Safe and Healthy DNS Ecosystem

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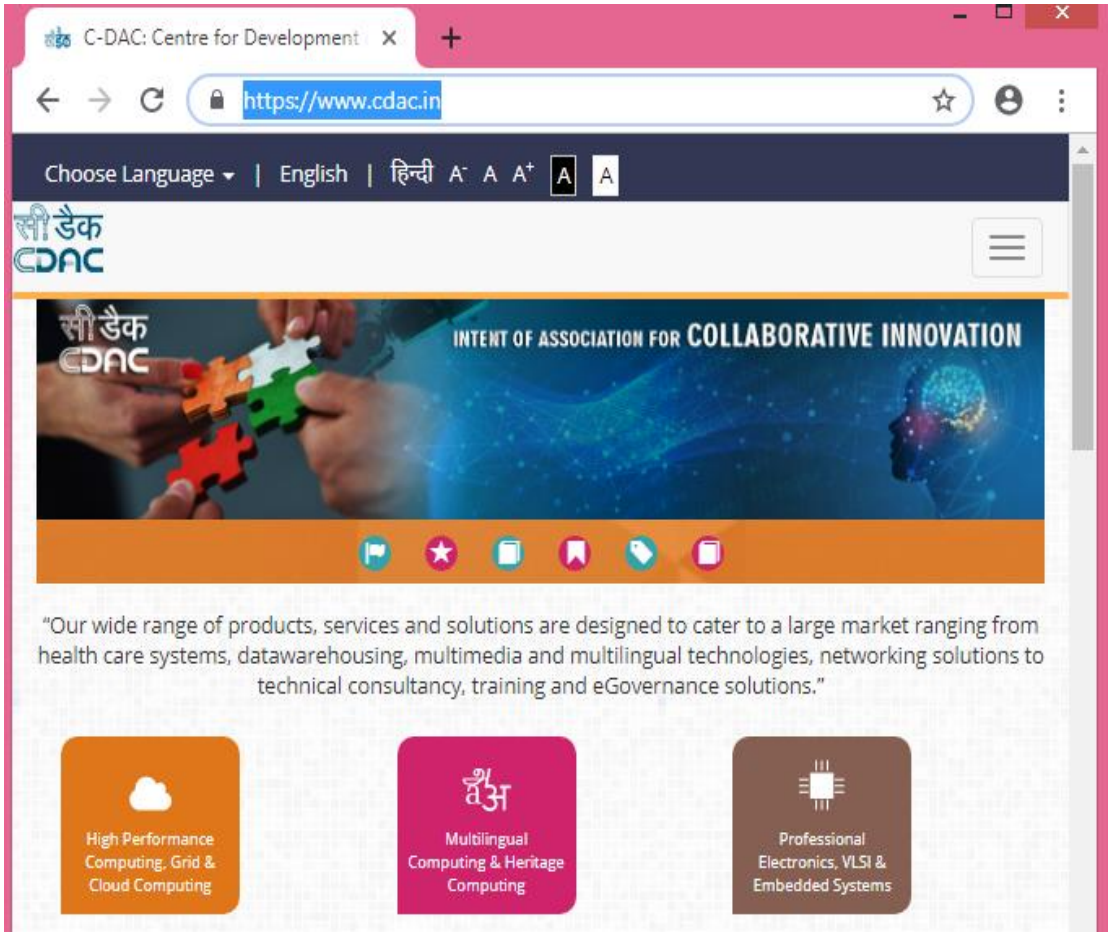
What is DNS?



Application Layer
- HTTP/HTTPS
- www.cdac.in

Transport Layer
- TCP
- Source Port:87878
- Destination Port:80/443

Network Layer
- Source IP: 202.141.136.152
- Destination IP: ?

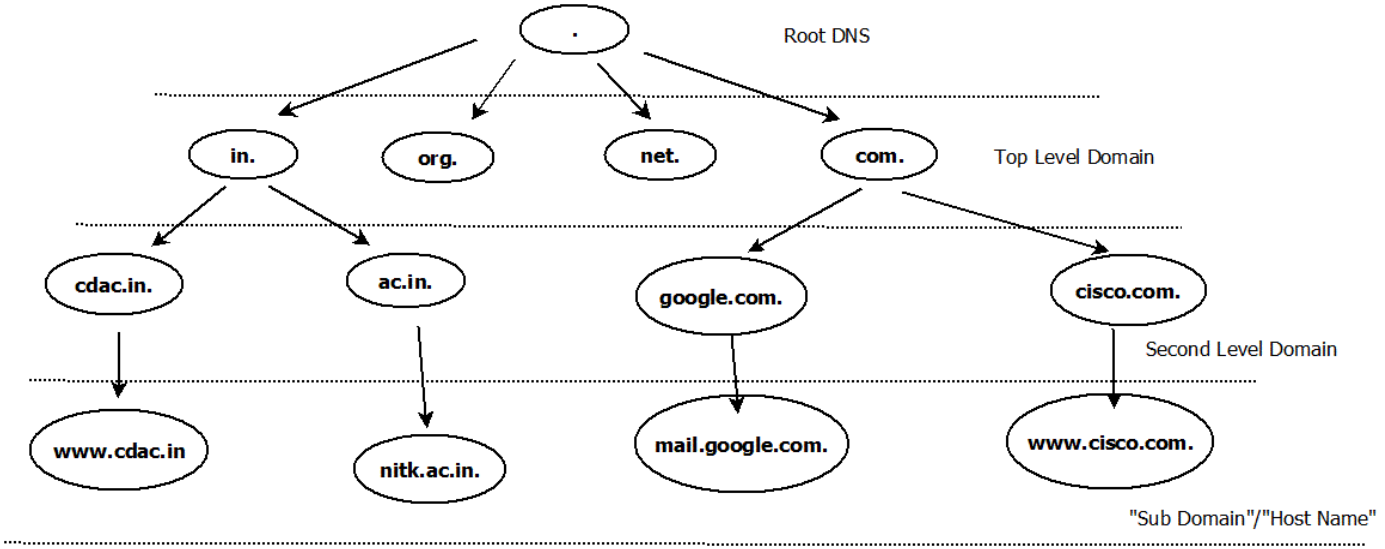
Data Link Layer
- Source Mac: aa:bb:cc:dd:ee:ff
- DMAC: MAC of Gateway

What is DNS?

- Service or Application that converts Domain names to IP Addresses:
  - www.cdac.in. → 196.1.113.45
  - www.cdac.in. → 2405:8a00:6029::45
- … and back:
  - 196.1.113.45 → www.cdac.in.
  - 2405:8a00:6029::45 → www.cdac.in.

How is DNS built ?

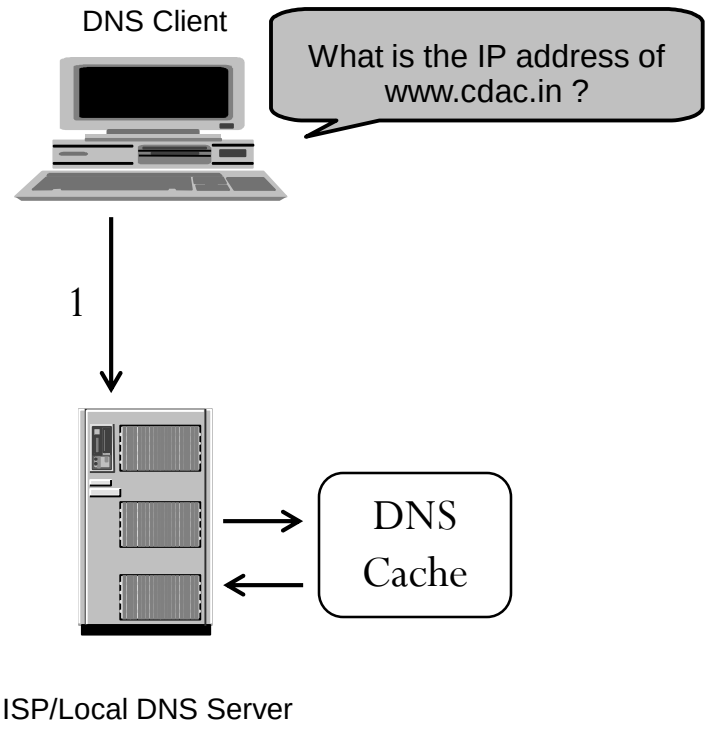
- DNS is hierarchical



- **www.cdac.in.**
- DNS administration is shared – no single central entity administrates all DNS data

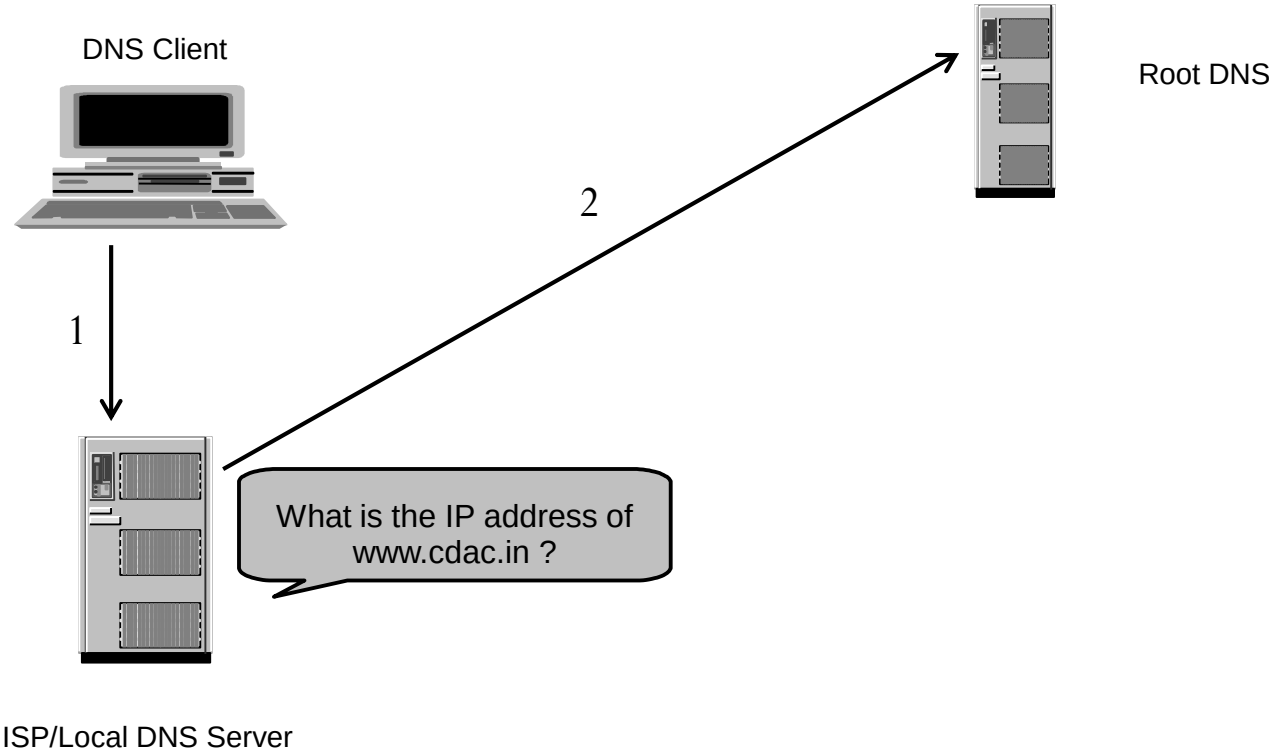
How DNS Works?

1. Client asks to Local/ISP DNS server for lookup.



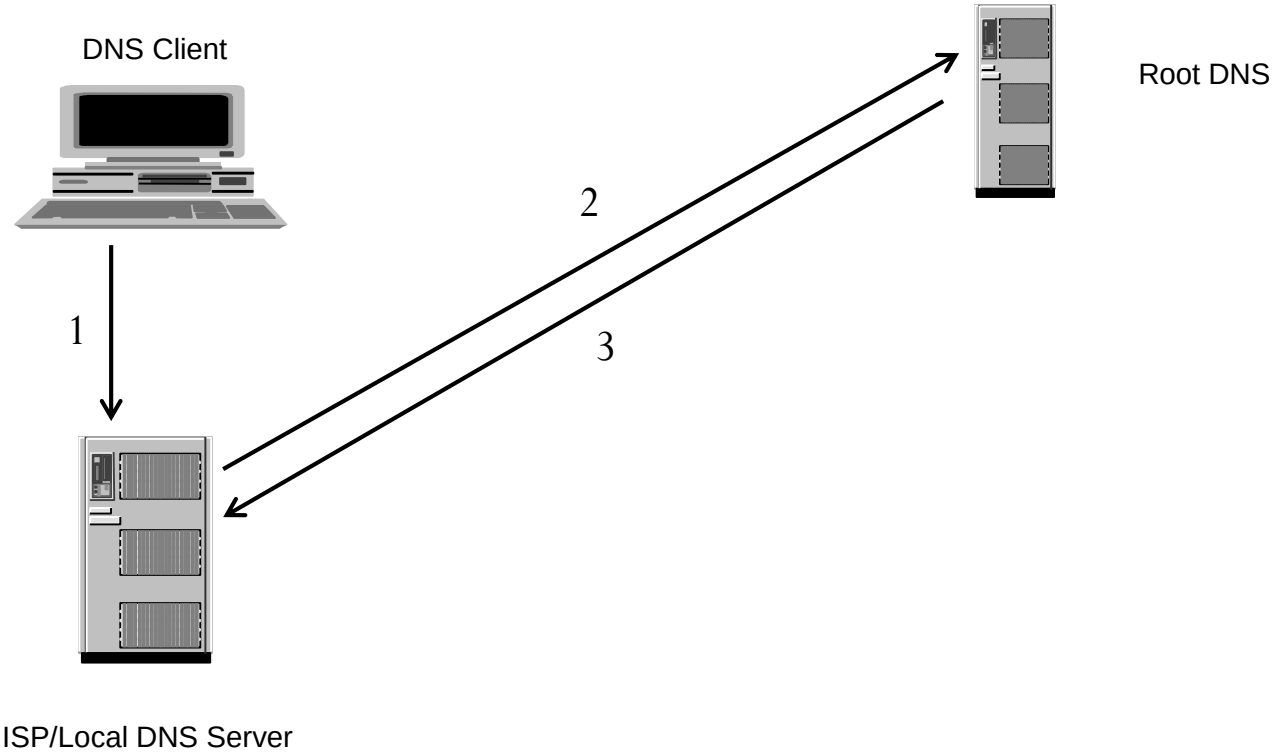
How DNS Works?

2. Local/ISP DNS Server asks Root DNS server.



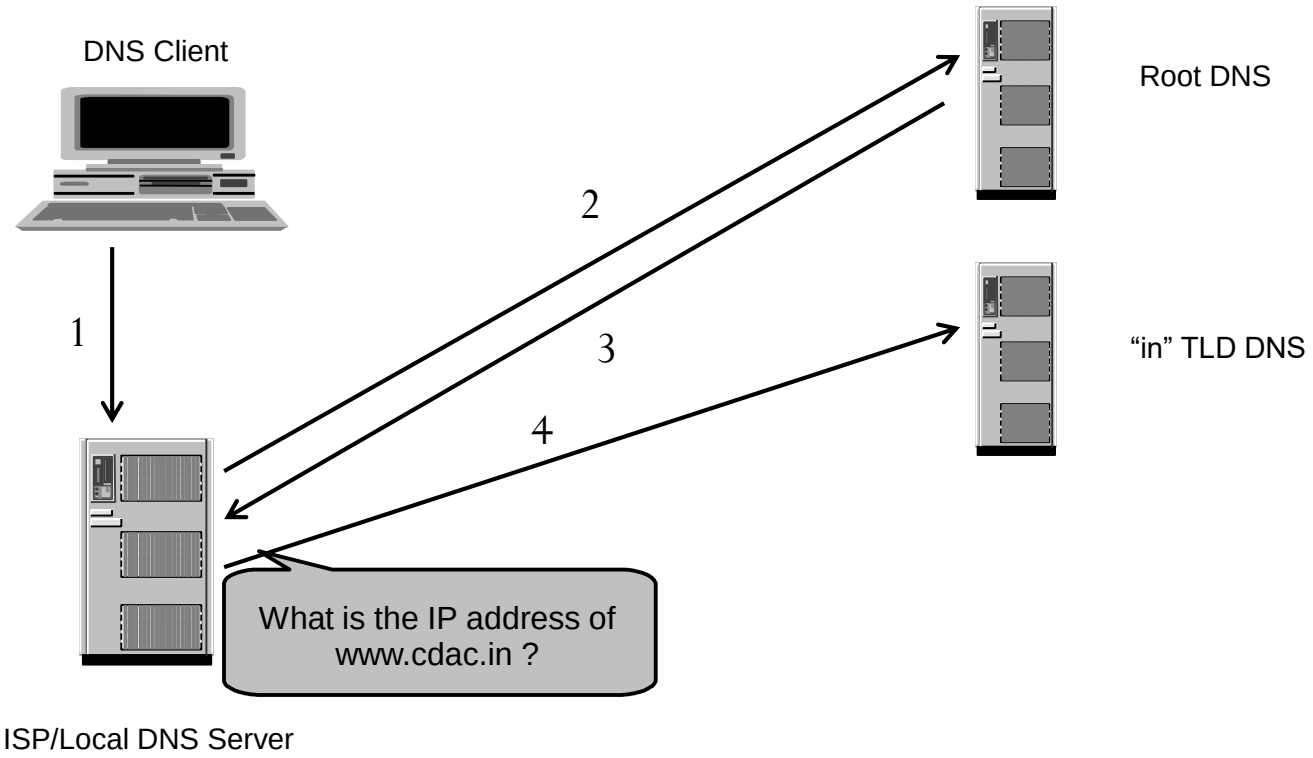
How DNS Works?

3. Root DNS server reply with referral to TLD DNS "in".



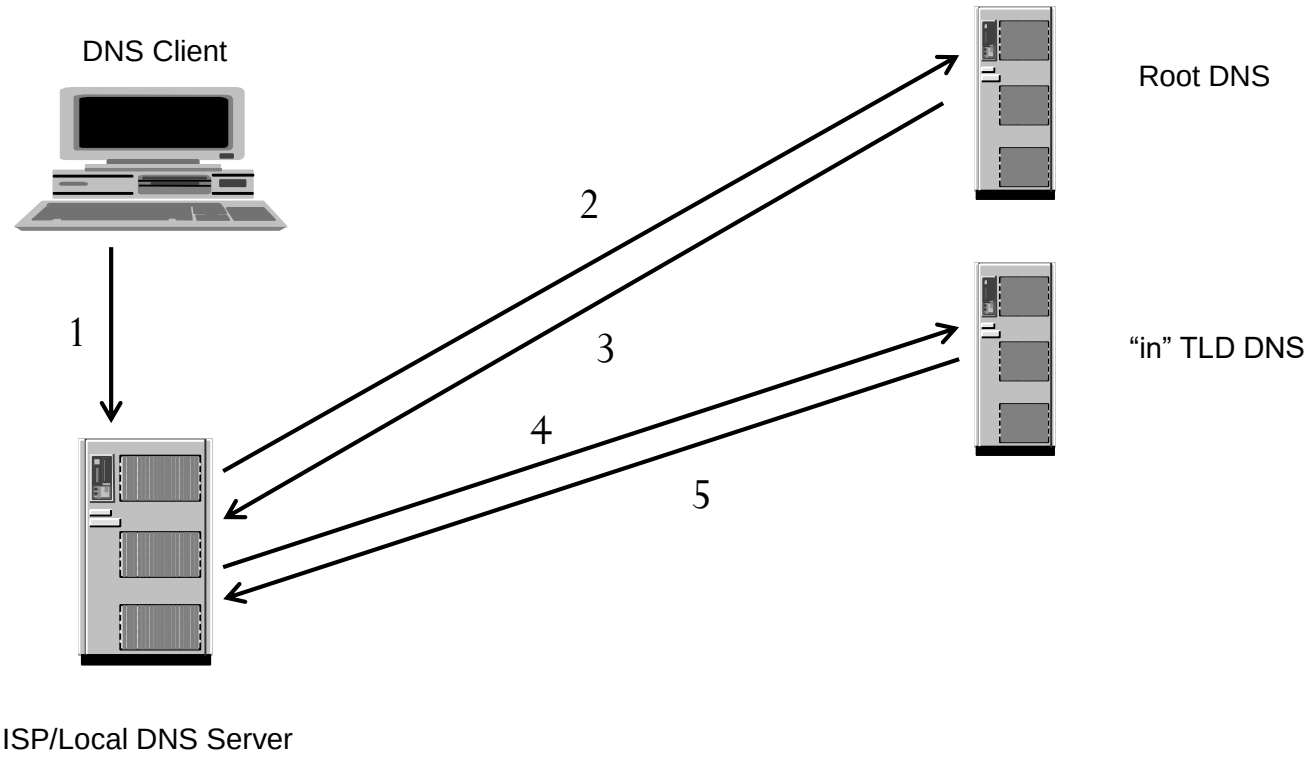
How DNS Works?

4.ISP/Local DNS Server queries TLD DNS.



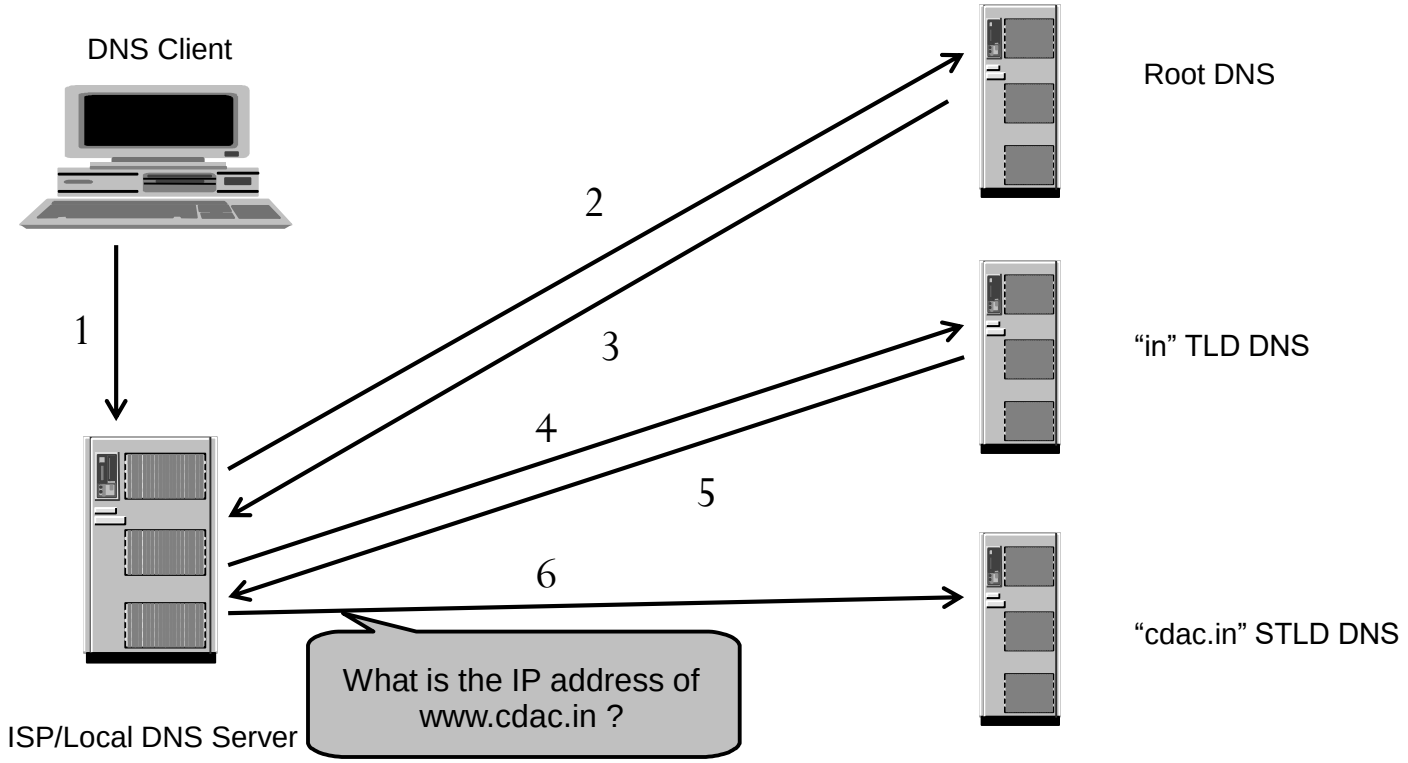
How DNS Works?

5. TLD DNS reply with referral to STLD DNS "cdac.in".



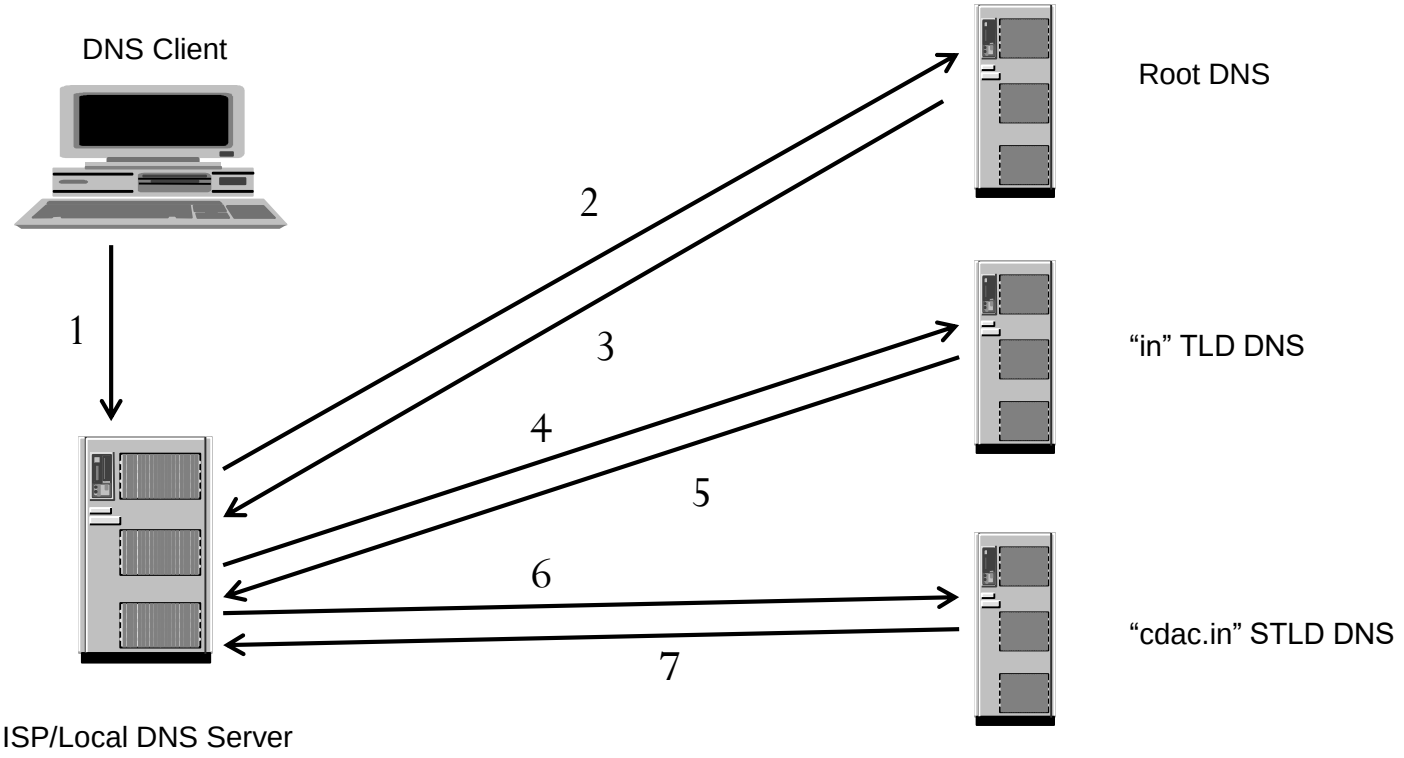
How DNS Works?

6.ISP/Local DNS Server queries STLD DNS.



How DNS Works?

7."cdac.in" STLD DNS Server will gives the reply i.e IP address of "www.cdac.in".



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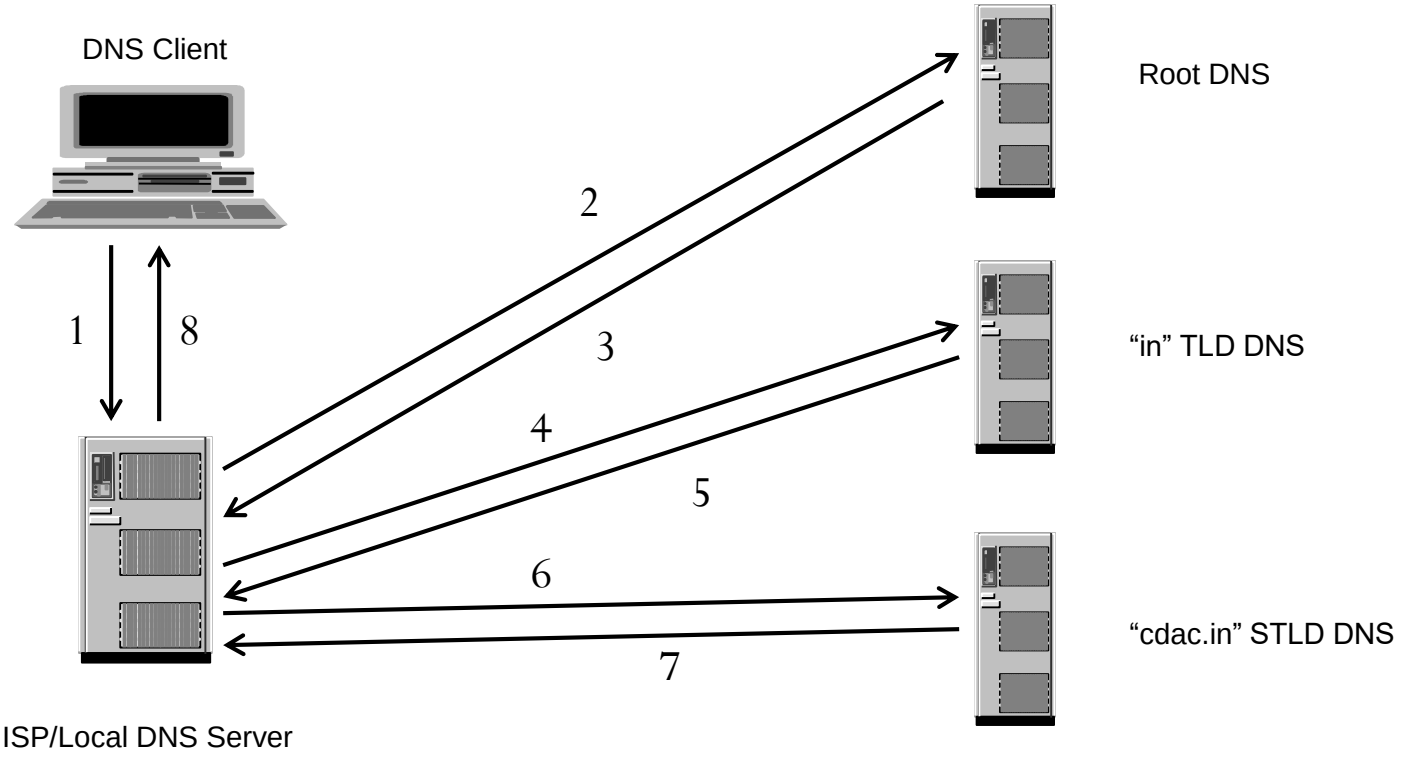


DNS Servers Classifications

- Root DNS Server
- Authoritative DNS Server
  - Master
  - Slave
- Recursive DNS Server
- Stub Resolver

Root DNS Server

- On the Top of the DNS Hierarchy.
- Contains the information(root zone) of all TLD (e.g. in, org, com, gov etc).
- There are 13 root Name Servers, maintained by 12 independent organisations.
  - There are several instances of all the Root Servers across the World.
  - In India we have instances of D,E,F,I,J,K,L Root Servers across the country.
- Root name server operations currently provided by volunteer efforts by a very diverse set of organizations

Root Name Server Operators

Nameserver	Operated by:
A	Verisign (US East Coast)
B	University of S. California –Information Sciences Institute (US West Coast)
C	Cogent Communications (US East Coast)
D	University of Maryland (US East Coast)
E	NASA (Ames) (US West Coast)
F	Internet Software Consortium (US West Coast)
G	U. S. Dept. of Defense (ARL) (US East Coast)
H	U. S. Dept. of Defense (DISA) (US East Coast)
I	Autonomica (SE)
J	Verisign (US East Coast)
K	RIPE-NCC (UK)
L	ICANN (US West Coast)
M	WIDE (JP)

Authoritative DNS Server

- Authoritative DNS servers serve the actual reply – i.e., the final translation of the FQDN to the IP address, as they are the authoritative source for the domain in question.
- DNS hosting companies typically manage the authoritative DNS servers for a domain name which, the users query through recursive resolvers.
- Master and Slave.

Recursive DNS Server

- Also called Recursive Resolver.
- The user queries to RR for domain lookup.
- RR queries the entire DNS Hierarchy for the final result.
- RR can also be Authoritative for some domain.

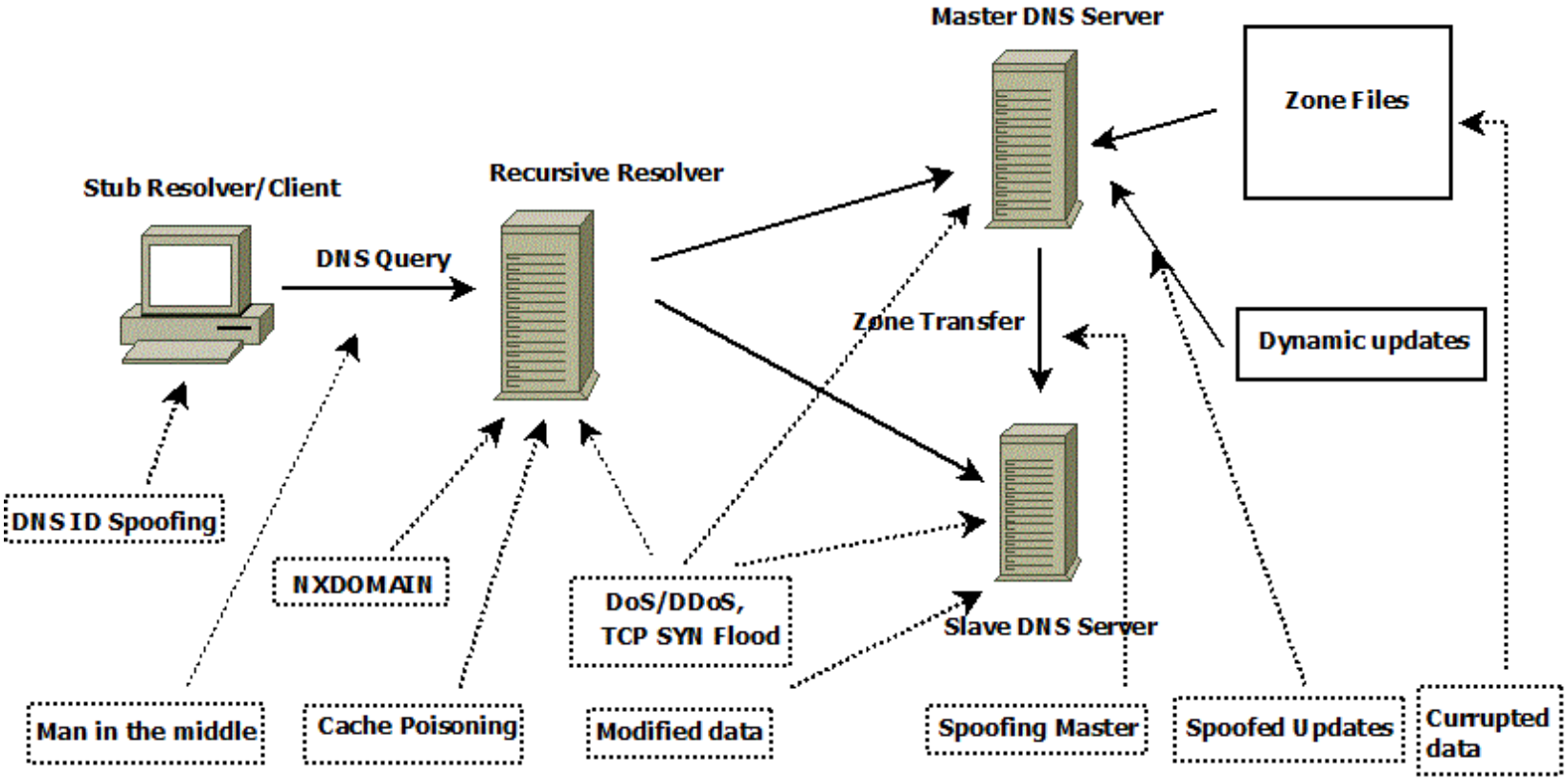
Stub Resolver

- DNS Client is called Stub Resolver.
- Always Queries RR.
- RR Replied back to Stub Resolver.

DNS Attacks

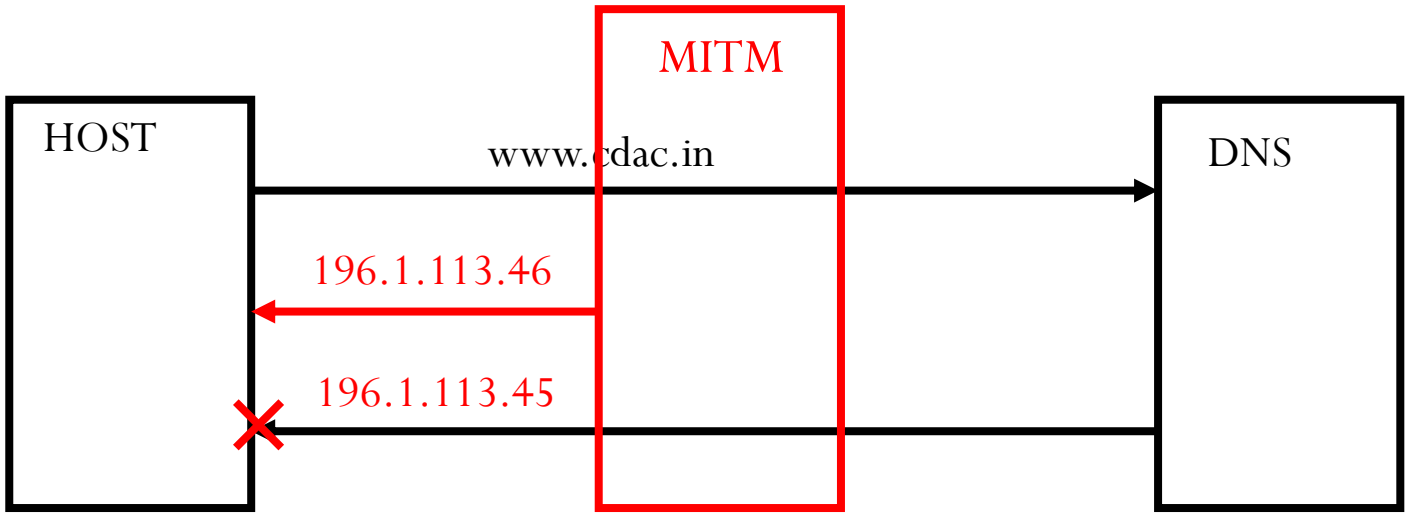
- Attacks on DNS Infrastructure
- Attacks exploiting the DNS Infrastructure

Attacks on DNS Infrastructure



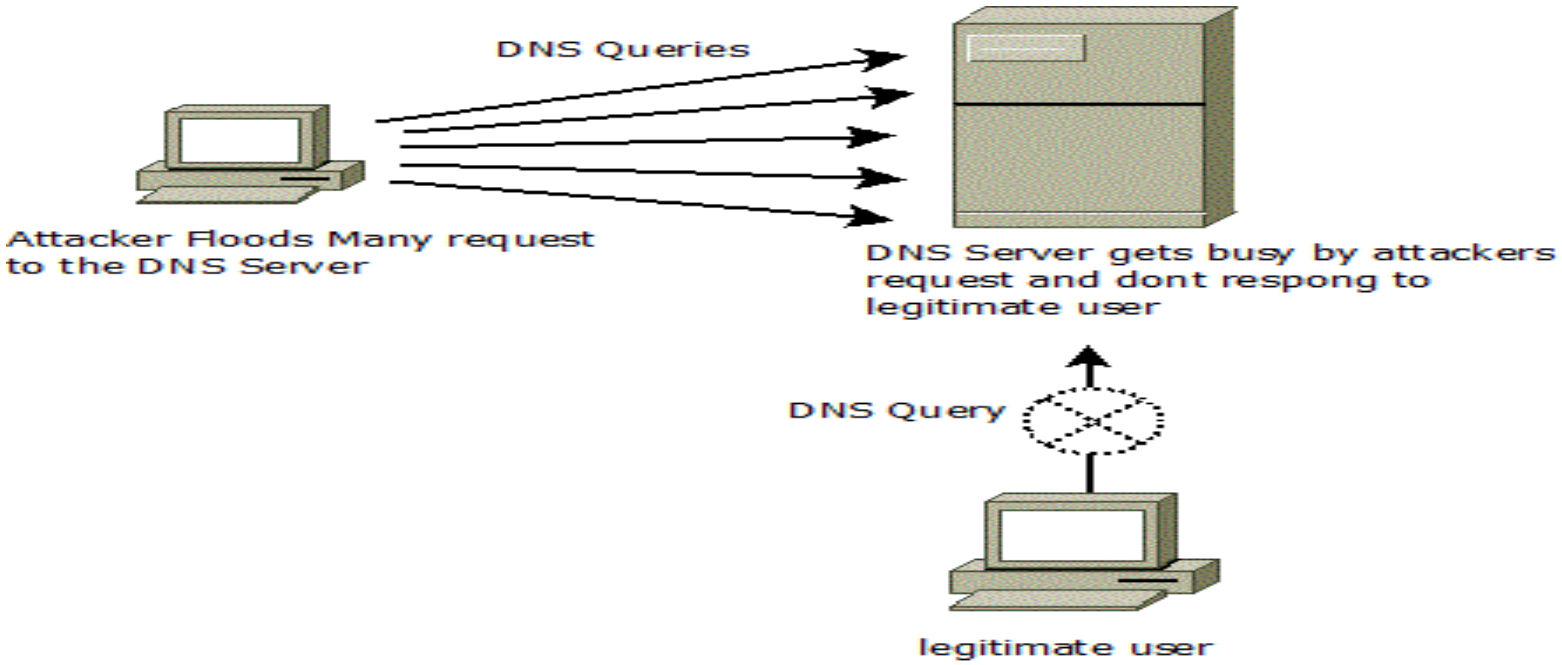
Man in The Middle Attack

- This is done by spoofing the source IP of the DNS servers and can become a bridge between the real DNS server and the client.



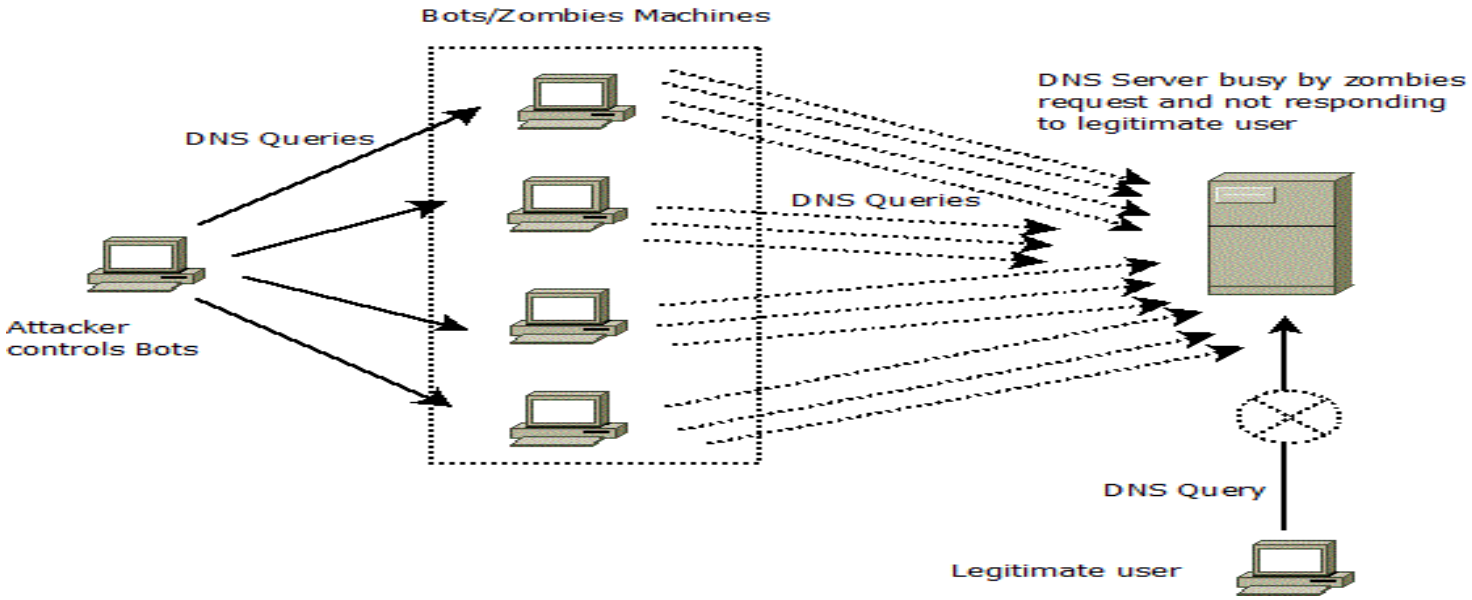
DoS

- Denial of Services(DoS) attack is a cyber-attack that is designed to bring down the network by creating unwanted traffic.



DDoS

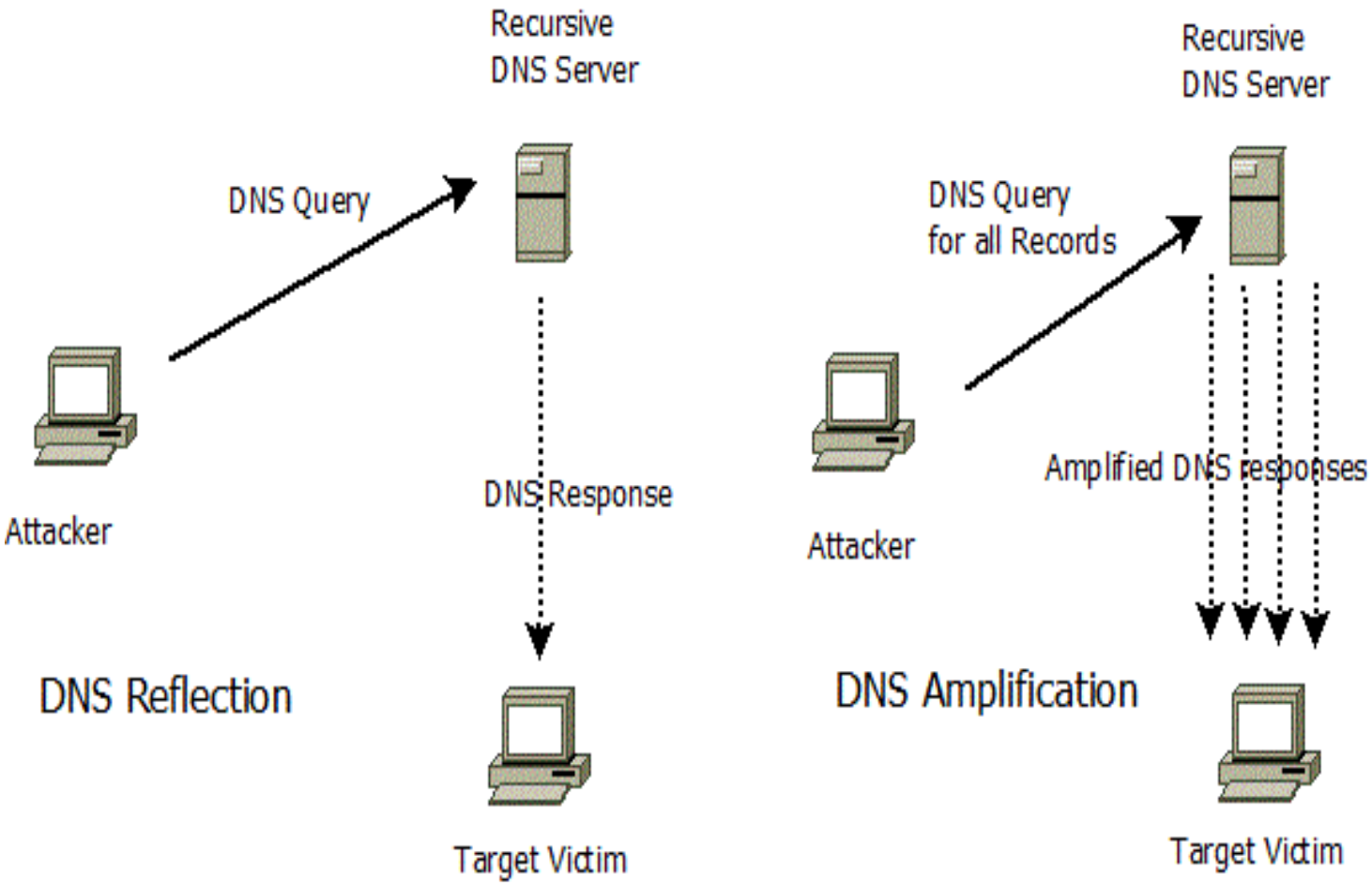
- Distributed Denial of Services(DDoS) attack, uses a Trojan horse in which it uses multiple systems to target a single system.



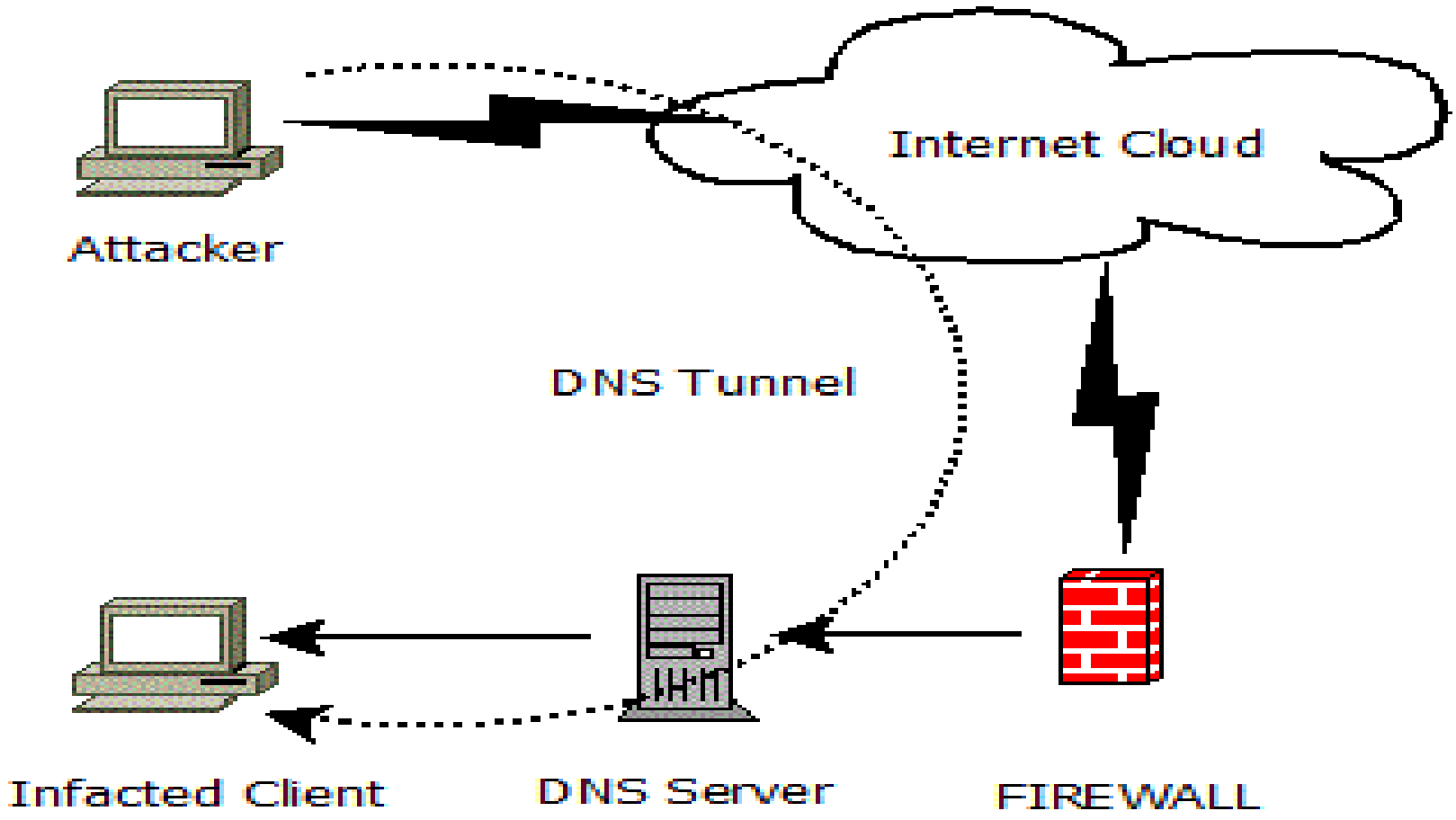
Attacks Exploiting DNS Infrastructure

- DNS Reflection
- DNS Amplification
- DNS Tunnelling
- DNS Hijacking

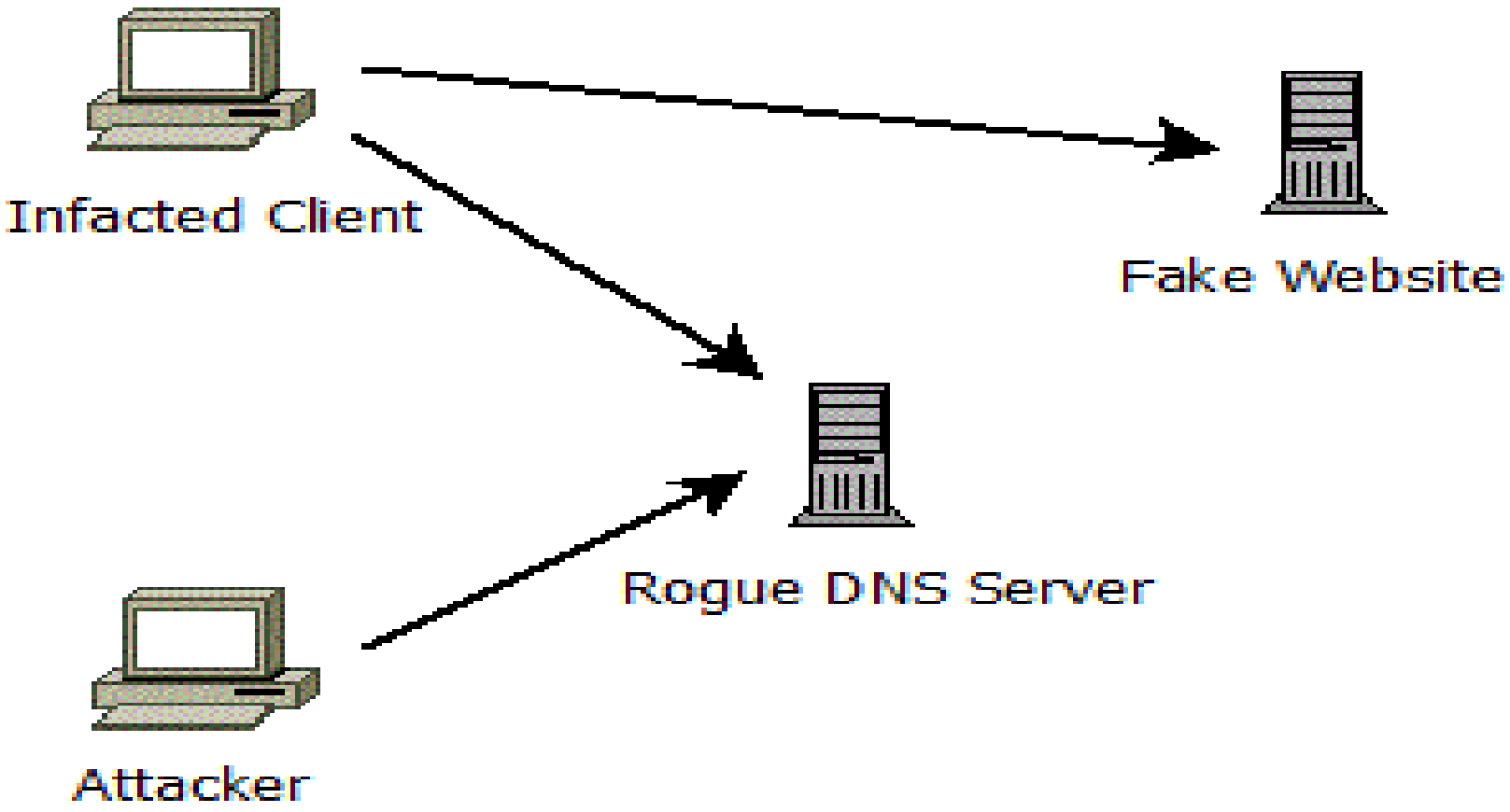
DNS Reflection and Amplification



DNS Tunnelling



DNS Hijacking



DNS Security Solution

- DNSSEC
- TSIG
- DNS Firewall
- DNS Health Measurement
- DNS Intrusion Detection

DNS Health Measurement

- DNS Vulnerabilities
  - DNS Version Check
  - SOA Check
  - Dual Stack
  - Recursion Check
  - DNSSEC Check
  - TSIG Check
- RTT Query Latency Check

DNS Intrusion Detection

- SNORT
- Signature for attacks
  - DOS/DDoS
  - Amplification
  - Tunneling
  - Hijacking

Thank You

- Queries?
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