TK1104 - Digital Technology

DNS

Ismail Hassan

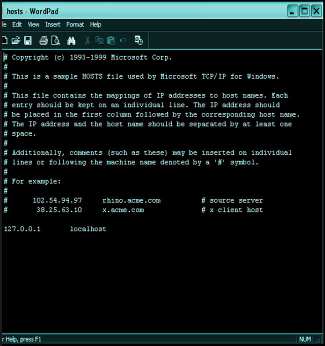
The challenge

- How does the computer know that **www.kristiania.no** is at the IP address **104.40.215.219**?

What is the IP address of www.kristiania.no
www.kristiania.no

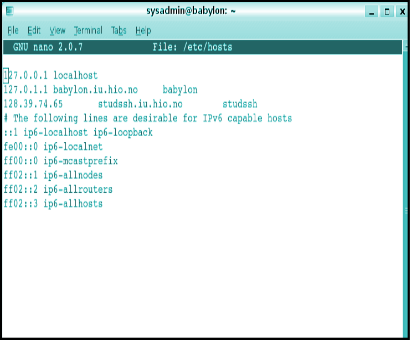
The *hosts* file

- Most operating systems (Unix / Linux and Windows) have a configuration file where you can manually configure mapping between a machines Fully Qualified Domain Name and an IP address



```
# Copyright (c) 1993-1999 Microsoft Corp.
#
# This is a sample HOSTS file used by Microsoft TCP/IP for Windows.
#
# This file contains the mappings of IP addresses to host names. Each
# entry should be kept on an individual line. The IP address should
# be placed in the first column followed by the corresponding host name.
# The IP address and the host name should be separated by at least one
# space.
#
# Additionally, comments (such as these) may be inserted on individual
# lines or following the machine name denoted by a '#' symbol.
#
# For example:
#
#      102.54.94.97     rhino.acme.com          # source server
#       38.25.63.10     x.acme.com              # x client host

127.0.0.1       localhost
```



```
  GNU nano 2.0.7              File: /etc/hosts

127.0.0.1 localhost
127.0.1.1 babylon.iu.hio.no      babylon
128.39.74.65       studssh.iu.hio.no        studssh
# The following lines are desirable for IPv6 capable hosts
::1 ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
ff02::3 ip6-allhosts
```

Challenges with the hosts file

- The problem:
  - As the network grows beyond more than a handful of machines, synchronization of the hosts file becomes difficult
  - If the machine you want to communicate with is not listed in hosts file, then the information must be retrieved from another location

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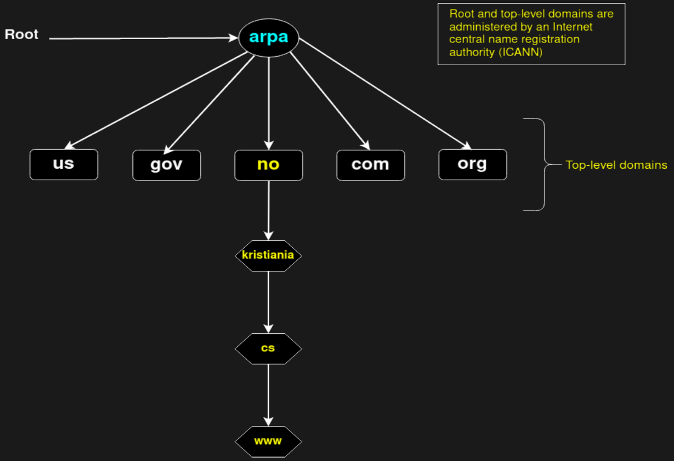
- The solution:
  - The Domain Name System (DNS) server
    - DNS is i a kind of *"Gulesider/1881"* for IP addresses.
    - Quite simply, it provides a mechanism for turning readable machine names and mapping it to IP addresses

Resolver and the DNS server

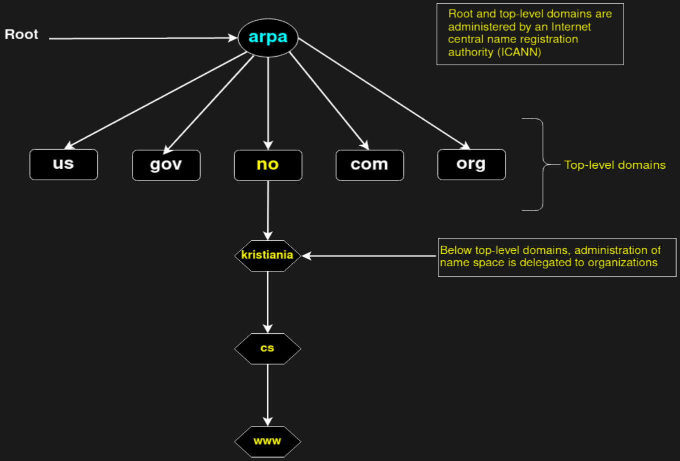
- If the machine I want to communicate with is not listed in the hosts file, then the request must be sent to a DNS server
- A DNS client often called resolver takes care of communication with the DNS server
  - The DNS server the client needs to contact is either configures manually or automatically configured by DHCP
  - The DNS server returns the IP address to the resolver which then forwards it to the application

DNS Hierarchy



Root and top-level domains are administered by an Internet central name registration authority (ICANN)

Hierarchical Name



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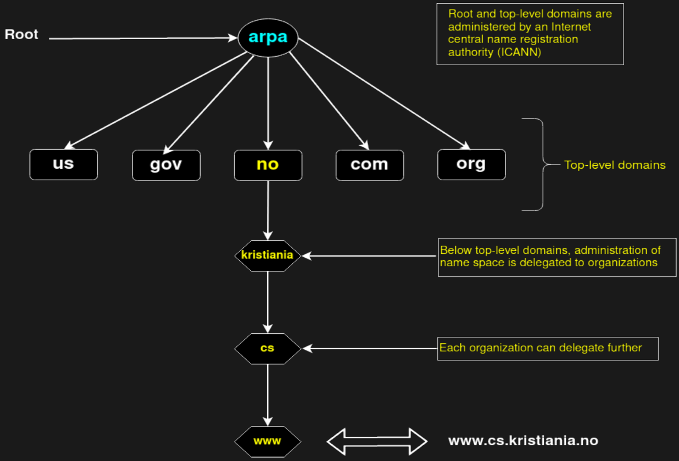
Top-level domains

Below top-level domains, administration of name space is delegated to organizations

Hierarchical Name



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Top-level domains

Below top-level domains, administration of name space is delegated to organizations

Each organization can delegate further

www.cs.kristiania.no

DNS: Architecture

- DNS servers are responsible for one or more domains
- Root servers are responsible for the Top Level Domains (TLD)
  - When you register a domain, an entry for that domain is added to the current root server (`http://www.root-servers.org/`)
- Owners of domain (s) or subdomain (s) maintain (or outsource) their own DNS servers that contain the correct information

DNS Servers

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- If a server is asked to provide the IP address of a machine outside its domain and the address is not in the server's cache, then:

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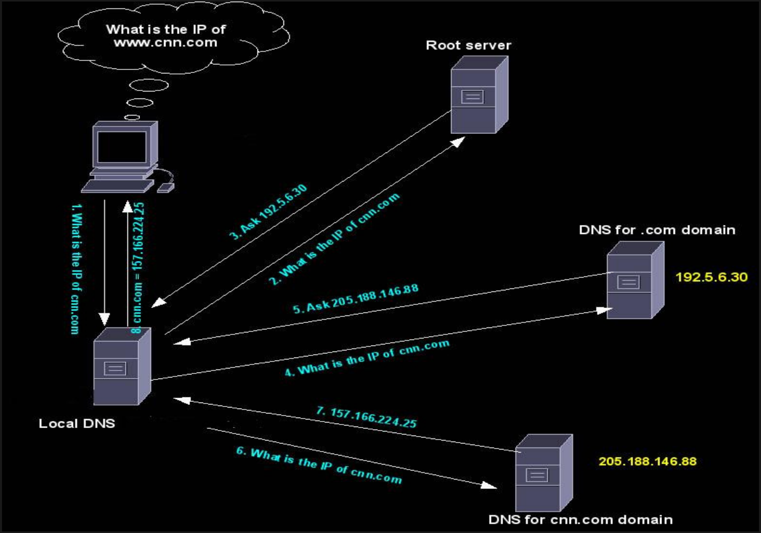
  - the root server will tell it which name server it should contact
  - The server then asks the name server for that domain for the IP address of the machine
- A request may be forwarded a few times

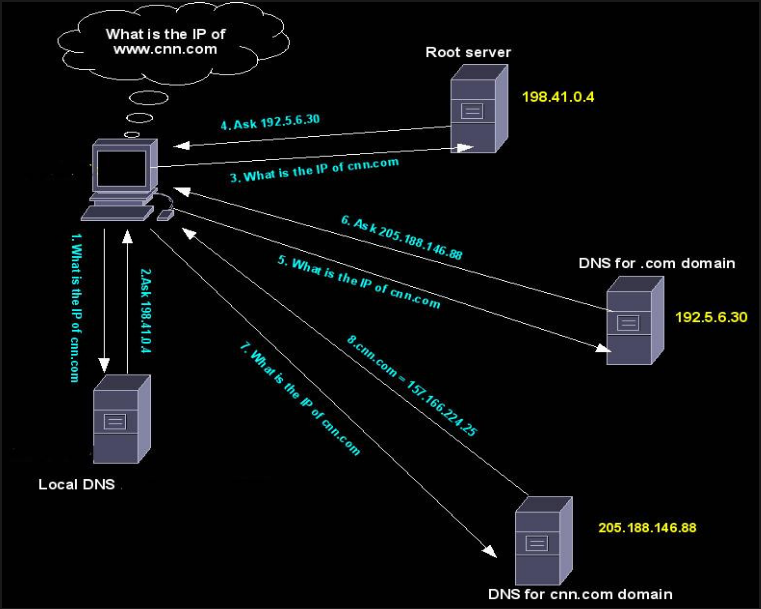
Recursive and Iterative queries

- There are 2 types of queries
  - Recursive queries
    - In a recursive query, the resolver expects the response from its local name server
  - Iterative (non-recursive) queries
    - In an iterative query, the name server sends the closest known authoritative name server then a reference to the root server.

Recursive Queries


What is the IP of www.cnn.com
Root server
1. What is the IP of cnn.com
8. cnn.com = 157.166.224.25
3. Ask 192.5.6.30
2. What is the IP of cnn.com
DNS for .com domain
192.5.6.30
5. Ask 205.188.146.88
4. What is the IP of cnn.com
Local DNS
7. 157.166.224.25
6. What is the IP of cnn.com
205.188.146.88
DNS for cnn.com domain

Iterative Queries


What is the IP of www.cnn.com
Root server
198.41.0.4
4. Ask 192.5.6.30
3. What is the IP of cnn.com
6. Ask 205.188.146.88
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DNS for .com domain
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7. What is the IP of cnn.com
8.cnn.com = 157.166.224.25
Local DNS
205.188.146.88
DNS for cnn.com domain

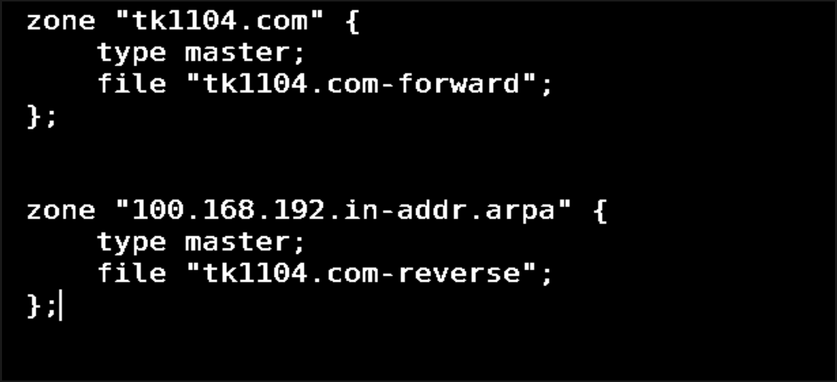
DNS server

- The organization that owns a domain is responsible for running a DNS server that can provide mappings between machine names within its domain to IP addresses. This mapping is listed in zone files
- The organization must have a primary server for the domain, and one or more secondary servers containing a copy of the zone files
- The most commonly used DNS server program is called BIND

ISC DNS server

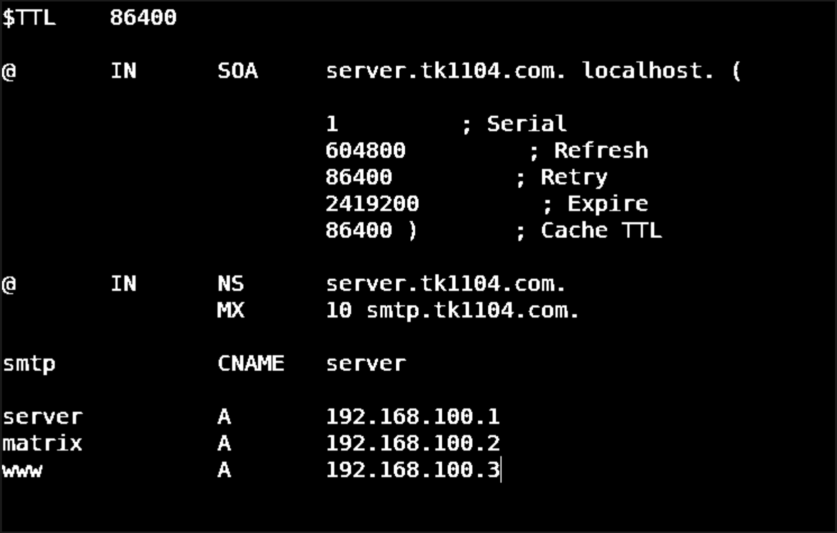
- ISC BIND is open-source software that implements Domain Name Server
  - It is the default DNS package on most Linux distributions
  - Server components:
    - Application: *named*
    - Configuration file: named.conf or /etc/named.conf.local in Ubuntu

Example of a named.conf file



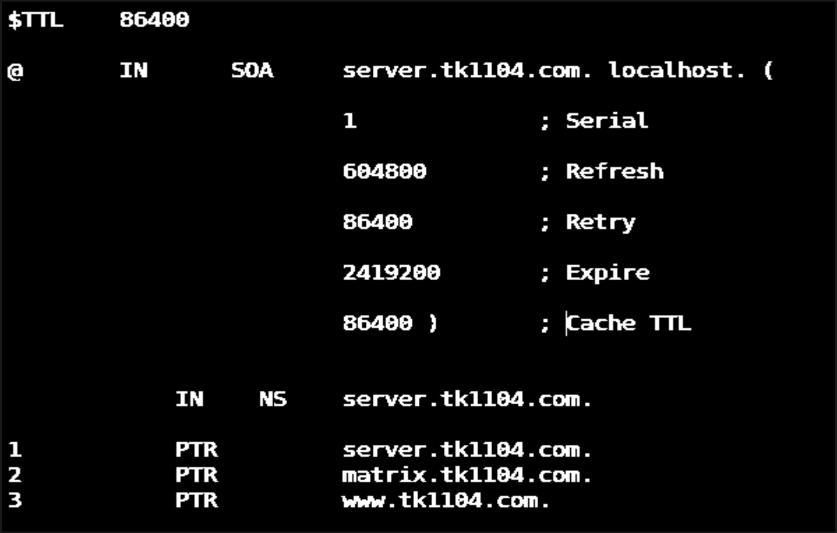
```
zone "tk1104.com" {
    type master;
    file "tk1104.com-forward";
};


zone "100.168.192.in-addr.arpa" {
    type master;
    file "tk1104.com-reverse";
};
```

Example of a forward lookup zone file



```
$TTL    86400

@       IN      SOA     server.tk1104.com. localhost. (

                        1          ; Serial
                        604800          ; Refresh
                        86400          ; Retry
                        2419200          ; Expire
                        86400 )          ; Cache TTL

@       IN      NS      server.tk1104.com.
                MX      10 smtp.tk1104.com.

smtp            CNAME   server

server          A       192.168.100.1
matrix          A       192.168.100.2
www             A       192.168.100.3
```

Example of a reverse-lookup zone file



```
$TTL    86400
@       IN      SOA     server.tk1104.com. localhost. (
                        1             ; Serial
                        604800        ; Refresh
                        86400         ; Retry
                        2419200       ; Expire
                        86400 )       ; Cache TTL

            IN    NS    server.tk1104.com.

1           PTR         server.tk1104.com.
2           PTR         matrix.tk1104.com.
3           PTR         www.tk1104.com.
```

DNS Resource Records

- A DNS zone file consists of a collection of resource records
- Every resource record specifies information about a particular object
- The server uses these records to respond to requests for the machines in its zone

Examples of DNS Resource Records

- NS (An authoritative name server)
- CNAME (The canonical name for an alias)
- SOA (Marks the start of a authority)
- MX (Inform SMTP of the Mail exchange for the domain)

- A list of all the DNS Resource Records:
  - `http://www.iana.org/assignments/dns-parameters/dns-parameters.xhtml`

Demo DNS server!

Hostname lookup using DNS client tools

- We can use the following DNS Linux client tools to query the DNS server
  - nslookup (Unix/Linux, Mac and Windows)
  - host (Unix and Linux)
  - dig (Unix and Linux)

Demo of nslookup!

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