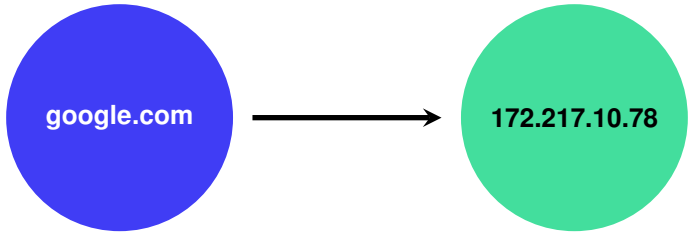
Domain Name System

Name resolution in a network

Richard Berger, 2021

Name resolution

Resolving a fully qualified domain name (FQDN) to its IP address



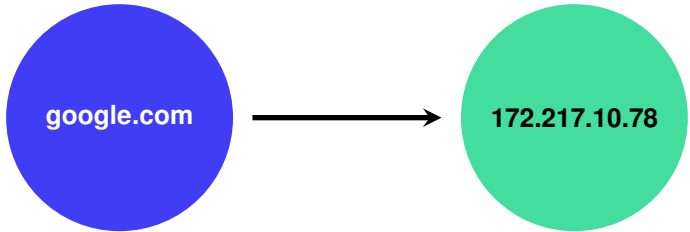
DNS: The Internet's Phonebook

Fully Qualified Domain Name (FQDN)	IPv4 Address
apple.com	17.253.144.10
amazon.com	176.32.103.205
google.com	142.250.64.78
microsoft.com	40.112.72.205

- networks use **Domain Name System (DNS) servers** to perform lookups
- a widely used DNS server implementation is BIND (Berkeley Internet Name Domain), also known as *named* (short for Name Daemon).
- UDP/TCP port 53

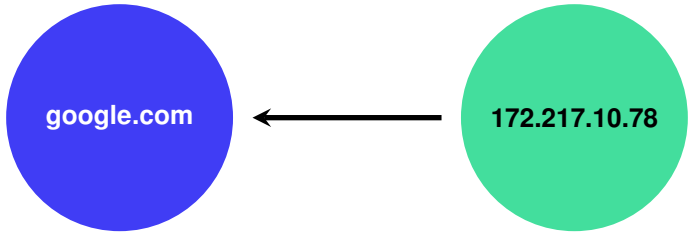
Forward Lookup

Resolving a fully qualified domain name (FQDN) to its IP address



Reverse Lookup

Finding the fully qualified domain name (FQDN) of an IP address



Fully Qualified Domain Name (FQDN)

www.hpc.temple.edu

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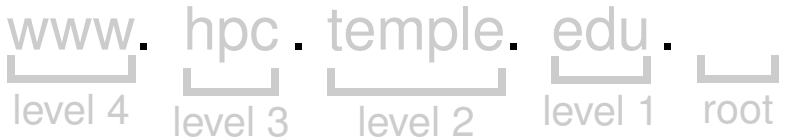

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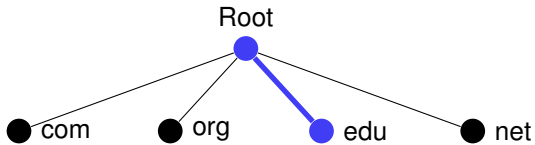

Top-Level Domains

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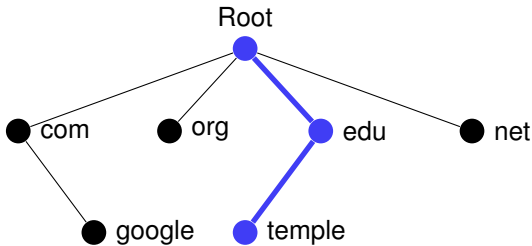

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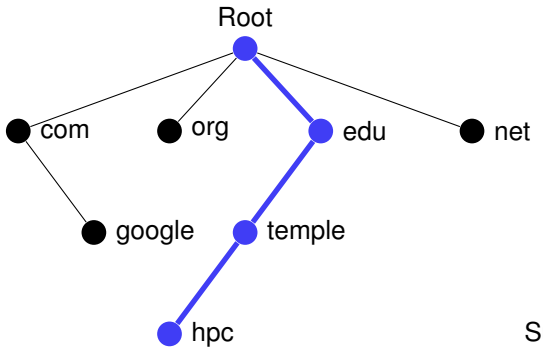


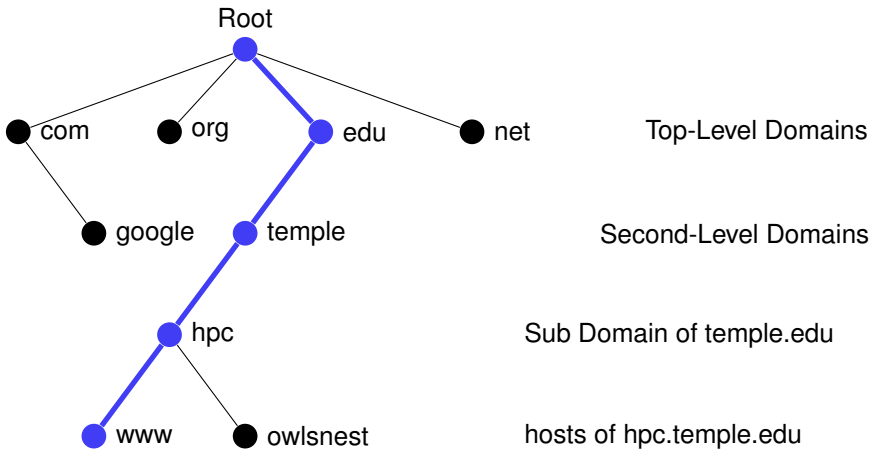
Top-Level Domains

Second-Level Domains

Sub Domain of temple.edu

Fully Qualified Domain Name (FQDN)

www.hpc.temple.edu.



How a DNS query works: `www.google.com.`

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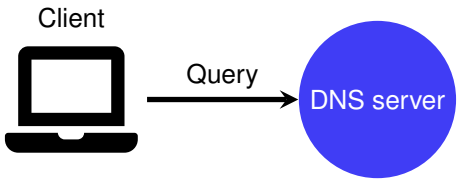

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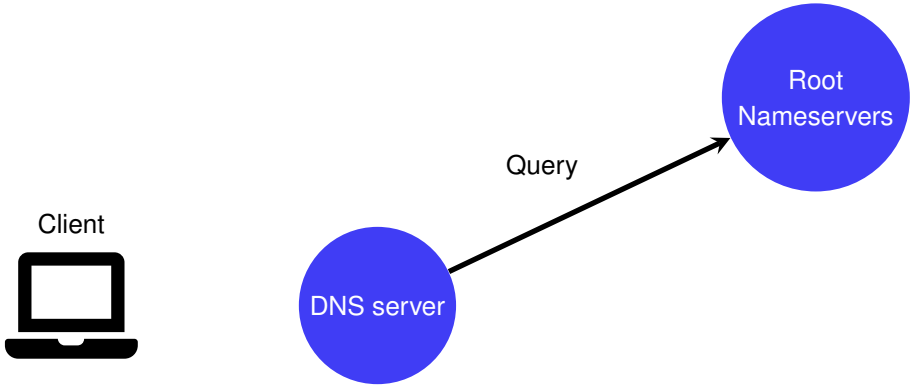

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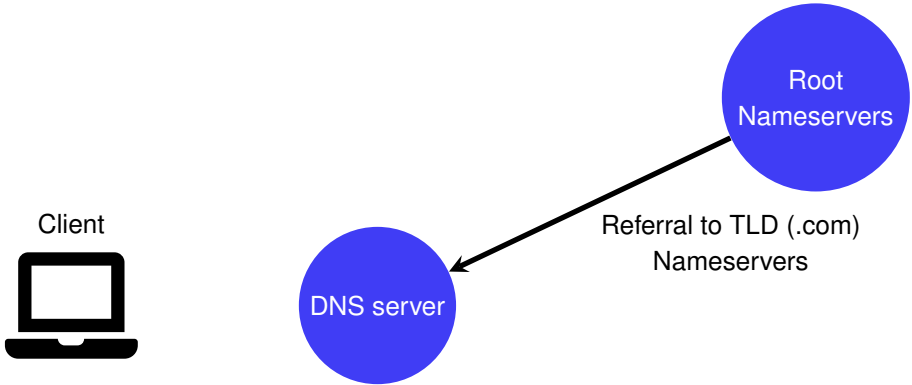

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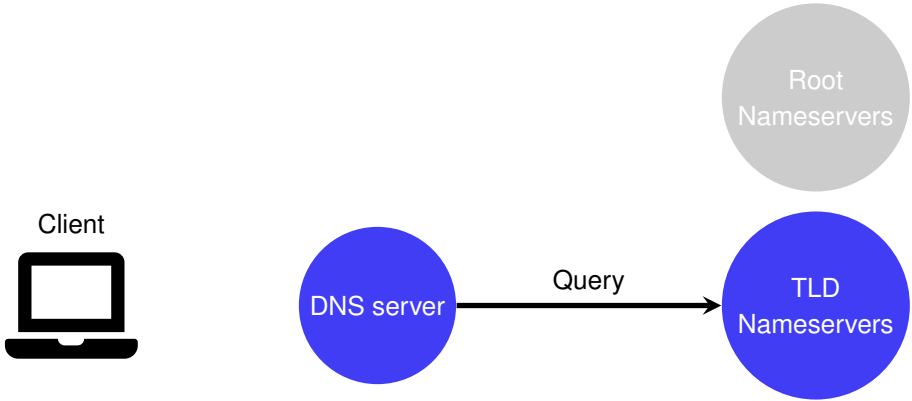

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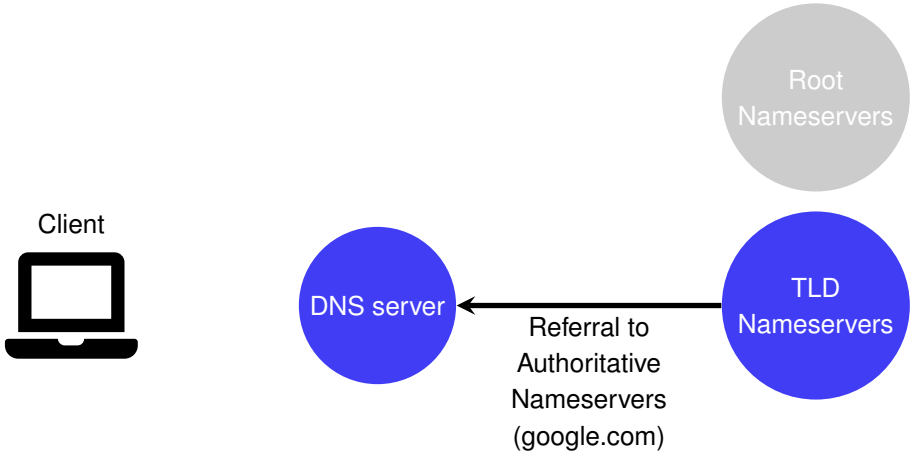

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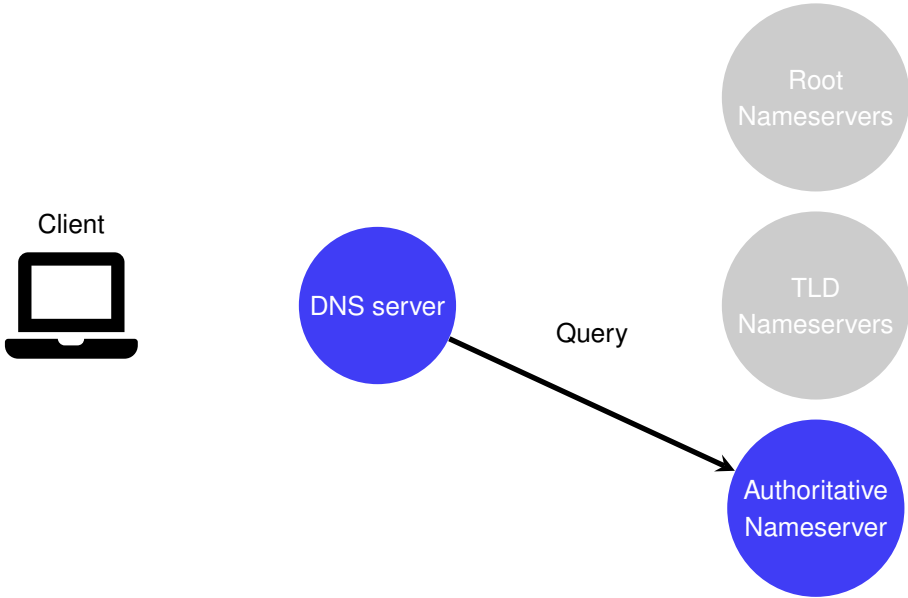

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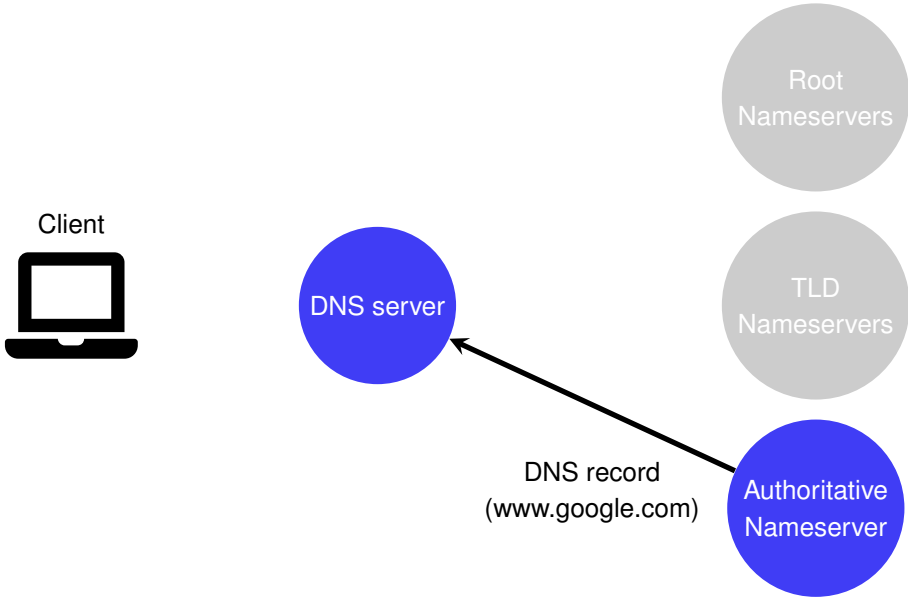

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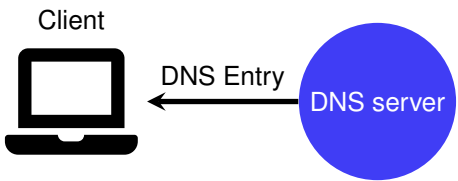


Root Nameservers

TLD Nameservers

Authoritative Nameserver

Inspecting DNS queries with `host` and `dig`

```
[root@master ~]# host www.google.com
www.google.com has address 172.217.12.164
www.google.com has IPv6 address 2607:f8b0:4006:81a::2004

[root@master ~]# dig www.google.com
...
;; QUESTION SECTION:
;www.google.com.                        IN      A

;; ANSWER SECTION:
www.google.com.         300     IN      A       172.217.12.164
...
```

DNS records

Address (A): Returns a 32bit IP address for a given name

```
; this defines www.google.com
www.google.com.      IN  A      172.217.12.164
```

IPv6 Address (AAAA): Returns a 128bit IPv6 address for a given name

```
; this defines the IPv6 address of www.google.com
www.google.com.  IN  AAAA     2607:f8b0:4006:81a::2004
```

DNS records

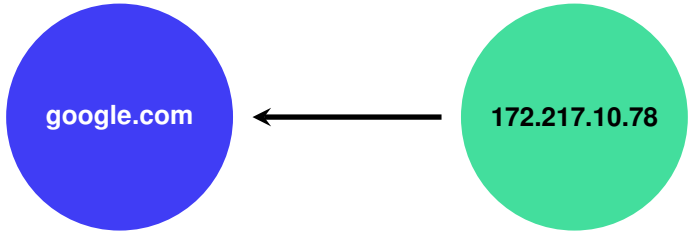
Name Server (NS): The authoritative nameserver for a given domain

```
google.com.   IN  NS  ns1.google.com.
google.com.   IN  NS  ns2.google.com.
google.com.   IN  NS  ns3.google.com.
google.com.   IN  NS  ns4.google.com.
```

Canonical Name (CNAME): Alias one name to another

```
; ntp.example.com -> master.example.com
ntp.example.com.     IN  CNAME master.example.com.
```

Reverse Lookup



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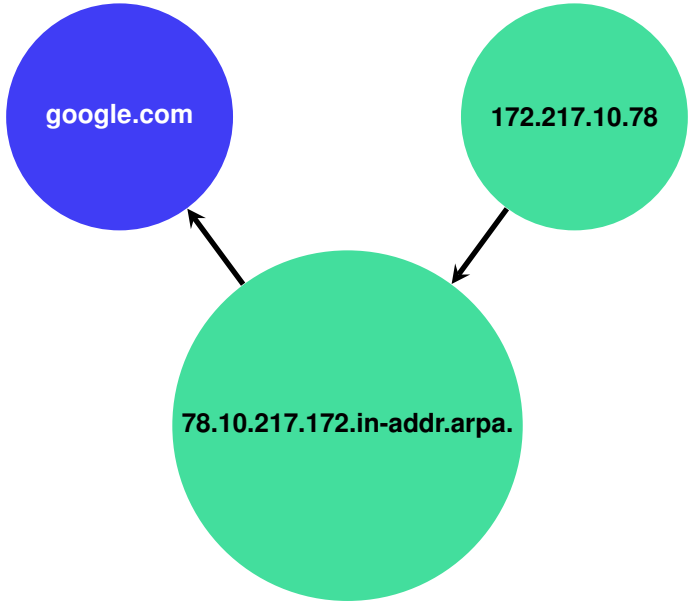

DNS PTR records for reverse lookup

Pointer (PTR): Pointer records point an IP to a canonical name and are used in reverse DNS lookups.

```
; 192.168.1.1 -> master.hpc.
1.1.168.192.in-addr.arpa.  IN  PTR  master.hpc.
```

Inspecting reverse DNS queries with `host` and `dig`

```
[root@master ~]# host 192.168.17.1
1.17.168.192.in-addr.arpa domain name pointer t301.hpc.

[root@master ~]# dig -x 192.168.17.1
...
;; QUESTION SECTION:
;1.17.168.192.in-addr.arpa.     IN      PTR

;; ANSWER SECTION:
1.17.168.192.in-addr.arpa. 300  IN      PTR     c01.hpc.
...
```