2 IP Addresses and DNS

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IP addresses

For computers to be accessible within a network, they need a unique address. This address is known as an IP address (Internet Protocol Address). For around two decades now, – there has been a gradual transition from the IPv4 system to IPv6. IPv4 addresses are 32-bit addresses represented in four octets (e.g. 192.0.2.1). This results in 2^{32} possible addresses, which is slightly more than 4.29 billion. This demonstrates the limited nature of IPv4 addresses. This limitation led to the development of IPv6. IPv6 addresses are 128 bits long. They are displayed in hexadecimal notation, with eight groups of four hexadecimal digits (e.g. 2001:0db8:85a3:0000:0000:8a2e:370:7334). The length of 128 bits allows for 2^{128} addresses, which in decimal notation corresponds to 3.4×10^{38}, a number with 39 digits. There would be approximately $6.7 \cdot 10^{23}$ IPv6 addresses per square metre of the Earth's surface - that is roughly one Avogadro number per square metre.

DNS Lookup

People find it difficult to remember IP addresses. Therefore, domain names were introduced, which are easier to remember. An example of a domain name is www.google.com. A possible IP address for Google's domain name is 172.217.168.68; often there are several IP addresses for a domain name. The Domain Name System (DNS) is responsible for 'translating' a domain name into an IP address.

How it works

1. **Request:** When a user visits a website, the browser sends a DNS request to a DNS server to determine the IP address of the desired domain.
2. **Resolution:** The DNS server checks its cache for an existing assignment. If no assignment is found, the server forwards the request to

other DNS servers until the IP address is determined.
3. **Response:** The DNS server sends the IP address it found back to the browser, which can then connect to the website.

Types of DNS records

- **A record:** Links a domain name to an IPv4 address.
- **AAAA record:** Links a domain name to an IPv6 address.
- **CNAME record:** Alias for another domain name.
- **MX record:** Specifies the mail server for a domain.

Significance

The domain name is crucial for the user-friendliness of the Internet, as it allows websites to be accessed via easy-to-remember names instead of numerical IP addresses. Without DNS, users would have to know the IP addresses of all the websites they want to visit.