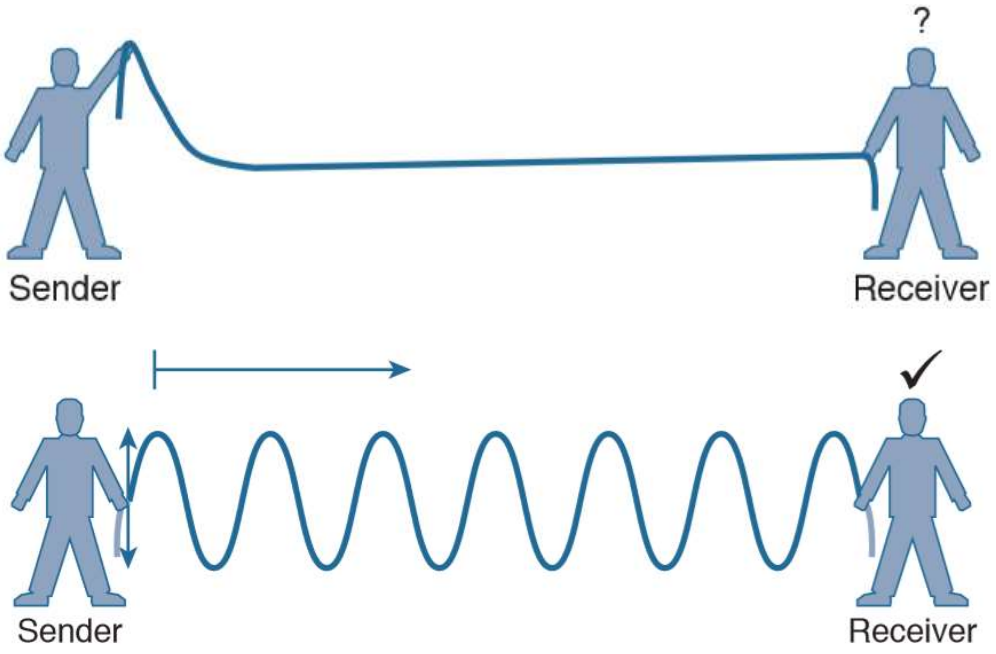
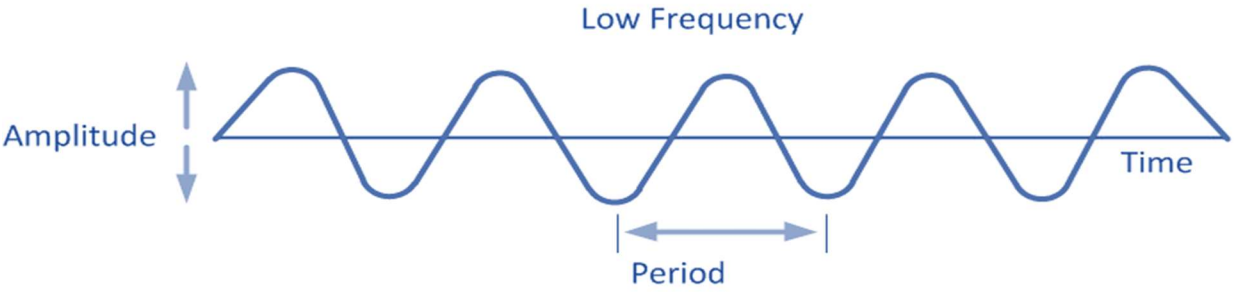
Wireless:

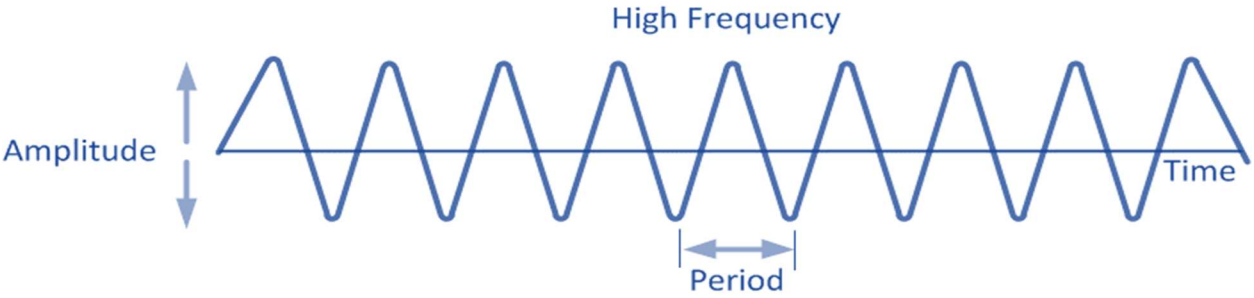
- Wi-Fi is a popular wireless networking technology; Wi-Fi stands for Wireless Fidelity.
- The Wireless Wi-Fi was invented by NCR corporation/AT&T in Netherlands in 1991.
- By using this technology, we can exchange the information between two or more devices.
- Wireless (Wi-Fi) has been developed for mobile computing devices, such has laptops etc.
- But it is now extensively using for mobile applications and consumer electronics like TV etc.
- Computer's wireless adaptor transfers data into radio signal & transfers data into antenna.
- Wireless signals are important because they can transfer information audio, video & voices.
- Wireless signal transfers data without the use of wires, and that makes them very useful.
- Wireless networks are computer networks that are not connected by cables of any kind.
- Wireless network is a network set up by using radio signal frequency to communicate other.
- Wireless networking is the easiest and most affordable way to set up an Internet network.
- It is term to refer to various types of networks that communicate without need of wire line.
- Wireless Fidelity Wireless signals are the electromagnetic waves travelling through the air.
- There are many, many types of Wireless Fidelity wireless technologies some of them are.
- Example are AM and FM radio, TV, Cellular phones, Wi-Fi, Satellite, radio, and Bluetooth.
- Wi-Fi is a high-speed internet connection and network connection without use of any wires.
- Wireless network is operating three essential element, radio signals, antenna and router.
- Basically, the radio waves are keys which make the Wireless (Wi-Fi) networking possible.
- The computers, Laptop, TV, and cellular phones, other device are ready with Wi-Fi cards.
- Radio signals are transmitted from antennas & routers that are picked up by Wi-Fi receivers.



Frequency:

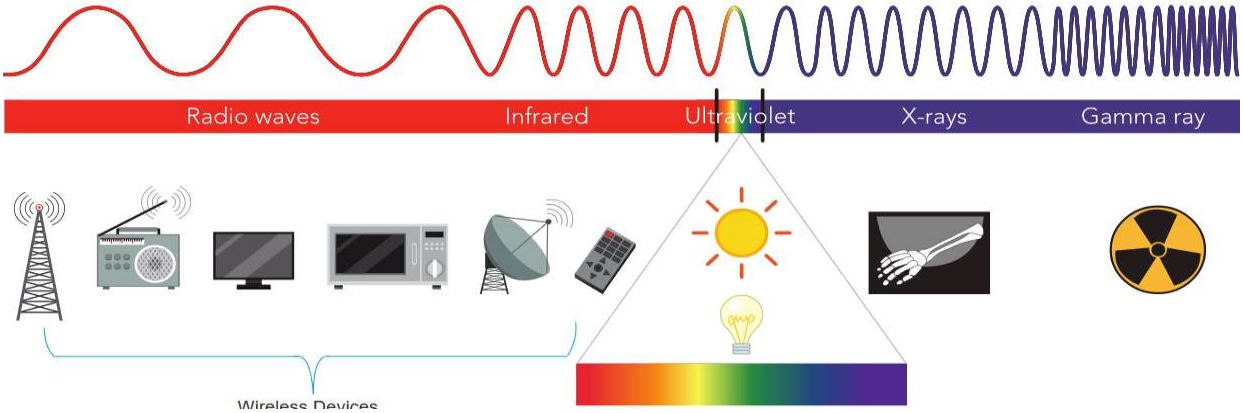
- Wireless signals occupy spectrum/wide range, of frequencies: rate at which signal vibrates.
- If signal vibrates slowly, it has low frequency, if vibrates very quickly, it has high frequency.
- Frequency is measured in Hertz, which is count of how quickly signal changes every second.
- Higher frequencies give higher data rates, higher frequency more waves in given time cycle.
- The Wireless technology uses the unlicensed radio spectrum/range to send & receive data.
- Unlicensed spectrum is accessible to anyone who has wireless router & wireless technology.
- Frequency is number of times signal makes one complete up and down cycle in 1 second.





Radio Frequencies:

- All wireless devices operate in the radio waves range of the electromagnetic spectrum.
- The Wireless LAN networks operate in the 2.4 GHz frequency band and the 5 GHz band.
- WLAN devices have transmitters & receivers tuned to specific frequencies of waves range.
- Specifically, the following frequency bands are allocated to the 802.11 wireless LANs.
- Wireless LAN 2.4 GHz (UHF) - 802.11b/g/n/ax and WLAN 5 GHz (SHF) - 802.11a/n/ac/ax.
- The strength of an Radio Frquency signal is usually measured by its power, in watts (W).



Terminologies:

Cycle:

- Cycle can begin signal rises from center line, falls through center line & rises again.
- Cycle can be measured from the center of one peak to the center of the next peak.
- In below image, during that 1 second, signal progressed through four complete cycles.

Hertz:

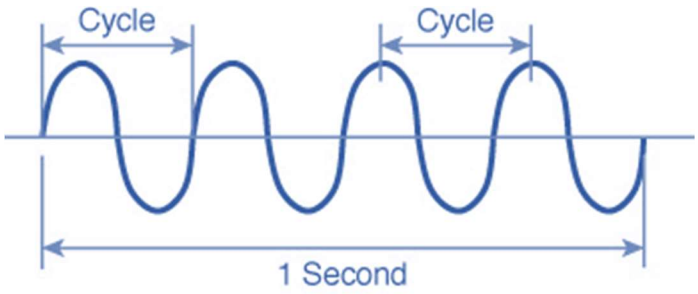
- Therefore, in blow image example its frequency is 4 cycles or 4 second or 4 hertz.
- Hertz is most commonly used frequency unit & is nothing than one cycle per second.

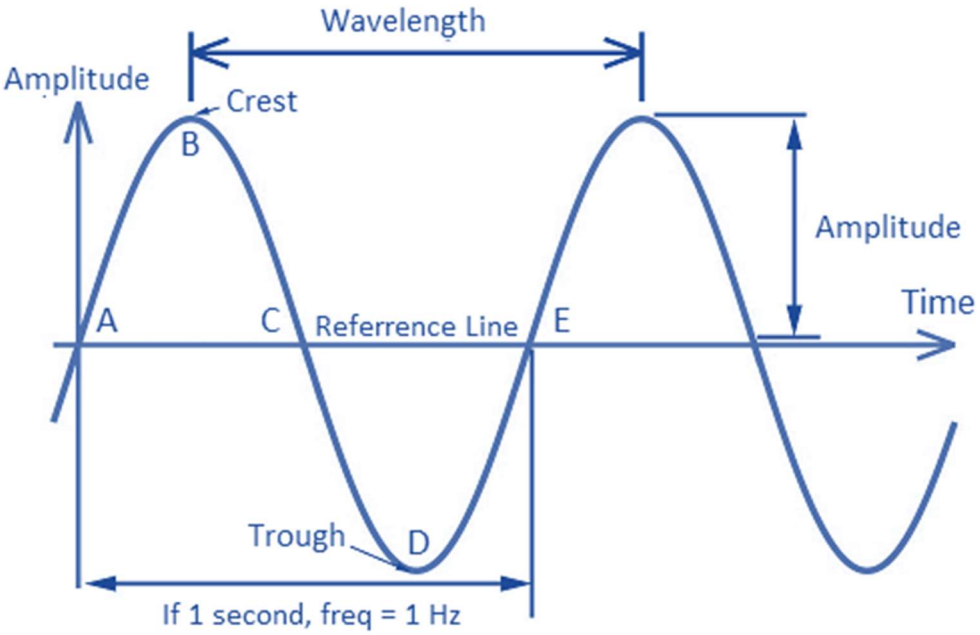
Amplitude:

- Amplitude the height from the top peak to the bottom peak of the signal's waveform.
- It is power or intensity of signal, the frequency is how often the signal repeated itself.
- Higher the amplitude it will produce the higher range, lower amplitude lower range.

Wavelength:

- In wavelength they are the crest which is the high point, the trough which is low point.
- the wavelength is the distance from one crest or higher point , or trough, to another.



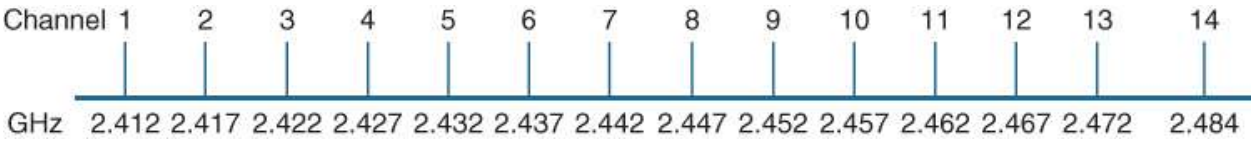


Bands:

- Wireless routers use one of the two Wi-Fi frequency bands for signal: 2.4 GHz or 5 GHz.
- Some routers are dual-band routers, so you can choose which frequency band to use.
- Main difference between these two frequency bands are range and bandwidth provide.
- In case, you are looking for more WIFI coverage, you want to be using the 2.4 GHz band.
- In case, if you are looking for the faster speeds, you want to be using the 5 GHz band.
- Within these WIFI frequency bands, have smaller bands which are referred to channels.
- Bands are ranges of radio wave frequencies used to transmit data in wireless spectrum.
- Bands are frequency ranges within wireless spectrum that are designated to carry WIFI.
- Bands is usually understood as a range of frequencies with a certain upper and lower limit.

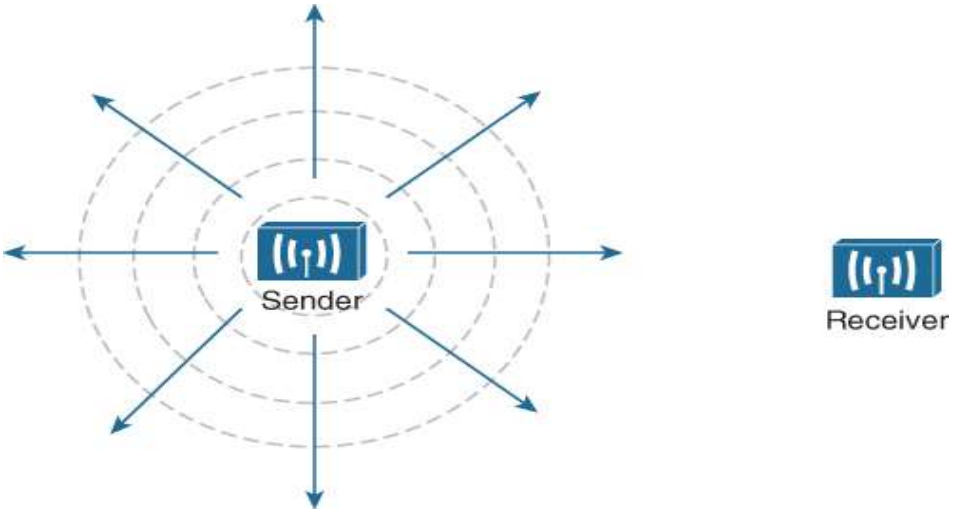
Channel:

- WIFI channel is medium through which our wireless networks can send and receive data.
- In Wireless frequency bands are usually divided up into a number of distinct channels.
- Each channel is known by a channel number and is assigned to a specific wireless frequency.
- The channel assignment for the 2.4 GHz band that is used for wireless LAN communication.
- The band contains 14 channels numbered 1 through 14, each assigned a specific frequency.
- Each channel is like rooms at party if one room is crowded it's hard to carry conversation.
- Move to the next room, but that might get crowded as well As soon as the building is full.



Receivers and Transmitters:

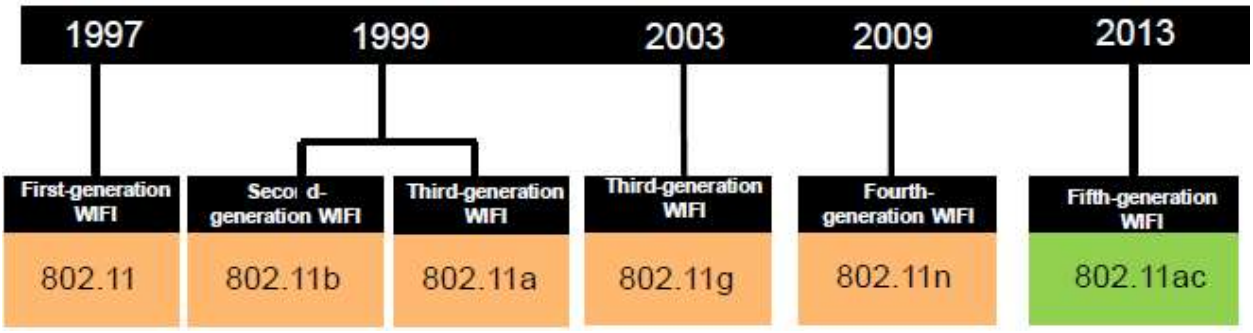
- In Wireless Network when a device sends out a wireless signal, it is called a transmitter.
- When another device picks up wireless signal & understands information called receiver.



IEEE Wireless Standard:

IEEE: Institute of Electrical and Electronic Engineers: These are the people that create all the standards we use today. Wireless is documented in the 802.11 standard.

IEEE WLAN Standard	Radio Frequency	Description
802.11	2.4 GHz	Speeds of up to 2 Mbps
802.11a	5 GHz	Speeds of up to 54 Mbps Small coverage area Less effective at penetrating building structures Not interoperable with the 802.11b and 802.11g
802.11b	2.4 GHz	Speeds of up to 11 Mbps Longer range than 802.11a Better able to penetrate building structures
802.11g	2.4 GHz	Speeds of up to 54 Mbps Backward compatible with 802.11b with reduced Bandwidth capacity
802.11n	2.4 GHz 5 GHz	Data rates range from 150 Mbps to 600 Mbps with a Distance range of up to 70 m (230 feet) APs and wireless clients require multiple antennas Backward compatible with 802.11a/b/g devices
802.11ac	5 GHz	Provides data rates ranging from 450 Mbps to 1.3 Gbps Up to eight antennas can be supported Backwards compatible with 802.11a/n devices
802.11ax	2.4 GHz 5 GHz	Released in 2019 - latest standard Also known as High-Efficiency Wireless (HEW) Higher data rates Increased capacity Handles many connected devices Improved power efficiency 1 GHz and 7 GHz capable when those frequencies



Access Point:

- A device that allows wireless devices to connect to a wired network using Wi-Fi.
- Access Point is a device that creates wireless local area network, or Wireless LAN.
- Access Point is a device creates Wireless LAN usually in an office or large building.
- AP is the device that allows multiple wireless devices to connect with each other.
- AP connects multiple wireless devices together in single or multiple wireless networks.
- AP is a networking device that is used to form wireless local area network in home.
- An access point connects to a wired router, switch, or hub via an Ethernet cable.
- AP is hardware device used to connect computer, laptops and mobile with each other.
- Wireless networks are suitable for those places where cables are difficult to install.
- An access point can also be used to extend the wired network to the wireless devices.
- The AP converts the wireless frequency subject into digital signals and then vice versa.

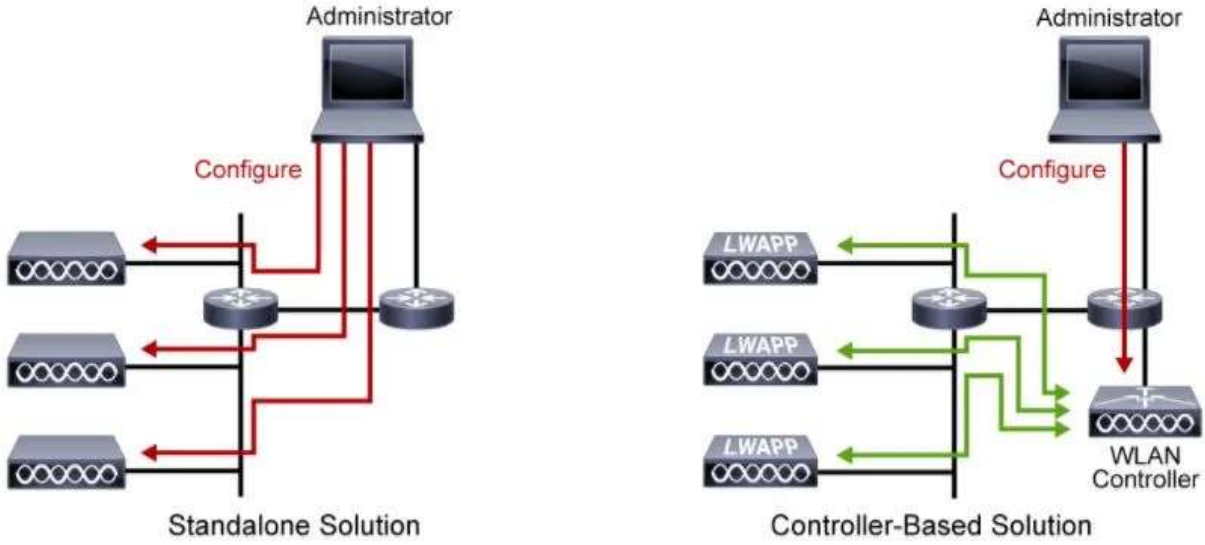
AP Categories:

Autonomous APs:

- These are standalone devices configured using a command line interface or a GUI.
- Autonomous APs are useful in situations where only couple of APs are required in org.
- Such as home router is autonomous AP because entire configuration resides on device.
- If wireless demands increase, more Access Points (APs) would be required to deploy.
- Each AP operate independent of other APs & each AP require manual configuration.
- Each AP operates independent of other APs & each AP require manual management.
- This would become overwhelming if many Access Points (APs) were needed in case.
- Autonomous Access Points is Standalone mode and Management address for remote.
- Single and standalone access points (APs) can offer the functionabilities of BSS only.
- APs can operate in autonomous or lightweight mode this depends on image that run.
- Autonomous AP called Mobility Express, is used when don't have Wireless Lan Controller.
- Standalone APs can be organized one-by-one & proffer staring functionality by themselves.

Controller-Based APs:

- These devices require no initial configuration and are often called lightweight APs (LAPs).
- LAPs use Lightweight Access Point Protocot to communicate with WLAN controller (WLC).
- Controller-based APs are useful in situations where many APs are required in the network.
- As more APs are added, each AP is automatically configured and managed by the WLC.
- Notice in the figure that the WLC has four ports connected to the switching infrastructure.
- These four ports are configured as a link aggregation group (LAG) to bundle them together.
- Much like how the EtherChannel operates, LAG provides redundancy and load-balancing.
- All ports on switch that are connected to WLC need to be trunking and EtherChannel on.

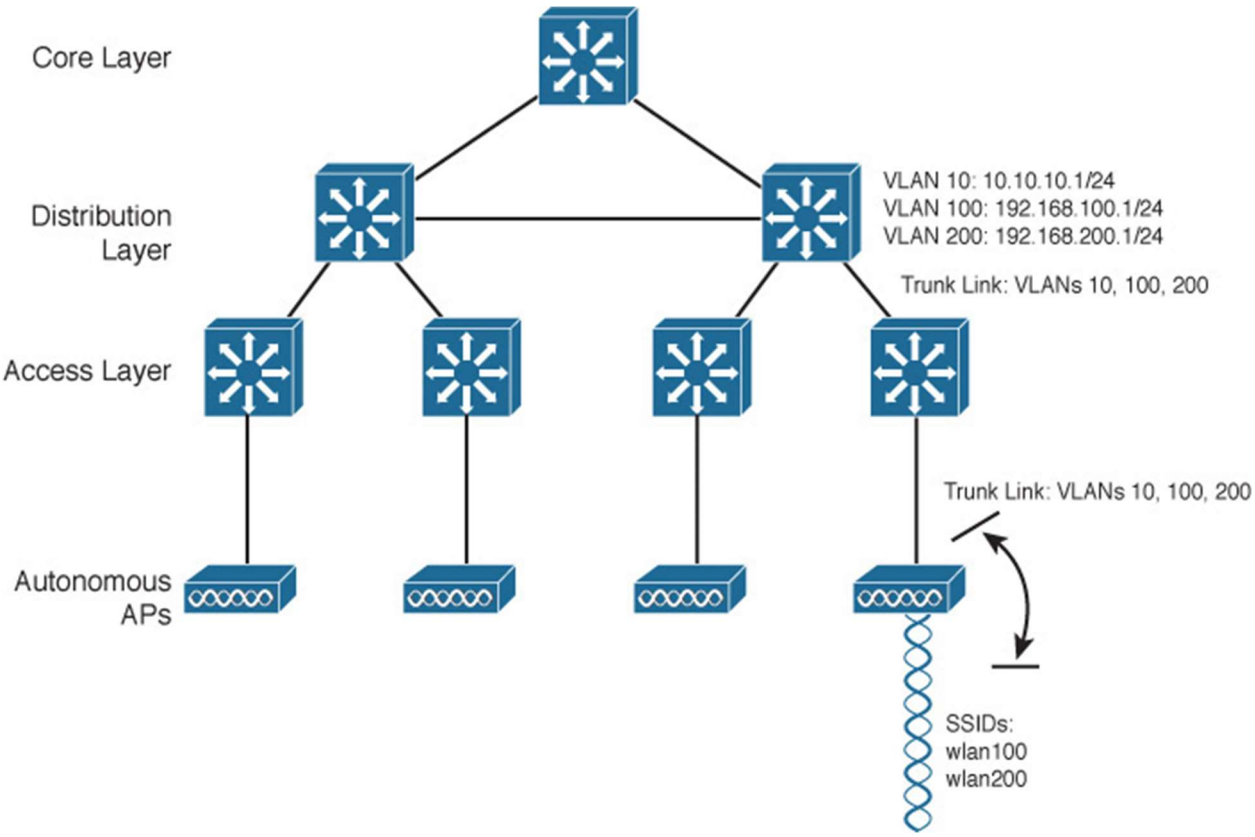


Wireless Architectures:

Take a look at different Cisco wireless architectures we can use for enterprise networks.

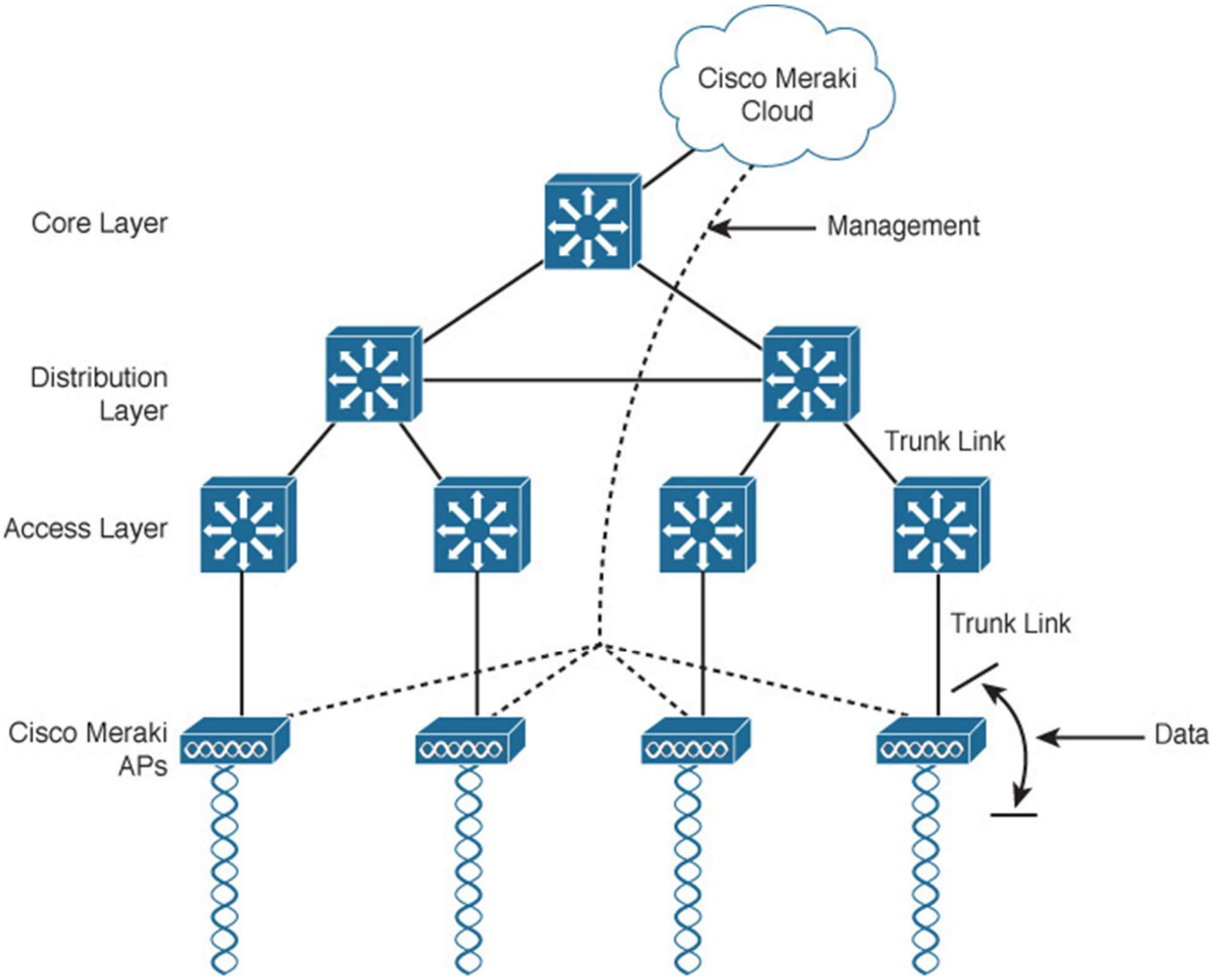
Autonomous AP Architecture:

- Autonomous Architecture, access points (APs) are stand-alone sometimes called fat APs.
- Autonomous AP has all required intelligence to serve wireless clients & to connect wired.
- Autonomous APs are self-contained, each offering one or more fully functional BSSs etc.
- An autonomous AP is self-contained; it is equipped with both wired & wireless hardware.
- So that wireless client associations can be terminated onto wired connection locally at AP.
- The VLANs must be trunked from the distribution layer switch to the access layer switch.
- Where they are extended further over a trunk link to the Wireless Access Points (AP).
- Autonomous AP offers a short & simple path for data to travel between wireless & wired.
- Autonomous AP must also be configured with management IP address to remotely manage.
- The Autonomous APs are stand-alone access points (AP) with fully integrated intelligence.
- Budget friendly form of access is intended for smaller organizations have small deployment.



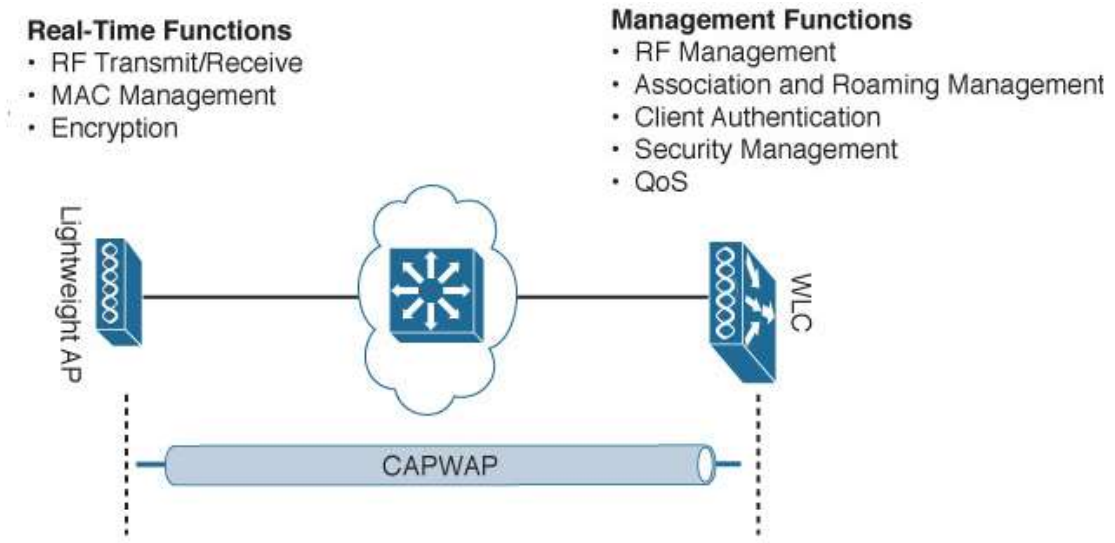
Cloud-Based Architecture:

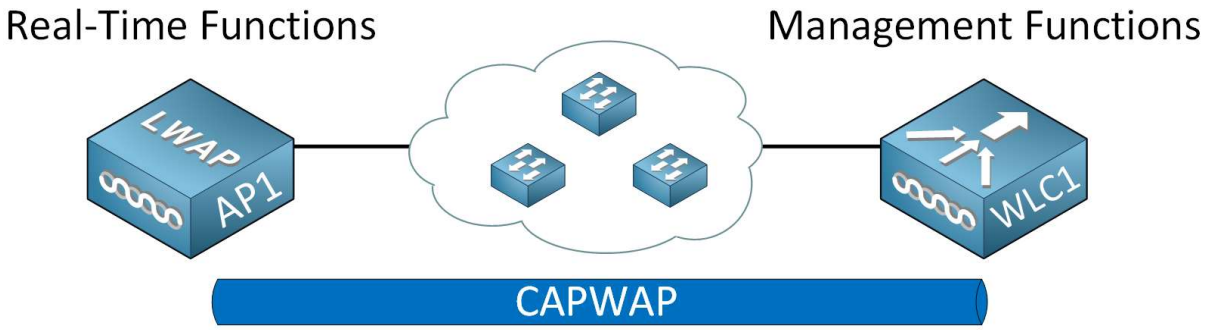
- Cloud-based AP management function is pushed out of the Enterprise into Internet cloud.
- Cisco Meraki is a cloud based solution that offers centralized management of the Wireless.
- Network is arranged same as autonomous AP, but managed would be redirected to a cloud.
- Where AP management function is pushed out of enterprise and into the Internet cloud.
- From cloud, can push out code upgrades & configuration changes to APs in the enterprise.
- Cloud-Based all of APs are managed, controlled, and monitored centrally from the cloud.
- The cloud-Based this is almost a 'hybrid' between Autonomous and Split-MAC architecture.
- Meraki are autonomous access points but All of managerial functions are available in cloud.
- This managerial style can be useful to administrators want to be able to oversee remotely.



Split-MAC Architecture:

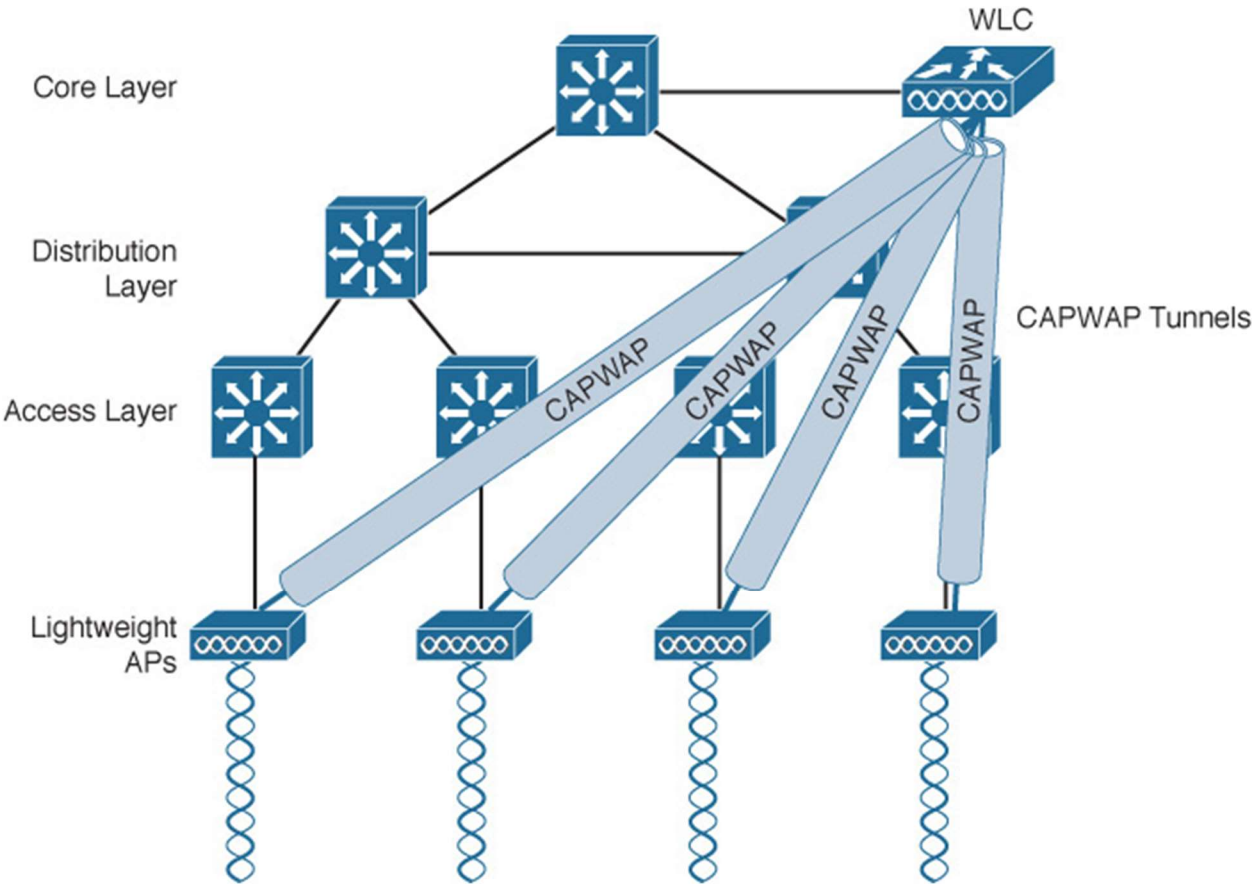
- Split-MAC means is that management process is divided into two separate streams of data.
- Access points get configuration from designated controller who orchestrate entire process.
- Wireless Controller have the ability to see all access points & coordinate them accordingly.
- In Split-MAC design because everything is centralized, this leads to reduced overhead costs.
- For a large-scale deployment, you're going to want to consider that split-MAC architecture.
- Entire data process is going to be handled by the Wireless Access Points (AP) themselves.
- Real-time functions always stay in the AP and the management functions go to the WLC.
- WLC for multiple APs, where do we set up WLC so that it can cover as much APs as it can.
- Split MAC architecture divides implementation of MAC functions between AP & controller.
- For that set Wireless LAN Controller in core layer, to have a centralized view of the network.
- Since these functions are not the real-time, we can move them to a central point, the WLC.
- take away some of intelligence of the AP, which is why we call them lightweight APs (LAP).
- The lightweight AP requires a Wireless LAN Controller (WLC) it can't function on its own.
- Splitting functions between the AP and WLC is what we call the split-MAC architecture.
- When a lightweight AP boots, it uses discovery mechanisms to search & connect to a WLC.





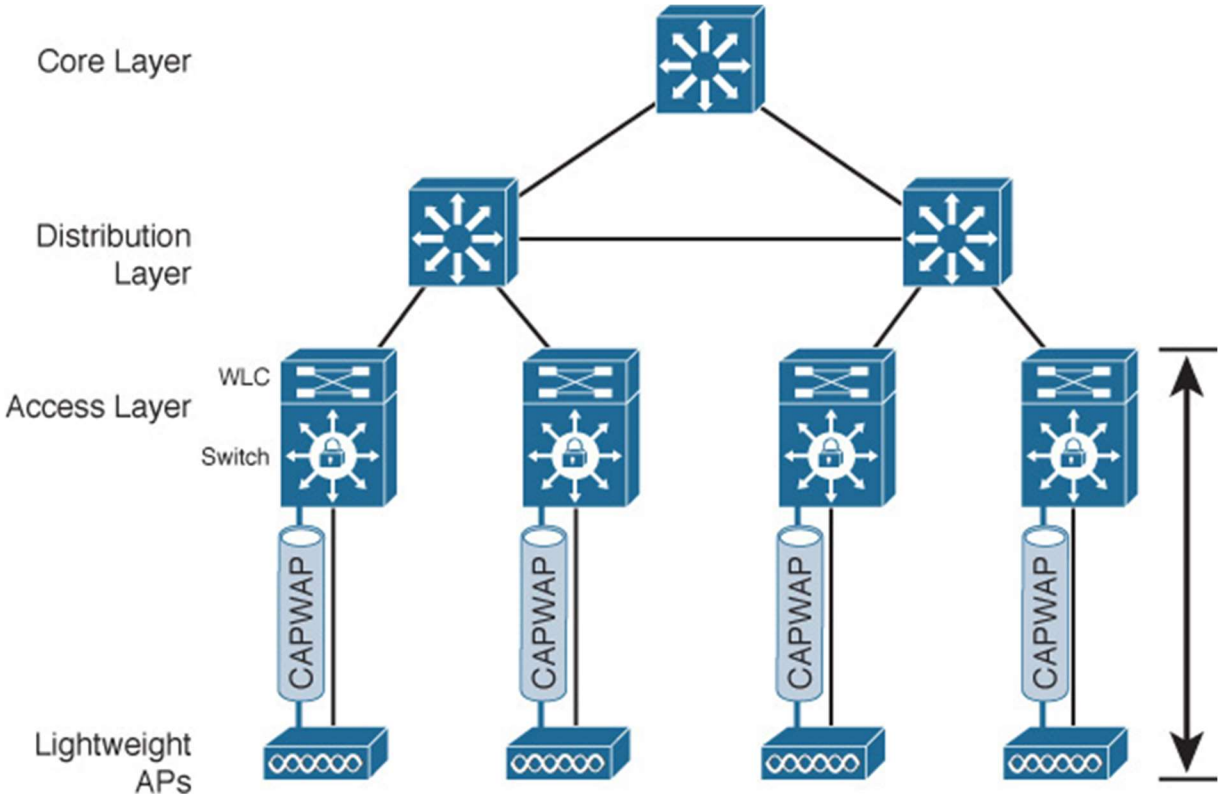
Centralized Wireless Network:

- WLC for multiple APs, where do set up WLC so that it can cover as much APs as it can.
- For that we set the WLC in the core layer, to have a centralized view of the network.
- If you want to deploy a WLC to support the multiple lightweight APs in your network.
- One approach is locate WLC in central location that maximize number of APs joined it.
- Traffic to & from wireless users travel over CAPWAP tunnels reach into center of network.
- Centralized WLC provides convenient place to enforce security policies that affect all users.
- In this design lightweight access point (LWAPP) performs only real-time 802.11 operation.
- All management functions are usually performed on a wireless LAN Controller (WLAC).



Converged Wireless Network Architecture:

- When we want a WLC to be closer to the APs and is more about a distributions functions.
- In that case, the Wireless LAN Controller (WLC) is move further down to the Access layer.
- In this Architecture the WLC function is moved closer to the LAPs and the wireless users.
- In this Architecture, the WLC function becomes distributed, rather than the centralized.
- The access layer turns out to be a convenient location for the Wireless LAN Controllers.
- With all types of user access merged into one layer called converged wireless network.
- In this architecture converged controllers are known as Wireless Control Modules (WCMs).
- One other advantage of the converged network architecture relates to wireless scalability.

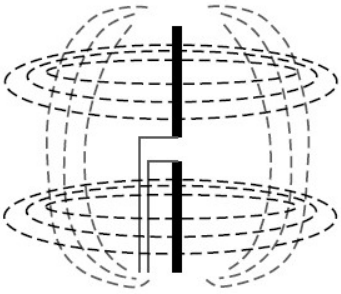


Antennas:

- Wireless routers have different types of antennas, some routers have antennas built in.
- Sometimes the Wifi routers will have a choice of antenna you can attach to the router.
- Antennas come in many sizes & shapes, each with its own gain value & intended purpose.
- There are many specific types of antennas, but three basic types are used most of time.
- Most business class APs require external antennas to make them fully functioning units.

Omnidirectional Antennas:

- An omnidirectional antenna sends a signal out equally in all directions around it.
- Using omnidirectional antennas has benefit of creating connections in any direction.
- You don't have to do as much planning to connect with multiple neighbors or buildings.
- Omnidirectional Antenna If there is enough signal between nodes, they should connect.
- All-direction strength of antennas comes with drawback of transmitting weaker signal.
- Since signal is going in all directions, it spreads out & gets weaker with distance very fast.
- If the nodes or clients, PC, Laptop or end point are far away, they may not connect well.
- In Wireless the Omni-directional antennas are used in point-to-multipoint configurations.
- Where they distribute the wireless signal to other computers or devices in your WLAN.
- So, basically, an Wireless access point (AP) would use an omni-directional antenna.
- Provide 360-degree coverage & are ideal in houses, office, conference rooms & outside.



Directional Antennas:

- Next type of antenna is known as directional--it sends out a signal in a more focused way.
- This Type of Antennas, Directional antennas focus the radio signal in a given direction.
- Using directional antennas has benefit of increasing distance signal travel in one direction.
- Power that would be sent out in all directions with omnidirectional nodes is now focused.
- This type of Directional antennas are commonly used in point-to-point configurations.
- This type of Directional antennas are commonly used in connecting two distant buildings.
- Also, this Directional Antennas sometimes point-to-multipoint connecting two WLANs.
- Few, examples of directional Wi-Fi antennas include Yagi and parabolic dish antennas.

Directional

MIMO Antenna:

- The MIMO is wireless terms, which stand for multiple input, multiple output.
- Basically, The MIMO is an antenna technology for wireless communications.
- In which multiple antennas are used at both the source and the destination.
- Antennas at each end of communications circuit are combined to minimize errors.
- Antennas at each end of communications circuit are combined optimize data speed.
- MIMO uses to make use of reflected signals to provide gains in channel robustness.
- MIMO uses to make use of reflected signals to provide gains in channel throughput.
- MIMO is uses multiple transmitters & receivers to transfer more data at the same time
- In this Up to eight transmit and receive antennas can be used to increase throughput.