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# Domain Name System

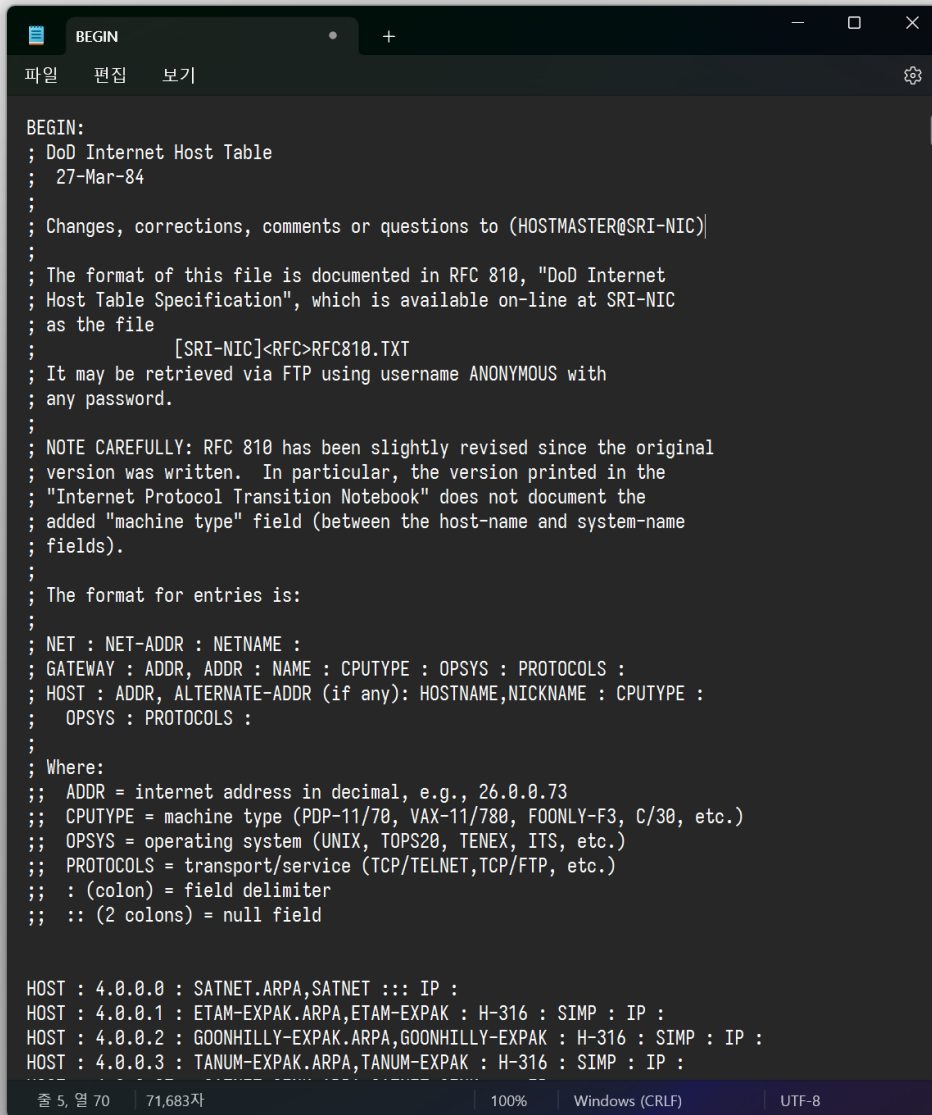
20210463 박연종

2024.03.13.

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# DNS의 등장



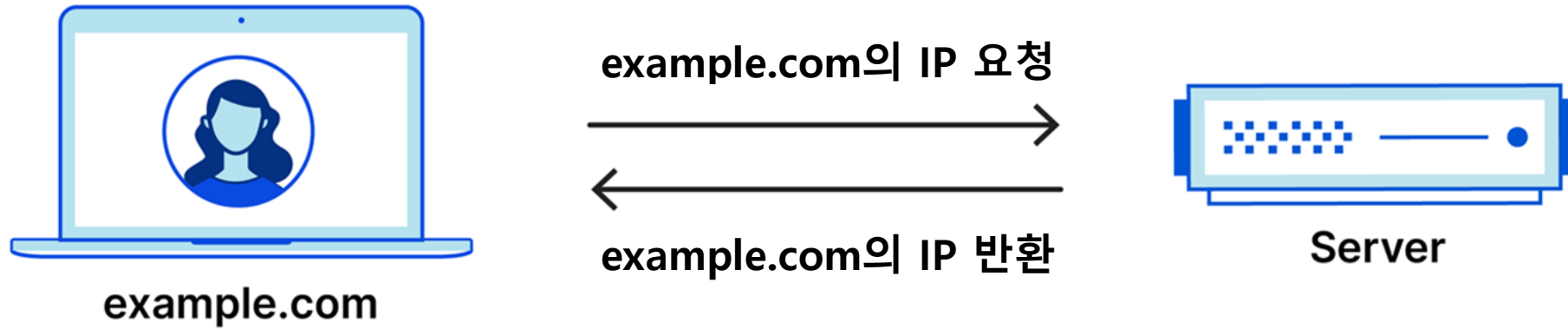
```
BEGIN:
; DoD Internet Host Table
; 27-Mar-84
;
; Changes, corrections, comments or questions to (HOSTMASTER@SRI-NIC)
;
; The format of this file is documented in RFC 810, "DoD Internet
; Host Table Specification", which is available on-line at SRI-NIC
; as the file [SRI-NIC]<RFC>RFC810.TXT
; It may be retrieved via FTP using username ANONYMOUS with
; any password.
;
; NOTE CAREFULLY: RFC 810 has been slightly revised since the original
; version was written. In particular, the version printed in the
; "Internet Protocol Transition Notebook" does not document the
; added "machine type" field (between the host-name and system-name
; fields).
;
; The format for entries is:
;
; NET : NET-ADDR : NETNAME :
; GATEWAY : ADDR, ADDR : NAME : CPUTYPE : OPSYS : PROTOCOLS :
; HOST : ADDR, ALTERNATE-ADDR (if any): HOSTNAME,NICKNAME : CPUTYPE :
; OPSYS : PROTOCOLS :
;
; Where:
;; ADDR = internet address in decimal, e.g., 26.0.0.73
;; CPUTYPE = machine type (PDP-11/70, VAX-11/780, FOONLY-F3, C/30, etc.)
;; OPSYS = operating system (UNIX, TOPS20, TENEX, ITS, etc.)
;; PROTOCOLS = transport/service (TCP/TELNET,TCP/FTP, etc.)
;; : (colon) = field delimiter
;; :: (2 colons) = null field

HOST : 4.0.0.0 : SATNET.ARPA,SATNET :: IP :
HOST : 4.0.0.1 : ETAM-EXPAK.ARPA,ETAM-EXPAK : H-316 : SIMP : IP :
HOST : 4.0.0.2 : GOONHILLY-EXPAK.ARPA,GOONHILLY-EXPAK : H-316 : SIMP : IP :
HOST : 4.0.0.3 : TANUM-EXPAK.ARPA,TANUM-EXPAK : H-316 : SIMP : IP :
```

<https://emallab.jp/dns/hosts/>

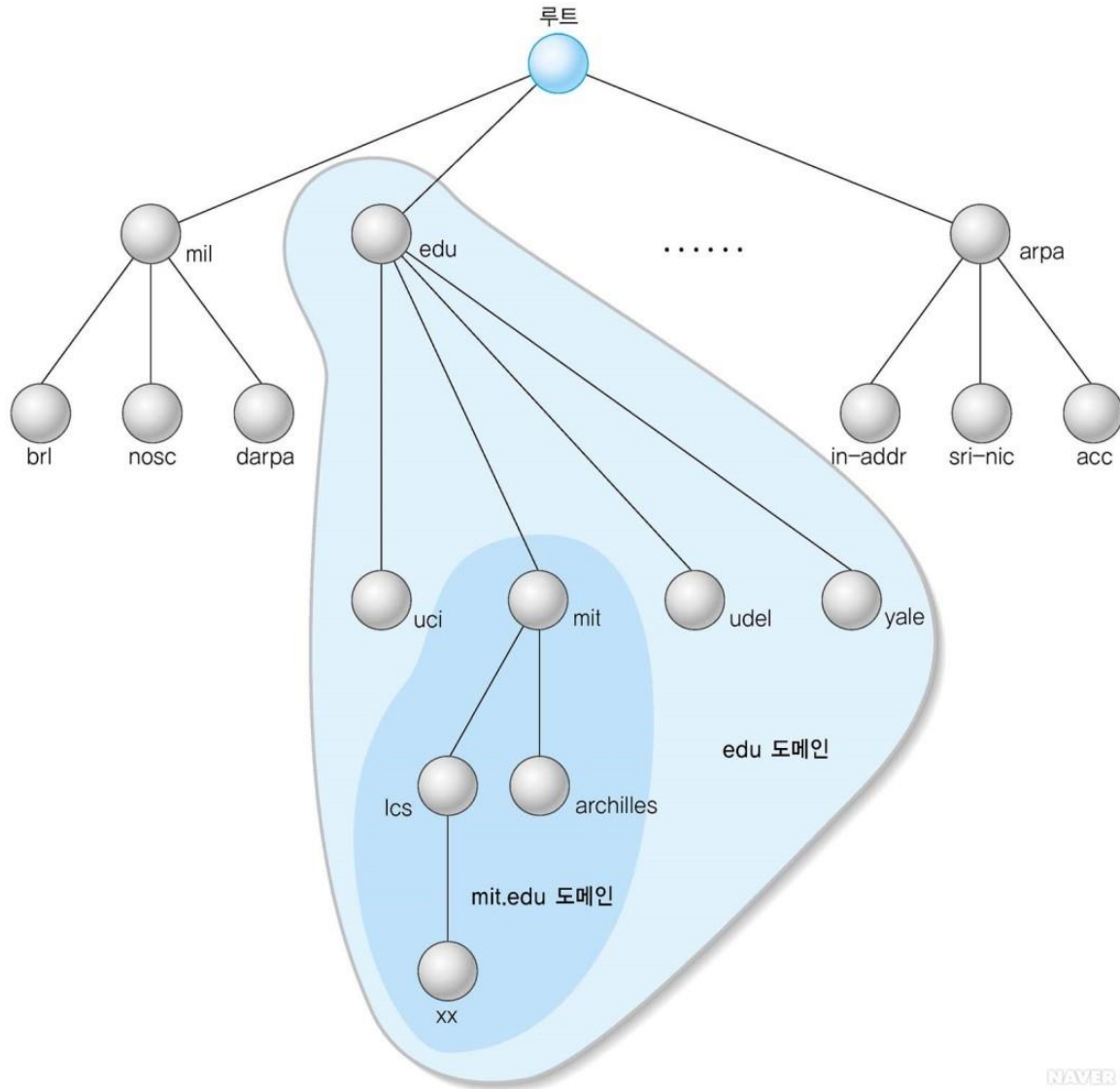
- ARPANet은 HOSTS.txt에 IP와 호스트 네임을 기록해 서로 매핑해 사용
- HOSTS.txt는 변경사항을 모아 사람이 NIC에서 수동 갱신한 후에 주기적으로 다운로드 받아 자신의 서버에 있는 파일 갱신
- ARPANet을 사용하는 서버가 증가하면서 문제점 발생
  1. NIC 서버의 트래픽 및 부하가 크게 증가
  2. 호스트 네임 중복으로 충돌 발생
  3. NIC 서버가 중단되면 파일을 다운로드할 수 없음
  4. 수동으로 관리하여 업데이트가 늦음
- ...

# Domain Name System



- 도메인을 IP 주소로 변환
- IP 주소를 도메인으로 변환
- 계층적이고 분산된 데이터베이스 시스템

# Domain Name Space



- DNS는 분산적이며 계층적 구조
- Domain Name Space는 DNS가 따르는 규칙
- 레이블을 dot으로 구분해 각 기관에서 관리
- 최상위 계층을 시작으로 하위 계층으로 순차적인 탐색을 통해 IP 주소를 반환

**xx.lcs.mit.edu.**

# Root Name Server

ce.kumoh.ac.kr.

- 도메인 맨 뒤에는 대부분 dot이 생략돼 있음
- Root Name Server는 국제인터넷주소관리기구 ICANN이 직접 관리
- .com, .kr 등의 도메인 확장자 레이블을 구분해 TLD Name Server로 안내

# Top-Level Domain Name Server

ce.kumoh.ac.kr.

- Authoritative Name Server의 주소를 저장하고 안내하는 역할
- 도메인 확장자를 사용하는 모든 호스트 정보를 관리

# Authoritative Name Server

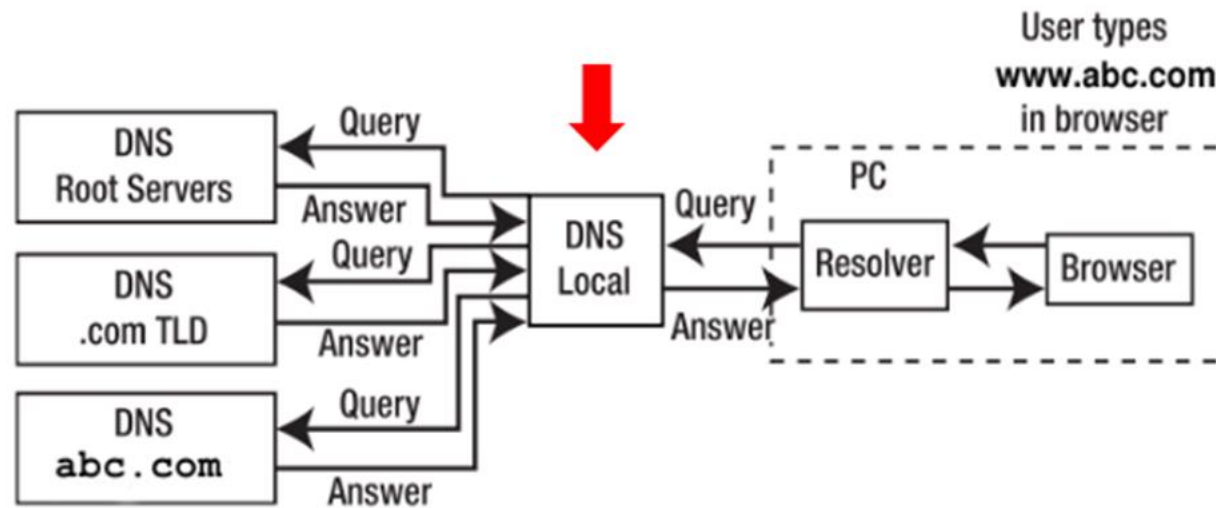
ce . kumoh . ac . kr .

- 일반적으로 DNS 서버의 최종 단계
- 실제 도메인과 IP 주소의 관계가 기록 · 저장 · 변경되는 서버



# DNS Resolver

- 클라이언트로부터 요청을 받아 네임 서버로 전달하고 반환 받은 정보를 클라이언트에게 알리는 중계자 역할
- 결과를 캐시에 저장해 동일한 도메인 주소를 요청할 때 불필요한 리소스가 발생하지 않도록 함



# DNS Query

## Recursive Query

- 재귀적으로 클라이언트가 요청한 실제 서버까지 쿼리가 이동해 실제 서버 IP 주소의 IP를 얻는 방법

- Root Name Server에 부담

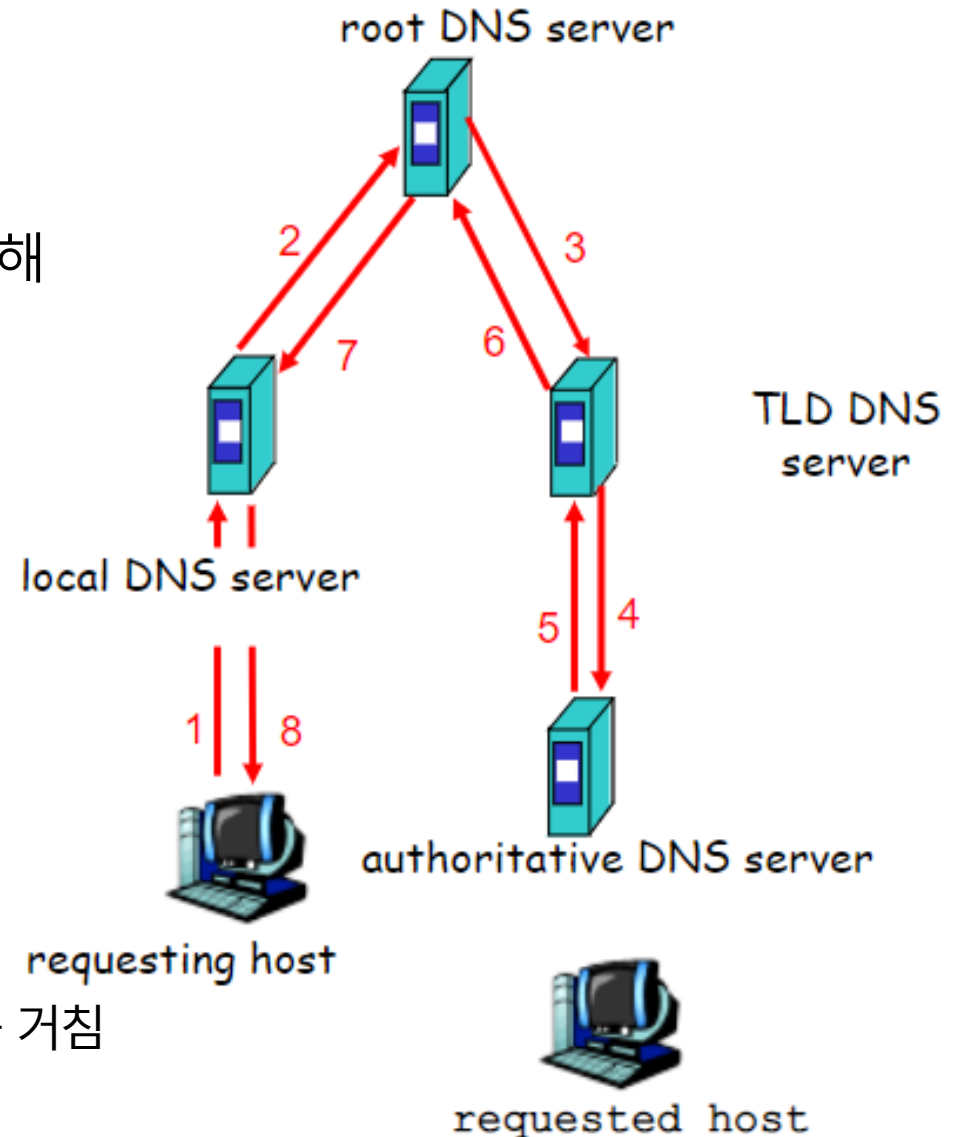
- 처리해야 할 쿼리의 양

DNS Resolver가 요청하면 Root Name Server에서 시작

DNS Resolver는 각 국에 여러 개, Root Name Server는 13개

- 캐시되지 않았을 때 요청

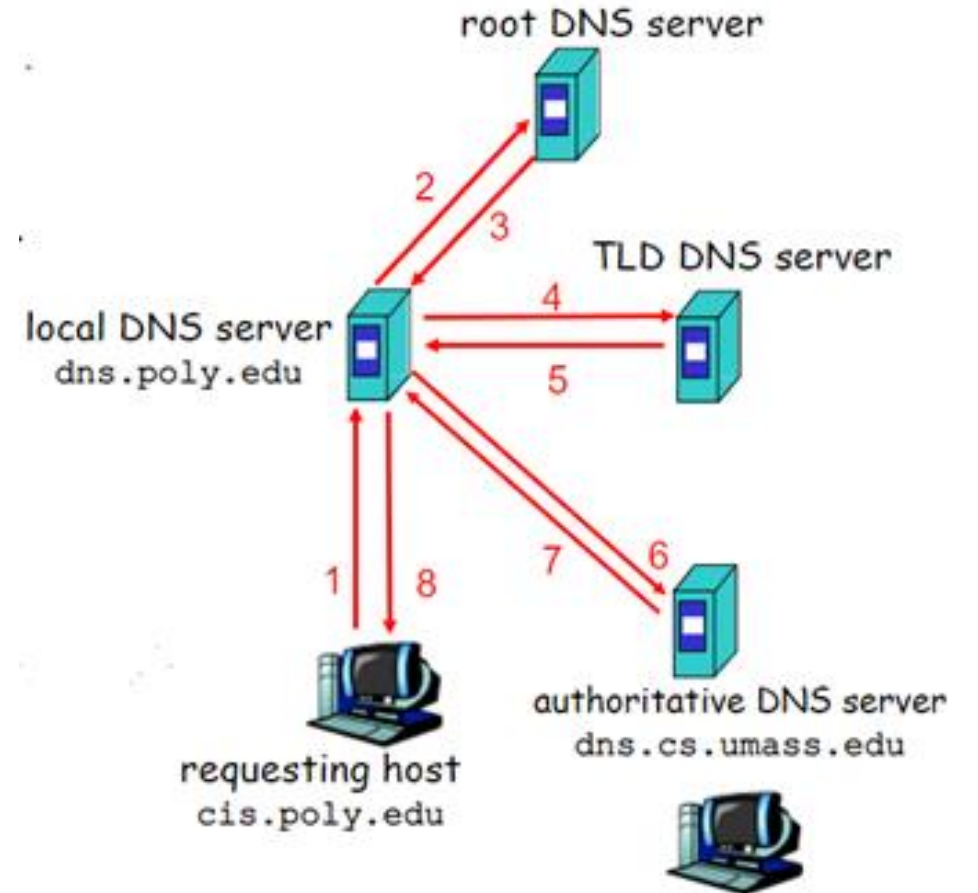
DNS Resolver에 캐시되지 않은 요청은 항상 Root Name Server를 거침



# DNS Query

## Iterative Query

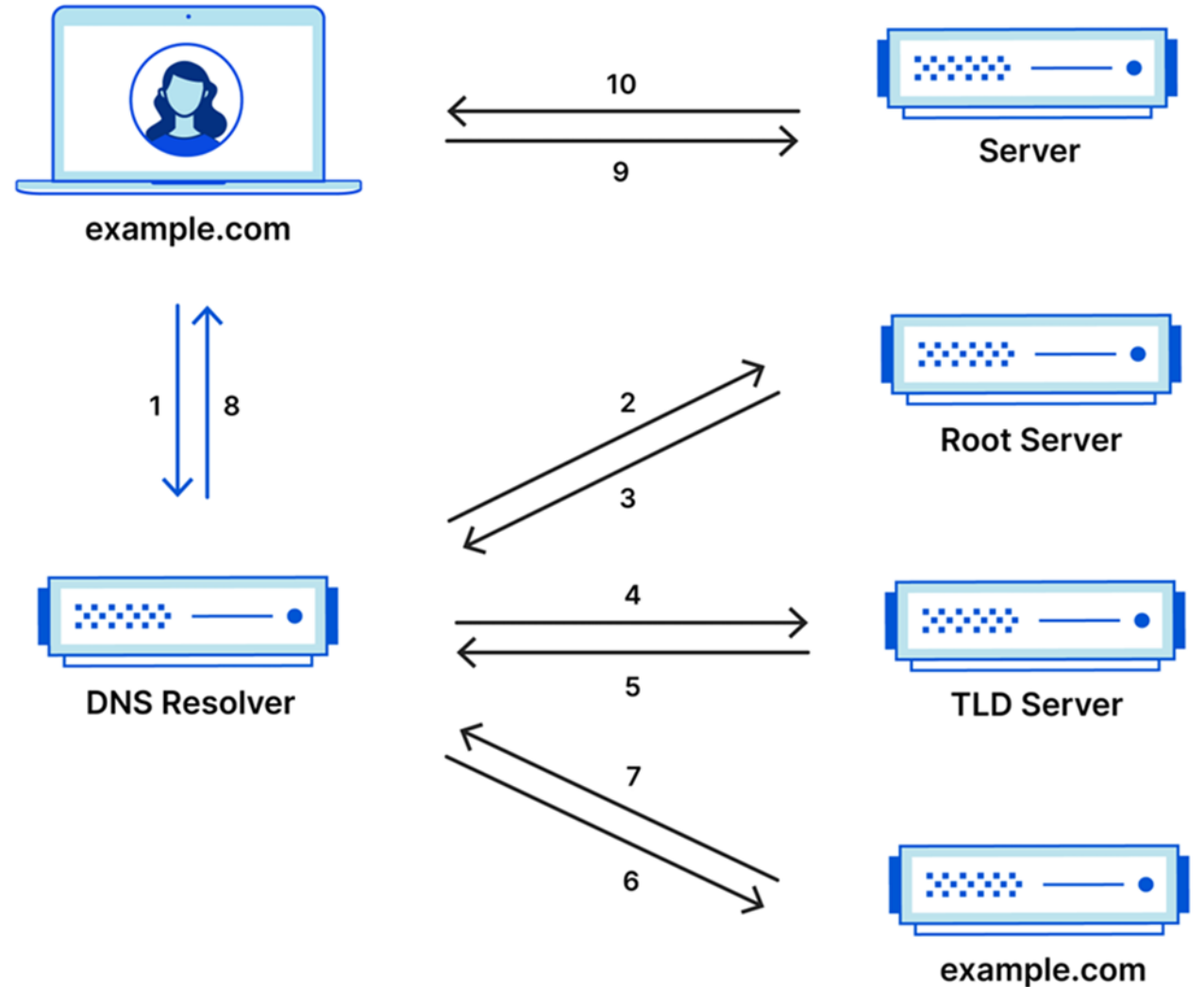
- 클라이언트가 요청한 실제 서버 IP 주소를 얻기 위해 여러 서버에 쿼리를 보내는 방법
- DNS Resolver에 부담
  - 여러 곳에 요청을 하고, 여러 곳으로부터 응답을 받음



# DNS 동작 과정

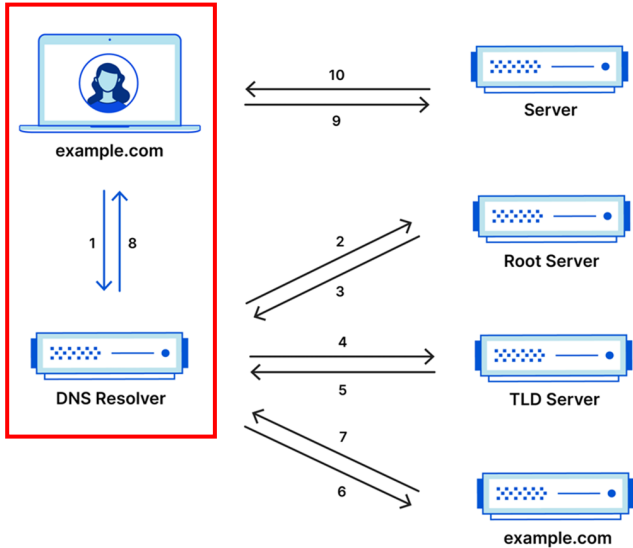
1. example.com 요청
2. example.com 요청
3. .com 관리 서버 주소로 응답
4. example.com 요청
5. example.com 관리 서버 주소로 응답
6. example.com 요청
7. example.com 서버 실제 IP 주소로 응답
8. example.com 서버 실제 IP 주소로 응답
9. example.com 서버 실제 IP 주소에 HTTP 요청
10. 브라우저에서 렌더링할 웹 페이지로 응답

## Complete DNS Lookup and Webpage Query



# 실제 동작 확인

## Complete DNS Lookup and Webpage Query



```
root@LAPTOP-CVNSG6:~# dig +trace ce.kumoh.ac.kr @1.1.1.1

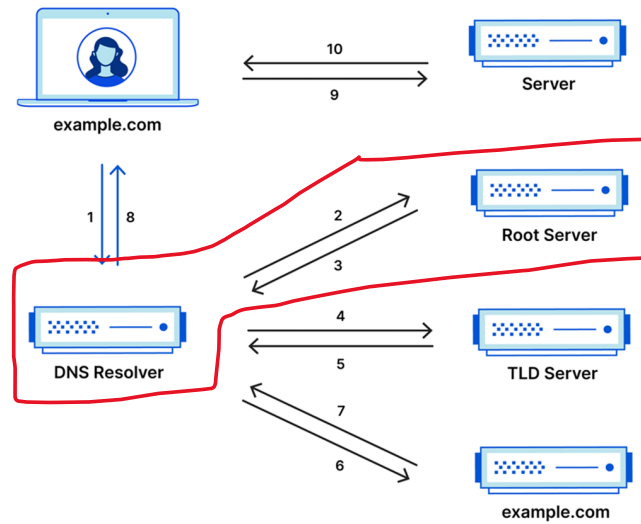
; <<>> DiG 9.18.18-0ubuntu0.22.04.2-Ubuntu <<>> +trace ce.kumoh.ac.kr @1.1.1.1
;; global options: +cmd

.          516844  IN      NS      a.root-servers.net.
.          516844  IN      NS      b.root-servers.net.
.          516844  IN      NS      c.root-servers.net.
.          516844  IN      NS      d.root-servers.net.
.          516844  IN      NS      e.root-servers.net.
.          516844  IN      NS      f.root-servers.net.
.          516844  IN      NS      g.root-servers.net.
.          516844  IN      NS      h.root-servers.net.
.          516844  IN      NS      i.root-servers.net.
.          516844  IN      NS      j.root-servers.net.
.          516844  IN      NS      k.root-servers.net.
.          516844  IN      NS      l.root-servers.net.
.          516844  IN      NS      m.root-servers.net.
.          516844  IN      RRSIG   NS 8 0 518400 20240325050000 20240312040000 30903 . UOvrkr7JYF+MxQcfUWxs
dF7+naqD7472xDelhaZ9SZtFB59MKoL7QVr8 073fdU7b/lSd2yPzSfI/abv2HkwVom1XqLomZHNNC0Np00U84wrYMBnD MNI0dgfo/zI/sF0Nh4t/ZT0tYh
BmME8MQ6jH9Zv7bmpYHhGScgrzHUr1 UL3FW3twNfFsfbDNyU618B0Bei6lb3jFqICDIGckp4IzMmE12wtzxGBH CH/TE9g5T436nmcmEvSy+/Lo+FiWsHmE
Ws/wmNyAZQ0wEN3CctW8eoaT_M8Py0hexlOVuPcTMXVDMwCRO2XI3KruynEomC7n0ztGhXUzI4WTopyo/ jeDcFg==
;; Received 525 bytes from 1.1.1.1#53(1.1.1.1) in 0 ms
```



# 실제 동작 확인

## Complete DNS Lookup and Webpage Query

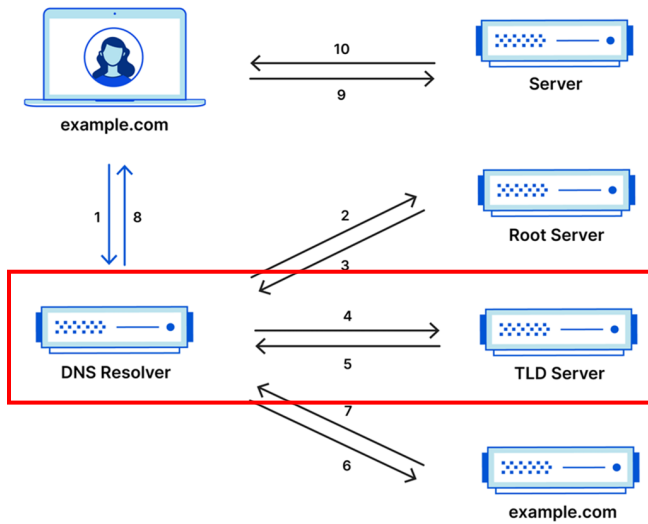


```
;; UDP setup with 2001:500:2::c#53(2001:500:2::c) for ce.kumoh.ac.kr failed: network unreachable.
;; UDP setup with 2001:500:2::c#53(2001:500:2::c) for ce.kumoh.ac.kr failed: network unreachable.
;; UDP setup with 2001:500:2::c#53(2001:500:2::c) for ce.kumoh.ac.kr failed: network unreachable.
;; UDP setup with 2001:500:2d::d#53(2001:500:2d::d) for ce.kumoh.ac.kr failed: network unreachable.
kr.      172800  IN      NS      b.dns.kr.
kr.      172800  IN      NS      c.dns.kr.
kr.      172800  IN      NS      d.dns.kr.
kr.      172800  IN      NS      e.dns.kr.
kr.      172800  IN      NS      f.dns.kr.
kr.      172800  IN      NS      g.dns.kr.
kr.      86400   IN      DS      61615 8 2 ED570AADC88713CE2775FB8AFFB2AD782D056EA21D0677E147F2FB7B F5440
4DA
kr.      86400   IN      RRSIG   DS 8 1 86400 20240325050000 20240312040000 30903 . YWeixe17oIvQHEcz/lSRP
dukmmAwYdQetSAHLHuaJWbu13GPoNx5DM7 GYxFIPRb1RGtOFTBkrvri6bhut+tZ6TKxmKYl5GTcK02bH6ucVt3uLv7 KBz0WruN34VKr4szQXWQTRWiJfU
nL/qCWpW99EKzPWwAOi+R1Bi9XbDB iLTG+WNv6KE8F5R95Rcs1XGaoRzXMmERxot0HoKbD44hnNAzzf9UPujs ojyu0v4c04AqBPHmOYBQYdJ2AC2D79iPs
2qLQUG+dIbUAAvvZGIm9t+h uL+zf/TTPtyPWnq3SjYAJNSsYBEPbRHFwPZ4bAV40y2zoUsTbduNaqmE 7VvtIw==
;; Received 686 bytes from 170.247.170.2#53(b.root-servers.net) in 110 ms
```



# 실제 동작 확인

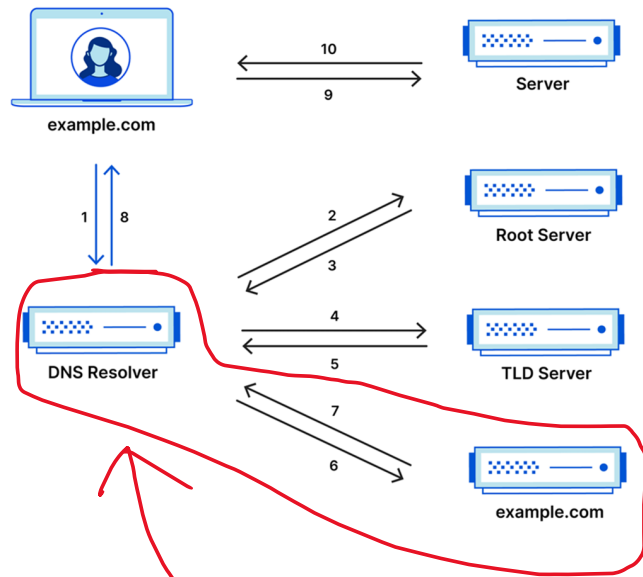
## Complete DNS Lookup and Webpage Query



```
kumoh.ac.kr. 86400 IN NS ns.kumoh.ac.kr.
hodikubdh5ijlgem475k0joe fk8ii4v4.ac.kr. 900 IN NSEC3 1 1 10 96E920 MGQ1UKCVI25AAT5I82F58LGOGV103R7Q NS SOA RRSIG DNSKEY
NSEC3PARAM
hodikubdh5ijlgem475k0joe fk8ii4v4.ac.kr. 900 IN RRSIG NSEC3 8 3 900 20240410192027 20240311192027 47133 ac.kr. QW+2fhcwQ/
KBPU4Fj8GUvBpaVVfTS0KJIPNkniZ5J0Ni9mFMd2KBPjK u6kjjNvLGy6Z/EncqHV6pL/YrZYwLszX1j39rK1oaJvhA8+AW1902wWD B/PI9BHrryzvNypj
sDisxd9d+Er/+r9sB0PLsGCEcIJZvtg/XFx60mtA VeQ=
qdrqp4vcd41ce0hslhe98qaeuqqs7cvr.ac.kr. 900 IN NSEC3 1 1 10 96E920 8P1U7FQ6L2JQG4570TMP9RVORAVM2TQK NS DS RRSIG
qdrqp4vcd41ce0hslhe98qaeuqqs7cvr.ac.kr. 900 IN RRSIG NSEC3 8 3 900 20240410192027 20240311192027 47133 ac.kr. mP3D1UMitr
umYsn1Tm3+eyl9FwK4AfPwncNu0shqLpuN+8T5mCSUi6lu JlwemSndLgK0zXqzvEcC5UKXUVLkQXl3cJMTDpugS61JxYF/UE6f9AJu T8HAYicaNhgPGQkb
qgenbeYVuBYtLG0B756Sa5XZZKYl2WV5T8/Sg7kC Ep0=
;; Received 571 bytes from 210.101.62.1#53(f.dns.kr) in 20 ms
```

# 실제 동작 확인

## Complete DNS Lookup and Webpage Query



```
ce.kumoh.ac.kr.      6600    IN      A       202.31.128.10
kumoh.ac.kr.         6600    IN      NS      ns.kumoh.ac.kr.
;; Received 120 bytes from 202.31.128.2#53(ns.kumoh.ac.kr) in 20 ms
```





# 참고 자료

- <https://www.cloudflare.com/en-gb/learning/dns/what-is-dns/>
- <https://velog.io/@park-moen/devcourse-study01>
- [https://en.wikipedia.org/wiki/Domain\\_Name\\_System](https://en.wikipedia.org/wiki/Domain_Name_System)
- <https://cl8d.tistory.com/64>
- <https://judahhh.tistory.com/65>
- <https://velog.io/@zinukk/9kpyzbdtd>
- <https://uzun.dev/155>
- <https://velog.io/@sdsd0908/%EB%B8%8C%EB%9D%BC%EC%9A%B0%EC%A0%80%EC%97%90-%EB%8F%84%EB%A9%94%EC%9D%B8%EC%9D%84-%EC%9E%85%EB%A0%A5%ED%95%A0-%EB%95%8C...%EB%8F%84%EB%A9%94%EC%9D%B8%EA%B3%BC-DNS>
- <https://ssudalim.tistory.com/4>
- <https://okky.kr/questions/1456713>



감사합니다

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