

Computer Networking – Simple Web Page Request

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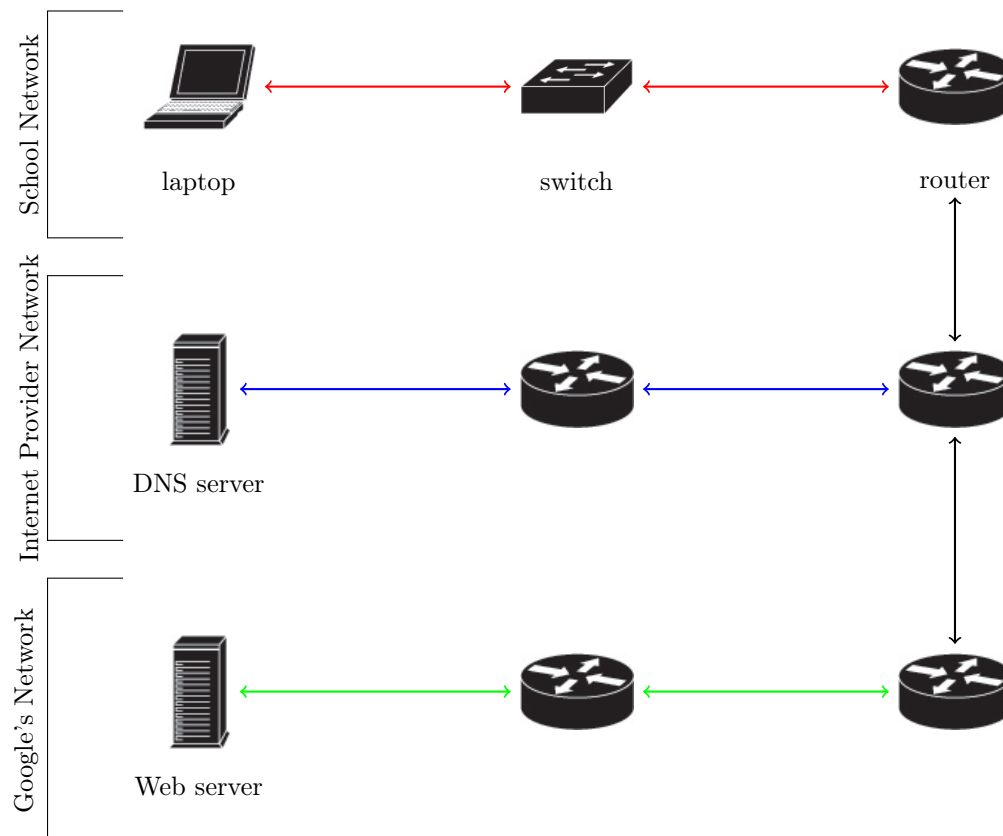
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1 Connecting to the Internet

Connecting your laptop to the internet and loading a webpage is a 4 steps process^{1 2} :

1. Get an IP address.
2. Get the MAC address of the gateway.
3. Get the IP address behind the domain name.
4. Get the webpage (e.g. `www.google.com`).

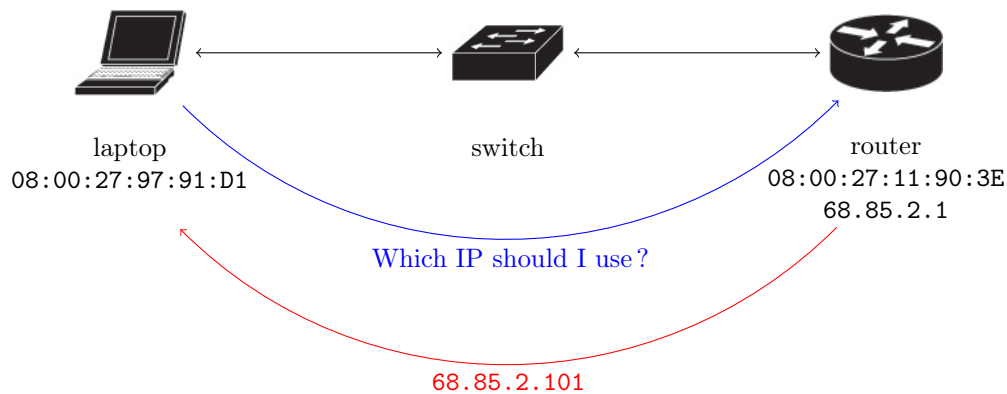
2 Topology of the Network



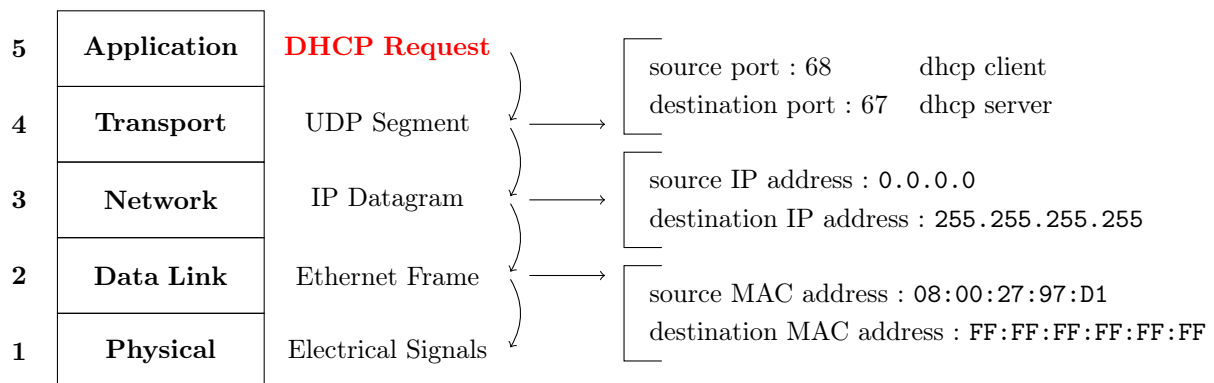
1. Reference : Computer Networking A Top-Down Approach 6th Edition, by Kurose & Ross.

2. The icons come from <https://www.cisco.com/c/en/us/about/brand-center/network-topology-icons.html>.

3 Get an IP Address

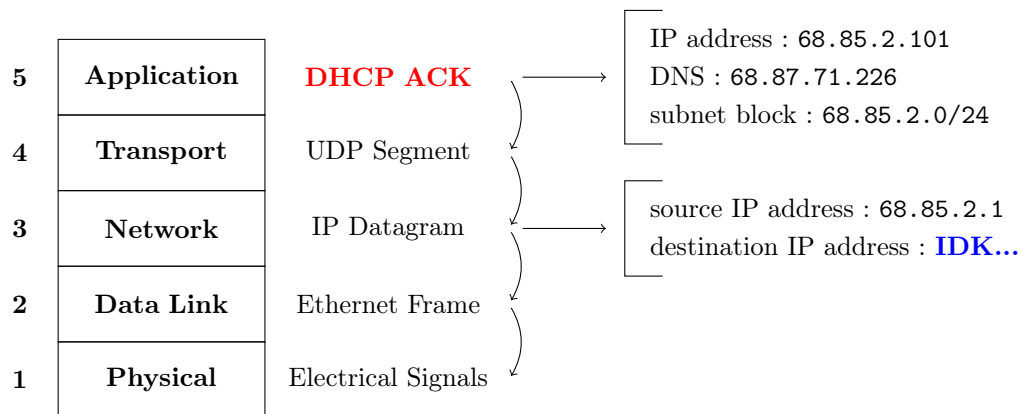


We connect our laptop to the school's network with an Ethernet cable. In order to communicate over the internet, we have to get an IP address. This is done with the DHCP protocol.



Process :

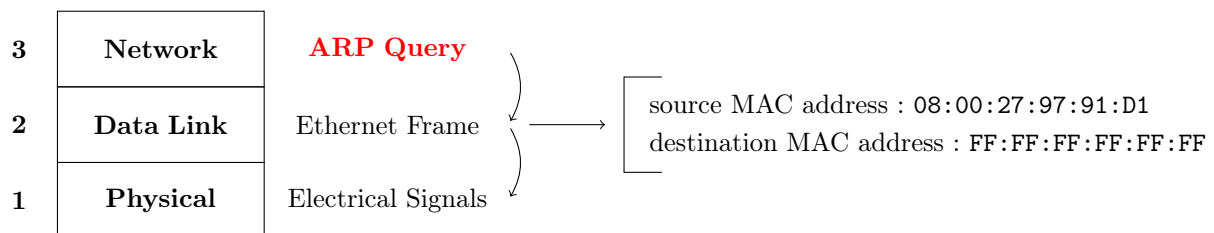
- The **laptop**'s OS creates a **DHCP Request** which is put inside a **UDP Segment**, which is put inside an **IP Datagram**, which is put inside an **Ethernet Frame**, which is transformed into electrical signals and sent over the cable.
- The **switch** receives the ethernet frame, which has a broadcast destination address (FF:FF:FF:FF:FF:FF), and transmits it on all ongoing ports, including the port connected to the router.
- The **router** receives the ethernet frame.
 - since the destination address of the internet frame is a broadcast (FF:FF:FF:FF:FF:FF), it extracts the IP datagram
 - since the IP datagram has a broadcast destination address (255.255.255.255), it demultiplexes the UDP segment
 - since the destination port is 67, the router opens a DHCP process and reads the DHCP Request message
- The **router** sends back a response :
 - the DHCP server creates a **DHCP ACK message** that contains the IP addresses of the laptop, the DNS, the default gateway and the subnet block (or the netmask)
 - the DHCP message is put inside a UDP segment, which is put inside an IP datagram, which is put inside an Ethernet frame.



5. The **switch** receives the ethernet frame. It reads the destination address (08:00:27:97:91:D1) and sends it to the corresponding laptop because it *learned* on which port this interface is connected.
6. The **laptop** receives the ethernet frame.
 - (a) it extracts the IP datagram, the UDP segment and, finally, the DHCP ACK message
 - (b) it stores its IP address as well as the DNS's IP address
 - (c) it installs the IP address of the default gateway into its *IP forwarding table*.

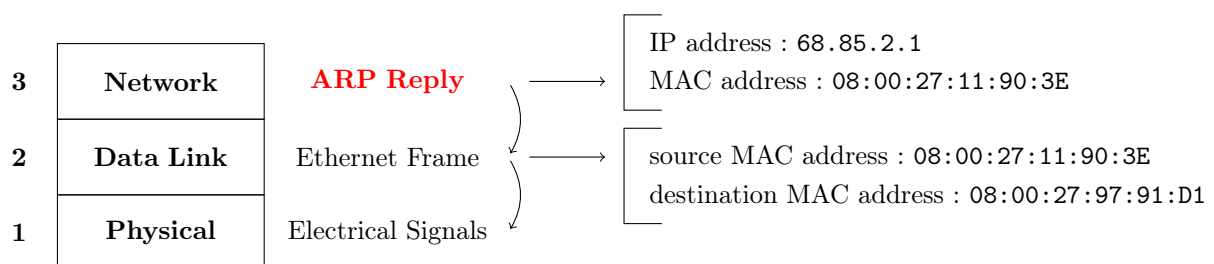
4 Get the MAC Address of the Gateway

The laptop can't access the internet if it can't send an ethernet frame to the gateway. That's why the next step is to get its the MAC address.



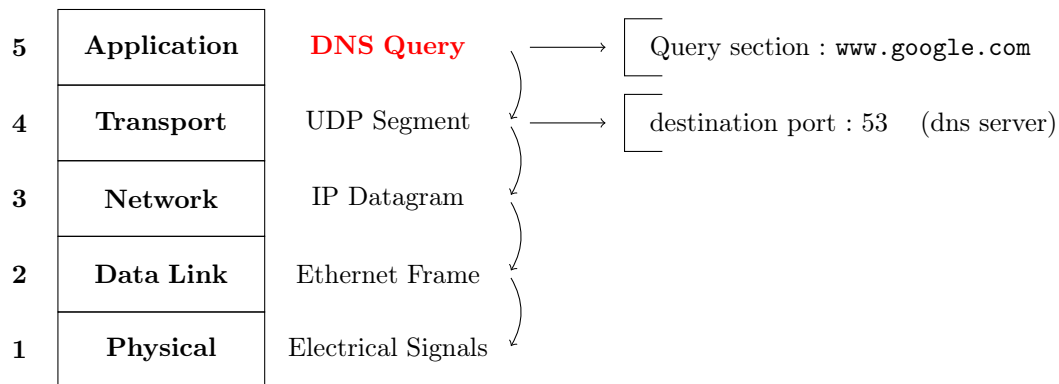
Process :

1. The **laptop** creates an **ARP Query**, put it inside an **Ethernet Frame**, sends it to the **switch**. Since this is a broadcast destination address (FF:FF:FF:FF:FF:FF), it transmits it on all ongoing ports.
2. The **router** (= gateway) receives the ethernet frame, extracts the ARP Query and see that the IP address in the query is the same as its interface's address.
3. The **router** sends back a response :
 - (a) it creates an **ARP Reply** indicating that the MAC address corresponding to : 68.85.2.1, is : 08:00:27:11:90:3E
 - (b) the ARP reply is put inside an ethernet frame and sent over to the **switch**, which sends it to the **laptop**.



5 Find the IP Address of the Website

The user of the laptop wants to get on the website : `www.google.com`. But the computer needs an IP address. In order to translate the domain name to an IP address, it will contact the DNS.



Note that the destination IP address is that of the DNS server **but** the destination MAC address of the Ethernet frame is that of the gateway.

1. The **router** receives the ethernet frame. It extracts the IP datagram, checks its forwarding table and decide to send it over to the internet provider's network. **Note** : the data link's frame is changed, even the protocol used could different.
2. The **internet provider's router** receives the frame, extracts the IP datagram and decide to send it over to the DNS server from its forwarding table.
3. The **DNS server** receives the IP datagram and extracts the DNS query message and it sends back the **DNS reply** with the IP address of `google.com` : `64.233.169.105`.
4. The **laptop** finally receives the IP address of the server of `google.com`.

6 Get the Website's Page

The protocol used to get the website's page is **HTTP** and it's located on the application layer. **But** we can't just send the **HTTP GET** message directly. Firstly, we have to open a **TCP** (transport layer) connection with a three-way handshake.

In the end, Google's server will send the **HTTP response** and the laptop's browser will display the webpage.