The Domain Name System (DNS)

Chapter 31

nslookup a Fully Qualified Domain Name (FQDN)

C: \> nslookup www.uab.edu
Server: engwins.eng.uab.edu
Address: 138.26.84.2
Name: pocates.lhl.uab.edu
Address: 138.26.153.182
Aliases: www.uab.edu

nslookup an IP Number

C: \> nslookup 138.26.152.111
Server: engwins.eng.uab.edu
Address: 138.26.84.2
Name: hyperion.lhl.uab.edu
Address: 138.26.152.111

Structure of Domain Names
- Fully qualified domain name (of a computer):
  hyperion.lhl.uab.edu
  - edu - top level, an educational institution
  - uab - next level, a particular school
  - lhl - next level, a particular building on campus (Lister Hill Library)
  - hyperion - bottom level, a particular computer

Top Level Domains

<table>
<thead>
<tr>
<th>Name</th>
<th>Assigned to</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>com</td>
<td>Commercial organization</td>
<td>ftp.redhat.com</td>
</tr>
<tr>
<td>edu</td>
<td>Educational institution</td>
<td><a href="http://www.uab.edu">www.uab.edu</a></td>
</tr>
<tr>
<td>mil</td>
<td>Military group</td>
<td><a href="http://www.defenselink.mil">www.defenselink.mil</a></td>
</tr>
<tr>
<td>net</td>
<td>Major network support</td>
<td><a href="http://www.bellsouth.net">www.bellsouth.net</a></td>
</tr>
<tr>
<td>org</td>
<td>Other organization</td>
<td><a href="http://www.ieee.org">www.ieee.org</a></td>
</tr>
<tr>
<td>uk</td>
<td>United Kingdom</td>
<td><a href="http://www.keats.co.uk">www.keats.co.uk</a></td>
</tr>
<tr>
<td>ca</td>
<td>Canada</td>
<td><a href="http://www.canada.gc.ca">www.canada.gc.ca</a></td>
</tr>
<tr>
<td>mx</td>
<td>Mexico</td>
<td>sunsite.unam.mx</td>
</tr>
</tbody>
</table>

Geographical Structure
- The structure of all FQDN’s is hierarchical.
  - Either by organization,
    - www.snt.bst.bls.com
  - Or by geography.
    - enr1.estro.va.us
DNS Client-Server Model
- DNS Servers convert FQDNs to IP addresses.
- DNS servers will also convert IP addresses to FQDNs.
- DNS servers can provide alias translation.
  - Clients ask for the translation.
  - nslookup is an example of such a client.
  - http, smtp & ftp are other example clients that use DNS.
- Autonomy allows each organization to assign names with informing a central authority.
  - An organization can control all names with a particular suffix.
- DNS servers are arranged in a hierarchy that matches the naming hierarchy.

DNS Server Hierarchy
- No one server has all the names and numbers.
- There are four types of Name Servers:
  - Local or Default Name Servers – Your ISP, university, company, etc.
  - Root Name Servers – .com, .edu, .uk
  - Authoritative Name Servers – for a particular registered domain name.
  - Intermediate Name Servers – linked downward to several Authoritative Name Servers.
- Links between servers are used to find a server which can translate a query.
- A single Query can involve several links. Four or more may be needed to resolve a name.

DNS Server Architectures

DNS Servers and Protocol
- DNS servers are usually UNIX machines.
- They run Berkeley Internet Name Domain (BIND) software.
- DNS protocol uses UDP.
- DNS protocol uses port number 53.

Name Resolution Example
- Browser requests www.uab.edu/index.html.
- Browser extracts the host name www.uab.edu
- Browser passes www.uab.edu to the client side of the DNS application (gethostbyname in Unix).
- The Client DNS application sends a request to the DNS server.
- The DNS server replies with the IP address for www.uab.edu

Optimization of DNS Performance
- Replication – Each root server is replicated. A new site uses the closest copy of the root server.
- Caching – Each server maintains a cache of names and bindings. First, it looks in its cache for the response to a query.
Types of DNS Entries

- Each entry in a DNS database has three items:
  - Domain name
  - Record type
  - Value
- Each query sent to the DNS server has
  - A domain name
  - A type
- The server returns the Value that matches both the supplied domain name and type.
- As a consequence, a DNS query that works for email may not work for web traffic.

<table>
<thead>
<tr>
<th>Type</th>
<th>Meaning</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOA</td>
<td>Start of Authority</td>
<td>Parameters for this zone</td>
</tr>
<tr>
<td>A</td>
<td>IP address of a host</td>
<td>32-bit integer</td>
</tr>
<tr>
<td>MX</td>
<td>Mail Exchange</td>
<td>Priority, domain willing to accept mail</td>
</tr>
<tr>
<td>NS</td>
<td>Name Server</td>
<td>Name of a server for this domain</td>
</tr>
<tr>
<td>CNAME</td>
<td>Canonical name</td>
<td>Domain name</td>
</tr>
<tr>
<td>PTR</td>
<td>Pointer</td>
<td>Alias for an IP address</td>
</tr>
<tr>
<td>HINFO</td>
<td>Host description</td>
<td>CPU and OS in ASCII</td>
</tr>
<tr>
<td>TXT</td>
<td>Text</td>
<td>Uninterrupted ASCII text</td>
</tr>
</tbody>
</table>

Aliases Using the CNAME Type

- [www.uab.edu](http://www.uab.edu) is an alias.
- The canonical name is [pocrates.lhl.uab.edu](http://pocrates.lhl.uab.edu)
- The DNS server can translate the alias to both the canonical name and the IP address.