

Hello! This will be your introduction to truly understanding how a VPN works, how one is made, learning about internet security and how to browse the internet more safely regardless if you are using a VPN or not! We already have some great articles that tackle recent and topical issues and concepts that are being talked about frequently these days amongst those in tech and IT. However, those articles may contain some jarring and weird terms that may be new and unheard of to you if you are just a beginner in learning about the greater sphere of networking that VPNs and the internet falls under. Listed below are the topics/sections that are covered in this three part introduction lesson series.

Topics Covered in this three-part Introductory Lesson Series

- [What is a “Network”? And all the Whys, Wheres, and Whos?](#)
- [IP Address, Subnet Mask and Default Gateway](#)
- [MAC Address and NICs](#)
- [Protocols & Ports](#)
- [Firewall](#)
- [LAN, WAN, MAN](#)
- [Ethernet vs Wifi vs Mobile Data](#)
- [Vulnerabilities, Threats and Risks](#)

If some or none of these topics are new to you, then we highly encourage you to continue reading on. If you are a more experienced internet user or work in the IT or tech industry, then we also encourage you to stick around! You might pick up a new nugget of knowledge about some of these topics you may already be familiar with.

Before we jump into the first topic, there are a few assumptions we have made about you as a reader and what you may or may not already know. After all, this is an article series teaching you about navigating and using the Internet, Networks and VPNs which is only a **part** of what goes on in a computer and what it is used for.

Foolish Assumptions I made about you as a Reader:

>>I assume you have used a computer to browse the internet at least once using any form of technological devices such as a smartphone, computer tablet, desktop computer or laptop computer. And that you have used or are aware of the bare essential hardware to use some of these devices such as a computer tower for desktops and keyboard and a mouse for a desktop or laptop.

>>I also assume that you have used one of these computational devices to visit a website. (Using Google, Youtube, Facebook, checking your emails using Yahoo or Gmail etc.)

>>You have an understanding of what “hardware” and “software” is and what the differences are between the two when discussing a computer and other computational devices.

What is a “Network” and the “Internet”? The Whys, Hows, and Wheres?

Network: in its most simple form, a network consists of two or more computers connected to each other by an appropriate transmission medium which allows them to share data.

You might have heard the term “home network” or “office network” be said before by your internet guy or on the news. And these networks are referring to at least 2 computers being connected to each other. And it doesn’t matter if they are connected to each other via a wired ethernet cable (more on that later) or wirelessly by “wifi”. What does matter is that if you have a device (PC, smartphone or laptop) on its own not connected to anything but its power, it is not considered to be in a network until it is connected to an internet router device or another device wirelessly or wired.

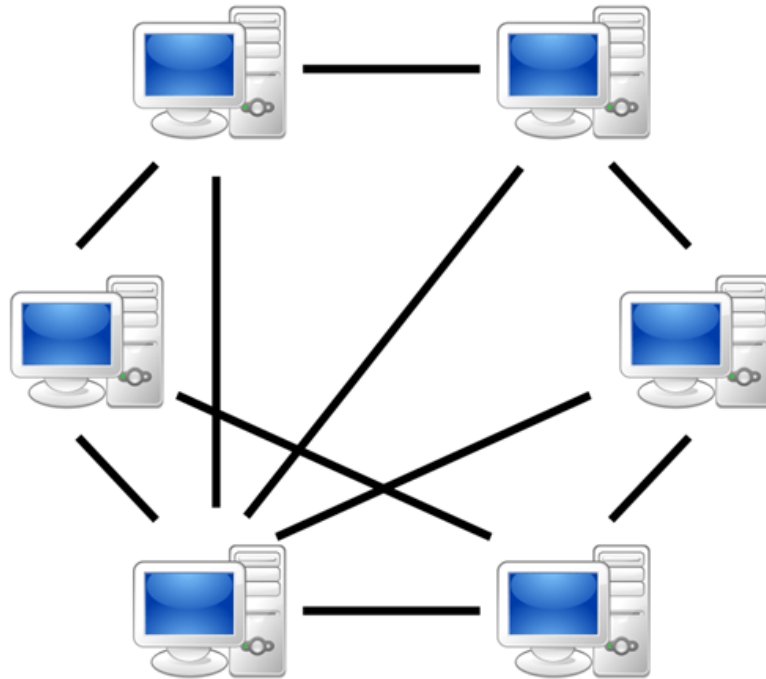


Image source: <https://www.networkstraining.com/peer-to-peer-vs-client-server-network/>

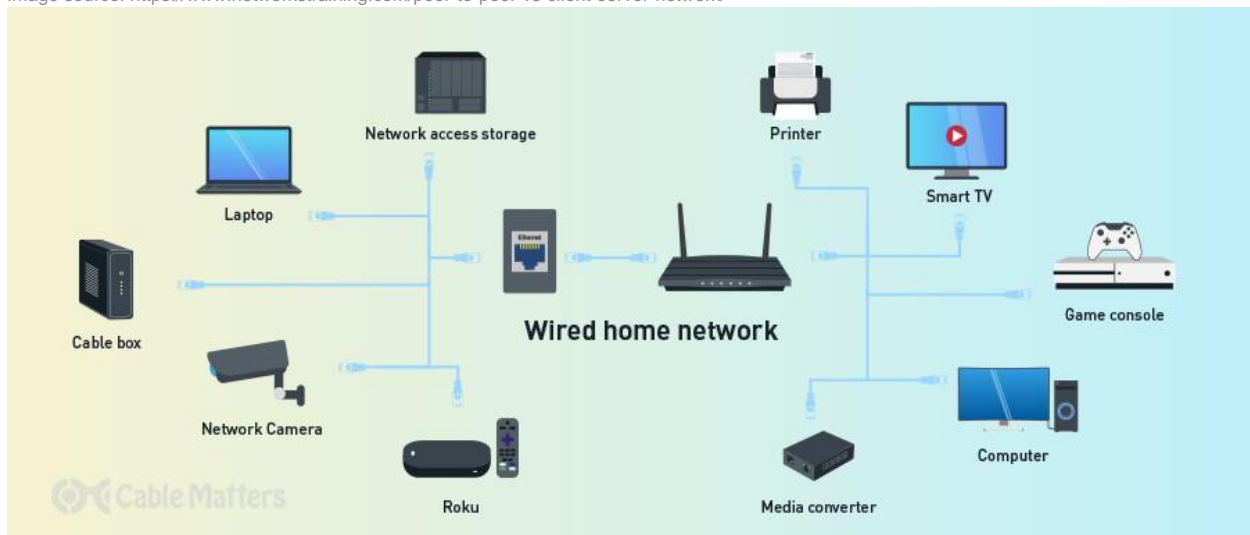


Image source: <https://www.cablematters.com/blog/Networking/set-up-home-network>

Here’s the fun part, you don’t need to have your device to be connected to the internet for it to be in a network. A network can just be two computers connected to each other with an ethernet cable.



Within this small two computer network, you can create documents, pictures and other pieces of files or data and transfer them between each other. This is the basis as to why we need a network: to transfer or access something between each device. But the wired cable can be optional as you can see that everyone is not walking around in public with their laptops and phones with wires being dragged across the ground.

So, if a network can be two or more devices connected to each other for the purpose of transferring data, then what is the Internet and how do we connect to it? The term “Internet” has a longer name of “**Inter**connected **Net**work” which is **a massive array of millions of computers connected to each other transferring data back and forth between themselves**. Think of it like a gargantuan club consisting of millions of members that you want to join. While it’s nice having your home network consist of two computers transferring and viewing files and other data between each other, I’m sure you want to see more by connecting/joining to the internet and to do this, you need 3 things: a router, a modem, and an Internet Service Provider (ISP). A **router** and **modem** can be their own devices or can be combined into one device! Regardless, **these device(s) are a type of computer that will “route” your device’s access to the internet**. And an **ISP is the provider of the internet such as Comcast’s Infinity, At&t, EarthLink and many more**. You can’t access a club without some bouncers getting in your way! So let’s compare your ISP to a bouncer that lets you access the greater club that is “The Internet”. Unfortunately these bouncers may need to be bribed to let you in which is why you pay your ISPs to access the internet.

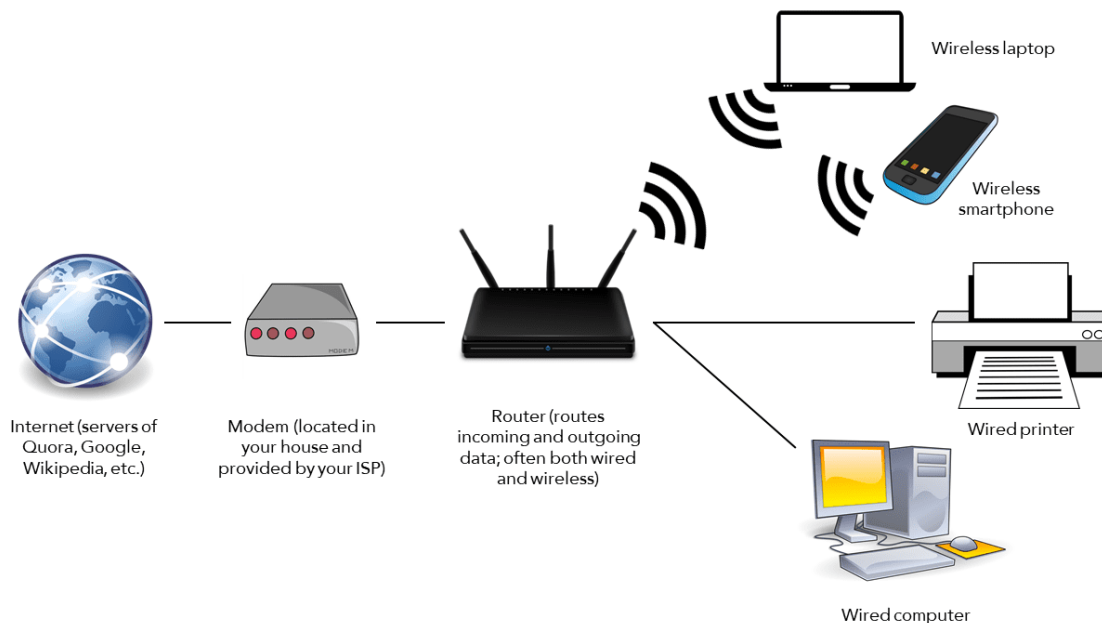


Image source: <https://www.hellotech.com/blog/what-is-the-difference-between-a-router-and-a-modem>

Now that we have covered **what** a network and the internet is and **why** it is needed, we can cover the “**where**”; as in where are networks? Networks can be everywhere really! They can reside in your own home as a “**home network**”, if you use a computer to access anything at your job, that is an office or business network and if you attend any classes and need to access your materials online while on campus, you are using their network as well. Networks can differ between each other in many ways by being created and used for different purposes and can be comprised of more than just computers, phones, printers and routers on a network but describing that in more detail is out of scope for this introductory course.

IP Address, Subnet Mask and Default Gateway

Now that we've learned about what Networks are, we have to learn the essential components that allow devices to communicate to each other on their own networks and over the internet. An IP (Internet Protocol) Address is a numerical string that identifies your computer when browsing the internet or communicating with other computers on a network. For example, on a home network, your laptop may have an IP address that's 192.168.0.34 and your smartphone that's also connected to the same network could have an IP address of 192.168.0.248. Each number in the set can range from 0 to 255. So, the full IP addressing range goes from 0.0.0.0 to 255.255.255.255. Now there is a logic to how these four numbers in an IP address are decided upon; this is called the Subnet mask. For the sake of simplicity, and saving on time, I will direct you to a thorough yet simple explanation on how Subnet masks affect IP addresses and the numbering of them. <https://avinetworks.com/glossary/subnet-mask/#:~:text=The%20subnet%20mask%20splits%20the,local%20devices%20to%20other%20networks>.

Each device connected to your network has a unique and different **IP address that is usually assigned to them in one of two ways**: either by a **DHCP server** (which is a server that in recent days is usually built into your router) **or is manually configured** (aka manually assigned). A DHCP server (Dynamic Host Configuration Protocol) assigns your device an IP address by picking from a pool of available IP addresses that haven't already been taken or assigned to other devices on the network. Think of a DHCP server as one of those "take one ticket" machines that you would find at a deli; only one person will get one ticket and each ticket will have a unique and different number on it with no ticket having the same number. Now just like a deli, once you have your order taken care of, you won't need to hold onto the ticket forever. Maybe on your next visit to the deli, the ticket you'll get may very well be a different number on your ticket than the one you got on your last visit. The same rule applies to your device if it was given an IP address via the DHCP server.



Image source: <https://www.groupon.com/deals/gg-cm-take-a-number-system-ticket-dispenser-machine-for-deli-counter-queuing-system>

Your device may have this DHCP assigned IP address for a few hours or up to a week. What happens once it expires? The DHCP server will just give your device(s) a new number (IP address). Last week, your laptop's IP address may have been 10.0.0.20, but this week, your IP address will now be 10.0.0.145. These IP addresses are "changing" or are "**dynamic**" if you will. And each "device" aka "**host**" is being "assigned" or "**configured**". This is why this process is called the **Dynamic Host Configuration Protocol**.

Now not every device needs to have their IP address changed. In fact, there are some devices that would be at a massive disadvantage if their IP address changed at all! Now you don't have to worry about whether your phone, PC or computer will need their IP address to stay the same

since they usually are already dynamically changing by default. I'm talking about the really, **really** important devices or computers such as your router or all the computers out on the internet that need to have their IP address stay the same. So if these sorts of devices can't have their IP address be dynamic, then the opposite of **dynamic** IP address is a **static** IP address. So if last week your laptop's IP address changed from being 10.0.0.20 to 10.0.0.145, then if you compare that to the IP address of your router, it was 10.0.0.1 last week and always will be until you or your ISP manually changes it.

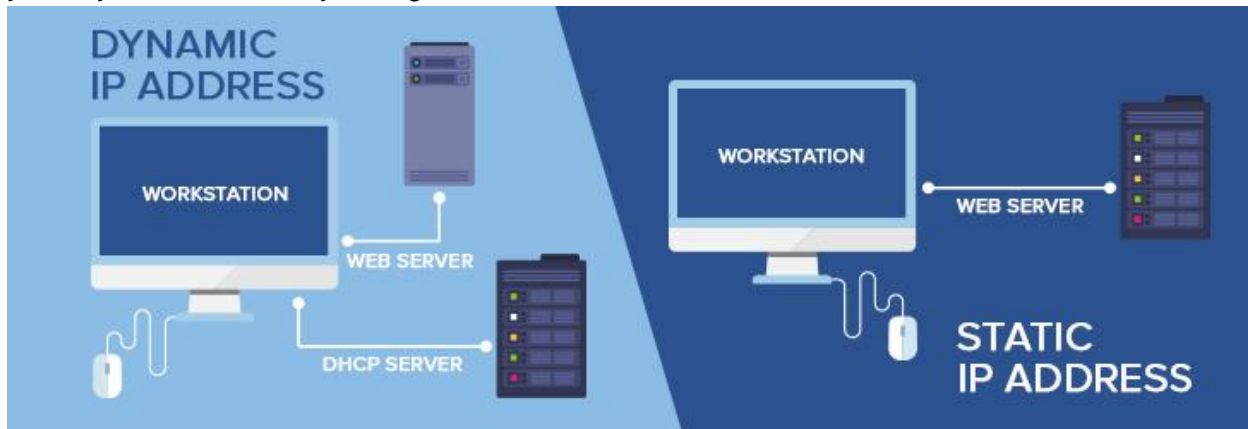


Image source: <https://www.iplocation.net/static-vs-dynamic-ip-address>

A default gateway is

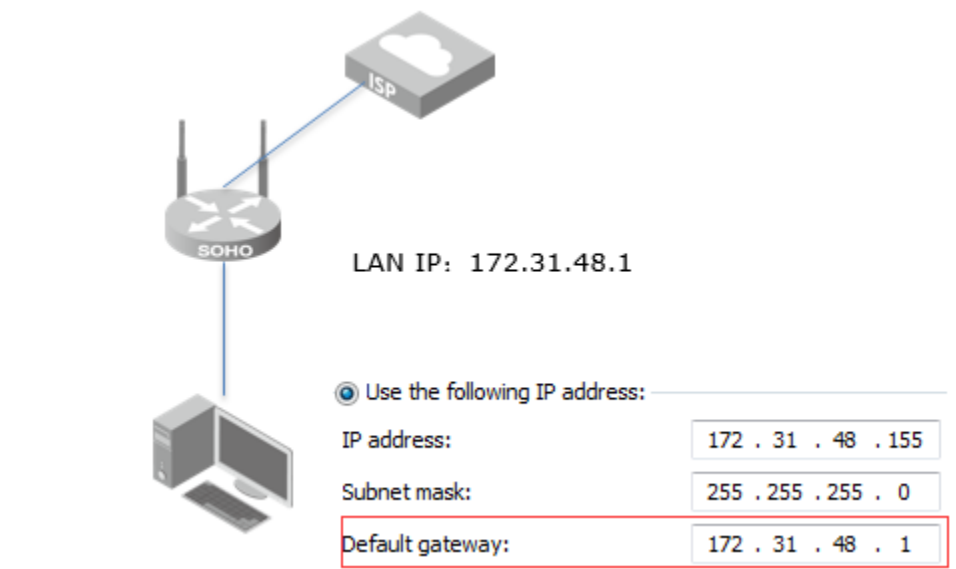


Image source: <https://www.tp-link.com/no/support/faq/1126/>

Network Types: LAN, WAN, MAN and other “ANs” :)

Learning what a network is is fine and dandy and all, but you must be aware of the different types of ways a network can exist and to what scale they can reach. In the earlier explanation of what we defined as a “network”, we explained that a network can consist of up to two devices or more and that scale of a network where *it only consists of two machines connected together and sharing files*, that is called a **Personal Area Network or PAN**. But obviously, the average person has more than just two devices in any given household. [According to a 2020 survey conducted by Federica Laricchia, the average American alone has at least 10 devices connected in their home](#). And with that many devices connected to the home network, the network can usually be shared and used by others with their own devices connected to it such as family members, spouses, roommates and more in the same general **local area where the network exists**. This is what is defined as a **Local Area Network (LAN)** where a small area like a home or a larger area such as a business, office or even a campus are all connected to the same network. Users may use their connection to the LAN to access the internet, but can also very well send and receive files/data to each other's devices **wirelessly or wired!** As long as their devices are connected to the same network, this is achievable.



Image source: <https://ipcisco.com/lesson/local-area-networks/>

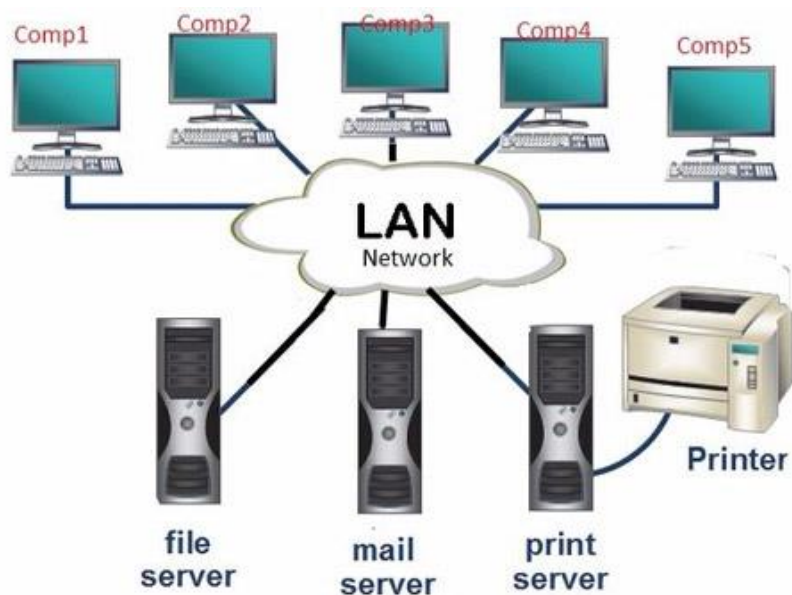
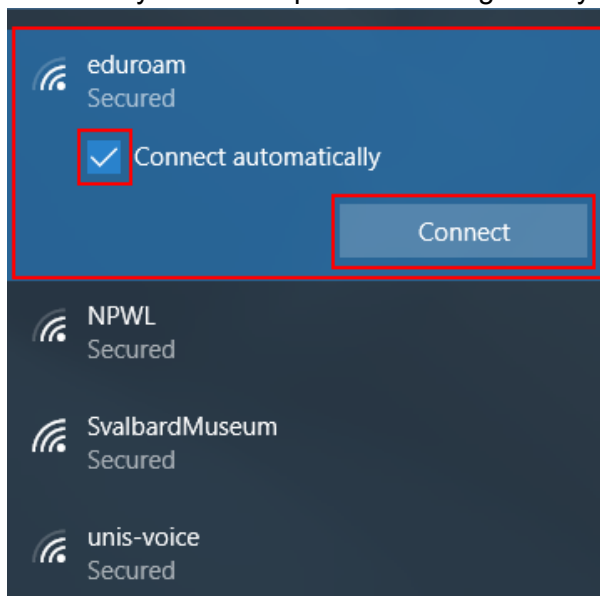


Image source: <https://cascadebusnews.com/pros-cons-local-area-network-lan/>

There's a reason as to why you need your printer and your laptop **to be connected to the same "network"** aka "that wave signal thingy you see on the bottom right corner of your screen" if you want to print something off of your computer.



When printing off a document using a program such as Microsoft Word, neither your laptop nor your printer may need to access the internet to get the document to print, but your laptop needs to somehow send the signal to your printer that “you need this printer right now!”. That’s where LAN’s come in. Once you have your printer and your laptop connected to the same ‘network’ via your router, you can finally send that print signal to your printer, your router can then **‘route’** the print signal to your printer, and the printing process of your document may start. Now **that same router can direct either you or your printer to the internet**, but in the process of printing off this document, you didn’t have to be directed or “routed” to the internet to accomplish this.

In a LAN, there are **two ways** that devices can communicate to each other **OR** use the internet: either wirelessly or wired by an ethernet cable. These cables give devices access to the LAN and the internet when they do not have any hardware that allows them to connect to it wirelessly. So these cables are usually hooked up to any device that has an ethernet port. These ports can be found on the backs or sides of desktop and laptop computers and they look like this:

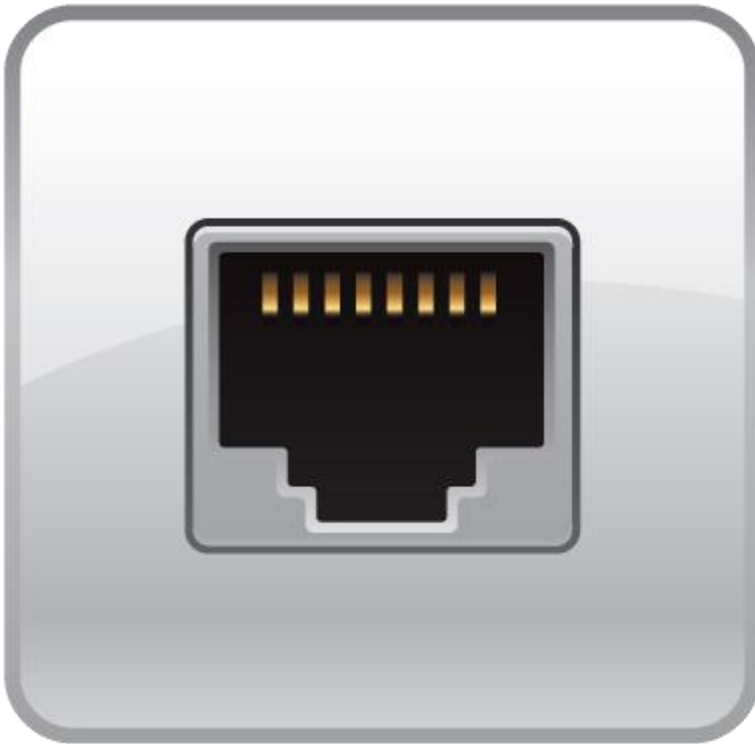


Image source: <https://ophtek.com/need-gigabit-network/>

Another name for ethernet cables is LAN cables, but just to clarify, **using an ethernet cable to connect to a LAN or the internet is optional but not mandatory**. If your phone is wirelessly connected to your home network aka home LAN, then it is still considered a device connected to and a part of a LAN.

Up to this point, we have made a point to make a clear distinction between a LAN and the Internet as if they are their own separate entities. And that’s because they are! **Simply stated, the Internet that exists outside of a LAN, in and of itself, is considered to be one of, if not the biggest WAN (Wide Area Network).**

[As HypertecDirect puts it:](#) “A WAN is a network covering any large geographic area. WANs can be as large as a state, a country, or the world. The Internet itself is a type of WAN, because it covers the entire globe. Although a network connecting LANs in the same city, like a group of offices belonging to the same company, these are usually called metropolitan area networks.”

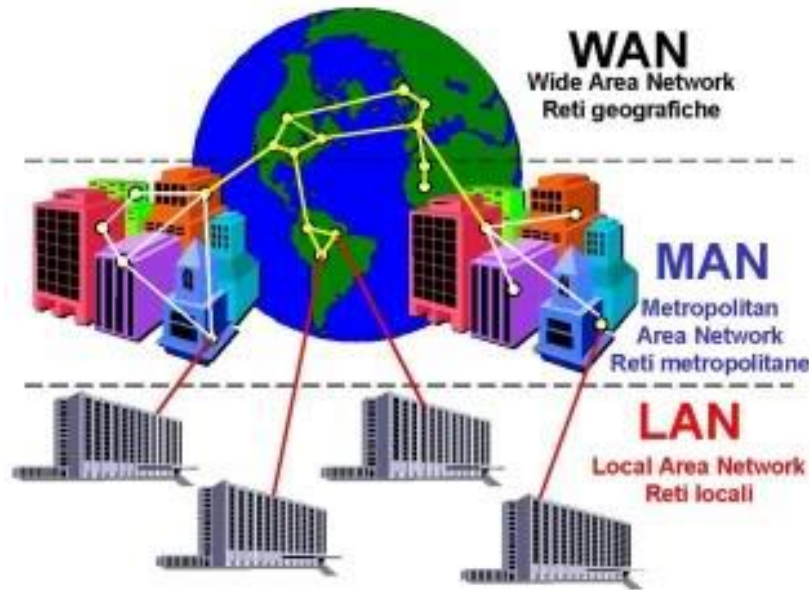


Image source: <http://www.differencebetween.net/technology/difference-between-lan-wan-and-man/>

And finally, between a LAN and the WAN, is something called a MAN Metropolitan Area Network which is a network meant to bridge the gap between the smallness of a LAN in an office or home, with the vast and seemingly endless size of the WAN. It is larger than a LAN but not as widespread as a WAN so it exists comfortably in between them in scale. A MAN can be a network spanning multiple buildings and even cities and these MANs purely exist to “...interconnect several LANs into a single large network by bridging them with backbone lines.” (source: Sagar Khillar, Difference Between LAN, WAN, and MAN).

Ethernet vs Wifi vs Mobile Data: The Different Ways to Connect to the Internet in a Network

In the previous section, we already went into detail regarding ethernet cables and how they allow users to connect to a LAN and the internet, so I will refer you to read that section if you have not already, but to summate: **an ethernet cable is meant to be plugged into devices that cannot connect to either a LAN or the Internet wirelessly.** Usual devices that call for Ethernet cables if they want to connect to a LAN or the internet are **desktop computers.**

Desktop computers are typically built without the equipment to connect wirelessly. Of course, if a user wants their desktop to be able to connect wirelessly, this can be changed and modified if the user wants to, but it will obviously cost some extra money to do so.

Now the equipment or “hardware” that is needed to connect to a network or the internet wirelessly is already built into most devices that can be taken anywhere such as laptops, tablets, and smartphones, but the questions we are looking to ask are: how this is achieved, what these wireless entities are called and what their differences are.

When using a laptop, tablet or phone, you can connect to a **LAN and the internet wirelessly which is called using “WiFi” aka “Wireless Fidelity”.**



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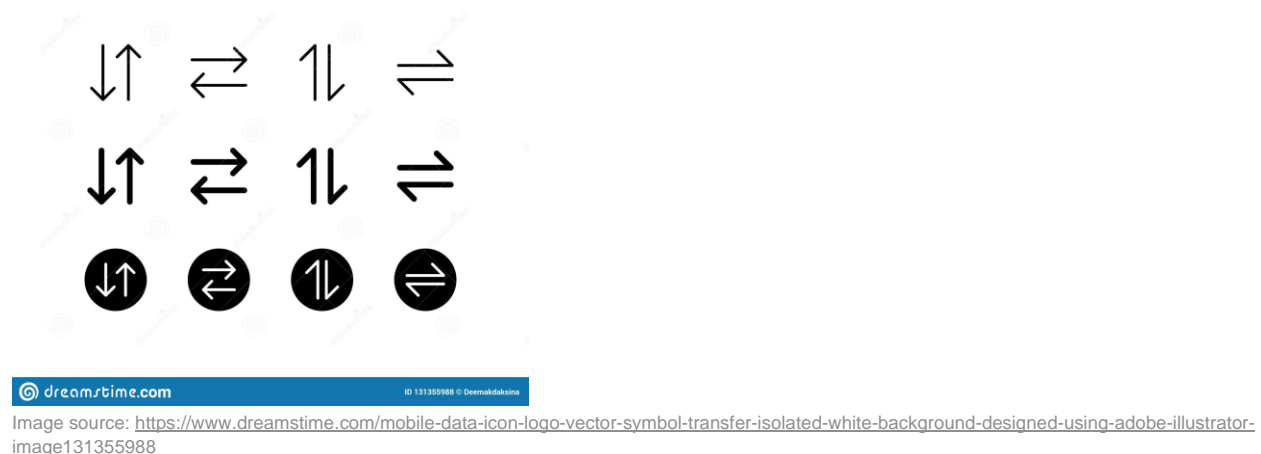
Image source: <https://www.shutterstock.com/search/wifi+symbol>

PLEASE NOTE: in recent years, the general public has had a tendency to use the term “wifi” to be a synonymous word for “the internet”, or a facility’s “LAN” (**Example:** “I have to connect to the school’s Wifi to check my grades”), but in actuality, “wifi” is the name of a technology that is **a means to connect users to the internet**. Wifi is a **tool** to connect users wirelessly to the internet and LANs.

Wifi does not equal internet

It is actually an alternative tool (besides using ethernet cables) used to connect to the internet. Please keep this in mind as you continue reading.

Another way to connect to the Internet on a smartphone/tablet is by using what is called: **Mobile data** (aka cellular data, aka 4G, 5G, LTE. These are different variations of ‘mobile data’ but all basically mean the same thing). This is data that a user is given access to use through their cellular provider and the user typically uses this data on the go to send texts, make calls, and access the internet when they are not within range of a wifi connection or are not connected to one.



Variations of the Mobile Data symbol as it is displayed on different devices

Please note and understand the differences between these two explanations: most laptops **cannot use mobile data**, but a tablet and mobile phone can if their cellular provider gives them **a SIM card**.



Image source: <https://www.online-tech-tips.com/smartphones/what-is-a-sim-card-used-for/>

Mobile data when used only connects you to the internet and not a LAN. Mobile Data is a separate entity from Wifi, which does connect you to a LAN and the internet. Laptops, Phones, and Tablets can connect to either the internet or a LAN using WiFi.

Wireless (Mobile Devices)	Can it use Mobile Data to connect to the Internet?	Uses Wifi (Wireless Fidelity) to connect to either LAN or the Internet?
Laptop	<i>No; few laptops have sim cards in them to use Mobile Data</i>	<i>Yes</i>
Smartphones (Android, iPhone, Google Pixel etc.)	<i>Yes; need to use a sim card to activate and use Mobile Data</i>	<i>Yes; can connect to internet using Wifi without a sim card</i>
Tablets	<i>Yes; need to use a sim card to activate and use Mobile Data</i>	<i>Yes; can connect to internet using Wifi without a sim card</i>

A short but insightful video that can help solidify these concepts is one made by Technologetic. [Click here to view it on Youtube.](#)

In part 2, we will continue our explanation of network fundamentals and concepts by discussing how laptop and desktop computers connect to a LAN and the Internet, and other concepts relating to it! :)