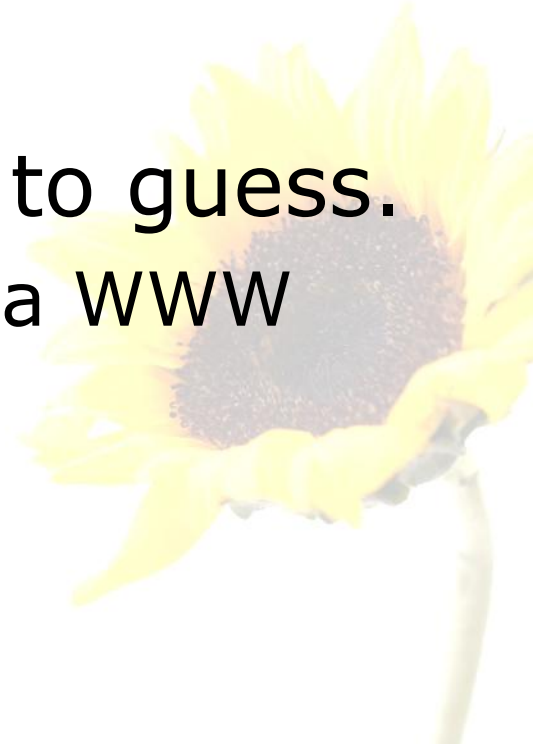
SECTION – B

Domain Name System (DNS)

Hostnames

- IP Addresses are great for computers
  - IP address includes information used for routing.
- IP addresses are tough for humans to remember,
- IP addresses are impossible to guess.
  - ever guessed at the name of a WWW site?

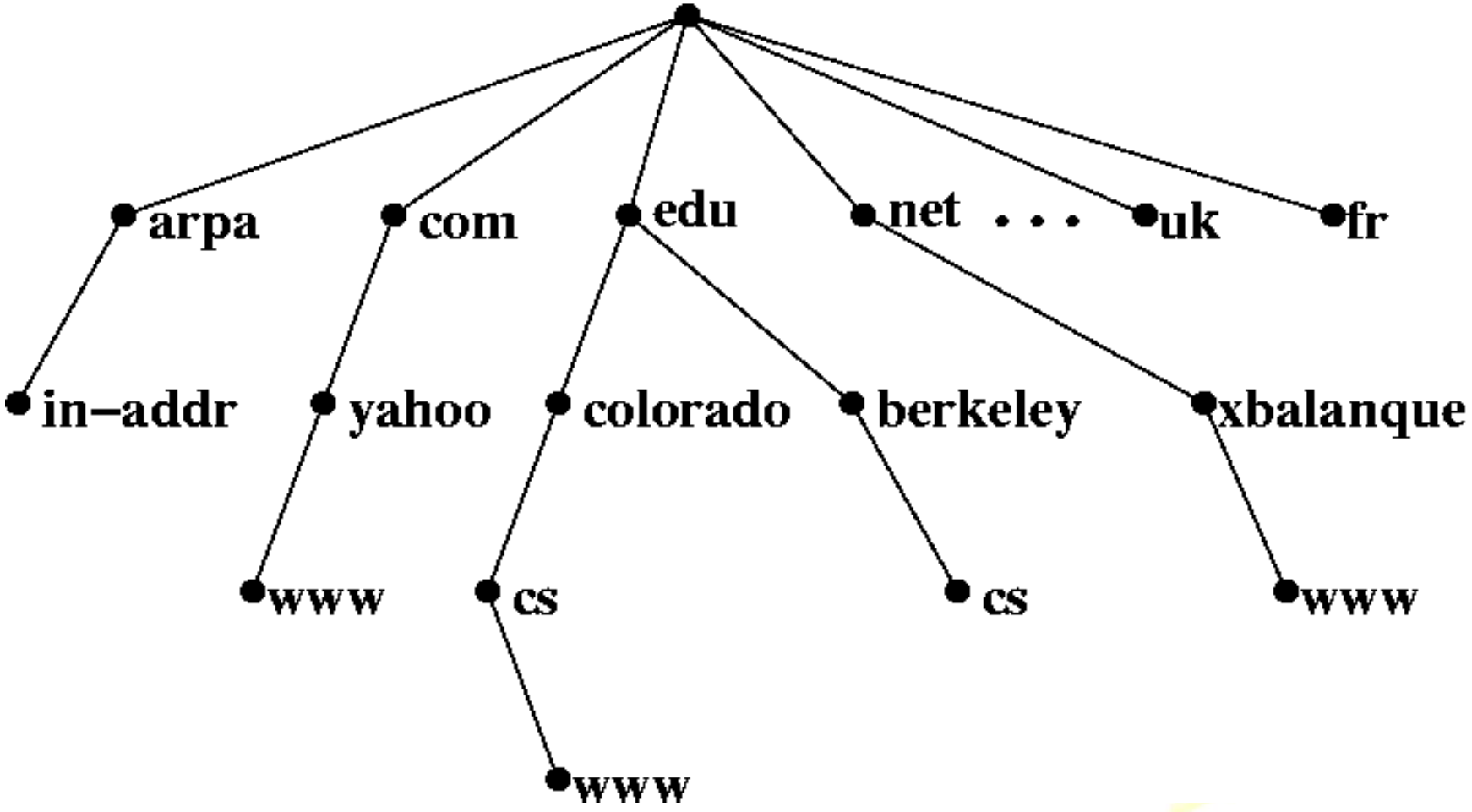


The Domain Name System

- The domain name system is usually used to translate a host name into an IP address.

- Domain names comprise a hierarchy so that names are unique, yet easy to remember

DNS Hierarchy



Host name structure

- Each host name is made up of a sequence of labels separated by periods.
  - Each label can be up to 63 characters.
  - The total name can be at most 255 characters.
  - Example: whitehouse.gov

    ece.dceggn.ernet.in

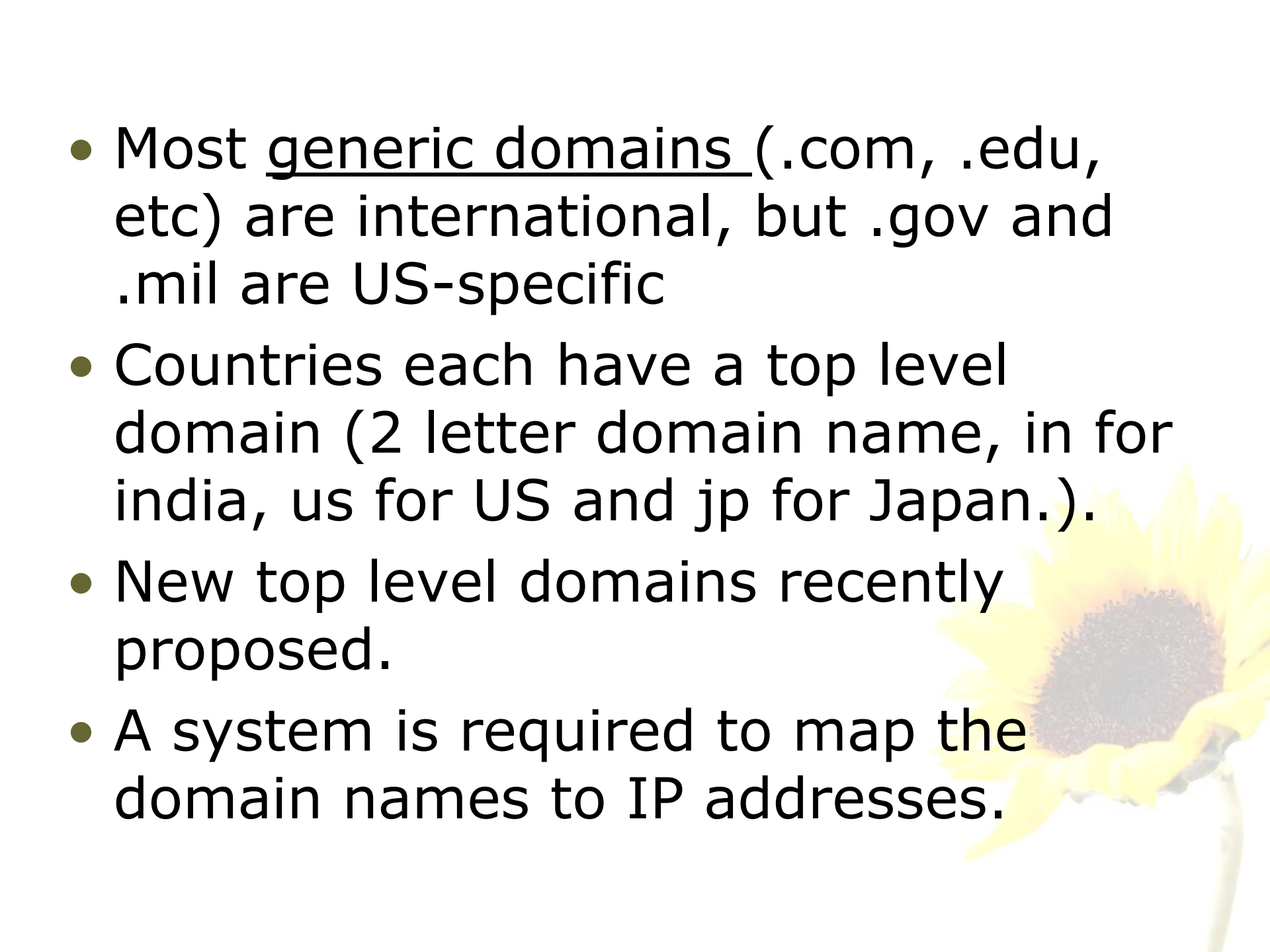
Domain Name

- The domain name for a host is the sequence of labels that lead from the host to the top of the worldwide naming tree
- A domain is a sub tree of the worldwide naming tree

Naming

- A host has a domain name specified using a sequence of names, each of which may be up to 63 characters long, separated by periods.
- Names are case insensitive
- A domain is an absolute domain name or a fully qualified domain name (FQDN) if it ends with a period.

- Most generic domains (.com, .edu, etc) are international, but .gov and .mil are US-specific
- Countries each have a top level domain (2 letter domain name, in for india, us for US and jp for Japan.).
- New top level domains recently proposed.
- A system is required to map the domain names to IP addresses.

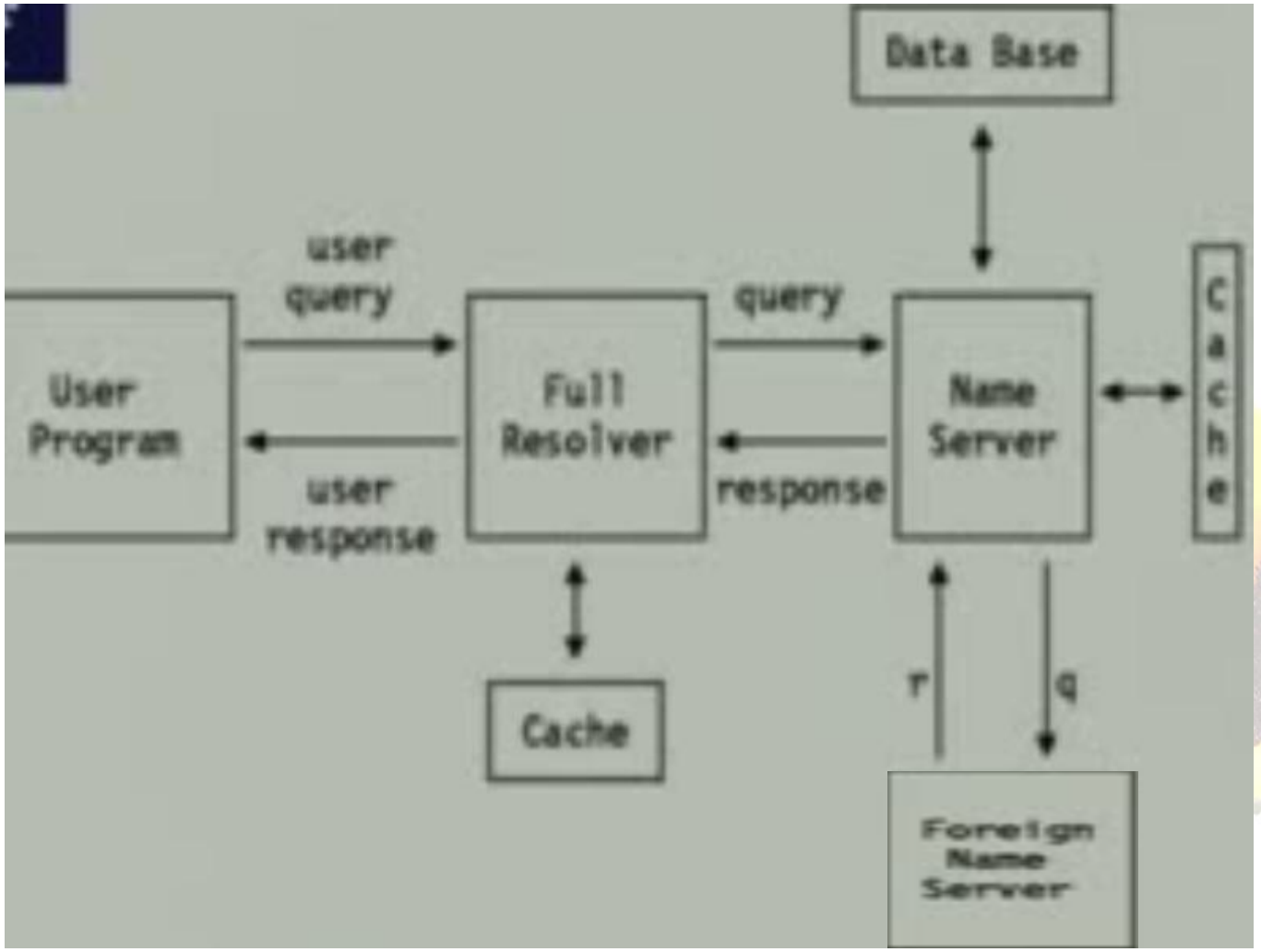


Implementing DNS

- *distributed database* implemented in hierarchy of many *name servers*.
- application-layer protocol host, routers, name servers to communicate to resolve names (address/name translation)
  - note: core Internet function.
  - Implemented as application-layer protocol
  - Complexity at network's "edge"

Full Resolver

- The client called the resolver is transparent to the user and is called by an application to resolve names into real IP-addresses or vice versa.
- A full resolver is a program distinct from the user program, which forwards all queries to a name server for processing.
- Responses are cached by the name server for future use, and often by the name server.

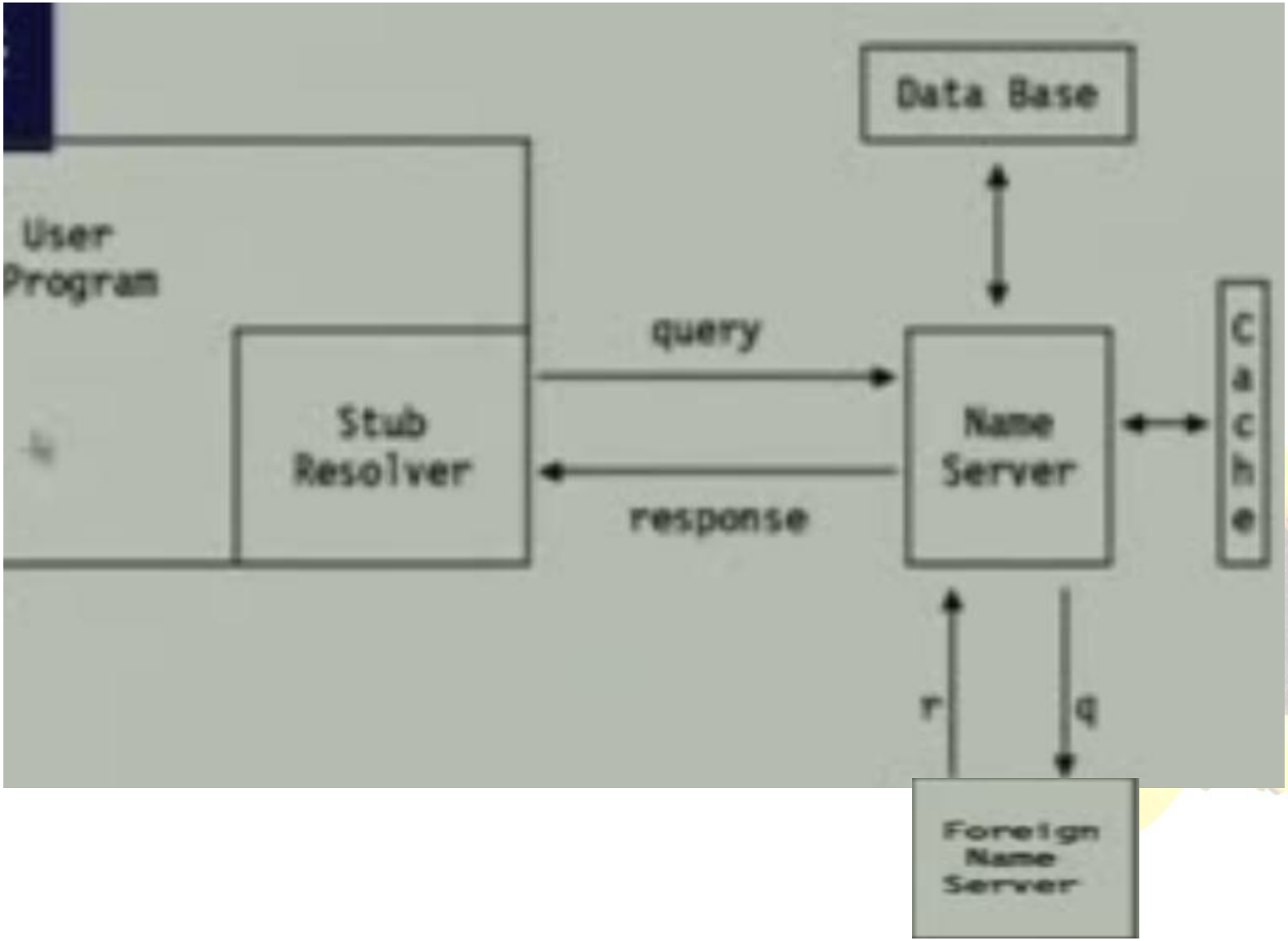

Data Base
user
query
query
User
Program
Full
Resolver
Name
Server
C
a
c
h
e
user
response
response
Cache
r
q
Foreign
Name
Server

Stub Resolver

- A stub resolver is a routine linked with the user program, which forwards the queries to a name server for processing.

  Responses are cached by the name server but not usually by the resolver.

On UNIX, the stub resolver is implemented by two library routines : gethostbyname() and gethostbyaddr() for converting host names to IP addresses and vice versa


Data Base
User Program
Stub Resolver
query
response
Name Server
Cache
r
q
Foreign Name Server

DNS Organization

- Distributed Database
  - The organization that owns a domain name is responsible for running DNS server that can provide the mapping between hostnames with in the domain to IP addresses.
  - So – some machine run by RPI is responsible for everything below with in the rpi.edu domain.
  - There is one primary server for a domain, and typically a number of secondary servers containing replicated databases.

DNS name servers

Why not centralize DNS?

- Single point of failure.
- traffic volume
- distant centralized database
- maintenance

- doesn't scale!

- no server has all name-to-IP address mappings.

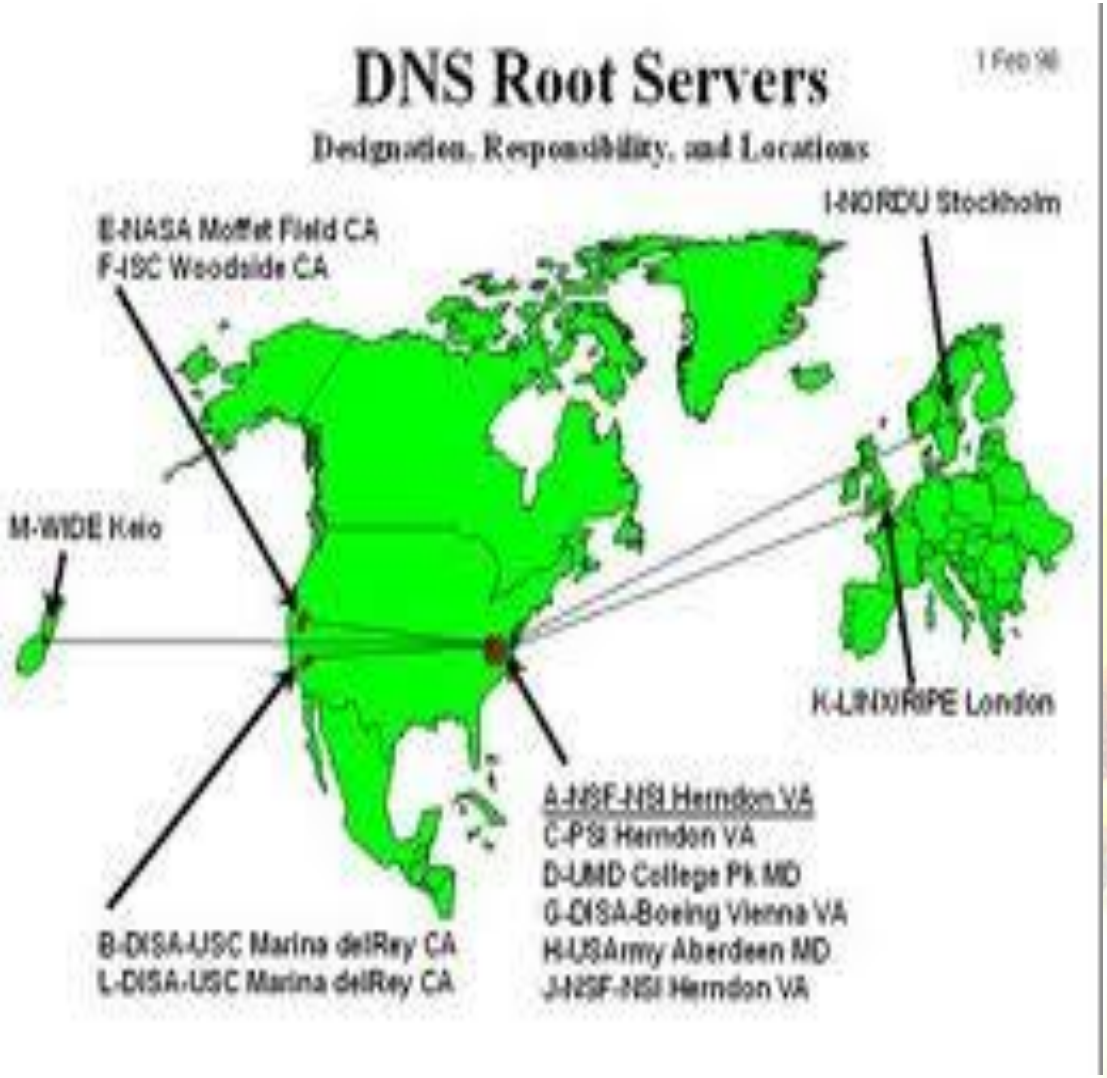
local name servers

  - each ISP company has local (default) name server.
  - host DNS query first goes to local name server.

- Authoritative name server:
  - For a host stores that host's IP address, name
  - Can perform name/address translation for that host's name

DNS Root name servers

- Contacted by local name server that can not resolve name.
- Root name server:
  - Contacts.
  - Authoritative name server if name mapping not known.
  - gets mapping
  - returns mapping to local name server
  - dozen root name servers worldwide.



nslookup

- nslookup(name server lookup) is an interactive resolver that allows the user to communicate directly with a DNS server.
- nslookup is usually available on UNIX workstations.

DNS Servers

- Server handle requests for their domain directory.
- Server handle requests for other domains by contacting remote DNS server(s).
- Servers cache external mappings.

Server Operation

- If a server has no clue about where to find the address for a hostname, ask the root server.
- The root server will tell you what nameserver to contact.
- A request may get forwarded a few times.

Server – Server Communication

- If a server is asked to provide the mapping for a host outside it's domain (and the mapping is not in the server cache):
  - The server finds a nameserver for the target domain.
  - The server asks the nameserver to provide the host name to IP translation.
- To find the right nameserver, use DNS!

Recursion

- A request can indicate that recursion is desired – this tells the server to find out the answer (possibly by contacting other servers).

- If recursion is not requested – the response may be a list of other name servers to contact.

TLD and Authoritative Servers

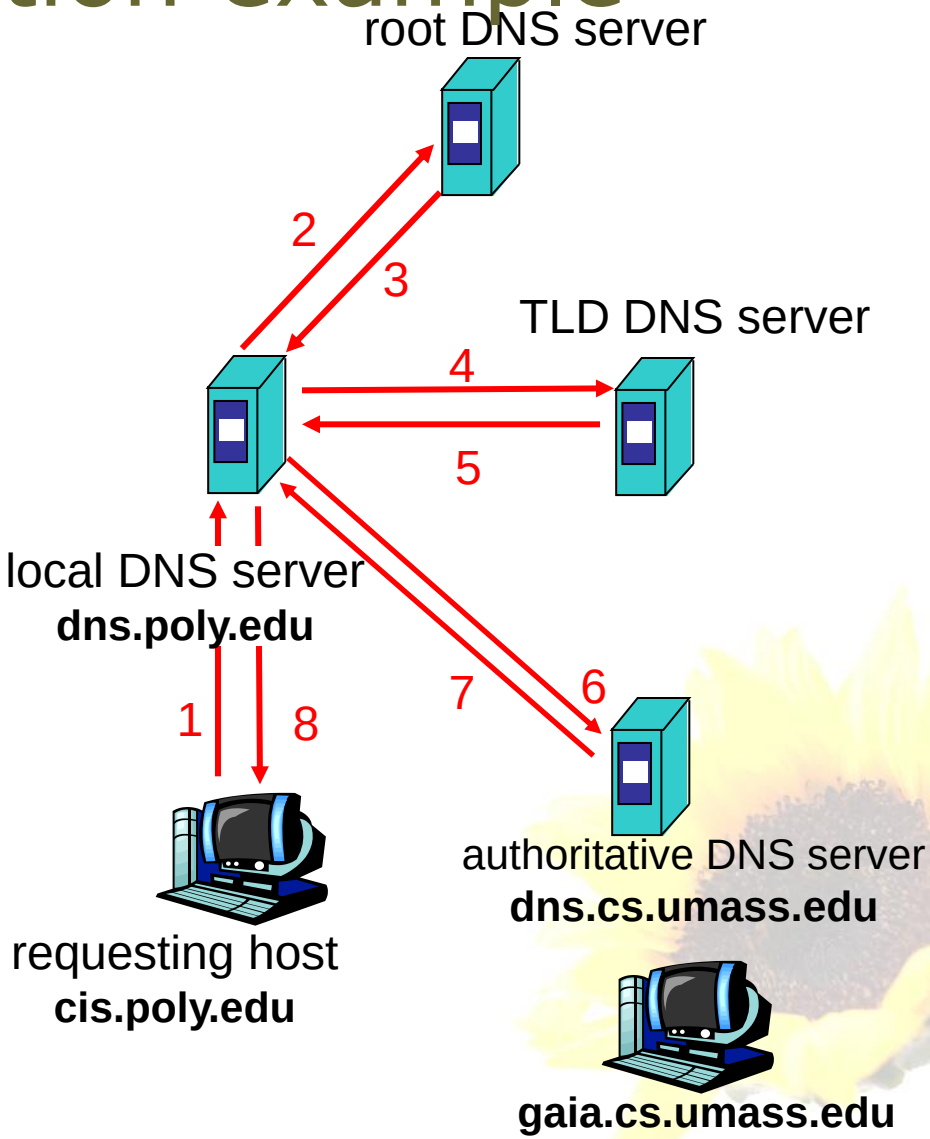
- Top-level domain (TLD) servers:
  - responsible for com, org, net, edu, etc, and all top-level country domains uk, fr, ca, jp.
  - Network Solutions maintains servers for com TLD
  - Educause for edu TLD
- Authoritative DNS servers:
  - organization's DNS servers, providing authoritative hostname to IP mappings for organization's servers (e.g., Web, mail).
  - can be maintained by organization or service provider

DNS name resolution example

- Host at cis.poly.edu wants IP address for gaia.cs.umass.edu

iterated query:

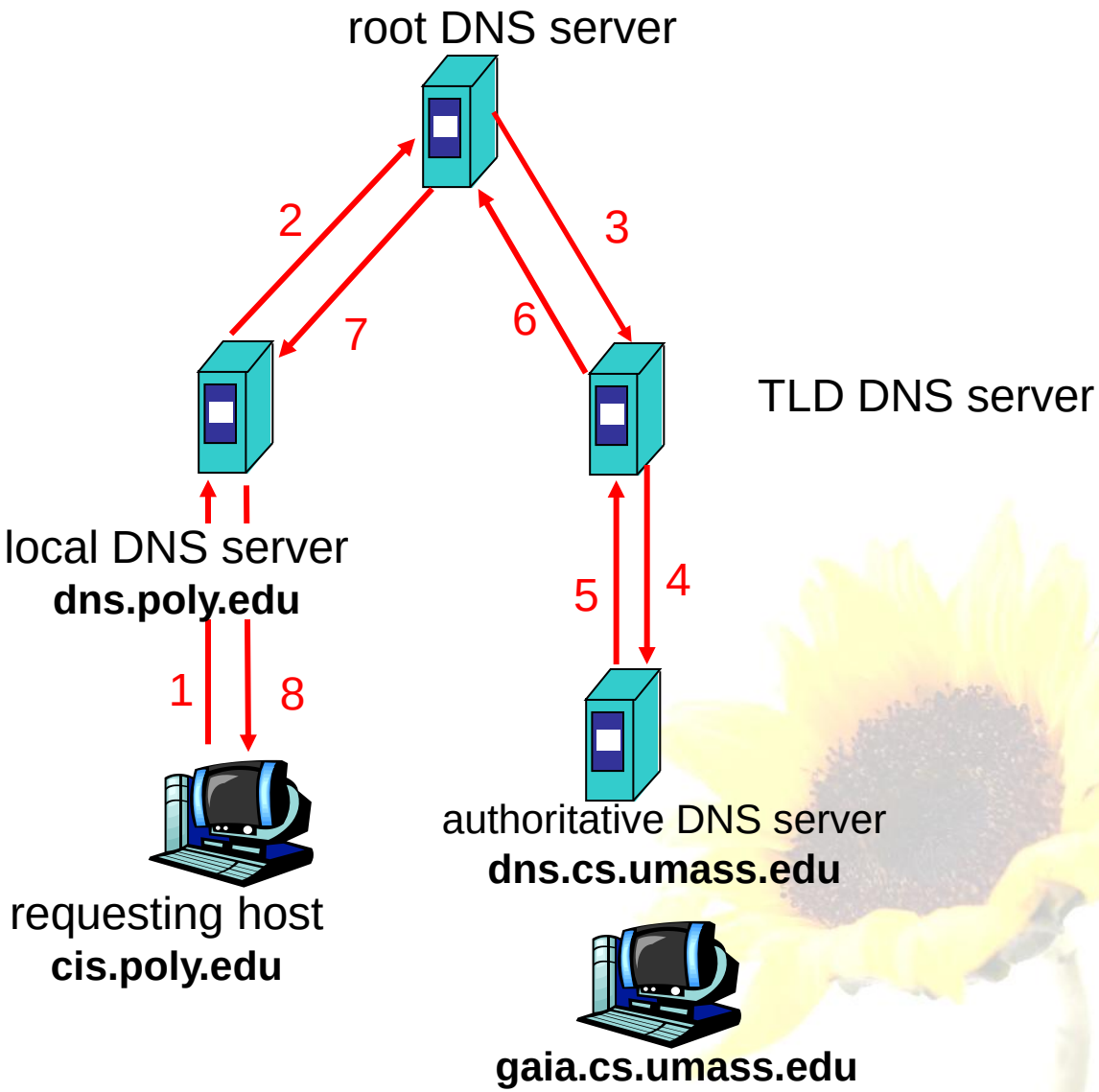
- contacted server replies with name of server to contact
- "I don't know this name, but ask this server"



DNS name resolution example

recursive query:

- puts burden of name resolution on contacted name server
- heavy load?



DNS Queries

- Recursive:
  - The client machine sends a request to the local name server, which, if it does not find the address in its database, sends a request to the root name server, which, in turn, will route the query to an intermediate or authoritative name server. Note that the root name server can contain some hostname to IP address mappings. The intermediate name server always knows who the authoritative name server is.

DNS Queries (cont'd)

- Iterative:
  - The local server queries the root server. If address not in its database, will have the name/address of an intermediate or authoritative name server and forward that information to the local name server so that it can directly communicate with the intermediate or authoritative name server. This is to prevent the overloading of the root servers that handle millions of requests.