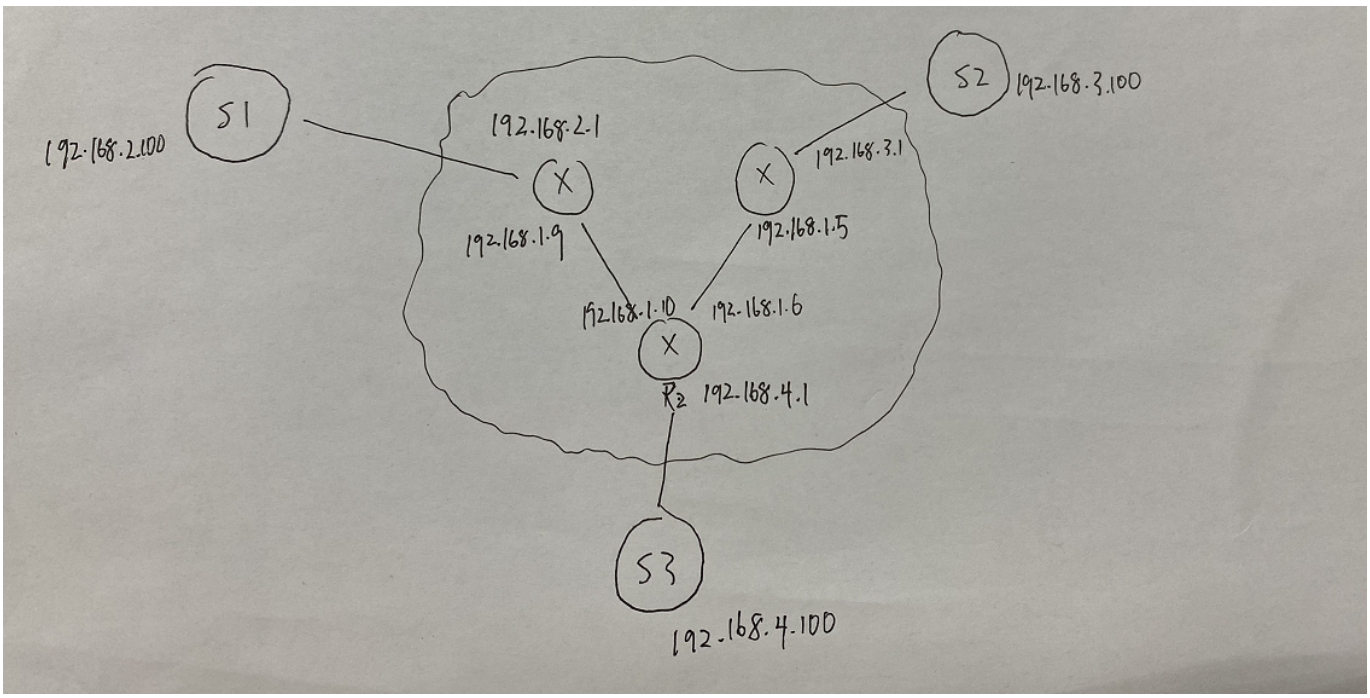
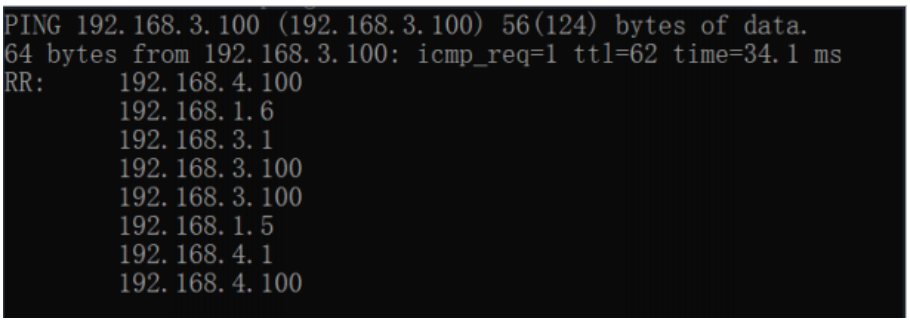
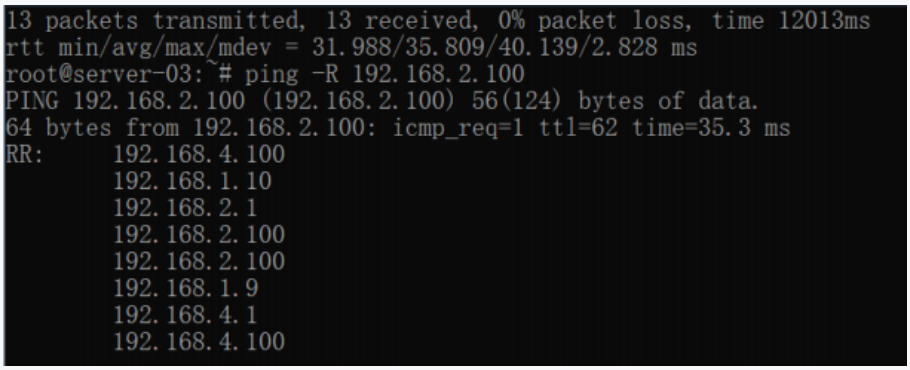
实验3：路由器操作实验

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
		
		

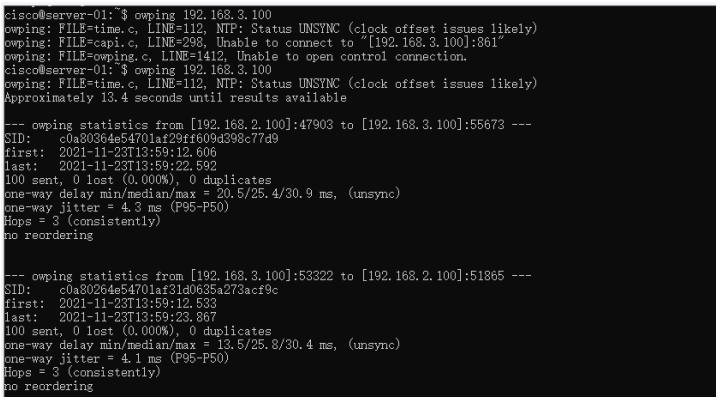
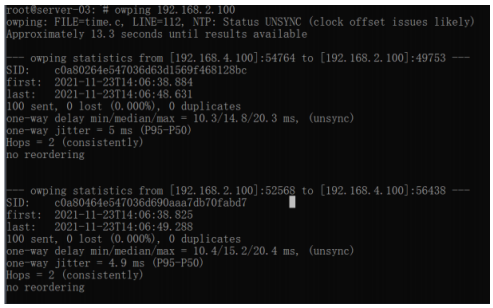
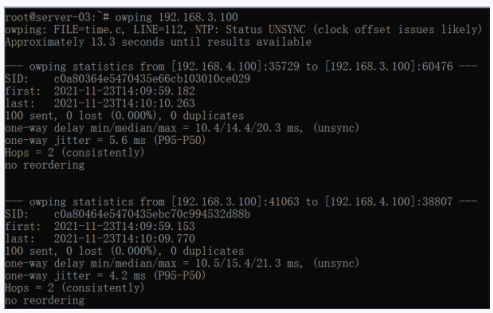
步骤二：双向延时

S3 ping S1和S2

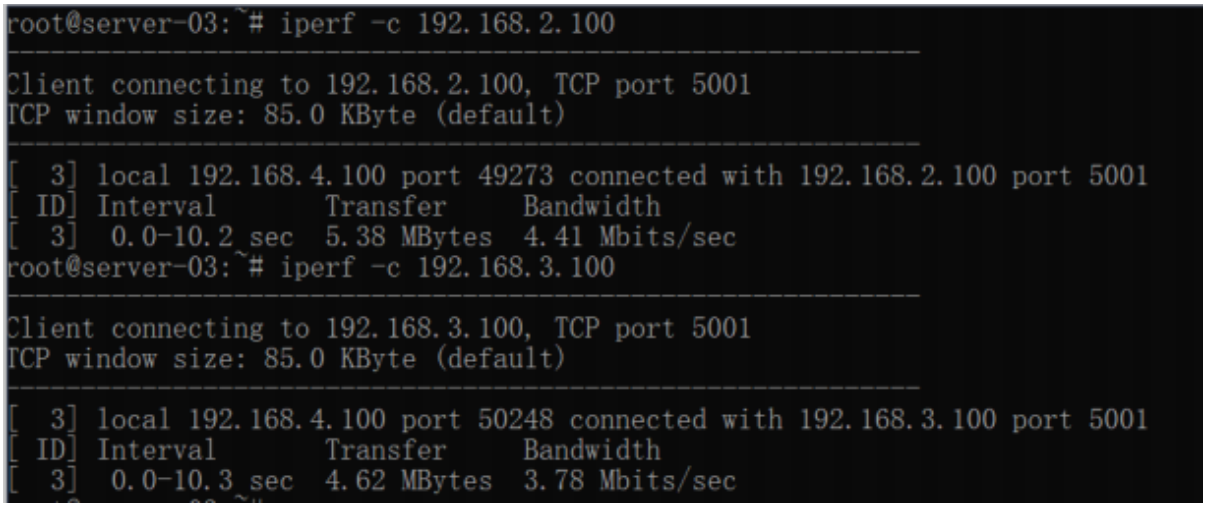
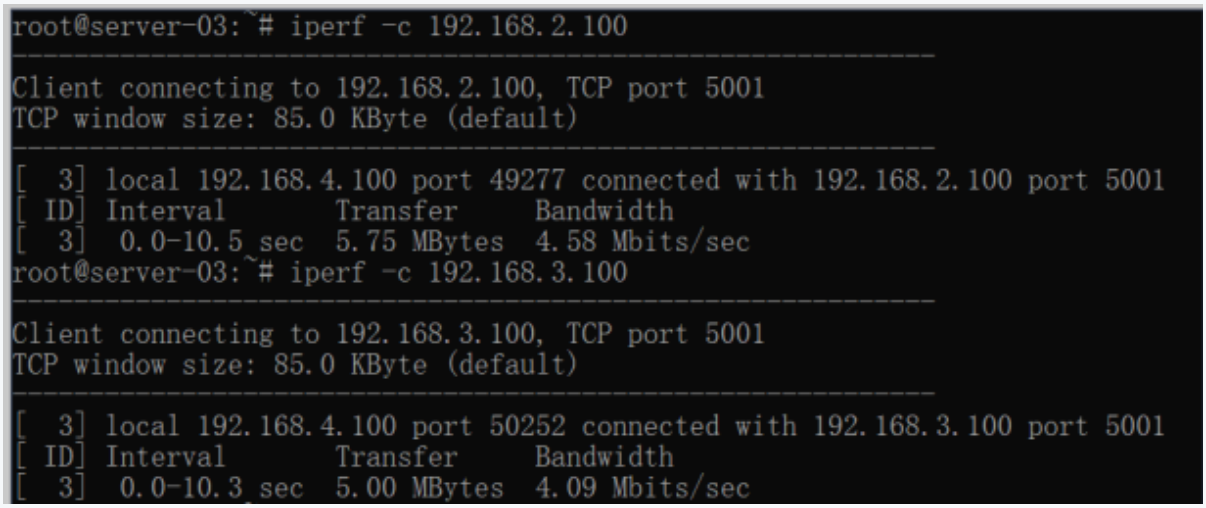
```
root@server-03:~# ping -R 192.168.2.100 -c 10 -i 3
PING 192.168.2.100 (192.168.2.100) 56(124) bytes of data.
64 bytes from 192.168.2.100: icmp_req=1 ttl=62 time=33.9 ms
RR:     192.168.4.100
        192.168.1.10
        192.168.2.1
        192.168.2.100
        192.168.2.100
        192.168.1.9
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

步骤四：带宽测试

		S3 iperf S1和S2
		
		

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
```