

**DNS Translation**

Up until now, we have been focused on delivering content and running web services. However, how does the user get to our service?!

- IP Protocol (Layer 3):
  
- User-Supplied Address:

**DNS:**

**Website Address vs. IP Address:**

**Fully Qualified Domain Name (FQDN):**

All DNS lookups are done based on a Fully Qualified Domain Name (FQDN). A FQDN has several properties always present:

- Does **NOT** contain protocol information:
  
- “Fully Qualified”:
  
- Comprised of multiple hierarchical levels:
  - Top-Level Domain (TLD):
  - Second-Level Domain (SLD/2LD):
  - Sub-Domains:

**DNS Record**

A DNS record is a dictionary-like structure with a key (“record type”) and an associated value and “Time to Live” (TTL) for age-based caching.

- Time To Live (TTL) Value:
  
- Records and Values:
  - A Record:
  - AAAA Record:
  - NS Record:
  - MX Record:
  - TXT Record:

DNS Record for illinois.edu		
Record Type	Value	TTL
A		
AAAA		
MX		
NS		
TXT		

DNS Record for cs.illinois.edu		
Record Type	Value	TTL
A		
AAAA		
MX		
NS		
TXT		

**DNS Resolution:** How do we retrieve DNS records so we can translate a domain name into an IP address?

- [Scale Problem]:

**Piece #1: DNS Root Servers:** There are only 13 authoritative root DNS servers in the world (as of 2021), managed by the International Assigned Numbers Authority (IANA):

Host Name	IP Address	Operator
a.root-servers.net	198.41.0.4, 2001:503:ba3e::2:30	Verisign, Inc.
b.root-servers.net	199.9.14.201, 2001:500:200::b	University of Southern California, Information Sciences Institute
c.root-servers.net	192.33.4.12, 2001:500:2::c	Cogent Communications
d.root-servers.net	199.7.91.13, 2001:500:2d::d	University of Maryland
e.root-servers.net	192.203.230.10, 2001:500:a8::e	NASA (Ames Research Center)
f.root-servers.net	192.5.5.241, 2001:500:2f::f	Internet Systems Consortium, Inc.
g.root-servers.net	192.112.36.4, 2001:500:12::d0d	US Department of Defense (NIC)
h.root-servers.net	198.97.190.53, 2001:500:1::53	US Army (Research Lab)
i.root-servers.net	192.36.148.17, 2001:7fe::53	Netnod
j.root-servers.net	192.58.128.30, 2001:503:c27::2:30	Verisign, Inc.
k.root-servers.net	193.0.14.129, 2001:7fd::1	RIPE NCC
l.root-servers.net	199.7.83.42, 2001:500:9f::42	ICANN
m.root-servers.net	202.12.27.33, 2001:dc3::35	WIDE Project

- Purpose of Root Name Servers:

**Phase #2: TLD Name Servers:** A collection of 1,502 (as of April 2021) valid top-level domain name servers. (ICANN maintains registration and approval for all TLDs.)

- Purpose of TLD Name Servers:

**Phase #3: SLD/2LD Name Servers:** When you “purchase” a domain name, part of the cost goes to maintaining your entry in the Domain Name System that points to your name server.

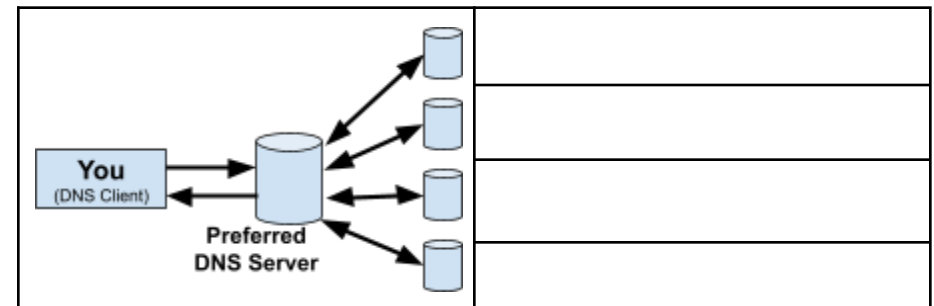
- Purpose of Second Level Domain Name Servers:

### DNS Record Caching

When you connect to the Internet, the protocol that initializes your connection will provide the IP address to a local DNS server called your “Preferred DNS Server”.

- Local:
- Intermediate Name Servers:
- Can be user-defined (ex: 1.1.1.1, 8.8.8.8, “Public DNS servers”):

### DNS Caching:



**Q1:** What servers must be contacted the first time that you visit **d7.cs.illinois.edu** if the cache is completely empty?

**Q2:** What servers must be contacted the second time that you visit **d7.cs.illinois.edu** after just a short time?

**Q3:** What servers must be contacted when you visit **waf.cs.illinois.edu** after the above requests?