LESSON – 23

DNS (DOMAIN NAME SERVER)

LEARNING OUTCOMES

- Identify the DNS hierarchy
- Use the /etc/hosts file
- Explain the DNS working mechanism
- Identify different types of DNS

DNS - Introduction

DNS HISTORY

- The HOSTS File
  - 1970s – issue with TCP/IP : "Mapping unfriendly numerical IP into people-friendly format"
  - Initially, IP address-to-name mapping by hosts via **FTP to all machines on the Internet**

- **Problems:**
  - Not a scalable way of managing association IP to host name
  - Traffic and load
  - Name collision
  - Consistency

- 1983 – Paul Mockapetris (RFC 1034 & 1035) created DNS.

DNS - Introduction

DNS HISTORY

- In most Linux & Unix location of file is in /etc/hosts
- 1970s – issue with TCP/IP : "Mapping unfriendly numerical IP into people-friendly format"

```
# Host table for Internal network
#
127.0.0.1 localhost.localdomain localhost
192.168.1.1 server1.example.org    server1
192.168.1.2 server2.example.org server2
192.168.1.6 server3
192.168.1.7 server4
```

- It keeps its information in a single tabular format, and is a basic naming service
  - First column: IP address
  - Second column: related hostname
  - Third column: Short version of hostname
  - White space separate columns
  - Pound symbol (#) at the beginning of a line represent comments

DNS – What is it?

What is DNS?

- DNS stands for Domain Name Service and System running this services is called Domain Name Server or Name Server.

- It is a mechanism of mapping IP address to hostname and vice-versa

    www.druknet.bt –> 202.144.128.145
    202.144.128.145 ← www.druknet.bt

- In other term, a DNS is an Internet service that maps IP addresses and fully qualified domain names (FQDN) to one.
- In this way, DNS alleviates to remember IP address

DNS – What is it?

What is DNS?

- • Names are more meaningful than numbers
  - This was true with IPv4
  - Even more so with IPv6

- Can you remember 8.8.8.8 ?
- How about 2001:4860:4860::8888 ?
- And 2607:8400:2880:4::80df:9d1c ... ?
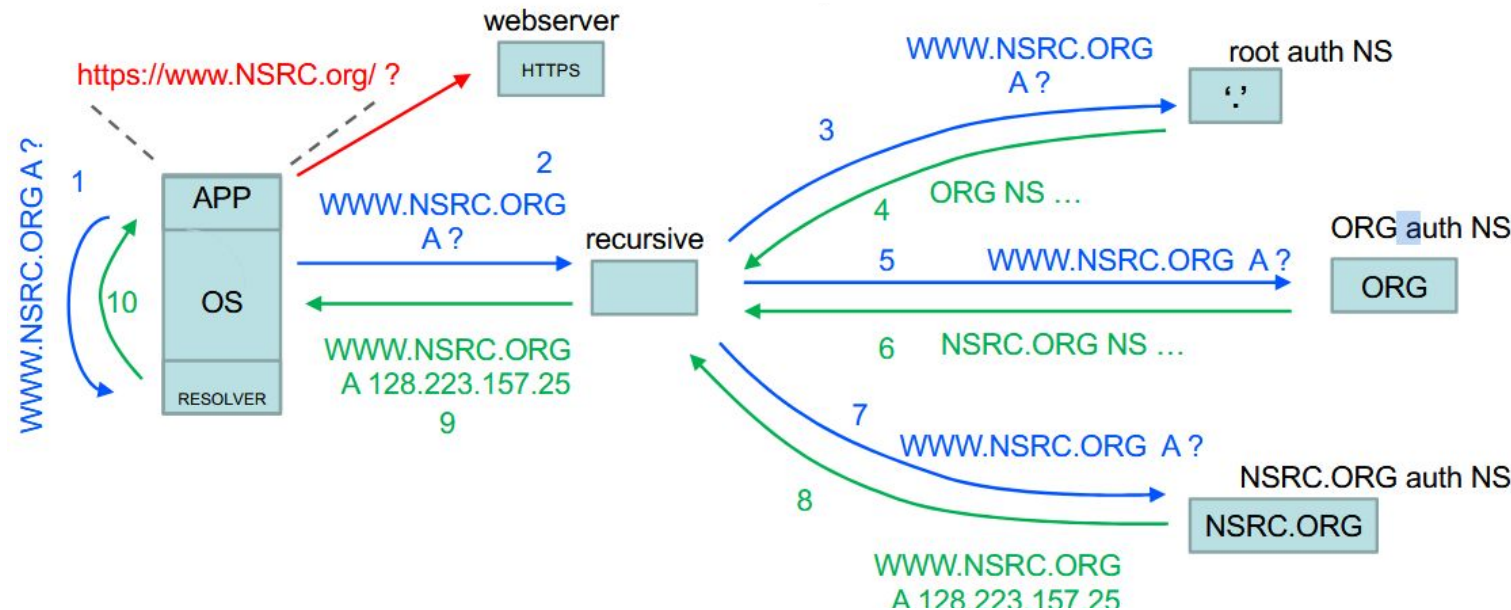
DNS – What is it?

What is DNS?

- It's a lookup mechanism
- Think of the DNS as an old fashioned telephone book...or a database
  - You have a name…
  - You want to look up the IP address for that name

"What is the IP address for www.cst.edu.bt ?"

DNS – What is it?

DNS QUERY – How Does It Works?

- It is a distributed database; each server has its own delegated zone of authority for one or more domain.
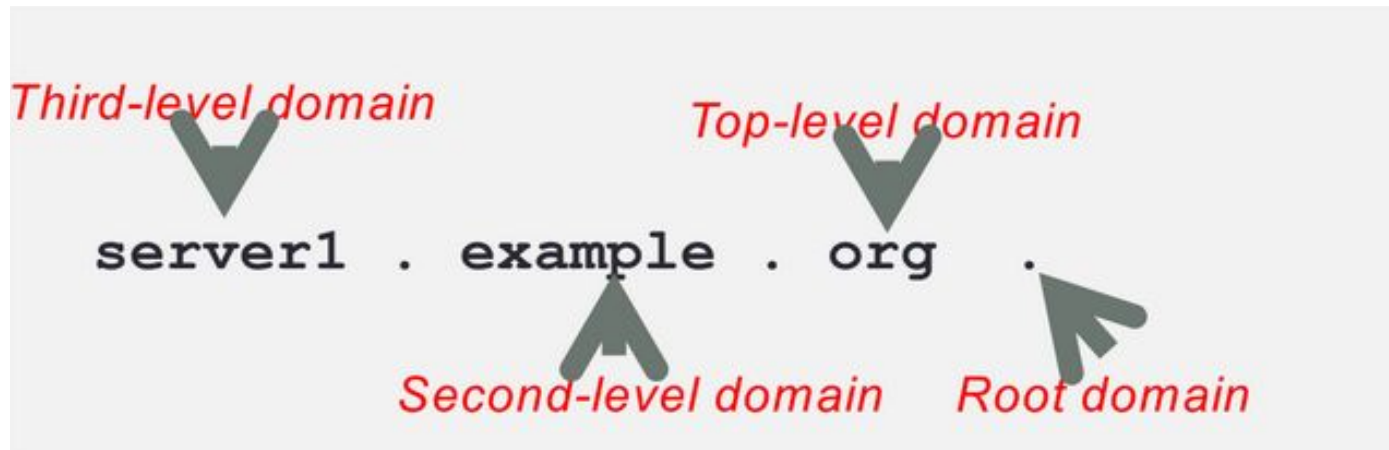

Pic Source: NSRC

- **Video Link**
  - https://www.youtube.com/watch?v=mpQZVYPuDGU
  - https://www.youtube.com/watch?v=eSrC-7yeF7c

DNS – How DNS Works?
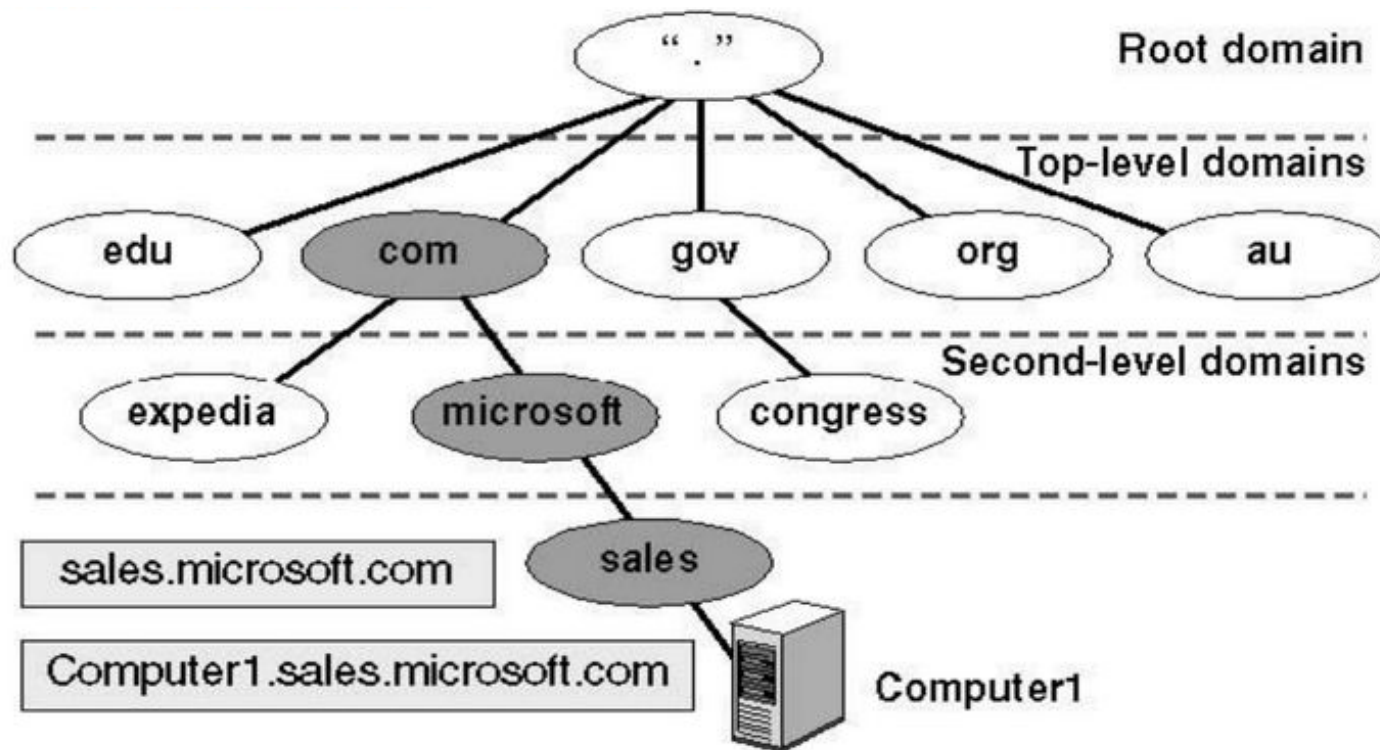
Understanding How DNS Works

- Domains & Host Naming Conventions
  - Site names appear as Fully Qualified domain name(FQDN)
    www.cst.edu.bt   **Labels are separated by dots**

- FQDN for server1.example.org is:

DNS – How DNS Works?

Understanding How DNS Works

- DNS Hierarchy

DNS – How DNS Works?

Understanding How DNS Works

- Root Servers
  - The top of the DNS Hierarchy

- There are 13 root name servers operated around the world [a –m].root-servers.net

- Root hints file come in many names (db.cache, named.root, named.cache, named.ca)
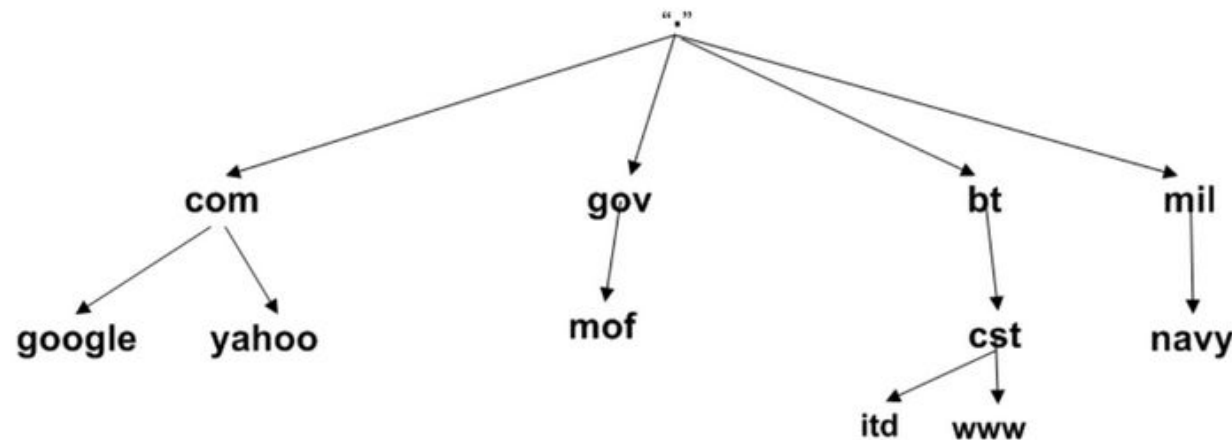
DNS – How DNS Works?

Understanding How DNS Works

- Structure of a DNS
  - DNS provides a name lookups facilities like Telephone directory.

- Three main components of DNS:
  - **Domain Name Space**: Define overall naming structure of the internet
  - **Name Server**: maintain portion of domain name space, resolves lookups and maintains a cache.
  - **Domain Name Resolution:** maps domain name to an IP address

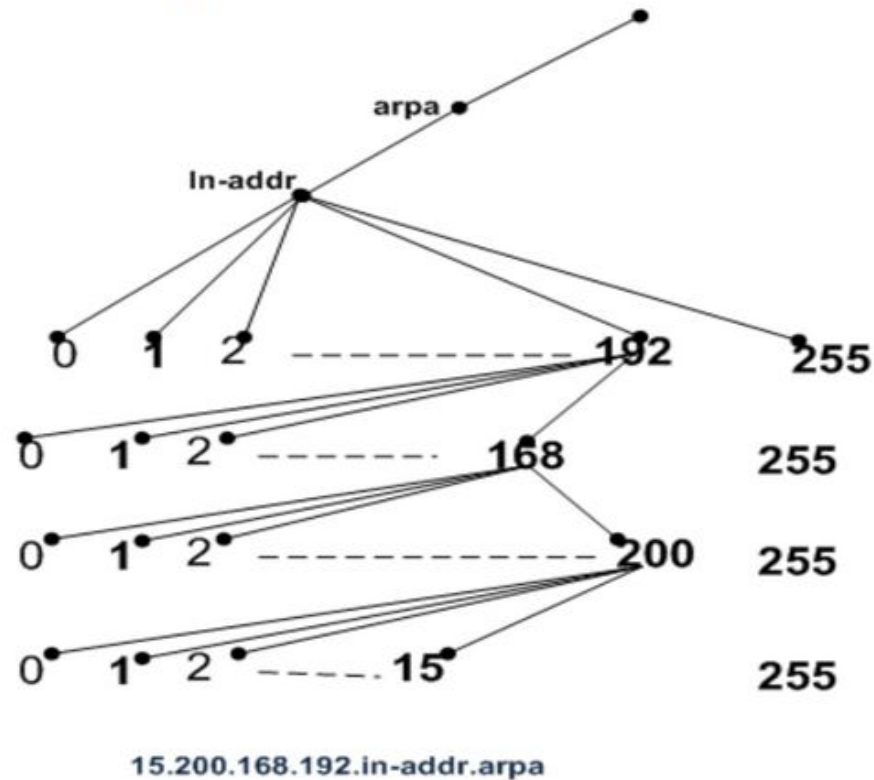# DNS – How DNS Works?

Understanding How DNS Works

- Domain Name Space:
  - Domain Name Space is the sequence of labels from a node to the root separated by dots(.), reads from left to right.
- Inverted-Tree structure
  - DNS processes domain name from right to left
  - The name space has a maximum depth of 127 levels
  - Domain names can contain up to 255 characters

DNS – How DNS Works?

Understanding How DNS Works

- The in-addr.arpa Domain

15.200.168.192.in-addr.arpa

DNS – How DNS Works?

The Name Server

- Name servers store information about the name space in units called "zones"
  - The name servers that load a complete zone are said to "have authority for" or "be authoritative for" the zone

- Usually, more than one name server are authoritative for the same zone
  - This ensures redundancy and spreads the load

- Also, a single name server may be authoritative for many zones

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DNS – How DNS Works?

Types of Name Server

- Two main types of servers
  - **Authoritative** – maintains the data
    - Master – where the data is edited
    - Slave – where data is replicated to

  - **Caching** – stores data obtained from an authoritative server

- No special hardware necessary

DNS – How DNS Works?

Name Resolution

- Name resolution is the process by which resolvers and name servers cooperate to find data in the name space

- Closure mechanism for DNS?
    - Starting point: the names and IP addresses of the name servers for the root zone (the "root name servers")
    - The root name servers know about the top-level zones and can tell name servers whom to contact for all TLDs

DNS – How DNS Works?

Name Resolution Cont..

- A DNS query has three parameters:
  - A domain name (e.g., www.example.com),
  - Remember, every node has a domain name!
  - A class (e.g., IN), and
  - A type (e.g., A)

- Upon receiving a query from a resolver, a name server
  1. looks for the answer in its authoritative data and its cache
  2. If step 1 fails, the answer must be looked up

DNS – How DNS Works?

DNS in LINUX

- Basic Parameters
    - The DNS service associated with Debian is the Berkeley Internet Name Domain(BIND)
    - The DNS on Linux System is based on the named daemon, built on the BIND package
    - Command rndc is used to manage DNS operation.

- DNS Package Options
  bind: Includes the basic name server software and extensive documentation.
  bind-utils: Contains tools such as dig & host.

DNS – How DNS Works?

Different Types of DNS Servers

- **Master DNS Server:** Authoritative for one or more domains, includes host records for that domain

- **Slave DNS Server:** Relies on a master DNS Server for data

- **Caching-only DNS Server**: It stores recently requests like a proxy server.

- **Forwarding-only DNS Server:** It refers all requests to other DNS servers.

DNS – How DNS Works?

Identification of DNS Configuration Files

DNS Configuration Files

- /etc/bind/named.conf
- /etc/bind/named.conf.options
- /etc/bind/named.conf.local

DNS – How DNS Works?

Sample Forward Zone

```
$TTL 86400
@    IN   SOA     primarydns.example.com. root.example.com. (
         2017081401  ;Serial
         3600        ;Refresh
         1800        ;Retry
         604800      ;Expire
         86400       ;Minimum TTL
)
@         IN   NS          primarydns.example.com.
@         IN   NS          secondarydns.example.com.
@         IN   A           192.168.1.1
@         IN   A           192.168.1.2
primarydns       IN   A    192.168.1.1
secondarydns     IN   A    192.168.1.2
```

DNS – How DNS Works?

Sample Forward Zone

```
$TTL 86400
@    IN   SOA    primarydns.example.com. root.example.com. (
              2017081401   ;Serial

              3600         ;Refresh
              1800         ;Retry
              604800       ;Expire
              86400        ;Minimum TTL
)
@         IN   NS           primarydns.example.com.
@         IN   NS           secondarydns.example.com.


@         IN   PTR          example.com.

primarydns        IN  A     192.168.1.1
secondarydns      IN  A     192.168.1.2

1         IN   PTR          primarydns.example.com.
2         IN   PTR          secondarydns.example.com.
```

DNS – How DNS Works?

THINGS NEEDED TO BE REMEMBERED

- File ownership for **/etc/bind/named.conf** (root:named)
- **rndc flush**: It is wise to flush the DNS cache after each configuration change.
- **named** Services: start/stop/reload/restart
- **Usage:**

  [root@Server1 ~]#service bind [start/stop/reload/restart/status]
  [root@Server1 ~]#systemctl [start/stop/reload/restart/status] bind
  [root@Server1 ~]#rndc [start/stop/reload/restart/status]

- System Booting:

  #systemctl enable bind
  #rndc enable bind

Reference

- Van Vugt, S. (2018). Red Hat RHCSA/RHCE 7 Red Hat Enterprise Linux 7 (EX200 and EX300). Noida, Uttar Pradesh:Pearson India Education Services Pvt. Ltd.
- Nemeth E., Snyder G., Hein T.R., Whaley B (2011). UNIX and Linux System Administration Handbook. Noida, Uttar Pradesh: Pearson Education Inc.
- Sham, S., Soyinka, V. (2005). Linux Administration: A Beginner's Guide. New Delhi, Delhi: Tata McGraw-Hill.

SUMMARY

- DNS was created as the hosts file lack scalability
- The hosts file is a text-based database with hostname and IP
- Two types of zones: forward zone and reverse zone
- The forward zone resolve from right to left of FQDN and reverse zone from left to right of IP address.
- DNS in Linux Server requires BIND packages to configure and setup
- The named.conf file is named configuration file