How does the Internet work?

What is Internet?

Internet is a global network of computers connected to each other which communicate through a standardized set of protocols. It was a result of another experiment called the ARPANET (Advance Research Project Agency Network), it was a defense Department research project.

Paul Baran (computer network pioneer) was trying to figure out how to build a communication that might actually survive a nuclear attack.

Types of networks: `centralized vs distributed`.

`A DISTRIBUTED PACKET-SWITCHED NETWORK`.

Paul had this idea of breaking messages up into block and sending them as fast as possible in every possible directions through the `mesh network`.

Is anyone in charge of the Internet?

The honest answer is well `nobody` and maybe another answer is `everybody`. But the real answer is that the internet is made up of an incredibly large number of `independently operated networks`. What's interesting about the system is that it's fully distributed. There's no central control that is deciding how packets are routed or where pieces of the network are built or even who interconnects with whom.

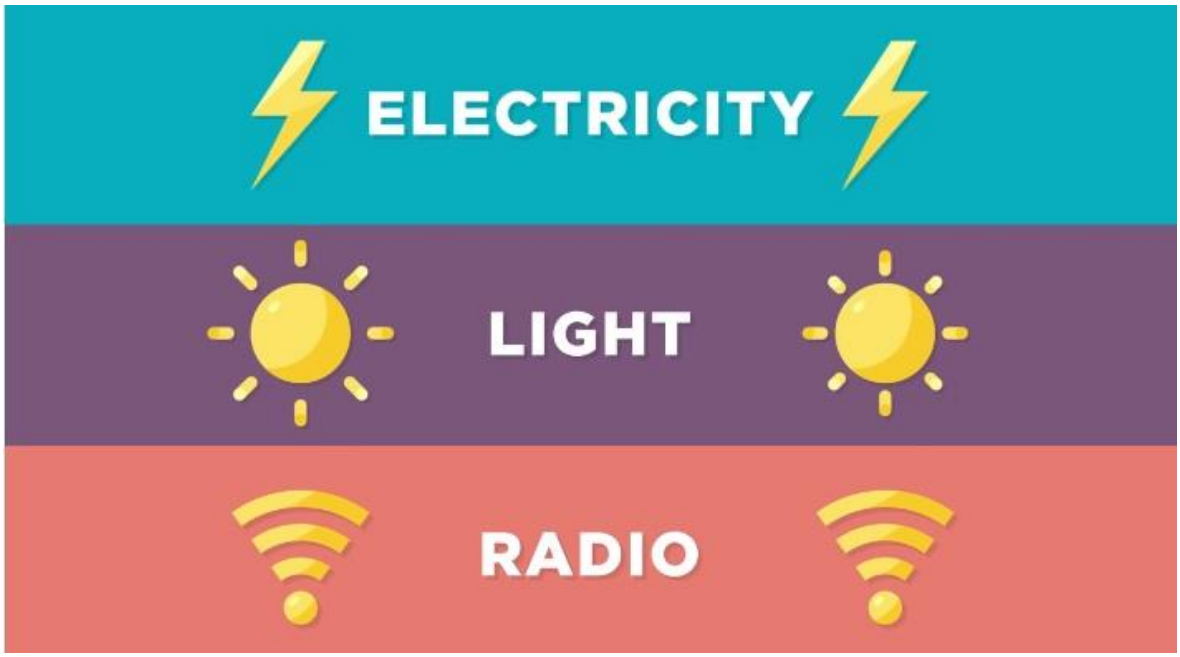
How does the information move on the Internet?

Information on the internet moves from computer to another in the form of `bits`. The medium for this transfer can be wires e.g. ethernet wires you might seen in your homes, it can be transferred in the form of light or fiber optic cables, also we can use wireless mediums.

The internet is a lot like the postal service, but the physical stuff that gets sent is a little bit different. Instead of like boxes and envelopes, the internet ships `binary information`.

Information is made of bits. A bit can be described as `any pair of opposites`, example: “on” or “off”, “yes” or “no”.

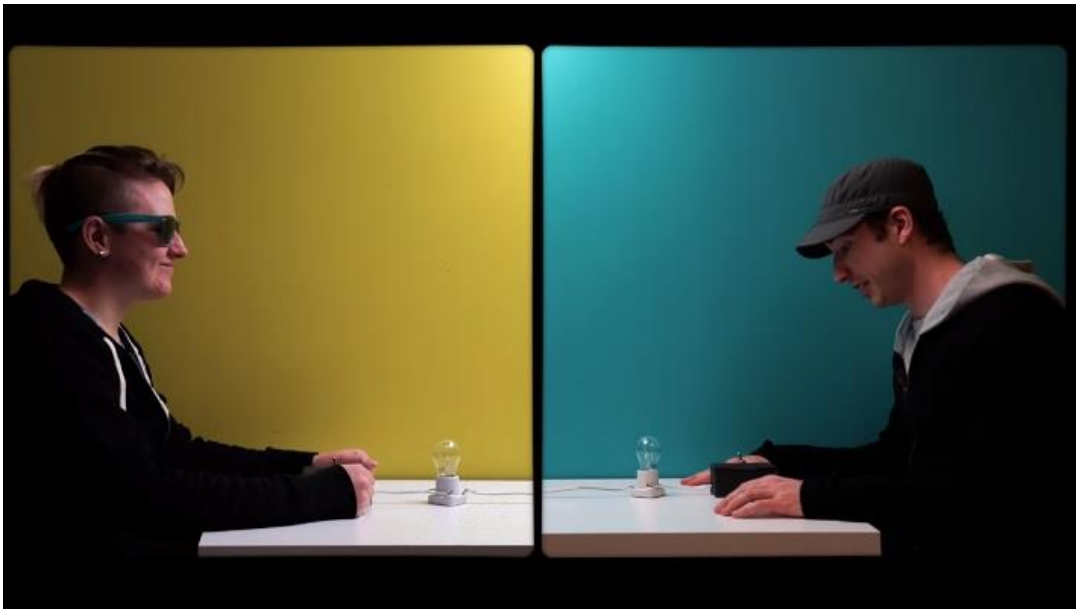
We typically use a `one` meaning “on” or a `zero` meaning “off”. Because a bit has two possible states, we call it `binary code`. 8 bits strung together make 1 byte. 1000 bytes all together is a `kilobyte`. 1000 kilobytes is a `megabyte`.



Today we physically send bits by electricity, light and radio waves.

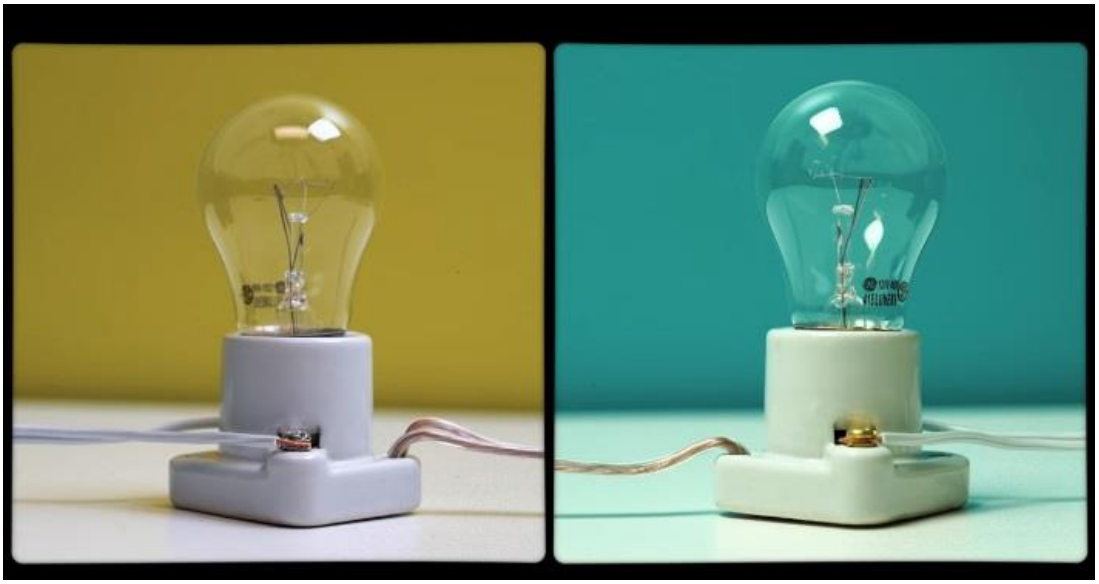
Electricity

To send a bit via electricity, imagine that you have two light bulbs connected by a copper wire.



If one device operator turns on the electricity then the light bulb lights up.

No electricity, no light.



If the operators on both ends agree that light on means `one` and light off means `zero` then we have the system for sending bits.

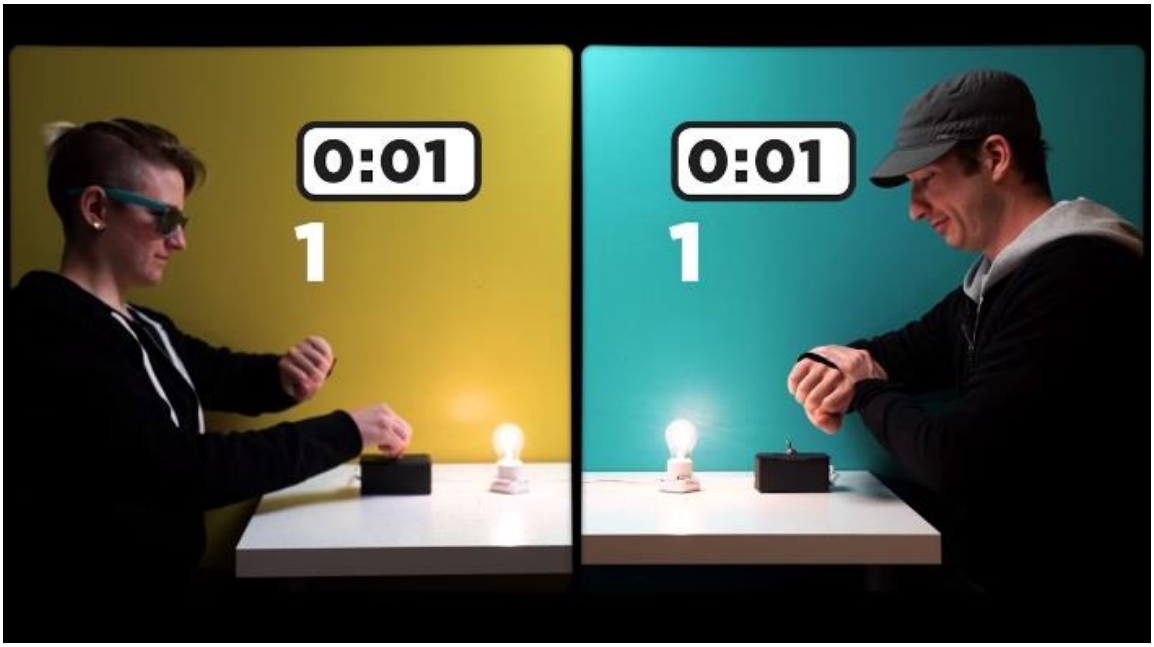
But we have a problem. Let's say that we want to send five zeros in a row. Well how can you do that in such a way that either person can actually count the number of zeros?

The solution is to introduce a clock or a timer.

The operators can agree that the sender will send one bit per second. And the receiver will sit down and record every single second and see

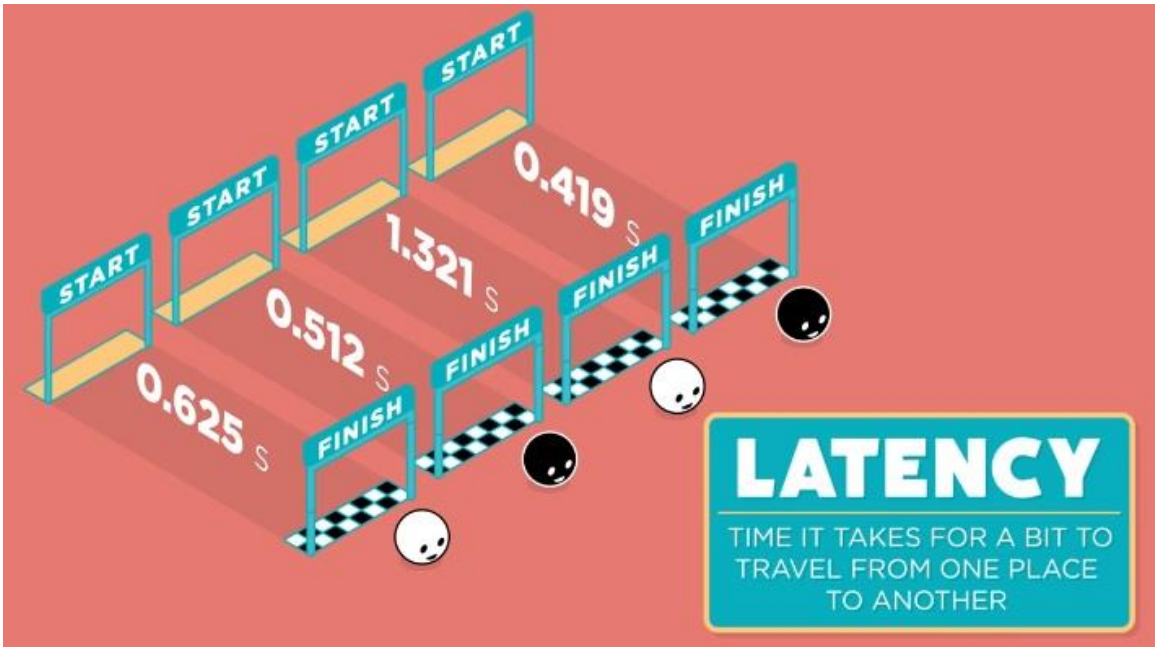
what one the line is. To send five zeros in a row you just turn off the light …wait five seconds, the person on the other end of the line will wrote down all five seconds …say zero zero zero zero zero.

And for ones do the opposite, turn on the light.



Obviously we'd like to send things a little bit faster than one bit per second. So we need to increase our `bandwidth`, the maximum transmission capacity of a device. Bandwidth is measured by `bit rate`, which is the number of bits that we can actually send over a given period of time, usually in seconds.

A different measure of speed is the `latency` (time it takes for a bit to travel from one place to another) or from the source to the requesting device.

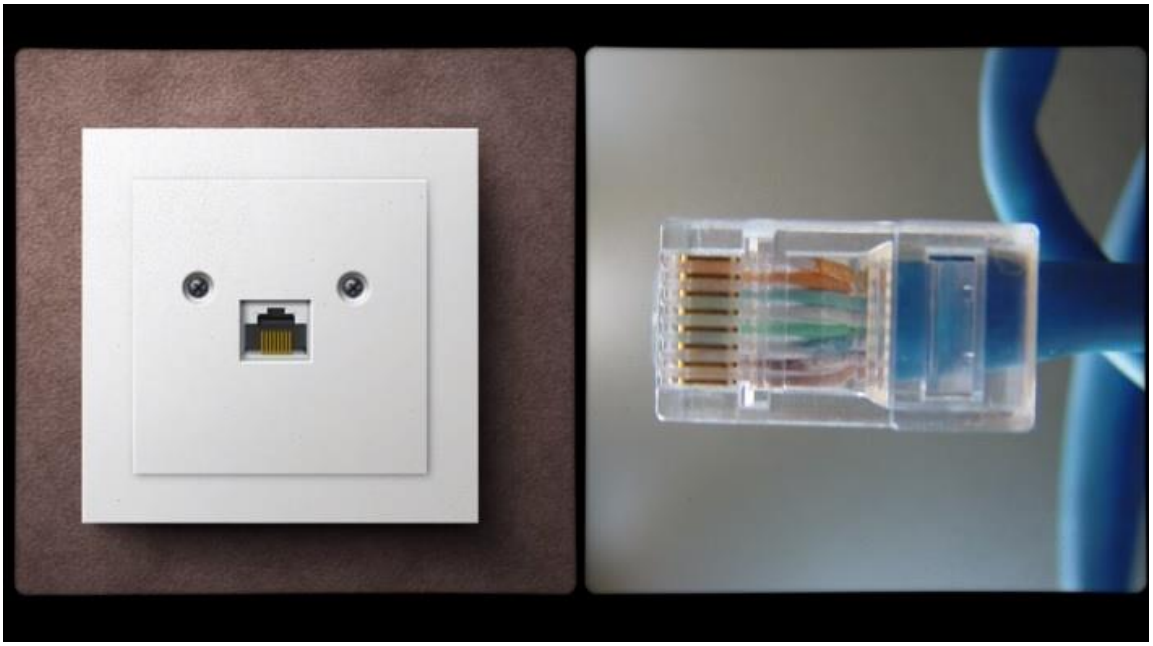


In our human analogy, one bit per second was pretty fast but kind of hard to human to keep up with.

So let's say that you want actually download a 3 megabyte song in like 3 seconds. At 8 million bit per megabyte that means a bit rate of about 8 million bits per second.

Obviously human can't send or receive 8 million bits per second. But a machine can do that just fine.

But now there's also a question of what sort of cable to send these message over? And how far the signals can go?



With an Ethernet wire, the kind that you find in your home or office or school, you see really measurable signal loss over just a few hundred feet.

So if we really want this internet thing to work over the entire world, we need a different way of sending this information really long distances. I mean across an `ocean`.

Light

So what else can we use? What is faster than electricity? The answer is `light`. We can actually send bits as light beams from one place to another using fiber optic cable. A fiber optic cable is a thread of glass engineered to reflect light.

When you send a beam of light down the cable, light bounces up and down the length of the cable until it's received on the other end.

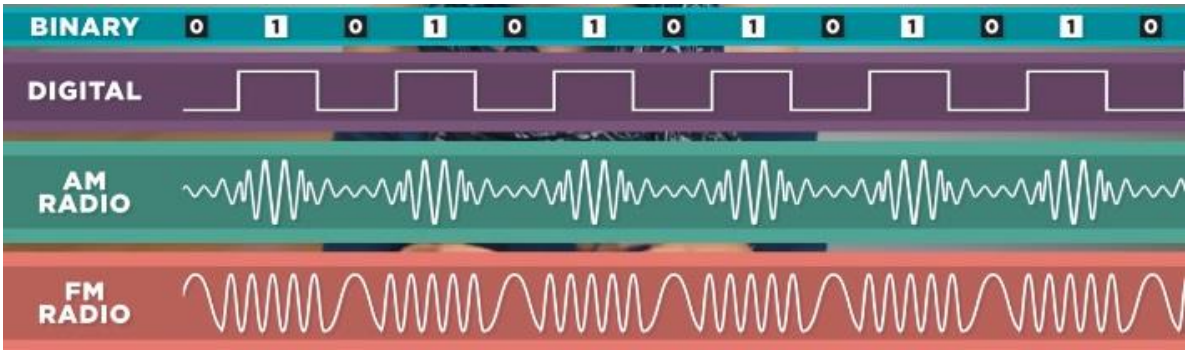
Depending on the bounces angle we can actually send multiple bits simultaneously, all of them travelling at the `speed of light`.

So fiber is really fast, but more importantly the signal doesn't really `degrade` over long distances. This is how you can go hundreds of miles without signal loss and this is why we use fiber optic cables across the ocean floors to connect one continent to another. In 2008 there was a cable that was actually cut near Alexandria, Egypt which really interrupted for most of the Middle East and India. So we take this internet thing for granted but it's really a pretty `fragile physical system`. Fiber is awesome, but it's also really expensive and hard to work with.

Radio

How do we move things without wires? How do we send things wirelessly?

Wireless bit sending machine typically use a radio signal to send bits from one place to another.



The machines have to actually translate the ones and zeros into radio waves different frequencies. The receiving machines reverse the process and convert it back into binary to your computer.

So wireless has made our internet mobile, but a radio signal doesn't travel all that far before it completely gets garbled. This is why you can't really pick up a Los Angeles radio station in Chicago.

METHOD	PRO	CON
ELECTRICITY	CHEAP	SIGNAL LOSS
LIGHT	REALLY FAST NO SIGNAL LOSS	EXPENSIVE HARD TO WORK WITH
RADIO	TOTALLY MOBILE	SHORT RANGE



As great as wireless is, today it still relies on the wired internet. If you're in a coffee shop using Wi-Fi, then the bits get sent through the wireless router and then are transferred to physical wire to travel the really long distances of the internet.

The physical method for sending bits may change in the future. Whether it is lasers sent between satellites or radio waves from balloons or drones. But the underlying binary representation of information and the protocols for sending that information and receiving that information have pretty much the same.

Summary

Everything on the internet whether it's words, emails, images, videos all come down to these `ones` and `zeros` being delivered by electronic pulses, light beams or radio waves.

Source

How does the Internet work?

The internet: Wires, Cable & Wifi