Project HY-335b
Phase 2

Group #44
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Question 2.1

By using the “update-source lo” command, you tell the current router to use the loopback address as the source address when accessing the referenced ip.

```
ATLA_router# show bgp summary

IPv4 Unicast Summary:
BGP router identifier 44.157.0.1, local AS number 44 vrf-id 0
BGP table version 202
RIB entries 127, using 23 KiB of memory
Peers 7, using 143 KiB of memory

Neighbor        V         AS MsgRcvd MsgSent   TblVer  InQ OutQ  Up/Down State/PfxRcd
44.151.0.1      4         44    3044    2867        0    0    0 1d23h39m           25
44.152.0.1      4         44    3037    2861        0    0    0 1d23h21m           35
44.153.0.1      4         44    3018    2868        0    0    0 1d23h40m            2
44.154.0.1      4         44    3039    2860        0    0    0 1d23h24m            4
44.155.0.1      4         44    4490    4375        0    0    0 3d00h45m           25
44.156.0.1      4         44    3081    2868        0    0    0 1d23h40m           25
44.158.0.1      4         44    4466    4368        0    0    0 3d00h17m            4

Total number of neighbors 7
ATLA_router# _
```

Question 2.2

The “next-hop-self” command is used on the iBGP sessions to inform the (internal) neighbors of the router (that the command was executed) that if they need to reach the destinations it advertised, they have to use as a next-hop the current router. If “next-hop-self” isn’t specified, the neighbor routers don’t know how to reach the advertised ip, therefore ignoring the advertisement.

Here we see the show ip bgp command executed on our PARI router

```
PARI_router# show ip bgp
BGP table version is 441, local router ID is 44.153.0.1, vrf id 0
Default local pref 100, local AS 44
Status codes:  s suppressed, d damped, h history, * valid, > best, = multipath,
               i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
* i1.0.0.0/8       44.152.0.1                    100      0 41 1 i
*                  179.1.22.1                             0 43 41 1 i
*>i                44.151.0.1                    100      0 42 1 i
* i                44.156.0.1                    100      0 42 1 i
* i2.0.0.0/8       44.152.0.1                    100      0 41 2 i
*                  179.1.22.1                             0 43 41 2 i
*>i                44.151.0.1                    100      0 42 2 i
* i                44.156.0.1                    100      0 42 2 i
* i3.0.0.0/8       44.152.0.1                    100      0 41 1 3 i
*                  179.1.22.1                             0 43 41 1 3 i
*>i                44.151.0.1                    100      0 42 1 3 i
* i                44.156.0.1                    100      0 42 1 3 i
* i                44.155.0.1                    100      0 21 24 3 i
* i4.0.0.0/8       44.152.0.1                    100      0 41 1 4 i
*                  179.1.22.1                             0 43 41 1 4 i
*>i                44.151.0.1                    100      0 42 1 4 i
* i                44.156.0.1                    100      0 42 1 4 i
* i5.0.0.0/8       44.152.0.1                    100      0 41 1 3 5 i
*                  179.1.22.1                             0 43 41 1 3 5 i
*>i                44.151.0.1                    100      0 42 1 3 5 i
* i                44.156.0.1                    100      0 42 1 3 5 i
* i                44.155.0.1                    100      0 21 24 3 5 i
*  6.0.0.0/8       179.1.22.1                             0 43 42 1 4 6 i
*>i                44.151.0.1                    100      0 42 1 4 6 i
* i                44.156.0.1                    100      0 42 1 4 6 i
*>i7.0.0.0/8       44.155.0.1                    100      0 21 24 7 i
*  8.0.0.0/8       179.1.22.1                             0 43 42 1 3 5 7 8 i
*>i                44.151.0.1                    100      0 42 1 3 5 7 8 i
* i                44.156.0.1                    100      0 42 1 3 5 7 8 i
* i                44.155.0.1                    100      0 21 24 3 5 7 8 i
*>i9.0.0.0/8       44.155.0.1                    100      0 21 24 9 i
*  10.0.0.0/8      179.1.22.1                             0 43 42 1 3 5 7 8 i
*>i                44.151.0.1                    100      0 42 1 3 5 7 8 i
* i                44.156.0.1                    100      0 42 1 3 5 7 8 i
* i                44.155.0.1                    100      0 21 24 3 5 7 8 i
*>i11.0.0.0/8      44.155.0.1                    100      0 21 24 9 11 i
*>i12.0.0.0/8      44.155.0.1                    100      0 21 24 9 12 i
*>i13.0.0.0/8      44.155.0.1                    100      0 21 24 13 i
*>i14.0.0.0/8      44.155.0.1                    100      0 21 24 9 11 14 i
*>i21.0.0.0/8      44.155.0.1               0    100      0 21 i
* i22.0.0.0/8      44.152.0.1                    100      0 41 22 i
*                  179.1.22.1                             0 43 41 22 i
*>i                44.151.0.1                    100      0 42 22 i
* i                44.156.0.1                    100      0 42 22 i
*>i23.0.0.0/8      44.155.0.1               0    100      0 23 i
*>i24.0.0.0/8      44.155.0.1                    100      0 21 24 i
*>i25.0.0.0/8      44.155.0.1                    100      0 21 24 25 i
*>i26.0.0.0/8      44.155.0.1                    100      0 21 24 26 i
*>i27.0.0.0/8      44.155.0.1               0    100      0 27 i
*>i29.0.0.0/8      44.155.0.1                    100      0 29 i
*>i31.0.0.0/8      44.155.0.1               0    100      0 31 i
*>i33.0.0.0/8      44.155.0.1               0    100      0 33 i
*>i34.0.0.0/8      44.155.0.1                    100      0 31 34 i
```

And here is the show ip bgp command executed on PARI router of team #46

```
chris@CP-HpLaptop:~$ python3 database-query.py 46-PARI

Database query script, trigger timestamp --> ****2021-05-23 18:33:31****

46-PARI
BGP table version is 1767, local router ID is 46.153.0.1, vrf id 0
Default local pref 100, local AS 46
Status codes:  s suppressed, d damped, h history, * valid, > best, = multipath,
               i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
* i1.0.0.0/8       46.156.0.1                    100      0 44 42 1 i
*>i                46.151.0.1                    100      0 44 41 1 i
* i2.0.0.0/8       46.156.0.1                    100      0 44 42 2 i
*>i                46.151.0.1                    100      0 44 41 2 i
*>i3.0.0.0/8       46.155.0.1                    100      0 21 24 3 i
* i4.0.0.0/8       46.156.0.1                    100      0 44 42 1 4 i
*>i                46.151.0.1                    100      0 44 41 1 4 i
* i                46.155.0.1                    100      0 21 24 1 4 i
*>i5.0.0.0/8       46.155.0.1                    100      0 21 24 3 5 i
* i6.0.0.0/8       46.156.0.1                    100      0 44 42 1 4 6 i
*>i                46.151.0.1                    100      0 44 42 1 4 6 i
* i                46.155.0.1                    100      0 21 24 1 4 6 i
*>i7.0.0.0/8       46.155.0.1                    100      0 21 24 7 i
*>i8.0.0.0/8       46.155.0.1                    100      0 21 24 3 5 7 8 i
*>i9.0.0.0/8       46.155.0.1                    100      0 21 24 9 i
*>i10.0.0.0/8      46.155.0.1                    100      0 21 24 3 5 7 8 i
*>i11.0.0.0/8      46.155.0.1                    100      0 21 24 9 11 i
*>i12.0.0.0/8      46.155.0.1                    100      0 21 24 9 12 i
*>i13.0.0.0/8      46.155.0.1                    100      0 21 24 13 i
*>i14.0.0.0/8      46.155.0.1                    100      0 21 24 9 11 14 i
*>i21.0.0.0/8      46.155.0.1               0    100      0 21 i
* i22.0.0.0/8      46.156.0.1                    100      0 44 42 22 i
*>i                46.151.0.1                    100      0 44 41 22 i
* i                46.155.0.1                    100      0 21 24 22 i
*>i23.0.0.0/8      46.155.0.1               0    100      0 23 i
*>i24.0.0.0/8      46.155.0.1                    100      0 21 24 i
*>i25.0.0.0/8      46.155.0.1                    100      0 21 24 25 i
*>i26.0.0.0/8      46.155.0.1                    100      0 21 24 26 i
*>i27.0.0.0/8      46.155.0.1               0    100      0 27 i
*>i29.0.0.0/8      46.155.0.1                    100      0 29 i
*>i31.0.0.0/8      46.155.0.1               0    100      0 31 i
*>i33.0.0.0/8      46.155.0.1               0    100      0 33 i
*>i34.0.0.0/8      46.155.0.1                    100      0 31 34 i
* i44.0.0.0/8      46.156.0.1               0    100      0 44 i
*>i                46.151.0.1               0    100      0 44 i
* i                46.151.0.1               0    100      0 i
* i                46.157.0.1               0    100      0 i
* i                46.155.0.1               0    100      0 i
* i                46.156.0.1               0    100      0 i
*>                 0.0.0.0                  0         32768 i
```

(we couldn't fit the whole output of the command in the screenshots so we captured the top-most of it)

And a traceroute from our PARI-host to PARI-host of team #43

```
root@PARI_host:~# traceroute 43.103.0.2
traceroute to 43.103.0.2 (43.103.0.2), 30 hops max, 60 byte packets
 1  PARI-host.group44 (44.103.0.2)  2.866 ms  2.801 ms  2.800 ms
 2  PARI-host.group43 (43.103.0.2)  5.621 ms  5.611 ms  5.598 ms
```

Question 2.3

Here we can see the running-config of the NEWY router

```
router bgp 44
 neighbor 44.151.0.1 remote-as 44
 neighbor 44.151.0.1 update-source lo
 neighbor 44.152.0.1 remote-as 44
 neighbor 44.152.0.1 update-source lo
 neighbor 44.153.0.1 remote-as 44
 neighbor 44.153.0.1 update-source lo
 neighbor 44.154.0.1 remote-as 44
 neighbor 44.154.0.1 update-source lo
 neighbor 44.156.0.1 remote-as 44
 neighbor 44.156.0.1 update-source lo
 neighbor 44.157.0.1 remote-as 44
 neighbor 44.157.0.1 update-source lo
 neighbor 44.158.0.1 remote-as 44
 neighbor 44.158.0.1 update-source lo
 neighbor 180.122.0.122 remote-as 122
 neighbor 180.122.0.122 update-source lo
 !
 address-family ipv4 unicast
  neighbor 44.151.0.1 next-hop-self
  neighbor 44.152.0.1 next-hop-self
  neighbor 44.153.0.1 next-hop-self
  neighbor 44.154.0.1 next-hop-self
  neighbor 44.156.0.1 next-hop-self
  neighbor 44.157.0.1 next-hop-self
  neighbor 44.158.0.1 next-hop-self
  neighbor 180.122.0.122 route-map IXP_OUT out
 exit-address-family
!
router ospf
 network 44.0.5.0/24 area 0
 network 44.0.8.0/24 area 0
 network 44.0.10.0/24 area 0
 network 44.0.11.0/24 area 0
 network 44.0.12.0/24 area 0
 network 44.105.0.0/24 area 0
 network 44.155.0.0/24 area 0
!
ip prefix-list MY_PREF_LIST seq 5 permit 44.0.0.0/8
!
route-map IXP_OUT permit 10
 match ip address prefix-list MY_PREF_LIST
 set community 122:21 122:23 122:25 122:27 122:29 122:31 122:33 122:42 122:46 122:48 122:50 122:52 122:54
!
line vty
!
end
```

set the “IXP_OUT” route map to all outbound traffic on the IXP eBGP session

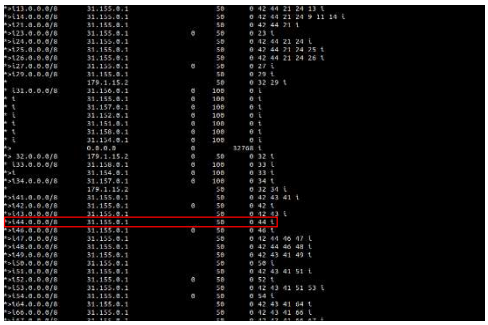
create a prefix list for all requests from our AS

create the route map where the community tags are added

launching a measurement from AS33 to our NEWY host passes through the IXP

```
root@ba8e646f2945:~# ./launch_traceroute.sh 31 44.105.0.1
Hop 1:  31.0.199.1 TTL=0 during transit
Hop 2:  31.0.4.2 TTL=0 during transit
Hop 3:  31.0.7.2 TTL=0 during transit
Hop 4:  31.0.10.1 TTL=0 during transit
Hop 5:  180.122.0.44 TTL=0 during transit
Hop 6:  44.105.0.1 Echo reply (type=0/code=0)
Hop 7:  44.105.0.1 Echo reply (type=0/code=0)
Hop 8:  ^CHop 9:  44.105.0.1 Echo reply (type=0/code=0)
Hop 10:  44.105.0.1 Echo reply (type=0/code=0)
Hop 11:  44.105.0.1 Echo reply (type=0/code=0)
```

And here is the bgp route from AS31 (Using BGP Looking glass)



Question 2.4

In order to follow the Gao-Rexford guidelines on our eBGP sessions, we use the following community values: 44:10 for Customers, 44:20 for Peers (including the IXP), 44:30 for Providers

Here is the running-config of router LOND:

```
router bgp 44
 neighbor 44.152.0.1 remote-as 44
 neighbor 44.152.0.1 update-source lo
 neighbor 44.153.0.1 remote-as 44
 neighbor 44.153.0.1 update-source lo
 neighbor 44.154.0.1 remote-as 44
 neighbor 44.154.0.1 update-source lo
 neighbor 44.155.0.1 remote-as 44
 neighbor 44.155.0.1 update-source lo
 neighbor 44.156.0.1 remote-as 44
 neighbor 44.156.0.1 update-source lo
 neighbor 44.157.0.1 remote-as 44
 neighbor 44.157.0.1 update-source lo
 neighbor 44.158.0.1 remote-as 44
 neighbor 44.158.0.1 update-source lo
 neighbor 179.0.23.1 remote-as 42
 neighbor 179.0.23.1 update-source lo
 !
 address-family ipv4 unicast
  network 44.0.0.0/8
  neighbor 44.152.0.1 next-hop-self
  neighbor 44.153.0.1 next-hop-self
  neighbor 44.154.0.1 next-hop-self
  neighbor 44.155.0.1 next-hop-self
  neighbor 44.156.0.1 next-hop-self
  neighbor 44.157.0.1 next-hop-self
  neighbor 44.158.0.1 next-hop-self
  neighbor 179.0.23.1 route-map PROVIDER_IN in
  neighbor 179.0.23.1 route-map PROVIDER_OUT out
 exit-address-family
!
router ospf
 network 44.0.2.0/24 area 0
 network 44.0.4.0/24 area 0
 network 44.0.7.0/24 area 0
 network 44.0.8.0/24 area 0
 network 44.101.0.0/24 area 0
 network 44.151.0.0/24 area 0
 network 198.0.0.0/24 area 0
!
ip prefix-list LOCAL_PREFIX seq 5 permit 44.0.0.0/8
!
bgp community-list 1 permit 44:10
!
route-map PROVIDER_IN permit 10
 set community 44:30
 set local-preference 20
!
route-map PROVIDER_OUT permit 10
 match ip address prefix-list LOCAL_PREFIX
!
route-map PROVIDER_OUT permit 20
 match community 1
!
```

inform the session about the incoming and outgoing routing tables

create a prefix list for all local prefixes

create a community list for the accepted community tags on the advertisements (here 44:10 is refering to all Customer adverts)

create a route map for taging the incoming trafic from provider 1 with the 44:30 community tag and set the preferance of the advert to 20

create a route map for allowing the local prefixes to advertise to the eBGP neighbor

create a route map for allowing adverts from community 1 (tag 44:10) to pass to the beighbor

```
*>i9.0.0.0/8         43.152.0.1               100      0 42 21 24 9 i
*>i11.0.0.0/8        43.152.0.1               100      0 42 21 24 9 11 i
*>i12.0.0.0/8        43.152.0.1               100      0 42 21 24 9 12 i
*>i13.0.0.0/8        43.152.0.1               100      0 42 21 24 13 i
*>i14.0.0.0/8        43.152.0.1               100      0 42 21 24 9 11 14 i
*>i21.0.0.0/8        43.152.0.1               100      0 42 21 i
*>i22.0.0.0/8        43.152.0.1               100      0 42 22 i
*>i23.0.0.0/8        43.152.0.1               100      0 42 23 i
*>i24.0.0.0/8        43.152.0.1               100      0 42 21 24 i
*>i25.0.0.0/8        43.152.0.1               100      0 42 21 24 25 i
*>i26.0.0.0/8        43.152.0.1               100      0 42 21 24 26 i
*>i27.0.0.0/8        43.152.0.1               100      0 42 27 i
*>i29.0.0.0/8        43.152.0.1               100      0 42 29 i
*>i31.0.0.0/8        43.152.0.1               100      0 42 31 i
*>i33.0.0.0/8        43.152.0.1               100      0 42 33 i
*>i34.0.0.0/8        43.152.0.1               100      0 42 31 34 i
*>i41.0.0.0/8        43.151.0.1               0    100      0 41 i
* i                  43.156.0.1               0    100      0 41 i
*>i42.0.0.0/8        43.152.0.1               0    100      0 42 i
*> 43.0.0.0/8        0.0.0.0                  0         32768 i
*> 44.0.0.0/8        179.1.22.2               0             0 44 i
*> 46.0.0.0/8        179.1.22.2                             0 44 46 i
*> 47.0.0.0/8        179.1.22.2                             0 44 46 47 i
*>i48.0.0.0/8        43.152.0.1               100      0 42 48 i
*> 49.0.0.0/8        179.1.22.2                             0 44 46 47 49 i
  i                  180.123.0.49             100      0 49 i
*>i50.0.0.0/8        43.152.0.1               100      0 42 50 i
*> 51.0.0.0/8        179.1.22.2                             0 44 46 47 49 51 i
  i                  180.123.0.51             0    100      0 51 i
*>i52.0.0.0/8        43.152.0.1               100      0 42 52 i
*> 53.0.0.0/8        179.1.22.2                             0 44 46 47 49 51 53 i
  i                  180.123.0.51             100      0 51 53 i
*>i54.0.0.0/8        43.152.0.1               100      0 42 21 23 54 i
  i                  180.123.0.51             100      0 51 54 i
*>i61.0.0.0/8        43.152.0.1               100      0 42 61 i
  i62.0.0.0/8        180.123.0.62             0    100      0 62 i
*>i                  43.152.0.1               100      0 42 62 i
  i63.0.0.0/8        180.123.0.62             100      0 62 63 i
```

By launching a looking glass from 43-PARI we can see that for our customers AS 46, 47, 48, 49, 21 and 53 there is a route passing through our AS. Also by looking for our Peers we can see that there is no path through our AS, instead they all pass through our provider AS42.

For the requested traceroute, we tried a traceroute from 45 but it seems like they hadn't don the project so we couldn't trace from them. Doing a traceroute from 46 couldt show us what we needed as all our peers from the IXP are their peers too, and our peer 43 is their provider so there is no need to use a path goint through us.

Question 2.5

For the example of our application we started a client on LOND-host with servers on the rest of the hosts in out AS (including student1 and staff1). Below is the output of the client which shows that all hosts executed measurements to each other.

```
PARI-host->student_1 / 5.349 / 3 / host-PARI - PARI-ZURI - student_1
PARI-host->staff_1 / 5.074 / 3 / host-PARI - PARI-ZURI - staff_1
PARI-host->BOST-host / 23.701 / 4 / host-PARI - PARI-LOND - LOND-BOST - BOST-host
PARI-host->NEWY-host / 42.500 / 5 / host-PARI - PARI-LOND - LOND-BOST - BOST-NEWY - NEWY-host
PARI-host->ATLA-host / 1.546 / 4 / host-PARI - PARI-LOND - MIAM-ATLA - ATLA-host
PARI-host->MIAM-host / 1.349 / 3 / host-PARI - PARI-MIAM - MIAM-host
staff_1->PARI-host / 4.727 / 3 / GENE-staff - ZURI-PARI - PARI-host
staff_1->student_1 / 5.737 / 2 / GENE-staff - student_1
staff_1->BOST-host / 26.440 / 5 / GENE-staff - ZURI-PARI - ZURI-LOND - LOND-BOST - BOST-host
staff_1->NEWY-host / 32.257 / 6 / GENE-staff - ZURI-PARI - PARI-LOND - LOND-BOST - BOST-NEWY - NEWY-host
staff_1->ATLA-host / 7.760 / 5 / GENE-staff - ZURI-PARI - ZURI-LOND - LOND-BOST - ATLA-host
staff_1->MIAM-host / 7.554 / 4 / GENE-staff - ZURI-PARI - PARI-MIAM - MIAM-host
MIAM-host->PARI-host / 1.079 / 3 / host-MIAM - MIAM-PARI - PARI-host
MIAM-host->student_1 / 7.232 / 4 / host-MIAM - MIAM-PARI - PARI-ZURI - student_1
MIAM-host->staff_1 / 6.503 / 4 / host-MIAM - MIAM-PARI - PARI-ZURI - staff_1
MIAM-host->BOST-host / 2.188 / 4 / host-MIAM - MIAM-NEWY - NEWY-BOST - BOST-host
MIAM-host->NEWY-host / 2.204 / 3 / host-MIAM - ATLA-NEWY - NEWY-host
MIAM-host->ATLA-host / 1.022 / 3 / host-MIAM - MIAM-ATLA - ATLA-host
student_1->PARI-host / 4.307 / 3 / GENE-students - ZURI-PARI - PARI-host
student_1->staff_1 / 5.680 / 2 / GENE-students - staff_1
student_1->BOST-host / 26.764 / 5 / GENE-students - ZURI-PARI - ZURI-LOND - LOND-BOST - BOST-host
student_1->NEWY-host / 29.869 / 6 / GENE-students - ZURI-PARI - PARI-LOND - LOND-BOST - BOST-NEWY - NEWY-host
student_1->ATLA-host / 7.050 / 5 / GENE-students - ZURI-PARI - PARI-MIAM - MIAM-ATLA - ATLA-host
student_1->MIAM-host / 4.879 / 4 / GENE-students - ZURI-PARI - PARI-MIAM - MIAM-host
BOST-host->PARI-host / 22.111 / 4 / host-BOST - BOST-LOND - LOND-PARI - PARI-host
BOST-host->student_1 / 27.066 / 4 / host-BOST - BOST-LOND - LOND-PARI - LOND-ZURI
BOST-host->staff_1 / 26.032 / 5 / host-BOST - BOST-LOND - LOND-PARI - LOND-ZURI - staff_1
BOST-host->NEWY-host / 0.516 / 3 / host-BOST - BOST-NEWY - NEWY-host
BOST-host->ATLA-host / 3.452 / 5 / host-BOST - BOST-NEWY - ATLA-MIAM - NEWY-ATLA - ATLA-host
BOST-host->MIAM-host / 2.085 / 4 / host-BOST - BOST-NEWY - NEWY-ATLA - MIAM-host
ATLA-host->PARI-host / 2.462 / 4 / host-ATLA - ATLA-MIAM - NEWY-BOST - PARI-host
ATLA-host->student_1 / 5.946 / 5 / host-ATLA - ATLA-MIAM - MIAM-PARI - BOST-LOND - student_1
ATLA-host->staff_1 / 6.005 / 5 / host-ATLA - ATLA-MIAM - MIAM-PARI - LOND-ZURI - staff_1
ATLA-host->BOST-host / 2.178 / 4 / host-ATLA - MIAM-NEWY - NEWY-BOST - BOST-host
ATLA-host->NEWY-host / 1.044 / 4 / host-ATLA - ATLA-MIAM - MIAM-NEWY - NEWY-host
ATLA-host->MIAM-host / 1.380 / 3 / host-ATLA - ATLA-MIAM - MIAM-host
NEWY-host->PARI-host / 22.598 / 5 / host-NEWY - NEWY-BOST - BOST-LOND - LOND-PARI - PARI-host
NEWY-host->student_1 / 27.575 / 5 / host-NEWY - NEWY-BOST - BOST-LOND - PARI-ZURI - student_1
NEWY-host->staff_1 / 25.884 / 5 / host-NEWY - NEWY-BOST - BOST-LOND - PARI-ZURI - staff_1
NEWY-host->BOST-host / 0.421 / 3 / host-NEWY - NEWY-BOST - BOST-host
NEWY-host->ATLA-host / 2.568 / 4 / host-NEWY - NEWY-MIAM - MIAM-ATLA - ATLA-host
NEWY-host->MIAM-host / 0.971 / 3 / host-NEWY - MIAM-ATLA - MIAM-host
```