

Address Conversion Functions and The Domain Name System

RFC 1034
RFC 1035

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Hostnames

- IP Addresses are great for computers
 - IP address includes information used for routing.
- IP addresses are tough for humans to remember.
- IP addresses are impossible to guess.
 - ever guessed at the name of a WWW site?

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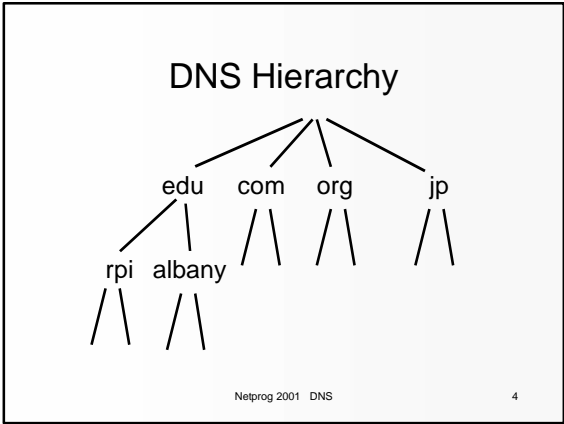
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The Domain Name System

- The *domain name system* is usually used to translate a host name into an IP address .
- Domain names comprise a hierarchy so that names are unique, yet easy to remember.

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Host name structure

- Each host name is made up of a sequence of *labels* separated by periods.
 - Each label can be up to 63 characters
 - The total name can be at most 255 characters.
- Examples:
 - whitehouse.gov
 - barney.the.purple.dinosaur.com
 - monica.cs.rpi.edu

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Domain Name

- The domain name for a host is the sequence of labels that lead from the host (leaf node in the naming tree) to the top of the worldwide naming tree.
- A domain is a subtree of the worldwide naming tree.

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Top level domains

- `edu`, `gov`, `com`, `net`, `org`, `mil`, ...
- Countries each have a top level domain (2 letter domain name).
- New top level domains proposed.

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DNS Organization

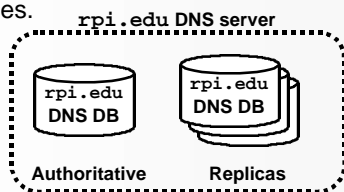
- Distributed Database
 - The organization that owns a domain name is responsible for running a DNS server that can provide the mapping between hostnames within the domain to IP addresses.
 - So - some machine run by RPI is responsible for everything within the `rpi.edu` domain.

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DNS Distributed Database

- There is one primary server for a domain, and typically a number of secondary servers containing replicated databases.



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DNS Clients

- A DNS client is called a *resolver*.
- A call to `gethostbyname()` is handled by a resolver (typically part of the client).
- Most Unix workstations have the file `/etc/resolv.conf` that contains the local domain and the addresses of DNS servers for that domain.

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`/etc/resolv.conf`

```
domain rpi.edu
128.113.1.5
128.113.1.3
```

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`nslookup`

- `nslookup` is an interactive resolver that allows the user to communicate directly with a DNS server.
- `nslookup` is usually available on Unix workstations.

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DNS Servers

- Servers handle requests for their domain directly.
- Servers handle requests for other domains by contacting remote DNS server(s).
- Servers cache external mappings.

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Server - Server Communication

- If a server is asked to provide the mapping for a host outside its domain (and the mapping is not in the server cache):
 - The server finds a nameserver for the target domain.
 - The server asks the nameserver to provide the host name to IP translation.
- To find the right nameserver, use DNS!

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DNS Data

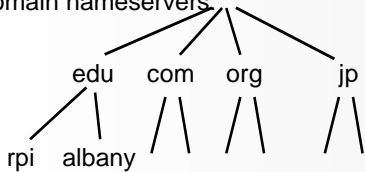
- DNS databases contain more than just hostname-to-address records:
 - Name server records NS
 - Hostname aliases CNAME
 - Mail Exchangers MX
 - Host Information HINFO

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The Root DNS Server

- The root server needs to know the address of 1st (and many 2nd) level domain nameservers.



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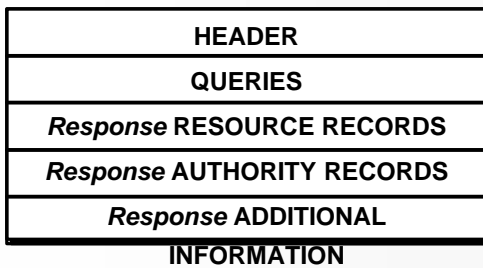
Server Operation

- If a server has no clue about where to find the address for a hostname, ask the root server.
- The root server will tell you what nameserver to contact.
- A request may get forwarded a few times.

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DNS Message Format



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DNS Message Header

- query identifier
- flags
- # of questions
- # of RRs
- # of authority RRs
- # of additional RRs

16 bit fields

} Response

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Message Flags

- QR: Query=0, Response=1
- AA: Authoritative Answer
- TC: response truncated (> 512 bytes)
- RD: recursion desired
- RA: recursion available
- rcode: return code

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Recursion

- A request can indicate that recursion is desired - this tells the server to find out the answer (possibly by contacting other servers).
- If recursion is not requested - the response may be a list of other name servers to contact.

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Question Format

- Name: domain name (or IP address)
- Query type (A, NS, MX, ...)
- Query class (1 for IP)

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Response Resource Record

- Domain Name
- Response type
- Class (IP)
- Time to live (in seconds)
- Length of resource data
- Resource data

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UDP & TCP

- Both UDP and TCP are used:
 - TCP for transfers of entire database to secondary servers (replication).
 - UDP for lookups
 - If more than 512 bytes in response - requestor resubmits request using TCP.

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Lots more

- This is not a complete description !
- If interested - look at:
 - RFC 1034: DNS concepts and facilities.
 - RFC 1035: DNS implementation and protocol specification.
 - play with nslookup.
 - Look at code for BIND (DNS server code).

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Name to Address Conversion

- The `InetAddress` class provides Name to address conversion.
- Sample code is on the web:
 - `Myaddress` – prints out local IP address
 - `Lookup` – prints out all the IP addresses for a hostname.

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