Government Women Engineering College, Ajmer

B.TECH V SEMESTER IT 2 MID TERM EXAMINATION – NOVEMBER 2017

SUBJECT : TELECOMMUNICATION FUNDAMENTALS

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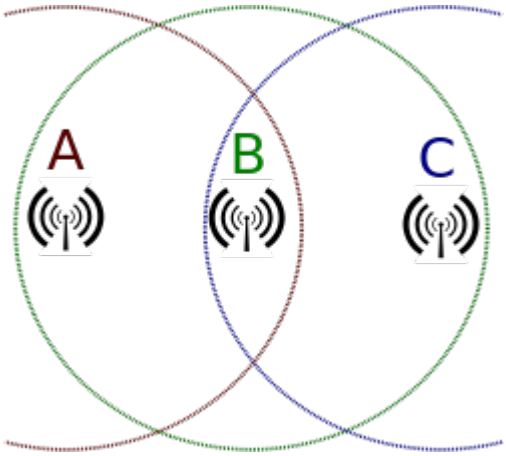
Q1.What is Hidden Node and Exposed Node Problem and how this problem is solved using MACA.

Ans.- In wireless networking, the hidden node problem or hidden terminal problem occurs when a node is visible from a wireless access point (AP), but not from other nodes communicating with that AP. Hidden nodes in a wireless network are nodes that are out of range of other nodes or a collection of nodes. Take a physical star topology with an access point with many nodes surrounding it in a circular fashion: Each node is within communication range of the AP, but the nodes cannot communicate with each other, as they do not have a physical connection to each other. In a wireless network, it is likely that the node at the far edge of the access point's range, which is known as **A**, can see the access point, but it is unlikely that the same node can see a node on the opposite end of the access point's range, **C**. These nodes are known as *hidden*. The problem is when nodes **A** and **C** start to send packets simultaneously to the access point **B**. Because the nodes **A** and **C** are out of range of each other and so cannot detect a collision while transmitting media access control sub layer.

In wireless networks, the **exposed node problem** occurs when a **node** is prevented from sending packets to other **nodes** because of a neighboring transmitter.



Multiple Access with Collision Avoidance (**MACA**) is a slotted media access control protocol used in wireless LAN data transmission to avoid collisions caused by the hidden station problem and to simplify exposed station problem.

The basic idea of MACA is a wireless network node makes an announcement before it sends the data frame to inform other nodes to keep silent. When a node wants to transmit, it sends a signal called *Request-To-Send* (RTS) with the length of the data frame to send. If the receiver allows the transmission, it replies the sender a signal called *Clear-To-Send*(CTS) with the length of the frame that is about to receive. Meanwhile, a node that hears RTS should remain silent to avoid conflict with CTS; a node that hears CTS should keep silent until the data transmission is complete.

WLAN data transmission collisions may still occur, and the MACA for Wireless (MACAW) is introduced to extend the function of MACA. It requires nodes sending acknowledgements after each successful frame transmission, as well as the additional function of Carrier sense.

Q2.Define Bluetooth and Discuss Architecture and Layer Architecture of Bluetooth.

Ans.- Bluetooth is a wireless LAN technology used to connect devices of different functions such as telephones, computers (laptop or desktop), notebooks, cameras, printers and so on.**Bluetooth Architecture**

Bluetooth architecture defines two types of networks:

1. Piconet

2. Scattenet

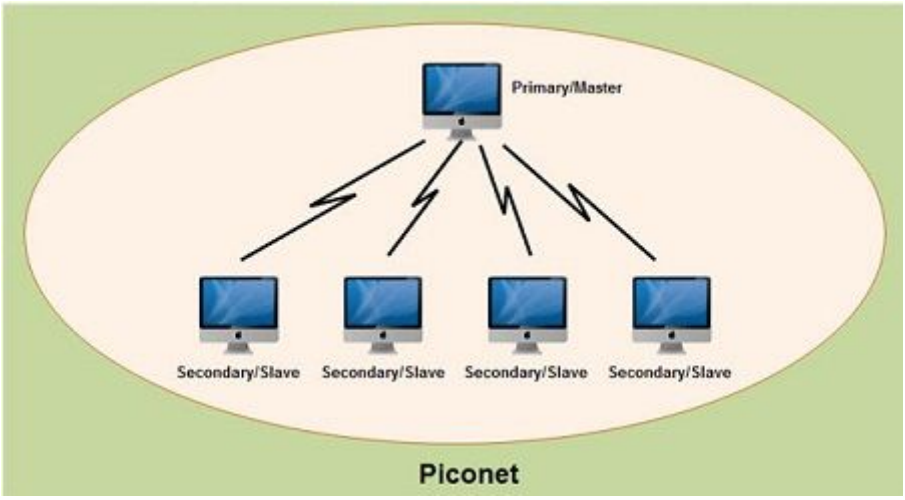
1. Piconet

• Piconet is a Bluetooth network that consists of one primary (master) node and seven active secondary (slave) nodes.

• Thus, piconet can have upto eight active nodes (1 master and 7 slaves) or stations within the distance of 10 meters.

• There can be only one primary or master station in each piconet.

• The communication between the primary and the secondary can be one-to-one or one-to-many.



• All communication is between master and a slave. Salve-slave communication is not possible.

• In addition to seven active slave station, a piconet can have upto 255 parked nodes. These parked nodes are secondary or slave stations and cannot take part in communication until it is moved from parked state to active state.

2. Scatternet

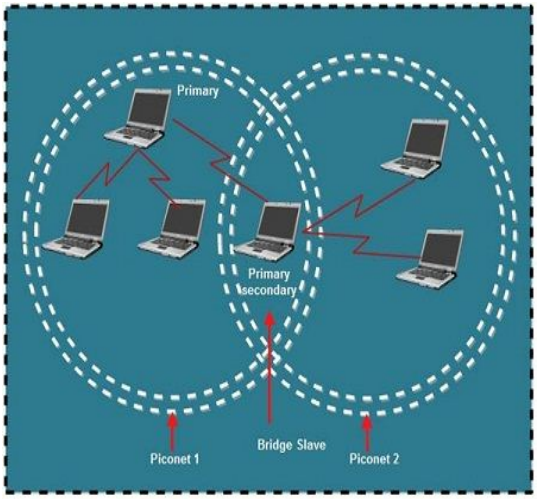
• Scattemet is formed by combining various piconets.

• A slave in one piconet can act as a master or primary in other piconet.

• Such a station or node can receive messages from the master in the first piconet and deliver the message to its slaves in other piconet where it is acting as master. This node is also called bridge slave.

• Thus a station can be a member of two piconets.

• A station cannot be a master in two piconets.

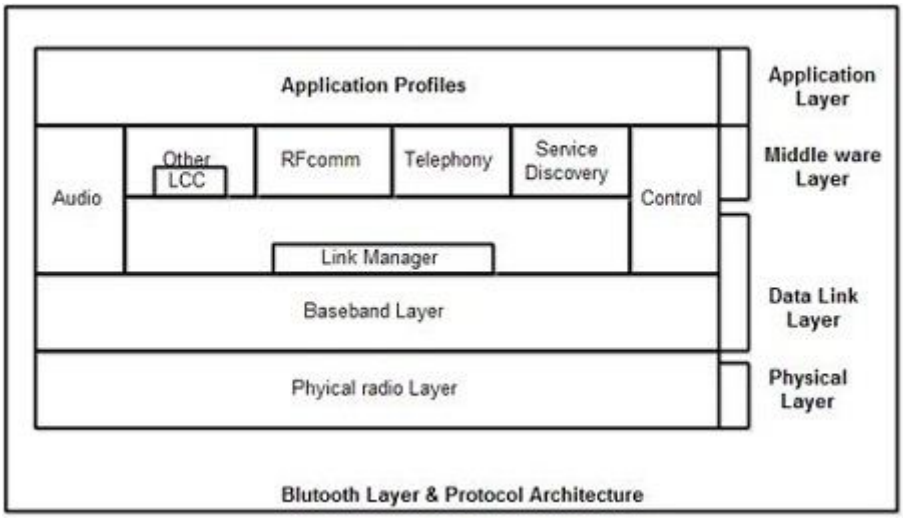


Bluetooth layers and Protocol Stack

• Bluetooth standard has many protocols that are organized into different layers.

• The layer structure of Bluetooth does not follow OS1 model, TCP/IP model or any other known model.

• The different layers and Bluetooth protocol architecture.



Radio Layer

• The Bluetooth radio layer corresponds to the physical layer of OSI model.

• It deals with ratio transmission and modulation.

• The radio layer moves data from master to slave or vice versa.

• It is a low power system that uses 2.4 GHz ISM band in a range of 10 meters.

• This band is divided into 79 channels of 1MHz each. Bluetooth uses the Frequency Hopping Spread Spectrum (FHSS) method in the physical layer to avoid interference from other devices or networks.

• Bluetooth hops 1600 times per second, *i.e.* each device changes its modulation frequency 1600 times per second.

• In order to change bits into a signal, it uses a version of FSK called GFSK *i.e.* FSK with Gaussian bandwidth filtering.

Baseband Layer

• Baseband layer is equivalent to the MAC sublayer in LANs.

• Bluetooth uses a form of TDMA called TDD-TDMA (time division duplex TDMA).

• Master and slave stations communicate with each other using time slots.

• The master in each piconet defines the time slot of 625 µsec.

• In TDD- TDMA, communication is half duplex in which receiver can send and receive data but not at the same time.

• If the piconet has only no slave; the master uses even numbered slots (0, 2, 4, ...) and the slave uses odd-numbered slots (1, 3, 5, ...). Both master and slave communicate in half duplex mode. In slot 0, master sends & secondary receives; in slot 1, secondary sends and primary receives.

• If piconet has more than one slave, the master uses even numbered slots. The slave sends in the next odd-numbered slot if the packet in the previous slot was addressed to it.

• In Baseband layer, two types of links can be created between a master and slave. These are:

1. Asynchronous Connection-less (ACL)

• It is used for packet switched data that is available at irregular intervals.

• ACL delivers traffic on a best effort basis. Frames can be lost & may have to be retransmitted.

• A slave can have only one ACL link to its master.

• Thus ACL link is used where correct delivery is preferred over fast delivery.

• The ACL can achieve a maximum data rate of 721 kbps by using one, three or more slots.

2. Synchronous Connection Oriented (SCO)

• sco is used for real time data such as sound. It is used where fast delivery is preferred over accurate delivery.

• In an sco link, a physical link is created between the master and slave by reserving specific slots at regular intervals.

• Damaged packet; are not retransmitted over sco links.

• A slave can have three sco links with the master and can send data at 64 Kbps.

Logical Link, Control Adaptation Protocol Layer (L2CAP)

• The logical unit link control adaptation protocol is equivalent to logical link control sublayer of LAN.

• The ACL link uses L2CAP for data exchange but sco channel does not use it.

• The various function of L2CAP is:

1. Segmentation and reassembly

• L2CAP receives the packets of upto 64 KB from upper layers and divides them into frames for transmission.

• It adds extra information to define the location of frame in the original packet.

• The L2CAP reassembles the frame into packets again at the destination.

2. Multiplexing

• L2CAP performs multiplexing at sender side and demultiplexing at receiver side.

• At the sender site, it accepts data from one of the upper layer protocols frames them and deliver them to the Baseband layer.

• At the receiver site, it accepts a frame from the baseband layer, extracts the data, and delivers them to the appropriate protocol1ayer.

3. Quality of Service (QOS)

• L2CAP handles quality of service requirements, both when links are established and during normal operation.

• It also enables the devices to negotiate the maximum payload size during connection establishment.

Q3.What are the difference between Circuit and Packet Switching .

Ans.- **CIRCUIT SWITCHING**	**PACKET SWITCHING**
In circuit switching there are 3 phases i) Connection Establishment. ii) Data Transfer. iii) Connection Released.	In Packet switching directly data transfer takes place .
In circuit switching, each data unit know the entire path address which is provided by the source	In Packet switching, each data unit just know the final destination address intermediate path is decided by the routers.

In Circuit switching, data is processed at source system only	In Packet switching, data is processed at all intermediate node including source system.
Delay between data units in circuit switching is uniform.	Delay between data units in packet switching is not uniform.
Resource reservation is the feature of circuit switching because path is fixed for data transmission.	There is no resource reservation because bandwidth is shared among users.
Circuit switching is more reliable.	Packet switching is less reliable.
Wastage of resources are more in Circuit Switching	Less wastage of resources as compared to Circuit Switching

Q4. What is Spread Spectrum Technique and Differentiate DSSS and FHSS.

Ans.- In telecommunication and radio communication, **spread-spectrum** techniques are methods by which a signal (e.g., an electrical, electromagnetic, or acoustic signal) generated with a particular bandwidth is deliberately spread in the frequency domain, resulting in a signal with a wider bandwidth. These techniques are used for a variety of reasons, including the establishment of secure communications, increasing resistance to natural interference, noise and jamming, to prevent detection, and to limit power flux density

In telecommunications, **direct-sequence spread spectrum** (**DSSS**) is a spread spectrum modulation technique used to reduce overall signal interference. The spreading of this signal makes the resulting wideband channel more noisy, allowing for greater resistance to unintentional and intentional interference.

A method of achieving the spreading of a given signal is provided by the modulation scheme. With DSSS, the message signal is used to modulate a bit sequence known as a Pseudo Noise (PN) code; this PN code consists of a radio pulse that is much shorter in duration (larger bandwidth) than the original message signal. This modulation of the message signal scrambles and spreads the pieces of data, and thereby resulting in a bandwidth size nearly identical to that of the PN sequence.[1] In this context, the duration of the radio pulse for the PN code is referred to as the chip duration. The smaller this duration, the larger the bandwidth of the resulting DSSS signal; more bandwidth multiplexed to the message signal results in better resistance against interference.

Frequency-hopping spread spectrum (**FHSS**) is a method of transmitting radio signals by rapidly switching a carrier among many frequency channels, using a pseudorandom sequence known to both transmitter and receiver. It is used as a multiple access method in the code division multiple access (CDMA) scheme **frequency-hopping code division multiple access** (**FH-CDMA**) .

FHSS is a wireless technology that spreads its signal over rapidly changing frequencies. Each available frequency band is divided into sub-frequencies. Signals rapidly change ("hop") among these in a pre-determined order. Interference at a specific frequency will only affect the signal during that short interval.

Q5.Write the short note:

Ans.- a) CDMA

Code Division Multiple Access (CDMA) is a sort of multiplexing that facilitates various signals to occupy a single transmission channel. It optimizes the use of available bandwidth. The technology is commonly used in ultra-high-frequency (UHF) cellular telephone systems, bands ranging between the 800-MHz and 1.9-GHz.

CDMA Overview

Code Division Multiple Access system is very different from time and frequency multiplexing. In this system, a user has access to the whole bandwidth for the entire duration. The basic principle is that different CDMA codes are used to distinguish among the different users.

Techniques generally used are direct sequence spread spectrum modulation (DS-CDMA), frequency hopping or mixed CDMA detection (JDCDMA). Here, a signal is generated which extends over a wide bandwidth. A code called **spreading code** is used to perform this action. Using a group of codes, which are orthogonal to each other, it is possible to select a signal with a given code in the presence of many other signals with different orthogonal codes.

CDMA working

CDMA allows up to 61 concurrent users in a 1.2288 MHz channel by processing each voice packet with two PN codes. There are 64 Walsh codes available to differentiate between calls and theoretical limits. Operational limits and quality issues will reduce the maximum number of calls somewhat lower than this value.

In fact, many different "signals" baseband with different spreading codes can be modulated on the same carrier to allow many different users to be supported. Using different orthogonal codes, interference between the signals is minimal. Conversely, when signals are received from several mobile stations, the base station is capable of isolating each as they have different orthogonal spreading codes.

The following figure shows the technicality of the CDMA system. During the propagation, we mixed the signals of all users, but by that you use the same code as the code that was used at the time of sending the receiving side. You can take out only the signal of each user.

Advantages of CDMA

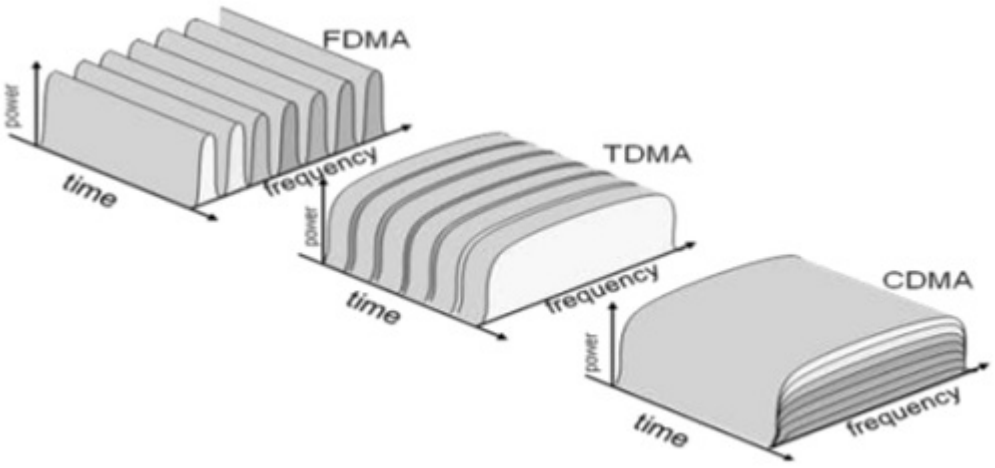
CDMA has a soft capacity. The greater the number of codes, the more the number of users. It has the following advantages −

- CDMA requires a tight power control, as it suffers from near-far effect. In other words, a user near the base station transmitting with the same power will drown the signal latter. All signals must have more or less equal power at the receiver
- Rake receivers can be used to improve signal reception. Delayed versions of time (a chip or later) of the signal (multipath signals) can be collected and used to make decisions at the bit level.
- Flexible transfer may be used. Mobile base stations can switch without changing operator. Two base stations receive mobile signal and the mobile receives signals from the two base stations.
- Transmission Burst − reduces interference.

Disadvantages of CDMA

The disadvantages of using CDMA are as follows −

- The code length must be carefully selected. A large code length can induce delay or may cause interference.
- Time synchronization is required.
- Gradual transfer increases the use of radio resources and may reduce capacity.
- As the sum of the power received and transmitted from a base station needs constant tight power control. This can result in several handovers.



Ans.- **b) Handoff**

When a mobile user travels from one area of coverage or cell to another cell within a call's duration the call should be transferred to the new cell's base station. Otherwise, the call will be dropped because the link with the current base station becomes too weak as the mobile recedes. Indeed, this ability for transference is a design matter in mobile cellular system design and is call *handoff*.

Two basic types of handoff - hard handoff and soft handoff.

With hard handoff, the link to the prior base station is terminated before or as the user is transferred to the new cell's base station. That is to say that the mobile is linked to no more than one base station at a given time.

In soft handoff ,a mobile station is temporary connected to more than one base station simultaneously.