CS50

DNS and DHCP

Overview

There are two important systems in place to make sure that devices on the Internet use IP addresses effectively. The first is the Domain Name System, or **DNS**, which is responsible for converting the words that are typed into an address bar in a web browser like Google Chrome or Safari into the corresponding IP address. The second is the Dynamic Host Configuration Protocol, or **DHCP**, which helps assign each device an IP address.

Key Terms

- DNS
- DHCP
- URL
- domain

DNS

Most people browsing the Internet don't type an IP address in when they want to access a web page. Instead, they type in a **URL**, a Uniform Resource Locator, which acts as a more human-readable and memorable web address than an IP address.

However, IP still requires the computer to know which IP address it is trying to access. This is where DNS comes in. DNS is responsible for taking the **domain**, which is just an identifier like "google.com" or "facebook.com", and translating it into its respective IP address(es).

When a user types a URL into a web browser, the computer contacts a DNS server, which stores information about which domain names map to which IP addresses. There are many DNS servers, and not all of them will updated at the same time when the mappings between domain names and their IP addresses are changed. As a result, and because it takes time for these changes in the DNS system to propagate throughout all of the DNS servers on the Internet, DNS servers must always communicate with one another about these updates.

DNS Hierarchy

Domains in DNS are organized in a tree-like hierarchy. There are a set of basic "top-level domains" (TLDs), which appear at the ends of many familiar websites. Two hierarchies exist at this level: organizational and geographic. Amongst the top-level organizational domains are com, edu, gov, net, org, among others. The geographic domains are two-letter country codes (such as uk, es, fr, ar).

Website URLs must branch off from one of these top-level domains. For instance, "google.com" branches off of the "com" top-level domain. And "google.co.uk" branches off both the "com" organizational domain and the "uk" geographic domain. Some websites, like "images.google.com" and "maps.google.com", branch even further and are known as subdomains.

DHCP

Computers, and the humans that use them, need a system for allocating these IP addresses. At one point in the Internet's history, a human network administrator was responsible for this, assigning IP addresses to computers manually. Nowadays, the Dynamic Host Configuration Protocol, or DHCP, can do this automatically. When computers connect to a network, they will connect to a DHCP server. The DHCP server then accesses a pool of available IP addresses and assigns each computer on the network a unique one.

So, using DHCP and DNS, devices on the Internet are able to receive their own IP address and determine which IP address corresponds to the website that a user is trying to visit. These systems are crucial, allowing the Internet Protocol to effectively facilitate communication across the Internet.