	192.168.19.254/24	<not set>	00D0.97C8.5801
Vlan7	Up	7	192.168.22.1/30	<not set>	00D0.97C8.5802

Hostname: Conver_switch1

(3) 宿舍区交换机配置

Port	Link	VLAN	IP Address	IPv6 Address	MAC Address
FastEthernet0/1	Up	8	<not set>	<not set>	0001.967A.8601
FastEthernet0/2	Up	--	<not set>	<not set>	0001.967A.8602
FastEthernet0/3	Up	--	<not set>	<not set>	0001.967A.8603
FastEthernet0/4	Down	1	<not set>	<not set>	0001.967A.8604
FastEthernet0/5	Down	1	<not set>	<not set>	0001.967A.8605
FastEthernet0/6	Down	1	<not set>	<not set>	0001.967A.8606
FastEthernet0/7	Down	1	<not set>	<not set>	0001.967A.8607
FastEthernet0/8	Down	1	<not set>	<not set>	0001.967A.8608
FastEthernet0/9	Down	1	<not set>	<not set>	0001.967A.8609
FastEthernet0/10	Down	1	<not set>	<not set>	0001.967A.860A
FastEthernet0/11	Down	1	<not set>	<not set>	0001.967A.860B
FastEthernet0/12	Down	1	<not set>	<not set>	0001.967A.860C
FastEthernet0/13	Down	1	<not set>	<not set>	0001.967A.860D
FastEthernet0/14	Down	1	<not set>	<not set>	0001.967A.860E
FastEthernet0/15	Down	1	<not set>	<not set>	0001.967A.860F
FastEthernet0/16	Down	1	<not set>	<not set>	0001.967A.8610
FastEthernet0/17	Down	1	<not set>	<not set>	0001.967A.8611
FastEthernet0/18	Down	1	<not set>	<not set>	0001.967A.8612
FastEthernet0/19	Down	1	<not set>	<not set>	0001.967A.8613
FastEthernet0/20	Down	1	<not set>	<not set>	0001.967A.8614
FastEthernet0/21	Down	1	<not set>	<not set>	0001.967A.8615
FastEthernet0/22	Down	1	<not set>	<not set>	0001.967A.8616
FastEthernet0/23	Down	1	<not set>	<not set>	0001.967A.8617
FastEthernet0/24	Down	1	<not set>	<not set>	0001.967A.8618
GigabitEthernet0/1	Down	1	<not set>	<not set>	0001.967A.8619
GigabitEthernet0/2	Down	1	<not set>	<not set>	0001.967A.861A
Vlan1	Down	1	<not set>	<not set>	0001.96DA.5050
Vlan8	Up	8	192.168.23.1/30	<not set>	0001.96DA.5001
Vlan11	Up	11	192.168.24.254/24	<not set>	0001.96DA.5002
Vlan12	Up	12	192.168.25.254/24	<not set>	0001.96DA.5003
Vlan13	Up	13	192.168.26.254/24	<not set>	0001.96DA.5004
Vlan14	Up	14	192.168.27.254/24	<not set>	0001.96DA.5005

Hostname: Conver_switch2

4.6 核心层设备配置

(1) 核心层配置

Port	Link	VLAN	IP Address	IPv6 Address	MAC Address
FastEthernet0/1	Up	6	<not set>	<not set>	00D0.D38D.0801
FastEthernet0/2	Up	7	<not set>	<not set>	00D0.D38D.0802
FastEthernet0/3	Up	8	<not set>	<not set>	00D0.D38D.0803
FastEthernet0/4	Down	1	<not set>	<not set>	00D0.D38D.0804
FastEthernet0/5	Down	1	<not set>	<not set>	00D0.D38D.0805
FastEthernet0/6	Down	1	<not set>	<not set>	00D0.D38D.0806
FastEthernet0/7	Down	1	<not set>	<not set>	00D0.D38D.0807
FastEthernet0/8	Down	1	<not set>	<not set>	00D0.D38D.0808
FastEthernet0/9	Down	1	<not set>	<not set>	00D0.D38D.0809
FastEthernet0/10	Down	1	<not set>	<not set>	00D0.D38D.080A
FastEthernet0/11	Down	1	<not set>	<not set>	00D0.D38D.080B
FastEthernet0/12	Down	1	<not set>	<not set>	00D0.D38D.080C
FastEthernet0/13	Down	1	<not set>	<not set>	00D0.D38D.080D
FastEthernet0/14	Down	1	<not set>	<not set>	00D0.D38D.080E
FastEthernet0/15	Down	1	<not set>	<not set>	00D0.D38D.080F
FastEthernet0/16	Down	1	<not set>	<not set>	00D0.D38D.0810
FastEthernet0/17	Down	1	<not set>	<not set>	00D0.D38D.0811
FastEthernet0/18	Down	1	<not set>	<not set>	00D0.D38D.0812
FastEthernet0/19	Down	1	<not set>	<not set>	00D0.D38D.0813
FastEthernet0/20	Down	1	<not set>	<not set>	00D0.D38D.0814
FastEthernet0/21	Down	1	<not set>	<not set>	00D0.D38D.0815
FastEthernet0/22	Down	1	<not set>	<not set>	00D0.D38D.0816
FastEthernet0/23	Down	1	<not set>	<not set>	00D0.D38D.0817
FastEthernet0/24	Down	1	<not set>	<not set>	00D0.D38D.0818
GigabitEthernet0/1	Down	1	<not set>	<not set>	00D0.D38D.0819
GigabitEthernet0/2	Down	1	<not set>	<not set>	00D0.D38D.081A
Vlan1	Down	1	<not set>	<not set>	0030.F232.C0B6
Vlan6	Up	6	192.168.21.2/30	<not set>	0030.F232.C001
Vlan7	Up	7	192.168.22.2/30	<not set>	0030.F232.C002
Vlan8	Up	8	192.168.23.2/30	<not set>	0030.F232.C003

Hostname: Core_layer0

五、 实验总结

5.1 分析核心设备路由条目和其它配置方案

(1) 核心设备路由条目

a) 首先要设置网络空间 192.168.16.0/27、192.168.17.0/24 和 192.168.18.0/24（对应办公区和服务器区）对应的核心设备接口为 192.168.21.2；

b) 192.168.19.0/24（对应教学区）对应的接口为 192.168.22.2；

c) 192.168.24.0、192.168.25.0、192.168.26.0、192.168.27.0 对应的核心设备接口 IP 为 192.168.23.2。

```
     192.168.16.0/27 is subnetted, 1 subnets
S       192.168.16.0 [1/0] via 192.168.21.1
S    192.168.17.0/24 [1/0] via 192.168.21.1
S    192.168.18.0/24 [1/0] via 192.168.21.1
S    192.168.19.0/24 [1/0] via 192.168.22.1
     192.168.21.0/30 is subnetted, 1 subnets
C       192.168.21.0 is directly connected, Vlan6
     192.168.22.0/30 is subnetted, 1 subnets
C       192.168.22.0 is directly connected, Vlan7
     192.168.23.0/30 is subnetted, 1 subnets
C       192.168.23.0 is directly connected, Vlan8
S    192.168.24.0/21 [1/0] via 192.168.23.1
                     [1/0] via 192.168.21.1
```

(2) 其他配置方案：若将所有的数据全部向出口发送也可达到满足配置要求。

5.2 比较宿舍区与其它汇聚层路由条目不同

(1) 宿舍区汇聚层路由条目

Network Address

192.168.16.0/27 via 192.168.23.2

(2) 原因：限制用户访问，禁止宿舍区的用户访问办公区的资源，所以在设置的时候没有增加宿舍区到办公区的路由表项，宿舍区用户只可以访问服务器区资源

5.3 办公室和教学区访问宿舍区（结合模拟工具）

(1) 办公区不可以访问宿舍区

```
Pinging 192.168.24.1 with 32 bytes of data:

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

(2) 教学区不可以访问宿舍区

```
Pinging 192.168.25.1 with 32 bytes of data:

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

(3) 原因分析：同样由于宿舍区汇聚层的路由器表项中没有设置到办公区和教学区的路由表项，因此在办公区和教学区的数据请求无法由宿舍区路由器转发给宿舍区，因此均无法访问。

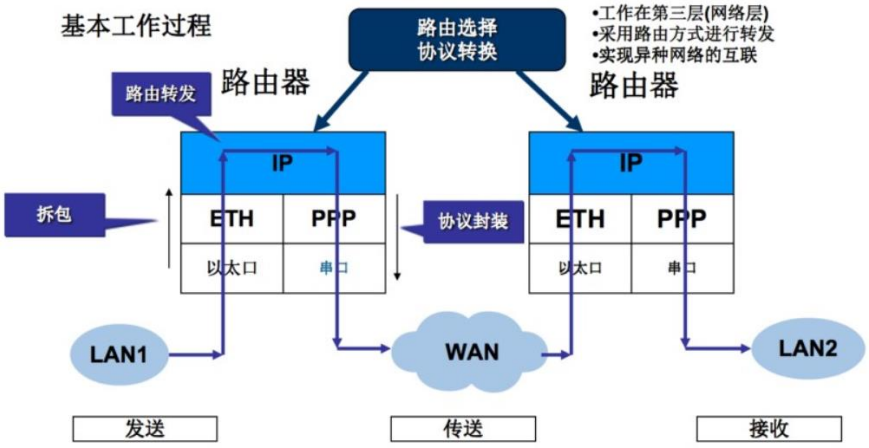
5.4 路由表作用，路由器和交换机原理

(1) 路由表作用：路由表包含若干条路由条目，每一个路由条目都有重要信息。一是目的子网（子网号和子网掩码），二是指出路由器发送数据包到下一台路由器或主机的方向（出口和下一跳路由器）。供路由器查找目标网络，进而确定转发接口及下一跳路由，完成数据包转发功能；

目的地址/前缀长度	下一跳地址	Metric	接口
202.197.10.0/24	直接传送	1	5
202.197.11.0/24	直接传送	10	1
202.197.12.0/24	202.197.11.3	20	3
0.0.0.0/0	202.197.11.2	30	3

路由表结构

(2) 路由器原理：路由器是 OSI 协议模型的网络层中的分组交换设备（或网络层中继设备），路由器的基本功能是把数据传送到正确的网络，包括：IP 数据报的转发，包括数据报的寻径和传送；子网隔离，抑制广播风暴；维护路由表，并与其他路由器交换路由信息，这是 IP 报文转发的基础；IP 数据报的差错处理及简单的拥塞控制；实现对 IP 数据报的过滤和记帐。路由器的主要功能是路由，即通过相互连接的网络把信息从源地点移动到目标地点的活动。

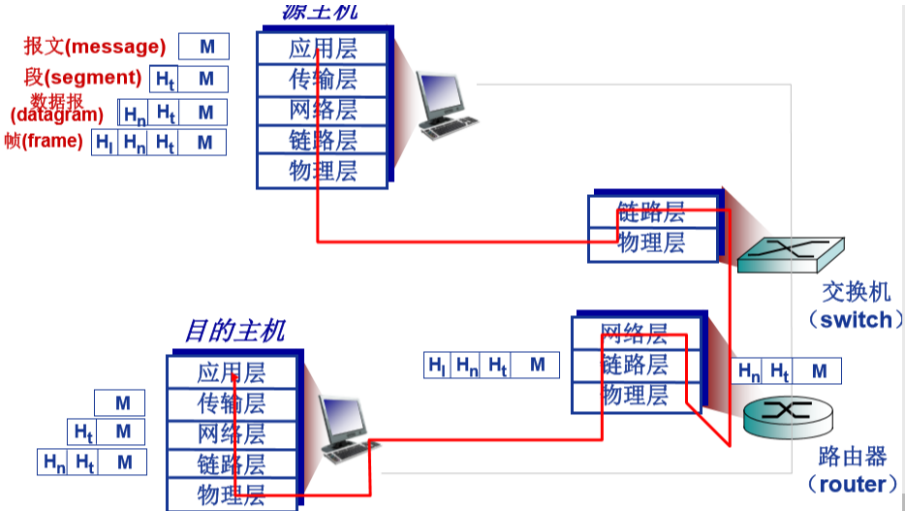


路由器工作过程

(3) 交换机原理：当交换机收到数据时，它会检查目的 MAC 地址，把数据从目的主机所在接口转发出去。交换机之所以能实现这一功能，是因为交换机内部有一个 MAC 地址表，MAC 地址表记录了网络中所有 MAC 地址与该交换机各端口的对应信息。某一数据帧需要转发时，交换机根据该数据帧的目的 MAC 地址来查找 MAC 地址表，从而得到该地址对应的端口，即知道具有该 MAC 地址的设备是连接在交换机的哪个端口上，然后交换机把数据帧从该端口转发出去。

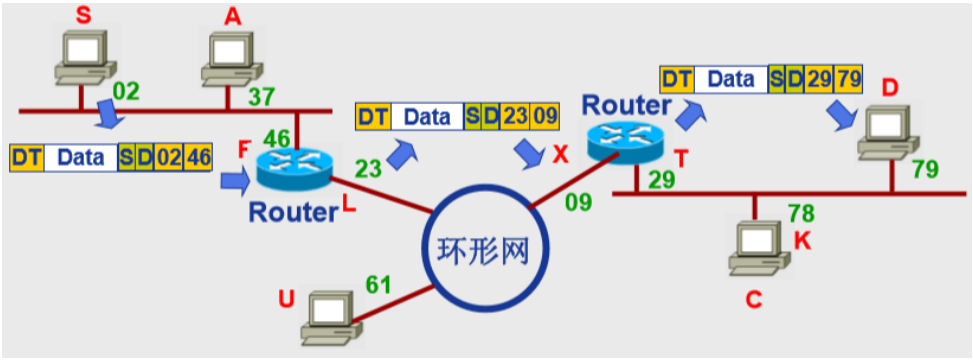
5.5 数据包在网路中的转发过程

(1) 数据包的产生与包装：产生于高层协议，并经过下层协议的一步步封装，最终发送到数据链路中进行比特传输；



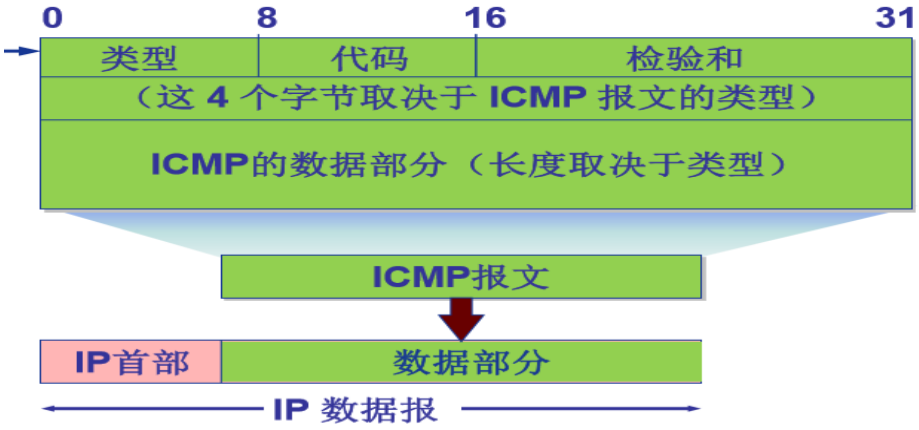
数据产生与封装

(2) 经过一跳的操作：路由器将数据还原为网络层 IP 数据包，基于路由转发表，查询目的地址根据最长前缀匹配将数据包封装后交付到下一跳地址所在的数据链路中。然后下一跳执行相同的处理过程，直到目的地址；



路由器功能

(3) ICMP 错误报文：若在经过一跳时，路由表中无对应表项、IP 头部 TTL 超期、校验和错误，该路由器会丢弃该报文，并产生和封装一个 ICMP 错误指示报文。



产生 ICMP 报文

六、 实验心得

1. 思考问题

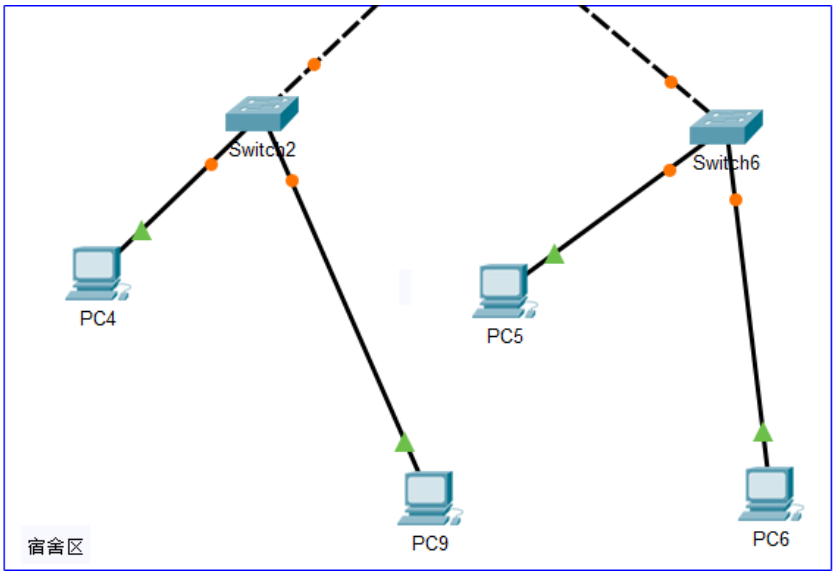
(1) 宿舍区用户较多，但策略相同；选择一个子网还是划分两个或多个子网呢，说说你的理由？

解答：可以划分为多个子网

a) 因为宿舍区用户较多，需要分配的地址空间大小至少为 1000 个，因此如果只采用一个子网的话，势必会给网络带来不必要的资源浪费，如网络数据的广播；

b) 同时，单一的子网不利于网络性能的提高，也给统一管理和未来的拓展性带来了一定的麻烦

c) 为了节约 IP 地址避免浪费，限定广播的传播，也为了保证网络的安全和未来的有可能出现的对拓展地理范围的需求能够被满足，需要进行划分子网，将宿舍区划分为 4 个连续的子网。



(2) 服务器区采用 IP 地址 192.168.16.0/27 和 IP 地址 192.168.16.0/24 哪个更好，说说你的看法依据？

答案：采用 192.168.16.0/27 更好

a) 要求和需求满足。服务器区设备所需 IP 地址数目至少为 20 个，而按此方式进行分配地址，可满足底线要求且可满足未来拓展需求；

b) 节约 IP 地址资源。采用后者 IP 地址分配方案，会占用 256 个 IP 地址资源，但因为闲置而浪费的 IP 地址数目为 200 多个；而若采用前者的分配方案，可以满足底线要求和一定的拓展需求，节约资源。

2. 项目收获

(1) 全面加深计算机网络理论知识感悟。通过真正的对一个简单网络的组建和配置操作，熟悉了相关的计算机网络知识，加深了对计算机网络的基础认识；

(2) 面向计算机网络学生的实用性软件。通过 Cisco Packet Tracer 软件进行项目实地组网前的模拟组网操作，真正的体会到了该软件对于网络组网项目工程的重要性。同时也让计算机网络课程的学员有机会在资源消耗比较少的情况下进行相关实验（网络实体设备的价格并非特别便宜）

(3) 对网络层和链路层认识更加深刻。对计算机网络的体系结构有了一个更加清楚的认识。通过第三次抓包实验对于上层协议有了一个全面的认识；而通过第四次简单组网实验，我对网络层和链路层设备理解更加深入。