# SNS COLLEGE OF TECHNOLOGY

**Coimbatore-35**
**An Autonomous Institution**

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
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## DEPARTMENT OF INFORMATION TECHNOLOGY

# BLOCK CHAIN AND CRYPTOCURRENCY

IV YEAR - VII SEM

## UNIT 3 – Domain Name Service

# Domain Name Service

# Domain Name Service

- Byzantine Generals Problem
- Definition of Byzantine adversary
  - **Byzantine:** Adversarial nodes can deviate from the protocol arbitrarily!
- Synchronous and asynchronous networks
  - **Synchronous network:** known upper bound Δ on network delay
- Byzantine Broadcast
- Dolev-Strong (1983)
- State Machine Replication (SMR)
- Security properties for SMR protocols: Safety and Liveness

# Computers use IP addresses.

- Names are easier for people to remember

- Computers may be moved between networks, in which case their IP address will change.

# The old solution: HOSTS.TXT

- A centrally-maintained file, distributed to all hosts on the Internet

| | |
|---|---|
| •***SPARKY*** | *128.4.13.9* |
| •***UCB-MAILGATE*** | *4.98.133.7* |
| •***FTPHOST*** | *200.10.194.33* |
| •... etc | |

- This feature still exists:
    - /etc/hosts (UNIX)
    - \windows\hosts

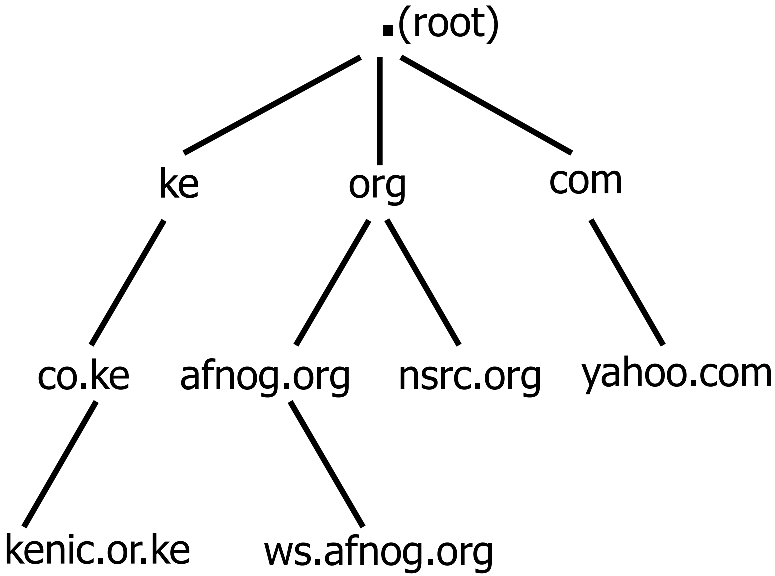
# hosts.txt does not scale

- ✗ Huge file (traffic and load)
- ✗ Name collisions (name uniqueness)
- ✗ Consistency
- ✗ Always out of date
- ✗ Single point of Administration
- ✗ Did not scale well

# The Domain Name System was born

- DNS is a distributed database for holding name to IP address (and other) information
- Distributed:
  - Shares the Administration
  - Shares the Load
- Robustness and performance achieved through
  - replication
  - and caching

# DNS is Hierarchical



.(root)

ke

org

com

co.ke

afnog.org

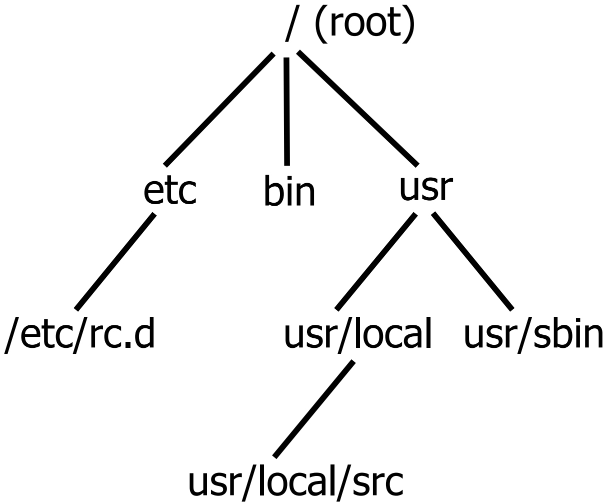
nsrc.org

yahoo.com

kenic.or.ke

ws.afnog.org

DNS Database



/ (root)

etc

bin

usr

/etc/rc.d

usr/local

usr/sbin

usr/local/src

Unix Filesystem

Forms a tree structure

# DNS is Hierarchical (contd.)

- Globally unique names
- Administered in zones (parts of the tree)
- You can give away ("delegate") control of part of the tree underneath you
- Example:
  - **afnog.org** on one set of nameservers

# Domain Names are (almost) unlimited

- Max 255 characters total length
- Max 63 characters in each part
  - RFC 1034, RFC 1035
- If a domain name is being used as a host name, you should abide by some restrictions
  - RFC 952 (old!)
  - a-z 0-9 and minus (-) only
  - No underscores ( _ )

# Using the DNS

- A Domain Name (like www.ws.afnog.org) is the KEY to look up information
- The result is one or more RESOURCE RECORDS (RRs)
- There are different RRs for different types of information
- You can ask for the specific type you want, or ask for "any" RRs associated with the domain name

# Commonly seen Resource Records (RRs)

- A (address): map hostname to IP address
- PTR (pointer): map IP address to hostname
- MX (mail exchanger): where to deliver mail for *user@domain*
- CNAME (canonical name): map alternative hostname to real hostname
- TXT (text)

# A Simple Example

- Query: **www.afnog.org.**
- Query type: **A**
- Result:

```
www.afnog.org.     14400     IN     A          196.216.2.4
```

- *In this case a single RR is found,* **but in general, multiple RRs may be returned.**
  - (IN is the "class" for INTERNET use of the DNS)

# Possible results from a Query

- Positive
    - one or more RRs found
- Negative
    - definitely no RRs match the query
- Server fail
    - cannot find the answer
- Refused
    - not allowed to query the server

# you use an IP address as the key for a DN

- Convert the IP address to dotted-quad
- Reverse the four parts
- Add ".in-addr.arpa." to the end; special domain reserved for this purpose

**e.g. to find name for 193.194.185.15**

*Domain name: 15.185.194.193.in-addr.arpa.*

*Query Type: PTR*

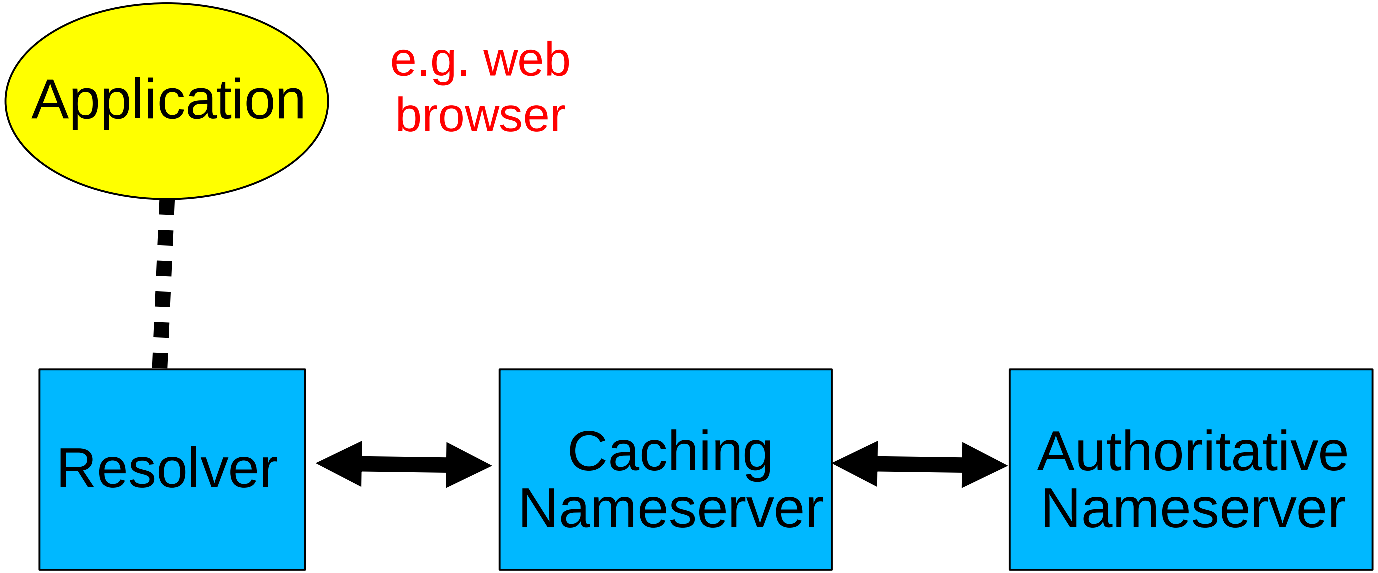
# Any Questions?

?

# DNS is a Client-Server application

- (Of course - it runs across a network)
- Requests and responses are normally sent in UDP packets, port 53
- Occasionally uses TCP, port 53
    - for very large requests (larger than 512-bytes) e.g. zone transfer from master to slave or an IPv6 AAAA (quad A) record.

# There are three roles involved in DNS



Application

e.g. web browser

Resolver

Caching Nameserver

Authoritative Nameserver

# Three roles in DNS

- RESOLVER
  - Takes request from application, formats it into UDP packet, sends to cache
- CACHING NAMESERVER
  - Returns the answer if already known
  - Otherwise searches for an authoritative server which has the information

# Three roles in DNS

- The SAME protocol is used for resolver <-> cache and cache <-> auth NS communication
- It is possible to configure a single name server as both caching and authoritative
- But it still performs only one role for each incoming query
- Common but NOT RECOMMENDED to configure in this way (we will see why later)

# ROLE 1: THE RESOLVER

- A piece of software which formats a DNS request into a UDP packet, sends it to a cache, and decodes the answer
- Usually a shared library (e.g. libresolv.so under Unix) because so many applications need it
- EVERY host needs a resolver - e.g.

# does the resolver find a caching namese

- It has to be explicitly configured (statically, or via DHCP etc)

- Must be configured with the IP ADDRESS of a cache (why not name?)

- Good idea to configure more than one cache, in case the first one fails

# do you choose which cache(s) to config

- Must have PERMISSION to use it
  - e.g. cache at your ISP, or your own
- Prefer a nearby cache
  - Minimises round-trip time and packet loss
  - Can reduce traffic on your external link, since often the cache can answer without contacting other servers
- Prefer a reliable cache

# ver can be configured with default dom

- If "foo.bar" fails, then retry query as "foo.bar.mydomain.com"
- Can save typing but adds confusion
- May generate extra unnecessary traffic
- Usually best avoided

# Example: Unix resolver configuration

/etc/resolv.conf

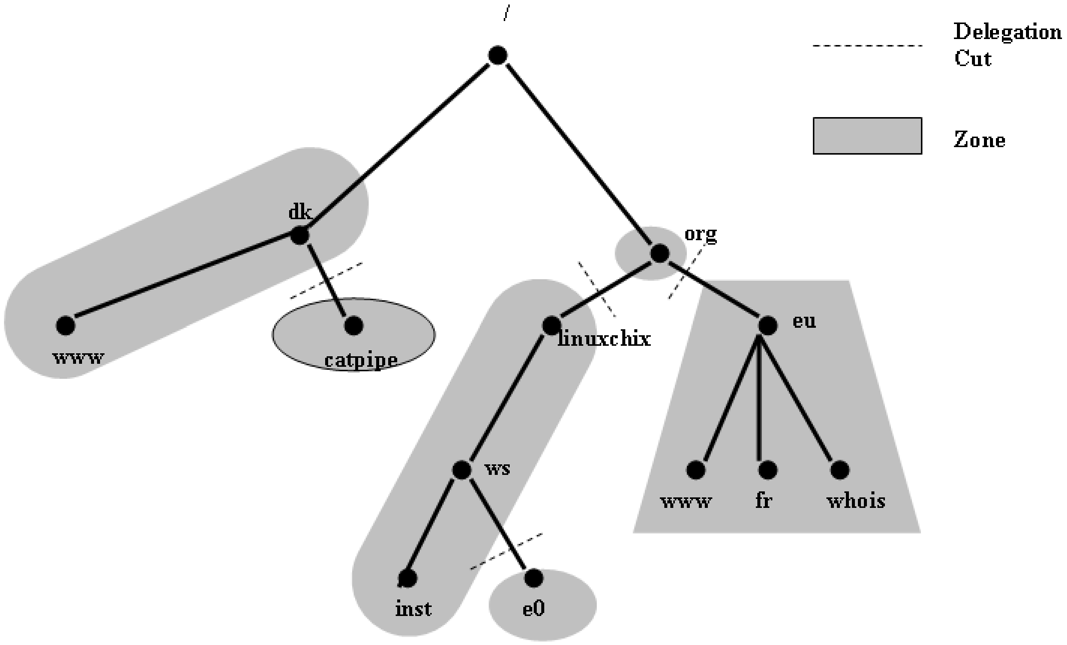
```
domain ws.linuxchix.or.ke
nameserver 196.216.76.52
nameserver 217.21.112.14
```

***That's all you need to configure a resolver***

# Delegation

- We mentioned that one of the advantages of DNS was that of distribution through shared administration. This is called delegation
- Delegation is done when there is an administrative boundary and you would like to turn over control of a subdomain to
  - A department (within a company)
  - A company (within a TLD)
  - A country (ccTLD)

# Delegation


/
Delegation Cut
Zone
dk
www
catpipe
org
linuxchix
ws
inst
e0
eu
www
fr
whois

# Delegation

- Creating a delegation is easy
  - Create the subdomain (zone) on the server which will answer authoritatively for it
  - Create the NS records for the zone to be delegated pointing it to the Authoritative Server
- That’s all!

# Testing DNS

- Just put "www.yahoo.com" in a web browser?
- Why is this not a good test?

# Testing DNS with "dig"

- "dig" is a program which just makes DNS queries and displays the results
- Better than "nslookup", "host" because it shows the raw information in full

```
dig ws.afnog.org.
  -- defaults to query type "A"
dig afnog.org. mx
  -- specified query type
dig @196.200.222.1 afnog.org. mx
  -- send to particular cache (overrides
     /etc/resolv.conf)
```

# The trailing dot

```
dig ws.afnog.org.
```

- Prevents any default domain being appended
- Get into the habit of using it always when testing DNS
  - only on domain names, not IP addresses or e-mail addresses

```
ns# dig @84.201.31.1 www.gouv.bj a

; <<>> DiG 8.3 <<>> @84.201.31.1 www.gouv.bj a
; (1 server found)
;; res options: init recurs defnam dnsrch
;; got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 4
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 4, ADDITIONAL: 3
;; QUERY SECTION:
;;      www.gouv.bj, type = A, class = IN

;; ANSWER SECTION:
www.gouv.bj.            1D IN CNAME     waib.gouv.bj.
waib.gouv.bj.           1D IN A         208.164.179.196

;; AUTHORITY SECTION:
gouv.bj.                1D IN NS        rip.psg.com.
gouv.bj.                1D IN NS        ben02.gouv.bj.
gouv.bj.                1D IN NS        nakayo.leland.bj.
gouv.bj.                1D IN NS        ns1.intnet.bj.

;; ADDITIONAL SECTION:
ben02.gouv.bj.          1D IN A         208.164.179.193
nakayo.leland.bj.       1d23h59m59s IN A  208.164.176.1
ns1.intnet.bj.          1d23h59m59s IN A  81.91.225.18

;; Total query time: 2084 msec
;; FROM: noc.t1.ws.afnog.org to SERVER: 84.201.31.1
;; WHEN: Sun Jun  8 21:18:18 2003
;; MSG SIZE  sent: 29  rcvd: 221
```

# Understanding output from dig

- STATUS
  - NOERROR: 0 or more RRs returned
  - NXDOMAIN: non-existent domain
  - SERVFAIL: cache could not locate answer
  - REFUSED: query not available on cache server
- FLAGS
  - AA: Authoritative answer (not

# Understanding output from dig

- Answer section (RRs requested)
  - Each record has a Time To Live (TTL)
  - Says how long the cache will keep it
- Authority section
  - Which nameservers are authoritative for this domain
- Additional section

# Practical Exercise

- Configure Unix resolver
- Issue DNS queries using 'dig'
- Use tcpdump to show queries being sent to cache