Domain Name System: DNS

Instructor: Carey Williamson
Office: ICT 740
Email: carey@cpsc.ucalgary.ca
Class Location: ICT 122
Lectures: MWF 12:00 - 12:50


Slides are adapted from the book’s companion Web site, with changes by Anirban Mahanti and Carey Williamson.
DNS: Domain Name System

Internet hosts:
- IP address (32 bit) - used for addressing datagrams
- “name”, e.g., ww.yahoo.com - used by humans

**DNS**: provides translation between host name and IP address

*distributed database* implemented in hierarchy of many *name servers*

*Distributed for scalability & reliability*
DNS Services

Hostname to IP address translation
Host aliasing
  Canonical and alias names
Mail server aliasing
Load distribution
  Replicated Web servers: set of IP addresses for one canonical name
DNS Infrastructure

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

Infrastructure:
- Client resolver
- Local DNS server
dns.poly.edu
- Authoritative DNS Server
dns.cs.umass.edu
- Root DNS Server
gai.cs.cs.umass.edu
- Top-Level Domain DNS Server
cis.poly.edu
- TLD DNS Server
gai.cs.cs.umass.edu
Root servers and TLD servers typically do not contain hostname to IP mappings; they contain mappings for locating authoritative servers.
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 and mail).

Can be maintained by organization or service provider
Local Name Server

Each ISP (residential ISP, company, university) has one.

Also called “default name server”

When a host makes a DNS query, query is sent to its local DNS server

Acts as a proxy, forwards query into hierarchy. Reduces lookup latency for commonly searched hostnames
Recursive queries

recursive query:
puts burden of name resolution on contacted name server
heavy load?

iterated query:
contacted server replies with name of server to contact
“I don’t know this name, but ask this server”
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

update/notify mechanisms under design by IETF

RFC 2136

DNS records

**DNS:** distributed db storing resource records (RR)

**RR format:** (name, value, type, ttl)

**Type=A**
- name is hostname
- value is IP address

**Type=NS**
- name is domain (e.g. foo.com)
- value is IP address of authoritative name server for this domain

**Type=CNAME**
- name is alias name for some “cannonical” (the real) name
  - www.ibm.com is really servereast.backup2.ibm.com
- value is cannonical name

**Type=MX**
- value is name of mailserver associated with name
**DNS protocol, messages**

**DNS protocol**: query and reply messages, both with same *message format*

**msg header**
- **identification**: 16 bit # for query, reply to query uses same #
- **flags**: query or reply
  - recursion desired
  - recursion available
  - reply is authoritative

<table>
<thead>
<tr>
<th>Identification</th>
<th>Flags</th>
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<tbody>
<tr>
<td>number of questions</td>
<td>number of answer RRs</td>
</tr>
<tr>
<td>number of authority RRs</td>
<td>number of additional RRs</td>
</tr>
<tr>
<td>questions</td>
<td>answers</td>
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<tr>
<td>(variable number of questions)</td>
<td>(variable number of resource records)</td>
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<tr>
<td>authority</td>
<td>additional information</td>
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**DNS protocol, messages**

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

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- Questions (variable number of questions)
- Answers (variable number of resource records)
- Authority (variable number of resource records)
- Additional information (variable number of resource records)

12 bytes
Inserting records into DNS

Example: just created startup “Network Utopia”
Register name networkuptopia.com at a registrar (e.g., Network Solutions)
Need to provide registrar with names and IP addresses of your authoritative name server (primary and secondary)
Registrar inserts two RRs into the com TLD server:

(networkuptopia.com, dns1.networkuptopia.com, NS)
(dns1.networkuptopia.com, 212.212.212.1, A)

Put in authoritative server Type A record for www.networkuptopia.com and Type MX record for networkuptopia.com

How do people get the IP address of your Web site?
Application Layer: Summary

Our study of network apps now complete!

Application architectures
  client-server
  P2P
  hybrid

Application service requirements:
  reliability, bandwidth, delay

Internet transport service model
  connection-oriented, reliable: TCP
  unreliable, datagrams: UDP

specific protocols:
  HTTP
  FTP
  SMTP, POP, IMAP
  DNS

socket programming
(Assignment 1 + tutorial sessions)
Application Layer: Summary

**Most importantly:** learned about protocols

typical request/reply message exchange:
- client requests info or service
- server responds with data, status code

message formats:
- headers: fields giving info about data
- data: info being communicated

control vs. data msgs
- in-band, out-of-band
- centralized vs. decentralized
- stateless vs. stateful
- reliable vs. unreliable msg transfer

“complexity at network edge”