7/1/2020

- MC can use any device/compute the mobile (moving) devices.
  e.g. phone, laptop
- In MC, atleast one device must be in movement.
  e.g. wifi, Bluetooth, Infrared, Internet, (applications of MC)
  Satellite, GPS, GSM, GPRS.

Applications of MC

- Horizontal
- Vertical

vhf : very high frequency
uhf : ultra high frequency
hf : high frequency

Defn of MC

- Mobile Computing is the ability to use technology while moving.
- It is a term used to describe technologies that enable people to access network services any place, any time and anywhere.
- MC is to work from a non-fixed location using portable computing or communication devices such as laptops, notebook, PDAs, smart cell phones etc.
- This technology enables the mobile workers to create, access, process, store and communicate information without being constrained to a single location.

→ Technologies that enable MC

* Wireless LAN (WLAN)
* Satellite
* Cellular Digital Packet Data (CDPD)
* Personal Communication System (PCS)
* Global System for Mobile Communication (GSM).
* Specialised Mobile Radio Service (SMR)
* One and two-way paging handover.
* Plane old telephone system (POTS)
* Internet
* Infrared
* Docking (serial, parallel or LAN)
* Disk swapping

→ Applications of MC

MC applications are divided into two categories.

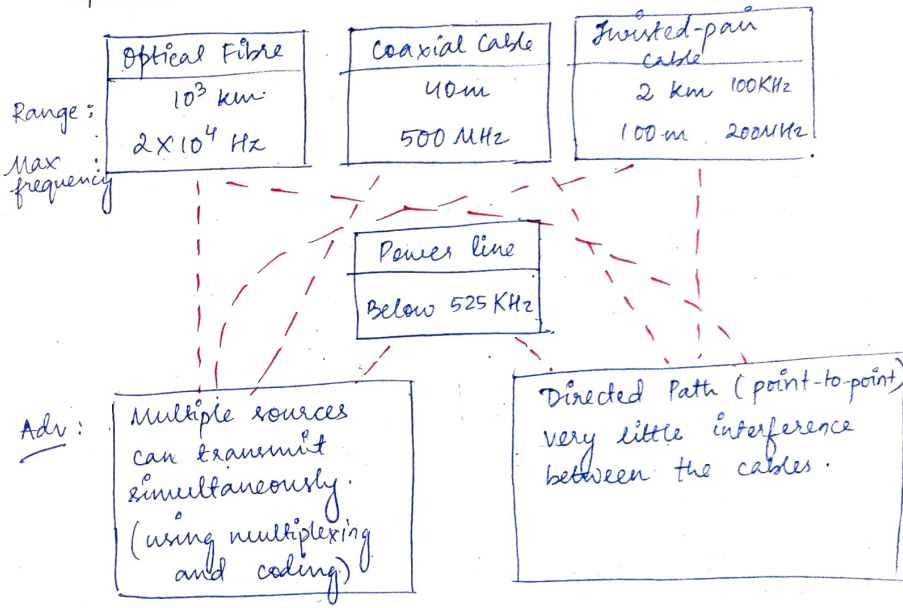
i) Horizontal : It is broad based application and includes S/W.
e.g email, web browsing, word processing, scheduling, messaging, to-do list, presentation.

ii) Vertical : It is industry-specified.
e.g retailing, utilities, warehousing, shipping, law enforcement and public safety.

• Mobile Communication :

- Mobile communication entails transmission of data to and from handheld devices.
- Out of two or more communication devices, at least one is handheld / mobile.
- The location of device can vary either locally/globally and communication takes place through a wireless, distributed, diversified network.
- Communication can be
  i) guided
  ii) unguided.

Guided transmission :



Disadvantages of transmission through cables :

* Signal transmitter and receiver are fixed (immobile). Hence, there is no mobility of transmission and reception points.
* No transmitter and receiver systems limit the total no. of interconnection possible.

Unguided Transmission / Wireless.

It is carried out through radiated electromagnetic energy.

Signal Propagation.

- Electrical signal are transmitted by converting them into electromagnetic ~~signals~~ radiation. This radiation is transmitted via antenna that radiates electromagnetic signals.
- There are various frequency bands within electromagnetic spectrum and all have different transmission requirement.
- We consider two frequency range for wireless transmission.
  - i) vhf : Very High Frequency.
  - ii) uhf : Ultra High Frequency → $\lambda/4$ length.

$$f = \frac{c}{\lambda}$$

f in MHz
λ in m.
For air, $c = 3 \times 10^8$ m/s

** Remember Frequencies of VHF, TVVHF / UHF.

VHF
R ~ 50 Km
f ~ 50-250 MHz.

TV VHF.
f ~ 174-230 MHz

Advantages

* Frequency modulation & multiple frequency band transmission is possible.
* Transmitting antenna length is 3m to 60cm (due to small $\frac{\lambda}{2}$ length)

Disadvantages

* Mobility is not practical as transmitting and receiving antenna length is 3m to 60cm and a directed multi-dipole or disk antenna is required

UHF
f: 200-2000 MHz

GSM
f: 890-960 MHz

DECT & 3G.
f: 1880-2890 MHz

Digital Audio Broadcasting

Advantages

* Multiple frequency bands, modulation methods, multiplexing and coding are feasible due to the availability of greater bandwidth.
* Mobility is quite practical.

Disadvantages

* Signal quality degrades due to loss within buildings and reflection from large buildings.
* A large no. of base stations are required at separation of about 1 to 5 km each.

DECT : Digital Enhanced Cordless Telecommunication

14/1/2020

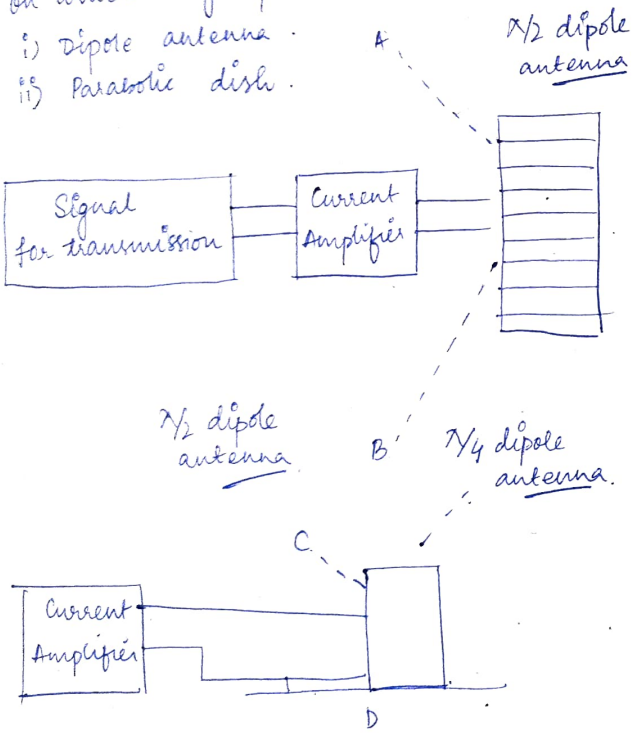
✓ Antenna is a device that transmits and receives electromagnetic signals.

✓ Normally, antenna functions properly for narrow frequency range.

✓ If an antenna is not properly tuned to the frequency band in which transmitting system connected to it operates, the transmitted / received signal may be impaired.

✓ The types of antenna based on the frequency range on which they operate. It can be:

i) Dipole antenna.
ii) Parabolic dish.



✓ λ/2 and λ/4 antenna are called dipole antenna as at any given instant, both ends A and B are 180° out of phase.

Q) A 200 MHz to 2000 MHz UHF signal is to be transmitted wirelessly. Calculate the length of dipole antenna required for the transmission.

Sol) length = $\frac{\lambda}{2}$.

$c = f\lambda$

$\Rightarrow \lambda_1 = \frac{c}{f} = \frac{3 \times 10^8}{200 \times 10^6} = 1.5$ m.

$\therefore$ length$_1$ = $\frac{1.5}{2}$ m = 0.75 m = 75 cm.

$\lambda_2 = \frac{c}{f} = \frac{3 \times 10^8}{2000 \times 10^6} = \frac{3}{20}$ m.

$\therefore$ length$_2$ = $\frac{\lambda}{2} = \frac{3}{20 \times 2} = \frac{3}{40}$ = 0.075 m = 7.5 cm

So, Range of antenna = 7.5 cm to 75 cm

✓

✓ Basically $\lambda/4$ dipole antenna is mounted on a long conducting surface.

e.g. roof of a car, moist ground surface.

At any time, the end C and surface D are 180° out of phase.

The original and the reflected waves then superimpose and create the same electrical effects as in $\lambda/2$ antenna

** ✓ In general,

Length of antenna $\propto$ wavelength

$\propto \frac{1}{\text{frequency of transmitted signal}}$.

Assignment

Q) A dipole antenna is to be mounted on a conducting surface ($\lambda/4$). Calculate the length of the required antenna to transmit the GSM signal of 900 MHz.

Sol)

$$L = \frac{\lambda}{4}$$

$$c = f\lambda.$$

$$\Rightarrow \lambda = \frac{c}{f} = \frac{3 \times 10^8}{900 \times 10^6} = \frac{1}{3}\,m = 0.333m = 33.3cm$$

$$L = \frac{1}{12}\,m = 8.32\,cm$$

✓ The radiation pattern of a given antenna defines a path on which each point will have identical signal strength at any given instant.

✓ A circular pattern means the radiated energy and thus the signal strength is equally distributed in all dirⁿ and the radiated energy on the plane.

→ Propagation of signal :

- Wireless propagation of signal faces many complications as the antenna height and size at mobile terminals are very small.
- In order to minimise the significant influence of obstacles, propagation routes have to be specially designed and calculated taking into account of various types of propagation loss.
- Also, the propagation properties vary with place and time for a mobile terminal. So, generally, statistical propagation model are used whereby no specific data paths are considered, rather the channel parameters are modelled as stochastic variables (Probability-based random variables)

Parameters which affect the propagation of a signal :-

i) Line of sight

↳ It is the transmission of signals without diffraction, refraction or scattering in between the transmitter and the receiver.

↳ Signal strength in free space decreases as the square of the distance from the transmitter because at larger distances, the radiated power is distributed over a larger spherical surface area.

imp

8) A transmitter sends a signal which has a strength of $9\,\mu W/cm^2$ at a distance of 500m. Assuming free space propagation in line of sight, calculate the signal strength at 1500m.

ii) Attenuation

↳ Signal strength also decreases due to attenuation when obstacles in the path ~~are~~ of signal are greater in size than the wavelength of the signal.

e.g. * If an FM radio transmitter sends out (imp) 90 MHz FM band signal ($\lambda = 3.3$ m), then the signal will be attenuated by an object of the size 10m and above.

* If a transmitter sends a GSM signal of 900 MHz ($\lambda = 0.33$ m), then it will face attenuation in objects of size > 1m.

iii) Scattering of signal.

↳ A signal scatters when it encounters an obstacle of size equal to or less than the wavelength

e.g. A GSM signal about 33 cm in wavelength is scattered by an object of 33 cm or less.

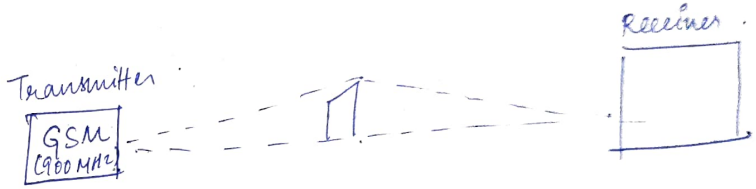
Only a small part of scattered signal reaches the receiver.

iv) Diffraction of signal.

↳ A signal bends as a result of diffraction from the edge of an obstacle of size equal to or less than the wavelength.

e.g. A GSM signal ($\lambda = 33$ cm) is diffracted from an object of 33 cm or less.

↳ A diffracted signal may or may not reach at the receiver depending on the geometry of obstacle and the separation between the object receiver and the transmitter.



v) Reflection of signal.

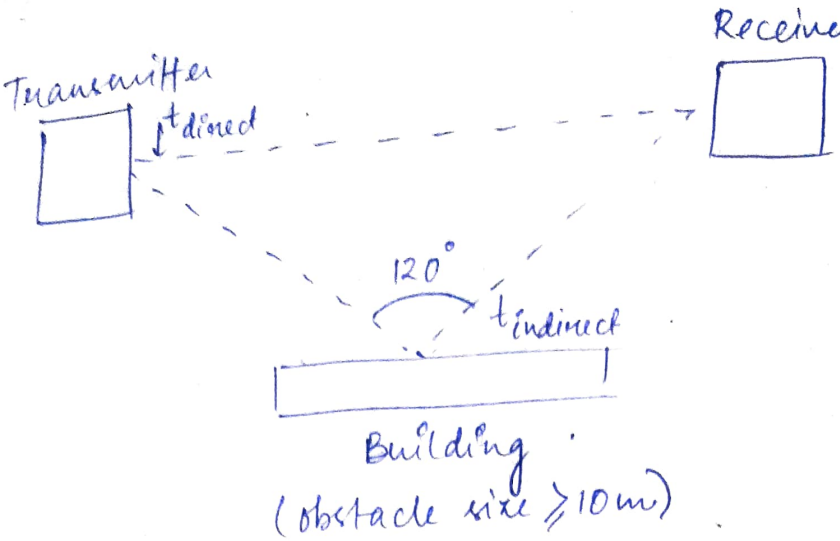
↳ A signal may get reflected from the surface of the obstacle when its ~~wave~~ size is greater than the wavelength of the signal.

e.g. GSM signal (900 MHz) reflects when obstacle size ≥ 10 m.

↳ Reflected signal suffers a delay in reaching its destination.

$$\text{Delay} = t_{\text{indirect}} - t_{\text{direct}}$$

$$= \frac{\text{additional path travelled on meters.}}{3 \times 10^8 \text{ m/s}}$$



Assignment

Q) A receiver receives two signals - one directly in line of sight and other after a reflection at 120° from a transmitter at a distance of 1000m. Calculate the delay in the reflected signal w.r.t the direct signal.

Sol)

$$\text{Delay} = t_{direct} - t_{indirect}$$

$$= \frac{1000}{3\times10^8} - \frac{1000}{\sin(120^\circ)\times3\times10^8}$$

$$= 3.33\,\mu s - 2.85\,\mu s$$

$$= 0.52\,\mu s.$$