Pure ALOHA and Slotted ALOHA both are the Random Access Protocols, that are implemented on the Medium Access Control (MAC) layer, a sublayer of Data Link Layer. The purpose of the ALOHA protocol is to determine that which competing station must get the next chance of accessing the multi-access channel at MAC layer.

Pure ALOHA

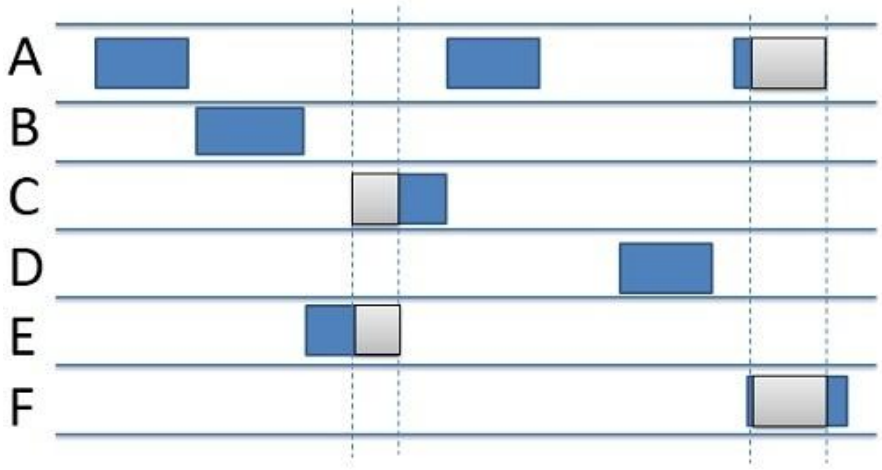
The version of the protocol "Pure ALOHA" is quite simple:

- If you have data to send, send the data

This first step implies that Pure ALOHA does not check whether the channel is busy before transmitting. Since collisions can occur and data may have to be sent again, ALOHA cannot use 100% of the capacity of the communications channel. How long a station waits until it transmits, and the likelihood a collision occurs are interrelated, and affects how efficiently the channel can be used.

- If, while you are transmitting data, you receive any data from another station, there has been a message collision. All transmitting stations will need to try resending "later".

The concept of "transmit later" is a critical aspect: the quality of the backoff scheme chosen significantly influences the efficiency of the protocol, the ultimate channel capacity, and the predictability of its behavior.



Pure ALOHA

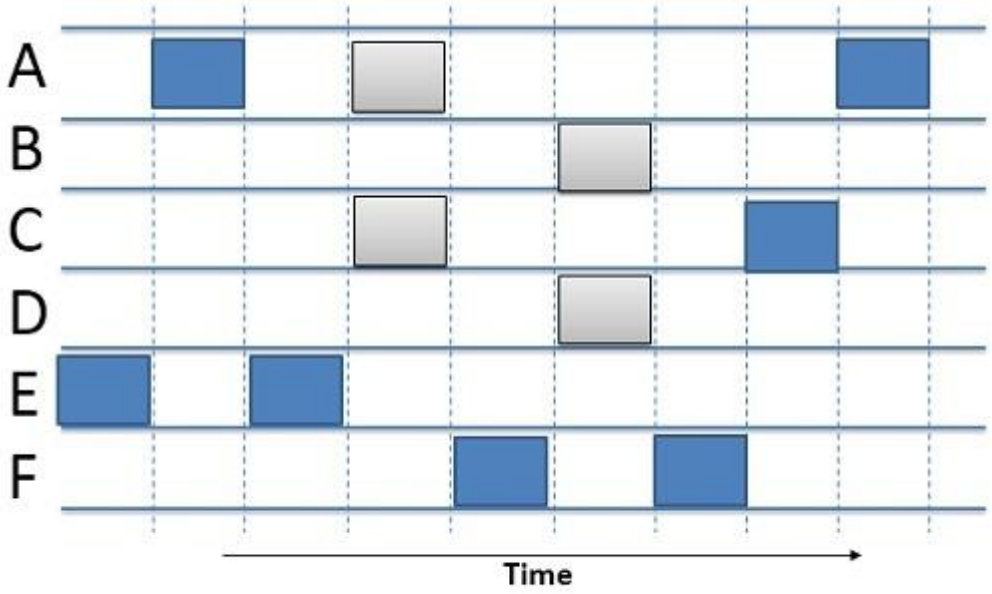
Slotted ALOHA

Slotted ALOHA was invented to improve the efficiency of pure ALOHA as chances of collision in pure ALOHA are very high.

In slotted ALOHA, there is still a possibility of collision if two stations try to send at the beginning of the same time slot

In this method it was proposed that the time be divided up into discrete intervals (T) and each interval correspond to one frame .i.e the user should agree on the slot boundaries and require each station to begin each transmission at the beginning of a slot.

Even if station is ready to send in middle of a slot, it must wait until the beginning of the next one.



Slotted ALOHA

CSMA (Carrier Sense Multiple Access)

It is a **carrier sense multiple access** based on media access protocol to sense the traffic on a channel (idle or busy) before transmitting the data. It means that if the channel is idle, the station can send data to the channel. Otherwise, it must wait until the channel becomes idle. Hence, it reduces the chances of a collision on a transmission medium.

CSMA/ CD

It is a **carrier sense multiple access/ collision detection** network protocol to transmit data frames. The CSMA/CD protocol works with a medium access control layer. Therefore, it first senses the shared channel before broadcasting the frames, and if the channel is idle, it transmits a frame to check whether the transmission was successful. If the frame is successfully received, the station sends another frame. If any collision is detected in the CSMA/CD, the station sends a jam/ stop signal to the shared channel to terminate data transmission. After that, it waits for a random time before sending a frame to a channel.

CSMA/ CA

It is a **carrier sense multiple access/collision avoidance** network protocol for carrier transmission of data frames. It is a protocol that works with a medium access control layer. When a data frame is sent to a channel, it receives an acknowledgment to check whether the channel is clear. If the station receives only a single (own) acknowledgments, that means the data frame has been successfully transmitted to the receiver. But if it gets two signals (its own and one more in which the collision of frames), a collision of the frame occurs in the shared channel. Detects the collision of the frame when a sender receives an acknowledgment signal.

Packet Reservation Multiple Access (PRMA) with Random Contention

Packet reservation multiple access (PRMA) can be considered as a merge of slotted ALOHA protocol and time division multiple access (TDMA) protocol. Independent terminals transmit packets to base station by contending to access an available time slots. A terminal that succeeds in reserving a certain time slot keeps on this reservation for transmitting its subsequent packets. Speech activity detection is used in PRMA to improve system capacity. In this work we propose a simpler

contention mechanism that does not depend on a predetermined permission probability as in the original PRMA. In the new method, terminals select the contention slot uniformly from the pool of remaining free slots in the current frame. We evaluate the performance of the new contention mechanism in terms of various metrics including maximum number of carried voice calls and packet delays for a given acceptable drop rate of voice packets. We show that the new mechanism is superior to that of the original PRMA for loaded systems and is expected to be insensitive for traffic source burstiness.

Multiple Access with Collision Avoidance (MACA)

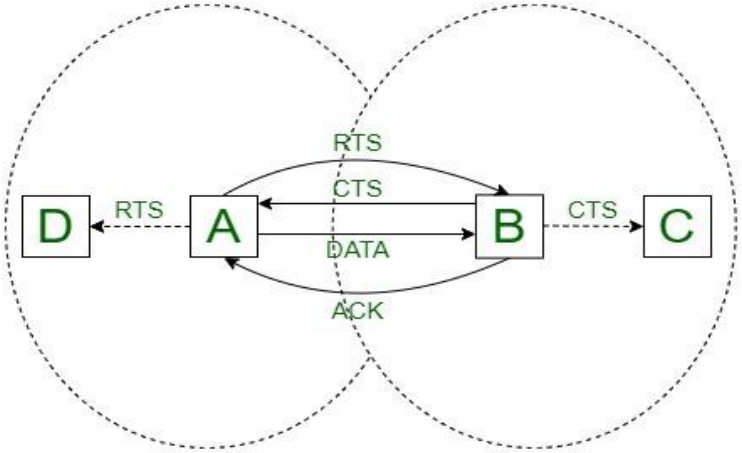
Multiple Access with Collision Avoidance (MACA) is a medium access control (MAC) layer protocol used in wireless ad hoc network. It is used to solve the hidden terminal problem and exposed terminal problem. It is an alternate to Carrier-sense multiple access (CSMA) which have the hidden terminal problem and the exposed terminal problem.

Working:-

The main condition for MACA to work, is that the stations are in sync with frame sizes and data speed. It includes transmission of two frame called RTS and CTS preceding information transmission. RTS means Request to Send and CTS means Clear to Send. Stations near to the transmitting station can hear RTS and remains silent to hear the CTS.
Assume a transmission station A has data frame to send to a receiving station B.

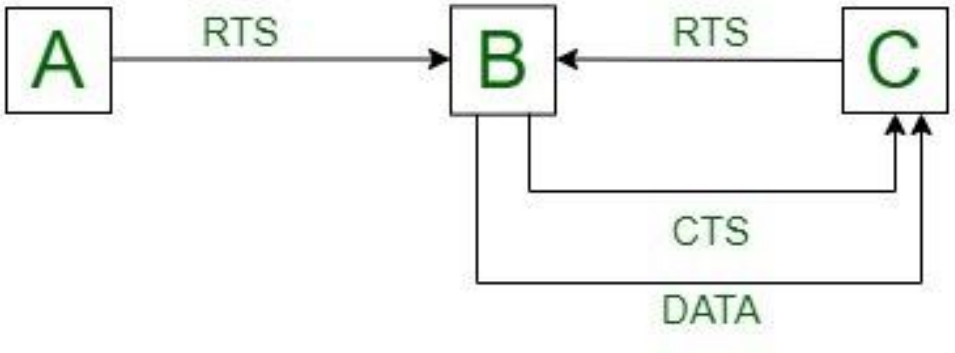
The whole process will work as follows:

- A will send RTS frame to the B
- Then b will send CTS frame to A
- When CTS frame is received by A then it will start sending data frame to B
- Upon receiving data successfully it will send acknowledgment frame(ACK)



Solution to Hidden/Exposed Terminal Problem: MACA protocol uses RTS and CTS to avoid hidden and exposed terminal problem. In hidden terminal problem two nodes try to contact same node at a same time which can create collision to combat this if two nodes send RTS to same node then the node which receives CTS will send the data not the other one which will avoid the collision.

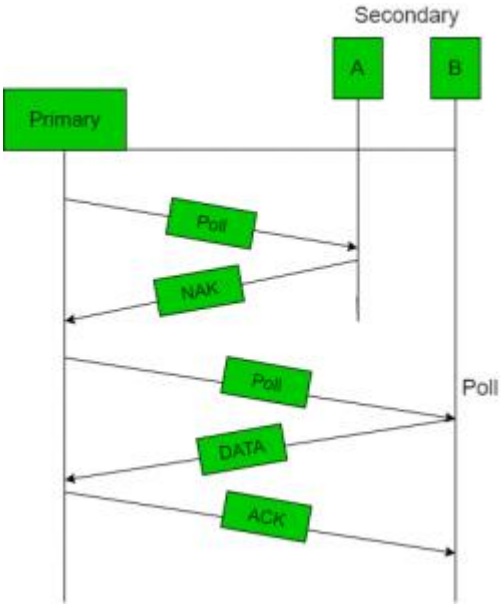
In exposed terminal problem one node stop receiving because it assumes that it can cause interference and so stops its transmission attempts which will make the further nodes out of range. In this case RTS and CTS solves the problem and no terminal can stop transmission because of interference.



Polling

- Polling process is similar to the roll-call performed in class. Just like the teacher, a controller sends a message to each node in turn.
- In this, one acts as a primary station(controller) and the others are secondary stations. All data exchanges must be made through the controller.

- The message sent by the controller contains the address of the node being selected for granting access.
- Although all nodes receive the message but the addressed one responds to it and sends data, if any. If there is no data, usually a “poll reject”(NAK) message is sent back.
- Problems include high overhead of the polling messages and high dependence on the reliability of the controller.



CDMA: Code Division Multiple Access

CDMA stands for Code Division Multiple Access. It is *a channel access method used by several radio communication technologies*. It is a digital cellular technology and an example of multiple access. It is generally used for mobile communication.

Multiple access means that several transmitters can send information simultaneously over a single communication channel. In this system, different CDMA codes are assigned to different users, and the user can access the whole bandwidth for the entire duration. It optimizes the use of available bandwidth as it transmits over the entire frequency range and does not limit the user's frequency range.

Thus, CDMA allows several users to share a band of frequencies without undue interference between the users. It is used as an access method in many mobile phone standards.

CDMA technology was developed during World War II. It was developed by English allies to protect their wireless transmissions from jamming. When the war ended, Qualcomm patented this technology and made it commercially available. The first CDMA system was launched in September 1995 in Hong Kong by Hutchison Telephone Co.

Usage

- It is used in the Global Positioning System (GPS).
- It is used by several mobile phone companies (e.g., Qualcomm standard IS-2000, also known as CDMA2000)
- W-CDMA is used in UTMS 3G mobile phone standards.
- CDMA has been used in OmniTRACS satellite system for transportation.

Categories of CDMA

- Synchronous CDMA (orthogonal codes)
- Asynchronous CDMA (pseudorandom codes)

Difference between CDMA and GSM

The major difference between CDMA and GSM are given below.

Criteria	CDMA	GSM
Technology	CDMA is based on spread-spectrum technology, which makes the optimum use of available bandwidth.	GSM operates on the wedge spectrum. It uses both time division multiple access (TDMA) and frequency division multiple access (FDMA). TDMA provides multi-user access by cutting up the channel into different time slices, and FDMA provides multi-user access by separating the used frequency.
Security	CDMA is more secure than GSM.	GSM is less secure than CDMA.
Global reach	CDMA is used in the USA and some parts of Canada and Japan. CDMA is used only by 24% of users worldwide.	GSM is used in over 80% of the world network in over 210 countries. GSM is used by 76% of users worldwide.
Data Transfer Rate	CDMA has faster data transfer as compared to GSM.	GSM has slower data transfer as compared to CDMA.
Radiation exposure	CDMA phones emit less radiation than GSM phones.	GSM phones emit continuous wave pulses and emit almost 28 times more radiati