DNS

CS 241

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University of Illinois
Host Names vs. IP addresses

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- Provide little (if any) information about physical location
- Examples: www.cnn.com and bbc.co.uk

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IP addresses
- Numerical address appreciated by routers
- Fixed length, binary number
- Hierarchical, related to host location
- Examples: 64.236.16.20 and 212.58.224.131
Separating Naming and Addressing
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  • Move www.cnn.com to 4.125.91.21
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Name could map to multiple IP addresses
• www.cnn.com to multiple (8) replicas of the Web site
• Enables
  ▪ Load-balancing
  ▪ Reducing latency by picking nearby servers
  ▪ Tailoring content based on requester’s location/identity
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Multiple names for the same address
• E.g., aliases like www.cnn.com and cnn.com
Domain Name System (DNS)
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Properties of DNS

• Hierarchical name space divided into zones
• Zones distributed over collection of DNS servers
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Hierarchy of DNS servers

- Root (hardwired into other servers)
- Top-level domain (TLD) servers
- Authoritative DNS servers
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Performing the translations

- Local DNS servers
- Resolver software
Distributed, Hierarchical Database

Root DNS Servers
Distributed, Hierarchical Database

Root DNS Servers

- com DNS servers
- org DNS servers
- edu DNS servers
Distributed, Hierarchical Database

Root DNS Servers

com DNS servers
- yahoo.com DNS servers
- amazon.com DNS servers

org DNS servers
- pbs.org DNS servers

edu DNS servers
- uiuc.edu DNS servers
- umass.edu DNS servers
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

Located in Virginia, USA

How do we make the root scale?

Verisign, Dulles, VA
DNS Root Servers

13 root servers (see http://www.root-servers.org/)
- Labeled A through M

Does this scale?

A Verisign, Dulles, VA
B USC-ISI Marina del Rey, CA
C Cogent, Herndon, VA
D U Maryland College Park, MD
E NASA Mt View, CA
F Internet Software Consortium Palo Alto, CA
G US DoD Vienna, VA
H ARL Aberdeen, MD
J Verisign

K RIPE London
I Autonomica, Stockholm

M WIDE Tokyo
DNS Root Servers

13 root servers each replicated via any-casting (localized routing for addresses)

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B USC-ISI Marina del Rey, CA
C Cogent, Herndon, VA (also Los Angeles, NY, Chicago)
D U Maryland College Park, MD
E NASA Mt View, CA
F Internet Software Consortium, Palo Alto, CA (and 37 other locations)
G US DoD Vienna, VA
H ARL Aberdeen, MD
I Autonomica, Stockholm (plus 29 other locations)
J Verisign (21 locations)
K RIPE London (plus 16 other locations)
L ICANN Los Angeles, CA
M WIDE Tokyo plus Seoul, Paris, San Francisco
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
- Provide authoritative hostname to IP mappings for organization’s servers (e.g., Web, mail).
- Can be maintained by organization or service provider
Local Name Server

One per ISP (residential ISP, company, university)
  • 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
  • Reduces lookup latency for commonly searched hostnames

Hosts learn local name server via...
  • DHCP (same protocol that tells host its IP address)
  • Static configuration (e.g., can use Google’s “local” name service at 8.8.8.8 or 8.8.4.4)
Applications’ use of DNS
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Client application (e.g., web browser)

- Extract server name (e.g., from the URL)
- Do `gethostbyname()` to trigger resolver code, sending message to local name server
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Server application (e.g. web server)
- Extract client IP address from socket
- Optional gethostbyaddr() to translate into name
DNS name resolution example

Host at cs.uiuc.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”
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An example demo.
Say your prayers!!
DNS: Caching

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