WTH is Anycast DNS and how does it work

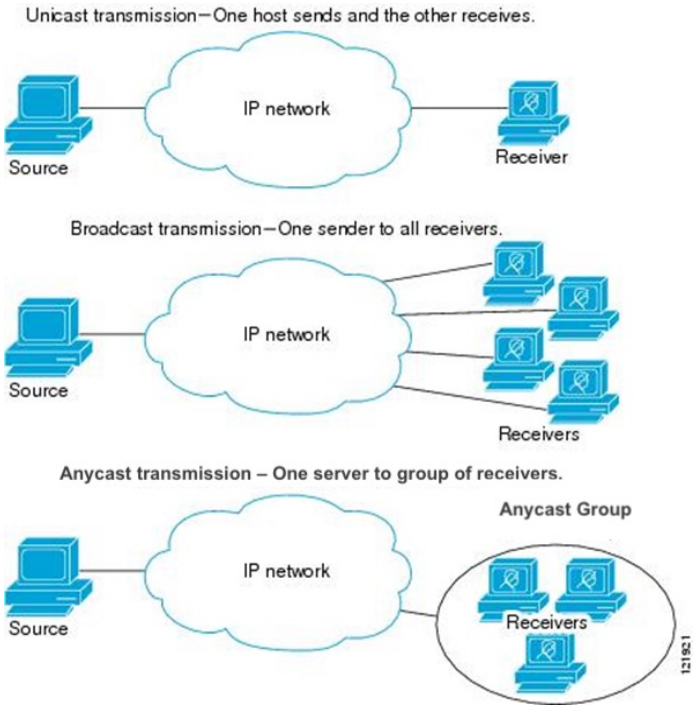
Dusan Stojicevic
Gransy

gransy

DNS at 100% up&running

Goal 100%? How?
Unicast is default method

No problems, right?



WRONG
1. maintance of DNS can make domain unstable
2. geographical distance is not a routing distance – ergo – latence
...

Unicast example (from Laos)

```
gransy@Honza-Air:~$ traceroute g.nic.rs
traceroute to g.nic.rs (147.91.8.6), 64 hops max, 52 byte packets
 1  192.168.200.1 (192.168.200.1)  130.172 ms  30.795 ms  4.954 ms
 2  115.84.76.2 (115.84.76.2)  11.237 ms  10.569 ms  8.909 ms
 3  202.137.151.69 (202.137.151.69)  7.616 ms  32.688 ms  7.259 ms
 4  202.137.151.246 (202.137.151.246)  6.163 ms  36.238 ms  43.260 ms
 5  115.84.120.237 (115.84.120.237)  72.225 ms
    202.137.151.1 (202.137.151.1)  88.376 ms  50.930 ms
 6  e0-44.switch3.hkg2.he.net (65.49.108.145)  52.178 ms  51.533 ms *
 7  port-channel10.core2.hkg1.he.net (184.104.194.89)  98.265 ms *  193.957 ms
 8  * e0-3.switch1.sin1.he.net (184.104.209.241)  167.686 ms *
 9  * * *
10  * * *
11  marseille.de-cix.ix.geant.net (185.1.47.34)  202.051 ms  412.399 ms  410.703 ms
12  * * *
13  * * *
14  ae2.mx2.zag.hr.geant.net (62.40.98.35)  231.148 ms  231.641 ms  230.284 ms
15  amres-ias-geant.zag.hr.geant.net (83.97.89.29)  233.530 ms  259.183 ms  233.962 ms
16  147.91.5.192 (147.91.5.192)  237.285 ms  320.564 ms  237.798 ms
17  rcub.etf.bg.ac.rs (147.91.15.254)  262.385 ms  235.871 ms  390.367 ms
18  rcub-rtr1.etf.bg.ac.rs (147.91.15.253)  234.136 ms  240.643 ms  234.311 ms
```

```
gransy@Honza-Air:~$ ping -c 10 g.nic.rs
PING g.nic.rs (147.91.8.6): 56 data bytes
64 bytes from 147.91.8.6: icmp_seq=0 ttl=45 time=232.438 ms
64 bytes from 147.91.8.6: icmp_seq=1 ttl=45 time=263.134 ms
64 bytes from 147.91.8.6: icmp_seq=2 ttl=45 time=240.586 ms
64 bytes from 147.91.8.6: icmp_seq=3 ttl=45 time=238.099 ms
64 bytes from 147.91.8.6: icmp_seq=4 ttl=45 time=270.151 ms
64 bytes from 147.91.8.6: icmp_seq=5 ttl=45 time=417.337 ms
64 bytes from 147.91.8.6: icmp_seq=6 ttl=45 time=237.971 ms
64 bytes from 147.91.8.6: icmp_seq=7 ttl=45 time=238.113 ms
64 bytes from 147.91.8.6: icmp_seq=8 ttl=45 time=282.286 ms
64 bytes from 147.91.8.6: icmp_seq=9 ttl=45 time=323.963 ms

--- g.nic.rs ping statistics ---
10 packets transmitted, 10 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 232.438/274.408/417.337/54.736 ms
```

Unicast example (from USA)

```
janhorak@an1:~$ traceroute g.nic.rs
traceroute to g.nic.rs (147.91.8.6), 30 hops max, 60 byte packets
 1  oarc-gw.dns-oarc.net (64.191.0.1)  0.177 ms  0.171 ms  0.159 ms
 2  * * *
 3  port-channel1.core1.fmt2.he.net (184.104.199.34)  11.605 ms * *
 4  * * *
 5  port-channel1.core2.nyc4.he.net (184.104.199.222)  61.427 ms * *
 6  * linx.ix.geant.net (195.66.226.161)  128.182 ms  128.557 ms
 7  linx.ix.geant.net (195.66.226.161)  127.032 ms  127.190 ms *
 8  * * *
 9  * * *
10  * * *
11  ae2.mx2.zag.hr.geant.net (62.40.98.35)  164.896 ms * *
12  amres-ias-geant.zag.hr.geant.net (83.97.89.29)  170.629 ms  170.621 ms  170.609 ms
13  amres-ias-geant.zag.hr.geant.net (83.97.89.29)  169.088 ms 147.91.5.192 (147.91.5.192)  170.309 ms amres-ias-geant.zag.hr.geant.net (83.97.89.29)  170.469 ms
14  147.91.5.192 (147.91.5.192)  169.563 ms rcub.etf.bg.ac.rs (147.91.15.254)  230.236 ms 147.91.5.192 (147.91.5.192)  169.534 ms
15  rcub.etf.bg.ac.rs (147.91.15.254)  170.398 ms rcub-rtr1.etf.bg.ac.rs (147.91.15.253)  170.851 ms  169.671 ms
```

```
janhorak@an1:~$ ping -c 10 g.nic.rs
PING g.nic.RS (147.91.8.6) 56(84) bytes of data.
64 bytes from ns.etf.bg.ac.rs (147.91.8.6): icmp_seq=1 ttl=48 time=170 ms
64 bytes from ns.etf.bg.ac.rs (147.91.8.6): icmp_seq=2 ttl=48 time=170 ms
64 bytes from ns.etf.bg.ac.rs (147.91.8.6): icmp_seq=3 ttl=48 time=170 ms
64 bytes from ns.etf.bg.ac.rs (147.91.8.6): icmp_seq=4 ttl=48 time=170 ms
64 bytes from ns.etf.bg.ac.rs (147.91.8.6): icmp_seq=5 ttl=48 time=170 ms
64 bytes from ns.etf.bg.ac.rs (147.91.8.6): icmp_seq=6 ttl=48 time=170 ms
64 bytes from ns.etf.bg.ac.rs (147.91.8.6): icmp_seq=7 ttl=48 time=170 ms
64 bytes from ns.etf.bg.ac.rs (147.91.8.6): icmp_seq=8 ttl=48 time=170 ms
64 bytes from ns.etf.bg.ac.rs (147.91.8.6): icmp_seq=9 ttl=48 time=170 ms
64 bytes from ns.etf.bg.ac.rs (147.91.8.6): icmp_seq=10 ttl=48 time=170 ms

--- g.nic.RS ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 22ms
rtt min/avg/max/mdev = 169.800/169.879/170.004/0.491 ms
```

Domain (unicast)

from Laos

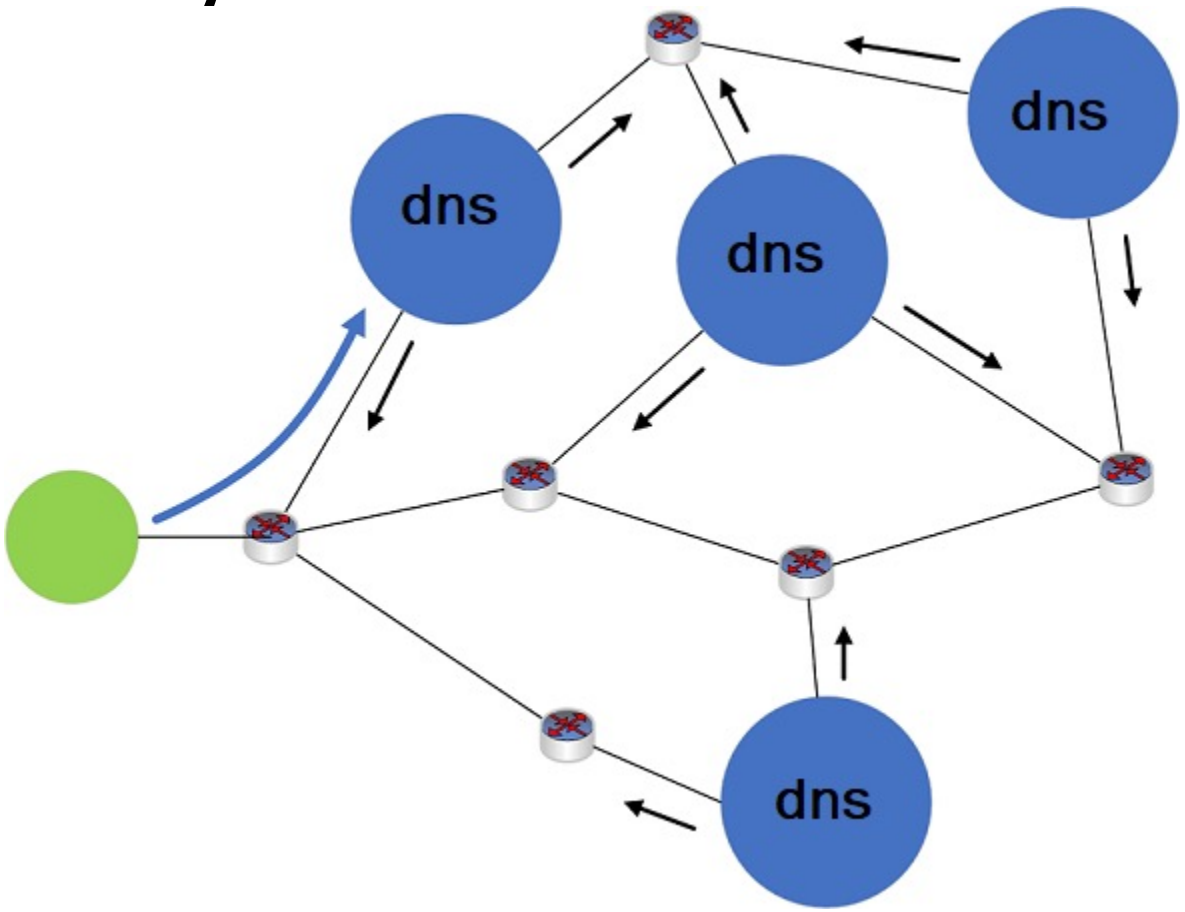
```
gransy@Honza-Air:~$ dig @g.nic.rs gransy.rs

; <<>> DiG 9.10.6 <<>> @g.nic.rs gransy.rs
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 828
;; flags: qr rd; QUERY: 1, ANSWER: 0, AUTHORITY: 5, ADDITIONAL: 1
;; WARNING: recursion requested but not available

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;gransy.rs.                     IN      A

;; AUTHORITY SECTION:
gransy.rs.              3600    IN      NS      ns4.gransy.com.
gransy.rs.              3600    IN      NS      ns.gransy.com.
gransy.rs.              3600    IN      NS      ns5.gransy.com.
gransy.rs.              3600    IN      NS      ns2.gransy.com.
gransy.rs.              3600    IN      NS      ns3.gransy.com.

;; Query time: 249 msec
;; SERVER: 147.91.8.6#53(147.91.8.6)
;; WHEN: Sun Feb 19 17:24:00 +07 2023
;; MSG SIZE  rcvd: 137
```

from USA

```
janhorak@an1:~$ dig @g.nic.rs gransy.rs

; <<>> DiG 9.18.12-1+0~20230215.79+debian10~1.gbp321e91-Debian <<>> @g.nic.rs gransy.rs
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 5403
;; flags: qr rd; QUERY: 1, ANSWER: 0, AUTHORITY: 5, ADDITIONAL: 1
;; WARNING: recursion requested but not available

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;gransy.rs.                     IN      A

;; AUTHORITY SECTION:
gransy.rs.              3600    IN      NS      ns5.gransy.com.
gransy.rs.              3600    IN      NS      ns4.gransy.com.
gransy.rs.              3600    IN      NS      ns3.gransy.com.
gransy.rs.              3600    IN      NS      ns2.gransy.com.
gransy.rs.              3600    IN      NS      ns.gransy.com.

;; Query time: 171 msec
;; SERVER: 147.91.8.6#53(g.nic.rs) (UDP)
;; WHEN: Sun Feb 19 10:39:33 UTC 2023
;; MSG SIZE  rcvd: 137
```

Anycast DNS is a solution

What is anycast?



gransy

Solution: Anycast example from Laos

```
ransy@Honza-Air:~$ traceroute l.nic.rs
raceroute to l.nic.rs (194.146.106.114), 64 hops max, 52 byte packets
1  192.168.200.1 (192.168.200.1)  9.188 ms  5.286 ms  7.324 ms
2  115.84.76.2 (115.84.76.2)  31.606 ms  9.886 ms  9.269 ms
3  202.137.151.69 (202.137.151.69)  6.792 ms  6.604 ms  7.693 ms
4  202.137.151.246 (202.137.151.246)  6.899 ms  6.052 ms  10.348 ms
5  115.84.120.233 (115.84.120.233)  36.590 ms
   202.137.151.5 (202.137.151.5)  42.872 ms  41.419 ms
6  8674.sgw.equinix.com (27.111.228.41)  65.312 ms  44.934 ms  62.629 ms
7  rs1.dnsnode.net (194.146.106.114)  49.432 ms  72.479 ms  46.574 ms
```

```
gransy@Honza-Air:~$ ping -c 10 l.nic.rs
PING l.nic.rs (194.146.106.114): 56 data bytes
64 bytes from 194.146.106.114: icmp_seq=0 ttl=58 time=61.633 ms
64 bytes from 194.146.106.114: icmp_seq=1 ttl=58 time=65.683 ms
64 bytes from 194.146.106.114: icmp_seq=2 ttl=58 time=42.120 ms
64 bytes from 194.146.106.114: icmp_seq=3 ttl=58 time=39.520 ms
64 bytes from 194.146.106.114: icmp_seq=4 ttl=58 time=43.254 ms
64 bytes from 194.146.106.114: icmp_seq=5 ttl=58 time=39.867 ms
64 bytes from 194.146.106.114: icmp_seq=6 ttl=58 time=56.362 ms
64 bytes from 194.146.106.114: icmp_seq=7 ttl=58 time=89.164 ms
64 bytes from 194.146.106.114: icmp_seq=8 ttl=58 time=131.735 ms
64 bytes from 194.146.106.114: icmp_seq=9 ttl=58 time=132.686 ms

--- l.nic.rs ping statistics ---
10 packets transmitted, 10 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 39.520/70.202/132.686/34.223 ms
```

Anycast example from USA

```
janhorak@an1:~$ traceroute l.nic.rs
traceroute to l.nic.rs (194.146.106.114), 30 hops max, 60 byte packets
 1  oarc-gw.dns-oarc.net (64.191.0.1)  10.427 ms  9.915 ms  9.901 ms
 2  * * *
 3  * * *
 4  AS8674.ixp.fcix.net (206.80.238.114)  9.246 ms  9.235 ms  9.224 ms
 5  rs1.dnsnode.net (194.146.106.114)  1.734 ms  1.554 ms  1.493 ms
```

```
janhorak@an1:~$ ping -4 -c 10 l.nic.rs
PING l.nic.RS (194.146.106.114) 56(84) bytes of data.
64 bytes from rs1.dnsnode.net (194.146.106.114): icmp_seq=1 ttl=60 time=1.39 ms
64 bytes from rs1.dnsnode.net (194.146.106.114): icmp_seq=2 ttl=60 time=1.13 ms
64 bytes from rs1.dnsnode.net (194.146.106.114): icmp_seq=3 ttl=60 time=1.13 ms
64 bytes from rs1.dnsnode.net (194.146.106.114): icmp_seq=4 ttl=60 time=1.06 ms
64 bytes from rs1.dnsnode.net (194.146.106.114): icmp_seq=5 ttl=60 time=1.12 ms
64 bytes from rs1.dnsnode.net (194.146.106.114): icmp_seq=6 ttl=60 time=1.10 ms
64 bytes from rs1.dnsnode.net (194.146.106.114): icmp_seq=7 ttl=60 time=1.12 ms
64 bytes from rs1.dnsnode.net (194.146.106.114): icmp_seq=8 ttl=60 time=1.10 ms
64 bytes from rs1.dnsnode.net (194.146.106.114): icmp_seq=9 ttl=60 time=1.11 ms
64 bytes from rs1.dnsnode.net (194.146.106.114): icmp_seq=10 ttl=60 time=1.21 ms

--- l.nic.RS ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 20ms
rtt min/avg/max/mdev = 1.063/1.146/1.387/0.088 ms
```

Domain example (anycast)

from Laos (anycast)

```
janhorak@an1:~$ dig @l.nic.rs gransy.rs

; <<>> DiG 9.18.12-1+0~20230215.79+debian10~1.gbp321e91-Debian <<>> @l.nic.rs gransy.rs
; (2 servers found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 53132
;; flags: qr rd; QUERY: 1, ANSWER: 0, AUTHORITY: 5, ADDITIONAL: 1
;; WARNING: recursion requested but not available

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
; COOKIE: 9e00e37ffdb83bc50100000063f1fd6bb95067195e850b67 (good)
;; QUESTION SECTION:
;gransy.rs.                     IN      A

;; AUTHORITY SECTION:
gransy.rs.              3600    IN      NS      ns3.gransy.com.
gransy.rs.              3600    IN      NS      ns5.gransy.com.
gransy.rs.              3600    IN      NS      ns2.gransy.com.
gransy.rs.              3600    IN      NS      ns.gransy.com.
gransy.rs.              3600    IN      NS      ns4.gransy.com.

;; Query time: 3 msec
;; SERVER: 2001:67c:1010:29::53#53(l.nic.rs) (UDP)
;; WHEN: Sun Feb 19 10:43:55 UTC 2023
;; MSG SIZE  rcvd: 165
```

USA

```
gransy@Honza-Air:~$ dig @l.nic.rs gransy.rs

; <<>> DiG 9.10.6 <<>> @l.nic.rs gransy.rs
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 7868
;; flags: qr rd; QUERY: 1, ANSWER: 0, AUTHORITY: 5, ADDITIONAL: 1
;; WARNING: recursion requested but not available

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;gransy.rs.                     IN      A

;; AUTHORITY SECTION:
gransy.rs.              3600    IN      NS      ns3.gransy.com.
gransy.rs.              3600    IN      NS      ns.gransy.com.
gransy.rs.              3600    IN      NS      ns4.gransy.com.
gransy.rs.              3600    IN      NS      ns5.gransy.com.
gransy.rs.              3600    IN      NS      ns2.gransy.com.

;; Query time: 57 msec
;; SERVER: 194.146.106.114#53(194.146.106.114)
;; WHEN: Sun Feb 19 18:12:20 +07 2023
;; MSG SIZE  rcvd: 137
```

Anycast DNS is a solution

What does it solve:

1. **Latency**
2. **Security – *perfect* *against* DDoS attacks**
3. **Maintenance of DNS**
   Failure of DNS server
4. **Statistics – post-mortem analysis**
5. **Your nerves, definitelly**

What Anycast DNS will NOT solve:

Failure of DNS software or zonefiles

Ukraine story

gransy

Questions ?

Thank you!

automated Gransy Anycast Service at:
https://anycast.systems/