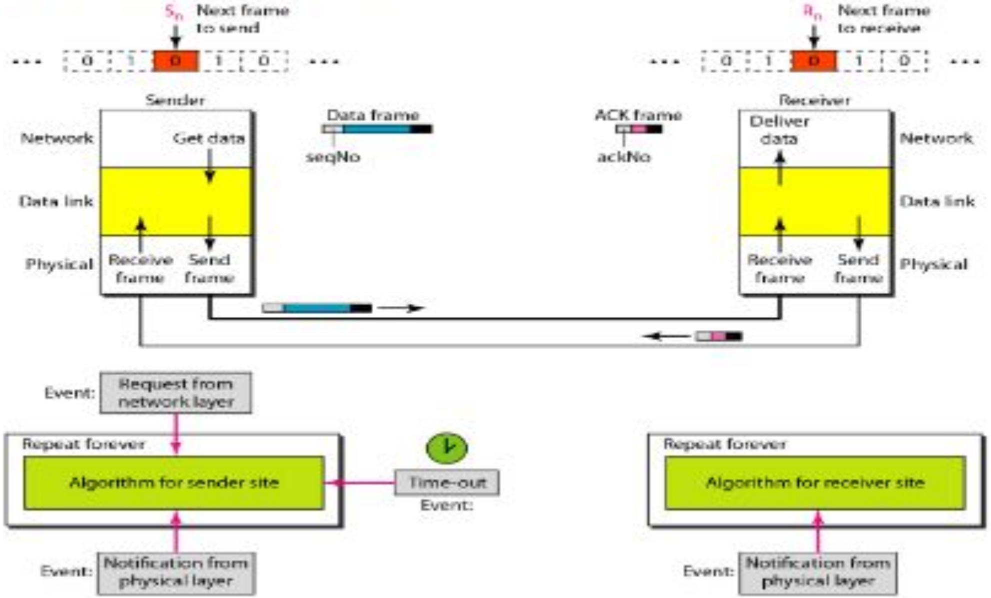
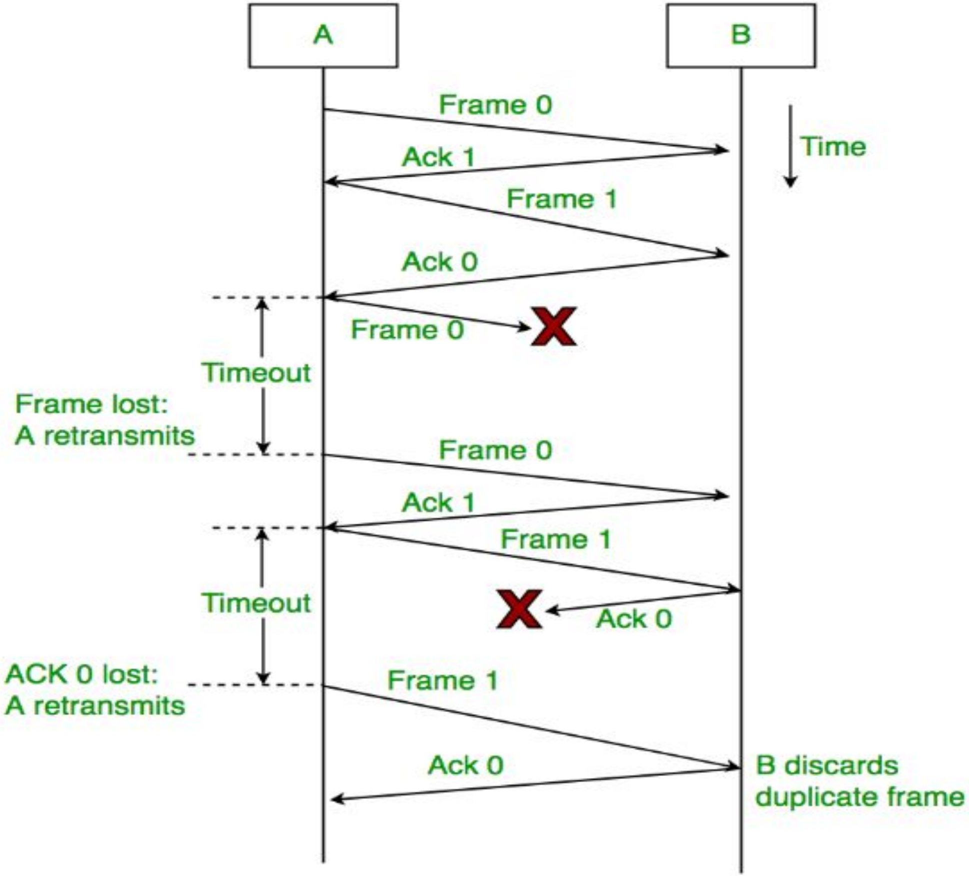
How does Stop and Wait ARQ regulates the data flow and controls transmission errors? Explain its design and implementation.

Stop-and-Wait Automatic Repeat Request (Stop-and Wait ARQ), adds a simple error control mechanism to the Stop-and-Wait Protocol.

Design of Stop and wait ARQ protocol:



Working of Stop and wait ARQ:



1) Sender A sends a data frame or packet with sequence number 0.

2) Receiver B, after receiving the data frame, sends an acknowledgement with sequence number 1 (the sequence number of the next expected data frame or packet)

There is only a one-bit sequence number that implies that both sender and receiver have a buffer for one frame or packet only.

The Stop and Wait ARQ solves the main three problems but may cause big performance issues as the sender always waits for acknowledgement even if it has the next packet ready to send. Consider a situation where you have a high bandwidth connection and propagation delay is also high (you are connected to some server in some other country through a high-speed connection). To solve this problem, we can send more than one packet at a time with a larger sequence number. We will be discussing these protocols in the next articles.

2. Explain the working of CSMA/CA random Access Protocol

In a wired network, the received signal has almost the same energy as the sent signal because either the length of the cable is short or there are repeaters that amplify the energy between the sender and the receiver. This means that in a collision, the detected energy almost doubles.

However, in a wireless network, much of the sent energy is lost in transmission. The received signal has very little energy. Therefore, a collision may add only 5 to 10 percent additional energy. This is not useful for effective collision detection. Hence CSMA/CA with Collision Avoidance based approach has been designed for random access of transmission link.

Collisions are avoided through the use of CSMA/CA's three strategies: **the interframe space, the contention window, and acknowledgments.**

Interframe Space (IFS):

First, collisions are avoided by deferring transmission even if the channel is found idle. When an idle channel is found, the station does not send immediately. It waits for a period of time called the interframe space or IFS. Even though the channel may appear idle when it is sensed, a distant station may have already started transmitting. The IFS time allows the front of the transmitted signal by the distant station to reach this station.

Contention Window

The contention window is an amount of time divided into slots. A station that is ready to send chooses a random number of slots as its wait time. The number of slots in the window changes according to the binary exponential back-off strategy. This means that it is set to one slot the first time and then doubles each time the station cannot detect an idle channel after the IFS time.

Acknowledgment

With all these precautions, there still may be a collision resulting in destroyed data. In addition, the data may be corrupted during the transmission. The positive acknowledgment and the time-out timer can help guarantee that the receiver has received the frame.

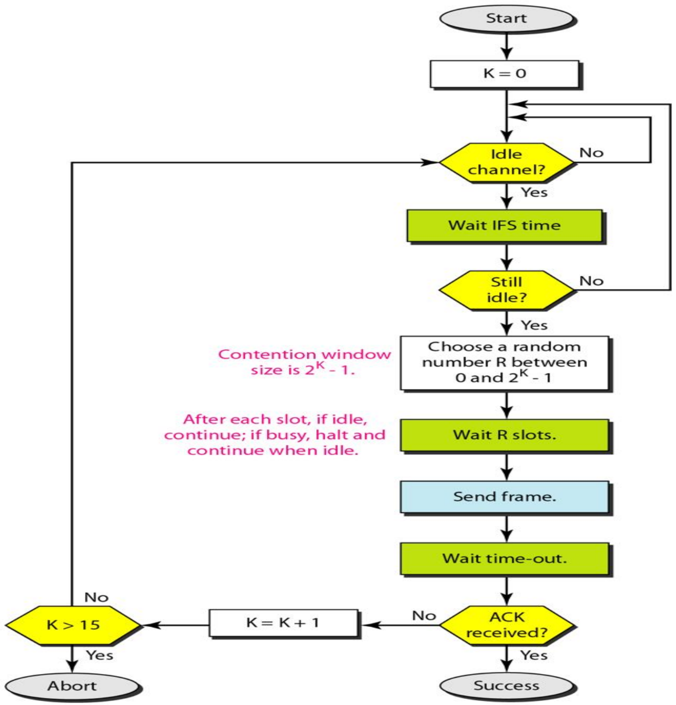
Workflow of CSMA/CA:

When a frame is ready, the transmitting station checks whether the channel is idle or busy.

If the channel is busy, the station waits until the channel becomes idle.

If the channel is idle, the station waits for an Inter-frame gap (IFG) amount of time and then sends the frame. After sending the frame, it sets a timer.

The station then waits for acknowledgement from the receiver. If it receives the acknowledgement before expiry of timer, it marks a successful transmission. Otherwise, it waits for a back-off time period and restarts the algorithm. Following flowchart summarizes the algorithm.



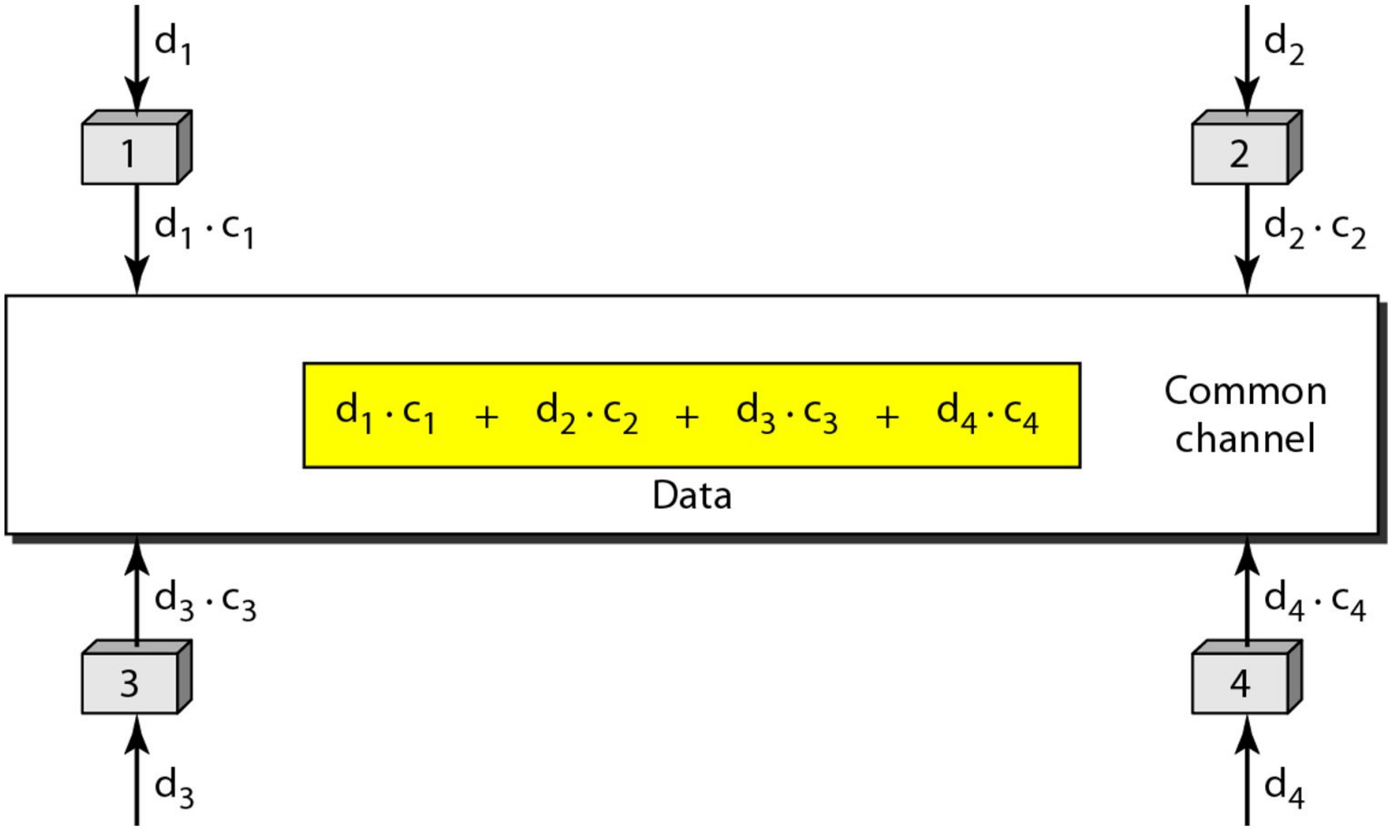
3. Prove that CDMA channelizes the data from multiple stations over shared medium. Justify how does a receiver extracts the intended data from the shared medium with the help of chip sequence.

CDMA stands for **Code Division Multiple Access**. It is basically a channel access method and is also an example of multiple access. Multiple access basically means that information by several transmitters can be sent simultaneously onto a single communication channel.

Let us assume we have four stations 1, 2, 3, and 4 connected to the same channel. The data from station 1 are d 1 , from station 2 are d2, and so on. The code assigned to the first station is cI, to the second is c2, and so on. We assume that the assigned codes have two properties.

1. If we multiply each code by another, we get 0.

2. If we multiply each code by itself, we get 4 (the number of stations).


d1
1
d1 · c1
d2
2
d2 · c2
d1 · c1 + d2 · c2 + d3 · c3 + d4 · c4
Data
Common channel
d3 · c3
3
d3
d4 · c4
4
d4

Station 1 multiplies its data by its code to get d1, Station 2 multiplies its data by its code to get d2 . c2' And so on. The data that go on the channel are the sum of all these terms, as shown in the box. Any station that wants to receive data from one of the other three multiplies the data on the channel by the code of the sender.

For example, suppose stations 1 and 2 are talking to each other. Station 2 wants to hear what station I is saying. It multiplies the data on the channel by cl' the code of station 1. Because (cl . cl) is 4, but (c2 . cI), (c3 . cI), and (c4 . cl) are all Os, station 2 divides the result by 4 to get the data from station 1. Same procedure will be repeated at all the stations connected to CDMA network. The codes generated for every node will be unique and generated using Walsh algorithm.

4. Explain the frame format of IEEE 802.3

The Ethernet frame contains seven fields: preamble, SFD, DA, SA, length or type of protocol data unit (PDU), upper-layer data, and the CRC.

PREAMBLE	SFD	DESTINATION ADDRESS	SOURCE ADDRESS	LENGTH	DATA	CRC
7 Bytes	1 Byte	6 Bytes	6 Bytes	2 Bytes	46 - 1500 Bytes	4 Bytes

PREAMBLE – Ethernet frame starts with 7-Bytes Preamble. This is a pattern of alternative 0's and 1's which indicates starting of the frame and allow sender and receiver to establish bit synchronization. PRE (Preamble) indicates the receiver that frame is coming and allow the receiver to lock onto the data stream before the actual frame begins.

Start frame delimiter (SFD): The second field (1 byte: 10101011) signals the beginning of the frame. The SFD warns the station or stations that this is the last chance for synchronization. The last 2 bits is 11 and alerts the receiver that the next field is the destination address.

Destination address (DA): The DA field is 6 bytes and contains the physical address of the destination station or stations to receive the packet.

Source address (SA): The SA field is also 6 bytes and contains the physical address of the sender of the packet.

Length or type: This field is defined as a type field or length field. The original Ethernet used this field as the type field to define the upper-layer protocol using the MAC frame. The IEEE standard used it as the length field to define the number of bytes in the data field. Both uses are common today.

Data: This field carries data encapsulated from the upper-layer protocols. It is a minimum of 46 and a maximum of 1500 bytes.

CRC: The last field contains error detection information, in this case a CRC-32

Ethernet Addressing:

In an Ethernet-network, each station has its own NIC (6-byte · 48 bits).
The NIC provides the station with a 6-byte physical-address (or Ethernet-address).
For example, the following shows an Ethernet MAC address:

06:01 :02:01:2C:4B

6 bytes = 12 hex digits = 48 bits

(NIC · network interface card)

- A source-address is always a unicast address i.e. the frame comes from only one station.

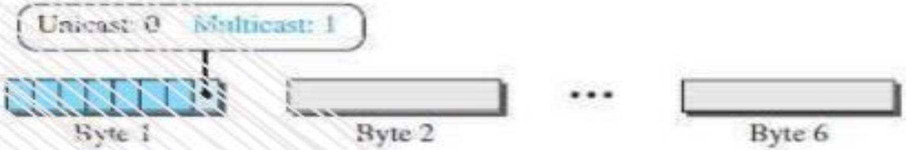


Figure 13.4 Unicast and multicast addresses

- However, the destination-address can be 1) Unicast 2) Multicast or 3) Broadcast.
- As shown in Figure 13.4,
  - If LSB of first byte in a destination-address is 0,
    - Then, the address is unicast;
      - Otherwise, the address is multicast.
    - 1) A unicast destination-address defines only one recipient.
      - ¤ The relationship between the sender and the receiver is one-to-one.
    - 2) A multicast destination-address defines a group of addresses.
      - ¤ The relationship between the sender and the receivers is one-to-many.
    - 3) The broadcast address is a special case of the multicast address.
      - ¤ The recipients are all the stations on the LAN.
      - ¤ A broadcast destination-address is 48 1s (6-byte · 48 bits).

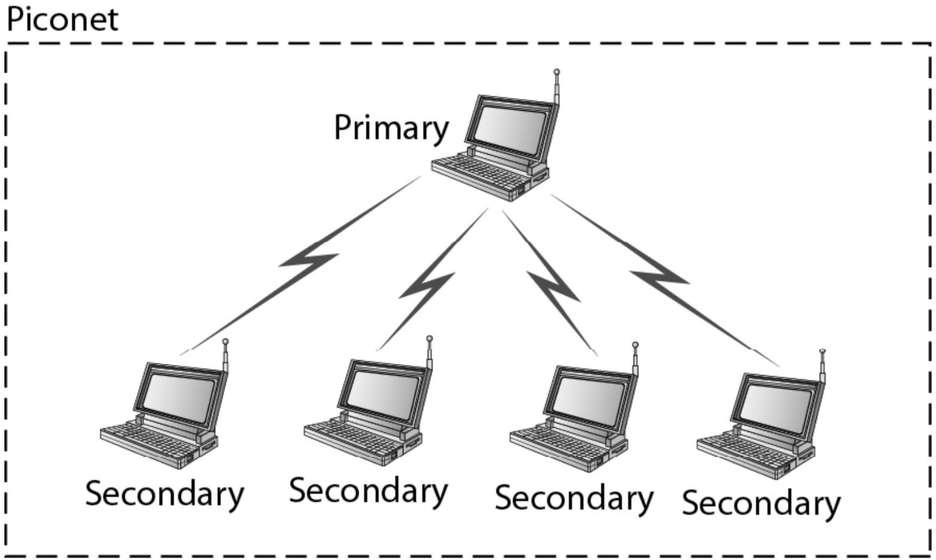
5. Explain different types of Bluetooth architectures.

Bluetooth is a wireless wireless LAN technology designed designed to connect connect devices devices of different different functions functions such as telephones, telephones, notebooks, notebooks, computers, computers, cameras, cameras, printers, coffee makers, makers, and so on. A Bluetooth Bluetooth LAN is an ad hoc network, network, which means that the network is formed spontaneously. There are two types of Bluetooth networks.

1. Piconet
2. Scatternet

Piconet:

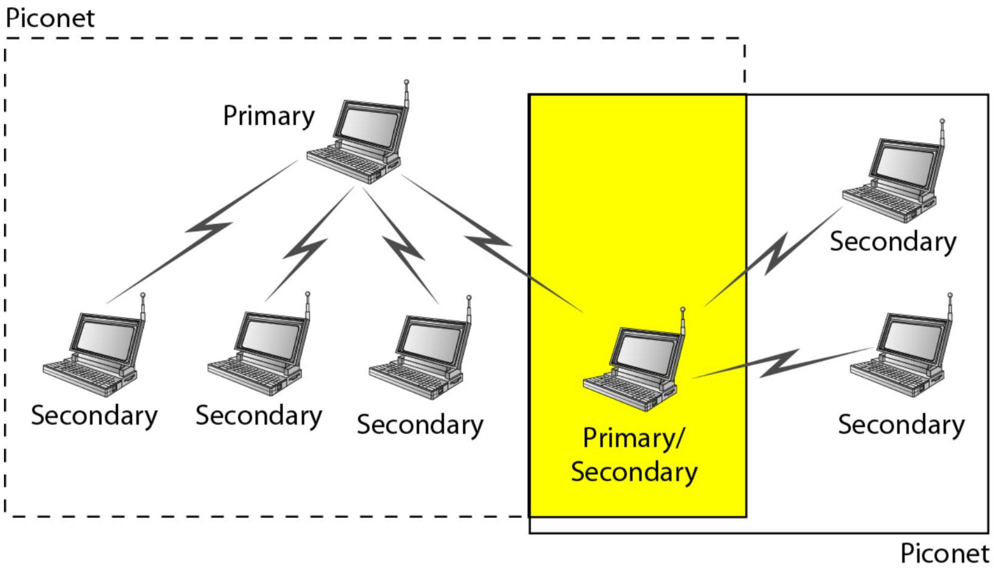
A Bluetooth network is called a piconet, or a small net. A piconet can have up to eight stations, one of which is called the primary;t the rest are called secondaries. All the secondary stations synchronize their clocks and hopping sequence with the primary. Note that a piconet can have only one primary station. The communication between the primary and the secondary can be one-to-one or one-to-many.



Although a piconet can have a maximum of seven secondaries, an additional eight secondaries can be in the parked state. A secondary in a parked state is synchronized with the primary, but cannot take part in communication until it is moved from the parked state. Because only eight stations can be active in a piconet, activating a station from the parked state means that an active station must go to the parked state.

Scatternet:

Piconets can be combined to form what is called a scatternet. A secondary station in one piconet can be the primary in another piconet. This station can receive messages from the primary in the first piconet (as a secondary) and, acting as a primary, deliver them to secondaries in the second piconet. A station can be a member of two piconets. Figure given below illustrates a scatternet.



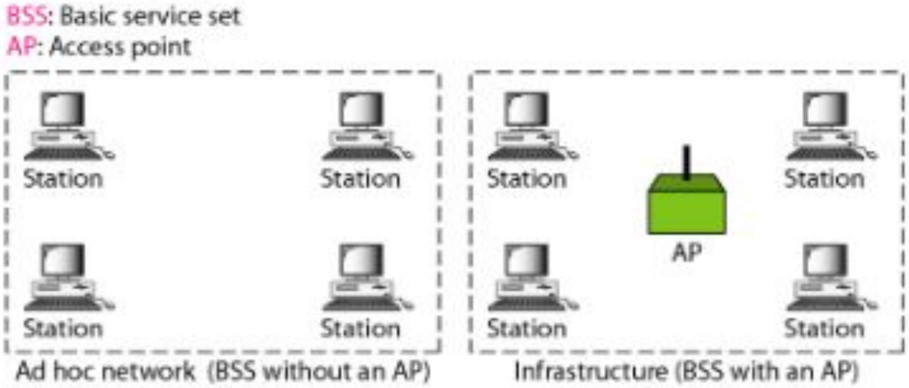
6. Explain two kinds of services offered by IEEE 802.11

IEEE 802.11 wireless LAN standard defines 2 types of services.

1. The Basic Service Set (BSS)
2. Extended Service Set (ESS)

Basic Service Set(BSS):

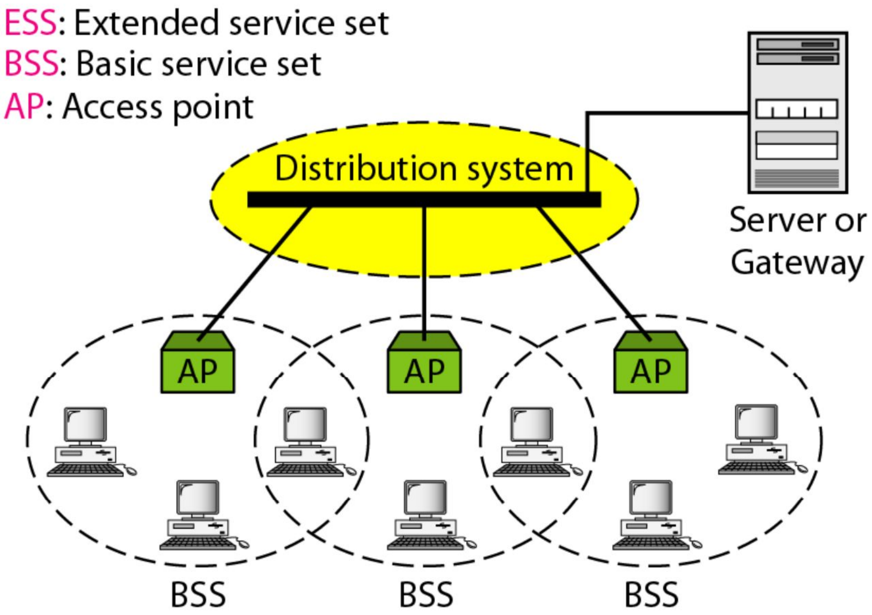
IEEE 802.11 defines the basic service set (BSS) as the building block of a wireless LAN. A basic service set is made of stationary or mobile wireless stations and an optional central base station, known as the access point (AP).



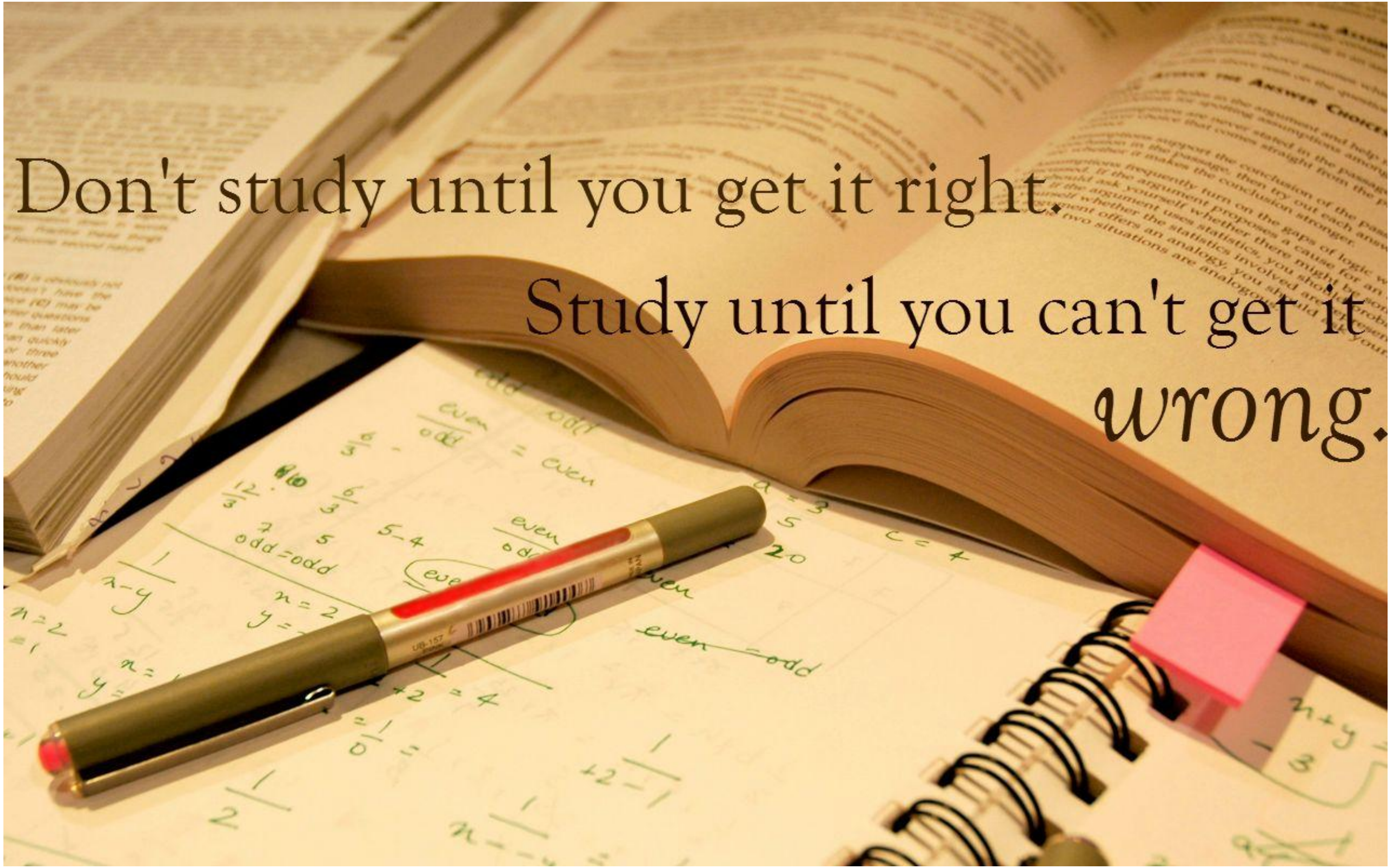
The BSS without an AP is a stand-alone network and cannot send data to other BSSs. It is called an ad hoc architecture. In this architecture, stations can form a network without the need of an AP; they can locate one another and agree to be part of a BSS. A BSS with an AP is sometimes referred to as an infrastructure network.

Extended Service Set (ESS):

An extended service set (ESS) is made up of two or more BSSs with APs. In this case, the BSSs are connected through a distribution system, which is usually a wired LAN. The distribution system connects the APs in the BSSs.The extended service set uses two types of stations: mobile and stationary. The mobile stations are normal stations inside a BSS. The stationary stations are AP stations that are part of a wired LAN. Figure given below shows an ESS.



When BSSs are connected, the stations within reach of one another can communicate without the use of an AP. However, communication between two stations in two different BSSs usually occurs via two APs. The idea is similar to communication in a cellular network if we consider each BSS to be a cell and each AP to be a base station. Note that a mobile station can belong to more than one BSS at the same time.


Don't study until you get it right.
Study until you can't get it wrong.