# Internet Technology

It used to be called the "Information Superhighway", and in one sense the analogy is accurate. In the same way that interstate highways connect the local roads of different communities with each other, the Internet connects different local area networks, or LANs, with each other. That's the origin of its name: it's the 'Inter' network.

If you work at a company or go to school, then there is probably a LAN for your organization. If you subscribe to an Internet Service Provider, or ISP, that in a sense is also a LAN, which is then connected to other LANs through fiber optic cables and switches which direct and regulate traffic. This is the essence of the Internet, and what enables computers, digital devices and servers all around the world to communicate with each other.

For the universal connectivity that the Internet provides, there have to be a number of components, both hardware and software, that work together, and some agreed-upon protocols, such as domain names and addresses, and common interfaces for different types of software to share information.

### Internet Map

This is a graphical representation of all the physical connections that make up the Internet:  In effect, an attempt to make a map of the Internet.
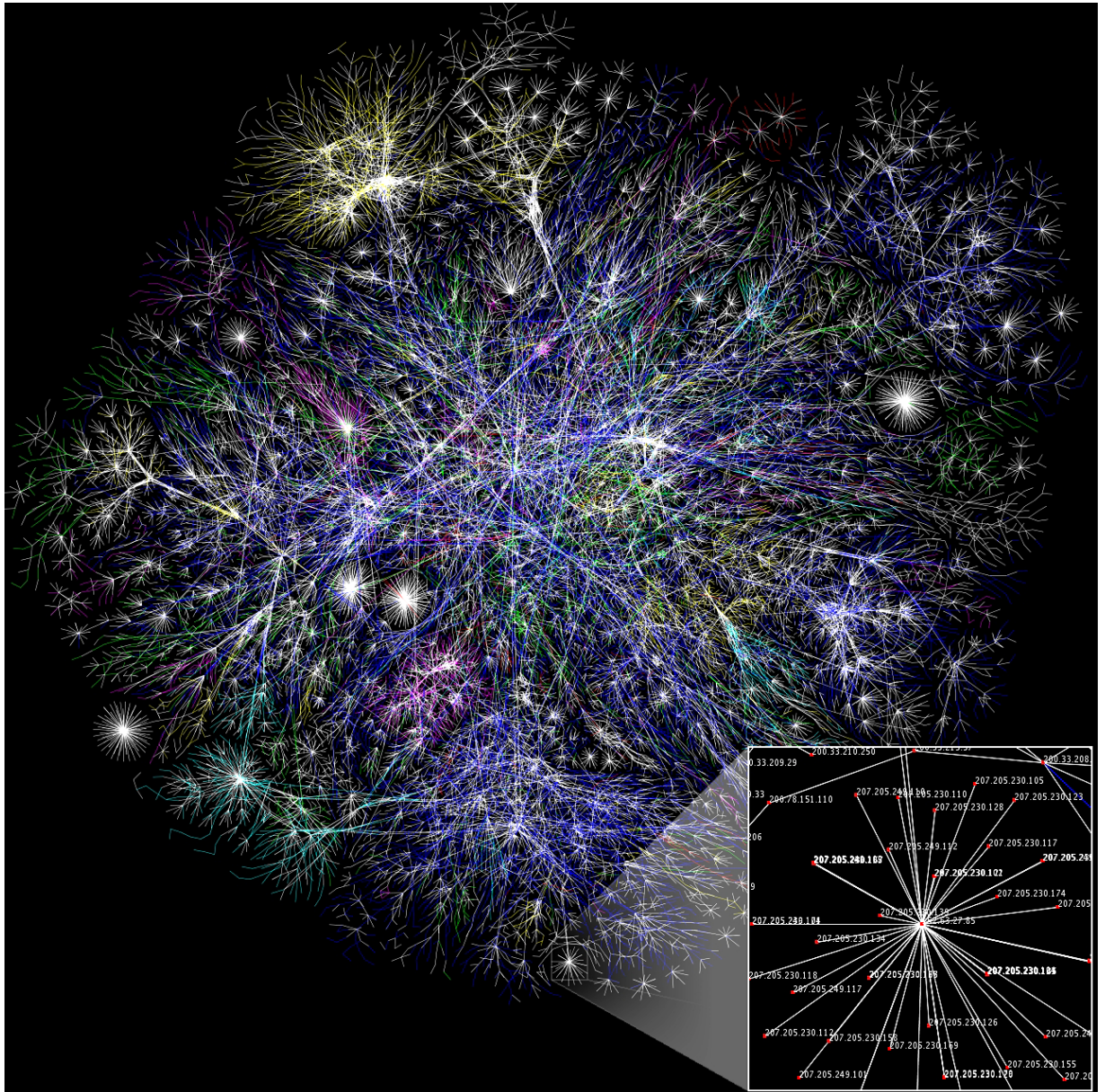


Source: http://en.wikipedia.org/wiki/Network_mapping

Wikimedia Commons

# Connecting to the Internet

Accessing a website that stores data, such as Google, requires a series of hardware connections to that company's servers, and several types of software that need to work together.

## HARDWARE

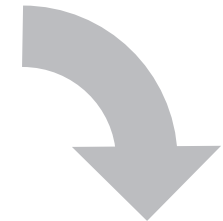**User doing a Google search**

### 1. Connections

- Wireless Network–4G or 5G
- Internet Over Satellite

- T1: High-speed data circuit
- Cable: On cable TV lines
- DSL: On phone lines
- ISDN: On fiber-optic phone lines
- Analog: Dial-up connection

### 2. ISP

Internet Service Provider: Comcast, Verizon or ATT, for example. They provide the gateway to the Internet.

### 3. Internet

Network of fiber-optic cables, switches, local area networks and servers.

**Google server**

## SOFTWARE

There are three tiers to access the information stored in Google's servers.

These three parts are sometimes referred to as the **Stack**: Presentation is called **Views**, application is the **Controller**, and storage is the **Model**.

### 6. Presentation

**Web browsers**
Software that interprets and displays HTML documents:

**Firefox, Google Chrome, Safari, Opera, Microsoft Edge**

### 5. Application

The software that retrieves and packages the data in the user's search request. Common applications:

**PHP** (Hypertext PreProcessor), **ASP, Ruby on Rails, Perl, Python, Django**

### 4. Storage

The databases that hold information.
Relational database management systems:

**MySQL** (My Structured Query Language)**, Oracle, DB2**

Google has thousands of servers located in data centers at different locations in the US and around the world.

## Google Data Center

Google publicly lists 14 data centers in the US and nine more around the world. Combined, they hold thousands of servers and consume roughly 1.5 percent of all the electricity generated in the world. Because the servers generate heat, the centers have to be refrigerated.



A server room in Council Bluffs, Iowa.                                    Google/Connie Zhou

Source: https://www.google.com/about/datacenters/locations

# Fiber optic cables
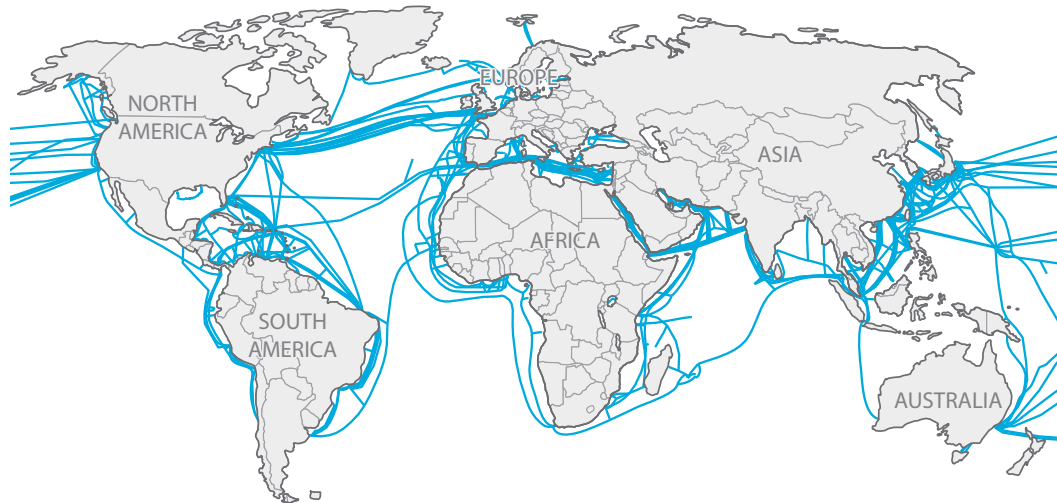
## How fiber optic cables work

Fiber optic cables are how most Internet traffic is carried. The cable's core is made of a clear material through which light, that is, electromagnetic energy, can travel virtually unimpeded. This electromagnetic energy can carry encoded digital information the same way as if it were transmitted over a copper wire. But compared to copper it's much faster, traveling at about two-thirds the absolute speed of light. It's also more reliable in certain ways, for example, it doesn't heat up as copper wires do, and it's not susceptible to interference such as from magnetic fields.

The outer layer, called the cladding, has a higher refractive index than the core. This causes light beams to reflect off the cladding and stay inside the core.

Individual fibers range in diameter from 0.25 mm to 3 mm.

FIBER CROSS SECTION

Core

Cladding
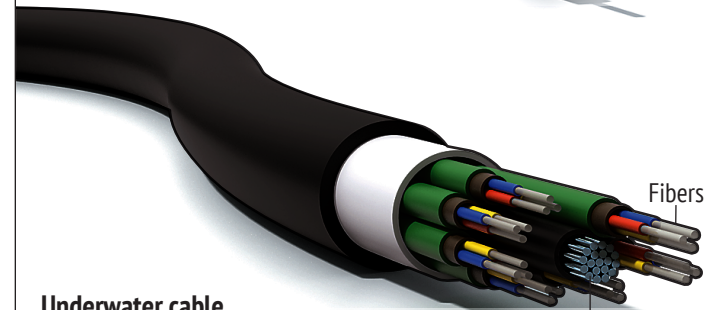
Light signal
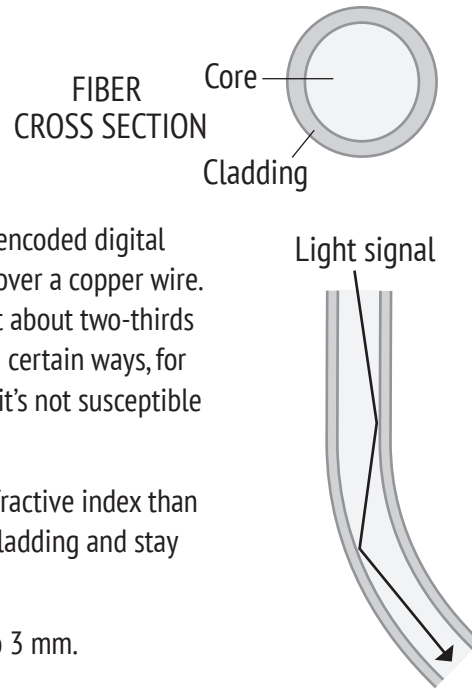
## Underwater fiber optic cable lines

NORTH AMERICA

EUROPE

ASIA

AFRICA

SOUTH AMERICA

AUSTRALIA

There are lots of configurations and sizes of cables, with different numbers of fibers.

**Single fiber cable**

Fiber

**Multi-fiber cable**

Fibers

**Underwater cable**

Polyethylene sheath

Steel wires

Mylar tape

Steel wires

Aluminum barrier

Polycarbonate

Copper tube

Petroleum jelly
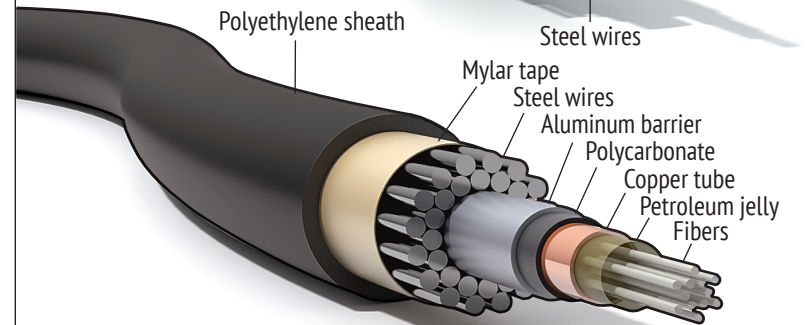
Fibers

**Trans-oceanic** underwater cables are composed of multiple layers of insulating materials and steel to protect the fibers.
Signal boosters called **repeaters** are needed to amplify the signal about every 100 kilometers (~60 miles) along the cable line. These are powered by a DC line in the cable.

Source: A History of Communication Technology, Philip A Loubere. Routledge 2021

# Common Terms

## INTERNET

**HTML/XHTML** (*HyperText Markup Language, Extensible HyperText Markup Language*): Display language. Web browsers translate it into web pages.

**XML** (*Extensible Markup Language*): A set of rules for writing markup languages and encoding digital documents. XHTML and RSS are examples of XML-based languages. Other applications such as Microsoft Office and Apple Pages also follow XML rules.

**CSS** (*Cascading Style Sheet*): Formatting language that applies appearance, position and some interactivity to HTML elements.

**Hypertext**: Link in an HTML document to another document or website, or to another part of a web page.

**Javascript** (*JS*)**:** Scripting language, originally created by Netscape, for interactive or animated page elements. Not the same as Java.

**jQuery:** A library of Javascript commands that can be used in an HTML document. It's one of many Javascript libraries available.

**PHP**: (*Hypertext Preprocessor*): Server-side scripting language commonly used on websites. Can be embedded in an HTML document; commonly used to read and write data between a database and a web page.

## HARDWARE

**LAN** (*Local Area Network*): A network within an organization or specific location. The Internet is a network of LANs.

**Server**: A computer specifically designed for data storage on a network to which clients, or users, can connect in order to exchange database information.

**Wifi**: A short-range wireless network, usually in a home or business, that allows devices to connect to a central modem for Internet access. Usual range is less than 300 yards.

## SOFTWARE

**Ajax** (*Asynchronous JavaScript and XML*): Used to create web applications that run on clients' computers. Examples: Flikr, Gmail, Google Maps.

**Java:** Object oriented programming language used to create software applications. This is different from Javascript.

**Applet**: small Java program that downloads to user's computer.

## INTERFACE

**GUI** (*Graphical User Interface*): An operating system such as Mac OS or Windows that provides icons and windows that can be interacted with through the use of a mouse, touchpad or touchscreen.

**Widget**: GUI element such as a button, scrollbar, etc.

## PROTOCOLS

**API** (*Application Programming Interface*): A common set of rules for software programs to work with each other.

**TCP/IP** (*Transmission Control Protocol/Internet Protocol*): Set of protocols that operating systems must obey to access the Internet. It was established in 1983 in order to provide a common set of rules for all Internet traffic.

**URL** (*Uniform Resource Locator*): System for assigning addresses to individual websites. Each site has both an alphabetical and a numerical address.

**DNS** (Domain Name System): This system was established in 1984 to allow URLs to have word names such as Yahoo.com. Previously site addresses were strings of numbers, which are harder to remember.

## DESIGN

**Graceful Degradation**: A concept for interface design, and more generally for any kind of machine design, in which if a component fails it doesn't cause the entire site or machine to cease functioning.

**Progressive Enhancement**: The complement of Graceful Degradation, this concept is to design a site whose basic functions are accessible on any device or browser, but more advanced functionality becomes available with devices and browsers that support them.