Services:
DNS – domain name system

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Buying numbers and names

- numbers are IP addresses
  - you buy them from an ISP
  - the ISP makes sure those addresses go to your place
- the names are domain names
  - you buy them from a name registrar
  - if you can connect the names to the addresses, those names will go to your place
Grouping numbers and names

- grouping IP addresses is called subnetting
  - you buy 164.67.*. from an ISP
  - you define subgroups 164.67.78.* 164.67.79.* etc
- grouping names is called creating zones
  - you buy mycompany.com from a name registrar
  - you define machine names like vp.mycompany.com
  - you define subgroups like sales.mycompany.com
    - you define machine names like
      manny.sales.mycompany.com, moe.sales.mycompany.com, jack.sales.mycompany.com

DNS job 1:

Assigning your numbers to your names by a cross-correlation of your choosing, and making the assignments accessible to the world by dynamic software lookup. Then, the world can use your names and forget about your numbers.
A poor-man’s, non-DNS alternative: /etc/hosts

```plaintext
# Do not remove the following line, or various programs
# that require network functionality will fail.
127.0.0.1    hostz.hostz.linnet.edu localhost.localdomain localhost
164.67.79.150 hostz.linnet.edu
164.67.79.151 hosta.linnet.edu
164.67.79.152 hostb.linnet.edu
164.67.79.153 hostc.linnet.edu
164.67.79.154 hostd.linnet.edu
164.67.79.155 hothe.linnet.edu
164.67.79.156 hostf.linnet.edu
164.67.79.157 hostg.linnet.edu
164.67.79.158 hosth.linnet.edu
164.67.79.159 hosti.linnet.edu
164.67.79.160 hostj.linnet.edu
164.67.79.161 hostk.linnet.edu
164.67.79.162 hostl.linnet.edu
164.67.79.163 hostm.linnet.edu
164.67.79.164 hostn.linnet.edu
164.67.79.165 hosto.linnet.edu
164.67.79.166 hostp.linnet.edu
164.67.79.167 hostq.linnet.edu
164.67.79.168 hostr.linnet.edu
```

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**Resolvers**

- Clients that query name-number databases
- Functions
  - issue query
  - interpret response
  - return response to program that requested it
- Resolvers can query local /etc/hosts file
The domain name space

Name-address correlation table

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>homepage.smc.edu</td>
<td>198.147.67.246</td>
</tr>
<tr>
<td><a href="http://www.smc.edu">www.smc.edu</a></td>
<td>198.147.67.242</td>
</tr>
<tr>
<td>sputnik.smc.edu</td>
<td>207.151.69.250</td>
</tr>
</tbody>
</table>
Addresses in a nameserver’s database

- **Always** (permanent, file-based)
  - for the nameserver’s own domain
    - the hosts in it
  - for a subdomain of the nameserver’s domain
    - the hosts in it, or
    - the nameserver(s) for it
  - hosts in the root zone
- **Maybe** (transient, cache-based)
  - for other, unrelated domains
    - some of the hosts in those

Name-resolution process

- Computers (including nameservers) query nameservers
- 2 query types
  - recursive
  - iterative
- Resolvers can query nameservers
  - configured with addresses of a few known nameservers
Name-resolution process

```
query (for www.smc.edu)  answer (198.147.67.242)
resolver
```

```
query for www.smc.edu
referral to edu name servers
edu name server
```

```
query for www.smc.edu
referral to smc name servers
smc name server
```

```
query for www.smc.edu
address of www.smc.edu
```

```
"." name server
```

Or maybe just…

```
query (for www.smc.edu)  answer (198.147.67.242)
resolver
```

```
query for www.smc.edu
referral to smc name servers
smc name server
```

```
query for www.smc.edu
address of www.smc.edu
```

```
"." name server
```

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Or maybe just…
DNS mechanism

A decentralized, distributed database for the internet as a whole. You keep the part internal to your company on your own nameserver for others to access. They do the same for you.

Software on linux to integrate your name-number list into the global database is Berkeley Internet Name Daemon (BIND). You supply your name-number list to BIND and BIND makes it available to outsiders.

DNS implements 2 lookup types

- Forward lookup – given a name provides a number
- Reverse lookup – give a number provides a name
BIND’s files

/etc/named.conf identifies the others

/var/named/

F F R F R R F R

“root server” list forward/reverse pair for “self” forward/reverse set for each zone you create

RedHat 8 default fileset

/etc/named.conf

/localhost.zone
(named.ca named.local)

/var/named/

F F R

No created zones!

named.ca localhost.zone named.local

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DNS and BIND’s example fileset

/etc/named.conf

/var/named/

F F F R R R

db.cache db.127.0.0 db.movie.edu db.192.249.249 db.192.253.253

Homegrown fileset

/etc/named.conf

/var/named/

F F F R R R

db.cache db.127.0.0 db.linnet db.128.97.25

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Zone data files have resource records of several types

- SOA – indicates authority for this zone
- NS – lists name server for this zone
- A – name-to-address mapping
- PTR – address-to-name mapping
- … others

SOA record – start of authority

<zone> IN SOA <zone’s nameserver> <mail address>
<numeric data for slaves>

movie.edu. IN SOA terminator.movie.edu. al.robocop.movie.edu. ( 1 ; serial 3h ; Refresh after 3 hours 1h ; Retry after 1 hour 1w ; Expire after 1 week 1h) ; Negative caching TTL of 1 day
NS record – name server

  <name> IN NS <zone’s nameserver>

  movie.edu. IN NS terminator.movie.edu.
  movie.edu. IN NS wormhole.movie.edu.

A record – address

  <name> IN A <address>

  terminator.movie.edu. IN A 192.249.249.3
  diehard.movie.edu. IN A 192.249.249.4
PTR record – pointer

<address in a name form> IN PTR <name>

3.249.249.192.in-addr.arpa. IN PTR terminator.movie.edu.
4.249.249.192.in-addr.arpa. IN PTR wormhole.movie.edu.

Notation shortcuts

- Appending domain names
- @ notation
- Repetition of name from last resource record
Appending domain names

- 2nd field of named.conf’s “zone” statement is a domain name
- Serves as “origin” of corresponding zone file’s data
- Gets auto-appended to all names in zone file that don’t end with a .

@ notation

- found in a zone file
- abbreviates that zone file’s origin/domain name (from named.conf), with trailing dot
- most common in SOA records
Name repetition

- for lines that begin with space or tab
- name from last resource record is implied at beginning of such lines

Running the nameserver

- conventional, as other servers
- /etc/rc.d/init.d/named { start, stop, restart, status }
- service named { start, stop, restart, status }
Client side – resolver configuration

- `/etc/resolv.conf` and `/etc/host.conf`
- `resolv.conf` contains directives of type
  - nameserver
  - domain
  - search
- `host.conf` contains directives of type
  - order
  - trim
  - multi

- `man resolv.conf` `man host.conf`

```
tools

- `dig`
- `nslookup`
- `h2n` – converts `/etc/hosts` to DNS fileset


  $ zcat dns.tar.Z | tar xf -

- `webmin`
- `redhat-config-bind`
```
Biblio

- DNS and BIND, Albitz and Liu, O’Reilly, 4th ed. 2001
- http://www.ibiblio.org/pub/Linux/docs/HOWTO/other-formats/html_single/DNS-HOWTO.html#ss5.1