Domain Name System

Review of domain names

- hierarchical tree: host.department.company.country
- depth varies from 2 to > 5
- can't tell from name what's a domain and what's a host
- important top-level domains: .com, .edu, .org, countries (.de, .uk)
- each level *delegates* authority to lower levels

Mapping names to (IP) addresses

- distributed: multiple servers cooperate
- efficient: most mappings done locally
- general purpose: in theory, any mapping
- reliable: no single point of failure; multiple (≥ 2) servers for each *zone of authority*

➠ implemented by *name servers* (hosts) arranged in tree, used by *resolver* clients

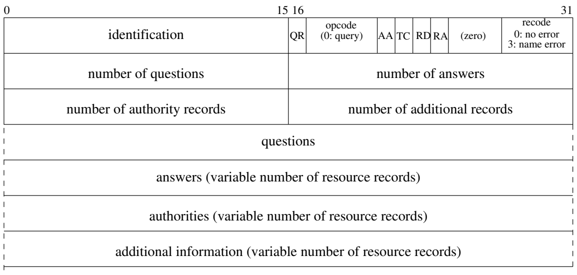
Name resolution

- hierarchy top-down, search bottom-up (most searches local?)
- client contacts local server (hard wired `/etc/resolv.conf`)
- each server knows address of root server
- server *may* know *parent* server (one level up)
- local server conceptually walks tree top down
- query: name, type of answer, flag: recursive/iterative
- response: either complete answer or next server to contact

Caching

- can’t contact root server for every query
- each server must maintain cache, hosts may
- if server has cached copy, return *non-authoritative* mapping, plus source of information
- answers include time-to-live (TTL) value ➠ decrease TTL before updates
- typical TTL: around a day
- mostly UDP (port 53), but can use TCP

DNS message format



QR	query (0) or response (1)
opcode	0: query; 1: inverse query; 2: server status
AA	authoritative answer
TC	truncated (only first 512 bytes returned)
RD	recursion desired
RA	from server: recursion available
rcode	0: no error; 3: name does not exist

DNS query

single question:
5 lupus 5 fokus 3 gmd 3 de 0; 16-bit query type; 16-bit query class (1: Internet address)

query type:

A	IP address
NS	authoritative name server
CNAME	canonical name
PTR	pointer record
HINFO	host info
MX	mail exchange record
AXFR	zone transfer

GMD fokus

Resource records

0	15 16	31
domain name (or abbreviation), not padded		
resource record type (A, NS, ...)	resource record class (1)	
time-to-live (TTL) (seconds)		
resource data length		
resource data (e.g., 4-byte IP address)		

- Domain name is *abbreviation* if 2 high-order count bits on: 16-bit pointer to location within DNS message
- may return extra records (e.g., MX also returns A, just in case)

GMD fokus

Inverse mappings and pointer queries

- IP address → domain name(s)
- needed (e.g.) for diskless machines
- IP addresses are not assigned by geography or administration
- 192.35.149.52 ➠ 52.149.35.192.in-addr.arpa

nslookup

```
> set norecurse
> www.sun.com
Server:  gaia.fokus.gmd.de
Address:  192.35.149.140
Name:    www.sun.com
Served by:
- NS.SUN.com
          192.9.9.3
          SUN.COM
- VGR.ARL.MIL
          128.63.2.6, 128.63.16.6, 128.63.4.4, 26.2.0.29
          SUN.COM
```

RR examples

```
> set query=a
Name:     lupus.fokus.gmd.de
Address:  192.35.149.52
> set query=mx
> tu-berlin.de
tu-berlin.de preference=100, mail exchanger=mail.zrz.TU-Berlin.DE
tu-berlin.de preference=100, mail exchanger=mailgzrz.TU-Berlin.DE
tu-berlin.de preference=150, mail exchanger=sc.ZIB-Berlin.DE
> set query=hinfo
> lupus
lupus.fokus.gmd.de CPU=SS20 OS=Solaris
> set query=soa
> fokus.gmd.de
origin = gaia.fokus.gmd.de
mail addr = wasserroth.fokus.gmd.de
serial = 236
refresh = 10800 (3 hours)
retry   = 1800 (30 mins)
expire  = 3600000 (41 days 16 hours)
minimum ttl = 86400 (1 day)
```


DNS: Summary

- *not* a general directory service (can't find company name → domain name) ➠ whois, whois++, X.500, …
- but: currently no "real" directory service (except Yahoo, Lycos, …) ➠ need memorable domain names
- trademarks, overloading (single .COM domain for Apple Records and Apple Computers)
- flu.com, stupid.com, diaper.com, mafia.com, …➠ 86,000 .COM domains
- ideas:
  - charge for domain names ($50/year) ➠ doesn't deter P&G
  - encourage geographic registration (.us domain)
  - new trade domains (.computer.com)