

Mason Walls

CPRE 489

## Lab 6: IPV4 Routing

What I learned:

When I took CPRE 430, routing tables was one of the most brushed-over sections of the course, making it hard to understand. When working on this lab, it initially was a bit daunting, needing to manage the ip-addresses and interface names of all three nodes. With a bit of research, some help from James, and a lot of failed tests (and so many typing mistakes that made every command say “you did it wrong”), I was able to figure out the subnet addresses and what was meant by gateway in the route command. The main take away I got was that a subnet (192.168.2.0 for example) is any address matching that with 0 basically being a wild card. And for gateway, it is the address that you can reach from your current point that has connection with your desired destination. These understandings took me a bit to understand, but the graphical interface on Geni made it a bit easier to see what ip addresses connected to what nodes. Using that, I was able to connect A to C with the route: 192.168.1.10 > 192.168.1.11 > 192.168.2.12. And C to A using the reverse of that.

Answers:

Status	Aggregate				
READY	FIU ExoGENI				

Aggregate FIU ExoGENI's Resources:

Node #1:

Status	Client ID	Component ID	Expiration	Type	Hostname
READY	NodeA	fiuvm-site:orca-vm-cloud	2021-03-31T20:09:17.000Z	xo.medium	(not specified)
Login	<a href="#">ssh walls594@131.94.144.106</a> <a href="#">ssh jabonner@131.94.144.106</a> <a href="#">ssh root@131.94.144.106</a>				
Interfaces		MAC	Layer 3		
VM:if0		fa:16:3e:00:3e:55	ipv4:	192.168.1.10	
VM:if1		fa:16:3e:00:77:3f	ipv4:	192.168.3.10	

Node #2:

Status	Client ID	Component ID	Expiration	Type	Hostname
READY	NodeB	fiuvm-site:orca-vm-cloud	2021-03-31T20:09:17.000Z	xo.medium	(not specified)
Login	<a href="#">ssh walls594@131.94.144.73</a> <a href="#">ssh jabonner@131.94.144.73</a> <a href="#">ssh root@131.94.144.73</a>				
Interfaces		MAC	Layer 3		
VM-0:if1		fa:16:3e:00:4d:42	ipv4:	192.168.2.11	
VM-0:if0		fa:16:3e:00:e3:00	ipv4:	192.168.1.11	

Node #3:

Status	Client ID	Component ID	Expiration	Type	Hostname
READY	NodeC	fiuvm-site:orca-vm-cloud	2021-03-31T20:09:17.000Z	xo.medium	(not specified)
Login	<a href="#">ssh walls594@131.94.144.69</a> <a href="#">ssh jabonner@131.94.144.69</a> <a href="#">ssh root@131.94.144.69</a>				
Interfaces		MAC	Layer 3		
VM-1:if1		fa:16:3e:00:19:22	ipv4:	192.168.3.12	
VM-1:if0		fa:16:3e:00:1b:c8	ipv4:	192.168.2.12	

Link #1:

Routing tables for A, B, C:

```
$ route
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref    Use Iface
default          10.10.11.1      0.0.0.0         UG      0      0      0 ens3
10.10.11.0       *               255.255.255.0   U        0      0      0 ens3
169.254.169.254  10.10.11.1      255.255.255.255 UGH      0      0      0 ens3
192.168.1.0      *               255.255.255.0   U        0      0      0 ens7
192.168.3.0      *               255.255.255.0   U        0      0      0 ens6
$
```

```
$ route
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref    Use Iface
default          10.10.11.1      0.0.0.0         UG      0      0      0 ens3
10.10.11.0       *               255.255.255.0   U        0      0      0 ens3
169.254.169.254  10.10.11.1      255.255.255.255 UGH      0      0      0 ens3
192.168.1.0      *               255.255.255.0   U        0      0      0 ens6
192.168.2.0      *               255.255.255.0   U        0      0      0 ens7
$
```

```
$ route
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref    Use Iface
default          10.10.11.1      0.0.0.0         UG      0      0      0 ens3
10.10.11.0       *               255.255.255.0   U        0      0      0 ens3
169.254.169.254  10.10.11.1      255.255.255.255 UGH      0      0      0 ens3
192.168.2.0      *               255.255.255.0   U        0      0      0 ens7
192.168.3.0      *               255.255.255.0   U        0      0      0 ens6
$
```

Ping results:

```
$ ping 192.168.2.11
PING 192.168.2.11 (192.168.2.11) 56(84) bytes of data.

--- 192.168.2.11 ping statistics ---
10 packets transmitted, 0 received, 100% packet loss, time 9072ms

$ ping 192.168.1.11
PING 192.168.1.11 (192.168.1.11) 56(84) bytes of data.
64 bytes from 192.168.1.11: icmp_seq=1 ttl=64 time=2.12 ms
64 bytes from 192.168.1.11: icmp_seq=2 ttl=64 time=0.454 ms
64 bytes from 192.168.1.11: icmp_seq=3 ttl=64 time=0.464 ms
64 bytes from 192.168.1.11: icmp_seq=4 ttl=64 time=0.508 ms
64 bytes from 192.168.1.11: icmp_seq=5 ttl=64 time=0.330 ms
64 bytes from 192.168.1.11: icmp_seq=6 ttl=64 time=0.370 ms
64 bytes from 192.168.1.11: icmp_seq=7 ttl=64 time=0.292 ms
64 bytes from 192.168.1.11: icmp_seq=8 ttl=64 time=0.350 ms
64 bytes from 192.168.1.11: icmp_seq=9 ttl=64 time=0.565 ms
64 bytes from 192.168.1.11: icmp_seq=10 ttl=64 time=0.393 ms

--- 192.168.1.11 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 8998ms
rtt min/avg/max/mdev = 0.292/0.585/2.127/0.520 ms

$ ping 192.168.3.12
PING 192.168.3.12 (192.168.3.12) 56(84) bytes of data.
64 bytes from 192.168.3.12: icmp_seq=1 ttl=64 time=1.83 ms
64 bytes from 192.168.3.12: icmp_seq=2 ttl=64 time=0.367 ms
64 bytes from 192.168.3.12: icmp_seq=3 ttl=64 time=0.354 ms
64 bytes from 192.168.3.12: icmp_seq=4 ttl=64 time=0.335 ms
64 bytes from 192.168.3.12: icmp_seq=5 ttl=64 time=0.340 ms
64 bytes from 192.168.3.12: icmp_seq=6 ttl=64 time=0.333 ms
64 bytes from 192.168.3.12: icmp_seq=7 ttl=64 time=0.340 ms
64 bytes from 192.168.3.12: icmp_seq=8 ttl=64 time=0.300 ms

--- 192.168.3.12 ping statistics ---
8 packets transmitted, 8 received, 0% packet loss, time 6999ms
rtt min/avg/max/mdev = 0.300/0.525/1.837/0.496 ms

$ ping 192.168.2.12
PING 192.168.2.12 (192.168.2.12) 56(84) bytes of data.

--- 192.168.2.12 ping statistics ---
11 packets transmitted, 0 received, 100% packet loss, time 9999ms
$
```

Traceroute from A (12.168.1.10) to C (192.168.2.12)

```
$ traceroute 192.168.2.12
traceroute to 192.168.2.12 (192.168.2.12), 30 hops max, 60 byte packets
 1  10.10.11.1 (10.10.11.1)  0.336 ms  0.329 ms  0.331 ms
 2  cr1.cs.fiu.edu (131.94.144.4)  0.485 ms  0.474 ms  0.464 ms
 3  fw1.cs.fiu.edu (131.94.131.92)  0.363 ms  0.395 ms  0.387 ms
 4  br1.cs.fiu.edu (131.94.134.134)  0.701 ms  0.554 ms  0.619 ms
 5  * * *
 6  * * *
 7  * * *
 8  * * *
 9  * * *
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
$
```

This result happens because the routing table for A does not know where to send a packet that has a 2 as the second to last chunk. A knows how to send to 192.168.1.0 and 192.168.3.0.

Routing table for A:

```
$ sudo route add -net 192.168.2.0 netmask 255.255.255.0 gw 192.168.1.11 ens6
$ route
Kernel IP routing table
Destination    Gateway         Genmask         Flags Metric Ref    Use Iface
default        10.10.11.1      0.0.0.0         UG    0      0      0 ens3
10.10.11.0     *              255.255.255.0   U      0      0      0 ens3
169.254.169.254 10.10.11.1      255.255.255.255 UGH    0      0      0 ens3
192.168.1.0    *              255.255.255.0   U      0      0      0 ens6
192.168.2.0    192.168.1.11   255.255.255.0   UG    0      0      0 ens6
192.168.3.0    *              255.255.255.0   U      0      0      0 ens7
$
```

Traceroute A to C after setup:

```
cannot handle host emit the arg 192.168.2.12 on position 1 (arg 1)
$ traceroute 192.168.2.12
traceroute to 192.168.2.12 (192.168.2.12), 30 hops max, 60 byte packets
 1 192.168.1.11 (192.168.1.11)  1.350 ms  1.336 ms  1.301 ms
 2 192.168.2.12 (192.168.2.12)  2.119 ms  *  *
```

As shown in the image, the route from A to C first goes to B at 192.168.1.11, then using B's connection to C on ens6, it can get to C. C also has a route setup to route 192.168.1.0 to node B. This creates a two-way communication allowing for traceroute and ping to work.

B TCPDUMP:

```
$ sudo tcpdump -i ens7 icmp
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on ens7, link-type EN10MB (Ethernet), capture size 262144 bytes
22:58:54.045104 IP 192.168.1.10 > 192.168.2.12: ICMP echo request, id 906, seq 1, length 64
22:58:54.046406 IP 192.168.2.12 > 192.168.1.10: ICMP echo reply, id 906, seq 1, length 64
22:58:55.046486 IP 192.168.1.10 > 192.168.2.12: ICMP echo request, id 906, seq 2, length 64
22:58:55.046742 IP 192.168.2.12 > 192.168.1.10: ICMP echo reply, id 906, seq 2, length 64
22:58:56.047348 IP 192.168.1.10 > 192.168.2.12: ICMP echo request, id 906, seq 3, length 64
22:58:56.047710 IP 192.168.2.12 > 192.168.1.10: ICMP echo reply, id 906, seq 3, length 64
22:58:57.047388 IP 192.168.1.10 > 192.168.2.12: ICMP echo request, id 906, seq 4, length 64
22:58:57.047767 IP 192.168.2.12 > 192.168.1.10: ICMP echo reply, id 906, seq 4, length 64
22:58:58.047491 IP 192.168.1.10 > 192.168.2.12: ICMP echo request, id 906, seq 5, length 64
22:58:58.047854 IP 192.168.2.12 > 192.168.1.10: ICMP echo reply, id 906, seq 5, length 64
22:58:59.048757 IP 192.168.1.10 > 192.168.2.12: ICMP echo request, id 906, seq 6, length 64
22:58:59.049221 IP 192.168.2.12 > 192.168.1.10: ICMP echo reply, id 906, seq 6, length 64
22:59:00.050100 IP 192.168.1.10 > 192.168.2.12: ICMP echo request, id 906, seq 7, length 64
22:59:00.050563 IP 192.168.2.12 > 192.168.1.10: ICMP echo reply, id 906, seq 7, length 64
22:59:01.051179 IP 192.168.1.10 > 192.168.2.12: ICMP echo request, id 906, seq 8, length 64
22:59:01.051617 IP 192.168.2.12 > 192.168.1.10: ICMP echo reply, id 906, seq 8, length 64
22:59:02.051345 IP 192.168.1.10 > 192.168.2.12: ICMP echo request, id 906, seq 9, length 64
22:59:02.051802 IP 192.168.2.12 > 192.168.1.10: ICMP echo reply, id 906, seq 9, length 64
22:59:03.051433 IP 192.168.1.10 > 192.168.2.12: ICMP echo request, id 906, seq 10, length 64
22:59:03.051845 IP 192.168.2.12 > 192.168.1.10: ICMP echo reply, id 906, seq 10, length 64
22:59:04.051364 IP 192.168.1.10 > 192.168.2.12: ICMP echo request, id 906, seq 11, length 64
22:59:04.051883 IP 192.168.2.12 > 192.168.1.10: ICMP echo reply, id 906, seq 11, length 64

22 packets captured
22 packets received by filter
0 packets dropped by kernel
```