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LAB: BGP

TASK 1: Stub autonomous system

1.a

Finding peer autonomous system of AS-155.

The screenshot shows a network visualization tool with a search bar at the top left containing the number '155'. A router configuration window for '155/router0' is open, displaying the following configuration:

```
local 10.102.0.155 as 155;
neighbor 10.102.0.4 as 4;
}
protocol bgp p_as156 {
  ipv4 {
    table t_bgp;
    import filter {
      bgp_large_community.add(PEER_COMM);
      bgp_local_pref = 20;
      accept;
    };
    export where bgp_large_community ~ [LOCAL_COMM, CUSTOMER_COMM];
    next hop self;
  };
  local 10.102.0.155 as 155;
  neighbor 10.102.0.156 as 156;
}
ipv4 table t_ospf;
protocol ospf ospf1 {
  ipv4 {
    table t_ospf;
    import all;
  }
}
```

The sidebar on the right shows details for 'AS155/router0':

- ASN: 155
- Name: router0
- Role: Router
- IP: net0, 10.155.0.254/24
- IP: ix102, 10.102.0.155/24
- ID: 8a2cfe986446
- ASN: 155
- Name: router0
- IP addresses: net0: 10.155.0.254/24, ix102: 10.102.0.155/24
- BGP sessions: u_as2: Established [Disable](#), u_as4: Established [Disable](#), p_as156: Established [Disable](#)
- Actions: [Launch console](#), [Disconnect](#), [Refresh](#)

It can be seen that AS 156 has a peer relationship with AS-150. AS 150 is interconnected with three autonomous systems.

1.a-2

AS-155 is connected to multiple ASs at the same time, and the loss of one of them will not affect AS-155's access to the Internet.

We used birdc disable command via command and also used the map to cut off the link

```

root@0a2cfef06446 / # birdc show protocols
BIRD 2.0.7 ready.
Name      Proto    Table    State    Since    Info
device1   Device   ---      up       01:57:53.171
kernel1   Kernel   master4  up       01:57:53.171
local_nets Direct   ---      up       01:57:53.171
pipe1     Pipe     ---      up       01:57:53.171  t_bgp <=> master4
pipe2     Pipe     ---      up       01:57:53.171  t_direct <=> t_bgp
u_as2     BGP      ---      up       01:57:56.135  Established
u_as4     BGP      ---      up       01:57:56.844  Established
p_as156   BGP      ---      up       01:57:57.430  Established
ospf1     OSPF     t_ospf   up       01:57:53.171  Alone
pipe3     Pipe     ---      up       01:57:53.171  t_ospf <=> master4

root@0a2cfef06446 / # birdc disable u_as2
BIRD 2.0.7 ready.
No such command. Press '?' for help.
root@0a2cfef06446 / # birdc disable u_as2
BIRD 2.0.7 ready.
u_as2: disabled

root@0a2cfef06446 / # birdc show protocols
BIRD 2.0.7 ready.
Name      Proto    Table    State    Since    Info
device1   Device   ---      up       01:57:53.171
kernel1   Kernel   master4  up       01:57:53.171
local_nets Direct   ---      up       01:57:53.171
pipe1     Pipe     ---      up       01:57:53.171  t_bgp <=> master4
pipe2     Pipe     ---      up       01:57:53.171  t_direct <=> t_bgp
u_as2     BGP      ---      down     02:33:45.803

```

```

155/websocket_1
Connecting to 67606bd5b743...
Connected to 67606bd5b743.
root@67606bd5b743 / # ping 10.156.0.72
PING 10.156.0.72 (10.156.0.72) 56(84) bytes of data:
64 bytes from 10.156.0.72: icmp_seq=1 ttl=62 time=0.139 ms
64 bytes from 10.156.0.72: icmp_seq=2 ttl=62 time=0.142 ms
64 bytes from 10.156.0.72: icmp_seq=3 ttl=62 time=0.192 ms
64 bytes from 10.156.0.72: icmp_seq=4 ttl=62 time=0.129 ms
64 bytes from 10.156.0.72: icmp_seq=5 ttl=62 time=0.141 ms
64 bytes from 10.156.0.72: icmp_seq=6 ttl=62 time=0.258 ms
64 bytes from 10.156.0.72: icmp_seq=7 ttl=62 time=0.134 ms
64 bytes from 10.156.0.72: icmp_seq=8 ttl=62 time=0.143 ms
From 10.155.0.254 icmp_seq=10 Destination Net Unreachable
From 10.155.0.254 icmp_seq=11 Destination Net Unreachable
From 10.155.0.254 icmp_seq=12 Destination Net Unreachable
From 10.155.0.254 icmp_seq=13 Destination Net Unreachable

```

Here, while pingging we cut off one link one by one and hence we reach the conclusion that only when all the links are cut off it will be unreachable.

1.b Run thr tcpdump commands on the router to store the data packets received there and store it in a pcap file. Cut off router connection and use wireshark to read the pcap file as follows.

1.c

Cut off the connection between AS 4 and AS 156.

The screenshot shows a network simulation interface. On the left, a terminal window titled '156/web service_1' displays the following output:

```
Connecting to 047c51582bee...
Connected to 047c51582bee.
root@047c51582bee / # ping 10.155.0.71
PING 10.155.0.71 (10.155.0.71) 56(84) bytes of data:
64 bytes from 10.155.0.71: icmp_seq=1 ttl=62 time=0.135 ms
64 bytes from 10.155.0.71: icmp_seq=2 ttl=62 time=0.135 ms
^C
--- 10.155.0.71 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1003ms
rtt min/avg/max/mdev = 0.135/0.191/0.248/0.056 ms
root@047c51582bee / #
root@047c51582bee / #
root@047c51582bee / # ping 10.161.0.71
PING 10.161.0.71 (10.161.0.71) 56(84) bytes of data:
From 10.156.0.254 icmp_seq=1 Destination Net Unreachable
From 10.156.0.254 icmp_seq=2 Destination Net Unreachable
From 10.156.0.254 icmp_seq=3 Destination Net Unreachable
^C
--- 10.161.0.71 ping statistics ---
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2048ms
```

On the right, a panel titled 'AS156/web service_1' shows the following details:

- ASN: 156
- Name: webservice_1
- Role: Host
- IP: net0, 10.156.0.72/24

Below this, a 'Router: 156/router0' panel shows:

- ID: b4f82c8766f9
- ASN: 156
- Name: router0
- Role: Router
- IP addresses: net0: 10.156.0.254/24, ix102: 10.102.0.156/24
- BGP sessions: u_as4: Disabled Enable, p_as155: Established Disable
- Actions: Launch console, Disconnect

It can be seen that 10.155.0.71 can be pinged but 10.161.0.71 cannot be pinged. AS 156 is connected to internet via AS 155 but their peer relation does not allow the data of AS 156 to be forwarded.

The screenshot shows a network simulation interface. On the left, a terminal window displays the following BGP configuration:

```
export where bgp_large_community ~ [LOCAL_COMM, CUSTOMER_COMM, PEER_COMM];
};
next hop self;
};
local 10.102.0.155 as 155;
neighbor 10.102.0.4 as 4;
}
protocol bgp p_as156 {
  ipv4 {
    table t_bgp;
    import filter {
      bgp_large_community.add(PEER_COMM);
      bgp_local_pref = 20;
      accept;
    };
    export where bgp_large_community ~ [LOCAL_COMM, CUSTOMER_COMM, PROVIDER_COMM];
    next hop self;
  };
  local 10.102.0.155 as 155;
}
```

On the right, a panel titled 'Router: 156/router0' shows the same details as in the previous screenshot:

- ID: b4f82c8766f9
- ASN: 156
- Name: router0
- Role: Router
- IP addresses: net0: 10.156.0.254/24, ix102: 10.102.0.156/24
- BGP sessions: u_as4: Disabled Enable, p_as155: Established Disable
- Actions: Launch console, Disconnect

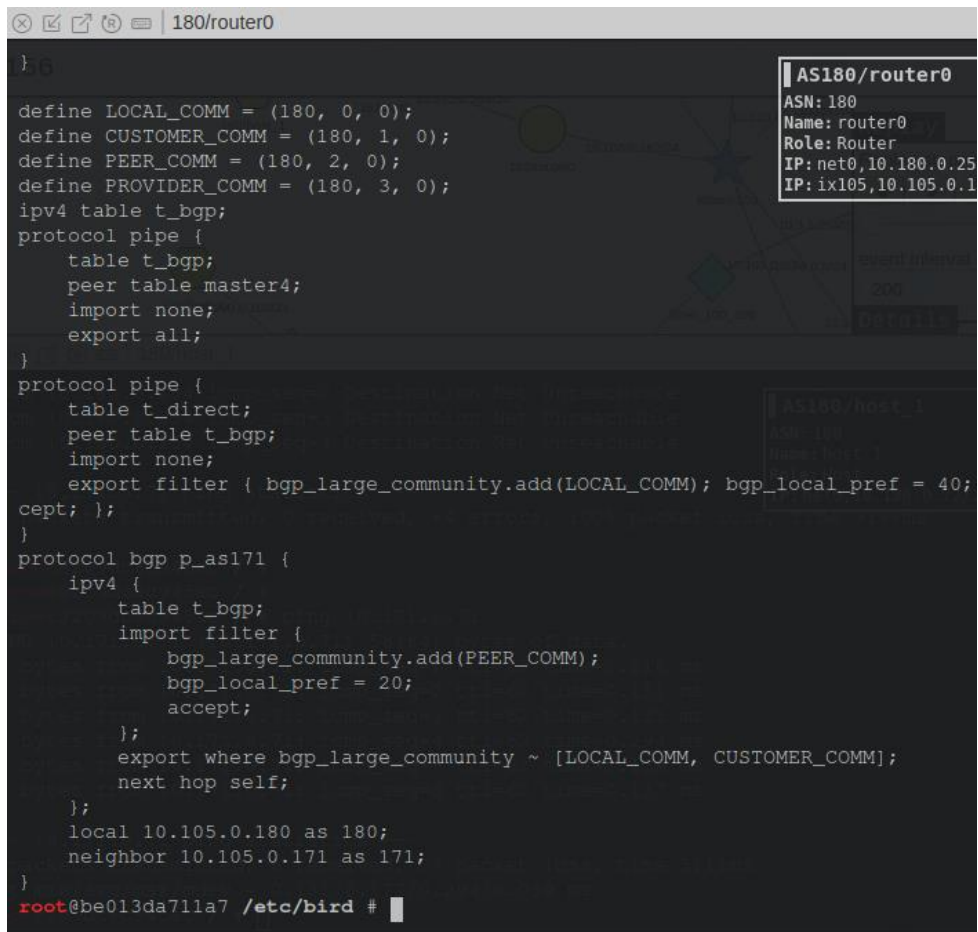
In the configuration file of the AS 155 router, We have added PEER_COMM for AS4 and PROVIDER_COMM for AS 156 here so that forwarding of packets from AS 156 happens through AS 155.

1.d

We need to modify configuration of Routers so that AS 180 is able to access the internet.

First we connect AS 180 and AS 171 .

For AS 180 config file we make the specific changes:

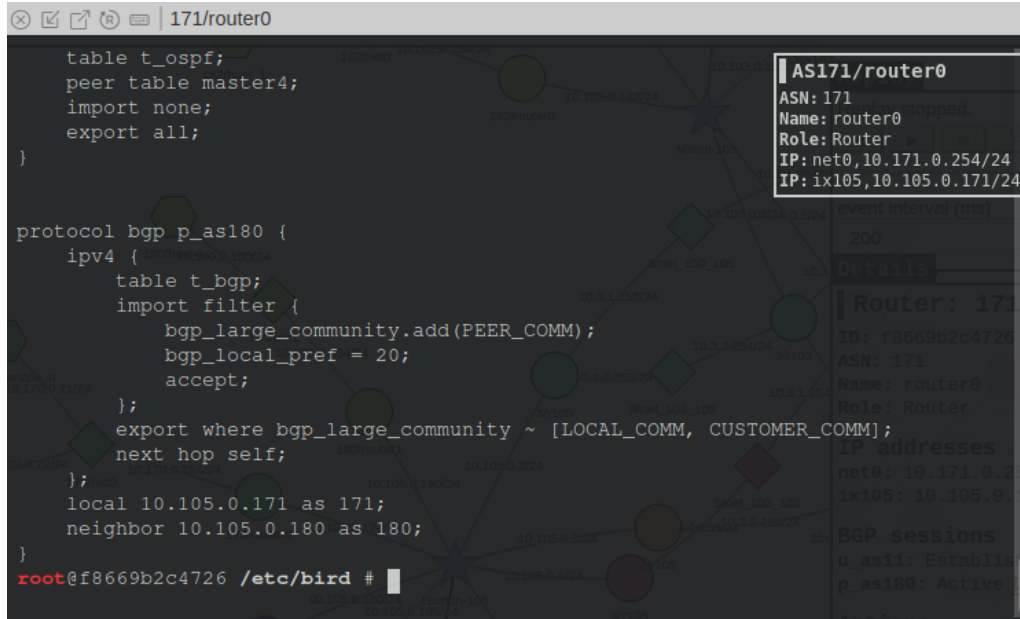


```
16
define LOCAL_COMM = (180, 0, 0);
define CUSTOMER_COMM = (180, 1, 0);
define PEER_COMM = (180, 2, 0);
define PROVIDER_COMM = (180, 3, 0);
ipv4 table t_bgp;
protocol pipe {
    table t_bgp;
    peer table master4;
    import none;
    export all;
}
protocol pipe {
    table t_direct;
    peer table t_bgp;
    import none;
    export filter { bgp_large_community.add(LOCAL_COMM); bgp_local_pref = 40;
cept; };
}
protocol bgp p_as171 {
    ipv4 {
        table t_bgp;
        import filter {
            bgp_large_community.add(PEER_COMM);
            bgp_local_pref = 20;
            accept;
        };
        export where bgp_large_community ~ [LOCAL_COMM, CUSTOMER_COMM];
        next hop self;
    };
    local 10.105.0.180 as 180;
    neighbor 10.105.0.171 as 171;
}
root@be013da711a7 /etc/bird #
```

AS180/router0
ASN: 180
Name: router0
Role: Router
IP: net0,10.180.0.25
IP: ix105,10.105.0.1

AS180/host 1
ASN: 180
Name: host 1

For AS 171 configuration file, we make the particular changes:



```

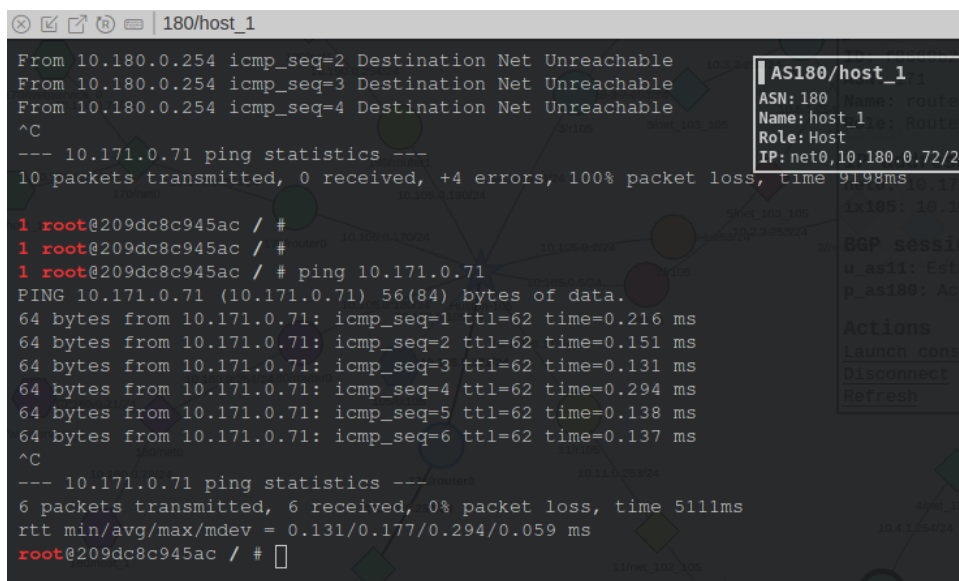
table t_ospf;
peer table master4;
import none;
export all;
}

protocol bgp p_as180 {
  ipv4 {
    table t_bgp;
    import filter {
      bgp_large_community.add(PEER_COMM);
      bgp_local_pref = 20;
      accept;
    };
    export where bgp_large_community ~ [LOCAL_COMM, CUSTOMER_COMM];
    next hop self;
  };
  local 10.105.0.171 as 171;
  neighbor 10.105.0.180 as 180;
}
root@f8669b2c4726 /etc/bird #
  
```

AS171/router0
 ASN: 171
 Name: router0
 Role: Router
 IP: net0,10.171.0.254/24
 IP: ix105,10.105.0.171/24

Router: 171
 ID: f8669b2c4726
 ASN: 171
 Name: router0
 Role: Router
 IP addresses
 net0: 10.171.0.254/24
 ix105: 10.105.0.171/24
 BGP sessions
 u as11: Established
 p as180: Active

After reconfiguring these routers, we try to communicate between the networks



```

From 10.180.0.254 icmp_seq=2 Destination Net Unreachable
From 10.180.0.254 icmp_seq=3 Destination Net Unreachable
From 10.180.0.254 icmp_seq=4 Destination Net Unreachable
^C
--- 10.171.0.71 ping statistics ---
10 packets transmitted, 0 received, +4 errors, 100% packet loss, time 9198ms

1 root@209dc8c945ac / #
1 root@209dc8c945ac / #
1 root@209dc8c945ac / # ping 10.171.0.71
PING 10.171.0.71 (10.171.0.71) 56(84) bytes of data.
64 bytes from 10.171.0.71: icmp_seq=1 ttl=62 time=0.216 ms
64 bytes from 10.171.0.71: icmp_seq=2 ttl=62 time=0.151 ms
64 bytes from 10.171.0.71: icmp_seq=3 ttl=62 time=0.131 ms
64 bytes from 10.171.0.71: icmp_seq=4 ttl=62 time=0.294 ms
64 bytes from 10.171.0.71: icmp_seq=5 ttl=62 time=0.138 ms
64 bytes from 10.171.0.71: icmp_seq=6 ttl=62 time=0.137 ms
^C
--- 10.171.0.71 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5111ms
rtt min/avg/max/mdev = 0.131/0.177/0.294/0.059 ms
root@209dc8c945ac / #
  
```

AS180/host_1
 ASN: 180
 Name: host_1
 Role: Host
 IP: net0,10.180.0.72/24

BGP sessi
 u as11: Est
 p as180: Ac

Actions
 launch cons
 Disconnect
 Refresh

Similarly we cnfigure AS2 for enabling connection to AS 180 and ping for connection :

2/r105

```

export all;
  igp table t_ospf;
};
local 10.0.0.4 as 2;
neighbor 10.0.0.3 as 2;
}

protocol bgp c_as180
  ipv4 {
    table t_bgp;
    import filter {
      bgp_large_community.add(CUSTOMER_COMM);
      bgp_local_pref = 30;
      accept;
    };
    export all;
    next hop self;
  };
  local 10.105.0.2 as 2;
  neighbor 10.105.0.180 as 180;
}

```

"bird.conf" 116L, 2259C

AS2/r105
 ASN: 2
 Name: r105
 Role: Router
 IP: ix105,10.105.0.2/24
 IP: net_100_105,10.2.2.253/24

Router: 2/r105
 ID: 030f37c9588d
 ASN: 2
 Name: r105
 Role: Router

IP addresses
 ix105: 10.105.0.2/24
 net_100_105: 10.2.2.253/24

BGP sessions
 p rx105: Established Dis
 ibgp1: Established Disal
 ibgp2: Established Disal
 ibgp3: Established Disal

 116,1 Bot

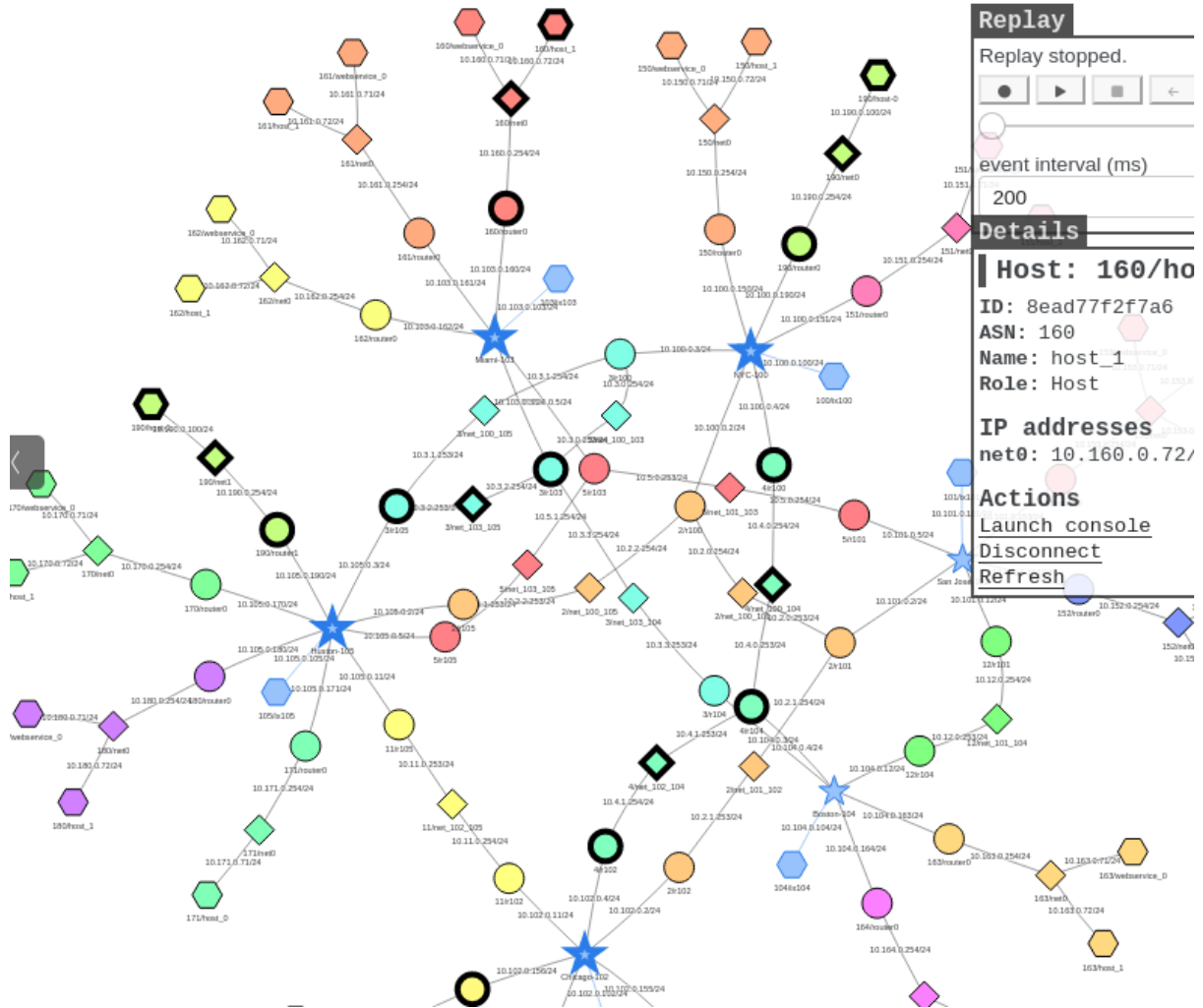
TASK 4:

Anycast can be said as one peer sending a message to a group of peers. Here we are pinging 10.190.0.100 from 10.156.0.71 and also from 10.160.0.72.

While observing the packets we can see that icmp packets of the hosts have been sent to two different hosts as it only follows path to the host. After receiving the routing information, other routers will select the optimal path forwarding according to the routing selection.

Filter Search

icmp



Replay

Replay stopped.



event interval (ms)

200

Details

Host: 160/ho

ID: 8ead77f2f7a6

ASN: 160

Name: host_

Role: Host

IP addresses

```
net0: 10.160.0.72/
```

Actions

Launch console

Disconnect

Refresh

TASK 5:

Modify Configuration of AS 161 so all traffic going to AS 154 will come to 161. We need to cover whole of 10.154.0.0/24 for this

```
Connecting to 6efa9aaec17b...
Connected to 6efa9aaec17b.
root@6efa9aaec17b / # ip route | grep 10.154
10.154.0.0/25 via 10.105.0.3 dev ix105 proto bird metric
10.154.0.0/24 via 10.11.0.254 dev net_102_105 proto bird metric
10.154.0.128/25 via 10.105.0.3 dev ix105 proto bird metric
root@6efa9aaec17b / #
```

| AS11/r105 | |
|-----------|----------------------------|
| ASN: | 11 |
| Name: | r105 |
| Role: | Router |
| IP: | ix105,10.105.0.11/24 |
| IP: | net_102_105,10.11.0.253/24 |

```
Connecting to 17c3f3e3235e...
Connected to 17c3f3e3235e.
root@17c3f3e3235e / # ip route | grep 10.154
10.154.0.0/25 via 10.3.2.254 dev net_103_105 proto bird metric
10.154.0.0/24 via 10.105.0.11 dev ix105 proto bird metric
10.154.0.128/25 via 10.3.2.254 dev net_103_105 proto bird metric
root@17c3f3e3235e / #
```

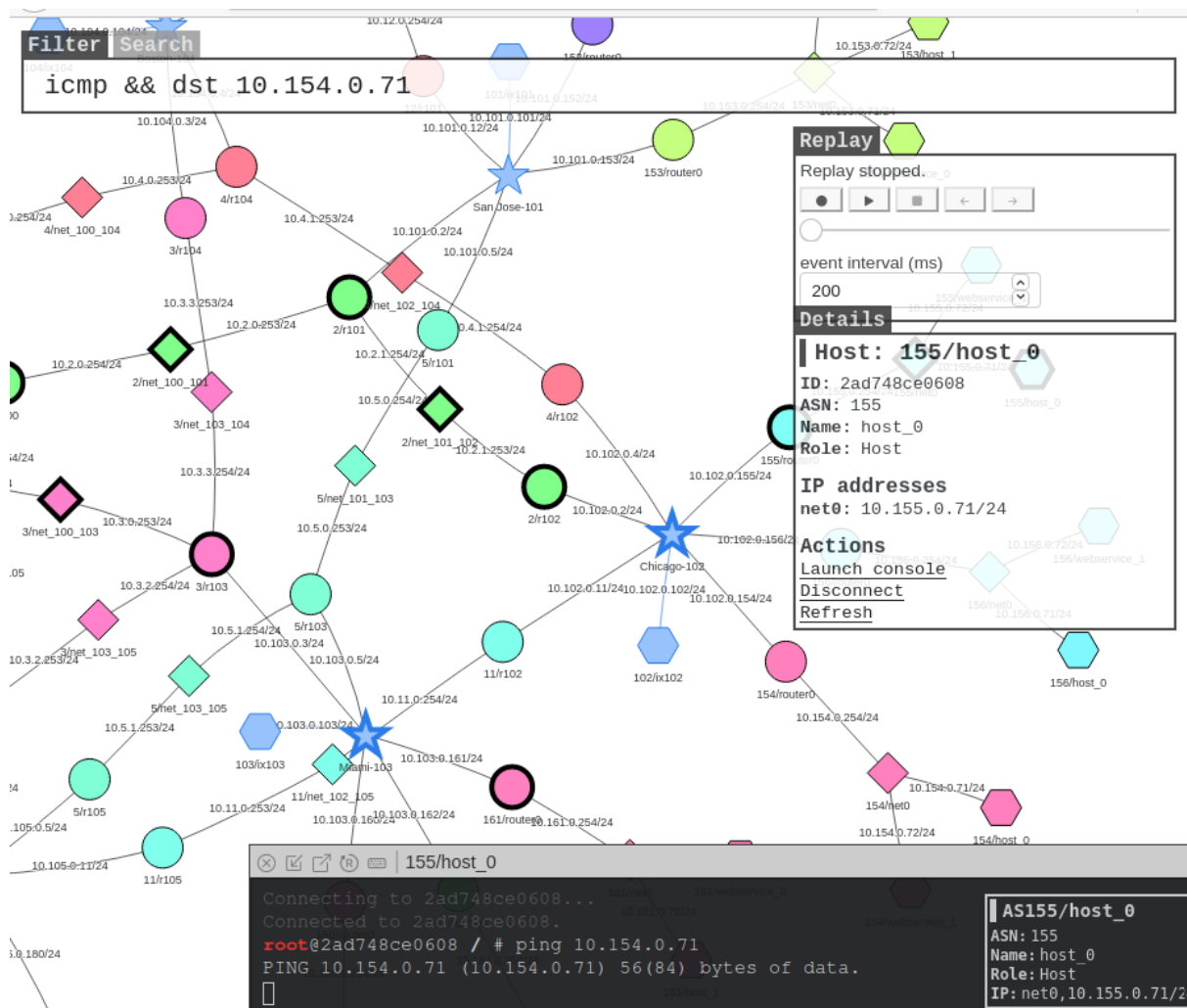
| AS3/r105 | |
|----------|---------------------------|
| ASN: | 3 |
| Name: | r105 |
| Role: | Router |
| IP: | ix105,10.105.0.3/24 |
| IP: | net_100_105,10.3.1.253/24 |
| IP: | net_103_105,10.3.2.253/24 |

```
Connecting to 6a3fdb27b11...
Connected to 6a3fdb27b11.
root@6a3fdb27b11 / # ip route | grep 10.154
10.154.0.0/25 via 10.103.0.161 dev ix103 proto bird metric
10.154.0.0/24 via 10.3.2.253 dev net_103_105 proto bird metric
10.154.0.128/25 via 10.103.0.161 dev ix103 proto bird metric
root@6a3fdb27b11 / #
```

| AS3/r103 | |
|----------|---------------------------|
| ASN: | 3 |
| Name: | r103 |
| Role: | Router |
| IP: | ix103,10.103.0.3/24 |
| IP: | net_100_103,10.3.0.253/24 |
| IP: | net_103_105,10.3.2.254/24 |
| IP: | net_103_104,10.3.3.254/24 |

```
*Untitled Document 1 x bird.conf x
62 interface "net0" { hello 1; dead count 2; };
63
64 };
65 }
66 protocol pipe {
67     table t_ospf;
68     peer table master4;
69     import none;
70     export all;
71 }
72
73 protocol static hijacks {
74     ipv4 { table t_bgp; };
75
76     route 10.154.0.0/25 blackhole {
77         bgp_large_community.add(LOCAL_COMM);
78     };
79
80     route 10.154.0.128/25 blackhole {
81         bgp_large_community.add(LOCAL_COMM);
82     };
83 }
```

We modify the configuration as to traffic with the destination AS 154 will come to AS 161.



5.b

Modify the AS-154 configuration so that it can grab back its own traffic:

```

protocol static {
    ipv4 { table t_bgp; };
    route 10.154.0.0/26 via "net0" {
        bgp_large_community.add(LOCAL_COMM);
    };
    route 10.154.0.64/26 via "net0" {
        bgp_large_community.add(LOCAL_COMM);
    };
    route 10.154.0.128/26 via "net0" {
        bgp_large_community.add(LOCAL_COMM);
    };
    route 10.154.0.192/26 via "net0" {
        bgp_large_community.add(LOCAL_COMM);
    };
};

root@710b0b5b2e72 / # birdc configure
BIRD 2.0.7 ready.
Reading configuration from /etc/bird/bird.conf
Reconfigured

```

AS154/router0

ASN: 154

Name: router0

Role: Router

IP: net0, 10.154.0.254/24

IP: ix102, 10.102.0.154/24

Router: 154/r

ID: 710b0b5b2e72

ASN: 154

Name: router0

Role: Router

IP addresses

net0: 10.154.0.254/24

ix102: 10.102.0.154/24

BGP sessions

ix102: Established

```
171/router0
Connecting to f8669b2c4726...
Connected to f8669b2c4726.
root@f8669b2c4726 / # ip route | grep 10.154
10.154.0.0/26 via 10.105.0.11 dev ix105 proto bird metric 32
10.154.0.0/25 via 10.105.0.11 dev ix105 proto bird metric 32
10.154.0.0/24 via 10.105.0.11 dev ix105 proto bird metric 32
10.154.0.64/26 via 10.105.0.11 dev ix105 proto bird metric 32
10.154.0.128/26 via 10.105.0.11 dev ix105 proto bird metric 32
10.154.0.128/25 via 10.105.0.11 dev ix105 proto bird metric 32
10.154.0.192/26 via 10.105.0.11 dev ix105 proto bird metric 32
root@f8669b2c4726 / #
```

AS171/router0
ASN: 171
Name: router0
Role: Router
IP: net0,10.171.0.254/24
IP: ix105,10.105.0.171/24

```
155/host_0
Connecting to 2ad748ce0608...
Connected to 2ad748ce0608.
root@2ad748ce0608 / # ping 10.154.0.71
PING 10.154.0.71 (10.154.0.71) 56(84) bytes of data.
64 bytes from 10.154.0.71: icmp_seq=1 ttl=61 time=0.330 ms
64 bytes from 10.154.0.71: icmp_seq=2 ttl=61 time=0.190 ms
64 bytes from 10.154.0.71: icmp_seq=3 ttl=61 time=0.189 ms
64 bytes from 10.154.0.71: icmp_seq=4 ttl=61 time=0.188 ms
64 bytes from 10.154.0.71: icmp_seq=5 ttl=61 time=0.300 ms
64 bytes from 10.154.0.71: icmp_seq=6 ttl=61 time=0.219 ms
64 bytes from 10.154.0.71: icmp_seq=7 ttl=61 time=0.306 ms
64 bytes from 10.154.0.71: icmp_seq=8 ttl=61 time=0.334 ms
```

AS155/host_0
ASN: 155
Name: host_0
Role: Host
IP: net0,10.155.0.71/24

5.c

Since AS-3 is the only provider of AS-161, AS-3 can modify its configuration to fix the wrong route.

```
pen  pen  bird3.conf  Save  ⋮
~/Downloads/BGP/Labsetup/task5

1      next hop self;
2      };
3      local 10.103.0.3 as 3;
4      neighbor 10.103.0.160 as 160;
5  }
6  protocol bgp c_as161 {
7      ipv4 {
8          table t_bgp;
9          import filter {
10             bgp_large_community.add(CUSTOMER_COMM);
11             bgp_local_pref = 30;
12             if (net != 10.161.0.0/24) then reject;
13             accept;
14         };
15         export all;
16         next hop self;
17     };
18     local 10.103.0.3 as 3;
19     neighbor 10.103.0.161 as 161;
20 }
```

It could be found that the traffic is still sent to AS 154

The network diagram illustrates a complex BGP topology with multiple Autonomous Systems (ASes) represented by colored nodes and their interconnections. A terminal window in the foreground shows a ping test being conducted from 171/router0 to the destination IP 10.154.0.71. The ping results show 51 packets transmitted with 0% packet loss and a round-trip time of 51128ms. A details panel on the right provides information about the host 155/host_0, including its ID, ASN (155), name, role, and IP address (10.155.0.71/24).

event interval (ms)
200

Details

Host: 155/host_0
ID: 2ad748ce0608
ASN: 155
Name: host_0
Role: Host

IP addresses
net0: 10.155.0.71/24

Actions

155/host_0

```
64 bytes from 10.154.0.71: icmp_seq=39 ttl=61 time=0.352 ms
64 bytes from 10.154.0.71: icmp_seq=40 ttl=61 time=0.196 ms
64 bytes from 10.154.0.71: icmp_seq=41 ttl=61 time=0.203 ms
64 bytes from 10.154.0.71: icmp_seq=42 ttl=61 time=0.179 ms
64 bytes from 10.154.0.71: icmp_seq=43 ttl=61 time=0.338 ms
64 bytes from 10.154.0.71: icmp_seq=44 ttl=61 time=0.226 ms
64 bytes from 10.154.0.71: icmp_seq=45 ttl=61 time=0.192 ms
64 bytes from 10.154.0.71: icmp_seq=46 ttl=61 time=0.205 ms
64 bytes from 10.154.0.71: icmp_seq=47 ttl=61 time=0.197 ms
64 bytes from 10.154.0.71: icmp_seq=48 ttl=61 time=0.542 ms
64 bytes from 10.154.0.71: icmp_seq=49 ttl=61 time=0.192 ms
64 bytes from 10.154.0.71: icmp_seq=50 ttl=61 time=0.288 ms
64 bytes from 10.154.0.71: icmp_seq=51 ttl=61 time=0.196 ms
^C
--- 10.154.0.71 ping statistics ---
51 packets transmitted, 51 received, 0% packet loss, time 51128ms
rtt min/avg/max/mdev = 0.093/0.246/1.205/0.155 ms
root@2ad748ce0608 / #
ad748ce0608 / #
ad748ce0608 / # ping 10.154.0.71
PING 10.154.0.71 (10.154.0.71) 56(84) bytes of data.
```

171/router0

