

# ΜΑΘΗΜΑ: ΔΙΑΧΕΙΡΙΣΗ ΔΙΚΤΥΩΝ - ΕΥΦΥΗ ΔΙΚΤΥΑ

**ΟΝΟΜΑ: ΠΑΠΑΔΟΠΟΥΛΛΟΣ ΜΙΧΑΛΗΣ**

**A.M: 03114702**

**ΟΝΟΜΑ: ΚΑΡΔΑΡΗΣ ΧΑΡΑΛΑΜΠΟΣ**

**A.M: 03114074**

**ΟΜΑΔΑ: netmg034**

## ΕΡΓΑΣΤΗΡΙΑΚΗ ΑΣΚΗΣΗ: 1

### 1.(α)

Αποτελέσματα ping

PING www.esa.int.cdngc.net (148.253.245.209) 56(84) bytes of data.

64 bytes from 148.253.245.209 (148.253.245.209): icmp\_seq=1 ttl=57 time=44.6 ms

64 bytes from 148.253.245.209 (148.253.245.209): icmp\_seq=2 ttl=57 time=44.7 ms

64 bytes from 148.253.245.209 (148.253.245.209): icmp\_seq=3 ttl=57 time=44.7 ms

64 bytes from 148.253.245.209 (148.253.245.209): icmp\_seq=4 ttl=57 time=44.7 ms

--- www.esa.int.cdngc.net ping statistics ---

4 packets transmitted, 4 received, 0% packet loss, time 3005ms

rtt min/avg/max/mdev = 44.684/44.721/44.748/0.260 ms

PING grnet.gr (62.217.124.68) 56(84) bytes of data.

64 bytes from 62.217.124.68 (62.217.124.68): icmp\_seq=1 ttl=61 time=2.07 ms

64 bytes from 62.217.124.68 (62.217.124.68): icmp\_seq=2 ttl=61 time=2.15 ms

64 bytes from 62.217.124.68 (62.217.124.68): icmp\_seq=3 ttl=61 time=2.20 ms

64 bytes from 62.217.124.68 (62.217.124.68): icmp\_seq=4 ttl=61 time=2.28 ms

--- grnet.gr ping statistics ---

4 packets transmitted, 4 received, 0% packet loss, time 3004ms

rtt min/avg/max/mdev = 2.074/2.179/2.285/0.095 ms

PING cluster90-elbwpeel-1jjv8xqi5kd5g-1169217295.us-east-1.elb.amazonaws.com (35.170.147.119) 56(84) bytes of data.

64 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp\_seq=1 ttl=234 time=153 ms

64 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp\_seq=2 ttl=234 time=153 ms

64 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp\_seq=3 ttl=234

time=153 ms

64 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp\_seq=4 ttl=234

time=153 ms

--- cluster90-elbwpeel-1jjv8xqi5kd5g-1169217295.us-east-1.elb.amazonaws.com ping statistics ---

4 packets transmitted, 4 received, 0% packet loss, time 3004ms

rtt min/avg/max/mdev = 153.082/153.184/153.274/0.484 ms

PING www.wikipedia.org (91.198.174.192) 56(84) bytes of data.

64 bytes from text-lb.esams.wikimedia.org (91.198.174.192): icmp\_seq=1 ttl=56 time=47.8 ms

64 bytes from text-lb.esams.wikimedia.org (91.198.174.192): icmp\_seq=2 ttl=56 time=47.9 ms

64 bytes from text-lb.esams.wikimedia.org (91.198.174.192): icmp\_seq=3 ttl=56 time=47.9 ms

64 bytes from text-lb.esams.wikimedia.org (91.198.174.192): icmp\_seq=4 ttl=56 time=47.9 ms

--- www.wikipedia.org ping statistics ---

4 packets transmitted, 4 received, 0% packet loss, time 3003ms

rtt min/avg/max/mdev = 47.869/47.943/47.985/0.161 ms

PING star-mini.c10r.facebook.com (31.13.84.36) 56(84) bytes of data.

64 bytes from edge-star-mini-shv-01-vie1.facebook.com (31.13.84.36): icmp\_seq=1 ttl=56 time=42.7 ms

64 bytes from edge-star-mini-shv-01-vie1.facebook.com (31.13.84.36): icmp\_seq=2 ttl=56 time=42.8 ms

64 bytes from edge-star-mini-shv-01-vie1.facebook.com (31.13.84.36): icmp\_seq=3 ttl=56 time=42.9 ms

64 bytes from edge-star-mini-shv-01-vie1.facebook.com (31.13.84.36): icmp\_seq=4 ttl=56 time=42.8 ms

--- star-mini.c10r.facebook.com ping statistics ---

4 packets transmitted, 4 received, 0% packet loss, time 3001ms

rtt min/avg/max/mdev = 42.783/42.855/42.901/0.257 ms

Βλέπουμε ότι όλοι οι κόμβοι είναι διαθέσιμοι, αφού έχουμε 100% επιτυχία αποστολής πακέτων.

## Traceroute results

Τα πρώτα αποτελέσματα σε κάθε host είναι με UDP πακέτα και τα δεύτερα με ICMP.

[www.esa.int](http://www.esa.int)

traceroute to www.esa.int (148.253.228.226), 30 hops max, 60 byte packets

```
1 * * *
2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168)  1.225 ms 1.185 ms 1.193 ms
3 grnet-ias-geant-gw.mx2.ath.gr.geant.net (83.97.88.69)  1.180 ms 1.154 ms 1.141 ms
4 ae2.mx1.mil2.it.geant.net (62.40.98.150)  28.894 ms 28.901 ms 28.951 ms
5 * * *
6 * * *
7 * * *
8 * * *
9 * * *
...
```

traceroute to www.esa.int (148.253.228.226), 30 hops max, 60 byte packets

```
1 * * *
2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168)  1.186 ms 1.183 ms 1.180 ms
3 grnet-ias-geant-gw.mx2.ath.gr.geant.net (83.97.88.69)  1.137 ms 1.150 ms 1.147 ms
4 ae2.mx1.mil2.it.geant.net (62.40.98.150)  28.834 ms 28.858 ms 28.933 ms
5 cdnetworks.mix-it.net (217.29.66.136)  25.372 ms 25.409 ms 25.403 ms
6 148.253.228.226 (148.253.228.226)  28.393 ms 28.305 ms 28.339 ms
```

[www.grnet.gr](http://www.grnet.gr)

traceroute to www.grnet.gr (62.217.124.68), 30 hops max, 60 byte packets

```
1 * * *
2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168) 1.151 ms 1.199 ms 1.137 ms
3 ypedcfs2-eier-1.backbone.grnet.gr (62.217.100.105) 2.575 ms ypedcfs1-eier-1.backbone.grnet.gr
(62.217.100.101) 2.375 ms ypedcfs2-eier-1.backbone.grnet.gr (62.217.100.105) 2.555 ms
4 * * *
5 * * *
6 * * *
7 * * *
8 * * *
9 * * *
10 * * *
...
```

traceroute to www.grnet.gr (62.217.124.68), 30 hops max, 60 byte packets

```
1 * * *
2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168) 1.064 ms 1.089 ms 1.085 ms
3 ypedcfs1-eier-1.backbone.grnet.gr (62.217.100.101) 2.401 ms 2.402 ms 2.399 ms
4 62.217.124.68 (62.217.124.68) 2.099 ms 2.103 ms 2.099 ms
```

[www.stanford.edu](http://www.stanford.edu)

traceroute to www.stanford.edu (34.206.192.89), 30 hops max, 60 byte packets

1 \* \* \*

2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168) 1.212 ms 1.380 ms 1.363 ms

3 grnet-ias-geant-gw.mx2.ath.gr.geant.net (83.97.88.69) 1.240 ms 1.232 ms 1.216 ms

4 ae0.mx1.ath2.gr.geant.net (62.40.98.141) 40.412 ms 40.357 ms 40.234 ms

5 ae23.mx1.vie.at.geant.net (62.40.98.147) 42.103 ms 42.040 ms 42.105 ms

6 te0-1-0-6.ccr52.vie01.atlas.cogentco.com (149.6.174.33) 33.290 ms 33.304 ms 40.272 ms

7 be3462.ccr22.muc03.atlas.cogentco.com (154.54.59.182) 46.333 ms 46.398 ms 46.331 ms

8 be2960.ccr42.fra03.atlas.cogentco.com (154.54.36.253) 45.127 ms 44.877 ms 52.105 ms

9 be2800.ccr42.par01.atlas.cogentco.com (154.54.58.238) 56.075 ms 63.020 ms 63.274 ms

10 be3628.ccr42.jfk02.atlas.cogentco.com (154.54.27.169) 134.931 ms 134.944 ms 128.221 ms

11 be3496.ccr31.jfk10.atlas.cogentco.com (154.54.0.142) 136.926 ms 130.080 ms 136.951 ms

12 38.140.107.42 (38.140.107.42) 128.735 ms 38.140.106.162 (38.140.106.162) 134.684 ms 127.891 ms

13 52.93.31.35 (52.93.31.35) 169.968 ms 52.93.31.53 (52.93.31.53) 147.840 ms 52.93.31.45

(52.93.31.45) 139.100 ms

14 52.93.4.42 (52.93.4.42) 136.680 ms 52.93.4.58 (52.93.4.58) 129.877 ms 52.93.4.42 (52.93.4.42)

138.373 ms

15 \* \* \*

16 54.240.229.147 (54.240.229.147) 140.211 ms 54.240.229.137 (54.240.229.137) 147.163 ms

54.239.44.218 (54.239.44.218) 145.411 ms

17 \* \* \*

18 \* \* \*

19 52.93.27.16 (52.93.27.16) 141.197 ms 52.93.27.0 (52.93.27.0) 152.728 ms 52.93.27.10 (52.93.27.10)

136.272 ms

20 \* \* 52.93.27.11 (52.93.27.11) 155.241 ms

21 54.239.111.1 (54.239.111.1) 132.934 ms 54.239.111.7 (54.239.111.7) 139.706 ms 52.93.25.116

(52.93.25.116) 142.880 ms

22 \* 52.93.27.199 (52.93.27.199) 155.576 ms \*

23 205.251.244.37 (205.251.244.37) 132.730 ms 205.251.244.57 (205.251.244.57) 139.544 ms

52.93.24.139 (52.93.24.139) 138.555 ms

24 \* \* \*

25 \* \* \*

...

traceroute to www.stanford.edu (35.170.147.119), 30 hops max, 60 byte packets

```
1 * * *
2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168)  1.106 ms 1.121 ms 1.117 ms
3 grnet-ias-geant-gw.mx2.ath.gr.geant.net (83.97.88.69)  1.114 ms 1.111 ms 1.134 ms
4 ae0.mx1.ath2.gr.geant.net (62.40.98.141)  40.292 ms 40.328 ms 40.380 ms
5 ae23.mx1.vie.at.geant.net (62.40.98.147)  35.045 ms 35.126 ms 35.181 ms
6 te0-1-0-6.ccr52.vie01.atlas.cogentco.com (149.6.174.33)  33.327 ms 33.268 ms 33.288 ms
7 be3462.ccr22.muc03.atlas.cogentco.com (154.54.59.182)  39.600 ms 39.594 ms 39.599 ms
8 be2960.ccr42.fra03.atlas.cogentco.com (154.54.36.253)  44.813 ms 45.056 ms 45.074 ms
9 be2800.ccr42.par01.atlas.cogentco.com (154.54.58.238)  55.928 ms 56.483 ms 56.174 ms
10 be3628.ccr42.jfk02.atlas.cogentco.com (154.54.27.169)  127.955 ms 128.193 ms 128.215 ms
11 be3496.ccr31.jfk10.atlas.cogentco.com (154.54.0.142)  129.867 ms 129.956 ms 129.950 ms
12 38.140.106.162 (38.140.106.162)  127.950 ms 127.942 ms 127.945 ms
13 52.93.31.45 (52.93.31.45)  139.585 ms 135.659 ms 136.753 ms
14 52.93.4.44 (52.93.4.44)  128.775 ms 128.713 ms 128.802 ms
15 * * *
16 54.240.229.139 (54.240.229.139)  138.340 ms 138.217 ms 138.195 ms
17 * * *
18 54.239.111.166 (54.239.111.166)  159.394 ms 153.254 ms 153.254 ms
19 54.239.110.166 (54.239.110.166)  134.788 ms 134.948 ms 134.929 ms
20 54.239.110.173 (54.239.110.173)  158.197 ms 144.819 ms 142.987 ms
21 52.93.26.36 (52.93.26.36)  141.615 ms 138.757 ms 138.661 ms
22 52.93.27.215 (52.93.27.215)  140.028 ms 140.033 ms 139.828 ms
23 72.21.197.21 (72.21.197.21)  140.397 ms 140.360 ms 140.413 ms
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119)  138.769 ms 138.804 ms 138.826
ms
```

[www.wikipedia.org](http://www.wikipedia.org)

traceroute to www.wikipedia.org (91.198.174.192), 30 hops max, 60 byte packets

```
1 * * *
2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168) 13.019 ms 13.002 ms 1.140 ms
3 grnet-ias-geant-gw.mx2.ath.gr.geant.net (83.97.88.69) 1.953 ms 19.324 ms 19.277 ms
4 ae2.mx1.mil2.it.geant.net (62.40.98.150) 51.504 ms 48.393 ms 51.449 ms
5 ae4.mx1.gen.ch.geant.net (62.40.98.88) 51.498 ms 51.602 ms 51.510 ms
6 ae1.mx1.fra.de.geant.net (62.40.98.109) 51.848 ms 51.222 ms 51.212 ms
7 ae1.mx1.ams.nl.geant.net (62.40.98.129) 48.063 ms 48.062 ms 51.102 ms
8 * * *
9 * * *
10 * * *
11 * * *
12 * * *
13 * * *
14 * * *
15 * * *
16 * * *
17 * * *
18 * * *
19 * * *
...
```

traceroute to www.wikipedia.org (91.198.174.192), 30 hops max, 60 byte packets

```
1 * * *
2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168) 4.510 ms 4.514 ms 4.506 ms
3 grnet-ias-geant-gw.mx2.ath.gr.geant.net (83.97.88.69) 1.169 ms 1.180 ms 1.174 ms
4 ae2.mx1.mil2.it.geant.net (62.40.98.150) 48.547 ms 48.587 ms 48.580 ms
5 ae4.mx1.gen.ch.geant.net (62.40.98.88) 51.451 ms 51.482 ms 51.527 ms
6 ae1.mx1.fra.de.geant.net (62.40.98.109) 51.408 ms 52.312 ms 52.304 ms
7 ae1.mx1.ams.nl.geant.net (62.40.98.129) 51.033 ms 50.906 ms 50.903 ms
8 ae2.cr2-esams.wikimedia.org (80.249.209.176) 47.910 ms 47.989 ms 47.964 ms
9 text-lb.esams.wikimedia.org (91.198.174.192) 50.942 ms 50.919 ms 50.905 ms
```

[www.facebook.com](http://www.facebook.com)

traceroute to www.facebook.com (31.13.84.36), 30 hops max, 60 byte packets

```
1 * * *
2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168) 1.298 ms 1.571 ms 16.256 ms
3 grnet-ias-geant-gw.mx2.ath.gr.geant.net (83.97.88.69) 1.266 ms 1.265 ms 1.244 ms
4 ae0.mx1.ath2.gr.geant.net (62.40.98.141) 42.222 ms 42.290 ms 42.120 ms
5 ae23.mx1.vie.at.geant.net (62.40.98.147) 35.156 ms 35.157 ms 41.920 ms
6 * * *
7 * * *
8 * * *
9 * * *
10 * * *
...
```

traceroute to www.facebook.com (31.13.84.36), 30 hops max, 60 byte packets

```
1 * * *
2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168) 1.799 ms 1.809 ms 1.806 ms
3 grnet-ias-geant-gw.mx2.ath.gr.geant.net (83.97.88.69) 1.070 ms 1.081 ms 1.079 ms
4 ae0.mx1.ath2.gr.geant.net (62.40.98.141) 42.106 ms 42.132 ms 42.175 ms
5 ae23.mx1.vie.at.geant.net (62.40.98.147) 35.117 ms 35.188 ms 35.249 ms
6 ae22.pr04.vie1.tfbnw.net (103.4.98.46) 33.585 ms 33.696 ms 33.694 ms
7 po104.psw02.vie1.tfbnw.net (31.13.28.25) 33.077 ms 33.144 ms 33.185 ms
8 157.240.38.133 (157.240.38.133) 34.779 ms 34.828 ms 34.852 ms
9 edge-star-mini-shv-01-vie1.facebook.com (31.13.84.36) 34.766 ms 34.729 ms 34.699 ms
```

Παρατηρούμε ότι το traceroute με UDP δεν ολοκληρώνει την διαδικασία σε κάποιες περιπτώσεις. Αυτό οφείλεται στο γεγονός ότι χρησιμοποιείται port που δεν είναι γνωστό (well-known), δηλαδή πάνω από το 1023, επομένως παρεμποδίζεται αυτή η διερχόμενη κίνηση (traffic) από κάποιο firewall που ενδεχομένως να έχουν οι routers.

Επιπλέον, σε συγκεκριμένους προορισμούς, παρατηρούνται πολλαπλές εγγραφές στο ίδιο βήμα. Αυτό συμβαίνει επειδή με το traceroute αποστέλλονται τρία μηνύματα, με το ίδιο TTL. Έτσι, σε κάποιο στάδιο – hop μπορεί τα μηνύματα να δρομολογηθούν σε διαφορετικές συνδέσεις, δηλαδή να ακολουθήσουν διαφορετική πορεία. Γι' αυτό μπορεί να εμφανιστούν ταυτόχρονα πολλαπλές εμφανίσεις.



## Whois results

[www.stanford.edu](http://www.stanford.edu)

Κανονικά έπρεπε να εμφανιστεί AS του NTUA

AS: 3323

2-3.

ASN: AS5408 GR-NET <http://www.grnet.gr>, GR (registered Sep 06, 1995)

ORG: GR-NET

4-5.

ASN: AS21320 GEANT\_IAS\_VRF, GB (registered Oct 31, 2001)

ORG: GEANT

6-12.

ASN: AS174

ORG: COGENT COMMS

13-29.

ASN: AS16509, AS14618

ORG: AMAZON AWS

[www.grnet.gr](http://www.grnet.gr)

1.

Κανονικά έπρεπε να εμφανιστεί AS του NTUA

AS: 3323

2-4.

ASN: AS5408 GR-NET <http://www.grnet.gr>, GR (registered Sep 06, 1995)

ORG: GR-NET

[www.wikipedia.org](http://www.wikipedia.org)

1.

Κανονικά έπρεπε να εμφανιστεί AS του NTUA

AS: 3323

2-3.

ASN: AS5408 GR-NET <http://www.grnet.gr>, GR (registered Sep 06, 1995)

ORG: GR-NET

4-7.

ASN: AS21320 GEANT\_IAS\_VRF, GB (registered Oct 31, 2001)

ORG: GEANT

8.

ASN: AS1200 AMS-IX1, NL (registered Sep 01, 1993)

ORG: WIKIMEDIA

9.

ASN: AS14907 WIKIMEDIA - Wikimedia Foundation Inc., US (registered Sep 27, 2006)

ORG: WIKIMEDIA

(β)

[www.esa.int](http://www.esa.int):

```
PING www.esa.int.cdngc.net (148.253.228.184) 56(84) bytes of data.  
64 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=1 ttl=59 time=23.5 ms  
64 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=2 ttl=59 time=23.5 ms  
64 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=3 ttl=59 time=23.4 ms  
64 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=4 ttl=59 time=23.4 ms  
64 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=5 ttl=59 time=23.4 ms  
64 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=6 ttl=59 time=23.4 ms  
64 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=7 ttl=59 time=23.4 ms  
64 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=8 ttl=59 time=23.4 ms  
64 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=9 ttl=59 time=23.4 ms  
64 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=10 ttl=59 time=23.4 ms  
  
--- www.esa.int.cdngc.net ping statistics ---  
10 packets transmitted, 10 received, 0% packet loss, time 9015ms  
rtt min/avg/max/mdev = 23.413/23.456/23.501/0.208 ms
```

```
PING www.esa.int.cdngc.net (148.253.228.184) 1400(1428) bytes of data.  
1408 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=1 ttl=59 time=24.8 ms  
1408 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=2 ttl=59 time=24.9 ms  
1408 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=3 ttl=59 time=24.8 ms  
1408 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=4 ttl=59 time=24.9 ms  
1408 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=5 ttl=59 time=24.8 ms  
1408 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=6 ttl=59 time=24.9 ms  
1408 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=7 ttl=59 time=24.9 ms  
1408 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=8 ttl=59 time=24.8 ms  
1408 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=9 ttl=59 time=24.9 ms  
1408 bytes from 148.253.228.184 (148.253.228.184): icmp_seq=10 ttl=59 time=24.9 ms  
  
--- www.esa.int.cdngc.net ping statistics ---  
10 packets transmitted, 10 received, 0% packet loss, time 9012ms  
rtt min/avg/max/mdev = 24.861/24.911/24.960/0.188 ms
```

[www.grnet.gr](http://www.grnet.gr):

```
PING grnet.gr (62.217.124.68) 56(84) bytes of data.
64 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=1 ttl=60 time=2.02 ms
64 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=2 ttl=60 time=2.06 ms
64 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=3 ttl=60 time=2.21 ms
64 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=4 ttl=60 time=2.02 ms
64 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=5 ttl=60 time=1.97 ms
64 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=6 ttl=60 time=2.06 ms
64 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=7 ttl=60 time=2.20 ms
64 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=8 ttl=60 time=2.04 ms
64 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=9 ttl=60 time=2.17 ms
64 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=10 ttl=60 time=2.13 ms

--- grnet.gr ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9013ms
rtt min/avg/max/mdev = 1.970/2.092/2.214/0.099 ms
netmg005@maria:~$ ping -c 10 -s 1400 www.grnet.gr
PING grnet.gr (62.217.124.68) 1400(1428) bytes of data.
1408 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=1 ttl=60 time=2.26 ms
1408 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=2 ttl=60 time=2.25 ms
1408 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=3 ttl=60 time=2.34 ms
1408 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=4 ttl=60 time=2.23 ms
1408 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=5 ttl=60 time=2.22 ms
1408 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=6 ttl=60 time=2.22 ms
1408 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=7 ttl=60 time=2.21 ms
1408 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=8 ttl=60 time=2.31 ms
1408 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=9 ttl=60 time=2.39 ms
1408 bytes from 62.217.124.68 (62.217.124.68): icmp_seq=10 ttl=60 time=2.36 ms

--- grnet.gr ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9015ms
rtt min/avg/max/mdev = 2.215/2.284/2.396/0.081 ms
```

[www.stanford.edu](http://www.stanford.edu):

```
PING cluster90-elbwpeel-1jjv8xqi5kd5g-1169217295.us-east-1.elb.amazonaws.com (34.206.192.89) 56(84) bytes of data.
64 bytes from ec2-34-206-192-89.compute-1.amazonaws.com (34.206.192.89): icmp_seq=1 ttl=234 time=127 ms
64 bytes from ec2-34-206-192-89.compute-1.amazonaws.com (34.206.192.89): icmp_seq=2 ttl=234 time=127 ms
64 bytes from ec2-34-206-192-89.compute-1.amazonaws.com (34.206.192.89): icmp_seq=3 ttl=234 time=127 ms
64 bytes from ec2-34-206-192-89.compute-1.amazonaws.com (34.206.192.89): icmp_seq=4 ttl=234 time=127 ms
64 bytes from ec2-34-206-192-89.compute-1.amazonaws.com (34.206.192.89): icmp_seq=5 ttl=234 time=127 ms
64 bytes from ec2-34-206-192-89.compute-1.amazonaws.com (34.206.192.89): icmp_seq=6 ttl=234 time=127 ms
64 bytes from ec2-34-206-192-89.compute-1.amazonaws.com (34.206.192.89): icmp_seq=7 ttl=234 time=127 ms
64 bytes from ec2-34-206-192-89.compute-1.amazonaws.com (34.206.192.89): icmp_seq=8 ttl=234 time=127 ms
64 bytes from ec2-34-206-192-89.compute-1.amazonaws.com (34.206.192.89): icmp_seq=9 ttl=234 time=127 ms
64 bytes from ec2-34-206-192-89.compute-1.amazonaws.com (34.206.192.89): icmp_seq=10 ttl=234 time=127 ms

--- cluster90-elbwpeel-1jjv8xqi5kd5g-1169217295.us-east-1.elb.amazonaws.com ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9006ms
rtt min/avg/max/mdev = 127.557/127.610/127.716/0.393 ms
```

```
PING cluster90-elbwpeel-1jjv8xqi5kd5g-1169217295.us-east-1.elb.amazonaws.com (35.170.147.119) 1400(1428) bytes of data.
1408 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp_seq=1 ttl=234 time=133 ms
1408 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp_seq=2 ttl=234 time=134 ms
1408 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp_seq=3 ttl=234 time=134 ms
1408 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp_seq=4 ttl=234 time=134 ms
1408 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp_seq=5 ttl=234 time=134 ms
1408 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp_seq=6 ttl=234 time=134 ms
1408 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp_seq=7 ttl=234 time=134 ms
1408 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp_seq=8 ttl=234 time=133 ms
1408 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp_seq=9 ttl=234 time=133 ms
1408 bytes from ec2-35-170-147-119.compute-1.amazonaws.com (35.170.147.119): icmp_seq=10 ttl=234 time=133 ms

--- cluster90-elbwpeel-1jjv8xqi5kd5g-1169217295.us-east-1.elb.amazonaws.com ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9012ms
rtt min/avg/max/mdev = 133.851/134.008/134.133/0.185 ms
```

Και στις τρεις παραπάνω περιπτώσεις δεν υπήρξε καμία απώλεια πακέτου. Οι χρόνοι άφιξης-επιστροφής στις περιπτώσεις πακέτου 1400 Bytes είναι αυξημένοι κατά 1.4ms, 0.2ms (περίπου) και 7ms αντίστοιχα διότι το πακέτο είναι μεγαλύτερο και άρα χρειάζεται περισσότερο χρόνο στην μεταφορά και την επεξεργασία.

2.(α)



Παρατηρούμε την απευθείας σύνδεση μεταξύ ΕΜΠ και ΕΚΠΑ, καθώς και τον τρόπο που όλα τα υπόλοιπα πανεπιστήμια συνδέονται μέσω του κεντρικού GRNET.

(β)

```
netmg034@maria:~$ traceroute www.cyta.gr
traceroute to www.cyta.gr (78.87.2.90), 30 hops max, 60 byte packets
 1 * * *
 2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168) 1.238 ms 1.191 ms 1.211 ms
 3 kolettir-eier-AE.backbone.grnet.gr (62.217.100.62) 1.430 ms 1.409 ms 1.236 ms
 4 cyta-gr.gr-ix.gr (176.126.38.37) 3.555 ms 3.532 ms 3.529 ms
 5 46-126-2.adsl.cyta.gr (46.103.126.2) 2.787 ms 2.716 ms 2.845 ms
 6 * * *
 7 * * *
 8 * * *
 9 * * *
10 * * *
11 *^C

netmg034@maria:~$ traceroute -U www.cyta.gr
traceroute to www.cyta.gr (78.87.2.90), 30 hops max, 60 byte packets
 1 * * *
 2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168) 1.135 ms 1.076 ms 1.088 ms
 3 kolettir-eier-AE.backbone.grnet.gr (62.217.100.62) 1.381 ms 1.361 ms 1.312 ms
 4 cyta-gr.gr-ix.gr (176.126.38.37) 5.177 ms 5.145 ms 5.141 ms
 5 46-126-2.adsl.cyta.gr (46.103.126.2) 2.728 ms 2.677 ms 2.701 ms
 6 * * *
 7 * * *
 8 * * *
 9 * * *
10 * * *
11 *^C

netmg034@maria:~$ traceroute -U www.forthnet.gr
traceroute to www.forthnet.gr (62.1.46.47), 30 hops max, 60 byte packets
 1 * * *
 2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168) 1.190 ms 1.227 ms 1.214 ms
 3 forthnet-2.gr-ix.gr (176.126.38.33) 3.225 ms 3.153 ms 3.214 ms
 4 distr-kln-01Be3.forthnet.gr (213.16.247.22) 3.066 ms 3.123 ms 3.211 ms
 5 gil-24.serv-kln-01.forthnet.gr (213.16.247.125) 3.199 ms 3.623 ms 2.961 ms
 6 * * *
 7 * * *
 8 * * *
 9 * * *
10 * * *
11 *^C

netmg034@maria:~$ traceroute -U www.sk routz.gr
traceroute to www.sk routz.gr (185.6.76.42), 30 hops max, 60 byte packets
 1 router.netmode.ece.ntua.gr (147.102.13.200) 0.567 ms * *
 2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168) 1.741 ms 1.168 ms 1.162 ms
 3 kolettir-eier-AE.backbone.grnet.gr (62.217.100.62) 1.430 ms 1.422 ms 1.405 ms
 4 bird1.sk routz.gr (185.6.77.0) 2.199 ms 2.155 ms 2.174 ms
 5 sparrow.sk routz.gr (185.6.77.1) 2.269 ms 2.263 ms 2.225 ms
 6 * * *
 7 * * *
 8 * * *
 9 * * *
10 * * *
11 *^C
```

```

netmg034@maria:~$ traceroute -U www.wind.com.gr
traceroute to www.wind.com.gr (79.107.98.11), 30 hops max, 60 byte packets
 1 * * *
 2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168)  1.171 ms  1.192 ms  1.181 ms
 3 wind.gr-ix.gr (176.126.38.9)  3.328 ms  3.321 ms  3.294 ms
 4 * * *
 5 62.169.249.202 (62.169.249.202)  7.795 ms  62.169.249.222 (62.169.249.222)  3.177 ms  62.169.249.202 (62.169.249.202)  7.658 ms
 6 ipa190.197.169.62.tellas.gr (62.169.197.190)  3.738 ms  62.169.196.134 (62.169.196.134)  3.444 ms  3.424 ms^C

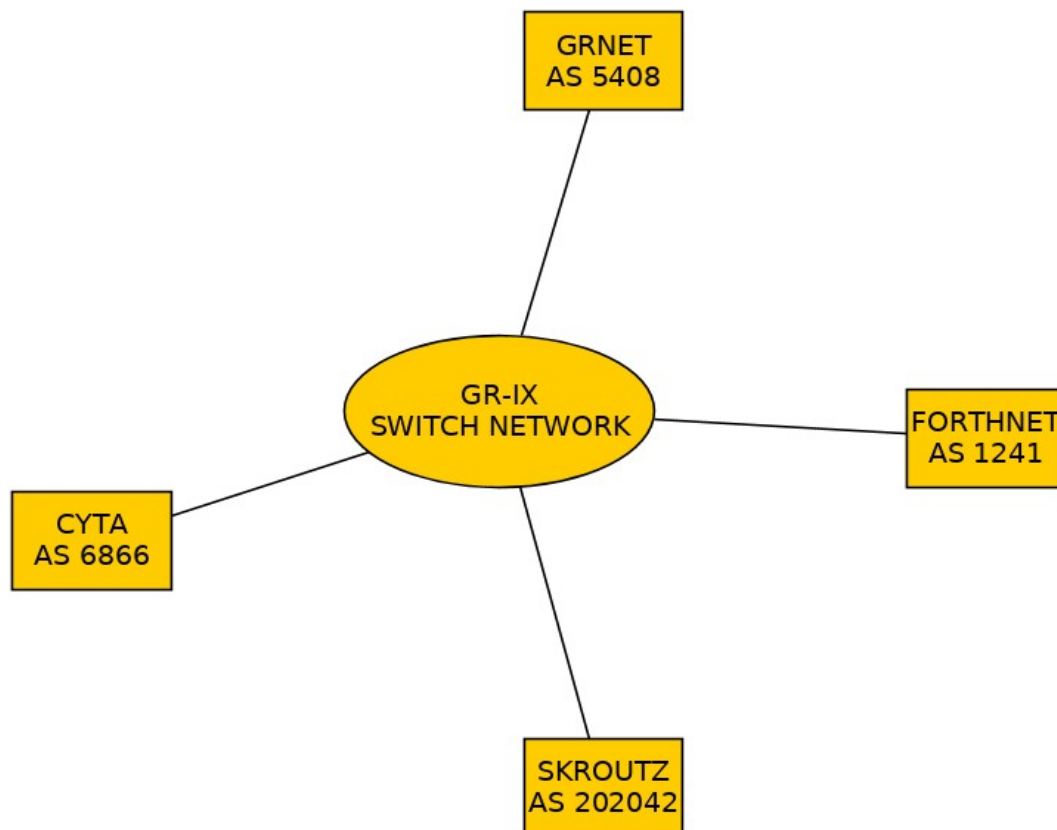
```

```

netmg034@maria:~$ traceroute -U www.lamdahellix.com
traceroute to www.lamdahellix.com (93.174.127.17), 30 hops max, 60 byte packets
 1 * * *
 2 ntua-zogr-3-gw.eier.access-link.grnet.gr (62.217.96.168)  1.266 ms  1.269 ms  12.652 ms
 3 lamdahellix.gr-ix.gr (176.126.38.13)  2.920 ms  2.844 ms  2.750 ms
 4 31.177.56.100 (31.177.56.100)  2.053 ms  2.029 ms  2.087 ms
 5 nohost.iphost.gr (93.174.120.134)  2.370 ms  2.316 ms  2.341 ms
 6 www.lamdahellix.com (93.174.127.17)  3.913 ms  2.790 ms  3.208 ms

```

Από τα παραπάνω αποτελέσματα των εντολών και γνωρίζοντας ότι ουσιαστικά το GR-IX παρέχει τρία κέντρα τα οποία έχουν switches για τον ορισμό των εσωτερικών μονοπατιών, μπορούμε να σχεδιάσουμε ένα κομμάτι του δικτύου.



Προφανώς ίδιες συνδέσεις έχουν και όλα τα υπόλοιπα AS που συμμετέχουν στο GR-IX. Δεν μπορούμε να δούμε σε ποιον/ποιους από τους 3 κόμβους το GR-IX συνδέεται κάθε AS, καθώς μιας και είναι επιπέδου 2 δεν εμφανίζονται στην traceroute. Συνεπώς το μόνο που μπορούμε να καταλάβουμε είναι το GR-IX παρέχει αυτές τις απευθείας συνδέσεις μεταξύ των αντίστοιχων AS

(γ)

Δεν θα μπορούσαμε να το σχεδιάσουμε καθώς σε αυτή την περίπτωση τα πακέτα δεν ακολουθούν τα εσωτερικά μονοπάτια του κόμβου ανταλλαγής GR-IX, αλλά αντίστοιχα αποδίδονται κατευθείαν στο δίκτυο της ISP του τελικού κόμβου.

(δ)

WIND : AS 25472

38001 → 6939 → 3491 → 25472  
2857 → 8365 → 3491 → 25472  
7575 → 3491 → 25472  
2857 → 8365 → 3491 → 25472  
28186 → 7738 → 12956 → 3491 → 25472  
28186 → 7738 → 6762 → 25472  
7575 → 6762 → 25472  
29680 → 3257 → 3491 → 25472  
38001 → 6939 → 3491 → 25472  
52888 → 1251 → 20080 → 6762 → 3491 → 25472  
28186 → 12956 → 3491 → 25472  
1916 → 2914 → 3491 → 25472  
1916 → 2914 → 6762 → 25472  
25152 → 1273 → 3491 → 25472  
52888 → 1251 → 20080 → 6762 → 25472

Τα παραπάνω είναι μερικά από τα μονοπάτια που μας έδωσε το bgplay.

Από τα παραπάνω AS Tier 1 providers είναι:

3491 → PCCW Global  
6762 → Telecom Italia Sparkle  
3257 → GTT Communications  
12956 → Telxius  
2914 → NTT Communications

Επίσης εμφανίζεται και το Tier 2 network που συχνά παρουσιάζεται ως Tier 1:

6939 → Hurricane Electric

Παρατηρούμε ότι οι παραπάνω Tier 1 providers κατέχουν ενδιάμεσες θέσεις στα μονοπάτια που ανακοινώνονται από το BGP, κάτι που εξηγείται από το ρόλο ως διαμεσολαβητή που έχουν για όλο το Internet. Επίσης υπάρχει τουλάχιστον ένας τέτοιος provider σε κάθε μονοπάτι το οποίο δείχνει το πόσο απαραίτητοι είναι για τη λειτουργία του Internet.