Distributed Name System

Slides adapted from:
Computer Networking: A Top Down Approach
Featuring the Internet,
2nd edition.
Jim Kurose, Keith Ross
Addison-Wesley, July 2002.

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DNS: Distributed Name System

- Reading assignment:
  - Chapter 2.5 "DNS - The Internet's Directory Service"
    from
    Computer Networking: A Top Down Approach Featuring the
    Internet, 2nd edition. Jim Kurose, Keith Ross
    Addison-Wesley, July 2002.
DNS: Domain Name System

People: many identifiers:
- SSN, name, passport #

Internet hosts, routers:
- IP address (32 bit) - used for addressing datagrams
- "name", e.g., gaia.cs.umass.edu - used by humans

Q: map between IP addresses and name?

Domain Name System:
- 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"

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

doesn't scale!
**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

![Diagram of root name servers worldwide](image)

**Simple DNS example**

Host `surf.eurecom.fr` wants IP address of `gaia.cs.umass.edu`

1. contacts its local DNS server, `dns.eurecom.fr`
2. `dns.eurecom.fr` contacts root name server, if necessary
3. root name server contacts authoritative name server, `dns.umass.edu`, if necessary

![Diagram of DNS example](image)
DNS example

Root name server:
- may not know authoritative name server
- may know intermediate name server: who to contact to find authoritative name server

DNS: iterated 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
- Update/notify mechanisms under design by IETF
  - RFC 2136

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**DNS records**

DNS: distributed db storing resource records (RR)

**RR format:** \( (\text{name}, \text{value}, \text{type}, \text{ttl}) \)

- **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
  - **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>
</tr>
</thead>
<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>(variable number of questions)</td>
</tr>
<tr>
<td>answers</td>
<td>(variable number of resource records)</td>
</tr>
<tr>
<td>authority</td>
<td>(variable number of resource records)</td>
</tr>
<tr>
<td>additional information</td>
<td>(variable number of resource records)</td>
</tr>
</tbody>
</table>

12 bytes

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