Domain Name System

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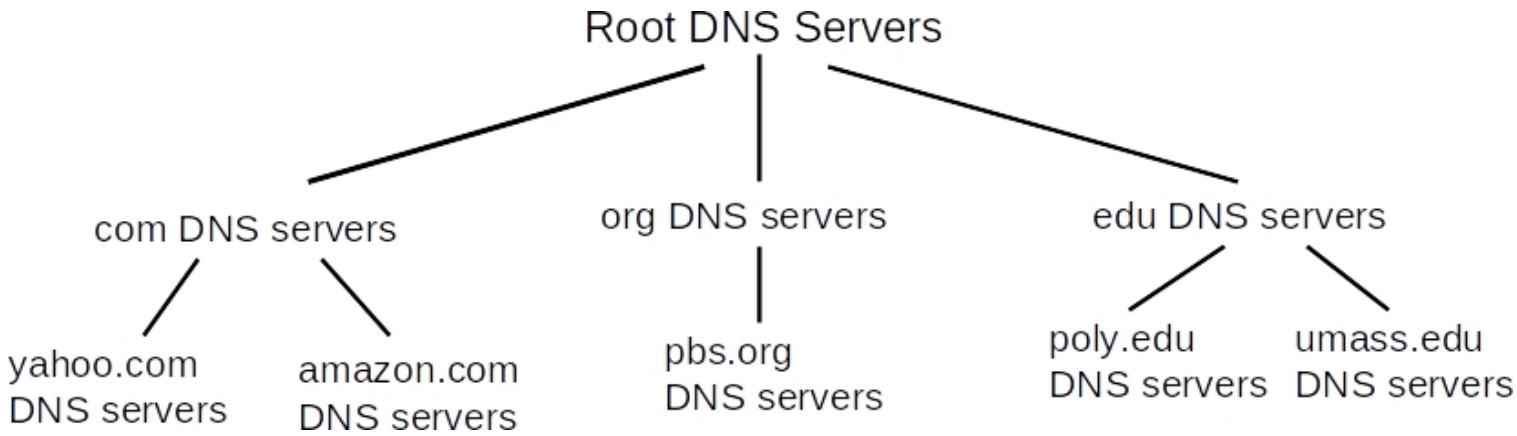
DNS: Domain Name System I

- People: many identifiers (SSN, name, passport no. etc.)
- Internet hosts, routers:
  - IP address (IPv4/IPv6)
  - "name", e.g., www.yahoo.com - used by humans
- Domain Name System
  - Distributed database implemented in hierarchy of many name servers
  - Application-layer protocol
  - Runs over UDP and uses port 53

DNS: Domain Name System II

- DNS services
  - Hostname to IP address translation
  - Host aliasing
    - Canonical, alias names
  - Mail server aliasing
  - Load distribution
    - Replicated Web servers: set of IP addresses for one canonical name
- Why not centralize DNS?
  - Single point of failure
  - Traffic volume
  - Distant centralized database
  - Maintenance
  - Does not scale

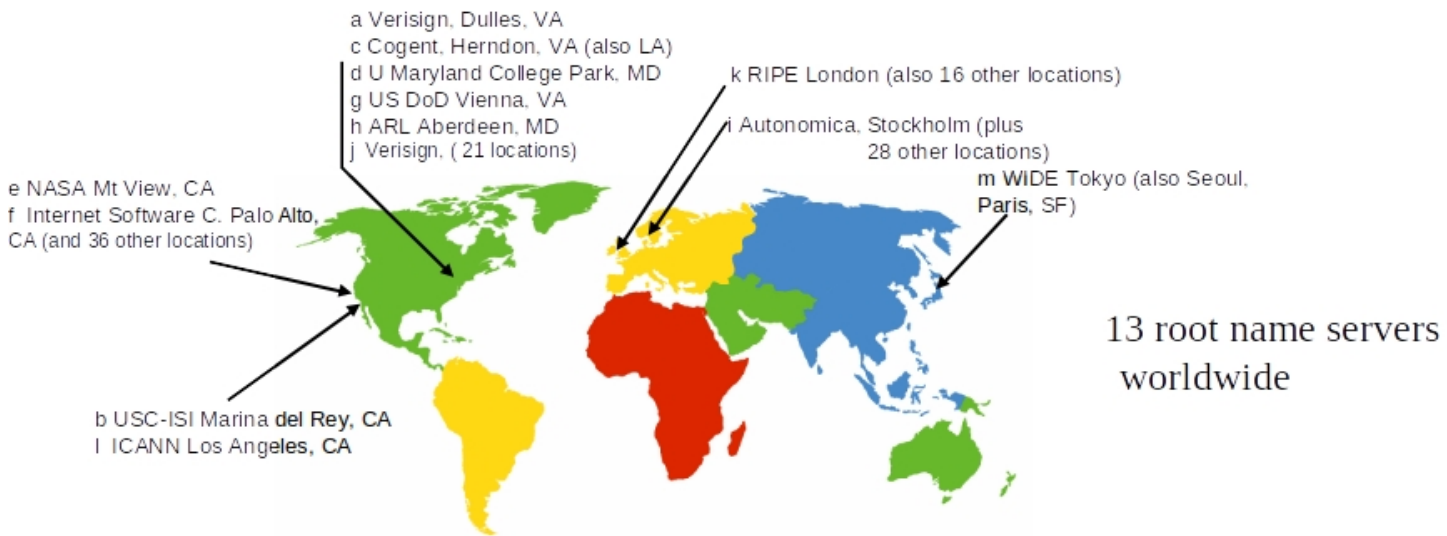
Distributed, Hierarchical Database



- Client wants IP for www.amazon.com
  - Client queries a root server to find .com DNS server
  - Client queries com DNS server to get amazon.com DNS server
  - Client queries amazon.com DNS server to get IP address for www.amazon.com

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



TLD and Authoritative Servers

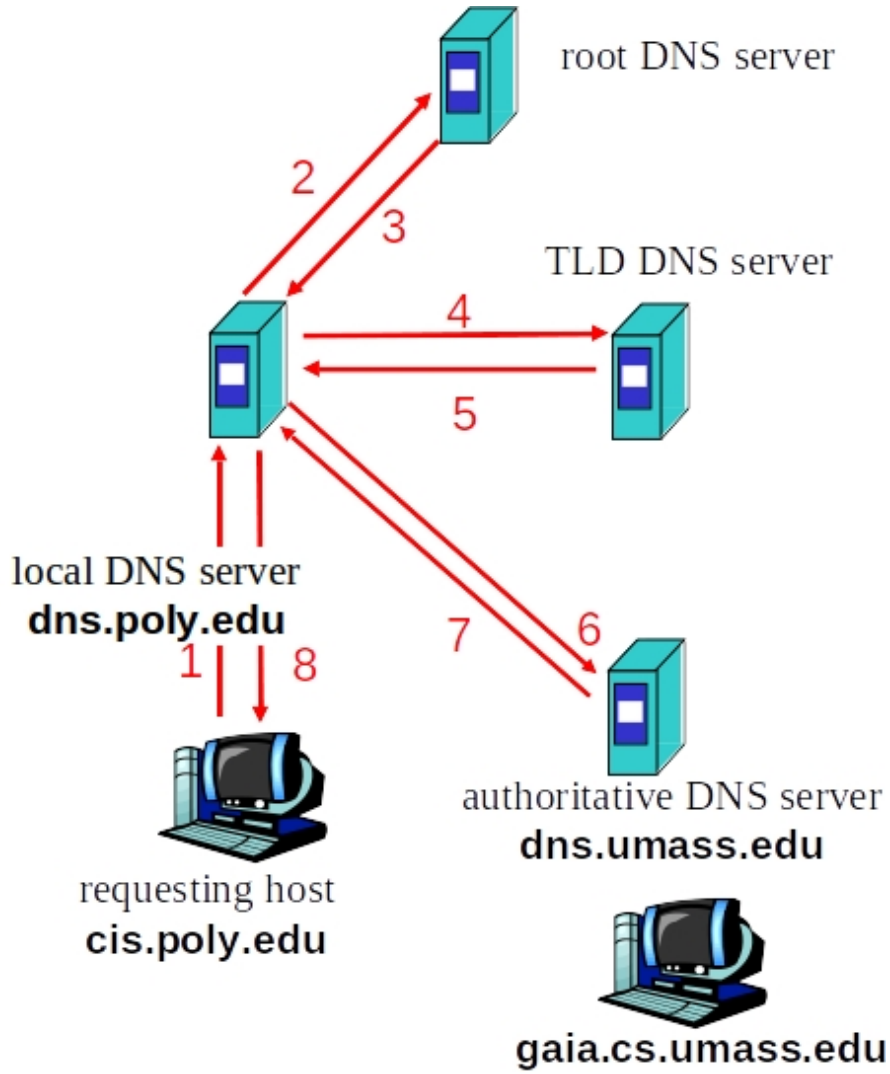
- Top-level domain (TLD) Servers:
  - Responsible for com, org, net, edu etc., and all top-level country domains uk, fr, ca, jp
  - Network Solutions maintains servers for com TLD
  - Educause for edu TLD
- Authoritative DNS Servers:
  - Organization's DNS servers, providing authoritative hostname to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

Local Name Server

- Does not strictly belong to hierarchy
- Each ISP (residential ISP, company, university) has one
  - Also called “default name server”
- When host makes DNS query, query is sent to its local DNS server
  - Acts as proxy, forwards query into hierarchy

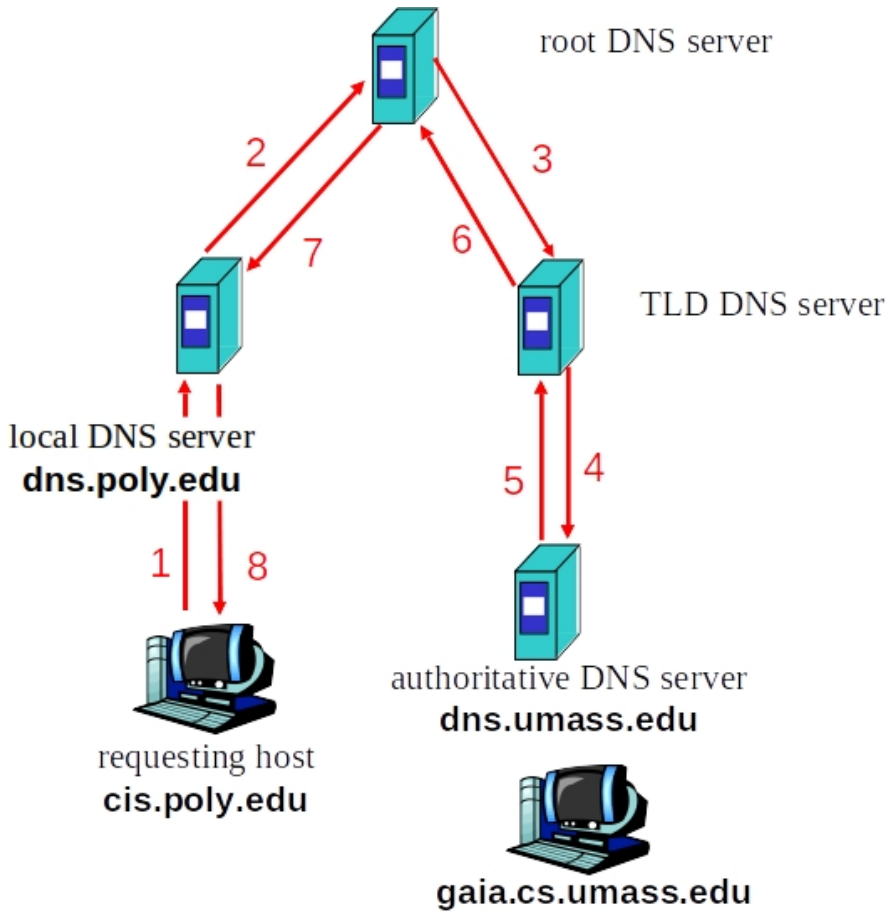
DNS Name Resolution Example I

- 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 II

- Host at cis.poly.edu wants IP address for gaia.cs.umass.edu
- Recursive Query
  - Puts burden of name resolution on contacted name server
  - Heavy load?



DNS: Caching and Updating Records

- Once (any) name server learns mapping, it caches mapping
  - Cache entries timeout (disappear) after some time
  - TLD servers typically cached in local name servers
    - Thus root name servers not often visited

DNS Records I

- DNS: distributed database storing resource records (RR)
  - RR Format: (Name, Value, Type, TTL)
- TTL : Time to Live of the RR
  - Determines when a resource should be removed from a cache

DNS Records II

- Type=A
  - Name is a hostname
  - Value is the IP address for the hostname
  - Provides standard hostname to IP address mappings
  - Example
    - (relay1.bar.foo.com, 145.37.93.126, A)

DNS Records III

- Type=NS
  - Name is a domain
  - Value is the hostname of an authoritative DNS server
  - Used to route DNS queries further along in the query chain
  - Example
    - (foo.com, dns.foo.com, NS)

DNS Records IV

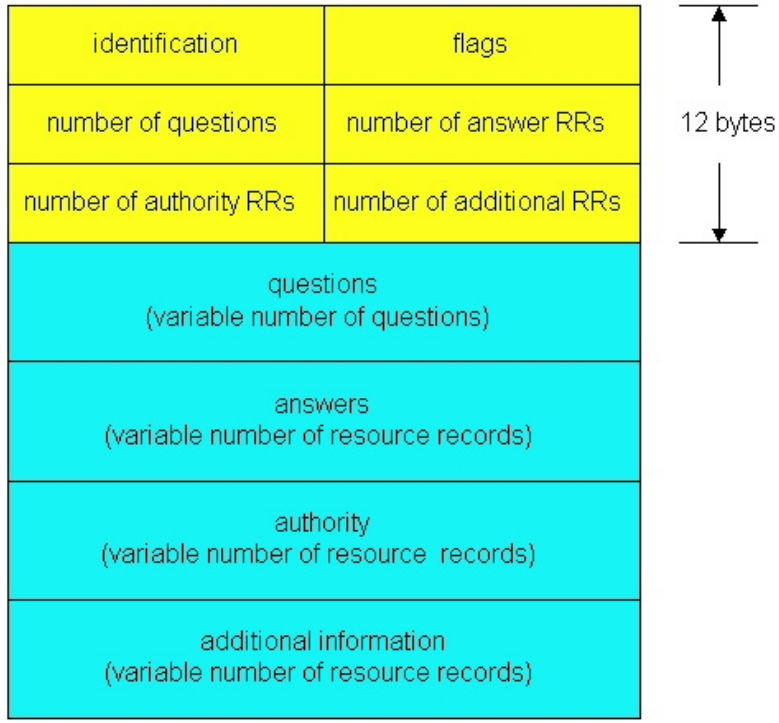
- Type=CNAME
  - Name is an alias hostname
  - Value is a canonical hostname
  - Used to answer DNS queries for canonical name for a hostname
  - Example
    - (foo.com, relay1.bar.foo.com, CNAME)
    - (www.foo.com, relay1.bar.foo.com, CNAME)
    - (mail.foo.com, relay1.bar.foo.com, CNAME)

DNS Records V

- Type=MX
  - Name is the alias hostname of the mailserver
  - Value is the canonical name of a mail server
  - Allows hostnames of mail servers to have simple aliases
  - Example
    - (foo.com, mail.bar.foo.com, MX)

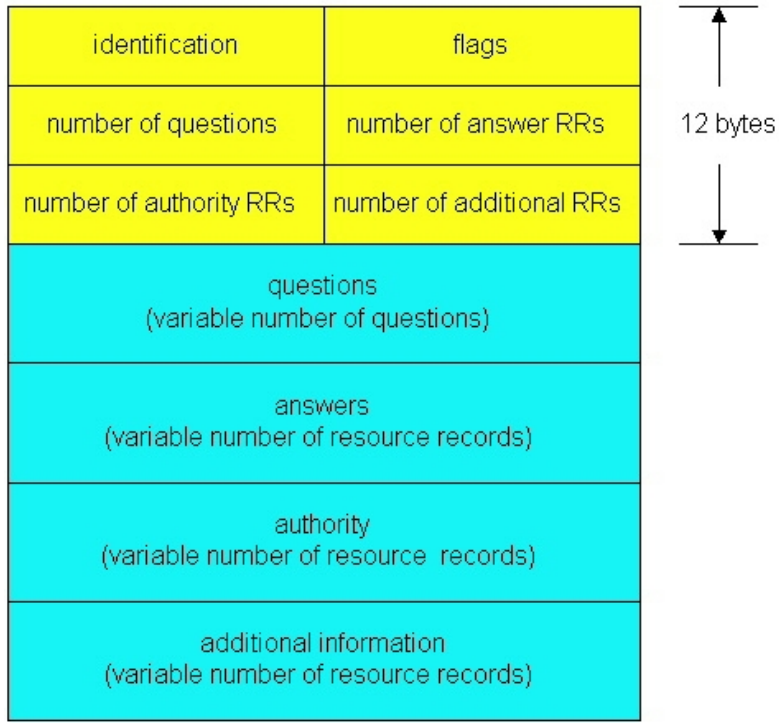
DNS Protocol, Messages I

- DNS protocol : query and reply messages, both with same message format
- Message header (12 bytes)
  - Identification: 16 bit number for query, reply to query uses same number
  - Flags:
    - Query or reply
    - Recursion desired
    - Recursion available
    - Reply is authoritative



DNS Protocol, Messages II

- Name, type fields for a query
- RRs in response to query
- Records for authoritative servers
- Additional "helpful" info that may be used



Inserting Records into DNS

- Example: new startup "Network Utopia"
- Register name networkuptopia.com at DNS registrar (e.g., Network Solutions)
  - Registrar is a commercial entity that verifies the uniqueness of the domain name
    - Internet Corporation for Assigned Names and Numbers (ICANN) accredits the various registrars
    - Complete list of accredited registrars is available at http://www.intenic.net
  - Provide names, IP addresses of authoritative name server (primary and secondary)
  - Registrar inserts two RRs into com TLD server:
    - (networkutopia.com, dns1.networkutopia.com, NS)
    - (dns1.networkutopia.com, 212.212.212.1, A)
- Create authoritative server
  - Type A record for www.networkutopia.com
  - Type MX record for networkutopia.com