Internet Engineering

241-461

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DNS

The Domain Name System

- Kurose & Ross: Computer Networking
  - Chapter 2 (2.5)

James F. Kurose & Keith W. Ross
Computer Networking
A Top-Down Approach Featuring the Internet
(2nd, 3rd or 4th Edition)
Addison Wesley

Contents

Domain Name System

- Translates Names to Addresses
  - (Finds where something is located)
- Also translates Addresses to Names
  - (Finds what is located there)
- Does not discover names
  - We have to know what name we want
  - The DNS is NOT a directory service
- Does provide other information
  - about known names

DNS Terminology

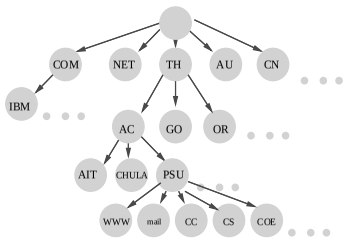
The DNS Name Tr

- Domain
  - Fully Qualified Domain Name
- Zone
  - Delegation
- Resource Record
  - Resource Record Set

DNS Sc

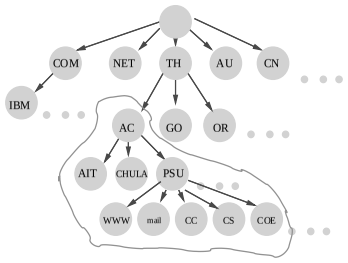
- DNS Server
- DNS Cache
- DNS Resolver
  - Stub Resolver

The DNS Name Tree



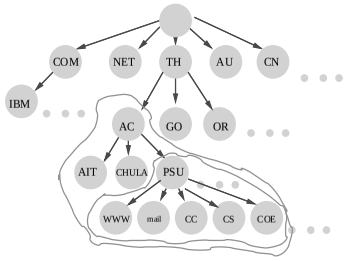
- A tree of domains
- The root at the top of the tree
  - There is exactly one Root
  - The root has no name - empty label
- Read from the bottom up
  - Produces Left -> Right answer
- Insert a '.' each time a link is crossed
- Name that ends in '.' (and empty root domain)
  - Fully Qualified Domain Name (FQDN)

A Domain

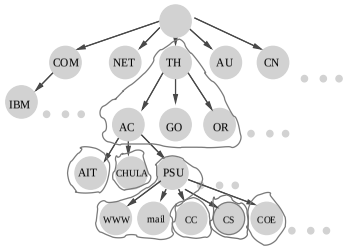


- Each domain is
  - A sub-domain of some other domain
  - Except the root domain
- That other domain is called its parent
- Any domain can have sub-domains
  - Sub-domains are part of the domain
- Domain named by name of its highest node
  - All subdomain names end .domain.name.

A Domain



Zone



- Domains can be divided into Zones
- Division at any sub-domain boundary
  - If domain is excluded
    - Entire domain is excluded
  - Cannot cross existing zone boundaries
    - But zone division can be removed
  - Domain is either
    - in a zone of its own
    - or in same zone as its parent
- Zones are independant DNS units

Zones and Domains

- A Zone is almost a Domain
  - Both named by domain name
    - Of highest node in tree contained
  - If no sub-domains are split
    - Domain and Zone are the same thing
  - But if a new zone is formed
    - Domain remains unchanged
    - The two zones are independant
  - Every node is in exactly one zone
    - Usually in many domains

Contents

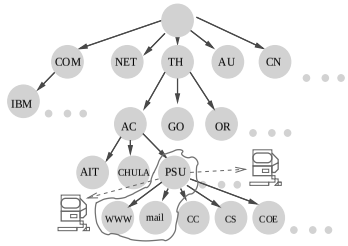
DNS database

- Keyed by domain name
- Contains Resource Records (RRs)
- RRs have a Type and a Class
- Class is not used much
  - INternet Class is almost everything
- Type specifies what kind of data is in the RR
  - A - Address (IPv4)
  - AAAA - 128 bit (IPv6) address
  - MX - Mail Exchange
  - LOC - Location
  - (many)

RRSets

- Group of RRs with
  - same class type & domain name
  - are an RRset
- RRset has a Time to Live
  - measured in seconds
- DNS Query gives domain name
    - required type (& class)
  - Gets RRset and its TTL
  - Or gets No Such Name
  - Or gets No Data of that Type
- Answer can be remembered
    - until TTL expires
  - Saves on DNS queries

DNS Servers



- Each zone has servers
  - to answer queries about it
- Each server has information
  - about its zone(s)
- There are redundant servers for reliability
- Servers can serve many zones
  - Related or unrelated zones

Contents

DNS Protocols

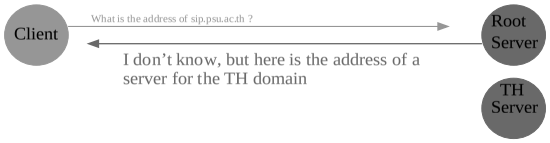
- UDP based (in general)
- Mostly lookup protocol
  - Don’t care if transactions are repeated
  - Don’t need to deal with duplicate packets
- Lost packets handled by retransmit
  - Not necessarily to same server

A DNS Query

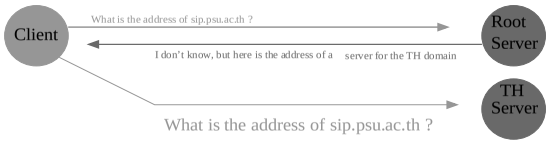
- Given a Domain Name, request information
- Information is typed
- Can ask for
  - Address (A)
    - Or IPv6 Address (AAAA)
  - Name Server (NS)
  - Mail eXchange (MX)
  - and much more.
- Assuming no other information, the query
  - Starts at the root of the tree
  - Gets referred to next lower subdomain
  - Until it reaches the domain of the name desired
- Each server replies with nameserver names
  - names of servers for the next lower sub-domain
  - (and usually their addresses)

Client Queries Root Server

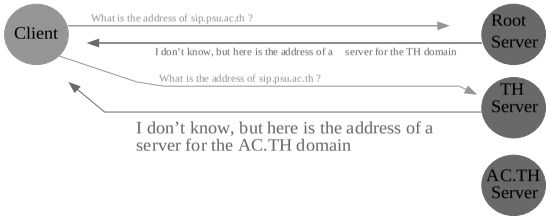
Root Server Reply



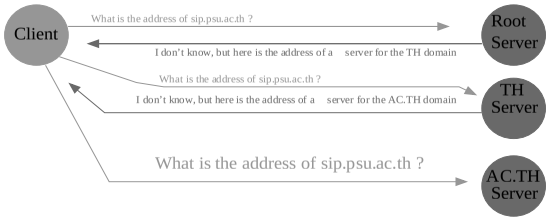
Client Queries TH Server



TH Server Reply

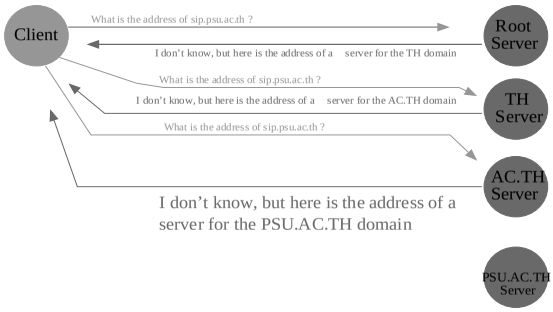


Client Queries AC.TH Server



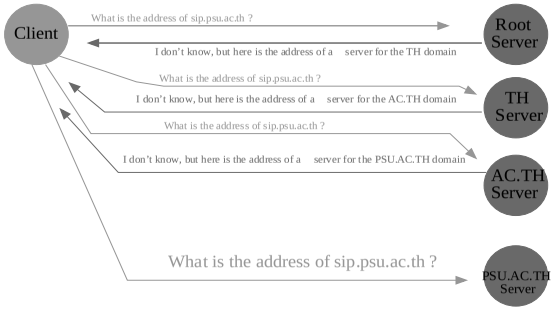
- Client called Resolver
  - because its job is to
  - resolve domain names
  - into the required information

AC.TH Server Reply

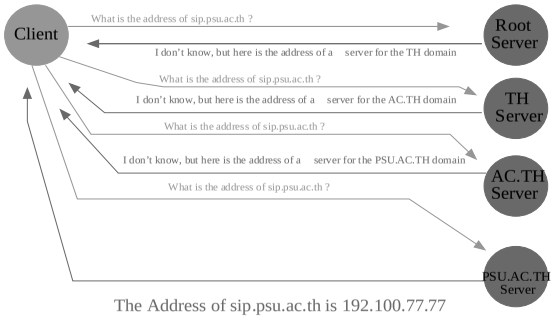


- Resolver is a library function
  - Included as part of every application
    - That requires name resolution

Query PSU.AC.TH Server



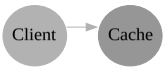
PSU.AC.TH Server Reply



The Address of sip.psu.ac.th is 192.100.77.77

- This is a complex process
  - Much code required
  - Many packets sent and received
  - All data lost when application exits

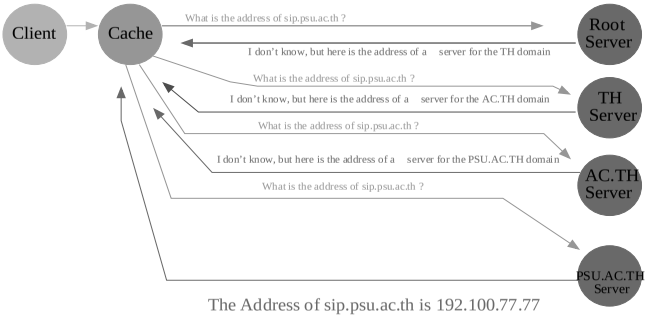
The Way it Really Works



What is the address of sip.psu.ac.th ?

- Client contains stub resolver
  - Able to ask question
  - Expects to get final answer returned
- Stub Resolver uses DNS Cache
  - or Back-End Resolver
  - To do the resolution work for it.

Cache Finds Answer



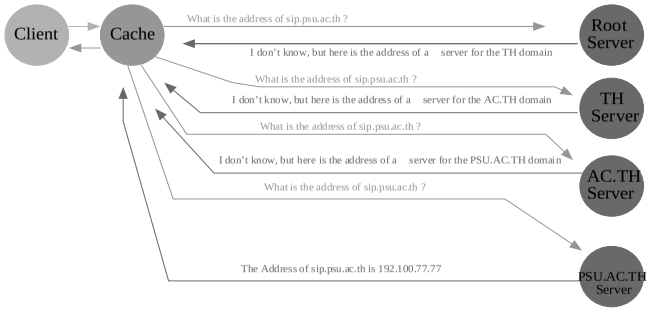
The Address of sip.psu.ac.th is 192.100.77.77

What is the address of sip.psu.ac.th ?

(if required)

- Back End Resolver (Cache) resolves name
  - Using its memory of earlier answers

Cache Tells Client



What is the address of sip.psu.ac.th ?

The Address of sip.psu.ac.th is 192.100.77.77

- Cache remembers each answer
  - in case it is required again
  - Every purple arrow is an answer
  - Each of these is remembered
- Query for www.ait.ac.th
  - starts at AC.TH server