ET0730

Chapter 6
Domain Name System (DNS)

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Objectives

- Explain why DNS service is needed.
- Explain how DNS service works.
- Identify different parts of a domain name.
- Describe the DNS Hierarchy.

Outline

- Why do we need DNS?
- How does DNS service work?
- Benefits of Using DNS
- Domain Names
- Hierarchy of DNS
- DNS Caching
- Domain Names Registration

Can We Remember IP Addresses?

- Which set of information would you remember better?

Domain Names:	versus	**IP Addresses:**
www.yahoo.com		106.10.139.246
www.cnn.com		103.245.222.73
www.sp.edu.sg		104.16.24.173

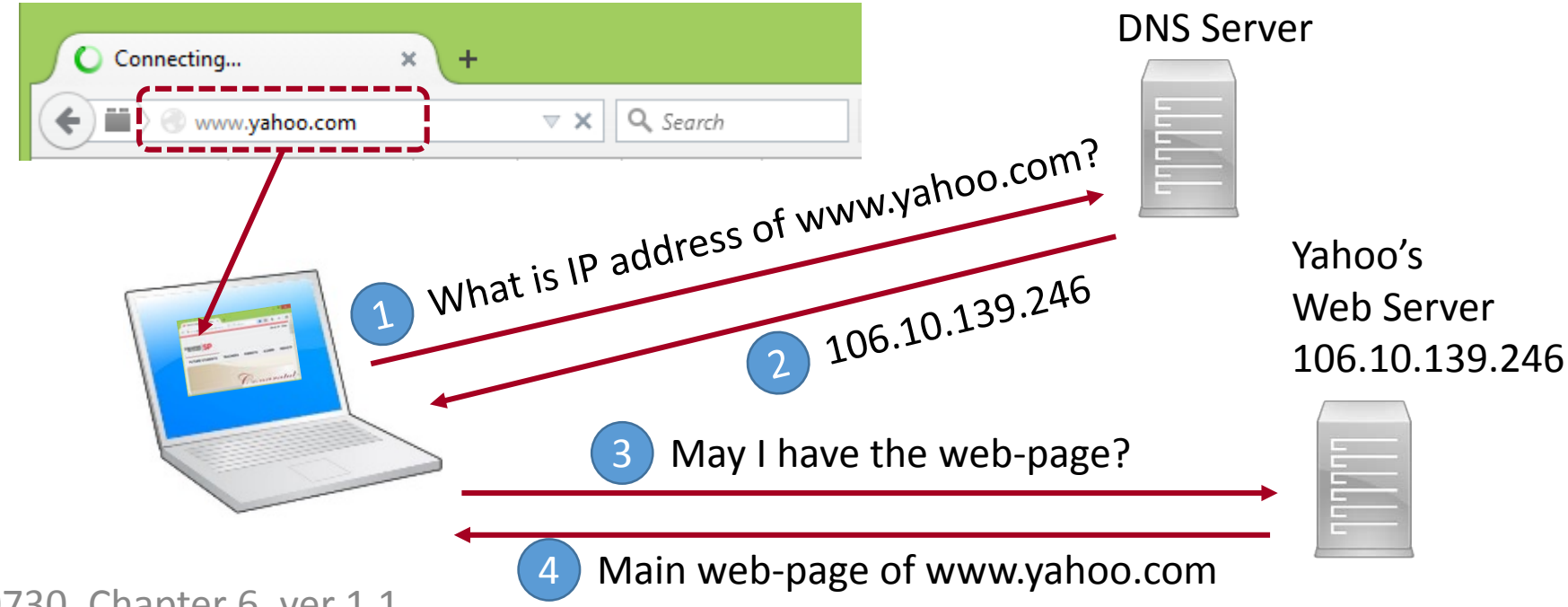
- Most of us find it hard to remember IP addresses. Therefore, "domain names" are used to represent IP addresses.
- The service to resolve domain name to IP address is Domain Name System (DNS) service.

Introduction to Domain Name System (DNS)

https://www.youtube.com/watch?v=72snZctFFtA

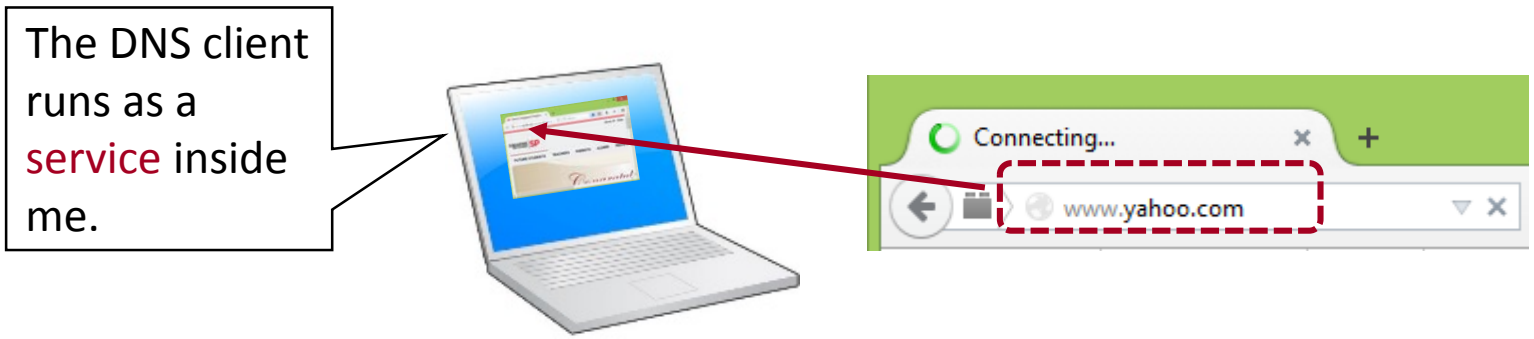
How does DNS service work?

- When a domain name is entered into the web browser, a domain name query (known as "DNS Query") is sent to a DNS Server.
- The DNS Server returns the IP address associated to the domain name.
- The web browser sends a request to the IP address (web-server) for the web-page.



DNS Service

- DNS service is responsible for domain name to address resolution.
- DNS uses servers to resolve the domain names associated with IP addresses.
- DNS is a client/server service.
- The DNS client runs as a service in the computer where the web browser is running.
- Besides web-browsing, the DNS client also supports name resolution for other network applications and services that need it.



Benefits of Using DNS

- Domain names are much easier to remember than IP addresses.
- IP address of a web-site may change (for example, a backup web-server is used), but the domain name remains the same.
  - Just need to link the IP address of the new server to the existing domain name.
  - The IP address change is transparent to the users.

Where & How are the Domain Names kept?

- DNS servers manage a massive database that maps domain names to IP addresses.
- DNS servers store different types of **resource records** used to resolve names.
- A resource record contains:
  - name
  - address
  - type of record

Resource Record Types (1)

- Some examples of Resource Record types:
  - **A (Address)**
    - An end device address. Use an “A record” if you want to assign an IP to a domain NAME or subdomain name.
  - **MX (Mail Exchange)**
    - Maps a domain name to a list of mail exchange servers for that domain.
    - When an e-mail message is sent through the Internet, the sending mail transfer agent makes a DNS query requesting the MX records for each recipient's domain name (the portion of the e-mail address following the "@“).
    - DNS server returns a list of mail exchange servers accepting incoming mail for that domain, together with a preference number.

Resource Record Types (2)

- More examples of Resource Record types:
  - **NS (Authoritative Name Server)**
    - A name server that can give an authoritative answer to a DNS query, and not just a cached answer that was given by another name server.
  - **CNAME (Canonical Name)**
    - Also known as “Fully Qualified Domain Name”.
    - Used for an alias, when multiple services have a single network address, but each service has its own entry in DNS.

What's in a Domain Name? (1)

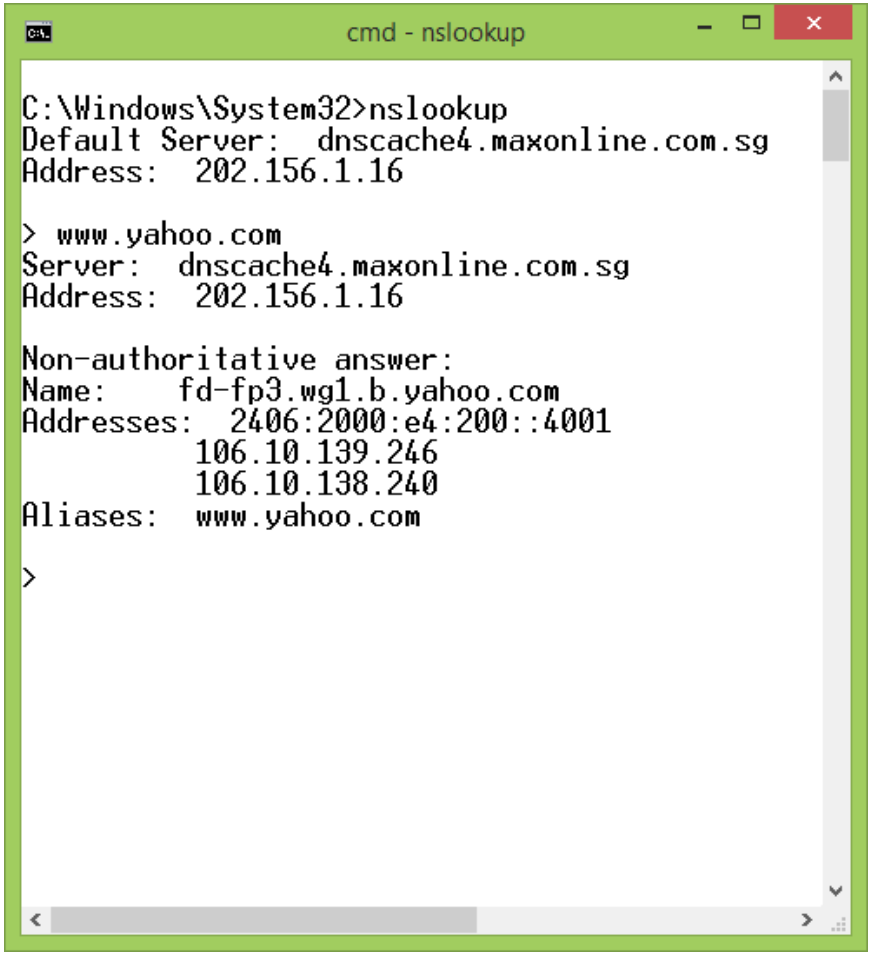
- Domain names are strings of characters separated by dots. Example: www.yahoo.com
- The last word in a domain name (example, "com" in "www.yahoo.com") represents a Top-level Domain (TLD).
- TLDs are controlled by the IANA in the Root Zone Database.
- Some common TLDs:
  - COM - Commercial Web sites, though open to everyone.
  - NET - Network Web sites, though open to everyone.
  - ORG - Non-profit organization Web sites, though open to everyone.
  - EDU - Restricted to schools and educational organisations.
  - GOV - Restricted to the U.S. government.
  - SG, MY, UK and other two-letter country codes
    - Known as "ccTLD".
    - Each is assigned to a domain name authority in the respective country.

What's in a Domain Name? (2)

- In a domain name, each word and dot combination added before a TLD indicates a level in the domain structure.
- Each level refers to a server or a group of servers that manage that domain level.
- The left-most word in the domain name (e.g. www or mail) is a host name.
  - A given domain can have many host names as long as they're all unique to that domain.
- Example: www.yahoo.com
  - .com = TLD
  - yahoo = second-level domain
  - www = a host name

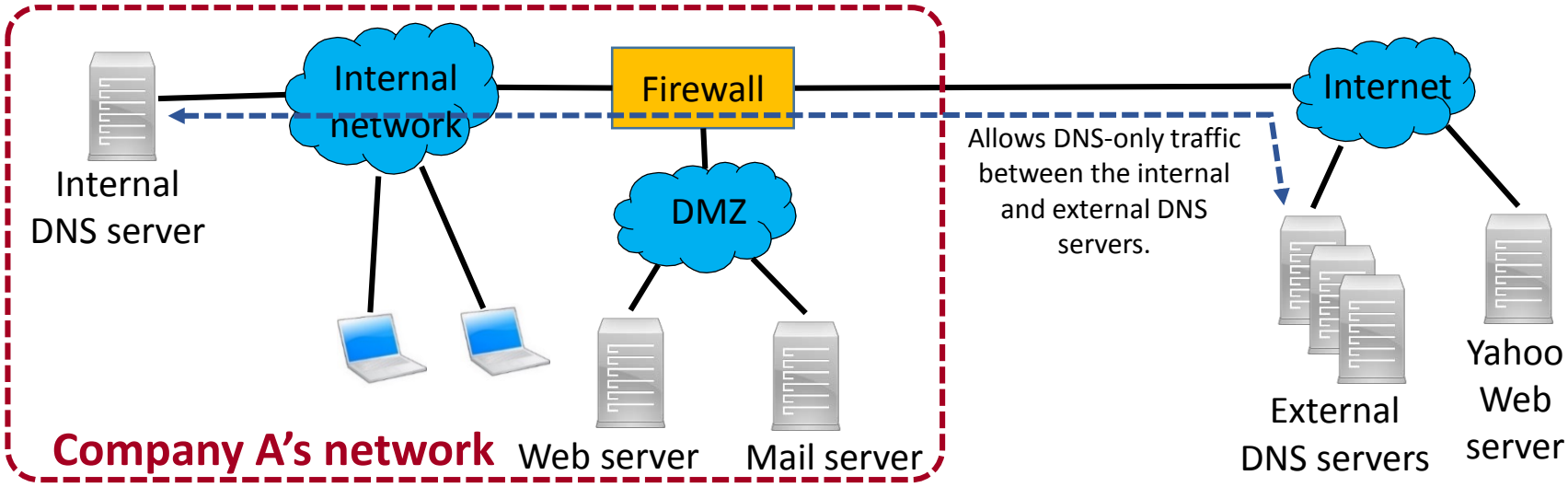
DNS Service In Action

- Windows Operating System has a utility called nslookup that can be used to manually query the name servers to resolve a domain name.
- Example:
  - A query is made for www.yahoo.com. The responding name server returns the address of 106.10.139.246.
  - It also shows the IP address of the DNS server in use.



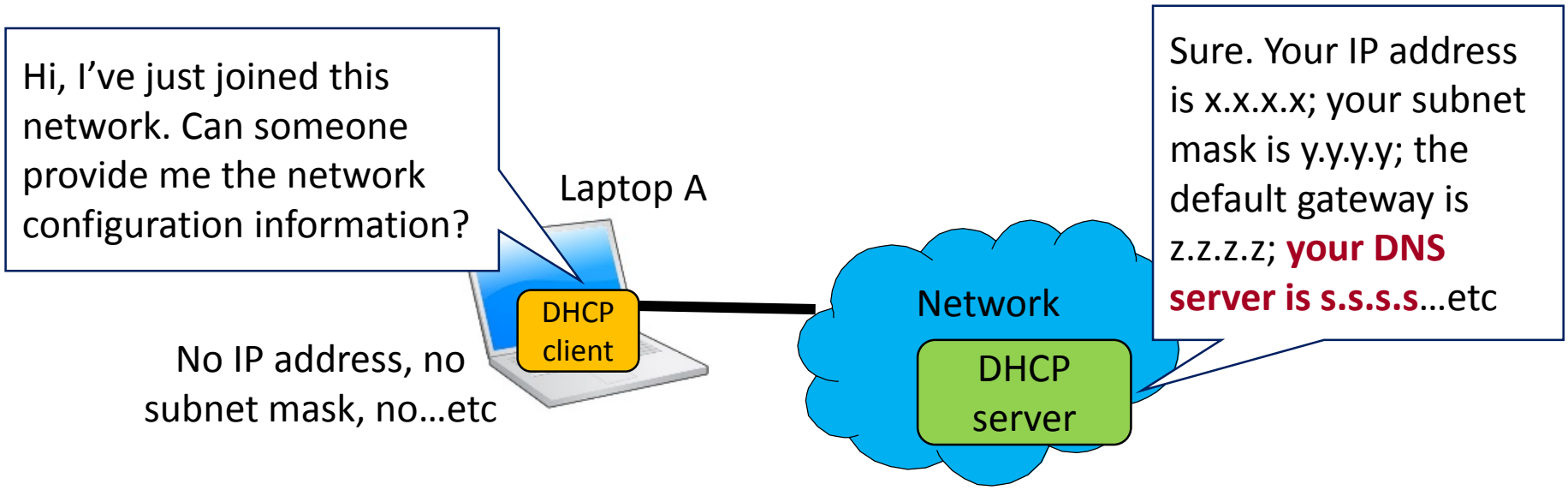
Where are the DNS servers?

- DNS servers can be internal or external.
- Example:
  - Internal DNS server knows names and addresses of all internal hosts inside Company A's network.
  - External DNS servers know names and addresses of Company A's mail server, web server, and firewall.



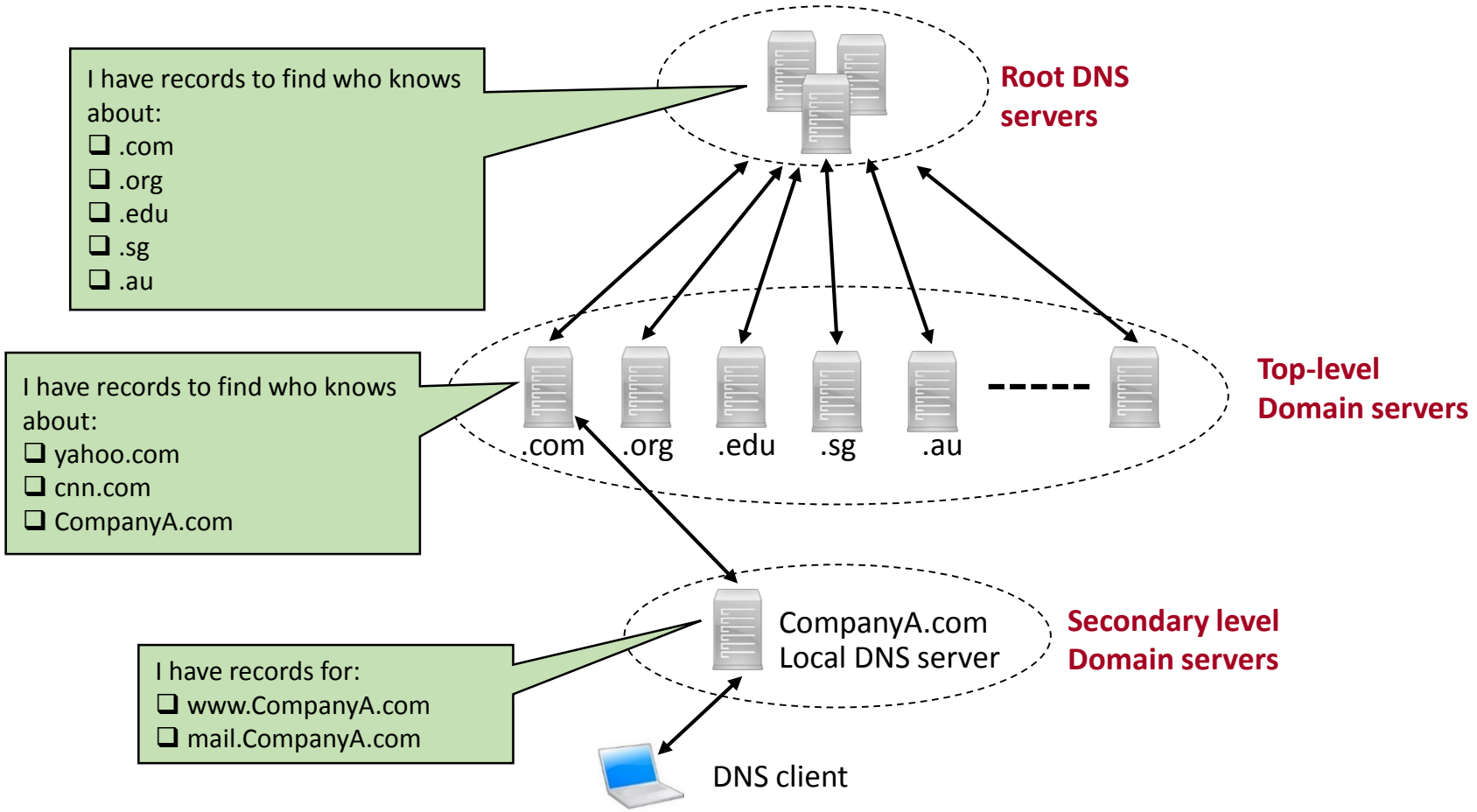
Which DNS Server to Use?

- When a computer connects to a network, the DHCP server sends network configuration information (example: IP address, subnet mask, default gateway) to the computer.
- That configuration information also includes one or more DNS servers that the computer should use for translation of DNS names to IP address.



Hierarchy of DNS (1)

- DNS uses a hierarchical system to create a name database to support name resolution.

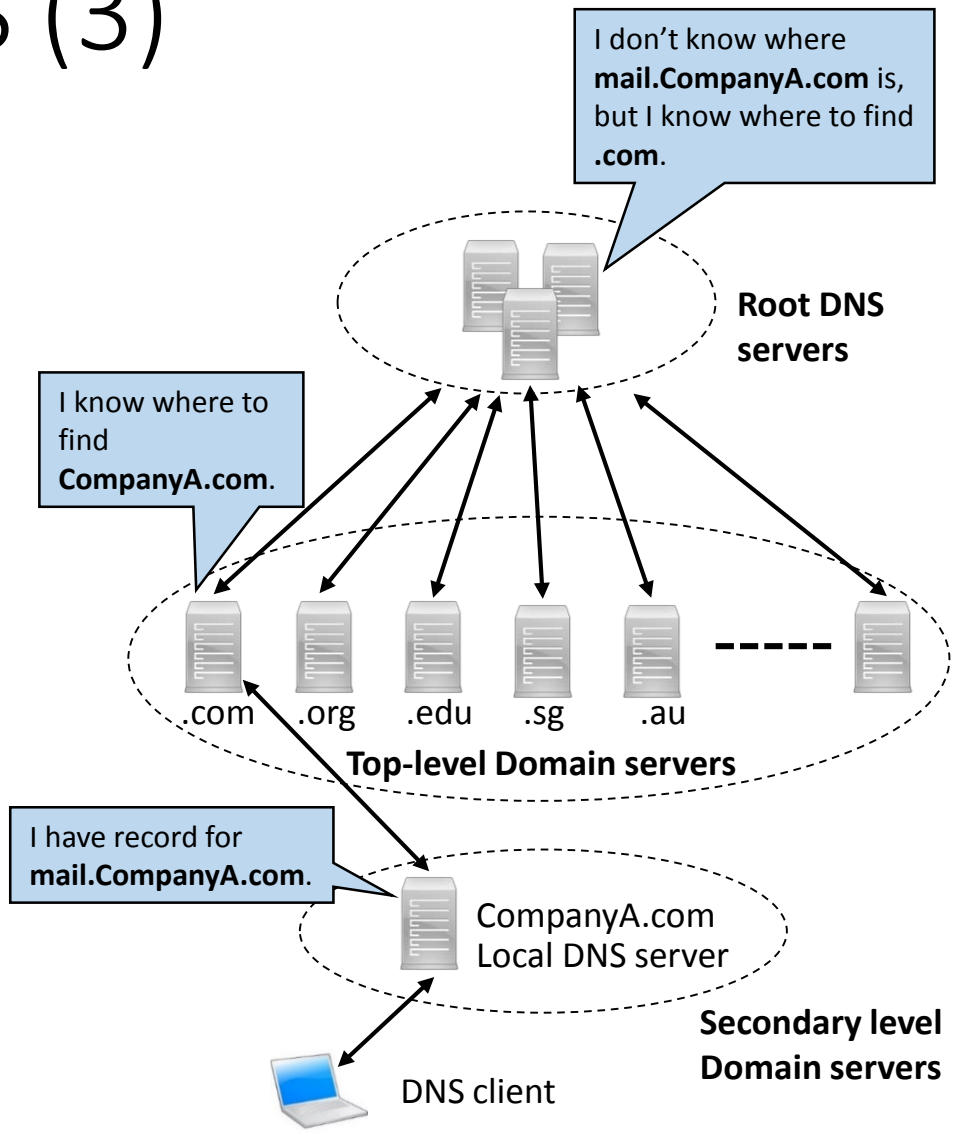


Hierarchy of DNS (2)

- The Root DNS servers maintain records about how to reach the top-level domain (TLD) servers.
- TLD servers have records about how to reach the secondary level domain servers, and so on.
- Examples of top-level domains are:
  - .com - a business or industry
  - .org - a non-profit organization
  - .edu – an education institute
  - .sg - Singapore

Hierarchy of DNS (3)

- Example:
  - Root DNS server may not know exactly where the e-mail server **mail.CompanyA.com** is located.
  - However, the Root DNS server maintains a record for the "com" domain within the top-level domain.
  - The servers within the "com" domain have a record for the “CompanyA.com" domain.
  - The servers within the CompanyA.com domain have a record for mail.CompanyA.com.



DNS Caching (1)

- When a DNS client makes a query, the DNS server looks at its own records first to see whether it can resolve the domain name.
- If it is unable to resolve the domain name, it contacts other servers to resolve the name.
- Once a match is found and returned to the original requesting server, the server stores the returned address in its cache.
- If a match cannot be found, the DNS server returns an error indicating that the name is invalid or does not exist.

DNS Caching (2)

- If that same name is requested again, the server returns the address stored in its name cache.
- Caching reduces both the DNS query traffic and the workloads of servers higher up the hierarchy.
- The DNS Client service on Windows computers stores previously resolved names in memory too.
  - The **`ipconfig /displaydns`** command displays all the cached DNS entries on a Windows computer.

Unique Domain Names

- All domain names need to be unique.
- ICANN enforces uniqueness of domain names across the Internet.
- Each domain registration becomes part of a central domain registration database known as the **whois** database.
- To check whether a domain name has been registered, visit http://www.networksolutions.com/whois/index.jsp

Domain Name Authority in Singapore

- Singapore Network Information Centre (SGNIC) Pte Ltd (www.sgnic.sg)
- A fully owned subsidiary of the Infocomm Development Authority (IDA) of Singapore.
- To administer the Internet domain name space in Singapore.
- Appointed national registry responsible for authorising and regulating the registration, administration and management of domain name ending with the ".sg" ccTLD.

SG Domain

- The .sg domain has 9 extensions:
  1) sg
  2) com.sg
  3) org.sg
  4) edu.sg
  5) gov.sg
  6) net.sg
  7) per.sg
  8) 新加坡 (Chinese Language)
  9) சிங்கப்பூர் (Tamil Language)
- Registration of domain name is done through registrars.
- For list of registrars accredited by SGNIC, visit https://www.sgnic.sg/accredited-registrars

Questions & Answers