



The Domain Name System

History of DNS

❑ Before DNS

- ARPAnet
 - *HOSTS.txt* contains all the hosts' information
 - Maintained by SRI's Network Information Center
 - In SRI-NIC host
- Problems: Not scalable!
 - Traffic and Load
 - Name Collision
 - Consistency

❑ Domain Name System

- **Administration decentralization**
- 1984
 - Paul Mockapetris (University of Southern California)
 - RFC 882, 883 → 1034, 1035
 - 1034: Concepts
 - 1035: Implementation and Specification

RFC Sourcebook:

<http://www.networksorcery.com/enp/default0304.htm>

DNS Introduction

– DNS Specification

□ Make domain name system as

- **Tree architecture**
 - Each subtree → “*domain*”
 - Domain can be divided in to “*subdomain*”
- **Distributed database**
 - Each site maintains segment of DB
 - Each site open self information via network
- **Client-Server architecture**
 - Name servers provide information (Name Server)
 - Clients make queries to server (Resolver)

DNS Introduction

– Domain and Subdomain

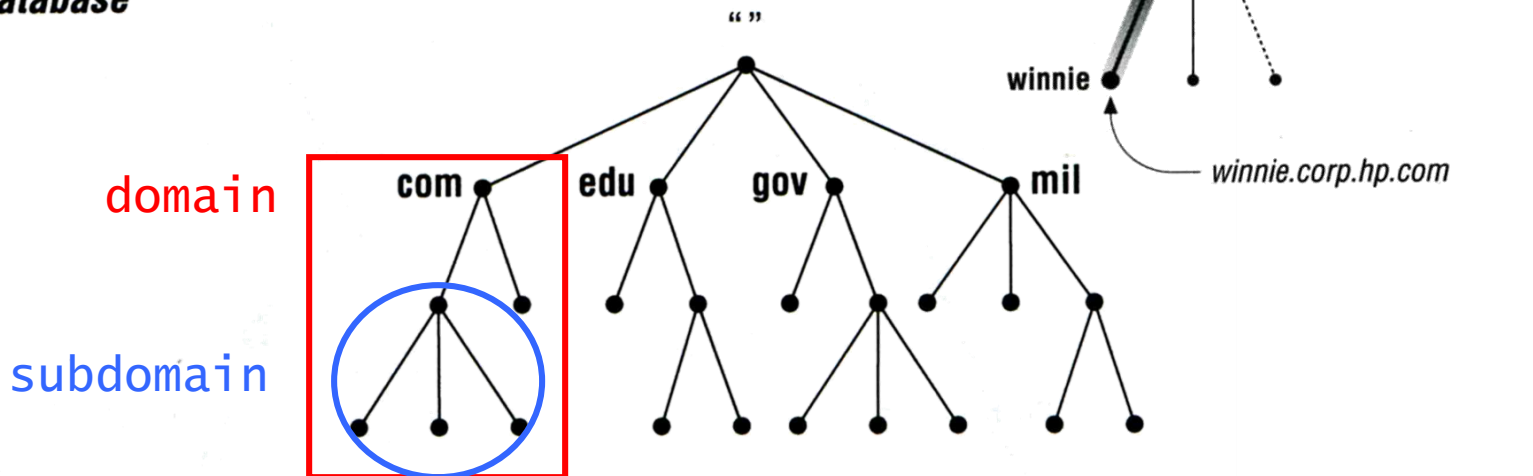
❑ DNS Namespace

- A tree of domains

❑ Domain and subdomain

- Each domain has a “domain name” to identify its position in database
 - EX: nctu.edu.tw
 - EX: cs.nctu.edu.tw

DNS database



The DNS Namespace (1)

❑ A inverted tree (Rooted tree)

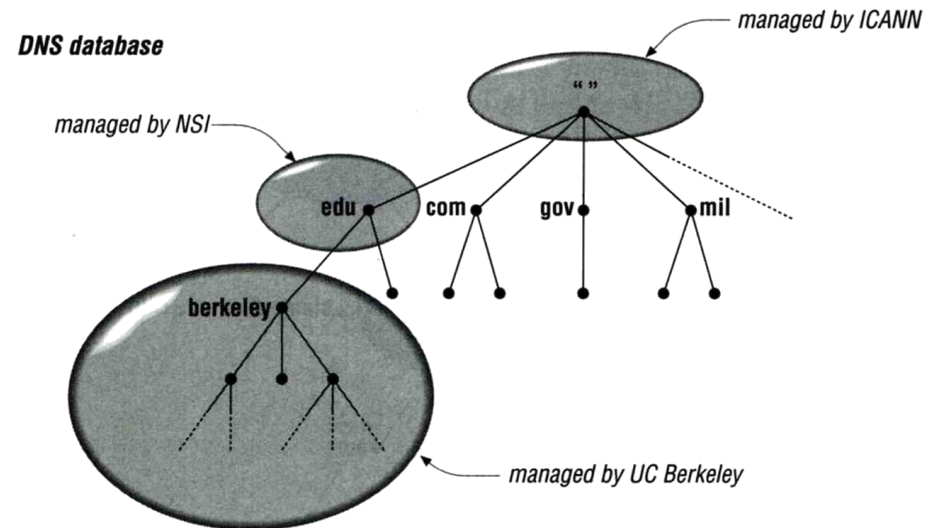
- Root with label “.”

❑ Domain level

- Top-level or First level
 - Child of the root
- Second-level
 - Child of a First-level domain

❑ Domain name limitation

- 63-characters in each component and
- Up to 255-characters in a complete name



The DNS Namespace (2)

❑ gTLDs

- generic Top-Level Domains, including:
- com: commercial organization, such as ibm.com
- edu: educational organization, such as purdue.edu
- gov: government organization, such as nasa.gov
- mil: military organization, such as navy.mil
- net: network infrastructure providing organization, such as hinet.net
- org: noncommercial organization, such as x11.org
- int: International organization, such as nato.int

ICANN – Internet Corporation for Assigned Names and Numbers
<http://www.icann.org/>

The DNS Namespace (3)

❑ New gTLDs launched in year 2000:

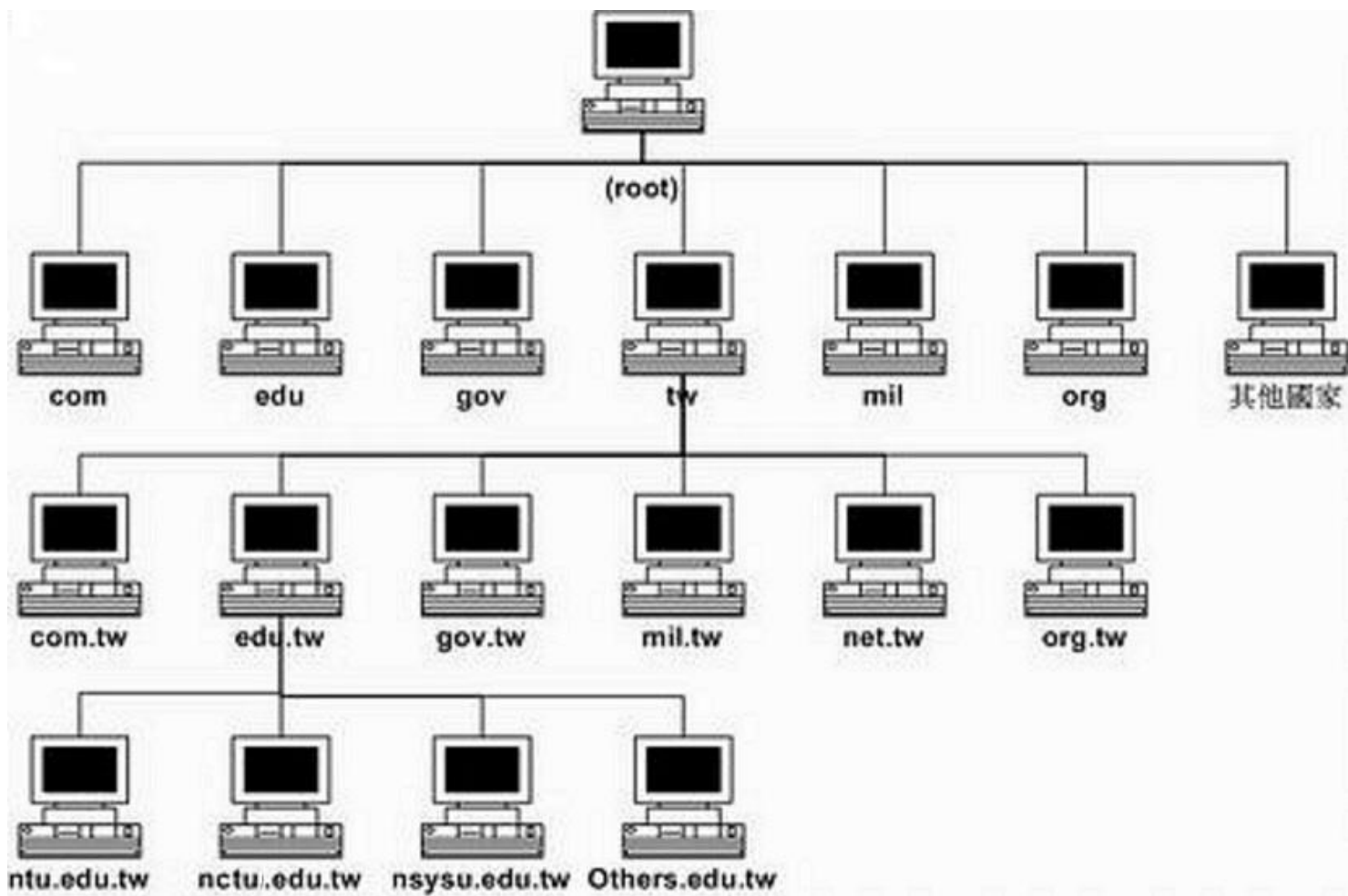
- **aero:** for air-transport industry
- **biz:** for business
- **coop:** for cooperatives
- **info:** for all uses
- **museum:** for museum
- **name:** for individuals
- **pro:** for professionals

The DNS Namespace (4)

❑ Other than US, ccTLD

- country code TLD (ISO 3166)
 - Taiwan → tw
 - Japan → jp
- Follow or not follow US-like scheme
 - US-like scheme example
 - edu.tw, com.tw, gov.tw
 - Other scheme
 - co.jp, ac.jp

DNS Namespace (5)

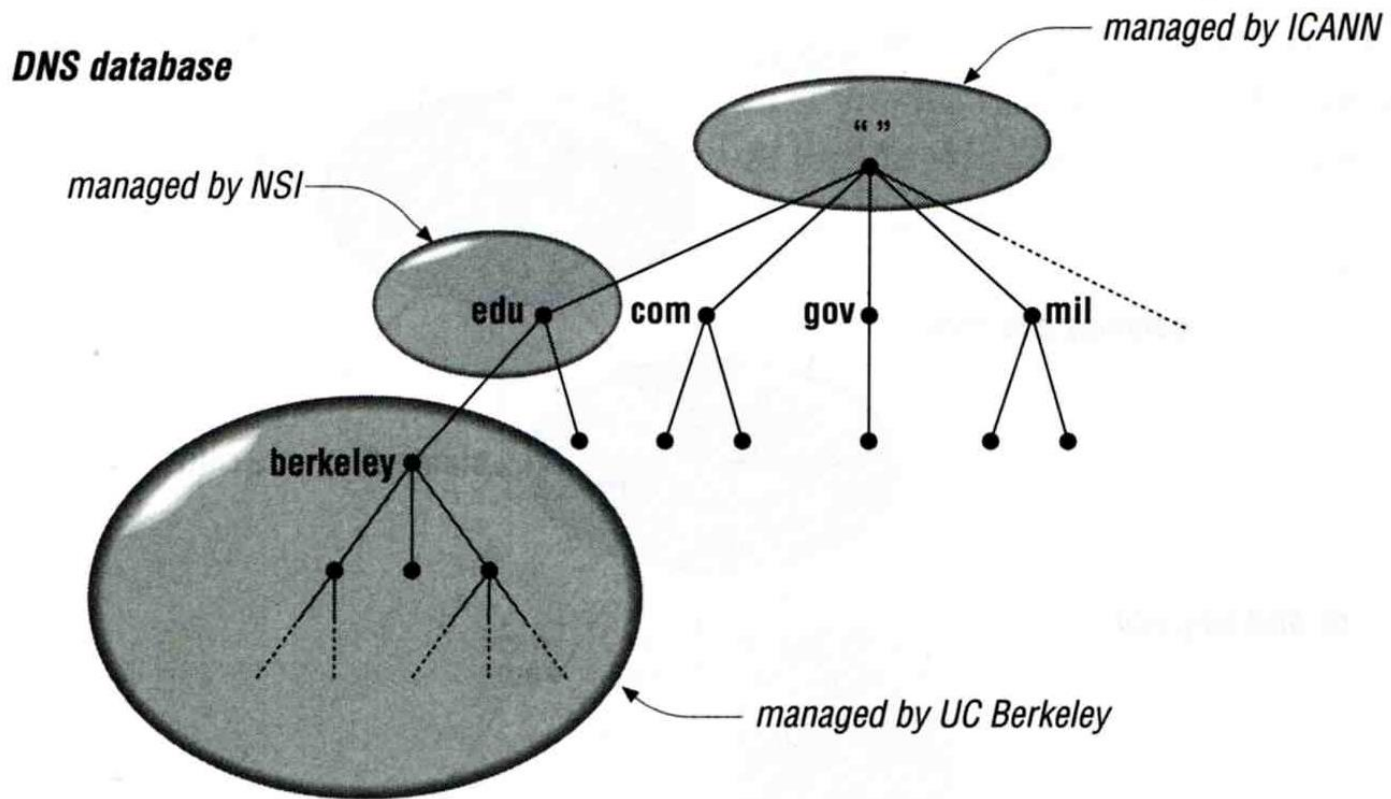


How DNS Works

– DNS Delegation

❑ Administration delegation

- Each domain can delegate responsibility to subdomain

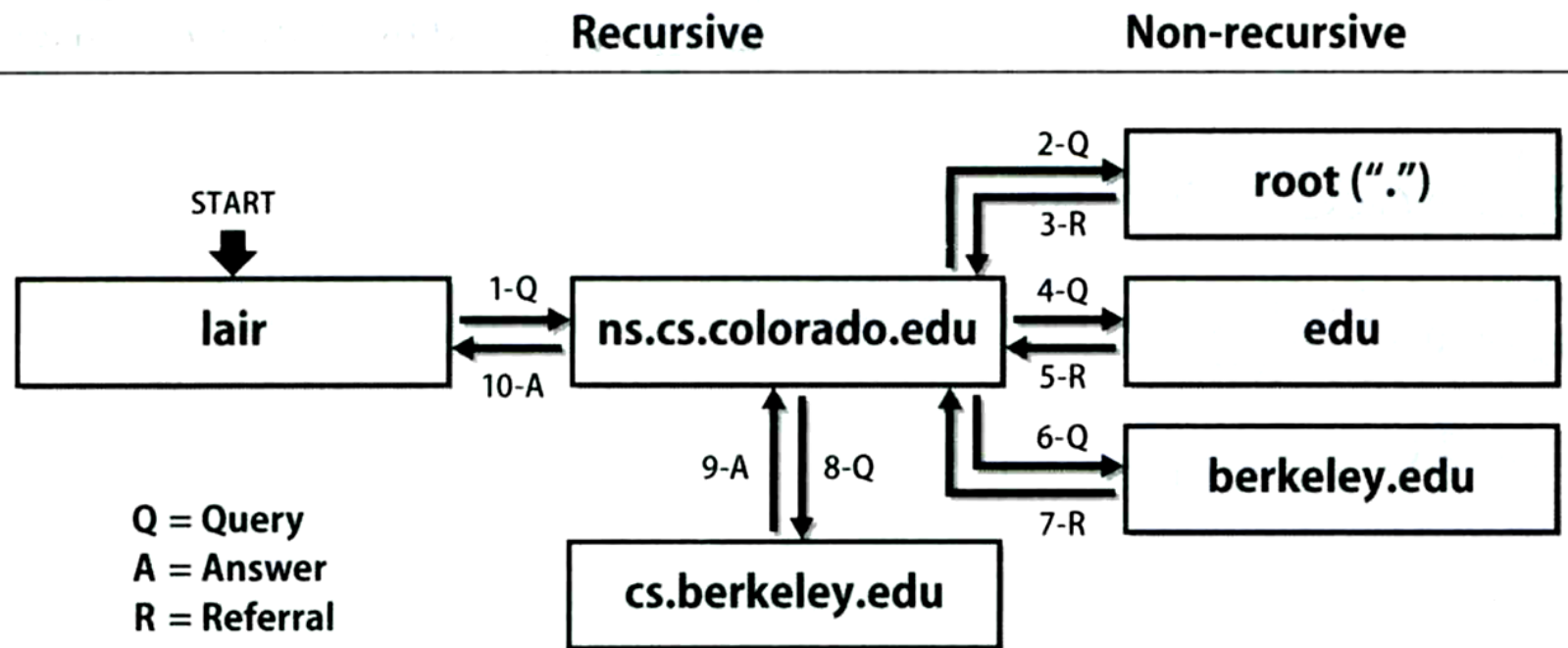


How DNS Works

– DNS query process

❑ Recursive query process

- Ex: query lair.cs.colorado.edu → vangogh.cs.berkeley.edu,
name server “ns.cs.colorado.edu” has no cache data

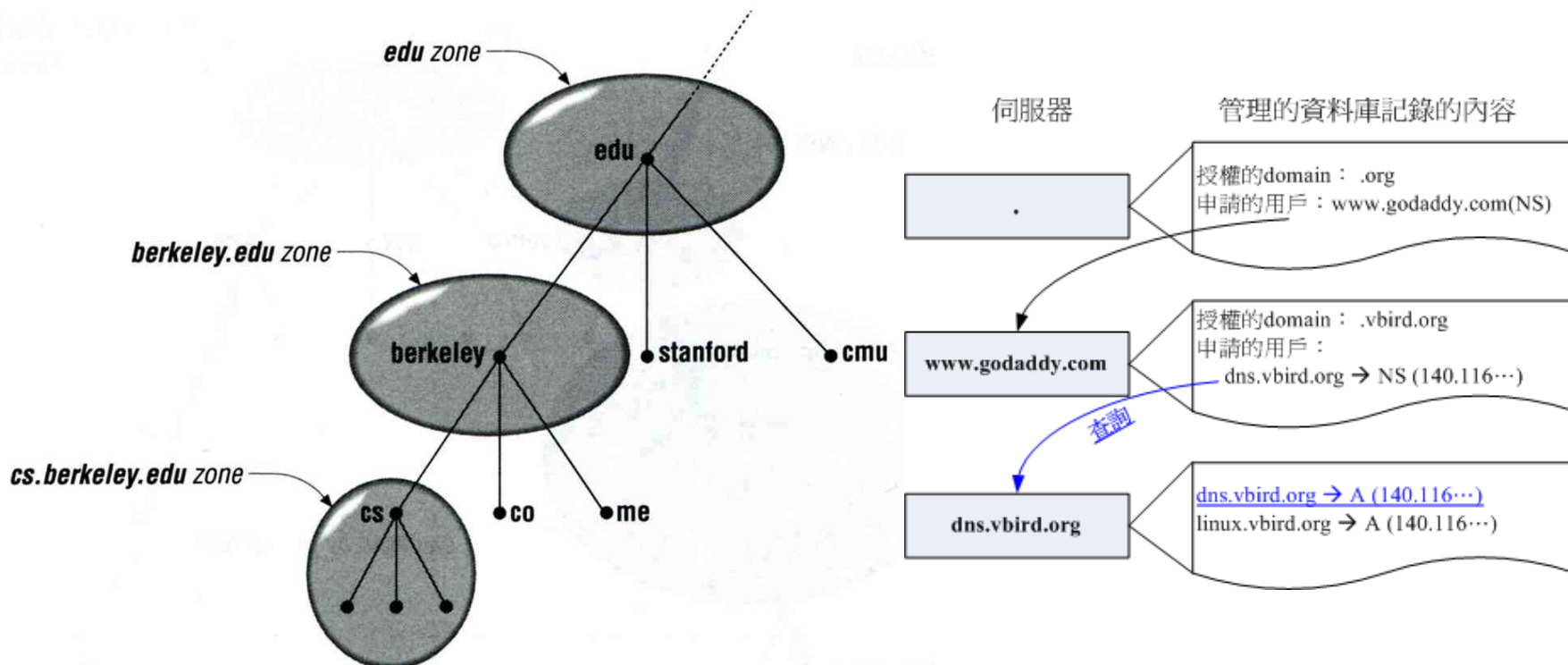


DNS Delegation

- Administrated Zone

□ Zone

- Autonomously administered piece of namespace
 - Once the subdomain becomes a zone, it is independent to it's parent
 - Even parent contains NS's A record



DNS Delegation

– Administrated Zone

❑ Zone

- Autonomously administered piece of namespace

❑ Two kinds of zone files

- Forward Zone files

- Hostname-to-Address mapping

- Ex:

- bsd1 IN A 140.113.235.131

- Reverse Zone files

- Address-to-Hostname mapping

- Ex:

- 131.235.113.140 IN PTR bsd1.cs.nctu.edu.tw.

- Forward zone is necessary

The Name Server Taxonomy (1)

□ Categories of name servers

- Based on a name server's source of data
 - **Authoritative**: official representative of a zone
 - **Master**: get zone data from disk
 - **Slave**: copy zone data from master
 - **Nonauthoritative**: answer a query from cache
 - **caching**: caches data from previous queries
- Based on the type of data saved
 - **Stub**: a slave that copy only name server data (no host data)
- Based on the type of answers handed out
 - **Recursive**: do query for you until it return an answer or error
 - **Nonrecursive**: refer you to the authoritative server
- Based on the query path
 - **Forwarder**: performs queries on behalf of many clients with large cache

The Name Server Taxonomy (2)

❑ Nonrecursive referral

- Hierarchical and longest known domain referral with cache data of other zone's name servers' addresses
- Ex:
 - Query lair.cs.colorado.edu from a nonrecursive server
 - Whether cache has
 - Name servers of cs.colorado.edu, colorado.edu, edu, root
- The resolver libraries do not understand referrals mostly. They expect the local name server to be recursive

The Name Server Taxonomy (3)

❑ Caching

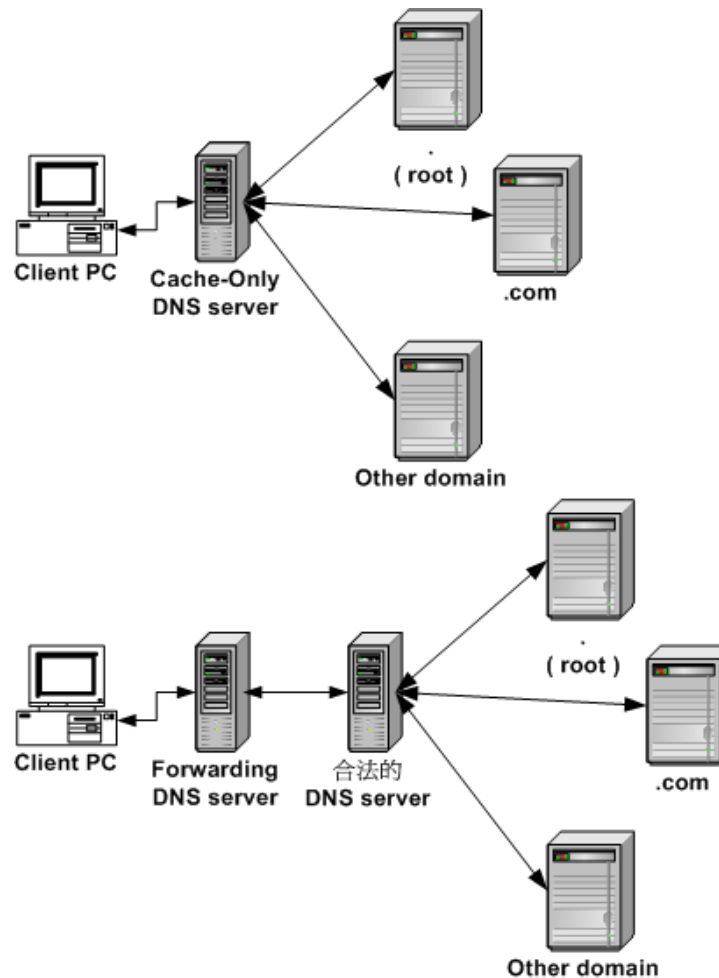
- Positive cache
- Negative cache
 - No host or domain matches the name queried
 - The type of data requested does not exist for this host
 - The server to ask is not responding
 - The server is unreachable of network problem

❑ Negative cache

- 60% DNS queries are failed
- To reduce the load of root servers, the authoritative negative answers must be cached

The Name Server Taxonomy (4)

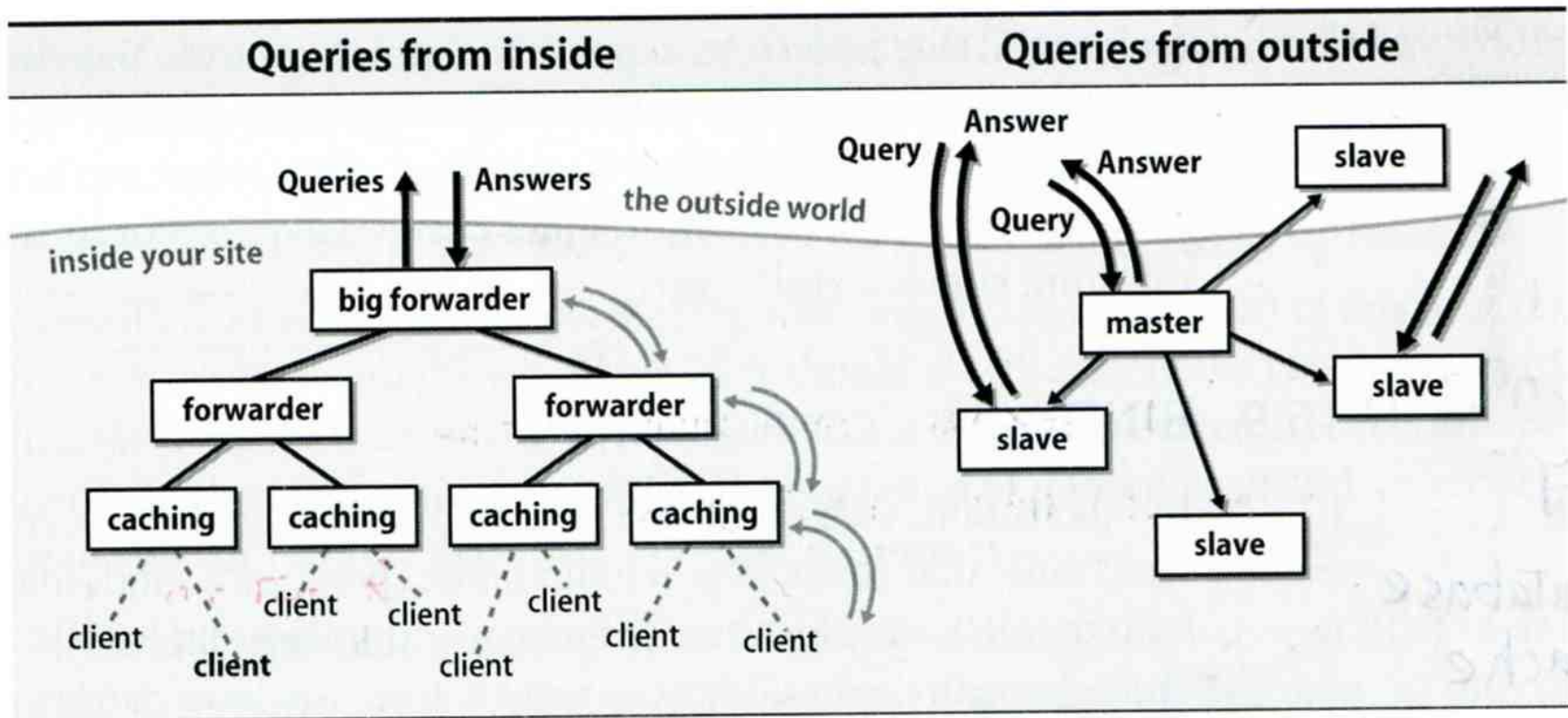
❑ Caching and forwarder DNS server



The Name Server Taxonomy (5)

□ How to arrange your DNS servers?

- Ex:



The Name Server Taxonomy (6)

☐ Root name servers

- List in named.root file of BIND

.	3600000	IN	NS	A.ROOT-SERVERS.NET.
A.ROOT-SERVERS.NET.	3600000		A	198.41.0.4
.	3600000		NS	B.ROOT-SERVERS.NET.
B.ROOT-SERVERS.NET.	3600000		A	192.228.79.201
.	3600000		NS	C.ROOT-SERVERS.NET.
C.ROOT-SERVERS.NET.	3600000		A	192.33.4.12
.	3600000		NS	D.ROOT-SERVERS.NET.
D.ROOT-SERVERS.NET.	3600000		A	128.8.10.90
.	3600000		NS	E.ROOT-SERVERS.NET.
E.ROOT-SERVERS.NET.	3600000		A	192.203.230.10
.	3600000		NS	F.ROOT-SERVERS.NET.
F.ROOT-SERVERS.NET.	3600000		A	192.5.5.241
.	3600000		NS	G.ROOT-SERVERS.NET.
G.ROOT-SERVERS.NET.	3600000		A	192.112.36.4
.	3600000		NS	H.ROOT-SERVERS.NET.
H.ROOT-SERVERS.NET.	3600000		A	128.63.2.53
.	3600000		NS	I.ROOT-SERVERS.NET.
I.ROOT-SERVERS.NET.	3600000		A	192.36.148.17
.	3600000		NS	J.ROOT-SERVERS.NET.
J.ROOT-SERVERS.NET.	3600000		A	192.58.128.30
.	3600000		NS	K.ROOT-SERVERS.NET.
K.ROOT-SERVERS.NET.	3600000		A	193.0.14.129
.	3600000		NS	L.ROOT-SERVERS.NET.
L.ROOT-SERVERS.NET.	3600000		A	198.32.64.12
.	3600000		NS	M.ROOT-SERVERS.NET.
M.ROOT-SERVERS.NET.	3600000		A	202.12.27.33

DNS Client

- ❑ /etc/resolv.conf
 - nameserver, domain, search

- ❑ /etc/hosts