Setting up Simple Anycast DNS Recursive Resolver for an ISP

Saw Yan Paing

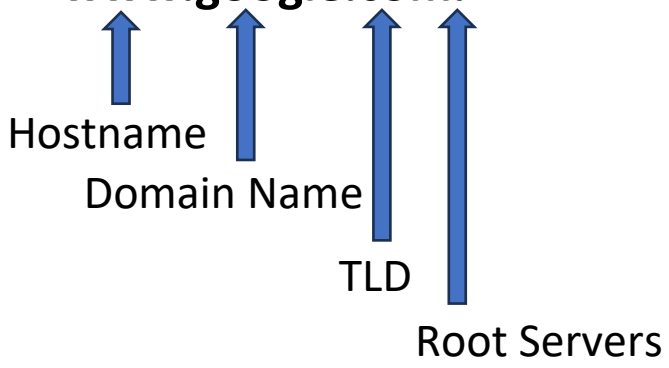
CCIE# 57007

MMIX

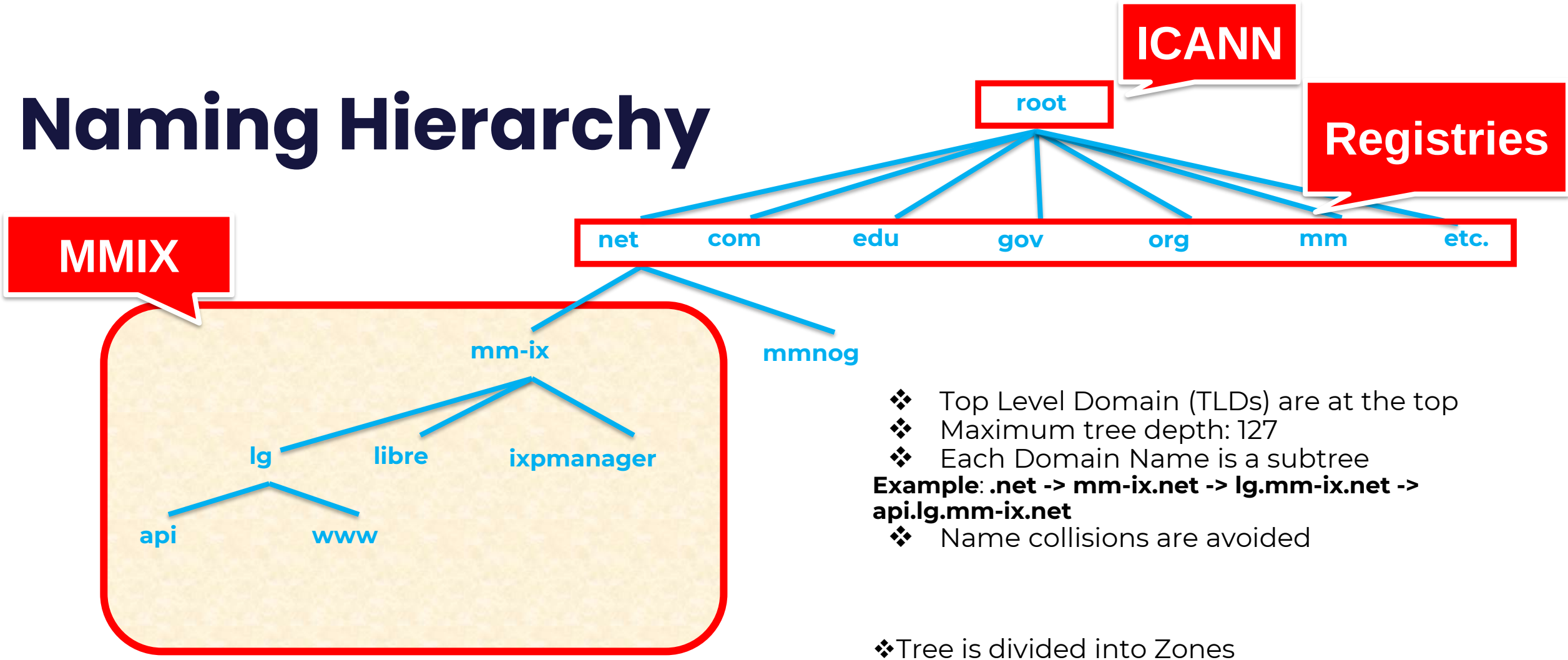
What is DNS?

- Resolve a fully qualified domain name (FQDN) to an IP Address IPs.
- hierarchical and decentralized naming system.

Example FQDN : **www.google.com.**



Naming Hierarchy



- Top Level Domain (TLDs) are at the top
- Maximum tree depth: 127
- Each Domain Name is a subtree

Example: **.net -> mm-ix.net -> lg.mm-ix.net -> api.lg.mm-ix.net**

- Name collisions are avoided

- Tree is divided into Zones
  - Each zone has an administrator
  - Responsible for the part of the hierarchy

Example:

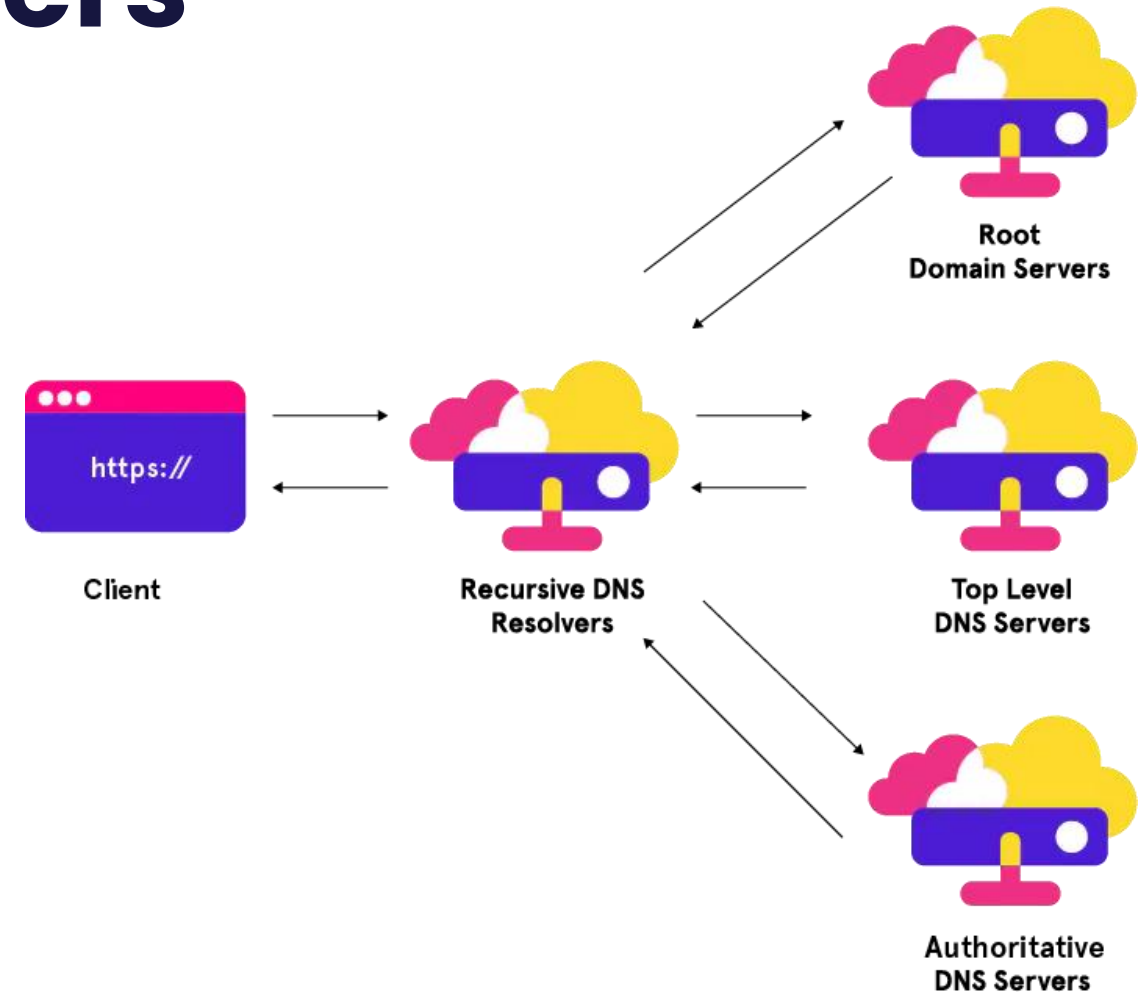
MMIX controls *.mm-ix.net
MMNOG controls *.mmnog.net

Without DNS.....?

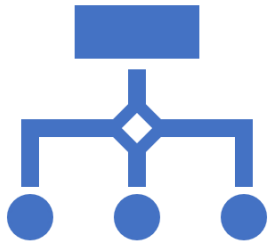
How could you get any websites?

Types of DNS servers

1. **Recursive resolver**
2. **DNS root name server**
3. **TLD name server**
   - generic TLDs (gTLDs)
   - Sponsored TLDs
   - Non-sponsored TLDs
   - Country Code TLDs (ccTLDs)
   - Internationalized TLDs
4. **Authoritative name server**



What is a Recursive DNS Server?

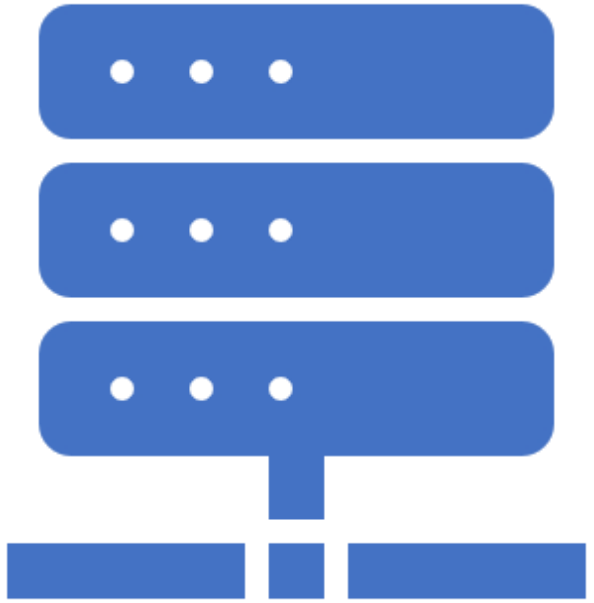


A recursive DNS server, also known as a recursive resolver or simply a resolver, is a fundamental component of the Domain Name System (DNS) infrastructure.

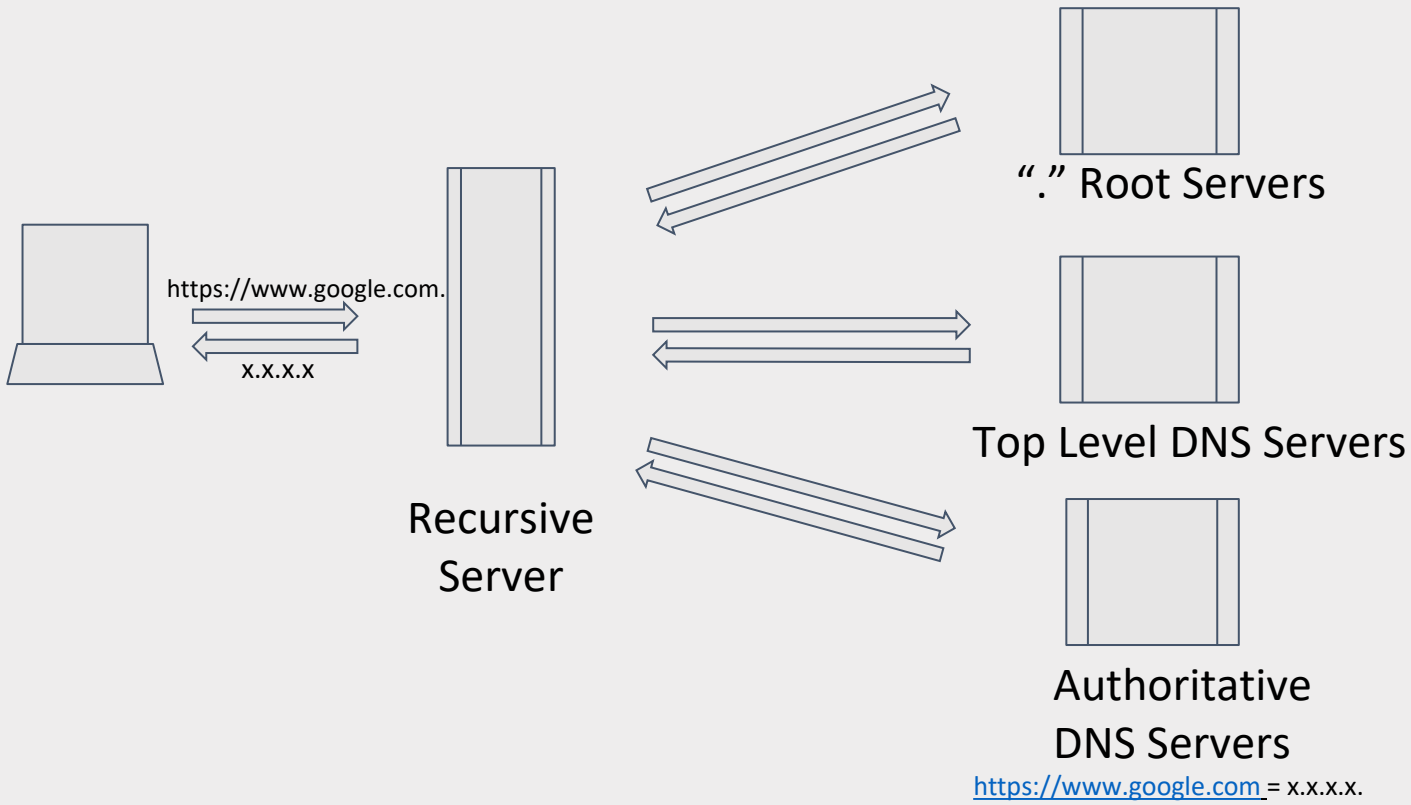
It’s is responsible for resolving the query. It starts by querying the root DNS servers, which point it to the appropriate Top-Level Domain (TLD) DNS server. The TLD server then directs the recursive server to the authoritative DNS server for the specific domain.

Recursive DNS Server's Mission:

- Is to efficiently and reliably resolve domain names to their corresponding IP addresses.
- It is emphasized that Name resolution, Caching, Query forwarding,...etc.
- Describe it as the essential intermediary that makes internet navigation seamless for users.



- **Here's the example picture how "Recursive DNS Server" works:**



Different between “Authoritative DNS Server” and “Recursive DNS Server”

	Authoritative DNS Server	Recursive DNS Server
Function	Provide official DNS records for a particular domain	Help resolve domain names to IPs by querying authoritative DNS servers.
Responsibility	Store and maintain DNS records for the domains	Don't store official records; they retrieve and cache info from authoritative servers.
Queries	respond to queries about specific domains with the accurate DNS records.	Issue queries to authoritative DNS servers to find the IP address associated with a domain.
Caching	don't typically cache records for other domains	Cache the results of queries to speed up future lookups.

Advantages of
“ Local Recursive Resolver”

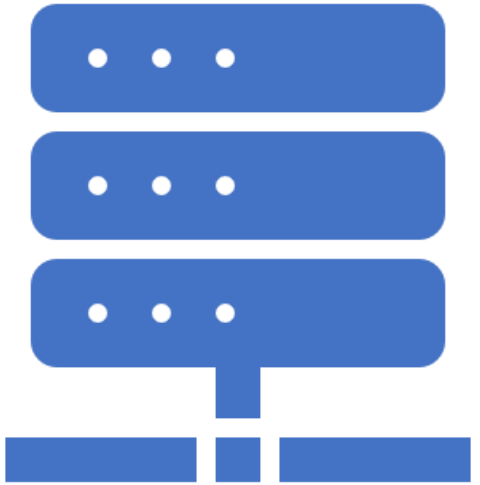
Efficient Name Resolution

Reduced Network Traffic

Improved User Experience

Load Balancing & Redundancy

...etc.



What is Anycast?

- Network routing method!
  - Multiple routing paths to a group of endpoints that are each assigned the same IP address.

- Route to one of several destinations / one-to-one-of-many association.
  - Routing is determined by one of two schemes:

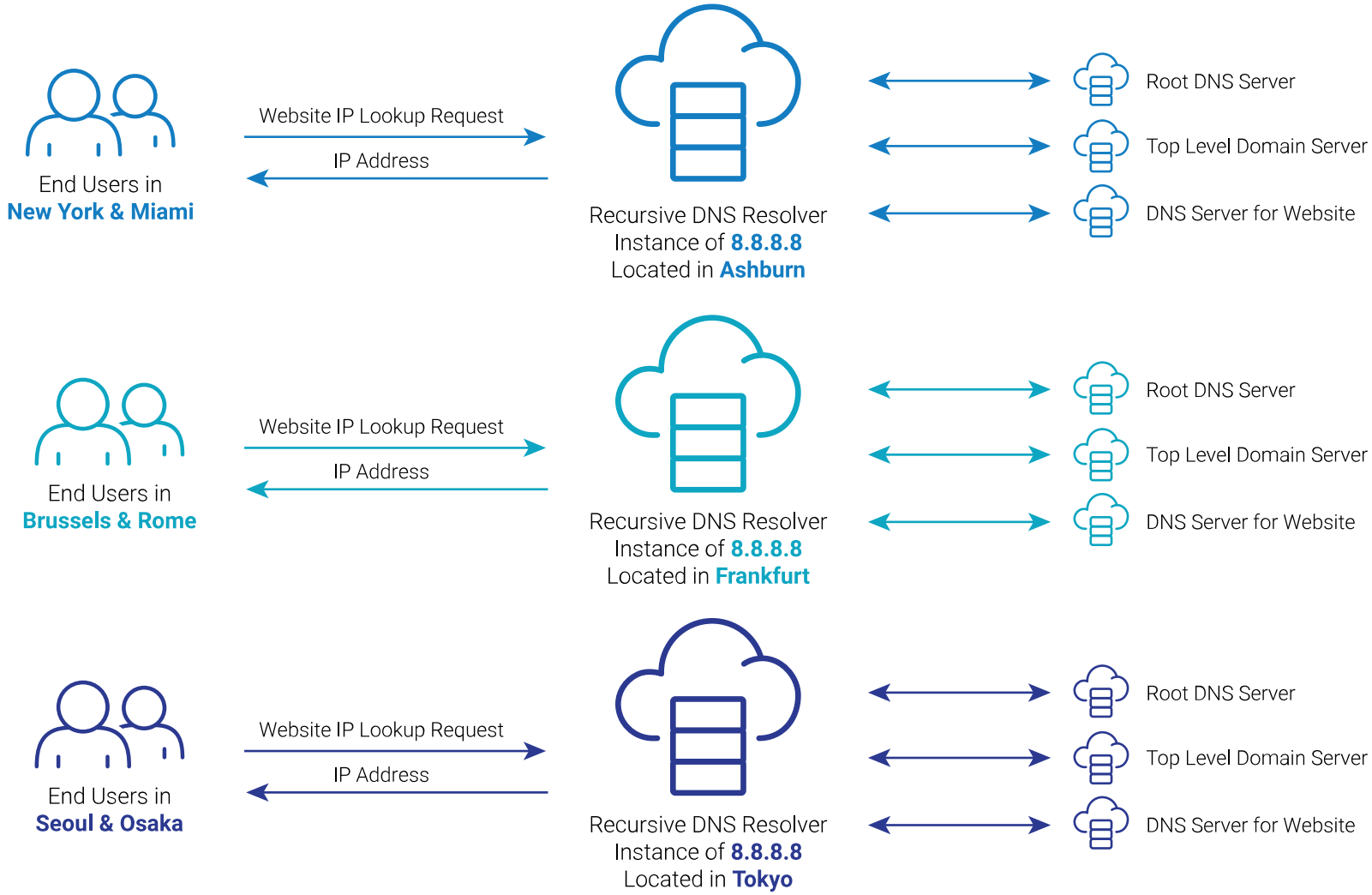
    Network Layer Anycast scheme: the router selects a destination optimal for the user and provider, based on number of hops.

    Application Layer Anycast scheme: the router may also take into account additional calculations, such as server availability, time to response, number of connections, and so on.

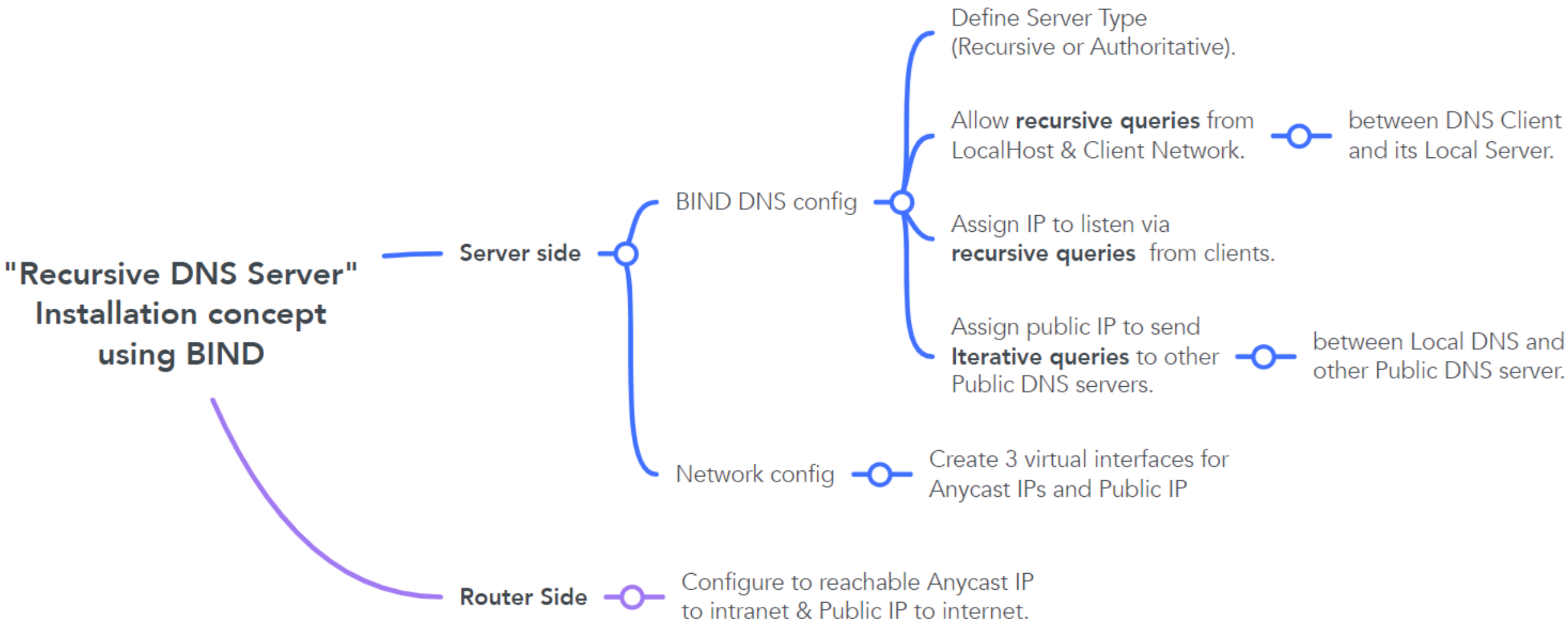
Why use Anycast with DNS?

- With Anycast DNS, we can enable a group of DNS servers with single IP address, to respond to DNS queries based on the geographical location of a DNS client.
- Benefits of the DNS anycasting:
  - Enhancing DNS response time
  - Simplify DNS client settings
  - Extra layer of redundancy
  - Protect against DNS denial of service attacks

Anycasting of the well-known public recursive DNS service



Recursive DNS Server Installation concept.



Recursive DNS Server Installation concept.

recursion
- To define Authoritative server or Recursive DNS Server.

allow-query
- To allow who can query the domain to this server.

listen-on
- To listen client DNS queries

query-source
- To send query to another DNS server.

Recursive DNS Server Installation Example.

- Network Configuration

$ IP addr

```
ens3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fqcodel state UP group default qlen 1000
    link/ether 00:50:01:00:16:00 brd ff:ff:ff:ff:ff:ff
    inet 172.16.1.2/24 brd 172.16.1.255 scope global ens3
       valid_lft forever preferred_lft forever
    inet6 fe80::250:1ff:fe00:1600/64 scope link
       valid_lft forever preferred_lft forever
any10.vip: <BROADCAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc noqueue state UNKNOWN group default qlen 1000
    link/ether 0e:f0:e8:74:2e:69 brd ff:ff:ff:ff:ff:ff
    inet 10.10.10.10/32 scope global any10.vip
       valid_lft forever preferred_lft forever
    inet6 fe80::cf0:e8ff:fe74:2e69/64 scope link
       valid_lft forever preferred_lft forever
any11.vip: <BROADCAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc noqueue state UNKNOWN group default qlen 1000
    link/ether 3a:e7:76:ec:28:13 brd ff:ff:ff:ff:ff:ff
    inet 11.11.11.11/32 scope global any11.vip
       valid_lft forever preferred_lft forever
    inet6 fe80::38e7:76ff:feec:2813/64 scope link
       valid_lft forever preferred_lft forever
public.vip: <BROADCAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc noqueue state UNKNOWN group default qlen 1000
    link/ether 22:94:a7:80:e7:e2 brd ff:ff:ff:ff:ff:ff
    inet 103.103.1.1/32 scope global public.vip
       valid_lft forever preferred_lft forever
    inet6 fe80::2094:a7ff:fe80:e7e2/64 scope link
       valid_lft forever preferred_lft forever
```

Recursive DNS Server Installation Example.

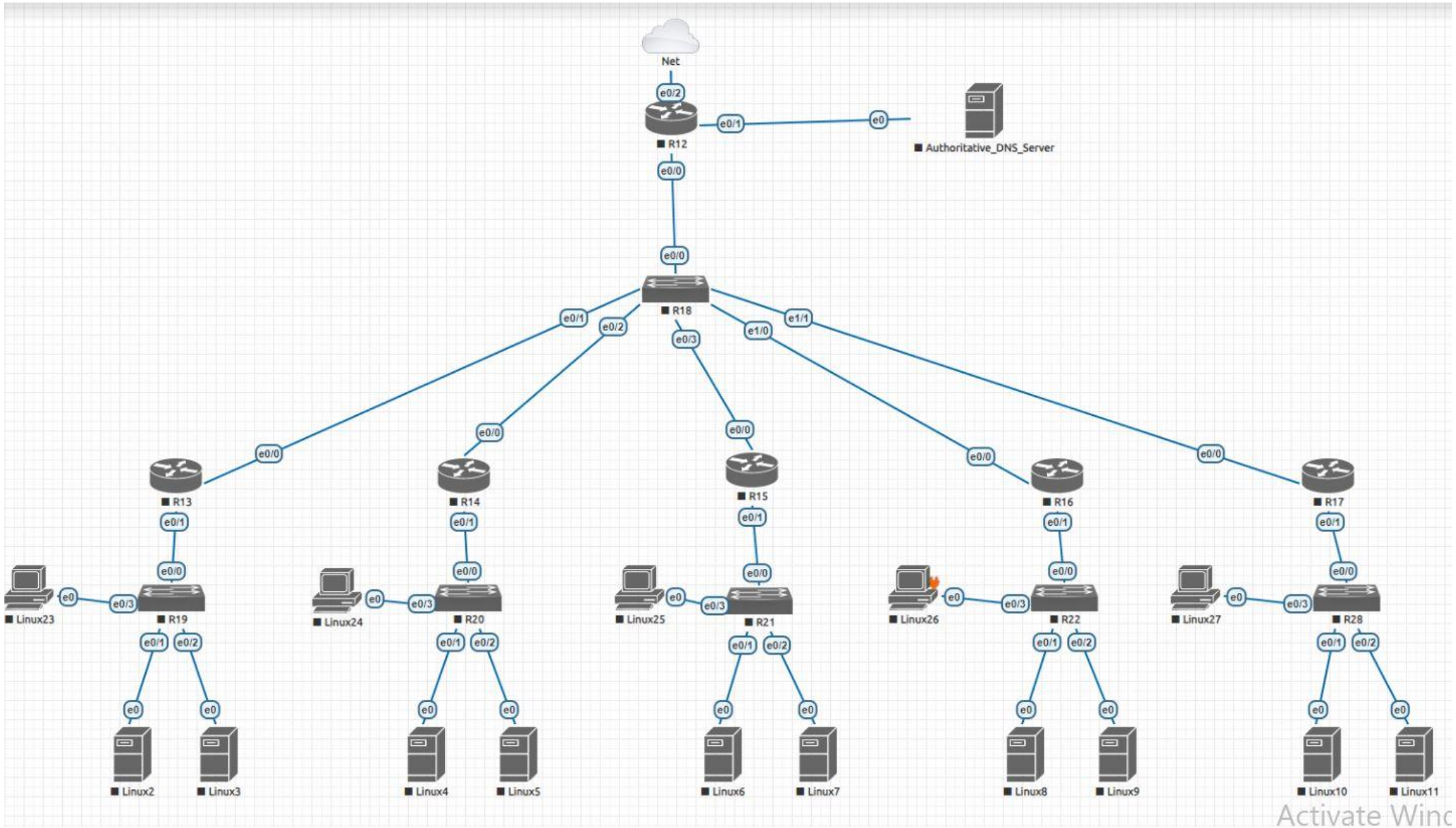
- Bind DNS Configuration

/etc/bind/named.conf.options

```
options {
        directory "/var/cache/bind";
        recursion yes; // allow recursive queries
        allow-query { localhost; 172.16.255.0/24; }; // allow queries from localhost and client network
        listen-on { localhost; 10.10.10.10; 11.11.11.11; }; // allow server IPV4 address to listen DNS queries from client
        query-source 103.103.1.1; //Specific IP address for DNS Server Outbound Query

        dnssec-validation auto;

        listen-on-v6 { any; };
};

logging{
        channel query logging {
                file "/var/log/named/query.log" versions 3 size 10m;
                severity debug 3;
                print-time yes;
                print-severity yes;
                print-category yes; };
        category queries {
                query logging; };
};
```

summary

- What is “Recursive DNS Server”
- How does it work.
- Advantages of Local Resolver.
- Different between Authoritative & Recursive DNS server.
- Advantages of enabling Anycast on DNS service.
- Recursive DNS server installation concept and example configuration using by BIND DNS software.



Thank you