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

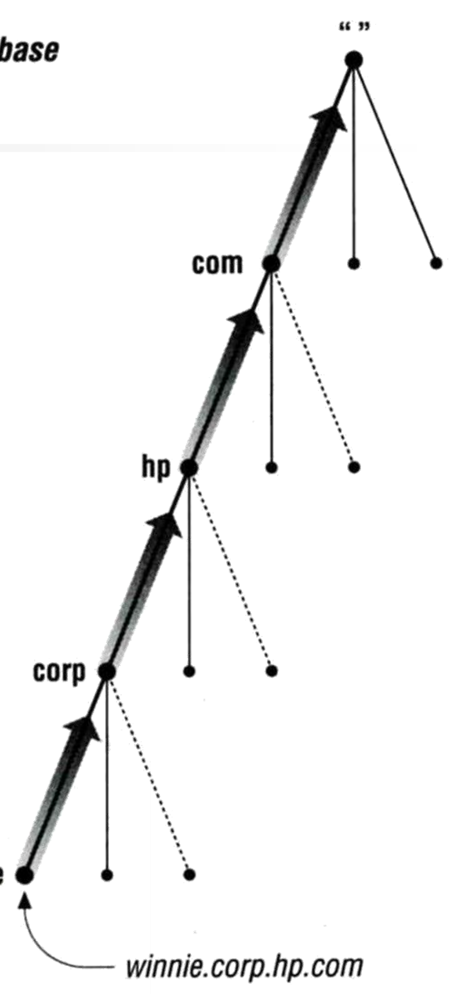
DNS Introduction – DNS Specification

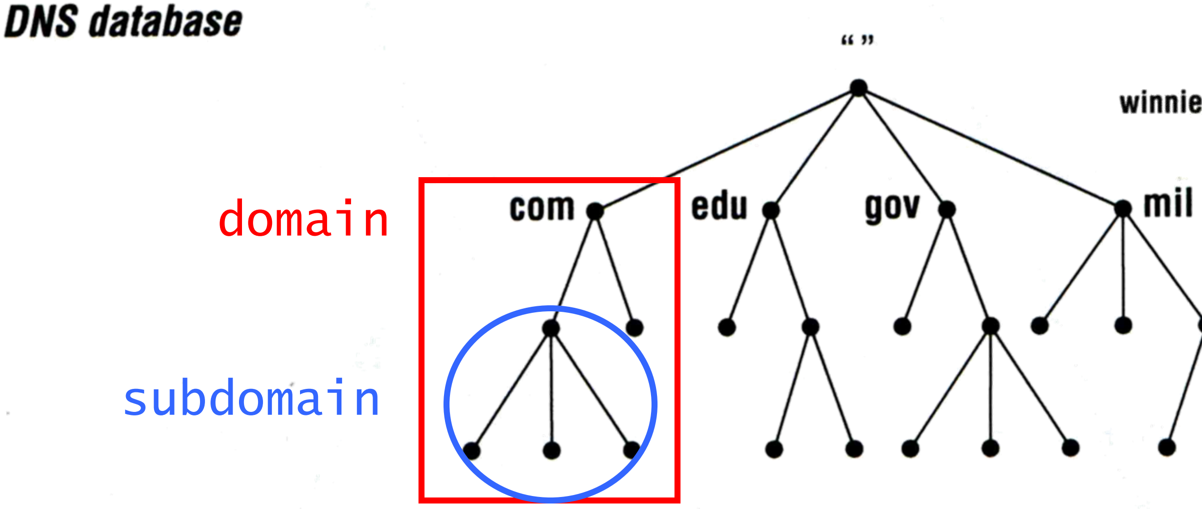
❑ Make domain name system as

- 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)

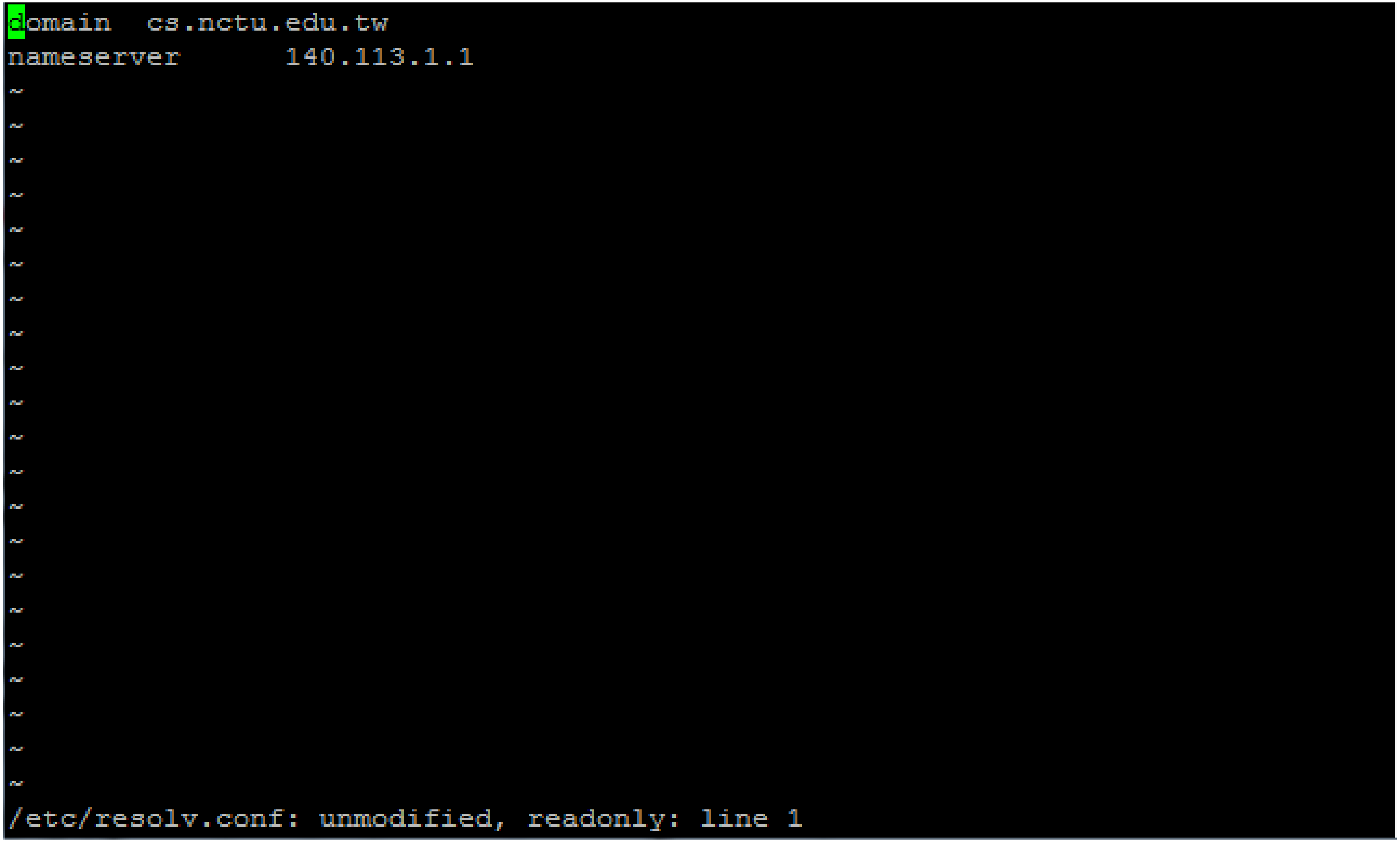
DNS Introduction – Domain and Subdomain

- ❑ 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





Reslov.conf



```
domain  cs.nctu.edu.tw
nameserver      140.113.1.1
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~
/etc/resolv.conf: unmodified, readonly: line 1
```
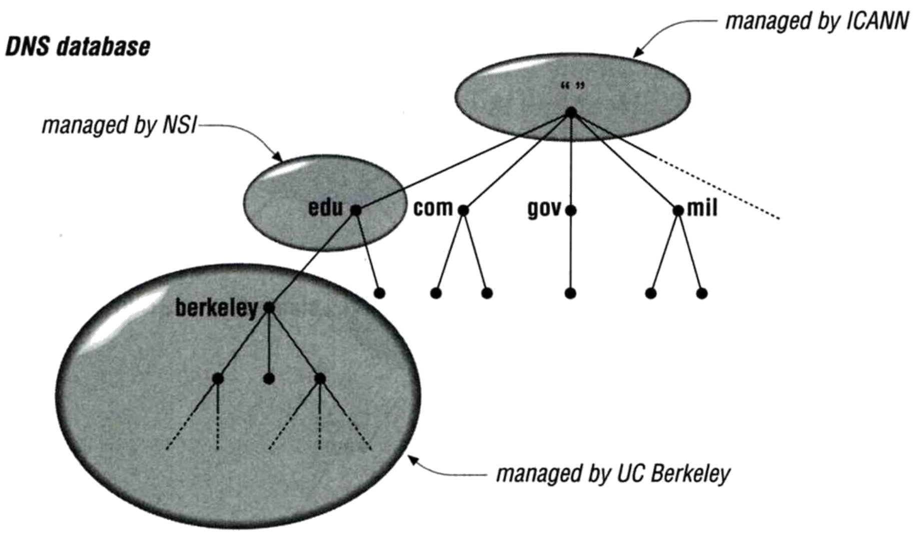

The DNS Namespace (1)

- ❑ 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:

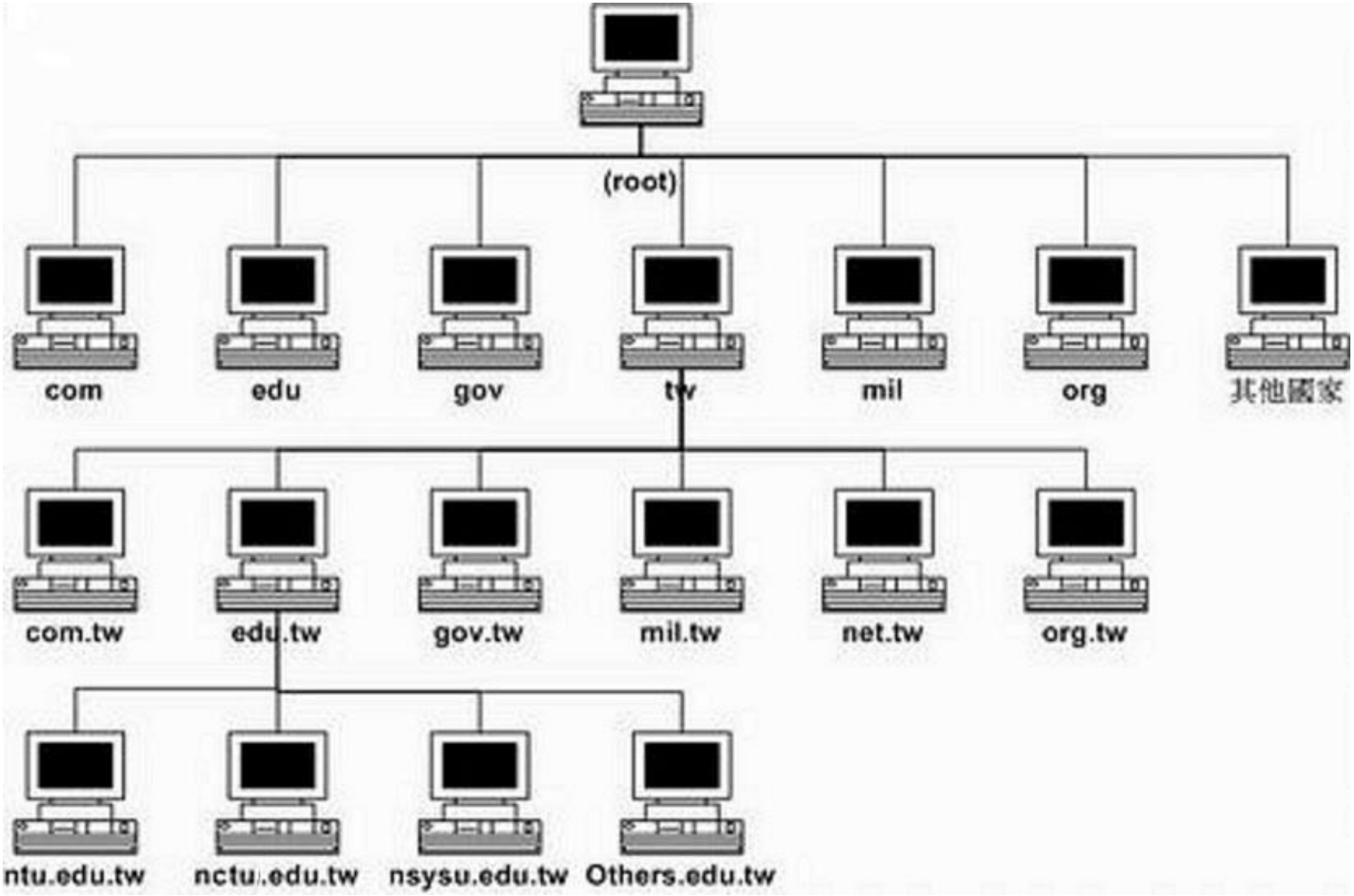
aero:	for air-transport industry
biz:	for business
coop:	for cooperatives
info:	for all uses
museum:	for museum
name:	for individuals
pro:	for professionals

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

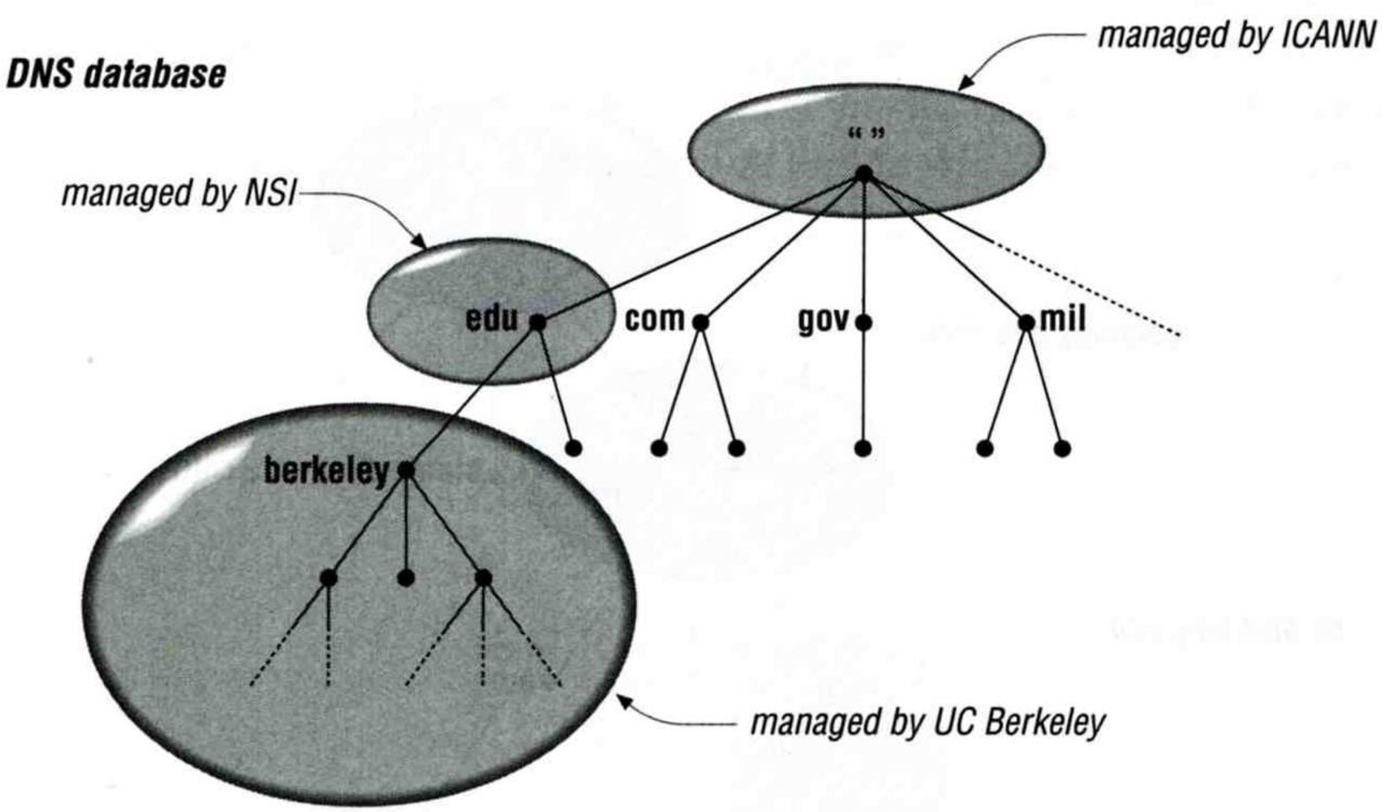
DNS Namespace (5)



How DNS Works
– DNS Delegation

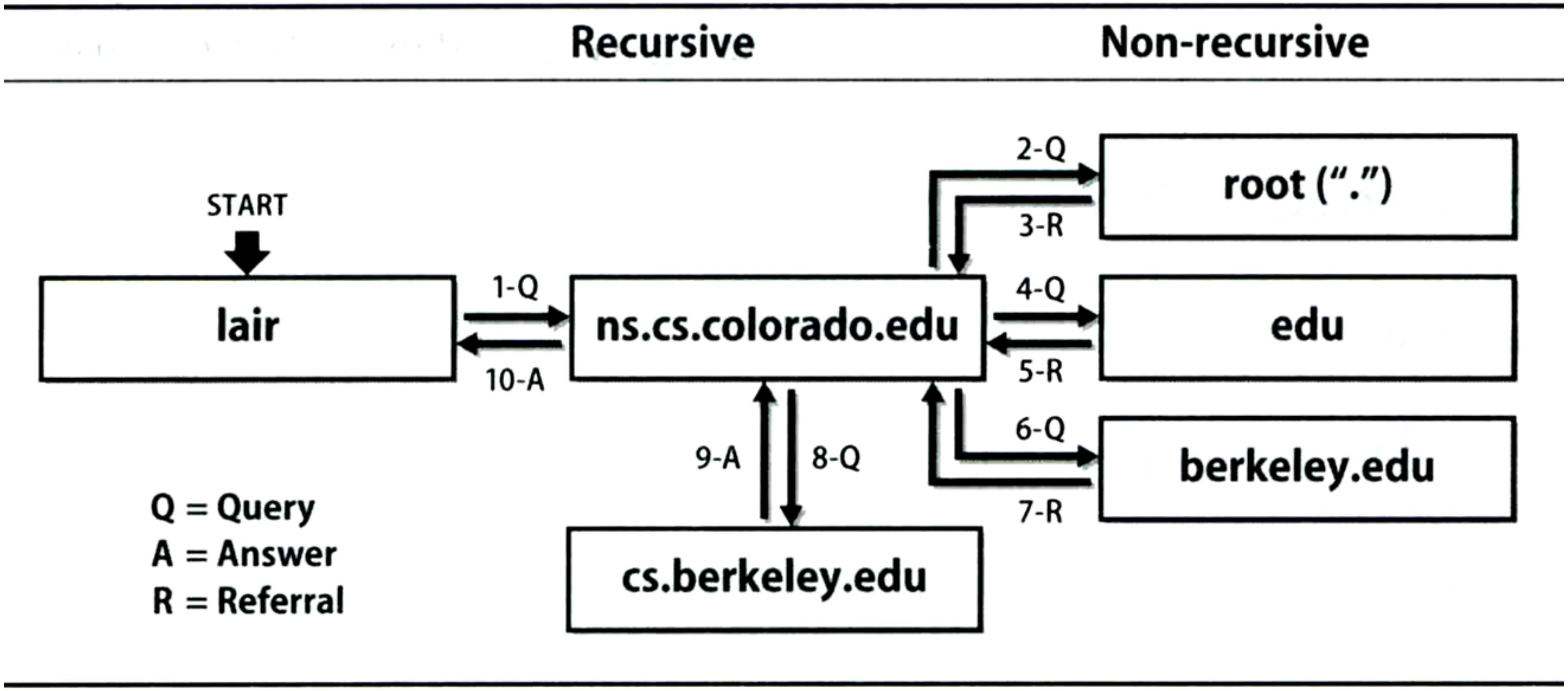
❑ Administration delegation

- Each domain can delegate responsibility to subdomain



How DNS Works
– DNS query process

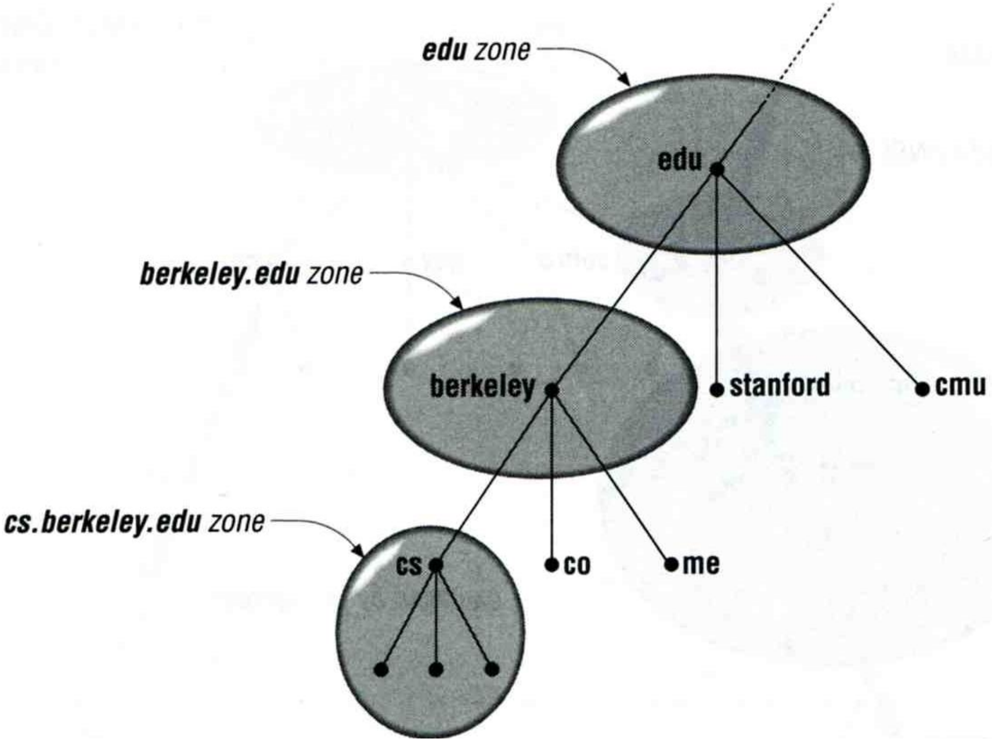
- ❑ Recursive query process
  - Ex: query lair.cs.colorado.edu → vangogh.cs.berkeley.edu, name server "ns.cs.colorado.edu" has no cache data

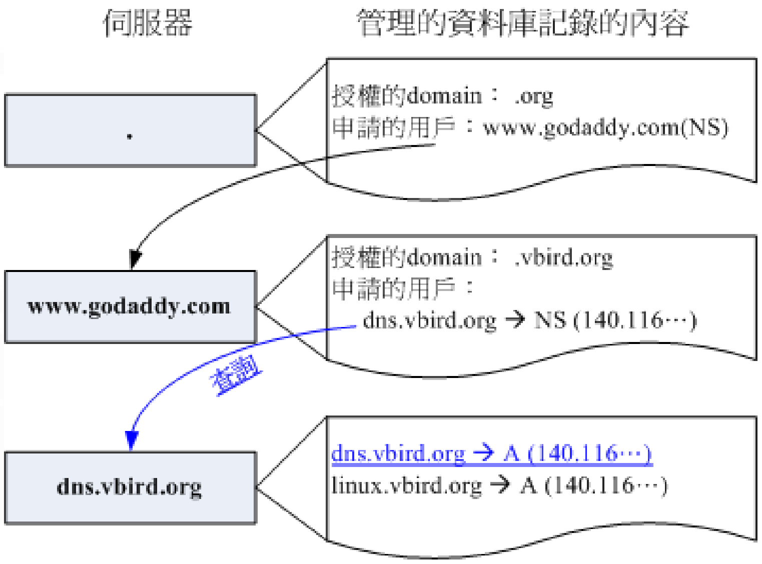


DNS Delegation – Administrated Zone

❑ 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




伺服器

管理的資料庫記錄的內容

.

授權的domain： .org
申請的用戶：www.godaddy.com(NS)

www.godaddy.com

授權的domain： .vbird.org
申請的用戶：
dns.vbird.org → NS (140.116…)

查詢

dns.vbird.org

dns.vbird.org → A (140.116…)
linux.vbird.org → A (140.116…)

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: cashes 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

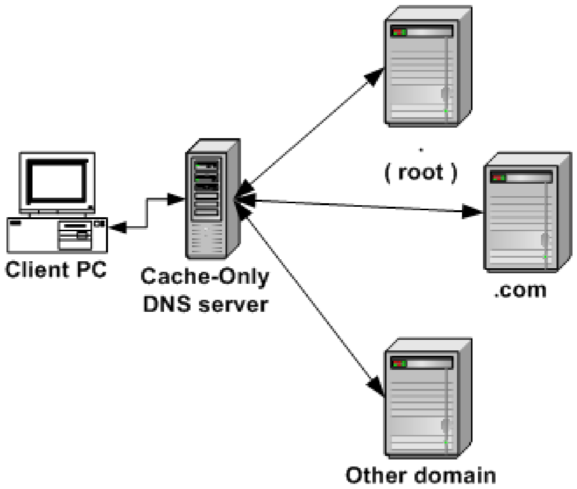
- Positive cache
- Negative cache
  - ➢ No host or domain matches the name queried
  - ➢ The type of data requested does not exist for this host
  - ➢ The server to ask is not responding
  - ➢ The server is unreachable of network problem

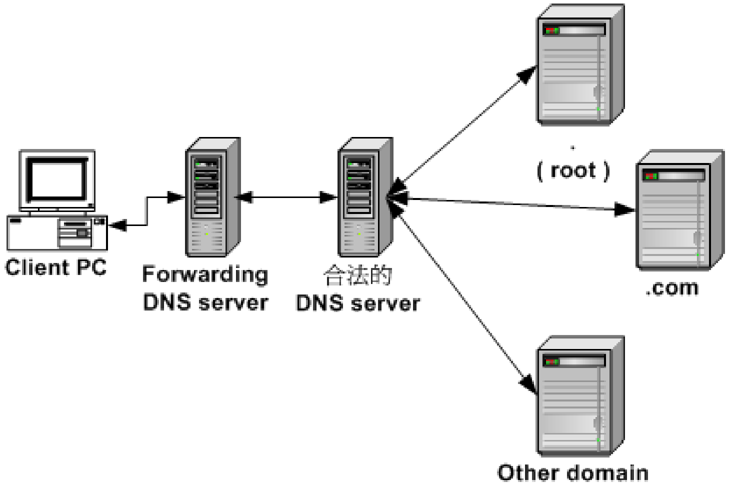
❑ Negative cache

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

The Name Server Taxonomy (4)

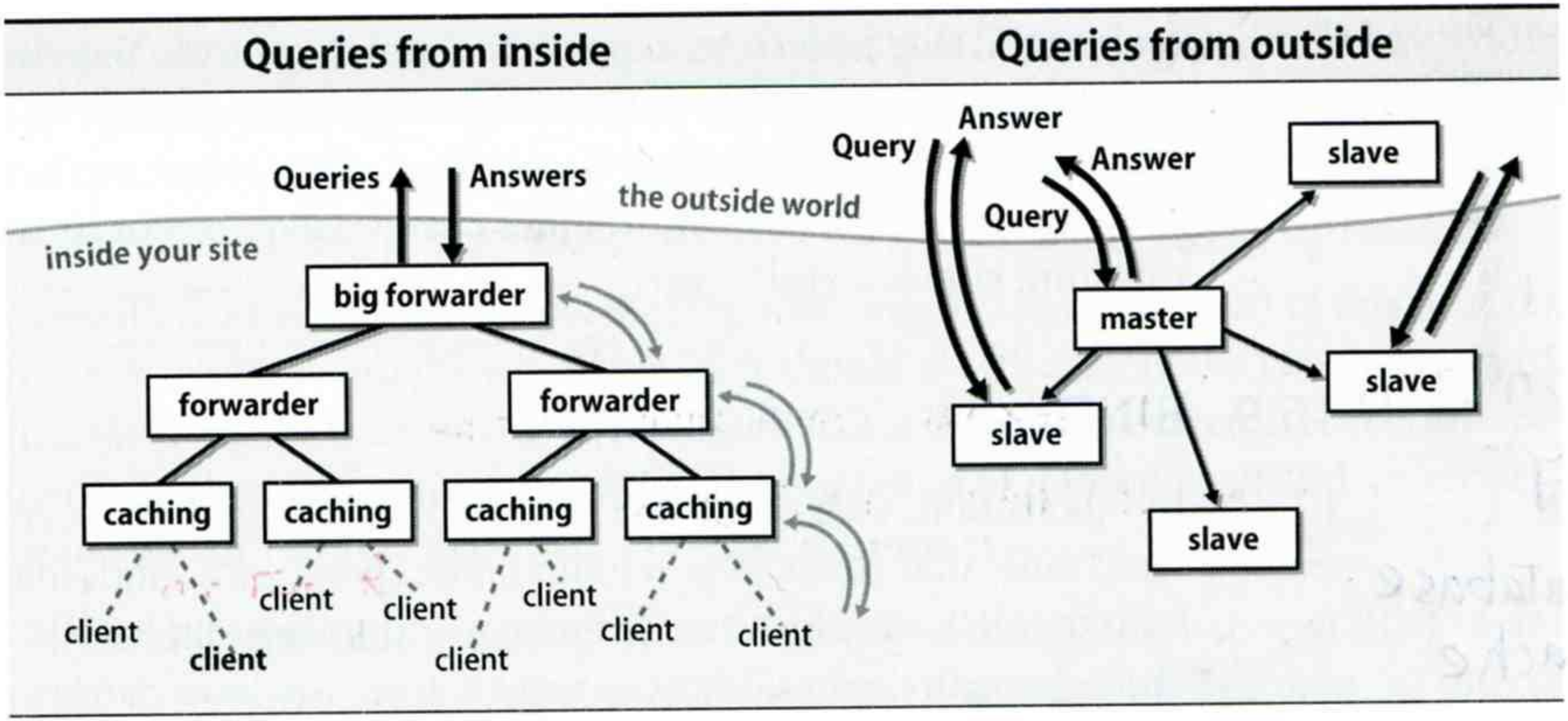
❑ Caching and forwarder DNS server





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