

DOMAIN NAME SYSTEM (DNS) - AN INTRODUCTION

One of the most important components of the application layer is the Domain Name System (DNS) server. DNS is a distributed hierarchical and global directory that translates machine or domain names to numerical IP addresses. DNS can run over either UDP or TCP. Some of the information-processing functions a DNS server handles are

- Finding the address of a particular host
- Delegating a subtree of server names to another server
- Denoting the start of the subtree that contains cache and configuration parameters, and giving corresponding addresses
- Naming a host that processes incoming mail for the designated target
- Finding the host type and the operating system information
- Finding an alias for the real name of a host
- Mapping IP addresses to host names

5.2.1. Domain Name Space

Any entity in the TCP/IP environment is identified by an IP address, which thereby identifies the connection of the corresponding host to the Internet. An IP address can also be assigned a domain name. Unique domain names assigned to hosts must be selected from a name space and are generally organized in a hierarchical fashion.

Domain names are defined in a tree-based structure with the root at the top, as shown in [Figure 5.2](#). A tree is structured with a maximum of 128 levels, starting at level 0 (root). Each level consists of nodes. A node on a tree is identified by a label, with a string of up to 63 characters, except for the root label, which has empty string.

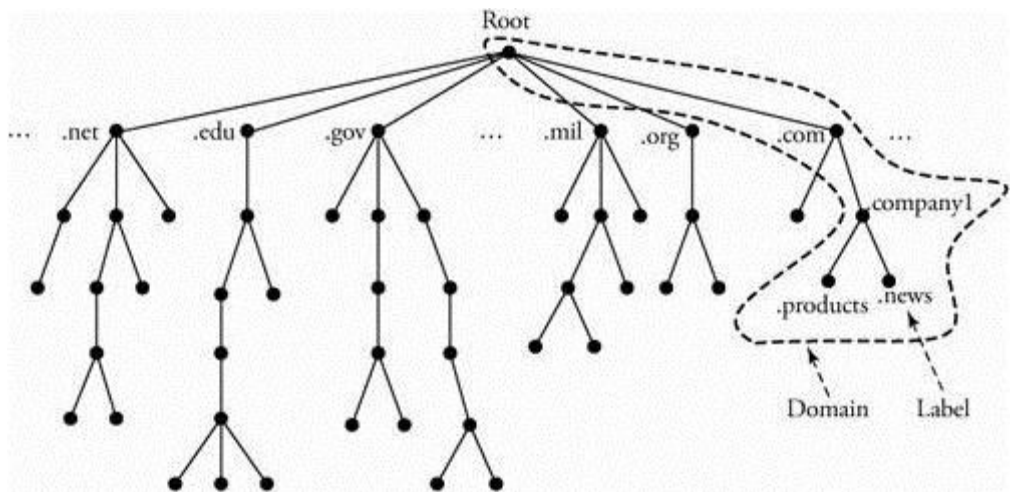


Figure 5.2. Hierarchy of domain name space, labels, and domain names

The last label of a domain name expresses the type of organization; other parts of the domain name indicate the hierarchy of the departments within the organization. Thus, an organization can add any suffix or prefix to its name to define its host or resources. A domain name is a sequence of labels separated by dots and is read from the node up to the root. For example, moving from right to left, we can parse as follows: domain name news.company1.com, a commercial organization (.com) and the "news" section of "company1" (news.company1). Domain names can also be partial. For example, company1.com is a partial domain name.

Domain-Name Servers

The domain name space is divided into sub domains, and each domain or sub domain is assigned a domain name server. This way, we can form a hierarchy of servers, as shown in [Figure 5.3](#), just as we did for the hierarchy of domain names. A domain name server has a database consisting of all the information for every node under that domain..

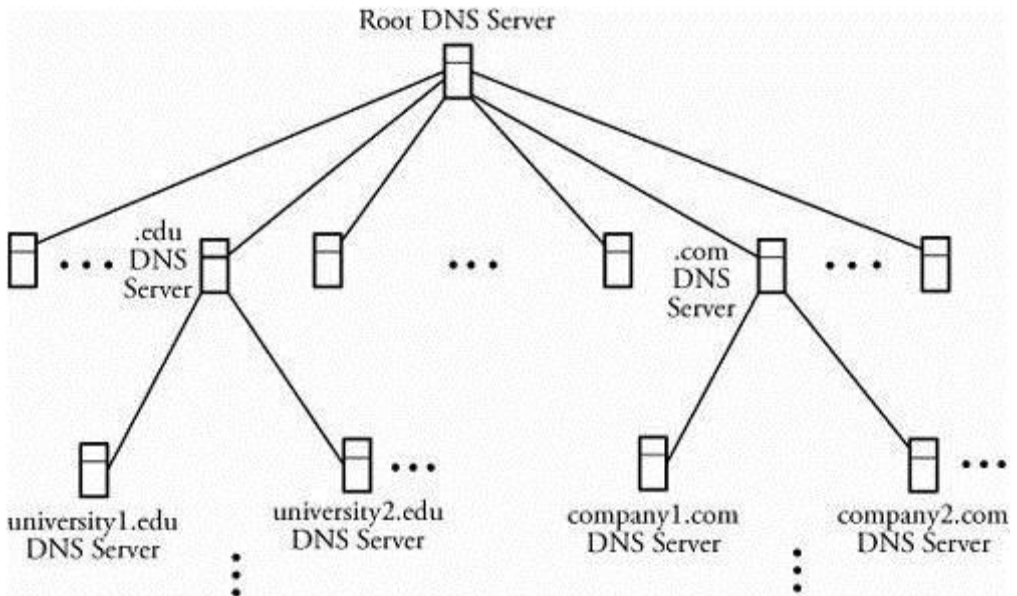


Figure 5.3. Hierarchy of DNS domain name servers

5.2.2. Name/Address Mapping

DNS operates based on the client/server application. Any client host can send an IP address to a domain name server to be mapped to a domain name. Each host that needs to map an address to a name or vice versa should access the closest DNS server with its request.

Mapping can be of either recursive or iterative. In recursive mapping ([Figure 5.4](#)), the client host makes the request to its corresponding DNS server. The DNS server is responsible for finding the answer recursively. The requesting client host asks for the answer through its local DNS server, news.company1.com

Finally, .com server sends the query to the local DNS server of the requested place, as

dns.company2.com, and finds the answer. The answer to a query in this method is routed back to the origin, as shown in the figure. The local DNS server of the requested place is called the authoritative server and adds information to the mapping, called time to live (TTL).

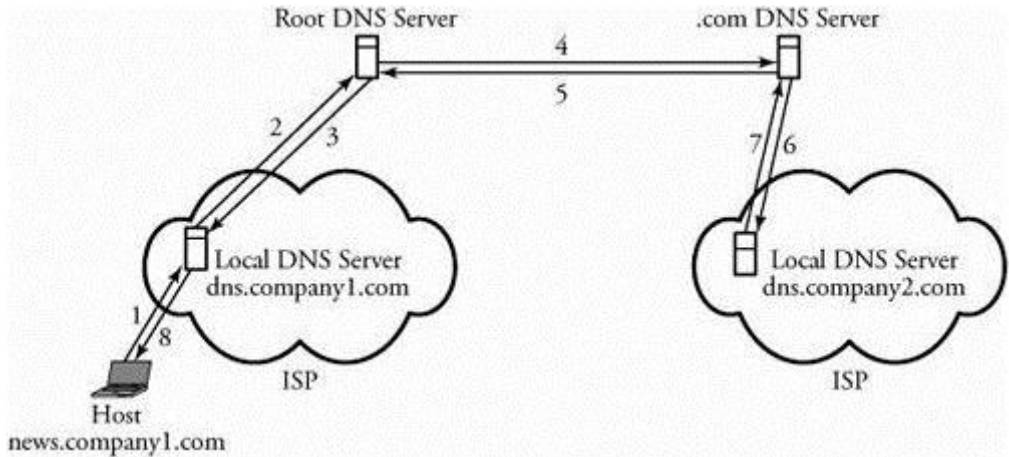


Figure 5.4. Recursive mapping

In the iterative approach, the mapping function is as shown in [Figure 5.5](#). In this case, if it does not have the name to provide, the server returns to the client host.

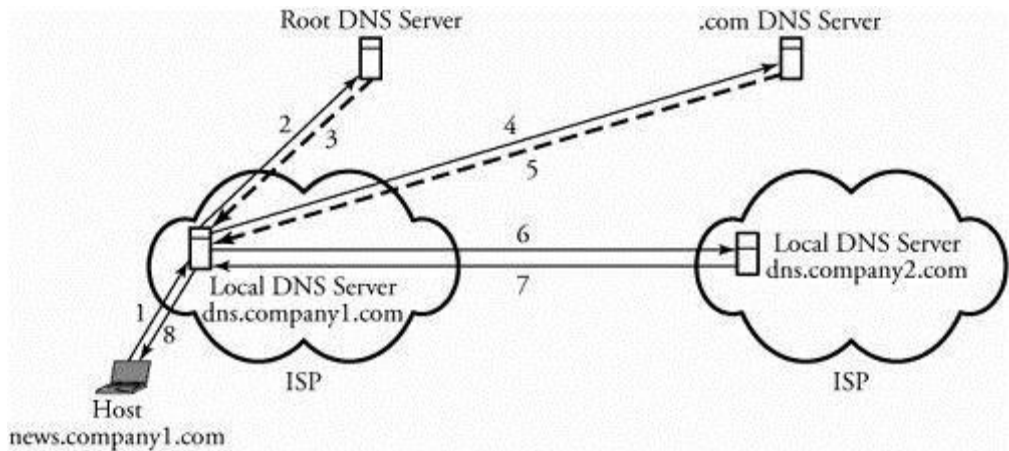


Figure 5.5. Iterative mapping

In [Figure 5.5](#), the news.company1.com host sends the query to its own local DNS server, dns.company1.com thus trying the root DNS server first and then tries .com server, finally ending up with the local DNS server of the requested place: dns.company2.com.

5.2.3. DNS Message Format

DNS communication is made possible through query and reply messages. Both message types have the 12-byte header format shown in [Figure 5.6](#).

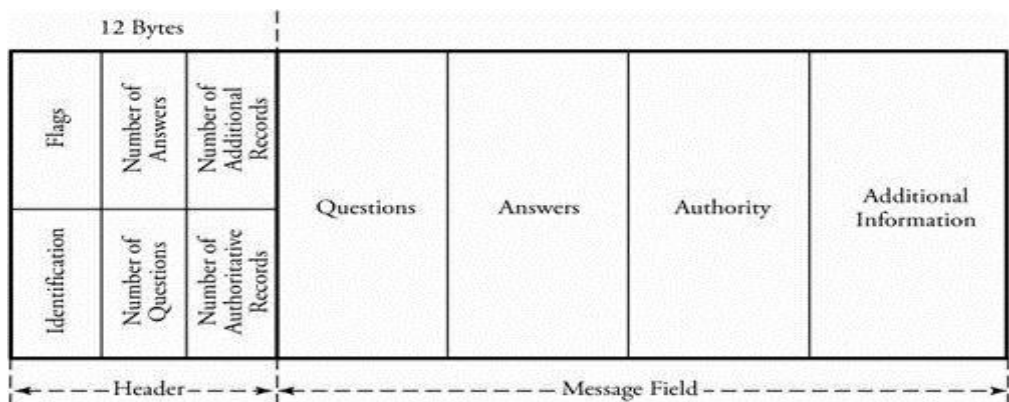


Figure 5.6. DNS message format

The header has six fields as follows. A client uses the identification field to match the reply with the query. This field may appear with a different number each time a client transmits a query. The server copies this number in its reply. The flags field contains subfields that represent the type of the message, such as the type of answer requested or requested DNS recursive or iterative mapping. The number of questions field indicates how many queries are in the question portion of the message. The number of answers shows how many answers are in the answer field. For the query message, this field contains all zeros. The number of authoritative records field consists of the number of authoritative records in the authority portion of a reply message. Similarly, this field is filled by zeros for a query message. Finally, the number of additional records field records are in the additional information portion of a reply message and is similarly filled by zeros in a query message.

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