What is DNS?

Each computer directly connected to the Internet has at least one specific IP address. However, users do not want to work with numerical addresses such as *194.153.205.26* but with a domain name or more specifically addresses (called FQDN addresses) such as www.commentcamarche.net.
It is possible to associate names in normal language with numerical addresses thanks to a system called **DNS** (*Domain Name System*).
This correlation between the IP addresses and the associated domain name is called *domain name resolution* (or *address resolution*).

Host names

At the beginning of TCP/IP, since the networks were not very extensive, or in other words the number of computers connected to the same network was low, network administrators created files called *manual conversion tables*. These manual conversion tables were sequential files, generally called *hosts* or *hosts.txt*, associating on each line the IP address of the machine and the related literal name called the *host name*.

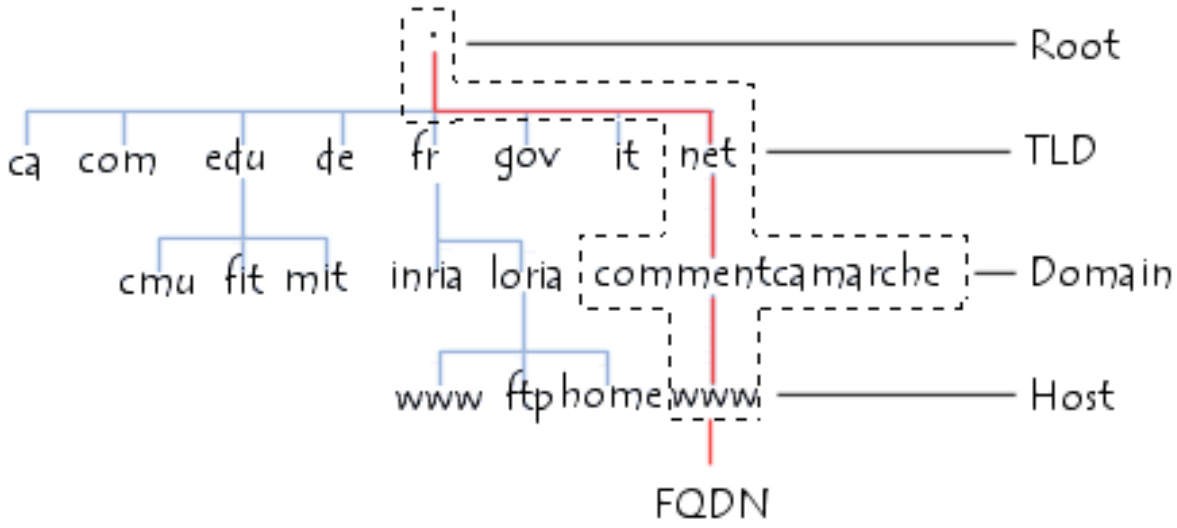
Introduction to the Domain Name System

However, the previous system of conversion tables required manual updating of the tables for all computers in the event of an addition or modification of a machine name. So with the explosion in the size of networks and their interconnection, it was necessary to implement a management system for names which was hierarchical and easier to administrate. The system called **Domain Name System** (**DNS**) was developed in November 1983 by Paul Mockapetris (RFC 882 and RFC 883) then revised in 1987 in RFCs 1034 and 1035. DNS has been subject to many RFCs.
This system offers:

- an hierarchical **namespace** allowing the uniqueness of a name to be guaranteed in a tree structure, like Unix file systems.
- a system of **distribution servers** enabling namespace to be made available.
- a **client** system making it possible to "resolve" domain names, i.e. interrogate the servers to find out the IP address corresponding to a name.

Namespace

The structure of the DNS system relies on a tree structure where the higher level domains (called **TLD**, for *Top Level Domains*) are defined, attached to a root node represented by a dot.



Each node of the tree is called a **domain name**. Each node has a *label* with a maximum length of 63 characters.
All domain names therefore make up an inverse tree where each node is separated from the following node by a dot (".").
The end of a branch is called the **host**, and corresponds to a machine or entity on the network. The host name given to it must be unique in the respective domain, or if the need arises in the sub-domain. For example a domain's web server generally bears the name *www*.
The word "**domain**" formally corresponds to the suffix of a domain name, i.e. the tree structure's collection of node labels, with the exception of the host.
The absolute name relating to all the node labels of a tree structure, separated by dots, and finished by a final dot is called the **FQDN address** (*Fully Qualified Domain Name*). The maximum depth of the tree structure is 127 levels and the maximum length of a FQDN name is 255 characters. The FQDN address makes it possible to uniquely locate a machine on the network of networks. So, *www.commentcamarche.net.* is an FQDN address.

Domain name servers

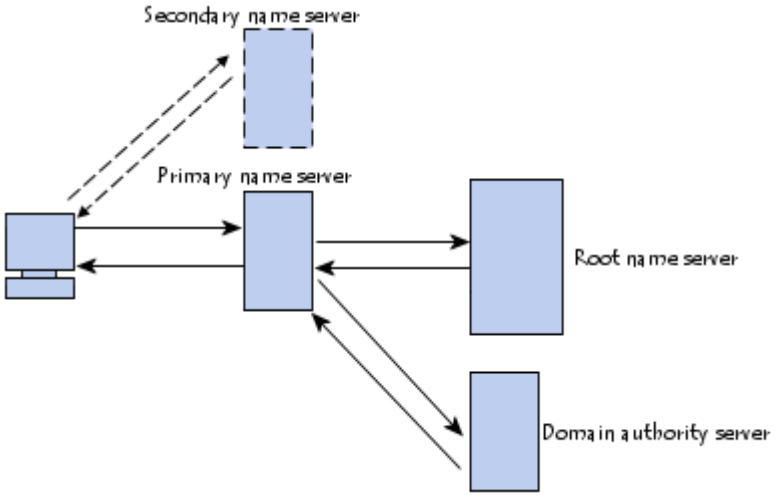
The machines called *domain name servers* make it possible to establish the link between domain names and IP addresses of machines on a network.
Every domain has a domain name server, called a *primary domain name server*, as well as a *secondary domain name server*, able to take over from the primary domain name server in the event of unavailability.
Every domain name server is declared in the domain name server of the immediately higher level, meaning authority can implicitly be delegated over the domains. The name system is a distributed architecture, where each entity is responsible for the management of its domain name. Therefore, there is no organisation with responsibility for the management of all domain names.
The servers relating to the top level domains (TLD) are called "**root name servers**". There are 13 of them, distributed around the planet with the names "a.root-servers.net" to "m.root-servers.net".
A domain name server defines a zone, i.e. a collection of domains over which the server has authority. The *domain name* system is transparent for the user, nevertheless, the following points must be remembered:

- Each computer must be configured with the address of a machine capable of transforming any name into an IP address. This machine is called the Domain Name Server. Don't panic: when you connect to the Internet, the service provider will automatically change your network parameters to make these domain name servers available to you.
- The IP address of a second *Domain Name Server* (secondary Domain Name Server) must also be defined: the secondary domain name server can take over from the primary domain name server in the event of malfunction.

The most commonly used server is called **BIND** (*Berkeley Internet Name Domain*). This is free software available under UNIX systems, initially developed by the University of Berkeley in California and now maintained by *ISC* (*Internet Systems Consortium*).

Domain name resolution

The consistent mechanism for finding the IP address relating to a host name is called "**domain name resolution**". The application making it possible to conduct this operation (generally integrated in the operating system is called "**resolving**".
When an application wants to connect to a known host by its domain name (e.g. "www.commentcamarche.net"), it interrogates a domain name server defined in its network configuration. In fact, each machine connected to the network has the IP addresses of its service provider's two domain name servers in its configuration.
A request is then sent to the first domain name server (called the "primary domain name server"). If this domain name server has the record in its cache, it sends it to the application, if not, it interrogates a root server (in our case a server relating to the TLD ".net"). The root name server sends a list of domain name servers with authority over the domain (in this case, the IP addresses of the primary and secondary domain name servers for *commentcamarche.net*).
The primary domain name server with authority over the domain will then be interrogated and will return the corresponding record to the domain host (in our case *www*).



Record types

A DNS is a distributed database containing records known as **RR** (*Resource Records*), relating to domain names. They alone are concerned with reading the information after the people responsible for the administration of a domain, the operation of domain name servers being totally transparent to users.
Because of the cache system enabling the DNS system to be distributed, the records for each domain have a lifetime known as **TTL** (*Time to Live*) enabling the intermediary servers to know the information's expiry date and therefore know if it is necessary to verify it or not.

Generally, a DNS record contains the following information:

Domain name (FQDN)	TTL	Type	Class	RData
www.commentcamarche.net.	3600	A	IN	163.5.255.85

- **Domain name**: the domain name must be a FQDN name, i.e. must end in a dot. If the dot is missing, the domain name is relative, that is the principal domain name will suffix the entered domain;
- **Type**: a value out of 16 bits specifying the type of resource described by the record. The resource type may be one of the following:
- **A**: this is a base type establishing the correspondence between the canonical name and an IP address. Moreover, there can be several A records relating to different network machines (servers).
- **CNAME** (*Canonical Name*): this enables an alias to be linked to the canonical name. It is particularly useful for supplying alternative names relating to different services on the same machine.
- **HINFO**: this is solely a descriptive field allowing the description in particular of the host's hardware (CPU) and operating system (OS). You are generally advised not to complete it in order to avoid supplying information which can be useful to computer pirates.
- **MX** (*Mail eXchange*): relates to the email server. When a user sends an email to an address (user@domain), the outgoing mail server interrogates the domain name server with authority over the domain in order to obtain the MX record. There can be several MX records per domain, in order to supply a repetition in the event of the breakdown of the principal email server. So, the MX record allows a priority with a value between 0 and 65,535 to be defined:

```
www.commentcamarche.net.                IN MX 10
mail.commentcamarche.net.
```

- **NS**: relates to the domain name server with authority over the domain.
- **PTR**: a pointer towards another part of the domain namespace.
- **SOA** (*Start Of Authority*): the SOA field allows the description of the domain name server with authority over the zone, as well as the email address of the technical contact (where the "@" character is replaced by a dot).
- **Class**: the class can either be **IN** (relating to internet protocols, so this is the system used in our case), or **CH** (for the chaotic system);
- **RDATA**: this is the data relating to the record. Here is the expected information according to the record type:
- A: a 32 bit IP address;
- CNAME: a domain name;
- MX: a priority 16 bit value, followed by the host name;
- NS: a host name;
- PTR: a domain name;

- SOA: several fields.

Top level domains

There are two categories of **TLD** (*Top Level Domains*):

- Domains known as "generic", called **gTLD** (*generic TLD*). gTLDs are top level generic domain names offering a classification according to the sector of activity. So each gTLD has its own access rules:
- historic gTLD:
- **.arpa** relates to machines from the original network;
- **.com** initially related to companies with a commercial purpose. However, this TLD became the "default TLD" and the purchase of domains with this extension is possible, including by individuals.
- **.edu** relates to educational organisations;
- **.gov** relates to governmental organisations;
- **.int** relates to international organisations;
- **.edu** relates to military organisations;
- **.net** initially related to organisations dealing with the networks. Over several years this TLD has become a common TLD. The purchase of domains with this extension is possible, including by individuals.
- **.org** usually relate to not for profit organisations.
- new gTLD introduced in November 2000 by ICANN:
- **.aero** relates to the aeronautical industry;
- **.biz** (*business*) relating to commercial companies;
- **.museum** relating to museums;
- **.name** relating to the name of people or imaginary people;
- **.info** relates to organisations dealing with information;
- **.coop** relating to cooperatives;
- **.pro** relating to liberal professions.
- special gTLD:
- **.arpa** relates to the network management infrastructures. The arpa gTLD also serve for the inverse resolution of network machines, enabling the name relating to an IP address to be found.
- Domains known as "national", called **ccTLD** (country code TLD). The ccTLD relate to the different countries and their names relate to the country name abbreviations defined by the ISO 3166 standard. The table below summarises the list of ccTLD.

Code	Country
AC	Ascension Islands
AD	Andorra
AE	United Arab Emirates
AF	Afghanistan
AG	Antigua and Barbuda
AI	Anguilla
AL	Albania
AM	Armenia
AN	Netherlands Antilles
AO	Angola
AQ	Antarctica
AR	Argentina
AS	American Samoa
AT	Austria
AU	Australia
AW	Aruba
AZ	Azerbaijan
BA	Bosnia-Herzegovina
BB	Barbados
BD	Bangladesh
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BH	Bahrain

BI	Burundi
BJ	Benin
BM	Bermuda
BN	Brunei
BO	Bolivia
BR	Brazil
BS	Bahamas
BT	Bhutan
BV	Bouvet Island
BW	Botswana
BY	Belorussia
BZ	Belize
CA	Canada
CC	Cocos Islands
CD	Democratic Republic of Congo
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Ivory Coast
CK	Cook Islands
CL	Chile
CM	Cameroon
CN	China
CO	Columbia
COM	Commercial organisation

CR	Costa Rica
CU	Cuba
CV	Cape Verde
CX	Christmas Island
CY	Cyprus
CZ	Czech Republic
DE	Germany
DJ	Djibouti
DK	Denmark
DM	Dominique
DO	Dominican Republic
DZ	Algeria
EC	Ecuador
EDU	Organisation with educational links
EE	Estonia
EG	Egypt
EH	Western Sahara
ER	Eritrea
ES	Spain
ET	Ethiopia
EU	Europe
FI	Finland
FJ	Fiji
FK	Falkland Islands (Malvinas)
FM	Micronesia

FO	Faeroe Islands
FR	France
FX	France (European Territory)
GA	Gabon
GB	Great Britain
GD	Grenada
GE	Georgia
GF	French Guyana
GG	Guernsey
GH	Ghana
GI	Gibraltar
GL	Greenland
GM	Gambia
GN	Guinea
GOV	Government organisation
GP	Guadeloupe
GQ	Equatorial Guinea
GR	Greece
GS	South Georgia
GT	Guatemala
GU	Guam (USA)
GW	Guinea Bissau
GY	Guyana
HK	Hong Kong
HM	Heard and McDonald Islands

HN	Honduras
HR	Croatia
HT	Haiti
HU	Hungary
ID	Indonesia
IE	Ireland
IL	Israel
IM	Isle of Man
IN	India
IO	British Indian Ocean Territory
IQ	Iraq
IR	Iran
IS	Iceland
IT	Italy
JM	Jamaica
JO	Jordan
JP	Japan
KE	Kenya
KG	Kyrgyzstan
KH	Cambodia
KI	Kiribati
KM	Comoros
KN	Saint Kitts and Nevis
KP	North Korea
KR	South Korea

KW	Kuwait
KY	Cayman Islands
KZ	Kazakhstan
LA	Laos
LB	Lebanon
LC	Saint Lucia
LI	Liechtenstein
LK	Sri Lanka
LR	Liberia
LS	Lesotho
LT	Lithuania
LU	Luxembourg
LV	Latvia
LY	Libya
MA	Morocco
MC	Monaco
MD	Moldova
MG	Madagascar
MH	Marshall Islands
MK	Macedonia
ML	Mali
MIL	Military organisation
MM	Myanmar
MN	Mongolia
MO	Macau

MP	Northern Mariana Islands
MQ	Martinique
MR	Mauritania
MS	Montserrat
MU	Maurice Island
MV	Maldives
MW	Malawi
MX	Mexico
MY	Malaysia
MZ	Mozambique
NA	Namibia
NC	New Caledonia
NE	Niger
NET	Organisation with Internet links
NF	Norfolk Islands
NG	Nigeria
NI	Nicaragua
NL	The Netherlands
NO	Norway
NP	Nepal
NR	Nauru
NT	Neutral Zone
NU	Niue
NZ	New Zealand
OM	Oman

ORG	Non referenced organisation
PA	Panama
PE	Peru
PF	French Polynesia
PG	Papua New Guinea
PH	Philippines
PK	Pakistan
PL	Poland
PM	Saint-Pierre and Miquelon
PN	Pitcairn
PR	Puerto Rico (USA)
PS	Palestinian Territories
PT	Portugal
PY	Paraguay
PW	Palau
QA	Qatar
RE	Réunion
RO	Romania
RU	Russian Federation
RW	Rwanda
SA	Saudi Arabia
SB	Solomon Islands
SC	Seychelles
SD	Sudan
SE	Sweden

SG	Singapore
SH	Saint Helena
SI	Slovenia
SJ	Svalbard and Jan Mayen Islands
SK	Slovak Republic
SL	Sierra Leone
SM	San Marin
SN	Senegal
SO	Somalia
SR	Suriname
ST	Sao Tomé and Principe
SU	Soviet Union
SV	El Salvador
SY	Syria
SZ	Swaziland
TC	Turks and Caicos Islands
TD	Chad
TF	French Austral Territories
TG	Togo
TH	Thailand
TJ	Tajikistan
TK	Tokelau
TM	Turkmenistan
TN	Tunisia
TO	Tonga

TP	East Timor
TR	Turkey
TT	Trinidad and Tobago
TV	Tuvalu
TW	Taiwan
TZ	Tanzania
UA	Ukraine
UG	Uganda
UK	United Kingdom
UM	US Minor Outlying Islands
US	United States
UY	Uruguay
UZ	Uzbekistan
VA	Vatican City
VC	Saint-Vincent and the Grenadines
VE	Venezuela
VG	British Virgin Islands
VI	American Virgin Islands
VN	Vietnam
VU	Vanuatu
WF	Wallis and Futuna
WS	Western Samoa
YE	Yemen
YT	Mayotte
YU	Yugoslavia

ZA	South Africa
ZM	Zambia
ZR	Zaire
ZW	Zimbabwe