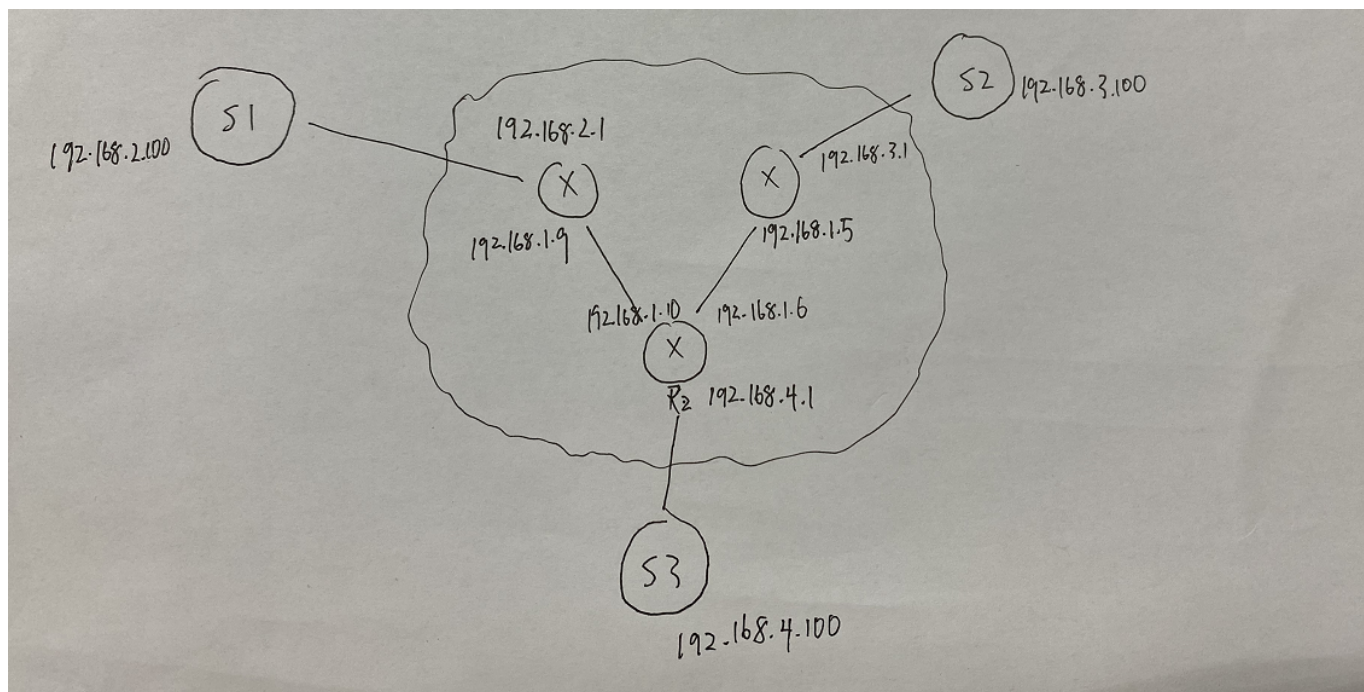


# 实验3：路由器操作实验

## 步骤一

网络拓扑图



设计好用ping来测试

S1 ping S2和S3	S2 ping S1和S3	S3 ping S1和S2
		<pre>PING 192.168.3.100 (192.168.3.100) 56(124) bytes of data. 64 bytes from 192.168.3.100: icmp_req=1 ttl=62 time=34.1 ms RR:      192.168.4.100           192.168.1.6           192.168.3.1           192.168.3.100           192.168.3.100           192.168.1.5           192.168.4.1           192.168.4.100</pre>
		<pre>13 packets transmitted, 13 received, 0% packet loss, time 12013ms rtt min/avg/max/mdev = 31.988/35.809/40.139/2.828 ms root@server-03:~# ping -R 192.168.2.100 PING 192.168.2.100 (192.168.2.100) 56(124) bytes of data. 64 bytes from 192.168.2.100: icmp_req=1 ttl=62 time=35.3 ms RR:      192.168.4.100           192.168.1.10           192.168.2.1           192.168.2.100           192.168.2.100           192.168.1.9           192.168.4.1           192.168.4.100</pre>

## 步骤二：双向延时

### S3 ping S1和S2

```

root@server-03:~# ping -R 192.168.2.100 -c 10 -i 3
PING 192.168.2.100 (192.168.2.100) 56(124) bytes of data.
64 bytes from 192.168.2.100: icmp_req=1 ttl=62 time=33.9 ms
RR:      192.168.4.100
          192.168.1.10
          192.168.2.1
          192.168.2.100
          192.168.2.100
          192.168.1.9
          192.168.4.1
          192.168.4.100

64 bytes from 192.168.2.100: icmp_req=2 ttl=62 time=33.3 ms      (same route)
64 bytes from 192.168.2.100: icmp_req=3 ttl=62 time=34.9 ms      (same route)
64 bytes from 192.168.2.100: icmp_req=4 ttl=62 time=34.5 ms      (same route)
64 bytes from 192.168.2.100: icmp_req=5 ttl=62 time=35.4 ms      (same route)
64 bytes from 192.168.2.100: icmp_req=6 ttl=62 time=33.8 ms      (same route)
64 bytes from 192.168.2.100: icmp_req=7 ttl=62 time=31.7 ms      (same route)
64 bytes from 192.168.2.100: icmp_req=8 ttl=62 time=40.3 ms      (same route)
64 bytes from 192.168.2.100: icmp_req=9 ttl=62 time=37.0 ms      (same route)
64 bytes from 192.168.2.100: icmp_req=10 ttl=62 time=35.5 ms      (same route)

--- 192.168.2.100 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 27015ms
rtt min/avg/max/mdev = 31.745/35.070/40.360/2.223 ms

```

```

root@server-03:~# ping -R 192.168.3.100 -c 10 -i 3
PING 192.168.3.100 (192.168.3.100) 56(124) bytes of data.
64 bytes from 192.168.3.100: icmp_req=1 ttl=62 time=38.4 ms
RR:      192.168.4.100
          192.168.1.6
          192.168.3.1
          192.168.3.100
          192.168.3.100
          192.168.1.5
          192.168.4.1
          192.168.4.100

64 bytes from 192.168.3.100: icmp_req=2 ttl=62 time=35.8 ms      (same route)
64 bytes from 192.168.3.100: icmp_req=3 ttl=62 time=40.8 ms      (same route)
64 bytes from 192.168.3.100: icmp_req=4 ttl=62 time=36.8 ms      (same route)
64 bytes from 192.168.3.100: icmp_req=5 ttl=62 time=31.8 ms      (same route)
64 bytes from 192.168.3.100: icmp_req=6 ttl=62 time=40.4 ms      (same route)
64 bytes from 192.168.3.100: icmp_req=7 ttl=62 time=40.3 ms      (same route)
64 bytes from 192.168.3.100: icmp_req=8 ttl=62 time=39.0 ms      (same route)
64 bytes from 192.168.3.100: icmp_req=9 ttl=62 time=35.4 ms      (same route)
64 bytes from 192.168.3.100: icmp_req=10 ttl=62 time=31.2 ms      (same route)

--- 192.168.3.100 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 27024ms
rtt min/avg/max/mdev = 31.235/37.048/40.811/3.296 ms

```

### 步骤三：owping

S1 owping S2和S3		S3 owping S1和S2
<pre>cisco@server-01:~\$ owping 192.168.3.100 owping: FILE=time.c, LINE=112, NTP: Status UNSYNC (clock offset issues likely) owping: FILE=capi.c, LINE=298, Unable to connect to "[192.168.3.100]:861" cisco@server-01:~\$ owping 192.168.3.100 owping: FILE=time.c, LINE=112, NTP: Status UNSYNC (clock offset issues likely) Approximately 13.4 seconds until results available  --- owping statistics from [192.168.2.100]:47903 to [192.168.3.100]:55673 --- SID: c0a80364e54701af29ff609d398c77d9 first: 2021-11-23T13:59:12.606 last: 2021-11-23T13:59:22.592 100 sent, 0 lost (0.000%), 0 duplicates one-way delay min/median/max = 20.5/25.4/30.9 ms, (unsync) one-way jitter = 4.3 ms (P95-P50) Hops = 3 (consistently) no reordering  --- owping statistics from [192.168.3.100]:53322 to [192.168.2.100]:51885 --- SID: c0a80264e54701af31d0635a273acf9c first: 2021-11-23T13:59:12.533 last: 2021-11-23T13:59:23.867 100 sent, 0 lost (0.000%), 0 duplicates one-way delay min/median/max = 13.5/25.8/30.4 ms, (unsync) one-way jitter = 4.1 ms (P95-P50) Hops = 3 (consistently) no reordering</pre>		<pre>root@server-02:~\$ owping 192.168.2.100 owping: FILE=time.c, LINE=112, NTP: Status UNSYNC (clock offset issues likely) Approximately 13.3 seconds until results available  --- owping statistics from [192.168.4.100]:54764 to [192.168.2.100]:49753 --- SID: c0a80264e547036d63d1569f468128bc first: 2021-11-23T14:06:38.884 last: 2021-11-23T14:06:48.631 100 sent, 0 lost (0.000%), 0 duplicates one-way delay min/median/max = 10.3/14.8/20.3 ms, (unsync) one-way jitter = 5 ms (P95-P50) Hops = 2 (consistently) no reordering  --- owping statistics from [192.168.2.100]:52568 to [192.168.4.100]:56438 --- SID: c0a80464e547036d89aaa7d570fabd7 first: 2021-11-23T14:06:38.835 last: 2021-11-23T14:06:49.288 100 sent, 0 lost (0.000%), 0 duplicates one-way delay min/median/max = 10.4/15.2/20.4 ms, (unsync) one-way jitter = 4.9 ms (P95-P50) Hops = 2 (consistently) no reordering</pre>
		<pre>root@server-03:~\$ owping 192.168.3.100 owping: FILE=time.c, LINE=112, NTP: Status UNSYNC (clock offset issues likely) Approximately 13.3 seconds until results available  --- owping statistics from [192.168.4.100]:35729 to [192.168.3.100]:60476 --- SID: c0a80364e5470435e6cb103010ce029 first: 2021-11-23T14:09:59.182 last: 2021-11-23T14:10:10.263 100 sent, 0 lost (0.000%), 0 duplicates one-way delay min/median/max = 10.4/14.4/20.3 ms, (unsync) one-way jitter = 5.6 ms (P95-P50) Hops = 2 (consistently) no reordering  --- owping statistics from [192.168.3.100]:41063 to [192.168.4.100]:38807 --- SID: c0a80464e5470435ebc70c994532d88b first: 2021-11-23T14:09:59.153 last: 2021-11-23T14:10:09.770 100 sent, 0 lost (0.000%), 0 duplicates one-way delay min/median/max = 10.5/15.4/21.3 ms, (unsync) one-way jitter = 4.2 ms (P95-P50) Hops = 2 (consistently) no reordering</pre>

## 步骤四：带宽测试

		S3 iperf S1和S2
		<pre>root@server-03:~# iperf -c 192.168.2.100 ----- Client connecting to 192.168.2.100, TCP port 5001 TCP window size: 85.0 KByte (default) ----- [ 3] local 192.168.4.100 port 49273 connected with 192.168.2.100 port 5001 [ ID] Interval      Transfer    Bandwidth [ 3]  0.0-10.2 sec  5.38 MBytes  4.41 Mbits/sec root@server-03:~# iperf -c 192.168.3.100 ----- Client connecting to 192.168.3.100, TCP port 5001 TCP window size: 85.0 KByte (default) ----- [ 3] local 192.168.4.100 port 50248 connected with 192.168.3.100 port 5001 [ ID] Interval      Transfer    Bandwidth [ 3]  0.0-10.3 sec  4.62 MBytes  3.78 Mbits/sec root@server-03:~#</pre>
		<pre>root@server-03:~# iperf -c 192.168.2.100 ----- Client connecting to 192.168.2.100, TCP port 5001 TCP window size: 85.0 KByte (default) ----- [ 3] local 192.168.4.100 port 49277 connected with 192.168.2.100 port 5001 [ ID] Interval      Transfer    Bandwidth [ 3]  0.0-10.5 sec  5.75 MBytes  4.58 Mbits/sec root@server-03:~# iperf -c 192.168.3.100 ----- Client connecting to 192.168.3.100, TCP port 5001 TCP window size: 85.0 KByte (default) ----- [ 3] local 192.168.4.100 port 50252 connected with 192.168.3.100 port 5001 [ ID] Interval      Transfer    Bandwidth [ 3]  0.0-10.3 sec  5.00 MBytes  4.09 Mbits/sec root@server-03:~#</pre>

步骤五：逐跳带宽

### S3 pchar S1和S2

```

root@server-03: # sudo pchar -R 3 192.168.2.100
pchar to 192.168.2.100 (192.168.2.100) using UDP/IPv4
Using raw socket input
Packet size increments from 32 to 1500 by 32
46 test(s) per repetition
3 repetition(s) per hop
0: 192.168.4.100 (server-03)
  Partial loss:      0 / 138 (0%)
  Partial char:      rtt = 1.284361 ms, (b = 0.000085 ms/B), r2 = 0.208917
                    stddev rtt = 0.020040, stddev b = 0.000025
  Partial queueing:  avg = 0.000190 ms (2249 bytes)
  Hop char:          rtt = 1.284361 ms, bw = 94623.538262 Kbps
  Hop queueing:      avg = 0.000190 ms (2249 bytes)
1: 192.168.4.1 (192.168.4.1)
  Partial loss:      0 / 138 (0%)
  Partial char:      rtt = 21.429271 ms, (b = 0.000033 ms/B), r2 = 0.014537
                    stddev rtt = 0.032988, stddev b = 0.000041
  Partial queueing:  avg = 0.000295 ms (2249 bytes)
  Hop char:          rtt = 20.144910 ms, bw = ---.--- Kbps
  Hop queueing:      avg = 0.000105 ms (0 bytes)
2: 192.168.1.9 (192.168.1.9)
  Partial loss:      26 / 138 (18%)
  Partial char:      rtt = 30.986776 ms, (b = 0.000918 ms/B), r2 = 0.072472
                    stddev rtt = 0.609642, stddev b = 0.000495
  Partial queueing:  avg = 0.000773 ms (2789 bytes)
  Hop char:          rtt = 9.557505 ms, bw = 9042.754692 Kbps
  Hop queueing:      avg = 0.000478 ms (540 bytes)
3: 192.168.2.100 (server-01)
  Path length:       3 hops
  Path char:          rtt = 30.986776 ms r2 = 0.072472
  Path bottleneck:   9042.754692 Kbps
  Path pipe:         35025 bytes
  Path queueing:     average = 0.000773 ms (2789 bytes)
  Start time:        Tue Nov 23 14:24:12 2021
  End time:          Tue Nov 23 14:27:11 2021

```



### S3 pchar S1和S2

```

root@server-03:~# sudo pchar -R 3 192.168.3.100
pchar to 192.168.3.100 (192.168.3.100) using UDP/IPv4
Using raw socket input
Packet size increments from 32 to 1500 by 32
46 test(s) per repetition
3 repetition(s) per hop
0: 192.168.4.100 (server-03)
  Partial loss:      0 / 138 (0%)
  Partial char:      rtt = 1.306706 ms, (b = -0.000010 ms/B), r2 = 0.002925
                     stddev rtt = 0.022295, stddev b = 0.000028
  Partial queueing:  avg = 0.000194 ms (0 bytes)
  Hop char:          rtt = 0.000000 ms, bw = 0.000000 Kbps
  Hop queueing:      avg = 0.000194 ms (0 bytes)
1: 192.168.4.1 (192.168.4.1)
  Partial loss:      0 / 138 (0%)
  Partial char:      rtt = 21.475265 ms, (b = 0.000020 ms/B), r2 = 0.004919
                     stddev rtt = 0.034672, stddev b = 0.000043
  Partial queueing:  avg = 0.000239 ms (1486 bytes)
  Hop char:          rtt = 20.168559 ms, bw = 267326.120557 Kbps
  Hop queueing:      avg = 0.000044 ms (1486 bytes)
2: 192.168.1.5 (192.168.1.5)
  Partial loss:      26 / 138 (18%)
  Partial char:      rtt = 31.672730 ms, (b = 0.000083 ms/B), r2 = 0.001378
                     stddev rtt = 0.417160, stddev b = 0.000339
  Partial queueing:  avg = 0.001140 ms (15692 bytes)
  Hop char:          rtt = 10.197465 ms, bw = 126126.258670 Kbps
  Hop queueing:      avg = 0.000901 ms (14206 bytes)
3: 192.168.3.100 (server-02)
  Path length:       3 hops
  Path char:         rtt = 31.672730 ms r2 = 0.001378
  Path bottleneck:   126126.258670 Kbps
  Path pipe:         499345 bytes
  Path queueing:     average = 0.001140 ms (15692 bytes)
  Start time:        Tue Nov 23 14:32:26 2021
  End time:          Tue Nov 23 14:35:25 2021

```