



## 警示

1. 实验报告如有雷同，雷同各方当次实验成绩均以 0 分计。
2. 当次小组成员成绩只计学号、姓名登录在下表中的。
3. 在规定时间内未上交实验报告的，不得以其他方式补交，当次成绩按 0 分计。
4. 实验报告文件以 PDF 格式提交。

|                                 |            |          |          |    |    |
|---------------------------------|------------|----------|----------|----|----|
| 院系                              | 数据科学与计算机学院 | 班 级      | 周一班      | 组长 | 曾妮 |
| 学号                              | 16340011   | 16340013 | 16340041 |    |    |
| 学生                              | 曾妮         | 曾翔       | 陈亚楠      |    |    |
| 实验分工                            |            |          |          |    |    |
| 本次实验，三人共同完成三组实验，报告的撰写则一人负责部分报告。 |            |          |          |    |    |

### 【实验题目】端口聚合实验

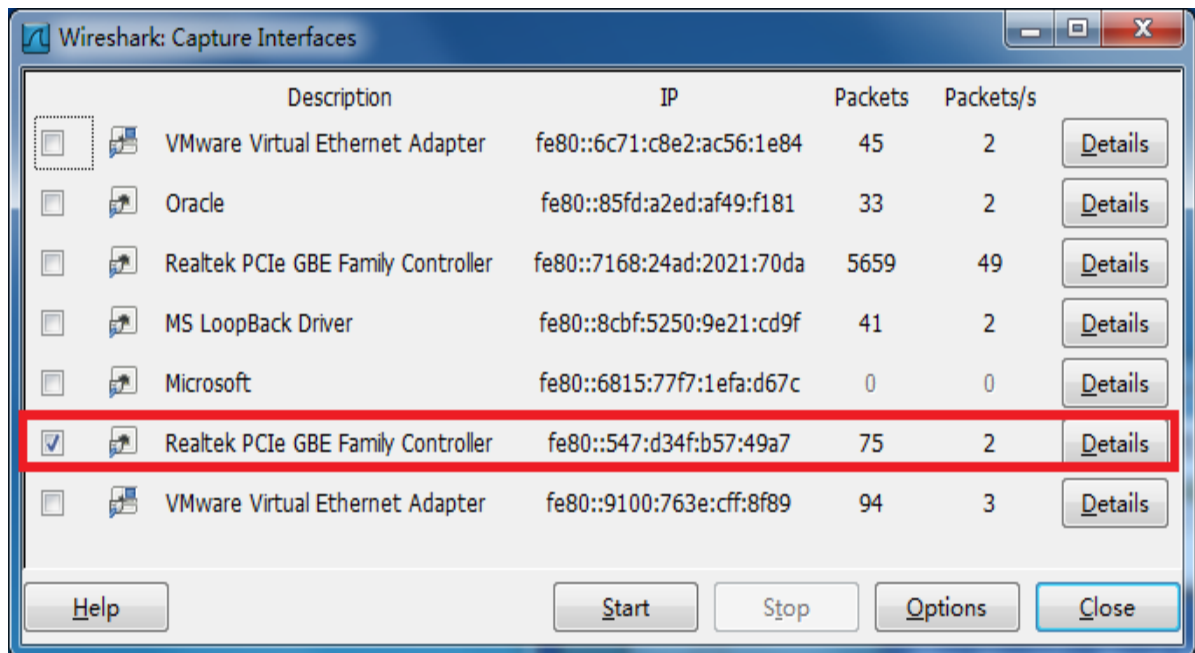
【实验目的】理解链路聚合的配置及原理。

### 【实验内容】

步骤 1：按照 6-20 所示拓扑图连接，注意此时两台交换机之间只连接一根跳线。

实验前带宽验证：

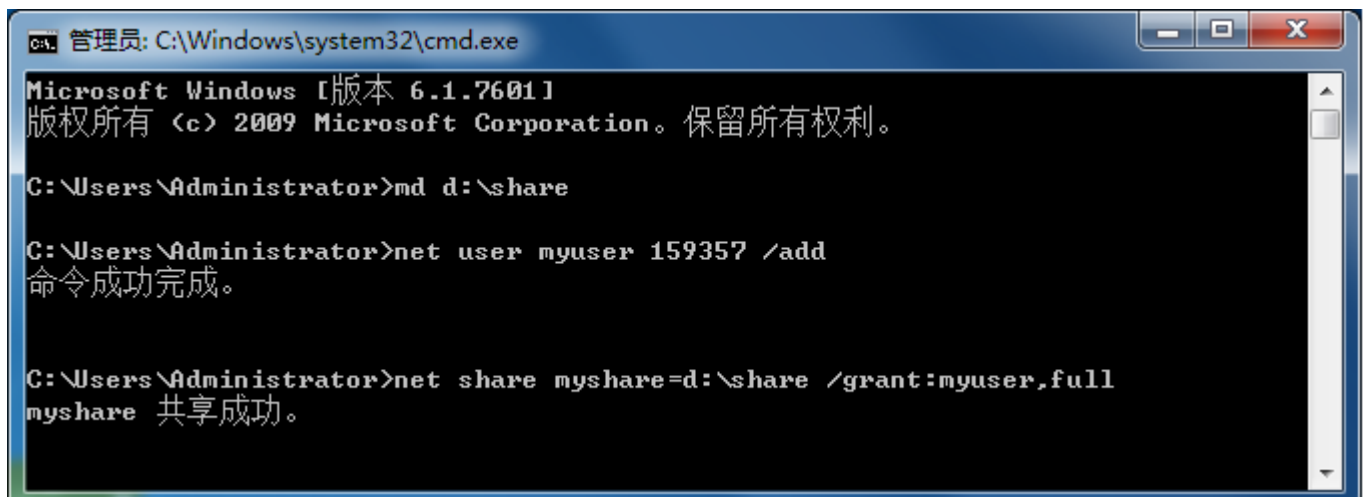
在 PC2 上建立一个共享目录（例如 D:\share），并启动 Wireshark 抓包软件，选中监控对象，将界面停留在 Caputer Interfaces 窗口上，观察此时数据包的传输情况。



从上图可以看出此时有少量数据包。

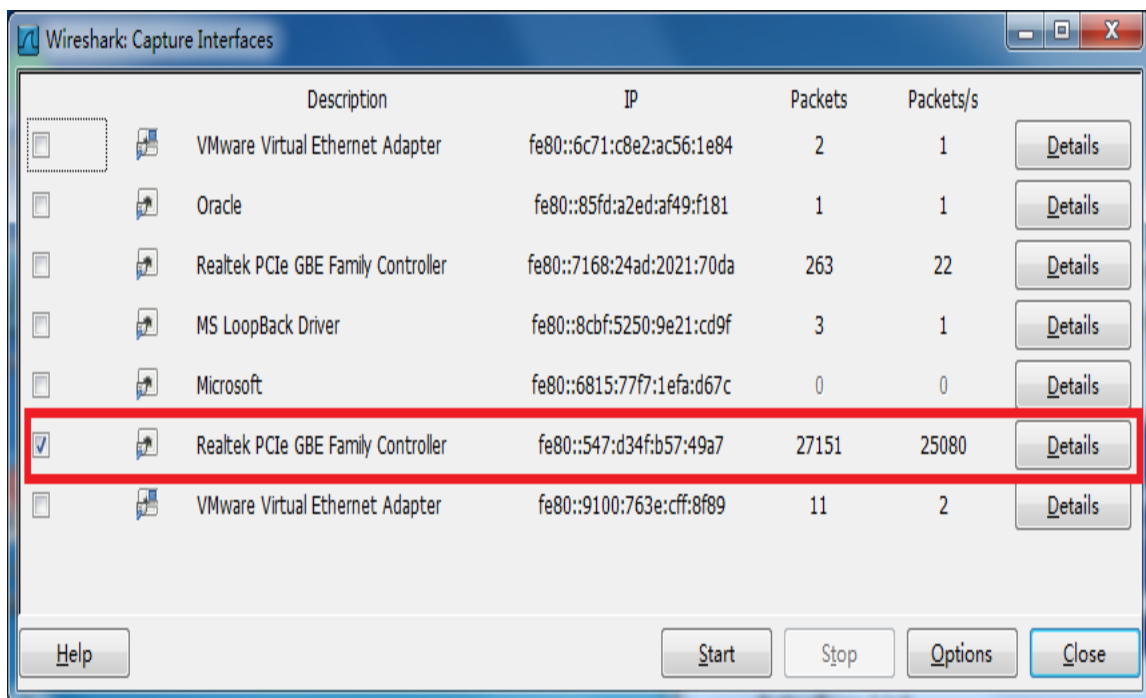
在 Windows7 中，共享目录（如 d:\share）在命令提示符窗口的建立过程如下：

```
md d:\share          \\ 在 D 盘建立文件夹 share
net user myuser 159357  \\ 建立用户 myuser、口令是 159357
net share myshare=d:\share /grant: myuser,full  \\建立 d: share 的共享名为 myshare,
访问用户 myuser、权限 full。
```



在 PC1 上选择一文件包，在“开始”|“搜索程序和文件”的对话框中输入\\192.168.10.20\myshare，输入用户名/口令，就进入了共享文件夹。

将 PC1 上的一个文件包复制到 PC2 的共享目录，此实验中选择的是一个视频文件。此时包的数量急剧增长，代表图如下：



包的数量比较少是因为选择的视频文件比较小。

步骤 2：交换机 A 的基本配置

步骤 3：在交换机 A 上配置聚合端口

步骤 2-3 如下图：



```
172.16.9.5 - SecureCRT
文件(F) 编辑(E) 查看(V) 选项(O) 传输(T) 脚本(S) 工具(L) 帮助(H)
172.16.9.5
9-S5750-1(config)#vlan 10
9-S5750-1(config-vlan)#name sales
9-S5750-1(config-vlan)#exit
9-S5750-1(config)#inter
9-S5750-1(config)#interface giga
9-S5750-1(config)#interface gigabitEthernet 0/5
9-S5750-1(config-if-GigabitEthernet 0/5)#swi
9-S5750-1(config-if-GigabitEthernet 0/5)#switchport access vlan 10
9-S5750-1(config-if-GigabitEthernet 0/5)#exit
9-S5750-1(config)#hostname SwitchA
SwitchA(config)#inter
SwitchA(config)#interface aggre
SwitchA(config)#interface aggregateport 1
SwitchA(config-if-AggregatePort 1)#swi
SwitchA(config-if-AggregatePort 1)#switchport mode trunk
SwitchA(config-if-AggregatePort 1)#exit
SwitchA(config)#inter
SwitchA(config)#interface range giga
SwitchA(config)#interface range gigabitEthernet 0/1-2
SwitchA(config-if-range)#port-group 1
%Warning: the link aggregation of port GigabitEthernet 0/1 may not match with its neighbor.
SwitchA(config-if-range)#*Apr 23 11:49:40: %LLDP-4-ERRDETECT: Link aggregation for the port GigabitEthernet 0/1 may not match with one for the neighbor port.
*Apr 23 11:49:42: %LINK-3-UPDOWN: Interface AggregatePort 1, changed state to up
.
*Apr 23 11:49:42: %LINEPROTO-5-UPDOWN: Line protocol on Interface AggregatePort 1, changed state to up.

SwitchA(config-if-range)#exit
SwitchA(config)#exit
SwitchA#*Apr 23 11:50:09: %SYS-5-CONFIG_I: Configured from console by console

SwitchA#show agg
SwitchA#show aggregatePort 1 summary
AggregatePort MaxPorts SwitchPort Mode Ports
-----
Ag1            8        Enabled   TRUNK  Gi0/1 ,Gi0/2
SwitchA#
```

就绪 Telnet 39, 9 39行, 80列 VT100 数字

可以看到端口 0/1 和端口 0/2 属于 AGI。

步骤 4: 交换机 B 的基本配置



```
9-S5750-2(config)#vlan 10
9-S5750-2(config-vlan)#name sales
9-S5750-2(config-vlan)#exit
9-S5750-2(config)#hostname SwitchB
SwitchB(config)#interface gigan
SwitchB(config)#interface gigab
SwitchB(config)#interface gigabitEthernet 0/5
SwitchB(config-if-GigabitEthernet 0/5)#switchport access vlan 10
SwitchB(config-if-GigabitEthernet 0/5)#exit
SwitchB(config)#eixt
% Unknown command.

SwitchB(config)#show vlan id 10
VLAN Name                Status    Ports
-----
10 sales                  STATIC    Gi0/5

SwitchB(config)#*Nov 19 17:18:05: %LLDP-4-ERRDETECT: Link aggregation for the po
rt GigabitEthernet 0/1 may not match with one for the neighbor port.
```

从上图可以看到已经在交换机 B 创建了 VLAN10，并将端口 0/5 划分到了 VLAN10 中。

步骤 5：在交换机 B 上配置聚合端口：

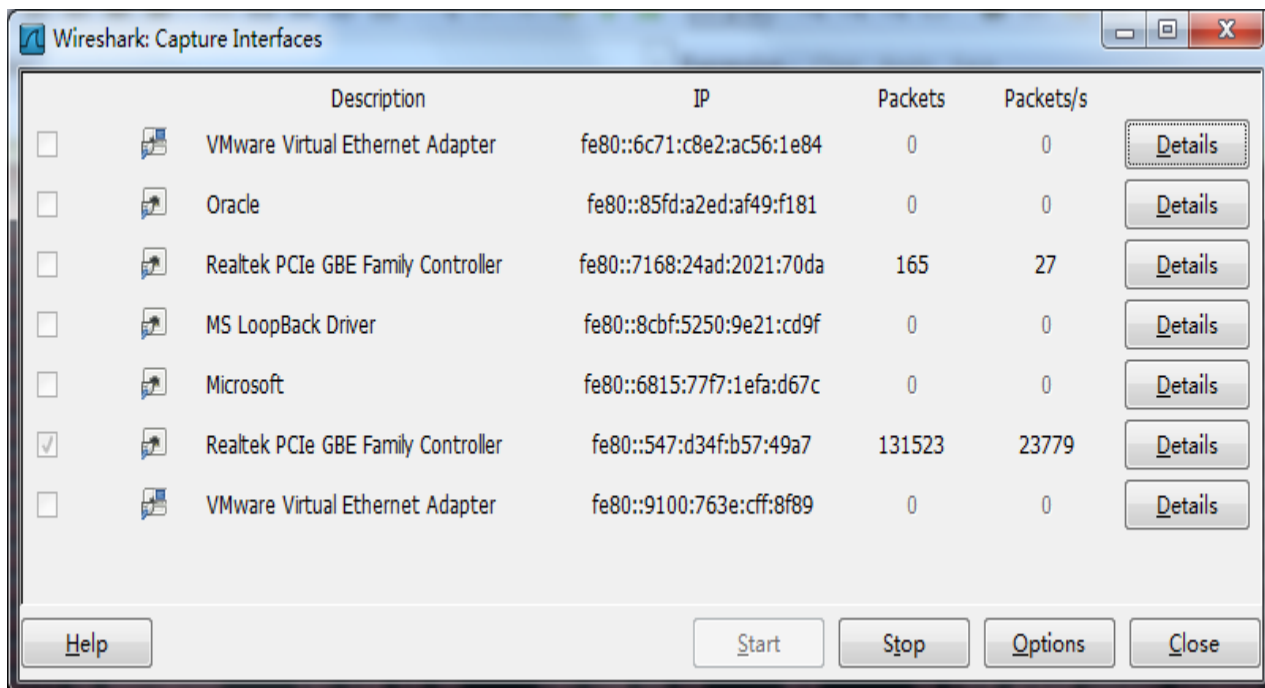
```
SwitchB(config)#interfa
SwitchB(config)#interface aggre
SwitchB(config)#interface aggregateport 1
SwitchB(config-if-AggregatePort 1)#switchport mode trunk
SwitchB(config-if-AggregatePort 1)#exit
SwitchB(config)#interface gigabi
SwitchB(config)#interface range gigabitEthernet 0/1-2
SwitchB(config-if-range)#port-group 1
SwitchB(config-if-range)*Nov 19 17:19:49: %LINK-3-UPDOWN: Interface AggregatePo
rt 1, changed state to up.
*Nov 19 17:19:49: %LINEPROTO-5-UPDOWN: Line protocol on Interface AggregatePort
1, changed state to up.
exit
SwitchB(config)#show aggreg
SwitchB(config)#show aggregatePort 1 summary
AggregatePort MaxPorts SwitchPort Mode    Ports
-----
Ag1           8         Enabled  TRUNK  Gi0/1   ,Gi0/2
SwitchB(config)#
```

可以看到在交换机 B 上端口 0/1 与端口 0/2 属于 AGI。

此时连接两台交换机之间的另一条跳线。

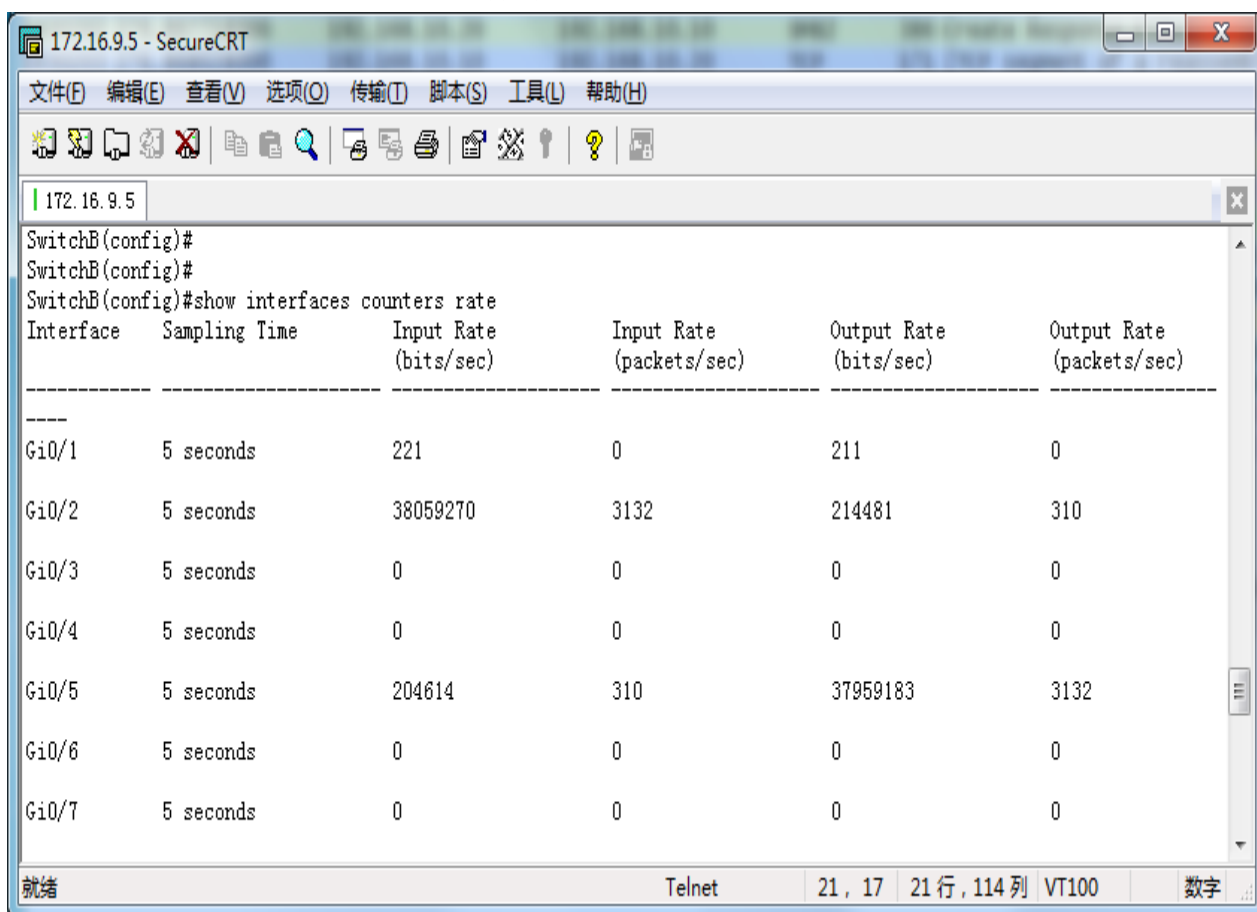
步骤 6：

(1)

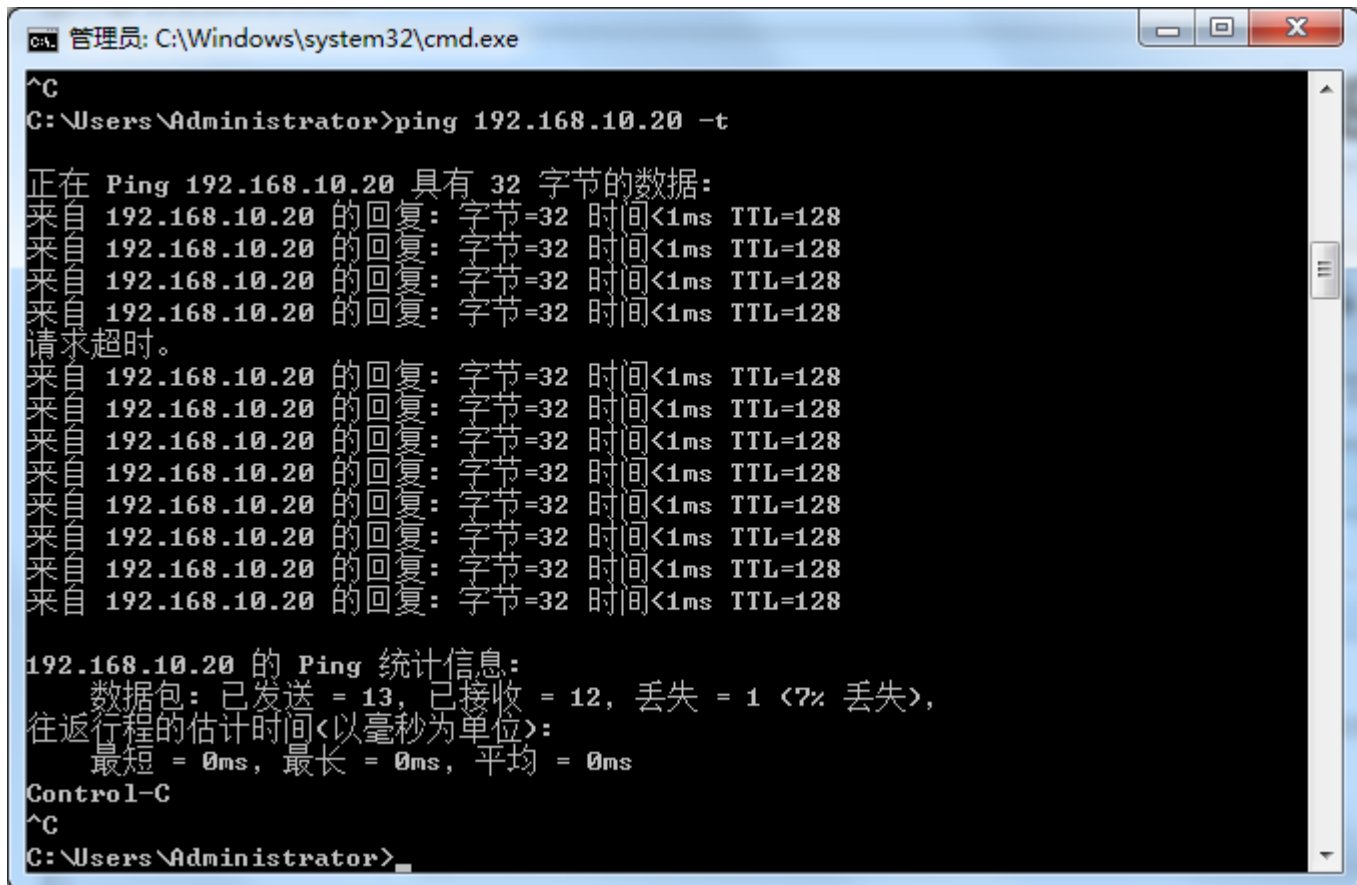


虽然传送了一个更大的文件，但是可以看到平均速度更快了，所以带宽也变大了。

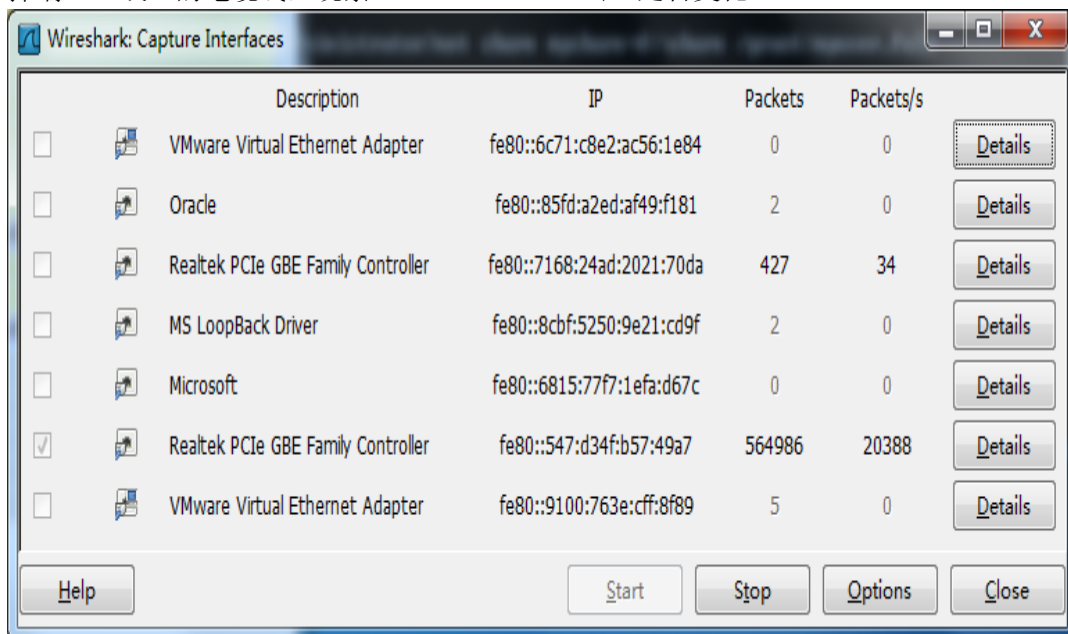
(2) 从下图可以看出是端口 0/2 正在传输数据



(3) 链路聚合的动态备份：可以看到 PC 间任可通信，即链路聚合的动态备份有效，接线过程中有丢包现象。

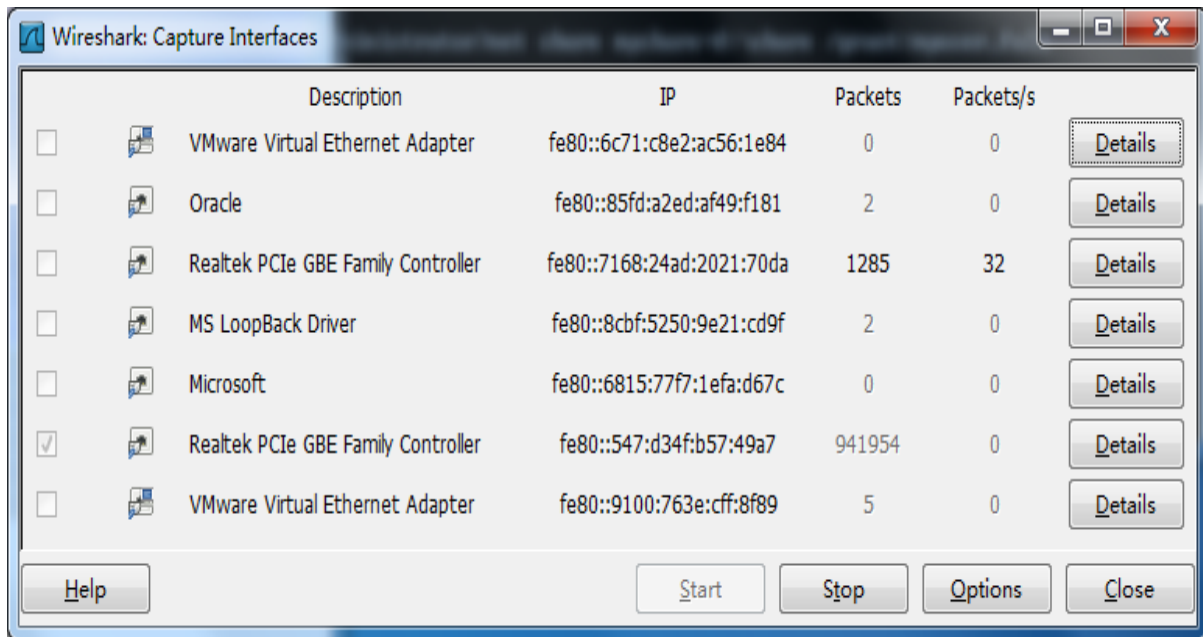


(4) 重做步骤 5 验证 (1)，监控窗口停留在 Caputer Interfaces 窗口上，在数据传送过程中，拔掉端口 1 或 2 的电缆线，观察 Packets、Packets/s 是否变化？



上图是没有拔掉电缆时候的截图。





上图是拔掉电缆线的截图。还有就是拔掉电缆下之后一段时间的截图忘了截，但是是包的数量以及包的传输速率都比刚拔掉的时候大。

所以从上图可知包的数量是不断增大的，包的传输速率会在拔掉电缆之后的快速下降，然后再慢慢的回升。

(5) 查看聚合端口：

```
SwitchB(config)#show interfaces aggregatePort 1
Index(dec):29 (hex):1d
AggregatePort 1 is UP , line protocol is UP
Hardware is Aggregate Link AggregatePort
Interface address is: no ip address
MTU 1500 bytes, BW 2000000 Kbit
Encapsulation protocol is Bridge, loopback not set
Keepalive interval is 10 sec , set
Carrier delay is 2 sec
Rxload is 12/255, Txload is 1/255
Switchport attributes:
  interface's description:""
  admin medium-type is Copper, oper medium-type is Copper
  lastchange time: 0 Day: 0 Hour:48 Minute: 5 Second
  current status duration: 0 Day: 0 Hour:26 Minute:39 Second
  Priority is 0
  admin duplex mode is AUTO, oper duplex is Full
  admin speed is AUTO, oper speed is 1000M
  flow control admin status is OFF, flow control oper status is OFF
  admin negotiation mode is OFF, oper negotiation state is OFF
  Storm Control: Broadcast is ON, Multicast is OFF, Unicast is ON
Port-type: trunk
Native vlan: 1
Allowed vlan lists: 1-4094
Active vlan lists: 1,10
Aggregate Port Informations:
  Aggregate Number: 1
  Name: "AggregatePort 1"
  Refs: 2
  Members: (count=2)
    GigabitEthernet 0/1      Link Status: Up
    GigabitEthernet 0/2      Link Status: Up
  5 minutes input rate 99874962 bits/sec, 8209 packets/sec
  5 minutes output rate 561642 bits/sec, 818 packets/sec
  5258824 packets input, 7991438858 bytes, 0 no buffer, 0 dropped
  Received 214 broadcasts, 0 runts, 0 giants
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 abort
  529193 packets output, 54851648 bytes, 0 underruns , 0 dropped
  0 output errors, 0 collisions, 0 interface resets
```

可以看出聚合端口类型：

**Port-type: trunk**

(6) 查看成员端口：



```
172.16.9.5 - SecureCRT
文件(F) 编辑(E) 查看(V) 选项(O) 传输(T) 脚本(S) 工具(L) 帮助(H)
172.16.9.5
SwitchB(config)#show interfaces gigabitethernet 0/1
Index(dec):1 (hex):1
GigabitEthernet 0/1 is UP, line protocol is UP
Hardware is Broadcom 5464 GigabitEthernet
Interface address is: no ip address
MTU 1500 bytes, BW 1000000 Kbit
Encapsulation protocol is Bridge, loopback not set
Keepalive interval is 10 sec, set
Carrier delay is 2 sec
Rxload is 8/255, Txload is 1/255
Switchport attributes:
  interface's description: ""
  admin medium-type is Copper, oper medium-type is Copper
  lastchange time: 0 Day: 0 Hour:31 Minute:41 Second
  current status duration: 0 Day: 0 Hour:44 Minute:28 Second
  Priority is 0
  admin duplex mode is AUTO, oper duplex is Full
  admin speed is AUTO, oper speed is 1000M
  flow control admin status is OFF, flow control oper status is OFF
  admin negotiation mode is OFF, oper negotiation state is ON
  Storm Control: Broadcast is ON, Multicast is OFF, Unicast is ON
5 minutes input rate 34718804 bits/sec, 2853 packets/sec
5 minutes output rate 193609 bits/sec, 282 packets/sec
1213672 packets input, 1835134348 bytes, 0 no buffer, 0 dropped
Received 573 broadcasts, 0 runts, 0 giants
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 abort
155269 packets output, 60054240 bytes, 0 underruns, 0 dropped
0 output errors, 0 collisions, 0 interface resets
SwitchB(config)#
SwitchB(config)#
SwitchB(config)#
```

(7) 查看端口状态:

```
172.16.9.5 - SecureCRT
文件(F) 编辑(E) 查看(V) 选项(O) 传输(T) 脚本(S) 工具(L) 帮助(H)
172.16.9.5
SwitchB(config)#show interfaces status
Interface              Status    Vlan Duplex  Speed  Type
-----
GigabitEthernet 0/1    up        1    Full   1000M  copper
GigabitEthernet 0/2    up        1    Full   1000M  copper
GigabitEthernet 0/3    down      1    Unknown Unknown copper
GigabitEthernet 0/4    down      1    Unknown Unknown copper
GigabitEthernet 0/5    up        10    Full   1000M  copper
GigabitEthernet 0/6    down      1    Unknown Unknown copper
GigabitEthernet 0/7    down      1    Unknown Unknown copper
GigabitEthernet 0/8    down      1    Unknown Unknown copper
GigabitEthernet 0/9    down      1    Unknown Unknown copper
GigabitEthernet 0/10   down      1    Unknown Unknown copper
GigabitEthernet 0/11   down      1    Unknown Unknown copper
GigabitEthernet 0/12   down      1    Unknown Unknown copper
GigabitEthernet 0/13   down      1    Unknown Unknown copper
GigabitEthernet 0/14   down      1    Unknown Unknown copper
GigabitEthernet 0/15   down      1    Unknown Unknown copper
GigabitEthernet 0/16   down      1    Unknown Unknown copper
GigabitEthernet 0/17   down      1    Unknown Unknown copper
GigabitEthernet 0/18   down      1    Unknown Unknown copper
GigabitEthernet 0/19   down      1    Unknown Unknown copper
GigabitEthernet 0/20   down      1    Unknown Unknown copper
GigabitEthernet 0/21   down      1    Unknown Unknown copper
GigabitEthernet 0/22   down      1    Unknown Unknown copper
GigabitEthernet 0/23   down      1    Unknown Unknown copper
GigabitEthernet 0/24   down      1    Unknown Unknown copper
GigabitEthernet 0/25   down      1    Unknown Unknown fiber
GigabitEthernet 0/26   down      1    Unknown Unknown fiber
GigabitEthernet 0/27   down      1    Unknown Unknown fiber
GigabitEthernet 0/28   down      1    Unknown Unknown fiber
AggregatePort 1        up        1    Full   1000M  copper
SwitchB(config)#
```

(8) 查看成员端口的速率流量:





```
172.16.9.5 - SecureCRT
文件(F) 编辑(E) 查看(V) 选项(O) 传输(T) 脚本(S) 工具(L) 帮助(H)
172.16.9.5
SwitchA#show interfaces counters rate
Interface      Sampling Time      Input Rate      Input Rate      Out
put Rate      Output Rate      (bits/sec)      (packets/sec)      (bi
ts/sec)      (packets/sec)
-----
Gi0/1          5 seconds          27587           39              479
0575          394
Gi0/2          5 seconds          91354           131             159
80157         1314
Gi0/3          5 seconds          0               0               0
0
Gi0/4          5 seconds          0               0               0
0
Gi0/5          5 seconds          20715921        1708            113
388          171
Gi0/6          5 seconds          0               0               0
0
Gi0/7          5 seconds          0               0               0
0
Gi0/8          5 seconds          0               0               0
0
Gi0/9          5 seconds          0               0               0
0
Gi0/10         5 seconds          0               0               0
0
Gi0/11         5 seconds          0               0               0
0
Gi0/12         5 seconds          0               0               0
0
Gi0/13         5 seconds          0               0               0
0
Gi0/14         5 seconds          0               0               0
0
Gi0/15         5 seconds          0               0               0
0
Gi0/16         5 seconds          0               0               0
0
Gi0/17         5 seconds          0               0               0
0
Gi0/18         5 seconds          0               0               0
0
Gi0/19         5 seconds          0               0               0
0
Gi0/20         5 seconds          0               0               0
0
Gi0/21         5 seconds          0               0               0
0
Gi0/22         5 seconds          0               0               0
0
Gi0/23         5 seconds          0               0               0
0
Gi0/24         5 seconds          0               0               0
0
Gi0/25         5 seconds          0               0               0
0
Gi0/26         5 seconds          0               0               0
0
Gi0/27         5 seconds          0               0               0
0
Gi0/28         5 seconds          0               0               0
0
RCMS Home Pa... Windows 防火墙 172.16.9.5 - Sec... buzhou6-(7) - 画...
```

|          |           |      |   |     |
|----------|-----------|------|---|-----|
| Gi0/15   | 5 seconds | 0    | 0 | 0   |
| Gi0/16   | 5 seconds | 0    | 0 | 0   |
| Gi0/17   | 5 seconds | 0    | 0 | 0   |
| Gi0/18   | 5 seconds | 0    | 0 | 0   |
| Gi0/19   | 5 seconds | 0    | 0 | 0   |
| Gi0/20   | 5 seconds | 0    | 0 | 0   |
| Gi0/21   | 5 seconds | 0    | 0 | 0   |
| Gi0/22   | 5 seconds | 0    | 0 | 0   |
| Gi0/23   | 5 seconds | 0    | 0 | 0   |
| Gi0/24   | 5 seconds | 0    | 0 | 0   |
| Gi0/25   | 5 seconds | 0    | 0 | 0   |
| Gi0/26   | 5 seconds | 0    | 0 | 0   |
| Gi0/27   | 5 seconds | 0    | 0 | 0   |
| Gi0/28   | 5 seconds | 0    | 0 | 0   |
| Ag1      | 5 seconds | 1956 | 0 | 327 |
| 1        | 0         |      |   |     |
| SwitchA# |           |      |   |     |



```
172.16.9.5 - SecureCRT
文件(F) 编辑(E) 查看(V) 选项(O) 传输(T) 脚本(S) 工具(L) 帮助(H)
172.16.9.5
SwitchA#show interfaces counters summary
Interface      InOctets      InUcastPkts      InMulticastPkts  InB
roadcastPkts
-----
Gi0/1          60063402      154025           749              558
Gi0/2          45298520      417548           65               260
Gi0/3          0             0               0               0
Gi0/4          0             0               0               0
Gi0/5          8108597655    5354901          841              103
Gi0/6          0             0               0               0
Gi0/7          0             0               0               0
Gi0/8          0             0               0               0
Gi0/9          0             0               0               0
Gi0/10         0             0               0               0
Gi0/11         0             0               0               0
Gi0/12         0             0               0               0
Gi0/13         0             0               0               0
Gi0/14         0             0               0               0
Gi0/15         0             0               0               0
Gi0/16         0             0               0               0
Gi0/17         0             0               0               0
Gi0/18         0             0               0               0
Gi0/19         0             0               0               0
Gi0/20         0             0               0               0
Gi0/21         0             0               0               0
Gi0/22         0             0               0               0
Gi0/23         0             0               0               0
Gi0/24         0             0               0               0
Gi0/25         0             0               0               0
Gi0/26         0             0               0               0
Gi0/27         0             0               0               0
Gi0/28         0             0               0               0
```



# 计算机网络实验报告

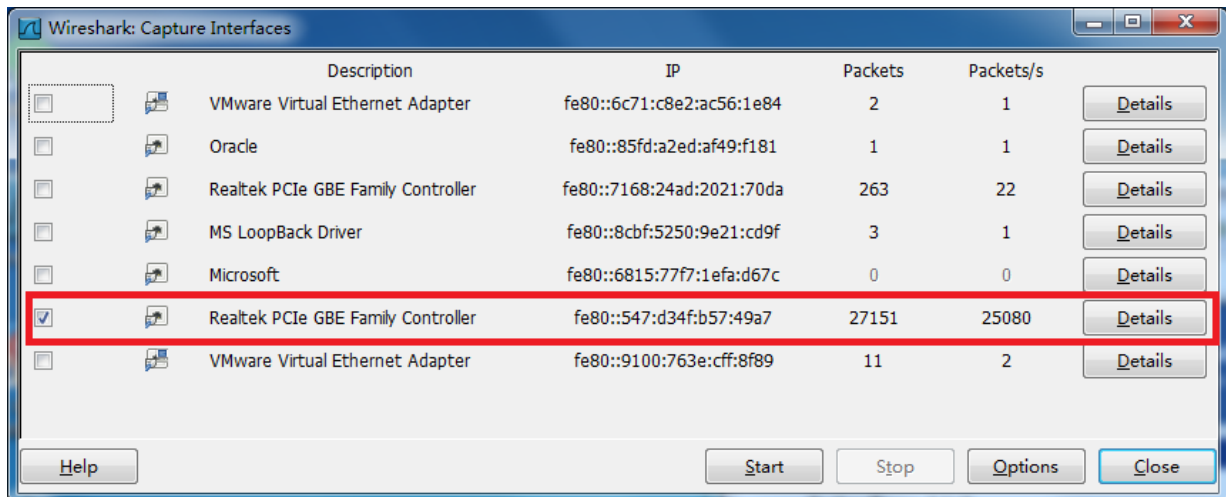
| 172.16.9.5 - SecureCRT                          |            |              |                  |     |
|---|------------|--------------|------------------|-----|
| 文件(F) 编辑(E) 查看(V) 选项(O) 传输(T) 脚本(S) 工具(L) 帮助(H) |            |              |                  |     |
| 172.16.9.5                                      |            |              |                  |     |
| Gi0/26  | 0          | 0            | 0                | 0   |
| Gi0/27  | 0          | 0            | 0                | 0   |
| Gi0/28  | 0          | 0            | 0                | 0   |
| Ag1   | 54911749   | 528704       | 321              | 300 |
| Interface                                       | OutOctets  | OutUcastPkts | OutMulticastPkts | Out |
| BroadcastPkts                                   |            |              |                  |     |
| -----   |            |              |                  |     |
| Gi0/1   | 1835209207 | 1212428      | 776              | 573 |
| Gi0/2   | 6294325049 | 4142473      | 58               | 219 |
| Gi0/3   | 0          | 0            | 0                | 0   |
| Gi0/4   | 0          | 0            | 0                | 0   |
| Gi0/5   | 103215660  | 571573       | 762              | 777 |
| Gi0/6   | 0          | 0            | 0                | 0   |
| Gi0/7   | 0          | 0            | 0                | 0   |
| Gi0/8   | 0          | 0            | 0                | 0   |
| Gi0/9   | 0          | 0            | 0                | 0   |
| Gi0/10  | 0          | 0            | 0                | 0   |
| Gi0/11  | 0          | 0            | 0                | 0   |
| Gi0/12  | 0          | 0            | 0                | 0   |
| Gi0/13  | 0          | 0            | 0                | 0   |
| Gi0/14  | 0          | 0            | 0                | 0   |
| Gi0/15  | 0          | 0            | 0                | 0   |
| Gi0/16  | 0          | 0            | 0                | 0   |
| Gi0/17  | 0          | 0            | 0                | 0   |
| Gi0/18  | 0          | 0            | 0                | 0   |
| Gi0/19  | 0          | 0            | 0                | 0   |
| Gi0/20  | 0          | 0            | 0                | 0   |
| Gi0/21  | 0          | 0            | 0                | 0   |
| Gi0/22  | 0          | 0            | 0                | 0   |
| Gi0/23  | 0          | 0            | 0                | 0   |
| Gi0/24  | 0          | 0            | 0                | 0   |



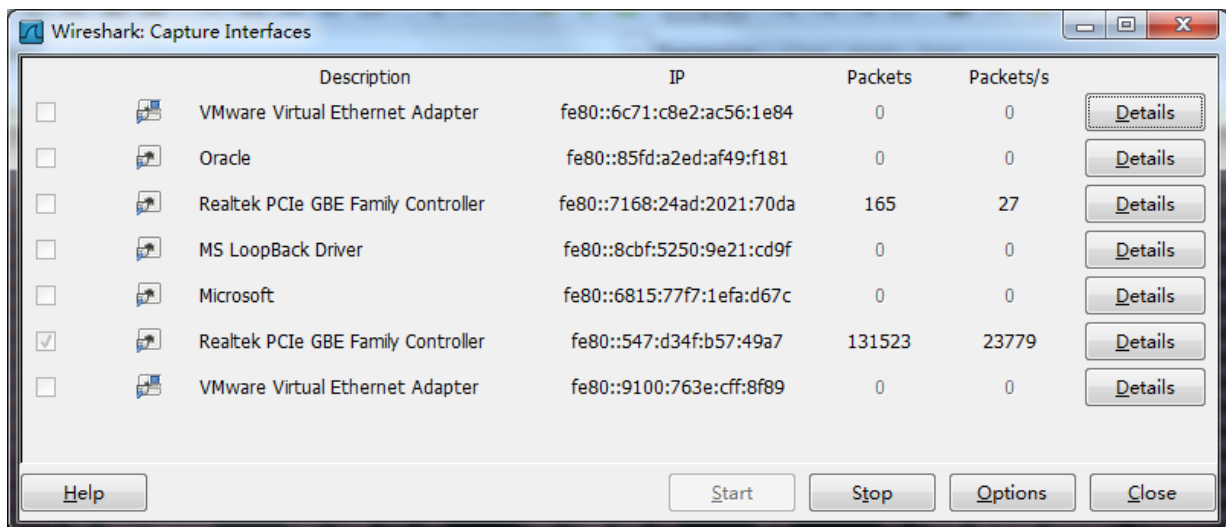
| 172.16.9.5 - SecureCRT                          |            |         |     |     |
|---|------------|---------|-----|-----|
| 文件(F) 编辑(E) 查看(V) 选项(O) 传输(T) 脚本(S) 工具(L) 帮助(H) |            |         |     |     |
| 172.16.9.5                                      |            |         |     |     |
| Gi0/4   | 0          | 0       | 0   | 0   |
| Gi0/5   | 103215660  | 571573  | 762 | 777 |
| Gi0/6   | 0          | 0       | 0   | 0   |
| Gi0/7   | 0          | 0       | 0   | 0   |
| Gi0/8   | 0          | 0       | 0   | 0   |
| Gi0/9   | 0          | 0       | 0   | 0   |
| Gi0/10  | 0          | 0       | 0   | 0   |
| Gi0/11  | 0          | 0       | 0   | 0   |
| Gi0/12  | 0          | 0       | 0   | 0   |
| Gi0/13  | 0          | 0       | 0   | 0   |
| Gi0/14  | 0          | 0       | 0   | 0   |
| Gi0/15  | 0          | 0       | 0   | 0   |
| Gi0/16  | 0          | 0       | 0   | 0   |
| Gi0/17  | 0          | 0       | 0   | 0   |
| Gi0/18  | 0          | 0       | 0   | 0   |
| Gi0/19  | 0          | 0       | 0   | 0   |
| Gi0/20  | 0          | 0       | 0   | 0   |
| Gi0/21  | 0          | 0       | 0   | 0   |
| Gi0/22  | 0          | 0       | 0   | 0   |
| Gi0/23  | 0          | 0       | 0   | 0   |
| Gi0/24  | 0          | 0       | 0   | 0   |
| Gi0/25  | 0          | 0       | 0   | 0   |
| Gi0/26  | 0          | 0       | 0   | 0   |
| Gi0/27  | 0          | 0       | 0   | 0   |
| Gi0/28  | 0          | 0       | 0   | 0   |
| Ag1   | 7991591330 | 5258438 | 337 | 300 |
| SwitchA#  |            |         |     |     |

| 测试项               | 端口聚合前            | 端口聚合后            |
|-------------------|------------------|------------------|
| 端口速度              | 1000Mbit/s       | 2000Mbit/s       |
| 聚合端口理论最大传输速度（包/秒） | 25281Packet/s 左右 | 24012Packet/s 左右 |
| 聚合端口实测最大传输速度（包/秒） | 25080Packet/s 左右 | 23779Packet/s 左右 |
| 传输时间（秒）           | 5s               | 5s               |
| 聚合端口的流量平衡模式       | 源 MAC 和目的 MAC 地址 | 源 MAC 和目的 MAC 地址 |

聚合前：



聚合后:



## 【实验思考】

(2) 如何验证聚合端口的负载平衡方式

答: 在交换机上配置另一个用于测试的 VLAN 10, 配置地址为 192.168.1/24, 然后在二层交换机 L2-SW 上配置默认网关(其作用相当于主机的网关, 交换机可将发往其他网段的数据包提交给网关处理), 这样交换机可以 ping 通 192.168.1.1/24 和 192.168.10.1/24, 说明聚合端口的 Trunk 配置已经生效。

(3) 什么情况下链路聚合会起分流作用?

答: 当服务器上有两块或者两块以上的网卡接到了网络中, 可以在无盘启动上设置分流, 均衡每块网卡的负载压力, 增强了服务器数据吐量能力。

| 学号       | 学生  | 自评分 |
|----------|-----|-----|
| 16340011 | 曾妮  | 100 |
| 16340013 | 曾翔  | 100 |
| 16340041 | 陈亚楠 | 100 |
|          |     |     |
|          |     |     |