

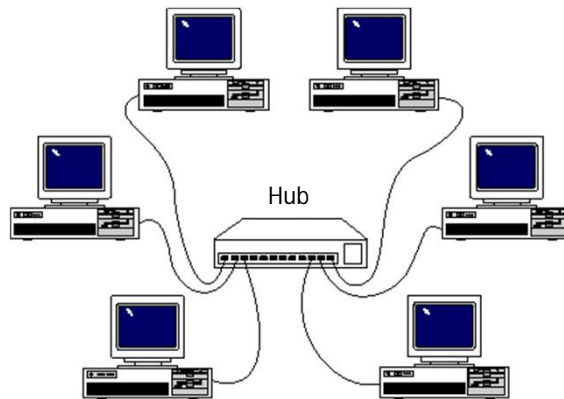
Ethernet: Hubs, switches, repeaters, bridges, routers, WAPs—what are these things?

A **hub** is an electronic emulation of a cable segment. (“Segment” as in the old “original Ethernet” or 10-Base5 Ethernet.) One connects a device to a hub with a point-to-point twisted-pair cable and RJ-45 connectors.

Two, three or four twisted pairs in a cable. Typically only two pairs, (four wires) are used. Cat 3 or better.

A hub repeats all frames—what goes in one port comes out all other ports. That’s its job and its only job.

If two ports simultaneously have traffic coming into them, then there is a collision.



A hub operates at the OSI layer 2, “datalink layer.” It is aware of frames but not the content thereof, nor where they should go.

<https://patlito0.wordpress.com/>

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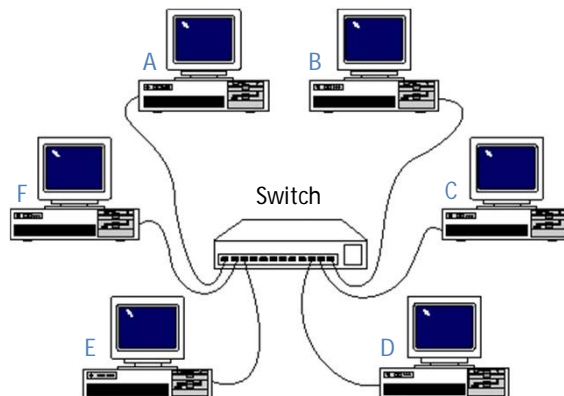
Ethernet: Hubs, switches, repeaters, bridges, routers, WAPs—what are these things?

A **switch** keeps track of MAC addresses and sends traffic only where needed. It no longer fully emulates a cable. When initially powered on, it may act like a hub.

Suppose computer A talks to computer C. Suppose the ports are labeled left to right from 1 to 12 in this illustration. The switch will discover that computer A is on port 1 and computer C is on port 11.

After discovery, all further communications to computer A will only be sent out of port 1.

After discovery, all further communications to computer C will only be sent out of port 2.



The process of building up the address table continues as operation proceeds. Practically all the traffic will be switched. Each computer will see hardly any traffic that is not intended for it.

A switch operates at the OSI Layer 3 “Network” level. It is aware of addresses within frames.

Modern switches usually have some OSI layer 4 or higher functionality to help manage VPNs and such

Hubs are now obsolete for security reasons.

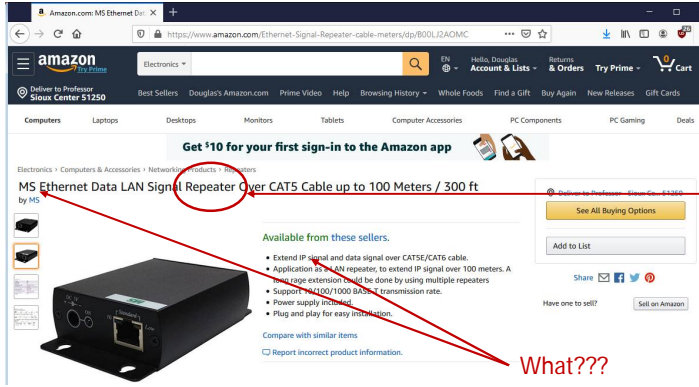
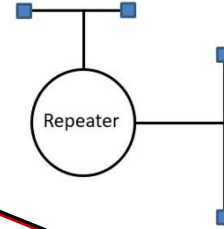
<https://patlito0.wordpress.com/>

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Ethernet: Hubs, switches, repeaters, bridges, routers, WAPs—what are these things?

A **repeater** is a bridge (next slide) between two “original Ethernet” segments or “thinernet” segments. Repeater are obsolete.

The word is now used (abused?) in various other contexts, such as with PoE injectors and Wi-Fi extenders. Consider it marketing hype (having no defined meaning).



Uhm... Nope. (This is probably a 2-port hub.) Not enterprise quality language!

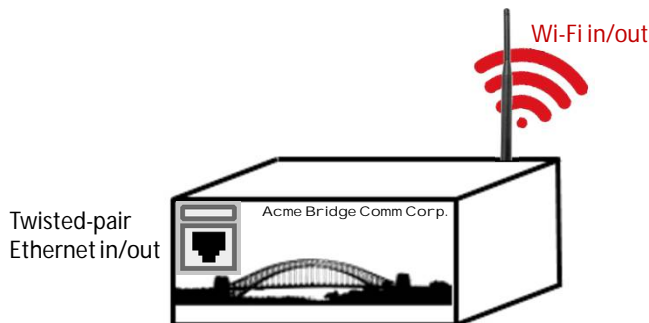
(Maybe it will do something useful for a small church or home office.)

What???

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Ethernet: Hubs, switches, repeaters, bridges, routers, WAPs—what are these things?

A **bridge** is a device that operates at the data-link layer to relay frames from one physical media to another. A bridge does not translate addresses or otherwise modify frames. The networks on each side of the bridge get merged into one single network. A common use for a bridge is to connect a Wi-Fi network to a wired network.



Prof. dB is unaware of any box that you can purchase that is simply a bridge, as illustrated here.

Either the box has a bunch of other functionality (WAP, switch, router) or the bridge is a software construct (Windows 10 can act as a bridge between two NICs.) or the bridge is a pair of half-bridges used to extend the distance of the network. (Powerline bridges are a last-ditch measure. Why not pull some cat 6 cable?)



<https://www.cnet.com/news/top-five-power-line-adapters-when-wi-fi-fails-you/>

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Ethernet: Hubs, switches, repeaters, bridges, routers, WAPs—what are these things?

A **router** is a device that operates between two networks without merging the two networks into one network.

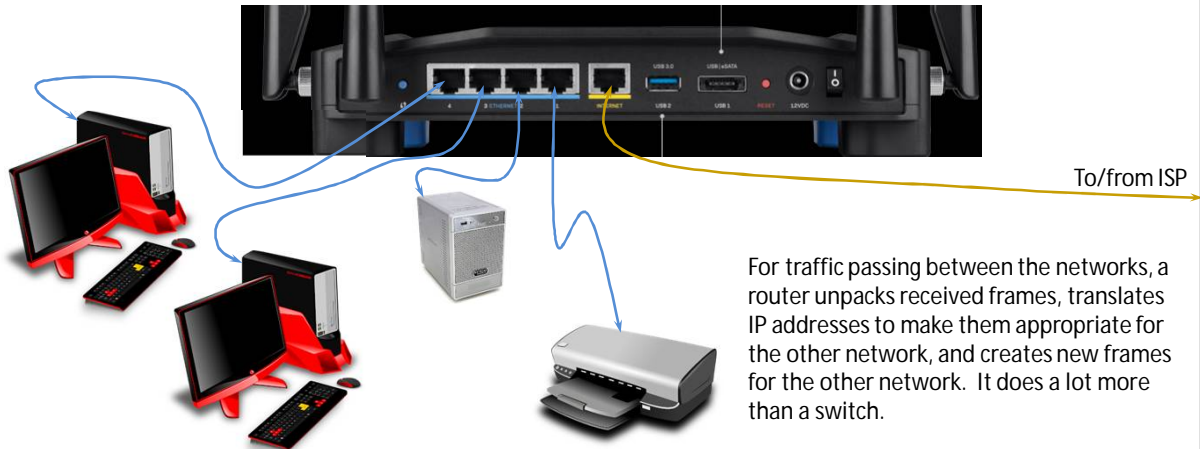
A router operates at least at the OSI layer 3, the "network" layer. It must be aware of addresses.

Most routers have built in firewalls. (OSI layer 4 and up.)

One side of the router is conventionally called the local area network (**LAN**) and the other the wide area network (**WAN**)

A common use for a bridge is to connect a **LAN** to an internet service provider's **WAN**.

Illustrated here is a router with a built-in 4-port hub or switch on the **LAN** side.



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Ethernet: Hubs, switches, repeaters, bridges, routers, WAPs—what are these things?

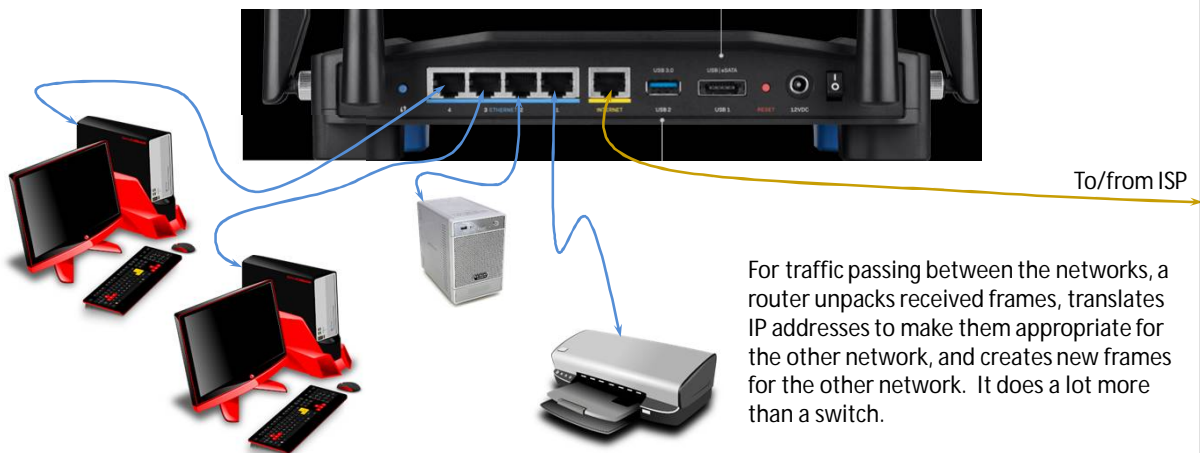
A **router** is a device that operates between two networks without merging the two networks into one network.

Internet Protocol requires a router!

All packets travel between device and router.

The router is what steers the traffic from source to destination.

These days, they "all" do it by the rules of the Internet Protocol.



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Most residential routers support three physical-layer connections:

Ethernet LAN, Ethernet WAN, Wi-Fi or WLAN

Conventionally, the LAN and WLAN will be bridged together.

The bridge between the LAN and WLAN is built into the router.

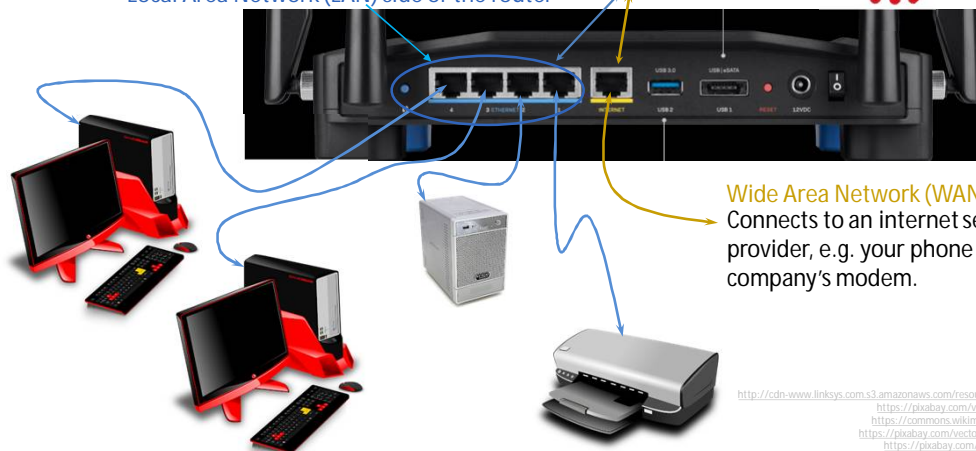
Typically a small hub or switch (about 4 ports) is also built into the router.



Wi-Fi or Wireless network  
or WLAN bridged to LAN

Local Area Network (LAN) side of the router

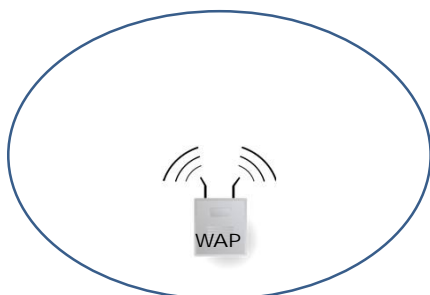
Router and firewall  
between LAN and WAN



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Ethernet: Hubs, switches, repeaters, bridges, routers, WAPs—what are these things?

A **wireless access point (WAP)** is a device that acts like a hub or switch but uses Wi-Fi for physical transport of data frames. It creates a wireless local area network (WLAN).



Wireless Access Point (WAP)  
Creates Wi-Fi connections at the physical layer.

<https://pixabay.com/vectors/router-wifi-wireless-connector-23240/>

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**All traffic on the WLAN passes through the WAP**

Devices within radio range **OF THE WAP** may communicate with each other via the WAP.

The WAP is analogous to a switch.

In order for these devices to communicate with each other, they use a protocol. Back in the day, there were many choices. Devices using different protocols could not talk with each other.

Protocols operate at OSI layer 2.  
 Various available protocols are:  
 Layer 2: Ethernet (IEEE802.2)  
 L2TP, LLDP, MAC, PPP ←mostly obsolete now



Wireless Access Point (WAP)  
 Creates Wi-Fi connections at the physical layer.

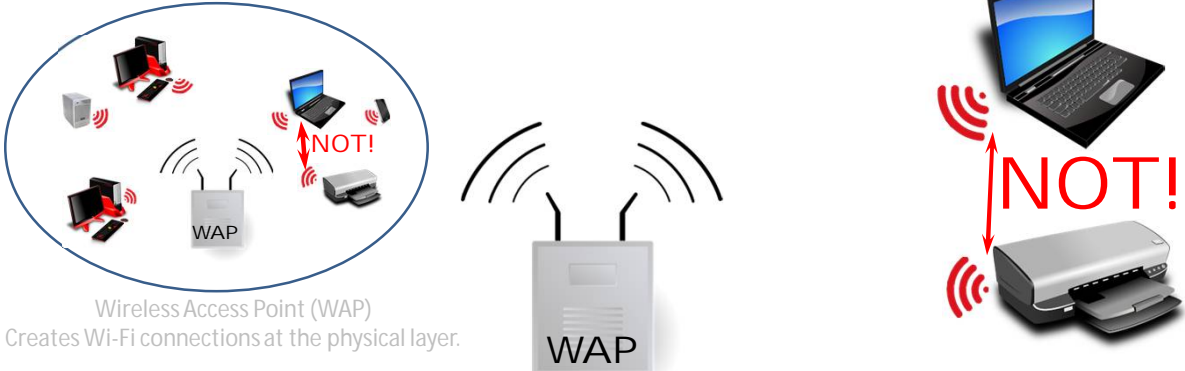
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**All traffic on the WLAN passes through the WAP**

Devices within radio range **OF THE WAP** may communicate with each other via the WAP.

The WAP is analogous to a switch.

Example: Client on laptop computer wants to print a page.  
 The communication between the laptop and the printer goes through the WAP, not directly between the computer and the printer.



Wireless Access Point (WAP)  
 Creates Wi-Fi connections at the physical layer.

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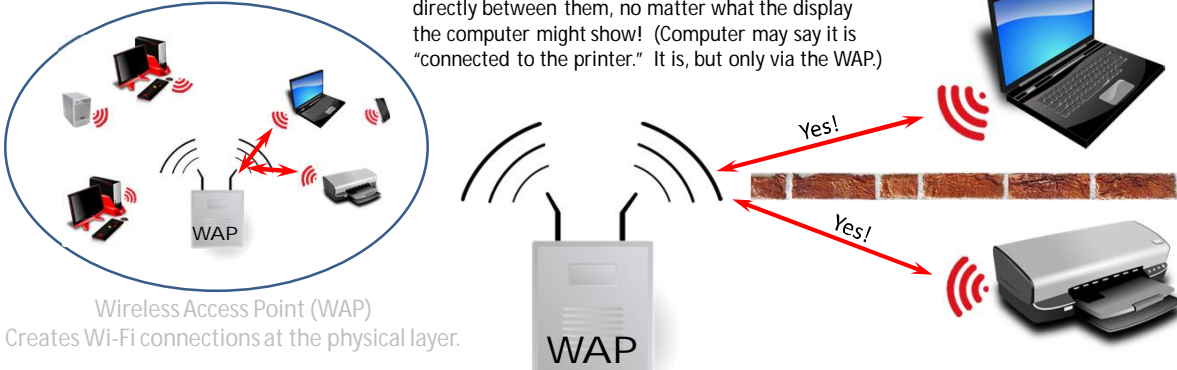
**All traffic on the WLAN passes through the WAP**

Devices within radio range **OF THE WAP** may communicate with each other via the WAP.

The WAP is analogous to a switch.

Example: User on laptop computer wants to print a page.  
The communication between the laptop and the printer goes through the WAP, not directly between the computer and the printer.

There may as well be a brick wall between the computer and the printer. There is no signal pathway directly between them, no matter what the display the computer might show! (Computer may say it is "connected to the printer." It is, but only via the WAP.)




Wireless Access Point (WAP)  
Creates Wi-Fi connections at the physical layer.

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The situation depicted here is a *local area network* (LAN).

So far, this LAN has no Internet connection.  
We will get to that later.



Wireless Access Point (WAP)  
Creates Wi-Fi connections at the physical layer.

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The situation depicted here is a *local area network (LAN)*.

So far, this LAN has no Internet connection. We will get to that later.

A local area network (LAN) could also be set up with a hub or switch using Ethernet connections instead of Wi-Fi connections.

This LAN also has no internet connection.



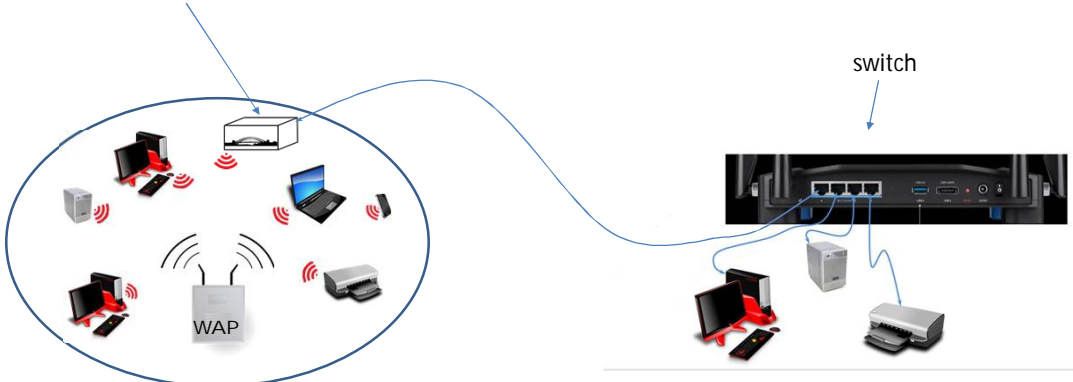
Wireless Access Point (WAP)  
Creates Wi-Fi connections at the physical layer.



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A *bridge* is a device that connects two disparate networks and makes them look like one. A bridge repeats the traffic of one network onto the other and vice versa. To the WAP the bridge just looks like another device on the network. To the switch, the bridge just looks like another device on the network.

This bridge is Wi-Fi on one side and Ethernet on the other side.



Wireless Access Point (WAP)  
Creates Wi-Fi connections at the physical layer.

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