Routing IP - Wprowadzenie

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KLUG

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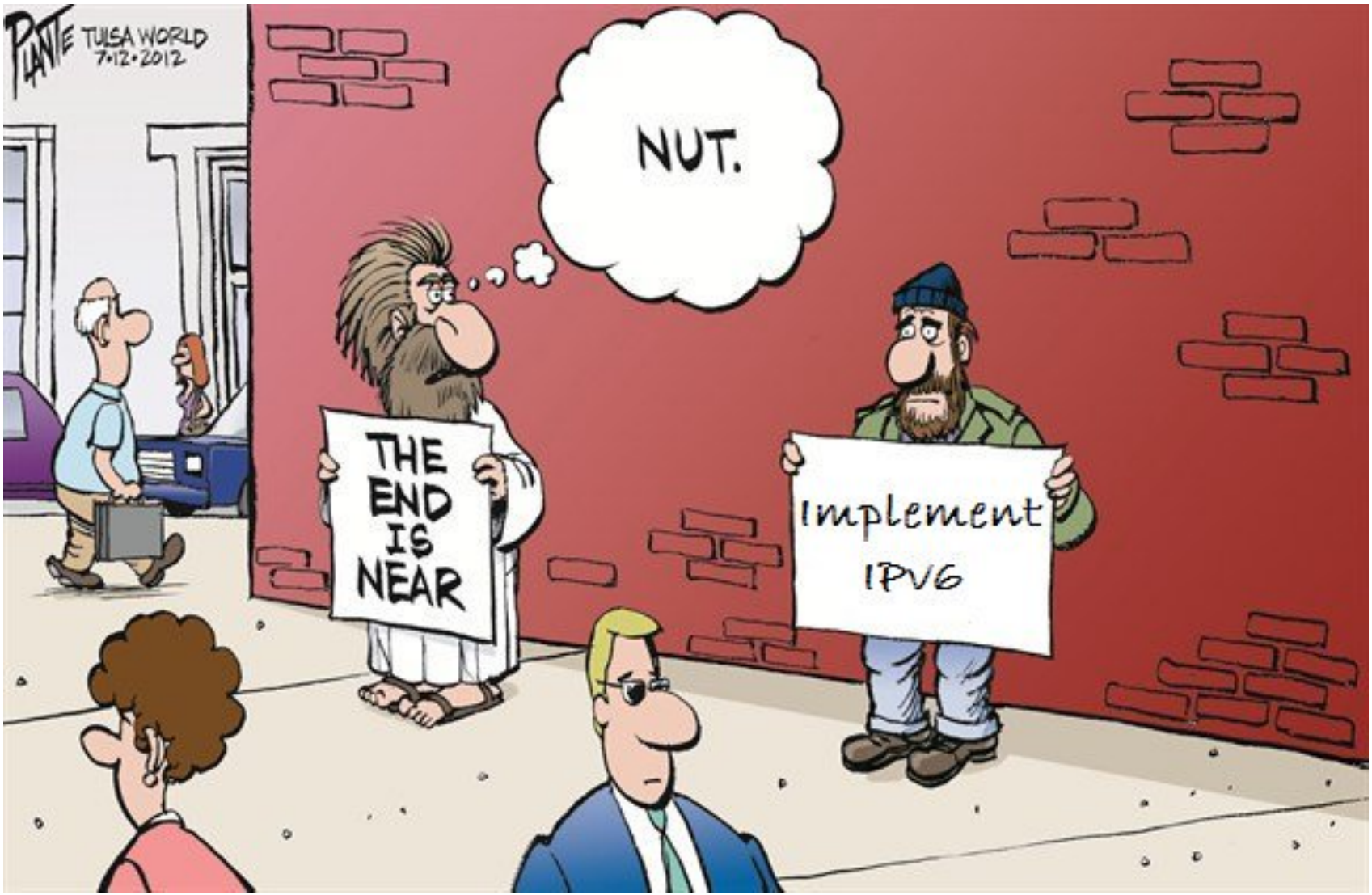
`http://klug.cc.edu.pl/`

Agenda

Tylko IPv4


PLANTE TULSA WORLD 7-12-2012
NUT.
THE END IS NEAR
Implement IPV6

ABC...

- 192.168.0.0/24
- 192.168.0.0 255.255.255.0

ABC...

Czy te adresy można wykorzystać jako adres hosta?

- 192.168.255.0
- 192.168.255.255

ABC...

- 192.168.255.0/24
- 192.168.255.255/24

ABC...

- 192.168.255.0/31
- 192.168.255.255/31
- 192.168.255.0/32
- 192.168.255.255/32

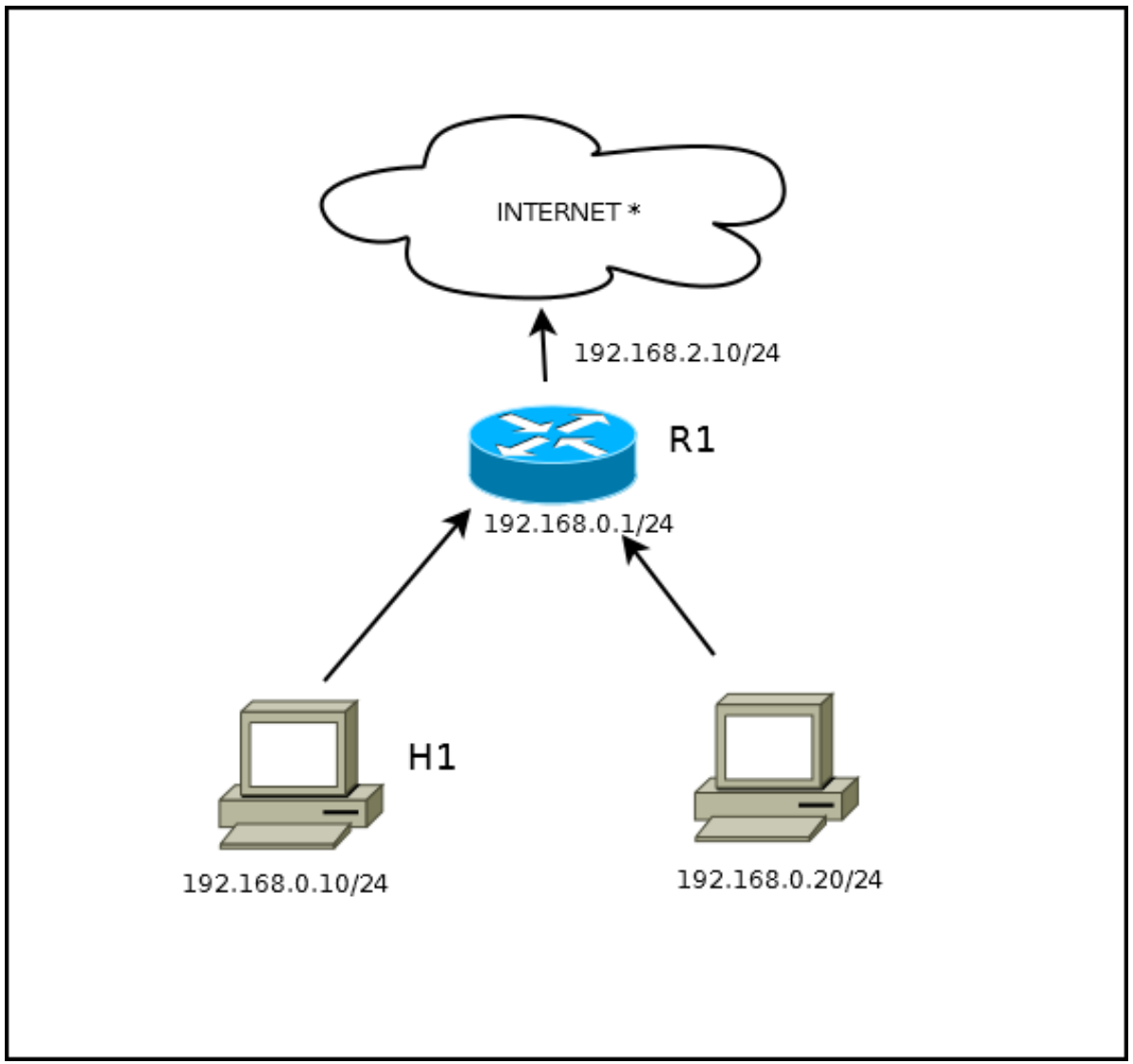
Symulatory/emulatory i inne

- GNS3 `https://www.gns3.com/`
- Virtual Box + Bird `http://bird.network.cz/`
- Juniper: vSRX (packet mode) lub vVMx
- VyOS (Vayatta) `https://vyos.io/`

Routing...

routing, ruting, rutowanie, trasowanie – wyznaczanie trasy i wysłanie nią pakietu danych w sieci komputerowej.

Podstawowy routing statyczny 1/1



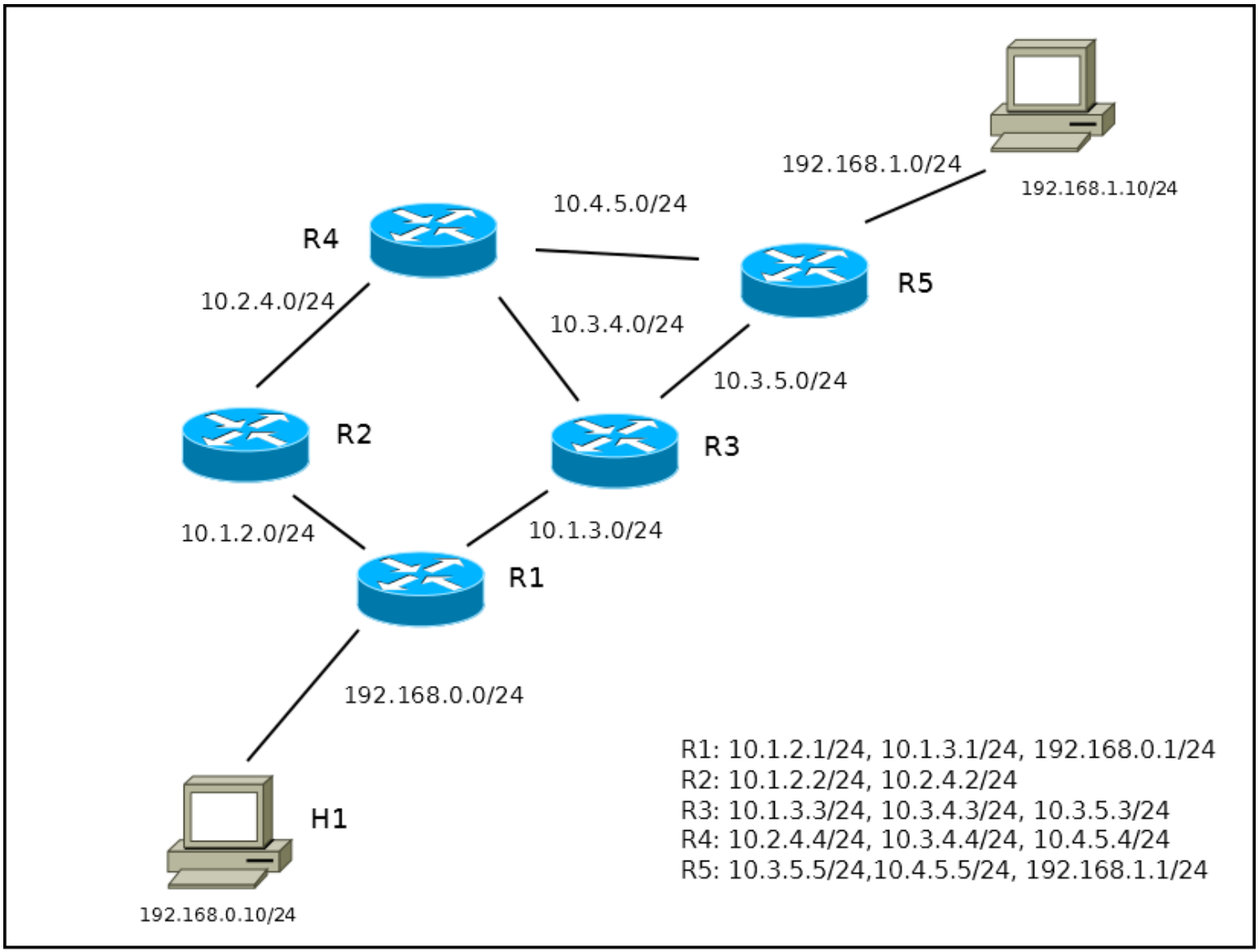
Podstawowy routing statyczny 1/2

```
root@r1:/etc/network# cat interfaces
source /etc/network/interfaces.d/*

auto lo
iface lo inet loopback

auto eth0
iface eth0 inet static
        address 192.168.2.10
        netmask 255.255.255.0
        gateway 192.168.2.1

auto eth1
iface eth1 inet static
        address 192.168.0.1
        netmask 255.255.255.0
```

Podstawowy routing statyczny 1/3

```
root@r1:~# ip -o addr show
1: lo    inet 127.0.0.1/8 scope host lo\       valid_lft forever prefe
2: eth0    inet 192.168.2.10/24 brd 192.168.2.255 scope global eth0\
3: eth1    inet 192.168.0.1/24 brd 192.168.0.255 scope global eth1\
root@r1:~#
root@r1:~# ip route show
default via 192.168.2.1 dev eth0
192.168.0.0/24 dev eth1  proto kernel  scope link  src 192.168.0.1
192.168.2.0/24 dev eth0  proto kernel  scope link  src 192.168.2.10
root@r1:~#
```

Routing statyczny 1



Routing statyczny 2

```
                                My traceroute  [v0.85]
h1 (0.0.0.0)                                          Sat Mar  4 18:32:53 2017
Keys:  Help   Display mode   Restart statistics   Order of fields   quit
                                          Packets               Pings
 Host                                    Snt   Last   Avg  Best  Wrst StDev
 1. 192.168.0.1                           13    0.6   0.8   0.6   0.9   0.0
 2. 10.1.3.3                              13    1.3   1.4   1.1   1.5   0.0
 3. 10.3.5.5                              13    2.2   2.1   1.3   2.4   0.0
 4. 192.168.1.10                          12    2.7   2.8   2.6   3.2   0.0
```

Routing statyczny 3

```
root@h1:~# ping -c 1 -R 192.168.1.10
PING 192.168.1.10 (192.168.1.10) 56(124) bytes of data.
64 bytes from 192.168.1.10: icmp_seq=1 ttl=61 time=1.33 ms
RR:     192.168.0.10
        10.1.3.1
        10.3.5.3
        192.168.1.1
        192.168.1.10
        192.168.1.10
        10.3.5.5
        10.1.3.3
        192.168.0.1


--- 192.168.1.10 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 1.330/1.330/1.330/0.000 ms
root@h1:~#
```

Routing statyczny 4

R1

#ip route add 192.168.1.0/24 via 10.1.3.3

```
root@r1:~# ip route
10.1.2.0/24 dev eth1  proto kernel  scope link  src 10.1.2.1
10.1.3.0/24 dev eth2  proto kernel  scope link  src 10.1.3.1
192.168.0.0/24 dev eth0  proto kernel  scope link  src 192.168.0.1
192.168.1.0/24 via 10.1.3.3 dev eth2
```

Routing statyczny 5

R3

#ip route add 192.168.0.0/24 via 10.1.3.1

#ip route add 192.168.1.0/24 via 10.3.5.5

```
root@r3:~# ip route
10.1.3.0/24 dev eth0  proto kernel  scope link  src 10.1.3.3
10.3.4.0/24 dev eth2  proto kernel  scope link  src 10.3.4.3
10.3.5.0/24 dev eth1  proto kernel  scope link  src 10.3.5.3
192.168.0.0/24 via 10.1.3.1 dev eth0
192.168.1.0/24 via 10.3.5.5 dev eth1
```

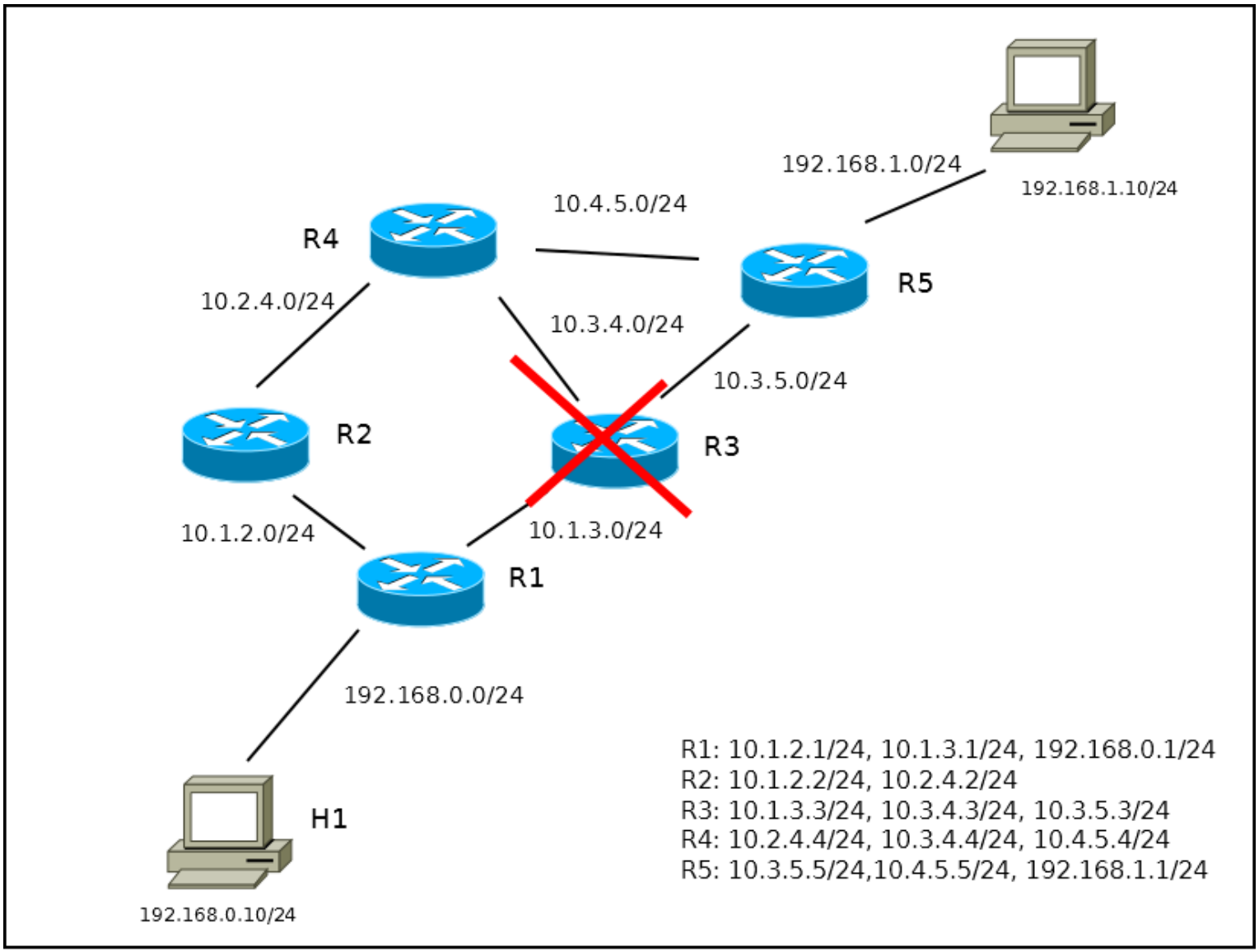
Routing statyczny 6

R5

#ip route add 192.168.0.0/24 via 10.3.5.3

```
root@r5:~# ip route
10.3.5.0/24 dev eth1  proto kernel  scope link  src 10.3.5.5
10.4.5.0/24 dev eth0  proto kernel  scope link  src 10.4.5.5
192.168.0.0/24 via 10.3.5.3 dev eth1
192.168.1.0/24 dev eth2  proto kernel  scope link  src 192.168.1.1
root@r5:~#
```

Routing statyczny 7



BIRD

http://bird.network.cz/

apt-get install bird

/etc/bird/bird.conf

```
protocol kernel {
        scan time 10;
        import all;
        export all;
}
protocol device {
        scan time 10;
}
protocol ospf {
        import all;
        export all;
        area 0 {
                interface "*";
        };
}
```

Toolsy/Windows

```
C:\>ping -n 3 dataspace.pl

Pinging dataspace.pl [193.105.125.51] with 32 bytes of data:
Reply from 193.105.125.51: bytes=32 time=22ms TTL=55
Reply from 193.105.125.51: bytes=32 time=22ms TTL=55
Reply from 193.105.125.51: bytes=32 time=22ms TTL=55

Ping statistics for 193.105.125.51:
    Packets: Sent = 3, Received = 3, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 22ms, Maximum = 22ms, Average = 22ms
```

Toolsy/Windows

```
C:\>tracert -d dataspace.pl

Tracing route to dataspace.pl [193.105.125.51]
over a maximum of 30 hops:

  1     3 ms     1 ms     1 ms  192.168.2.1
  2     2 ms     1 ms     1 ms  192.168.1.254
  3     5 ms     2 ms     2 ms  192.168.0.249
  4     5 ms     3 ms     3 ms  81.15.225.153
  5    10 ms     3 ms     4 ms  88.220.34.249
  6    12 ms    14 ms    11 ms  88.220.31.146
  7    19 ms    15 ms    16 ms  88.220.31.146
  8    19 ms    17 ms    18 ms  213.172.170.10
  9    34 ms    19 ms    21 ms  212.91.0.109
 10    24 ms    19 ms    19 ms  193.105.125.252
 11    21 ms    21 ms    23 ms  193.105.125.51

Trace complete.
```

Toolsy/Windows

```
C:\>pathping -n -q 10 dataspace.pl

Tracing route to dataspace.pl [193.105.125.51]
over a maximum of 30 hops:
  0  192.168.2.66
  1  192.168.2.1
  2  192.168.1.254
  3  192.168.0.249
  4  81.15.225.153
  5  88.220.34.249
  6  88.220.31.146
  7  88.220.31.146
  8  213.172.170.10
  9  212.91.0.109
 10  193.105.125.252
 11  193.105.125.51

Computing statistics for 27 seconds...
            Source to Here   This Node/Link
Hop  RTT    Lost/Sent = Pct  Lost/Sent = Pct  Address
  0                                           192.168.2.66
                                   0/  10 =  0%   |
  1    1ms     0/  10 =  0%     0/  10 =  0%  192.168.2.1
                                   0/  10 =  0%   |
  2    3ms     0/  10 =  0%     0/  10 =  0%  192.168.1.254
                                   0/  10 =  0%   |
  3    7ms     0/  10 =  0%     0/  10 =  0%  192.168.0.249
                                   0/  10 =  0%   |
  4    7ms     0/  10 =  0%     0/  10 =  0%  81.15.225.153
                                   0/  10 =  0%   |
  5   10ms     0/  10 =  0%     0/  10 =  0%  88.220.34.249
                                   0/  10 =  0%   |
  6   14ms     0/  10 =  0%     0/  10 =  0%  88.220.31.146
                                   0/  10 =  0%   |
  7   14ms     0/  10 =  0%     0/  10 =  0%  88.220.31.146
                                   0/  10 =  0%   |
  8   22ms     0/  10 =  0%     0/  10 =  0%  213.172.170.10
                                   0/  10 =  0%   |
  9   29ms     0/  10 =  0%     0/  10 =  0%  212.91.0.109
                                   0/  10 =  0%   |
 10   23ms     0/  10 =  0%     0/  10 =  0%  193.105.125.252
                                   0/  10 =  0%   |
 11   24ms     0/  10 =  0%     0/  10 =  0%  193.105.125.51

Trace complete.
```

Toolsy/Windows

```
Computing statistics for 27 seconds...
            Source to Here   This Node/Link
Hop  RTT    Lost/Sent = Pct  Lost/Sent = Pct  Address
  0                                           192.168.2.66
                                   0/  10 =  0%   |
  1    1ms     0/  10 =  0%     0/  10 =  0%  192.168.2.1
                                   0/  10 =  0%   |
  2    2ms     0/  10 =  0%     0/  10 =  0%  192.168.1.254
                                   0/  10 =  0%   |
  3    4ms     0/  10 =  0%     0/  10 =  0%  192.168.0.249
                                   0/  10 =  0%   |
  4    8ms     0/  10 =  0%     0/  10 =  0%  81.15.225.153
                                   0/  10 =  0%   |
  5    8ms     0/  10 =  0%     0/  10 =  0%  88.220.34.249
                                   0/  10 =  0%   |
  6   15ms     0/  10 =  0%     0/  10 =  0%  88.220.31.146
                                   0/  10 =  0%   |
  7   15ms     0/  10 =  0%     0/  10 =  0%  88.220.31.146
                                   0/  10 =  0%   |
  8   21ms     0/  10 =  0%     0/  10 =  0%  213.172.170.10
                                   0/  10 =  0%   |
  9   24ms     0/  10 =  0%     0/  10 =  0%  212.91.0.109
                                   0/  10 =  0%   |
 10   23ms     0/  10 =  0%     0/  10 =  0%  193.105.125.252
                                   0/  10 =  0%   |
 11   21ms     0/  10 =  0%     0/  10 =  0%  193.105.125.51
```

Toolsy/Linux

```
LINUX# ping -R -n -c 3 dataspace.pl
PING dataspace.pl (193.105.125.51) 56(124) bytes of data.
64 bytes from 193.105.125.51: icmp_seq=1 ttl=55 time=47.7 ms
RR:     192.168.2.61
        192.168.1.253
        192.168.0.250
        81.15.225.156
        213.172.160.129
        88.220.31.146
        213.172.170.10
        193.105.125.251
        193.105.125.125

64 bytes from 193.105.125.51: icmp_seq=2 ttl=55 time=39.7 ms    (same route)
64 bytes from 193.105.125.51: icmp_seq=3 ttl=55 time=57.8 ms    (same route)

--- dataspace.pl ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 39.750/48.441/57.820/7.397 ms
LINUX#
```

Toolsy/Linux

```
LINUX# mtr -o SRDLN -n dataspace.pl

                                My traceroute  [v0.85]
LINUX (0.0.0.0)                                  Sat Mar  4 10:54:51 2017
Keys:  Help   Display mode   Restart statistics   Order of fields   quit
                                          Packets                 Pings
 Host                                    Snt   Rcv Drop Loss%   Last   Wrst StDev
 1. 192.168.2.1                           14    14    0  0.0%    2.3    5.9   1.0
 2. 192.168.1.254                         14    14    0  0.0%    2.7   11.5   2.5
 3. 192.168.0.249                         14    14    0  0.0%    4.8    9.9   1.9
 4. 81.15.225.153                         14    14    0  0.0%    9.4    9.4   1.4
 5. 88.220.34.249                         14    14    0  0.0%    6.8    8.6   1.0
 6. 88.220.31.146                         14    14    0  0.0%   17.2   19.4   1.8
 7. 88.220.31.146                         14    14    0  0.0%   17.3   24.4   3.0
 8. 213.172.170.10                        13    13    0  0.0%   22.0   56.4  10.1
 9. 212.91.0.109                          13    13    0  0.0%   22.2   38.2   4.7
10. 193.105.125.252                       13    13    0  0.0%   20.3   27.2   2.0
11. 193.105.125.51                        13    13    0  0.0%   24.1   24.1   1.0
```

Toolsy/Linux

```
                                My traceroute  [v0.85]
LINUX (0.0.0.0)                                    Sat Mar  4 10:54:51 2017
Keys:  Help   Display mode   Restart statistics   Order of fields   quit
                                 Packets                  Pings
 Host                          Snt   Rcv  Drop  Loss%   Last   Wrst StDev
 1. 192.168.2.1                 14    14     0   0.0%   2.3    5.9   1.0
 2. 192.168.1.254               14    14     0   0.0%   2.7   11.5   2.5
 3. 192.168.0.249               14    14     0   0.0%   4.8    9.9   1.9
 4. 81.15.225.153               14    14     0   0.0%   9.4    9.4   1.4
 5. 88.220.34.249               14    14     0   0.0%   6.8    8.6   1.0
 6. 88.220.31.146               14    10     0  30.0%  17.2   19.4   1.8
 7. 88.220.31.146               14    10     0  30.0%  17.3   24.4   3.0
 8. 213.172.170.10              13    13     0   0.0%  22.0   56.4  10.1
 9. 212.91.0.109                13    13     0   0.0%  22.2   38.2   4.7
10. 193.105.125.252             13    13     0   0.0%  20.3   27.2   2.0
11. 193.105.125.51              13    13     0   0.0%  24.1   24.1   1.0
```

Toolsy/Linux

```
root@LINUX:~# traceroute -n dataspace.pl
traceroute to dataspace.pl (193.105.125.51), 30 hops max, 60 byte packets
 1  192.168.2.1  3.187 ms  3.557 ms  3.542 ms
 2  192.168.1.254  3.526 ms  5.260 ms  6.138 ms
 3  192.168.0.249  9.009 ms  11.189 ms  13.508 ms
 4  81.15.225.153  15.594 ms  16.061 ms  17.102 ms
 5  88.220.34.249  18.863 ms  19.023 ms  19.585 ms
 6  88.220.31.146  25.314 ms  22.869 ms  22.689 ms
 7  88.220.31.146  22.983 ms  22.973 ms  21.491 ms
 8  213.172.170.10  28.121 ms  30.283 ms  28.133 ms
 9  212.91.0.109  25.749 ms  23.575 ms  23.183 ms
10  193.105.125.252  22.146 ms  20.409 ms  25.294 ms
11  193.105.125.51  26.918 ms !X  22.352 ms !X  22.768 ms !X
root@LINUX:~#
```

Toolsy/Linux

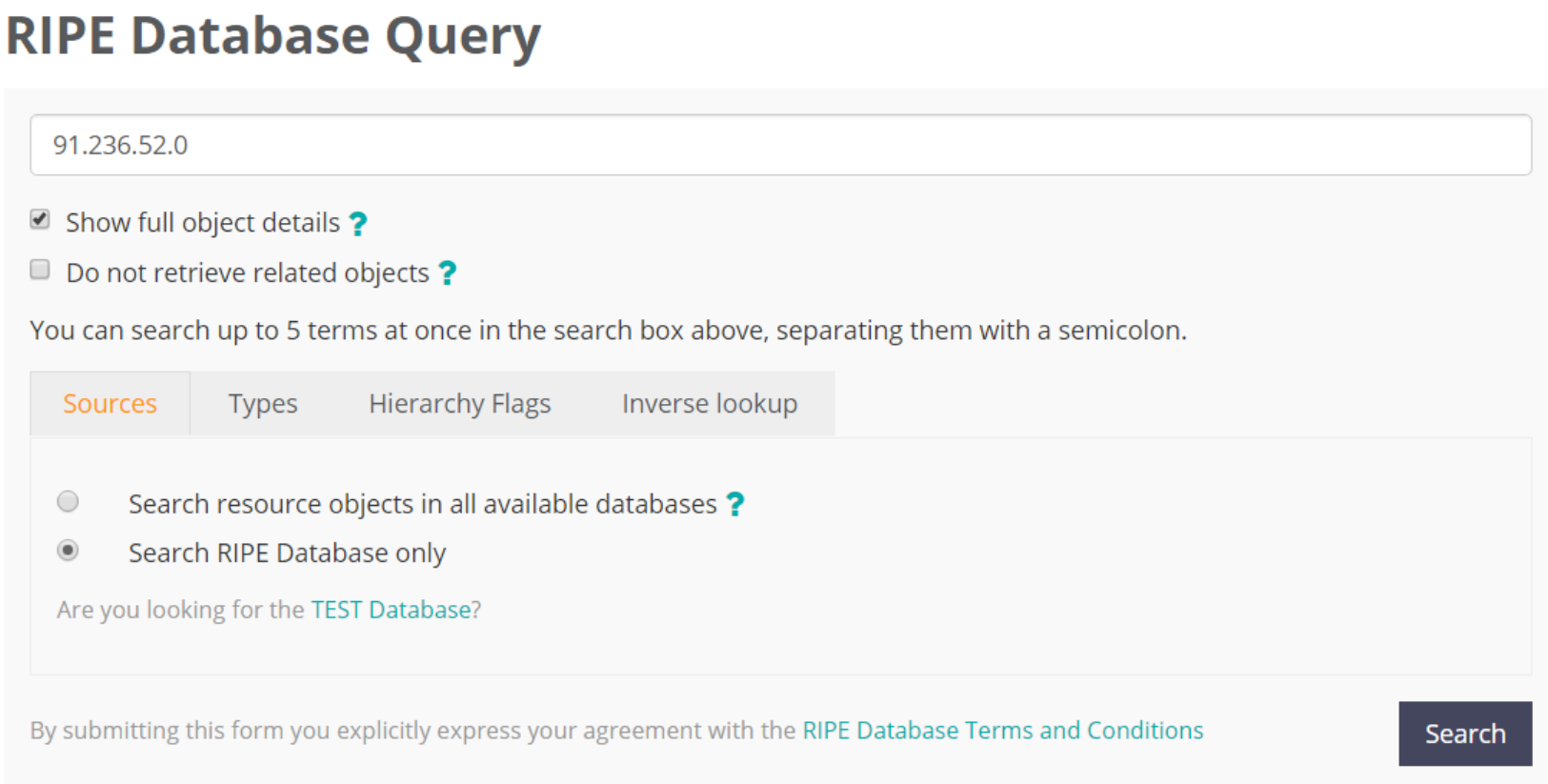
```
root@LINUX:~# traceroute -I -n dataspace.pl
traceroute to dataspace.pl (193.105.125.51), 30 hops max, 60 byte packets
 1  192.168.2.1  1.774 ms  3.864 ms  4.091 ms
 2  192.168.1.254  4.519 ms  7.396 ms  7.408 ms
 3  192.168.0.249  8.597 ms  10.091 ms  11.364 ms
 4  81.15.225.153  14.185 ms  14.361 ms  14.654 ms
 5  88.220.34.249  14.657 ms  15.397 ms  16.045 ms
 6  88.220.31.146  24.735 ms  23.045 ms  22.863 ms
 7  88.220.31.146  22.651 ms  22.257 ms  21.149 ms
 8  213.172.170.10  25.979 ms  24.754 ms  23.761 ms
 9  212.91.0.109  55.876 ms  54.850 ms  54.561 ms
10  193.105.125.252  21.373 ms  21.805 ms  21.123 ms
11  193.105.125.51  21.048 ms  21.133 ms  21.148 ms
root@LINUX:~#
```

Toolsy/Linux

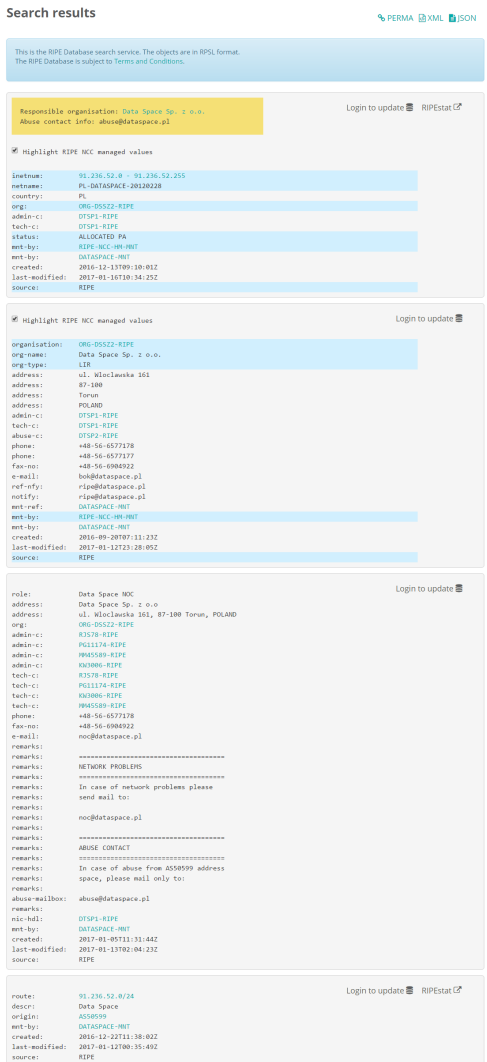
```
root@LINUX:~# traceroute -A -I -n dataspace.pl
traceroute to dataspace.pl (193.105.125.51), 30 hops max, 60 byte packets
 1  192.168.2.1 [*]  1.213 ms  1.631 ms  2.408 ms
 2  192.168.1.254 [*]  3.183 ms  3.932 ms  6.380 ms
 3  192.168.0.249 [*]  7.348 ms  12.529 ms  12.540 ms
 4  81.15.225.153 [AS20804]  12.720 ms  13.113 ms  13.480 ms
 5  88.220.34.249 [AS20804]  13.491 ms  13.491 ms  14.563 ms
 6  88.220.31.146 [AS20804]  24.912 ms  14.182 ms  23.048 ms
 7  88.220.31.146 [AS20804]  22.632 ms  45.389 ms  44.693 ms
 8  213.172.170.10 [AS20804]  44.270 ms  20.938 ms  22.103 ms
 9  212.91.0.109 [AS24748]  21.413 ms  21.431 ms  21.229 ms
10  193.105.125.252 [AS50599]  23.760 ms  20.449 ms  20.238 ms
11  193.105.125.51 [AS50599]  19.107 ms  36.964 ms  36.755 ms
root@LINUX:~#
```

RIPE

https://apps.db.ripe.net/search/query.html



RIPE



Search results

PERMA XML JSON

This is the RIPE Database search service. The objects are in RPSL format.
The RIPE Database is subject to Terms and Conditions.

Responsible organisation: Data Space Sp. z o.o.
Abuse contact info: abuse@dataspace.pl

Login to update RIPEstat

Highlight RIPE NCC managed values

```
inetnum:        91.236.52.0 - 91.236.52.255
netname:        PL-DATASPACE-20120228
country:        PL
org:            ORG-DSSZ2-RIPE
admin-c:        DTSP1-RIPE
tech-c:         DTSP1-RIPE
status:         ALLOCATED PA
mnt-by:         RIPE-NCC-HM-MNT
mnt-by:         DATASPACE-MNT
created:        2016-12-13T09:10:01Z
last-modified:  2017-01-16T10:34:25Z
source:         RIPE
```

Highlight RIPE NCC managed values

Login to update

```
organisation:   ORG-DSSZ2-RIPE
org-name:       Data Space Sp. z o.o.
org-type:       LIR
address:        ul. Wloclawska 161
address:        87-100
address:        Torun
address:        POLAND
admin-c:        DTSP1-RIPE
tech-c:         DTSP1-RIPE
abuse-c:        DTSP2-RIPE
phone:          +48-56-6577178
phone:          +48-56-6577177
fax-no:         +48-56-6904922
e-mail:         bok@dataspace.pl
ref-nfy:        ripe@dataspace.pl
notify:         ripe@dataspace.pl
mnt-ref:        DATASPACE-MNT
mnt-by:         RIPE-NCC-HM-MNT
mnt-by:         DATASPACE-MNT
created:        2016-09-20T07:11:23Z
last-modified:  2017-01-12T23:28:05Z
source:         RIPE
```

Login to update

```
role:           Data Space NOC
address:        Data Space Sp. z o.o
address:        ul. Wloclawska 161, 87-100 Torun, POLAND
org:            ORG-DSSZ2-RIPE
admin-c:        RJ578-RIPE
admin-c:        PG11174-RIPE
admin-c:        MM4589-RIPE
admin-c:        KW3006-RIPE
tech-c:         RJ578-RIPE
tech-c:         PG11174-RIPE
tech-c:         KW3006-RIPE
tech-c:         MM4589-RIPE
phone:          +48-56-6577178
fax-no:         +48-56-6904922
e-mail:         noc@dataspace.pl
remarks:
remarks:        ------------------------------------
remarks:        NETWORK PROBLEMS
remarks:        ------------------------------------
remarks:        In case of network problems please
remarks:        send mail to:
remarks:
remarks:        noc@dataspace.pl
remarks:
remarks:        ------------------------------------
remarks:        ABUSE CONTACT
remarks:        ------------------------------------
remarks:        In case of abuse from AS50599 address
remarks:        space, please mail only to:
remarks:
abuse-mailbox:  abuse@dataspace.pl
remarks:
nic-hdl:        DTSP1-RIPE
mnt-by:         DATASPACE-MNT
created:        2017-01-05T11:31:44Z
last-modified:  2017-01-13T02:04:23Z
source:         RIPE
```

Login to update RIPEstat

```
route:          91.236.52.0/24
descr:          Data Space
origin:         AS50599
mnt-by:         DATASPACE-MNT
created:        2016-12-22T11:38:02Z
last-modified:  2017-01-12T00:35:49Z
source:         RIPE
```

connection reset by beer...
Pytania?