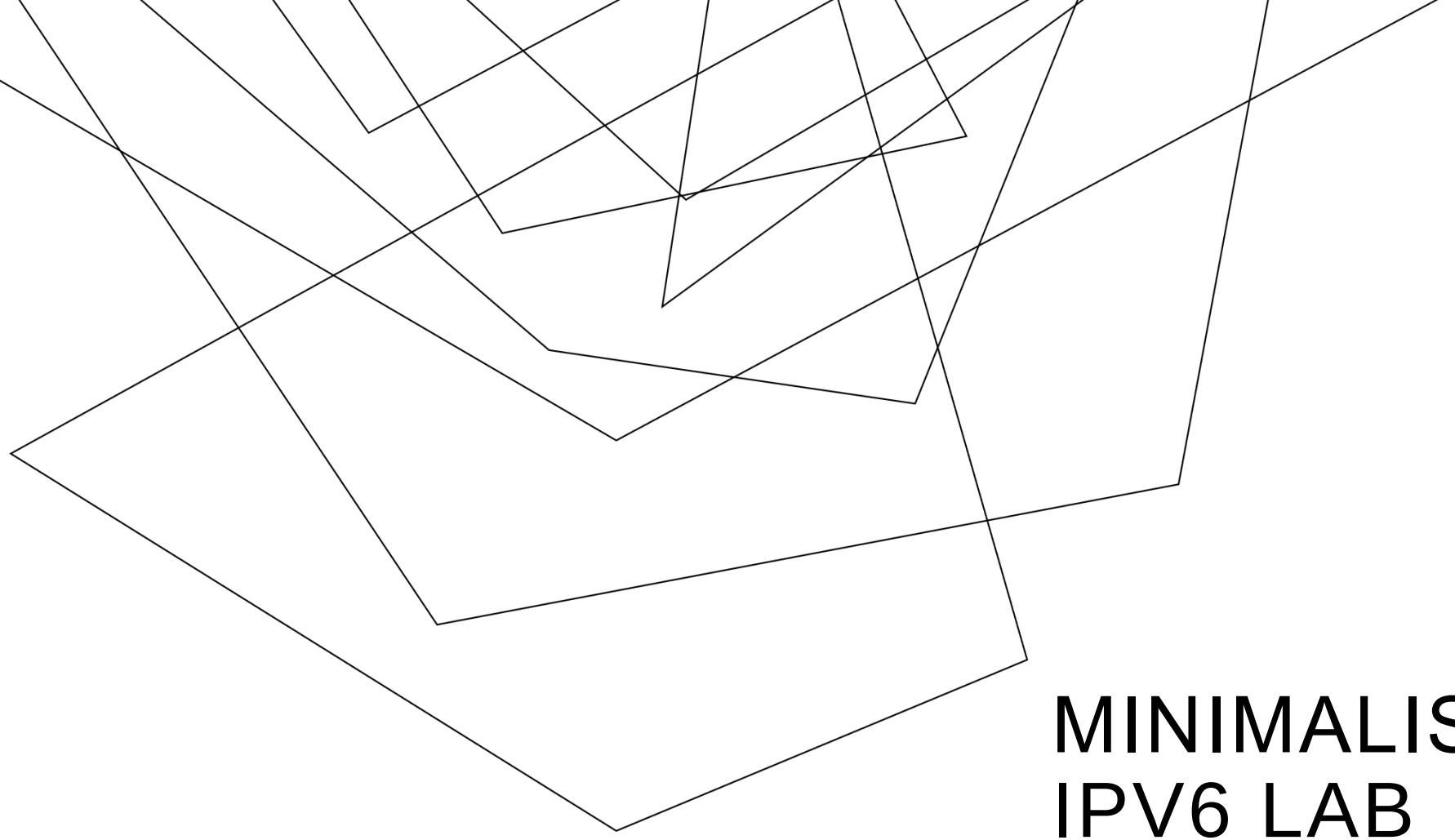


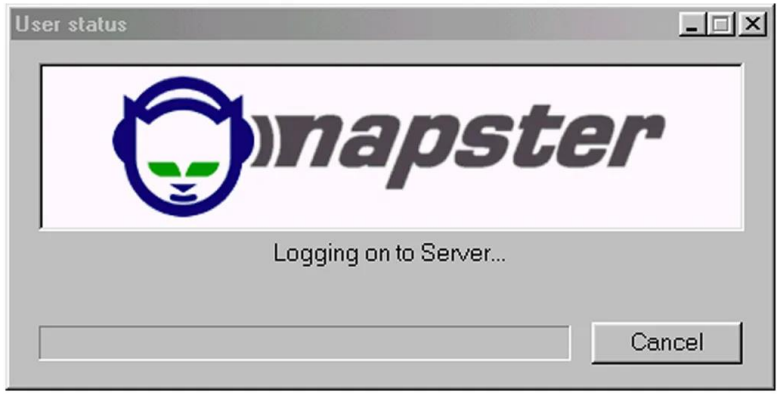
MINIMALISTICKÝ IPV6 LAB

RADIM FRIEDEL

BACKGROUND

Internetový pravěk

- Poprvé na internetu v roce 1995
- Dial-up 14.4 Kkps
- ISDN
- ADSL 192/64 kbps
- CDMA
- Random IPv4



PROBLÉM ADOPCE TECHNOLOGIÍ

Usual suspects:

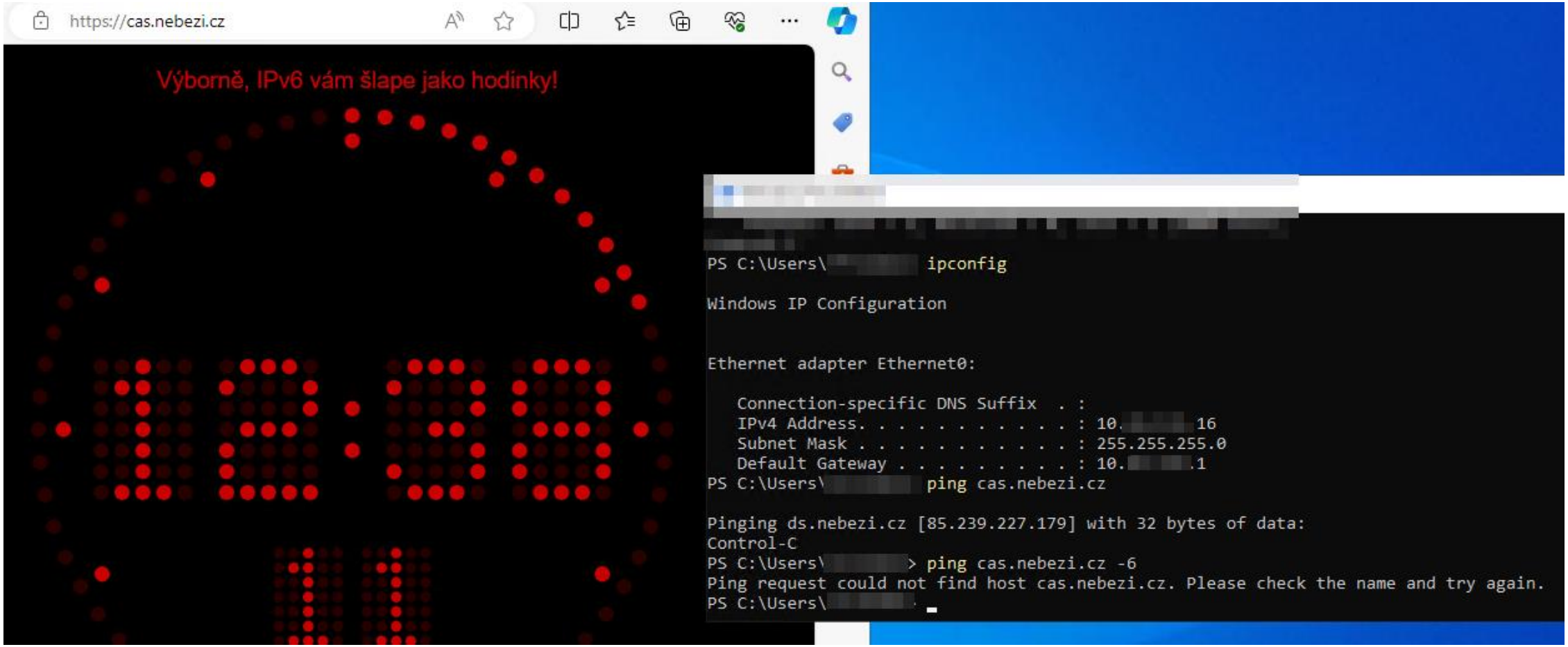
1. automation
2. virtualization
3. containers
4. IPv6


ŠKODA
CZ
1AA X425

IPV6 – FIRST CONTACT

1. business requirements
2. enthusiast
3. real use case

TZV. PLZEŇSKÝ MODEL IMPLEMENTACE IPV6



POMALÝ GPON

- GPON
- 1000/500Mbps

[redacted].mkv

Download

- GPON
- 1000/1000Mbps

[redacted].mkv

37m left — 17.9 MB of 5.2 GB (2.3 MB/sec)

POMALÝ GPON VS RYCHLÁ WIFI

- GPON
- 1000/500Mbps

[redacted].mkv

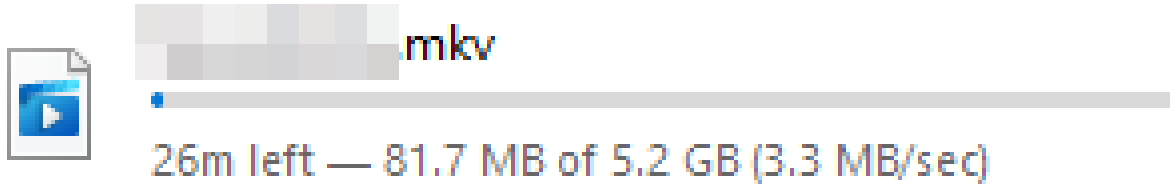
Download

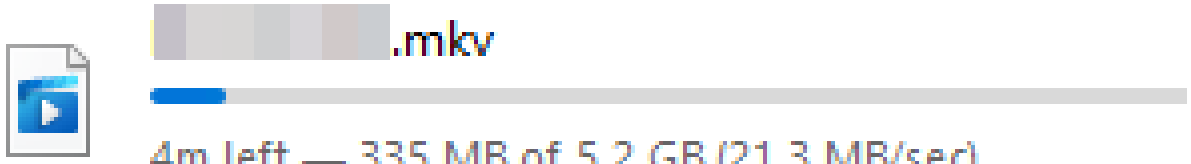
- WIFI
- 100/20Mbps

[redacted].mkv

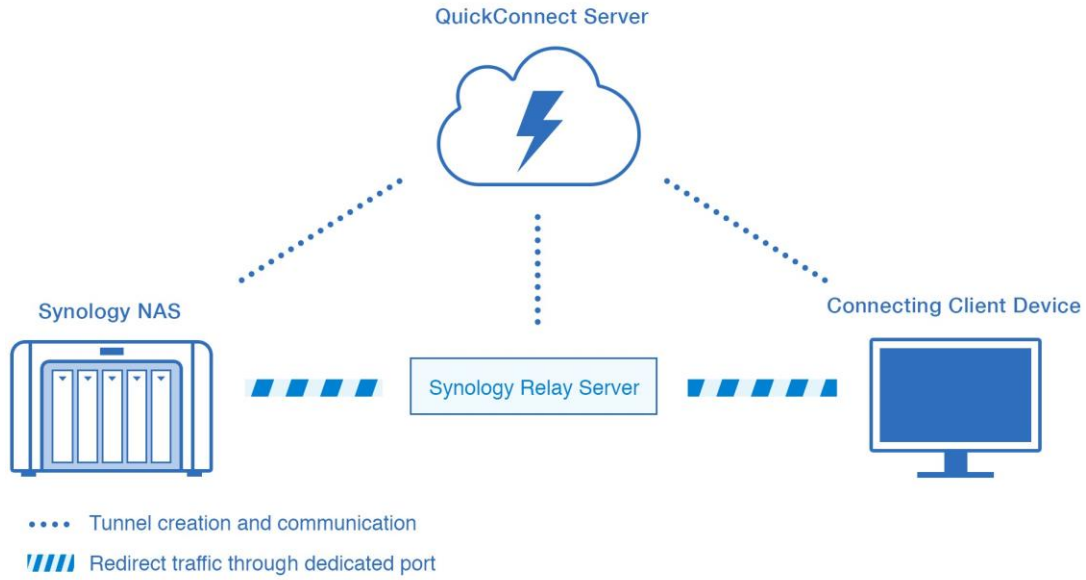
7m left — 234 MB of 5.2 GB (11.1 MB/sec)

TEMP SOLUTION





IPV6 MAGIC

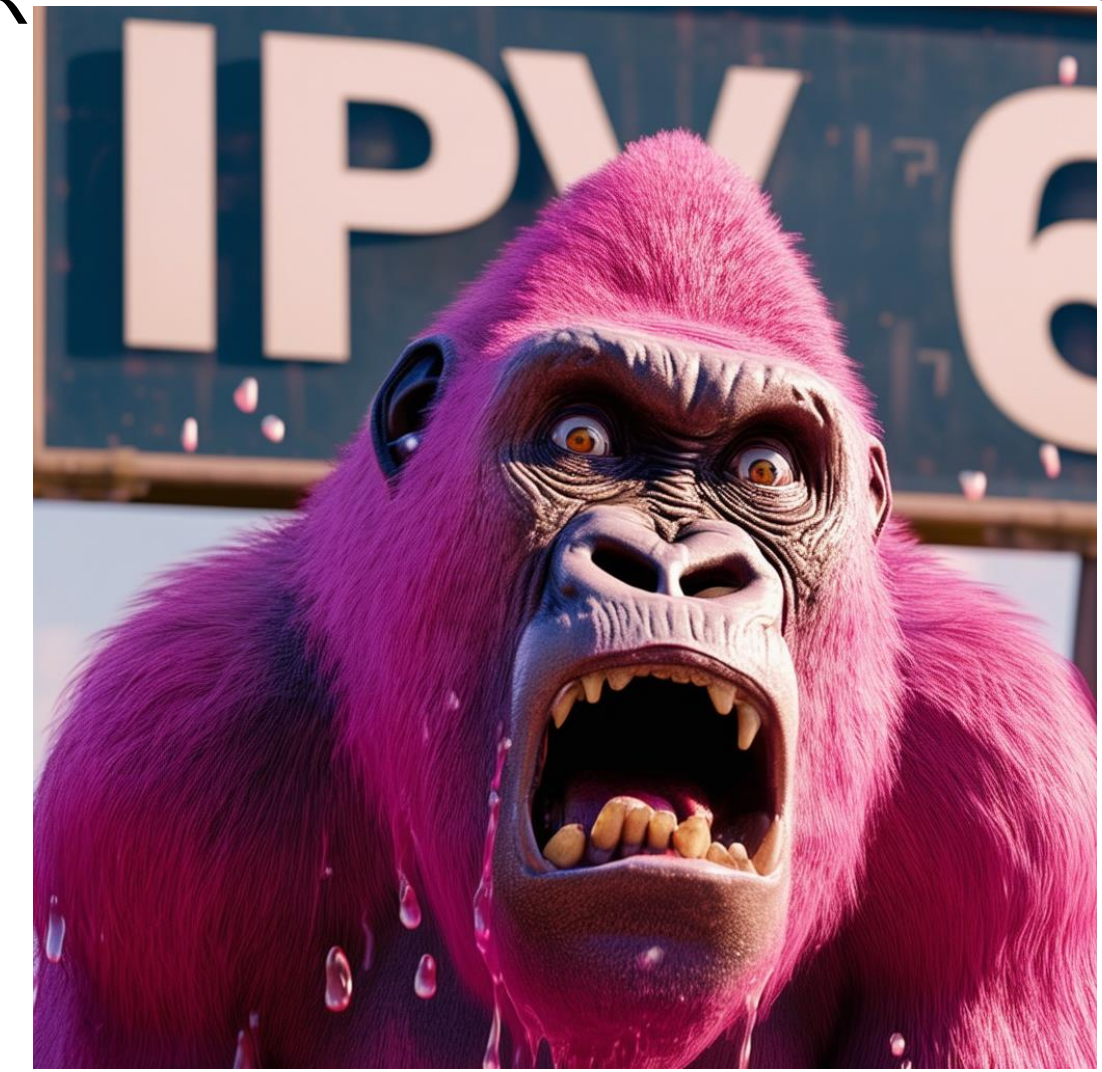


CDN77

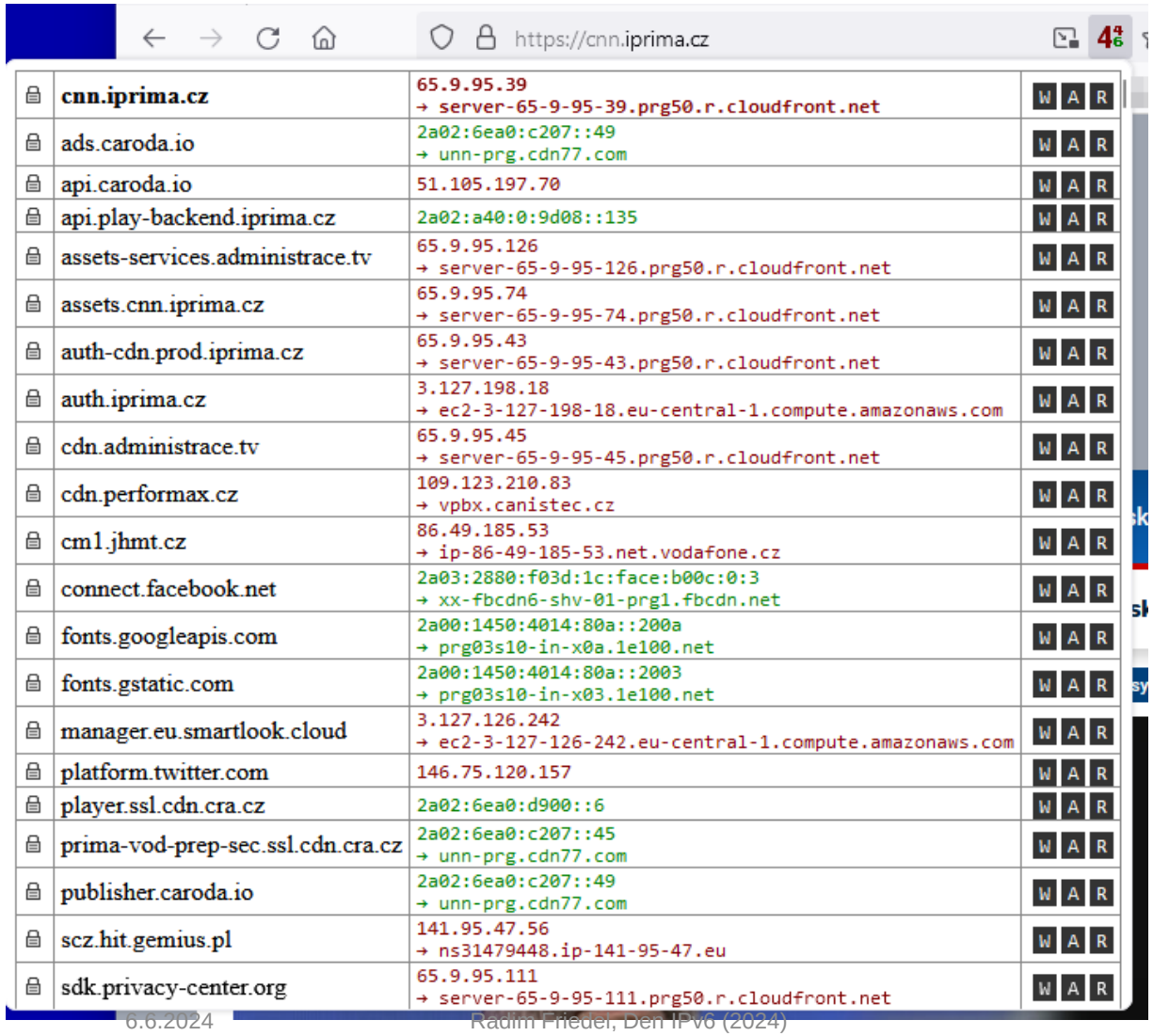
IPv4	3MB/s	IPv4
IPv4	3MB/s	IPv6
IPv6	3MB/s	IPv4
IPv6	20MB/s	IPv6

TECHNOLOGICKÝ LEADER

1. mobilní i optická síť bez IPv6
2. ghosting dotazů
3. 208



IPVFOOBAR


https://cnn.iprima.cz
cnn.iprima.cz 65.9.95.39 → server-65-9-95-39.prg50.r.cloudfront.net
ads.caroda.io 2a02:6ea0:c207::49 → unn-prg.cdn77.com
api.caroda.io 51.105.197.70
api.play-backend.iprima.cz 2a02:a40:0:9d08::135
assets-services.administrace.tv 65.9.95.126 → server-65-9-95-126.prg50.r.cloudfront.net
assets.cnn.iprima.cz 65.9.95.74 → server-65-9-95-74.prg50.r.cloudfront.net
auth-cdn.prod.iprima.cz 65.9.95.43 → server-65-9-95-43.prg50.r.cloudfront.net
auth.iprima.cz 3.127.198.18 → ec2-3-127-198-18.eu-central-1.compute.amazonaws.com
cdn.administrace.tv 65.9.95.45 → server-65-9-95-45.prg50.r.cloudfront.net
cdn.performax.cz 109.123.210.83 → vpbx.canistec.cz
cm1.jhmt.cz 86.49.185.53 → ip-86-49-185-53.net.vodafone.cz
connect.facebook.net 2a03:2880:f03d:1c:face:b00c:0:3 → xx-fbcdn6-shv-01-prg1.fbcdn.net
fonts.googleapis.com 2a00:1450:4014:80a::200a → prg03s10-in-x0a.1e100.net
fonts.gstatic.com 2a00:1450:4014:80a::2003 → prg03s10-in-x03.1e100.net
manager.eu.smartlook.cloud 3.127.126.242 → ec2-3-127-126-242.eu-central-1.compute.amazonaws.com
platform.twitter.com 146.75.120.157
player.ssl.cdn.cra.cz 2a02:6ea0:d900::6
prima-vod-prep-sec.ssl.cdn.cra.cz 2a02:6ea0:c207::45 → unn-prg.cdn77.com
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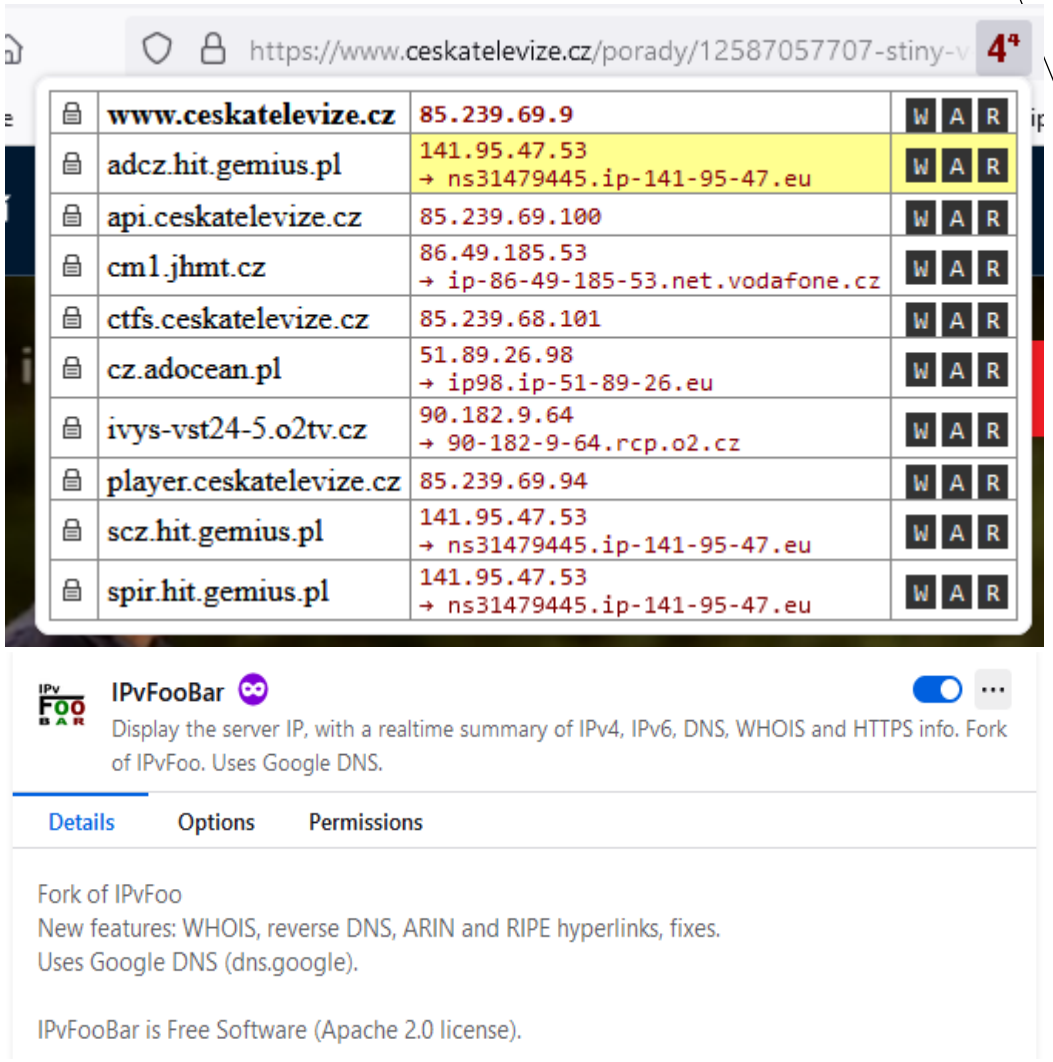
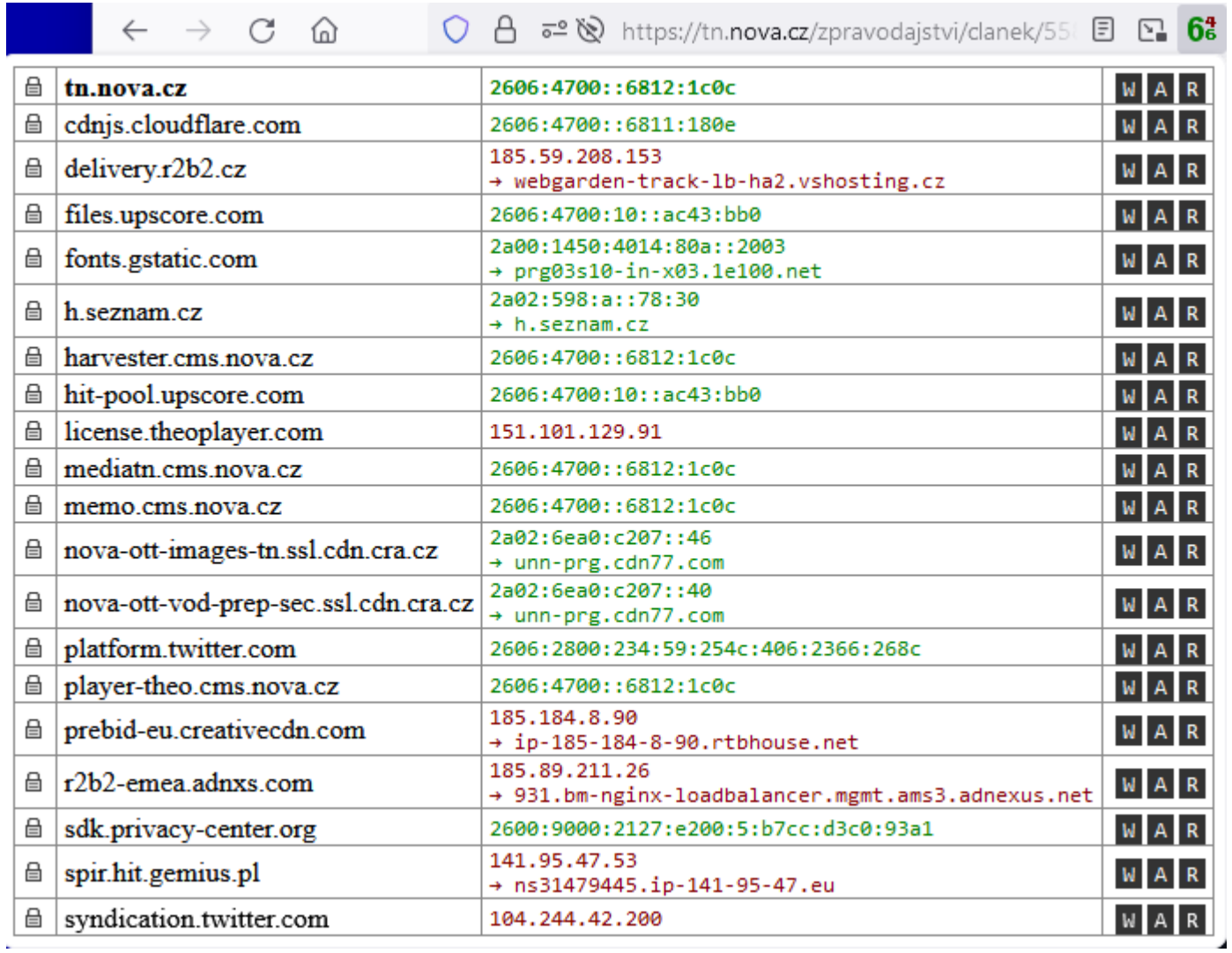
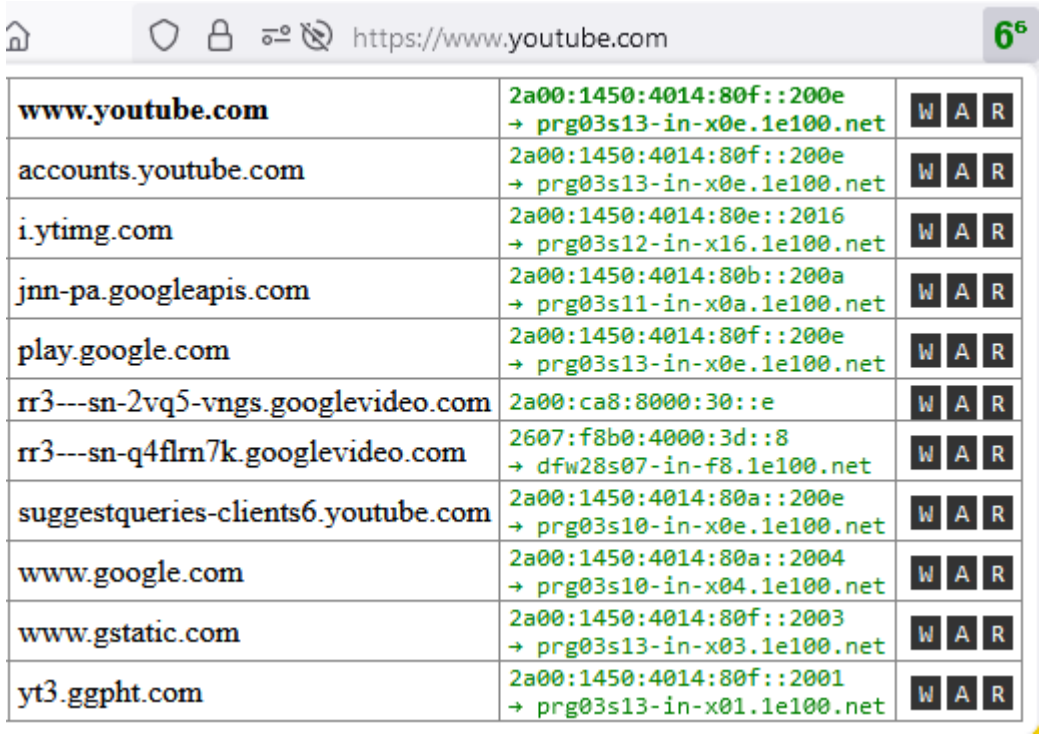
scz.hit.gemius.pl 141.95.47.56 → ns31479448.ip-141-95-47.eu
sdk.privacy-center.org 65.9.95.111 → server-65-9-95-111.prg50.r.cloudfront.net


https://www.ceskatelevize.cz/porady/12587057707-stiny-v
www.ceskatelevize.cz 85.239.69.9
adcz.hit.gemius.pl 141.95.47.53 → ns31479445.ip-141-95-47.eu
api.ceskatelevize.cz 85.239.69.100
cm1.jhmt.cz 86.49.185.53 → ip-86-49-185-53.net.vodafone.cz
ctfs.ceskatelevize.cz 85.239.68.101
cz.adocean.pl 51.89.26.98 → ip98.ip-51-89-26.eu
ivys-vst24-5.o2tv.cz 90.182.9.64 → 90-182-9-64.rcp.o2.cz
player.ceskatelevize.cz 85.239.69.94
scz.hit.gemius.pl 141.95.47.53 → ns31479445.ip-141-95-47.eu
spir.hit.gemius.pl 141.95.47.53 → ns31479445.ip-141-95-47.eu
IPvFooBar
Display the server IP, with a realtime summary of IPv4, IPv6, DNS, WHOIS and HTTPS info. Fork of IPvFoo. Uses Google DNS.
Details
Options
Permissions
Fork of IPvFoo
New features: WHOIS, reverse DNS, ARIN and RIPE hyperlinks, fixes.
Uses Google DNS (dns.google).
IPvFooBar is Free Software (Apache 2.0 license).

IPVFOOBAR

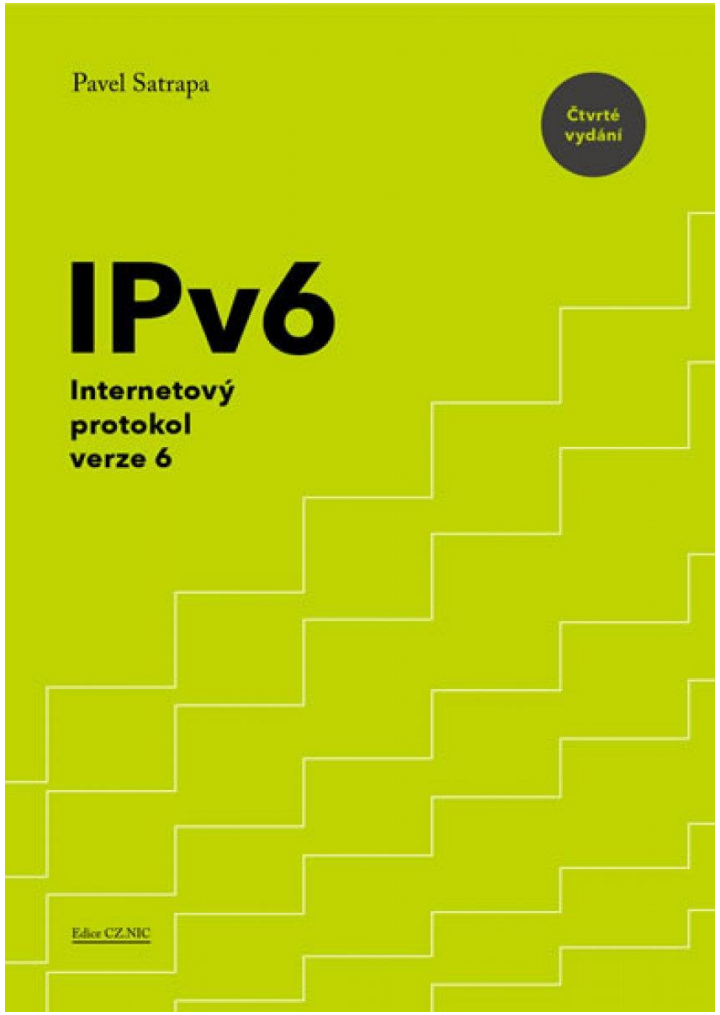


tn.nova.cz	2606:4700::6812:1c0c
cdnjs.cloudflare.com	2606:4700::6811:180e
delivery.r2b2.cz	185.59.208.153 → webgarden-track-lb-ha2.vshosting.cz
files.upscore.com	2606:4700:10::ac43:bb0
fonts.gstatic.com	2a00:1450:4014:80a::2003 → prg03s10-in-x03.1e100.net
h.seznam.cz	2a02:598:a::78:30 → h.seznam.cz
harvester.cms.nova.cz	2606:4700::6812:1c0c
hit-pool.upscore.com	2606:4700:10::ac43:bb0
license.theoplayer.com	151.101.129.91
mediatn.cms.nova.cz	2606:4700::6812:1c0c
memo.cms.nova.cz	2606:4700::6812:1c0c
nova-ott-images-tn.ssl.cdn.cra.cz	2a02:6ea0:c207::46 → unn-prg.cdn77.com
nova-ott-vod-prep-sec.ssl.cdn.cra.cz	2a02:6ea0:c207::40 → unn-prg.cdn77.com
platform.twitter.com	2606:2800:234:59:254c:406:2366:268c
player-theo.cms.nova.cz	2606:4700::6812:1c0c
prebid-eu.creativecdn.com	185.184.8.90 → ip-185-184-8-90.rtbhouse.net
r2b2-emea.adnxs.com	185.89.211.26 → 931.bm-nginx-loadbalancer.mgmt.ams3.adnexus.net
sdk.privacy-center.org	2600:9000:2127:e200:5:b7cc:d3c0:93a1
spir.hit.gemius.pl	141.95.47.53 → ns31479445.ip-141-95-47.eu
syndication.twitter.com	104.244.42.200



www.youtube.com	2a00:1450:4014:80f::200e → prg03s13-in-x0e.1e100.net
accounts.youtube.com	2a00:1450:4014:80f::200e → prg03s13-in-x0e.1e100.net
i.ytimg.com	2a00:1450:4014:80e::2016 → prg03s12-in-x16.1e100.net
jnn-pa.googleapis.com	2a00:1450:4014:80b::200a → prg03s11-in-x0a.1e100.net
play.google.com	2a00:1450:4014:80f::200e → prg03s13-in-x0e.1e100.net
rr3---sn-2vq5-vngs.googlevideo.com	2a00:ca8:8000:30::e
rr3---sn-q4flrn7k.googlevideo.com	2607:f8b0:4000:3d::8 → dfw28s07-in-f8.1e100.net
suggestqueries-clients6.youtube.com	2a00:1450:4014:80a::200e → prg03s10-in-x0e.1e100.net
www.google.com	2a00:1450:4014:80a::2004 → prg03s10-in-x04.1e100.net
www.gstatic.com	2a00:1450:4014:80f::2003 → prg03s13-in-x03.1e100.net
yt3.ggpht.com	2a00:1450:4014:80f::2001 → prg03s13-in-x01.1e100.net

EXPLORING IPV6



Everybody has a testing environment.

Some people are lucky enough to have a totally separate environment to run production in.

ROUTER/FIREWALL

VYOS

- Open source router and firewall platform
- Debian based – CLI-only
- Operational/Configuration Mode
- Full IPv6 support
- Wireguard support
- NAT64 support
- Commercial & CE available
- Automation (Ansible/Terraform/Salt)
- Advanced networking

```
vyos@vyos:~$ show [tab]
Possible completions:
  arp             Show Address Resolution Protocol (ARP) information
  bridge          Show bridging information
  cluster         Show clustering information
  configuration   Show running configuration
  conntrack       Show conntrack entries in the conntrack table
  conntrack-sync
                  Show connection syncing information
  date            Show system date and time
  dhcp            Show Dynamic Host Configuration Protocol (DHCP) information
  dhcpv6          Show status related to DHCPv6
  disk            Show status of disk device
  dns             Show Domain Name Server (DNS) information
  file            Show files for a particular image
  firewall        Show firewall information
  flow-accounting
                  Show flow accounting statistics
  hardware        Show system hardware details
  history         show command history
  host            Show host information
```

ENVIRONMENT

IPV6 CONNECTIVITY

- No IPv6
- IPv6 badly implemented
- IPv6 correct implementation

IPV6 TUNNEL


HURRICANE ELECTRIC
INTERNET SERVICES


route64.org


vpsFree.cz

INSTALL

VyOS VM

- 1 vCPU
- 512MB RAM
- 2GB disk space
- 2 NIC

configure
set interfaces ethernet eth0 address DHCP
set interfaces ethernet eth0 description WAN
set system name-server 1.1.1.1
set service ssh port 22
commit
Save

generate pki wireguard key-pair
Private key: xx
Public key: xx

CONFIGURE TUNNEL

```
configure
set interfaces wireguard wg10 private-key xxx
set interfaces wireguard wg10 peer to-wg10 address 37.205.8.113
set interfaces wireguard wg10 peer to-wg10 port 51820
set interfaces wireguard wg10 peer to-wg10 public-key xxx
set interfaces wireguard wg10 port 51820
set interfaces wireguard wg10 address 2a03:3b40:200::21a/64
set interfaces wireguard wg10 ipv6 address autoconf
set interfaces wireguard wg10 peer to-wg10 allowed-ips ::/0
set protocols static route6 ::/0 interface wg10
commit
save
```

IPV6 FIRST CONTACT

```
vyos@vyos# ping 2600::
PING 2600::(2600::) 56 data bytes
64 bytes from 2600::: icmp_seq=1 ttl=50 time=121 ms
64 bytes from 2600::: icmp_seq=2 ttl=50 time=120 ms

vyos@vyos# ping 2600::1
PING 2600::1(2600::1) 56 data bytes
64 bytes from 2600::1: icmp_seq=1 ttl=51 time=22.0 ms
64 bytes from 2600::1: icmp_seq=2 ttl=51 time=21.6 ms

vyos@vyos# ping 1.1
PING 1.1 (1.0.0.1) 56(84) bytes of data.
64 bytes from 1.0.0.1: icmp_seq=1 ttl=128 time=7.64 ms
64 bytes from 1.0.0.1: icmp_seq=2 ttl=128 time=7.58 ms

vyos@vyos# ping www.root.cz
PING www.root.cz(2001:67c:68::76 (2001:67c:68::76)) 56 data bytes
64 bytes from 2001:67c:68::76 (2001:67c:68::76): icmp_seq=1 ttl=58 time=8.60 ms
64 bytes from 2001:67c:68::76 (2001:67c:68::76): icmp_seq=2 ttl=58 time=8.17 ms
```

LAN SIDE

Single stack - IPv6 only from the beginning

ip6prefix '2a03:3b40:21a::/48'

set interfaces ethernet eth1 address 2a03:3b40:21a::1/64
set service router-advert interface eth1 prefix 2a03:3b40:21a::/64

Name server 1.1.1.1
set service router-advert interface eth1 name-server 2606:4700:4700::1001

Name server nat64.net
set service router-advert interface eth1 name-server 2a01:4f8:c2c:123f::1

WWW.NAT64.NET

Name server nat64.net
set service router-advert interface eth1 name-server 2a01:4f8:c2c:123f::1

LOCAL NAT64

```
set service dns forwarding allow-from 2a03:3b40:21a::/64
set service dns forwarding cache-size '20000’
set service dns forwarding dns64-prefix '64:ff9b::/96'
set service dns forwarding listen-address  2a03:3b40:21a::1
set service dns forwarding name-server 2620:fe::9
set nat64 source rule 1 source prefix 64:ff9b::/96
commit
save
```

Name server local NAT64

```
set service router-advert interface eth1 name-server 2a03:3b40:21a::1
```

FINAL

```
[root@sysrescue ~]# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
       valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 00:0c:29:1e:7f:79 brd ff:ff:ff:ff:ff:ff
    altname enp2s1
    inet6 2a03:3b40:21a:0:bd24:efda:dfd3:f47f/64 scope global dynamic noprefixroute
       valid_lft 2591931sec preferred_lft 14331sec
    inet6 fe80::cd0e:cd0c:540d:29e0/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
[root@sysrescue ~]# ping www.root.cz
PING www.root.cz (2001:67c:68::76) 56 data bytes
64 bytes from 2001:67c:68::76: icmp_seq=1 ttl=57 time=7.76 ms
64 bytes from 2001:67c:68::76: icmp_seq=2 ttl=57 time=8.20 ms
^C
--- www.root.cz ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 7.761/7.981/8.201/0.220 ms
[root@sysrescue ~]# ping www.github.com
PING www.github.com (64:ff9b::8c52:7903) 56 data bytes
64 bytes from lb-140-82-121-3-fra.github.com (64:ff9b::8c52:7903): icmp_seq=1 ttl=127 time=32.7 ms
64 bytes from lb-140-82-121-3-fra.github.com (64:ff9b::8c52:7903): icmp_seq=2 ttl=127 time=32.7 ms
64 bytes from lb-140-82-121-3-fra.github.com (64:ff9b::8c52:7903): icmp_seq=3 ttl=127 time=32.8 ms
^C
```

END

Děkuji za pozornost