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Do Not forget DNS

info@mm-ix.net

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why DNS locally

why DNS on premise POP/Edge

Contact Info:			
	Uncle Naing :	**bronaing@y**mail.com	
	Server Admin:	DNS, mail, Cloud Infra, HCI, Apps, --- ** HA Clusters, ...	
	IT / … :		
	Peering Location:	YGN, MDY, POL, NPT, ...	

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demystifying **DNS Terms**

- simple Internet Directory
- Systematic & Hierarchical nomenclature
- Identity and existence on the Net
- Access by well defined structure & naming standards
- Key DNS Players, root servers, TLD, ccTLD, AU
- A, PTR, MX, NS, TXT, SOA, … **record types, ...**

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demystifying **DNS Terms**

- Domain Name System
  - Distributed naming system for computers and services connected to the internet
  - Translates domain names to IP addresses and vice versa
  - well defined Hierarchical structure
  - DNSOP in IETF, IANA; RIR, RFC, …; ICANN, APNIC, … are steering

- unlikely an Address Book, a Phone Directory
  - Vital for internet navigation, to reach desire destinations
  - Identity and existence on the Net
  - provide further security related information of a domain name

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Core Components of DNS

- Domain Name
  - my-company-org . edu . sg

    google.com → ▪ **root** NS → .mm NS --→ .com.mm (2nd lvl) --> google.com.mm 3rd lvl ; --> zone file/dB
  - (at least **4** DNS servers involved [to get an IP address] in loading a web page)
- enables users to access websites easily without memorizing complex IP addresse
  - mmix.net.mm mm-ix.net == 103.103.194.30
  - 2404:6800:4001:808::200e ; 142.250.199.46 ; 172.217.26.68
  - mirror.ygn.mmix.net.mm -- 103.103.194.80 (for ubuntu/debian distros)
- IP AddressES IPv6, IPv4 classes and CIDR
- DNS ServerS Auth, /split horizen/ & recursive + caching + Resolve
- help to understand DNS Resolution Process

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Reserved IPv4 addresses

- 127.x.x.x/ ; 0.0.0.0/8
- 10.x.x.x /8
  - 10.0.0.0 to 10.255.255.255 (16 million addresses per 16,777,216 subnets)
- 172.16. x . x /12
  - 172.16.0.0 to 172.31.255.255 (1,048,576 private networks)
- 192.168. xxx . Xxx /24
  - 192.168.0.0 to 192.168.255.255
  - 254 usable hosts per subnet, in 256 private networks
- APIPA (Automatic Private IP Addressing)
  - **169.254.0.0/16** == 169.254.0.0 to 169.254.255.255
- ??? 224.0.0.x/4 ?? (former class D) ; 240.0.0.0/4 class E, reserved for future use, ...
- In 2012, the IANA allocated 4 million addresses of **100.64.0.0/10** for use in carrier-grade NAT environ
  - 100.119.x.x/16 ? ; ...

Related Terms

- Bogons
- Martian Packets
- SLAAC, Link-local address, APIPA, Auto-IP

- IP hijacking
- IP/Mac address spoofing
- zeroconf, DHCP, TCP/IP Suite, mDNS, DDNS, DNS-SD, NetBIOS, ...
- IBN Internet background noise/ Internet background radiation
- Backscatter, DDoS, ...

The Origins of the DNS

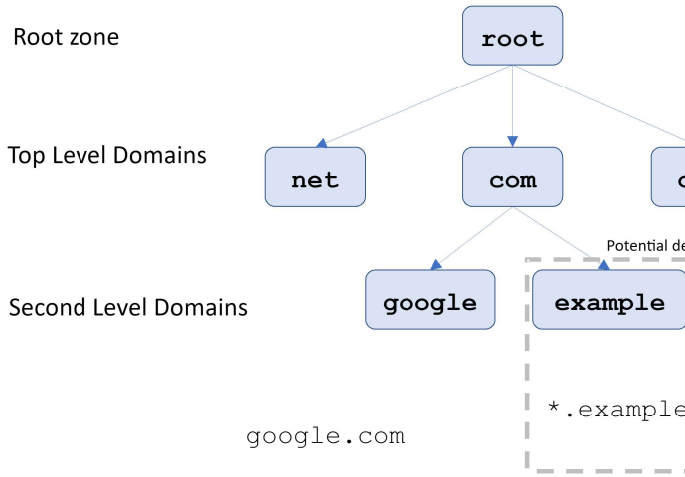
- The DNS was created as a replacement for a static list of hosts and addresses - /etc/hosts
  - Which was a list of host names and their IP addresses
    - `Localhost  127.0.0.1`
    - `ns0  127.0.0.53`
    - `web.lab  192.0.2.80`
    - onu-gw 192.168.2.1 isp-ns0 10.10.10.10
  - To resolve a name you look up the name in /etc/hosts or c:\Windows\System32\drivers\etc**hosts** ; **...**

LocalNET, list of hosts, servers and their IP , ... $2^{\wedge 32}$ number of hosts ? ~4.29

How does a Resolver DNS work !!

RFC 822 – November **1983**

- "tree-structured" name hierarchy
- Multiple "types" can be associated with each label
- Defines aliases (CNAME) and wildcards
- Distributed set of name servers aligned with the distributed name structure
- Resolvers to traverse the name server structure to resolve a name
- DNS protocol defined as a simple query/response datagram protocol




```
;; zone record sample
foo.bar.      3600    IN    A        1.2.3.4
FQDN           TTL     rec type    IP of host/answer
```

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OK, maybe there is more to the DNS sto

The DNS is not perfect: … yet

- It can be extremely slow!
- It leaks information like crazy
- It's prone to manipulation and disruption
- It's rigid
- It's insecure
- It's a source of incredibly effective DOS attacks

- For a common service that everybody uses its not exactly a parago of good engineering design
- IDN / unicode – any language glyphs - ကာခန်ဝတ်.com.mm
- So there are continual efforts to make the DNS "**bette**

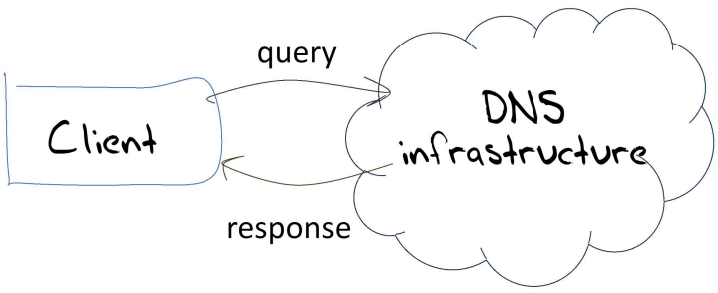
Common upgrade as of 2012 to date

progressive growth and developments going on ..

- more DNS **daemons** than BIND, Micro$oft, … powerDNS, unbound, redis--
- better **monitorin**g systems with NOC team efforts and open communities
- more and **more** open/free + public NS services 8.8.8.8, 9---, 1---, 4.2.2.2, ..
- Deploy on multi VM hosts with clustered and HA + DR ready **Infra**:
- **anycast** deployment for easily adding more DNS servers on same IP
- managed by firewall, load balancer and multi-region **setup**
- **scalable deployment(s)** to various cloud, kXs and distributed systems

- regular monitoring, patches and upgrades by DNS makers
- mixed and hybrid deployment and better CDN delivery, …
- DNSBL, verified blacklists, + + ; DoH, DOT, DoQ, dnssec signed zo

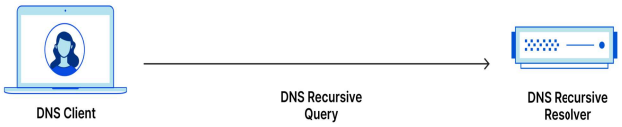
A DNS model

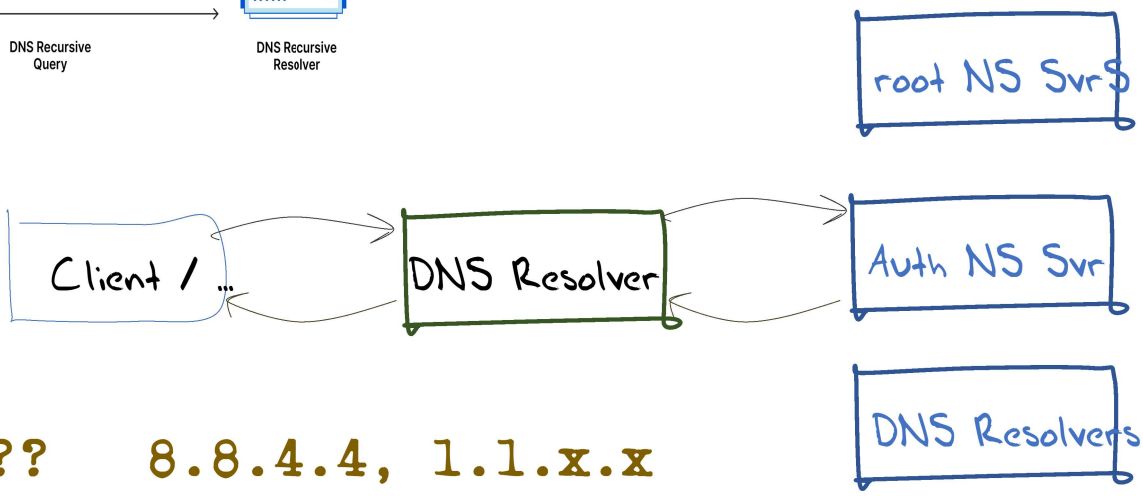


named.root
13 root servers?
backed by thousan
of multi-region anycasted -r-

ftp://ftp.internic.net/domain/named.cache
Worth checking every 6 months or so for up

How we might like to think the DNS wo





Latency ??? 8.8.4.4, 1.1.x.x
Or 10.10.10.10
Or to 9.9.9.10 , 4.2.2.2 , ...

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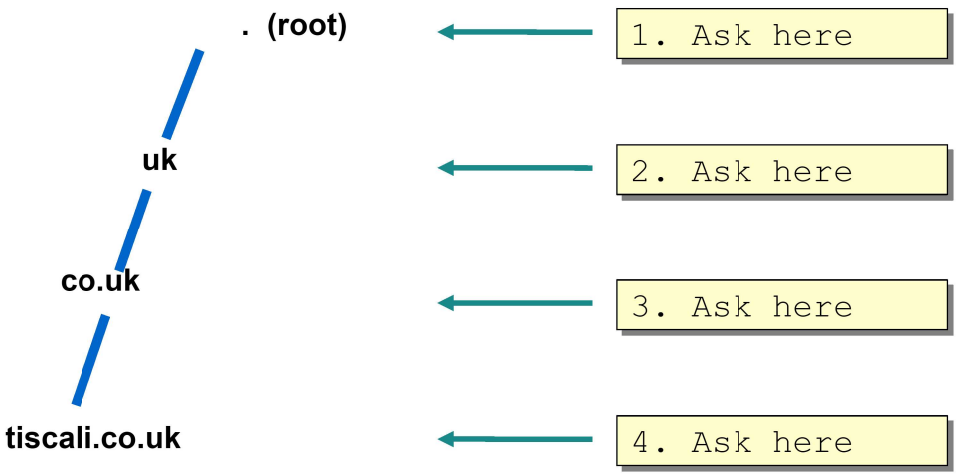
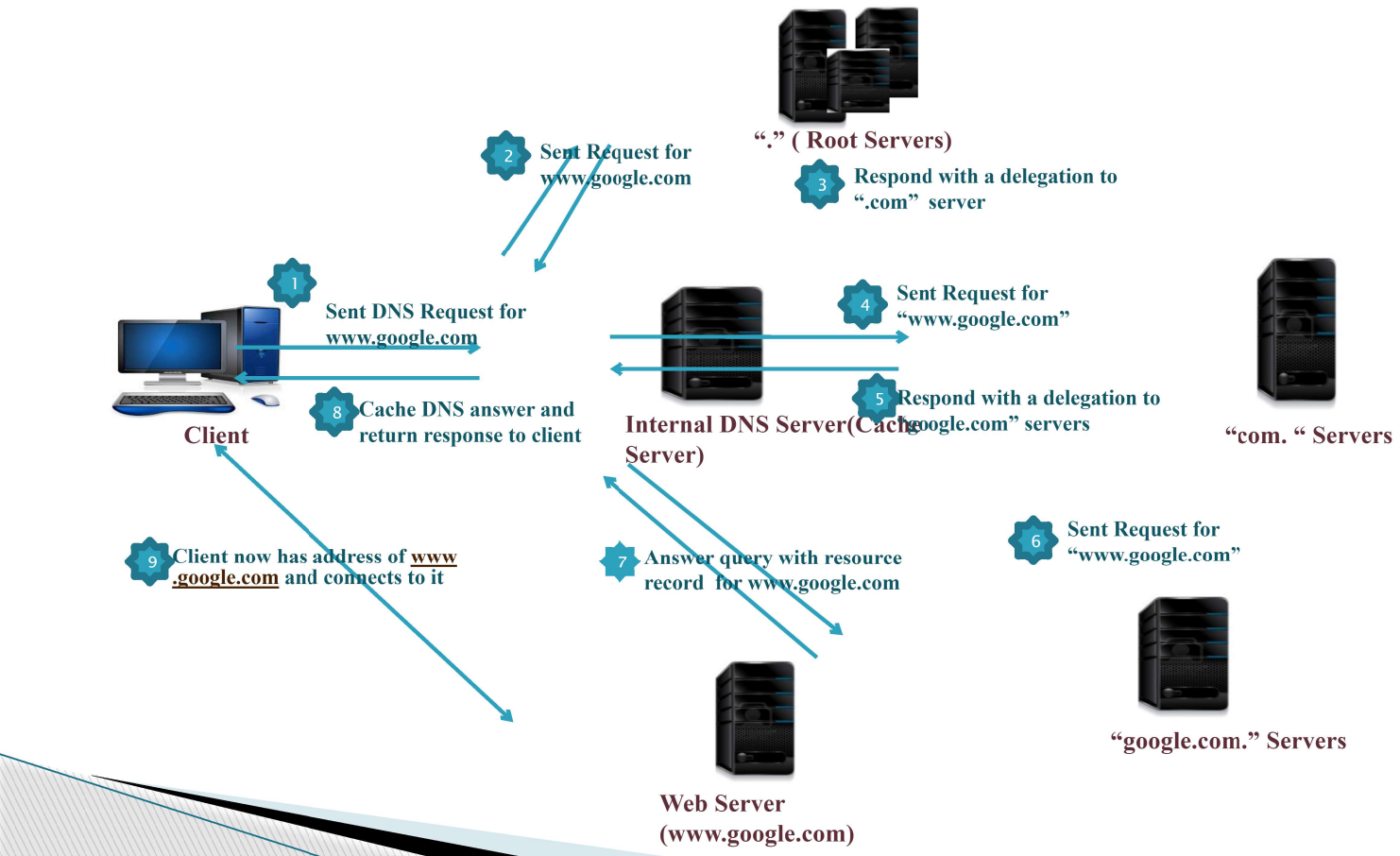
Basic Resolver process

- It follows the hierarchical tree structure
- e.g. to query "www.**tiscali**.co.uk"




“.” (Root Servers)
2
Sent Request for www.google.com
3
Respond with a delegation to “.com” server
1
Sent DNS Request for www.google.com
4
Sent Request for “www.google.com”
5
Respond with a delegation to “google.com” servers
“com. “ Servers
8
Cache DNS answer and return response to client
Client
Internal DNS Server(Cache Server)
9
Client now has address of www .google.com and connects to it
7
Answer query with resource record for www.google.com
6
Sent Request for “www.google.com”
“google.com.” Servers
Web Server (www.google.com)

Domain Name	Assigned To
com	Commercial organization
edu	Educational institution
gov	Government organization
mil	Military group
net	Major network support center
org	Organization other than those a
arpa	Temporary ARPA domain (still
int	International organization
country code	A country

host/www/ftp = svc ; Domain Name string s can be up to 63-characters

and total label length can be up to 255 characters in length ; still this in 2026

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Type	Meaning	Value
SOA	Start of Authority	Parameters for this zone
A	IP address of a host	32-Bit integer
MX	Mail exchange	Priority, domain willing to accept email
NS	Name Server	Name of a server for this domain
CNAME	Canonical name	Domain name
PTR	Pointer	Alias for an IP address
HINFO	Host description	CPU and OS in ASCII
TXT	Text	Uninterpreted ASCII text

Basic check & diagnosis

`dig +trace www.ytp.com.mm.`

Instead of sending the query to the cache, "dig +trace" tra
the tree from the root and displays the responses it gets

`dig +trace` is a bind 9 feature

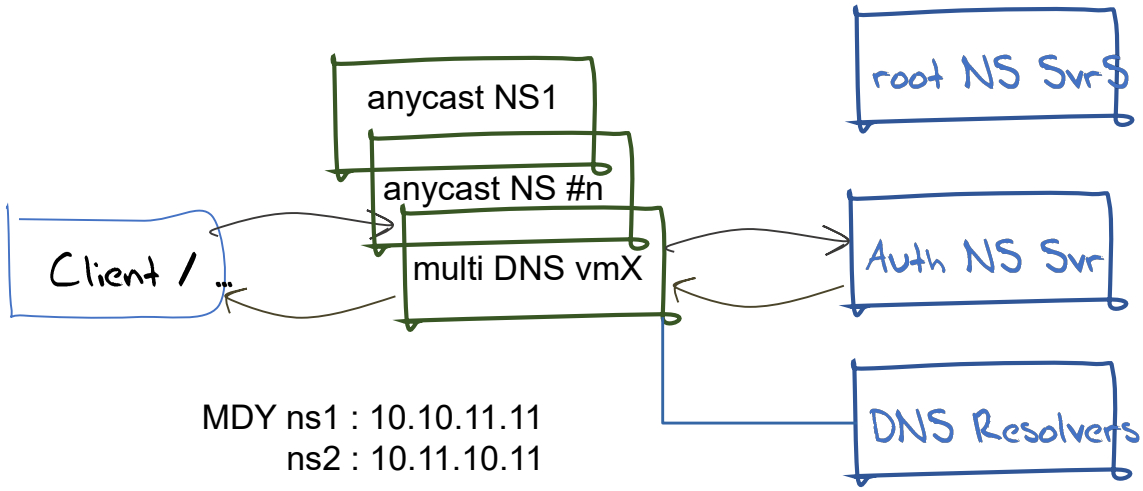
useful as a demo but not for debugging

```
dig +norec @1.2.3.4 fqdn.org.cctld   a
```

host, nslookup

ping , … tracert, traceroute, tracepath, … ping6 ?

AnyCast DNS proposed Design

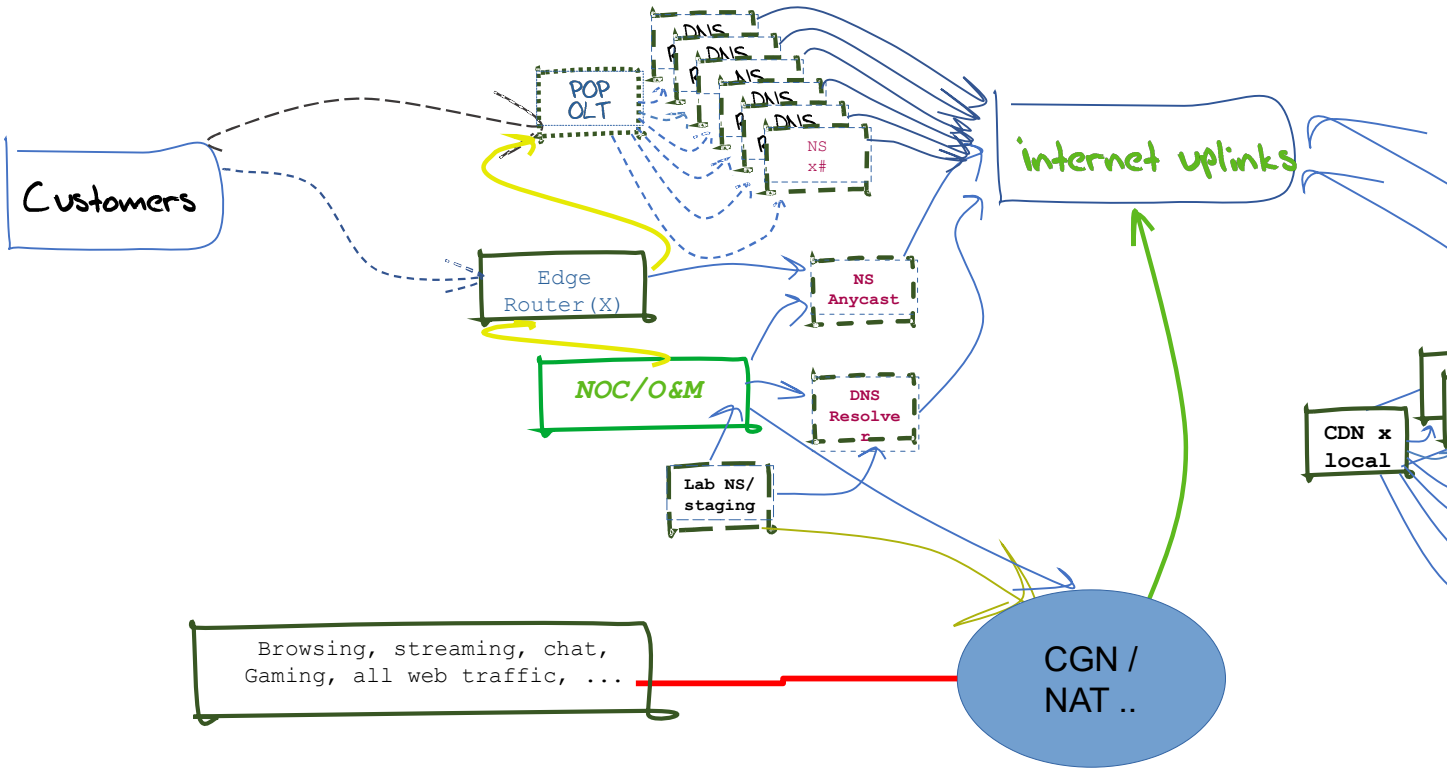


MDY ns1 : 10.10.11.11
ns2 : 10.11.10.11

YGN ns1 : 10.10.11.11
ns2 : 10.11.10.11

POL ns1 : 10.10.11.11
any ns2 : 10.11.10.11

Deployment Design Customers to Resolver



Anycast DNS Resolver requirements

- Based on Theory and best practices
- minimum: 2 Anycast sites / POP or Edges / for a City … depends
- Recommended: 3 sites (geo + failure domain separation)
- Each Site advertise anycast service IP (2+ VM or Servers)
  - Public IP towards Internet uplink for smooth upstream queries to ROOT, TLD and AUTH: DNS serv
  - Anycast IP addresses dedicated as 10.10.11.11/32 and 10.11.10.11/32
  - Unique management IP for NOC and O&M [actual team tasks]
  - BGP/suitable route steering to serve same IP anywhere in DC...s

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Each DNS Server in Anycast Farm

- HW or VM Specifications (assume serving of 10K to 25K users)
  - HW and VM Spec: (refer to next sheet)
  - Public IP (use different uplinks on edge node resolvers, recommended!)
  - Anycast Service IP
  - O&M unique management IP
  - internal routing mechanism (private ASN 64512-65534, BGP setup)
- recommended managed cluster or private cloud to host the VM
  - VMware, KVM, XCP/Xen, Hyper-V, … any HA ready Infra at each POP/Site
  - Monitoring the NS resolver and its host hardware, Log Access, …
  - K8s, k3s upgrade plans, ...

NOC tasks for tasking care of resolver N

- Monitoirng Server Health
  - QPS at each node
  - System Resource Utlization (CPU, RAM, HDD)
  - Network flow rate, latency, session and BW usage
  - staging NS; live lab system & internal testing before upgrade/changes
  - Maintenance and attendance if resolver process down, cache hit ratio issues, ..
- IP Address and uplinks
  - 1 public to separate uplinks for each node in same Edge/POP
  - 2 anycast service IP, 10.10.11.11/32 and 10.11.10.11/32
  - 1 private management IP for NOC, O&M access
  - Private ASN for internal anycast Infra:
  - iBGP with route reflectors & FRRouting or BIRD on DNS nodes

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The DNS is a mystery

- DNS Privacy Issues
- hi-Jack
- Amplification attacks
- DNS Privacy - Qname Minimisation
- Oversharing
- Overly chatty web sites
- Blockchain DNS … ?

NO! Than

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back to DNS components

- . roots Servers, TLDs & ccTLDs, … ; 1st level, 2nd levls, … 3rd , ..
- Authoritative (Auth: DNS) Servers
  - Official NS ; definitive answers for DNS queries related to specific authoriz domains.
  - DNSSEC & Signed Zones
    - could be anycast ServerS with zone /databases, balancers, CDN split horizons ...
- Caching Resolver Servers
  - Free/Public (9.9.9.9, 8.8.4.4, 1.1.1.1, … 4,2.2.1-2) ;
  - ISP private DNS resolvers like 10.10.10.10, 10.10.10.11, … or SOHO/local cach servers
- Resolver Clients
  - softwares responsible for initiating and processing DNS queries
  - Web browsers, mail/messenger clients, Diag: tools like **host, dig, nslooku**
  - DOH, DOT (DNS-over-TLS), DNScrypt, …, …

Other rarely used Terms

- **WHOIS** (not for .mm yet ? why some are with WHOIS protection
- **IDN** (non-Latin scripts)
- **Punycode** (to represent non-ASCII, Unicode chars)
  - ASCII-compatible format
  - characters using the Punycode algorithm
  - prepended with the prefix "xn--"
    - 例え．テスト ==> xn—r8jz45g.xn--zckzah
    - http://ဓဓဗဝ.org ==> http://xn--l1bza5c7b4be0a.org
    - ftp://ပထမမြန်မ.com ==> @ftp://xn--l1b7a8b.com/
    - ftp://%E3%83%86%E3%82%B9%E3%83%88...%88@ftp.example.com/

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Deployment Planning

- System Resources
- Estimated /potential **qps**, Sizing & Planning
- Designing for robustness and security
- Auth: DNS Server with backend databases
  - Hidden Master, Reduce Attack Surface, …
  - Plan to avoid Single Point of Failure, Complexity ; benefit & challenges
- DNSSEC (cryptographic protocol that adds integrity & authenticity checks to DNS data, preventing unauthorized m records)
- Geographic Redundancy, Anycast DeploymentS
- Caching Resolver with **blacklist filtering options**
- Rate Limiting (if in case …,)
- Logging & Monitoring, … analyze, measure advantages & detect attack beh

record types practically used

- SOA
- NS
- A, AAAA
- PTR
- CNAME
- **MX** (Mail Exchange, priority 5, 10, …)
- TXT , ...
- TTL, SRV, ...

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Query & diagnose from CLI clien

- dig, host, … nslookup, ...

```
Non-authoritative answer:
Name:    msn.com
Address:  204.79.197.219


E:\usefu1>nslookup google.com 8.8.4.4
Server:  dns.google
Address:  8.8.4.4

Non-authoritative answer:
Name:    google.com
Addresses:  2404:6800:4001:810::200e
          172.217.26.78
```

```
E:\usefu1>nslookup google.com 9.9.9.9
Server:  dns9.quad9.net
Address:  9.9.9.9

Non-authoritative answer:
Name:    google.com
Addresses:  2404:6800:4001:803::200e
          216.58.199.238
```

```
E:\usefu1>nslookup google.com 10.
Server:  ns1
Address:  10.223.1.222

Non-authoritative answer:
Name:    google.com
Addresses:  2404:6800:4001:808::2
          142.250.199.46
```

```
E:\usefu1>nslookup -type=NS google.com
Server:  ns53
Address:  192.168.0.53

Non-authoritative answer:
google.com      nameserver = ns4.google.
google.com      nameserver = ns3.google.
google.com      nameserver = ns2.google.
google.com      nameserver = ns1.google.

E:\usefu1>nslookup google.com ns4.google
Server:  ns4.google.com
Address:  216.239.38.10

Name:    google.com
Addresses:  2404:6800:4001:80a::200e
          216.58.200.14
```

$/# >_ nslookup **-type=MX** google.com

nslookup **-type=MX** gmail.com

```
Server:  ns53
Address:  192.168.0.53

Non-authoritative answer:
gmail.com       MX preference = 10, mail exchanger = alt1.gmail-smtp-in.l.google.com
gmail.com       MX preference = 40, mail exchanger = alt4.gmail-smtp-in.l.google.com
gmail.com       MX preference = 30, mail exchanger = alt3.gmail-smtp-in.l.google.com
gmail.com       MX preference = 20, mail exchanger = alt2.gmail-smtp-in.l.google.com
gmail.com       MX preference = 5, mail exchanger = gmail-smtp-in.l.google.com
```

TXT ID, spf, … additional fields

```
E:\usefu1>nslookup -type=TXT gmail.com
Server:  ns53
Address:  192.168.0.53

Non-authoritative answer:
gmail.com       text =

        "v=spf1 redirect=_spf.google.com"
gmail.com       text =

        "globalsign-smime-dv=CDYX+XFHUw2wml6/Gb8+59BsH31KzUr6c1l2BPvqKX8="

E:\usefu1>nslookup -type=TXT teleport.net.mm
Server:  ns53
Address:  192.168.0.53

Non-authoritative answer:
teleport.net.mm text =

        "version=djb1"
teleport.net.mm text =

        "v=spf1 ip4:203.81.163.104/29 ip4:61.4.64.96/27 ~all"
teleport.net.mm text =

        "google-site-verification=aaav18w78roMNOuROPo6n0CeGdrJJkKkjtZZw8UbP4Y"
teleport.net.mm text =

        "google-site-verification=3afN9GMcHEIprgmujK9oQgQVgMCBTmfwbWzqrAZnyPw"
```

```
E:\usefu1>nslookup 142.
Server:  ns53
Address:  192.168.0.53

Name:    kul08s12-in-f1
Address:  142.250.199.4
```

```
root@p:/# nslookup 142.250.199.46
46.199.250.142.in-addr.arpa     name = kul08s12-in-f1

Authoritative answers can be found from:
```

```
root@p:/# nslookup -type=TXT microsoft.com
;; Truncated, retrying in TCP mode.
Server:         192.168.0.153
Address:        192.168.0.153#53

Non-authoritative answer:
microsoft.com   text = "docusign=d5a3737c-c23c-4bd0-9095-d2ff621f2840"
microsoft.com   text = "t7sebee51jrj7vm932k531hipa"
microsoft.com   text = "v=spf1 include:_spf-a.microsoft.com include:_spf-b.microsoft.com in
.com include:_spf1-meo.microsoft.com -all"
microsoft.com   text = "facebook-domain-verification=fwzwhbbzwmg5fzgotc2go51olc3566"
microsoft.com   text = "atlassian-domain-verification=xvoaqRfxSg3PnlVnR4xCSOlKywlAln0MMxRiK
microsoft.com   text = "google-site-verification=pjPOauSPcrfXOZ89jnPPa5axowcHGCDAl1_86dCqFp
microsoft.com   text = "fg2t0gov9424p2tdcuo94goe9j"
microsoft.com   text = "hubspot-developer-verification=OTQ5NGIwYWEtODNmZi00YWE1LTkyNmQtNDhj
microsoft.com   text = "d365mktkey=8xDf1EZxLvMwx6eEZUzjFFgHoapF8DvtWEUjwq7ZTwx"
microsoft.com   text = "google-site-verification=M--CVfn_YwsV-2FGbCp_HFaEj23BmT0cTF418hXgpv
microsoft.com   text = "d365mktkey=6358r1b7e13hox60t1luagv14"
microsoft.com   text = "d365mktkey=j2qHWq9BHdaa3ZXZH8x64daJZxEWsFa0dxDeilxDoYYx"
microsoft.com   text = "google-site-verification=GfDnTUdATPsK123OJOmXbfsYw-3A9BVMVaKSd4DcKg
microsoft.com   text = "d365mktkey=QDa792dLCZhvaAOOCe2Hz6WTzmTssOp1snABhxWibhMx"
microsoft.com   text = "google-site-verification=uFg3wr5PWsK8lVO29RoXXBBUW0_B6qf1WEWVHhetkO
microsoft.com   text = "d365mktkey=3uc1cf82cpv750lzk70v9bvf2"

Authoritative answers can be found from:
```

nslookup -type=TXT microsoft.com

who's answering … ?

- how fast are you getting DNS reponse/answers
  (the fewer in ms, the faster, the better)

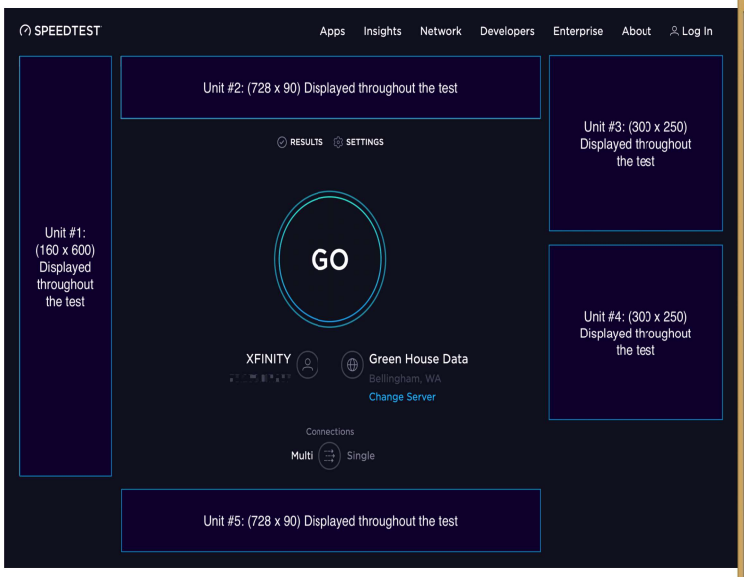
1 web site/page has many HTML elements !!!

```
root@p:/# ping 1.1.1.1 -c 5
PING 1.1.1.1 (1.1.1.1) 56(84) bytes of data.
64 bytes from 1.1.1.1: icmp_seq=1 ttl=56 time=16.3 ms
64 bytes from 1.1.1.1: icmp_seq=2 ttl=56 time=16.3 ms
64 bytes from 1.1.1.1: icmp_seq=3 ttl=56 time=16.3 ms
64 bytes from 1.1.1.1: icmp_seq=4 ttl=56 time=16.3 ms
64 bytes from 1.1.1.1: icmp_seq=5 ttl=56 time=16.3 ms

--- 1.1.1.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4006ms
rtt min/avg/max/mdev = 16.250/16.302/16.342/0.033 ms
root@p:/# ping 192.168.0.53 -c 5
PING 192.168.0.53 (192.168.0.53) 56(84) bytes of data.
64 bytes from 192.168.0.53: icmp_seq=1 ttl=64 time=0.391 ms
64 bytes from 192.168.0.53: icmp_seq=2 ttl=64 time=0.422 ms
64 bytes from 192.168.0.53: icmp_seq=3 ttl=64 time=0.375 ms
64 bytes from 192.168.0.53: icmp_seq=4 ttl=64 time=0.467 ms
64 bytes from 192.168.0.53: icmp_seq=5 ttl=64 time=0.459 ms

--- 192.168.0.53 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4101ms
rtt min/avg/max/mdev = 0.375/0.422/0.467/0.036 ms
```

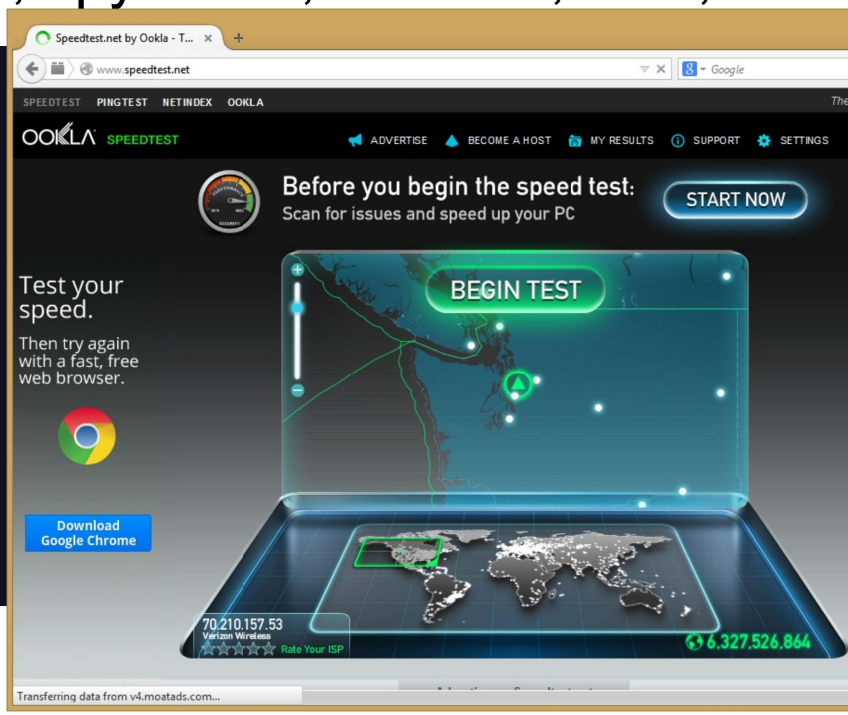
```
root@p:/# ping 8.8.4.4
PING 8.8.4.4 (8.8.4.4) 56(84) bytes of data.
64 bytes from 8.8.4.4: icmp_seq=1 ttl=115 time=43.9
64 bytes from 8.8.4.4: icmp_seq=2 ttl=115 time=43.9
64 bytes from 8.8.4.4: icmp_seq=3 ttl=115 time=43.8
^C
--- 8.8.4.4 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, t
rtt min/avg/max/mdev = 43.830/43.880/43.949/0.050 ms
root@p:/# ping 9.9.9.9
PING 9.9.9.9 (9.9.9.9) 56(84) bytes of data.
64 bytes from 9.9.9.9: icmp_seq=1 ttl=56 time=33.4 ms
64 bytes from 9.9.9.9: icmp_seq=2 ttl=56 time=32.7 ms
64 bytes from 9.9.9.9: icmp_seq=3 ttl=56 time=32.6 ms
^C
--- 9.9.9.9 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, t
rtt min/avg/max/mdev = 32.566/32.893/33.395/0.360 ms
root@p:/# ping 10.223.1.222
PING 10.223.1.222 (10.223.1.222) 56(84) bytes of data
64 bytes from 10.223.1.222: icmp_seq=1 ttl=60 time=3
64 bytes from 10.223.1.222: icmp_seq=2 ttl=60 time=3
64 bytes from 10.223.1.222: icmp_seq=3 ttl=60 time=2
^C
--- 10.223.1.222 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, t
rtt min/avg/max/mdev = 2.308/2.924/3.316/0.441 ms
root@p:/# ping 192.168.0.53
PING 192.168.0.53 (192.168.0.53) 56(84) bytes of data
64 bytes from 192.168.0.53: icmp_seq=1 ttl=64 time=0
64 bytes from 192.168.0.53: icmp_seq=2 ttl=64 time=0
64 bytes from 192.168.0.53: icmp_seq=3 ttl=64 time=0
^C
--- 192.168.0.53 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, t
rtt min/avg/max/mdev = 0.359/0.445/0.581/0.097 ms
```

DNS Resolvers for saving time & B

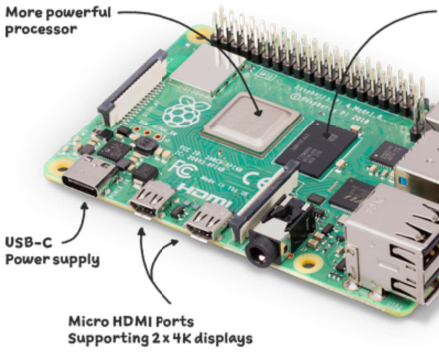
- Ads, malwares, trojans, spywarez, trackers, bots, ...



https://www.speedtest.net/about/advertising/direct



handy Caching DNS setup



- by docker
- on SBC like Raspberry Pi zero, 3, 4, …
- inside a guest VM
- on generic commodity servers
- powerful/dedicated hardware appliances
- with proper Anycast setup with ISP/Telco: routing systems
- Multi-region deployments, + HA, + hyper scaling HCI infra

DNS daemons

- **BIND**
- **NSD, Knot**
- Pi-Hole, dnsmasq, FTL
- Adguard-DNS
- MS-DNS
- PowerDNS, **recursor**, **DNSdist**,
- **djbdns**
- **unbound**
- + loadbalancers, HA, hyper scaler systems, + subscription support options ove FOSS

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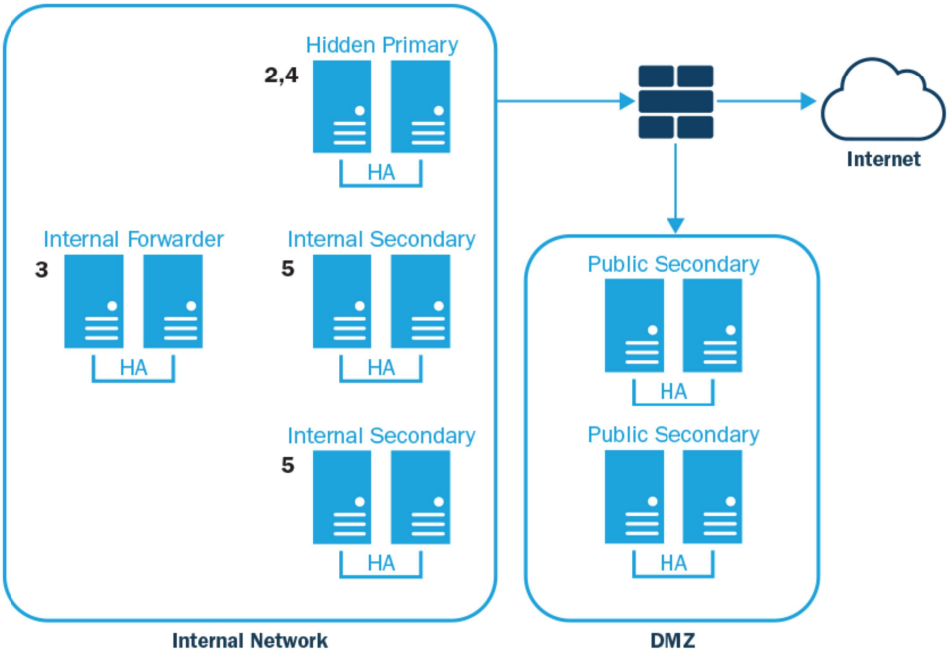
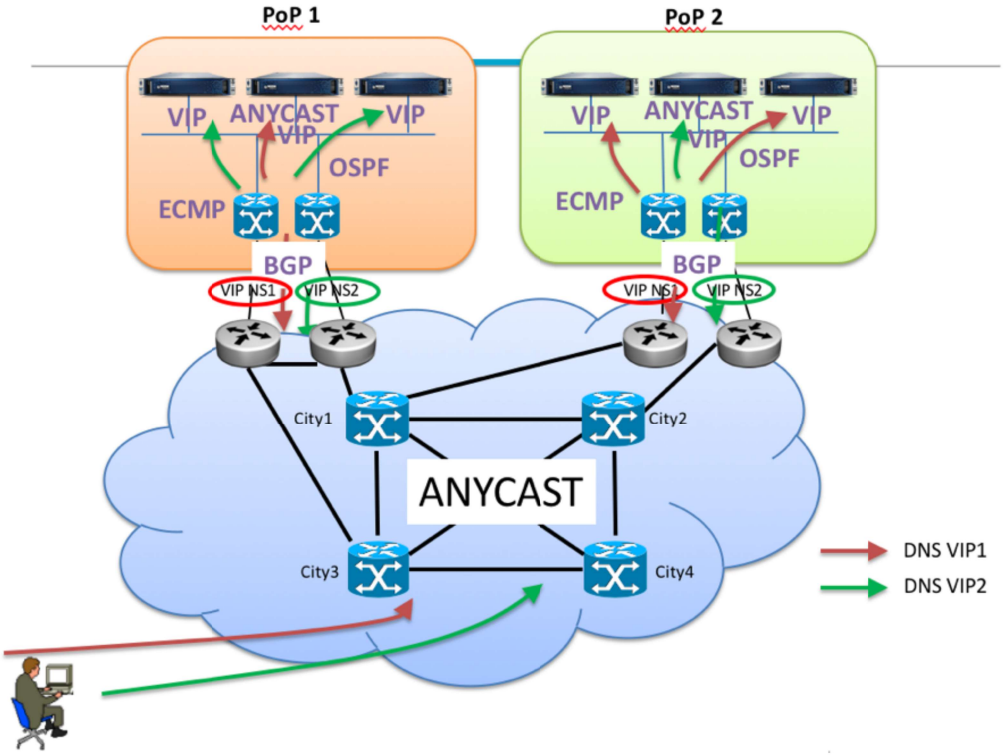
Common **Auth**: NS deployments



anycast design by Infoblox



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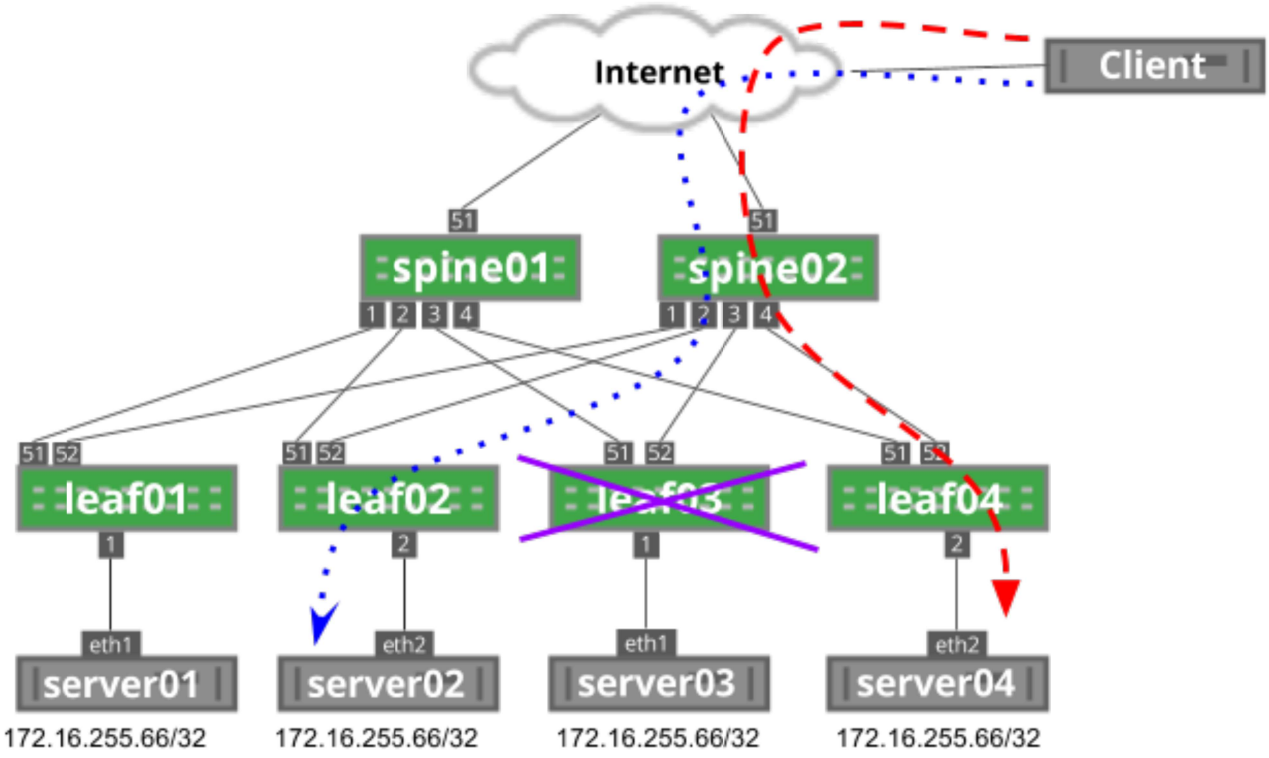
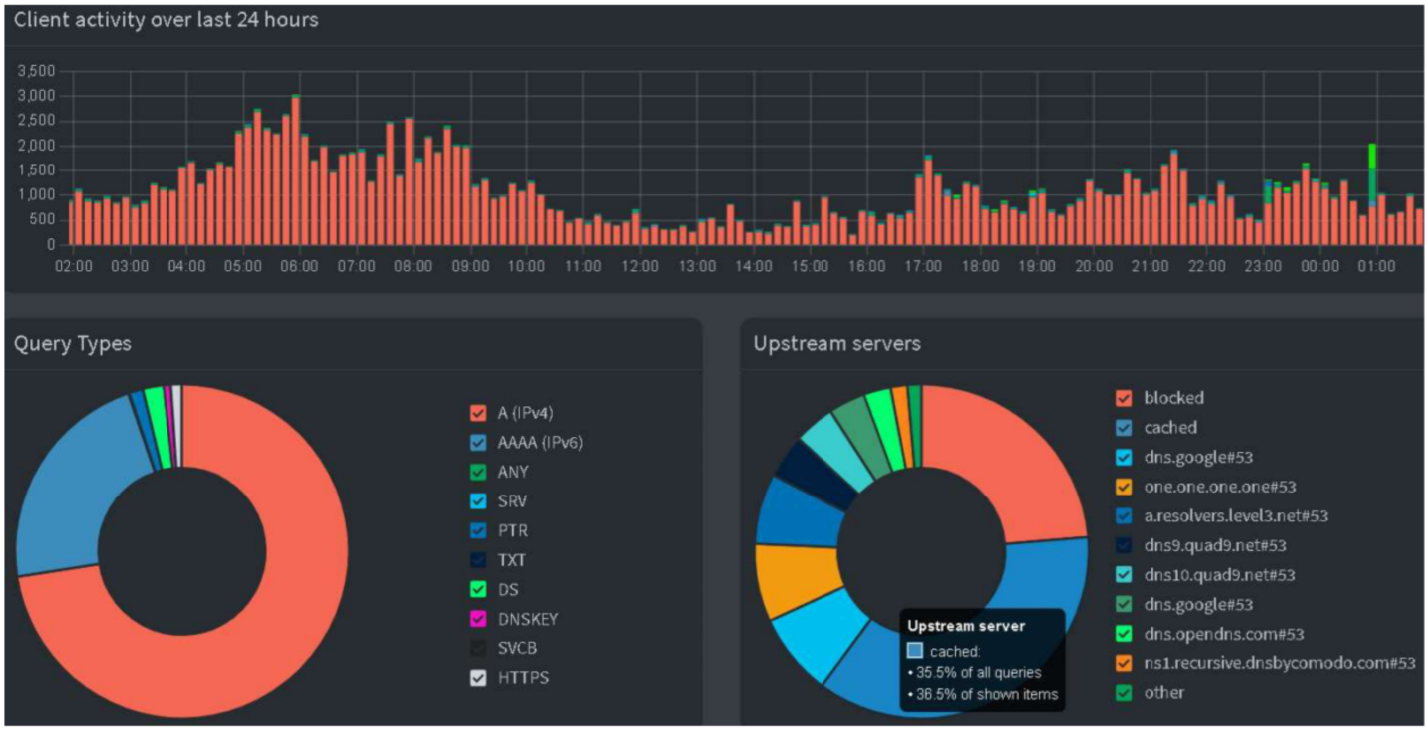
Alt: Anycast Architecture



Typical DNS admin dashboard



DNS query stats: from a test server with 10 average users

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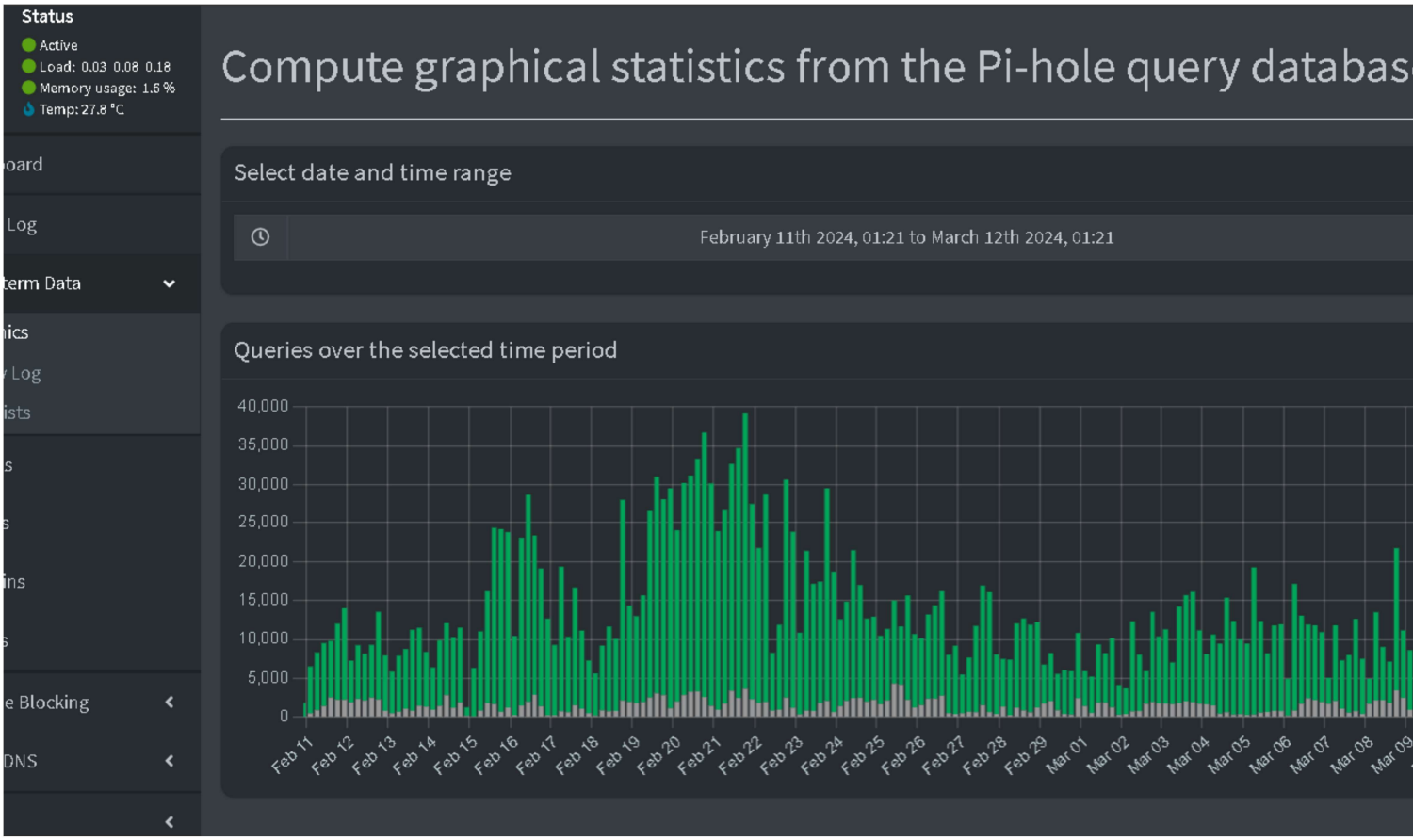

Traffic saved per hours !!

```
ens160  /  hourly

        hour        rx       |     tx       |    total     |   avg. rate
    ------------------------+--------------+--------------+---------------
    2024-03-02
        22:00     23.78 GiB |    15.41 GiB |    39.18 GiB |    93.50 Mbit/s
        23:00     16.78 GiB |    12.68 GiB |    29.46 GiB |    70.30 Mbit/s
    2024-03-03
        00:00     15.89 GiB |    11.33 GiB |    27.22 GiB |    64.95 Mbit/s
        01:00     15.68 GiB |    10.57 GiB |    26.25 GiB |    62.63 Mbit/s
        02:00     15.38 GiB |     9.58 GiB |    24.96 GiB |    59.55 Mbit/s
        03:00     14.78 GiB |     8.90 GiB |    23.68 GiB |    56.50 Mbit/s
        04:00     16.31 GiB |     8.65 GiB |    24.96 GiB |    59.56 Mbit/s
        05:00     12.58 GiB |     7.62 GiB |    20.20 GiB |    48.20 Mbit/s
        06:00     13.51 GiB |     8.14 GiB |    21.65 GiB |    51.65 Mbit/s
        07:00     11.15 GiB |     9.15 GiB |    20.30 GiB |    48.44 Mbit/s
        08:00     13.41 GiB |     9.92 GiB |    23.33 GiB |    55.66 Mbit/s
        09:00     14.61 GiB |    10.46 GiB |    25.06 GiB |    59.81 Mbit/s
        10:00     15.83 GiB |    11.20 GiB |    27.03 GiB |    64.50 Mbit/s
        11:00     13.37 GiB |    10.86 GiB |    24.23 GiB |    57.82 Mbit/s
        12:00     15.95 GiB |    11.63 GiB |    27.57 GiB |    65.79 Mbit/s
        13:00     15.36 GiB |    10.62 GiB |    25.98 GiB |    61.99 Mbit/s
        14:00     17.77 GiB |    11.13 GiB |    28.90 GiB |    68.95 Mbit/s
        15:00     20.40 GiB |    12.08 GiB |    32.49 GiB |    77.51 Mbit/s
        16:00     18.24 GiB |    11.50 GiB |    29.73 GiB |    70.95 Mbit/s
        17:00     17.80 GiB |    12.53 GiB |    30.33 GiB |    72.36 Mbit/s
        18:00     20.06 GiB |    13.91 GiB |    33.98 GiB |    81.07 Mbit/s
        19:00     22.54 GiB |    16.43 GiB |    38.97 GiB |    92.98 Mbit/s
        20:00     24.06 GiB |    18.22 GiB |    42.27 GiB |   100.87 Mbit/s
        21:00     10.41 GiB |     7.76 GiB |    18.17 GiB |   104.03 Mbit/s
    ------------------------+--------------+--------------+---------------
root@ns1:~#
```

```
ens160  /  hourly

        hour        rx       |     tx       |    total     |
    ------------------------+--------------+--------------+
    2024-03-11
        02:00    296.21 MiB |   473.78 MiB |   769.99 MiB |
        03:00    564.47 MiB |   659.80 MiB |     1.20 GiB |
        04:00    509.32 MiB |   604.80 MiB |     1.09 GiB |
        05:00    331.77 MiB |   474.13 MiB |   805.90 MiB |
        06:00    310.80 MiB |   526.56 MiB |   837.37 MiB |
        07:00    370.88 MiB |   664.40 MiB |     1.01 GiB |
        08:00    460.10 MiB |   853.94 MiB |     1.28 GiB |
        09:00    518.39 MiB |   968.92 MiB |     1.45 GiB |
        10:00    577.39 MiB |     1.06 GiB |     1.62 GiB |
        11:00    597.28 MiB |     1.10 GiB |     1.69 GiB |
        12:00    616.84 MiB |     1.14 GiB |     1.75 GiB |
        13:00    603.54 MiB |     1.12 GiB |     1.71 GiB |
        14:00    567.79 MiB |     1.05 GiB |     1.60 GiB |
        15:00    581.00 MiB |     1.07 GiB |     1.64 GiB |
        16:00    597.24 MiB |     1.09 GiB |     1.67 GiB |
        17:00    670.42 MiB |     1.23 GiB |     1.88 GiB |
        18:00    777.35 MiB |     1.42 GiB |     2.18 GiB |
        19:00    941.84 MiB |     1.72 GiB |     2.64 GiB |
        20:00      1.00 GiB |     1.88 GiB |     2.88 GiB |
        21:00      1.05 GiB |     1.98 GiB |     3.04 GiB |
        22:00    964.42 MiB |     1.78 GiB |     2.72 GiB |
        23:00    710.91 MiB |     1.29 GiB |     1.99 GiB |
    2024-03-12
        00:00    521.33 MiB |   938.25 MiB |     1.43 GiB |
        01:00    179.50 MiB |   315.33 MiB |   494.82 MiB |
    ------------------------+--------------+--------------+
root@ns2:~#
```

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nature of FTTx users

```
ens160                                                                  01:25
  ^                                                                t
  |                                                           t  t
  |                                                        t  t  t  t
  |                                                     t  t  t  t  t
  |                                                  t  t  t  t  t  t  t
  |                           t  t  t  t  t  t  t  t  t  t rt rt  t  t
  |                     t  t  t  t  t  t  t  t  t  t  t rt rt rt rt  t  t
  |      t           t  t  t  t  t rt  t  t  t  t rt rt rt rt rt rt rt  t
  |   t rt rt  t  t  t rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt
  |  rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt rt  t
 -+-------------------------------------------------------------------------->
  |  02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01

 h  rx (MiB)    tx (MiB)   ][  h  rx (MiB)    tx (MiB)   ][  h  rx (MiB)    tx (MiB)
02       296.2       473.8 ][ 10       577.4     1,082.7 ][ 18       777.4     1,454.3
03       564.5       659.8 ][ 11       597.3     1,130.2 ][ 19       941.8     1,765.4
04       509.3       604.8 ][ 12       616.8     1,171.7 ][ 20     1,022.8     1,921.7
05       331.8       474.1 ][ 13       603.5     1,142.4 ][ 21     1,076.8     2,031.6
06       310.8       526.6 ][ 14       567.8     1,075.3 ][ 22       964.4     1,823.2
07       370.9       664.4 ][ 15       581.0     1,096.3 ][ 23       710.9     1,322.2
08       460.1       853.9 ][ 16       597.2     1,117.1 ][ 00       521.3       938.3
09       518.4       968.9 ][ 17       670.4     1,254.6 ][ 01       179.5       315.3
root@ns2:~#
```

Huge Traffic saving by date

root@ns1: ~

```
ens160  /  daily

        day        rx       |     tx       |    total     |   avg. rate
    -----------------------+--------------+--------------+---------------
    2024-02-03   381.77 GiB |  378.05 GiB  |  759.82 GiB  |   75.54 Mbit/s
    2024-02-04   442.96 GiB |  399.44 GiB  |  842.40 GiB  |   83.75 Mbit/s
    2024-02-05   400.66 GiB |  355.98 GiB  |  756.64 GiB  |   75.23 Mbit/s
    2024-02-06   455.74 GiB |  357.46 GiB  |  813.20 GiB  |   80.85 Mbit/s
    2024-02-07   330.75 GiB |  327.12 GiB  |  657.87 GiB  |   65.41 Mbit/s
    2024-02-08   344.80 GiB |  350.79 GiB  |  695.59 GiB  |   69.16 Mbit/s
    2024-02-09   390.54 GiB |  361.60 GiB  |  752.15 GiB  |   74.78 Mbit/s
    2024-02-10   450.11 GiB |  372.40 GiB  |  822.51 GiB  |   81.77 Mbit/s
    2024-02-11   438.93 GiB |  376.21 GiB  |  815.14 GiB  |   81.04 Mbit/s
    2024-02-12   492.08 GiB |  403.17 GiB  |  895.26 GiB  |   89.01 Mbit/s
    2024-02-13   449.59 GiB |  355.04 GiB  |  804.62 GiB  |   80.00 Mbit/s
    2024-02-14   398.73 GiB |  350.26 GiB  |  748.99 GiB  |   74.46 Mbit/s
    2024-02-15   332.60 GiB |  324.00 GiB  |  656.60 GiB  |   65.28 Mbit/s
    2024-02-16   287.40 GiB |  260.43 GiB  |  547.83 GiB  |   54.47 Mbit/s
    2024-02-17   317.37 GiB |  241.35 GiB  |  558.72 GiB  |   55.55 Mbit/s
    2024-02-18   332.53 GiB |  256.55 GiB  |  589.08 GiB  |   58.57 Mbit/s
    2024-02-19   276.04 GiB |  237.04 GiB  |  513.08 GiB  |   51.01 Mbit/s
    2024-02-20   253.58 GiB |  235.94 GiB  |  489.52 GiB  |   48.67 Mbit/s
    2024-02-21   251.37 GiB |  252.56 GiB  |  503.93 GiB  |   50.10 Mbit/s
    2024-02-22   217.12 GiB |  223.27 GiB  |  440.39 GiB  |   43.78 Mbit/s
    2024-02-23   232.12 GiB |  240.23 GiB  |  472.36 GiB  |   46.96 Mbit/s
    2024-02-24   231.17 GiB |  250.16 GiB  |  481.32 GiB  |   47.85 Mbit/s
    2024-02-25   279.05 GiB |  254.15 GiB  |  533.20 GiB  |   53.01 Mbit/s
    2024-02-26   269.62 GiB |  216.46 GiB  |  486.08 GiB  |   48.33 Mbit/s
    2024-02-27   218.22 GiB |  213.48 GiB  |  431.71 GiB  |   42.92 Mbit/s
    2024-02-28   244.13 GiB |  232.40 GiB  |  476.53 GiB  |   47.38 Mbit/s
    2024-02-29   248.20 GiB |  234.07 GiB  |  482.26 GiB  |   47.95 Mbit/s
    2024-03-01   257.08 GiB |  259.05 GiB  |  516.13 GiB  |   51.31 Mbit/s
    2024-03-02   321.05 GiB |  262.41 GiB  |  583.47 GiB  |   58.01 Mbit/s
    2024-03-03   355.06 GiB |  242.18 GiB  |  597.25 GiB  |   66.54 Mbit/s
    -----------------------+--------------+--------------+---------------
    estimated    397.89 GiB |  271.40 GiB  |  669.29 GiB  |
root@ns1:~#
```

root@ns2: ~

```
ens160  /  daily

        day        rx       |     tx       |    total     |
    -----------------------+--------------+--------------+--
    2024-02-12    14.12 GiB |   30.53 GiB  |   44.66 GiB  |
    2024-02-13    12.35 GiB |   26.69 GiB  |   39.04 GiB  |
    2024-02-14    12.27 GiB |   26.50 GiB  |   38.77 GiB  |
    2024-02-15    11.73 GiB |   24.93 GiB  |   36.66 GiB  |
    2024-02-16    12.35 GiB |   24.07 GiB  |   36.42 GiB  |
    2024-02-17    13.44 GiB |   24.81 GiB  |   38.25 GiB  |
    2024-02-18    14.11 GiB |   25.92 GiB  |   40.03 GiB  |
    2024-02-19    12.80 GiB |   23.27 GiB  |   36.07 GiB  |
    2024-02-20    12.96 GiB |   23.67 GiB  |   36.63 GiB  |
    2024-02-21    12.97 GiB |   23.95 GiB  |   36.92 GiB  |
    2024-02-22    12.35 GiB |   21.59 GiB  |   33.94 GiB  |
    2024-02-23    13.27 GiB |   24.17 GiB  |   37.44 GiB  |
    2024-02-24    13.88 GiB |   25.57 GiB  |   39.45 GiB  |
    2024-02-25    14.67 GiB |   26.89 GiB  |   41.56 GiB  |
    2024-02-26    12.31 GiB |   22.46 GiB  |   34.76 GiB  |
    2024-02-27    12.44 GiB |   22.78 GiB  |   35.22 GiB  |
    2024-02-28    12.73 GiB |   23.10 GiB  |   35.83 GiB  |
    2024-02-29    12.78 GiB |   23.23 GiB  |   36.02 GiB  |
    2024-03-01    13.80 GiB |   25.10 GiB  |   38.91 GiB  |
    2024-03-02    14.48 GiB |   26.72 GiB  |   41.20 GiB  |
    2024-03-03    13.62 GiB |   24.71 GiB  |   38.34 GiB  |
    2024-03-04    13.49 GiB |   24.52 GiB  |   38.02 GiB  |
    2024-03-05    13.52 GiB |   24.38 GiB  |   37.90 GiB  |
    2024-03-06    13.41 GiB |   24.77 GiB  |   38.18 GiB  |
    2024-03-07    13.58 GiB |   24.93 GiB  |   38.50 GiB  |
    2024-03-08    13.97 GiB |   25.80 GiB  |   39.78 GiB  |
    2024-03-09    14.72 GiB |   26.94 GiB  |   41.66 GiB  |
    2024-03-10    15.30 GiB |   28.33 GiB  |   43.63 GiB  |
    2024-03-11    14.52 GiB |   25.83 GiB  |   40.35 GiB  |
    2024-03-12   700.83 MiB |    1.22 GiB  |    1.91 GiB  |
    -----------------------+--------------+--------------+--
    estimated     11.59 GiB |   20.74 GiB  |   32.33 GiB  |
```

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How big is a month Saving

```
ens160  /  monthly

      month        rx       |     tx       |    total     |   avg. rate
    -----------------------+--------------+--------------+---------------
      2023-09    30.96 GiB |   67.37 GiB  |   98.33 GiB  |  325.88 kbit/s
      2023-10     5.80 TiB |    5.32 TiB  |   11.12 TiB  |   36.51 Mbit/s
      2023-11     6.80 TiB |    6.61 TiB  |   13.41 TiB  |   45.50 Mbit/s
      2023-12    10.10 TiB |    9.42 TiB  |   19.53 TiB  |   64.13 Mbit/s
      2024-01    12.92 TiB |   11.29 TiB  |   24.21 TiB  |   79.50 Mbit/s
      2024-02     9.56 TiB |    8.62 TiB  |   18.18 TiB  |   63.84 Mbit/s
      2024-03   933.20 GiB |  763.64 GiB  |    1.66 TiB  |   58.33 Mbit/s
    -----------------------+--------------+--------------+---------------
    estimated     9.77 TiB |    7.99 TiB  |   17.76 TiB  |
root@ns1:~#
```

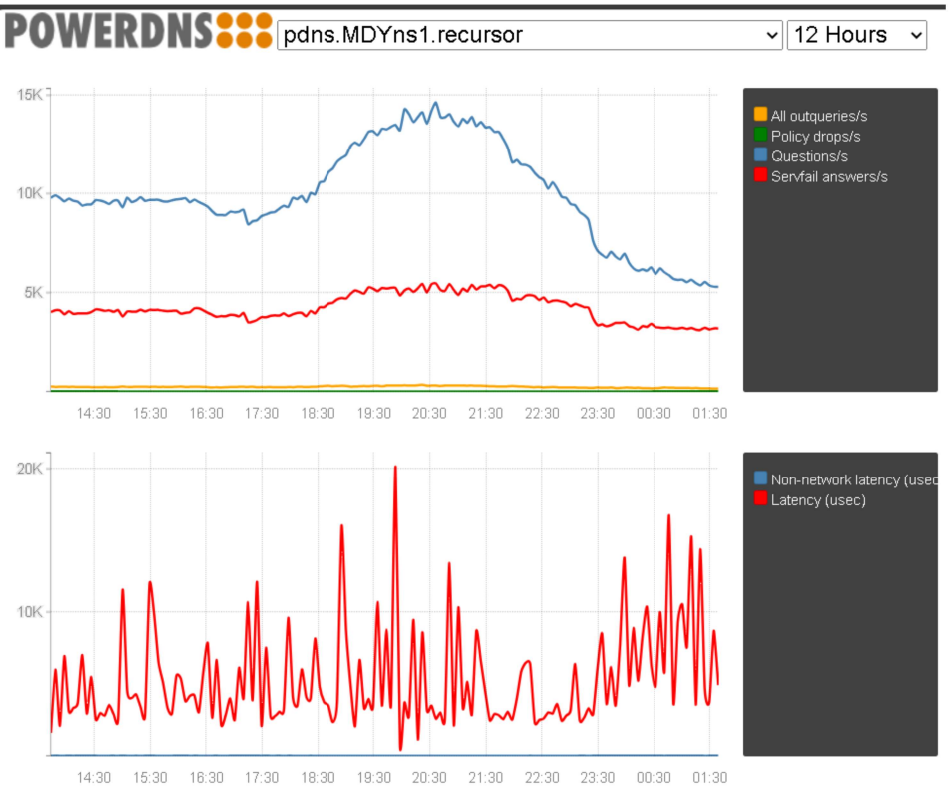
City ISP : 4,800+ users

```
ens160  /  monthly

      month        rx       |     tx       |    total     |   avg
    -----------------------+--------------+--------------+------
      2023-09    59.71 GiB |  135.36 GiB  |  195.07 GiB  |  646.4
      2023-10   200.06 GiB |  462.45 GiB  |  662.50 GiB  |    2.1
      2023-11   452.04 GiB |  997.66 GiB  |    1.42 TiB  |    4.8
      2023-12   327.25 GiB |  725.32 GiB  |    1.03 TiB  |    3.3
      2024-01   381.03 GiB |  821.44 GiB  |    1.17 TiB  |    3.8
      2024-02   371.38 GiB |  742.16 GiB  |    1.09 TiB  |    3.8
      2024-03   155.13 GiB |  283.32 GiB  |  438.45 GiB  |    3.9
    -----------------------+--------------+--------------+------
    estimated   434.72 GiB |  793.94 GiB  |    1.20 TiB  |
root@ns2:~#
```

Village ISP : 450+ users only

monitoring metrics



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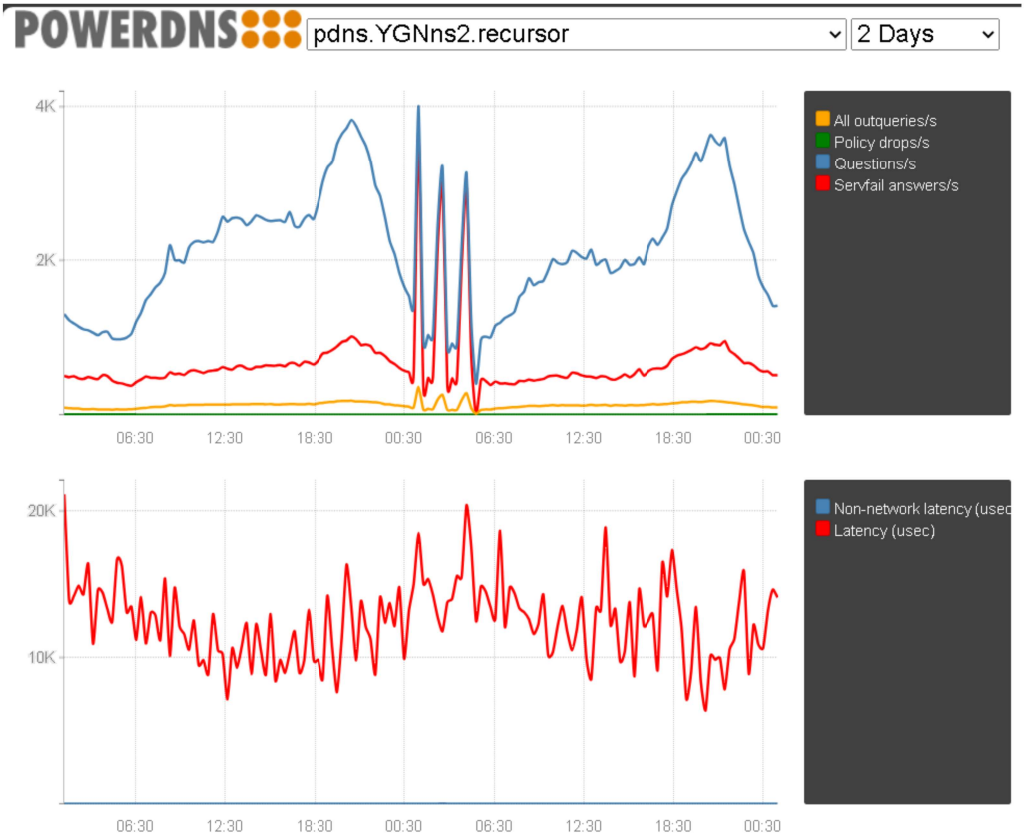
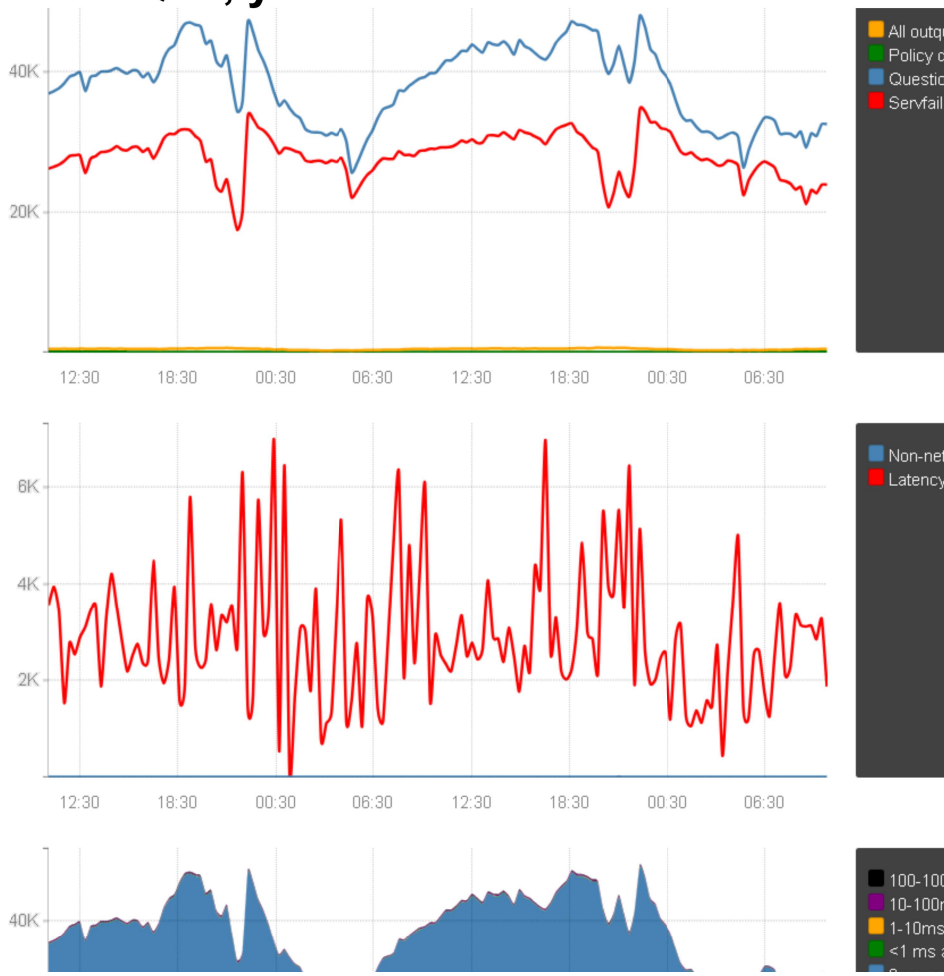
know your user behaviors



know QPs, your user behaviors



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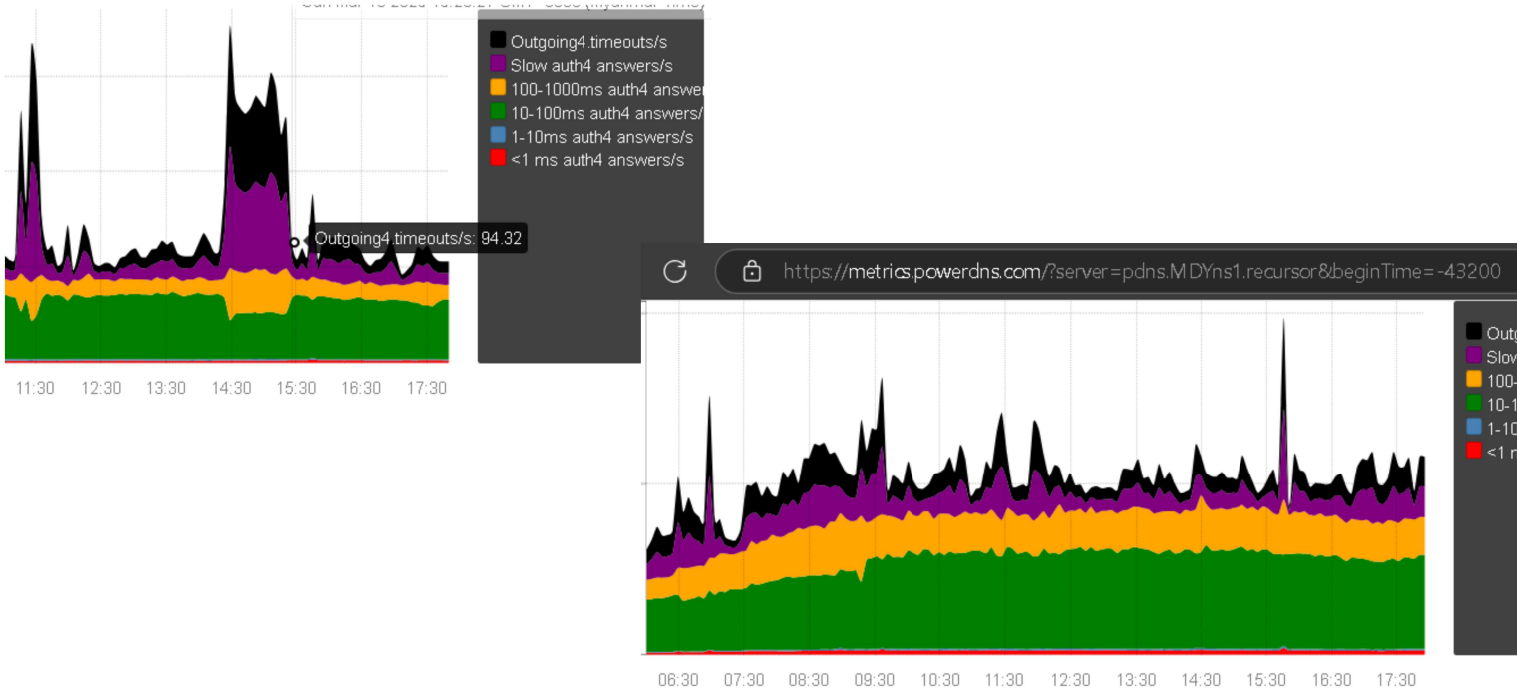
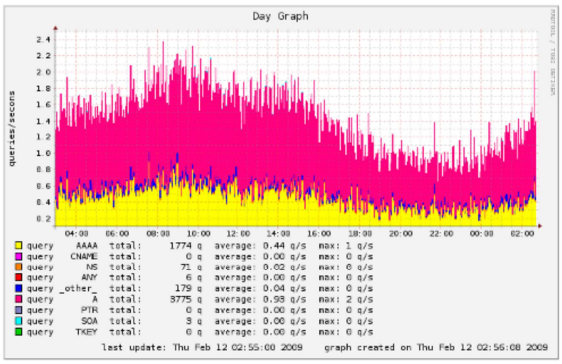
Forum 2026

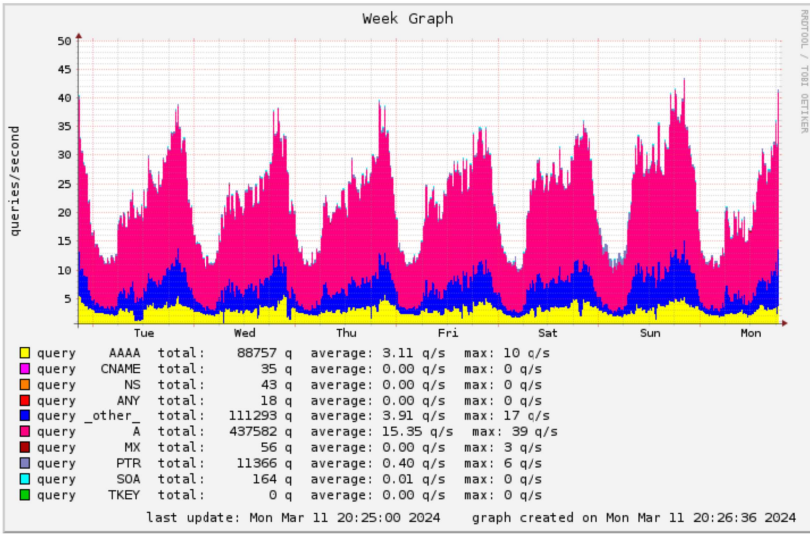
DNS monitoring can even track upstream failures,



BIND graphs

Day Graph





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there are

some more other untold use of DNS

Let me … reveal them, later!

for both AUTH: and caching/resolvers

sample unbound stats:

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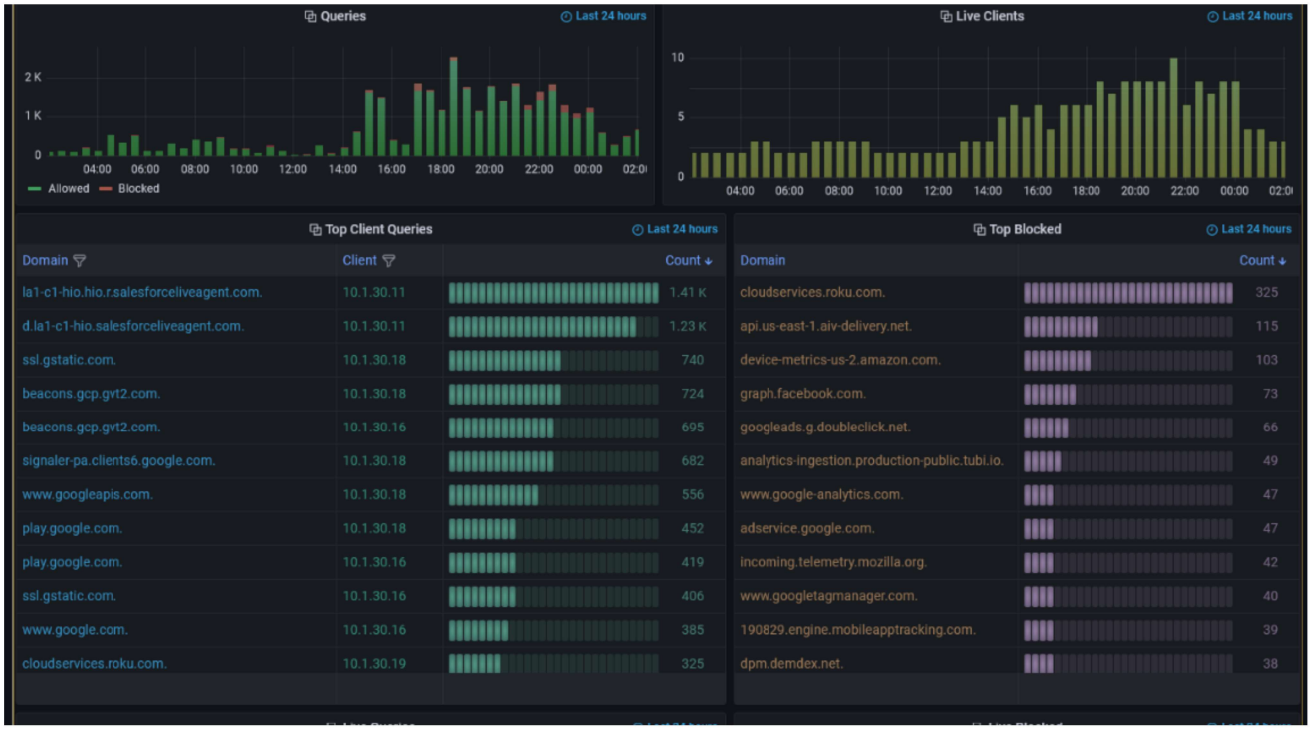
query counts by domains



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how BIG is your saving !!

```
192  /  daily

     day        rx        |     tx      |    total    |   avg. rate
------------------------+-------------+-------------+---------------
2025-01-21    51.66 GiB  |   90.58 GiB |  142.24 GiB |   14.14 Mbit/s
2025-01-22   171.91 GiB  |  297.40 GiB |  469.31 GiB |   46.66 Mbit/s
2025-01-23   181.81 GiB  |  312.35 GiB |  494.16 GiB |   49.13 Mbit/s
2025-01-24   181.99 GiB  |  314.48 GiB |  496.48 GiB |   49.36 Mbit/s
2025-01-25   177.12 GiB  |  305.14 GiB |  482.26 GiB |   47.95 Mbit/s
2025-01-26   190.32 GiB  |  328.71 GiB |  519.03 GiB |   51.60 Mbit/s
2025-01-27   183.68 GiB  |  315.09 GiB |  498.77 GiB |   49.59 Mbit/s
2025-01-28   181.90 GiB  |  312.99 GiB |  494.89 GiB |   49.20 Mbit/s
2025-01-29   190.67 GiB  |  325.99 GiB |  516.66 GiB |   51.37 Mbit/s
2025-01-30   180.31 GiB  |  304.13 GiB |  484.44 GiB |   48.16 Mbit/s
2025-01-31   189.65 GiB  |  318.82 GiB |  508.46 GiB |   50.55 Mbit/s
2025-02-01   210.99 GiB  |  353.74 GiB |  564.73 GiB |   56.15 Mbit/s
2025-02-02   207.25 GiB  |  346.08 GiB |  553.33 GiB |   55.01 Mbit/s
2025-02-03   202.34 GiB  |  338.18 GiB |  540.52 GiB |   53.74 Mbit/s
2025-02-04   198.09 GiB  |  332.01 GiB |  530.11 GiB |   52.70 Mbit/s
2025-02-05   169.73 GiB  |  279.59 GiB |  449.32 GiB |   44.67 Mbit/s
2025-03-17    34.61 GiB  |   51.44 GiB |   86.05 GiB |   21.42 Mbit/s
------------------------+-------------+-------------+---------------
estimated     86.67 GiB  |  128.83 GiB |  215.50 GiB |
@ns2:~#
```

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Forum 2026

LOGs ...

```
36G -rw-r--r-- 1 root root  36G Mar 17 09:36 pdns.log
.0G -rw-r--r-- 1 root root 2.0G Oct 20  2023 pdns.log-20231020000.gz
.0G -rw-r--r-- 1 root root 2.0G Oct 21  2023 pdns.log-20231021000.gz
.0G -rw-r--r-- 1 root root 2.0G Oct 22  2023 pdns.log-20231022000.gz
.1G -rw-r--r-- 1 root root 2.1G Oct 23  2023 pdns.log-20231023000.gz
.1G -rw-r--r-- 1 root root 2.1G Oct 24  2023 pdns.log-20231024000.gz
.1G -rw-r--r-- 1 root root 2.1G Oct 25  2023 pdns.log-20231025000.gz
.1G -rw-r--r-- 1 root root 2.1G Oct 26  2023 pdns.log-20231026000.gz
.1G -rw-r--r-- 1 root root 2.1G Oct 27  2023 pdns.log-20231027000.gz
.1G -rw-r--r-- 1 root root 2.1G Oct 28  2023 pdns.log-20231028000.gz
.1G -rw-r--r-- 1 root root 2.1G Oct 29  2023 pdns.log-20231029000.gz
.0G -rw-r--r-- 1 root root 2.0G Oct 30  2023 pdns.log-20231030000.gz
.1G -rw-r--r-- 1 root root 2.1G Oct 31  2023 pdns.log-20231031000.gz
.2G -rw-r--r-- 1 root root 3.2G Apr  4  2024 pdns.log-20240404000.gz
.8G -rw-r--r-- 1 root root 1.8G May 29  2024 pdns.log-20240529000.gz
.0G -rw-r--r-- 1 root root 4.0G May 30  2024 pdns.log-20240530000.gz
.0G -rw-r--r-- 1 root root 5.0G May 31  2024 pdns.log-20240531000.gz
15G -rw-r--r-- 1 root root  15G Dec 23 00:05 pdns.log-20241223000.gz
15G -rw-r--r-- 1 root root  15G Dec 24 00:56 pdns.log-20241224000.gz
15G -rw-r--r-- 1 root root  15G Dec 25 00:57 pdns.log-20241225000.gz
.5G -rw-r--r-- 1 root root 2.5G Dec 27 00:00 pdns.log-20241227000.gz
17G -rw-r--r-- 1 root root  17G Dec 28 00:14 pdns.log-20241228000.gz
16G -rw-r--r-- 1 root root  16G Jan  4 00:04 pdns.log-20250104000.gz
.4G -rw-r--r-- 1 root root 3.4G Jan 21 01:00 pdns.log-20250121000.gz
16G -rw-r--r-- 1 root root  16G Jan 22 00:15 pdns.log-20250121w.gz
.9G -rw-r--r-- 1 root root 8.9G Feb  5 00:02 pdns.log-20250205000.gz
13G -rw-r--r-- 1 root root  13G Feb 11 00:03 pdns.log-20250211000.gz
.7G -rw-r--r-- 1 root root 6.7G Feb 15 00:01 pdns.log-20250215000.gz
16G -rw-r--r-- 1 root root  16G Feb 15 20:36 pdns.log-2025feb20-.gz
```

```
ar 17 09:57:24 3 question answered from packet cache tag=0 from 10.21.96.40:25808
ar 17 09:57:24 3 question answered from packet cache tag=0 from 10.6.143.180:1165
ar 17 09:57:24 3 question answered from packet cache tag=0 from 10.3.16.97:4009
ar 17 09:57:24 2 [3883957/38] question for 'devlog.ys7.com|A' from 10.6.91.144:329
ar 17 09:57:24 3 question answered from packet cache tag=0 from 10.18.160.40:64853
ar 17 09:57:24 3 question answered from packet cache tag=0 from 10.2.43.73:62176
ar 17 09:57:24 3 question answered from packet cache tag=0 from 10.19.161.90:50519
ar 17 09:57:24 3 question answered from packet cache tag=0 from 10.16.134.65:11718
ar 17 09:57:24 2 [3883957/38] answer to question 'devlog.ys7.com|A': 4 answers, 0
dnssec=Insecure
ar 17 09:57:24 2 question answered from packet cache tag=0 from 10.7.115.226:60395
)9:57:24 3 question answered from packet cache tag=0 from 10.15.179.249:2480
)9:57:24 3 question answered from packet cache tag=0 from 10.9.144.177:2082
)9:57:24 2 question answered from packet cache tag=0 from 10.2.16.116:48303
)9:57:24 2 question answered from packet cache tag=0 from 10.21.67.66:2284
)9:57:24 3 question answered from packet cache tag=0 from 10.2.148.66:9871
)9:57:24 2 question answered from packet cache tag=0 from 10.2.72.39:4329
)9:57:24 3 question answered from packet cache tag=0 from 10.2.16.103:15266
)9:57:24 3 question answered from packet cache tag=0 from 10.29.40.83:9399
)9:57:24 3 question answered from packet cache tag=0 from 10.1.240.43:13627
)9:57:24 3 question answered from packet cache tag=0 from 10.2.75.195:43059
)9:57:24 2 [3883958/38] question for 'm.baidu.com|A' from 10.23.0.248:62839
)9:57:24 2 question answered from packet cache tag=0 from 10.6.136.114:26462
)9:57:24 3 question answered from packet cache tag=0 from 10.8.180.227:60904
)9:57:24 2 question answered from packet cache tag=0 from 10.2.148.66:1218
)9:57:24 3 question answered from packet cache tag=0 from 10.16.32.137:12016
)9:57:24 2 question answered from packet cache tag=0 from 10.6.202.32:5604
)9:57:24 3 question answered from packet cache tag=0 from 10.18.131.83:64120
)9:57:24 2 question answered from packet cache tag=0 from 10.3.5.14:58876
)9:57:24 2 question answered from packet cache tag=0 from 10.2.42.51:46600
)9:57:24 3 question answered from packet cache tag=0 from 10.6.133.102:2016
)9:57:24 2 question answered from packet cache tag=0 from 10.2.60.11:7391
)9:57:24 3 question answered from packet cache tag=0 from 10.8.138.248:54163
)9:57:24 3 question answered from packet cache tag=0 from 10.19.49.29:25580
)9:57:24 3 question answered from packet cache tag=0 from 10.6.247.54:22241
)9:57:24 2 question answered from packet cache tag=0 from 10.3.12.211:4886
)9:57:24 3 question answered from packet cache tag=0 from 10.2.16.103:15266
)9:57:24 2 question answered from packet cache tag=0 from 10.8.83.62:32116
)9:57:24 3 question answered from packet cache tag=0 from 10.7.196.76:25622
)9:57:24 2 question answered from packet cache tag=0 from 10.2.90.133:50902
)9:57:24 2 question answered from packet cache tag=0 from 10.1.212.16:8612
)9:57:24 2 question answered from packet cache tag=0 from 10.15.149.39:50496
)9:57:24 2 question answered from packet cache tag=0 from 10.8.180.227:9961
ar 17 09:57:24 2 question answered from packet cache tag=0 from 10.8.131.105:57948
ar 17 09:57:24 3 [4550785/52] answer to question 'login.ml.youngjoygame.com|A': 1
connections, rcode=0, dnssec=Insecure
ar 17 09:57:24 2 [3883959/39] question for 'conn1.oppomobile.com|A' from 10.23.0.2
ar 17 09:57:24 3 question answered from packet cache tag=0 from 10.9.128.52:38035
ar 17 09:57:24 3 question answered from packet cache tag=0 from 10.7.160.13:34641
```

root@ns2: ~

```
Mar 17 09:55:13 2 [3854524/12] question for 'nvyfy70cbfa191ea.top|A' from 10.16.33.63:30561
Mar 17 09:55:13 3 [4515679/141] answer to question 'static-s3.vitaepurus.com|A': 3 answers, 0 additional, took 1 packets, 48.977 netw ms, 49.088 tot ms, 0 throttled, 0
 connections, rcode=0, dnssec=Insecure
Mar 17 09:55:13 3 [4515240/140] answer to question 'pull-flv-l77-gcp01.tiktokcdn.com|A': 1 answers, 0 additional, took 1 packets, 1500.03 netw ms, 1500.12 tot ms, 3 th
/0 tcp/dot connections, rcode=2, dnssec=Insecure
Mar 17 09:55:13 3 [4515689/140] question for 'imgcache.qq.com|A' from 10.15.130.130:51494
Mar 17 09:55:13 2 [3854526/13] question for 'cdn.hellosayarwon.com|HTTPS' from 10.8.178.39:9063
Mar 17 09:55:13 2 [3854527/14] question for 'reportms.singaporepaya.com|AAAA' from 10.7.4.165:56196
Mar 17 09:55:13 2 [3854528/15] question for 'tm-sdk.platinumai.net|A' from 10.18.176.27:65473
Mar 17 09:55:13 3 [4515242/140] answer to question 'pull-flv-f77-gcp01.tiktokcdn.com|A': 1 answers, 0 additional, took 1 packets, 1500.18 netw ms, 1500.27 tot ms, 3 th
/0 tcp/dot connections, rcode=2, dnssec=Insecure
Mar 17 09:55:13 3 [4515663/139] answer to question 'magazine-staticapi-cn.heytapdownload.com|AAAA': 1 answers, 0 additional, took 1 packets, 120.01 netw ms, 120.147 to
imeouts, 0/0 tcp/dot connections, rcode=0, dnssec=Insecure
Mar 17 09:55:13 3 [4515691/139] question for 'rr1.sn-npoldn76.googlevideo.com|AAAA' from 10.29.44.242:43135
Mar 17 09:55:13 3 [4515691/139] answer to question 'rr1.sn-npoldn76.googlevideo.com|AAAA': 1 answers, 0 additional, took 0 packets, 0 netw ms, 0 tot ms, 0 throttled, 0
 connections, rcode=0, dnssec=Insecure
Mar 17 09:55:13 3 [4515243/138] answer to question 'pull-flv-l77-gcp01.tiktokcdn.com|A': 1 answers, 0 additional, took 1 packets, 1500.04 netw ms, 1500.11 tot ms, 3 th
/0 tcp/dot connections, rcode=2, dnssec=Insecure
Mar 17 09:55:13 3 [4515692/138] question for 'analytics-log.withhive.com|A' from 10.7.96.3:40099
Mar 17 09:55:13 2 [3854529/16] question for 'ccleaner.tools.avcdn.net|A' from 10.15.160.221:62024
Mar 17 09:55:13 3 [4515693/139] question for 'drcn.video.cloud.huawei.com|A' from 10.7.36.16:5341
Mar 17 09:55:13 2 [3854488/16] answer to question 'pull-tsl-vr-l26.douyincdn.com|A': 14 answers, 0 additional, took 1 packets, 228.716 netw ms, 228.836 tot ms, 0 throt
tcp/dot connections, rcode=0, dnssec=Insecure
Mar 17 09:55:13 2 [3854529/15] answer to question 'ccleaner.tools.avcdn.net|A': 4 answers, 0 additional, took 1 packets, 0.826 netw ms, 1.014 tot ms, 0 throttled, 0 ti
nnections, rcode=0, dnssec=Insecure
Mar 17 09:55:13 3 [4515575/139] answer to question 'msgchannel.qunar.qunaer.com|A': 3 answers, 0 additional, took 2 packets, 468.858 netw ms, 469.047 tot ms, 0 throttl
p/dot connections, rcode=0, dnssec=Insecure
Mar 17 09:55:13 2 [3854530/15] question for 'tmfsdktcp.m.qq.com|AAAA' from 10.16.176.167:36204
Mar 17 09:55:13 2 [3854518/15] answer to question 'sdkapiv2.bizport.cn|A': 1 answers, 0 additional, took 1 packets, 48.83 netw ms, 48.9 tot ms, 0 throttled, 0 timeouts
ons, rcode=0, dnssec=Insecure
Mar 17 09:55:13 1 [826868/56] TCP question for 'dpm.demdex.net|HTTPS' from 10.7.162.180:2395
Mar 17 09:55:13 1 [826868/56] answer to question 'dpm.demdex.net|HTTPS': 3 answers, 0 additional, took 0 packets, 0 netw ms, 0 tot ms, 0 throttled, 0 timeouts, 0/0 tcp
e=0, dnssec=Insecure
Mar 17 09:55:13 1 [826869/56] TCP question for 'match.adsrvr.org|HTTPS' from 10.7.162.180:2397
Mar 17 09:55:13 1 [826869/56] answer to question 'match.adsrvr.org|HTTPS': 0 answers, 0 additional, took 0 packets, 0 netw ms, 0 tot ms, 0 throttled, 0 timeouts, 0/0 t
ode=0, dnssec=Insecure
Mar 17 09:55:13 2 [3854531/15] question for 'api-d.hiaiabc.com|A' from 10.5.4.31:20343
Mar 17 09:55:13 2 [3854531/15] answer to question 'api-d.hiaiabc.com|A': 2 answers, 0 additional, took 0 packets, 0 netw ms, 0 tot ms, 0 throttled, 0 timeouts, 0/0 tcp
e=0, dnssec=Insecure
Mar 17 09:55:13 1 [826870/56] TCP question for 'ib.adnxs.com|A' from 10.7.162.180:50258
Mar 17 09:55:13 3 [4515246/138] answer to question 'pull-flv-l77-gcp01.tiktokcdn.com|A': 1 answers, 0 additional, took 1 packets, 1500.82 netw ms, 1500.9 tot ms, 3 thr
0 tcp/dot connections, rcode=2, dnssec=Insecure
Mar 17 09:55:13 1 [826870/56] answer to question 'ib.adnxs.com|A': 14 answers, 0 additional, took 0 packets, 0 netw ms, 0 tot ms, 0 throttled, 0 timeouts, 0/0 tcp/dot
dnssec=Insecure
Mar 17 09:55:13 1 [826871/56] TCP question for 'dpm.demdex.net|A' from 10.7.162.180:50254
Mar 17 09:55:13 1 [826871/56] answer to question 'dpm.demdex.net|A': 7 answers, 0 additional, took 0 packets, 0 netw ms, 0 tot ms, 0 throttled, 0 timeouts, 0/0 tcp/dot
 dnssec=Insecure
Mar 17 09:55:13 3 [4515695/138] question for 'disc501.prod.do.dsp.mp.microsoft.com|A' from 10.6.247.100:53871
Mar 17 09:55:13 3 [4515695/138] answer to question 'disc501.prod.do.dsp.mp.microsoft.com|A': 3 answers, 0 additional, took 0 packets, 0 netw ms, 0 tot ms, 0 throttled,
ot connections, rcode=0, dnssec=Insecure
--More--
[0] 0:bash*
```

MMIX MMNOG Forum 2026

usual System Monitoring, perf: check, ..

```
root@ns1:~# uptime
 10:02:27 up  7:33,  1 user,  load average: 1.20, 1.23, 1.22
root@ns1:~# df -h
Filesystem      Size  Used Avail Use% Mounted on
tmpfs           3.2G  1.7M  3.2G   1% /run
/dev/sda2       251G  155G   84G  65% /
tmpfs            16G     0   16G   0% /dev/shm
tmpfs           5.0M     0  5.0M   0% /run/lock
tmpfs           3.2G  4.0K  3.2G   1% /run/user/0
```

admin2@ns2: ~

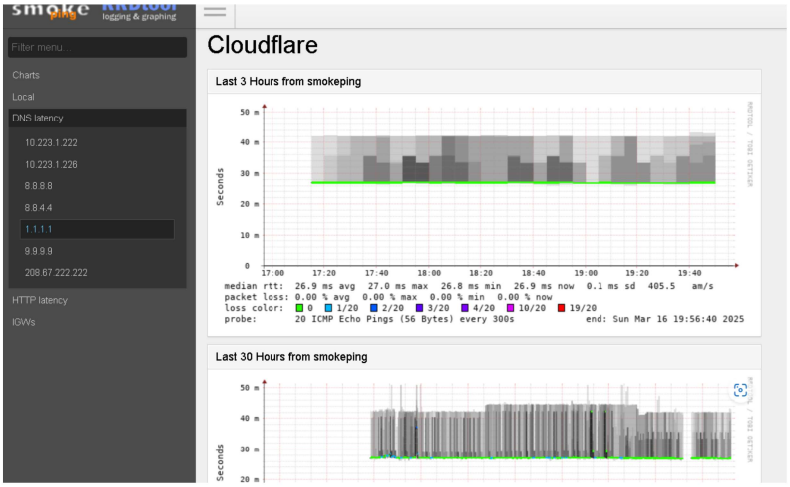
```
in2@ns2:~$ w
s160  /  hou
```

hour	rx	tx	total	avg. rate
2025-01-20				
14:00	8.51 GiB	12.30 GiB	20.82 GiB	49.67 Mbit/s
15:00	8.87 GiB	12.84 GiB	21.72 GiB	51.82 Mbit/s
16:00	9.21 GiB	13.25 GiB	22.46 GiB	53.59 Mbit/s
17:00	8.06 GiB	11.79 GiB	19.85 GiB	47.36 Mbit/s
18:00	9.95 GiB	14.69 GiB	24.64 GiB	58.79 Mbit/s
19:00	12.86 GiB	19.15 GiB	32.02 GiB	76.39 Mbit/s
20:00	15.57 GiB	23.30 GiB	38.87 GiB	92.74 Mbit/s
21:00	16.18 GiB	24.17 GiB	40.35 GiB	96.27 Mbit/s
22:00	14.68 GiB	21.49 GiB	36.17 GiB	86.30 Mbit/s
23:00	11.07 GiB	15.55 GiB	26.62 GiB	63.53 Mbit/s
2025-01-21				
00:00	8.50 GiB	11.26 GiB	19.75 GiB	47.13 Mbit/s
01:00	6.65 GiB	8.49 GiB	15.14 GiB	36.12 Mbit/s
02:00	6.53 GiB	8.02 GiB	14.55 GiB	34.72 Mbit/s
03:00	6.64 GiB	8.01 GiB	14.64 GiB	34.94 Mbit/s
04:00	6.13 GiB	7.38 GiB	13.52 GiB	32.25 Mbit/s
05:00	3.91 GiB	4.92 GiB	8.83 GiB	21.06 Mbit/s
06:00	5.00 GiB	6.67 GiB	11.68 GiB	27.86 Mbit/s
07:00	6.01 GiB	8.30 GiB	14.32 GiB	34.16 Mbit/s
08:00	6.41 GiB	9.06 GiB	15.47 GiB	36.92 Mbit/s
09:00	6.78 GiB	9.66 GiB	16.44 GiB	39.22 Mbit/s
10:00	7.46 GiB	10.66 GiB	18.12 GiB	43.23 Mbit/s
11:00	7.82 GiB	11.33 GiB	19.15 GiB	45.70 Mbit/s
12:00	8.08 GiB	11.82 GiB	19.90 GiB	47.49 Mbit/s
13:00	3.52 GiB	5.24 GiB	8.76 GiB	41.82 Mbit/s

2023-10	200.06 GiB	462.45 GiB	662.50 GiB	2.1
2023-11	452.04 GiB	997.66 GiB	1.42 TiB	4.8
2023-12	327.25 GiB	725.32 GiB	1.03 TiB	3.3
2024-01	381.03 GiB	821.44 GiB	1.17 TiB	3.8
2024-02	371.38 GiB	742.16 GiB	1.09 TiB	3.9
2024-03	432.42 GiB	795.40 GiB	1.20 TiB	3.9
2024-04	409.49 GiB	754.34 GiB	1.14 TiB	3.8
2024-05	473.83 GiB	873.73 GiB	1.32 TiB	4.3
2024-06	690.06 GiB	1.25 TiB	1.92 TiB	6.5
2024-07	399.05 GiB	734.33 GiB	1.11 TiB	3.6
2024-12	3.49 TiB	5.03 TiB	8.52 TiB	27.9
2025-01	4.01 TiB	5.67 TiB	9.68 TiB	47.9

day	rx	tx	total	avg. rat
2024-12-23	173.79 GiB	247.21 GiB	421.01 GiB	41.86 Mb
2024-12-24	175.28 GiB	249.50 GiB	424.78 GiB	42.23 Mb
2024-12-25	186.97 GiB	269.55 GiB	456.52 GiB	45.39 Mb
2024-12-26	176.03 GiB	248.14 GiB	424.18 GiB	42.17 Mb
2024-12-27	183.65 GiB	260.48 GiB	444.13 GiB	44.16 Mb
2024-12-28	221.38 GiB	312.74 GiB	534.12 GiB	53.10 Mb
2024-12-29	233.09 GiB	330.11 GiB	563.20 GiB	55.99 Mb
2024-12-30	259.36 GiB	360.61 GiB	619.96 GiB	61.64 Mb
2024-12-31	256.83 GiB	359.95 GiB	616.78 GiB	61.32 Mb
2025-01-01	208.11 GiB	294.21 GiB	502.32 GiB	49.94 Mb
2025-01-02	195.46 GiB	272.69 GiB	468.15 GiB	46.54 Mb
2025-01-03	207.80 GiB	289.45 GiB	497.25 GiB	49.44 Mb
2025-01-04	240.67 GiB	336.76 GiB	577.43 GiB	57.41 Mb
2025-01-05	202.45 GiB	284.11 GiB	486.55 GiB	48.37 Mb
2025-01-06	177.12 GiB	246.39 GiB	423.51 GiB	42.11 Mb
2025-01-07	183.55 GiB	259.25 GiB	442.80 GiB	44.02 Mb
2025-01-08	190.46 GiB	269.86 GiB	460.32 GiB	45.77 Mb
2025-01-09	193.20 GiB	274.24 GiB	467.44 GiB	46.47 Mb
2025-01-10	189.00 GiB	269.52 GiB	458.52 GiB	45.59 Mb
2025-01-11	195.21 GiB	278.64 GiB	473.85 GiB	47.11 Mb
2025-01-12	225.66 GiB	323.31 GiB	548.97 GiB	54.58 Mb
2025-01-13	195.47 GiB	277.73 GiB	473.20 GiB	47.05 Mb
2025-01-14	193.99 GiB	274.50 GiB	468.49 GiB	46.58 Mb

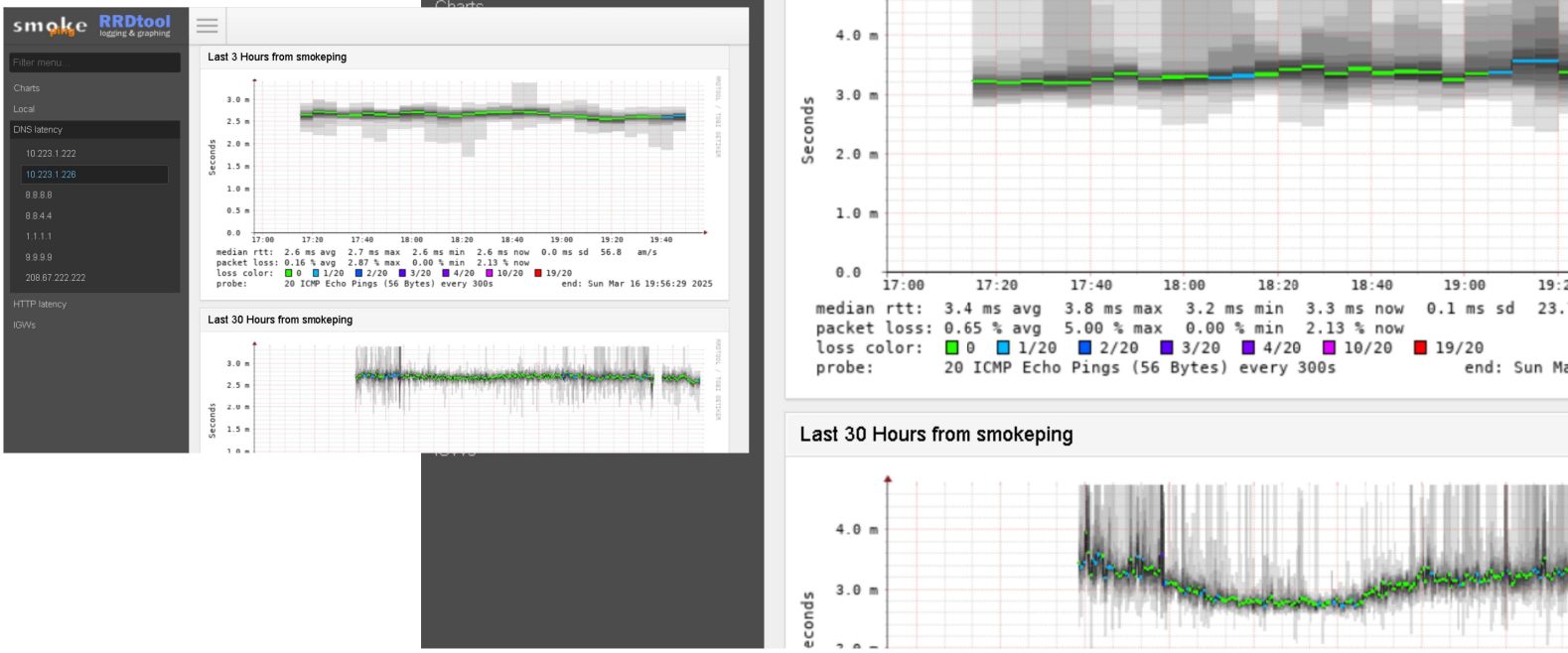
where is your resolver? How FAR away



What's better?
getting IP addr results from local/home cache?
3ms away ? or 40+ms and above?

MMIX MMNOG Forum 2026

Surfing Experience; how fast your dest: IP is kno



Common home page HTML

```
!DOCTYPE html>
html lang="en">
head>
 <meta charset="UTF-8">
 <meta name="viewport" content="width=device-width, initial-scale=1.0">
 <title>Sample Home Page</title>

 <!-- External CSS -->
 <link rel="stylesheet" href="https://stackpath.bootstrapcdn.com/bootstrap/4.3.1/css/bootstrap.min.css">
 <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/6.0.0-beta3/css/all.min.css">

 <!-- Google Fonts -->
 <link href="https://fonts.googleapis.com/css?family=Roboto&display=swap" rel="stylesheet">

 <!-- External Scripts -->
 <script src="https://code.jquery.com/jquery-3.6.0.min.js"></script>
 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js/1.14.7/umd/popper.min.js"></script>
 <script src="https://stackpath.bootstrapcdn.com/bootstrap/4.3.1/js/bootstrap.min.js"></script>

 <!-- Analytics and Tracking -->
 <script async src="https://www.googletagmanager.com/gtag/js?id=UA-XXXXXXX-X"></script>
 <script>
   window.dataLayer = window.dataLayer || [];
   function gtag(){dataLayer.push(arguments);}
```

How many DNS resolving calls were made by a web page

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Forum 2026

further readings

- https://en.wikipedia.org/wiki/Top-level_domain#Reserved_dor
- https://en.wikipedia.org/wiki/Country_code_top-level_domain
- https://www.cloudflare.com/learning/dns/dns-server-types/#recursive-dns-serv
- https://www.cloudflare.com/learning/dns/dns-records/
- https://www.cloudflare.com/learning/cdn/glossary/anycast-net
- https://docs.digitalocean.com/glossary/dns/

Thanks !!

- **Expecting … no … Questions :)**